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OCTOBER 13, 2004

FINAL
PILOT EXTRACTION AND AQUIFER RESPONSE TEST
WORKPLAN
MONTROSE SITE
TORRANCE, CALIFORNIA
DSGWRD 26 – 036

PREPARED FOR:
MONTROSE CHEMICAL CORPORATION OF CALIFORNIA

HARGIS + ASSOCIATES, INC.
HYDROGEOLOGY • ENGINEERING

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25th Anniversary 2004

October 13, 2004

VIA FEDERAL EXPRESS

Mr. Jeffrey Dhont
Superfund Project Manager
U.S. ENVIRONMENTAL PROTECTION AGENCY
75 Hawthorn Street (SFD-7-1)
San Francisco, CA 94105-3901

Re: Submittal of Final Workplan for Pilot Extraction and Aquifer Response Test, Montrose Site, Torrance, California

Dear Mr. Dhont:

Enclosed are replacement pages for your copies of the final report titled:

Final
Workplan for Pilot Extraction
And Aquifer Response Test
Montrose Site
Torrance, California
DSGWRD 26-**036**

Transmitted are the report cover and spine; the text revision 1.0, Figures 11 through 19; Appendix A text; Appendix A Tables A-4 and A-10; and Appendix A Figures A-3 through A-6. Please replace the relevant pages of the draft document dated June 11, 2004 with these replacement pages.

This report is being submitted to the U. S. Environmental Protection Agency (EPA) in accordance with the statement of work for the Unilateral Administrative Order for Initial Groundwater Remedial Design Activities.

This document has been prepared to incorporate responses to EPA comments received in correspondence dated August 23, 2004 (Attachment 1).

If you have any questions or comments, please contact us.

Sincerely,

HARGIS + ASSOCIATES, INC.

Michael A. Palmer, RG 5915, CHG 146
Principal Hydrogeologist

MAP/ama

Enclosure

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Other Offices:
Mesa, AZ
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cc: Mr. Jeffrey Dhont, U.S. Environmental Protection Agency (3 copies)
Ms. Natasha Raykhman, CH2M Hill (2 copies)
Mr. Steve Acree, U.S. Environmental Protection Agency (1 copy)
Mr. Frank Gonzales, Department of Toxic Substances Control (1 copy)
Mr. Safouh Sayed, Department of Toxic Substances Control (1 copy)
Mr. Joe Kelly, Montrose Chemical Corporation of California (1 copy)
Mr. Paul Sundberg, Consultant to Montrose Chemical Corporation of California (1 copy)
Karl Lytz, Esq., Latham & Watkins (1 copy)
Mr. John Dudley, URS Corporation (1 copy)
Luke Mette, Esq., Stauffer Management Company, LLC (1 copy)
Mr. Lee Erickson, Stauffer Management Company, LLC (1 copy)
Paul Galvani, Esq., Ropes & Gray (without enclosure)

HARGIS + ASSOCIATES, INC.

ATTACHMENT 1

RESPONSE TO EPA COMMENTS ON
DRAFT PILOT EXTRACTION AND AQUIFER RESPONSE TEST WORKPLAN
DSGWRD 26-036
MONTROSE CHEMICAL SITE
LOS ANGELES COUNTY, CALIFORNIA
DUAL SITE GROUNDWATER OPERABLE UNIT
DATED JUNE 11, 2004

ATTACHMENT 1

RESPONSE TO EPA COMMENTS ON
DRAFT PILOT EXTRACTION AND AQUIFER RESPONSE TEST WORKPLAN
DSGWRD 26 - 036
MONTROSE CHEMICAL SITE
LOS ANGELES COUNTY, CALIFORNIA
DUAL SITE GROUNDWATER OPERABLE UNIT
DATED JUNE 11, 2004

Comments received August 23, 2004, in a letter from Mr. Jeffrey Dhont, U.S. Environmental Protection Agency, to Mr. Joe Kelly, Montrose Chemical Corporation.

General Comments

1. *The following issues pertain to permits, authorizations, access, and public safety.*

1. The Workplan states that discharge of treated water to the storm sewer will take place pursuant to an NPDES permit. However, this permit has not yet been obtained from the Regional Water Quality Control Board, and so its requirements are not established. Montrose should note that EPA will issue approval to the Workplan contingent on the approval of the NPDES permit process. EPA requests to receive from Montrose approved copies of all required NPDES permits prior to clearing this contingency.

RESPONSE: As noted in the Workplan, Section 4.0, "Treatment and Disposal of Water", Montrose will obtain a National Priority Pollutant Discharge Elimination System (NPDES) permit from the Los Angeles Regional Water Quality Control Board (RWQCB). Pursuant to the August 23, 2004, EPA request, a copy of the approved NPDES permit will be provided to EPA prior to starting the extraction tests. The NPDES permit application was submitted to the RWQCB on October 12, 2004. It is understood that EPA will issue only conditional approval of this Workplan until such time that a copy of the NPDES permit is provided to the EPA.

2. The Workplan does not mention permits or Agencies which are being contacted with respect to the use of hydrant water. Please identify these Agencies in the Workplan. Montrose should note that EPA will issue approval to the Workplan contingent on the approval of such applicable permitting processes. EPA requests to receive from Montrose approved copies of all required water or hydrant use permits prior to clearing this contingency.

RESPONSE: The Workplan has been updated to indicate that written notifications have been provided to EPA and to the RWQCB, Los Angeles Region, prior to initiation of the injection testing. These notifications were sent on October 5, 2004. Additionally, the Los Angeles Department of Water and Power (LADWP) and the Rancho-Dominguez District of the California Water Service (CWS) have been contacted regarding connection to fire hydrants which will be utilized as a potable water source. While this work must be coordinated with the RWQCB, the LADWP, and the CWS, no additional permitting is anticipated. In response to this request, EPA has been provided copies of correspondence regarding potable water use and injection during these testing activities.

3. The Workplan does not mention whether Montrose has contacted the RWQCB with respect to the hydrant water reinjection. Please clarify. While a permit is not required for this injection, the RWQCB should be contacted. EPA should also issue a notice to the RWQCB; EPA requests that Montrose provide EPA with any necessary information such that EPA can execute this coordination.

RESPONSE: As detailed in the previous response, written notifications have been provided to EPA and to the RWQCB in letters dated October 5, 2004.

4. The Workplan does not mention real property access agreements which may be necessary, nor their status. Montrose should identify in the plan any properties for which Montrose it believes will need real property access to execute this plan.

RESPONSE: Access agreements will be required for all but one of the proposed wells including all three of the Gage aquifer wells (G-IW-1, G-IW-2, and G-EW-1) and three of the Bellflower sand wells (BF-IW-1, GW-IW-2, and BF-EW-1). Bellflower extraction well BF-EW-2 is located in the County of Los Angeles right-of-way and will require an excavation permit prior to installation, but no access agreement is necessary. Montrose's legal counsel is actively pursuing access agreements from the appropriate parties, as detailed below.

- G-IW-1 and BF-IW-1: located west of the Montrose property
- BF-IW-2: located on the Alpine Village property
- G-IW-2: located on the Del Amo Waste Pit area
- G-EW-1 and BF-EW-1: located within the Los Angeles Department of Water and Power right-of-way

Sections 3.1.1 and 3.2.1 of the Workplan have been revised accordingly.

5. The Workplan lacks and should include a segment on potential public safety hazards and plan for mitigating these hazards, as well as general security of equipment and data during the test.

RESPONSE: A number of precautions will be taken to minimize the risk to both the public and also equipment operators. Traffic control measures including the use of flag men, road construction signage, and delineators will be utilized where traffic controls are required. Temporary fencing will be set around each drilling location and will be utilized, as needed, during potable water injection and groundwater recovery activities. The drill rig and other drilling equipment will be locked and secured each night prior to departing the site for the evening. Equipment utilized during the injection and recovery tests will be under 24-hour observation by equipment operators. Additionally, a security guard will remain at the drilling and test sites overnight. In addition, local law enforcement agencies will be asked to monitor the drilling and testing sites. The Workplan has been modified to include details regarding site security, health, and safety.

2. As was discussed at the July 1, 2004 modeling meeting, the data gap analysis performed by EPA as part of the initial modeling calibration efforts indicated that the remedial wellfield could fail to contain the toe of the chlorobenzene plume in the Bellflower Sand, if high permeability materials are present in this area. Consequently, EPA believes that assessing the hydraulic properties of the Bellflower Sand at the toe of the chlorobenzene plume should be an objective of the pilot test. This can be achieved by moving the location of one of the proposed extraction test wells in the Bellflower Sand to the toe of the plume. We understand that siting of the extraction test wells will depend on the groundwater quality at the proposed locations to ensure compliance with the NPDES permit for the disposal of extracted groundwater. We have held conversations with Montrose regarding the optimum location of the moved extraction well; we request that the modified Workplan be reflective of those conversations.

RESPONSE: Bellflower sand extraction well BF-EW-2 has been relocated to the toe of the chlorobenzene plume as discussed in the July 1, 2004 meeting. Section 3.1.1 and Figure 11 of the Workplan have been revised accordingly.

3. The location of the proposed eastern injection well (BF-IW-2) in the Bellflower Sand is not appropriate because it is adjacent to well SWL0040, which has 100,000 ppb of benzene. As was discussed at the July 1, 2004 modeling meeting, the alternate location for this well could be adjacent to well SWL0027. We have held conversations with Montrose regarding the optimum location of the moved extraction well; we request that the modified Workplan be reflective of those conversations.

RESPONSE: Bellflower sand injection well BF-IW-2 has been relocated adjacent to SWL0027. Section 3.2.1 and Figure 11 of the Workplan have been revised accordingly.

4. The location of the proposed western injection well (BF-IW-1) in the Bellflower Sand appears to be close to well BF-20, which has 2,100 ppb of chlorobenzene based on the 2004 baseline sampling results. As was discussed at the July 1, 2004 meeting, groundwater samples should be collected in the Bellflower Sand at this location from the CPT boring prior to finalizing the location of this injection well. If elevated chlorobenzene concentrations are detected in these samples, the location of this injection well should be moved. We recommend that alternate location(s) for this well be identified in the Workplan to avoid delays in implementing the pilot test in the case that the currently proposed location is within the chlorobenzene plume.

RESPONSE: Prior to constructing Bellflower sand injection well BF-IW-1, a groundwater sample will be obtained from the Bellflower sand by installing a temporary well in the planned exploratory borehole. The exploratory boring will be drilled using small diameter mud rotary drilling and coring equipment to obtain data for the injection well design. Prior to grouting the exploratory boring, the mud will be thinned and a temporary well casing and 0.020-inch slotted screen assembly will be installed within the Bellflower sand. The screen will be filter packed with #2-/16 Lonestar sand. A two-foot #60 silica sand grout filter will be placed over the filter pack using a tremie pipe. A ten-foot bentonite pellet annular seal will then be emplaced above the sand, opposite the overlying aquitard sediments and allowed to hydrate. The temporary well will be surged and pumped for several hours to remove the residual drilling mud. After field parameters have stabilized, a groundwater sample will be collected from a low flow tap on the submersible pump discharge for laboratory analysis. The sample will be analyzed on an expedited 24-hour turn around time for volatile organic compounds (VOCs) and para-chlorobenzene sulfonic acid (pCBSA) using EPA Methods 8260 and 314.0.

Following the collection of the grab sample, the temporary casing and screen will be pulled from the exploratory boring and the exploratory boring will be completed and geophysically logged. If the grab sample concentrations are approximately equal to or less than the Maximum Contaminant Levels (MCLs) for individual VOCs, the exploratory boring will be completed as an observation well cluster. The injection well will then be constructed near the observation well cluster as planned.

If the grab sample concentration exceeds the approximate MCL for any individual VOC, the exploratory boring will be abandoned by pressure grouting and the injection well and observation well cluster will then be constructed at one of two alternate locations as indicated in the revised Workplan.

5. As was discussed at several conference calls and the July 1, 2004 modeling meeting, the Bellflower Sand pilot extraction wells are also planned to be screened in the UBA (MBFB Sand). This is in anticipation of the wells being used not only in the pilot test but in the final wellfield. However, if the pilot extraction well is moved to the toe of the plume as suggested in General Comment #1, screening this well in the UBA may not be needed unless elevated concentrations of chlorobenzene are detected in the UBA and/or UBA and Bellflower Sand merge at this location. We agree that well BF-EW-1 (if not moved to the toe of the plume) should be screened in both units, because this well may be used for containing the chlorobenzene plume within the TI waiver zone in both UBA and Bellflower Sand. Therefore, the Workplan should state that the water level data

will be collected from the UBA monitoring wells during extraction from the pilot well(s) screened in both UBA and Bellflower Sand to assess whether these wells are sufficient to contain the plume in the UBA or whether separate UBA wells would be required. If well BF-EW-2 is left near the ARMCO site, it should also be cross-screened in both units because elevated concentrations were detected in the UBA at this location.

RESPONSE: Bellflower sand extraction well BF-EW-1 will not be moved to the toe of the plume. It is currently planned that Bellflower sand extraction well BF-EW-1 will be screened opposite all sand zones that may be encountered from the water table to the base of the Bellflower sand. Blank casing with individual annular bentonite seals will be placed opposite any significant aquitard sediments that effectively separate the coarser sand zones. This will allow for the potential use of packers in the future to hydraulically isolate or adjust the amount of groundwater extraction occurring from different zones should it become necessary to optimize the remedial pumping. Groundwater extraction from Bellflower sand extraction well BF-EW-1 will likely focus on what has been defined at the Del Amo site as the Bellflower C and B sands, as well as the upper Bellflower aquitard. The Workplan has been revised to indicate that water level data will be collected from upper Bellflower aquitard monitor wells during extraction from the pilot well BF-EW-1 to assess whether this well is sufficient to contain the plume in the upper Bellflower aquitard or whether additional upper Bellflower aquitard wells would be required.

Bellflower sand extraction well BF-EW-2 has been relocated to the toe of the chlorobenzene plume as discussed in the July 1, 2004 meeting. The same approach will be used to select the blank casing and screen intervals for pilot extraction well BF-EW-2 as described above. It is not currently possible to predict whether a single merged sand or several sand intervals will be encountered at the proposed location. Based on the log of nearby Bellflower sand monitor well BF-17, a single coarse sand interval overlain by fine-grained aquitard sediments may be encountered. The Workplan has been revised to indicate that water level data will be collected from nearby upper Bellflower aquitard monitor wells located at the ARMCO Site to assess to what extent extraction from Bellflower sand extraction well BF-EW-2 hydraulically affects the upper Bellflower aquitard in the vicinity.

6. We request that locations of monitoring wells for the pilot test be selected based on the results of model simulations of the proposed pilot test, which were provided at the July 1, 2004 modeling meeting. These results indicate that the radius of influence of the test extraction wells is expected to extend over a large area in the MBFC Sand, which covers most of the chlorobenzene plume.

RESPONSE: As requested, the locations of monitor wells have been modified based on the currently proposed locations of the extraction and injection wells and also based on model simulations. For each test well, the monitor wells are sorted into three categories: Tier 1, Tier 2, and Tier 3. The Tier 1 wells represent those wells which are nearest to the test well and therefore most likely to demonstrate observable influence. The Tier 2 and 3 wells are located at further distances from the test wells. If influence is seen at any of the outermost Tier 1 wells, monitoring will be extended to the Tier 2 wells. Monitoring will be further expanded to the Tier 3 wells, if influence is observed in the outermost Tier 2 wells. Regardless of the extent of influence observed during the test, water levels will be measured at all monitor wells prior to the test. After completion of the test and after completion of recovery, water levels will be measured in Tier 1 wells, and Tiers 2 and 3, if appropriate. Additional details regarding this protocol are included in Section 4.2.2 of Appendix A of the Workplan.

7. We request that at least three water level gauging rounds be performed on all existing monitoring wells including first round prior to the test, second round at the end of the test (i.e., prior to shutting down extraction), and third round at the end of recovery. This will provide the best information with which to triangulate the impact of extraction on the water level surface. The proper procedures should be included or cited in the Workplan for performing these water level gauging operations. The Workplan should include a clear description of the coordination of the timing of these efforts with the test procedure.

RESPONSE: Three rounds of water level measurements will be conducted. See response to Comment # 6 for details regarding which wells will be monitored for each portion of the test. All Tier 1, 2, and 3 wells will be measured before the test. After completion of the test and after completion of recovery, water levels will be measured in Tier 1 wells, and Tiers 2 and 3, if appropriate. The proposed water level monitoring schedule has been updated and is included in Table A-10 of Appendix A. This table details when manual water level measurements will be recorded and also provides details regarding the duration that transducers will remain in the wells for continuous logging of water level responses.

8. The Workplan should include contingencies for the test in the event that injection cannot be maintained (such as if there is plugging of well screens) and what steps will be taken to ascertain the cause of the plugging (one objective is to evaluate the potential for this plugging and its cause if observed). The Workplan should also include contingencies in the event that extraction must be shut down due to a problem with the treatment unit or other unforeseen lack of sewer capacity) such as to still obtain the greatest possible quality of data from the test.

RESPONSE: Workplan Sections 3.1.5, 3.2.5, 4.0, and 5.0 have been amended to include details regarding contingencies for interruption of the injection or extraction tests. This includes provisions both for troubleshooting, i.e., identification of the cause of the interruption, and for determining whether a test will be resumed or terminated. Injection well specific capacity will be closely monitored during each injection test for evidence of decreased well capacity. A small percentage of the injected water will be continuously directed to a 5-micron bypass filter apparatus during the injection test to assess the amount of suspended solids in the source water and correlate the rate of filter plugging with the change in well capacity. A field meter will be used to periodically monitor the residual chlorine concentration in the source water to evaluate the potential for inhibiting biological fouling in the well. The injection tubing will be designed to prevent cascading water or vacuum situations which could lead to air entrainment.

9. Please provide in a table in the Workplan a list of the data and information that will be obtained as a direct result of this test.

RESPONSE: Review of the document which was originally supplied suggests that this information was provided in the draft copy of the Workplan as Table A-10 in Appendix A. A copy of this table, which has been revised to include additional details, is provided in the Workplan.

Specific Comments

10. Section 3.1.2 - Extraction Well Design and Installation: The Workplan should clarify that the MBFC Sand extraction wells will be also screened in the MBFB Sand. The Workplan should also discuss whether both units are planned to be screened continuously, or a blank casing will be installed between the screens in the MBFB and MBFC Sand, if silts and clays are identified during drilling that separate these units.

RESPONSE: Bellflower sand extraction wells will be screened opposite each substantial sand zone encountered from the water table to the base of the Bellflower sand, including the MBFB sand and MBFC sand, if encountered. Blank casing with a corresponding bentonite annular seal will be placed opposite silty or clayey aquitard zones to allow hydraulic isolation of individual zones in the future, if warranted. If the MBFC sand and MBFB sand are merged and no aquitard sediments are encountered, then one continuous screen will be installed. For clarification, Section 3.1.2 of the Workplan has been revised.

11. Section 3.1.5 - Extraction Well Testing: Please clarify in the Workplan that the extraction/injections tests on the wells will be performed sequentially (not simultaneously)

RESPONSE: This section was revised to include additional details related to the completion of the pilot test. Revisions include clarification of the proposed schedule for testing activities, i.e., extraction and injection tests will be completed sequentially, not simultaneously.

12. Section 3.2.4 - Injection Well Sampling and Analysis: The Workplan should state that groundwater samples will be collected from the CPT boring prior to finalizing the location of the west injection well in the MBFC Sand.

RESPONSE: See response to Comment 4.

13. Appendix A; Section 4.2 - Water Level Measurements: Locations of monitoring wells for the extraction tests in the MBFC Sand should be revised based on the final locations of the extraction wells and results of model simulations presented at the July 1, 2004 modeling meeting. We also request that Montrose monitor wells G-12 and G-13 during the extraction test in the Gage Aquifer. We also request that at least three water level gauging rounds were performed on all existing monitoring wells (See general comment 7).

RESPONSE: Details regarding monitoring are included in previous responses; see responses to Comments numbers 6 and 7. Additionally, as requested, monitor wells G-12 and G-13 will be included as Tier 1 monitor wells during the extraction test in the Gage aquifer.

14. Appendix A; Section 6.1.3.4 - Bellflower Sand and Gage Aquifer Extraction and Injection Wells: The Workplan should provide the rationale for the construction of the pilot injection and extraction wells. For example, it should be clarified why PVC was selected for well casings and screens as supposed to steel. The use of PVC may impact the longevity and complicate maintenance of these wells, which are supposed to serve as actual remediation wells and will need to last for over 50 years. The use of steel casings and screens, on the other hand, would allow more effective redevelopment of these wells (especially injection wells) using wire-brush and other methods (e.g., chemicals) that can not be used for PVC casings and screens. In addition, Montrose should evaluate the use of stainless steel wire rap screens for both inside and outside portions of the screen or shutter (full flow) screens for injection wells as opposed to perforated PVC proposed by the Workplan. These screens provide greater open area and allow more effective redevelopment, which is an important issue for an injection well that will be operated for more than 50 years. The basis for a 12-inch diameter, well depths, and screened intervals should also be presented in the Workplan.

RESPONSE: The Workplan has been revised to indicate that stainless steel casing and wire wrap screen will be used for both injection and extraction wells. As detailed in the revised Workplan, the 12-inch well diameter was selected to accommodate all down-hole monitoring equipment and also the largest diameter submersible pump.

15. Appendix A; Section 6.3 - Pilot Extraction and Aquifer Response Testing: Equipment and Instrumentation section should describe the submersible pump which will be used for the test (the pump description could be moved from Section 4 - Treatment and Disposal of Water).

RESPONSE: This section has been amended to include specifications for the submersible groundwater extraction pump.

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June 11, 2004

VIA FEDERAL EXPRESS

Mr. Jeffrey Dhont
Superfund Project Manager
U.S. ENVIRONMENTAL PROTECTION AGENCY
75 Hawthorn Street (SFD-7-1)
San Francisco, CA 94105-3901

Re: Submittal of Draft Workplan for Pilot Extraction and Aquifer Response Test, Montrose Site, Torrance, California

Dear Mr. Dhont:

Enclosed are three copies of the draft report titled:

Draft
Workplan for Pilot Extraction
And Aquifer Response Test
Montrose Site
Torrance, California
DSGWRD 26-036

This report is being submitted to the U. S. Environmental Protection Agency (EPA) in accordance with the statement of work for the Unilateral Administrative Order for Initial Groundwater Remedial Design Activities.

If you have any questions or comments, please contact us.

Sincerely,

HARGIS + ASSOCIATES, INC.

Michael A. Palmer, RG 5915, CHG 146
Principal Hydrogeologist

David R. Hargis, PhD, RG 3824

MAP/ama

Enclosure

cc: Mr. Jeffrey Dhont, U.S. Environmental Protection Agency (3 copies)
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HARGIS + ASSOCIATES, INC.

PILOT EXTRACTION AND AQUIFER RESPONSE TEST WORKPLAN

MONTROSE SITE

TORRANCE, CALIFORNIA

DSGWRD 26 – **036**

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ACRONYMS AND ABBREVIATIONS

BHC	Hexachlorocyclohexane
bls	Below land surface
DDT	Dichlorodiphenyltrichloroethane
DPW	Los Angeles Department of Water and Power
DQOs	Data quality objectives
EPA	U.S. Environmental Projection Agency
FSP	Field Sampling Plan
gpm	Gallons per minute
H+A	Hargis + Associates, Inc.
JGWFS	Joint Groundwater Feasibility Study
MBFB	Middle Bellflower B sand
MBFC	Middle Bellflower C sand
Montrose	Montrose Chemical Corporation of California
msl	Mean sea level
NPDES	National Pollution Discharge Elimination System
pCBSA	para-Chlorobenzene Sulfonic Acid
Pilot Testing Program	Pilot Test and Aquifer Response Program
Property	Area within the fenced property boundary located at 20201 South Normandie Avenue, in Los Angeles (near Torrance), California
psig	Pounds per square inch gage
PVC	Polyvinyl chloride
QAPP	Quality Assurance Project Plan
QA/QC	Quality assurance/quality control
RD	Remedial Design
RI	Remedial Investigation
ROD	Record of Decision
Site	Montrose Chemical Corporation of California Site
SOPs	Standard operating procedures
SOW	Statement of Work
UAO	Unilateral Administrative Order

ACRONYMS AND ABBREVIATIONS (continued)

UBF	Upper Bellflower
ug/l	Micrograms per liter
VOCs	Volatile organic compounds
Workplan	Pilot Extraction and Aquifer Response Test Workplan

DRAFT

PILOT EXTRACTION AND AQUIFER RESPONSE TEST WORKPLAN
MONTROSE SITE
TORRANCE, CALIFORNIA
DSGWRD 26 – **036**

1.0 INTRODUCTION

This Pilot Extraction and Aquifer Response Test Workplan (Workplan) has been prepared for Montrose Chemical Corporation of California (Montrose) in accordance with the requirements outlined in Section 4 of the Unilateral Administrative Order (UAO) Statement of Work (SOW), First Amendment (U.S. Environmental Protection Agency [EPA], 2004). The Pilot Extraction and Aquifer Response Test program (Pilot Testing Program) is being conducted to provide additional data needed for the design of the Montrose-Del Amo Joint Groundwater Remedy as specified in the Record of Decision (ROD) (EPA, 1999). The Montrose Site (Site) and Del Amo site are independent Superfund sites with separate histories, but are considered a joint site by EPA with respect to the groundwater operable unit and associated remedial design investigations.

EPA is currently conducting a comprehensive groundwater modeling program leading to the development of the final design for the remediation wellfield. A significant component of the modeling effort will be focused on conducting iterative simulations to assess and account for the uncertainties inherent in the model with the goal of achieving a wellfield design which will meet the ROD cleanup criteria. Uncertainties in the model and the subsequent remedial wellfield design can be minimized by obtaining field performance data through a program of phased installation and testing of groups of full scale extraction and injection wells. This approach will enable the modeling to move forward and reduce the number of iterative model simulations.

This Workplan describes the proposed location, design, and construction of three pilot extraction wells, four pilot injection wells, and three observation wells. The pilot extraction and

injection wells will be designed and constructed in a manner that will allow them to be incorporated into the final remediation wellfield. The Workplan also describes the proposed extraction and injection testing procedures to be used.

The field sampling plan (FSP) that describes the objectives, rationale, methods, field equipment, standard operating procedures (SOPs), and additional details for the pilot extraction and aquifer response testing has been included with this Workplan as Appendix A. The FSP was developed in accordance with the EPA guidance document "Preparation of a U.S. EPA Region 9 Field Sample Plan for EPA-Lead Superfund Projects", Document Control No. 9QA-06-93" (EPA, 1994). The quality assurance project plan (QAPP) that describes the data quality objectives (DQOs) and quality assurance/quality control (QA/QC) SOPs that will be implemented during field and laboratory activities for the pilot extraction and aquifer response testing program has been included with this Workplan as Appendix B. The QAPP was developed in accordance with the EPA guidance document "EPA Guidance for Quality Assurance Project Plans, Document Control No. EPA QA/G-5" (EPA, 1998a).

Due to the comprehensive and extensive nature of supporting documentation, information contained in the Montrose Remedial Investigation (RI) Report is frequently incorporated by reference in this Workplan and has not been duplicated herein (EPA, 1998b).

1.1 PURPOSE

The purpose of the Pilot Testing Program is to provide data on full scale extraction and injection well performance and the resulting aquifer and aquitard response, which will reduce the uncertainties involved in modeling and lead to a more robust and cost effective remedial design. Information regarding the specific capacity of full scale extraction and injection wells is needed to determine the number of wells that may be required to meet remedial objectives, and therefore is critical to the wellfield design. In addition, data will be obtained during the pilot testing program from surrounding monitor wells completed in the extraction and injection zones, as well as the adjacent aquitards. This monitoring data, once incorporated into the model, will reduce the uncertainty in the model results, provide a more reliable wellfield design, and eliminate unnecessary conservatism and costs. In addition, these wells will define the

standards by which other extraction and injection wells will be installed as part of the final remedial program implementation.

To date, estimates of aquifer hydraulic parameters have been based primarily on short-term aquifer and slug tests conducted in small diameter monitor wells by the Montrose and Del Amo respondents. This Pilot Testing program will provide more reliable estimates of aquifer and aquitard hydraulic properties and extraction/injection well performance based on longer-term pumping of full scale pilot extraction and injection wells.

1.2 DEFINITION OF TERMS

To facilitate the discussion within this document, several defined terms are used as described below. For clarity of discussion only, this report will refer to the "Property" as the area within the fenced property boundary located at 20201 South Normandie Avenue, in Los Angeles, near Torrance, California (Figure 1). The term "central process area" refers to an approximate two-acre portion of the Property where most of the manufacturing operations were historically performed.

The term dichlorodiphenyltrichloroethane (DDT) or total DDT, will be used to refer to the sum of the isomers and metabolites of DDT. The term hexachlorocyclohexane (BHC) or total BHC, will be used to refer to the sum of the isomers of BHC.

1.3 OBJECTIVES

In accordance with the UAO SOW Section 4, the objectives of the Pilot Testing Program are to:

- Obtain data regarding the response of the hydrostratigraphic system to the stress of pumping and injection on a scale approaching that to be used in the full scale production wells.

- Obtain more reliable estimates of aquifer transmissivity, hydraulic conductivity, storativity, and aquitard leakance that can be used to improve the reliability of the groundwater model and wellfield simulations.

- Obtain data regarding the radius of influence and capture zones likely to be achieved by full scale extraction wells.

- Obtain information about injection rates for full scale injection wells and evaluate injection well plugging issues.

- Provide information needed to develop specifications for extraction and injection wells, treatment system, piping and control systems, and facilitate the design of these physical systems upon completion of the modeling and wellfield optimization.

1.4 SCOPE

Pursuant to Section 4.0 of the UAO SOW, the Workplan shall include the following major components:

- The specific objectives to be met by the pilot testing with the data needs clearly identified;

- Clear identification of the data and the interpretation that will be provided after the test;

- Proposed pilot extraction and injection well construction details; drilling methods and equipment; construction materials; borehole, casing and annular seal materials; depths of screened and blank casing intervals; and well development procedures;

- Proposed nested piezometer construction details; drilling methods; construction materials; borehole, casing and annular seal materials; depths of screened and blank casing intervals; and well development procedures;

- Proposed pilot testing procedures and equipment including: pump, transducers, and other dedicated or temporary downhole equipment;

- Details regarding the treatment and/or disposal of development water, drilling fluids, and other potentially contaminated media;

- Groundwater sampling procedures and chemical and physical parameters to be included in the sample analysis of the new wells, pending incorporation into the overall monitoring plan;

- A diagram with a description of any treatment and disposal/injection systems to be tested, along with descriptions of test equipment, procedures, and measurements of performance;

- A discussion of the treatment process;

- A description of pilot system installation and startup;

- A discussion of pilot system operation and maintenance procedures and description of any ancillary facilities required to conduct the testing;

- Identification of the data type and frequency that will be collected during the pilot testing;

- Discussion of permitting requirements;

- Identification of the methodology and procedures for data collection during pilot testing and the DQOs, which define the statistical accuracy, precision, and representative ness of the data;

- A discussion of the quality control samples needed to meet the data quality objectives;

- Pollution control planning which outlines the process, procedures, and safeguards that shall be used to ensure contaminants are not improperly released during the pilot test;

- Investigation derived waste management planning which includes procedures for managing wastes from conducting the pilot testing, including procedures for transporting these wastes off-site for purpose of storage, treatment and/or disposal. The Workplan will provide details on discharge or disposal requirements for treated water.

These items are addressed in the Workplan, FSP (Appendix A) and in the QAPP (Appendix B).

2.0 BACKGROUND

Background information including site location and description, site history, stratigraphy, hydrogeology, and previous investigations is provided in the subsequent sections.

2.1 SITE LOCATION AND DESCRIPTION

The Montrose Property occupies approximately 13 acres in the City of Los Angeles near Torrance, California (Figure 1). The Property is bounded by the Union Pacific Railroad right-of-way and Normandie Avenue to the east; Jones Chemical Company and a right-of-way owned by the Los Angeles Department of Water and Power to the south; former Boeing Realty Corporation to the north; and Frito-Lay to the west. The Montrose property is generally level. Elevations range from 40 feet above mean sea level (msl) to 45 feet msl. The surrounding area consists of mixed residential, commercial, and industrial facilities. The Property is accessible by city streets in the area and Interstates 405 and 110. Los Angeles International Airport is located approximately 10 miles from the Property.

The former Del Amo Synthetic Rubber plant and property, operated between 1942 and 1972. The Del Amo plant and property lies in an area roughly bounded by Normandie Avenue on the west, Interstate 110 on the east, 190th Street on the north and Del Amo Boulevard on the south (Figure 2).

2.2 SITE HISTORY

Montrose manufactured DDT at the Site from 1947 to 1982. The facility was closed in 1982 and the Site was subsequently cleared and capped with asphalt. Previous investigations addressing the potential for contamination at the Site included on- and off-property sampling of soil, groundwater, sediment, and surface water. The investigations were performed by the EPA, its contractors, the California Department of Health Services, the Regional Water Quality Control

Board, and Montrose's consultants. The RI Report provides a detailed summary of the Site history (EPA, 1998b).

2.3 STRATIGRAPHY

The stratigraphy of the Site was defined using published regional geologic information and by site-specific data collected from monitor wells and borings drilled during numerous Site investigations. While a brief summary of the stratigraphy is provided below to provide context to this Workplan, the reader is referred to the RI Report for additional detailed information (EPA, 1998b).

The stratigraphy of the Site, starting at land surface, consists of fill material, the Playa deposits, the Palos Verdes sand, the Bellflower aquitard, the Gage aquifer, an unnamed aquitard, and the Lynwood aquifer (EPA, 1998b). Three geologic units comprise the vadose zone encountered at the Site: recent Playa deposits, late Pleistocene marine deposits referred to as the Palos Verdes sand, and the upper portion of the Pleistocene Bellflower aquitard.

Fill material consisting of moderately to highly plastic dark brown clay with occasional brick and concrete debris is generally encountered from land surface to approximately 4 feet below land surface (bls). On the pads, fill material is generally encountered from land surface to approximately 8 feet bls. In the vicinity of the former water recycling pond in the CPA, fill material is approximately 20 feet thick. The Playa deposits, consisting of olive-brown silty sand, sandy silt, and silt are generally encountered beneath the fill material to a depth of approximately 22 feet bls. The Palos Verdes sand, consisting of a fine-grained, light yellowish brown to light olive-brown, well sorted sand, is generally encountered to a depth of approximately 44 feet bls. A well-cemented fossiliferous sand is encountered at the base of the Palos Verdes sand. This cemented fossiliferous sand is thickest in the western portions of the Property, and appears to dip slightly and pinch out toward the east. The thickness of this unit in the western portion of the Property was approximately 8 feet and was approximately 2 feet in the eastern portion of the Property.

The Bellflower aquitard immediately underlies the Palos Verdes sand. Three lithologically distinct subunits of the Bellflower aquitard are encountered at the Site: the upper Bellflower aquitard, the Bellflower sand, and the lower Bellflower aquitard. The first groundwater beneath the Site is encountered within the upper Bellflower aquitard at a depth of approximately 65 feet bls. The upper Bellflower aquitard consists of fine-grained sand, silty sand, silt and clay. These sediments are interbedded, discontinuous, and vary in thickness. The upper Bellflower aquitard is encountered to a depth of approximately 100 feet bls. The Bellflower sand underlies the upper Bellflower aquitard. The Bellflower sand is a fine- to medium-grained sand. The Bellflower sand is encountered to a depth of approximately 130 feet bls. The lower Bellflower aquitard, consisting of a brown silty sand and silt, is encountered beneath the Bellflower sand to a depth of approximately 140 feet bls.

At the nearby Del Amo Site, the upper Bellflower aquitard has been further subdivided into the following units: the upper Bellflower or UBF, the middle Bellflower B Sand or MBFB, and the middle Bellflower C Sand MBFC. The water table occurs in the UBF at most of the Del Amo Site, but it occurs in the MBFB sand at the Montrose Site. The MBFC correlates with the Bellflower sand

The Gage aquifer, consisting of fine-grained sand, is encountered beneath the lower Bellflower aquitard to a depth of approximately 220 feet bls. An unnamed aquitard underlying the Gage aquifer has been informally named the Gage-Lynwood aquitard. It consists of silt, sandy silt, and/or clayey silt interbedded with fine-grained silty sand and appears to be laterally continuous across the Site.

The upper 20 feet of the Lynwood aquifer consists of dark gray fine- to medium-grained sand. This sand is underlain by as much as 8 feet of dark gray silt or clay of varying plasticity. Approximately 10 to 30 feet of gray, well-graded sand, gravelly sand, and sandy gravel with some silty sand interbeds underlie the top 20 to 30 feet of the Lynwood aquifer. The Lynwood aquifer occurs approximately between 270 to 305 feet bls across the Site. The thickness of the Lynwood aquifer, based on borings drilled at the Site, varies from 33 feet to greater than 108 feet.

An unnamed aquitard, approximately 205 feet thick, separates the Lynwood aquifer and the underlying Silverado aquifer beneath and east of the Site. The Silverado aquifer consists of fine- to coarse-grained blue-gray sands and gravels with discontinuous layers of silt and clay. These deposits reportedly attain a maximum thickness of about 500 feet.

2.4 HYDROGEOLOGY

Most of the recharge to the West Coast Basin aquifers occurs at the West Coast Barrier Project and the Dominguez Gap Barrier Project. Fresh water is injected into a line of injection wells that parallels the coastline. The injected water forms a freshwater pressure ridge that acts as a barrier to protect basin groundwater from saltwater intrusion. A slight seaward flow of groundwater is maintained between the barrier and the ocean that prevents intrusion of seawater. Most of the injected water flows from the barrier toward the interior of the basin.

The regional direction of groundwater flow within the West Coast Basin is controlled by the injection barriers and pumping centers. The predominant flow direction in the Silverado aquifer is to the east from the West Coast Basin Barrier Project to pumping centers located in Gardena, Wilmington, and Carson.

In general, the groundwater flow direction in the upper Bellflower aquitard during January 2004 was to the south and southeast, but varied locally (Figure 3). The regional direction of groundwater flow in the upper Bellflower aquitard has been about the same since 1988 (Hargis + Associates, Inc., [H+A], 2004b).

In general, the groundwater flow direction in the Bellflower sand in the vicinity of the Site during January 2004 was to the southeast (Figure 4). The regional direction of groundwater flow in the Bellflower sand has been about the same since 1987 (H+A, 2004b).

In general, the groundwater flow direction in the Gage aquifer during January 2004 was to the southeast (Figure 5). The regional direction of groundwater flow in the Gage aquifer has been about the same since 1987 (H+A, 2004b).

In general, the groundwater flow direction in the Lynwood aquifer during January 2004 was to the east (Figure 6). The direction of groundwater flow in January 2004 was about the same as the direction of groundwater flow observed in 2002 (H+A, 2004b). In 1995, groundwater flow in this unit was to the southeast.

2.5 PREVIOUS INVESTIGATIONS

The following summarizes the previous investigations that have been conducted at the Site from 1985 through January 2004.

Montrose has conducted groundwater monitoring since 1985. A total of 97 monitor and extraction/test/injection wells were originally constructed as part of RI activities conducted by Montrose to evaluate the nature and extent of Montrose-related compounds in groundwater. A number of monitor wells have been destroyed by different entities during construction, grading, or paving activities on surrounding properties. Presently there are over 85 monitor wells and six extraction/test/injection wells at the Site (Figure 2).

Montrose monitor wells are completed in each of the following four hydrostratigraphic zones, which are identified in order of increasing depth bls:

- Upper Bellflower aquitard
- Bellflower sand
- Gage aquifer
- Lynwood aquifer.

Detailed discussion and conclusions regarding hydrostratigraphic interpretations, directions of groundwater flow, and the nature and extent of contamination in each of these hydrostratigraphic zones are provided in the RI Report (EPA, 1998b). The RI Report also describes the historical background; history of response; assessment objectives; assessment results; laboratory analyses; quality assurance; fate and transport of compounds of concern; and other pertinent information, such as aquifer test results, well construction, and well development specifications.

A baseline groundwater sampling round was conducted in January 2004. Prior to beginning groundwater sampling, water level measurements were obtained from 88 accessible Montrose monitor wells and one Del Amo well (Figures 3 through 6). A total of 72 monitor wells were sampled during the baseline sampling event consisting of 20 upper Bellflower aquitard monitor wells, 29 Bellflower sand monitor wells, 18 Gage aquifer monitor wells, and 5 Lynwood aquifer monitor wells. All groundwater samples were analyzed for volatile organic compounds (VOCs) using EPA Method 8260B, and for para-Chlorobenzene Sulfonic Acid (pCBSA) using modified EPA Method 314. Additionally, groundwater samples from selected wells were analyzed for DDT, hexachlorocyclohexane, and other organochlorine pesticides using EPA Method 8081A and for parameters used to evaluate the potential for plugging injection wells during remedial action and in support of future engineering studies. Sampling methods and analytical results are provided in the Baseline Groundwater Sampling Results Report (H+A, 2004b).

2.6 NATURE AND EXTENT OF CHLOROBENZENE IN GROUNDWATER

The following sections outline the nature and extent of chlorobenzene in groundwater in each of the hydrostratigraphic units based on data collected in January 2004. An understanding of the extent of the chlorobenzene plumes is necessary in order to evaluate the locations of proposed extraction and injection wells.

2.6.1 Upper Bellflower Aquitard

Chlorobenzene was detected in 13 of the 20 upper Bellflower aquitard monitor wells sampled during the baseline sampling round (Table 1; Figure 7). Concentration of chlorobenzene detected in groundwater from the upper Bellflower aquitard ranged from 3.3 micrograms per liter (ug/l) in monitor well MW-19 to 130,000 ug/l in monitor well MW-01. A comparison of previous chlorobenzene data with results from the baseline sampling round indicates that chlorobenzene concentrations have increased in 5 monitor wells, decreased in 8 monitor wells, and remained relatively unchanged in 7 monitor wells since the previous groundwater sampling round. Chlorobenzene concentrations in samples collected from monitor wells MW-01, MW-04, and MW-13 exceed the historical high concentrations for these wells. Seven of the eight monitor

wells where decreases in chlorobenzene concentrations occurred were below the historic range of chlorobenzene concentrations at these wells. Chlorobenzene results for two of these seven monitor wells were below the method detection limit of 2 ug/l (Table 1).

The chlorobenzene plume in the upper Bellflower aquitard originates at the CPA and extends downgradient a distance of approximately 1,500 feet (Figure 7). The extent of the chlorobenzene plume in the upper Bellflower aquitard is similar to that observed in 2002 and 1995 with the following exceptions:

- Chlorobenzene was detected at a concentration of 5.1 ug/l in monitor well MW-08, located northeast of the Property, in 2004 (Figure 7). In 1995, chlorobenzene was not detected in this well. This well was not sampled in 2002. Previously, the concentration of chlorobenzene in this well ranged from less than the detection limit to 5.0 ug/l (Table 1). The 1 ug/l concentration contour has been extended to the northeast in the vicinity of this monitor well (Figure 7;).

- Chlorobenzene was not detected in monitor well MW-17, located southeast of Jones Chemical, in 2004 (Figure 7). Chlorobenzene at this monitor well has been historically detected at concentrations ranging from 2 ug/l to 7.5 ug/l (Table 1). The 1 ug/l contour in the vicinity of this monitor well has contracted (Figure 7).

2.6.2 Bellflower Sand

Chlorobenzene was detected in 23 of the 29 Bellflower sand monitor wells sampled during the baseline sampling round (Table 1; Figure 8). Concentrations of chlorobenzene detected in groundwater from the Bellflower sand ranged from 3.6 ug/l in monitor well BF-26 to 47,000 ug/l in monitor well BF-02. A comparison of previous chlorobenzene data with results from the baseline sampling round indicates that chlorobenzene concentrations have increased in 12 monitor wells, decreased in 11 monitor wells, and remained relatively unchanged in 6 monitor wells. Chlorobenzene concentrations in samples collected at monitor wells BF-02, BF-10, BF-11, BF-16, BF-17, BF-20, and BF-24 exceed the historical high concentrations for these wells (Table 1). Eight of the eighteen monitor wells where decreases in chlorobenzene concentrations occurred were below the historical low concentrations at these monitor wells.

The lateral extent of chlorobenzene in the Bellflower sand is much greater than other hydrogeologic units. The chlorobenzene plume in the Bellflower sand originates at the CPA and extends downgradient a distance of approximately 6,500 feet (Figure 8). The lateral extent of the chlorobenzene plume in the Bellflower sand is similar to that observed in 2002 and 1995, with the exception that chlorobenzene was not detected in monitor well BF-32A, located southwest of the Property, in 2004 (Figure 8). Chlorobenzene at this monitor well had been detected previously at concentrations as great as 180 ug/l (Table 1). The 1 ug/l contour in this area has contracted (Figure 8).

2.6.3 Gage Aquifer

Chlorobenzene was detected in 14 of the 16 Gage aquifer monitor wells sampled during the baseline sampling round (Table 1; Figure 9). Concentrations of chlorobenzene detected in groundwater from the Gage aquifer ranged from 13 ug/l in monitor well G-15 to 17,000 ug/l in monitor well G-02. A comparison of previous chlorobenzene data with results from the baseline sampling round indicates that chlorobenzene concentrations have increased in 9 monitor wells, decreased in 5 monitor wells, and remained relatively unchanged in 2 monitor wells. Chlorobenzene concentrations in samples collected at monitor wells G-01, G-08, G-09, G-11, G-13, G-17, and G-19 exceed the historical high concentrations for these wells (Table 1).

Lower Gage aquifer monitor wells LG-01 and LG-02 were sampled during the baseline event. Concentrations of chlorobenzene in samples collected in these wells were 9.5 ug/l and 120 ug/l, respectively. These concentrations are below the historical high concentrations previously detected at these wells (Table 1; Figure 9).

The extent of the chlorobenzene plume, as defined by the 1 ug/l contour, in the Gage aquifer is similar to that observed in 2002 and 1995 (Figure 9)(H+A, 2004b). The chlorobenzene plume in the Gage aquifer extends from sources in the CPA to the southeast for a distance of approximately 4,000 feet.

2.6.4 Lynwood Aquifer

Chlorobenzene was detected in 2 of the 5 Lynwood aquifer monitor wells sampled during the baseline sampling round (Table 1; Figure 10). Concentrations of chlorobenzene detected in groundwater from the Lynwood aquifer were 8.4 ug/l in monitor well LW-02 and 64 ug/l in monitor well LW-01 (Table 1). Chlorobenzene has not been previously detected at monitor well LW-02. The concentration of chlorobenzene detected in monitor well LW-01 is within the historical concentration range for this well.

Chlorobenzene isoconcentration contours indicate that the lateral limit of chlorobenzene, as defined by the 1 ug/l concentration contour, in the Lynwood aquifer is defined (Figure 10).

2.7 JOINT GROUNDWATER MODELING

The original model of the Site was developed in support of the Joint Groundwater Feasibility Study (JGWFS) to perform feasibility-study level analysis of the remedial alternatives. MODFLOW, a three-dimensional finite difference model, was used to simulate groundwater flow at the Joint Site. MODFLOW was linked to the transport model MT3D for the simulations of contaminant transport. The model domain was a rectangular area centered on, and extending beyond, the Joint Site, incorporating known and potential sources of contamination, which lie in the vicinity of the Joint Site. The model grid consisted of 5,229 rectangular cells of 200 by 200-foot size in the primary area of interest, and 200 by 400-foot cells in the peripheral areas. Vertically, the model was divided into 13 layers of variable thickness to represent eight affected hydrostratigraphic units discussed in the JGWFS. Hydrogeologic properties were assigned to the model based on the results of remedial investigations performed at the Montrose and Del Amo Sites. EPA selected the 700 gallons per minute (gpm) scenario as the preferred alternative (EPA, 1999). This alternative includes extraction wells located along the axis of the Bellflower sand and Gage aquifer chlorobenzene plume, and one extraction well in the Lynwood aquifer. This alternative also included injection wells located at the periphery of the Bellflower sand and Gage aquifer chlorobenzene plumes in order to dispose of the treated water and control the chlorobenzene plume.

Although the JGWFS model was based on the results of the extensive remedial investigations conducted at the Site, and was sufficient for the feasibility-study-level analysis, it was concluded that additional modeling was required for the Remedial Design (RD) (CH2M Hill, 2003). There are a number of uncertainties associated with the JGWFS model input parameters. These uncertainties result from the inherent complexity of the hydrogeologic conditions beneath the Site and the absence of constraints associated with the model boundaries. While these uncertainties are not uncommon when modeling complex physical systems such as that found at the Site, and are acceptable for the comparative evaluation of remedial scenarios performed during the JGWFS, they need to be re-evaluated, quantified to the extent possible, and reduced during the RD to increase the accuracy of modeling predictions of the performance of the remedial wellfield. This can be achieved through the use of an improved and systematic calibration process utilizing automatic calibration software, which was not available at the time of the original calibration of the JGWFS model, and the collection of additional data in the field.

The model developed for the RD is based on the existing JGWFS model, which will be enhanced using additional data collected during the RD, and calibrated using the automatic calibration software package PEST (Doherty, 2002; Doherty and Johnston, 2003). PEST is a parameter estimation program that should produce a significant improvement in the calibration of both flow and transport simulations. PEST will also be used to help assess quantitatively the uncertainties in model predictions regarding the performance of the remedial wellfield, and its ability to satisfy the performance criteria specified in the ROD.

3.0 DATA GAP ANALYSIS AND RECOMMENDED WORK

Available data from the Site do not provide adequate estimates of horizontal and vertical hydraulic conductivity and storativity within the modeling domain. The EPA has prepared a Draft Modeling Work Plan outlining a comprehensive groundwater modeling program leading to the development of the final design for the remediation wellfield (CH2M Hill, 2003). A significant component of the modeling effort will be focused on conducting iterative simulations to assess and account for the uncertainties inherent in the model in order that the final wellfield design will meet the ROD cleanup criteria. Model uncertainties will be addressed by obtaining field data through a program of phased installation and testing of groups of full scale extraction and injection wells in combination with a focused modeling program. The extraction and injection wells will be designed and constructed in a manner that will allow them to be incorporated into the final remediation wellfield.

This approach will provide data regarding extraction and injection well performance as well as data regarding aquifer and aquitard response, which can be used to further refine and validate the model. Extraction and injection well specific capacity and yield have a direct bearing on the number of wells that may be required to meet remedial objectives, and therefore this information is critical to the wellfield design. In addition, data will be obtained during the Pilot Testing program from surrounding monitor wells completed in the extraction and injection zones and the adjacent aquitards. This monitoring data will be incorporated into the model to reduce the uncertainty in the model results, resulting in a more reliable wellfield design and eliminating unnecessary conservatism and cost.

The following identifies the proposed extraction and injection well locations and provides a brief overview of well construction and sampling. Details regarding the extraction and injection testing are provided. Information regarding groundwater treatment and disposal required for the extraction testing is described in Section 4.0. Information regarding water filtration and injection testing is described in Section 5.0. Information regarding investigation derived waste handling and disposal is provided in the FSP (Appendix B).

3.1 EXTRACTION WELLS

3.1.1 Proposed Extraction Well Locations

Based on the configuration of the chlorobenzene plume as determined by the recent baseline sampling results, analysis of available short-term aquifer test data, and the results of the feasibility study modeling, it is possible to select extraction well locations, two for the Bellflower sand and one for the Gage aquifer, that will be compatible with the final wellfield design. The plume distribution in the Bellflower sand and the Gage aquifer has been well characterized so there is little risk that the initial wells will be inconsistent with the final remedial wellfield.

Previous modeling has shown that plume reduction occurs more rapidly when extraction occurs along the axis of the plume where concentrations are highest. As the plume contracts and the concentrations of contaminants are reduced below in situ groundwater standards, some wells will be taken out of service. The groundwater extraction from wells that are shut down will need to be transferred to other wells in order to maintain the minimum 700 gpm flowrate specified in the ROD. It is not currently known whether increasing the pumping rate of the original extraction wells can make up the lost extraction. This uncertainty will also be addressed by the proposed testing program by pumping the extraction wells at a relatively high rate. These data can be used to assess the feasibility of maintaining the ROD-mandated extraction rate as the remedy progresses.

The central plume area lies largely under residential neighborhoods and suitable well locations are limited. Extraction wells will have to be located in city streets or along utility corridors. Because of these constraints, as well as those imposed by the plume distribution, extraction well location alternatives useable for the final wellfield design are so limited that extraction well locations can be identified with a high level of certainty. The proposed locations for the extraction wells are shown on Figures 11 and 12. The proposed extraction wells BF-EW-1, BF-EW-2, and G-EW-1 are located along the axis of the Bellflower sand and Gage aquifer plumes where chlorobenzene concentrations tend to be high.

Extraction wells BF-EW-1 and G-EW-1 are proposed to be installed on property the Los Angeles Department of Water and Power right-of-way. Extraction well BF-EW-2 is proposed to be installed in a County of Los Angeles street. Montrose has begun the access process.

3.1.2 Extraction Well Design And Installation

A small diameter exploratory boring will first be advanced at each extraction well location to obtain core samples for physical and chemical testing, and to provide the lithologic data required to ensure a proper well design. Grain size analyses will be conducted to evaluate proposed well screen slot sizes. Compressibility and permeability tests will be conducted on aquitard samples to aid in assessing vertical hydraulic conductivity. Aquitard samples will also be analyzed for chlorobenzene, pCBSA, and total organic carbon to allow assessment of aquitard mass and transport properties. Upon completion, the exploratory boring will be reamed and utilized for the installation of the observation wells (Section 3.1.3).

The construction and design of the extraction wells will be typical of full scale water production wells. Data from the short-term aquifer tests conducted on monitor wells during the RI indicate that extraction well capacities in excess of 100 to 300 gpm may be achievable. The extraction wells will be drilled using the conventional mud-rotary drilling method. A conductor casing will first be installed and cemented in place from ground surface to near the base of the aquitard overlying the target aquifer zone. The borehole will then be advanced to the total depth. The well casing diameter will be sufficiently large to accommodate the largest pump that may be required based on the maximum anticipated well yield and downhole monitoring equipment that may be required. The well screen will consist of 12-inch diameter 316L stainless steel wire wrap screen and the screen interval will be selected to fully penetrate the unit being tested. Bellflower sand extraction wells will be screened opposite each substantial sand zone encountered from the water table to the base of the Bellflower sand, including the MBFB sand and MBFC sand, if encountered. Blank 316L stainless steel casing with a corresponding bentonite annular seal will be placed opposite silty or clayey aquitard zones to allow hydraulic isolation of individual zones in the future, if warranted. If the MBFC sand and MBFB sand are merged and no aquitard sediments are encountered then the one continuous screen will be installed. The extraction wells will be developed using a combination of bailing, swabbing, jetting, and/or pumping.

SOPs for the drilling, construction, and development of the extraction wells are provided in the FSP (Appendix A). QA/QC procedures that will be implemented during field and laboratory activities are provided in the QAPP (Appendix B). All field work will be conducted in accordance with the Site-specific Health and Safety Plan (H+A, 2003). Well design, drilling, lithologic logging, and well construction will be conducted under the supervision of a California Registered Geologist. Prior to drilling the wells, a well permit will be obtained from the County of Los Angeles. Wells will be designed in accordance with the procedures outlined in the FSP, Department of Water Resources guidelines, and with applicable County of Los Angeles regulations.

3.1.3 Observation Well Installation

An observation well, OW-2, will be installed within approximately 50 feet of extraction well BF-EW-1 and G-EW-1 to obtain data regarding the hydraulic response in the lower Bellflower aquitard (Figure 11). No additional monitor wells are needed in the vicinity of these two extraction wells since these wells will be drilled in close proximity to existing upper Bellflower aquitard monitor well MW-14, Bellflower sand monitor well BF-7, and Gage aquifer monitor well G-6. Data from the observation well completed in the lower Bellflower aquitard will be used to evaluate the vertical hydraulic conductivity and leakance of this unit.

An observation well cluster, OW-3, will be installed within approximately 50 feet of extraction well BF-EW-2 to obtain data regarding the hydraulic response in the lower Bellflower aquitard and the Gage aquifer (Figure 11). Water level data from monitor well BF-17 will be used to verify the drawdown in the pumped aquifer near the extraction well. Data from the observation well completed in the lower Bellflower aquitard and Gage aquifer will be used to evaluate the vertical hydraulic conductivity and leakance of the lower Bellflower aquitard.

The observation well or cluster will be drilled using the mud rotary drilling method. The exploratory borehole described in Section 3.1.2 will be utilized to construct the observation well or well cluster. The lower portion of the exploratory boring may need to be grouted depending on the depth of the screened interval of the deepest well. Prior to reaming the boring, the lower portion of the borehole will be grouted with neat cement. The borehole will be reamed to a

diameter sufficient to accommodate the individual casings, once the grout has cured. Observation well or well clusters will be constructed with individual 2-inch PVC casings and screens set in a single borehole. Details regarding the well construction, including the screen length, may be found in Appendix A, Table A-4. The annulus between individual well screens will be sealed with bentonite. The observation wells will be developed by bailing and pumping using a small diameter pump.

SOPs for the drilling, construction, and development of the extraction wells are provided in the FSP (Appendix A). QA/QC procedures that will be implemented during field and laboratory activities are provided in the QAPP (Appendix B). All field work will be conducted in accordance with the Site-specific Health and Safety Plan (H+A, 2003). Well design, drilling, lithologic logging, and well construction will be conducted under the supervision of a California Registered Geologist. Prior to drilling the wells, a well permit will be obtained from the County of Los Angeles. Wells will be designed in accordance with the procedures outlined in the FSP, Department of Water Resources guidelines, and with applicable County of Los Angeles regulations.

These observation wells will be drilled on the same property as the extraction wells and thus, additional access to other property is not necessary.

3.1.4 Extraction Well Sampling And Analysis

Groundwater samples will be collected from the extraction wells at the end of the development phase for laboratory analysis of VOCs, including chlorobenzene, pCBSA, metals, pesticides and PCBs, semi-volatile organic compounds, and various miscellaneous compounds in accordance with the requirements of the General National Pollutant Discharge Elimination System (NPDES) Permits (Appendix A). A groundwater sample will be collected from the observation well cluster wells at the end of development for laboratory analysis of VOCs, including chlorobenzene, and pCBSA. These data will be used to assess the effluent water quality to the final treatment plant as well as the variability of the water quality compounds for RD purposes.

SOPs for the sampling of wells are provided in the FSP (Appendix A). QA/QC procedures that will be implemented during groundwater sampling field and laboratory activities are provided in the QAPP (Appendix B). All field work will be conducted in accordance with the Site Health and Safety Plan (H+A, 2003).

3.1.5 Extraction Well Testing

Groundwater extraction and injection testing will be completed as independent events. It is anticipated that extraction testing will require a minimum of 36 days to complete and that injection testing will require a minimum of 48 days to complete. Due to the extensive process involved with obtaining an NPDES Permit, it is likely that the injection tests will be completed prior to the extraction tests. Following are details regarding the extraction test which will be conducted upon completion of extraction well installation and upon approval of the NPDES Permit. Subsequent sections provide details regarding injection well installation and injection test protocols.

Pilot testing at the extraction wells will commence following well construction and development. It is anticipated that three separate testing events will be completed; one per extraction well. Testing will consist of a one-day step-test and then a constant-rate test. The constant-rate test will involve a 5-day, constant-rate groundwater extraction test followed by a groundwater recovery period during which time groundwater levels will be monitored until pre-testing elevations are observed. It is anticipated that the groundwater recovery period will last approximately 5 days. Therefore, it is likely that a total of 36 days will be required to complete extraction testing.

The purpose of the one-day step tests will be to assess the specific capacity at increasing extraction rates for each of the three extraction wells. The data obtained from the step-tests will be utilized to select the appropriate pumping rate for the long-term, constant-rate tests. The step-tests will consist of a minimum of three, two-hour long, steps at flow rates of approximately 150 gpm, 225 gpm and 300 gpm. The flow rates which are utilized during each of the step-tests will be finalized after installation of the extraction wells and will be based upon the performance observed during well-development.

Following each of the one-day step-tests, a five-day, constant-rate extraction test will be conducted at each of the three wells. The constant-rate tests will be completed at the optimum flow rate, as determined by evaluation of the step-test data. It is estimated that a total of 1.2 to 2.3 million gallons of treated groundwater will be recovered, treated, and discharged during the step and constant-rate tests at each of the extraction wells. The actual volume of water discharged will be dependent upon the discharge rate utilized during the constant-rate tests.

Prior to initiation of the step-test, static water levels will be manually measured in all wells to be monitored. In conjunction with collection of this data, transducers will be deployed in selected wells, including distant monitor wells for tracking background/regional water level changes, to measure groundwater levels and barometric pressure (Appendix A). Barometric pressure readings will be utilized to evaluate potential barometric effects on water levels. Transducers, programmed to record data at 5-minute intervals, will continue logging after completion of the step-tests to provide pre-test data for the constant-rate portions of the pilot test. Additionally, transducers will remain down-well following completion of the constant-rate tests to monitor the recovery of groundwater levels to pre-test elevations.

Three water level rounds will be conducted for each test, one before the test to establish static conditions, one at the end of the pumping phase, and one at the conclusion of the recovery phase of the test. For each test well, the wells to be monitored are sorted into three categories: Tier 1, Tier 2, and Tier 3 (Appendix A). The Tier 1 wells represent those wells which are nearest to the test well and therefore most likely to demonstrate observable influence. The Tier 2 and 3 wells are located at further distances from the test wells. If influence is observed at any of the outermost Tier 1 wells, monitoring will be extended to the Tier 2 wells. Monitoring will be further expanded to the Tier 3 wells if influence is observed in the outermost Tier 2 wells. Regardless of the extent of influence observed during the test, manual water level measurements will be taken at all Tier 1, 2, and 3 wells prior to the test. After completion of the test and after completion of recovery, manual water levels measurements will again be taken in Tier 1 wells, and Tier 2 and 3 wells, if appropriate.

A specific list of wells which will be monitored during these tests is included (Appendix A). Additional details regarding the field measurement protocol are included (Appendix A). SOPs for water level measurement and aquifer testing are provided in the FSP (Appendix A). QA/QC procedures that

will be implemented during water level measurement and aquifer testing field activities are provided in the QAPP (Appendix B).

A variety of protocols are in place in the event that a step-test or constant-rate test is interrupted. Due to the limited duration of the step-test, if an interruption of the test can not be resolved within 2 hours, a field assessment of data will be completed to determine if sufficient information has been collected to properly conduct the constant-rate portion of the test. If so, the test will be terminated; if not, testing will be resumed at such time that the cause of the interruption can be remedied.

Following is a summary of the procedures to be implemented for the constant-rate testing. For all alternatives below, it is expected that the duration of the test will be extended, at a minimum, for a period equal to the duration of the interruption. Additional extensions to the test are detailed, as appropriate, below.

- Shut-down period is less than 4 hours – upon identification of the cause of shut-down and subsequent resolution of the problem, all extraction and treatment equipment will be restarted and monitoring will resume at the pre-shut-down schedule.
- Shut-down period is greater than 4 hours
    - Overall test duration less than 48 hours
        - If the cause of the shut-down may be identified and subsequently remedied, testing will resume and field parameters will be monitored to determine the additional time required to reach pre-shut down conditions; the overall test duration will be extended by this amount of time. Monitoring will resume at the pre-shut-down schedule.
        - If the cause of the shut-down is not identified or if it is identified but can not be immediately remedied, testing will be repeated at such time that the cause of the interruption is resolved.
    - Overall test duration longer than 48 hours – data will be evaluated to determine if sufficient information is available to properly design the full-scale remediation system
        - If data are sufficient, testing will be terminated and collection of recovery will be initiated.

- If data are not sufficient, an attempt will be made to identify and remedy the cause of the interruption.
    - If the cause of the shut-down is identified and subsequently remedied; testing will resume and field parameters will be monitored to determine the additional time required to reach pre-shut down conditions; the overall test duration will be extended by this amount of time. Monitoring will resume at the pre-shut-down schedule.
    - If the cause of the shut-down is not identified or if it is identified but can not be immediately remedied, testing will be repeated at such time that the cause of the interruption is resolved.

Data obtained from the long-term test will be analyzed using a number of methods. Data will initially be evaluated using conventional Theis log-log and Jacob semi-log aquifer test analysis methods (Cooper and Jacob, 1946; Theis, 1935). If the test data deviate from the theoretical Theis response, then alternate methods of analysis may be used for evaluating the test data. Semi-log plots of drawdown vs. distance from the extraction well will also be prepared. These plots will be used to assess the hydraulic radius of influence of the pumped well. Results from the aquitard observation well will be used to evaluate the vertical hydraulic conductivity of the lower Bellflower aquitard using the Neuman-Witherspoon method of analysis (Neuman and Witherspoon, 1972). The long-term test will also be simulated using the groundwater model to validate the model hydraulic properties. In the event that the model is not able to replicate the observed hydraulic response to pumping, the model parameters will be adjusted to achieve a reasonable match to the observed water level response. This will also allow evaluation of potential deviations from Theis assumptions based on variability in aquifer geometry and properties and may aid in interpreting prior aquifer test data. The test results will also be used to better assess remediation well performance, well interference, capture area, and aquitard leakance.

3.2 INJECTION WELLS

As specified in the groundwater ROD, the groundwater remedy will include injection of treated groundwater into the Bellflower sand and Gage aquifers at the perimeter of the chlorobenzene plumes in these units. No injection well tests have been conducted to date. In order to design the injection wellfield, data are needed regarding sustainable injection rates; water level buildup in the injection well and aquifer; injection well specific capacity; and the potential for well plugging.

3.2.1 Proposed Injection Well Locations

In accordance with the groundwater ROD, injection wells will be located on either flank of the chlorobenzene plume in the Bellflower sand and Gage aquifer to dispose of treated groundwater as part of the groundwater remedy. Given the substantial plume width, aquifer characteristics may vary in these areas. It is therefore proposed that full scale pilot injection wells be installed on each flank of the chlorobenzene plumes in the Bellflower sand and Gage aquifer to obtain data in these areas. One injection well would be installed on each flank of the Bellflower sand plume and one on each flank of the Gage plume. A total of four injection wells would be installed and tested (Figures 11 and 12).

Locations for injection wells are less critical than for extraction wells because injection wells are primarily for disposal purposes and have less influence on plume size reduction. Pilot injection wells will be located east and west of the site along the Del Amo corridor. Injection wells have been located in areas believed to be outside of the known extent of elevated chlorobenzene, pCBSA, benzene, and TCE to minimize the potential for inducing adverse plume migration (H+A, 2004b). The eastern pilot injection wells are located in close proximity to existing groundwater monitoring wells, which will allow evaluation of aquifer response during the injection tests in this area. There are no existing monitor wells in the vicinity of the proposed western pilot injection wells. A small diameter observation well cluster will be installed on the western flank of the plume in both the Bellflower sand and Gage aquifer so that aquifer response can be measured during the injection test. It is anticipated that a nearby fire hydrant will be identified and used as the source water for injection testing.

Injection wells BF-IW-1 and G-IW-1 are proposed to be installed on private property occupied by Tireco (Figures 11 and 12). The proposed location for injection well BF-IW-1 was selected to be just beyond the estimated western flank of the chlorobenzene plume. However, because there are no monitor wells in the immediate vicinity of BF-IW-1, there is a possibility that chlorobenzene or other VOCs may extend into this area. Two alternate locations have been selected for injection well BF-IW-1 should the initial location be found to be unsuitable due to elevated VOC concentrations (Figure 11). Alternate locations were designated along the Del Amo corridor nearest to the Bellflower sand chlorobenzene plume where access appears to be feasible. Although Gage injection well G-IW-1 appears to be well outside of the chlorobenzene plume in this unit, two alternate locations have also been identified in case access cannot be obtained to the Tireco property.

Prior to constructing Bellflower sand injection well BF-IW-1, a groundwater sample will be obtained from the Bellflower sand by installing a temporary well in the planned exploratory borehole. The exploratory boring will be drilled using small diameter mud rotary drilling and coring equipment to obtain data for the injection well design. Prior to grouting the exploratory boring, the mud will be thinned and a temporary well casing and 0.020-inch slotted screen assembly will be installed within the Bellflower sand. The screen will be filter packed with #2-/16 Lonestar sand. A two-foot #60 silica sand grout filter will be placed over the filter pack using a tremie pipe. A ten-foot bentonite pellet annular seal will then be emplaced above the sand, opposite the overlying aquitard sediments and allowed to hydrate. The temporary well will be surged and pumped for several hours to remove the residual drilling mud. After field parameters have stabilized, a groundwater sample will be collected from a low flow tap on the submersible pump discharge for laboratory analysis. The sample will be analyzed on an expedited 24-hour turn around time for VOCs and pCBSA using EPA Methods 8260 and 314.0.

Following the collection of the grab sample, the temporary casing and screen will be pulled from the exploratory boring and the exploratory boring will be completed and geophysically logged. If the grab sample concentrations are approximately equal to or less than the Maximum Contaminant Levels (MCLs) for individual VOCs, the exploratory boring will be completed as an observation well cluster. The injection well will then be constructed near the observation well cluster as planned.

If the grab sample concentration exceeds the approximate MCL for any individual VOC, the exploratory boring will be abandoned by pressure grouting and the injection well and observation well cluster will then be constructed at one of two alternate locations as indicated on Figure 11.

If the concentrations for individual VOCs are approximately equal to or less than their respective MCLs, then the injection well will be installed as planned. If the groundwater concentration exceeds the approximate MCL for an individual VOC, then the injection well will be installed at one of the two alternate locations.

Injection well BF-IW-2 is proposed to be installed on property owned by Alpine Village. Injection well G-IW-2 is proposed to be installed on the former Del Amo site, on land under the control of the County of Los Angeles, Department of Water and Power. Montrose has begun the access process.

3.2.2 Injection Well Design And Installation

The injection wells will be designed and constructed using methods and materials typically used for full scale production wells so that they will be suitable for use in the final groundwater remedy. Based on data obtained from previous short-term aquifer tests conducted during the RI, achievable injection well capacities may range from approximately 50 to more than 150 gpm.

Prior to installing the injection wells, a small diameter exploratory boring will be advanced at each injection well location using a mud-rotary drill rig to provide the lithologic data required to ensure a proper well design. Grain size analyses will be conducted on selected core samples to evaluate proposed well screen slot sizes. Additional soil samples from the injection zone will be analyzed for cation exchange capability to determine the concentration of various cations in core samples and x-ray diffraction to quantify the percentage of minerals and clays in the core samples. These analyses may be needed to evaluate potential in situ geochemical reactions caused by incompatibility with the injection water.

At the western injection well site, the exploratory boring will be reamed out and an observation well cluster will be installed as described in Section 3.2.3 (Figure 11). At the eastern injection well site, a well cluster is not necessary since the injection well will be located close enough to the existing monitoring wells to allow the aquifer response to be monitored during injection. This exploratory boring will be grouted from the bottom up using a tremie pipe.

The injection wells will be drilled using the conventional mud-rotary drilling method. A mild steel conductor casing will first be installed and cemented in place from ground surface to near the base of the aquitard overlying the target aquifer zone. The borehole will then be advanced to the total depth. Because pumping of the injection well is required for initial development and periodic redevelopment during the groundwater remedy, the well casing diameter will be sufficiently large to accommodate the development pump and downhole injection control equipment that may be required. The well screen will consist of 12-inch 316L stainless steel wire wrap screen. The screen interval will be selected to fully penetrate the B and C units of the Bellflower sand or the Gage aquifers. The well head will be fitted with a water tight flange to allow the well pressure to be shut in, if necessary. Openings in the wellhead will be provided for installing necessary pumping, injection, and monitoring equipment. The wellhead may be completed above ground if located in an undeveloped area or in a below ground vault if constructed in a developed area such as in a street.

The injection wells will be developed using a combination of bailing, swabbing, jetting, air-lifting, and/or pumping. The filter pack will be monitored during development and replenished as needed if settling occurs. Following development, the annular space between the well and conductor casing will be sealed with bentonite grout. A stainless steel plate will be welded between the conductor casing and well casing to ensure a positive wellhead seal.

SOPs for the drilling, construction, and development of the injections wells are provided in the FSP (Appendix A). QA/QC procedures that will be implemented during field and laboratory activities are provided in the QAPP (Appendix B). All field work will be conducted in accordance with the Site-specific Health and Safety Plan (H+A, 2003). Monitor well design, drilling, lithologic logging, and well construction will be conducted under the supervision of a California Registered Geologist. Prior to drilling the wells, a well permit will be obtained from the County of Los Angeles. Wells will be designed in accordance with the procedures outlined in the FSP,

Department of Water Resources guidelines, and with applicable County of Los Angeles regulations.

3.2.3 Observation Well Cluster Installation

An observation well cluster will be installed within approximately 50 feet of injection wells BF-IW-1 and G-IW-1 to obtain data regarding the hydraulic response in the Bellflower sand and the Gage aquifer (Figure 11). Water level data from the observation well cluster will be used to verify the buildup in the aquifer near the injection well.

The observation well cluster will be drilled using the mud rotary drilling method. A pilot borehole will be initially advanced using continuous coring in selected intervals to verify hydrogeologic conditions and screen placement. The borehole will be reamed to a diameter sufficient to accommodate the individual casings. Observation well clusters will be constructed with individual 2-inch PVC casings and screens set in a single large diameter borehole. The annulus between individual well screens will be sealed with bentonite. Details regarding the well construction, including the screen length, may be found in Appendix A, Table A-4. The observation wells will be developed by bailing and pumping using a small diameter pump.

SOPs for the drilling, construction, and development of the extraction wells are provided in the FSP (Appendix A). QA/QC procedures that will be implemented during field and laboratory activities are provided in the QAPP (Appendix B). All field work will be conducted in accordance with the Site Health and Safety Plan (H+A, 2003). Well design, drilling, lithologic logging, and well construction will be conducted under the supervision of a California Registered Geologist. Prior to drilling the wells, a well permit will be obtained from the County of Los Angeles. Wells will be designed in accordance with the procedures outlined in the FSP, Department of Water Resources guidelines, and with applicable County of Los Angeles regulations.

The observation well will be drilled on the same property as the injection wells and thus, additional access to other property is not necessary.

3.2.4 Injection Well Sampling and Analysis

Prior to constructing BF-IW-1, a groundwater sample will be obtained from the Bellflower sand by installing a temporary well in the planned exploratory borehole. Following surging and pumping of the well, field parameters will be allowed to stabilize. A groundwater sample for laboratory analysis will then be collected utilizing low flow techniques. The sample will be analyzed with an expedited turn-around-time for VOCs and pCBSA. The water quality data will be used to verify that injection well BF-IW-1 is located sufficiently outside of the contaminant plume as described in Section 3.2.1,

A groundwater sample for laboratory analysis of VOCs, including chlorobenzene, pCBSA, and additional inorganic compounds and water quality parameters will be collected from each injection well at the end of development. A groundwater sample will also be collected from the observation wells at the end of development for laboratory analysis of VOCs, including chlorobenzene, and pCBSA. These data will be used to assess the ground water quality within the proposed injection zones prior to commencing injection testing operations. The water quality data will be used to verify that the injection wells are sufficiently outside of the contaminant plumes and to evaluate native and treated water compatibility issues.

SOPs for the sampling of wells are provided in the FSP (Appendix A). QA/QC procedures that will be implemented during groundwater sampling field and laboratory activities are provided in the QAPP (Appendix B). All field work will be conducted in accordance with the Site-specific Health and Safety Plan (H+A, 2003).

3.2.5 Injection Well Test Procedure

The injection tests will be independent tests done in series. Pilot injection testing will commence following injection well construction and development. It is anticipated that four separate testing events will be completed; one per injection well. Each testing event will consist of a one-day step test, followed by a constant-rate test. The constant-rate test will involve a 5-day constant-rate injection of potable water event followed by a groundwater recovery period during which time groundwater levels will be monitored until pre-testing elevations are observed. It is anticipated that

the groundwater recovery period will last approximately 5 days. Therefore, it is likely that a total of 48 days will be required to compete injection testing.

The purpose of the one-day step test will be to assess the efficiency and specific capacity at increasing injection rates for each of the four injection wells. The data obtained from the step test will be utilized to select an appropriate injection rate for the long-term, constant rate injection tests. The step-tests will consist of a minimum of three, two-hour long steps.

Following each of the one-day step tests, a five-day, constant-rate injection test will be conducted at each of the four wells. The 5-day constant-rate, potable water injection tests will be completed at the optimum flow rate, as determined by evaluation of the step-test data. Water level data will be obtained from the injection well, nearby monitor wells, and newly installed observation wells screened in the injection zone.

Three water level rounds will be conducted for each test, one before the test to establish static conditions, one at the end of the pumping phase, and one at the conclusion of the recovery phase of the test. For each test well, the wells to be monitored are sorted into three categories: Tier 1, Tier 2, and Tier 3 (Appendix A). The Tier 1 wells represent those wells which are nearest to the test well and therefore most likely to demonstrate observable influence. The Tier 2 and 3 wells are located at further distances from the test wells. If influence is observed at any of the outermost Tier 1 wells, monitoring will be extended to the Tier 2 wells. Monitoring will be further expanded to the Tier 3 wells if influence is observed in the outermost Tier 2 wells. Regardless of the extent of influence observed during the test, manual water level measurements will be taken at all Tier 1, 2, and 3 wells prior to the test. After completion of the test and after completion of recovery, manual water levels measurements will again be taken in Tier 1 wells, and Tier 2 and 3 wells, if appropriate.

It is anticipated that the injection tests will be conducted utilizing potable water from fire hydrants. Written notification has been provided to the EPA Underground Injection Control Program and the California Regional Water Quality Control Board (RWQCB), Los Angeles Region (H+A, 2004c and 2004d). Additionally, the Los Angeles Department of Water and Power (LADPW) and the Rancho Dominguez District of the California Water Service Company will be contacted regarding connection to fire hydrants which will be utilized as a potable water source. If suitable hydrants are unavailable,

an alternative potable water source, such as a connection to a city water supply, may be utilized. Regardless of the source, potable water will be filtered prior to injection in order to minimize the potential for well plugging due to suspended sediment, as detailed in Section 5. The estimated potable water usage for these tests is estimated to be a total of approximately 1,440,000 gallons or 4.4 acre-feet of potable water.

Monitoring during the injection tests will include, but not be limited to, water level responses in the injection zone, water table levels in several surrounding wells, and injection flow rates. Prior to initiation of the step-test, static water levels will be manually measured in all wells to be monitored. In conjunction with collection of this data, transducers will be deployed in selected wells, including distant monitor wells for tracking background/regional water level changes, to measure groundwater levels and barometric pressure. Barometric pressure readings will be utilized to evaluate potential barometric effects on water levels. Transducers, programmed to record data at 5-minute intervals, will continue logging after completion of the step-tests to provide pre-test data for the constant-rate portions of the pilot study. Additionally, transducers will remain down-well following completion of the constant-rate tests to monitor the recovery of groundwater levels to pre-test elevations. A specific list of wells which will be monitored during these tests is included (Appendix A). Additional details regarding the field measurement protocol are included in (Appendix A).

A variety of protocols are in place in the event that a step-test or constant-rate test is interrupted. Details are included in Section 3.1.5 of this work plan; a procedure identical to the extraction test will be implemented in the event of an interruption during an injection test. Details for identifying the cause of well-plugging, if this is the cause of the interruption, are included in Section 5.

The data obtained from the constant-rate test will be utilized to evaluate numerous site and system design parameters including: aquifer transmissivity, hydraulic conductivity, storativity in the vicinity of the injection wells, and injection well specific capacity and efficiency. Eventually, injection wells will be utilized for injection of groundwater that is recovered and treated as part of the full-scale remedial solution of this site. Therefore, information obtained from injection testing will be incorporated into the groundwater model, as described in Section 2, in order to minimize uncertainty in the remedial system injection well-field design.

Procedures for conducting constant-rate injection tests are similar to conducting conventional aquifer tests. SOPs for aquifer testing are provided in the FSP (Appendix A). QA/QC procedures that will be implemented during aquifer testing field activities are provided in the QAPP (Appendix B).

4.0 TREATMENT AND DISPOSAL OF WATER

In accordance with Section 4.1 of the SOW for UAO, the following provides a description of the treatment and disposal system to be implemented for the pilot extraction and aquifer response testing. Locations of the nearest storm drains have been provided (Figures 13 and 14). In addition, the treatment process, pilot installation and startup, operation and maintenance procedures, and ancillary facilities are discussed. A process flow diagram for the pilot extraction treatment system has been provided (Figure 15). Montrose will obtain an NPDES permit from the Los Angeles Regional Water Quality Control Board prior to discharging water from the extraction testing.

Given the duration of the aquifer test, electricity for the aquifer test pump will be provided by an internally regulated 60-kilowatt engine driven generator. Since testing is proposed at flows ranging from 150 to 300 gpm, it is likely that more than one pump will be utilized (Figure 15). The aquifer test pumps will be constructed of stainless steel, and have discharge pressures of up to 270 feet of water at 300 gpm, and a shutoff pressure of 580 feet of water or 250 pounds per square inch gage (psig). The aquifer test pump will have a 30 horsepower, 480 volt, three phase motor and will be installed in the extractions wells at depths up to 145 feet bls. The aquifer test pumps will be installed in the well using 3-inch nominal galvanized carbon steel pipe. Exact specifications will be finalized prior to initiation of the test.

The groundwater extraction rate from the test well will be measured using a positive displacement or a turbine style flow meter. The flowrate from the flow meter will be verified at the start of testing based on comparison to a second factory-calibrated flow meter. The groundwater extraction rate will be adjusted to maintain flowrate by adjusting a flow control valve. The conveyance piping from the aquifer test pump will be carbon steel with a pressure rating exceeding the maximum output pressure of the pump. All the components of the pilot extraction test will be designed and selected to have a pressure rating greater than the maximum pump pressure. Conveyance piping from the treatment system to storm drain discharge location will be schedule 40 PVC.

A temporary groundwater treatment system consisting, at a minimum, of skid mounted carbon vessels will be set up adjacent to, or in close proximity to each test extraction well (Figure 15). The treatment system will include a U.S. Filter® Model PV810L skid-mounted carbon absorption system. The PV810L system includes two 10,000-pound capacity vessels that are operated in series. The carbon vessels are designed for pressure up to 75 psig and flowrates up to 500 gpm. Each vessel contains approximately 10,000 pounds of granular activated carbon. Additionally, pre- and post-carbon solids filtration will be utilized to reduce solids loading to the carbon and discharge to the storm drain. If necessary based on NPDES requirements, an additional treatment unit may be utilized for metals treatment. The carbon vendor will provide the interconnecting valve skid.

Groundwater will be pumped through the system by the aquifer test pump. Sampling ports will be provided at the inlet and outlet of the system and between the two carbon adsorbers. Treated groundwater will be discharged into the nearest storm drain (Figures 13 and 14). The treatment system may be modified as necessary based on NPDES permit requirements.

Start up of the pilot extraction test system will consist of pre-start preparations and normal system start. Pre-start preparations will include leak testing of the treatment system piping, and verifying operation of the pump control system. In addition, prior to the start of each aquifer test instrument readings will be recorded from the extraction well and treatment system, and all valves will be configured for proper operation. The motor driven generator will be started and warmed up in accordance with manufacturer's operating requirements. Once the system is deemed ready to operate, the well pump will be activated.

During the pilot extraction tests, a field technician will be onsite on a continuous basis to record data on the treatment system, to monitor treatment system performance, and perform system maintenance. The technician will check the status of the pilot extraction test on a frequent basis to make necessary adjustments to flowrates; monitor the status of the carbon adsorption system; monitor the status of the generator; and monitor water levels. Field data forms have been prepared to document field measurement data and test operating conditions (Appendix A). Treatment system field notes will be entered as required and will include a record of any operation. Monitoring of the extraction and treatment system during operation will include recording all extraction well totalizer readings and discharge pressures along with the time and

date of the measurement. The instantaneous flowrate from each extraction well will be determined and the control valve adjusted as necessary. Additionally, the discharge point will be visually inspected prior to and on a periodic basis throughout the test to confirm that treated groundwater is discharging properly. A more detailed monitoring protocol is included (Appendix A).

All wellheads and pipelines, and the treatment system, will be inspected on a regular basis. Preventative measures, such as equipment inspections prior to installation, will be taken to reduce the risk of equipment failure. Spare equipment will be available to ensure that down time is minimized. The generator will be fueled and serviced by the generator vendor on a periodic basis to provide reliable power to the aquifer test pump.

Monitoring will be required in accordance with the NPDES permit. The sampling schedule and frequency of monitoring will be determined by the RWQCB when they approve the NPDES permit.

5.0 FILTRATION AND INJECTION OF WATER

In accordance with Section 4.1 of the SOW for UAO, the following provides a description of the filtration and injection system to be implemented for the pilot extraction and aquifer response testing. The injection water will be potable water obtained from the nearest fire hydrant (Figures 16 and 17). In addition, pilot installation and startup, operation and maintenance procedures, and ancillary facilities are discussed. A process flow diagram for the injection system has been provided (Figure 18).

Water for the injection testing will be obtained from the Los Angeles Department of Water and Power (DWP) or the California Water Service Company fire hydrant. Prior to initiation of injection testing, a permit will be obtained from DWP to connect to the nearest fire hydrant for each injection well. Since potable water will be used in the injection testing, it is anticipated that an injection permit will not be required. Both EPA and the RWQCB have been notified of the intent to inject potable water prior to the initiation of the injection testing (H+A, 2004c and 2004d).

In order to maximize the efficiency of the injection wells, consideration was given to a number of likely causes for well plugging: biological fouling, air locking, and sediment build-up. To minimize/eliminate plugging due to biological fouling, potable water, which typically contains residual chlorine, will be utilized for injection. The chlorine in potable water prevents biological growth. Field measurement of the chlorine levels will be completed to ensure that there is indeed chlorine present and that biological fouling may be excluded as a possible cause of fouling. To minimize/eliminate the potential for an air lock in the well to reduce injection capacity, proper equipment will be utilized for connection to the injection well and for delivery of the potable water.

The remaining and most likely source of well plugging is sediment build-up in the injection wells. Therefore, prior to injecting potable water into the injection wells, the water will be filtered to remove suspended solids. Additionally, a bypass filter assembly will be installed downstream of the primary filter bank. A small percentage of the injection water will be diverted to the bypass filter assembly which will contain a filter with a micron rating smaller than the most restrictive filter(s) utilized in the main bank. This will allow assessment of the size and amount of solids

which are progressing through the main filter bank and therefore are being injected into the well. If well plugging is observed, identified by a rise in the water level or a reduction in the injection rate, the differential pressure across the bypass filter assembly will be assessed and the actual filter will be inspected. If solids loading is evident, adjustments will be made to the main filter system to resolve plugging due to sediment build-up such as utilization of additional filters and/or utilization of filters with a smaller micron rating.

A water meter will be installed on each hydrant by DWP to monitor the volume of water used. An isolation valve and backflow preventor will be installed down stream of the DWP water meter in accordance with DWP requirements for temporary water services. After the DWP fire hydrant equipment, the injection system will consist of a bag filter system, a flow meter, pressure gauges, and a flow control valve (Figure 18). The bag filter system will consist of two parallel trains of three bag filters in series to minimize the potential disruption to the injection test. Each filtration train will consist of three bag filters in series, with 20, 5, and 1-micron elements. The filtered water flowrate will be measured using a positive displacement or turbine style flow meter. Flow rate will be controlled using a manual globe valve. Water will be conveyed to the injection well via a PVC pipeline.

Prior to conducting the injection test, the water conveyance pipelines and appurtenances will be pressure tested to check for leaks. Start up of the injection system will consist of pre-start preparations and normal system start. Pre-start preparations will include inspecting each injection well wellhead for proper valve configuration, and verifying the correct positions for all control and isolation valves. In addition, prior to the start of each aquifer test, instrument readings will be recorded from flow meters. Once the system is deemed ready to operate, the isolation valves will be opened and the injection rate adjusted to the test rate.

During the pilot injection tests, a field technician will be onsite, at a minimum, on a daily basis to record data on the injection system, to monitor injection system performance, and perform system maintenance. The technician will check the status of the pilot injection well to make necessary adjustments to flowrates; monitor the status of the filter system; and monitor water levels. The differential pressure across the filter elements will be monitored, at a minimum daily, during the pilot injection test, and the filter element will be changed when the differential

pressure across the filter element approaches the manufacturer's recommend operating criteria. The spent filter element will be placed in containers for appropriate off-site disposal.

Field data forms have been prepared to document field measurements data and test operating conditions (Appendix A). Injection system field notes will be entered as required, and will be include a record of operation. Monitoring of the injection system during operation will include recording all injection well flow totalizer and pressures along with time and date of the measurement. The instantaneous flowrate to each injection well will be determined and the control valve adjusted as necessary.

All wellheads and pipelines, and the filter system, will be visually inspected on a daily basis. Preventative measures, such as equipment inspections prior to installation, will be taken to reduce the risk of equipment failure. Spare parts and equipment will be available to ensure that down time is minimized.

6.0 HEALTH AND SAFETY

All on-site field work will be conducted in accordance with the Site-specific Health and Safety Plan (H+A, 2003). The Site-specific Health and Safety Plan will be included in the field version of the FSP.

On-site field personnel will have 40-Hour Hazardous Waste Operations and Emergency Response training and current 8-Hour Refresher Training in accordance with 29 CFR 1910.120. Field personnel will also have certification of current respirator fit-testing and first aid training.

A number of precautions will be taken to minimize the risk to both the public and also equipment operators. Traffic control measures including the use of flag men, road construction signage, and delineators will be utilized where traffic controls are required. Temporary fencing will be set around each drilling location and will be utilized, as needed, during potable water injection and groundwater recovery activities. The drill rig and other drilling equipment will be locked and secured each night prior to departing the site for the evening. Equipment utilized during the injection and recovery tests will be under 24-hour observation by equipment operators. Additionally, a security guard will remain at the drilling and test sites overnight. In addition, local law enforcement agencies will be asked to monitor the drilling and testing sites.

7.0 SCHEDULE AND REPORTING

A proposed schedule based on the UAO SOW for the model refinement program is provided as Figure 19. Following completion of the pilot extraction and aquifer response testing field activities, a completion report will be prepared and submitted to EPA. Information to be provided as part of this report is specified in the UAO SOW Section 4.3. The Completion Report will include:

- Objectives of the aquifer response testing and any issues that occurred relative to meeting the objectives.
- Documentation and a chronological discussion of the preparation and running of the test.
- Discussion of the bases of measurement and performance criteria.
- Description of the field activities documentation and well or equipment installation tasks.
- Methods and procedures followed during the pilot extraction and aquifer response testing, including a description of events in the field that provide either context or impact the results of the testing.
- Field notes and discussion confirming how the pilot extraction and aquifer response tests were performed.
- Documentation of the test durations.
- Calculations and step-by-step intermediate and final results from the methodology to reduce the test data to generate estimates of aquifer response parameters.
- Appendix showing the raw drawdown and/or recovery data.
- Summary of conclusions and measured values.
- Documentation of field activities and other data derived from the tests.
- Description of the capture, storage, and/or disposal of extracted groundwater during the tests.
- Description of the field activities documenting well drilling and construction; sampling and analysis methods and procedures; and how these differ from the FSP.
- Summary of the existing data regarding the distribution of the chlorobenzene plume in the vicinity of the former Montrose property.
- Results of any groundwater quality sampling or measurements.

- Graphics depicting hydrostratigraphic cross-sections
- Information necessary to document the installation and sampling of the new monitor wells.

The Completion Report will be provided to EPA approximately 20 business days after completion of the aquifer response testing and review of the test results.

Data collected during the pilot extraction test program including flowrate data, water level data, parameter data collected during well purging, and laboratory analytical data will be entered into the project database. Data will be managed in accordance with the Data Management Plan (H+A, 2004a).

8.0 REFERENCES

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TABLE 1

CHLOROBENZENE IN GROUNDWATER

WELL IDENTIFIER	CONCENTRATION (micrograms per liter) PREVIOUS RESULT (DATE)	RANGE OF PREVIOUS SAMPLING RESULTS*			JANUARY 2004 SAMPLING RESULTS
Upper Bellflower Aquitard Monitor Wells					
MW-01	78,000 (11/29/95)	1,400	-	78,000	130,000
MW-03	<1 (11/20/91)	<1	-	59	<2/<1 (SPT)
MW-04	500 (04/20/90)	58	-	1,600	3,900
MW-05	8.4 (11/28/95)	8.4	-	200,000	480/380 (FD)
MW-06	190 (12/01/95)	190	-	13,000	130/130 (FD)
MW-08	<1 (04/20/90)	<1	-	5.0	5.1
MW-09	8,400 (11/30/95)	8,400	-	180,000	320
MW-10	820 (04/20/90)	790	-	2,200	31
MW-11	20,000 (04/18/90)	18,000	-	34,000	930/780 (SPT)
MW-12	4,100 (12/02/95)	3,200	-	8,200	2,800
MW-13	2,600 (04/21/90)	1,700	-	3,200	11,000
MW-14	400 (04/17/90)	130	-	900	160/160 (SPT)
MW-16	<20 (10/14/02)	<5	-	<20	<2
MW-17	4.4 (10/15/02)	2.0	-	7.5	<2/<2 (FD)
MW-19	3.4 (11/30/95)	<1	-	9.0	3.3
MW-22	<2 (10/10/02)	<1	-	<2	<2
MW-25	210 (10/15/02)	44	-	990	340
MW-26	<2 (10/16/02)	<1	-	9.0	<2
MW-27	3.9 (12/02/95)	3.9	-	15	<2/2 (SPT)
MW-30	<2 (10/15/02)	<1	-	<2	<2
Bellflower Sand Monitor Wells					
BF-01	86 (01/25/99)	86	-	570	11
BF-02	4,700 (04/20/90)	3,600	-	16,000	47,000
BF-03	9,000 (04/20/90)	9,000	-	23,000	13,000
BF-04	30,000 (11/19/91)	23,000	-	42,000	15,000
BF-05	2 (10/14/02)	2.0	-	3,400	6.4

TABLE 1 (continued)
CHLOROBENZENE IN GROUNDWATER

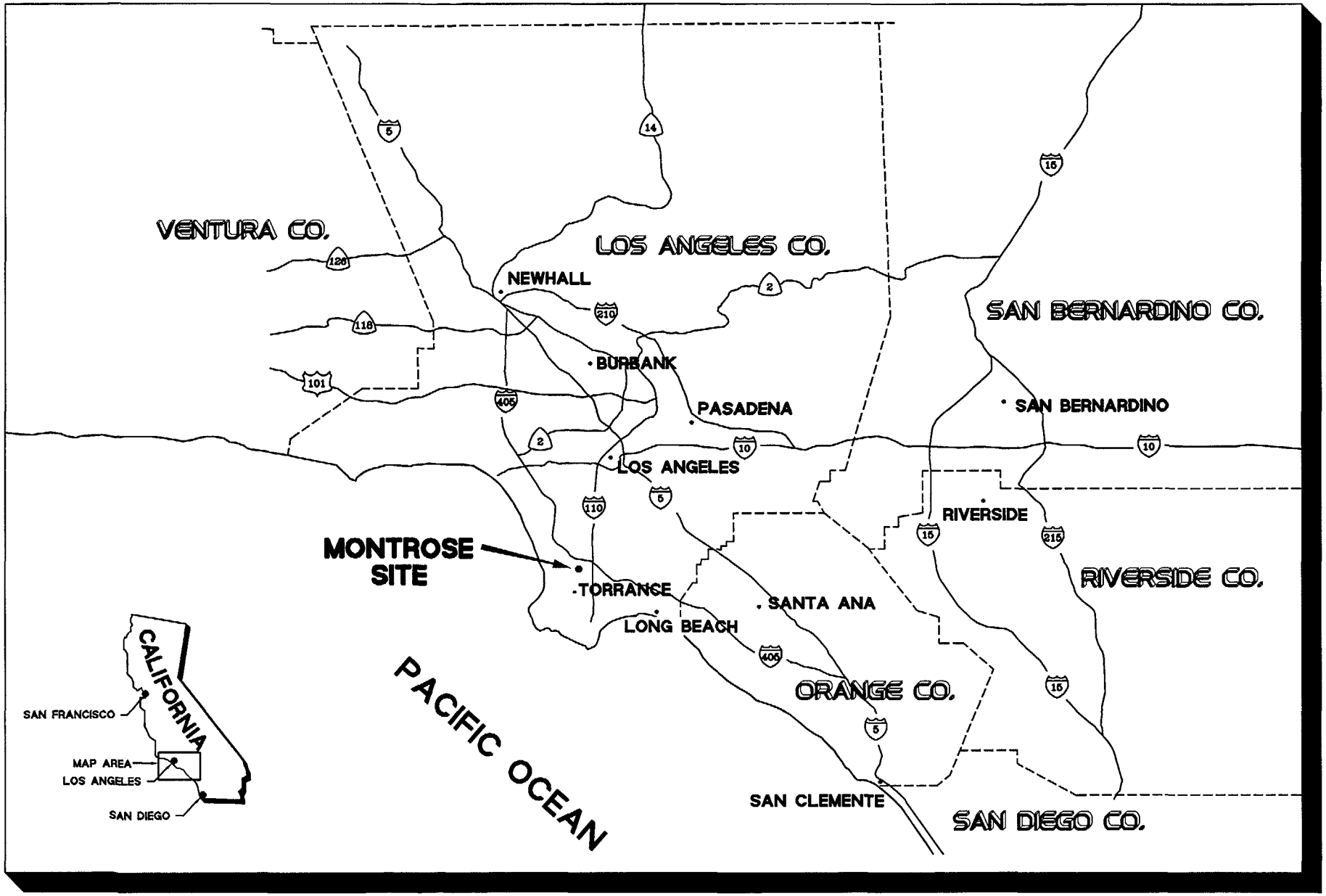
WELL IDENTIFIER	CONCENTRATION (micrograms per liter) PREVIOUS RESULT (DATE)	RANGE OF PREVIOUS SAMPLING RESULTS*			JANUARY 2004 SAMPLING RESULTS
Bellflower Sand Monitor Wells (continued)					
BF-06	23,000 (01/22/99)	23,000	-	34,000	26,000
BF-07	31,000 (01/22/99)	31,000	-	66,000	25,000
BF-09	25,000 (01/25/99)	11,000	-	25,000	19,000
BF-10	<1 (01/20/99)	<1	-	<1	17
BF-11	2,300 (08/04/90)	190	-	2,300	8,800
BF-12	450 (10/08/02)	<1	-	580	330/390 (FD)
BF-14	2,000 (08/05/90)	1,200	-	2,000	730
BF-15	21,000 (01/25/99)	21,000	-	42,000	8,300
BF-16	2,000 (01/20/99)	150	-	2,000	3,000/2,700 (SPT)
BF-17	2,700 (01/22/99)	2,300	-	4,300	5,200
BF-19	<1 (01/20/99)	<1	-	<1	<2
BF-20	29 (01/21/99)	29	-	1,000	1,800/2,100**
BF-21	1,500 (01/21/99)	1,500	-	8,900	1,800/1,400 (SPT)
BF-22	450 (06/18/91)	360	-	450	420/410 (FD)
BF-24	4,300 (01/22/99)	4,300	-	17,000	18,000
BF-25	320 (01/19/99)	62	-	320	21
BF-26	5 (10/08/02)	5.0	-	46	3.6
BF-27	<2 (10/09/02)	<1	-	<2	<2/<2 (FD)
BF-28	<2 (10/08/02)	<1	-	5.0	<2
BF-29	620 (08/08/91)	270	-	620	130
BF-30	<2 (10/09/02)	<1	-	<2	<2
BF-31	18 (10/10/02)	18	-	430	21
BF-32A	24 (10/09/02)	<1	-	180	<2
BF-33	<2 (10/09/02)	<1	-	<2	<2
Gage Aquifer Monitor Wells					
G-01	190 (11/21/91)	170	-	710	990/800 (SPT)

TABLE 1 (continued)
CHLOROBENZENE IN GROUNDWATER

WELL IDENTIFIER	CONCENTRATION (micrograms per liter) PREVIOUS RESULT (DATE)	RANGE OF PREVIOUS SAMPLING RESULTS*			JANUARY 2004 SAMPLING RESULTS
Gage Aquifer Monitor Wells (continued)					
G-02	6,900 (11/21/91)	6,900	-	20,000	17,000
G-03	1,100 (01/27/93)	240	-	2,200	470
G-04	1,400 (11/21/91)	9.0	-	2,000	96/93 (FD)
G-05	14,000 (04/21/90)	1,700	-	22,000	3,500
G-06	2,400 (04/18/90)	2,100	-	4,600	2,000
G-08	75 (11/20/91)	73	-	120	710
G-09	170 (10/10/02)	<2	-	170	370
G-11	5 (10/11/02)	<1	-	5.0	15
G-13	1,700 (11/21/91)	1,100	-	1,700	4,400
G-15	11 (10/11/02)	11	-	19	13
G-16	<2 (10/11/02)	<1	-	<2	<2
G-17	200 (07/03/91)	150	-	200	430
G-18	<2 (10/08/02)	<1	-	<2	<2
G-19	7,400 (10/10/02)	<1	-	7,400	12,000
SWL0034	8,600 (07/19/00)	5,400	-	11,000	6,600
Lower Gage Monitor Wells					
LG-01	70 (08/03/90)	33	-	110	9.5
LG-02	390 (04/19/90)	180	-	390	120
Lynwood Aquifer Monitor Wells					
LW-01	83 (10/17/02)	<1	-	560	64/75 (FD)/71 (SPT)
LW-02	<2 (10/14/02)	<1	-	<2	8.4
LW-03	<2 (10/14/02)	<1	-	<2	<2
LW-04	<2 (10/11/02)	<1	-	<2	<2
LW-06	<2 (10/17/02)	<1	-	<2	<2

* = Based on original sample results only.
** = Reanalysis result
Sampling results in tabulation are original samples unless specified with the following codes:
SPT = Split Sample, FD = Duplicate Sample
< = Less than; numerical value is detection limit for analyte

Figures



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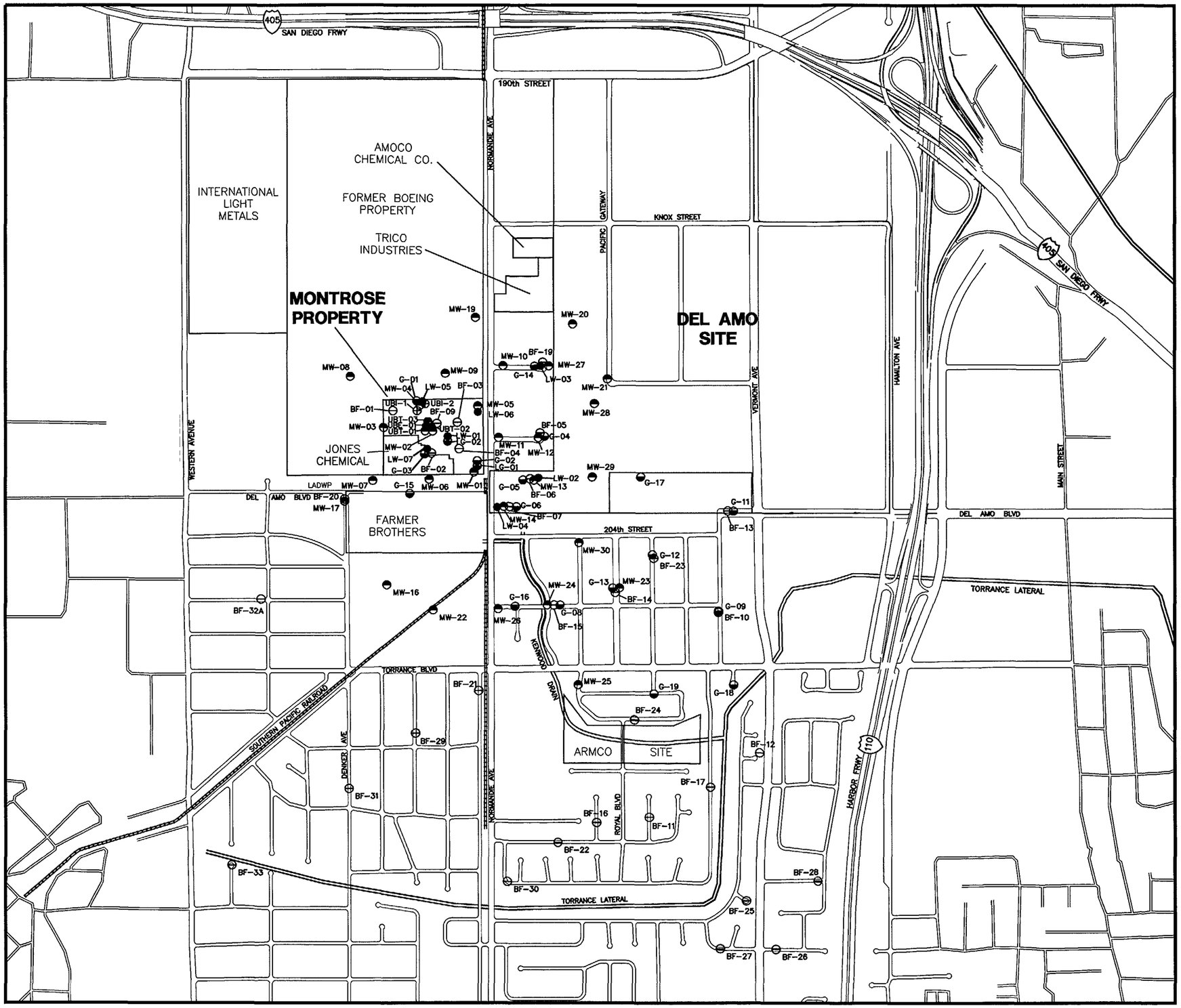
RPT NO. 857	410-3831	A

FIGURE 1. SITE LOCATION



EXPLANATION

MW-25	UPPER BELLFLOWER AQUITARD MONITOR WELL
UBE-1	UPPER BELLFLOWER AQUITARD EXTRACTION WELL
UBT-3	UPPER BELLFLOWER AQUITARD OBSERVATION WELL
UBI-1	UPPER BELLFLOWER AQUITARD INJECTION WELL
BF-17	BELLFLOWER SAND MONITOR WELL
G-7	GAGE AQUIFER MONITOR WELL
LW-7	LYNWOOD AQUIFER MONITOR WELL

NOTE: THIS MAP SHOWS LOCATIONS FOR MONITOR WELLS CONSTRUCTED BY MONTROSE DURING REMEDIAL INVESTIGATION ACTIVITIES AND DOES NOT INCLUDE MONITOR WELLS AND EXPLORATORY BORINGS CONSTRUCTED BY OTHERS FOR OTHER INVESTIGATIONS.

N

0 1,000 2,000

FEET

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TORRANCE, CALIFORNIA

MONITOR WELL LOCATIONS

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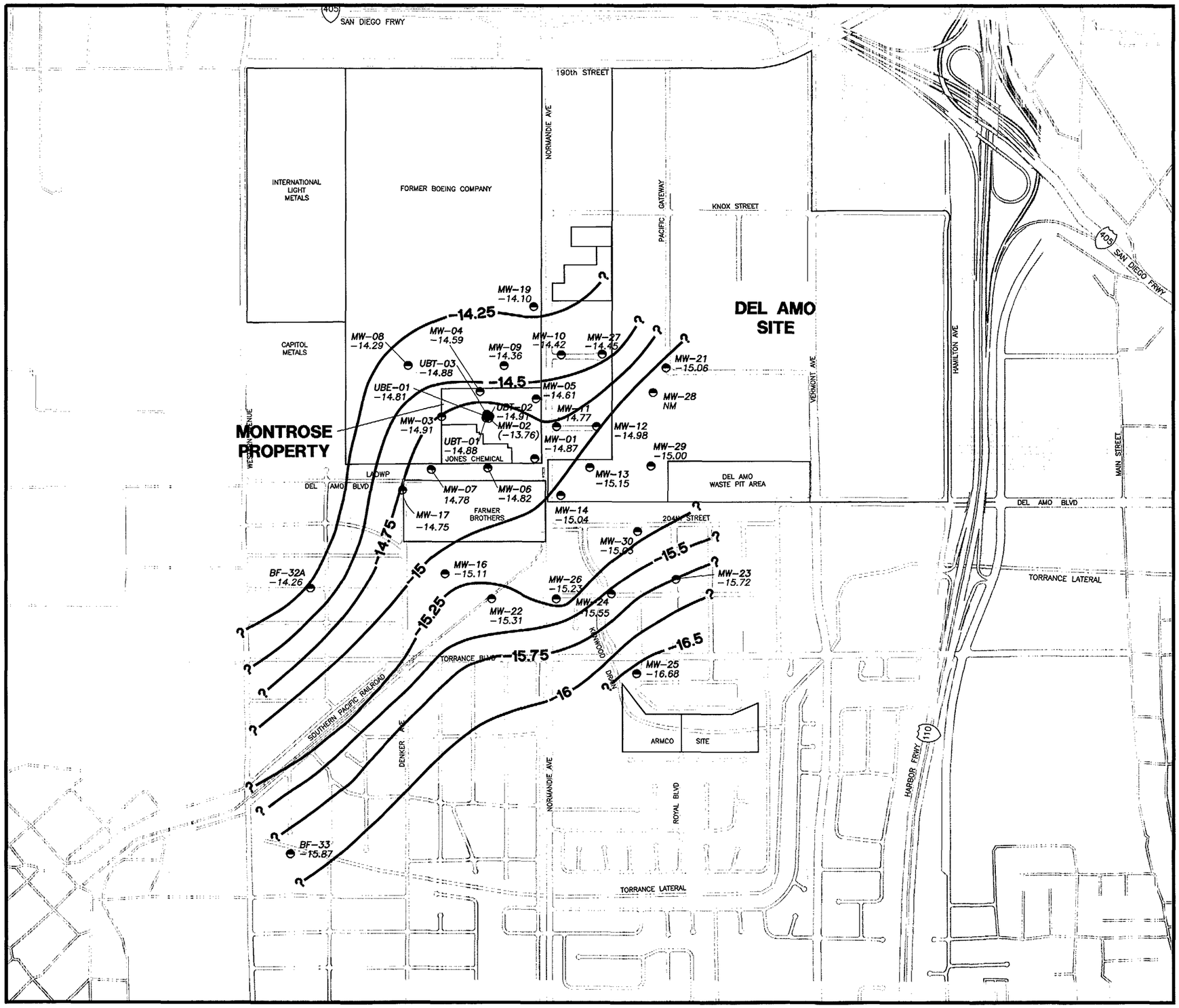
FIGURE 2

PREP BY	SPN	REV BY	MAP	RPT NO	857 38	410-4696	A



EXPLANATION

MW-19	UPPER BELLFLOWER AQUITARD MONITOR WELL
UBE-1	UPPER BELLFLOWER AQUITARD EXTRACTION WELL
UBT-3	UPPER BELLFLOWER AQUITARD OBSERVATION WELL
-14.2	WATER LEVEL ELEVATION (FEET MEAN SEA LEVEL)
( )	NOT CONTOURED
NM	NOT MEASURED
*	FREE PRODUCT ENCOUNTERED. WATER LEVEL ELEVATION ADJUSTED FOR PRESENCE OF PRODUCT

? —— -18 —— ?

CONTOUR LINE OF EQUAL WATER LEVEL ELEVATION IN FEET BELOW MEAN SEA LEVEL; DASHED WHERE APPROXIMATE, QUERIED WHERE INFERRED.

NOTE: WATER LEVELS MEASURED JANUARY 12–13, 2004
WATER LEVELS AT MW-01, MW-02, MW-03 AND MW-05 MEASURED FEBRUARY 6, 2004

0 1,000 2,000
FEET

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UPPER BELLFLOWER AQUITARD WATER LEVEL ELEVATION JANUARY 2004

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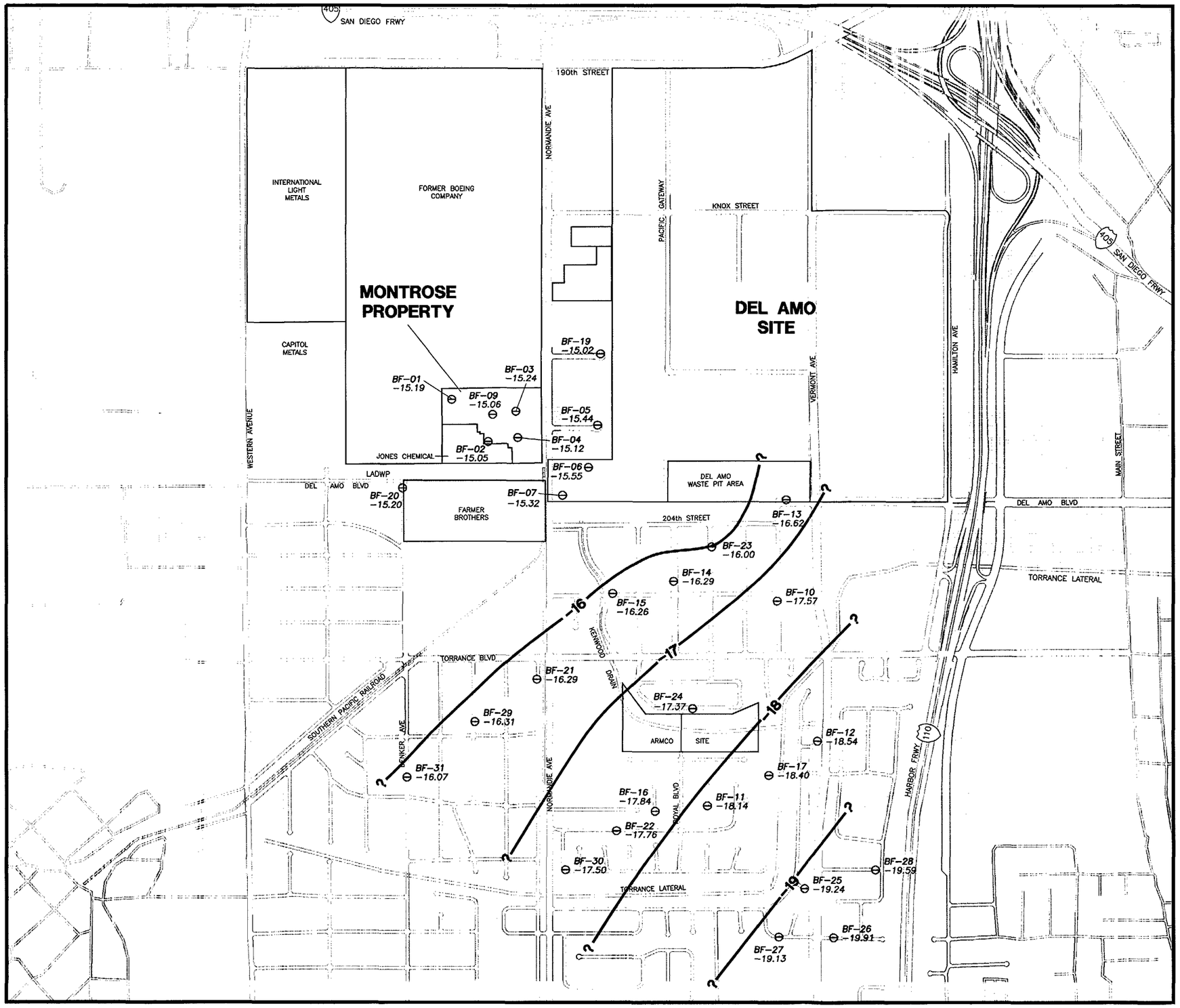
FIGURE 3

PREP BY EJB REV BY MAP RPT NO. 857.38 | 220-1481 | A



EXPLANATION

BF-07 ⊖ BELLFLOWER SAND MONITOR WELL

-15.32 WATER LEVEL ELEVATION FEET MEAN SEA LEVEL

? ——— -18 ——— ?
CONTOUR LINE OF EQUAL WATER LEVEL ELEVATION IN FEET BELOW MEAN SEA LEVEL; DASHED WHERE APPROXIMATE, QUERIED WHERE INFERRED.

NOTE: WATER LEVELS MEASURED JANUARY 12–14, 2004
WATER LEVELS AT BF–01, BF–03, BF–06, BF–09, BF–10 MEASURED FEBUARY 6, 2004

N

0 1,000 2,000
FEET

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TORRANCE, CALIFORNIA

BELLFLOWER SAND WATER LEVEL ELEVATION JANUARY 2004

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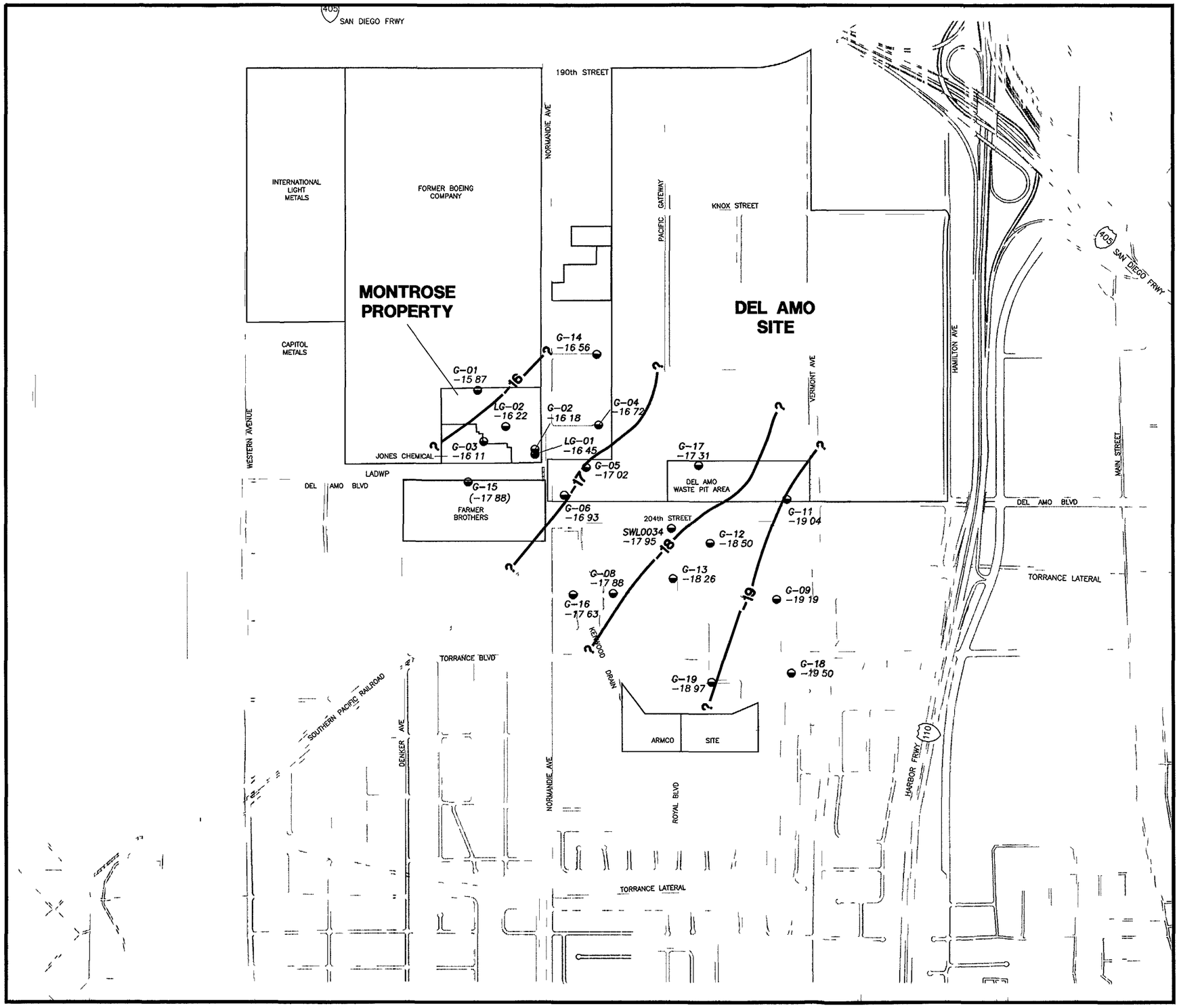
FIGURE 4

PREP BY EJB REV BY MAP RPT NO. 857.38 | 220-1478 | A



EXPLANATION

G-04 — GAGE AQUIFER MONITOR WELL

-16 72 — WATER LEVEL ELEVATION FEET MEAN SEA LEVEL

( ) — NOT CONTOURED

? —— -18 —— ? — CONTOUR LINE OF EQUAL WATER LEVEL ELEVATION IN FEET BELOW MEAN SEA LEVEL, DASHED WHERE APPROXIMATE, QUERIED WHERE INFERRED

NOTE — WATER LEVELS MEASURED JANUARY 12–19, 2004

0 1 000 2 000
FEET

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GAGE AQUIFER WATER LEVEL ELEVATION JANUARY 2004

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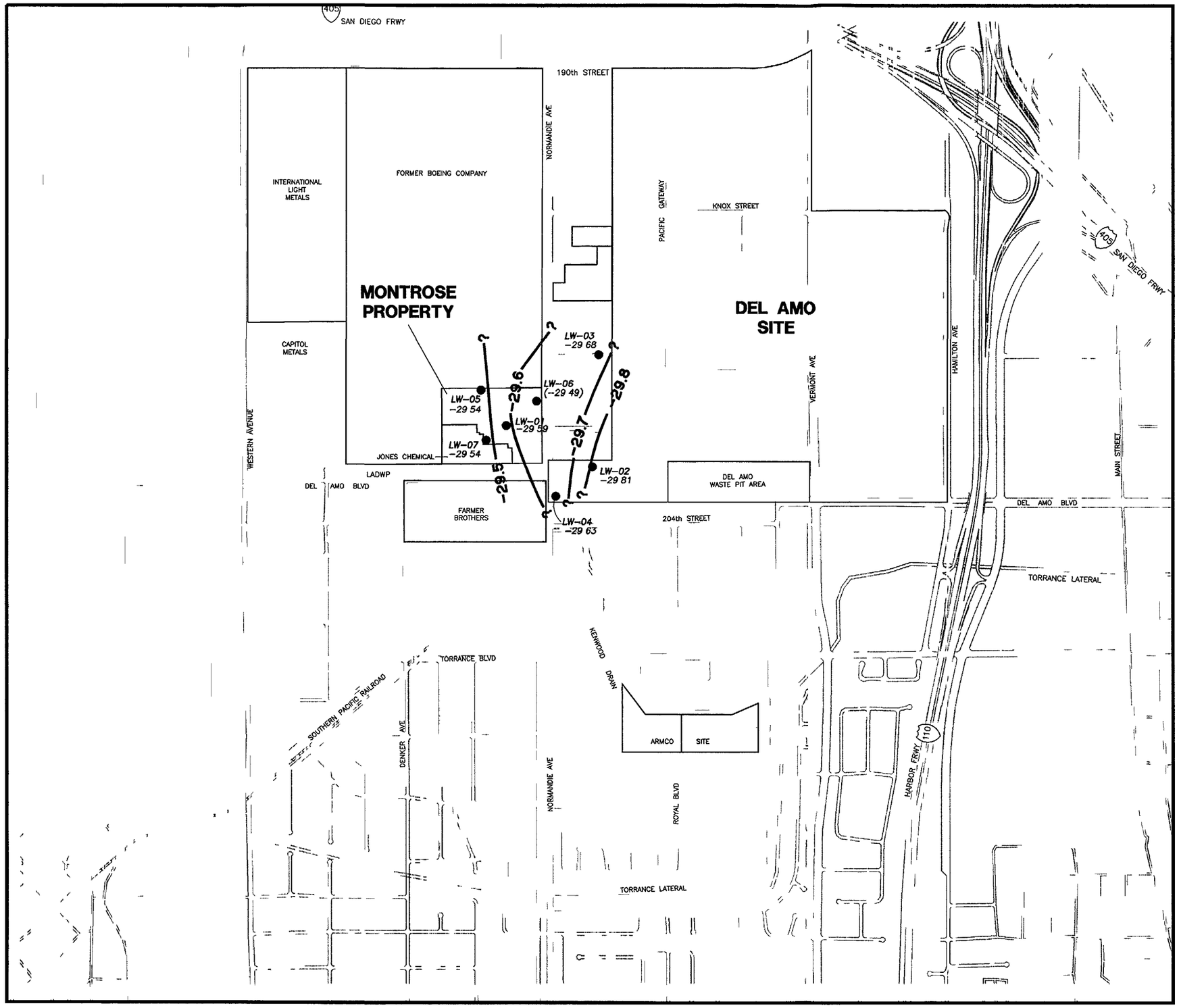
FIGURE 5

PREP BY EJB REV BY MAP RPT NO 857 38 | 220 1479 | A



EXPLANATION

LW-01 ● LYNWOOD AQUIFER MONITOR WELL

-29 59 WATER LEVEL ELEVATION (FEET MEAN SEA LEVEL)

( ) NOT CONTOURED

? —— 29.7 —— ?
CONTOUR LINE OF EQUAL WATER LEVEL ELEVATION IN FEET BELOW MEAN SEA LEVEL, DASHED WHERE APPROXIMATE, QUERIED WHERE INFERRED

NOTE WATER LEVELS MEASURED JANUARY 12–13, 2004

0 1,000 2 000
FEET

MONTROSE CHEMICAL CORPORATION
TORRANCE CALIFORNIA

LYNWOOD AQUIFER WATER LEVEL ELEVATION JANUARY 2004

HARGIS + ASSOCIATES, INC
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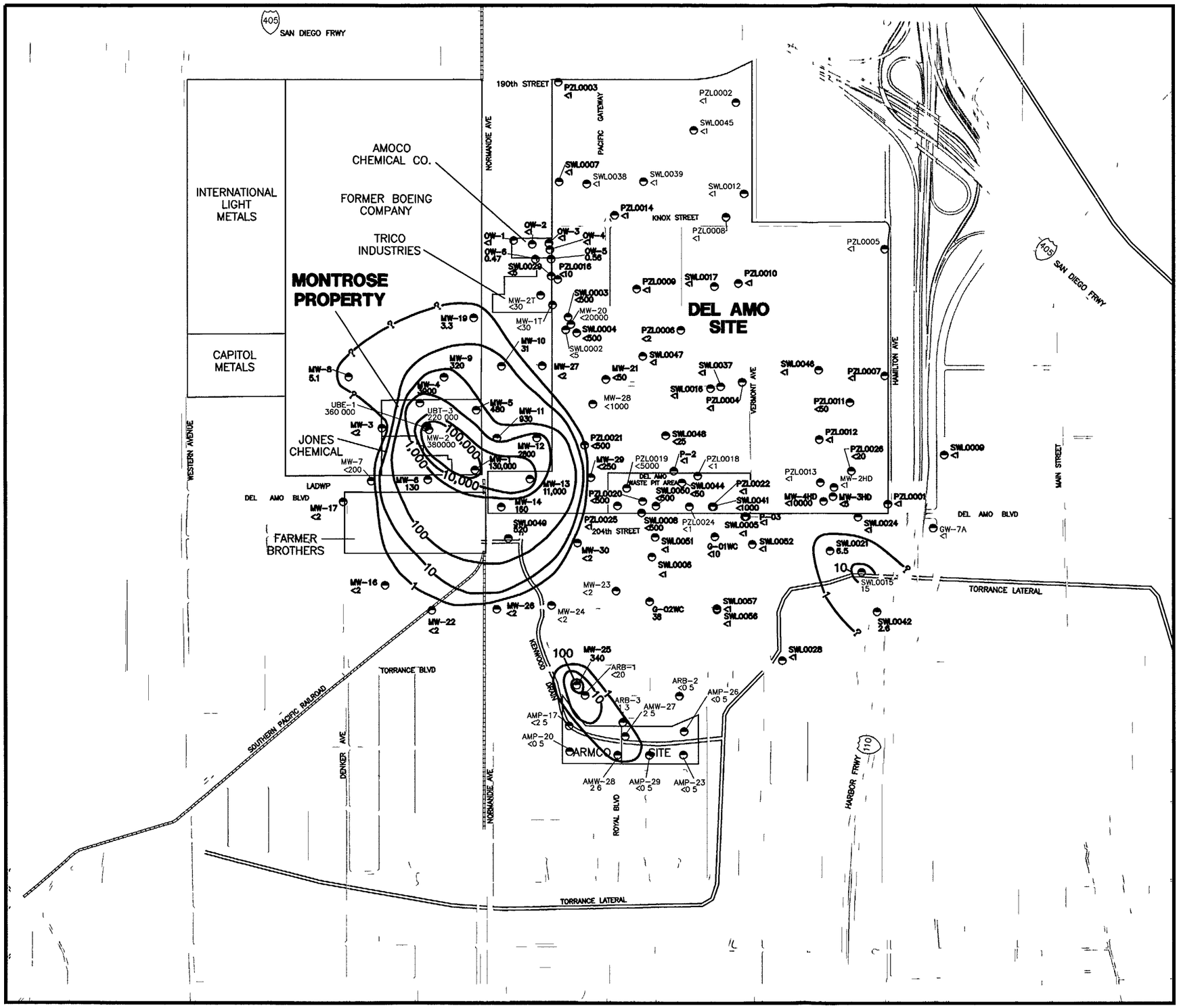
FIGURE 6

PREP BY EJB REV BY MAP RPT NO 857 38 | 220-1482 | A



EXPLANATION

MW-17	UPPER BELLFLOWER AQUITARD MONITOR WELL
<2	CONCENTRATION IN MICROGRAMS PER LITER, SAMPLED JANUARY 2004
3 4	CONCENTRATION IN MICROGRAMS PER LITER, SAMPLED PRIOR TO 2004.
(8 4)	CONCENTRATION NOT CONTOURED

?————1,000—— ——?

CONTOUR LINE OF EQUAL CONCENTRATION OF CHLOROBENZENE IN MICROGRAMS PER LITER DASHED WHERE APPROXIMATE, QUERIED WHERE INFERRED BASED ON MOST RECENT SAMPLING RESULTS

< = LESS THAN; NUMERICAL VALUE IS THE LIMIT OF DETECTION FOR THIS ANALYSIS.

WELL IDENTIFIER NOTES
MW = MONTROSE MONITOR WELLS
SWL, PZL, GW, P, AND MW-_HD = DEL AMO MONITOR WELLS
AMW, AMP, AND ARB = ARMCO MONITOR WELLS

NOTE. CONCENTRATION DATA FOR DEL AMO MONITOR WELLS PROVIDED BY URS, 2004.

WATER QUALITY DATA PRESENTED ON THIS MAP ARE THE MOST RECENT DATA AVAILABLE FOR EACH WELL AS OF JANUARY 2004 DATA FOR MONTROSE WELLS WERE SUPPLEMENTED WITH AVAILABLE DATA OBTAINED BY OTHERS FROM NON-MONTROSE MONITOR WELLS LOCATED IN THE SITE VICINITY.

0 1000 2000
FEET

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TORRANCE CALIFORNIA

CHLOROBENZENE
UPPER BELLFLOWER AQUITARD

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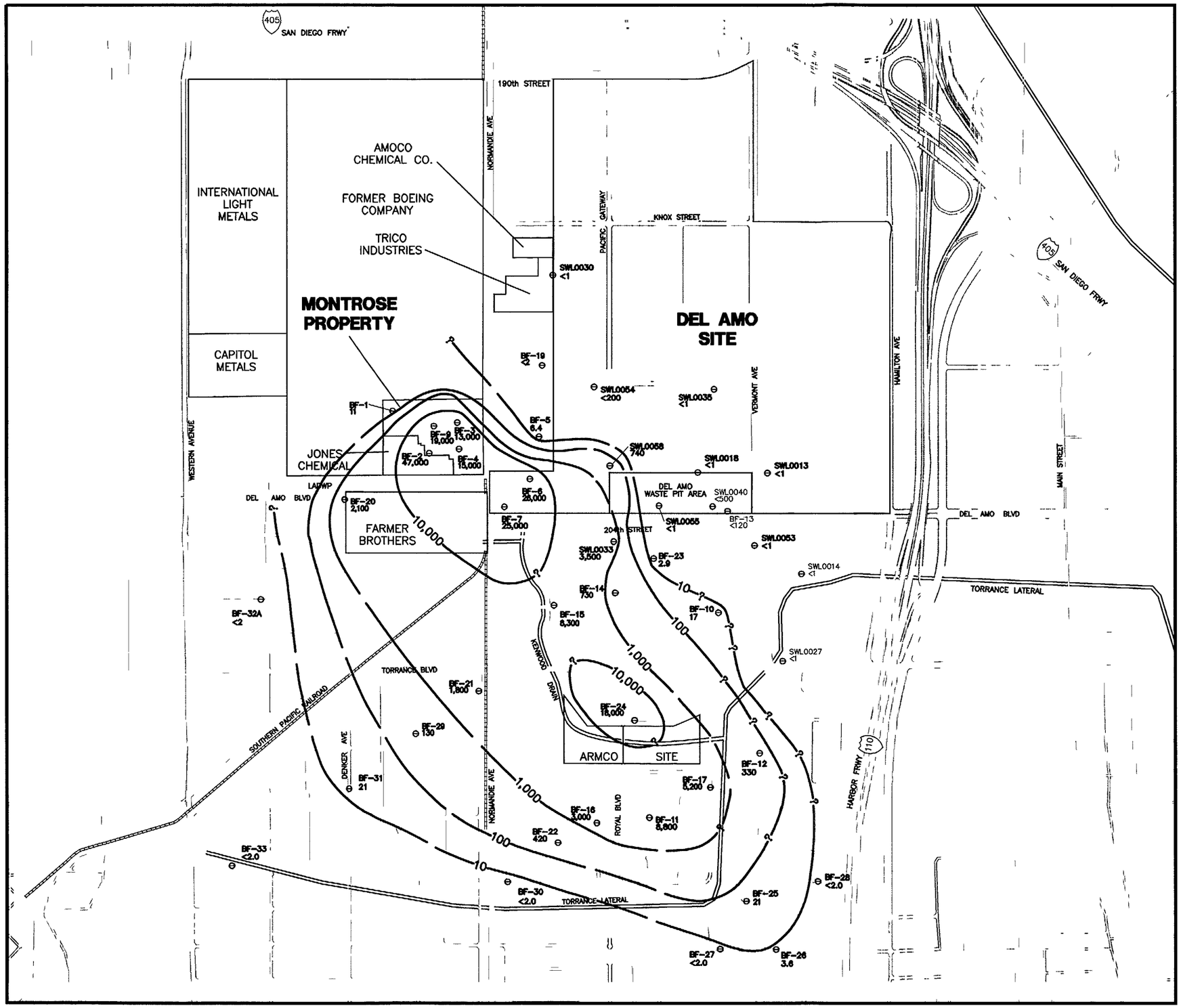
FIGURE 7

PREP BY EJB	REV BY MAP	RPT NO 857 38	210-2289	A



EXPLANATION

BF-15 ⊖	BELLFLOWER SAND MONITOR WELL
8,300	CONCENTRATION IN MICROGRAMS PER LITER, SAMPLED JANUARY 2004.
270	CONCENTRATION IN MICROGRAMS PER LITER, SAMPLED PRIOR TO 2004

?——————100——— ———?

CONTOUR LINE OF EQUAL CONCENTRATION OF CHLOROBENZENE IN MICROGRAMS PER LITER DASHED WHERE APPROXIMATE, QUERIED WHERE INFERRED BASED ON MOST RECENT SAMPLING RESULTS.

< = LESS THAN; NUMERICAL VALUE IS THE LIMIT OF DETECTION FOR THIS ANALYSIS.

WELL IDENTIFIER NOTES:
BF = MONTROSE MONITOR WELLS
SWL = DEL AMO MONITOR WELLS

NOTE: CONCENTRATION DATA FOR DEL AMO MONITOR WELLS PROVIDED BY URS, 2004.

WATER QUALITY DATA PRESENTED ON THIS MAP ARE THE MOST RECENT DATA AVAILABLE FOR EACH WELL AS OF JANUARY 2004. DATA FOR MONTROSE WELLS WERE SUPPLEMENTED WITH AVAILABLE DATA OBTAINED BY OTHERS FROM NON-MONTROSE MONITOR WELLS LOCATED IN THE SITE VICINITY.

0 1000 2000
FEET

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

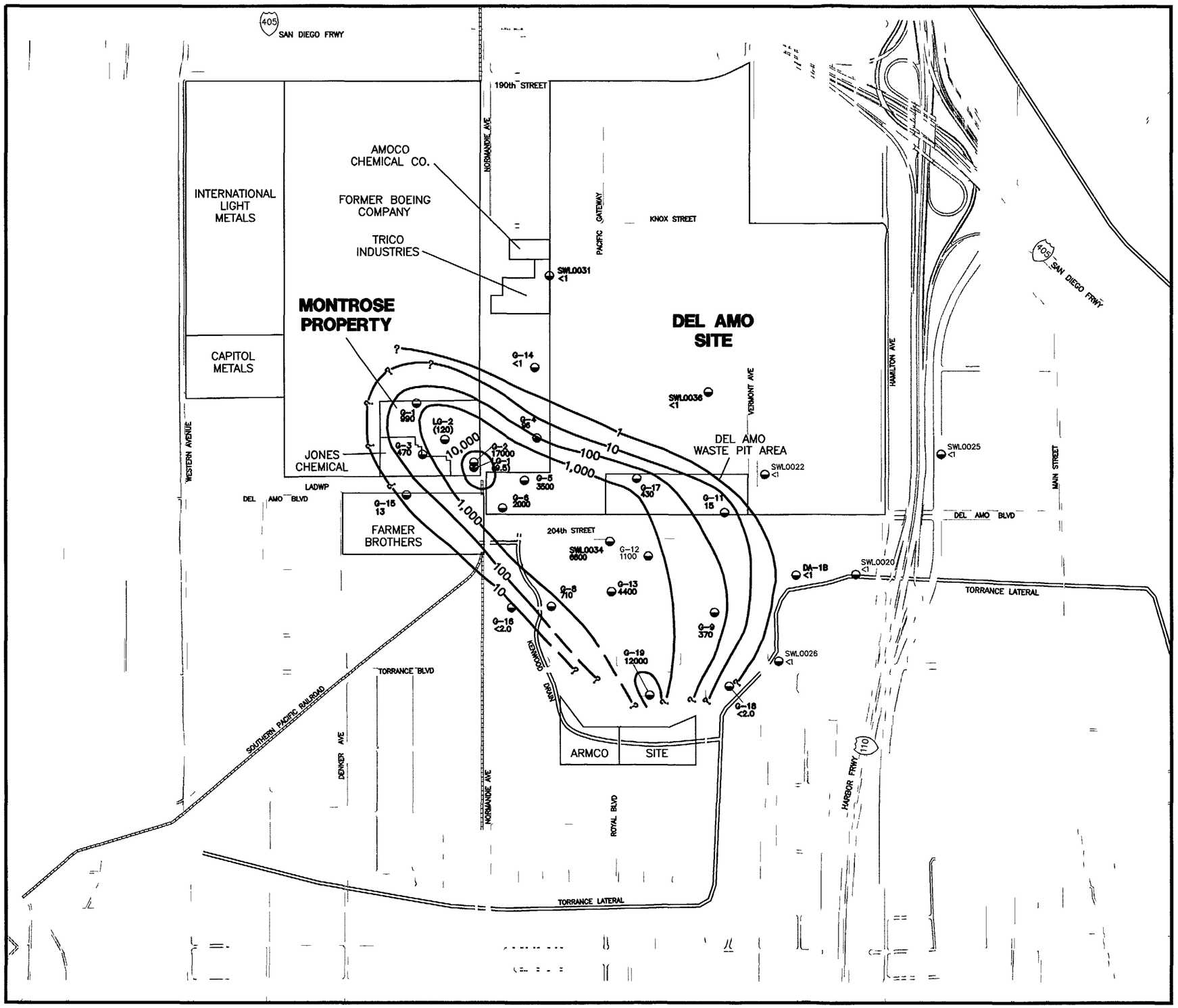
CHLOROBENZENE
BELLFLOWER SAND

HARGIS + ASSOCIATES, INC
Hydrogeology/Engineering

05/04

FIGURE 8

PREP BY EJB REV BY MAP RPT NO 857 38 | 210-2290 | A



EXPLANATION

G-4	GAGE AQUIFER MONITOR WELL
96	CONCENTRATION IN MICROGRAMS PER LITER, SAMPLED JANUARY 2004
<1	CONCENTRATION IN MICROGRAMS PER LITER, SAMPLED PRIOR TO 2004
LG-2	LOWER GAGE AQUIFER MONITOR WELL CONCENTRATION IN MICROGRAMS PER LITER
(120)	NOT CONTOURED

?——100——?

CONTOUR LINE OF EQUAL CONCENTRATION OF CHLOROBENZENE IN MICROGRAMS PER LITER DASHED WHERE APPROXIMATE, QUERIED WHERE INFERRED BASED ON MOST RECENT SAMPLING RESULTS

< = LESS THAN, NUMERICAL VALUE IS THE LIMIT OF DETECTION FOR THIS ANALYSIS

WELL IDENTIFIER NOTES
G AND LG = MONTROSE MONITOR WELLS
DA AND SWL = DEL AMO MONITOR WELLS

NOTE CONCENTRATION DATA FOR DEL AMO MONITOR WELLS PROVIDED BY URS, 2004

WATER QUALITY DATA PRESENTED ON THIS MAP ARE THE MOST RECENT DATA AVAILABLE FOR EACH WELL AS OF JANUARY 2004. DATA FOR MONTROSE WELLS WERE SUPPLEMENTED WITH AVAILABLE DATA OBTAINED BY OTHERS FROM NON-MONTROSE MONITOR WELLS LOCATED IN THE SITE VICINITY

N

0 1000 2000
FEET

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TORRANCE CALIFORNIA

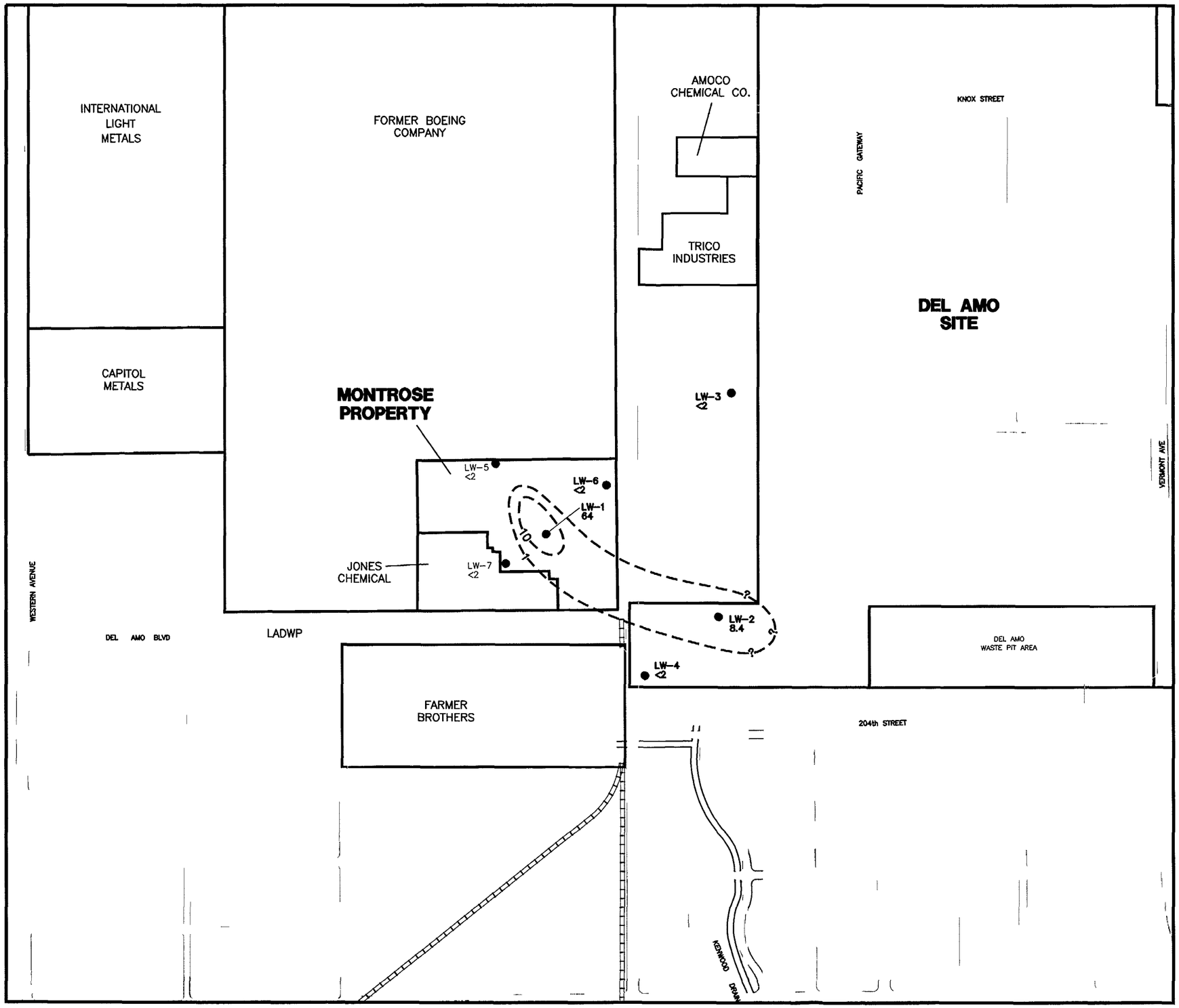
CHLOROBENZENE
GAGE AQUIFER

HARGIS + ASSOCIATES, INC
Hydrogeology/Engineering

05/04

FIGURE 9

PREP BY EJB REV BY MAP RPT NO 857 38 | 210-2291 | A



EXPLANATION

LW-4 ●	LYNWOOD AQUIFER MONITOR WELL
<2	CONCENTRATION IN MICROGRAMS PER LITER, SAMPLED JANUARY 2004
<2	CONCENTRATION IN MICROGRAMS PER LITER, SAMPLED PRIOR TO JANUARY 2004

?——100——?

CONTOUR LINE OF EQUAL CONCENTRATION OF CHLOROBENZENE IN MICROGRAMS PER LITER DASHED WHERE APPROXIMATE, QUERIED WHERE INFERRED BASED ON MOST RECENT SAMPLING RESULTS

< = LESS THAN, NUMERICAL VALUE IS THE LIMIT OF DETECTION FOR THIS ANALYSIS

N

0 500 1000

FEET

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TORRANCE CALIFORNIA

CHLOROBENZENE
LYNWOOD AQUIFER

HARGIS + ASSOCIATES, INC
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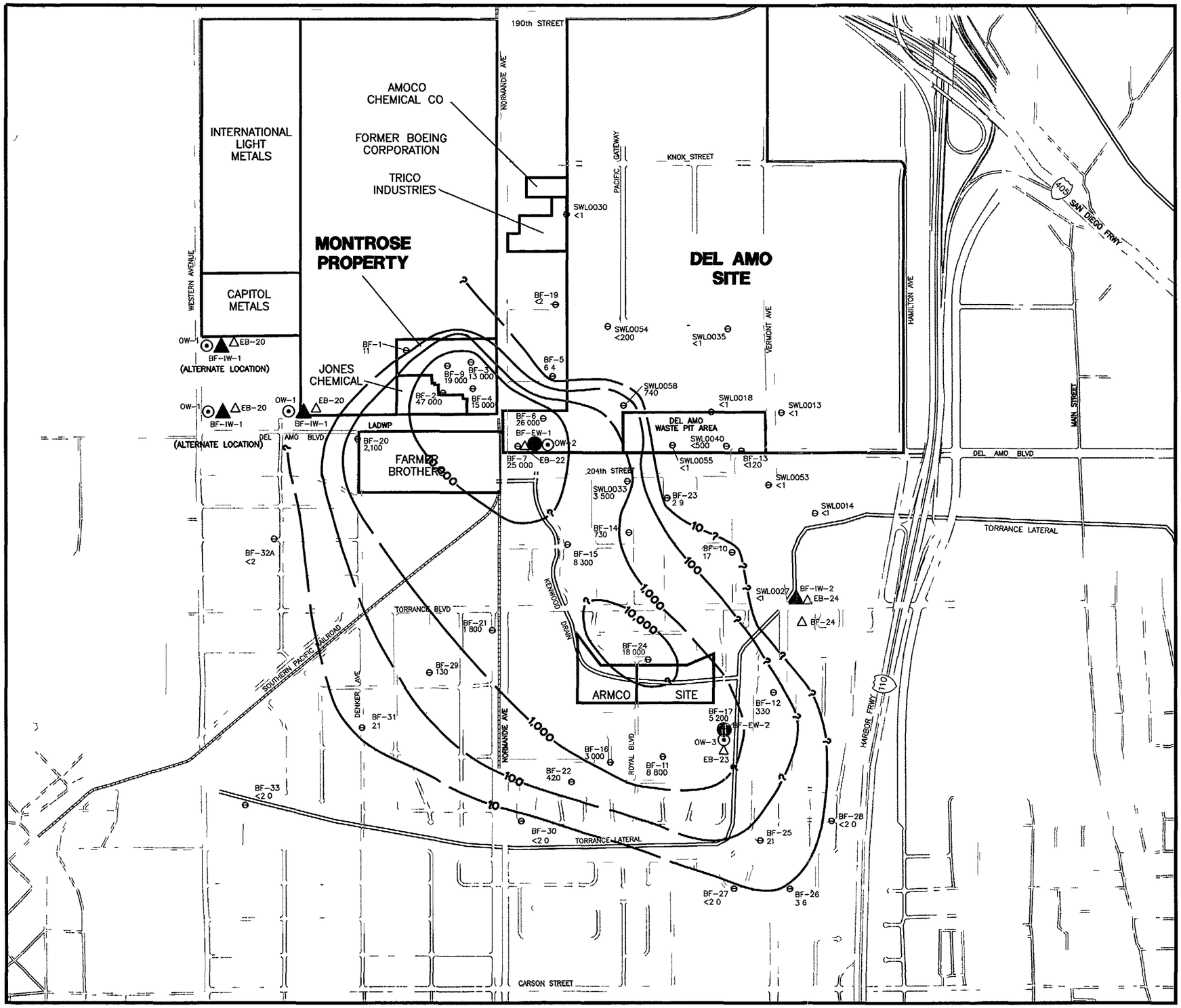
05/04

FIGURE 10

PREP BY EJB REV BY MAP RPT NO 857 38 | 210-2292 | A



EXPLANATION

BF-15 ⊖	BELLFLOWER SAND MONITOR WELL
8,300	CONCENTRATION IN MICROGRAMS PER LITER
▲	PROPOSED PILOT TEST INJECTION WELL
●	PROPOSED PILOT TEST EXTRACTION WELL
⊙	PROPOSED OBSERVATION WELL
△	PROPOSED EXPLORATORY BORING

?———— 100 ——— ——?

CONTOUR LINE OF EQUAL CONCENTRATION OF CHLOROBENZENE IN MICROGRAMS PER LITER
DASHED WHERE APPROXIMATE, QUERIED WHERE INFERRED
BASED ON MOST RECENT SAMPLING RESULTS

< = LESS THAN, NUMERICAL VALUE IS THE LIMIT OF DETECTION FOR THIS ANALYSIS

WELL IDENTIFIER NOTES
BF = MONTROSE MONITOR WELLS
SWL = DEL AMO MONITOR WELLS

NOTE CONCENTRATION DATA FOR DEL AMO MONITOR WELLS PROVIDED BY URS, 2004

WATER QUALITY DATA PRESENTED ON THIS MAP ARE THE MOST RECENT DATA AVAILABLE FOR EACH WELL AS OF JANUARY 2004. DATA FOR MONTROSE WELLS WERE SUPPLEMENTED WITH AVAILABLE DATA OBTAINED BY OTHERS FROM NON-MONTROSE MONITOR WELLS LOCATED IN THE SITE VICINITY

0 1 000 2 000
FEET

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TORRANCE CALIFORNIA

PROPOSED PILOT TEST EXTRACTION-INJECTION WELL LOCATIONS BELLFLOWER SAND

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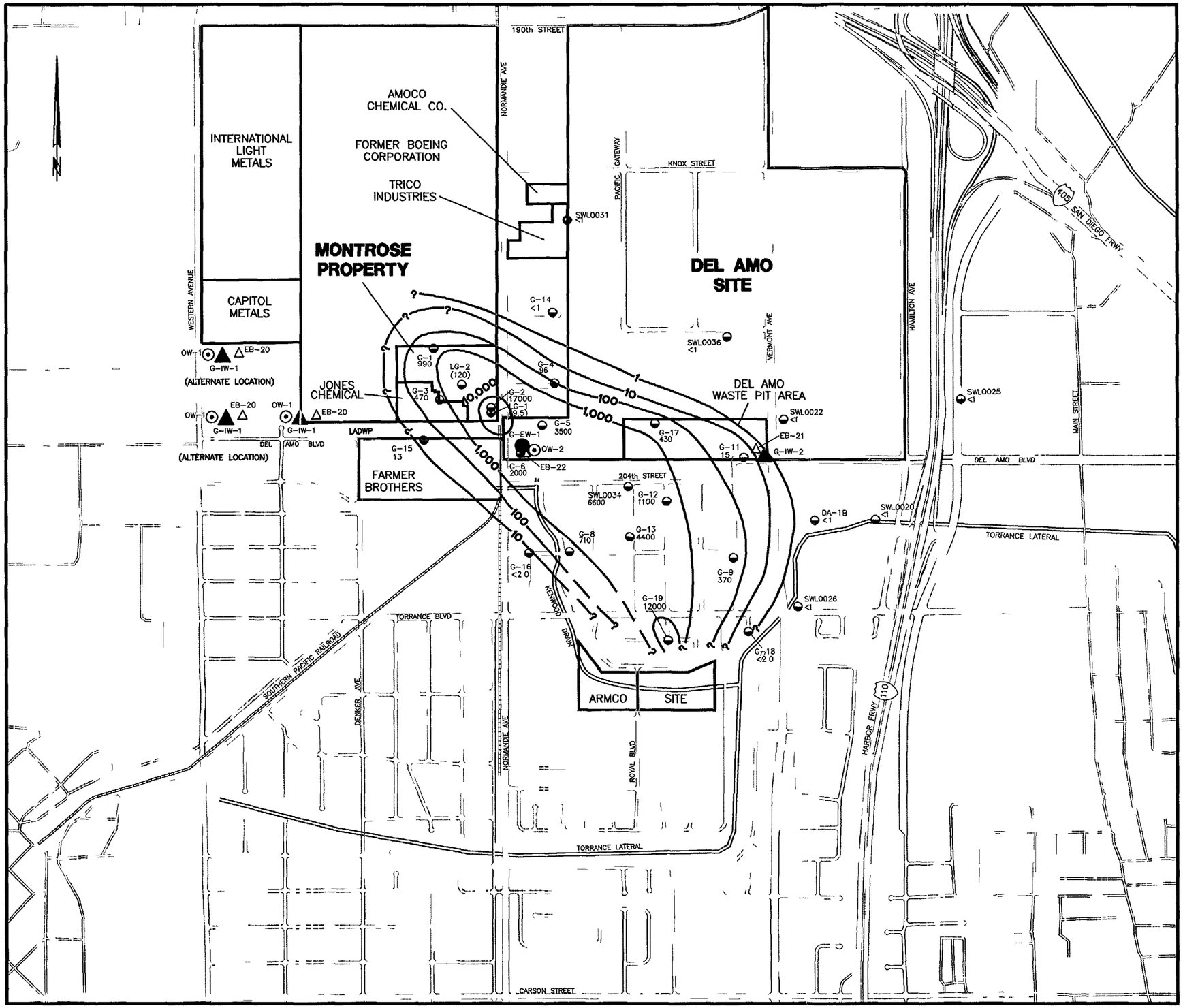
FIGURE 11

PREP BY PSR	REV BY MAP	RPT NO 857 38	410 4654	B



EXPLANATION

G-4 ◒ 96	GAGE AQUIFER MONITOR WELL CONCENTRATION IN MICROGRAMS PER LITER
LG-2 ◒ (309)	LOWER GAGE AQUIFER MONITOR WELL (CONCENTRATION NOT CONTOURED)
▲	PROPOSED PILOT TEST INJECTION WELL
●	PROPOSED PILOT TEST EXTRACTION WELL
⊙	PROPOSED OBSERVATION WELL
△	PROPOSED EXPLORATORY BORING

?——— 100 ——— ——?
CONTOUR LINE OF EQUAL CONCENTRATION OF CHLOROBENZENE IN MICROGRAMS PER LITER DASHED WHERE APPROXIMATE, QUERIED WHERE INFERRED BASED ON MOST RECENT SAMPLING RESULTS

< = LESS THAN, NUMERICAL VALUE IS THE LIMIT OF DETECTION FOR THIS ANALYSIS

WELL IDENTIFIER NOTES
G AND LG = MONTROSE MONITOR WELLS
DA AND SWL = DEL AMO MONITOR WELLS

NOTE: CONCENTRATION DATA FOR DEL AMO MONITOR WELLS PROVIDED BY URS, 2004

WATER QUALITY DATA PRESENTED ON THIS MAP ARE THE MOST RECENT DATA AVAILABLE FOR EACH WELL AS OF JANUARY 2004 DATA FOR MONTROSE WELLS WERE SUPPLEMENTED WITH AVAILABLE DATA OBTAINED BY OTHERS FROM NON-MONTROSE MONITOR WELLS LOCATED IN THE SITE VICINITY

0 1,000 2,000
FEET

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE CALIFORNIA

PROPOSED PILOT TEST EXTRACTION-INJECTION WELL LOCATIONS GAGE AQUIFER

HARGIS + ASSOCIATES, INC
Hydrogeology/Engineering

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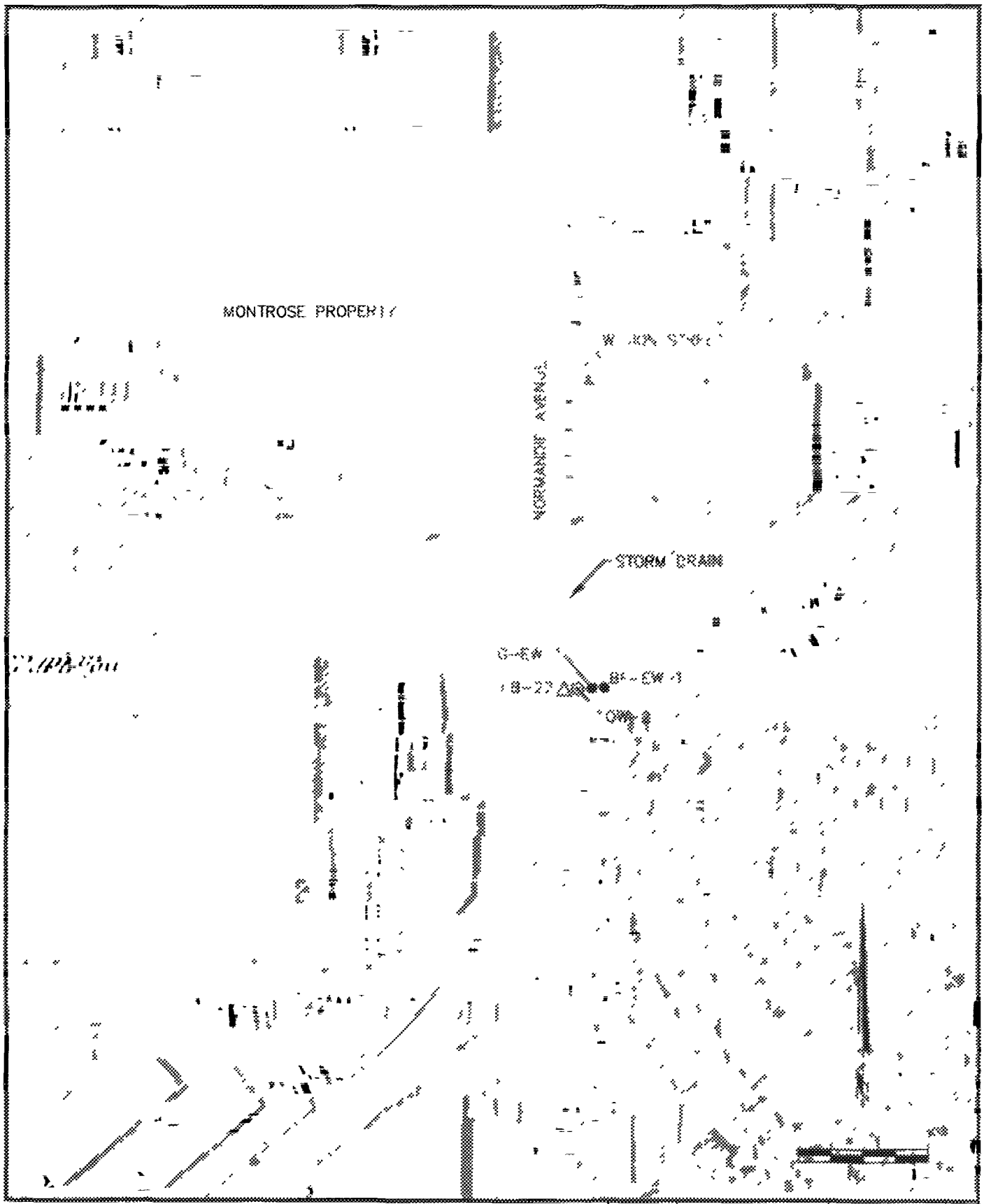
FIGURE 12

PREP BY PSR REV BY MAP RPT NO 857.38 | 410-4655 | B



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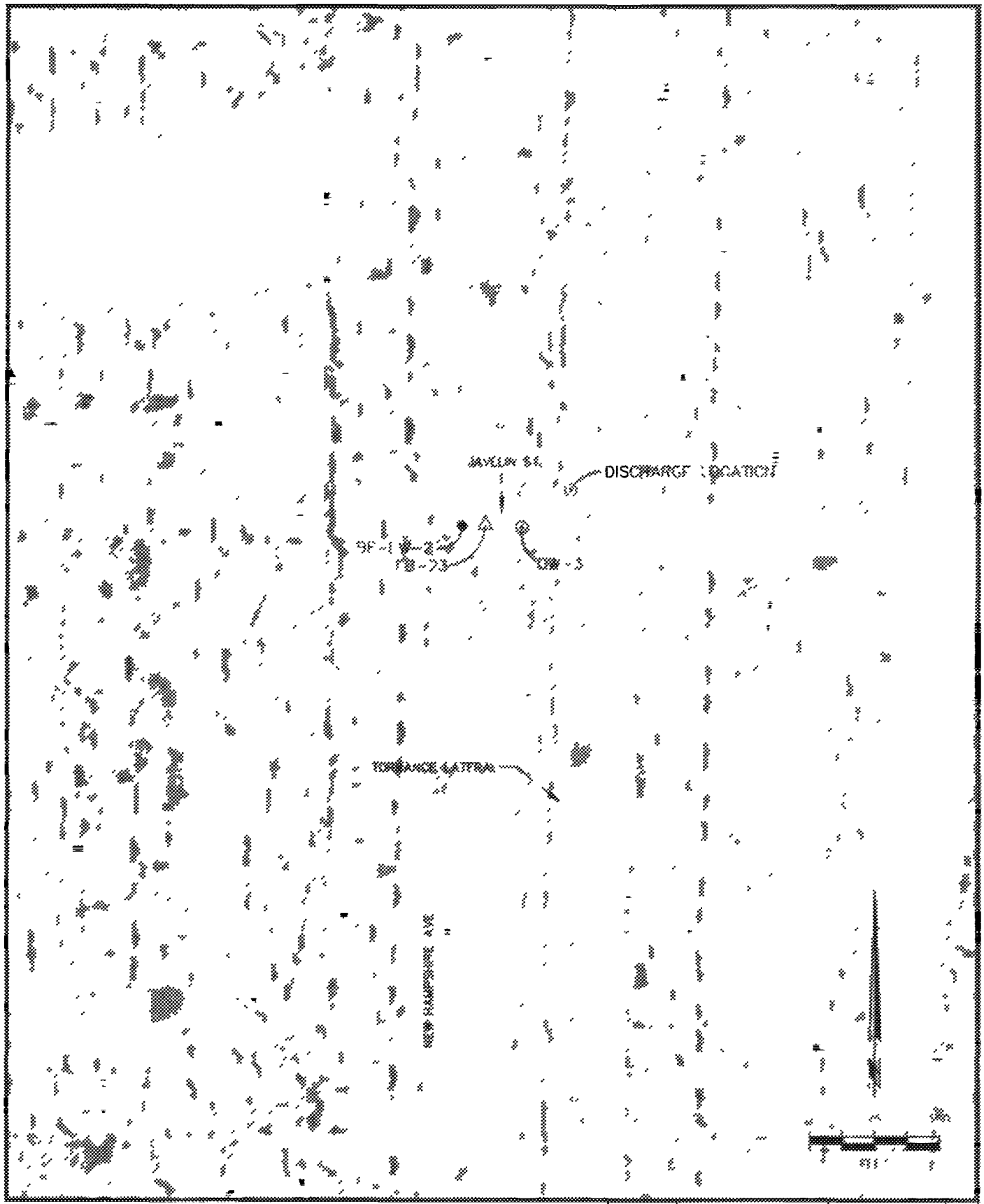
10/04	RPT NO 857 38	410-4675	B

FIGURE 13.
STORM DRAIN LOCATIONS FOR EXTRACTION WELL BF-EW-1 AND G-EW-1



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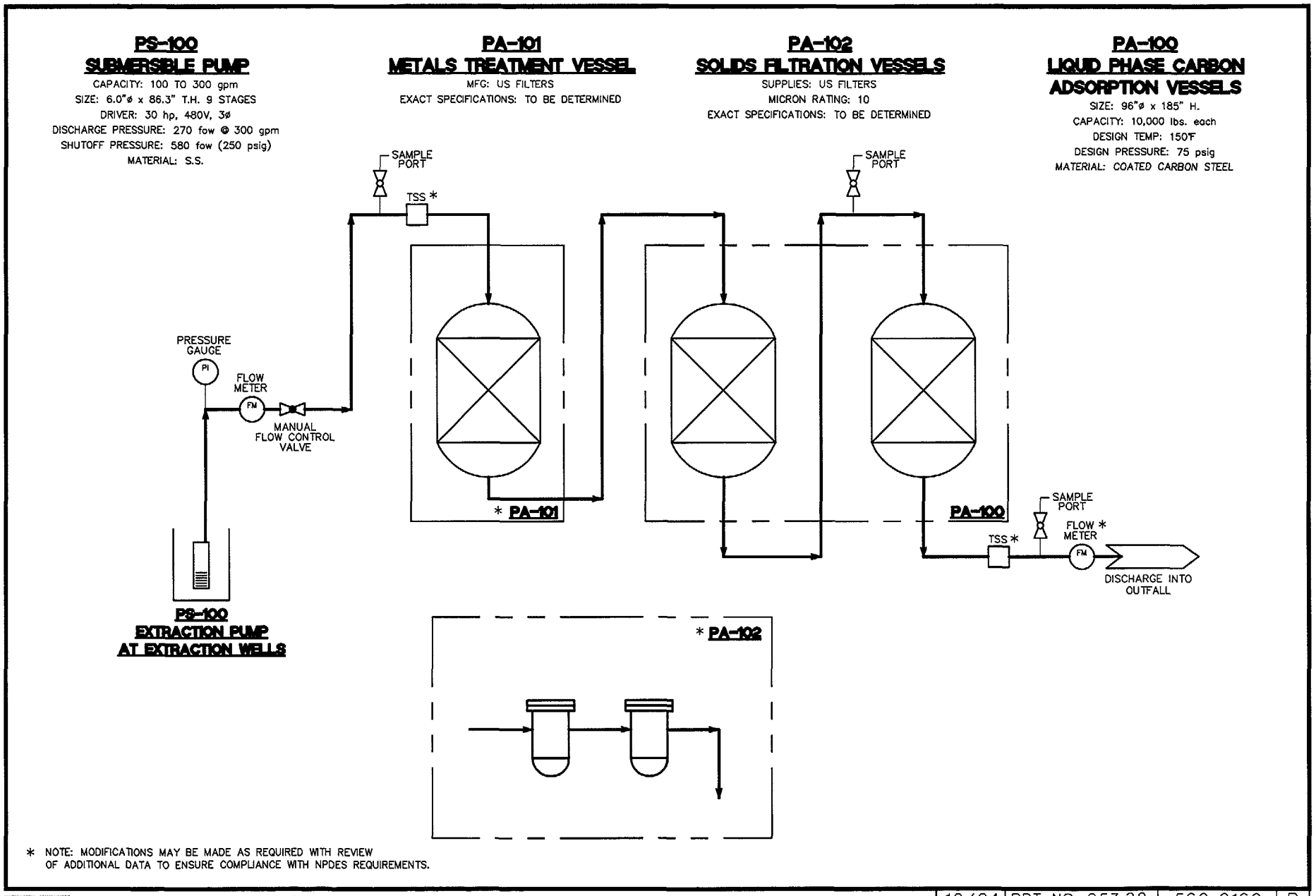
Hydrogeology/Engineering

10/04	RPT NO 857 38	410-4882	B

FIGURE 14.
STORM DRAIN LOCATION FOR EXTRACTION WELL BF-EW-2



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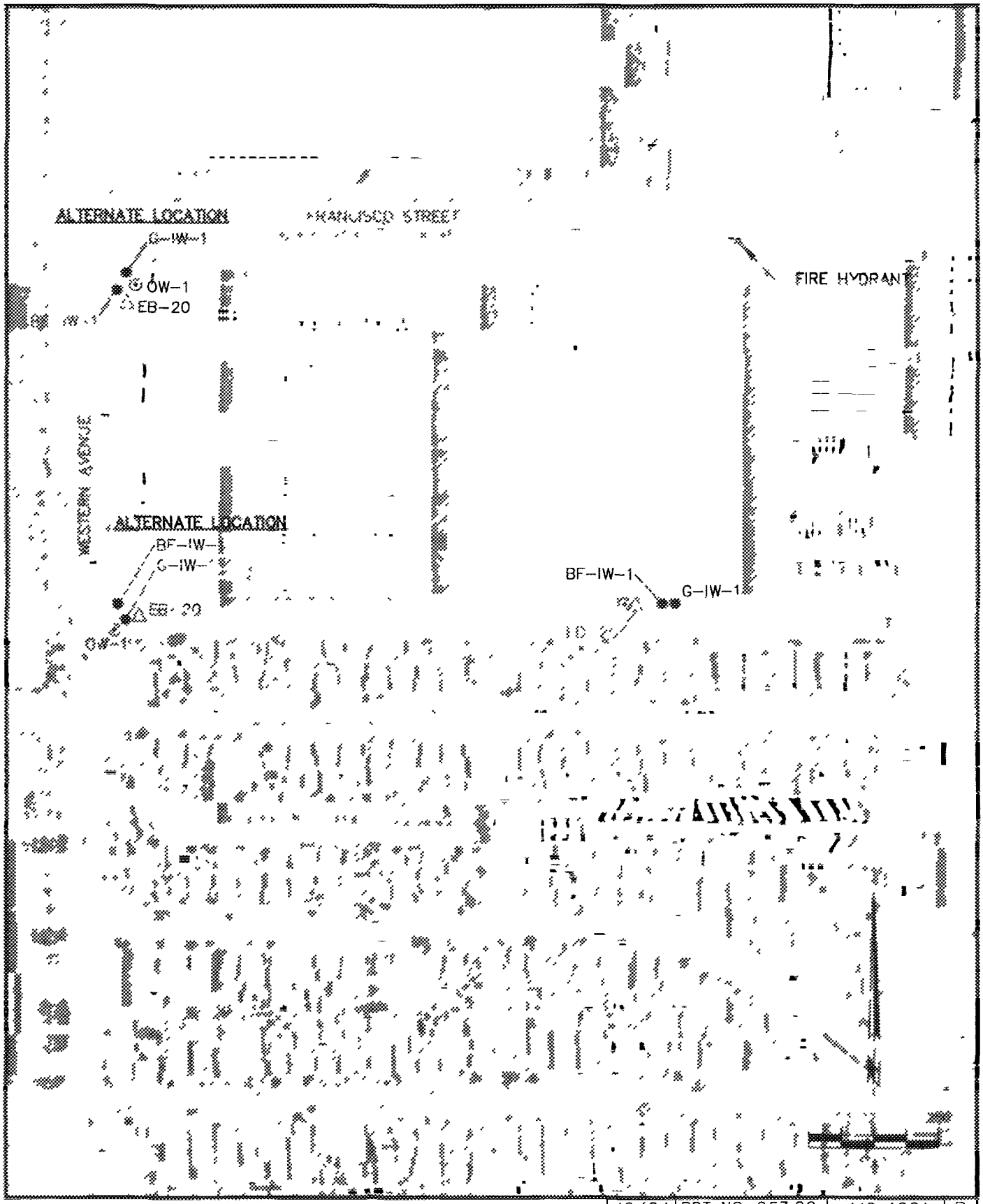
Hydrogeology/Engineering

10/04	RPT NO. 857.38	560-0160	B

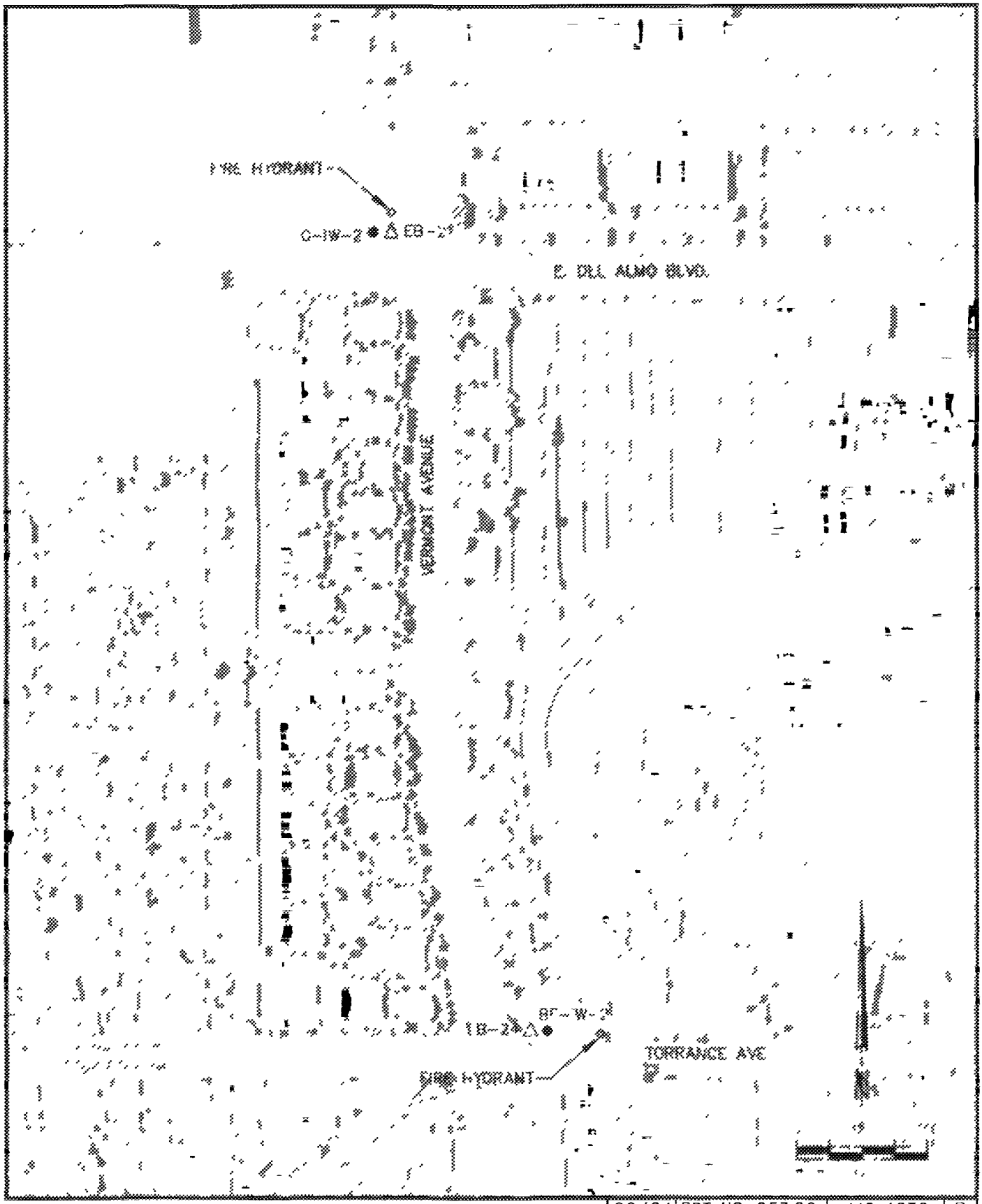
FIGURE 15. PILOT EXTRACTION TREATMENT SYSTEM PROCESS FLOW DIAGRAM



HARGIS + ASSOCIATES, INC
Hydrogeology/Engineering

10/04	RPT NO 85739	410-4881	B

FIGURE 16.
FIRE HYDRANT LOCATION FOR
INJECTION WELL BF-IW-1 AND G-IW-1



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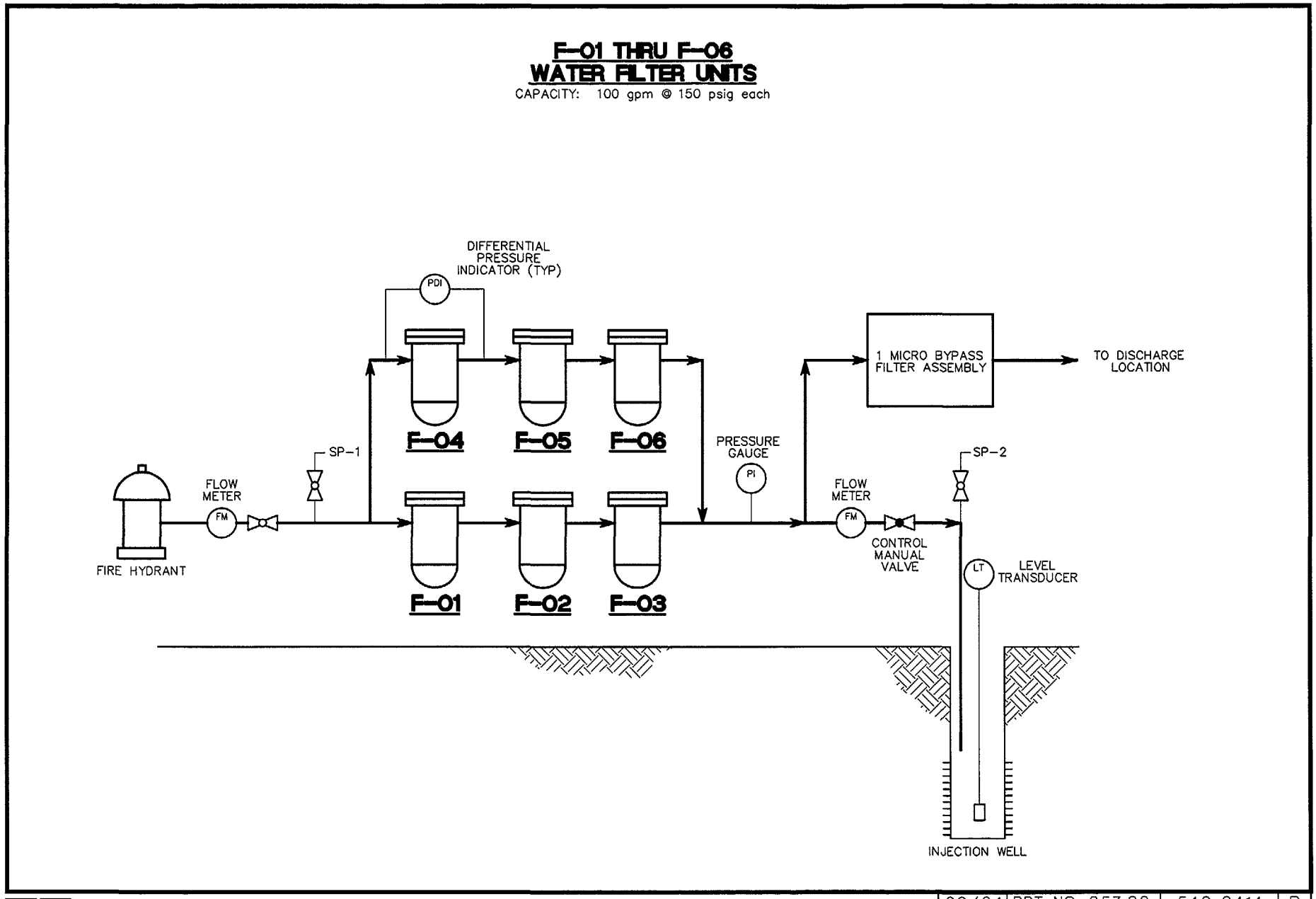
08/04	RPT NO 857 38	410 4676	B

FIGURE 17.
FIRE HYDRANT LOCATION FOR INJECTION WELL BF-IW-2 AND G-IW-2



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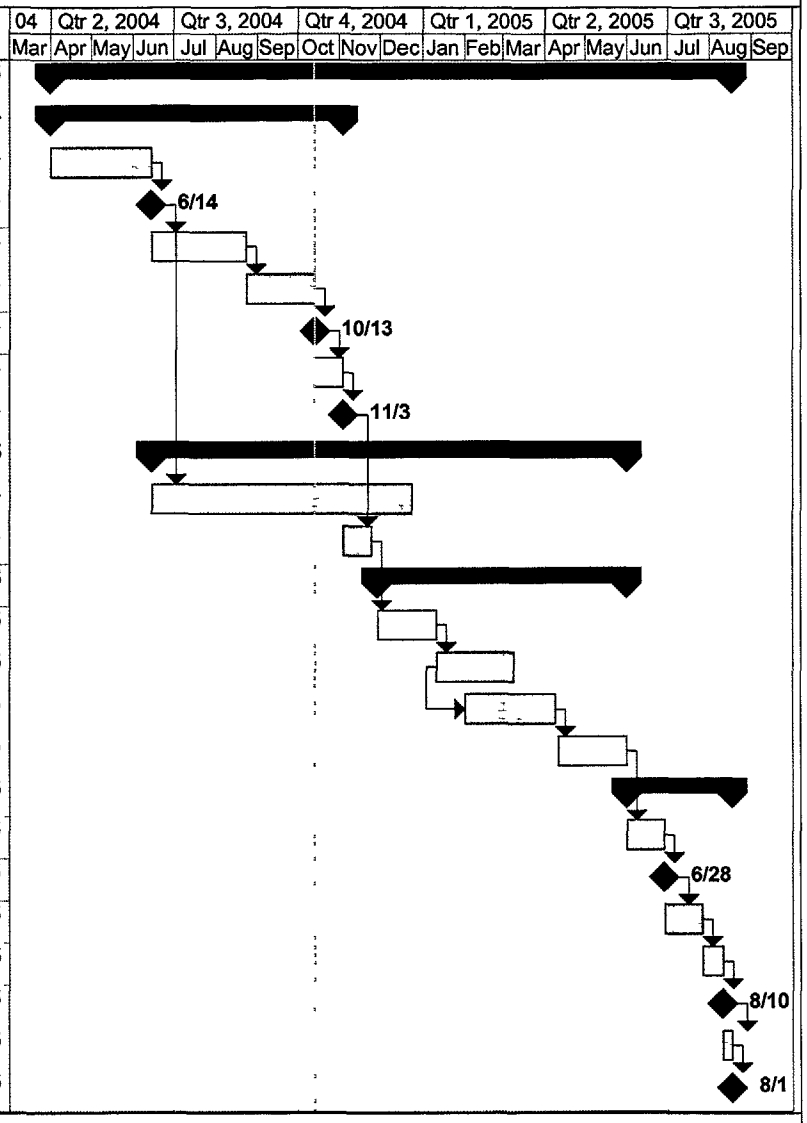
09/04	RPT NO. 85738	540-0414	B

FIGURE 18. INJECTION SYSTEM PROCESS FLOW DIAGRAM

Figure 19
Schedule

ID	Task Name	Duration	Start	Finish
1	**Pilot Extraction and Aquifer Response Test**	**346 days**	**Thu 4/1/04**	**Wed 8/17/05**
2	**Workplan/FSP/QAPP-DIN 036**	**152 days**	**Thu 4/1/04**	**Wed 11/3/04**
3	Prepare Plan/Montrose Review	52 days	Thu 4/1/04	Mon 6/14/04
4	Submit Draft to EPA	0 days	Mon 6/14/04	Mon 6/14/04
5	EPA Review	49 days	Tue 6/15/04	Mon 8/23/04
6	Revise Plan	36 days	Tue 8/24/04	Wed 10/13/04
7	Submit Final to EPA	0 days	Wed 10/13/04	Wed 10/13/04
8	EPA Review	15 days	Thu 10/14/04	Wed 11/3/04
9	EPA Approval	0 days	Wed 11/3/04	Wed 11/3/04
10	**Pilot Testing**	**238 days**	**Tue 6/15/04**	**Tue 5/31/05**
11	Access and Permitting	134 days	Tue 6/15/04	Thu 12/23/04
12	Mobilization	15 days	Thu 11/4/04	Wed 11/24/04
13	**Fieldwork**	**123 days**	**Mon 11/29/04**	**Tue 5/31/05**
14	Exploratory Borings/Observation wells	24 days	Mon 11/29/04	Mon 1/10/05
15	Install Extraction/Injection Wells	40 days	Tue 1/11/05	Tue 3/8/05
16	Injection Testing	48 days	Tue 2/1/05	Fri 4/8/05
17	Extraction Testing	36 days	Mon 4/11/05	Tue 5/31/05
18	**Completion Report DIN 037**	**56 days**	**Wed 6/1/05**	**Wed 8/17/05**
19	*Prepare Report/Montrose Review*	20 days	Wed 6/1/05	Tue 6/28/05
20	Submit to EPA	0 days	Tue 6/28/05	Tue 6/28/05
21	EPA Review	20 days	Wed 6/29/05	Tue 7/26/05
22	Revise Report	11 days	Wed 7/27/05	Wed 8/10/05
23	Submit Final to EPA	0 days	Wed 8/10/05	Wed 8/10/05
24	EPA Review	5 days	Thu 8/11/05	Wed 8/17/05
25	EPA Approval	0 days	Wed 8/17/05	Wed 8/17/05



Project: 857 Rpts 2004-10 Fig 19 Sche
Date: Wed 10/13/04

Task		Milestone		External Tasks	
Split		Summary		External Milestone	
Progress		Project Summary		Deadline	

HARGIS + ASSOCIATES, INC.

APPENDIX A

FIELD SAMPLING PLAN
PILOT EXTRACTION AND AQUIFER RESPONSE TEST
MONTROSE SITE
TORRANCE, CALIFORNIA

APPENDIX A

FIELD SAMPLING PLAN
PILOT EXTRACTION AND AQUIFER RESPONSE TEST
MONTROSE SITE
TORRANCE, CALIFORNIA

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ACRONYMS AND ABBREVIATIONS

ASTM	American Society of Testing and Materials
BHC	Hexachlorocyclohexane
bls	Below Land Surface
D&M	Dames & Moore
DDT	Dichlorodiphenyltrichloroethane
DO	Dissolved oxygen
DOT	Department of Transportation
EC	Electrical conductivity
EPA	U.S. Environmental Projection Agency
FSP	Field Sampling Plan
gpm	Gallons per minute
H+A	Hargis + Associates, Inc.
ID	Internal diameter
LNAPL	Light nonaqueous phase liquid
ml	Milliliter
Montrose	Montrose Chemical Corporation of California
msl	Mean sea level
NPDES	National Pollutant Discharge Elimination System
NTUs	Nephelometric Turbidity Units
ORP	Oxidation-reduction potential
pCBSA	para-Chlorobenzene Sulfonic Acid
PPE	Personal protective equipment
Property	Area within the fenced property boundary located at 20201 South Normandie Avenue, in Los Angeles (near Torrance), California
PVC	Polyvinyl chloride
QAPP	Quality Assurance Project Plan
QA/QC	Quality assurance/quality control
RI	Remedial Investigation
Site	Montrose Chemical Corporation of California Site
SOPs	Standard operating procedures

ACRONYMS AND ABBREVIATIONS (continued)

SOW	Statement of Work
UAO	Unilateral Administrative Order
USCS	Unified Soil Classification System
VOCs	Volatile organic compounds
Workplan	Pilot Extraction and Aquifer Response Testing Workplan

APPENDIX A

FIELD SAMPLING PLAN
PILOT EXTRACTION AND AQUIFER RESPONSE TEST
MONTROSE SITE
TORRANCE, CALIFORNIA

1.0 PROJECT DESCRIPTION

This Field Sampling Plan (FSP) has been prepared for Montrose Chemical Corporation of California (Montrose) in accordance with the requirements outlined in Section 4.1 of the Unilateral Administrative Order (UAO) Statement of Work (SOW) (U.S. Environmental Protection Agency [EPA], 2004). This FSP describes the objectives, rationale, methods, and procedures for extraction, injection, and observation well drilling and construction, well development, water level measurement, groundwater sampling, and aquifer response testing for the Pilot Extraction and Aquifer Response Test program to be conducted at the Montrose Site (Site). This FSP is a companion document to the Workplan and associated Quality Assurance Project Plan (QAPP) for the Pilot Extraction and Aquifer Response Test.

This FSP was developed in accordance with the EPA guidance document "Preparation of a U.S. EPA Region 9 Field Sample Plan for EPA-Lead Superfund Projects", Document Control No. 9QA-06-93" (EPA, 1994).

1.1 DEFINITION OF TERMS

To facilitate the discussion within this document, several defined terms are used as described below. For clarity of discussion only, this report will refer to the "Property" as the area within the fenced property boundary located at 20201 South Normandie Avenue, in Los Angeles, near Torrance, California (Figure A-1). The term "central process area" refers to an approximate two

acre portion of the Property where most of the manufacturing operations were performed historically.

The term dichlorodiphenyltrichloroethane (DDT) or total DDT, will be used to refer to the sum of the isomers and metabolites of DDT. The term hexachlorocyclohexane (BHC) or total BHC, will be used to refer to the sum of the isomers of BHC.

1.2 OBJECTIVES

In accordance with the UAO SOW Section 4, the objectives of the Pilot Extraction and Aquifer Response Test Program are to:

- Obtain data regarding the response of the hydrostratigraphic system to the stress of pumping and injection on a scale approaching that to be used in the full-scale production wells.

- Obtain more reliable estimates of aquifer transmissivity, hydraulic conductivity, storativity, and aquitard leakance that can be used to improve the reliability of the groundwater model and wellfield simulations.

- Obtain data regarding the radius of influence and capture zones likely to be achieved by full scale extraction wells.

- Obtain information about injection rates for full-scale injection wells and evaluate injection well plugging issues.

- Provide information needed to develop specifications for extraction and injection wells, treatment system, piping and control systems, and facilitate the design of these physical systems upon completion of the modeling and wellfield optimization.

Additional details regarding the testing program are provided in the workplan. This FSP provides additional information regarding the proposed well installation and testing, including:

- Proposed pilot extraction and injection well construction details; drilling methods and equipment; construction materials; borehole, casing and annular seal materials; depths of screened and blank casing intervals; well development procedures;

- Proposed nested piezometer construction details; drilling methods; construction materials; borehole, casing and annular seal materials; depths of screened and blank casing intervals; well development procedures;

- Proposed pilot testing procedures and equipment including: pump, transducers, and other dedicated or temporary downhole equipment.

- Details regarding the treatment and/or disposal of development water, drilling fluids, and other potentially contaminated media.

- Groundwater sampling procedures and chemical and physical parameters to be included in the sample analysis of the new wells, pending incorporation into the overall monitoring plan.

A description of the DQOs and the QA/QC procedures that will be implemented during field and laboratory activities is provided in the QAPP (Appendix B).

1.3 OVERVIEW OF THE FIELD EFFORT

Three extraction wells, four injection wells, and three observation well clusters will be installed as part of this field effort in order to meet the objectives of the UAO SOW (EPA, 2004). Water level measurement and groundwater sampling of the new wells will also be conducted in accordance with the Workplan. Water levels will be measured and groundwater samples will be collected from extraction and injection wells. During the pilot extraction and aquifer response testing, water levels will be measured and recorded in the observation well clusters and selected monitor wells.

1.4 DATA NEEDS AND USES

Data needs and the intended uses of the data to be collected are presented below. A QAPP has been prepared for sampling to be conducted as part of this FSP. The QAPP is included as Appendix B of the Workplan.

A summary table of data uses and limitations for this program is presented in Table A-1.

2.0 BACKGROUND

Background information related to the Site and previous groundwater investigations are outlined in Sections 2.1 through 2.5.

2.1 SITE LOCATION AND DESCRIPTION

The Property occupies approximately 13 acres in the City of Los Angeles near Torrance, California (Figures A-1 and A-2). The Property is bounded by the Union Pacific Railroad right-of-way and Normandie Avenue to the east; Jones Chemical Company and a right-of-way owned by the Los Angeles Department of Water and Power to the south; the former Boeing Realty Corporation to the north, and Frito-Lay to the west. The Property is generally flat. Elevations range from 40 feet above mean sea level (msl) to 45 feet msl. The surrounding area consists of mixed residential, commercial, and industrial facilities. The property is accessible by city streets in the area and Interstates 405 and 110. The Los Angeles International Airport is located approximately 10 miles from the property.

2.2 STRATIGRAPHY

The stratigraphy of the Site was defined using published regional geologic data and by site-specific data collected from monitor wells and borings drilled during multiple Site investigations. For more information about the stratigraphy at the Site, the reader is referred to the Workplan Section 2.3 and the Remedial Investigation (RI) Report (EPA, 1998).

2.3 HYDROGEOLOGY

The hydrogeology of the Site has been defined using published regional data and site-specific data collected from monitor wells drilled during multiple investigations at both the Montrose and

Del Amo sites. For more information about the regional hydrogeology, local hydrogeology, and groundwater flow directions the reader is referred to the Workplan Section 2.4, the RI Report and the 2004 Baseline Sampling Results Report (Hargis + Associates, Inc. [H+A], 2004b; EPA, 1998).

2.4 SITE HISTORY

Montrose manufactured DDT at the Site from 1947 to 1982. The facility was closed in 1982 and the Site subsequently cleared and capped. Previous investigations addressing the potential for contamination at the Site included on- and off-property sampling of soil, groundwater, sediment, and surface water. The investigations were performed by the EPA, its contractors, the California Department of Health Services, the Regional Water Quality Control Board, and Montrose's consultants. The RI Report provides a detailed summary of the Site history (EPA, 1998).

2.5 PREVIOUS INVESTIGATIONS

Groundwater monitoring has been conducted by Montrose since 1985. A total of 97 monitor and extraction/test/injection wells were originally constructed as part of RI activities conducted by Montrose to evaluate the nature and extent of Montrose-related compounds in groundwater (Figure A-2). A number of monitor wells have been destroyed by different entities during construction, grading, or paving activities on surrounding properties. Presently there are over 85 monitor wells and six extraction/test/injection wells at the Site (Table A-3).

Quarterly groundwater monitoring of all Montrose monitor wells was conducted until 1990, when an EPA-approved key well monitoring program was implemented and frequency of monitoring, the number of sampling locations, and the level of documentation required were reduced (EPA, 1998). The number of sampling locations and number of analytes for the key well monitoring program were further reduced to 11 wells in 1992. The key well monitoring program concluded in January 1993. Limited groundwater sampling was done between 1995 and 2002. A baseline groundwater sampling round was conducted in January 2004.

In addition to the Montrose RI, other groundwater contamination investigations have been conducted by other parties in the vicinity of the Montrose Site. In particular, an RI has been conducted at the adjacent Del Amo Site by Dames & Moore (D&M) on behalf of the Del Amo respondents. For additional information, please refer to the RI Report or the most recent monitoring report (D&M, 1998; URS, 2004).

Montrose monitor wells are screened in each of the following four hydrostratigraphic zones, which are identified in order of increasing depth below land surface (bls):

- Upper Bellflower aquitard;
- Bellflower sand;
- Gage aquifer; and
- Lynwood aquifer.

Detailed discussion and conclusions regarding hydrostratigraphic interpretations, directions of groundwater flow, and the nature and extent of contamination in each of these hydrostratigraphic zones are provided in the RI Report (EPA, 1998). The RI Report also describes the historical background; history of response; assessment objectives; assessment results; laboratory analyses; quality assurance; fate and transport of compounds of concern; and other pertinent information, such as aquifer test results, well construction, and well development specifications. Due to the comprehensive and extensive nature of supporting documentation, information contained in the Montrose RI Report is frequently incorporated by reference in this FSP and has not been duplicated herein.

3.0 MAPS AND FIGURES

For ease of use in the field, the figures described in this section have been compiled together into a single section behind the tab marked "Figures" which follows the text and tables sections of this FSP. A list of these figures can be found in the Table of Contents, which precedes the text portion of this FSP.

- FIGURE A-1. SITE LOCATION: This figure shows the location of the Property relative to the major freeways and cities in the greater Los Angeles metropolitan area. The figure also provides the reader with a perspective of the location of the Property within the State of California.

- FIGURE A-2. MONITOR WELL LOCATIONS: This figure depicts the outline of the Property and the locations of monitor wells currently installed at the Property and elsewhere at the Site and vicinity. Also depicted on this figure, for reference, is the local surrounding area including adjoining streets, rights-of-way, and railroad locations. The central process area, the area located near the center of the Property where the majority of the manufacturing occurred during the period of plant operations, is also depicted on Figure A-2.

- FIGURE A-3: PROPOSED PILOT TEST EXTRACTION – INJECTION WELL LOCATIONS, BELLFLOWER SAND: This figure illustrates concentrations of chlorobenzene in the groundwater and the proposed extraction and injection well locations in the Bellflower sand.

- FIGURE A-4: PROPOSED PILOT TEST EXTRACTION – INJECTION WELL LOCATIONS, GAGE AQUIFER: This figure illustrates concentrations of chlorobenzene in the groundwater and the proposed extraction and injection well locations in the Gage aquifer.

- FIGURE A-5: SCHEMATIC EXTRACTION/INJECTION WELL CONSTRUCTION DIAGRAM: This figure illustrates the proposed construction details for new extraction and injection wells to be installed within the Bellflower sand and Gage aquifer. Although the depth intervals for these wells will differ, the basic well design is similar.

- FIGURE A-6: SCHEMATIC OBSERVATION WELL CLUSTER CONSTRUCTION DIAGRAM: This figure illustrates the proposed construction details for the observation well clusters to be installed within the Bellflower sand, lower Bellflower aquitard, and Gage aquifer.

- FIGURE A-7: ROUTE TO HOSPITAL: This figure was derived from the project-specific Health and Safety Plan and depicts the route to the hospital in the event that a medical emergency should arise during the field program described in this FSP (H+A, 2003a).

4.0 RATIONALE FOR SAMPLING AND ANALYSIS PLAN

The following sections describe the objectives and rational for the drilling and construction of new extraction and injection wells; observation well clusters; measurement of water levels; and collection and analysis of groundwater samples from the new wells.

4.1 WELL DRILLING AND CONSTRUCTION

4.1.1 Objectives

The extraction and injection wells will be designed and constructed in a manner that will allow them to be incorporated into the final remediation wellfield. This approach will provide data regarding extraction and injection well performance as well as data regarding aquifer and aquitard response, which can be used to further refine and validate the model. Injection and extraction well specific capacity and yield has a direct bearing on the number of wells that may be required to meet remedial objectives, and therefore this information is critical to the wellfield design. In addition, data would be obtained during the pilot testing program from surrounding monitor wells completed in the extraction/injection zones as well as the adjacent aquitards. This monitoring data, once incorporated into the model, will reduce the uncertainty in the model results, will result in a more reliable wellfield design, and will reduce unnecessary conservatism and cost.

4.1.2 Frequency and Location

Locations of existing monitor wells are shown in Figure A-2. Proposed locations of exploratory borings and new extraction, injection, and observation wells are shown on Figures A-3 and A-4.

A small diameter exploratory boring will first be advanced at each extraction well location to obtain core samples for physical and chemical testing, and to provide the lithologic data required to ensure a proper well design. Grain size analyses will be conducted to evaluate

proposed well screen slot sizes. The number of samples for grain size will be dependent on the geology encountered. Compressibility and permeability tests will be conducted on a minimum of two aquitard samples to aid in assessing vertical hydraulic conductivity. A minimum of two aquitard samples will also be analyzed for chlorobenzene, para-chlorobenzene sulfonic acid (pCBSA), and total organic carbon to allow assessment of aquitard mass and transport properties.

A small diameter exploratory boring will be advanced at each injection well location using a mud-rotary drill rig to provide the lithologic data required to ensure a proper well design. Grain size analyses will be conducted on selected core samples to evaluate proposed well screen slot sizes. The number of samples for grain size will be dependent on the geology encountered. A minimum of two soil samples from the injection zone will be analyzed for cation exchange capability to determine the concentration of various cations in core samples and x-ray diffraction to quantify the percentage of minerals and clays in the core samples. These analyses may be needed to evaluate potential in situ geochemical reactions caused by incompatibility with the injection water.

4.2 WATER LEVEL MEASUREMENT

4.2.1 Objectives

Water level measurements will be utilized to provide data for evaluating groundwater levels at flow conditions at each of the new wells. Additionally, these data will be utilized to assess water table responses during the pilot testing; specifically, this data will be evaluated to determine: the horizontal and vertical hydraulic gradients that are generated, the response of hydrogeologic units to extraction and injection, the impact upon the direction of groundwater flow, and the potential impact of extraction and injection on the distribution of the contaminant plume.

4.2.2 Frequency and Location

Upon completion of installation, water levels will be manually measured in each new well. During the pilot extraction and aquifer response testing, water levels will be measured manually and will also be monitored continuously in selected wells using pressure transducers, as indicated below. The transducers will also be utilized to measure barometric pressure in order to assess the potential barometric effects on water level data. Additional water level measurements will be completed in accordance with the requirements outlined in the Monitoring and Aquifer Compliance Plan, which is being prepared by EPA. Water level data will be utilized to evaluate the magnitude of the hydraulic influence that develops around the test well.

Water levels will be recorded in several background monitor wells in order to track regional water level changes. Additional monitoring well locations have been selected based upon the locations of the extraction and injection wells and also based upon model simulations. Monitoring well locations take into consideration the model assumption that steady-state conditions were fully achieved; that is, that the extent of influence shown in the model will not be fully achieved during these short-duration tests.

Three water level rounds will be conducted for each test, one before the test to establish static conditions, one at the end of the pumping phase and one at the conclusion of the recovery phase of the test. For each test well, the wells to be monitored are sorted into three categories: Tier 1, Tier 2, and Tier 3. The Tier 1 wells represent those wells which are nearest to the test well and therefore most likely to demonstrate observable influence. The Tier 2 and 3 wells are located at further distances from the test wells. If influence is observed at any of the outermost Tier 1 wells, monitoring will be extended to the Tier 2 wells. Monitoring will be further expanded to the Tier 3 wells if influence is observed in the outermost Tier 2 wells. Regardless of the extent of influence observed during the test, manual water level measurements will be taken at all Tier 1, 2, and 3 wells prior to the test. After completion of the test and after completion of recovery, manual water levels measurements will again be taken in Tier 1 wells and Tier 2 and 3 wells, if appropriate.

Prior to obtaining manual measurements, personnel will verify that the instrument is calibrated and functioning properly. To further assure the quality of field readings, measurements will be

compared to previous readings. If there is a discrepancy as compared to previous measurements at a well which cannot be explained by local groundwater conditions, changes, or trends, proper operation of the equipment will be confirmed and the measurement repeated. If possible, an alternate instrument will be utilized to verify the accuracy of the data. Water levels measured manually will be recorded to the nearest 0.01 foot.

For each test, pressure transducers will be installed in the test well and the appropriate monitor wells at least one hour prior to initiation of the step-test. The transducers will continue logging upon completion of the step-test which will provided data for a minimum of 24-hours prior to the start of the constant-rate test at each test well. Additional detail regarding the water level monitoring plan is provided in Table A-10. The pressure transducers will be installed to a depth approximately 5 feet below the deepest water level expected in the monitor and target wells and will be operated in accordance with the manufacturer's specifications.

A barometric pressure transducer will also be utilized to measure potential barometric effects on water level data. All transducers will be set to measure water levels every 15 minutes, starting on the hour, throughout the duration of the test. Transducer data will be downloaded and water levels will be measured manually in each of the observation wells to verify transducer operation and check for transducer drift.

Following are the wells which will be utilized for monitoring during testing:

Background monitor wells: **MW-5, BF-33, G-18, LW-3**

Well: BF-EW-1

<u>Tier 1 Monitoring Wells</u>

- Upper Bellflower Aquitard: MW-1, MW-6, MW-12, MW-13, **MW-14**, MW-29, MW-30, SWL0049, SWL0050, PZL0020, PZL0021, PZL0025
- Bellflower Sand: **BF-EW-1**, BF-2, **BF-5**, BF-6, **BF-7, BF-9, BF-15, BF-20, SWL0033, SWL0058**
- Lower Bellflower Aquitard: LBF-OW-2
- Gage Aquifer: G-5, **G-6**

Tier 2 Monitoring Wells

- Upper Bellflower Aquitard: MW-3, MW-7, MW-9, MW-16, MW-22, MW-23, MW-26, MW-27, MW-28, SWL0048, PZL0024
- Bellflower Sand: BF-IW-1, BF-1, BF-14, BF-21, BF-23, SWL0054, SWL0055
- Gage Aquifer: G-2, G-4, G-8, G-15, SWL0034

Tier 3 Monitoring Wells

- Bellflower Sand: BF-10, BF-13, **BF-24, BF-29, BF-35**, BL-10B, BL-11B*, SWL0031, SWL0035

Well: BF-EW-2

Tier 1 Monitoring Wells

- Upper Bellflower Aquitard: Armco Wells MP-23 and MP-29
- Bellflower Sand: **BF-EW-2, BF-OW-3, BF-11, BF-12, BF-17, BF-24, BF-25**
- Gage Aquifer: **G-OW-3**, G-18, G-19, **G-22, G-23**

Tier 2 Monitoring Wells

- Upper Bellflower Aquitard: MW-25, SWL0028
- Bellflower Sand: **BF-10, BF-15,** BF-21, **BF-22**, BF-26, BF-28, SWL0027
- Gage Aquifer: G-24, SWL0026

Tier 3 Monitoring Wells

- Bellflower Sand: BF-7, BF-23, BF-29, **BF-30**, BF-36, SWL0014

Well: G-EW-1

Tier 1 Monitoring Wells

- Bellflower Sand: BF-6, **BF-7**
- Lower Bellflower Aquitard: **LBF-OW-2**
- Gage Aquifer: **G-EW-1, G-1**, G-2, G-3, **G-4**, G-5, **G-6, G-8**, G-13, **G-15**, G-16, **G-17**, SWL0034
- Lynwood: LW-2, LW-4

Tier 2 Monitoring Wells

- Bellflower Sand: BF-2, BF-4, BF-5, BF-9, BF-15, BF-20, SWL0033, SWL0058
- Gage Aquifer: G-11, G-14, G-24, SWL0036
- Lynwood: LW-1, LW-3, LW-5, LW-6, LW-7

Tier 3 Monitoring Wells

- Gage Aquifer: **G-IW-1, G-12**, G-22, **G-23**, BL-10C, BL-11C, SWL0022, **SWL0026**, SWL0031

Well: BF-IW-1

Tier 1 Monitoring Wells

- Upper Bellflower Aquitard: MW-3, MW-7, MW-8, **MW-31**, UBE-1
- Bellflower Sand: **BF-IW-1, BF-OW-1, BF-20**, BF-32A, **BF-34, BL-11B**
- Gage Aquifer: **G-OW-1, G-IW-1**, G-15, G-20

Tier 2 Monitoring Wells

- Upper Bellflower Aquitard: MW-1, MW-9, MW-16, MW-22, BL-10A
- Bellflower Sand: **BF-02, BF-3**, BF-07, BF-9, BF-35
- Gage Aquifer: G-1, G-2, G-6, G-21, BL-11C

Tier 3 Monitoring Wells

- Bellflower Sand: **BF-5, BF-15**, BF-19, BF-21, **BF-31**, BF-33, **BL-10C**

Well: BF-IW-2

Tier 1 Monitoring Wells

- Upper Bellflower Aquitard: SWL0015, **SWL0027, SWL0028**, SWL0042, SWL0057, MP-23,
- Bellflower Sand: **BF-IW-2, BF-10, BF-12, BF-24, SWL0014**, SWL0019, SWL0027, SWL0056
- Gage Aquifer: G-9, **G-18**, SWL0020, **SWL0026**, DA-1B

Tier 2 Monitoring Wells

- Bellflower Sand: BF-11, **BF-14**, BF-17, BF-23, SWL0023, SWL0052, SWL0053
- Gage: G-9, G-11, G-12, G-13, G-19, G-22, SWL0025

Tier 3 Monitoring Wells

- Bellflower Sand: **BF-13, BF-16**, BF-15, SWL0013, SWL0033

Well: G-IW-1

Tier 1 Monitoring Wells

- Upper Bellflower Aquitard: MW-17, MW-31
- Bellflower Sand: **BF-OW-1**, BF-20, BF-32A, BF-34, BL11B*
- Gage Aquifer: **G-IW-1, G-OW-1, G-3, G-15, G-20**
- Lynwood: LW-05, LW-07

Tier 2 Monitoring Wells

- Bellflower Sand: BF-9, BF-35
- Gage Aquifer: **G-1, G-2**, BL-11C

Tier 3 Monitoring Wells

- Gage Aquifer: G-4, **G-6, G-16**, G-21, BL-10C

Well: G-IW-2

Tier 1 Monitoring Wells

- Bellflower Sand: **BF-IW-2**, BF-13, BF-23, SWL0011, SWL0013, SWL0018, SWL0041, SWL0052, SWL0053, SWL0055
- Gage Aquifer: **G-IW-2**, DA-1B, **G-9, G-11**, G-12, **G-17**, SWL0022
- Lynwood: LW-2, LW-3

Tier 2 Monitoring Wells

- Gage Aquifer: **G-6, G-13, G-19A, SWL0026**, SWL0034, **SWL0036**

Tier 3 Monitoring Wells

- Gage Aquifer: G-4, G-14, **G-16**, G-22, G-23

* – denotes a proposed well which, if installed, will be utilized for monitoring

MW-5: Denotes a well which will have a pressure transducer installed.

4.3 GROUNDWATER SAMPLING FOR NEW WELLS

4.3.1 Objectives

The newly installed extraction, injection, and observation wells will be sampled to provide additional information pertaining to the distribution of contaminants at the Site.

4.3.2 Frequency and Locations

Groundwater samples will be collected from the extraction wells at the end of the development phase for laboratory analysis of volatile organic compounds (VOCs), including chlorobenzene, pCBSA, metals, pesticides and PCBs, semi-volatile organic compounds, and various miscellaneous compounds in accordance with the requirements of the General National Pollutant Discharge Elimination System (NPDES) permit (Table A-2). These data will be used to assess the effluent water quality to the final treatment plant as well as the variability of the water quality compounds for treatment system design purposes.

A groundwater sample will be collected from the injection wells at the end of the development phase for laboratory analysis of VOCs, including chlorobenzene, pCBSA, and additional inorganic compounds and water quality parameters (Table A-2). These data will be used to assess the groundwater quality within the proposed injection zones prior to commencing injection testing operations. The water quality data will be used to verify that the injection wells are located outside the area of the contaminant plumes, and to evaluate native and treated water compatibility issues.

A groundwater sample will be collected from the observation wells at the end of development for the laboratory analysis of VOCs and pCBSA. This data will be used to establish the baseline water quality in the vicinity of the observation wells.

4.4 NATIONAL PRIORITY POLLUTANT DISCHARGE ELIMINATION SYSTEM MONITORING

The water extracted during the pilot extraction test will be treated and disposed of into the nearest storm drain inlet under a NPDES Permit. The NPDES Permit will require monitoring of the effluent on a regular basis to be determined by the Regional Water Quality Control Board upon approval of the permit. The anticipated chemicals to be analyzed are discussed in Section 5.1.4.

5.0 REQUEST FOR ANALYSES

This section describes the parameters to be analyzed and the methods to be used during sampling of newly installed extraction, injection, and observation wells for the pilot extraction and aquifer response testing program. In addition, this section addresses the parameters to be analyzed for compliance with the NPDES permit.

Original and field duplicate groundwater samples, field blank, and trip blank water samples, will be analyzed by Del Mar Analytical, Irvine, California. Laboratory split groundwater samples and associated trip blank samples will be analyzed by West Coast Analytical Services, Inc., Santa Fe Springs, California. Core samples will be analyzed by PTS Laboratories, Santa Fe Springs, California.

5.1 GROUNDWATER

5.1.1 VOLATILE ORGANIC COMPOUNDS

Groundwater samples collected from the new extraction, injection, and observation wells and samples required for the NPDES permit will be analyzed for chlorobenzene and other VOCs using EPA Method 8260B (Table A-2).

5.1.2 pCBSA

Groundwater samples collected from new extraction, injection, and observation wells and samples required for the NPDES permit will be analyzed for pCBSA using Modified EPA Method 314 (Table A-2).

5.1.3 NPDES Baseline Parameters

In accordance with the General NPDES permit baseline groundwater samples will be collected from the extraction wells. In addition to VOCs and pCBSA described above, samples will be collected for California Title 22 metals in accordance with the appropriate EPA method, pesticides using EPA Method 8081A, PCBs using EPA Method 8082, semi-volatile organic compounds using EPA Method 8270C. Miscellaneous compounds to be analyzed in accordance with the appropriate EPA method include asbestos, fuel oxygenates, methanol, 1,4-dioxane, perchlorate, hexavalent chromium, trivalent chromium, cyanide, dioxin, and total petroleum hydrocarbon.

5.1.4 NPDES Effluent Monitoring

It is anticipated that effluent monitoring for the NPDES permit may include total suspended solids, turbidity, biological oxygen demand, oil and grease, settleable solids, sulfides, phenols, residual chlorine, VOCs, 1,4-dioxane, fuel oxygenates, N-Nitroso-di-methyl amine, perchlorate, and total petroleum hydrocarbons in accordance with the appropriate EPA methods. The actual monitoring requirements will be determined at the time the NPDES permit is authorized.

5.1.5 Injection Well Plugging

In order to evaluate the potential for injection well plugging, groundwater samples will be collected from injection wells and analyzed for general minerals, Title 22 metals, silica, hydrogen sulfide, total organic carbon, TKN, ammonia, total nitrogen, nitrate, nitrite, total phosphorus, and orthophosphorus in accordance with the appropriate EPA method (Table A-2). In addition, samples for BART® test kit analysis will be collected to qualitatively evaluate the potential occurrence of iron bacteria, sulfate reducing bacteria, and slime forming bacteria.

5.2 CORE SAMPLES

Soil core samples will be obtained for grain size analyses in accordance with ASTM D4464M. Compressibility will be analyzed using ASTM D2166 and permeability tests will be analyzed

using ASTM D5084. Aquitard samples will be analyzed for chlorobenzene using EPA Method 8260A, pCBSA using EPA method 314, and total organic carbon using EPA Method 9060. Soil samples from the injection well exploratory borings will be analyzed for cation exchange capability using EPA Method 9081 and x-ray diffraction.

6.0 FIELD METHODS AND PROCEDURES

Standard operating procedures (SOPs) for extraction, injection, and observation well cluster drilling and construction, well development, groundwater sampling, and water level measurement are provided.

6.1 EXTRACTION, INJECTION AND OBSERVATION WELL DRILLING AND CONSTRUCTION

6.1.1 Equipment and/or Instrumentation

The Bellflower sand and Gage aquifer extraction, injection, and observation wells proposed as part of the Pilot Extraction and Aquifer Response Test Program will be installed using the mud rotary drilling method. Preliminary well construction specifications for the proposed new injection and extraction wells are provided (Table A-4).

Based on an evaluation of the distribution of contaminants in the overlying hydrostratigraphic units, the proposed Bellflower sand and Gage aquifer extraction and injection wells have the potential to penetrate zones of elevated chlorobenzene contamination. To prevent potential cross contamination from the overlying zones during drilling, a conductor casing will be installed and grouted in place to seal off the contaminated zones prior to drilling into the target completion zones for these wells. The proposed Bellflower sand and Gage extraction and injection wells will be completed with 18-inch steel conductor casing and 12-inch diameter 316L stainless steel casing and wire-wrapped screen (Figure A-5).

Equipment used as part of lithologic logging may include any or all of the following: hand lens, dropper bottle containing dilute hydrochloric acid, Munsell color chart, sand size chart, sample collection bags, wire mesh sieves, and pocket knife. Reference materials such as American Geologic Institute Data Sheets for Field Geology (Dietrich, et al., 1982), Manual of Field Geology (Compton, 1962), or Earth Manual (U.S. Department of Interior, 1980) may be used.

6.1.2 Preparation

Essential field equipment and supplies will be ordered prior to commencing drilling, lithologic logging, and well construction. References relating to the Site vicinity such as lithologic logs, geologic reports, and other information from previous site assessments will be reviewed to evaluate the nature of the study area geology.

A qualified driller will be selected to drill well borings, and to install the wells. A qualified driller will have appropriate equipment capabilities, a California C-57 license, experience on similar projects, and documentation of health and safety training. This experience requirement shall apply both to the individual driller in the field and to the drilling company as a whole.

Prior to entering the field, authorized personnel will contact property owners and appropriate agencies to obtain and comply with regulatory requirements regarding permits, access, drilling, and underground utility clearance, if required.

6.1.3 Standard Operating Procedures

SOPs for drilling, lithologic logging, and well installation are detailed in the following sections.

6.1.3.1 Lithologic Logging

A lithologic log will be compiled during drilling of pilot boreholes. The following procedures will be used during lithologic logging activities:

- Describe the soil sample or drill cuttings and record in field notebook. Take into account alterations caused by the sampling or drilling process.

- Note unusual drilling conditions or rig behavior.

The following procedures will be used for lithologic description of soil samples or drill cutting samples:

- Textural Classification of Soil:

  - Record the ratio of the following grain size fractions present in the sample to the nearest five percent: gravel, sand, and fines (silt and clay). The size limits for each fraction will be in accordance with the Unified Soil Classification System (USCS) Visual-Manual Procedure D-2488-84 [American Society for Testing and Materials (ASTM), 1984]. Estimate and record the predominant grain size(s) present within the gravel and sand fractions in the sample.

  - Provide textural classification name for the soil/sediment and classify the soil/sediment using the USCS. The root of the name is determined by the highest percentage of gravel, sand, silt, or clay fractions. The modifying terms are based on the relative percentage of the other major size fractions in the sample. A major size fraction is defined as a textural fraction that constitutes 30 percent or more of the sample, by volume. For example, a sample containing 90 percent sand and 10 percent silt would be classified as a sand with silt. Record the appropriate USCS classification on the lithologic log form.

- Color:

  - Compare sample to Munsell color chart and provide hue and chroma values for moist soil samples. Indicate in the field notebook if the color was determined based on a dry sample. Record the Munsell color descriptor.

- Moisture Content:

  - For soil/sediment samples collected using drilling methods that do not involve introduction of fluids, estimate relative moisture content using the terms "dry", "moist", and "wet".

- Consistency or Relative Density:

  - Estimate the consistency or relative density of the sample based on rig hammer blow counts, examination of samples, and on observation of the drilling characteristics of the soil/sediment. Consistency descriptors for fine-grained soils/sediments are: very soft, soft, firm, stiff, very stiff, and hard. Relative density descriptors for coarse-grained soils/sediments are: very loose, loose, medium dense, dense, and very dense. Descriptors of the degree of induration for a soil/sediment as a whole are: poorly indurated, moderately indurated, and well indurated.

- Plasticity:

  - Determine the degree of plasticity for fine-grained lithologic samples. Plasticity is the property in which a soil/sediment can be rapidly deformed or molded without rebounding elastically, changing volume, cracking, or crumbling (ASTM, 1984). Plasticity descriptors are: non-plastic, low plasticity, medium plasticity, and high plasticity.

- Sorting:

  - Estimate the degree of sorting, or overall grain size distribution, of soil/sediment samples that consist predominantly of sand-sized or larger particles. Designate by using one of the following descriptors: poorly sorted, moderately sorted, and well sorted. The descriptor "poorly sorted" applies to soils/sediments in which there is a good representation of the continuum of particle sizes. The descriptor "well sorted" applies to soils/sediments in which most particles are about the same size.

- Roundness:

  - Estimate the predominant roundness categories for the sand and gravel size fractions according to the roundness scale (Dietrich et al., 1982). The roundness categories are: angular, subangular, subrounded, and rounded. The on-site hydrogeologist will record in the field notebook actions of drilling bits or auger flights that may be

responsible for increasing the angularity of the sand or gravel size fractions in the sample, if applicable.

- Miscellaneous Properties:

  - Additional properties should be reported if noted in the soil/sediment sample. These properties include the following: mineralogical composition; degree of iron or manganese staining of coarse fraction; reactance with dilute hydrochloric acid; odor; other physical properties, including soil structure and fracture spacing and width, if applicable; orientation and coatings on fractures, if applicable; presence of man-made, animal, or plant material; and organic vapor readings determined using equipment such as an organic vapor analyzer.

- Core Recovery:

  - Record core recovery - ratio of the length of core recovered to the total length of the core run.

6.1.3.2 Exploratory Borings

A small diameter exploratory boring will first be advanced at each extraction well location to obtain core samples for physical and chemical testing, and to provide the lithologic data required to ensure a proper well design. Grain size analyses will be conducted to evaluate proposed well screen slot sizes. Compressibility and permeability tests will be conducted on aquitard samples to aid in assessing vertical hydraulic conductivity. Aquitard samples will also be analyzed for chlorobenzene, pCBSA, and total organic carbon to allow assessment of aquitard mass and transport properties. The borings for exploratory borings EB-20, EB-21, EB-22 and E-23 will be converted into observation wells (Section 6.1.3.5). The exploratory borings for EB-22 and EB-24 will be grouted from the bottom up using a tremie pipe.

Prior to constructing Bellflower sand injection well BF-IW-1, a groundwater sample will be obtained from the Bellflower sand by installing a temporary well in the planned exploratory

borehole. The exploratory boring will be drilled using small diameter mud rotary drilling and coring equipment to obtain data for the injection well design. Prior to grouting the exploratory boring, the mud will be thinned and a temporary well casing and 0.020-inch slotted screen assembly will be installed within the Bellflower sand. The screen will be filter packed with #2-/16 Lonestar sand. A two-foot #60 silica sand grout filter will be placed over the filter pack using a tremie pipe. A ten-foot bentonite pellet annular seal will then be emplaced above the sand, opposite the overlying aquitard sediments and allowed to hydrate. The temporary well will be surged and pumped for several hours to remove the residual drilling mud. After field parameters have stabilized, a groundwater sample will be collected from a low flow tap on the submersible pump discharge for laboratory analysis. The sample will be analyzed on an expedited 24-hour turn around time for VOCs and para-Chlorobenzene Sulfonic Acid (pCBSA) using EPA Methods 8260 and 314.0.

Following the collection of the grab sample, the temporary casing and screen will be pulled from the exploratory boring and the exploratory boring will be completed and geophysically logged. If the grab sample concentrations are approximately equal to or less than the Maximum Contaminant Levels for individual VOCs, the exploratory boring will be completed as an observation well cluster. The injection well will then be constructed near the observation well cluster as planned.

If the grab sample concentration exceeds the approximate MCL for any individual VOC, the exploratory boring will be abandoned by pressure grouting and the injection well and observation well cluster will then be constructed at one of two alternate locations as indicated on Figure A-3.

6.1.3.3 Extraction, Injection, and Observation Well Boreholes

Information regarding borehole diameters and depths for proposed extraction and injection wells are provided (Table A-4). The boreholes for the Bellflower sand and Gage aquifer extraction and injection wells proposed as part of the pilot extraction and aquifer response testing program will be advanced using a mud-rotary drill rig. Upon completion the boring for exploratory borings EB-20,

EB-22, and EB-23 will be reamed and utilized for the installation of observation wells (Section 6.1.3.5).

Well design, drilling, lithologic logging, and well construction will be conducted under the supervision of a California Registered Geologist. Extraction and injection wells will be designed in accordance with the procedures outlined in the FSP, Department of Water Resources guidelines, and with applicable County of Los Angeles regulations.

6.1.3.4 Bellflower Sand and Gage Aquifer Extraction and Injection Wells

Bellflower sand and Gage aquifer injection and extraction wells will be drilled using mud rotary drilling methods. Preliminary construction details for the wells have been provided (Table A-4).

The proposed Bellflower sand and Gage aquifer extraction and injection wells will be installed with a conductor casing to prevent cross-contamination. The on-site hydrogeologist will closely monitor the mud density, viscosity, and sand content to assure proper hydrostatic head, thus minimizing the potential for cross contamination during drilling. An approximate 24-inch diameter pilot borehole will be drilled from land surface to the depth at which the steel conductor casing will be set (Figure A-6).

A string of 18-inch internal diameter steel conductor casing with will be set in the borehole. Steel centralizers will be spaced approximately every 40 feet in the annulus between the steel casing and the borehole. A grouting header will be attached to the steel casing to allow both grout and, when appropriate, the chase plug and water to be injected into the casing. The steel conductor casing will be grouted in place with neat cement. The neat cement will consist of a mixture of 5 to 6 gallons of water per 94-pound sack of Type I/II Portland cement with an accelerator or Type III Portland cement. Neat cement will be mixed using a cement/grout mixer. A volume of cement equal to or in excess of the annular volume will be pumped through conductor casing and into the annular space. After the cement has been pumped, a chase plug will be inserted. The plug will be pushed down the conductor casing using water, which will force the cement out of the casing and into the annular space. Once the plug reaches the bottom of the casing, all valves are closed

to maintain pressure and allow the cement to cure. The cement will be allowed to cure for at least 24 hours before drilling resumes.

A 17 5/8-inch diameter borehole will be drilled from the base of the steel conductor casing, through the plug and any cement in the bottom of the conductor casing, to the total depth of each extraction/injection well. After drilling the borehole to total depth, the final casing string will be installed.

Extraction wells will be constructed with 12-inch diameter 316L stainless steel blank well casing and 50 to 75 feet of 0.020- to 0.040-inch factory slotted wire-wrapped 316L stainless steel well screen, depending on the hydrogeologic unit and lithology encountered. Injection wells will be constructed with 12-inch diameter 316L stainless steel blank well casing and 50 to 75 feet of 0.020- to 0.040-inch factory slotted wire wrapped 316L stainless steel well screen, depending on the lithology encountered. The well screen will be placed throughout the water bearing portions of the Bellflower sand or Gage aquifer to ensure that VOCs that may migrate through the overlying aquitard will be detected. The proposed wells will be located in areas away from contaminant source areas and thus there are no issues related to chemical incompatibilities at these locations. Well casings will be fitted with stainless steel centralizers above and below the screened interval and at 40-foot intervals along blank casing. A filter pack consisting of Lonestar sand no finer than Lonestar No. 2/16 for 0.020-inch well screen or no finer than Lonestar No. 3 for 0.040-inch well screen, will be installed in the annulus between the borehole and the well screen from the total depth of the well to approximately 3 to 5 feet above the top of the screened interval. A very fine-grained sand (No. 60) grout filter may be emplaced in the annulus above the top of the filter pack. An approximate 2- to 3-foot thick bentonite seal will be emplaced in the annulus above the filter pack using granular bentonite or bentonite pellets. Sufficient time will be allowed for the bentonite to hydrate prior to grouting the remaining annulus. The annulus between the borehole/conductor casing and well casing will be grouted from the top of the bentonite seal to approximately 2 to 3 feet bls using bentonite grout. The bentonite grout will be tremied down the annular space of the borehole to ensure a competent annular seal. The well will be completed with a locking steel casing installed inside a steel and concrete utility vault or monument cover, depending on the well location, unless regulatory requirements or site conditions warrant alternate completion.

6.1.3.5 Observation Well Clusters

A total of 3 observation well clusters will be installed for the purposes of the aquifer response testing. The observation well clusters will be installed within approximately 50 feet of each extraction well to obtain data regarding the hydraulic response in the pumped aquifer, if necessary, and in the adjacent lower Bellflower aquitard. Preliminary well construction details for these wells have been provided (Table A-4).

Upon completion the boring for exploratory borings EB-20, EB-22, and EB-23 will be reamed and utilized for the installation of observation wells. The lower portion of the exploratory boring may need to be grouted depending on the depth of the screened interval of the deepest well. Prior to reaming the boring, the lower portion of the boring will be grouted with neat cement. The neat cement will consist of a mixture of 5 to 6 gallons of water per 94-pound sack of type I/II Portland cement with an accelerator or Type III Portland cement. Neat cement will be mixed using a grout mixer. The neat cement will be tremied to the bottom of the boring using a tremie pipe. The cement will be allowed to cure for at least 12 hours if an accelerator is used, otherwise, for a minimum of 24 hours.

The observation wells will be constructed with 2-inch ID schedule 80 PVC blank well casing and 0.020-inch factory slotted PVC well screen (Figure A-6). The monitor well completed in mud-rotary boreholes would include the use of filter pack consisting of Lonestar sand No. 2/16 for 0.020-inch well screen. The filter pack will be installed in the annulus between the borehole and the well screen from the total depth of the well to approximately 3 to 5 feet above the top of the screened interval. If necessary to settle the filter pack, monitor wells may be initially developed at this stage using conventional bailing or surging. A very fine-grained sand (No. 60) grout filter may be emplaced in the annulus above the top of the filter pack. An approximate 2- to 3-foot thick bentonite seal will be emplaced in the annulus above the filter pack using granular bentonite or bentonite pellets. Sufficient time will be allowed for the bentonite to hydrate prior to grouting the remaining annulus. The annulus between the borehole and well casing will be grouted from the top of the bentonite seal to approximately 2 to 3 feet bls or the bottom of the next screened interval, if appropriate, using bentonite grout. If multiple screened intervals are required, then the above well construction specifications will be repeated. The bentonite grout will be tremied down the annular space of the borehole to ensure a competent annular seal. The well will be completed

with a locking steel casing installed inside a steel and concrete utility vault or monument cover, depending on the monitor well location, unless regulatory requirements or site conditions warrant alternate completion.

6.1.4 Equipment Decontamination

All downhole drilling equipment will be steam cleaned prior to commencing drilling operations, and between drilling locations. All rinse waters will be stored and will be properly disposed.

All materials generated during drilling activities will be contained, labeled, and temporarily stored in 55-gallon drums, roll-off bins, and/or Baker-type portable tanks until an appropriate disposal option is determined. This includes all drill cuttings and wash and rinse water. SOPs for handling, storage, characterization, and disposal of investigation-generated waste have been prepared and are detailed in Section 6.6.

6.1.5 Documentation

A log of conditions encountered during drilling will be maintained by an experienced hydrogeologist. The log will include lithologic and hydrogeologic descriptions, as well as notations on drilling characteristics and conditions encountered during drilling. Field lithologic descriptions will be based on examination of undisturbed core samples. All logging will be supervised by a California Registered Geologist. Documentation will be compiled for each boring and will include the following:

- Lithologic log of drill cutting and core samples in a field notebook. Lithologic descriptions for soil will follow the USCS procedures (ASTM, 1984). A project-specific lithologic log form has been developed (Table A-5). In addition to lithologic data, the lithologic log form includes:

    - Project name;
    - Date(s);
    - Boring identifier;

- Boring location;
- Geologist's name;
- Drilling company's name;
- Drill rig operator's name;
- Drilling method;
- Weather conditions; and
- Space for remarks and comments.

- Field notes compiled by the on-site hydrogeologist during drilling operations.

- Photographs, if available.

Final logs will be prepared based on all available information including core samples and drill cuttings. A copy of the field notebook entries for monitor well borings will be maintained in the field for reference purposes. One set of the completed documentation forms will also be maintained in the field for reference purposes. The original set of notes and forms will be filed in the project files. Drill cutting samples and core samples will be retained until the lithologic log is finalized.

A well completion report will be compiled for each extraction, injection, and observation well. The completion report will include the following:

- Well completion report for wells and lithologic log form (Tables A-5 and A-6).

- Schematic well construction diagram illustrating as-built well construction details (Figure A-4).

6.1.6 Quality Assurance

Quality assurance during drilling, sampling, and logging of boreholes and during extraction, injection, and monitor well construction activities will be accomplished by following this SOP. In addition, the Project Manager will review all drilling documentation, including field notes, well

completion forms, and lithologic logs throughout drilling operations to ensure conformity with this SOP.

6.2 WELL DEVELOPMENT

Wells will be developed using a combination of conventional surging, bailing, swabbing, and pumping technologies, or using an alternative method approved by the Project Manager in consultation with EPA. Monitor well development will be conducted under the supervision of a California Registered Geologist.

SOPs for monitor well development are detailed in the following sections.

6.2.1 Equipment and/or Instrumentation

A well development rig will be used to conduct well development. Wells will be developed, as appropriate, using vented surge blocks, bailing, or pumping until the discharge water is clear and sand-free to the maximum extent practicable.

Turbidity will be monitored using a turbidity meter during well development. In addition, the parameters temperature, pH, and electrical conductivity (EC) will be measured during development using a field thermometer, pH meter, and EC meter, respectively.

6.2.2 Preparation

A qualified drilling contractor will be selected to develop monitor wells. A qualified contractor will have appropriate equipment capabilities, a California C-57 license, experience on similar projects, and documentation of health and safety training. This experience requirement shall apply both to the individual in the field and to the drilling company as a whole.

Prior to entering the field, authorized personnel will contact property owners and applicable agencies to obtain and comply with regulatory requirements regarding access, if required.

The following procedures will be performed in preparation for development of monitor wells:

- Identify the well(s) to be developed;
- Identify the established measuring point for each well;
- Measure the depth to water from the measuring point elevation for each well;
- Measure the total depth of casing of each well; and
- Record the depth to water, well depth, hardness of the bottom of the well, date, and time of measurement on a field observation sheet.

6.2.3 Standard Operating Procedures

Extraction, injection and observation wells will be developed within approximately 2 weeks of well completion. Wells will first be bailed to remove sand and fines that may have accumulated in the bottom of the well. Wells will then be surged and pumped until the discharge is clear and sand-free. Water quality parameters including temperature, pH, EC, and turbidity will be monitored. These parameters will not be used as performance criteria. Calibration forms for EC and pH meters are included in Tables A-12 and A-13. Development pumping of wells will be conducted for a period of two to eight hours or until turbidity is reduced to 5 Nephelometric Turbidity Unit (NTUs), whichever occurs first. Development procedures may be modified due to conditions encountered at the site.

The total volume of water purged, water quality parameters measured, sand content, water levels, and the development methods used will be recorded in the field notebook.

6.2.4 Equipment Decontamination

All downhole equipment will be steam cleaned and maintained in a clean condition prior to commencing development operations at each well location. Water generated during decontamination procedures will be handled as detailed in Section 6.6 of this FSP.

6.2.5 Documentation

A development report will be compiled for each well. The development report will include the following:

- Well development report form for wells (Table A-6).
- Field notes compiled by the on-site hydrogeologist during development operations.

6.2.6 Quality Assurance

QA during monitor well development activities will be accomplished by following this SOP. In addition, the Project Manager will review all field notes and well completion and development forms to ensure conformity with this SOP.

6.3 PILOT EXTRACTION AND AQUIFER RESPONSE TESTING

Aquifer response tests will be conducted to evaluate the hydraulic parameters of the hydrogeologic unit in selected monitor wells during the pilot extraction testing. Groundwater recovery will be accomplished utilizing a submersible, electric pump. Water level drawdown, recovery, and well discharge rates will be monitored throughout the pilot extraction test. The water quality parameters temperature, EC, dissolved oxygen (DO), oxidation-reduction potential (ORP), and pH of discharged water will be monitored periodically.

6.3.1 Equipment and/or Instrumentation

Equipment used during aquifer testing includes a submersible, electric groundwater recovery pump and discharge and water level measuring devices. A calibrated in-line flow meter will be used to measure discharge rates. Water levels will be measured with calibrated water level indicators, and synchronized watches will be used to note the time of each measurement.

Given the duration of the aquifer test, electricity for the aquifer test pump will be provided by an internally regulated 60-kilowatt engine driven generator. Since testing is proposed at flows ranging from 150 to 300 gpm, it is likely that more than one pump will be utilized (Figure 15). The aquifer test pumps will be constructed of stainless steel, and have discharge pressures of up to 270 feet of water at 300 gpm, and a shutoff pressure of 580 feet of water or 250 pounds per square inch gage (psig). The aquifer test pump will have a 30 horsepower, 480 volt, three phase motor and will be installed in the extraction wells at depths up to 145 feet bls. The aquifer test pump will be installed in the well using 3-inch nominal galvanized carbon steel pipe. Exact specifications will be finalized prior to initiation of the test.

Pressure transducers and electronic data loggers will also be used to record water levels. Solinst® Levelogger™ integrated transducers / data loggers or similar instruments can be pre-programmed and set entirely within the well using a suspension cable, eliminating the need for a data logger unit at the surface.

6.3.2 Preparation

The following procedures will be performed during preparation for the pilot extraction and aquifer response tests.

- Extraction Tests:
    - Measure the total depth of the well to be tested.
    - Familiarize all personnel with the aquifer test procedures.

- Install submersible test pump in the well at the depth determined by the on-site hydrogeologist. Install a check valve in the discharge pipe above the pump to prevent return flow after pump shutoff.

- Install a gate valve in the pump discharge line. Discharge will be controlled to maintain a constant flowrate.

- Provide a reliable portable power supply if a standard power source will not be available.

- Prepare equipment for discharge measurement. A calibrated in-line flow meter will be used to monitor discharge from wells. Calibrate the water level sounder (Section 6.4.2) (Table A-7).

- Assemble all necessary forms and graph paper.

- Prior to the start of pumping, measure static water level in the pumping and observation wells, and record measurement time on the appropriate water level record sheet (Table A-8). If the well has been pumped for development or pump performance purposes, water levels must regain pre-pumping levels prior to beginning the test.

- Install pressure transducers and electric data loggers and recorders in selected observation wells prior to initial testing.

- Perform a limited pumping pretest to determine appropriate valve settings, to test for leaks in the discharge system.

- Calibrate instruments for the measurement of pH, EC, DO, ORP, and temperature, if appropriate.

- Synchronize all personnel's watches and chronometers, then start the pump.

- Injection Tests:
    - Measure the total depth of the well to be tested.
    - Familiarize all personnel with the aquifer test procedures.
    - Install injection piping in the well at the depth determined by the on-site hydrogeologist.
    - Install a gate valve in the injection line. Injection will be controlled to maintain a constant flow rate.
    - Assemble all necessary forms and graph paper.
    - Prior to the start of injection, measure static water level in the injection and observation wells, and record measurement time on the appropriate water level record sheet (Table A-8).
    - Install pressure transducers and electric data loggers and recorders in selected observation wells prior to initial testing.
    - Perform a limited injection pretest to determine appropriate valve settings, and to test for leaks in the injection system.
    - Calibrate instruments for the measurement of pH, EC, DO, ORP, and temperature, if appropriate.
- Synchronize all personnel's watches and chronometers, then start the injection of water.

6.3.3 Standard Operating Procedures

The following procedures will be used to conduct the aquifer test.

- Extraction Tests:

  - Start pump and maintain a constant discharge. Constant discharge aquifer tests will be conducted for a pumping period of 5 days and a recovery period of up to 5 days.

  - In the pumping well and observation wells, water levels will be measured automatically by the transducer / data logger at five-minute intervals for the duration of the test. Manual water level measurement of the pumping well and observation wells will be conducted periodically. These measurements are used as a check on the response of the transducer. Record measurements on water level record sheets with corresponding measurement time (Table A-8).

  - Adjust valve as needed to maintain constant discharge. Monitor treatment system parameters (Table A-9).

  - After the pump is turned off, begin water level recovery measurements according to the schedule indicated above. Record measurements and measurement times on the water level record sheets (Table A-8).

  - If the on-site hydrogeologist determines that recovery has reached approximate pre-pumping water levels before 5 days, the test may be terminated.

- Injection Test:

  - Start injection of water and maintain a constant injection rate. Injection tests will be conducted for an injection period of 5 days and a recovery period of up to 5 days.

- In the injection well and observation wells, water levels will be measured automatically by the transducer / data logger at 5-minute intervals for the duration of the test. Manual water level measurement of the injection well and observation wells will be conducted periodically. These measurements are used as a check on the response of the transducer. Record measurements on water level record sheets with corresponding measurement time (Table A-8).

- Adjust valve as needed to maintain a constant rate of injection. Monitor injection system parameters (Table A-9).

- After the injection of water is stopped, begin water level recovery measurements according to the schedule indicated above. Record measurements and measurement times on the water level record sheets (Table A-8).

- If the on-site hydrogeologist determines that recovery has reached approximate pre-injection water levels before 5 days, the test may be terminated.

6.3.4 Equipment Decontamination

Nondedicated downhole equipment will be decontaminated between monitor wells to be tested by steam cleaning or by using a nonphosphate detergent wash, followed by a tap water rinse and a final distilled water rinse. Water generated during decontamination procedures will be containerized and stored in an on-property storage tank.

6.3.5 Documentation

Observations made during pilot extraction and aquifer response testing activities will be recorded on water level record sheets and on the Operation and Monitoring Log (Tables A-8 and A-9). The water level record sheets and field plots of aquifer test data will be compiled for each monitor well tested. Electronic data collected by pressure transducers will be downloaded onto a portable computer and processed upon returning from the field. Electronic data will be stored, and hard

copy plots of transducer readings will be retained in the project file with other aquifer testing field documentation.

6.3.6 Quality Assurance

Quality assurance objectives for aquifer test data will be satisfied by following the procedures described in this section.

Upon return to the office after the field event, all mathematical computations, field data plots, and aquifer parameter computations will be checked for correctness. The Project Manager will assess the applicability of the selected analytical method to the particular data set.

6.4 WATER LEVEL MEASUREMENT

Water levels will be measured using calibrated two-wire electric water level sounders. Depth to water will be measured from surveyed reference points. Water level elevations will be calculated as the difference between the surveyed reference point elevation and the depth to water for each well. Water level data will be recorded on preprinted water level data sheets. Water level measuring equipment will be decontaminated between measuring of wells.

Standard operating procedures for water level monitoring are detailed in the following sections. Pilot extraction/injection test field measurement protocol is summarized in Section 6.3 and on Table A-10.

6.4.1 Equipment and/or Instrumentation

If at all possible, a flat tape sounder will be used to measure water levels. The QED® or Solinst® flat tape sounder is equipped with a plastic, laminated, two-wire cable with a weighted electrode attached to the end of the cable. The cable is graduated in markings every 0.01 foot or 0.02 foot, depending on the model.

If required for access, an electrical sounder equipped with a narrower probe may be used for water level measurement. Sounders manufactured by Fisher or Slope Indicator Company may be used at wells with small sounding ports. These sounders function in a similar manner to flat-tape sounders, although some types require a measuring tape to interpolate between 10-foot or 1-foot gradations printed on the wire.

In the event that floating fuel product is observed in a well, product levels and water levels will be measured using a Keck or similar interface probe. Interface probes function in a similar manner to flat-tape sounders, but use a two-tone signal to indicate whether the probe has encountered water or light non-aqueous phase liquid (LNAPL).

6.4.2 Preparation

Water level sounders, including QED® or Solinst® flat tape sounders, will be calibrated on-site at the beginning of each water level round by comparing a water level measured with the sounder against a water level measured with a steel tape or other water level sounder (Table A-7). Additionally, the first ten feet of the sounder will be verified using a steel measuring tape.

The following procedures will be performed in preparation for measuring water levels in wells:

- Identify the wells to be measured;
- Identify the established measuring point for each well. Measuring point elevations for existing wells were determined by a licensed land surveyor. If new wells are installed at the Site, measuring point elevations will be determined by a licensed surveyor. The same measuring point should be used for all water level measurements at each well;
- Review the amount of water level change from the previous water level measurements for each well; and

- Decontaminate the water level sounder by using a non-phosphate detergent wash, followed by a tap water rinse and a distilled water rinse.

6.4.3 Standard Operating Procedures

The following detailed procedures will be used for measuring water levels in wells:

- Measure the depth to water from the measuring point elevation twice for each well. The variation between the two consecutive measurements must be no more than 0.02 foot.

- For the QED®, Solinst® or Slope Indicator® sounder, mark the water level and read the measurement from the marking on the flat tape or sounder wire.

- For the Fisher® sounder, measure the distance from the held mark at the measuring point to the nearest footage mark on the electrical sounder wire using a steel tape graduated in hundredths of feet.

- For the Keck or similar interface probe, measure both the depth to LNAPL and the depth to water from the measuring point elevation twice for each well. The variation between the two consecutive measurements must be no more than 0.02 foot. Mark the LNAPL level and water level and read the measurement from the marking on the interface probe.

- Record the depth to water, the depth to DNAPL or LNAPL, if present, date, and time of measurement on the static water level data sheet (Table A-8). Examine previously measured water levels for the well, if available. If the difference between the current water level measurement and the previous water level measurement is greater than approximately 2.0 feet, recheck the current measurement. The field personnel will indicate the method(s) of water level measurement and any rechecked water levels on the water level measurement form.

- Remove water level measurement equipment and decontaminate according to procedures outlined below.

- Upon completion of a water level measurement, the water level data should be compared to the previous water level data, if available, to evaluate the potential for any anomalies. For wells with anomalous results, for example a well that does not follow the seasonal trend, the well must be measured again. The newly measured water level must be entered into the field notebook.

6.4.4 Equipment Decontamination

Water level sounders will be decontaminated between monitor wells by using a non-phosphate detergent wash, followed by a tap water rinse and a final distilled water rinse. Interface probes will be decontaminated between monitor wells using a non-phosphate detergent wash, followed by a tap water rinse and a final distilled water rinse.

6.4.5 Documentation

All water level measurements will be recorded on a static water level data sheet (Table A-8). The static water level data sheet includes the following information:

- Well identifier;
- Date;
- Time;
- Method of measurement;
- Sounder identifier;
- Depth to water from the reference point in the nearest 0.01 foot;
- Reference point elevation, if available;
- Previous depth to water in feet;
- Change in water level between the current sampling round and the previous round;
- Comments; and
- Initials of the sampling team.

Calibration of the water level sounders will be documented on a separate form (Table A-7). The water level calibration form includes the following information:

- Date;
- Time;
- Water level sounder type;
- Water level sounder number;
- Calibration method;
- Initials of the person performing the calibration; and
- Remarks.

For wells where floating product is observed, equivalent water levels will be calculated based on the measured thickness and estimated specific gravity of the free product in each of these wells using the following formula:

$$E_{wt} = E_{pw} + (T_p * G_p)$$

Where E_{wt} is the equivalent water table elevation in feet msl, E_{pw} is the elevation of the product-water interface in feet msl, T_p is the thickness of floating product in feet, and G_p is the specific gravity of the floating product.

6.4.6 Quality Assurance

QA of water level measurement data will be accomplished by following the procedures described in this SOP (Table A-7). Calibration information will be entered onto a calibration form. In addition, the following QA procedures for water level measurements will be implemented:

- Measure water levels with a calibrated water level sounder.

- At each location and/or time interval, measure water levels a minimum of twice during routine water level measurement activities. Measure water levels until two consecutive

measurements are obtained that have a difference of less than 0.02 foot. Record the measurement on the static water level data sheet (Table A-8). Measure and record water levels to the nearest 0.01 foot.

- Compare measurement data to previous measurements obtained at each well. For variations from previous measurements greater than 2.0 feet or for data that cannot be explained by observed trends at the Site, repeat the measurements. If possible, use an alternate instrument to verify the accuracy of the data. Indicate the method(s) of water level measurement, the water level sounder serial number, and any rechecked water levels in the comments section on the static water level data sheet (Table A-8).

6.5 GROUNDWATER SAMPLE COLLECTION

The following section describes methods and procedures for collecting groundwater samples from wells at and in the vicinity of the Site.

Representative groundwater samples will be collected from wells for chemical analysis. At a minimum, the field parameters temperature, pH, and EC of the purge water will be measured to ensure that they have stabilized prior to sampling. In addition, DO, ORP, and turbidity will be measured in the field and recorded in the field notebook. Methods and procedures for collecting groundwater samples are detailed in the following sections.

6.5.1 Equipment and/or Instrumentation

Well purging equipment for the newly installed wells will consist of non-dedicated stainless steel Grundfos® Redi-Flo 2 electric submersible pumps with dedicated tubing, dedicated electrical submersible pumps, air lift pumps, or bladder pumps depending on equipment installed in each well. Groundwater samples will be collected through dedicated discharge tubing of the non-dedicated Grundfos® Redi-Flo 2 pumps or dedicated electrical submersible or bladder pumps. The Grundfos® Redi-Flo 2 environmental pump is constructed of stainless steel and teflon components and is capable of discharging at variable rates of up to approximately 7 gallons per minute (gpm). Purge pumps will be set to a depth just above the top of the screened interval.

A variable speed controller will be used to reduce the discharge rate prior to collecting samples. Groundwater samples from the Grundfos® Redi-Flo 2 pump will be collected at a flowrate of approximately 0.03 gpm.

Purge water samples will be directed to a flow-through cell for real time measurement of field parameters. Field equipment consists of a conductivity meter to measure EC, a pH meter to measure pH, and a field thermometer to measure temperature. If applicable, DO will be measured by a DO meter, ORP will be measured by an ORP meter, and turbidity will be measured by a turbidity meter. Some of these measurements are available as functions of an integrated instrument or "multi-meter".

The types and volumes of sample containers used for groundwater sampling have been summarized (Table A-2).

6.5.2 Preparation

Prior to commencing with a sampling event, the following information will be determined and reviewed with all field personnel:

- Objective of the monitoring event;
- Analytical schedule;
- Water quality parameters to be measured;
- Required frequency of measurement;
- Laboratory selected for sample analysis;
- Appropriate methodologies to accomplish objective; and
- QC samples required accomplishing the objective.

The following procedures will be used during preparation for groundwater sample collection:

- Review project objectives; sampling location; sampling procedures; preservation; special handling requirements; packaging; shipping; analytical parameters and detection limits; and sampling schedule with all personnel;

- Review the health and safety procedures with field personnel;
- Follow site access procedures, if applicable;
- Inform the laboratory of expected sample shipment;
- Obtain the appropriate sample bottles from the laboratory;
- Obtain from the laboratory trip blank water vials containing organic-free water for VOC analyses at a rate of two vials for each ice chest containing samples for VOC analysis. Trip blanks will be prepared by the laboratory using organic-free water. The purpose of the trip blanks is to identify potential contamination associated with container preparation and sample transport; and
- Determine the volume of water to be purged from the well prior to sampling.

6.5.3 Standard Operating Procedures

The following sections provide standard operating procedures for well purging, water quality parameter measurement, and groundwater sample collection during groundwater monitoring activities.

6.5.3.1 Detailed Procedures for Well Purging

The following detailed procedures will be used for purging wells prior to the collection of groundwater samples. Consistent with previous sampling events conducted at the Site, the approach taken for purging wells at the Site for routine groundwater monitoring will be the purging of three casing volumes. The use of this purging volume has resulted in parameters being stable at the time of sample collection and has allowed reproducible samples to be collected.

- Measure depth to water in well to be sampled (Section 6.4).

- Determine the volume of water to be purged from the well. One casing volume is determined by multiplying the volume of water in one foot of monitor well casing by the distance between the bottom of the monitor well and the water level measured in the monitor well.

- For routine groundwater sampling, purge the monitor well until at least three casing volumes have been removed and the field parameter measurements for pH, EC, and temperature have stabilized, provided that the well yields sufficient groundwater to remove three casing volumes within approximately 90 minutes. Detailed procedures for water quality parameter measurement have been provided (Section 6.5.3.2). In the event that a monitor well yield is insufficient, one casing volume will be purged and a sample collected after the well recovers to approximately 80 percent of its static condition or within 2 hours of completing purging. Measure the water quality parameters and determine whether parameters have stabilized in accordance with the procedures outlined in Section 6.5.3.2.

- Record the following information on the field data sheet (Table A-15):

  - Static depth to groundwater;
  - Time that pumping is started;
  - Field parameter measurements for each casing volume;
  - Field parameter measurements at time of sampling;
  - Physical characteristics of the water including color, odor, turbidity, etc.;
  - Total gallons removed at end of purging; and
  - Water level at end of purging.

- Handle purge water as described below (Section 6.6).

6.5.3.2 Detailed Procedures for Water Quality Parameter Measurements

The following detailed procedures will be used in conjunction with routine collection of groundwater samples.

Prior to collecting groundwater samples for laboratory analysis, the water quality parameters EC, pH, and temperature will be measured in water samples at each sampling location using a conductivity meter, a pH meter, and a field thermometer, respectively. In addition, DO, ORP, and turbidity will be measured using the appropriate meters.

The probes on the conductivity meter, thermometer, and pH meter will be thoroughly rinsed with distilled water prior to use at each well. At a minimum, the pH meter will be calibrated in pH 4 and pH 10 buffered solutions prior to commencing field work each day. These pH values are expected to bracket the range of pH in groundwater samples collected from monitor wells at the Site. The conductivity meter will be calibrated prior to commencing field work each day. The conductivity meter will be calibrated using standard calibration solutions selected to bracket the range of conductivity expected in groundwater samples collected from monitor wells at the Site. The manufacturers' instructions for use of the instruments will be followed. The field thermometer will be rinsed with distilled water prior to use at each well. The accuracy of the field thermometer will be determined by checking the measured reading against other thermometers. The DO meter will be calibrated in air prior to commencing field work each day. Calibration of the EC, pH, and DO meters will be documented on separate forms (Tables A-12 through A-14). If a photometer-type turbidity meter is used, it will be calibrated to 0 NTUs and 10 NTUs prior to commencing field work each day, and zeroed to 0 NTUs prior to each reading. Depending on the type of meter used, calibration to the parameters EC, pH, DO, and turbidity can be accomplished automatically using the auto-calibration solution provided by the meter's manufacturer. The ORP meter cannot be calibrated in the field.

Parameters will be measured directly at the well discharge point using a flow-through cell. The parameters EC, pH, and temperature at each sampling location will be measured as follows:

- Rinse the flow-through cell with distilled water prior to use at each well. Direct sample water from the pump discharge through the flow-through cell.

- Immediately submerge the probes and thermometer in the flow-through cell and record measurements after they have stabilized.

- Record all field measurements in the field notebook.

- Repeat this sequence for a minimum of once for each casing volume until the difference in subsequent measurements of EC, pH, and temperature are less than 10 percent.

- Periodic measurements of EC, pH, and temperature for pumped wells will be recorded on the groundwater sampling information form (Table A-15).

- In addition, DO, ORP, and turbidity will be measured using the same procedure as that described above.

QA of water quality parameter measurements will be accomplished by following the procedures described in this SOP and by following the equipment manufacturers' operating instructions (Table A-11). Temperature, pH, and EC will be measured during each groundwater-sampling event. Prior to measuring water quality parameters, field personnel will verify that the instruments are properly calibrated according to procedures specified by the manufacturer. Calibration documentation for each instrument will be maintained for reference purposes (Tables A-12 through A-14). Reference solutions for pH and EC will be obtained and used to properly calibrate the instrument. The calibration of the pH meter and conductivity meter will be checked prior to the start of each day.

6.5.3.3 Detailed Procedures for Groundwater Sample Collection

The following detailed procedures will be used for the collection of groundwater samples.

- After purging is complete, collect water samples for laboratory analysis.

- Record the following information on the field data sheet:

- Time of sample collection;
- Number of containers collected and analyses to be performed;
- Total gallons purged at time of sampling; and
- Depth to water at the time of sampling.

- Decrease flowrate from pump.

- Collect water samples in appropriate sample containers from the pump discharge (Table A-2).

- Include one trip blank sample containing organic-free water for VOC analysis to accompany each ice chest shipped each day for these analyses. The trip blanks will be prepared by the primary analytical laboratory, using organic-free water.

- Collect duplicate groundwater samples for VOCs and pCBSA at a rate representing ten percent of the number of original groundwater samples.

- Collect laboratory split groundwater samples for VOCs and pCBSA at a rate representing ten percent of the number of original groundwater samples.

- Prepare split samples for EPA or other agencies during groundwater sampling, if required, by alternately filling agency and H+A sample containers in sequential order for each parameter until all containers are filled.

- Handle QA water samples in a manner identical to other water samples.

- Attach labels to sample containers immediately after samples are collected. Affix custody seals to each sample container following collection of samples.

- Record all pertinent data concerning each sample on the groundwater sampling information field data form (Table A-15).

- Record all pertinent data concerning blank samples on the appropriate field data log form (Table A-16).

- Record all pertinent data concerning duplicate samples on the appropriate field data log form (Table A-17).

- Record all pertinent data concerning laboratory split samples on the appropriate field data log form (Table A-18).

- Complete chain-of-custody record at each sample location prior to sampling at the next well.

- Finalize chain-of-custody record (Table A-19) at the completion of each sampling day.

- Package, store, and transport the samples to the laboratory at the conclusion of each sampling day. The ice chests used to store samples for transmittal to the laboratory will be sealed closed with filament tape and at least two custody seals will be placed across the contact between the ice chest lid and the ice chest, on sides without hinges. The custody seals will indicate whether any tampering occurred during handling and shipment. Samples will be delivered to the laboratories within approximately 24 hours of sample collection.

6.5.4 Sample Containers, Preservation, and Transmittal

A list of the types and volumes of sample containers used for groundwater sampling has been prepared (Table A-2). The laboratory will prepare the sampling containers for each analysis in accordance with the applicable EPA method.

The primary laboratory designated for analysis of groundwater samples is Del Mar Analytical, Irvine, California. The designated split laboratory is West Coast Analytical Services, Inc., Santa Fe Springs, California.

Upon collection, all samples will be sealed with custody seals, labeled, and stored on ice in ice chests until received by the laboratory. Sample shipments will contain completed chain-of-custody records stored in re-sealable plastic bags for shipment to the laboratory (Table A-19). Each ice chest containing samples will be clearly labeled and sealed to prevent tampering.

6.5.5 Equipment Decontamination

Groundwater samples will be collected from wells using non-dedicated pumps with dedicated tubing. Groundwater sampling using dedicated pumps will not require equipment decontamination. Non-dedicated pumps used for well purging will be decontaminated.

Non-dedicated sampling equipment will be decontaminated between wells to be sampled during the monitoring round by using a non-phosphate detergent wash, followed by a tap water rinse and a final distilled water rinse. Water generated during decontamination procedures will be containerized and stored in an on-property storage tank.

6.5.6 Documentation

Documentation required for groundwater sample collection includes field data forms, sample labels, custody seals, and chain-of-custody records.

A record of sample identification numbers will be maintained on standardized field data forms (Tables A-19 and A-20). Additional field data include a record of significant events, observations, measurements, personnel, site conditions, sampling procedures, measurement procedures, and calibration records.

All field data entries in the field notebook will be signed, dated, and kept as a permanent record. Erroneous entries will be corrected by crossing a line through the error and entering the correct information. Corrections will be initialed by field personnel making the re-entry.

Sample identification documents will be prepared so that sample identification and chain-of-custody records are maintained and sample disposition is controlled. The following sample identification documents are to be used:

- Sample identification labels (Table A-20); and
- Chain-of-custody records (Table A-19).

Standard sample identification labels and chain-of-custody records will be used to record all information. Sample documentation forms and labels will be completed with waterproof ink. The sample documentation forms will accompany the samples to the laboratory. Copies of the sample documentation forms will be retained by the samplers and sent directly to the Project Manager.

Preprinted adhesive sample labels will be secured to the sample containers by field personnel. The following information will be recorded on the sample label:

- Sample location/identifier;
- Depth at which sample was collected, if applicable;
- Date and time sample was collected;
- Analyses to be performed;
- Preservation instructions;
- Project number;
- Sampler's initials;
- Any other pertinent information; and
- Any special instructions to laboratory personnel.

Official custody of samples will be maintained and documented from the time of sample collection until the validation of analytical results. The chain-of-custody record is the document that records the transfer of sample custody. The chain-of-custody record also serves to cross-reference the sample identifier with the sample identifier assigned by the laboratory. The chain-of-custody record includes the following information:

- Sample location/identifier;
- Project number;

- Sampling date;
- Sampling personnel;
- Shipping method;
- Sample description;
- Sample volume;
- Number of containers;
- Sample destination;
- Preservatives used;
- Analyses to be performed;
- Special handling and reporting procedures; and
- The identity of personnel relinquishing and accepting custody of the samples.

The sampling personnel will be responsible for the samples and will sign the chain-of-custody record to document sample transfer or transport. Samples will be packaged in sealed containers for transport and dispatched to the appropriate laboratory for analysis with a separate chain-of-custody record and sample transmittal letter accompanying each shipment. During transport, samples will be accompanied by the chain-of-custody record and sample transmittal letter.

After receipt at the laboratory, laboratory custody procedures apply. It is the laboratory's responsibility to acknowledge receipt of samples and verify that the containers have not been opened or damaged. It is also the laboratory's responsibility to maintain custody and sample tracking records throughout sample preparation and analysis. A copy of the chain-of-custody record is then sent to the Project Manager.

6.5.7 Quality Assurance

QA for groundwater samples collected will be accomplished by following the procedures described in this SOP and by monitoring laboratory QA procedures. In addition, the following field quality control methods will be implemented during sample collection:

- Include one trip blank sample containing organic-free water for VOC analyses to accompany each ice chest shipped each day for these analyses. The trip blanks will be prepared by the analytical laboratory using organic-free water. The purpose of the trip blank is to identify possible contamination associated with container preparation and sample transport.

- Collect duplicate groundwater samples at a rate representing ten percent of the number of original groundwater samples for VOC and pCBSA analysis.

- Collect laboratory split groundwater samples at a rate representing ten percent of the number of original groundwater samples for VOC and pCBSA analysis.

- Prepare split samples for EPA or other agencies during groundwater sampling, if required, by alternately filling agency and H+A sample containers in sequential order for each parameter until all containers are filled.

- Identify blank samples in the same manner as all other samples. Identifiers will be determined prior to the sampling round and will be indicated to field sampling personnel prior to the start of sampling activities.

- Additional QA/QC samples, including field blanks and/or equipment rinsate blanks, may be collected at the discretion of the Project Manager.

Prior to the start of a sampling round, the Project Manager will determine the sampling locations for split sample collection, field blank preparation, and duplicate sample collection, if required. Additionally, the Project Manager will specify labeling procedures for these samples. This information will be contained in the field notebooks issued to field sampling personnel prior to the start of sampling activities.

6.6 HANDLING, STORAGE, CHARACTERIZATION, AND DISPOSAL OF INVESTIGATION-DERIVED WASTES

SOPs have been developed for the handling, storage, characterization, and disposal of wastes generated during field work activities. Investigation-derived wastes will consist of soil cuttings, personal protective equipment (PPE), decontamination and well purge water, and general trash.

6.6.1 Water

Water will be generated during decontamination, groundwater sampling, and well development activities. Water generated during well development and groundwater sampling will be contained at the wellhead in drums or a water trailer and transferred to the wastewater storage tanks. Large capacity aboveground wastewater storage tanks will be used to contain decontamination, groundwater sampling, and well development water generated during this investigation.

A central staging area for decontamination of drilling and sampling equipment will be established at the Property. Water generated during decontamination procedures will be containerized and transferred to the wastewater storage tanks.

Extraction, decontamination, and well purge water will be stored separately in Baker tanks or Department of Transportation (DOT) 17H 55-gallon drums. Each container will be clearly marked to indicate the waste source and contents. Prior to disposal, the waste disposal contractor will label containers with appropriate DOT identification and classification information.

The waste disposal contractor will use data generated during initial sampling of the wells to determine the appropriate disposal of the extraction, purge, and decontamination water. If necessary, the waste disposal contractor or H+A field staff will sample the tanks in order to obtain the necessary data for waste profiling and disposal. After reviewing the results of the waste profiling, disposal will be arranged.

6.6.2 Soil

Drill cuttings will be generated during well drilling. Drill cuttings will be stored in 55-gallon drums or roll off bins at each well location. Each container will be clearly labeled with the well identifier, date, and depth interval for drill cuttings contained therein.

6.6.3 Characterization

Waste characterization by the waste handling contractor may include sample collection and laboratory analysis of drill cuttings generated during field activities. Characterization of drill cuttings will be required to determine appropriate waste disposal. Drill cutting samples will be analyzed for VOCs, DDT, and pCBSA.

6.6.4 Disposal

Drill cuttings generated during drilling and well installation activities will be stored in storage containers pending evaluation of disposal options. Montrose will be responsible for disposal of all wastes generated during field activities.

Water generated during decontamination procedures will be containerized and stored at the Property. Spent health and safety equipment will be containerized and stored at the Property. Purge water from monitor wells will be contained at the wellhead and transported to a storage tank at the Property. Purge water and decontamination water will be sent off-site for treatment. All waste will be disposed at an EPA-approved waste disposal facility. Wastes classified as hazardous waste will be disposed offsite by the waste disposal subcontractor within 90 days of collection. The waste disposal subcontractor will provide services including, but not limited to, sampling and profiling; handling and manifesting; and transportation and disposal of wastes. The waste disposal contractor or H+A field staff will collect waste samples for analysis and waste profiling as soon as practicable. After reviewing the results of the profiling, disposal will be arranged.

PPE and other disposal equipment used at locations where Level D site safety protocols are required will be bagged and characterized as non-hazardous and disposed in industrial trash

dumpsters. Heavily soiled PPE will be bagged and stored separately pending review of the analytical results from sampling. If the analytical results indicate that the wastes generated at the Site were hazardous, the heavily soiled PPE will be characterized and disposed as hazardous waste. Used PPE worn at locations requiring a higher level of personal protection than Level D will be characterized as hazardous waste. No sampling or analysis of this PPE will be performed.

7.0 HEALTH AND SAFETY

All on-site field work will be conducted in accordance with the Site-specific Health and Safety Plan (H+A, 2003). The Site-specific Health and Safety Plan will be included in the field version of the FSP. A hospital route map has been prepared (Figure A-7).

On-site field personnel will have 40-Hour Hazardous Waste Operations and Emergency Response training and current 8-Hour Refresher Training in accordance with 29 CFR 1910.120. Field personnel will also have certification of current respirator fit-testing and first aid training.

A number of precautions will be taken to minimize the risk to both the public and also equipment operators. Traffic control measures including the use of flag men, road construction signage, and delineators will be utilized where traffic controls are required. Temporary fencing will be set around each drilling location and will be utilized, as needed, during potable water injection and groundwater recovery activities. The drill rig and other drilling equipment will be locked and secured each night prior to departing the site for the evening. Equipment utilized during the injection and recovery tests will be under 24-hour observation by equipment operators. Additionally, a security guard will remain at the drilling and test sites overnight. In addition, local law enforcement agencies will be asked to monitor the drilling and testing sites.

8.0 REPORTING AND DATA MANAGEMENT

After completion of field activities, a report will be prepared and submitted to EPA. Information to be provided as part of this report is specified in the UAO SOW Section 4. This report will be provided to EPA 20 business days after completion of the pilot extraction and aquifer response testing.

Data collected during this sampling round including water level data, parameter data collected during purging, and laboratory analytical data will be entered into the project database. Data will be managed in accordance with the Data Management Plan (H+A, 2004a).

9.0 REFERENCES CITED

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TABLE A-1

DATA USES AND LIMITATIONS

PARAMETER	USES	LIMITATIONS
Water Level Measurements	• Preparation of water level elevation contour maps. • Determination of direction of groundwater flow • Determination of horizontal and vertical hydraulic gradients. • Tracking of water levels over time at discrete point in the hydrostratigraphic unit (hydrograph). • Tracking changes in water table and effect on saturated thickness. • Calculation of volume of groundwater required for purging prior to groundwater sampling. • Evaluation of aquifer response	• Precision of water level measurement is 0.01 foot. • Measured water level only representative of hydrostratigraphic unit screened at time of measurement. • Preparation of contour maps requires that water level elevations be interpolated between measurement locations.
Groundwater Samples	• Monitor concentrations of analyzed compounds dissolved in groundwater. • Preparation of compound concentration contour maps. • Tracking of groundwater quality over time at discrete point in the hydrostratigraphic unit (hydrograph).	• Precision of each analysis varies by compound, analytical method, and laboratory capabilities. • Each analytical result only representative of location of well, hydrostratigraphic unit, and time of sampling. • Preparation of contour maps requires that groundwater concentrations be interpolated between sample collection locations.

TABLE A-1

DATA USES AND LIMITATIONS

PARAMETER	USES	LIMITATIONS
Lithology	• Preparation of lithologic logs • Preparation of cross sections • Evaluate change in thickness of geologic units	• Precision of depth measurements is approximately 1 foot • Core loss will require extrapolation between adjacent samples with recovery • Preparation of cross section requires geologic unit depths be interpolated between wells.

TABLE A-2

HANDLING PROTOCOL FOR GROUNDWATER SAMPLES

ANALYTE	EPA METHOD	SAMPLE CONTAINER	OTHER REQUIREMENTS	PRESERVATION METHOD	MAXIMUM HOLDING TIME
VOLATILE ORGANIC COMPOUNDS	8260B	3 X 40 ml VOA VIAL, TEFLON LINED SEPTUM	VIALS FILLED COMPLETELY, NO HEAD SPACE	HCl, COOL TO 4°C	14 DAYS
Additional requested parameters:					
Di-isoproply ether (DIPE)					
Ethanol					
Methyl tertiary butyl ether (MTBE)					
Ethyl tertiary butyl ether (ETBE)					
Tertiary amyl methyl ether (TAME)					
Tertiary butyl alchohol (TBA)					
DDT, BHC, and Other Organochlorine Pesticides	8081A	2 X 1 LITER AMBER GLASS BOTTLE	BOTTLE FILLED TO NECK	UNPRESERVED, COOL TO 4°C	7 DAYS TO EXTRACT 40 DAYS TO ANALYZE
POLYCHLORINATED BYPHENALS	8082/608	2 X 1 LITER AMBER GLASS BOTTLE	BOTTLE FILLED TO NECK	UNPRESERVED, COOL TO 4°C	
SEMI-VOLATILE ORGANIC COMPOUNDS	8270	2 X 1 LITER AMBER GLASS BOTTLE	BOTTLE FILLED TO NECK	UNPRESERVED, COOL TO 4°C	
PARACHLOROBENZENE SULFONIC ACID (pCBSA)	Modified 314 0	1 X 500 ML PLASTIC	BOTTLE FILLED TO NECK	UNPRESERVED, COOL TO 4°C	28 DAYS
BIOLOGICAL PARAMETERS		1 X 500 ML PLASTIC BOTTLE	BOTTLE FILLED TO NECK	H_2SO_4 TO pH <2, COOL TO 4°C	
Total Kjeldahl Nitrogen (TKN)	SM 4500-N-O,C				28 DAYS
Total Phosporus	365.3				28 DAYS
Orthophosphate	365.3				2 DAYS
Ammonia	350.3				28 DAYS
Total Nitrogen	300.0	1 X 250 ML PLASTIC	BOTTLE FILLED TO NECK	COOL TO 4°C	48 HOURS
Nitrate/Nitrite	300.0				
BART TEST KIT (iron bacteria, sulfate reducing bacteria, slime forming bacteria)	NA	NA	Collect and store samples in accordance with manufacture's recommendations	NA	NA
GENERAL MINERALS		1 X 1 LITER PLASTIC	BOTTLE FILLED TO NECK	UNPRESERVED, COOL TO 4°C	
Aluminum	6010B				6 MONTHS
Total Alkalinity	SM 2320B				14 DAYS
Carbonate	SM 2320B				
Bicarbonate	SM 2320B				
Calcium	6010B				6 MONTHS
Chloride	300 0				28 DAYS
Fluoride	300 0				28 DAYS
Potassium	6010B				6 MONTHS
Iron (dissolved)	6020B				6 MONTHS
Magnesium	6010B				6 MONTHS
Manganese	6010B				6 MONTHS

TABLE A-2

HANDLING PROTOCOL FOR GROUNDWATER SAMPLES

ANALYTE	EPA METHOD	SAMPLE CONTAINER	OTHER REQUIREMENTS	PRESERVATION METHOD	MAXIMUM HOLDING TIME
Sodium	6010B				6 MONTHS
Sulfate	300.0				28 DAYS
Total Suspended Solids	160 2				7 DAYS
Total Dissolved Solids	160.1				7 DAYS
Turbidity	EPA 180.1				48 HOURS
Settleable Solids	EPA 160.5	1 X 1 LITER PLASTIC	BOTTLE FILLED TO NECK	UNPRESERVED, COOL TO 4°C	7 DAYS
Biochemical Oxygen Demand	EPA 405.1	1 X 1 LITER PLASTIC	BOTTLE FILLED TO NECK	UNPRESERVED, COOL TO 4°C	48 HOURS
METALS (expressed as total recoverable)		1 X 1 LITER PLASTIC	BOTTLE FILLED TO NECK	HNO_3 TO Ph <2, COOL TO 4°C	6 MONTHS
Antimony	6020B				
Arsenic	6020B				
Barium	6020B				
Beryllium	6020B			*FOR METALS, INSTRUCT LAB TO FILTER AND ACIDIFY UPON RECEIPT*	
Cadmium	6020B				
Total Chromium	6020B				
Trivalent Chromium	Calculation				
Hexavalent Chromium	7196				
Cobalt	6020B				
Copper	6020B				
Lead	6020B				
Molybdenum	6020B				
Mercury	7470A				28 DAYS
Nickel	6020B				
Selenium	6020B				
Silver	6020B				
Thallium	6020B				
Vanadium	6020B				
Zinc	6020B				
OTHER PARAMETERS					
Cyanide	9014	1 X 1 LITER PLASTIC	BOTTLE FILLED TO NECK	NaOH, COOL TO 4oC	14 DAYS
Hydrogen Sulfide	SM 4500-S	500 ml PLASTIC	BOTTLE FILLED TO NECK	ZnAc/NaOH TO pH >12, COOL TO 4°C	7 DAYS
Total Organic Carbon	415.1	3 X 40 ml VOA VIAL, TEFLON LINED SEPTUM	VIALS FILLED COMPLETELY, NO HEAD SPACE	HCl, COOL TO 4°C	28 DAYS
Asbestos	100.1	1 X 1 LITER PLASTIC	BOTTLE FILLED TO NECK	COOL TO 4°C	2 DAYS
1,4-Dioxane	8260	3 X 40 ml VOA VIAL, TEFLON LINED SEPTUM	VIALS FILLED COMPLETELY, NO HEAD SPACE	HCl, COOL TO 4°C	14 DAYS
Methanol	8015	3 X 40 ml VOA VIAL, TEFLON LINED SEPTUM	VIALS FILLED COMPLETELY, NO HEAD SPACE	HCl, COOL TO 4°C	14 DAYS
Perchlorate	314 0	500 ml PLASTIC	BOTTLE FILLED TO NECK	COOL TO 4°C	28 DAYS
2,3,7,8-TCDD (Dioxin)	8290	2 X 1 LITER AMBER GLASS BOTTLE	BOTTLE FILLED TO NECK		
N-Nitroso-di-methyl amine (NDMA)	1625C	2 X 1 LITER AMBER GLASS BOTTLE	BOTTLE FILLED TO NECK	COOL TO 4°C	7 DAYS
Total Silica	6010B				6 MONTHS

TABLE A-2

HANDLING PROTOCOL FOR GROUNDWATER SAMPLES

ANALYTE	EPA METHOD	SAMPLE CONTAINER	OTHER REQUIREMENTS	PRESERVATION METHOD	MAXIMUM HOLDING TIME
Total Petrolium Hydrocarbons	418.1	2 X 1 LITER AMBER GLASS BOTTLE	BOTTLE FILLED TO NECK	HCl, COOL TO 4°C	28 DAYS
Oil and Grease	413.1	2 X 1 LITER AMBER GLASS BOTTLE	BOTTLE FILLED TO NECK	HCl, COOL TO 4°C	28 DAYS
Phenols	420	1 LITER AMBER GLASS BOTTLE	BOTTLE FILLED TO NECK	H_2SO_4 TO pH <2, COOL TO 4°C	28 DAYS
Residual chlorine	SM 4500	250 ml PLASTIC	BOTTLE FILLED TO NECK	COOL TO 4oC	IMMEDIATE

FOOTNOTES

(<) = Less than
DDT = Dichlorodiphenyltrichloroethane
°C = degrees Celsius
EPA = U.S. Environmental Protection Agency
HCl = Hydrochloric Acid
HDPE = High Density Polyethylene
lab = Laboratory
ml = Milliliter
VOA = Volatile Organic Analysis
NA = Not Applicable
H_2SO_4 = Sulfunc Acid
ZnAc = Zinc Acetate
NaOH = Sodium Hydroxide
HNO_3 = Nitric Acid

TABLE A-3

WELL CONSTRUCTION DATA FOR EXISTING WELLS

WELL IDENTIFIER	DATE DRILLED	DEPTH OF WELL (ft bls)	WELL DIAMETER (inches)	PERFORATED INTERVAL (ft bls)
UBE-1	04/02/91	94.3	8	60.7 - 90.7
UBI-1	02/08/04	91.7	6	43.7 – 88.7
UBI-2	02/10/04	92.5	6	44.5 – 89.5
UBT-1	09/22/89	99	6	60 - 91
UBT-2	09/16/89	99	4	50 - 91
UBT-3	09/12/89	99	4	60 - 91
MW-1	04/26/85	76.6	4	63 - 73
MW-2	04/27/85	77.5	4	66.7 - 76.7
MW-3	04/26/85	75	4	64.4 - 74.4
MW-4	04/26/85	75.3	4	64.9 - 74.9
MW-5	04/25/85	72.4	4	61.5 - 72.5
MW-6	11/17/88	85	4	65 - 80
MW-7	11/18/88	85	4	65 - 80
MW-8	05/10/89	85	4	65 - 80
MW-9	05/09/89	85	4	66 - 81
MW-10	11/22/88	83	4	62 - 77
MW-11	11/23/88	84	4	62 - 77
MW-12	11/19/88	85	4	61 - 76
MW-13	11/15/88	81	4	62 - 77
MW-14	11/21/88	80	4	58 - 73
MW-16	03/31/90	78	4	59 - 76
MW-17	04/02/90	83	4	65 - 81
MW-19	03/30/90	80	4	63 - 79
MW-20	04/04/90	74	2	57 - 73
MW-21	03/28/90	73	4	54 - 70
MW-22	04/01/90	74	4	57 - 73
MW-23	08/03/89	80	4	60 - 75
MW-24	08/04/89	68	4	49 - 64
MW-25	08/05/89	75	4	56 - 71
MW-26	08/06/89	80	4	59 - 74
MW-27	09/19/91	77	4	59 - 75
MW-28	11/16/91	74	4	54 - 71
MW-29	09/18/91	75	4	57 - 73
MW-30	09/20/91	80	4	54 - 70

Note: Refer to page 3 of this table for footnotes.

TABLE A-3

WELL CONSTRUCTION DATA FOR EXISTING WELLS

WELL IDENTIFIER	DATE DRILLED	DEPTH OF WELL (ft bls)	WELL DIAMETER (inches)	PERFORATED INTERVAL (ft bls)
BF-1	12/11/86	126.5	4	113.5 - 124.0
BF-2	12/09/86	128	4	114.0 - 124.5
BF-3	12/05/86	125 5	4	113.5 - 124.0
BF-4	12/08/86	126	4	112 - 123
BF-5	01/14/89	135	4	122 - 132
BF-6	12/03/88	132	4	115 - 125
BF-7	12/09/88	119	4	106 - 116
BF-9	01/03/89	129	6	107 - 128
BF-10	12/01/89	131	4	120 - 130
BF-11	12/06/89	124	4	104 - 124
BF-12	11/30/89	120	4	110 - 120
BF-13	11/01/89	138	4	117 - 137
BF-14	10/04/89	122	4	111 - 121
BF-15	10/10/89	114	4	98 - 113
BF-16	12/16/89	130	4	103 - 124
BF-17	12/18/89	124	4	100 - 120
BF-19	06/26/91	135	4	128 - 133
BF-20	08/14/91	130	4	110 - 129
BF-21	05/24/91	123	4	96 - 121
BF-22	06/12/91	120	4	87 - 117
BF-23	06/17/91	120	4	101 - 116
BF-24	05/17/91	122	4	96 - 121
BF-25	06/20/91	115	4	94 - 104
BF-26	08/28/91	110	4	90 - 105
BF-27	07/11/91	122	4	101 - 121
BF-28	07/18/91	115	4	95 - 110
BF-29	08/06/91	126	4	100 - 120
BF-30	08/19/91	120	4	82 - 113
BF-31	08/22/91	135	4	105 - 135
BF-32A	12/09/93	120	4	65 - 115
BF-33	09/05/91	101	4	60 - 100
G-1	11/26/86	164.5	4	140.5 - 161.0
G-2	11/16/86	180	4	155.0 - 175.5
G-3	12/01/86	170	4	145.5 - 166.0
G-4	01/17/89	195	4	154 - 194
G-5	12/07/88	194	4	151 - 190
G-6	12/12/88	192	4	149 - 190

Note: Refer to page 3 of this table for footnotes.

TABLE A-3

WELL CONSTRUCTION DATA FOR EXISTING WELLS

WELL IDENTIFIER	DATE DRILLED	DEPTH OF WELL (ft bls)	WELL DIAMETER (inches)	PERFORATED INTERVAL (ft bls)
G-8	12/13/89	181	4	140 - 180
G-9	12/04/89	213	4	171 - 213
G-11	11/04/89	218	4	177 - 217
G-12	10/21/89	198	4	158 - 198
G-13	10/07/89	197	4	157 - 197
G-14	08/30/91	196	4	155 - 195
G-15	08/09/91	184	4	142 - 182
G-16	06/06/91	187	4	145 - 185
G-17	06/29/91	213	4	172 - 212
G-18	05/30/91	202	4	161 - 201
G-19	07/25/91	187	4	145 - 185
LG-1	11/12/86	211	4	188.5 - 209.0
LG-2	12/21/88	207	4	185 - 205
LW-1	08/24/89	251	4	230 - 250
LW-2	08/31/89	253	4	232 - 252
LW-3	11/18/89	261	4	238 - 259
LW-4	09/09/91	246	4	225 - 245
LW-5	09/17/91	251	4	230 - 250
LW-6	09/21/91	256	4	235 - 255
LW-7	09/24/91	251	4	230 - 250

FOOTNOTES

Ft bls = Feet below land surface
NM = Not measured

TABLE A-4

WELL CONSTRUCTION DATA FOR PROPOSED WELLS AND BORINGS

WELL IDENTIFIER	TOTAL DEPTH DRILLED (feet bls) (a)	BOREHOLE DIAMETER (inches)	WELL CASING / SCREEN DIAMETER / TYPE (g)	18-INCH STEEL CONDUCTOR CASING INTERVAL (feet bls) (a)	SCREEN INTERVAL (feet bls) (a)	SCREEN SLOT SIZE (inches) (b)	FILTER PACK SIZE (c)	FILTER PACK INTERVAL (feet bls) (a)	FINE SAND SEAL INTERVAL (feet bls) (a,d)	BENTONITE SEAL INTERVAL (feet bls) (a,e)	GROUT SEAL (feet bls) (a,f)
Extraction Wells											
BF-EW-1 & 2	135	24	12-inch/ SCH 40 PVC with Wire Wrap	0-60	60-135	0.020-0.040	#2/16-#3	57-135	55-57	52-55	0-52
G-EW-1	195	24	12-inch/ SCH 40 PVC with Wire Wrap	0-140	145-195	0.020	#2/16	142-195	140-142	137-140	0-137
Injection Wells											
BF-IW-1 & 2	135	24	12-inch/ SCH 40 PVC with Wire Wrap	0-60	60-135	0.020-0.040	#2/16-#3	57-135	55-57	52-55	0-52
G-IW-1 & 2	195	24	12-inch/ SCH 40 PVC with Wire Wrap	0-140	145-195	0.020	#2/16	142-195	140-142	137-140	0-137
Observation Wells											
BF-OW-1		12	2-inch/ SCH 40 PVC	NA	60-135	0.020	#2/16	57-135	55-57	52-55	0-52
G-OW-1		12	2-inch/ SCH 40 PVC	NA	145-195	0.020	#2/16	142-195	140-142	137-140	0-137
LBF-OW-2		6	2-inch/ SCH 40 PVC	NA	130-131	0.020	#2/16	129-131	128-129	125-128	0-125
LBF-OW-3		12	2-inch/ SCH 40 PVC	NA	130-131	0.020	#2/16	129-131	128-129	125-128	0-125
G-OW-3		12	2-inch/ SCH 40 PVC	NA	145-195	0.020	#2/16	142-195	140-142	137-140	0-137

TABLE A-4

WELL CONSTRUCTION DATA FOR PROPOSED WELLS AND BORINGS

WELL IDENTIFIER	TOTAL DEPTH DRILLED (feet bls) (a)	BOREHOLE DIAMETER (inches)	WELL CASING / SCREEN DIAMETER / TYPE (g)	18-INCH STEEL CONDUCTOR CASING INTERVAL (feet bls) (a)	SCREEN INTERVAL (feet bls) (a)	SCREEN SLOT SIZE (inches) (b)	FILTER PACK SIZE (c)	FILTER PACK INTERVAL (feet bls) (a)	FINE SAND SEAL INTERVAL (feet bls) (a,d)	BENTONITE SEAL INTERVAL (feet bls) (a,e)	GROUT SEAL (feet bls) (a,f)
Exploratory Borings											
EB-20	195	6	NA	NA	NA	NA	NA	NA	NA	NA	NA (h)
EB-21	195	6	NA	NA	NA	NA	NA	NA	NA	NA	0-195
EB-22	195	6	NA	NA	NA	NA	NA	NA	NA	NA	NA (h)
EB-23	195	6	NA	NA	NA	NA	NA	NA	NA	NA	NA (h)
EB-24	195	6	NA	NA	NA	NA	NA	NA	NA	NA	NA (h)

NOTE: Conductor casing for Bellflower sand and Gage extraction and injection wells will be installed in a 24-inch diameter borehole.

FOOTNOTES

Ft bls = Feet below land surface.
PVC = Polyvinyl Chloride.

(a) Depths are approximate and will be adjusted in the field based on the lithology encountered.
(b) Screen slot size is approximate and may be adjusted based on the lithology of the screened interval.
(c) Filter pack size is approximate and may be adjusted based on the screen slot size that is selected for the well. Filter pack consists of Monterey sand. Filter pack sizes are Lone Star Lapis Lustre size designations.
(d) #60 silica sand.
(e) Granular bentonite or pellets.
(f) Volclay grout or equivalent.
(g) Schedule 40 PVC.
(h) Boring will be converted into observation well cluster.

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TABLE A-5

LITHOLOGIC LOG FORM

BOREHOLE ID:	LOCATION:		PAGE 1 OF
PROJECT NO.:	PROJECT NAME:	LOGGED BY:	
WEATHER:			DATE(S):
DRILLING METHOD, EQUIPMENT:			HOLE DIA.:
DRILLING CONTRACTOR:		OPERATOR:	
SAMPLING METHOD, EQUIPMENT:			
SURFACE ELEVATION: ft/msl	TOTAL DEPTH: ft/bls	DTW: ft/bmp	
REMARKS:			

SAMPLES	CORE RECOVERY	DEPTH (feet bls)	GRAPHIC LITHOLOGY	USCS GROUP SYMBOL	LITHOLOGIC DESCRIPTION Textural classification (modifier, root), Munsell color descriptor (value), moisture content, consistency or relative density, plasticity, grain size, sorting, roundness, miscellaneous properties.	NOTES, REMARKS, OBSERVATIONS
		0				

FOOTNOTES

DIA = Diameter
DTW = Depth to water
ft/bls = Feet below land surface
ft/bmp = Feet below measuring point
ft/msl = Feet mean sea level
USCS = Unified Soil Classification System

TABLE A-6

WELL COMPLETION AND DEVELOPMENT REPORT

Project No. _____

Project Name _____

COMPLETION REPORT FOR WELL _____

Drilling Company: _____

Driller: _____

Drill Rig: _____

Date drilling started: _____

Date drilling completed: _____

Description of drilling _____

_____

_____

A. GENERAL

Location: _____

Location coordinates: x _____ y _____

Total depth of borehole: _____ feet bls

Borehole diameter: _____ inches, from _____ to _____ feet bls

_____ inches, from _____ to _____ feet bls

Lost circulation zones: _____

Lithology logged by: _____

B. CONSTRUCTION

Conductor Casing

Type: _____, O.D.: _____

Wall thickness: _____, from _____ to _____ feet bls

Centralizers/Shoe: _____

TABLE A-6

WELL COMPLETION AND DEVELOPMENT REPORT

Project No. _____

Project Name _____

COMPLETION REPORT FOR WELL _____

Well Casing

Type: _____ , O.D.: _____

Wall thickness: _____ , from _____ to _____ feet bls

Type: _____ , O.D.: _____

Wall thickness: _____ , from _____ to _____ feet bls

Well Screen

Type: _____ , O.D.: _____

Wall thickness: _____ , from _____ to _____ feet bls

Type: _____ , O.D.: _____

Wall thickness: _____ , from _____ to _____ feet bls

Centralizers/Shoe: _____

C. GROUT AND CEMENTING RECORD

Annular space: _____

Type of cement/grout: _____

Method of emplacement: _____

Approximate number of yards/bag: _____

Comments: _____

_____

_____

Annular space: _____

Type of cement/grout: _____

Method of emplacement: _____

Approximate number of yards/bag: _____

Comments: _____

_____

TABLE A-6

WELL COMPLETION AND DEVELOPMENT REPORT

Project No. _____

Project Name _____

COMPLETION REPORT FOR WELL _____

D. **GRAVEL PACK**

Type: _____ , from _____ to _____ feet bls

Volume emplaced: _____ , Method emplaced: _____

Type: _____ , from _____ to _____ feet bls

Volume emplaced: _____ , Method emplaced: _____

Grout Filter

Type: _____ , from _____ to _____ feet bls

Volume emplaced: _____ , Method emplaced: _____

Bentonite Seal

Type: _____ , from _____ to _____ feet bls

Volume emplaced: _____ , Method emplaced: _____

E. DEVELOPMENT RECORD

Date: _____

Procedure: _____

Duration: _____ minutes

Procedure: _____

Duration: _____ minutes

Pumping duration: _____ minutes

Average pump discharge rate: _____ gpm

Drawdown at end of pumping: _____ feet bls

Field parameters (initial): pH _____ , Conductivity _____ (umhos),

Temperature _____ (°C), Turbidity _____

Field parameters (final): pH _____ , Conductivity _____ (umhos),

Temperature _____ (°C), Turbidity _____

TABLE A-6

WELL COMPLETION AND DEVELOPMENT REPORT

Project No. _____

Project Name _____

COMPLETION REPORT FOR WELL _____

F. PUMP INSTALLATION DATA

Pump installer: _____

Installation date: _____

Pump purpose/type: _____

Pump model/specs: _____

Pump setting: _____

Pump purpose/type: _____

Pump model/specs: _____

Pump setting: _____

Surface completion (hole vault type, etc.): _____

G. REFERENCE ELEVATIONS

Land surface elevation: _____ feet msl

Measuring point elevation: _____ feet msl

Description of measuring point: _____

Date surveyed: _____, by: _____

H. COMMENTS AND NOTES RE DRILLING WELL CONSTRUCTION OPERATIONS

_____

_____

_____

_____

_____

TABLE A-6

WELL COMPLETION AND DEVELOPMENT REPORT

Project No. _____

Project Name _____

MONITOR WELL PLACEMENT FORM

Proposed Well ID: _____ Actual Well ID: _____

Date: _____ By: _____

Street Address or APN: _____

City/Town: _____

Nearest Cross Street: _____

Thomas Brothers Reference: _____

Owner/Jurisdiction: _____

County Permit No. : _____

USA Alert Ticket: _____

Comments: _____

_____

_____

Sketch Map

TABLE A-6

WELL COMPLETION AND DEVELOPMENT REPORT

Project No. _____

Project Name _____

DEVELOPMENT REPORT FOR WELL _____

A DEVELOPMENT REPORT

Well Type: _____

Development Company: _____

Developer/Helper: _____

Development Rig: _____

Date of Development: _____

H+A Field Notebook: _____

H+A Personnel: _____

Description of Development: _____

_____

_____

_____

B. WELL DEVELOPMENT

Total Well (Driller): _____ feet bls

Depth to bottom of well before development: _____ feet bls

Bottom: soft, medium, hard

Depth to water before development: _____ feet bls

Procedure: _____

Duration: _____ minutes, Comment: _____

Procedure: _____

Duration: _____ minutes, Comment: _____

Procedure: _____

Duration: _____ minutes, Comment: _____

Procedure: _____

Duration: _____ minutes, Comment: _____

TABLE A-6

WELL COMPLETION AND DEVELOPMENT REPORT

Project No. _____

Project Name _____

DEVELOPMENT REPORT FOR WELL _____

Procedure: _____

Duration: _____ minutes, Comment: _____

Pumping duration: _____ minutes

Field parameters (initial): pH _____ , Conductivity _____ (umhos),

Temperature _____ (°C), Turbidity _____

Average pump discharge rate: _____ gpm Gallons purged: _____

Depth to water at end of pumping: _____ feet bls, Drawdown _____ feet

Specify Capacity: _____ gpm/ft

Field parameters (final): pH _____ , Conductivity _____ (umhos),

Temperature _____ (°C), Turbidity _____

Depth to bottom of well after development: _____ feet bls

Bottom: soft, medium, hard

Depth to water after development and recovery: _____ feet bls

Measured: _____ hours after final pumping

C. PUMP INSTALLATION DATA

Pump installer: _____

Installation date: _____

Pump purpose/type: _____

Pump model/specs: _____

Pump setting: _____

Pump purpose/type: _____

Pump model/specs: _____

Pump setting: _____

Comments: _____

_____

TABLE A-6

WELL COMPLETION AND DEVELOPMENT REPORT

Project No. _____

Project Name _____

DEVELOPMENT REPORT FOR WELL _____

D SURVEY DATA

Surveyor: _____

Date surveyed: _____

Land surface elevation: _____ feet msl

Measuring point elevation: _____ feet msl

Location coordinate: x _____ y _____

Description of measuring point: _____

E. COMMENTS

_____

_____

_____

_____

_____

_____

_____

_____

FOOTNOTES

°C = degrees Celsius
bls = Below land surface
ft = Feet
gpm = Gallons per minute
msl = Mean sea level
O.D. = Outer Diameter
specs = Specifications
umhos = Micromhos

TABLE A-7

WATER LEVEL INDICATOR CALIBRATION DOCUMENTATION FORM

PROJECT NUMBER:_____

DATE	TIME	WATER LEVEL INDICATOR TYPE	WATER LEVEL INDICATOR NUMBER	CALIBRATION METHOD	CALIBRATED BY (INITIALS)	REMARKS

HARGIS + ASSOCIATES, INC.

TABLE A-8

STATIC WATER LEVEL DATA SHEET

MONTH/YEAR: _____

PROJECT NUMBER: _____

METHOD OF MEASUREMENT/SOUNDER IDENTIFIER: _____

WELL IDENTIFIER	DATE	TIME	REFERENCE POINT	REPORTED TOTAL DEPTH OF WELL (feet bls)	DEPTH TO WATER FROM REFERENCE POINT (feet)	DEPTH TO PRODUCT (feet bls)	REFERENCE POINT ELEVATION (feet msl)	WATER LEVEL ELEVATION (feet msl)	PREVIOUS DEPTH TO WATER (feet)	CHANGE IN WATER LEVEL (feet)	COMMENTS	INITIALS

FOOTNOTES

msl = Mean sea level
bls = Below land surface

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TABLE A-9

OPERATION AND MONITORING LOG

Date	Time:	Operator:

Extraction Well Operation					
Extraction Well	**Time**	**Totalizer**	**Flow Rate**	**Water Level**	**Pressure**
		gal	gpm	ft bls	psig

Injection Well Operation					
Injection Well	**Time**	**Totalizer**	**Flow Rate**	**Water Level**	**Pressure**
		gal	gpm	ft bls	psig

Injection Field Observation Data	Time: _____	
Water Filter Differential Pressure, F-01	psid	PDI-01
Water Filter Differential Pressure, F-02	psid	PDI-02
Water Filter Differential Pressure, F-03	psid	PDI-03
Water Filter Differential Pressure, F-04	psid	PDI-04
Water Filter Differential Pressure, F-05	psid	PDI-05
Water Filter Differential Pressure, F-06	psid	PDI-06

Comments:_____

FOOTNOTES

ft bls = Feet below land surface
gpm = Gallons per minute
psig = Pounds per square inch gauge
psid = Pounds per square inch differential

TABLE A-10

FIELD MEASUREMENT PROTOCOL

FIELD PARAMETER	FREQUENCY	DURATION	COMMENT
Extraction Well			
▪ Depth to Water, Manual (step test, 1 day)	Once	N/A	Collect reading when deploying dataloggers prior to initiation of the test
▪ Depth to Water, Manual (constant-rate test, 5 days)	Once, one day prior to extraction	N/A	Pre-test measurement (static)
	Daily, Days 1-5	N/A	Drawdown to be calculated after each water level measurement
	Once, approximately five days	N/A	Upon completion of groundwater recovery
▪ Depth to Water, Transducer (step test, 1 day)	Data logging at 5-minute intervals	Begin data logging 1 hour prior to test; allow to continue logging upon	Download data prior to the test and after completion of the test
▪ Depth to Water, Transducer (constant-rate test, 5 days)	Data logging at 5-minute intervals	Begin data logging at least 1 day prior to test; terminate upon return to static GW levels	Download data prior to the test, after completion of the test and as necessary during the test
▪ Barometric Pressure, Transducer (step test, 1 day)	Data logging at 5-minute intervals	Begin data logging 1 hour prior to test; allow to continue logging upon completion of test	Download data prior to the test and after completion of the test
▪ Barometric Pressure, Transducer (constant-rate test, 5 days)	Data logging at 5-minute intervals	Begin data logging at least 1 day prior to test; terminate upon return to static GW levels	Download data prior to the test, after completion of the test and as necessary during the test
▪ Extraction Rate & Volume (step test, 1 day)	15-minute intervals	Duration of test (1 day)	Additional flow rate readings with all manual adjustment of extraction rate; cumulative & instantaneous volume readings
▪ Extraction Rate & Volume Recovered Groundwater (constant-rate test)	Hourly	Duration of tests (5 days)	Additional flow rate readings with all manual adjustment of extraction rate; cumulative & instantaneous volume readings
▪ GW Parameters, Manual (step test, 1 day)	None	N/A	These parameters are not of concern for the step test
▪ GW Parameters, Manual	Once, one day prior to extraction	N/A	Pre-test measurement (static)
(constant-rate test, 5 days)	Daily, Days 1-5	N/A	
(see table A-11 for parameters)	Once, approximately five days	N/A	Upon completion of groundwater recovery
Groundwater Treatment System			
▪ Pressure, LGAC unit influent and effluent	Hourly	Duration of tests (6 days)	Confirm pressures are within the appropriate ranges
▪ Pressure, TSS filter influent and effluent	Hourly	Duration of tests (6 days)	Confirm pressures are within the appropriate ranges
▪ Outfall Inspection	6-hour intervals	Duration of tests (6 days)	Confirm groundwater is discharging properly into the designated outfall

TABLE A-10

FIELD MEASUREMENT PROTOCOL

FIELD PARAMETER	FREQUENCY	DURATION	COMMENT
Groundwater Treatment System (continued)			
▪ Discharge Rate (step test, 1 day)	30-minute intervals	Duration of test (1 day)	Additional readings with all manual adjustments of discharge rate
▪ Discharge Rate (constant-rate test, 5 days)	Hourly	Duration of test (5 days)	Additional readings with all manual adjustment of discharge rate
▪ Volume, discharged groundwater	Hourly	Duration of tests (6 days)	Cumulative and instantaneous
▪ Equipment Inspection (step test, constant-rate test)	Once, prior to each start-up	Duration of tests (6 days)	Visually inspect system to ensure proper installation and operation
	6-hour intervals	Duration of tests (6 days)	Visually inspect system to ensure proper
Injection Well			
▪ Depth to Water, Manual (step test, 1 day)	Once	N/A	Collect reading when deploying dataloggers prior to initiation of the test
▪ Depth to Water, Manual (constant-rate test, 5 days)	Once, one day prior to test	N/A	Pre-test measurement (static)
	Daily, Days 1-5	N/A	Mounding to be calculated after each water level measurement
	Once, approximately five days after completion of injection	N/A	Upon completion of groundwater recovery
▪ Depth to Water, Transducer (step test, 1 day)	Data logging at 5-minute intervals	Begin data logging 1 hour prior to test; allow to continue upon completion of	Download data prior to the test and after completion of the test
▪ Depth to Water, Transducer (constant-rate test, 5 days)	Data logging at 5-minute intervals	Begin data logging at least 1 day prior to test; terminate upon return to static GW levels	Download data prior to the test, after completion of the test and as necessary during the test
▪ Barometric Pressure, Transducer (step test, 1 day)	Data logging at 5-minutes intervals	Begin data logging 1 hour prior to test; allow to continue upon completion of test	Download data prior to the test and after completion of the test
▪ Barometric Pressure, Transducer (constant-rate test, 5 days)	Data logging at 5-minutes intervals	Begin data logging at least 1 day prior to test; terminate upon return to static GW levels	Download data prior to the test, after completion of the test and as necessary during the test
▪ Injection Rate & Volume Injected (step test, 1 day)	15-minute intervals	Duration of test (1 day)	Additional flow rate readings with all manual adjustment of injection rate; cumulative & instantaneous volume readings
▪ Injection Rate & Volume Injected Potable Water (constant-rate test)	Hourly	Duration of tests (5 days)	Additional flow rate readings with all manual adjustment of injection rate; cumulative & instantaneous volume readings

TABLE A-10

FIELD MEASUREMENT PROTOCOL

FIELD PARAMETER	FREQUENCY	DURATION	COMMENT
Injection Well (continued)			
▪ GW Parameters (step test, 1 day)	None	N/A	These parameters are not of concern for the step test
▪ GW Parameters, Manual (constant-rate test, 5 days)	Once, one day prior to injection Daily, Days 1-5	Duration of test (5 days)	Pre-test measurement (static)
(see Table A-11 for parameters)	Once, approximately five days after completion of injection		Upon completion of potable water injection
Injection Equipment			
▪ Pressure, TSS filter influent and effluent	Hourly	Duration of tests (6 days)	Confirm pressures are within the appropriate ranges
▪ Hydrant Inspection	6-hour intervals	Duration of tests (6 days)	Confirm hydrant equipment is properly connected
▪ Hydrant Parameters, flow rate, volume and pressure (step test, 1 day)	Hourly	Duration of test (1 day)	
▪ Hydrant Parameters, flow rate, volume and pressure (constant-rate test, 5 days)	Every 4 hours	Duration of test (5 days)	
▪ Potable Water, residual chlorine concentration at system influent & effluent	Twice Daily	Duration of tests (6 days)	Field analysis using a portable test kit
▪ Equipment Inspection (step test, constant-rate test)	Once, prior to each start-up	Duration of tests (6 days)	Visually inspect system to ensure proper installation and operation
	6-hour intervals	Duration of tests (6 days)	Visually inspect system to ensure proper
Observation/Monitor Wells			
▪ Depth to Water, Manual (step test, 1 day)	Once	N/A	Collect reading when deploying dataloggers prior to initiation of the test
▪ Depth to Water, Manual (constant-rate test, 5 days)	Once, one day prior to test Daily, Days 1-5	N/A N/A	Pre-test measurements (static) Drawdown or mounding to be calculated after each water level measurement
	Once, approximately five days after completion of extraction or	N/A	Upon completion of groundwater recovery
▪ Depth to Water and Barometric Pressure, Transducer	Data logging at 5 minute intervals	Begin data logging 1 week prior to the step test; terminate upon groundwater recovery	Download data prior to the test, after completion of the test, after groundwater recovery and as necessary during the test
▪ GW Parameters, Manual (step test, 1 day)	None	N/A	These parameters are not of concern for the step test

TABLE A-10

FIELD MEASUREMENT PROTOCOL

FIELD PARAMETER	FREQUENCY	DURATION	COMMENT
Observation/Monitor Wells (continued)			
▪ GW Parameters, Manual	Once, one day prior to test	Duration of test	Pre-test measurements (static)
(constant-rate test, 5 days)	Daily, Days 1-5		
(see Table A-11 for parameters)	Once, approximately five days		Upon completion of groundwater recovery

NOTE: Individual tests will be completed at each of the following wells: G-EW-1, BF-EW-1, BF-EW-2, G-IW-1, G-IW-2, BF-IW-1, BF-IW-2. Tasks will be completed, as appropriate, for each of the seven tests that will be conducted.

Modifications may be made to the above protocol for the following reasons:

1 Test disruption - if groundwater pumping/injection is interrupted, monitoring of certain field parameters will be completed approximately one hour after resuming the test Field measurements will then continue at the pre-shut down monitoring schedule.

2. Test Termination - if the test is terminated early for unforeseen reasons such as equipment failure, or inclement weather, data collected prior to shut down will be evaluated. Results of this evaluation will dictate further action such as a decision to repeat the test or to proceed with continuation of the test

3. Field conditions - review of field parameters during the test may warrant modification to this protocol This may include, but not be limited to, evaluation of the target well performance, groundwater measurements, or hydraulic influence data.

N/A = Not applicable

TABLE A-11

FIELD PROCEDURES AND QUALITY ASSURANCE OBJECTIVES

PROCEDURE	EQUIPMENT CHECK AND/OR CALIBRATION	OPERATIONAL PROCEDURE	PERSONNEL	DATA STORAGE SYSTEM	PRECISION	ACCURACY
Water Level Measurement	Electric water level sounder, steel tape, interface probe	SOP and manufacturer instructions for equipment	Hydrogeologist, field technician	Hard copy, electronic	0.01 foot	±0.1 foot
Water Sample Collection (excludes determination of electrical conductivity, pH, and temperature)	Depth specific sampling devices, sample bottles, shipping containers, transmittal forms, chain-of-custody records, field forms	SOP	Hydrogeologist, field technician	Hard copy	NA	NA
Electrical Conductivity	Conductivity meter, field form	SOP and manufacturer instructions for equipment	Hydrogeologist, field technician	Hard copy	±5 umhos when scale units are x1	±10 umhos when scale units are x1
Turbidity	Turbidity meter, field form	SOP and manufacturer instructions for equipment	Hydrogeologist, field technician	Hard copy	Based on instrument	Based on instrument
Dissolved Oxygen	Photometric meter, appropriate filters, high and low range ampoules, field form	SOP and manufacturer instructions for equipment	Hydrogeologist, field technician	Hard copy	Based on instrument	Based on instrument
pH	pH meter, field form	SOP and manufacturer instructions for equipment	Hydrogeologist, field technician	Hard copy	±0.05 unit	0.5 unit
Temperature	Field thermometer, field form	SOP and manufacturer instructions for equipment	Hydrogeologist, field technician	Hard copy	±0.1°C	±0.5°C

FOOTNOTES

SOP = Standard Operational Procedure
NA = Not Applicable
umhos = Micromhos
°C = Degrees Celsius

HARGIS + ASSOCIATES, INC.

TABLE A-12

ELECTRICAL CONDUCTIVITY METER CALIBRATION FORM

PROJECT NUMBER:_____

MONTH/YEAR:_____

PAGE _____ OF _____

DATE	TIME	EC STANDARD SOLUTION (umhos/cm @ 25°C)	TEMPERATURE OF SOLUTION °C	EC METER READINGS (umhos/cm)	REDLINES (Y/N)	BATTERY GOOD (Y/N)	METER TYPE	METER SERIAL #	COMMENTS	INITIALS

FOOTNOTES

umhos/cm = Microhmos per centimeter
°C = Degrees Centigrade

857 Rpts 2004-10 App A Tbl A-12
06/07/04

HARGIS + ASSOCIATES, INC.

TABLE A-13

pH METER CALIBRATION FORM

PROJECT NUMBER:_____

MONTH/YEAR:_____

PAGE _____ OF _____

DATE	TIME	pH BUFFER	TEMPERATURE OF BUFFER, °C	pH READING	METER TYPE	METER SERIAL NO.	COMMENTS	INITIALS

FOOTNOTE

°C = degrees Celsius

857 Rpts 2004-10 App A Tbl A-13
06/07/04

HARGIS + ASSOCIATES, INC.

TABLE A-14

Project _____

INSTRUMENT CALIBRATION LOG FOR GROUNDWATER SAMPLING

DISSOLVED OXYGEN METER CALIBRATIONS
(AIR METHOD)

Page ____ of ____

DATE	TIME	METER MODEL	TEMP (°C)	ELEVATION (ft msl)	SOLUBILITY OF OXYGEN [a]	ALTITUDE CORRECTION FACTOR [b]	CALIBRATION VALUE[c] (mg/l)	COMMENTS	INITIALS

FOOTNOTES

(a) Solubility of oxygen.
(b) Altitude correction factor.
(c) Calibration value determined by multiplying solubility value by altitude correction factor.

°C = degrees Celsius
ft msl = Feet mean sea level
mg/l = Milligrams per liter

857 Rpts 2004-10 App A Tbl A-14
06/07/04

HARGIS + ASSOCIATES, INC.

TABLE A-15
GROUNDWATER SAMPLING INFORMATION FORM

WELL ID:_____

STATIC DTW _____FT
TD CASING _____FT
FT OF WATER _____FT
CAPACITY OF CASING _____GAL/FT

VOLUME OF WATER IN CASING _____GAL
3 CASING VOLUMES _____GAL
MONITOR WELL RECHARGE RATE _____SLOW _____FAST
PURGE METHOD _____BAILED _____PUMPED

DATE: _____

INITIALS:_____

.... FIELD PARAMETERS							APPROX. GALLONS PURGED	APPROX. CASING VOLUMES PURGED	COMMENTS
TIME	T° ( )	pH	EC	O.R.P.	D.O.	TURB.			

BEGIN PURGING @_____HRS

STOP PURGING @_____HRS

GALLONS PURGED_____

CASING VOLS PURGED_____

WL_____FT@_____ HRS

WEATHER CONDITIONS

TIME_____ TEMP_____

SKIES_____

WIND_____(mph) FROM_____

AIR MONITORING PID/FID ppm

VAULT_____ BKGD_____

BREATHING ZONE_____

DISCHARGE WATER_____

HEALTH & SAFETY EQUIPMENT
(circle)

RESPIRATORS GLOVES
TYVEK GOGGLES

SAMPLE COLLECTION SAMPLE TIME_____

ANALYSIS	QUANTITY	TYPE

DUPLICATES / SPLITS / BLANKS? Y N
If yes, complete appropriate forms.

NOTES
(Color, odor, sand & silt content, factors possibly affecting samples, condition of vault, wellhead, sampling apparatus, etc.)

HARGIS + ASSOCIATES, INC.

TABLE A-16

BLANK SAMPLE LOG FORM

PROJECT NUMBER:_____

MONTH/YEAR:_____

PAGE _____OF_____

DATE	TYPE BLANK (Field, Trip, Rinsate)	TIME	PREPARATION LOCATION	SAMPLE IDENTIFIER	ANALYTICAL METHOD	BLANK WATER SOURCE & DATE	BATCH NUMBER	COMMENTS AND SAMPLING CONDITIONS	INITIALS

HARGIS + ASSOCIATES, INC.

TABLE A-17

DUPLICATE SAMPLE LOG FORM

PROJECT NUMBER:_____

MONTH/YEAR:_____

PAGE _____OF_____

SAMPLE DATE	SAMPLE TIME ACTUAL / REPORTED	SAMPLE LOCATION	SAMPLE IDENTIFIER	ANALYTICAL METHOD	COMMENTS	INITIALS

HARGIS + ASSOCIATES, INC.

TABLE A-18

LABORATORY SPLIT SAMPLE LOG FORM

PROJECT NUMBER:_____

MONTH/YEAR:_____

PAGE _____OF_____

DATE	TIME	SAMPLE LOCATION	LABORATORY	ANALYTICAL METHOD	COMMENTS	INITIALS

HARGIS + ASSOCIATES, INC.

TABLE A-19

HARGIS + ASSOCIATES, INC.

CHAIN-OF-CUSTODY RECORD AND ANALYSIS REQUEST FORM

DATE _____ PAGE ____ OF ____

PROJECT NAME	PROJECT No./TASK No.
PROJECT MANAGER	Phone No.
QA MANAGER	FAX No.
SAMPLER (SIGNATURE)	SAMPLER (PRINTED)

LAB ID	SAMPLE ID	SAMPLE COLLECTION		MATRIX				PRESERVATION						SAMPLE CONTAINERS	ANALYSES REQUESTED	ESTIMATED CONCENTRATION RANGE (ppb) FOR VOAS	SPECIAL HANDLING	LABORATORY INFORMATION / REMARKS
		Date	Time	Soil	Ground-water	Surface water		HCl	HNO_3	NaOH	H_2SO_4	Ice						
Total number of Containers per analysis:																	Total No. of Containers: _____	

Relinquished by:	Date	Received by:	Date
	Time		Time
Company		Company	
Relinquished by:	Date	Received by:	Date
	Time		Time
Company		Laboratory	

INSTRUCTIONS

1. Fill out form completely except for shaded areas (lab use only); sign only after verified for completeness.
2. Complete in ballpoint pen. Draw one line through errors, initial and date correction.
3. Indicate number of sample containers in analysis request space; indicate choice with ✓ or x.
4. Note applicable preservatives, special instructions, and deviations from typical environmental samples.
5. Consult project QA documents for specific instructions.

Sample Receipt:

☐ No. of containers correct ☐ received good condition/cold

☐ custody seals secure ☐ conforms to COC document

Shipment Method: _____

Send Results to: _____

☐ 2365 NORTHSIDE DRIVE, SUITE C-100 SAN DIEGO, CA 92108 (619) 521-0155

☐ 1400 EAST SOUTHERN AVENUE, SUITE 620 TEMPE, AZ 85282 (480) 345-0888

☐ 1820 EAST RIVER ROAD, SUITE 100 TUCSON, AZ 85718 (520) 881-7300

Send invoice to San Diego, CA
Attn: Accounts Payable

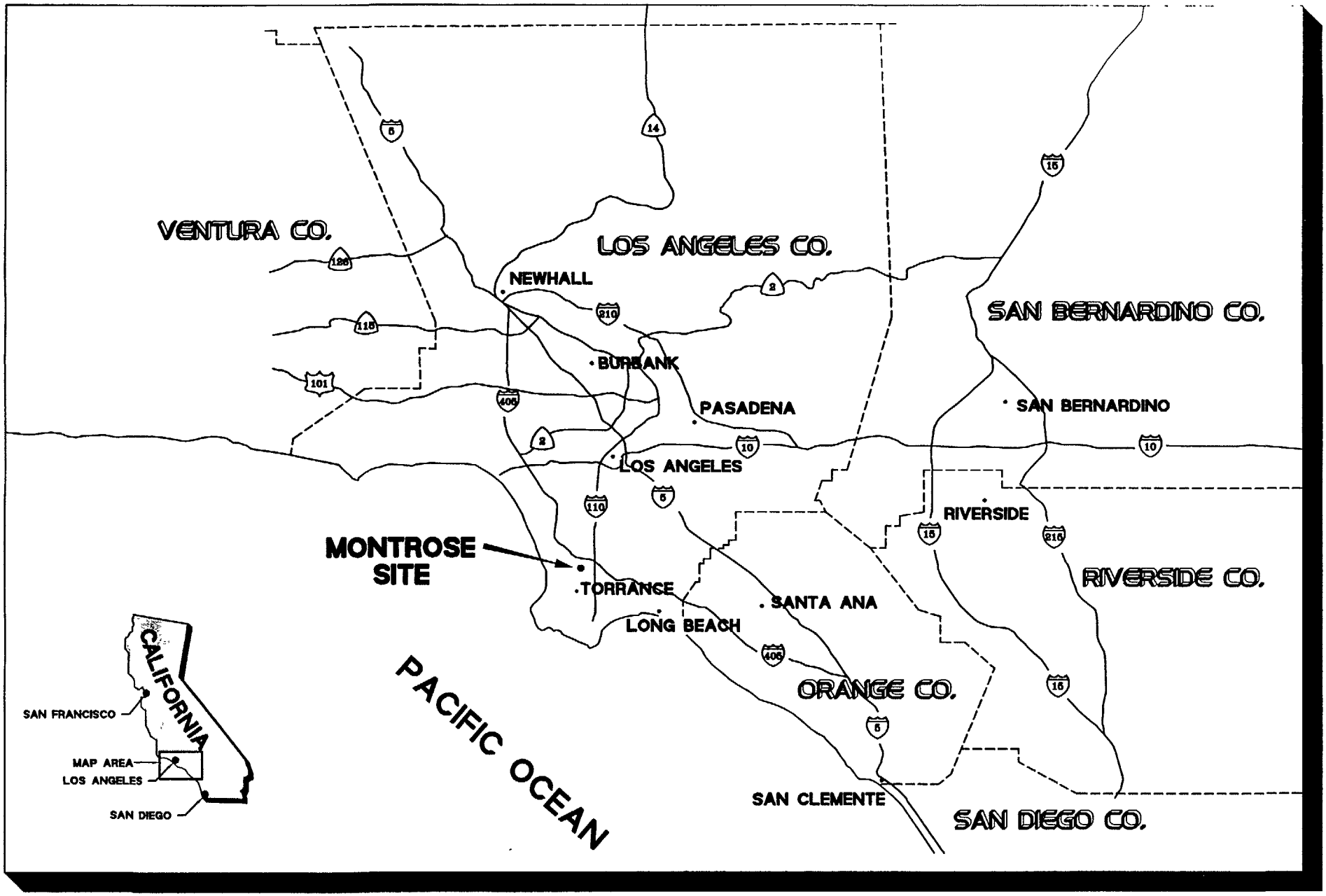
ORIGINAL: LABORATORY YELLOW: QA MANAGER PINK: FIELD/TASK MANAGER

TABLE A-20

SAMPLE IDENTIFICATION LABEL

HARGIS + ASSOCIATES, INC.
Mission City Corporate Center
2365 Northside Drive, Suite C-100
San Diego, CA 92108
Phone: 619.521.0165

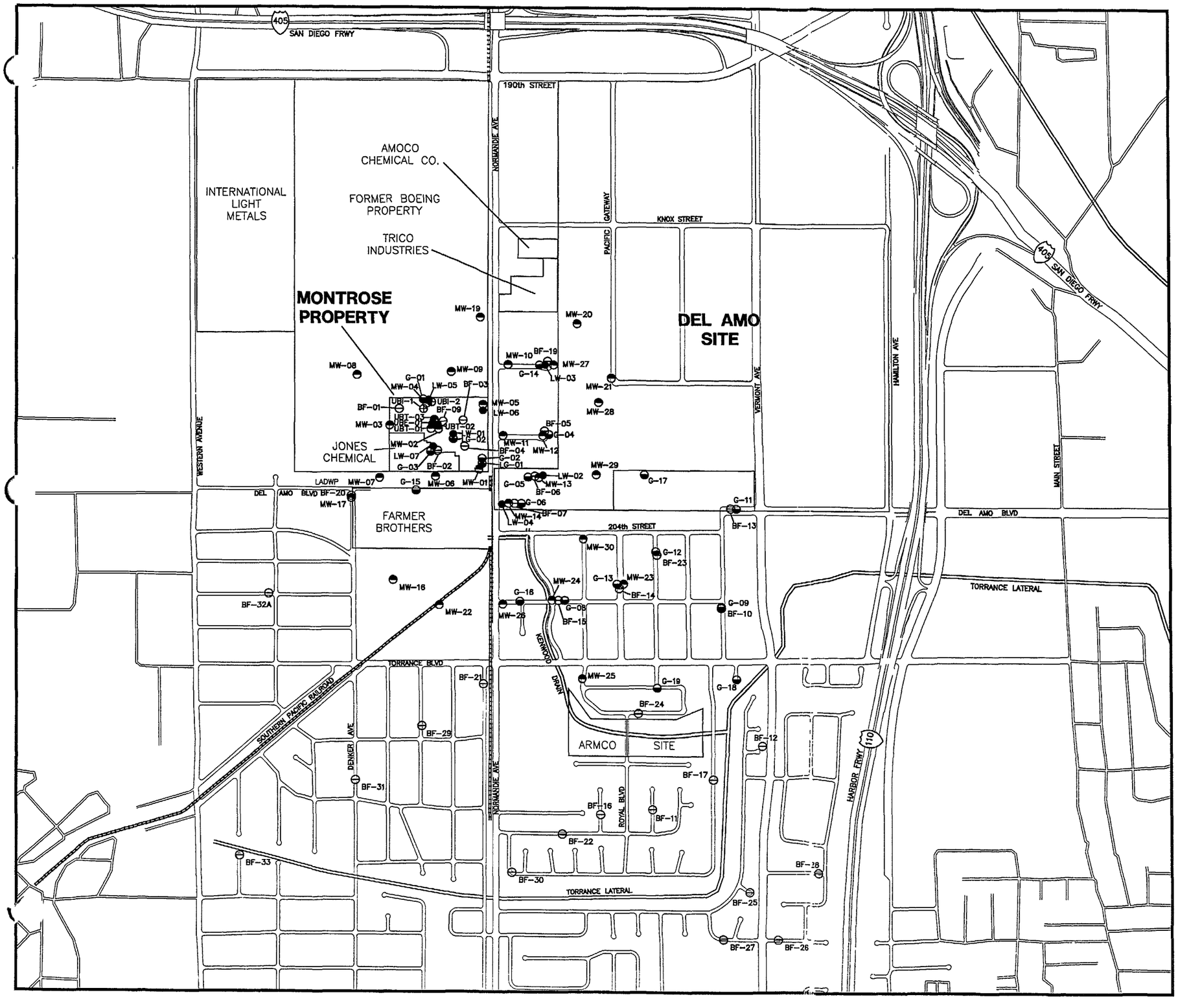
Client	Date
H+A Project No.	Sample ID
Initials	Time
Analyze for:	
Preservative/Special Instructions:	



HARGIS + ASSOCIATES, INC.

RPT NO. 857.13a	410-4185	A

FIGURE A-1. SITE LOCATION



EXPLANATION

MW-25	UPPER BELLFLOWER AQUITARD MONITOR WELL
UBE-1	UPPER BELLFLOWER AQUITARD EXTRACTION WELL
UBT-3	UPPER BELLFLOWER AQUITARD OBSERVATION WELL
UBI-1	UPPER BELLFLOWER AQUITARD INJECTION WELL
BF-17	BELLFLOWER SAND MONITOR WELL
G-7	GAGE AQUIFER MONITOR WELL
LW-7	LYNWOOD AQUIFER MONITOR WELL

NOTE: THIS MAP SHOWS LOCATIONS FOR MONITOR WELLS CONSTRUCTED BY MONTROSE DURING REMEDIAL INVESTIGATION ACTIVITIES AND DOES NOT INCLUDE MONITOR WELLS AND EXPLORATORY BORINGS CONSTRUCTED BY OTHERS FOR OTHER INVESTIGATIONS.

0 1,000 2,000

FEET

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA

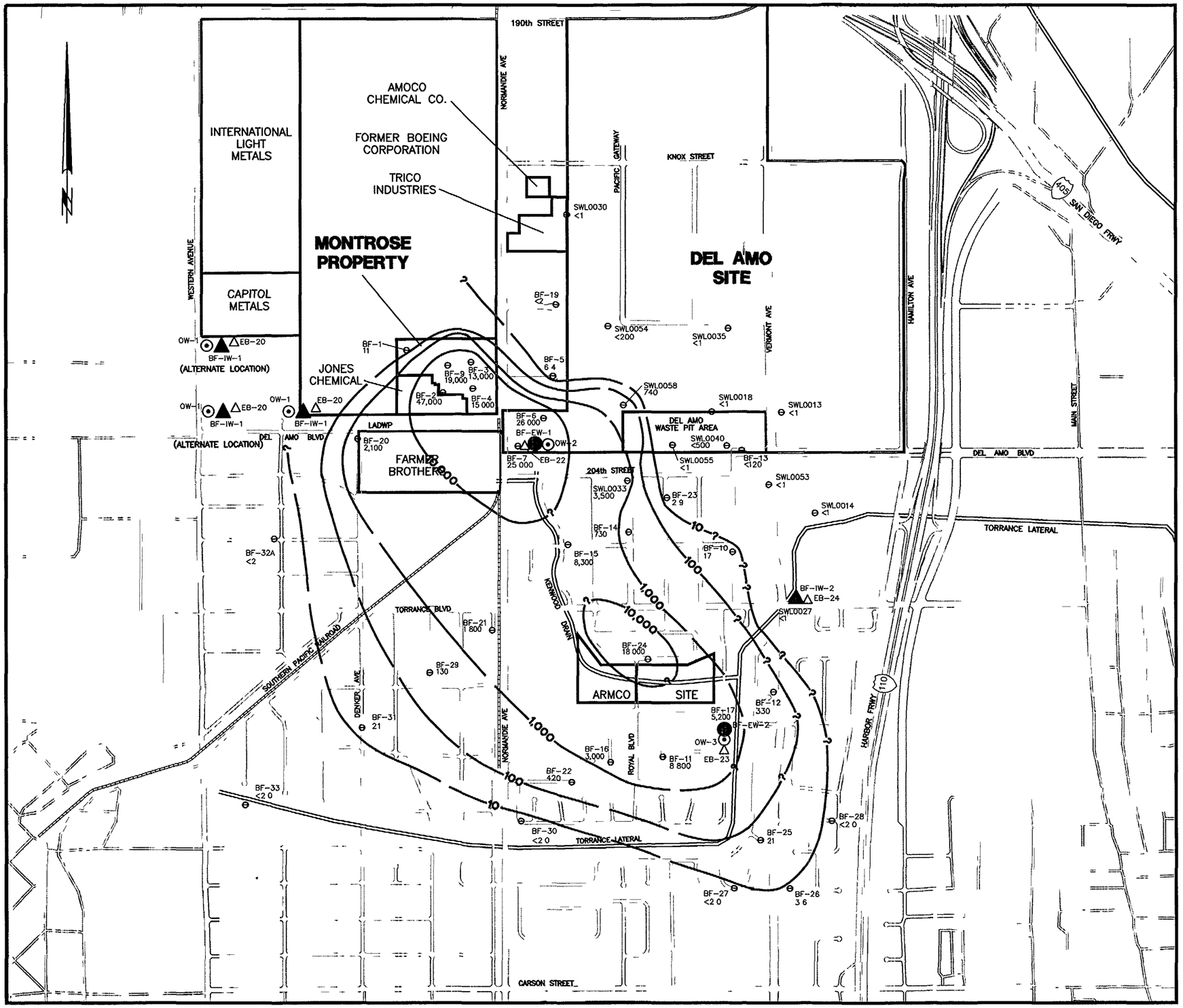
TORRANCE, CALIFORNIA

MONITOR WELL LOCATIONS

05/04

FIGURE A-2

PREP BY SPN	REV BY MAP	RPT NO 857 38	410-4696	A



EXPLANATION

BF-15 ⊖	BELLFLOWER SAND MONITOR WELL
8,300	CONCENTRATION IN MICROGRAMS PER LITER
▲	PROPOSED PILOT TEST INJECTION WELL
●	PROPOSED PILOT TEST EXTRACTION WELL
⊙	PROPOSED OBSERVATION WELL
△	PROPOSED EXPLORATORY BORING

?———— 100 ——— ——?

CONTOUR LINE OF EQUAL CONCENTRATION OF CHLOROBENZENE IN MICROGRAMS PER LITER DASHED WHERE APPROXIMATE, QUERIED WHERE INFERRED BASED ON MOST RECENT SAMPLING RESULTS

< = LESS THAN; NUMERICAL VALUE IS THE LIMIT OF DETECTION FOR THIS ANALYSIS.

WELL IDENTIFIER NOTES
BF = MONTROSE MONITOR WELLS
SWL = DEL AMO MONITOR WELLS

NOTE. CONCENTRATION DATA FOR DEL AMO MONITOR WELLS PROVIDED BY URS, 2004.

WATER QUALITY DATA PRESENTED ON THIS MAP ARE THE MOST RECENT DATA AVAILABLE FOR EACH WELL AS OF JANUARY 2004. DATA FOR MONTROSE WELLS WERE SUPPLEMENTED WITH AVAILABLE DATA OBTAINED BY OTHERS FROM NON-MONTROSE MONITOR WELLS LOCATED IN THE SITE VICINITY.

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

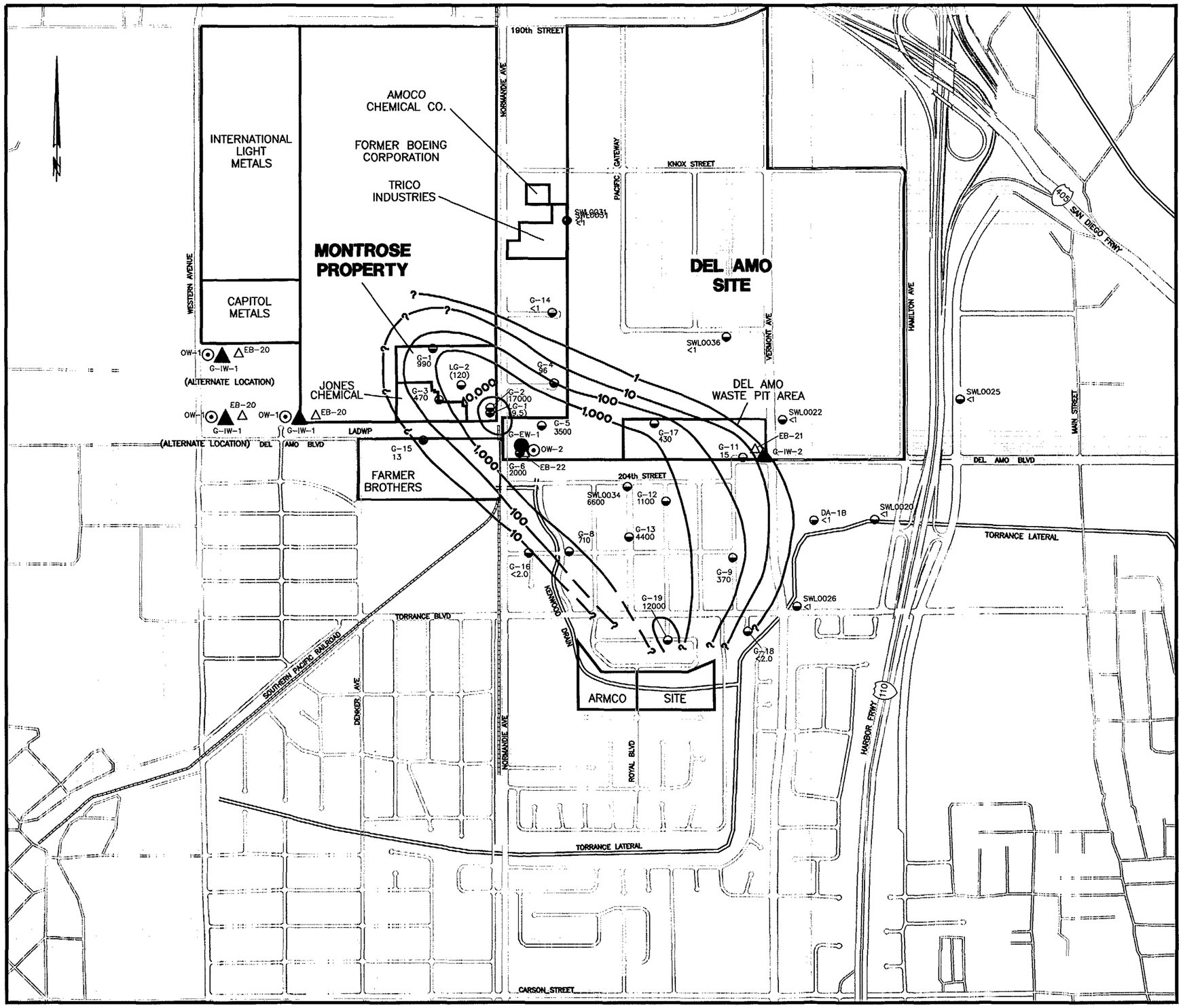
PROPOSED PILOT TEST EXTRACTION-INJECTION WELL LOCATIONS BELLFLOWER SAND

HARGIS + ASSOCIATES, INC
Hydrogeology/Engineering

10/04

FIGURE A-3

PREP BY PSR REV BY MAP RPT NO 857 38 | 410-4650 | B



EXPLANATION

G-4	GAGE AQUIFER MONITOR WELL
96	CONCENTRATION IN MICROGRAMS PER LITER
LG-2	LOWER GAGE AQUIFER MONITOR WELL
(309)	(CONCENTRATION NOT CONTOURED)
▲	PROPOSED PILOT TEST INJECTION WELL
●	PROPOSED PILOT TEST EXTRACTION WELL
⊙	PROPOSED OBSERVATION WELL
△	PROPOSED EXPLORATORY BORING

?——— 100 ——— ——?
CONTOUR LINE OF EQUAL CONCENTRATION OF CHLOROBENZENE IN MICROGRAMS PER LITER DASHED WHERE APPROXIMATE, QUERIED WHERE INFERRED BASED ON MOST RECENT SAMPLING RESULTS.

< = LESS THAN; NUMERICAL VALUE IS THE LIMIT OF DETECTION FOR THIS ANALYSIS.

WELL IDENTIFIER NOTES:
G AND LG = MONTROSE MONITOR WELLS
DA AND SWL = DEL AMO MONITOR WELLS

NOTE: CONCENTRATION DATA FOR DEL AMO MONITOR WELLS PROVIDED BY URS, 2004.

WATER QUALITY DATA PRESENTED ON THIS MAP ARE THE MOST RECENT DATA AVAILABLE FOR EACH WELL AS OF JANUARY 2004. DATA FOR MONTROSE WELLS WERE SUPPLEMENTED WITH AVAILABLE DATA OBTAINED BY OTHERS FROM NON-MONTROSE MONITOR WELLS LOCATED IN THE SITE VICINITY.

0 1,000 2,000
FEET

MONTROSE CHEMICAL CORPORATION OF CALIFORNIA
TORRANCE, CALIFORNIA

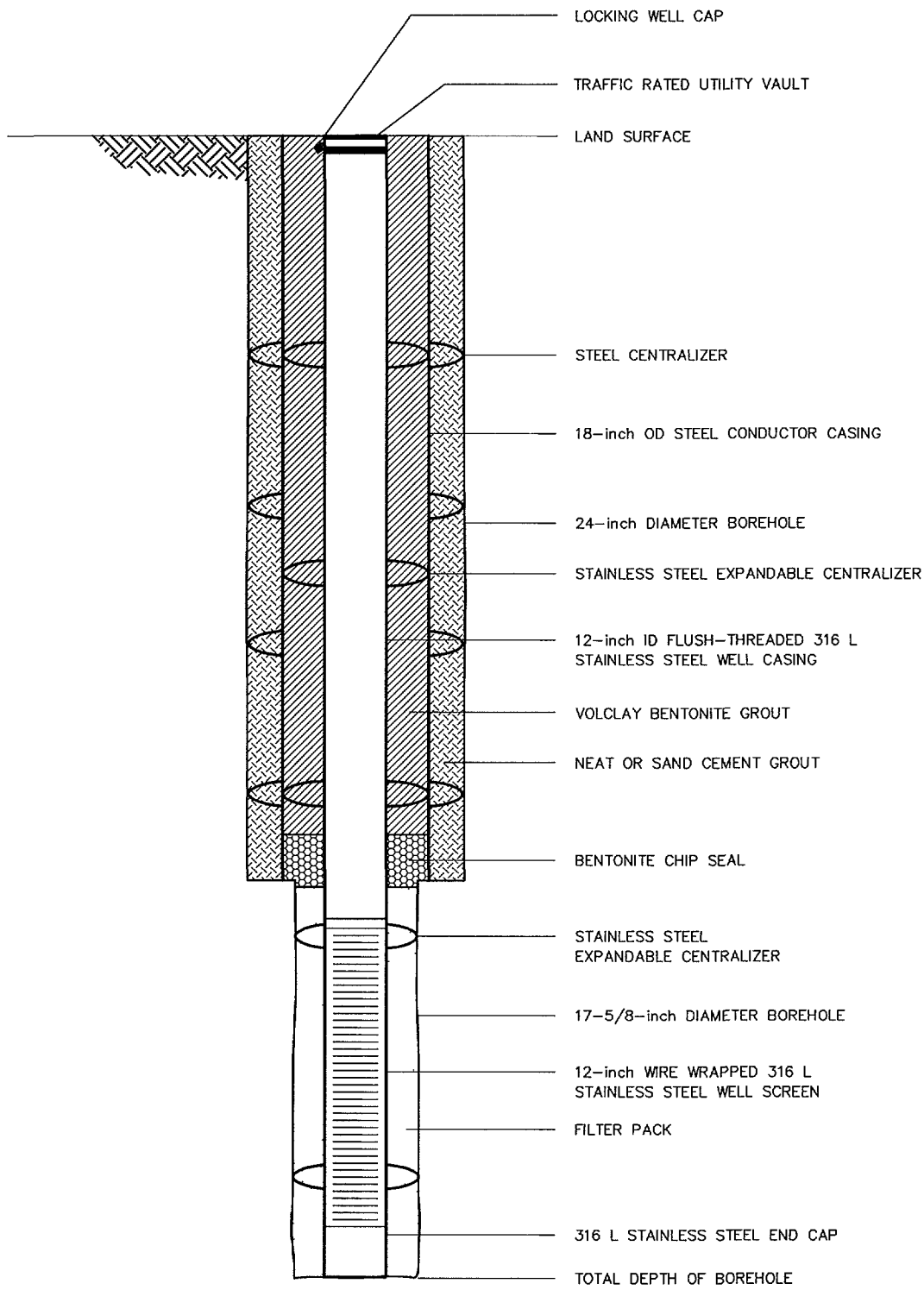
PROPOSED PILOT TEST EXTRACTION-INJECTION WELL LOCATIONS GAGE AQUIFER

HARGIS + ASSOCIATES, INC.
Hydrogeology/Engineering

10/04

FIGURE A-4

PREP BY PSR REV BY MAP RPT NO. 857.38 | 410-4651 | B



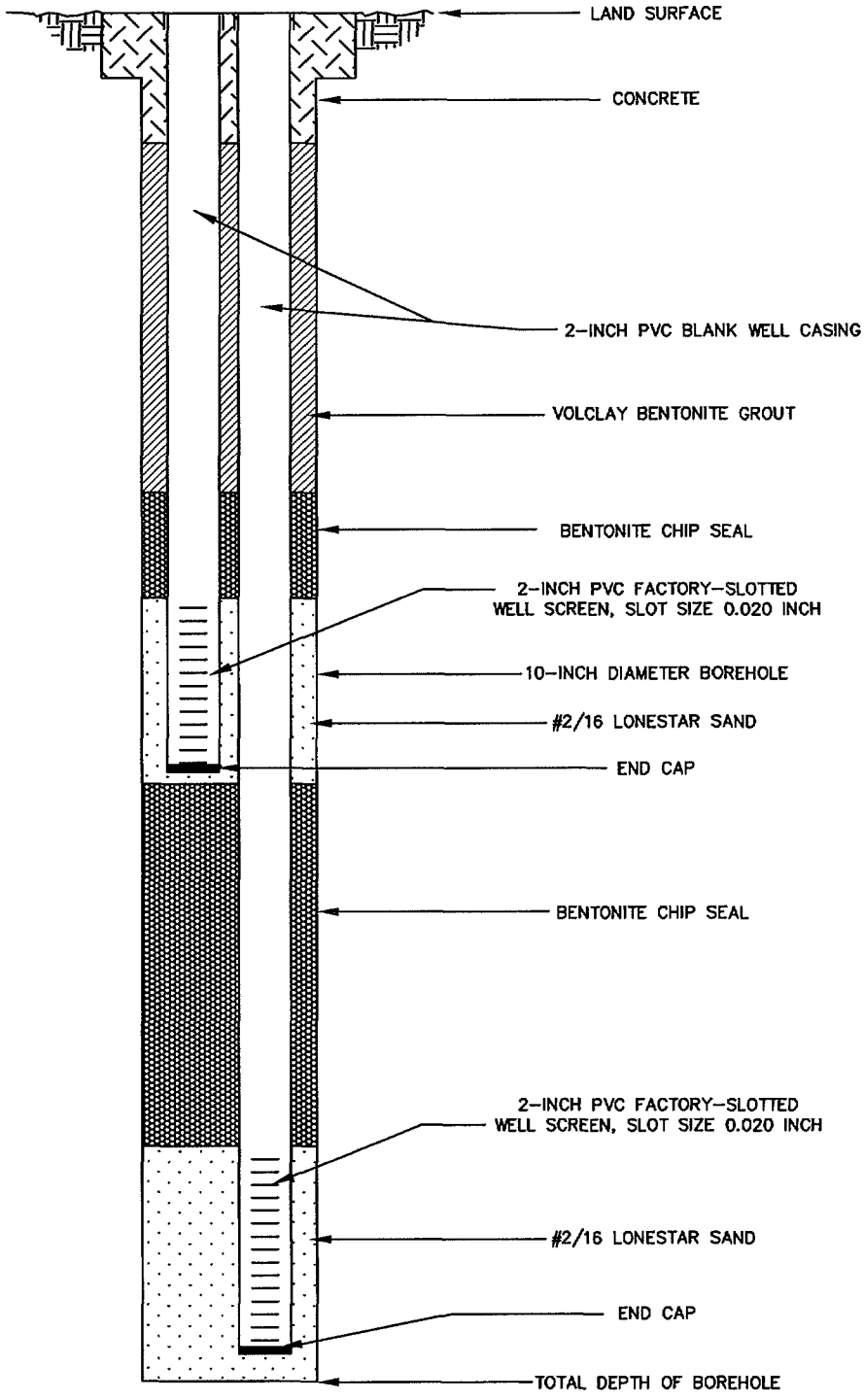
NOTES:

DRAWING NOT TO SCALE
OD = OUTER DIAMETER
ID = INNER DIAMETER
PVC = POLYVINYL CHLORIDE

HARGIS+ASSOCIATES, INC

10/04	RPT NO 857.38	710-0397	B

FIGURE A-5. SCHEMATIC CONSTRUCTION DIAGRAM PILOT EXTRACTION-INJECTION WELL

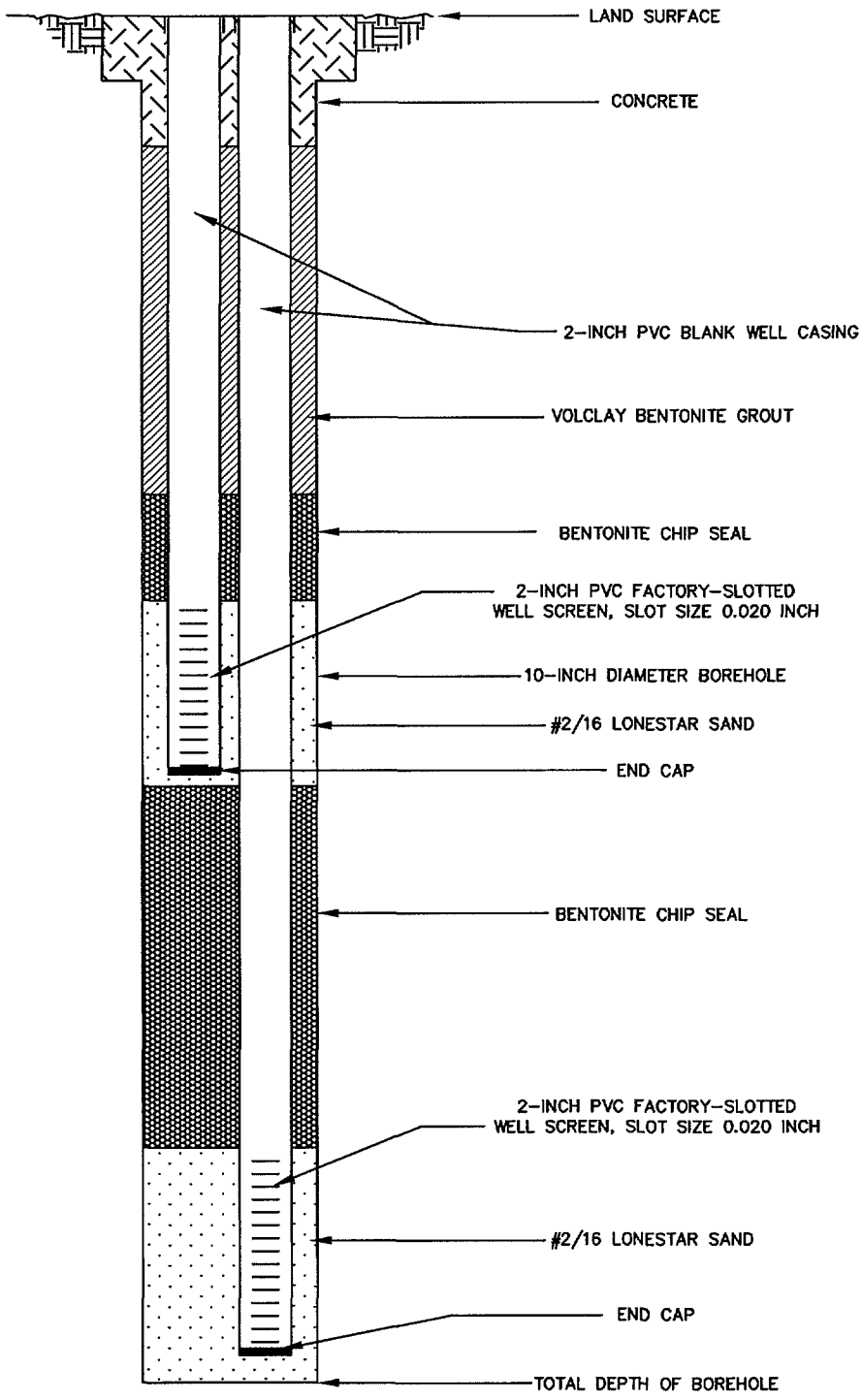


NOT TO SCALE

HARGIS + ASSOCIATES, INC

10/04	RPT NO. 857.38	710-0398	B

FIGURE A-6. SCHEMATIC CONSTRUCTION DIAGRAM OBSERVATION WELL CLUSTER

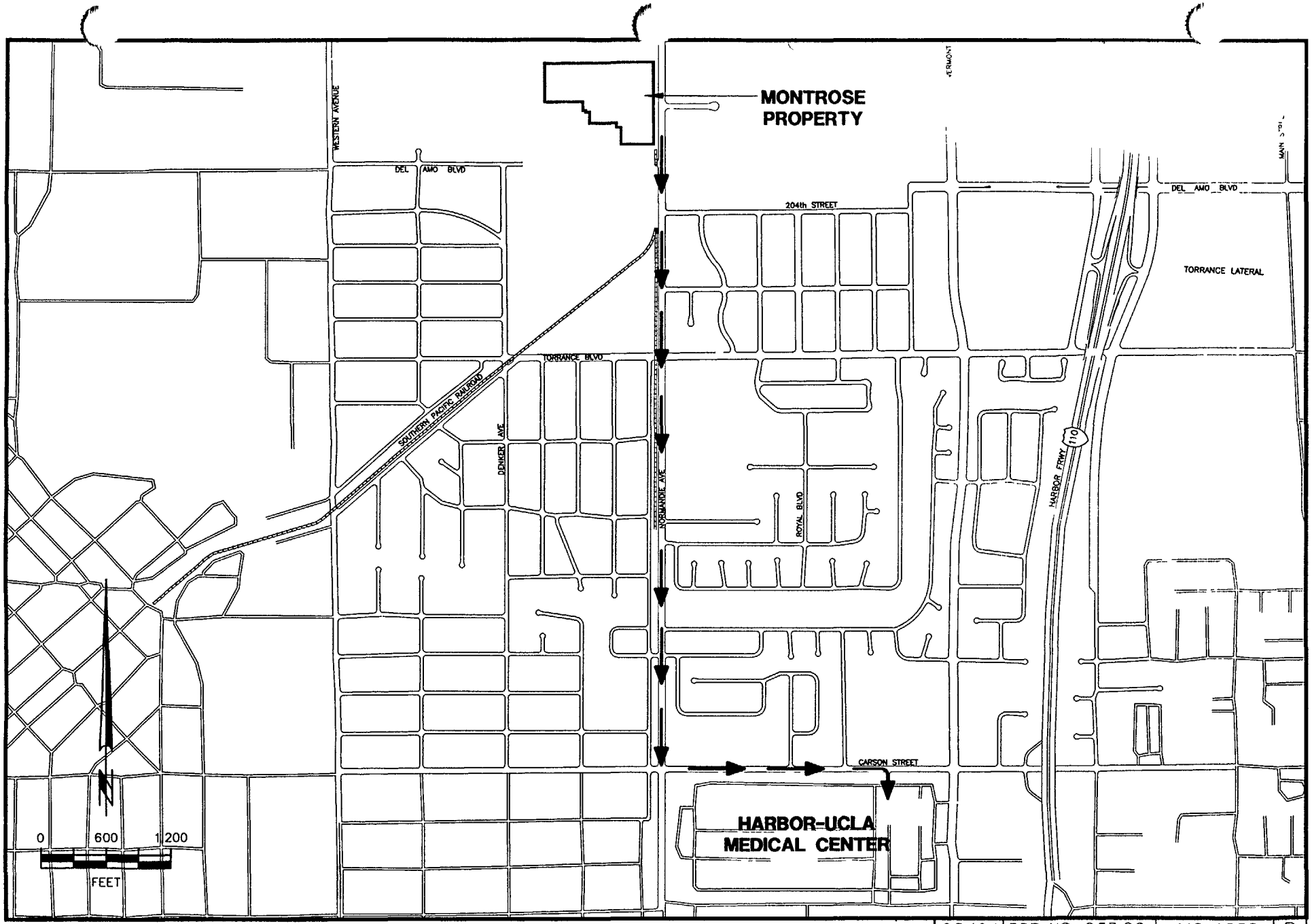


NOT TO SCALE

HARGIS+ASSOCIATES, INC

10/04	RPT NO. 857.38	710-0398	B

FIGURE A-6. SCHEMATIC CONSTRUCTION DIAGRAM OBSERVATION WELL CLUSTER



HARGIS + ASSOCIATES, INC
Hydrogeology/Engineering

05/04	RPT NO 857 38	410-4653	B

FIGURE A-7. ROUTE TO HOSPITAL

APPENDIX B

QUALITY ASSURANCE PROJECT PLAN
PILOT EXTRACTION AND AQUIFER RESPONSE TEST
MONTROSE SITE
TORRANCE, CALIFORNIA

APPENDIX B

QUALITY ASSURANCE PROJECT PLAN
PILOT EXTRACTION AND AQUIFER RESPONSE TEST
MONTROSE SITE
TORRANCE, CALIFORNIA

TITLE AND APPROVAL SHEET

Workplan Title:	Workplan for Pilot Extraction and Aquifer Response Test
Site Name	The Montrose Superfund Site
Site Location:	20201 S. Normandie Avenue
City, State:	Los Angeles, California
Site EPA ID#:	CAD 008 242 711
Anticipated Fieldwork Dates:	2004
Prepared By:	Michael A. Palmer, RG 5915, CHG 146
Date:	June 2004
Firm:	Hargis + Associates, Inc.
Address:	2365 Northside Drive, Suite C-100
City, State, Zip Code:	San Diego, California 92108
Telephone:	(619) 521-0165

Approved _____ _____
Hargis + Associates, Inc. Project Manager Date

Approved _____ _____
Hargis + Associates, Inc. Quality Assurance Manager Date

Approved _____ _____
EPA Remedial Project Manager Date

Approved _____ _____
EPA Quality Assurance Officer Date

Approved _____ _____
EPA Region IX Quality Assurance Reviewer Date

APPENDIX B

QUALITY ASSURANCE PROJECT PLAN
PILOT EXTRACTION AND AQUIFER RESPONSE TEST
MONTROSE SITE
TORRANCE, CALIFORNIA

DISTRIBUTION LIST

_____ Jeff Dhont, EPA Region IX Remedial Project Manager

_____ Joe Kelly, Montrose Chemical Corporation

_____ Paul Sundberg, Montrose Chemical Corporation

_____ Natasha Rayhkman, CH2M Hill Site Manager

_____ Mr. Steve Acree, U.S. Environmental Protection Agency

_____ Karl Lytz, Esq., Latham & Watkins

_____ Mr. John Dudley, URS Corporation

_____ Gloria Conti, Department of Toxic Substances Control

_____ Frank Gonzales, Department of Toxic Substances Control

_____ Michael A. Palmer, Hargis + Associates, Inc. Project Manager

_____ Luke Mette, Esq., Stauffer Management Company, LLC

_____ Mr. Lee Erickson, Stauffer Management Company, LLC

APPENDIX B

QUALITY ASSURANCE PROJECT PLAN
PILOT EXTRACTION AND AQUIFER RESPONSE TEST
MONTROSE SITE
TORRANCE, CALIFORNIA

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ATTACHMENTS

Attachment	
B-1	DEL MAR ANALYTICAL QUALITY ASSURANCE PROGRAM MANUAL (CD ROM)
B-2	WEST COAST ANALYTICAL SERVICE, INC. QUALITY ASSURANCE MANUAL (CD ROM)
B-3	PTS LABORATORIES, QUALITY ASSURANCE MANUAL (CD ROM)

ACRONYMS AND ABBREVIATIONS

BHC	Hexachlorocyclohexane
CLP	Contract Laboratory Program
DDT	Dichlorodiphenyltrichloroethane
DMA	Del Mar Analytical, Inc., Irvine, California
DO	Dissolved oxygen
DQOs	Data Quality Objectives
DVPs	Data validation packages
EC	Electrical conductivity
EPA	U.S. Environmental Protection Agency
FSP	Field sampling plan
H+A	Hargis + Associates, Inc.
ISGS	In-situ Groundwater Standards
LCS	Laboratory Control Sample
LDC	Laboratory Data Consultants, Carlsbad, California
MDLs	Method Detection Limits
Montrose	Montrose Chemical Corporation of California
MS	Matrix spike
MSDs	Matrix spike duplicates
msl	Mean sea level
NPDES	National Pollutant Discharge Elimination System
NTUs	Nephelometric Turbidity Units
PARCC	Precision, accuracy, representativeness, completeness, and comparability
pCBSA	para-Chlorobenzene sulfonic acid
%R	Percent recovery
QAPP	Quality Assurance Project Plan
QA/QC	Quality assurance/quality control
RD	Remedial Design
RI	Remedial Investigation
RPD	Relative percent difference
the Site	Montrose Chemical Corporation of California Site

ACRONYMS AND ABBREVIATIONS (continued)

SOPs	Standard Operating Procedures
SOW	Statement of Work
SDG	Sample Delivery Group
UAO	Unilateral Administrative Order
VOCs	Volatile organic compounds
WCAS	West Coast Analytical Service, Inc., Santa Fe Springs, California
Workplan	Workplan for Pilot Extraction and Aquifer Response Testing

APPENDIX B

QUALITY ASSURANCE PROJECT PLAN
PILOT EXTRACTION AND AQUIFER RESPONSE TEST
MONTROSE SITE
TORRANCE, CALIFORNIA

1.0 INTRODUCTION

This Quality Assurance Project Plan (QAPP) has been prepared for Montrose Chemical Corporation of California (Montrose) in accordance with the requirements outlined in Section 4 of the Unilateral Administrative Order (UAO) Statement of Work (SOW) (U.S. Environmental Protection Agency [EPA], 2004). This QAPP has been prepared for data obtained as part of the model refinement program which includes the pilot extraction and aquifer response test.

1.1 DEFINITION OF TERMS

To facilitate the discussion within this document, several defined terms are used as described below. For clarity of discussion only, this QAPP will refer to the "Property" as the area within the fenced property boundary located at 20201 South Normandie Avenue, in Los Angeles, near Torrance, California. The term "central process area" refers to an approximate two-acre portion of the Property where most of the manufacturing operations were historically performed.

The term dichlorodiphenyltrichloroethane (DDT), or total DDT, will be used to refer to the sum of the isomers and metabolites of DDT. The term hexachlorocyclohexane (BHC), or total BHC, will be used to refer to the sum of the isomers of BHC.

1.2 OBJECTIVES

In accordance with the UAO SOW Section 4, the objectives of the pilot extraction and aquifer response test program are to:

- Obtain data regarding the response of the hydrostratigraphic system to the stress of pumping and injection on a scale approaching that to be used in the full-scale production wells.

- Obtain more reliable estimates of aquifer transmissivity, hydraulic conductivity, storativity, and aquitard leakance that can be used to improve the reliability of the groundwater model and well field simulations.

- Obtain data regarding the radius of influence, and capture zones likely to be achieved by full scale extraction wells.

- Obtain information about injection rates for full-scale injection wells and evaluate injection well plugging issues.

- Provide information needed to develop specifications for extraction and injection wells, treatment system, piping and control systems, and facilitate the design of these physical systems upon completion of the modeling and wellfield optimization.

1.3 SUPPORTING DOCUMENTS

This QAPP was developed in accordance with the EPA guidance document "EPA Guidance for Quality Assurance Project Plans, Document Control No. EPA QA/G-5" (EPA, 1998a). Site-specific documentation is also provided in the Final Remedial Investigation (RI) Report for the Montrose Superfund Site, Los Angeles, California" (EPA, 1998b), in the accompanying Workplan for Pilot Extraction and Aquifer Response Test, Montrose Site, Torrance, California

Workplan), and the Field Sampling Plan (FSP), Pilot Extraction and Aquifer Response Test, Montrose Site, Torrance, California (Appendix A to the Workplan).

2.0 PROJECT MANAGEMENT

The following QAPP sections cover the general areas of project management, project history, objectives, and roles and responsibilities of the project participants.

2.1 PROJECT ORGANIZATION

A project organization chart lists Hargis + Associates, Inc. (H+A), EPA, and subcontractor personnel responsible for implementation of field and laboratory QA activities (Figure B-1). QA activities at the Montrose Site (Site) will be overseen by a QA team comprising the following project personnel: Project Manager, Technical Directors, QA Managers, Field Task Managers, and Laboratory Project Managers. The QA team is responsible for ensuring that valid measurement data are obtained and for routinely verifying field and laboratory data. The following sections describe the roles and responsibilities of the individual members of the QA team.

2.1.1 Project Manager

The Project Manager is responsible for general project supervision, including reviewing the activities of the QA Managers and the Field Task Managers. The Project Manager will directly perform or supervise the performance of the following:

- Coordinate and oversee project-related activities and data management.
- Ensure that the procedures specified in this QAPP as well as the supporting Workplan and FSP are implemented and that activities conducted at the Site meet stated objectives.

- Determine sampling and analytical strategies with the assistance of the QA team.
- Ensure that data meet project-specific objectives.
- Review data quality verification results.
- Assess and approve project documents.
- Approve, designate, and monitor corrective action of field and office activities, as needed.
- Act as the H+A liaison to Montrose and EPA.

2.1.2 EPA Project Manager

The EPA Project Manager bears overall responsibility for the direction of the scope of work to be performed for the project. The EPA Project Manager will provide final review and approval of this QAPP, the supporting Workplan and FSP, as well as the reports generated upon conclusion of field work. The EPA Project Manager will provide coordination of the overall project and will provide consultant overview and direction.

2.1.3 Technical Directors

Technical Directors will review field, laboratory, and office procedures to ensure compliance with the standard operating procedures (SOPs) designated in this QAPP and the supporting Workplan and FSP. Technical Directors will assist the Project Manager as needed to evaluate data quality with respect to project objectives and to interpret data generated.

2.1.4 Quality Assurance Managers

The H+A QA Manager is responsible for informing field personnel of the QC practices to be employed prior to field work; performing and overseeing quality assurance/quality control (QA/QC) functions throughout field and laboratory activities; and communicating QA/QC status and requirements to the Project Manager and, if required, to Technical Directors. The QA Manager will directly perform or supervise the performance of the following:

- Coordinate QA/QC functions with the Project Manager.
- Review and approve QA/QC documents pertaining to Site activities.
- Assess and approve modifications to this QAPP, as necessary, and distribute modifications to project participants.
- Coordinate field sampling efforts with the analytical laboratory.
- Maintain a record of samples submitted for analysis to the laboratory, the analyses performed, and the final results.
- Ensure that proper sample custody procedures are followed.
- Review chain-of-custody records and sample transmittal documents for completeness.
- Ensure that appropriate field measurement data and analytical laboratory data are entered, stored, and maintained.
- Perform the verification and validation of the quality of data and review analytical results with project personnel.
- Monitor progress in correcting laboratory deficiencies, if necessary.

The H+A QA Manager and other members of the QA team will be assisted as needed by a consulting QA Manager employed by Laboratory Data Consultants, Carlsbad, California (LDC). The LDC QA Manager will review verification and validation of the quality of data to assure that Data Quality Objectives (DQOs) have been met for the designated project.

The EPA Project QA Officer will review QA documents, including QAPPs submitted pursuant to a task assignment. The EPA Project QA Officer will provide comments and recommendations to the EPA Project Manager regarding appropriate methodologies, reporting limits, sampling, and preservation techniques, DQOs, and other chemistry-related issues. The EPA Project QA Officer will perform data validation tasks or will assign and supervise EPA data validation tasks as requested by the EPA Project Manager.

2.1.5 Field Task Managers

Field Task Managers are responsible for overseeing field activities, communicating field activities with the Project Manager, and coordinating sampling efforts with the H+A QA Manager and the analytical laboratories. The Field Task Managers, to be assigned prior to scheduled activities, will perform the following:

- Contact off-site private property or facility owners and obtain permission to conduct field activities, if required.

- Coordinate field activities with permitting agencies and subcontractors and establish contractual agreements, as necessary.

- Provide training for field personnel, as necessary. Training may include extraction and injection testing, water level measurement, sample collection procedures, and decontamination procedures. Field Task Managers and field personnel will be required to be in compliance with applicable H+A health and safety requirements, as well as Occupational Safety and Health Administration training requirements for hazardous waste sites.

- Coordinate field efforts with field personnel and the H+A QA Manager.

- Designate sampling locations and assign sample identifiers for associated QC samples, which will be comprised of trip blanks, field blanks, duplicate samples, and laboratory split samples.

- Ensure that field supplies and equipment, including sampling equipment, containers, labels, custody seals, preservatives, and shipping supplies necessary to properly sample wells, are available and are in good working order.

- Assure that field personnel adhere to the procedures documented in this QAPP unless field conditions require project modifications.

- Review field notebooks and ensure that appropriate field data forms are complete and correct.

- Coordinate corrective action for field activities, as necessary.

2.1.6 Laboratory Project Managers

The Laboratory Project Manager ensures laboratory resources are available; reviews final analytical reports produced by the laboratory; reviews and approves the laboratory QA manual; coordinates scheduling of laboratory analyses; and supervises in-house chain-of-custody procedures. Laboratories specified for this project are Del Mar Analytical, Inc., Irvine, California (DMA), West Coast Analytical Services, Inc., Santa Fe Springs, California (WCAS), and PTS Laboratories, Santa Fe Springs, California.

2.2 PROBLEM DEFINITION AND BACKGROUND

2.2.1 Purpose

This QAPP has been prepared to support field and laboratory activities for the pilot extraction

and aquifer response testing conducted as part of the model refinement program.

2.2.2 Problem Statement

EPA has prepared a Draft Modeling Work Plan outlining a comprehensive groundwater modeling program leading to the development of the final design for the remediation wellfield. A significant component of the modeling effort will be focused on conducting iterative simulations to assess and account for the uncertainties inherent in the model with the goal of achieving a wellfield design which will meet the Record of Decision cleanup criteria. Uncertainties in the model and the subsequent remedial wellfield design can be minimized by obtaining field performance data through a program of phased installation and testing of groups of full-scale extraction and injection wells. The extraction and injection wells will be designed and constructed in a manner that would allow them to be incorporated into the final remediation wellfield.

This approach will provide data regarding extraction and injection well performance as well as data regarding aquifer and aquitard response, which will reduce uncertainties in the modeling and lead to a more robust and cost effective RD. Injection and extraction well specific capacity and yield has a direct bearing on the number of wells that may be required to meet remedial objectives, and therefore this information is critical to the wellfield design. In addition, data would be obtained during the pilot testing program from surrounding monitor wells completed in the extraction and injection zones as well as the adjacent aquitards. This monitoring data, once incorporated into the model, will significantly reduce the uncertainty in the model results, resulting in a more reliable wellfield design.

2.2.3 Physical Setting

The Property occupies approximately 13 acres in the City of Los Angeles near Torrance, California (Figure B-2). The Property is bounded by the Union Pacific Railroad right-of-way and Normandie Avenue to the east; Jones Chemical Company and a right-of-way owned by the Los Angeles Department of Water and Power to the south; former Boeing Realty Corporation to the

north, and Frito-Lay to the west. The Montrose property is generally level. Elevations range from 40 feet above mean sea level (msl) to 45 feet msl. The surrounding area consists of mixed residential, commercial, and industrial facilities. The Property is accessible by city streets in the area and Interstates 405 and 110. The Los Angeles International Airport is located approximately 10 miles from the Property.

2 2 4 Site History and Past Investigations

Montrose manufactured DDT at the Site from 1947 to 1982. The facility was closed in 1982 and the Site was subsequently cleared and capped with asphalt. Previous investigations addressing the potential for contamination at the Site included on- and off-property sampling of soil, groundwater, sediment, and surface water. The investigations were performed by the EPA, its contractors, the California Department of Health Services, the Regional Water Quality Control Board, and Montrose's consultants. The RI Report provides a detailed summary of the Site history (EPA, 1998b).

Groundwater monitoring has been conducted by Montrose since 1985. A total of 97 monitor and extraction/test/injection wells were originally constructed as part of RI activities conducted by Montrose to evaluate the nature and extent of Montrose-related compounds in groundwater. A number of monitor wells have been destroyed by different entities during construction, grading, or paving activities on surrounding properties. Presently there are 85 monitor wells and 6 extraction/test/injection wells at the Site.

Previous groundwater investigations at the Site are summarized in the RI report, Section 2.5 of this Workplan, and Section 2.5 of the supporting FSP (Appendix A) (EPA, 1998b). Groundwater data obtained from these previous investigations are contained in the Montrose groundwater database. The geologic setting, stratigraphy, and hydrogeologic conditions at and in the vicinity of the Site as determined by previous investigations are described in Sections 2.2 and 2.3 of the supporting FSP (Appendix A).

2 2 5 Data Needs and Uses

Data needs and uses for the objectives have been identified through the data quality objective process presented in Section 2.4. Date is needed to supplement existing RI data, which will be used in the RD wellfield modeling. Appropriate detection limits are based on project needs, applicable regulatory requirements and available methodology.

2 3 TASK DESCRIPTION AND SCHEDULE

The model refinement program field tasks and proposed schedule are summarized in the following QAPP sections.

2 3.1 Description of Work to be Performed

Field tasks for the pilot extraction and aquifer response testing program will consist of extraction, injection, and observation well installation, water level measurement, groundwater sampling, and aquifer response testing. Additional details regarding the scope of this work may be found in the associated Workplan or FSP.

2.3.2 Schedule of Activities

A proposed schedule for the model refinement program field activities is provided in the Workplan. Model refinement field activities are scheduled to be initiated in 2004.

2.4 DATA QUALITY OBJECTIVES

The DQOs for the pilot extraction and aquifer response test were developed in accordance with the EPA guidance document "Guidance for the Data Quality Objectives Process", EPA QA/G-4 (EPA, 2000). The DQO process outlined in the EPA guidance is designed to provide systematic planning in data collection efforts. The data collection efforts resulting from such planning

should support the decision making process. This section of the QAPP is designed to parallel the EPA guidance for the DQO process to the extent possible. Therefore, this section will discuss the steps specified in the DQO process as outlined in the EPA guidance (EPA, 2000). As described by EPA, the DQO process is especially designed to address problems that require making a decision between two clear alternatives. However, the principles used in the DQO process are also applicable to programs with objectives other than decision making, such as the Pilot Extraction and Aquifer Response test. The basic steps in the DQO process are:

1) State the Problem
2) Identify the Decision
3) Identify the Inputs to the Decision
4) Define the Boundaries of the Study
5) Develop a Decision Rule
6) Specify Tolerable Limits on Decision Errors
7) Optimize the Design for Obtaining Data

2.4.1 State the Problem

The first step of the DQO process, State the Problem, has already been presented in Section 2.2.2 of this QAPP

2.4.2 Identify the Decision

As noted in the EPA guidance, the DQO process is particularly designed to address problems that require making a decision between two clear alternatives. However, the principles of systematic planning and the DQO process are applicable to all scientific studies (EPA, 2000). Therefore, the DQO process will be applied to this phase of data collection to the extent practicable.

As part of the decision process, the planning team and decision makers should be identified. For this project, the members of the planning team include hydrogeologists from H+A, Montrose

Chemical Corporation personnel, and EPA personnel including the Remedial Project Manager and Quality Assurance Management Section representatives. Decisions will be made by consensus between the EPA, Montrose, and H+A.

The planning team has determined that additional aquifer property data such as transmissivity, hydraulic conductivity, storativity, and aquifer leakance are required to refine the model to meet the final RD objectives. The goal of the decision is to obtain information regarding the response of the hydrostratigraphic system to the stress of pumping and injection, and to estimate the needed aquifer property data. In addition, data will be obtained regarding the radius of influence and capture zones to be achieved by full scale extraction wells, and practical injection rates for full-scale injection wells. Data needed to develop specifications for extraction and injection wells, including injection well plugging issues will be obtained, as well as information needed for the design of treatment, piping, and control systems.

2.4.3 Identify the Inputs to the Decision

The pilot extraction and aquifer response test will consist of the extraction and injection of water, and associated water level measurements as defined in the FSP. Water levels will be measured in designated monitor wells. Groundwater samples will be collected from the newly installed extraction and injection wells prior to conducting the Pilot extraction and aquifer response test, as specified in the FSP. Groundwater samples will be analyzed for chlorobenzene and other volatile organic compounds (VOCs) using EPA Method 8260B; for para-Chlorobenzene Sulfonic Acid (pCBSA) using modified EPA Method 314.0; for organochlorine pesticides including DDT and its isomers and metabolites; BHC isomers, and other organochlorine pesticides using EPA Method 8081A.. Tables B-1 through B-7 included in this QAPP summarize the analytical methods to be used, and the analytes for each method. The following summarizes the information included in the tables:

TABLE	ANALYTICAL METHOD INFORMATION
B-1	VOCs
B-2	Organochlorine Pesticides

TABLE	ANALYTICAL METHOD INFORMATION
B-3	PCBSA
B-4	General Minerals
B-5	Other Parameters
B-6	California Title 22 Metals
B-7	Semi-Volatile Organic Compounds

2 4 4 Define Boundaries of the Study

The pilot extraction and aquifer response testing will be conducted in 2004, and will be performed utilizing newly installed extraction, injection, and observation wells, and existing monitor wells. Monitor wells are located across the Site, and are screened in the following hydrostratigraphic units:

- upper Bellflower aquitard
- Bellflower sand
- Gage aquifer
- Lynwood aquifer.

The pilot extraction and aquifer response testing will focus on the Bellflower sand and Gage aquifer. Water levels will be measured in the Montrose monitor wells as described in the FSP. Groundwater samples will be collected from the newly installed extraction, injection, and observation wells as described in the FSP.

Project specific goals for the detection limit of each analyte will be the in situ groundwater standards (ISGS). Where applicable, the ISGS for VOCs are included in Table B-1, and the ISGS for organochlorine pesticides are included in Table B-2. The project goals for accuracy, precision, and completeness are also included in Tables B-11 and B-12. The proposed methods and corresponding method detection limits have been set to be below the ISGS for VOCs and organochlorine pesticides.

The pilot extraction and aquifer response test will be implemented after EPA has approved this QAPP and the associated FSP.

2.4.5 Develop a Decision Rule

The proposed pilot extraction and aquifer response test is designed to obtain data regarding the response of the hydrostratigraphic system to the stress of pumping and injection on a scale approaching that to be used in the full scale production wells. This testing will provide a basis for future work at the site. The data developed by the pilot extraction and aquifer response test will be integral to future decisions on remedial activities.

The following provides a summary of the purposes of the pilot extraction and aquifer response test, and the associated decision:

PURPOSE	DECISION
• Additional aquifer property data will be obtained to refine the groundwater model.	• Determine the number, location, and pumping capacities of full-scale remedial wells.

2.4.6 Specify Tolerable Limits On Decision Errors

Results of this data collection and evaluation effort will provide information for future remedial decisions and activities, including the response of the hydrostratigraphic system to the stress of pumping and injection on a scale approaching that to be used in the full-scale production wells.

Although there is no specific decision that will result from the pilot extraction and aquifer response test program, acceptable limits on the data itself are discussed in the Data Acquisition section of this QAPP (Section 3.8). Previous sampling and laboratory analyses results, as summarized in the RI report, provide an estimation of aquifer properties at the Site, as well as

the expected ranges of water level elevations in the various hydrostratigraphic units underlying the Site (EPA, 1998b).

2.4.7 Optimize the Design for Obtaining Data

In accordance with the task requirements of UAO Section 4, the pilot extraction and aquifer response test will be performed to estimate aquifer properties within the modeling domain. The newly installed wells will be sampled to provide additional information regarding the distribution of contaminants at the site. To further evaluate the potential for biological plugging to occur during injection of treated water, and to support engineering studies to be conducted as part of the RD, groundwater samples will be collected from the newly installed extraction and injection wells Samples will also be obtained in accordance with the National Pollutant Discharge Elimination System (NPDES) permit for disposal of the extracted water. The locations of the wells are provided on Figures A-3 and A-4 of the FSP.

2.5 PROJECT QUALITY OBJECTIVES

The DQO process was used to ensure that the right type, quality, and quantity of aquifer property and groundwater data collected satisfy the needs of the model refinement program. Project-specific goals for each analyte reporting limit will be the ISGS. Where applicable, the ISGS for VOCs are included in Table B-1, and the ISGS for organochlorine pesticides are included in Table B-2. The project goals or data quality indicators for accuracy, precision, and completeness are also included in Tables B-1 through B-7. The proposed methods and corresponding method detection limits (MDLs) are below the ISGS for VOCs and organochlorine pesticides. The pilot extraction and aquifer response test is intended to supplement existing data for the purpose of refining the groundwater model. Sampling and analysis will also be required for NPDES permit compliance.

2.6 MEASUREMENT PERFORMANCE CRITERIA

Measurement performance criteria apply to quantitative data generated during the course of this pilot extraction and aquifer response testing program. Performance criteria for water level measurement data will be as specified in the FSP. Performance criteria for quantitative measurements, such as laboratory analytical data, will be those specified in the QA Manual published by each laboratory associated with this project (Attachments B-1 through B-2). Evaluation of data with respect to performance criteria will be conducted by the QA Manager of each laboratory, and will also be reviewed by the H+A and LDC QA Managers. Throughout the pilot extraction and aquifer response testing program activities, routine SOPs will be used to assess precision, accuracy, representativeness, completeness, and comparability (PARCC) parameters depending on the DQOs for the sampling event. Descriptions of the PARCC parameters to be evaluated are described in the following sections.

2.6.1 Precision

Precision is a measure of the agreement or reproducibility among replicate measurements. Examination of precision is a means to evaluate the reproducibility of measurements under a given set of conditions. Precision is expressed as the relative percent difference (RPD) between duplicates of the same sample. Duplicates consist of internal laboratory duplicates and external field duplicates. Internal laboratory duplicates include sample duplicates and/or matrix spike duplicates (MSDs), depending on the analytical method. Analytical results from field duplicate samples provide information on the precision of sample collection procedures. Analytical results from laboratory duplicates and laboratory MSDs provide information on laboratory precision. The RPD between duplicate sample results is calculated using the following equation:

$$RPD = \frac{(D1 - D2)}{(D1 + D2)/2} x100$$

Where:

RPD = relative percent difference

D1 = first sample value

D2 = second sample value (duplicate).

The calculated laboratory and field duplicate RPDs are evaluated and compared to established project-specific precision control limits (Tables B-1 through B-7). Unacceptable precision values will be noted in the project file. Data associated with unacceptable laboratory precision results will be qualified, and recommendations for corrective action will be discussed with the laboratory or field personnel, as appropriate.

2.6.2 Accuracy

Accuracy is the degree of agreement between a value and an accepted reference or true value. Accuracy can be expressed numerically as the percent recovery (%R) of a spiked sample. A sample spike is prepared in the laboratory by adding a known concentration of one or more chemicals to one sample in each analytical batch. The chemicals spiked are chosen from the list of analytes detectable by the method being evaluated. Analytical results from spiked samples provide data on matrix interferences and method performance.

Accuracy for the analytical measurement system is defined as the %R for a spiked sample. The %R is calculated as follows:

$$P = \frac{(A - B)\ x\ 100}{C}$$

Where:

P = Percent recovery

A = Measured concentration in spiked sample (sample + spike)

B = Measured concentration in sample

C = Known concentration of spike compound.

The calculated %R results are compared to project-specific and/or EPA-specified accuracy control limits (Tables B-1 through B-7).

Unacceptable accuracy results will be noted in the project file. Data associated with unacceptable laboratory accuracy results may be qualified, and recommendations for corrective action will be discussed with the laboratory or field personnel, as appropriate.

Accuracy may be qualitatively verified by evaluating blank contamination. Compounds detected in any trip blanks or laboratory blanks will be evaluated during data assessment procedures. Guidelines are established to evaluate the effects of blank contamination on the accuracy of the analytical results of associated field samples. Unacceptable effects of blank contamination will be noted in the project file. Data associated with contamination will be noted in the project file. Data associated with unacceptable blank results will be qualified, and recommendations for corrective action will be discussed with the laboratory and field personnel, as appropriate.

Trip blanks pertain to VOC analysis. When samples for VOC analysis are to be collected, trip blanks are prepared prior to the sampling event and kept with the samples throughout the entire sampling event and during transport to the laboratory. Trip blanks are useful in detecting VOC contamination in sample containers and cross contamination of VOCs between samples during shipment, storage, and handling.

Equipment rinsate blanks are defined as samples that are obtained by running analyte-free, deionized water through any non-dedicated sample collection equipment after decontamination. These samples are used to determine if decontamination procedures are sufficient.

Laboratory blanks are samples made up in the laboratory using analyte-free water and analyzed along with the investigative samples. Laboratory blanks are useful for detecting contamination in the sample handling and analytical processes at the laboratory.

2 6 3 Representativeness

Representativeness is the reliability with which a measurement or measurement system reflects the true conditions under investigation. Representativeness is influenced by the number and location of the water level measurement and sampling points; water level measurement timing and frequency during aquifer response testing; and field and laboratory sampling procedures.

Representativeness is a qualitative parameter that is addressed by describing sampling techniques and the rationale used to select sampling locations. Sample location selection may be determined based on existing data, instrument surveys, or observations, or may be randomly selected. Data used to select sample locations may include water measurements, water and soil sample results, geologic descriptions such as lithologic logs, and interpretations of study area hydrogeologic conditions.

2.6.4 Completeness

Completeness is defined as a comparison of the number of valid data points obtained from a measurement effort to the total number needed to meet the project goals. Data completeness incorporates sample loss and data acceptability.

Analytical data completeness is described as the ratio of acceptable analytical results to the total number of results requested. A completeness value of less than 90 percent indicates that corrective action is necessary to limit the number of incomplete or unacceptable results and to avoid similar problems in future sampling events.

Criteria for incomplete or unacceptable results may include vials broken during shipment or at the laboratory and data qualified as unusable during data assessment or data validation procedures. Analytical data completeness is calculated using the following equation:

$$C = \frac{(number\ of\ acceptable\ results)}{(total\ number\ of\ requested\ results)}\ x\ 100$$

Where:

C = percent completeness.

2 6 5 Comparability

Comparability is a qualitative parameter that expresses the confidence with which one data set can be compared to another. Comparability is dependent on consistency in sampling conditions and on selection of sampling procedures, sample preservation methods, analytical methods, and expressed units of data.

The comparability requirements for field measurement, sampling, and analysis activities are met by complying with SOPs during sample collection and analysis. Because of the similarity of data collection and analysis methods, data collected during the planned activities will be comparable to data collected during previous Site investigations.

2.7 SPECIAL TRAINING REQUIREMENTS AND CERTIFICATION

Personnel responsible for and involved in the implementation of the pilot extraction and aquifer response testing program activities will be thoroughly knowledgeable and experienced in the various aspects of the work to be completed. This knowledge and experience will include, but not be limited to, familiarity with the Site geologic and hydrogeologic conditions; laboratory data review and verification; Site physical conditions and access; Site personnel and contacts; and Site health and safety rules, procedures, and protocols.

Field personnel will have 40-hour Hazardous Waste Operations and Emergency Response training and current 8-hour annual refresher training in accordance with 29 Code of Federal Regulations 1910.120 [Title 8 California Code of Regulations 5192]. Field personnel will also have current certification for a respirator fit-test as well as first-aid and cardiopulmonary resuscitation training. Site field work will be conducted in accordance with the Site-specific Health and Safety Plan (H+A, 2003). Extraction and injection well drilling and construction will be conducted under the supervision of a California Registered Geologist.

Subcontractor personnel involved in the implementation of the pilot extraction and aquifer response testing activities will be similarly knowledgeable and experienced. A qualified well driller will have appropriate equipment capabilities, a California C-57 license, experience on similar projects, and documentation of health and safety training. Analytical laboratories will be certified by the California Department of Health Services to perform laboratory analyses for methods specified in this QAPP.

2.8 DOCUMENTATION AND RECORDS

QA objectives require that field and laboratory activities be documented as completely and accurately as practicable. Field documentation and records will be in accordance with the SOPs described in Section 3.3 of this QAPP. Laboratory documentation will be in accordance with the SOPs listed in the appended laboratory QA Manuals (Attachments B-1 and B-2). The minimum laboratory documentation elements have been listed below:

Analytical Report:

- Client Name and Address
- Sampling Date
- Receipt Date
- Project Name
- Sample Description/Identification
- Analysis Reported
- Analytical Results and Units
- Sample Surrogate Recoveries
- Method of Analysis
- Analyst.

QA Package:

- Chain-of-Custody Record
- Case Narrative
- Non-Conformance Reports/Corrective Action

- QC Report (Recoveries and Limits for Matrix Spike [MS], MSD)
- Method Blank Results and Surrogate Recoveries
- Internal Standard Recoveries
- Bench Sheets
- Raw Analytical Data
- Preparation Logs
- Instrument Sequence Logs
- Initial Calibration Curve or Standards
- Instrument Performance Checks
- Continuing Calibration Check
- Laboratory Control Sample (LCS) Standards.

Chain-of-custody records will be reviewed by the QA Manager for completeness. The analytical laboratory will notify the QA Manager to acknowledge receipt of samples listed on the chain-of-custody record.

3.0 MEASUREMENT AND DATA ACQUISITION

The following QAPP sections cover the aspects of measurement system design and implementation to ensure that appropriate methods for sampling, analysis, data handling, and QC are employed and thoroughly documented.

3 1 SAMPLING PROCESS DESIGN

EPA has determined that pilot extraction and aquifer response testing is necessary to refine the model and complete the final RD. The data obtained will be used to fulfill the objectives stated in Section 1.2 of this QAPP.

Representative groundwater samples will be collected from the extraction and injection wells and analyzed for the parameters using EPA methods specified in Section 3.2 of this QAPP and listed in Tables B-1 through B-7. The associated FSP provides the proposed aquifer response test locations; extraction and injection well installations; groundwater samples collection schedule; the types, locations, and number of samples to be collected; procedures for preparation and decontamination of sampling equipment; and methods of waste disposal.

The following QAPP sections describe the types of data that will be generated during the pilot extraction and aquifer response testing program field activities, as well as the data quality requirements that will allow these data to be interpreted and integrated into a conceptual understanding of subsurface processes that govern the movement of groundwater and contaminants in groundwater at the Site.

3.1.1 Extraction and Injection Well Installation

A total of 3 extraction and 4 injection wells will be installed for the purposes of the aquifer response testing, and provide estimates of aquifer properties. The following extraction and injection wells will be installed as part of the pilot extraction and aquifer response testing program:

- 2 extraction and 2 injection wells in the Bellflower sand
- 1 extraction and 2 injection wells in the Gage aquifer

The proposed extraction wells are located along the axis of the Bellflower sand and Gage aquifer plumes where chlorobenzene concentrations tend to be high. The proposed injection wells will be located in areas outside of the known extent of elevated chlorobenzene, pCBSA, benzene, and TCE to minimize the potential for inducing adverse plume migration. Further details regarding the extraction and injection wells, and SOPs for the installation of these wells, are included in the FSP.

3.1.2 Observation Well Cluster Installation

A total of 3 observation well clusters will be installed for the purposes of the aquifer response testing. The observation well clusters will be installed within approximately 50 feet of each extraction well to obtain data regarding the hydraulic response in the pumped aquifer and in the adjacent lower Bellflower aquitard.

3.1.3 Water Level Measurement

Water levels will be measured for each new extraction or injection well. Water level measurements will be conducted following well construction and development, prior to collection of the initial groundwater samples and pumping. Transducers will be installed in the observation well clusters and selected monitor wells to measure water levels during the pilot extraction and

aquifer response testing. Further details and SOPs for water level measurement are provided in the FSP.

3.1.4 Groundwater Sampling

Groundwater samples will be collected from the extraction wells at the end of the development phase for laboratory analysis of VOCs, including chlorobenzene, pCBSA, metals, pesticides and PCBs, semi-volatile organic compounds, and various miscellaneous compounds in accordance with the requirements of the General NPDES permit (Table B-8). These data will be used to assess the effluent water quality to the final treatment plant as well as the variability of the water quality compounds for treatment system design purposes.

A groundwater sample will be collected from the injection wells at the end of the development phase for laboratory analysis of VOCs, including chlorobenzene, pCBSA, and additional inorganic compounds and water quality parameters (Table B-8). These data will be used to assess the groundwater quality within the proposed injection zones prior to commencing injection testing operations. The water quality data will be used to verify that the injection wells are located outside the area of the contaminant plumes, and to evaluate native and treated water compatibility issues.

A groundwater sample will be collected from the observation wells at the end of development for the laboratory analysis of VOCs and pCBSA. This data will be used to establish the baseline water quality in the vicinity of the observation wells.

The water extracted during the pilot extraction test will be treated and disposed of into the nearest storm drain inlet under a NPDES Permit. The NPDES Permit will require monitoring of the effluent on a regular basis to be determined by the Regional Water Quality Control Board upon approval of the permit.

3.1.5 Aquifer Response Testing

Aquifer response testing will consist of both pumping water from and injecting water into newly installed extraction and injection wells at the Site. Extraction wells will be pumped at a rate between 100 and 300 gpm for a period of approximately 5 days. The actual pumping rate and duration will be based on data obtained from an initial step test, and may be terminated earlier if the water level drawdown reaches a steady-state condition. Injection tests will consist of injecting potable water at an estimated sustainable rate for a period of at least 5 days. Water level data will be obtained during the testing.

3.2 ANALYTICAL METHODS REQUIREMENTS

Groundwater samples and discharge water samples will be analyzed in accordance outlined in the FSP for VOCs using EPA Method 8260B; for pCBSA using Modified EPA Method 314.0; and for DDT and its isomers and metabolites, BHC isomers, and other organochlorine pesticides using EPA Method 8081A; PCBs using EPA Method 8082, (Tables B-1 through B-3). Analytical methods for general minerals, other parameters, and California Title 22 metals are provided in Tables B-4 through B-6, respectively. Discharge samples will also be analyzed for semi-volatile organic compounds using EPA Method 8270C (Table B-7). Analytical methods used for this project will meet the requirements of SW-846 (EPA, 1996).

3.3 SAMPLE HANDLING AND CUSTODY REQUIREMENTS

This QAPP section summarizes SOPs for sample handling and custody requirements. The purposes of these SOPs are to ensure proper sample documentation, collection, handling, transport, storage, and analysis.

3.3.1 Field Activity Documentation

Field documentation includes field notebooks, water level data sheets, groundwater sampling forms, sample labels, and chain-of-custody forms. Field data forms not submitted with samples

to the laboratory will be compiled in the field notebook. Additionally, field notebooks will include a record of significant events, observations, and measurements made during field investigations, including names of personnel present, Site conditions, sampling procedures, measurement procedures, and calibration records. Field data forms will be signed, dated, and kept as a permanent record. Erroneous entries on the field data forms will be corrected by drawing a line through the error and entering the correct information. Corrections will be initialed by the individual making them.

Field notebooks and copies of field data forms will be reviewed by the Field Task Manager. Field notebooks and field data forms will be retained in the project files. The Field Task Managers will be responsible for the collection and maintenance of field documentation until those documents are forwarded to the project file.

3.3.2 Sample Collection

QC procedures will be implemented for sample collection to ensure that groundwater samples are collected in a manner consistent with the DQOs. The Field Task Manager will determine the sampling locations and sample identifiers for QC samples, which will be comprised of duplicate and laboratory split samples collected from the same wells and at the same time as original groundwater samples. The Field Task Manager will direct the selection of the locations of duplicate and split sampling so that QC samples are collected at different locations that are representative of the variability of contaminant concentrations in groundwater throughout the Site vicinity. QC samples will be identified in the same manner as other samples so that the laboratory will not be aware of their nature as QC samples. Identifiers will be determined by the Field Task Manager prior to the sampling event and will be indicated on the sampling memorandum. The number of QC samples to be collected and QC sampling locations will be confirmed by the QA Manager and will be contained in a memorandum issued to the field sampling personnel prior to the sampling event. As a general guideline, one duplicate and one laboratory split sample will be collected and analyzed for VOCs and pCBSA for every 10 original groundwater samples collected.

Samples designated for laboratory analysis will be identified, preserved, and transported in such a manner that data are representative of the actual Site conditions and sample integrity is maintained during sample transport. Sample handling protocols have been developed for groundwater samples collected at the Site (Table B-8). SOPs provided in the FSP will be followed during the collection of groundwater samples (Appendix A). If specialized equipment is necessary, arrangements will be made or subcontractors will be contacted by the Field Task Manager. Sampling and measurement equipment will be thoroughly checked for proper operation and calibration prior to any field activity.

3.3.3 Sample Identification Labels

Sample identification and transmittal documents will be maintained so that sample identification, location, and disposition can be monitored and controlled. The following sample identification and transmittal documents will be used:

- Field Data Forms
- Sample Identification Labels
- Custody Seals
- Chain-of-Custody Records.

Pre-printed, adhesive, sample identification labels will be secured to the sample containers by the field sampler (Table B-9). Sample documentation forms and labels will be completed using waterproof ink. Sample identification labels will contain the following information:

- Sample Location/Identifier
- Date and Time Sample was Collected
- Analyses to be Performed
- Project Number
- Sampler Initials
- Preservation Method Used.

3.3.4 Chain-of-Custody Record

Official sample custody will be maintained and documented from the time of sample collection to the presentation of analytical results in the final report. The chain-of-custody records will document the transfer or shipment of samples to the analytical laboratory personnel and will detail the analyses requested for each sample (Table B-10). Chain-of-custody records will contain the following information:

- Sample Location/Identifier
- Project Code
- Date and Time Sample was Collected
- Project Manager and QA Manager Names, Telephone Number, and Fax Telephone Number
- Names of Sampling Personnel
- Shipping Method Used and Date
- Sample Description
- Sample Matrix
- Sample Volume and Number of Containers
- Sample Destination
- Preservation Method Used
- Analyses to be Performed
- Special Handling Procedures.

Sample custody is documented from the time samples are received by the laboratory sample custodian throughout the analytical process, until the samples are disposed. Upon receipt at the laboratory, each sample is assigned a unique laboratory identification number that is used to track that sample. The sample identification number will be documented by the laboratory sample custodian on the chain-of-custody record. The temperature inside the cooler containing samples should be measured and recorded on the chain-of-custody record upon receipt at the laboratory.

3.3.5 Corrections to Documentation

Erroneous entries on field forms, sample labels and/or chain-of-custody records will be corrected by drawing a line through the error and entering the corrected information. Corrections will be initialed by the individual making them.

3.4 QUALITY CONTROL REQUIREMENTS

QC procedures have been developed for field activities and laboratory analyses to ensure that samples are collected and analyzed in a manner consistent with the DQOs. Field and laboratory QC procedures have been prepared for field instrument and equipment calibration, sample collection, field parameter measurements, and laboratory analyses (Tables B-1 through B-11).

3.4.1 Field Quality Control Procedures

QC procedures will be implemented to ensure that field measurements are performed and recorded in a manner consistent with the DQOs. In general, the following steps must be implemented as part of the QC procedures for field measurements:

- Document field equipment maintenance and calibration.
- Establish written SOPs that are accessible.
- Train personnel in SOPs related to their assigned tasks.
- Specify professional oversight for various field procedures.
- Maintain well-organized, verified, and accessible data files, including original data and field notes.
- Perform an informal, internal peer audit of work performed by field personnel and conduct a formal audit performed by the QA Manager or a designate, through interaction with the Project Manager.
- Document any corrective action taken in the field notes.
- Request MS/MSDs analyses on the chain-of-custody records.

- Collect the following types of field QC samples:
  - Duplicates
  - Equipment rinsate blanks
  - Trip blanks
  - Split samples

3 4 2 Laboratory Quality Control Procedures

DMA and WCAS are the designated primary and split analytical laboratories, respectively, for sample analyses. Other qualified analytical laboratories may be designated to perform analyses. Laboratory QA objectives and procedures are specified in their respective QA Manuals (Attachments B-1 and B-2). Analytical summaries containing project-specific QC criteria to be followed by the laboratory for analysis of groundwater samples are provided (Tables B-1 through B-7).

Generalized standard laboratory QC procedures include, but are not limited to, the following:

- Analyze the following:
  - Samples according to the methods specified.
  - Samples within the holding time required by the analytical method or as requested by the sampling personnel, according to the objectives of the particular task, whichever time period is shorter.
  - Calibration standard and instrument blanks daily to check instrument consistency and performance.
  - One set of calibration standards each 8-hour shift or every 12 hours, as applicable, or whenever a calibration check standard does not meet project-specific acceptance criteria.
  - One set of method blanks daily or per analytical batch of 20 samples or fewer, whichever is more frequent.
  - At least one spike sample with each analytical batch of 20 or fewer samples.
  - At least one duplicate sample or spike duplicate sample with each analytical batch of 20 or fewer samples.

- A LCS and laboratory control sample duplicate with each analytical batch of 20 or fewer samples.

- Calibrate each instrument used in the analyses prior to sample analysis to ensure that analyses meet the method requirements.

- Perform continuing calibration verification at the beginning of each day or every 12 hours for EPA Method 8260B.

- Compare accuracy and precision from spike sample analyses to established project-specific QC criteria.

- Maintain performance records to document data quality.

- Use confirmatory methods whenever the identification of an analyte of interest cannot be determined by the main analytical method or when unfamiliar, nonroutine samples are analyzed. Confirmatory methods may include analyses by alternate analytical methods or second-column confirmation for organic compounds, as specified by the appropriate methods.

- Routinely determine the limit of detection or MDL for each analyte analyzed on each instrument.

- The laboratories will report both non-diluted and diluted results to ensure that the lowest detection limit is attained for all compounds.

The laboratory will have the appropriate equipment available for sample preparation and analysis for the analytical methods requested. The laboratory will use reagents and supplies that meet the minimum requirements in the analytical methods. Instruments and equipment used for sample analysis will be maintained, calibrated, and operated according to laboratory SOPs, analytical method criteria, and manufacturer guidelines and recommendations.

3.5 INSTRUMENT AND EQUIPMENT TESTING, INSPECTION, AND MAINTENANCE REQUIREMENTS

Field equipment testing, inspecting, and maintenance will be carried out in accordance with procedures and schedules outlined in the manufacturer's operation and maintenance handbook for each instrument/equipment. Specific procedures for laboratory instrument/equipment testing, inspecting, and maintenance requirements are described in the appended analytical laboratory QA manuals (Attachments B-1 and B-2).

3.6 INSTRUMENT CALIBRATION AND FREQUENCY

Field equipment calibration procedures and the frequency of calibration will be carried out in accordance with procedures and schedules outlined in the manufacturer's operation and maintenance handbook. Laboratory instrument calibration procedures and the frequency of calibration are described in the appended analytical laboratory QA manuals (Attachments B-1 and B-2).

3.6.1 Field Calibration Procedures

Field equipment, such as water quality parameter measuring instruments, will be calibrated and used to perform the necessary field measurements, in a manner such that data are representative of the actual Site conditions. Field equipment will be maintained, calibrated, and operated according to manufacturer guidelines and recommendations. At a minimum, field equipment will be inspected and calibrated on receipt from a vendor or from another H+A office. Field equipment will be calibrated prior to field activities.

Depending on the type of meter used, calibration to the parameters pH, electrical conductivity (EC), dissolved oxygen (DO), and turbidity can be accomplished automatically using the auto-calibration solution provided by the meter's manufacturer. The oxidation-reduction potential meter cannot be calibrated in the field. The following guidelines apply to field equipment calibration.

- At a minimum, the pH meter will be calibrated in pH 4 and pH 10 buffered solutions prior to commencing field work each day. These pH values are expected to bracket the range of pH in groundwater samples collected from monitor wells at the Site.

- The EC meter will be calibrated prior to commencing field work each day. The conductivity meter will be calibrated using standard calibration solutions selected to bracket the range of conductivity expected in groundwater samples collected from monitor wells at the Site.

- The accuracy of the field thermometer will be determined by checking the measured reading against other thermometers.

- The DO meter will be calibrated in air prior to commencing field work each day.

- If a photometer-type turbidity meter is used, it will be calibrated to 0 Nephelometric Turbidity Units (NTUs) and 10 NTUs prior to commencing field work each day, and zeroed to 0 NTUs prior to each reading.

If the calibration of an instrument cannot be easily checked, either test it against another instrument of a similar type or return it to the manufacturer for appropriate calibration on a quarterly basis at a minimum. A routine schedule and record of field equipment calibration will be maintained in the field notebook. This will enable the user to document the procedures used in verifying the accuracy of the field equipment. Lastly, sufficient critical spare parts, batteries and supplies will be maintained for field instruments at an easily accessible, on-site storage location to repair or maintain equipment with a minimal impact to field activities.

3.6.2 Laboratory Calibration Procedures

Specific procedures for calibration, operation, and maintenance of laboratory instruments/equipment are described in the appended analytical laboratory QA manuals (Attachments B-1 and B-2).

3.7 INSPECTION AND ACCEPTANCE REQUIREMENTS FOR SUPPLIES AND CONSUMABLES

Supplies and consumables anticipated for use during the pilot extraction and aquifer response testing program include, but are not limited to, sample containers, preservation and/or decontamination fluids, and personal protection equipment Consumables will be purchased in original packaging and stored in a manner that protects their usability. If long-term storage of consumables is necessary, the consumables will be inspected prior to their use to detect any damage or disintegration of the material.

3.8 DATA ACQUISITION REQUIREMENTS

Previously collected data and other information to be used in the decisions of this pilot extraction and aquifer response testing task are contained in the RI (EPA, 1998b).

3.9 DATA MANAGEMENT

The data quality management program is designed to ensure that QC procedures are maintained from data collection to report preparation. Data quality management will be initiated prior to data collection by implementing QC procedures established to ensure that all data are obtained and analyzed in a manner consistent with QA objectives and are representative of the actual Site conditions. Laboratory data will be maintained by DMA and WCAS in accordance with their respective QA Manuals (Attachments B-1 and B-2). Montrose will maintain field data

for a period of no less than five years after EPA determination that the work under the UAO SOW is complete, unless otherwise approved by EPA (EPA, 2004).

Field and laboratory data will be managed as it is obtained and compiled. Field data will be obtained and compiled in field notebooks or on the appropriate field data forms. Laboratory data will be compiled in the data report packages. Field and laboratory data will be entered, stored, and maintained in electronic files or databases, as appropriate. Tables will be prepared based on these data for use in summary reports. Use of these standard data reporting forms and tables will ensure that data are presented consistently. The QA Manager will maintain copies of field data forms, original transmittal letter, chain-of-custody records, and the laboratory data packages in the project files. The following sections summarize field and laboratory data quality management and assessment.

3.9.1 Field Data

The Field Task Manager will ensure field notebooks and copies of field data forms are forwarded to the project file. These data files will contain original data and field notes. Files will be well organized, indexed, verified, and accessible. Field sampling files will be compiled. Field sampling files will include, but are not limited to, the following information:

- Field notes compiled by sampling personnel during the water level measurement and aquifer test events.
- Field data, including sampling data forms and calibration documentation.
- Sample documentation forms, including chain-of-custody records, and courier receipts, as appropriate.

3 9 2 Analytical Data

Analytical data files will be established for sampling activities. These data files will be organized, indexed, verified, and accessible. Analytical data will include original chain-of-custody records, and laboratory data packages assembled by the laboratory performing the analyses. The laboratory data packages will be provided by the laboratory to H+A as hard copy. Analytical data may also be provided on a diskette or by electronic transmission. Analytical data with corresponding review qualifiers will be entered, stored, and maintained in an electronic database. Analytical data files will include, but are not limited to, the following information:

- Original chain-of-custody records
- Laboratory analytical reports from sampling events
- QC sample results, including field duplicates, trip blanks, and equipment rinsate blanks
- Data deliverables packages
- Assessment and validation forms compiled during data evaluation.

3.9.3 Database

Spreadsheets and databases are used to store data collected as part of the pilot extraction and aquifer response test. Software to be used in support of the spreadsheet or database will be Microsoft Access. The data will also be migrated into the Geographic Information System database for the Site.

3.9.4 Data Management Procedures

Data management procedures are a crucial part of the data management system. Established procedures are necessary to ensure consistency among data sets; internal database integrity; and a verified, usable data set. The tasks and procedures that will be performed for project data before they are entered include:

- Data mapping
- Electronic data interchange
- Data entry and verification
- Data presentation and analysis
- Data administration.

3 9 5 Personnel

Successful implementation of a data management system requires a clear definition of responsibilities. The Project Manager and a database technician will implement and maintain the database management system. The Project Manager has oversight responsibility for database integrity, redundancy control, data sharing and versions control, performance, security, and backup. The database technician has a comprehensive understanding of the database structure, software, and associated analysis tools. The database technician responsibilities include data logging and tracking; data preparation; data entry and verification; data archiving; data requests; and report generation (H+A, 2004).

4.0 ASSESSMENT AND OVERSIGHT

The following QAPP sections address the activities for assessing the effectiveness of the implementation of the pilot extraction and aquifer response testing program and the associated QA/QC activities.

4.1 ASSESSMENT AND RESPONSE ACTIONS

The QA Manager is responsible for QA oversight. QA oversight is accomplished by verifying that established QC procedures are followed; conducting field procedure audits on a regular basis to ensure that the data being collected are reliable, of acceptable quality, and are representative of Site conditions; identifying deficiencies and ensuring that corrective actions are implemented when necessary; and reporting project status to project management on a regular basis.

4.1.1 Preventive Maintenance

Preventive maintenance includes those activities that must be carried out to minimize downtime of the field and laboratory measurement systems. Specific laboratory preventive maintenance measures are provided by each laboratory in its respective QA Manual (Attachments B-1 through B-2). Procedures for preventive maintenance during sampling and field measurement activities include, but are not limited to, the following:

- Calibrate and check field measurement equipment before use.
- Ensure that critical spare parts for instruments are immediately available in case of equipment failure.

- When practical, ensure that back-up equipment is available.

- If samples are subcontracted by DMA or WCAS, then the contract laboratory shall be held accountable to ensure that the subcontractor follows analytical requirements in this QAPP.

- Identify and review sampling locations and procedures each day prior to starting field activities.

- Ensure that additional materials for sample collection, including containers, caps, labels and chain-of-custody records are available onsite.

4.1.2 Field Procedure Audits

The QA manager may schedule an audit of field procedures during field activities to evaluate the execution of SOPs. The field procedure audit will consist of observations and documentation of the field activities. Checklists will be used for documenting observations of sampling activities, including:

- Calibration documentation for sampling and measurement instrumentation
- Documentation of adherence to this QAPP and the associated FSP
- Completion of field notebooks and field data forms
- Sample handling, storage, and transmittal procedures
- Chain-of-custody procedures.

Observations recorded on the completed checklist will be discussed with the Field Task Manager during the audit debriefing. Specific deficiencies noted and recommendations for corrective action will be discussed at this time. A copy of the completed checklist will be forwarded to the H+A Project Manager. Depending on the severity of the deficiencies, adherence to corrective action recommendations may be verified by a follow-up audit of that deficiency.

4 1 3 Technical Systems Audits

A laboratory technical systems audit has been performed on the primary laboratory. Laboratory technical systems audits of split and other laboratories will be conducted on an as needed basis The laboratory technical systems audit monitors the capability and performance of a laboratory and provides an optional verification of compliance with project-specific and method-specific QC criteria. Each laboratory technical systems audit will include a careful evaluation of equipment and facilities and adherence to SOPs and QC procedures. In addition, double-blind performance samples may be submitted to the laboratory by Montrose or EPA

Upon completion of the laboratory technical systems audit, an audit report is prepared and copies are distributed to the Project Manager and QA Manager. This report outlines the audit approach and presents a summary of results and recommendations. Upon completion of the laboratory technical systems audit, the specific deficiencies are discussed with the Project Manager and laboratory personnel, and recommendations are made for corrective action. Depending on the severity of the deficiencies, adherence to corrective action recommendations may be verified by a follow-up audit.

4.1.4 Performance Evaluation Audits

Analytical laboratories will participate in performance audits as described in the associated QA manuals (Attachments B-1 and B-2). Participating laboratories receive ampules from an approved vendor for the proficiency programs. The laboratory may also receive additional blind check samples. These evaluations contain a variety of organic and inorganic analytes whose values are unknown to the laboratory. The analytes must be correctly identified and accurately quantified to maintain various certifications and accreditations. The results of the performance evaluation audits are kept on file in the laboratory and are available upon request.

4.2 REPORTS TO MANAGEMENT

Field measurements, analytical data, and data quality information may be summarized and included in a final report to management. These reports may include the assessment of measurement data quality, results of systems audits, results of performance audits, or any significant QA problems and recommended solutions.

Overall data quality verification results and corrective actions are reported to the Project Manager via the QA Manager. Prior to the preparation of a technical memorandum summarizing field activities, the QA Manager informs the Project Manager of internal analytical data verification checklist results. Data verification SOPs are detailed in Section 5.0 of this QAPP. The QA Manager informs the Project Manager of corrective actions to be implemented. The Project Manager informs project staff of any corrective action to be followed. Corrective actions taken are recorded in a technical memorandum.

5.0 DATA VALIDATION AND USABILITY

This QAPP section covers the QA activities that occur after the data collection phase of the project has been completed.

5.1 DATA REVIEW, VALIDATION, AND VERIFICATION REQUIREMENTS

To determine the quality of the data, a systematic process will be used to review, validate, and verify groundwater data obtained as part of the pilot extraction and aquifer response testing program (Table B-12). Data assessment and validation is a systematic process of evaluating analytical data against a pre-established set of QC criteria, which is based on project-specific criteria and selected method-specific criteria specified in the appropriate EPA test methods (EPA, 1996). Therefore, data generated from sampling events will be verified and validated to determine if they meet QC criteria.

Laboratory data will be validated in accordance with EPA National Functional Guidelines (EPA, 1994, 1996, and 1999). The quality and appropriate use of data obtained will be determined based on the results of routine assessment of 100 percent of the data as follows:

- Tier 2 validation procedures will be performed on 100 percent of the groundwater sampling analytical data.

- Tier 3 validation procedures will be performed on 20 percent of the groundwater sampling analytical data.

The laboratory will, however, provide Tier 3 documentation packages for 100 percent of the samples so that a greater percentage of samples could be subject to Tier 3 validation, if warranted. The laboratory performing the analyses will assemble Data Validation Packages (DVPs).

5 1.1 Tier 2 Data Validation

EPA Tier 2 data validation will be performed on the summary (i.e., no raw data) packages for analyses of groundwater samples analyzed by EPA and non-EPA methods. The data reviewer will request any missing information from the laboratory and facsimile a copy of this request to the client's Project Manager when missing information is requested. The data reviewer will validate components of the data package even when an individual QC element has rejected the data. Data will continue through the validation process and be qualified and requalified as many times as it fails to meet established criteria. An overall final qualification of results will encompass the impact of individual findings and will be determined using the professional judgment of a senior data reviewer. DVPs provided by the contract laboratory should consist of sample results and QA/QC summaries (equivalent to EPA Contract Laboratory Program [CLP] Forms I through X for organic analyses and Forms I through XIV for inorganic analyses).

5.1.2 Tier 3 Data Validation

EPA Tier 3 data validation will be performed on the summary and raw data packages for analyses of groundwater samples analyzed by EPA and non-EPA methods. The data reviewer will request any missing information from the laboratory and facsimile a copy of this request to the client's project chemist when missing information is requested. The data reviewer will validate components of the data package even when an individual QC element has rejected the data. Data will continue through the validation process and be qualified and requalified as many times as it fails to meet established criteria. An overall final qualification of results will encompass the impact of individual findings and will be determined using the professional judgment of a senior data reviewer. DVPs provided by the contract laboratory will consist of sample results and QA/QC summaries (equivalent to CLP Forms I through X for organic analyses and Forms I through XIV for inorganic analyses), and raw data associated with the sample results and QA/QC summaries.

5.2 VALIDATION AND VERIFICATION METHODS

Chemical quality data for samples analyzed using various EPA methods will be reviewed during data assessment activities to determine the quality of the data and to assess its use according to the DQOs established for the specific field sampling activity. This SOP has been prepared to ensure that data assessment activities are performed in a consistent manner.

Data assessment procedures will be performed on all analytical data collected as part of routine project activities. Data assessment procedures include evaluation of the following categories of support documentation associated with analytical data:

- Sample Holding Times
- Preservation Procedures
- Analytical Methods and Data Reporting
- Field Blanks, Trip Blanks, and Laboratory Reagent Blanks
- MS Recovery
- MSD Analysis
- Field Duplicate Analysis
- Split Sample Analysis
- Data Trending.

SOPs will be used to perform routine data assessment of chemical quality data reported by the laboratory and to assign data qualifiers (Tables B-12 and B-13). Data assessment will be performed using hard copy and/or electronic laboratory reports.

In general, data validation and verification methods for organic analyses include the review of, but are not limited to, the following:

- Holding Times
- Initial Calibration
- Continuing Calibration

- Blanks
- Surrogate Recovery
- MS/MSD Recovery
- LCS Recovery
- Internal Standard Performance
- Field Duplicate Sample Analysis RPD
- Reporting Limits
- Compound Identification (Tier 3)
- Compound Quantitation and Detection Limits (Tier 3).
- Tentatively Identified Compound Verification (Gas Chromatograph/Mass Spectrometer (Tier 3)
- System Performance (Tier 3)
- Overall Assessment of Data in the Sample Delivery Group (SDG).

In general, data validation and verification methods for inorganic analyses include the review of, but are not limited to, the following:

- Holding Times
- Initial Calibration
- Continuing Calibration
- Blanks
- Surrogate Recovery
- MS Recovery
- Duplicate Sample RPD
- LCS Recovery
- Inductively-Coupled Plasma Interference Check
- Method of Standard Addition and Serial Dilution Checks
- Field Duplicate Sample Analysis RPD
- Reporting Limits
- Analyte Identification (Tier 3)
- Analyte Quantitation and Detection Limits (Tier 3)

- System Performance (Tier 3)
- Overall Assessment of Data in the SDG.

5 2 1 Holding Times

A comparison will be made between the sampling date and the date of laboratory analysis for each sample submitted to the laboratory. The analytical results, including less-than detection limit results, for samples identified as exceeding the required holding time will be qualified with "J" and will be documented in the summary memorandum.

5.2.2 Analytical Methods and Data Reporting

The laboratory report will be checked against the sample chain-of-custody record to verify that appropriate analytical results were reported for all samples submitted and that the analytical methods requested in sample documentation were used by the laboratory. Instances of requested analyses not included in the laboratory report, due to occurrences such as breakage in the laboratory, misidentification of samples, missing or incomplete analyses, or use of incorrect analytical methods, will be documented in the summary memorandum.

5.2.3 Field Blanks, Rinsate Blanks, Trip Blanks, and Laboratory Reagent Blanks

The hard copy laboratory reports will be reviewed to determine whether any analytes were detected in any of the field blanks, rinsate blanks, trip blanks, or laboratory reagent blanks associated with the sampling event and analysis procedures. The results of the data search will be documented in the summary memorandum. If an analyte is detected in a blank sample, the following procedures will be performed to identify data subject to qualification:

- Compile a list of blank samples in which analytes were detected including method of analysis, analyte concentration, batch number of water used to prepare the blank, if available, dates of blank sample collection and analysis, and specific laboratory instrument used for blank sample analysis, if applicable.

- For analyte detections in field or trip blanks, review the hard copy laboratory reports for all water samples in which the analyte was detected that were listed on the same chain-of-custody record as the blank sample. Review laboratory reports and identify all detections of the analyte in water samples that were analyzed using the same laboratory instrument, if known, on the same date of sample analysis, using the same analytical method. Compile a list of identified water sample analytical results for qualification.

- For analyte detections in laboratory reagent blanks, review analytical reports and identify all detections of the analyte in water samples that were analyzed on the same laboratory instrument, if known, on the same date of sample analysis, using the same analytical method. Compile a list of identified water sample analytical results for qualification.

- Assign data qualifiers to the compiled list(s) of results as follows:

    - If the concentration of the analyte in the water sample is less than or equal to the concentration in the associated blank, qualify the data with a "R".

    - If the concentration of the analyte in the water sample is greater than the concentration in the associated blank but is less than or equal to five times the blank concentration, qualify the data with a "J".

    - If the concentration of the analyte in the water sample is greater than five times the blank concentration, the data is acceptable.

- Document the review of blank samples and list data qualified in the summary memorandum.

5 2 4 Matrix Spike Recovery

MS recovery data in the laboratory report will be compared with the acceptable range of percent recovery for each analyte (Tables B-1 through B-7). If a MS recovery percentage is less than the minimum acceptable percent recovery, the following procedures will be used to identify data subject to qualification:

- Compile a list of analyte MS recoveries that are less than the minimum acceptable percent recovery, along with sample identifiers and date of spike sample analysis.

- Review the analytical reports to identify all water samples analyzed for the same analyte, for the same analytical method, and on the same date of MS analysis. Compile a list of identified analytical results for qualification, including all less-than detection limit results.

- Assign the data qualifier "J" to all analytical results on the compiled list.

- Document the review of MS recovery data and list data qualified in the summary memorandum.

If a MS percent recovery is greater than the maximum acceptable percent recovery, the following procedures will be used to identify data subject to qualification:

- Compile a list of MS recovery values that are greater than the maximum acceptable percent recovery, along with sample identifiers and date of spike sample analysis.

- Review the analytical reports to identify all water samples analyzed for the same analyte, for the same analytical method, and on the same date of MS analysis. Compile a list of identified analytical results for qualification. Do not include less-than detection limit results.

- Assign the data qualifier "J" to all analytical results on the compiled list.

- Document the review of MS recovery data and list data qualifiers in the summary memorandum for the data assessment.

5.2.5 Matrix Spike Duplicates

MSD data in the laboratory report will be compared against the acceptable RPDs (Tables B-1 through B-7). If a MSD analysis for an analyte exceeds the acceptable RPD for the analyte, the following procedures will be used to identify data subject to qualification:

- Compile a list of analytes for which MSD RPDs are greater than the acceptable RPD for that analyte, including sample identifier of the MSD sample and date of MSD analysis.

- Review the analytical reports to identify all water samples analyzed for the same analyte, using the same method, on the same date of MSD analysis. Compile a list of identified analytical results for qualification, including less-than detection limit results.

- Assign the data qualifier "J" to all analytical results on the compiled list.

- Document the review of MSD analyses and list data qualified in the summary memorandum.

5.2.6 Field Duplicates

The analytical results for field duplicate samples will be tabulated and RPDs for each analyte will be computed. Instances in which an analyte was not detected in both samples will be identified. Instances in which an analyte was detected in only one sample and not in its duplicate sample will also be identified, and an approximate RPD will be calculated by substituting the analytical detection limit for the less-than detection limit result in the RPD formula. For RPDs between original samples and duplicate samples, the following criteria are used:

- If the detected concentrations are between the undiluted detection limit and 10 times (10X) that detection limit, the RPD should be less than 100 percent.

- If detected concentrations are between 10x and 100x the detection limit, the RPD should be less than 30 percent.

- If the detected concentrations are greater than 100x the detection limit, the RPD should be less than 50 percent.

- Both diluted and non-diluted results will be reported to ensure that the lowest detection limit is attained for all compounds.

If field duplicate analysis for an analyte exceeds the acceptable RPD for the analyte, the concentrations of the analyte detected in the original and associated duplicate samples are subject to further review based on additional data for the Site, as described below (Section 5.2.8). Based on the outcome of this review, the data qualifiers "J" or "R" may be assigned to the original and/or the duplicate analytical result for the analyte. The results of the duplicate sample review, including rationale for assigning data qualifiers, along with the list of data qualified will be included in the summary memorandum.

5.2.7 Split Samples

The analytical results for split samples will be tabulated and RPDs for each analyte will be computed. Instances in which an analyte was not detected in both samples will be identified. Instances in which an analyte was detected in only one sample and not in its split sample will also be identified, and an approximate RPD calculated by substituting the analytical detection limit for the less-than detection limit result in the RPD formula. For RPDs between original samples and split samples, the following criteria are used:

- If the detected concentrations are between the undiluted detection limit and 10X that detection limit, the RPD should be less than 100 percent.

- If the detected concentrations are between 10x and 100x the detection limit, the RPD should be less than 30 percent.

- If the detected concentrations are greater than 100x the detection limit, the RPD should be less than 50 percent.

If split sample analysis for an analyte exceeds the acceptable RPD for the analyte, the concentrations of the analyte detected in the original and associated split samples will be subject to further review based on additional data for the Site, as described below (Section 5.2.8). Based on the outcome of this review, the data qualifiers "J" or "R" may be assigned to the original and/or the split analytical result for the analyte. The results of the split sample review, including rationale for assigning data qualifiers and the list of data qualified, will be included in the summary memorandum.

5.2.8 Data Trending

Groundwater quality data for a particular sampling event will be compared to previous chemical quality data collected at that same location to accomplish the following: 1) screen field duplicate and split results that have RPDs greater than the historical data or acceptance criteria to identify data that may have to be qualified; and 2) identify any analytical results that may require qualification for which no field and/or laboratory quality control problem was identified during the assessment process. This additional review is necessary to alert the user to data that are not representative of the Site. Review of previous analytical results for samples collected from a particular site may include one or all of the following:

- Long-term and/or short-term chemical quality hydrographs for all analytes analyzed at the sampling location.

- Chemical quality hydrographs for other sampling locations in the same and adjacent hydrogeologic units in the immediate vicinity of the sampling location evaluated.

- Maps showing areal distribution of the concentrations of the analyte in the same hydrogeologic unit.

- Water level hydrographs, water level contour maps, and pumpage records from nearby production wells.

- Historic surface water records and investigation of sources of potential recharge to groundwater systems in the vicinity of the sampling location.

Individuals familiar with the hydrogeological conditions at the Site will evaluate this information and identify a list of data that may require qualification. This list will be reviewed by the Project Manager prior to assignment of data qualifiers. Laboratory personnel may be contacted during the review process to ensure that the data subject to review were correctly reported. Field duplicate and split sample results identified as having unacceptable RPDs and determined to be out of trend will be qualified with a "J" or "R". Analytical results with no associated quality control problem will be assigned the data qualifier "J" if the concentration of the sample subject to review is less than one order of magnitude higher or lower than the expected concentration of the analyte at the sampling location and is clearly outside the historic water quality trends at the Site. Analytical results with no associated quality control problem will be assigned the data qualifier "R" if the concentration of the sample subject to review is greater than or equal to one order of magnitude higher or lower than the expected concentration at the sampling location; is clearly outside of the historic water quality trends at the Site; exhibits a concentration for an analyte not previously detected at the Site; or does not indicate an analyte that is routinely detected at the Site. The results of the review of data based on trend analysis will be documented in the summary memorandum.

5.2.9 Data Qualifier Reporting

The Project Manager will review the list of all data to be qualified and approve data qualifiers. Analytical results found to be satisfactory based on the data assessment process will not be qualified. Data qualifiers will appear in tables summarizing the results of water quality analyses.

EPA data qualifiers, with the exception of "U", will appear in tables summarizing the results of water quality analyses (Table B-13). H+A uses a "less than sign" or "negative value" (< or -), to indicate that an analyte was not detected and, therefore, use of EPA's "U" qualifier is not required.

5.3 RECONCILIATION WITH DATA QUALITY OBJECTIVES

Corrective action will be implemented if it is determined during the data quality verification and assessment processes that the field procedures and documentation, analytical procedures, or analytical results are not adequate to achieve the DQOs. Corrective actions that may be implemented include, but are not limited to, the following:

- Altering procedures in the field
- Providing additional training for field personnel
- Using alternative sample containers
- Increasing the frequency of calibration or maintenance of field measurement instruments
- Resampling or reanalyzing samples
- Contacting the laboratory to initiate specific internal corrective actions
- Auditing laboratory procedures.

The Project Manager or Field Task Manager will be responsible for initiating corrective action for field activities. The QA Manager will be responsible for ensuring that corrective actions for laboratory activities are initiated and for ensuring that corrective actions implemented are adequate to meet DQOs. Corrective actions taken will be addressed and summarized in a technical memorandum.

Should field measurement data for analytical results indicate inconsistencies resulting from field procedures, field corrective actions will be implemented as follows:

- Sampling and decontamination procedures will be reviewed if target compounds are detected in any trip blanks or equipment rinsate blanks in concentrations exceeding method reporting detection limits or documented laboratory contaminant levels.

- Sampling and decontamination procedures will be reviewed if analytical results of field duplicates indicate poor precision.

- Laboratory corrective actions will be initiated if analytical results are not provided in a timely manner or are determined to contain inconsistencies during the data quality assessment and validation processes. The laboratory will be contacted to discuss corrective action for specific inconsistencies.

- At a minimum, the laboratory will adhere to corrective action procedures outlined in Title 40, Code of Federal Regulations, Section 136 or as outlined by EPA (EPA, 1986).

Corrective actions may be required at any point in the data assessment process. Problems with laboratory or field quality control data or analytical results should be relayed as soon as possible by H+A to the Laboratory Manager. The laboratory will be instructed to check raw data and computations, as necessary, to identify any problems due to data transposition, reported units of measurement, or calculation errors The laboratory may be instructed to re-run a partial sample if sample holding time limits have not been exceeded. The laboratory will issue an amended hard-copy analytical report if any previously reported data are found to be in error. If major quality control problems are identified during data assessment procedures, the Project Manager may request that additional samples be collected from a sample location for laboratory analysis.

5.3.1 Assessment of Measurement Performance

Data with EPA "J" qualifiers may be used for general site characterization purposes. These data will not be used for Site decision-making purposes, such as determining the presence or absence of contaminants, determining the effectiveness of remedial actions, assessing the cleanup status of an aquifer, or assessing the attainment of cleanup goals in an aquifer. Data

with EPA "R" qualifiers will not be used for either site characterization or site decision-making purposes.

5 3 2 Data Objective Assessment

Data obtained for the pilot extraction and aquifer response testing program will be reconciled with the requirements specified in the DQO Section 2.4 of this QAPP. Assessment of data for PARCC parameters will be in accordance with the measurement performance criteria Section 2.6 of this QAPP.

6.0 REFERENCES CITED

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TABLE B-1

ANALYTICAL METHOD INFORMATION FOR VOLATILE ORGANIC COMPOUNDS

ANALYTE	MDL (µg/l)	REPORTING LIMIT (µg/l)	ISGS (µg/l)	MATRIX SPIKE % R	MATRIX SPIKE RPD	BLANK SPIKE/LCS % R	BLANK SPIKE/LCS RPD
Acetone	4.5	5.0	610	10-200	50	30-145	50
Acrolein	TBD	5.0	TBD	TBD	TBD	TBD	TBD
Acrylonitrile	TBD	2.0	TBD	TBD	TBD	TBD	TBD
Benzene	0.28	2.0(0.5)	1	60-125	20	70-120	20
Bromobenzene	0.27	5.0	--	None	20	80-120	20
Bromochloromethane	0.32	5.0	--	None	20	65-135	20
Bromodichloromethane	0.30	2.0	--	70-140	20	70-140	20
Bromoform	0.25	5.0(0.5)	100	50-140	25	55-135	30
Bromomethane	0.20	5.0	8.7	None	30	65-140	30
2-Butanone (MEK)	3.8	5.0	1,900	15-180	50	45-155	50
n-Butylbenzene	0.37	5.0	--	None	20	75-130	20
sec-Butylbenzene	0.25	5.0	--	None	20	75-125	20
tert-Butylbenzene	0.22	5.0	--	None	20	75-125	20
Carbon disulfide	0.33	1.0	1,000	None	None	None	None
Carbon tetrachloride	0.28	0.5	0.5	None	20	65-155	20
Chlorobenzene	0.36	2.0	70	75-125	20	80-125	20
Chloroethane	0.33	5.0(2)	8,600	None	20	60-145	20
Chloroform	0.33	2.0	100	70-130	20	70-130	20
Chloromethane	0.14	1.5	1.5	None	30	40-145	20
2-Chlorotoluene	0.28	5.0	--	None	20	75-125	20
4-Chlorotoluene	0.29	5.0	--	None	20	75-125	20
2-Chloroethyl vinyl ether	TBD	1.0	TBD	TBD	TBD	TBD	TBD
Dibromochloromethane	0.28	2.0(0.5)	100	65-145	20	65-145	20
1,2-Dibromo-3-chloropropane	2.8	5.0	--	None	40	50-130	30
1,2-Dibromoethane (EDB)	0.32	2.0	--	None	20	75-125	20
Dibromomethane	0.36	2.0	--	None	20	70-130	20
1,2-Dichlorobenzene	0.32	2.0(0.5)	600	None	20	80-120	20
1,3-Dichlorobenzene	0.35	2.0	17	None	25	75-120	20
1,4-Dichlorobenzene	0.37	2.0(0.5)	5	70-120	20	75-120	20
Dichlorodifluoromethane	1.1	5.0	--	None	30	10-160	20
1,1-Dichloroethane	0.27	2.0(1.0)	5	65-135	20	70-135	20
1,2-Dichloroethane	0.28	0.5	0.5	60-150	20	60-150	20
1,1-Dichloroethylene	0.32	5.0(0.5)	--	60-135	20	70-130	20
cis-1,2-Dichloroethylene	0.32	2.0	--	None	20	70-125	20
trans-1,2-Dichloroethylene	0.27	2.0(1.0)	--	None	20	70-130	20
1,2-Dichloropropane	0.35	2.0(0.5)	5	None	20	65-120	20
1,3-Dichloropropane	0.30	2.0	--	None	20	70-130	20
2,2-Dichloropropane	0.29	2.0	--	None	20	70-150	20
1,1-Dichloropropylene	0.28	2.0	--	None	20	75-130	20
1,3-Dichloropropylene	TBD	0.5	TBD	TBD	TBD	TBD	TBD
cis-1,3-Dichloropropylene	0.22	2.0	--	None	25	75-130	20
trans-1,3-Dichloropropylene	0.24	2.0	--	None	20	70-135	20

TABLE B-1

ANALYTICAL METHOD INFORMATION FOR VOLATILE ORGANIC COMPOUNDS

ANALYTE	MDL (µg/l)	REPORTING LIMIT (µg/l)	ISGS (µg/l)	MATRIX SPIKE % R	MATRIX SPIKE RPD	BLANK SPIKE/LCS % R	BLANK SPIKE/LCS RPD
Ethylbenzene	0.25	2.0	700	65-125	20	70-125	20
Ethylene Dibromide	TBD	na	TBD	TBD	TBD	TBD	TBD
Hexachlorobutadiene	0.42	5.0	--	None	20	70-140	20
2-Hexanone	2.5	5.0	1,604	35-165	50	40-145	50
Isopropylbenzene	0.25	2.0	61	None	20	70-125	20
p-Isopropyltoluene	0.28	2.0	--	None	20	75-125	20
4-Methyl-2-pentanone (MIBK)	2.5	5.0	160	35-175	45	45-135	45
Methyl bromide	TBD	2.0	TBD	TBD	TBD	TBD	TBD
Methyl chloride	TBD	0.5	TBD	TBD	TBD	TBD	TBD
Methylene chloride	0.33	5.0(0.5)	5	None	25	60-135	20
Methyl ethyl ketone	TBD	na	TBD	TBD	TBD	TBD	TBD
Methyl tertiary butyl ether	TBD	na	TBD	TBD	TBD	TBD	TBD
Ethyl tertiary butyl ether	TBD	2.0	TBD	TBD	TBD	TBD	TBD
Tertiary amyl methyl ether	TBD	2.0	TBD	TBD	TBD	TBD	TBD
Tertiary butyl alcohol	TBD	10.0	TBD	TBD	TBD	TBD	TBD
Naphthalene	0.33	5.0	6.2	50-145	30	50-145	30
n-Propylbenzene	0.27	2.0	61	None	20	75-130	20
Styrene	0.16	2.0	100	None	30	80-135	30
1,1,1,2-Tetrachloroethane	0.27	5.0	--	None	20	70-145	20
1,1,2,2-Tetrachloroethane	0.29	1.0(0.5)	1	None	30	60-135	30
Tetrachloroethylene	0.32	2.0(0.5)	5	70-130	20	80-125	20
Toluene	0.49	2.0	150	65-125	20	70-120	20
1,2,3-Trichlorobenzene	0.45	5.0	--	None	20	65-135	20
1,2,4-Trichlorobenzene	0.51	5.0	70	None	20	70-140	20
1,1,1-Trichloroethane	0.30	2.0	200	None	20	70-140	20
1,1,2-Trichloroethane	0.30	2.0(0.5)	5	None	20	70-125	20
Trichloroethylene	0.26	2.0(0.5)	--	70-125	20	75-120	20
Trichlorofluoromethane	0.34	5.0	--	None	25	65-145	20
1,2,3-Trichloropropane	0.34	10	--	None	25	60-130	25
1,2,4-Trimethylbenzene	0.31	2.0	12	None	20	80-125	20
1,3,5-Trimethylbenzene	0.26	2.0	--	None	25	80-125	35
Vinyl acetate	0.35	2.0	410	None	None	None	None
Vinyl chloride	0.19	0.5	0.5	40-135	20	50-130	20
o-Xylene	0.24	2.0	1,750	65-125	20	70-125	25
m,p-Xylenes	0.38	2.0	1,750	65-120	20	70-120	20

TABLE B-1

ANALYTICAL METHOD INFORMATION FOR VOLATILE ORGANIC COMPOUNDS

FOOTNOTES

MDL = Method Detection Limit
ISGS = In Situ Groundwater Standards
µg/l = Micrograms per liter
% R = Percent Recovery
RPD = Relative Percent Difference
LCS = Laboratory Control Sample
(--) = Not available
TBD = To Be Determined

TABLE B-2

ANALYTICAL METHOD INFORMATION FOR ORGANOCHLORINE PESTICIDES AND POLYCHLORINATED BIPHYNELS

ANALYTE	MDL	REPORTING LIMIT (µg/l)	ISGS (µg/l)	MATRIX SPIKE % R	MATRIX SPIKE RPD	BLANK SPIKE/LCS % R	BLANK SPIKE/LCS RPD
EPA METHOD 8081							
Aldrin	0.0026	0.004	0.004	35-115	20	45-115	20
alpha-BHC	0.00049	0.005	0.011	30-110	25	50-115	20
beta-BHC	0.0023	0.01(0.005)	0.037	30-115	25	65-115	20
delta-BHC	0.015	0.20(0.005)	--	40-135	30	70-115	20
gamma-BHC (Lindane)	0.015	0.10(0.02)	0.2	35-125	20	55-115	20
Alpha-endosulfan	TBD	0.02	TBD	TBD	TBD	TBD	TBD
Beta-endosulfan	TBD	0.01	TBD	TBD	TBD	TBD	TBD
Chlordane	0.057	1.0(0.1)	--	None	None	None	None
2,4'-DDD*	0.0076	0.10	0.28	55-120	20	70-120	20
2,4'-DDE*	0.012	0.10	0.20	55-115	20	65-115	20
2,4'-DDT*	0.0092	0.10	0.20	60-120	20	70-120	20
4,4'-DDD	0.013	0.10(0.05)	0.28	55-120	20	70-120	20
4,4'-DDE	0.013	0.10(0.05)	0.20	55-115	20	65-115	20
4,4'-DDT	0.019	0.10(0.01)	0.20	60-120	20	70-120	20
Dieldrin	0.012	0.10(0.01)	--	50-115	20	60-115	20
Endosulfan I	0.011	0.10	--	45-115	20	60-115	20
Endosulfan II	0.037	0.10	--	55-120	20	55-115	20
Endosulfan sulfate	0.025	0.20(0.05)	--	50-150	25	65-120	20
Endrin	0.011	0.10(0.01)	2	60-115	20	65-115	20
Endrin aldehyde	0.016	0.10(0.01)	--	50-125	20	65-115	20
Endrin ketone	0.012	0.10	--	55-145	20	65-115	20
Heptachlor	0.0025	0.01	0.01	35-125	20	55-120	20
Heptachlor epoxide	0.0033	0.005	0.01	35-115	20	60-115	20
Methoxychlor	0.031	0.10	--	35-135	25	70-115	20
Toxaphene	1.3	5.0(0.5)	--	None	None	None	None
EPA METHOD 8082							
PCB 1016	TBD	0.5	TBD	TBD	TBD	TBD	TBD
PCB 1221	TBD	0.5	TBD	TBD	TBD	TBD	TBD
PCB 1232	TBD	0.5	TBD	TBD	TBD	TBD	TBD
PCB 1242	TBD	0.5	TBD	TBD	TBD	TBD	TBD
PCB 1248	TBD	0.5	TBD	TBD	TBD	TBD	TBD
PCB 1254	TBD	0.5	TBD	TBD	TBD	TBD	TBD
PCB 1260	TBD	0.5	TBD	TBD	TBD	TBD	TBD

TABLE B-2

ANALYTICAL METHOD INFORMATION FOR ORGANOCHLORINE PESTICIDES AND POLYCHLORINATED BIPHYNELS

FOOTNOTES

*	=	Result for this compound is qualitative due to coelution difficulties
MDL	=	Method Detection Limit
ISGS	=	In Situ Groundwater Standards
µg/l	=	Micrograms per liter
% R	=	Percent Recovery
RPD	=	Relative Percent Difference
TBD	=	To be determined based on future MDL study
LCS	=	Laboratory Control Sample
BHC	=	Hexachlorocyclohexane
DDD	=	Dichlorodiphenyldichloroethane
DDE	=	Dichlorodiphenyldichloroethylene
DDT	=	Dichlorodiphenyltrichloroethane
(--)	=	Not available
TBD	=	To Be Determined

TABLE B-3

ANALYTICAL METHOD INFORMATION FOR pCBSA

ANALYTE	MDL (µg/l)	REPORTING LIMIT (µg/l)	MATRIX SPIKE % R	MATRIX SPIKE RPD	BLANK SPIKE/LCS % R	BLANK SPIKE/LCS RPD
pCBSA	5	10	75-125	15	85-115	20

FOOTNOTES

MDL = Method Detection Limit
µg/l = Micrograms per liter
% R = Percent Recovery
RPD = Relative Percent Difference
LCS = Laboratory Control Sample
pCBSA = parachlorobenzene Sulfonic Acid

TABLE B-4

ANALYTICAL METHOD INFORMATION FOR GENERAL MINERALS

ANALYTE	MDL (mg/l)	REPORTING LIMIT (mg/l)	MATRIX SPIKE % R	MATRIX SPIKE RPD	BLANK SPIKE/LCS % R	BLANK SPIKE/LCS RPD
Aluminum	0.047	0.050	75-125	20	80-120	20
Alkalinity[a]	2.0	2.0	None	None	None	None
Calcium	0.015	0.10	70-130	20	85-115	20
Chloride	0.26	0.50	80-120	20	90-110	20
Potassium	0.066	0.50	70-130	20	85-115	20
Iron	0.0088	0.040	70-130	20	85-115	20
Magnesium	0.0030	0.020	70-130	20	85-115	20
Manganese	0.0032	0.020	70-130	20	85-115	20
Sodium	0.095	0.50	70-130	20	85-115	20
Sulfate	0.25	0.50	80-120	20	90-110	20
Total Dissolved Solids	10	10	None	None	90-110	20
Nitrate	0.072	0.11	80-120	20	90-110	20
Hardness	1.0	1.0	None	None	None	None
Specific Conductance [a] [b]	1.0	1.0	None	None	90-110	None

FOOTNOTES

(a) The only QC performed is a duplicate analysis.
(b) MDL and reporting limits given in µmhos per centimeter.

MDL = Method Detection Limit
mg/l = Milligrams per liter
% R = Percent Recovery
RPD = Relative Percent Difference
LCS = Laboratory Control Sample
QC = Quality Control

TABLE B-5

ANALYTICAL METHOD INFORMATION FOR OTHER PARAMETERS

ANALYTE	MDL (mg/l)	REPORTING LIMIT (mg/l)	MATRIX SPIKE % R	MATRIX SPIKE RPD	BLANK SPIKE/LCS % R	BLANK SPIKE/LCS RPD
Asbestos	TBD	na	TBD	TBD	TBD	TBD
Total Kjeldahl Nitrogen	0.22	0.50	85-120	15	85-120	15
Total Phosphorus	0.0087	0.050	65-130	15	80-120	20
Orthophosphorus	0.0087	0.050	75-125	20	90-110	20
Nitrate/Nitrite	0.072	0.15	80-120	20	90-110	20
Biochemical Oxygen Demand	TBD	30	TBD	TBD	TBD	TBD
Cyanide	0.0042	0.025	70-115	15	90-110	10
Chlorine (residual)		0.1				
1,4-Dioxane	TBD	na	TBD	TBD	TBD	TBD
2,3,7,8-TCDD (Dioxin)	TBD	na	TBD	TBD	TBD	TBD
Di-isopropyl ether	TBD	0.002	TBD	TBD	TBD	TBD
Ethanol	TBD	1.0	TBD	TBD	TBD	TBD
Methanol	TBD	1.0	TBD	TBD	TBD	TBD
Total Organic Carbon	0.29	1.0	80-120	20	90-110	20
Fluoride	0.20	0.50	80-120	20	90-110	20
Nitrite	0.058	0.15	80-120	20	90-110	20
pH*	None	None	None	None	None	None
Specific Conductance[a]*	1.0	1.0	None	None	90-110	None
Color[b]*	1.0	1.0	None	None	None	None
Suspended Solids	10	10	None	None	85-115	None
Settleable Solids		0.3				
Hardness	1.0	1.0	None	None	None	None
Total Silica	0.012	0.11	75-125	20	80-120	20
Turbidity	TBD	150 (d)	TBD	TBD	TBD	TBD
Sulfide	0.017	0.10	70-130	30	80-120	20
Boron	0.0074	0.050	75-125	20	80-120	20
Strontium	0.0093	0.020	75-125	20	80-120	20
MBAS (Surfactants)	0.0086	0.10	50-125	20	90-110	20
Ammonium	0.11	0.50	75-125	15	85-115	15
Total coliform	1.0	1.0	None	None	None	None
Perchlorate	TBD	na	TBD	TBD	TBD	TBD
Phenols	TBD	1.0	TBD	TBD	TBD	TBD
Pseudomonas	**	**	None	None	None	None
Heterotrophic Plate Count[c]*	1.0	1.0	None	None	None	None
TRPH	0.31	1.0	60-120	15	80-120	15
Oil and Grease	TBD	15	TBD	TBD	TBD	TBD
N-Nitroso-di-methyl amine (NDMA)	TBD	TBD	TBD	TBD	TBD	TBD

TABLE B-5

ANALYTICAL METHOD INFORMATION FOR OTHER PARAMETERS

FOOTNOTES

(*)	=	The only QC performed is a duplicate analysis.
(a)	=	MDL and Reporting Limits given in umhos per centimeter
(b)	=	MDL and Reporting Limits given in color units
(c)	=	MDL and Reporting Limits given in Colony Forming Units per milliliter
(d)	=	Nephelometric Turbidity Units
**	=	Less than 2.0/100 milliliters
MDL	=	Method Detection Limit
mg/l	=	Milligrams per liter
% R	=	Percent Recovery
RPD	=	Relative Percent Difference
LCS	=	Laboratory Control Spike
MBAS	=	Methylene Blue Active Substances
TRPH	=	Total Recoverable Petroleum Hydrocarbons
QC	=	Quality Control
TBD	=	To Be Determined

TABLE B-6

ANALYTICAL METHOD INFORMATION FOR CALIFORNIA TITLE 22 METALS AND TRIVALENT AND HEXAVALENT CHROMIUM

ANALYTE	MDL (µg/l)	REPORTING LIMIT (µg/l)	MATRIX SPIKE % R	MATRIX SPIKE RPD	BLANK SPIKE/LCS % R	BLANK SPIKE/LCS RPD
Antimony	0.54	2.0	75-125	20	80-120	20
Arsenic	0.70	1.0	75-125	20	80-120	20
Barium	0.053	1.0	75-125	20	80-120	20
Beryllium	0.078	0.50	75-125	20	80-120	20
Cadmium	0.13	1.0(0.5)	75-125	20	80-120	20
Chromium	0.35	1.0	75-125	20	80-120	20
Chromium III	TBD	10	TBD	TBD	TBD	TBD
Chromium VI	TBD	5	TBD	TBD	TBD	TBD
Cobalt	0.11	1.0	75-125	20	80-120	20
Copper	0.24	2.0(0.5)	75-125	20	80-120	20
Lead	0.070	1.0(0.5)	75-125	20	80-120	20
Molybdenum	0.14	1.0	75-125	20	80-120	20
Mercury	0.063	0.20	75-120	20	90-115	20
Nickel	0.20	1.0	75-125	20	80-120	20
Selenium	0.28	2.0	75-125	20	80-120	20
Silver	0.13	1.0(0.25)	75-125	20	80-120	20
Thallium	0.083	1.0	75-125	20	80-120	20
Vanadium	0.70	1.0	75-125	20	80-120	20
Zinc	0.97	20	75-125	20	80-120	20

FOOTNOTES

MDL = Method Detection Limit
µg/l = Micrograms per liter
% R = Percent Recovery
RPD = Relative Percent Difference
LCS = Laboratory Control Sample
TBD = To Be Determined

TABLE B-7

ANALYTICAL METHOD INFORMATION FOR SEMI-VOLATILE ORGANIC COMPOUNDS

ANALYTE	MDL (ug/l)	REPORTING LIMIT (ug/l)	ISGS (ug/l)	MATRIX SPIKE % R	MATRIX SPIKE RPD	BLANK SPIKE/LCS % R	BLANK SPIKE/LCS RPD
1,2-Dichlorobenzene	TBD	0.5	TBD	TBD	TBD	TBD	TBD
1,2-Diphenylhydrazine	TBD	1	TBD	TBD	TBD	TBD	TBD
1,2,4-Trichlorobenzene	TBD	5	TBD	TBD	TBD	TBD	TBD
1,3-Dichlorobenzene	TBD	2	TBD	TBD	TBD	TBD	TBD
1,4-Dichlorobenzene	TBD	2	TBD	TBD	TBD	TBD	TBD
2-Chlorophenol	TBD	5	TBD	TBD	TBD	TBD	TBD
2,4-Dichlorophenol	TBD	5	TBD	TBD	TBD	TBD	TBD
2,4-Dimethylphenol	TBD	2	TBD	TBD	TBD	TBD	TBD
2,4-Dinitrophenol	TBD	5	TBD	TBD	TBD	TBD	TBD
2,4-Dinitrotoluene	TBD	5	TBD	TBD	TBD	TBD	TBD
2,4,6-Trichlorophenol	TBD	10	TBD	TBD	TBD	TBD	TBD
2,6-Dinitrotoluene	TBD	5	TBD	TBD	TBD	TBD	TBD
2-Nitrophenol	TBD	10	TBD	TBD	TBD	TBD	TBD
2-Chloronaphthalene	TBD	10	TBD	TBD	TBD	TBD	TBD
3,3'-Dichlorobenzidine	TBD	5	TBD	TBD	TBD	TBD	TBD
3-Methyl-4-Chlorophenol	TBD	1	TBD	TBD	TBD	TBD	TBD
2-Methyl-4,6-Dinitrophenol	TBD	5	TBD	TBD	TBD	TBD	TBD
4-Nitrophenol	TBD	5	TBD	TBD	TBD	TBD	TBD
4-Bromophenyl phenyl ether	TBD	5	TBD	TBD	TBD	TBD	TBD
4-Chlorophenyl phenyl ether	TBD	5	TBD	TBD	TBD	TBD	TBD
Acenaphthene	TBD	1	TBD	TBD	TBD	TBD	TBD
Acenaphthylene	TBD	10	TBD	TBD	TBD	TBD	TBD
Anthracene	TBD	5	TBD	TBD	TBD	TBD	TBD
Benzidine	TBD	5	TBD	TBD	TBD	TBD	TBD
Benzo (a) Anthracene	TBD	5	TBD	TBD	TBD	TBD	TBD
Benzo (a) Pyrene	TBD	2	TBD	TBD	TBD	TBD	TBD
Benzo (b) Fluoranthene	TBD	10	TBD	TBD	TBD	TBD	TBD
Benzo (g,h,i) Perylene	TBD	5	TBD	TBD	TBD	TBD	TBD
Benzo (k) Fluoranthene	TBD	2	TBD	TBD	TBD	TBD	TBD
Bis(2-Chloroethoxyl) methane	TBD	5	TBD	TBD	TBD	TBD	TBD
Bis(2-Chloroethyl) ether	TBD	1	TBD	TBD	TBD	TBD	TBD
Bis(2-Chloroisopropyl) ether	TBD	10	TBD	TBD	TBD	TBD	TBD
Bis(2-Ethylhexyl) phthalate	TBD	5	TBD	TBD	TBD	TBD	TBD
Butyl benzyl phthalate	TBD	10	TBD	TBD	TBD	TBD	TBD
Chrysene	TBD	5	TBD	TBD	TBD	TBD	TBD
Dibenzo (a,h) Anthracene	TBD	0.1	TBD	TBD	TBD	TBD	TBD
Diethyl phthalate	TBD	10	TBD	TBD	TBD	TBD	TBD
Dimethyl phthalate	TBD	10	TBD	TBD	TBD	TBD	TBD
di-n-Butyl phthalate	TBD	10	TBD	TBD	TBD	TBD	TBD
di-n-Octyl phthalate	TBD	10	TBD	TBD	TBD	TBD	TBD
Fluoranthene	TBD	10	TBD	TBD	TBD	TBD	TBD

TABLE B-7

ANALYTICAL METHOD INFORMATION FOR SEMI-VOLATILE ORGANIC COMPOUNDS

ANALYTE	MDL (ug/l)	REPORTING LIMIT (ug/l)	ISGS (ug/l)	MATRIX SPIKE % R	MATRIX SPIKE RPD	BLANK SPIKE/LCS % R	BLANK SPIKE/LCS RPD
Fluorene	TBD	1	TBD	TBD	TBD	TBD	TBD
Hexachlorobenzene	TBD	1	TBD	TBD	TBD	TBD	TBD
Hexachlorobutadiene	TBD	1	TBD	TBD	TBD	TBD	TBD
Hexachloro-cyclopentadiene	TBD	5	TBD	TBD	TBD	TBD	TBD
Hexachloroethane	TBD	1	TBD	TBD	TBD	TBD	TBD
Indeno(1,2,3,cd) Pyrene	TBD	0.05	TBD	TBD	TBD	TBD	TBD
Isophorone	TBD	1	TBD	TBD	TBD	TBD	TBD
N-Nitrosodimethyl amine (NDMA)	TBD	5	TBD	TBD	TBD	TBD	TBD
N-Nitroso-di-n-propyl amine	TBD	5	TBD	TBD	TBD	TBD	TBD
N-Nitrosodiphenyl amine	TBD	1	TBD	TBD	TBD	TBD	TBD
Naphthalene	TBD	10	TBD	TBD	TBD	TBD	TBD
Nitrobenzene	TBD	10	TBD	TBD	TBD	TBD	TBD
Pentachlorophenol	TBD	1	TBD	TBD	TBD	TBD	TBD
Phenanthrene	TBD	5	TBD	TBD	TBD	TBD	TBD
Phenol	TBD	50	TBD	TBD	TBD	TBD	TBD
Pyrene	TBD	10	TBD	TBD	TBD	TBD	TBD

FOOTNOTES

ISGS = In Situ Groundwater Standards
MDL = Method Detection Limit
ug/l = Micrograms per liter
% R = Percent Recovery
RPD = Relative Percent Difference
LCS = Laboratory Control Spike
TBD = To Be Determined

TABLE B-8

HANDLING PROTOCOL FOR GROUNDWATER SAMPLES

ANALYTE	EPA METHOD	SAMPLE CONTAINER	OTHER REQUIREMENTS	PRESERVATION METHOD	MAXIMUM HOLDING TIME
VOLATILE ORGANIC COMPOUNDS	8260B	3 X 40 ml VOA VIAL, TEFLON LINED SEPTUM	VIALS FILLED COMPLETELY, NO HEAD SPACE	HCl, COOL TO 4°C	14 DAYS
Additional requested parameters:					
Di-isoproply ether (DIPE)					
Ethanol					
Methyl tertiary butyl ether (MTBE)					
Ethyl tertiary butyl ether (ETBE)					
Tertiary amyl methyl ether (TAME)					
Tertiary butyl alchohol (TBA)					
DDT, BHC, and Other Organochlorine Pesticides	8081A	2 X 1 LITER AMBER GLASS BOTTLE	BOTTLE FILLED TO NECK	UNPRESERVED, COOL TO 4°C	7 DAYS TO EXTRACT 40 DAYS TO ANALYZE
POLYCHLORINATED BYPHENALS	8082/608	2 X 1 LITER AMBER GLASS BOTTLE	BOTTLE FILLED TO NECK	UNPRESERVED, COOL TO 4°C	
SEMI-VOLATILE ORGANIC COMPOUNDS	8270	2 X 1 LITER AMBER GLASS BOTTLE	BOTTLE FILLED TO NECK	UNPRESERVED, COOL TO 4°C	
PARACHLOROBENZENE SULFONIC ACID (pCBSA)	Modified 314 0	1 X 500 ML PLASTIC	BOTTLE FILLED TO NECK	UNPRESERVED, COOL TO 4°C	28 DAYS
BIOLOGICAL PARAMETERS		1 X 500 ML PLASTIC BOTTLE	BOTTLE FILLED TO NECK	H_2SO_4 TO pH <2, COOL TO 4°C	
Total Kjeldahl Nitrogen (TKN)	SM 4500-N-O,C				28 DAYS
Total Phosporus	365.3				28 DAYS
Orthophosphate	365.3				2 DAYS
Ammonia	350.3				28 DAYS
Total Nitrogen	300.0	1 X 250 ML PLASTIC	BOTTLE FILLED TO NECK	COOL TO 4°C	48 HOURS
Nitrate/Nitrite	300.0				
BART TEST KIT (iron bacteria, sulfate reducing bacteria, slime forming bacteria)	NA	NA	Collect and store samples in accordance with manufacture's recommendations	NA	NA
GENERAL MINERALS		1 X 1 LITER PLASTIC	BOTTLE FILLED TO NECK	UNPRESERVED, COOL TO 4°C	
Aluminum	6010B				6 MONTHS
Total Alkalinity	SM 2320B				14 DAYS
Carbonate	SM 2320B				
Bicarbonate	SM 2320B				
Calcium	6010B				6 MONTHS
Chloride	300.0				28 DAYS
Fluoride	300.0				28 DAYS
Potassium	6010B				6 MONTHS
Iron (dissolved)	6020B				6 MONTHS
Magnesium	6010B				6 MONTHS
Manganese	6010B				6 MONTHS

TABLE B-8

HANDLING PROTOCOL FOR GROUNDWATER SAMPLES

ANALYTE	EPA METHOD	SAMPLE CONTAINER	OTHER REQUIREMENTS	PRESERVATION METHOD	MAXIMUM HOLDING TIME
Sodium	6010B				6 MONTHS
Sulfate	300.0				28 DAYS
Total Suspended Solids	160.2				7 DAYS
Total Dissolved Solids	160.1				7 DAYS
Turbidity	EPA 180.1				48 HOURS
Settleable Solids	EPA 160.5	1 X 1 LITER PLASTIC	BOTTLE FILLED TO NECK	UNPRESERVED, COOL TO 4°C	7 DAYS
Biochemical Oxygen Demand	EPA 405.1	1 X 1 LITER PLASTIC	BOTTLE FILLED TO NECK	UNPRESERVED, COOL TO 4°C	48 HOURS
METALS (expressed as total recoverable)		1 X 1 LITER PLASTIC	BOTTLE FILLED TO NECK	HNO_3 TO Ph <2, COOL TO 4°C	6 MONTHS
Antimony	6020B				
Arsenic	6020B				
Barium	6020B				
Beryllium	6020B			*FOR METALS, INSTRUCT LAB TO FILTER AND ACIDIFY UPON RECEIPT*	
Cadmium	6020B				
Total Chromium	6020B				
Trivalent Chromium	Calculation				
Hexavalent Chromium	7196				
Cobalt	6020B				
Copper	6020B				
Lead	6020B				
Molybdenum	6020B				
Mercury	7470A				28 DAYS
Nickel	6020B				
Selenium	6020B				
Silver	6020B				
Thallium	6020B				
Vanadium	6020B				
Zinc	6020B				
OTHER PARAMETERS					
Cyanide	9014	1 X 1 LITER PLASTIC	BOTTLE FILLED TO NECK	NaOH, COOL TO 4oC	14 DAYS
Hydrogen Sulfide	SM 4500-S	500 ml PLASTIC	BOTTLE FILLED TO NECK	ZnAc/NaOH TO pH >12, COOL TO 4°C	7 DAYS
Total Organic Carbon	415.1	3 X 40 ml VOA VIAL, TEFLON LINED SEPTUM	VIALS FILLED COMPLETELY, NO HEAD SPACE	HCl, COOL TO 4°C	28 DAYS
Asbestos	100.1	1 X 1 LITER PLASTIC	BOTTLE FILLED TO NECK	COOL TO 4°C	7 DAYS
1,4-Dioxane	8260	3 X 40 ml VOA VIAL, TEFLON LINED SEPTUM	VIALS FILLED COMPLETELY, NO HEAD SPACE	HCl, COOL TO 4°C	14 DAYS
Methanol	8015	3 X 40 ml VOA VIAL, TEFLON LINED SEPTUM	VIALS FILLED COMPLETELY, NO HEAD SPACE	HCl, COOL TO 4°C	14 DAYS
Perchlorate	314.0	500 ml PLASTIC	BOTTLE FILLED TO NECK	COOL TO 4°C	7 DAYS
2,3,7,8-TCDD (Dioxin)	8290	2 X 1 LITER AMBER GLASS BOTTLE	BOTTLE FILLED TO NECK		
N-Nitroso-di-methyl amine (NDMA)	1625C	2 X 1 LITER AMBER GLASS BOTTLE	BOTTLE FILLED TO NECK	COOL TO 4°C	14 DAYS
Total Silica	6010B				6 MONTHS

TABLE B-8

HANDLING PROTOCOL FOR GROUNDWATER SAMPLES

ANALYTE	EPA METHOD	SAMPLE CONTAINER	OTHER REQUIREMENTS	PRESERVATION METHOD	MAXIMUM HOLDING TIME
Total Petrolium Hydrocarbons	418.1	2 X 1 LITER AMBER GLASS BOTTLE	BOTTLE FILLED TO NECK	HCl, COOL TO 4°C	28 DAYS
Oil and Grease	413.1	2 X 1 LITER AMBER GLASS BOTTLE	BOTTLE FILLED TO NECK	HCl, COOL TO 4°C	28 DAYS
Phenols	420	1 LITER AMBER GLASS BOTTLE	BOTTLE FILLED TO NECK	H_2SO_4 TO pH <2, COOL TO 4°C	28 DAYS
Residual chlorine	SM 4500	250 ml PLASTIC	BOTTLE FILLED TO NECK	COOL TO 4oC	IMMEDIATE

FOOTNOTES

(<) = Less than
DDT = Dichlorodiphenyltrichloroethane
°C = degrees Celsius
EPA = U.S. Environmental Protection Agency
HCl = Hydrochloric Acid
HDPE = High Density Polyethylene
lab = Laboratory
ml = Milliliter
VOA = Volatile Organic Analysis
NA = Not Applicable
H_2SO_4 = Sulfuric Acid
ZnAc = Zinc Acetate
NaOH = Sodium Hydroxide
HNO_3 = Nitric Acid

HARGIS + ASSOCIATES, INC.
Mission City Corporate Center
2365 Northside Drive, Suite C-100
San Diego, CA 92108
Phone: 619.521.0165

Client	Date
H+A Project No.	Sample ID
Initials	Time
Analyze for:	
Preservative/Special Instructions.	

TABLE B-9. SAMPLE IDENTIFICATION LABEL

TABLE B-10

HARGIS + ASSOCIATES, INC.

CHAIN-OF-CUSTODY RECORD AND ANALYSIS REQUEST FORM

DATE _____ PAGE ____ OF ____

PROJECT NAME	PROJECT No./TASK No.
PROJECT MANAGER	Phone No.
QA MANAGER	FAX No.
SAMPLER (SIGNATURE)	SAMPLER (PRINTED)

LAB ID	SAMPLE ID	SAMPLE COLLECTION		MATRIX				PRESERVATION						SAMPLE CONTAINERS	ANALYSES REQUESTED	ESTIMATED CONCENTRATION RANGE (ppb) FOR VOAS	SPECIAL HANDLING	LABORATORY INFORMATION
		Date	Time	Soil	Ground-water	Surface water		HCl	HNO3	NaOH	H2SO4	Ice						REMARKS
Total number of Containers per analysis:																	Total No. of Containers: _____	

Relinquished by:	Date	Received by:	Date
	Time		Time
Company		Company	
Relinquished by:	Date	Received by:	Date
	Time		Time
Company		Laboratory	

INSTRUCTIONS

1. Fill out form completely except for shaded areas (lab use only); sign only after verified for completeness.
2. Complete in ballpoint pen. Draw one line through errors, initial and date correction.
3. Indicate number of sample containers in analysis request space; indicate choice with ✓ or x.
4. Note applicable preservatives, special instructions, and deviations from typical environmental samples
5. Consult project QA documents for specific instructions.

Sample Receipt:

☐ No. of containers correct ☐ received good condition/cold

☐ custody seals secure ☐ conforms to COC document

Shipment Method: _____

Send Results to: _____

☐ 2365 NORTHSIDE DRIVE, SUITE C-100 SAN DIEGO, CA 92108 (619) 521-0165

☐ 1400 EAST SOUTHERN AVENUE, SUITE 620 TEMPE, AZ 85282 (480) 345-0688

☐ 1820 EAST RIVER ROAD, SUITE 100 TUCSON, AZ 85718 (520) 881-7300

Send invoice to San Diego, CA
Attn: Accounts Payable

ORIGINAL: LABORATORY YELLOW: QA MANAGER PINK: FIELD/TASK MANAGER

TABLE B-11

FIELD PROCEDURES AND QUALITY ASSURANCE OBJECTIVES

PROCEDURE	EQUIPMENT CHECK AND/OR CALIBRATION	OPERATIONAL PROCEDURE	PERSONNEL	DATA STORAGE SYSTEM	PRECISION	ACCURACY
Water Level Measurement	Electric water level sounder, steel tape, interface probe	SOP and manufacturer instructions for equipment	Hydrogeologist, field technician	Hard copy, electronic	0.01 foot	±0.1 foot
Water Sample Collection (excludes determination of electrical conductivity, pH, and temperature)	Depth specific sampling devices, sample bottles, shipping containers, transmittal forms, chain-of-custody records, field forms	SOP	Hydrogeologist, field technician	Hard copy	NA	NA
Electrical Conductivity	Conductivity meter, field form	SOP and manufacturer instructions for equipment	Hydrogeologist, field technician	Hard copy	±5 umhos when scale units are x1	±10 umhos when scale units are x1
Turbidity	Turbidity meter, field form	SOP and manufacturer instructions for equipment	Hydrogeologist, field technician	Hard copy	Based on instrument	Based on instrument
Dissolved Oxygen	Photometric meter, appropriate filters, high and low range ampoules, field form	SOP and manufacturer instructions for equipment	Hydrogeologist, field technician	Hard copy	Based on instrument	Based on instrument
pH	pH meter, field form	SOP and manufacturer instructions for equipment	Hydrogeologist, field technician	Hard copy	±0.05 unit	0.5 unit
Temperature	Field thermometer, field form	SOP and manufacturer instructions for equipment	Hydrogeologist, field technician	Hard copy	±0.1°C	±0.5°C

FOOTNOTES

SOP = Standard Operational Procedure
NA = Not Applicable
umhos = Micromhos
°C = Degrees Celsius

HARGIS + ASSOCIATES, INC.

TABLE B-12
ANALYTICAL DATA ASSESSMENT CHECKLIST

Laboratory:_____
Reviewed By:_____
Review Date:_____
Project Name:_____
Project #:_____

Category:_____
Method:_____
Parameters:_____

SAMPLE ID#	LABORATORY ID#	SAMPLE TYPE	MATRIX	PARAMETER	QC BATCH ID#	DATE SAMPLED	DATE EXTRACTED/PREP	DATE ANALYZED

TABLE B-12
ANALYTICAL DATA ASSESSMENT CHECKLIST

QUESTION	YES	NO	NA	ASSESSMENT FINDINGS	ASSIGNED QUALIFIER	ASSOCIATED DATA
I. Documentation Verification & Holding Times						
A. Was the sampling date, sample ID, sample description, and project number on the chain of custody (COC) record verified with those on the laboratory analytical report?	___	___	___			
B. Were the analytical methods specified on the COC record and lab work order verified with those on the laboratory analytical report?	___	___	___			
C. Were the correct sample preservation methods used? Note preservation.	___	___	___			
D. Were the holding times met for all samples?	___	___	___			
E. Are the "totals" listed for isomers and metabolites, such as BHC and DDT, correctly added?	___	___	___			

TABLE B-12
ANALYTICAL DATA ASSESSMENT CHECKLIST

QUESTION	YES	NO	NA	ASSESSMENT FINDINGS	ASSIGNED QUALIFIER	ASSOCIATED DATA
II. Blanks, Spikes, and Surrogates						
A. 1. Were any analytes detected in the trip blanks? Note the presence of these analytes in the trip blank and their concentrations.	___	___	___			
2. Were any of the analytes present in the trip blanks detected in any of the samples? Note these analytes and concentrations.	___	___	___			
B. 1. Were any analytes detected in the field blanks? Note the presence of these analytes in the field blank and their concentrations.	___	___	___			
2. Were any of the analytes present in the field blanks detected in any of the samples? Note these analytes and concentrations.	___	___	___			
C. 1. Were any analytes detected in the reagent or method blanks? Note the presence of these analytes in the reagent or method blanks and their concentrations.	___	___	___			
2. Were any of the analytes present in the reagent or method blanks detected in any of the samples? Note these analytes and concentrations.	___	___	___			
D. Are check standards or laboratory control standards (LCS) within the laboratory acceptance criteria?	___	___	___			

TABLE B-12
ANALYTICAL DATA ASSESSMENT CHECKLIST

QUESTION	YES	NO	NA	ASSESSMENT FINDINGS	ASSIGNED QUALIFIER	ASSOCIATED DATA
E. Are the spike recovery results within the laboratory acceptance criteria? Equation: % Recovery = (Spike sample result - Sample result) x 100 Spike concentration	___	___	___			
F. Are relative percent differences (RPDs) between the spike and spike duplicate within the laboratory acceptance criteria? Equation: RPD = (Spiked sample result - Duplicate spike result) x 100 Average result	___	___	___			
G. Are the surrogate recovery results within the laboratory acceptance criteria?	___	___	___			
III. Field Duplicates & Splits						
A. Are the RPDs for original samples versus field duplicates within the Hargis + Associates, Inc. (H+A) acceptance criteria? Equation: RPD = (Original sample result - Field duplicate result) x 100 Average result	___	___	___			
B. Are the RPDs for original sample versus split lab samples within the H+A acceptance criteria? Equation: RPD = (Original sample result - Split sample result) x 100 Average result	___	___	___			

TABLE B-12
ANALYTICAL DATA ASSESSMENT CHECKLIST

QUESTION	YES	NO	NA	ASSESSMENT FINDINGS	ASSIGNED QUALIFIER	ASSOCIATED DATA
IV. Reportable Detection Limits						
A. Are the reportable detection limits (RDLs) the same as laboratory established RDLs?	___	___	___			
B. Are any analytes reported at less than the RDL?	___	___	___			
C. Are the RDLs consistent with the dilution factor reported?	___	___	___			
V. Trending						
A. Are data comparable to past concentration trends? Note and evaluate any apparent anomalies. Use order of magnitude as a guideline.	___	___	___			

QC = Quality control
ID = Identifier
NA = Not applicable
COC = Chain of custody
BHC = Hexachlorocyclohexane
DDT = Dichlorodiphenyltrichloroethane
LCS = Laboratory control standards
RPDs = Relative percent differences
H+A = Hargis + Associates, Inc.
RDLs = Reportable detection limits

TABLE B-13

U.S. ENVIRONMENTAL PROTECTION AGENCY DATA QUALIFIERS

J	The associated numerical value is an estimated quantity because quality control criteria were not met.
R	Quality control indicates that data are unusable (compound may or may not be present). Resampling and/or reanalysis is necessary for verification.
Q	No analytical result.
N	Presumptive evidence of presence of material (tentative identification).

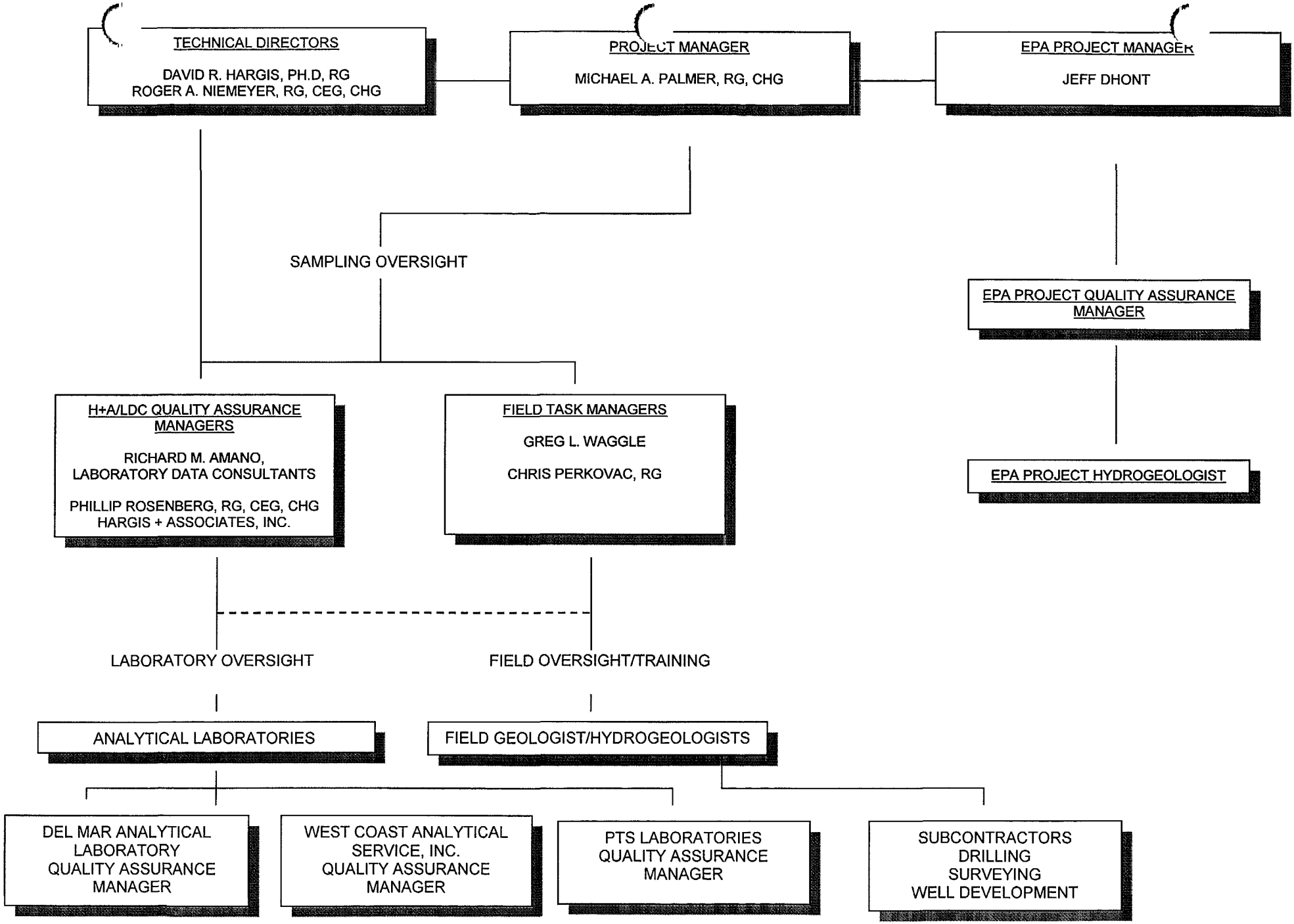
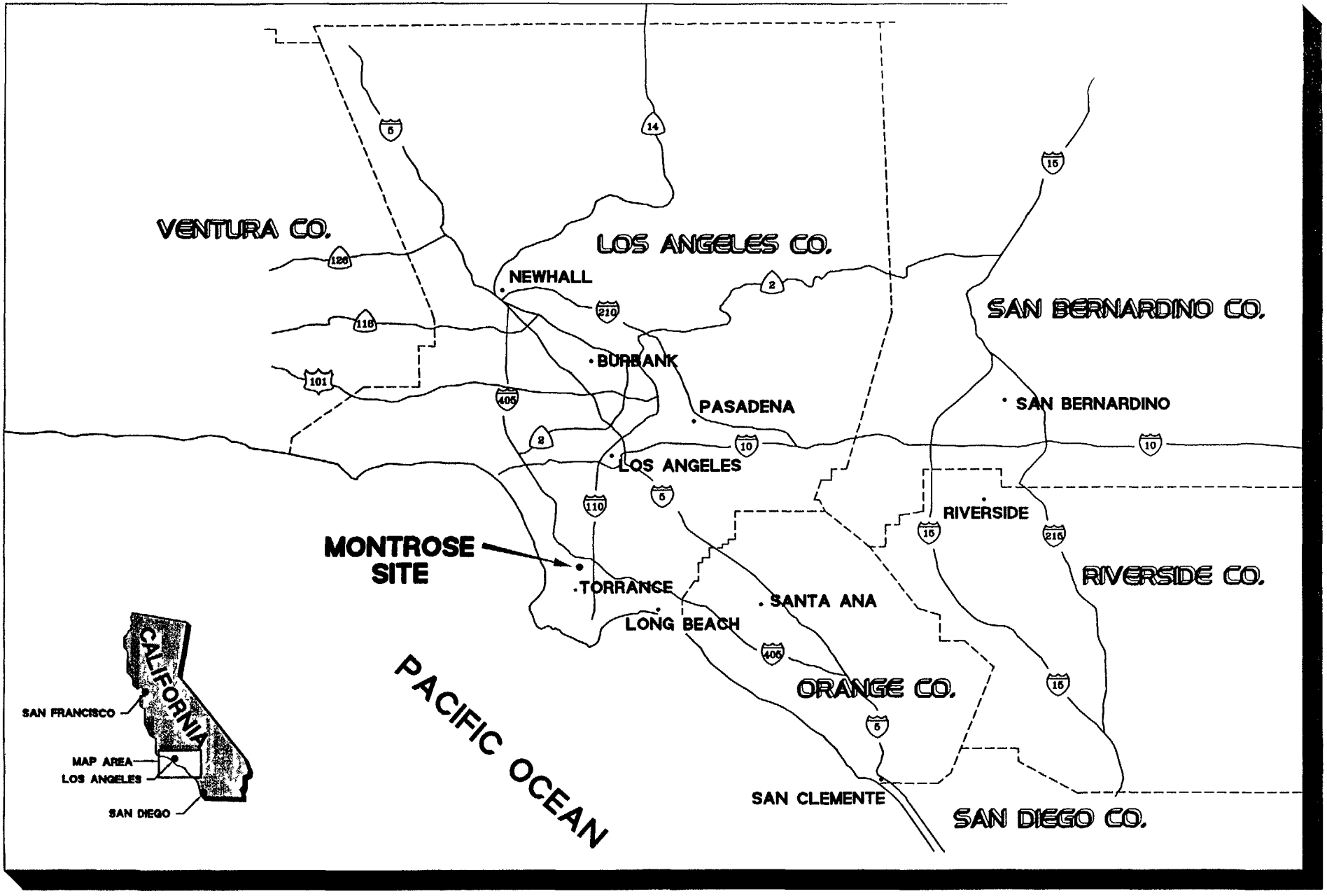


FIGURE B-1. QUALITY ASSURANCE ORGANIZATION CHART



HARGIS + ASSOCIATES, INC.

RPT NO 857 38	410-4717	A

FIGURE B-2. SITE LOCATION

HARGIS + ASSOCIATES, INC.

ATTACHMENTS B-1 THROUGH B-3

CD ROM

ATTACHMENT B-1: DEL MAR ANALYTICAL QUALITY ASSURANCE PROGRAM MANUAL

ATTACHMENT B-2: WEST COAST ANALYTICAL SERVICE, INC. QUALITY ASSURANCE MANUAL

ATTACHMENT B-3: PTS LABORATORIES, QUALITY ASSURANCE MANUAL

UNSCANNABLE MEDIA

To use the unscannable media document(s),
contact the Superfund Records Center.

(Document # 2054880)

Unscannable media - parent