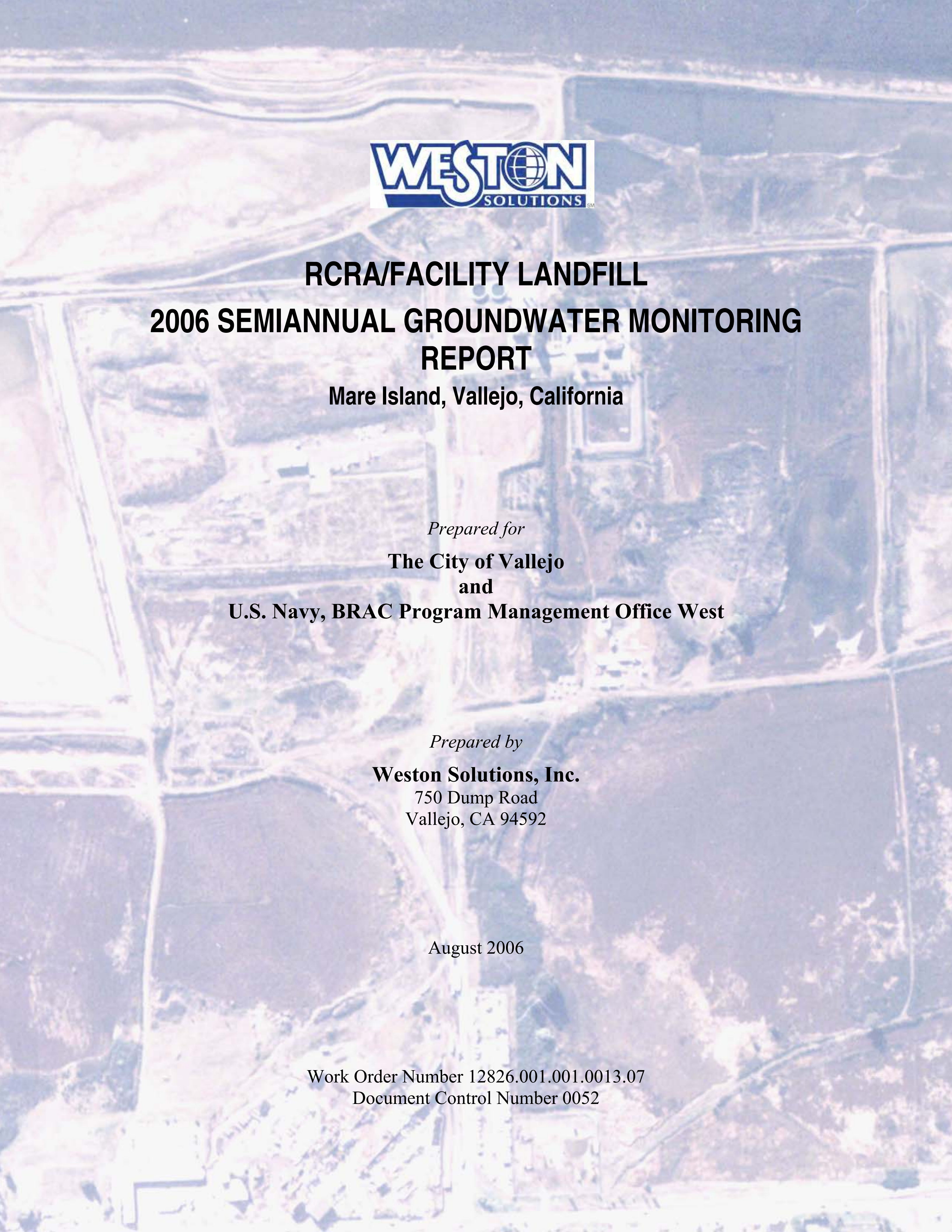

RCRA/FACILITY LANDFILL

2006 SEMIANNUAL GROUNDWATER MONITORING REPORT

Mare Island, Vallejo, California

Prepared for

The City of Vallejo
and
U.S. Navy, BRAC Program Management Office West

Prepared by

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RCRA/FACILITY LANDFILL
2006 SEMIANNUAL GROUNDWATER MONITORING REPORT
Mare Island, Vallejo, California

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ACRONYMS AND ABBREVIATIONS

°C	degrees Celsius
μg/L	microgram per liter
AM	Action Memorandum
bgs	below ground surface
btoc	below top of casing
CCR	California Code of Regulations
CD	compact disk
CDQM	Chemical Data Quality Manual
CERCLA	Comprehensive Environmental Response, Compensation, Liability Act
CLP	Contract Laboratory Program
DQOs	data quality objectives
DTSC	Department Toxic Substances Control
DWBZ	deep water-bearing zone
ELAP	Environmental Laboratory Accreditation Program
EMP	Evaluation Monitoring Program
EPA	U.S. Environmental Protection Agency
FSP	Field Sampling Plan
ft	foot, feet
IA	Investigation Area
ID	identification
IPOC	interim point of compliance
IR	Installation Restoration
IRAP	Interim Remedial Action Plan
IWBZ	intermediate water-bearing zone
IWTP	industrial wastewater treatment plant
L/min	liter per minute

ACRONYMS AND ABBREVIATIONS continued

MINS	Mare Island Naval Shipyard
MIRA	Mare Island Remediation Agreement
mg/L	milligram per Liter
MS	matrix spike
MSD	matrix spike duplicate
mg/L	milligram per liter
msl	mean seal level
mV	millivolt
NE	nature and extent
NFESC	Naval Facilities Engineering Service Center
NFECSW	Naval Facilities Engineering Command Southwest
ORP	Oxidation Reduction Potential
PID	photoionization detector
POC	point of compliance
PQLs	practical quantitation limits
PVC	polyvinyl chloride
Q	quarter
QA	quality assurance
QAO	Quality Assurance Officer
QAPP	Quality Assurance Project Plan
QC	quality control
RCRA	Resource Conservation and Recovery Act
SWBZ	shallow water-bearing zone
SWDIV	Southwest Division
TCRA	time-critical removal action
TPH	total petroleum hydrocarbon(s)
UPL	Upper Prediction Limits
UTL	Upper Tolerance Limit

ACRONYMS AND ABBREVIATIONS continued

VOCs	volatile organic compounds
VSFCD	Vallejo Sanitary and Flood Control District
Water Board	San Francisco Regional Water Quality Control Board
WESTON	Weston Solutions, Inc.
WETP	Western Early Transfer Parcel
WQSAP	Water Quality Sampling and Analysis Plan

EXECUTIVE SUMMARY

This 2006 Semiannual Groundwater Monitoring Report (Report) describes the sampling and analysis, quality assurance (QA), and quality control (QC) activities that Weston Solutions, Inc., (WESTON) implemented in the course of Resource Conservation and Recovery Act (RCRA)/Facility Landfill groundwater Evaluation Monitoring Program (EMP) at the Investigation Area (IA) H1 Mare Island, Vallejo, California. The Landfill and adjoining areas received and used hazardous materials after November 19, 1980, and as Interim Status Facilities must comply with the requirements of California Code of Regulations (CCR) Title 22 Division 4.5 Chapter 15 Article 6 for water quality and response monitoring. The evaluation monitoring described in this Report constitute the monitoring and response program for regulated units as described in §66265.99 “Evaluation Monitoring Program.” WESTON performed the monitoring activities described in this Report on behalf of the Naval Facilities Engineering Command Southwest (NFECSW).

The Report summarizes the EMP field activities at IA H1 conducted in the first two quarters of 2006 (Q1 and Q2). The objective of the data collection was to describe the current analyte concentrations and hydrologic conditions in compliance monitoring wells, nature and extent wells, and background wells.

Sampling and analysis of the IA H1 monitoring wells were conducted according to the requirements of the *Draft Final Water Quality Sampling and Analysis Plan, RCRA/Facility Landfill Groundwater Monitoring, Mare Island, California, Revision 2, August* (WESTON, 2005b).

Additional Navy, U.S. Environmental Protection Agency (EPA) and WESTON guidance and requirements documents were also used in the course of evaluation monitoring. Field sampling and laboratory analysis were performed according to the WQSAP requirements; no deviations that could affect data quality or usability were noted.

Specific project tasks included the following:

- Inspect and document the condition of monitoring wells; perform maintenance as necessary.

- Measure water quality field indicator parameters: pH, conductivity, temperature, turbidity, dissolved oxygen, oxidation-reduction potential (ORP).
- Collect water level measurements to delineate the direction of groundwater flow and to calculate hydraulic gradients.
- Collect groundwater samples and appropriate field QC samples.
- Analyze the samples for the monitoring parameters.
- Evaluate the data for compliance with the WQSAP requirements.
- Prepare the Semiannual Report.

Groundwater monitoring events described in this Report were performed between February 7 and March 23, 2006 (Q1) and May 23 and June 15, 2006 (Q2). A total of 32 point of compliance (POC), interim point of compliance (IPOC), nature and extent (NE) and background wells were sampled in Q1 and Q2 2006. An additional background well was sampled in Q2 2006. Groundwater levels were measured in 72 wells and piezometers during the Q1 and Q2 2006 monitoring event. In both quarters WESTON measured the water levels in 15 sumps associated with the groundwater extraction trench inside the slurry wall installed at the Landfill in 2004. No new wells were installed or old wells abandoned at IA H1 in Q1 and Q2 2006.

Water level measurements were used for the preparation of potentiometric surface maps for groundwater in three water-bearing zones under IA H1, shallow, intermediate and deep. Groundwater flow patterns in all three water-bearing zones remained consistent with previous data. Groundwater elevations measured in the extraction trench sumps are significantly higher for the Q1 and Q2 2006 monitoring events as compared to the Q3 and Q4 2005 monitoring events. The rise in water levels during Q1 and Q2 2006 is attributed to the extraction trench being shut down for maintenance in Q1 prior to the water level measurements and due to increased infiltration during the rainy season. Potentiometric surface maps are included as part of the Report.

The hydrographs for the SWBZ wells are enclosed in Appendix A. The hydrographs did not indicate any significant trends in SWBZ groundwater levels.

Analytical data and field notes for Q1 2006 and Q2 2006 are enclosed in Appendix B and Appendix C, respectively. All data validation reports, prepared by a third party validation company, are enclosed in Appendix D. All analyses were conducted by the state of California-accredited laboratories. All data were valid and usable for project decisions. Data interpretation has shown that no discernable changes took place in contaminant concentrations during the first half of year 2006.

Combined Shewhart-Cumulative Sum (CUSUM) control charts will be constructed for metal constituents of concern after eight quarters of data have been collected from POC/IPOC wells. The charts will provide a visual tool of detecting both trends and recent or cumulative releases in these well.

1. INTRODUCTION

This 2006 Semiannual Groundwater Monitoring Report (Report) describes the sampling and analysis, quality assurance (QA), and quality control (QC) activities that Weston Solutions, Inc., (WESTON) implemented in the course of Resource Conservation and Recovery Act (RCRA)/Facility Landfill groundwater Evaluation Monitoring Program (EMP) at the Investigation Area (IA) H1 Mare Island, Vallejo, California. In this document, "the Landfill" refers to Installation Restoration (IR) Site 06 (IR06) and the RCRA/Facility Landfill together. These facilities received and used hazardous materials after November 19, 1980, and as Interim Status Facilities must comply with the requirements of California Code of Regulations (CCR) Title 22 Division 4.5 Chapter 15 Article 6 for water quality and response monitoring. Under Article 6, the owner/operator of a landfill must implement a monitoring and response program at the regulated unit that includes evaluation monitoring as described in §66265.99 “Evaluation Monitoring Program.” WESTON performed the monitoring activities described in this Report on behalf of the Naval Facilities Engineering Command Southwest (NFECSW) according to the CCR Title 22 requirements for evaluation monitoring programs.

This Report summarizes the EMP field activities at the Landfill conducted in the first two quarters of 2006 (Q1 and Q2).

The work was performed under the Mare Island Remediation Agreement (MIRA) with the City of Vallejo. The MIRA was put in place to implement the requirements of the Environmental Services Cooperative Agreement Number N68711-01-MDC-1061 between the United States Department of the Navy, Southwest Division (SWDIV) and the City of Vallejo for the Western Early Transfer Parcel (WETP), Former Mare Island Naval Shipyard (MINS), Vallejo, California. The MIRA also includes remediation activities at certain areas of Mare Island that are located outside the WETP boundaries such as IA H1.

Sampling and analysis of the IA H1 monitoring wells was conducted according to the requirements of the following documents:

- Draft Final Water Quality Sampling and Analysis Plan, RCRA/Facility Landfill Groundwater Monitoring, Mare Island, California, Revision 2, August (WESTON, 2005a)

- Naval Facilities Engineering Service Center (NFESC), Navy Installation Restoration Chemical Data Quality Manual (CDQM) (NFESC, 1999)
- U.S. Navy Southwest Division November 2001, Environmental Work Instruction 3EN2.1—Chemical Data Validation (SWDIV, 2001)
- Final Site-Specific Health and Safety Plan, Mare Island Remediation Agreement Sites (WESTON, 2003b)

The objective of the data collection at IA H1 was to describe the current analyte concentrations and hydrologic conditions in the compliance monitoring and background wells at IA H1 as required for the EMP.

The 2006 Semiannual Report has been prepared to the requirements of *Guidance Document Appendix D* (DTSC, 2001) and contains the following elements:

- Executive summary that describes evaluation monitoring performed and identifies significant findings.
- Reference to the WQSAP; a list of variances from the WQSAP with an explanation of conditions that led to the variances and a description of corrective measures taken to avoid any future deviations.
- Description of any changes to the monitoring program, such as changes in the sampling and analysis protocol, addition of new or replacement wells, and the use of updated concentration limits.
- A narrative summarizing and interpreting the results, including hydrographs and potentiometric surface maps; a discussion of QA/QC issues; a statement on data quality and usability; a description of maintenance conducted at the Landfill.
- Data validation reports.
- Supporting documentation, such as copies of Monitoring Well Sampling Sheets, Calibration Logs, field parameter measurement results; copies of the Field Logbook pages related to sampling.

This Semiannual Report evaluates the data for two calendar quarters of year 2006 as follows:

- Sampling for the first quarter of year 2006 (Q1) was conducted between February 7 and March 23, 2006.
- Sampling for the second quarter of year 2006 (Q2) was conducted between May 23 and June 15, 2006.

Field and laboratory data has been included in this Report, and appendices have been organized as follows:

Appendix A—Shallow water-bearing zone well hydrographs

Appendix B—Laboratory results for Q1 2006, chain-of-custody forms, copies of field logbook pages and monitoring well sampling sheets.

Appendix C—Laboratory results for Q2 2006, chain-of-custody forms, copies of field logbook pages and monitoring well sampling sheets

Appendix D—Data validation reports

Appendices B through D are attached on a compact disk (CD). A copy of the Report in the PDF format on a CD is also enclosed.

2. PROJECT DESCRIPTION

2.1 PROBLEM DEFINITION AND BACKGROUND

This section describes the history and the background of the site, and the suspected contaminants of concern and their origin.

2.1.1 Site History and Background

Mare Island is located west of the City of Vallejo, approximately 25 miles northeast of San Francisco, California, as shown in area map in Figure 1. It is a peninsula, surrounded by three surface water bodies (Carquinez Strait, Napa River, and San Pablo Bay). Its dimensions are approximately 3.5 miles by 1.25 miles. Since 1854, Mare Island has been home to MINS.

The Navy initiated an IR Program at Mare Island in 1981. The IR program, performed over the past 20 years, primarily consisted of evaluating public health and environmental risks associated with the shipyard's historical operations. IA H1, which lies outside the WETP boundaries, is bordered by a series of dredge spoils ponds located to the south, north, and west as shown in Figure 2. Figure 3 shows IA H1 details, such as the Landfill and the surrounding IR sites. From 1909 until 1978, almost all solid wastes generated at the MINS were disposed of in various unlined pits and low-lying terrain along A Street and Dump Road. Waste oil was discharged into unlined sumps constructed in an area adjacent to the Landfill. This area has been designated as IR02. The sumps reportedly received approximately 4.5 million gallons of waste oil and solvents before disposal ended in the late-1960s. An unknown quantity of the waste oil was reported by a former MINS worker to have been removed by a reclamation contractor prior to the site being backfilled (Lemmon, 2006).

The original 30-acre landfill, referred to as the Facility Landfill, located within the IA H1, operated from 1965 to late 1977. It overlies an area originally (pre-1854) occupied by tidal flats. The area has been filled with dredge material and wastes created by the operation of the former MINS. The waste disposed of at the Facility Landfill is today assumed to consist of shipyard construction debris, municipal wastes, and minor amounts of hazardous materials. In 1978, the Facility Landfill reached capacity, and a new landfill area was established on top of the western half of the Facility Landfill. This new interim status landfill, referred to as the RCRA Landfill because it accepted RCRA-type wastes, was prohibited from accepting most hazardous wastes. The waste stream was primarily composed of non-hazardous materials (wet garbage, construction and demolition debris), but it also included a small proportion of hazardous wastes (asbestos-containing materials, solvent-laden rags, paint sludge, and spent sandblast abrasives). These materials were segregated in designated cell within the RCRA Landfill. The Landfill is estimated to contain approximately 600,000 tons of waste. The RCRA Landfill was closed in 1989; thereafter, all solid wastes were disposed of off-site.

Areas adjacent to the Landfill include former waste oil disposal sumps (IR02), a lead oxide storage area (IR16), inactive dredge ponds, and a former industrial wastewater treatment plant (IWTP). The unlined waste oil sumps located to the east of the Landfill were emptied of oil and backfilled before the early 1960s. The same area that contained the waste oil sumps was known to store spent lead-acid batteries and sand blast abrasives in the 1970s and 1980s. During the mid-1980s, most surface debris at this Lead Oxide Storage and Disposal area was removed, but small remnants were still found at the site. The former IWTP was constructed in the early 1970s just north of the landfill area. It contained four surface impoundments for equalization of the industrial wastes and drying sludge. These impoundments were all unlined until the early 1980s, and filled in 1989 after the IWTP ceased operations. Because the IWTP surface impoundments handled RCRA type wastes, it had the status of an interim RCRA facility.

The Landfill is situated approximately 1,700 feet (ft) northeast of San Pablo Bay and 4,400 ft southwest of Mare Island Strait. In total, the Facility Landfill covers 30 acres, and the RCRA Landfill covers 20 acres on top of the Facility Landfill. The elevation surrounding the Landfill ranges from 10 to 15 ft above mean sea level (msl). The top of the RCRA/Facility Landfill is approximately 42 ft msl. The maximum landfill refuse thickness is in the southern portion of the site, where the Landfill is approximately 45 ft thick. To prevent unauthorized access to the Landfill, it is completely fenced, and the primary access road to the Landfill (Dump Road) is closed to unauthorized traffic.

2.1.2 Site Geology

Investigations of the Landfill began in 1976 and focused on obtaining hydrogeological, geotechnical, and environmental data at the Landfill and its vicinity. Investigations identified four geologic units at the Landfill: artificial fill material and upper silty clay (includes landfill material, silty clay derived from the Navy's land reclamation and channel dredging activities, and naturally deposited silty clay); the intermediate sand; the lower silty clay; and the lower sand. The thickness of the Landfill material ranges from 20 to 45 ft; the underlying silty clays (Young Bay Mud) are 20 to 30 ft thick. The intermediate sand is up to 6 ft thick and the lower sand is at least 34 ft thick. The lower silty clay (Old Bay Mud) is 3 to 5 ft thick between the intermediate and deep sand units. Bedrock underlies the Old Bay Mud and is present from approximately 140 to 185 ft below ground surface (bgs) underneath the Landfill.

Three hydrogeologic units were identified beneath the Landfill. These units are referred to as the shallow, intermediate, and deep water-bearing zones. The shallow water-bearing zone (SWBZ) corresponds to artificial fill and a portion of the upper silty clay. The intermediate water-bearing zone (IWBZ) corresponds to the intermediate sand. The deep water-bearing zone (DWBZ) corresponds to the lower sand unit. These units, characterized by low SWBZ well yields and naturally high salinity, are not suitable for beneficial water supply (Water Board, 2004).

2.1.3 Current Site Conditions

The IA H1 is undergoing a cleanup and closure process under Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). In October 2004 WESTON completed a time-critical removal action (TCRA)/interim remedial action at IA H1 according to the provisions of Final Action Memorandum (AM)/Interim Remedial Action Plan (IRAP) (WESTON, 2004) approved by the Navy and DTSC in June 2004. The purpose of the TCRA was to construct a Containment Barrier consisting of a slurry wall and a groundwater collection trench around the perimeter of the RCRA/Facility Landfill, IWTP, and adjacent disposal areas. The encircled area is therefore referred to as the Containment Area.

The Final Action Memorandum/IRAP (WESTON, 2004) describes the design and construction of the vertical barrier and leachate collection system that manage groundwater and landfill leachate and prevent lateral movement of contaminants in the SWBZ. The vertical Containment Barrier is approximately 7,300 ft in length and encompasses approximately 70 acres. The Containment Barrier, which is keyed a minimum of 5 ft into the Young Bay Mud with total depths ranging from 15 to 30 ft bgs, is designed to prevent lateral migration of contaminants within the SWBZ.

A groundwater collection trench system was installed approximately 30 ft inside the slurry wall as shown in Figure 4. Fifteen collection sumps equipped with pneumatic pumps were placed every 500 ft along the trench. The extraction trench was designed to remove water and landfill leachate from within the Containment Area and reduce the existing groundwater mound.

The AM/IRAP has been followed by a Feasibility Study and a Remedial Action Plan/Record of Decision/RCRA Closure Plan. The IRAP was consistent with the anticipated final remedy for IA H1, namely constructing a cap over the landfill and vertical barrier as part of a presumptive remedy. The final landfill closure under RCRA will occur in conjunction with implementation of the final CERCLA remedy for the site.

Final closure of this facility will be conducted in accordance with California Code of Regulations (CCR) Title 22, Chapter 14, Article 7, Closure and Post Closure (22 CCR §66264.111-116).

2.2 CONSTITUENTS OF CONCERN

Potential impacts to groundwater as a result of releases from the Landfill are being studied under this groundwater EMP. The program comprises the following network of wells, piezometers and sumps listed with their construction details in Table 1:

- Fifteen point of compliance (POC) and interim point of compliance (IPOC) wells (the same wells also serve as the nature and extent (NE) wells)—seven in the SWBZ, three in the IWBZ, and five in the DWBZ
- Ten additional NE wells in the SWBZ
- Seven background wells—three in the SWBZ and two in the IWBZ and DWBZ each
- Forty monitoring wells and piezometers used for groundwater level measurements
- Fifteen sumps associated with the extraction trench

Table 2 presents the Landfill EMP analytical program. The following monitoring parameters requiring quarterly monitoring in POC, IPOC, and NE wells have been identified for the Landfill (WESTON, 2005a):

- Volatile organic compounds (VOCs)
- Total petroleum hydrocarbons (TPH) as gasoline, diesel and motor oil
- Metals (dissolved)

The constituents of concern, which require monitoring in POC/IPOC wells every five years, include the following (WESTON, 2005a):

- VOCs
- Semivolatile organic compounds (SVOCs)
- TPH as gasoline, diesel and motor oil
- Metals (dissolved)
- Gross alpha/beta
- Radium 226, Radium 228
- Organotins
- Hexavalent chromium
- Explosives
- Cyanide
- Pesticides
- Herbicides
- Polychlorinated biphenyls (PCBs)

According to CCR Title 22 Article 6, annual monitoring for the Appendix IX compound list is also required in POC/IPOC wells. The Q4 2005 monitoring combined the constituent of concern and the Appendix IX parameters. Table 3 summarizes the sampling and analysis during the Q1 and Q2 2006 monitoring events.

2.3 PROJECT/TASK DESCRIPTION

The project consists of sampling, analysis and elevation measurements of the groundwater in the Landfill monitoring wells in order to establish compliance with CCR Title 22 Division 4.5 Chapter 15 Article 6.

Specific project tasks included the following:

- Inspect and document the condition of monitoring wells and correct deficiencies
- Measure water quality field indicator parameters: pH, conductivity, temperature, turbidity, dissolved oxygen, oxidation-reduction potential (ORP)
- Collect water level measurements to delineate the direction of groundwater flow and to calculate hydraulic gradients
- Collect groundwater samples and appropriate field QC samples
- Analyze the samples for the monitoring parameters listed in Table 2
- Evaluate the data for compliance with the WQSAP requirements
- Prepare the Semiannual Report

WESTON personnel performed the field work in compliance with the requirements of the *Site Specific Health and Safety Plan,* Mare Island Remediation Agreement Sites (WESTON, 2003a) and *Construction Quality Control Plan,* Mare Island Remediation Agreement Sites (WESTON, 2003b).

2.4 PROJECT SCHEDULE

Groundwater monitoring events described in this Report were performed between February 7 and March 23, 2006 (Q1) and May 23 and June 15, 2006 (Q2). In the future, evaluation monitoring will be conducted for all wells on the following schedule:

Q1—January through March

Q2—April through June

Q3—July through September

Q4 (annual)—October through December

In accordance with the requirements of CCR Title 22 §66265.97, the groundwater flow direction is determined on a quarterly basis by measuring static water levels in a wide network of monitoring wells and piezometers at and near the Landfill and in the extraction trench sumps.

3. PROJECT ORGANIZATION

This section presents the project organization, quality control responsibilities, and laboratory qualifications for project activities during the investigation.

WESTON provided overall project management and coordinated and directed the efforts of project team members. WESTON was responsible for scheduling conference calls and/or meetings, and providing status reports as needed. Key project personnel and their responsibilities and authorities are outlined in Table 4. The Navy provides the QA oversight through Mr. Nars Ancog, the Navy Quality Assurance Officer (QAO).

A State of California Department of Health Services Environmental Laboratory Accreditation Program (ELAP)-certified laboratory provided analytical services for the project:

Organic and inorganic parameters:	Curtis and Tompkins, LTD. 2323 Fifth Street, Berkeley, CA 94710

This laboratory has successfully completed the NFESC laboratory assessment process.

Independent data validation is required by the *SWDIV Environmental Work Instruction 3EN2.1* (SWDIV, 2001). The independent data validation was conducted by Laboratory Data Consultants, located at 7750 El Camino Real, Suite 2L, Carlsbad, CA 92009.

4. DISCUSSION OF RESULTS

This section summarizes the findings of the groundwater monitoring events at the Landfill. Field activities included monitoring well inspections, static water level measurements for the purpose of determining the groundwater flow direction; and groundwater sampling for chemical analysis. Appendices B and C contain copies of the analytical laboratory results and field notes prepared during groundwater sampling for Q1 and Q2 2006, respectively.

4.1 MONITORING WELL INSPECTION

Before sampling, WESTON inspected the exterior condition of each well. The inspections evaluated and recorded the following for each monitoring well:

- Condition of external well identification information
- Condition of the concrete pad and surrounding area
- Condition of the well vault, lid, rubber seal, and lid bolts or well stickup and riser standpipe
- Air pressure within the well (note whether under pressure, vacuum, or at equilibrium)
- Presence of standing water (precipitation or other) in the vault
- Location of vault in relation to surrounding ground surface (for example, whether the surrounding grade allows drainage towards the well vaults)
- Condition of the internal well identification tags or other external identifiers
- Condition of well lock and well cap
- Condition of water-level measuring mark or notch
- Condition of the well casing

The well deficiency logs and corrective action records are presented in Appendices B and C. The deficiencies were corrected in June 2006 after the rainy season was over.

4.2 WATER LEVELS AND GROUNDWATER FLOW DIRECTION

Static water level measurements were performed on March 30, 2006 (Q1) and June 5, 2006 (Q2). Water level elevations are summarized in Table 5. There was no free product in any of the wells.

Water levels were measured using an electronic sounder; measurements were taken from a reference elevation point marked on the top of the well casing. All measurements were recorded to the nearest 0.01 ft. Potentiometric surface maps generated from the 1988 elevation datum and showing the groundwater flow directions in the three water-bearing zones are shown in Figures 5 through 10. These maps reflect the conditions in the SWBZ affected by rainwater infiltration and the following extraction system shutdowns.

- February 27 to March 1, 2006—East Trench shut down due to oil removal from the oil/water separator.
- March 13 to 15, 2006—The whole system was down due to an air compressor electrical problem.
- March 15 to 28, 2006—The whole system was only operating Monday through Friday 7 am to 3:30 pm (using a temporary air compressor until repair parts were obtained).
- March 28, 2006—Resumed full time operation.
- June 1, 2006 to present—Shut down due to an outage by VSFCD of the sanitary sewer pipeline used to discharge groundwater from IA H1.

The SWBZ within the Containment Barrier is characterized by a radial flow pattern emanating from a groundwater mound centered within the boundaries of the Landfill and extending to the perimeter groundwater extraction trench system. The high point of the mound is centered at well 01W19A. Groundwater elevations measured in the extraction trench sumps are significantly higher for the Q1 and Q2 monitoring events as compared to the Q3 and Q4 2005 monitoring events. The rise in water levels during Q1 and Q2 is attributed to increased infiltration during the rainy season and to periodic shutdowns of the extraction trench system as described above. The SWBZ outside of the Containment Barrier is marked by variable flow directions ranging from west to east which are the result of groundwater mounds in the vicinity of the former IWTP on the north side of the Landfill and well 01W35A on the south side of the Landfill.

The IWBZ flow directions range from north to west. Flow directions in the DWBZ vary from north to westerly. Based on Q1 and Q2 groundwater elevation data presented in Table 5, the hydraulic parameters of the three water-bearing zones have been calculated and are summarized in Table 6. For the SWBZ, hydraulic parameters have been calculated for both inside and outside the Containment Barrier. The horizontal seepage velocity is much higher inside the Containment Barrier because of the effect of the groundwater mound within the Landfill and the operating sump pumps within the surrounding extraction trench system.

Vertical hydraulic gradients presented in Table 7 were calculated using the Q1 and Q2 2006 groundwater elevation data for two SWBZ/IWBZ well clusters (01W35A/B and 01W39AR/BR). Groundwater elevations in well cluster 01W35AR/BR show a downward hydraulic gradient while 01W39AR/BR shows an upward gradient. Table 8 presents the calculated values of the vertical seepage velocity using the Q1 and Q2 water level data from wells 01W35AR/BR and 01W39AR/BR.

Appendix A contains a series of hydrographs for SWBZ wells, which include groundwater elevation data collected from 1991 to June 2006. Hydrographs for SWBZ wells illustrate historical groundwater levels with respect to the top of the well screen in each well. In general, the data shown in the hydrographs indicate a seasonally fluctuating water table with the highest water levels measured during the spring months (wet season) and lowest water levels measured during the fall months (end of dry season).

4.3 FIELD MEASUREMENTS

Water quality field indicator parameters (pH, conductivity, temperature, turbidity, dissolved oxygen, ORP) were measured in the field as part of well stabilization procedures. The water quality parameter results and well purging information are provided in the monitoring well sampling field sheets (Appendices B and C).

4.4 ANALYTICAL DATA OVERVIEW

This section summarizes the analytical data collected in Q1 and Q2 2006 and provides the data interpretation. Chemical data were collected according to the WQSAP requirements (WESTON, 2005a).

4.4.1 Concentration Limits

Concentration limits are the action levels used to identify exceedances in evaluation monitoring. For naturally occurring inorganic compounds, such as metals, they are the background concentrations statistically determined from the data obtained from an upgradient background well. For anthropogenic compounds they are the laboratory practical quantitation limits (PQL). Metal concentrations detected in the POC wells, which are above the background levels, are considered exceedances and so are any detected organic constituents.

4.4.2 Background Concentrations

For Interim Status Facilities, background metal concentrations must be obtained from a background well located upgradient from the Landfill. To determine whether a release from the Landfill has taken place, dissolved metal concentrations must be compared to background (ambient) concentrations obtained from the data collected from upgradient (background) wells.

The upper tolerance limit (UTL) background concentrations of metals were calculated for the *Final Remedial Investigation IA H1* (WESTON, 2005b) using historical data for the wells selected, based on existing potentiometric maps, as representing background groundwater conditions. In accordance with the *WQSAP Appendix C Statistical Evaluation Plan* (WESTON, 2005a), in the future, the background concentrations will be calculated as the Upper Prediction Limits (UPLs) and re-evaluated every two years. New background wells were placed at IA H1 in Q3 2005. New data from eight monitoring events must be collected from these wells before the UPLs may be calculated. Therefore, new background concentrations will be calculated in Q4 2007 and presented in the 2007 Annual Report. Until this is done, the concentrations of metals in POC/IPOC wells will be compared to the UTL background concentrations.

The WQSAP (WESTON, 2005a) presented the rationale for the background well selection. The selected wells were located upgradient or cross-gradient from the Landfill based on the groundwater flow direction maps.

A review of the background well data collected to date has shown that wells 01W07A and 01W09A may not have been a proper selection for SWBZ background wells. Groundwater in these wells has elevated concentrations of cadmium, nickel and zinc. Figures 11, 12 and 13 present a comparison of these metal concentrations in background wells to the UTL background concentrations indicated in these figures as “regulatory limit”.

Well 01W07A was included in the UTL background concentration calculations, and its high concentrations of nickel and zinc were the data set outliers. The data collected after the UTLs have been calculated proved that these metals consistently exceed the respective UTLs, in some cases by an order of magnitude. Well 01W09A proposed to be included into the UTL calculations was not used because sufficient data quantity was obtained from other wells. The data collected under the EMP have also shown that the cadmium, nickel, and zinc concentrations in this well exceed the background.

In the course of discussions of future background well monitoring at IA H1 with Mr. B. King of DTSC in June and July 2006, the following changes to the EMP were outlined:

1. Continued sampling of well 01W07A, which will be reclassified as a nature and extent well
2. Continued sampling of background well 01W09A
3. Addition of 01W49A as a background well

The IWBZ and DWBZ background wells did not show any metals concentrations significantly exceeding the UTLs.

4.4.3 Q1 2006 Monitoring

Samples collected for the Q1 2006 event were analyzed for the monitoring parameters specified in the WQSAP (WESTON, 2005a), including VOCs (EPA Method 8260B), TPH as gasoline (EPA Methods 5030B/8015B), TPH as diesel and motor oil with silica gel cleanup (EPA Methods 3520C/3630C/8015B) and dissolved metals (EPA Methods 6010B/7470A). The TPH as diesel and motor oil analysis was performed with silica gel cleanup to remove interferences from naturally occurring materials. Table 9 is the Sample Tracking Log for the Q1 2006 sampling event.

The dissolved metal results obtained during Q1 2006 sampling are summarized in Tables 10, 11, and 12 for each water-bearing zone separately. The concentrations exceeding the UTL background are shown in bold print.

In Q1 2006, the following metals exceeded the UTLs in the SWBZ wells:

- Arsenic—01W33AR, 01W35A, 01W39AR, MW84A, MW85A, MW86A, and MW87A
- Barium—01W33AR, 01W38AR, 01W39AR, 01W53A, 24W04A, MW80A, MW84A, MW85A, MW86A
- Cadmium—01W07A
- Cobalt—01W07A, 01W34AN
- Mercury—MW82A
- Nickel—01W07A, 01W13A, 01W34AN, 01W35A, 01W38AR, MW82A
- Selenium—01W34AN, MW85A, MW86A
- Silver—01W33AR, 01W34AN, DPW76A
- Vanadium—01W33AR
- Zinc—01W07A, 01W13A, MW82A

The data indicate that the SWBZ primary contaminants are arsenic, barium, nickel and zinc; the rest of the detected metals exceeded the UTLs by a small margin.

Silver marginally exceeded the UTL in the IWBZ well 01W39BR. The following metals slightly exceeded the UTLs in the DWBZ wells:

- Cobalt—MW84C
- Selenium—01W39CR
- Silver—01W33CR, 01W39CR, 01W41C, DPW76C, MW84C
- Thallium—DPW76C

Table 13 summarizes the detected TPH and organic compound concentrations in all wells. The TPH as diesel and motor oil analysis was performed with silica gel cleanup to remove interferences from naturally occurring materials. Petroleum hydrocarbons in the gasoline and diesel ranges were detected in wells 01W38AR and MW80A. In addition, trace levels of diesel range hydrocarbons were detected in wells 16W05A and MW81A; a trace level of hydrocarbons in the motor oil range was detected in well 01W16A. A low level of gasoline was detected in a field duplicate sample (not the primary sample) from well MW84C; this finding is considered suspect and could be ambient contamination during sampling.

Trace levels of VOCs found in wells above the PQLs and listed in Table 13 are primarily the constituents of gasoline-range petroleum fuels. Trace levels of industrial chemicals chloroethane and chlorobenzene were identified in well 01W38AR. All of these contaminants have been previously found in these two wells at similar concentrations.

4.4.4 Q2 2006 Monitoring

Samples collected for the Q2 2006 event were analyzed for the monitoring parameters specified in the WQSAP (WESTON, 2005a), including VOCs (EPA Method 8260B), TPH as gasoline (EPA Methods 5030B/8015B), TPH as diesel and motor oil with silica gel cleanup (EPA Methods 3520C/3630C/8015B) and dissolved metals (EPA Methods 6010B/7470A). The TPH as diesel and motor oil analysis was performed with silica gel cleanup to remove interferences from naturally occurring materials. Table 14 is the Sample Tracking Log for the Q1 2006 sampling event.

Dissolved metal results are summarized in Tables 15, 16, and 17 for each water-bearing zone separately. In this table the dissolved metal concentrations are compared to the UTL background values.

In Q2 2006, the following metals exceeded the UTLs in the SWBZ wells:

- Arsenic—01W33AR, 01W35A, DPW76A, MW84A, MW85A, and MW87A
- Barium—01W33AR, 01W38AR, 01W39AR, 01W53A, 24W04A, MW80A, MW84A, MW85A, MW86A
- Cadmium—01W07A, 01W34AN
- Cobalt—01W07A
- Copper—01W49A, MW82A
- Mercury—MW82A
- Nickel—01W07A, 01W13A, 01W35A, 01W38AR, MW82A
- Selenium—01W34AN, 01W35A
- Silver—01W07A, DPW76A
- Zinc—01W07A, 01W13A, MW82A

Similar to conditions in Q1, the data indicate that the SWBZ primary contaminants are arsenic, barium, nickel and zinc; the rest of the detected metals exceeded the UTLs by a small margin. As in the past monitoring, the highest concentrations of barium were found in wells 01W38AR and MW80A located along the northern side of the Containment Area and well MW82A located at the eastern side of the Containment Area contained the highest concentrations of nickel and zinc.

Silver marginally exceeded the UTL in the IWBZ well 01W38BR, DPW75B, and DPW76B; zinc was slightly above the UTL in well MW80B.

The following metals slightly exceeded the UTLs in the DWBZ wells:

- Selenium—01W38CR
- Silver—01W38CR, DPW76C, MW80C

Table 18 summarizes the detected TPH and organic compound concentrations in all wells. The TPH as diesel and motor oil analysis was performed with silica gel cleanup to remove interferences from naturally occurring materials. Petroleum hydrocarbons in the gasoline and diesel ranges were detected in wells 01W38AR and MW80A. While gasoline is definitely present in groundwater from these wells, the presence of diesel fuel is highly questionable and is not supported by chromatographic patterns. Trace levels of diesel and motor range hydrocarbons were detected in well 16W05A, although the chromatographic patterns were not representative of petroleum fuels.

Trace levels of VOCs listed in Table 18 for wells 01W38AR and MW80A are primarily the constituents of gasoline-range petroleum fuels. Trace levels of industrial chemicals chloroethane and chlorobenzene were identified in well 01W38AR. All of these contaminants have been previously found in these two wells at similar concentrations.

4.5 GRAPHICAL AND STATISTICAL EVALUATION OF DATA

After eight quarters of data are collected from IPOC/POC wells, combined Shewhart-cumulative sum (CUSUM) control charts will be constructed for metal constituents of concern to provide a visual tool of detecting both trends and recent or cumulative releases in POC/IPOC wells. The control charts will be constructed following methodology presented in *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities* (EPA, 1989) and according to the procedures described in the *Statistical Evaluation Plan*, Appendix C to WQSAP (WESTON, 2005a).

5. SAMPLE MANAGEMENT

5.1 FIELD QUALITY CONTROL

To verify the reliability of field sampling procedures and materials, field QC samples were collected. Field QC samples are necessary for determining the total measurement error (the overall precision of the measurement system from sample collection to analysis) and for quality assurance during sample handling and shipment. Field QC samples included field duplicates, equipment rinsates, trip blanks, and temperature blanks.

Field Duplicates—Field duplicates are samples collected at the same time and from the same source as the corresponding primary samples. The identity of the field duplicate is concealed ("blinded") from the laboratory, and the sample identification (ID) consists only of a sequential sample number per the WQSAP requirements. The purpose of duplicate samples is to assess the overall precision of the sampling effort and contaminant variability in the sample matrix; the purpose of submitting them blind is to assess the laboratory's precision. During Q1 and Q2 2006 sampling events, field duplicate samples were collected as follows:

Well ID	Primary sample ID	Field duplicate ID	Date collected
01W33AR	01W33AR-081	MW99-082	2/8/06
01W39BR	01W39BR-100	MW99-101	2/8/06
01W81A	MW81A-087	MW99-088	2/16/06
MW84C	MW84C-109	MW99-110	2/15/06
01W39AR	MW39AR-117	MW99-118	5/23/06
MW82A	MW82A-123	MW99-124	5/24/06
MW80B	MW80B-136	MW99-137	6/1/06
01W41C	01W41C-145	MW99-146	6/14/06

The frequency of collection was approximately 10 percent as required by the WQSAP. Results of field duplicate analysis, while in some cases exceeding WQSAP criterion for precision, were acceptable, considering the low level of detected analytes.

Matrix Spike (MS)/Matrix Spike Duplicate(MSD)—MS/MSD samples are field samples spiked at the laboratory with the contaminants of concern and analyzed together with the field samples. MS/MSD measure the laboratory's accuracy and precision. Additional volumes of samples were collected and submitted to the laboratory for MS/MSD analysis. MS/MSD recoveries were influenced by matrix constituents (metals, naturally-occurring organic compounds), however, this did not have any reflection on the data quality.

Equipment Rinsate—Equipment rinsate is a sample of analyte-free water collected from a final rinse of sampling equipment after the decontamination procedure has been performed. The purpose of rinsate blanks is to determine whether the sampling equipment may be causing cross-contamination between samples. During equipment decontamination, analyte-free water used as a final rinse is collected in appropriate sample containers and analyzed together with the field samples.

Dedicated tubing was used for the sampling of groundwater monitoring wells in the Landfill evaluation monitoring program, reducing the need for equipment decontamination. A submersible pump was decontaminated between the samples and one rinsate sample for each event (WB1008 in Q1 and WB1021 in Q2) was collected and analyzed to verify the effectiveness of the applied procedure. This approach had been proven to be reasonable due to low levels of constituents of concern in groundwater. The equipment rinsate blanks did not show any contamination indicating adequate decontamination procedures.

Trip blanks—Trip blanks are analyte-free water in 40-milliliter (mL) vials, which are prepared in the laboratory, shipped to the field together with sample containers, and returned to the laboratory for storage and analysis along with the field samples. The trip blank data demonstrate whether the samples were exposed to ambient contamination or cross-contamination during storage and transport to the laboratory. Trip blanks are analyzed for VOCs only; therefore, the 40-mL vials must not contain any headspace. During Q1 and Q2 2006 sampling events trip blanks were used whenever samples for VOC analysis were collected and shipped to the laboratory together with the samples. Trip blanks were analyzed every third day as specified in the WQSAP. This procedure was selected based on the knowledge that the vast majority of samples were historically VOC-free and could not be cross-contaminating each other. The short time needed for delivery of samples from Mare Island to the laboratory in Berkeley and the segregation of samples in individual coolers further reduced the probability of cross-contamination. The analyzed trip blanks did not show any contamination, indicating adequate sample handling procedures.

Temperature blanks—Temperature blanks were vials of tap water shipped in each cooler containing field samples. Laboratory personnel used temperature blanks to measure the temperature of the cooler upon arrival at the laboratory. If the required temperature range of 2 to 6 degrees Celsius (°C), is exceeded, the data would be appropriately qualified in the course of data validation.

5.2 SAMPLE CONTAINERS, PRESERVATION AND CUSTODY

Certified sample containers precleaned, according to EPA protocols were provided by the subcontract laboratories. The laboratory guaranteed the purity of preservation chemicals. Sample volumes and container materials were according to the EPA method requirements.

The Chain-of-Custody Forms used to transfer samples from the field to the laboratory are enclosed together with the complete results of analysis in Appendices B and C.

5.3 SAMPLE PACKING AND SHIPMENT

Samples were collected in pre-labeled containers. Upon delivery to the job trailer, samples were placed in the sample refrigerator kept at 2-6 °C. A laboratory courier picked up samples for organic and inorganic analysis for daily delivery to the laboratory. Radioactivity samples shipped by a commercial courier were packed in coolers with ice.

5.4 FIELD DOCUMENTS AND RECORDS

A field logbook with consecutively numbered pages was assigned to this project. All entries were recorded in indelible ink. Preprinted matrix-specific forms for groundwater samples were used during sampling. Copies of these field records are enclosed in Appendices B and C.

6. FIELD PROCEDURES

To ensure that groundwater samples were representative of aquifer conditions, wells were purged prior to sampling. The low-recharge SWBZ wells that needed to be completely evacuated prior to sampling were purged dry using a Grundfos Redi-Flow® submersible pump and sampled within 24 hours with a peristaltic pump; the SWBZ wells with good recharge rates were micro-purged and sampled with a peristaltic pump. The IWBZ and DWBZ wells were micro-purged and sampled using either a peristaltic or a Grundfos Redi-Flow® submersible pump. Each well was purged and sampled with dedicated tubing.

6.1 LOW-FLOW MICRO-PURGE SAMPLING

The following procedure was used for micro-purge sampling:

1. Before mobilizing to the field, calibrate field instruments in accordance with the manufacturer directions. Record all calibration data in the Calibration Logbook.
2. Confirm the well identification at the monitoring well. Inspect the condition of the monitoring well and document it in the *Monitoring Well Inspection Checklist.*
3. Put on a new, clean, and chemical-resistant pair of disposable gloves.
4. Monitor the breathing zone with a PID and record it in the *Monitoring Well Sampling Sheet*. Unlock the wellhead and remove the inner casing cap. Measure the VOC concentration in the breathing zone again and record it in the *Monitoring Well Sampling Sheet.* Compare the readings to select an appropriate level of personal protection.
5. Measure the depth to water in the monitoring well using a clean (decontaminated) electronic water level sounding probe. Use a surveyor mark on the casing or a mark made during previous sampling as a reference point. Record the water level measurement to the nearest 0.01 ft in the *Monitoring Well Sampling Sheet*. Measure the depth to water the second time to confirm the initial measurement; the measurements should agree within 0.01 ft. Calculate the height of the water column and the volume of water in the well using information on well diameter and depth provided on the *Monitoring Well Sampling Sheet*. Record the water column height and volume. Do not measure the total well depth until sampling has been completed.

6. Attach the premeasured dedicated tubing to the pump. Straighten the polyethylene tubing used for shallow well sampling or weigh it down with a suitable stainless steel weight using a plastic zip-tie. Attach the shroud to the submersible pump when sampling 4-inch wells. Secure the submersible pump with a Teflon-coated safety cable.

7. Insert the YSI field parameter meter probe assembly into the flow-through cell and tighten the connection. Connect the discharge end of the pump to the lower inlet of the flow-through cell. Connect the discharge end of the flow-through cell to the upper outlet of the cell.

8. Carefully lower the tubing or the submersible pump into the well with as little disturbance to the groundwater as possible. Using a premeasured mark on the tubing, place the intake into the middle of the screened interval. If the screened interval is not completely filled with water, lower the tubing to the middle of the water column. Measure and record the water level again prior to starting the pump.

9. Set the pump speed at a flow rate of about 300 milliliters per minute (mL/min). Adjust the flow rate as necessary to minimize the drawdown and to keep it under 0.33 ft. Measure the flow from the discharge end of the flow-through cell in a graduated container. Monitor and record the flow rate and the water level every 3-5 minutes during purging. In some wells the level may drop off by more than 0.33 ft initially and then stabilize as the well reaches the equilibrium between the recharge rate and the uptake rate.

10. Purge the well. Remove at least one tubing volume (including the volume of water in the tubing and the flow-through cell) before recording well stabilization parameters. The volume for SWBZ wells is 0.6 liter (L); for IWBZ and DWBZ sampled with a peristaltic pump it is 0.8 L; for IWBZ and DWBZ sampled with a submersible pump it is 3.0 L.

11. Monitor water parameters (pH, temperature, conductivity, DO, ORP) using the YSI multi-parameter meter and the flow-through cell. Take at least eight readings. Measure the water level every 3 to 5 minutes during purging. At the same frequency collect a water sample into a measuring cuvette from a port installed in the discharge end of the pump before the flow-through cell and measure turbidity using the Hanna Turbidity Meter. Record the water quality parameters and water levels on the Monitoring Well Sampling Sheet. Stabilization is achieved if three successive readings for all parameters (except ORP) have met the following criteria:

    - pH: ± 0.1
    - Temperature: ± 1.0°C
    - Electrical conductivity: ± 3 percent
    - Dissolved oxygen: ±0.3 percent
    - Turbidity: ± 10 percent when readings are greater than 10 nephelometric turbidity units

12. If the water quality parameters are stable within three consecutive readings and the water level drawdown is within 0.33 ft, collect samples for chemical analysis. If the parameters are stable, but the stabilized drawdown cannot be maintained, reduce the pump flow rate to control the drawdown. If the water quality parameters have not stabilized, continue purging until stabilization occurs.

13. Reduce the pump flow to a rate of approximately 200 mL/min, and disconnect the pump from the flow-through cell. Collect samples for VOC analysis from the discharge end of the pump. Fill the containers so that a meniscus forms at the mouth of the vial prior to capping to eliminate the formation of air bubbles and headspace.

14. Increase the flow rate to the previously established value at which the drawdown is below 0.33 ft and collect the remaining samples. Fill the appropriate sample containers from the pump discharge end to the neck of the container within a minimum of turbulence by allowing the water to flow gently down the inside of the container. Collect samples for total metals last in the sequence, followed by the collection of samples for dissolved metals analysis.

15. Collect field duplicates and additional volumes for MS/MSD analysis as required.

16. Prior to sample collection, label sample containers with the date and time of the start of sampling and the sampler's initials. Place each sample into a resealable bag and transfer to a cooler containing ice as soon as possible after collection (VOC vials may be placed into one bag).

17. Cap the well and lock the lid.

18. Decontaminate the pump and the water level probe following the procedure described in Section 6.3.

6.2 DRY-PURGE PROCEDURE

Where low–flow-rate purging was not feasible due to the low hydraulic conductivity and well recharge rates, wells were purged dry with a Grundfos Redi-Flow® submersible pump using the following procedure:

1. Confirm the well identification at the monitoring well. Inspect the condition of the monitoring well and document it in the *Monitoring Well Inspection Checklist.*

2. Put on a new, clean, and chemical-resistant pair of disposable gloves.

3. Monitor the breathing zone with a PID and record it in the *Monitoring Well Sampling Sheet*. Unlock the wellhead and remove the inner casing cap. Measure the VOC concentration in the breathing zone again and record it in the *Monitoring Well Sampling Sheet.* Compare the readings to select an appropriate level of personal protection.

4. Measure the depth to water in the monitoring well using a clean (decontaminated) electronic water level indicator probe. Use a surveyor mark on the casing or a mark made during previous sampling as a reference point. Record the water level measurement to the nearest 0.01 ft in the *Monitoring Well Sampling Sheet*. Measure the depth to water the second time to confirm the initial measurement; the measurements should agree within 0.01 ft. Calculate the height of the water column and the volume of water in the well using information provided on the *Monitoring Well Sampling Sheet*. Record the water column height and volume.
5. Attach the dedicated tubing labeled *DRY PURGE* to the pump. The same tubing will be used for all wells. Attach the shroud to the submersible pump. Secure the submersible pump with a Teflon-coated safety cable.
6. Lower the pump to the bottom of the well and lift approximately 1-2 inches off the bottom. Start the pump and establish a flow rate of 1-2 gallons per minute. Discharge the removed water into a graduated bucket. Stop the pump when the water flow stops.
7. Remove the pump from the well. Record the total volume removed from the well in the *Monitoring Well Sampling Sheet.* Compare the volume removed to the volume calculated to confirm complete purging.
8. Decontaminate the pump, the tubing and the cables externally following the procedure described in Section 6.3.
9. Cap the well and lock the lid.
10. Return to the well every 2-3 hours and measure the water level. Start sampling as described below as soon as possible after purging (when a sufficient volume of water is present in the well to complete the planned sampling). If at all possible, wells should be sampled on the same day as purging. Wells that do not sufficiently recharge by the end of the work day, will be sampled the next morning.
11. Sample the well with a peristaltic pump. Follow the procedure described in Section 6.2 starting with step 12 with one exception: the water quality parameters are recorded but are not used as an indicator of well stabilization. Once one tubing/flow-through cell volume has been removed, record at least three readings of the water quality parameters within a 5-minute period and then begin sampling.

6.3 EQUIPMENT DECONTAMINATION

Decontamination of nondisposable sampling equipment that came in contact with samples was performed to prevent the introduction of extraneous material into samples and to prevent cross-contamination between samples. All sampling equipment was decontaminated by washing with a nonphosphate Liquinox™ detergent. Decontamination water was collected in a 55-gallon drum.

The following procedure was used for decontamination of nondisposable sampling equipment (submersible pump, water level meter, oil-water interface probe):

1. In a dedicated plastic container labeled *SOAP*, scrub equipment using a soft-bristled brush with the detergent and water solution. Use the detergent sparingly (one capful for 4 gallons of water). This step will remove contamination from the equipment.
2. In a dedicated plastic container labeled *RINSE No.1*, rinse equipment with potable water. Change the water frequently. This step will rinse the detergent solution away from the equipment.
3. In a dedicated plastic container labeled *RINSE No.2*, rinse equipment with deionized water. Change the water frequently. This step will remove any remaining detergent solution and potable water residues. For internal decontamination, pump approximately 2 L (0.5 gallon) of clean water through the pump and discard the water.
4. Fill a 5-gallon bucket labeled *EQUIPMENT BLANK*, with deionized water. For equipment blank collection, attach a length of tubing labeled *Equipment Blank* to the pump; pump approximately 2 L (0.5 gallons of clean water) and discard the water; then fill the sample containers by pumping deionized water at a flow rate of 200 mL/min for VOC analysis and 500-1,000 mL/min for all other analysis.
5. Dispose of the decontamination water in a poly-tank containing well purge water.
6. Decontaminate the pump and the flow-through cell internally and externally upon completion of the sampling event before placing them in storage

Wastewater contained in a poly-tank was combined with the extracted groundwater stream, which was sampled, analyzed and discharged to the sanitary sewer upon obtaining permission from the Vallejo Sanitation and Flood Control District (VSFCD).

6.4 FIELD SCREENING

A portable PID was used to screen wellheads for evidence of the VOC presence. The PID measures the presence of volatile ionizable contaminants in vapor. The PID was operated and calibrated daily according to the manufacturer’s specifications. The procedure for PID operation is summarized below:

1. Turn on instrument according to the manufacturer’s directions and allow the lamp to stabilize.

2. Establish “zero” for the PID calibration using atmospheric air.
3. Verify the instrument is in calibration by reading a known concentration (100 parts per million by volume of isobutylene in air). If the instrument reading is more than 25% off from the true value, recalibrate the PID following manufacturer’s directions.
4. Collect the reading of the wellhead space from the instrument, and record it in the field logbook.

6.5 STATIC WATER LEVEL MEASUREMENTS

All measurements were performed with electronic water level sounding probes using the following procedure:

1. Using a site map familiarize yourself with the well and piezometers locations and access roads.
2. To measure water levels, put on a new, clean, and chemical-resistant pair of disposable gloves.
3. Measure the depth to water in the monitoring well using an electronic water level sounding probe. Use a surveyor mark on the casing or a mark made during previous sampling as a reference point. Measure the depth to water the second time to confirm the initial measurement; the measurements should agree within 0.01 ft. Record the water level measurement to the nearest 0.01 ft in the *Well Water Level Sheet*. (The probe may need rinsing with deionized water between the two measurements due to high salt contents.)
4. Cap the well and lock the lid.
5. Decontaminate the probe by rinsing it in a gallon jug of deionized water and wipe it with a paper towel.

6.6 WASTEWATER MANAGEMENT

Wastewater accumulated in the course of well purging and equipment decontamination was stored on-site in a plastic holding tank. It was sampled, profiled and disposed of according to the requirements of *Waste Management Plan, Mare Island Remediation Sites* (WESTON, 2002) and VSFCD.

7. DATA VALIDATION

Data validation was conducted by an independent data validation company, Laboratory Data Consultants. The data validation company had the following qualifications:

- A minimum of five years of experience in the environmental data validation
- Prior experience on Navy Remedial Action Contracts or EPA projects
- Navy data validation experience
- Active peer review program

The validation procedure was according to the requirements of the following documents:

- EPA National Functional Guidelines for Organic Data Review (EPA, 1999)
- EPA National Functional Guidelines for Inorganic Data Review (EPA, 2002a)
- EPA National Functional Guidelines for Polychlorinated Dioxin/Furan Data Review (EPA, 2002b)
- QC criteria specified in the WQSAP

Ninety percent of the data were validated at Level III; 10 percent at Level IV. Although some data points were qualified as estimated values, no data were rejected due to inadequate QC or laboratory procedures.

8. DATA QUALITY ASSESSMENT

Based on data validation/review, WESTON determined whether the project data quality objectives (DQOs) were met. No data were rejected due to laboratory or field procedure deficiencies. A few data points were qualified as estimated value ("J" flag) but this did not influence the data usability. A Data Quality Assessment Report is included in Appendix D.

The following conclusions related to data quality and usability were reached:

- The data are of acceptable accuracy and precision as determined in the course of data validation.
- The sample holding time was met for all analysis with a few exceptions, which did not affect data validity or usability.
- The sampling completeness was 100 percent.
- Sample field sampling procedures, sample handling and storage were adequate and samples were representative of the sampled matrix.

The data are accurate, precise, complete, and representative of the sampled matrix and can be used as intended.

9. QUALITY ASSURANCE OVERSIGHT

Quality assurance oversight for this project may include system audits of field activities and of the laboratory subcontracted to perform the analysis. The QA oversight performed during Q1 and Q2 2006 sampling consisted of preparatory meeting and inspection, and initial and follow-up inspections. Inspection checklists are enclosed in Appendices B and C.

As part of QA and as required by DTSC (DTSC, 2001), sampling personnel were trained in groundwater sampling, field record keeping, and sample management procedures prior to start of sampling. Each member of the sampling crew was issued a copy of the WQSAP and was required to read it. Each sampling crew member was required to sign a document stating that he/she has read and understands the current version of the WQSAP.

10. DEVIATIONS FROM THE WQSAP

A field decision was made in Q2 2006 to sample well 01W49A, which used for the initial background concentrations calculations as described in Section 4.4.2.

Several compounds were reported at reporting limits that were different from these in the WQSAP as follows:

Compound	**Laboratory reporting limit**	**WQSAP requirement**
Methylene chloride	10 µg/L	2 µg/L
Nickel	20 µg/L	10 µg/L
Tin	40 µg/L	20 µg/L
Zinc	20 µg/L	10 µg/L

These deviations in reporting limits did not affect data usability.

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