Chapter 1

Environmental Restoration: The Vision

"Our mission is to restore the environment to protect our people and support the defense mission by ensuring continued use of lands necessary for military operations,"

Dave Olson, Branch Head for the Chief of Naval Operations (CNO) Environmental Readiness Division.

The Department of the Navy (DON) must protect the lands we use for military training and operations. Restoring the environment at DON installations from past contamination not only helps us provide a safe working environment for our personnel, it helps ensure continued use of U.S. government holdings—land where our troops train every day for their mission.

World events of the past year, including the on-going War on Terrorism, have required heightened levels of vigilance and effort by all DON personnel, and have resulted in increased DON costs and burdens. This reality underscores the importance of the DON Installation Restoration Program (IRP) and Munitions Response Program (MRP). The main purposes of these programs are to eliminate past and future impacts resulting from DON operations, and to reduce the burden on the war-fighter and their necessary resources. The DON Installation Restoration and Munitions Response Programs are dedicated to fostering SMART cleanup decisions and to leveraging lessons learned through technology development—SMART is translated to: Saves Money and Alleviates Risk in a Timely manner. Using streamlined, innovative, and consistent approaches to

common challenges, DON is on track to complete responses for the Installation Restoration Program on schedule by 2014 and to begin determining the cost to complete the Munitions Response Program.

Environmental Restoration—Defined

In 1980, Congress enacted the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), commonly known as Superfund. This law created the legal mechanism for cleaning up abandoned or uncontrolled hazardous waste sites. Although CERCLA did not apply to military installations, the Department of Defense (DoD) adopted its provisions as a pattern for environmental cleanups by DON and the other military components, known as the Installation Restoration Program (IRP).

When Congress passed the Superfund Amendments and Reauthorization Act (SARA) in 1986, it included provisions for the Defense Environmental Restoration Program (DERP). Through the DERP, DoD conducts environmental restoration activities at sites on active installations, installations undergoing Base Realignment and Closure (BRAC), and Formerly Used Defense Sites (FUDS). The Office of the Secretary of Defense (OSD) provides oversight for the program, which each of the military components (Navy, Marine Corps, Army, and Air Force) is responsible for implementing. The DON Installation Restoration Program was designed to identify and clean up contamination from hazardous substances, pollutants, and contaminants in order to protect human health, safety, and the environment. The

DON Installation Restoration Program combines aggressive policies, technical training, innovative technologies, and proactive, dedicated personnel to restore and preserve property under Navy and Marine Corps stewardship. Chapter 2 of this report explains the Installation Restoration Program in greater detail, including DON's new policies and guidance, technology developments, and focus areas.

DON has several goals for the Installation Restoration Program to accomplish its mission:

- Fully comply with federal, state, and local requirements.
- Act immediately to eliminate human exposure to contamination that poses imminent threats.
- First clean up those sites that pose the greatest relative risk to human health and environment.
- Develop partnerships with federal, state, and local regulatory agencies.
- Involve local communities in the Installation Restoration Program. Establish Restoration Advisory Boards (RABs). Encourage stakeholder participation, make information available in a timely manner, encourage public input, and consider all comments in the decision-making process.
- Expedite the cleanup process and demonstrate a preference for action.
- Consider current planned land use in developing cleanup strategies.

Stakeholder involvement is an important component of DON's environmental restoration mission.

DON Environmental Restoration Plan

The DON Environmental Restoration Plan describes the comprehensive goals and developments that DON seeks to achieve over the next five years, and provides a projection of Installation Restoration and Munitions Response Programs site progress. Within the next five years, DON will continue to complete the restoration phases at many sites and gradually transition into the final phase of the program, which is long-term management and completion of all program requirements. Chapter 3 of this plan discusses these future activities in greater detail. Chapter 4 of this plan provides overall funding and program status of the Installation Restoration and Munitions Response Programs. Chapter 5 provides installation summaries.

The DON environmental restoration website is http://5yrplan.nfesc.navy.mil

The purpose of this plan is to communicate the DON vision, explain the Installation Restoration and Munitions Response Programs, highlight recent program progress, delineate future goals, and summarize funding data. This plan serves multiple audiences, including: community members, stakeholders, DON policy makers, project managers, technical managers, installation personnel, engineers, and scientists. To facilitate SMART cleanup decisions, information exchange among participants is critical. In addition, this plan provides DON installations the opportunity to share lessons learned from cleanup experiences and to transfer knowledge about technological achievements.

Restoration Roadmap

The process DON uses in all of its Installation Restoration Program activities is illustrated in Figure 1.1. Restoration Process Roadmap. This process mirrors the CERCLA process. DON is using a similar CERCLA process for the Munitions Response Program.

The restoration process is the primary alternative for most Installation Restoration Program sites. It provides a full and careful progression through identification and investigation, to cleanup and closeout. Brief descriptions of each phase are provided below.

Preliminary Assessment (PA)—This determines the probability of and possible locations of potentially contaminated areas.

Site Inspection (SI)—This includes a physical inspection of potential sites and, depending on site type, would include soil, surface water, and/or groundwater sampling.

Hazard Ranking Sytem (HRS)—A systematic process used to score a site to determine if a site should be listed on the National Priorities List (NPL).

Remedial Investigation/Feasibility Study (RI/FS)—Includes characterizing a site, determining the regulatory requirements, conducting a baseline risk assessment for human health and the environment, and developing cleanup goals to be applied to the site. Once the RI/FS has been completed, the Decision Document is developed to identify, analyze, and select the remedial action approach for cleaning up the site.

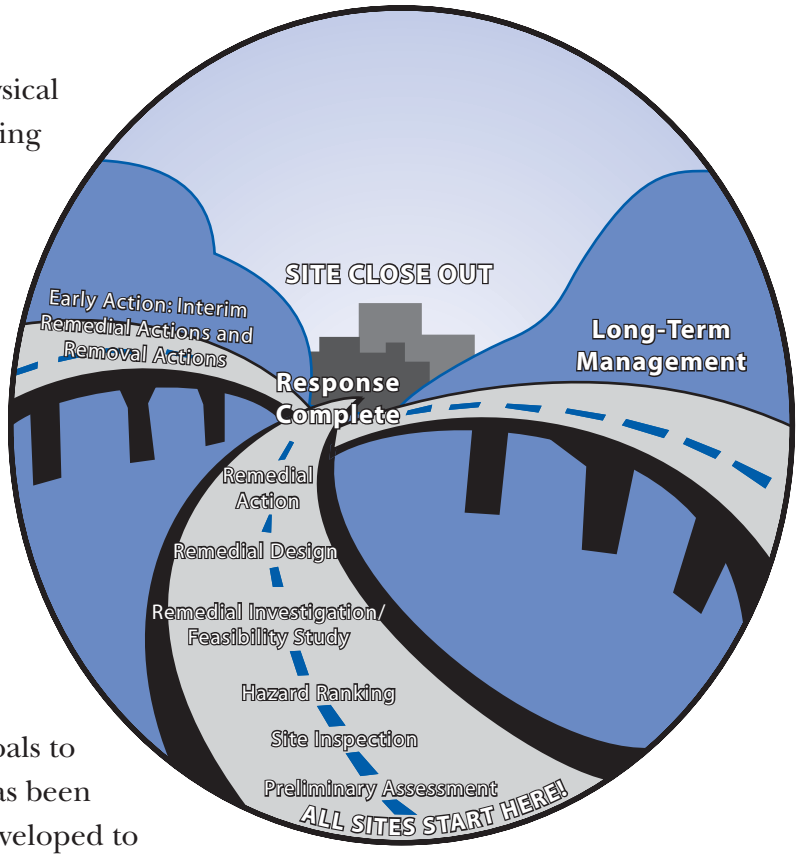

Figure 1.1 Restoration Process Roadmap.

Remedial Design (RD)—Once the remediation, or cleanup, alternative has been selected, engineers design the remedial system according to the instructions in the Decision Document. Once the design is complete, the plans are turned over to a construction contractor, who then builds the remediation system.

Remedial Action (RA)—This phase is the actual cleanup work that takes place.

Long-Term Management (LTM)—Long-term management and monitoring may be required to ensure the site remains free of contamination.

Response Complete (RC)—Once all the cleanup goals are achieved, the site is considered response complete. A site can also be response complete without remedial action if it is determined to pose no threat to human health or the environment.

The DON environmental restoration website (*http://5yrplan.nfesc.navy.mil/*) contains more detailed information about DON's Installation Restoration Program at each installation. In addition, this website provides installation mission statements, community involvement narratives, regulatory information, installation background information, accomplishments, cleanup actions, and funding information.

Roles and Responsibilities

The two primary organizations within the Navy overseeing and implementing the Installation Restoration Program are the Chief of Naval Operations (CNO) Environmental Readiness Division, and the Naval Facilities Engineering Command (NAVFAC).

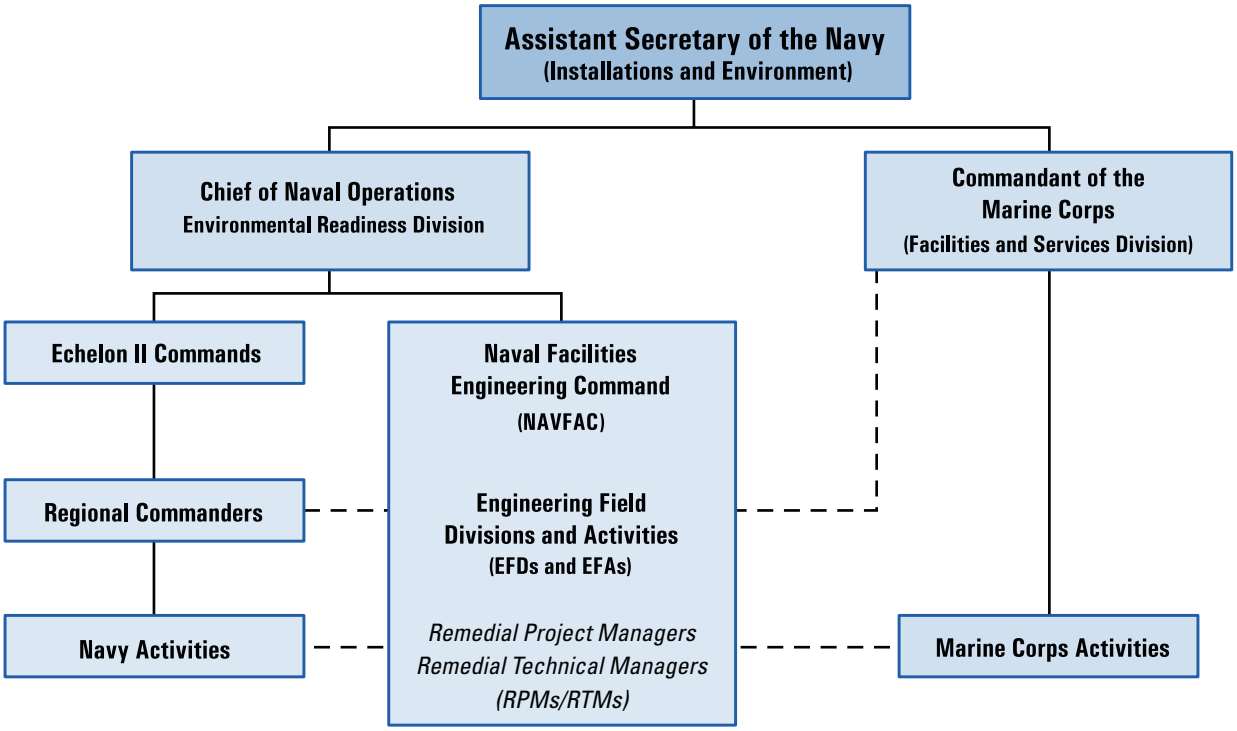

Figure 1.2 Department of the Navy organizational chart.

CNO is the resource and assessment sponsor for the Navy's environmental restoration funds, and works with the Navy budget office to prepare the Program Objective Memorandum (POM). CNO is responsible for review of the budget to ensure conformity to policy, and the review of site-specific data prepared by NAVFAC for over 3,600 sites to ensure that budget requests align with program needs. NAVFAC, the Budget Submitting Office (BSO), and their Engineering Field Divisions and Activities (EFD/As) (See Figure 1.3) are responsible for meeting the Defense Planning Guidance (DPGs).

CNO develops, compiles, analyzes, and reports Navy environmental restoration data. These reports include the Defense Environmental Restoration Program (DERP) Annual Report to Congress, the DoD Report to Congress on Munitions and Unexploded Ordnance, Cost-To-Complete (CTC) data, Consent Orders, Congressional requirements (e.g., legislative proposals, and briefing packages), Measures of Merit, the DON Environmental Restoration Plan, and posture statements.

CNO and NAVFAC are the two primary organizations within DON administering the Installation Restoration Program.

NAVFAC implements the Installation Restoration Program for both Navy and Marine Corps installations. As a result, DON requirements are planned, programmed, and budgeted for both Navy and Marine Corps installations. NAVFAC's roles in the Installation Restoration Program include support and project execution, contracting, design and construction, and Base Realignment and Closure (BRAC) support. To implement the program, NAVFAC workgroups help with innovative technologies, risk assessments, and other program issues.

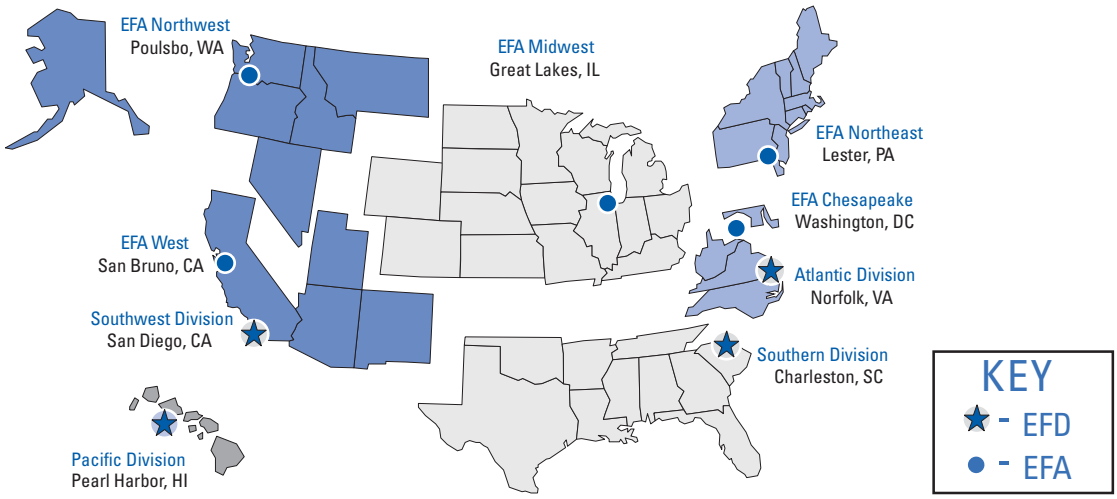

Figure 1.3 NAVFAC's Engineering Field Divisions (EFDs) and Activities (EFAs).

Joint Responsibility and Accountability—the Navy and the Community

Community and stakeholder input is a valuable tool to ensure Navy environmental restoration, or cleanup, efforts and activities gain stakeholder acceptance. DON began seeking stakeholder input on the Installation Restoration Program as early as 1985. In the early 1990s, DoD Service - level restoration program managers and local communities surrounding their installations initiated dialogue and reviewed several areas of concern within the Installation Restoration Program, including public participation. This initial dialogue marked the beginning of DON's more interactive approach to restoration. The primary mechanism for ensuring the public is proactively involved in the Installation Restoration Program is the Restoration Advisory Board (RAB), through which the community has the opportunity to participate in cleanup decisions.

Another key element is the DON partnering effort with regulatory agencies. Partnering agreements can accelerate the process by improving coordination. The progress at Marine Corps Logistics Base, Barstow, California (page1-13), is a good example of improved coordination.

Restoration Advisory Boards

As in past years, Restoration Advisory Boards (RABs) continue to serve as an important interface between the Navy and the community on environmental restoration issues. Navy and Marine Corps installations have formed RABs at all major BRAC and active installations where sufficient, sustained community interest exists. These RABs, which are made up of DON installation representatives, local citizens, and regulators, are a means of public outreach and a forum for dialogue between the community and the installations. RAB members participate in regular meetings run by

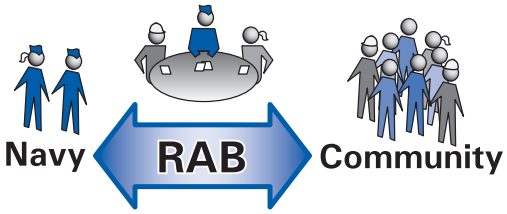

Figure 1.4 Community involvement through a Restoration Advisory Board (RAB).

installation and community co-chairs. At these meetings, the installation provides updates on site progress through the Installation Restoration Program phases and announces new activities and challenges at the sites. RABs have fostered an exchange of knowledge about scientific and engineering issues, contributed to cost avoidance at IRP sites, and facilitated a greater understanding of total Navy readiness issues.

The successful completion of a Time Critical Removal Action (TCRA) at Alameda Point, California (see page 1-15) is an example of DON and the community working together to minimize neighborhood disruption while taking action to remediate a site. A similar effort impacting a residential area on Ford Island, Hawaii, is highlighted on page 1-17.

Guidance for making TAPP requests is available on-line at http://5yrplan.nfesc.navy.mil

Technical Assistance for Public Participation

CNO manages the Navy's Technical Assistance for Public Participation (TAPP) program, which provides technical assistance to RAB and Technical Review Committee (TRC) local community members through contracts with small businesses. DON has issued guidance for TAPP requests at Navy installations, which can be downloaded from the DON environmental restoration website (*http://5yrplan.nfesc.navy.mil*). To receive TAPP assistance, one must first define the proposed project, evaluate alternative sources of funding, and submit a TAPP application. Funded by the Environmental Restoration, Navy (ER, N) Account for active bases, and from the BRAC account for closing bases, TAPP projects include the review of proposed remediation technologies and participation in relative risk evaluations. Through these activities, TAPP enables community members to better understand and provide input to the Navy environmental restoration process.

Program Accomplishments

New Technology

While DON continues to make progress cleaning up Installation Restoration Program (IRP) sites, we are continuously looking for faster, more cost effective, and more efficient technologies. Finding innovative technologies is becoming more important as we begin to identify and assess sites under our new Munitions Response Program (MRP). The Navy supports research and pilot studies of innovative and emerging remediation technologies, and continues to be a leader among the military components in fostering new technologies for site characterization and cleanup.

The Navy is able to test and implement these technologies through strategic partnerships and joint efforts with the Interstate Technology and Regulatory Council (ITRC), workgroups, outside organizations and contractors, and RAB member input. See page 2-9 for more information on the ITRC. Examples of new technologies used by DON include: the Charleston Naval Complex application of Electrical Resistance Heating (ERH) technology for successful remediation of chlorinated solvents in groundwater (page 1-19); and the Naval Amphibious Base Little Creek application of Oxygen Releasing Compound (ORC™) technology to effectively remediate pentachloro-phenol (PCP) contaminated groundwater (page 1-22).

Sludge lagoon sampling.

Cleanup Techniques

Effective site restoration can require many different cleanup techniques such as: traditional construction and earth-moving equipment; scientific processes for monitoring, collecting, and analyzing samples; contaminant reclamation and purification techniques; and data sharing methods that enable Remedial Project Manager (RPMs), the public, and other stakeholders to effectively monitor and share remediation process data, information, and status.

During this fiscal year, DON has participated in a number of innovative cleanup techniques that were relevant to the Installation Restoration Program and allowed DON to more efficiently achieve its cleanup goals. A good example of DON's application of an innovative cleanup technique is the landfill capping and closure techniques used at former Naval Air Station Agana on the island of Guam (page 1-24).

Lessons Learned

DON realizes that an important component of the remedial process and SMART cleanup is to share lessons learned from the application of different approaches, techniques, and technologies among the various NAVFAC EFD/As. The China Lake Naval Air Weapons Station gravel quarry project (page 1-26) highlights the effectiveness of recognizing the lessons learned from prior experience, and the benefits of applying those lessons to current practices and plans in order to improve the effectiveness and maximize the efficiency of DON cleanup efforts. An example of lessons learned on a project that can potentially benefit other projects can be seen in the use of polychlorinated biphenyls (PCB) field test kits at Naval Base Ventura County (see page 1-28).

Conclusion

By working with our stakeholders and using new and innovative technologies, we are making steady progress toward our Installation Restoration Program goals. We are using the most efficient practices available, supporting DON's operational mission by providing a safe environment for our personnel, and gaining community support for DON activities.

To our Remedial Project Managers and Remedial Technical Managers, the Department of the Navy says "Thank You!" for handling the decisions that make cleanup happen everyday!

• *From the Field* •

• PARTNERNING •

Navy Makes Steady Progress, Completes Four of Seven Operable Units

Marine Corps Logistics Base, Barstow, California

Project Background

As of 17 June 2002, four of the seven Operable Units (OUs) of the Installation Restoration Program (IRP) at the Marine Corps Logistics Base (MCLB) Barstow, California are closed. The Remedial Action Report for OUs 5 and 6 was finalized on 17 June 2002 with the concurrence of the California Regional Water Quality Control Board, the California Environmental Protection Agency Department of Toxic Substances, and the U.S. EPA. The completion of this report brings the total number of completed Comprehensive Environmental Response, Compensation, and Liability (CERCLA) Areas of Concern (CAOCs) to 34 at this National Priority List (NPL) Base.

The Numbers

The four OUs closed at MCLB Barstow include OUs 3, 4, 5, and 6, consisting of 32 CAOCs and a riparian fringe habitat. The Remedial Action Report for OUs 3 and 4 was finalized on 27 August 2000. Sixteen of the 32 CAOCs completed have institutional controls in place, and eight required active remediation including four landfill caps and four removal actions. Twenty CAOCs were identified as low risk sites, seven were medium risk, and five were high risk. CAOCs 25 and 33, were originally scheduled to be included in OUs 5 and 6, but were removed from the program in March 1994 after the site investigation failed to find sufficient evidence to pursue an investigation. To date, a total of 34 CAOCs and one riparian fringe have been closed. The Remedial Action Reports for OUs 3, 4, 5, and 6 were prepared in-house by Southwest Division Naval Facilities Engineering Command (SWDIV), at a government cost avoidance of at least $60,000.

The Challenges

Remedial actions conducted in the MCLB Barstow desert environment created some unique challenges, namely the severe heat and cold of the desert environment. Summertime temperatures can be extreme, exceeding 100 degrees Fahrenheit, while winter temperatures can sometimes drop below freezing. In addition, remedial action construction required careful attention in order to protect the Desert tortoise, an endangered species in the Nebo area. These reptiles are attracted to vibrating and pounding machinery. Special fences were used to keep them out of landfill caps, and workers are always on the lookout for any adventurous tortoises.

Effective coordination with regulatory agencies is a key component of successful remediation. During the remedial action implementation for OUs 3, 4, 5, and 6, at least thirteen regulatory personnel changes were made, making regulatory coordination a significant challenge. Bi-weekly telephone conferences with all representatives were instrumental in keeping regulatory agencies informed and involved.

Continued on page 1-14

Continued from page 1-13

What's Left

There are nine CAOCs left at MCLB Barstow that are in the Remedial Investigation/Feasibility Study (RI/FS) stage. These nine CAOCs are being combined to create OU 7, the last new OU planned for MCLB Barstow. The four landfill caps completed under OUs 3, 4, 5, and 6 require long-term management. In addition, there are two large CAOCs (i.e., 37 and 38) that cover groundwater contamination under OUs 1 and 2. CAOCs 37 and 38 are scheduled to be completed in 2030, but both the Navy and Marine Corps are working to shorten the remediation time by optimizing the current treatment system and installing additional systems in key hot-spot areas. A Five-Year Review, intended to help identify deficiencies and recommend solutions to speed up the cleanup program, is currently underway.

• *From the Field* •

• COMMUNITY INVOLVEMENT •

Navy Conducts Time-Critical Removal Action at Occupied Housing Area

Alameda Point (formerly NAS Alameda), California

Project Summary

Alameda Point (formerly Naval Air Station (NAS) Alameda) is located in northern California, along the eastern side of the San Francisco Bay. NAS Alameda consisted of 2,676 acres; 1,562 acres of dry land, and 1,114 acres of submerged land. NAS Alameda was closed under BRAC in April 1997, and is now known as Alameda Point.

Southwest Division Naval Facilities Engineering Command (SWDIV) initiated a time-critical removal action (TCRA) at Alameda Point in response to widespread and severe polycyclic aromatic hydrocarbon (PAH) soil contamination at an occupied housing area with an adjacent school and day care center.

SWDIV completed this large and complex removal action in a residential area with minimal disruption to the families and surrounding schools. All work was completed in a timely, meticulous, and accommodating manner. The TCRA reduced soil contamination concentrations to levels acceptable to ensure the protection of human health by preventing exposure to the contaminated soil.

Site 25 clean backfill and sod.

Background

The contaminated area, IRP Site 25, consists of Estuary Park and the North Village Housing Area, which occupy 42 acres at Alameda Point. Releases from former gas manufacturing plants and an oil refinery located in the vicinity of Alameda Point resulted in extremely high levels of PAH contamination in the soils. PAH is a known human carcinogen, and the contaminant levels found within IRP Site 25 posed a long-term risk to the health of the residents, particularly the children.

After discovering the PAH

Continued on page 1-16

Continued from page 1-15

contamination, SWDIV decided to remove the top two feet of soil in the affected area. From January to July 2002, approximately 160,000 tons of contaminated soil (approximately 70 percent of the housing area and 100 percent of the park and playgrounds) was excavated and transported to an off-site landfill. An orange safety net was placed along the entire bottom of the excavated area to mark the top of the contaminated soil layer. The excavated area was then backfilled with clean soil and agricultural grade topsoil, and new sod was placed over the entire excavated area. To avoid any potential PAH exposure to the residents, all excavations were backfilled daily before the contractor left the site.

Community Involvement

SWDIV took extraordinary measures to minimize any potential disruptions to the families and neighboring school facilities affected by the remediation activities. Residents were granted access to their houses during the excavation activities, but all affected house windows and secondary doors were covered and sealed with plastic and tape to minimize dust getting into the houses. Throughout the remediation, water and sweeper trucks cleaned up dust and construction debris on the surrounding roadways and walkways hourly.

Site 25 excavation activities.

SWDIV teamed closely with the RAB, residents in the housing area, and the school district by holding public meetings; setting up a hotline; providing residents, teachers, and the school board with fact sheets; and conducting site tours.

• *From the Field* •

• COMMUNITY INVOLVEMENT •

Navy Performs Time-Critical Removal Action for Abandoned Aviation Gasoline Pipeline

Ford Island, Pearl Harbor Naval Complex, Oahu, Hawaii

Project Background

Ford Island is part of the Pearl Harbor Naval Complex (PHNC), encompassing an area of approximately 450 acres situated in the central portion of Pearl Harbor, Hawaii. Ford Island hosts several major tenants and commands, including housing and recreational facilities for Navy personnel.

During the 1940s, approximately 33,200 linear feet of underground aviation gasoline (AVGAS) piping was installed to distribute fuel to various locations throughout the island. A Remedial Investigation (RI) conducted on Ford Island determined that portions of the pipeline might contain residual fuel even though the AVGAS pipeline system had not been actively used since the late 1960s. Additionally, the RI concluded that the subsurface soil, groundwater, and ambient air associated with the inactive AVGAS pipeline posed no risks to human health and the environment. However, to minimize the long-term risks associated with a potential future release of residual AVGAS, the RI recommended the removal of the residual liquids and in-place closure of the AVGAS pipeline.

High-density (lying on side) and low-density (2 cylinders standing) pigs (a flexible device that expands in the pipe and seals it, and when pushed through, cleans the lines).

A portion of the AVGAS pipeline system was located in an area planned for a future housing development. To minimize risks posed by future excavations in the area, a time-critical removal action was performed to close-in-place this portion (5,843 linear feet) of the AVGAS pipeline system.

Due to the planned development schedule for the site, this time-critical removal action was performed during the three-month period between 17 July 2001 and 17 October 2001. The Navy's Remedial Action Contract (RAC) contractor performed all removal action activities, which included site preparation, pipeline cleaning and closure, and site restoration.

Clean-Up Strategy

During the RI, petroleum was the only contaminant identified at the AVGAS site. Based on the petroleum

Continued on page 1-18

Continued from page 1-17

exclusion under CERCLA (42 USC Section 9601 [14]), all removal action activities were performed in accordance with the State of Hawaii Department of Health (HDOH), Hawaii State Contingency Plan.

The section of the AVGAS pipeline addressed in this project included approximately 3,970 linear feet of ten-inch and 1,873 linear feet of six-inch abandoned underground pipelines. The AVGAS pipeline was located at varying depths ranging from three to ten feet below the ground surface, and included a system of two concrete fueling pits, and eight concrete valve boxes.

Site preparation activities included demolishing the concrete lids and manhole covers, and removing pipeline valves on each of the valve boxes to allow for access to the pipeline for cleaning, and grouting. All valve box contents (such as accumulated soil and debris) were removed to provide adequate workspace.

Approximately 2,850 gallons of residual AVGAS were removed from the pipeline and associated structures during the removal action activities. The pipeline was cleaned in six segments between valve boxes using mechanical pigs (a flexible device that expands in the pipe and seals it, and when pushed through, cleans the lines). Compressed nitrogen was used to launch a high-density, five-pound pig through each segment, followed by two low-density, two-pound pigs. Residual pipeline contents were pushed through the pipeline and collected by a vacuum truck that was attached to the pig receiver. Following pigging of the pipeline, each section of the pipeline was filled with grout composed of a sand/cement slurry. All 2,850 gallons of AVGAS recovered from the pipeline were transported to a local fuel reclamation facility.

Removing contents of fuel pits using vacuum trucks.

Grouting of 10-inch line section.

Site Heath and Safety Measures

Approximately 30 percent of the underground pipeline was located in a residential area of Ford Island. To minimize potential hazards posed to nearby residents and onsite workers, site security, health and safety procedures, and dust control measures were implemented during all removal action activities. During all fieldwork activities, the ambient air was monitored for potentially hazardous conditions using a combustible gas indicator.

Project Successes

In addition to completing this removal action in three months, the Navy completed timely consultations with the State Historic Preservation Officer on potential historic preservation issues for Ford Island before beginning the field activities. Open coordination and communication between the Navy, HDOH, and the RAC contractor during all phases of the project facilitated efficient and successful completion of this time-critical removal action.

• *From the Field* •

• NEW TECHNOLOGY •

Electrical Resistance Heating Treats Chlorinated Solvents in Low-Permeability Soils

Charleston Naval Complex, Charleston, South Carolina

Project Summary

The Navy completed the first phase of cleanup at a former Dry-Cleaner Site using Electrical Resistance Heating (ERH) to treat chlorinated solvent contamination in groundwater at the Charleston Naval Complex (CNC). The technology was used at a site that would have required years of groundwater treatment under conventional methods. Tetrachloroethene (PCE), a typical dry-cleaning solvent, was released at the site, and sequential dechlorination products of PCE were detected in soil and groundwater several orders of magnitude above regulatory standards. PCE migrated vertically downward as a dense non-aqueous phase liquid (DNAPL) through subsurface soil and into the shallow groundwater (three to five feet below ground surface), until encountering a clay layer ranging from 8.5 to 13.5 feet below ground surface across the site. DNAPLs have not been observed in groundwater samples, but are suspected to be present based on analysis of dissolved phase PCE in concentrations up to 120,000 parts per billion.

ERH is also known as three-phase, or six-phase heating. The concept of using heat to mobilize petroleum, or other constituents, in the subsurface has long been used by the petroleum industry. Only recently has the technology been developed for use in application to shallow groundwater contamination, using electrical resistance heating as a source of energy. ERH has been demonstrated to effectively remove DNAPL without exact knowledge about the DNAPL pool. ERH is an in-situ technology that uses commonly available electricity, and applies it to the ground through electrodes to generate heat. These electrodes can be installed vertically to any depth, or horizontally underneath buildings or operating facilities, and in the presence of buried utilities. The technology is equally effective in treating soil and groundwater.

ERH is a thermal enhancement for soil vapor extraction (SVE) which is effective in removing volatile organics by boiling groundwater in-situ over an extended period of time at a controlled rate, resulting in volatilization and steam-stripping of sorbed compounds. The objectives of the ERH implementation are to achieve between 90 to 95 percent reduction in groundwater concentration of the total chlorinated solvent concentrations in the target treatment area (16,525 square feet, 6,700 cubic feet), and to achieve removal of any DNAPL residual or pools to the extent practicable.

The ERH system that extends between Building 225 and inside Building 1189 consists of 97 electrodes, 12 piles, and 244 ground rods on service. Two 960 KV transformers supplied three phase voltage through separate power control units (PCUs) at the site. The PCUs monitor temperature at the subsurface, voltage at each electrode, and are electrically disconnected upon failure of the vacuum extraction system.

Approximately 190 pounds of chlorinated solvent has been removed from the site to date. The removal rate continues to be somewhat constant, indicating that removal of the DNAPL is occurring. The system is expected to reach

Continued on page 1-20

Continued from page 1-19

approximately 90 percent solvent reduction upon completion.

Community Involvement

The need for a technology that addressed the groundwater at the site in a relatively short time frame was an issue for the community at this site. Charleston County had implemented a very successful social service program in Building 225, and the staff and residents were very concerned that displacement of the program for an extended length of time could be financially devastating. After careful consideration, the Navy, regulatory agencies, and remediation contractor, determined there was a possibility of exposure to the residents of Building 225 once the groundwater temperature reached the boiling point. Relocation of the residents was required, and the staff expressed concern that the interruption could adversely affect the program.

In order to provide clear communication to staff and residents of Building 225, the Navy and the CNC team implemented a Public Relations Plan for conveying information on the type of contamination present, and the health risk that it presented to them. The Navy and the CNC team then worked together with these individuals and RAB members to develop a schedule for implementation of the remedy. The start date for mobilization of the remedial construction was closely coordinated with the timeframe required by the program for finding suitable facilities. The ERH technology was a key component of reaching a successful solution to this dilemma in the short time frame needed to treat the contamination. An extended cleanup would not have allowed the program to plan on returning after the eight months that the ERH was expected to operate.

Northwest view after installation of ERH system.

Challenges

ERH is an emerging technology that has found application in treating shallow soil and groundwater contamination (LNAPL (light NAPL), DNAPL, and dissolved phase), in permeable soils, and in areas that are highly industrialized and populated. Subsurface lithology and site infrastructure, such as sewer piping, can cause migration of vapor laterally, resulting in uncontrolled emissions to the surface and exposure to individuals at these emission points. Adequate capacity of the SVE system, and monitoring for volatile contaminants at the site, is essential to preventing this exposure. At the CNC, the area was monitored daily due to the close proximity of this site to a nearby neighborhood (within 100 feet), and a nearby high school (within 300 feet).

The ERH technology is still evolving and there have been instances where the electrodes will not accept additional power, and the target treatment temperatures in the subsurface have not been reached. The temperature required to volatilize contaminants increases with depth as the hydraulic pressure increases. Conductivity of the soil is often not uniform, and therefore may require supplemental installation of ground rods to increase the current, and subsequent heating of certain areas. Boiling of groundwater adjacent to electrodes can cause drying-out of the soil and decreased conduction of the heat as well. This can be addressed through wetting systems that maintain a flow of water to the electrodes during operation. Pilot studies should be performed to provide the necessary information to determine electrode spacing and the necessity for the electrode wetting systems.

Continued on page 1-21

Continued from page 1-20

Cost Avoidance Measures

A major cost of ERH is the power consumption delivered to the subsurface in order to heat the groundwater to the boiling point of both the water and contaminant mixture. Pilot studies are essential in order to provide the empirical parameters needed to maximize the electrode spacing, and to conserve power use. Poor conductivity soils, potential for drying of soils, and an inadequate understanding of the target treatment zone, can elevate the power requirements. While conducting pilot studies may reduce the amount of power needed to remediate the site, use of risk transfer mechanisms in the contract with the ERH vendor may increase attention to this aspect. Some ideas include sharing costs for power during startup until the target temperature is reached, and/or using a fixed price element for power consumption coupled with a guaranteed reduction in contamination levels.

Project Successes

- The Navy benefits from a significant reduction in the residual levels of chlorinated solvent remaining at the site; subsequent treatment will likely be in the form of less costly alternatives, such as monitored natural attenuation.
- The CNC Redevelopment Authority (CNCRA) is assured of an accelerated cleanup that will allow them to meet their goals for long-term property use, and for the creation of jobs and new tax revenues.
- The regulatory agencies are satisfied that a major source of contamination has been removed, and that what remains can be addressed through continued monitoring, or less aggressive treatment.
- The community is able to continue to use the building with the additional assurance that the contaminant concentration is further reduced, and that future activities at the site will be much less intrusive.
- The project demonstrated the Navy's commitment to the environment, and interest in seeing BRAC facilities quickly returned to positive use.

Lessons Learned

- ERH is an emerging technology that can be used to address soil and groundwater contamination in soils of varying permeability. Pilot studies should be conducted in order to reduce costs during operation.
- The cost of power consumption should be addressed in the contract in order to provide means of risk sharing, or risk transfer, in the event the technology is unable to reach target treatment temperatures.
- ERH is well suited for addressing contamination at sites where DNAPL is not completely characterized. The advantage of using heat conducted through the subsurface eliminates the need for identifying the exact location of the pooled contaminant.

• *From the Field* •

• INNOVATIVE TECHNOLOGY •

Navy Uses Promising Groundwater Treatment for Pentachlorophenol

Naval Amphibious Base Little Creek, Virginia Beach, Virginia

Project Summary

Government agencies are continually searching for faster, less expensive, alternative technologies and approaches to contaminated groundwater remediation. Traditional pump-and-treat remediation techniques are prohibitively expensive and can take decades to achieve the desired cleanup goals. Through the application of an Oxygen Releasing Compound (ORC™), Naval Amphibious Base Little Creek (NABLC) has demonstrated the abilty to speed up the process of groundwater remediation significantly, while reducing cleanup costs.

A former public works pentachlorophenol (PCP) dip-tank at NABLC, comprised of an in-ground tank with a one-to-ten mixture of PCP and diesel fuel, had been used to treat wood for approximately 14 years (from the early 1960s to 1974). During dip-tank operations and related activities over the 14 years of its use, contamination was released to the soil and groundwater in the immediate area surrounding the tank. Approximately 442 tons of PCP contaminated soil was removed in 1999. However, residual PCP contamination remained in the groundwater at the site. The Navy, in coordination with EPA, the Virginia Department of Environmental Quality (VDEQ), and local community members, was interested in identifying viable alternative innovative remediation technologies to clean up the contaminated groundwater present at the site.

ORC™ containers prior to mixing.

The Navy investigated various ways of enhancing existing natural conditions already actively treating contamination at the site, and biodegradation. Since PCP has been shown to degrade both aerobically (oxygen environment) and anaerobically (oxygen-depleted environment) under the right conditions, two types of enhanced biodegradation were evaluated for their effectiveness. Side-by-side laboratory-scale test-tube tests were performed using site soils spiked with PCP to evaluate which approach, if any, would be most effective for the site remediation. Aerobic tests were prepared using ORC™, a proprietary magnesium peroxide-based product. Anaerobic test-tube tests were prepared using a Hydrogen Release Compound (HRC™), a proprietary lactate-based product.

Continued on page 1-23

Continued from page 1-22

The test result data suggested that ORC™ would be the preferred method for the proposed field-treatability test for three reasons:

1. ORC™ was shown to degrade PCP to a greater extent than HRC™ during the 90-day test;
2. By using ORC™ it was less likely that aerobic degradation would create toxic by-products; and
3. Aerobic conditions were more likely to provide the added benefit of breaking down the residual total petroleum hydrocarbon (TPH) concentrations in the soil at the NABLC site.

The field-treatability test focused on the application of ORC™ within and around the footprint of the former dip-tank. Baseline groundwater samples were collected from each of the seven wells in the monitoring network to identify the baseline aquifer characteristics and water quality.

The ORC™ application rates were conservatively designed based on the maximum concentrations of PCP and TPH found in both the groundwater and soil in the treatment area over the past four years. Approximately 1,400 pounds of ORC™ powder was mixed with water and injected into the water table aquifer using direct push (Geoprobe) technology. The slurry was injected at 17 injection points over an 800 square foot area.

Project Results

Six rounds of post-injection monitoring were conducted over a period of approximately one year to measure the PCP concentrations present in the groundwater at the injection site. On average, PCP concentrations were reduced by over 90 percent at the site. PCP concentrations increased initially, followed by a noticeable downward trend. The pilot-scale implementation successfully demonstrated the use of ORC™ to enhance natural biodegradation processes, resulting in significant reductions of PCP contamination in groundwater.

Additionally, the projected cost avoidance for full-scale ORC™ injection is significant when compared to traditional pump-and-treat methods. Full-scale ORC™ injection deployment does not require a permanent treatment process plant, implementation is simple, zero operation and maintenance costs are incurred, less monitoring and reporting are required, and cleanup timeframes are drastically reduced. ORC™ has proven to be an efficient, viable alternative to conventional groundwater pump-and-treat facilities.

ORC™ injection.

• *From the Field* •

• STAKEHOLDER INVOLVEMENT •

Navy Consolidates and Caps Old Landfill Waste

Former Naval Air Station Agana, Guam

Project Summary

The Pacific Division, Naval Facilities Engineering Command (PACDIV) is undertaking a major environmental restoration effort at the former Naval Air Station (NAS) Agana on the island of Guam. NAS Agana was transferred to the Government of Guam in the fall of 2000 under the BRAC Early Transfer Authority. One of the last remaining environmental restoration actions was waste consolidation and capping of the station's old landfill.

NAS Agana was established soon after the liberation of Guam during World War II, and remained very active through closure in 1995. Since transfer, former NAS Agana has become a growing hub of governmental, commercial, and aviation activity for Guam and Micronesia. NAS Agana Landfill is an inactive, government-owned municipal and military waste disposal area that once accepted household, commercial, and military wastes. Placed waste was reportedly covered with clean soil on a daily basis. The facility is unlined.

The NAS Agana landfill began operations in the mid 1950s, and closed in 1976, and served both military and civilian customers. Much of the waste was household rubbish and green waste; however, electronic parts, paint, solvents, and fuel containers were also reportedly disposed in the landfill. While the bulk of the waste was initially placed in an abandoned quarry, the waste eventually spread over a 32-acre area.

Installation of geosynthetic clay liner cap.

PACDIV performed a thorough site evaluation that included an assessment of the type of waste present, and it's horizontal and vertical extent. Following characterization, cleanup options were discussed with Guam Environmental Protection Agency (GEPA), U.S. EPA Region IX, Guam International Airport Authority (GIAA) as the new landowner, the RAB, and interested community members. Land is precious on Guam, and all affected local parties wanted to see as much land as possible returned to productive use. Therefore, a plan was developed to consolidate waste back into the original footprint of the old abandoned quarry.

The characterization effort had shown that much of the waste consisted of surficial placements and shallow pockets over the 32-acre site. Waste was excavated and placed in dump trucks for a short haul to the newly designed landfill that occupied an approximate 8-acre area where the thickest accumulations of waste had been found. Metal debris uncovered during excavation was separated from the other landfill waste, cleaned, and trucked to an on-island

Continued on page 1-25

Continued from page 1-24

metals recycler. Areas where wastes had been present were over-excavated, and confirmation samples were collected and analyzed to be sure that potentially hazardous components of the waste had not been left behind. This excavation and consolidation effort removed old landfill waste from 24 of the site's 32 acres.

Following waste consolidation, a foundation layer of clean soil was placed on top of the waste. PACDIV, working with GIAA, excavated soil material for this foundation layer from a hill that was planned for removal as part of a future runway expansion project. A geotextile landfill gas collection layer and geosythetic clay liner, were installed over the foundation layer to prevent rainfall infiltration and potential generation of leachate.

PACDIV has partnered with GEPA in an effort to familiarize their personnel with landfill capping and closure technology, installation techniques, and problem resolution for the upcoming closure of the island's main municipal landfill. It is anticipated that GEPA personnel will continue to be frequent site visitors through the planned completion of this project.

Excavation of soil for landfill cover.

Conclusion

In response to regulatory and public comments, waste from an old 32-acre landfill were consolidated into an 8-acre parcel, freeing over 75 percent of the site for other productive use. By working with GIAA, a hillside that needed to be removed for runway expansion was excavated for needed cover soil. By teaming with GEPA, valuable technical knowledge was shared with the regulators to assist them with their upcoming closure of the island's municipal landfill.

• *From the Field* •

• INNOVATIVE TECHNOLOGY/COST AVOIDANCE •

Using Native Materials for Landfill Grading Achieves Cost Avoidance of $2M

Naval Air Weapons Station China Lake, California

Project Summary

Site 12 is a former landfill in an abandoned gravel quarry located approximately 1.5 miles west of the Naval Air Weapons Station (NAWS) China Lake Main Gate, along the southern boundary of the China Lake Complex. The quarry covers an area of approximately 35 acres and achieved a depth of at least 50-feet below the surrounding topography.

The Site 12 landfill received approximately 100 tons of solid waste per year from 1952 to 1979, including construction debris, cans and barrels, small electrical parts, plastics, rags, and possibly miscellaneous unspecified chemicals. Site 12 was classified as a military landfill due to its disposal history. The debris-filled former quarry had a depressed surface approximately 40-feet below the surrounding topography, with the closed landfill area occupying approximately 15 acres.

During the RI/FS, the Navy determined the site conditions posed no current risk to human health and the environment. The existing site conditions did, however, allow rainwater to pond in the center of the landfill, posing a potential threat to the groundwater in the future if drainage improvements were not implemented. All involved parties agreed that a remedial action was necessary to eliminate this potential threat. The Navy chose landfill drainage control improvements as the least intrusive, and most cost effective approach.

Landfill prior to cover construction.

The selected remedy was to complete construction of site drainage by providing adequate grading to eliminate storm water ponding over the landfill, and subsequent infiltration of storm water into the landfill. The intent of the site drainage improvements was to minimize degradation of the landfill cover by erosion. The earthen soil cover placed over the area was designed to allow water to flow off the landfill area and into a perimeter drainage system connected to an existing drainage swale.

The Navy briefed RAB members before, during, and after the project, and held conference calls with regulatory agencies at key decision-making points during the construction phase to ensure that all issues were resolved quickly.

Construction Challenges

The major construction challenge for this site was developing a plan to allow movement of enough material to provide adequate grading at the site. In all, 135,000 cubic yards of soil were moved at the site to gain

Continued on page 1-27

Continued from page 1-26

necessary cover. The "borrow areas" for material were located as close to the site as possible in an effort to increase efficiency.

Cost Avoidance

The Navy fostered a partnership between the various regulatory agencies and the design and construction firms involved in the project from the start. The result was the development of a design that will provide years of trouble-free service, and did not involve costly retention ponds for storm water runoff or geotextile liner materials for landfill cover. By choosing a design that relied on native material usage, the $1.5 million project realized a cost avoidance of $2 million dollars, in both upfront construction costs and long-term maintenance.

Swale construction to prevent "run-on" to landfill.

Project Success

This project took only six months to complete after the ROD was signed for the site, due in large part to the effective teamwork of all involved parties.

Lessons Learned

- Keep all parties involved in the decision making process from concept to completion.
- Ensure that the remedy chosen takes into consideration the long-term maintenance costs associated with maintaining that remedy.

• *From the Field* •

• COST AVOIDANCE •

Using PCB Field Test Kits Save Time and Money

Naval Base Ventura County, Port Hueneme, California

Project Summary

As part of the on-going Installation Restoration Program (IRP) at the Naval Base Ventura County (NBVC) Port Hueneme, the NBVC Restoration Team decided to perform active remediation on three of the IRP sites: 9, 12B, and 23. The sole contaminant was polychlorinated biphenyls (PCBs). These three sites were comprised of a former fire-fighting training pit (Site 9), a former repair yard for electrical equipment (Site 12B), and a storage yard (Site 23). During the project documentation process, IRP Site 9 was reevaluated and additional risk assessments were performed. IRP Site 12B had an estimated total of 600 gallons of dielectric fluid containing PCBs spilled at the site. The goals proposed for the removal action were consistent with the factors set forth in the National Contingency Plan (NCP) and the California Health and Safety Code. The objective was to reduce the exposure from hazardous substances, at or near the surface, to nearby populations or food chains. An engineering evaluation was conducted that identified soil excavation with off-site disposal as the preferred method of removal. This preferred method was formally selected and documented in the Action Memorandum/Removal Action Work-plan dated April 2002.

Construction challenges included working around active utilities and nearby structures.

The remedial action objective was established at 1.0 mg/kg for residential soil, the EPA-recommended action level. Both the State and the Navy agreed that the Toxic Substances Control Act (TSCA) was not applicable to this remedial action, but felt that it would be both relevant and appropriate in this instance. It was agreed that a site-specific risk assessment would be conducted for each of the sites and appropriate institutional controls would be required.

Cost Avoidance

The field activities were conducted immediately after Navy approval of the contractor's project documentation. Using PCB field test kits allowed the excavation to proceed and expedited implementation of the removal action. The additional excavation was completed by the end of August 2002. A total of 3,871 tons of PCB-contaminated soil from IRP Site 12B, and 590 tons of PCB-contaminated soil from IRP Site 23 has been transported off-site and

Continued on page 1-29

Continued from page 1-28

disposed of in a hazardous waste landfill.

Due to the type and quantity of PCB contamination, the soil excavation efforts at IRP Site 23 have achieved both the remedial action objective of the removal action, and the current residential preliminary remediation goal levels published by EPA Region 9. The excavation activities attained the established remedial action objective at IRP Site 12B, allowing for a site-specific risk assessment to determine if future institutional controls should be implemented.

Lessons Learned

Three important lessons learned from the Port Hueneme project are that

1. Site characterization can be approximate,
2. A detailed approach to the fieldwork yields the greatest benefit, and
3. Using of a firm- fixed-price contractor can be applied to excavation projects.

Use of PCB field test kits helped avoid costs and accelerate project schedule.