

RPM News

▲ Remedial Project Manager News ▲

"COMMUNICATING NAVY INSTALLATION RESTORATION PROGRAM NEWS AND INFORMATION AMONG ALL PARTICIPANTS"

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Life-Cycle Design

Bioslurping and Natural Attenuation



Let's face it, conditions will change over the life of your project. To manage these changes, a good up front design must be implemented, accounting for the entire life of the project, not just the conditions found at the beginning of the project. Simply put, a life cycle design approach should be used when planning for any environmental restoration project. Environmental life cycle design includes three major objectives:

- Reduce concentration of contaminants over time
- Minimize capital cost and operator expenses
- Clean-up and close-out the environmental restoration site

There are really two phases to any environmental restoration project. The first phase is the removal of contaminant

mass. The second phase is reaching regulatory requirements and declaring the site clean. It is very important to separate these phases conceptually as you prepare your life cycle design. Before selecting the remedy for your site, ask yourself, 1) what will the treatment technology do to remove mass? And, 2) what will the treatment technology do to close out the site? Asking these two questions will assist in predicting what will happen over the entire life of the remediation remedial action project. Often times, different technologies may have to be applied to a site at different points in the project in order to complete the environmental restoration. One example of using a life cycle design approach is the remediation of light non-aqueous phase liquid (LNAPL) using a bioslurper system followed by monitoring for natural attenuation.

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RPM NEWS

Remedial Project Manager News

Published By
NFESC



Using Appropriated Funds

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Information Management Branch:

Mr. Tom Flor

"Life Cycle Design"
continued from page 1

The primary objective of bioslurping is to recover free product existing as LNAPL to the maximum extent practicable and to minimize the lateral migration of LNAPL in the subsurface. During bioslurping activities, hydrocarbon-contaminated vadose zone soils are aerated, thereby stimulating the biodegradation of hydrocarbons in soil. Bioslurping allows flexibility without high costs for equipment. For example, extraction wells can be converted to bioventing wells for treatment of vadose zone soils. A blower can be installed and connected to existing bioslurping wells to provide subsurface aeration and promote the degradation of hydrocarbons in the vadose zone. Bioventing can be performed simultaneously to bioslurping activities in order to minimize the duration of the mass removal portion of the project and maximize conditions necessary for natural attenuation. The Navy has developed detailed guidance for the application of

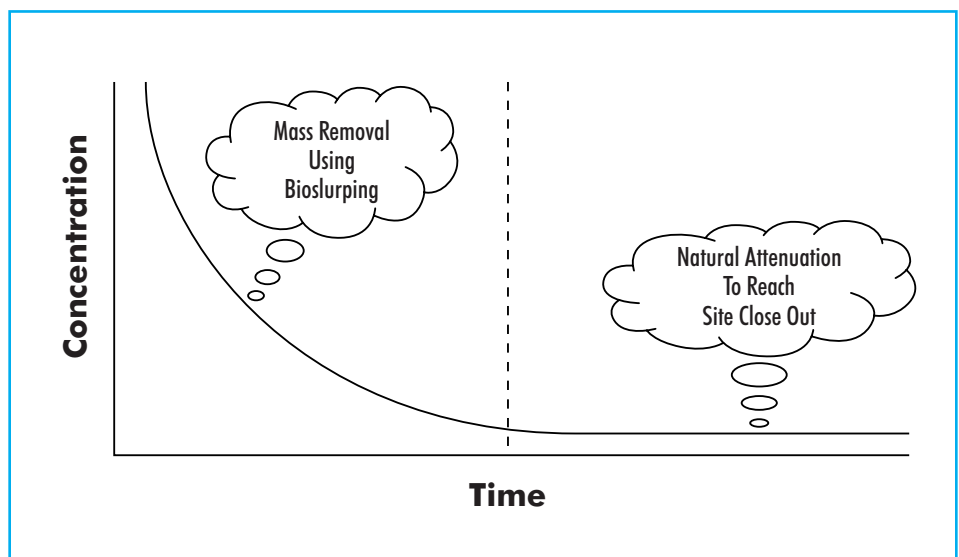
bioslurping in the *Application Guide for Bioslurping, Vol. I-II, October 1998.*

The exit strategy for bioslurping is to determine the endpoint for free-product recovery. At some point, the rate at which hydrocarbons are being removed using bioslurping will no longer be technically feasible or cost-effective. Simple monitoring may show that natural attenuation is sufficient for the completion of the site restoration. In this case, the bioslurper system can be turned off and extraction wells and monitoring wells can be monitored for natural attenuation (See Figure 1). This cuts the cost of active management and reduces the expenses of operating and maintaining the bioslurper system.

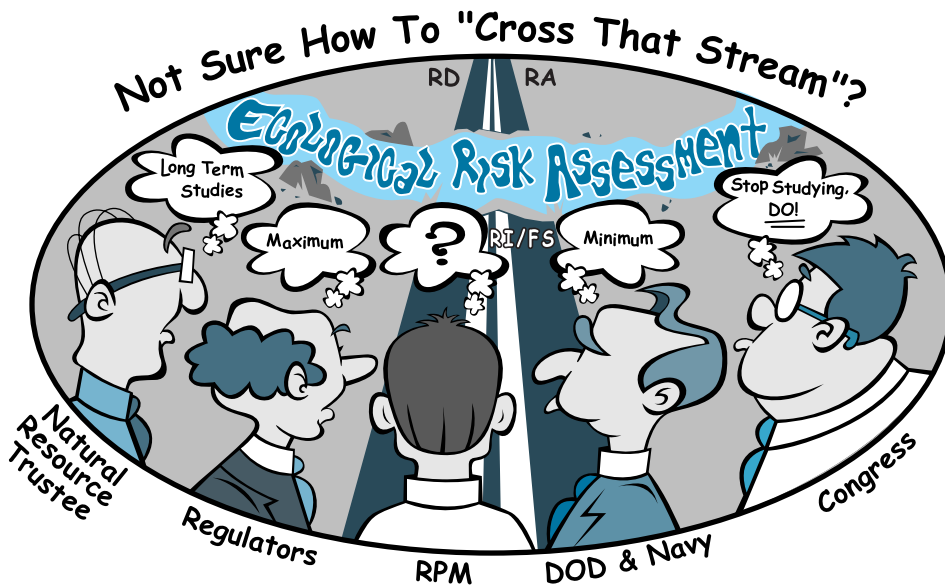
An operational method that may satisfy the regulatory agency is to leave bioslurping equipment in place even though the end of the project is near. The bioslurper system can simply be turned off at any time and the soil and groundwater monitored

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Figure 1



Centrally Funded Ecological Risk Technical Assistance Team (ERTAT) Established



Across NAVFAC's clean-up programs, a common occurrence has been encountered in consistently and cost effectively conducting Ecological Risk Assessments (ERAs). As a result, NAVFAC has established a centrally funded Ecological Risk Technical Assistance Team (ERTAT) to assist Engineering Field Divisions/Activities (EFD/As) with the technical issues associated with Environmental Protection Agency's (EPA's) Ecological Risk Assessment process. The ERTAT consists of the Naval Facilities Engineering Service Center (NFESC), as Team Coordinator, EPA's Environmental Response Team (ERT), and Space and Naval Warfare (SPAWAR) System Center (SSC) for technical support. NAVFAC's unique relationship with ERT allows the EFD/As access to the EPA experts that developed the ERA

guidance. Inclusion of SSC provides the EFD/As access to the Navy's in-house sediment, marine sampling, and analytical expertise.

Using the ERTAT will ensure that the Navy conducts technically sound, efficient ERAs within the IR process. This will help bring sites to closure in a manner that is fully protective of the environment in accordance with Navy Policy and EPA guidance.

*For further information or access to the ERTAT, please contact the NFESC Team Coordinators:
(805) 982-4798/DSN 551-4798,*

The ERTAT is available to EFD/As to provide the following types of support:

- Work one-on-one with Remedial Project Managers (RPMs) and Navy contractors to develop strategies for strengthening current ERAs and addressing regulator concerns
- Assist with ERA scoping and reviewing workplans and reports
- Provide concrete direction to Navy ERA support contractors on the Navy's ERA approach
- Provide technical assistance at regulatory meetings
- Work with EFD/A management to strengthen existing in-house ERA technical support
- Expedite ERA training and technology transfer to the EFD/As through the CECOS ERA Course and the NFESC Remedial Innovative Technology Seminars (RITS)
- Develop ERA Tools to assist RPMs
- Transfer lessons learned throughout the Navy
- Access to specialized EPA ecological risk expertise
- Access to Navy contaminated sediment risk analysis and modeling expertise
- Access to advanced sediment and water column assessment technologies
- Elevate guidance needs to NAVFAC

The New NORM Cost Estimating Wizard Fields A Curve

NORM 4 to include Cost Estimating Relationships

Remedial Project Managers (RPMs), analysts, managers, and cost estimators are all involved in the overall budget process. In order to justify the Navy's environmental budget, somehow, somewhere, someone has to perform a cost estimate for every site for which funding is sought. In addition, data to support each cost estimate needs to be readily available to answer questions from auditors and comptrollers.

To ease the pain of cost estimating the Navy has integrated an advanced, client/server based Technology Decision Tree Wizard and cost estimating system into the upcoming release of NORM 4. The wizard is an improved, intuitive, interactive, user-friendly remedy selection system for the cost estimating system based upon sound scientific principles, actual field experience, and the Cleanup Review Tiger Team (CURTT) recommended strategies for cleanup. By making the wizard a useful tool for the RPM and Cost Estimator, NAVFAC will see a marked improvement in the overall estimating process that will help them better defend the basis for budget preparation.

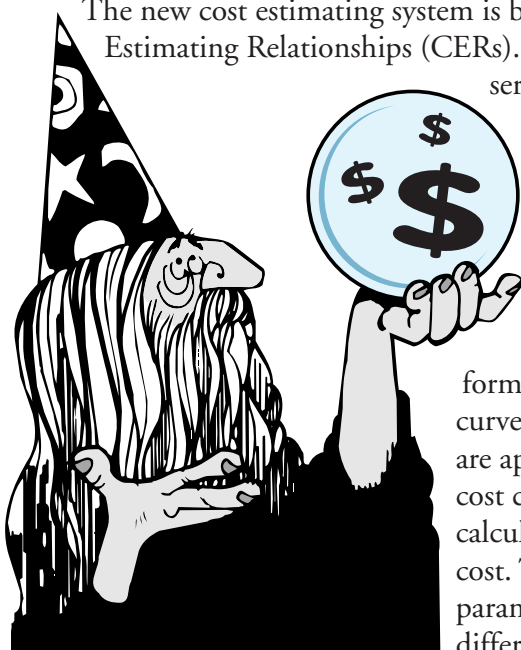
The new cost estimating system is based on Cost Estimating Relationships (CERs). A CER is a series of equations driven by multiple cost parameters and refined through analyses to formulate a cost curve. Parameters are applied to these cost curves to calculate a line item cost. These multi-parameter curves differ from the old

Cost-to-Complete (CTC) methodology where costs were estimated as discrete units over a range of quantities, usually based on only one parameter. The new CERs provide greater visibility and flexibility of detail parameters and yet, do not require additional user input. CERs will continue to be updated based on analyses of actual cleanup costs and lessons learned. This analytical approach coupled with a more comprehensive series of CERs, including professional labor and non-treatment elements such as site work, greatly improves the correlation of costs with site cleanup work.

An array of new cleanup technologies with CERs have been added to NORM 4. Help screens with technology profiles and diagrams and CER profiles are available to assist the user in selecting technologies and estimating cleanup costs. Listed below are just a few technologies targeted for this release:

- Enhanced Bioremediation
- Slurry Walls
- Thermal Oxidation
- Thermal Wells & Blankets
- Biopile
- Biofilter
- Solvent Extraction
- Site Work
- Confined Disposal Facilities
- Drum Removal

While the task of cost estimating often seems part science, part art, and part "black box," the Navy's new system uses spreadsheet-like format to present user line items on screen. The detail will be readily available through the client server to all data stakeholders. New report features include "canned" and custom reports to assist documenting technology selection, cost, and schedule. All this is provided in a tightly wrapped package to support everyone from the RPM to the headquarters policy staff.



NORM 4 Is Coming

Client/Server Version to Ship in Second Quarter of 1999



The goal was simple. Produce a client/server version of NORM that makes use of the NAVFAC Corporate Intranet, tightly integrates Cost-to-Complete (CTC), captures all the backup data, and simplifies installation, maintenance, and support. The upcoming release of NORM 4 exceeds the original goal while still delivering useful tools for the Remedial Project Manager (RPM).

NORM 4 is an Intranet/Internet ready multi-tier client/server application that uses the latest in database access and World Wide Web transport technologies. The new user interface is a hybrid web browser that allows the NORM user community to share ideas and knowledge quickly and easily across the corporation. When large calculations and batch updates are run, they are executed on a server machine, alleviating the bottlenecks on your local area network. In addition, the new architecture has the capability of allowing remote access, via a dial-up connection, to real time data. That means access to critical information while you're on the road.

NORM 4 allows NAVFAC Environmental users to unite and support each other from all across the country whether it be sharing a custom report written by an analyst in San Francisco or a useful web site discovered by an RPM in Charleston, South Carolina. As soon as information is discovered, it can be disseminated. You can even collaborate on a site, schedule, or cost estimate with another RPM or a contractor.

RPMs will appreciate the new cost estimating system, which includes many new cost models and an advanced Technology Decision Tree Wizard. The Technology

Decision Tree Wizard walks you through all the questions you need to answer to determine which technologies are recommended for your site. And the list of technologies is extensive, including many innovative and several conventional ones that were not included before. Many new technologies have been added and will be available for evaluation and application. Extensive on-line documentation will provide further information on technologies, applications and cost details. (See the article "New NORM 4 Cost Estimating Wizard Fields a Curve")

Budget Analysts and Managers can anticipate easier budget interaction and the elimination of data calls. In the past, each division had to await the instructions from headquarters (in the form of a BDU or budget data update) and submit data back to headquarters (BDC, or budget data call). Now, as soon as the guidance is ready, it is available live in the system. And when you are finished with the data, you simply notify headquarters that it is completed.

Managers can use the new platform to assist in training new RPMs and doing on-line research with all the environmental information in a focused location. You can find experts or counterparts within the system using the integrated NORM communication (a.k.a., system email) to collaborate or find answers.

NORM Administrators will appreciate the simplified utilities that support the new version. NORM 4 components are tightly integrated into an interactive user interface that automatically checks the server for the latest versions of any component, including Relative Risk, Cost-to-Complete (CTC), etc. If a new version is found, it is downloaded to the user and installed automatically. Patches, updates, upgrades, budget instructions, and content are all available in real time. This eliminates the need for deployments and Navy-wide installations.

The setup program will be executed from the Corporate Intranet, so the latest setup is always available: the need to distribute setup disks has been eliminated.

NORM 4 represents more than four years of comprehensive institutional knowledge using packaged and fully integrated applications designed to support every level of the environmental business practice. It is faster, more efficient and more flexible than before to improve business performance required in today's reduced staff environment.

Naval Facilities Engineering Command (NAVFAC), Environmental completed beta testing NORM 4.0 during the week of February 8, 1999, at EFA West, in San Bruno, California. This new release of the Navy's environmental management information system represents a dramatic leap forward in terms of performance, flexibility, system design, and architecture.

For technical, system, or any other NORM questions, please contact:

(703) 941-4900 ext. 363

Are Leaking Underground Pipelines A Problem At Your Facility?

There are, in the private sector, a number of vendors who exploit several technologies to detect and locate leaks in underground pipelines. Naval Facilities Engineering Service Center (NFESC) has written a Technical Application Guide (TAG) entitled "Underground Pipeline Leak Detection and Location Technology Application Guide" that describes these technologies for leak detection and location (LDL).

This document is to be used by Navy and other Department of Defense (DoD) personnel responsible for procuring, operating and maintaining fueling systems at Navy facilities. It addresses the merits of LDL technologies available in the private sector. These systems are based on seven different approaches to detect and locate leaks and are itemized as follows:

Temperature Compensated Volumetric Test
 Marker Gas Inoculation
 Pigging
 Product Sensitive Cable
 Fiber Optic Cable
 Acoustic Emission
 Pressure Point Analysis

The attributes of these technologies are addressed in the insert accompanying this issue of the RPM News. The insert describes the seven technologies, discusses their implementation, and outlines the performance characteristics of the technologies as effected by environmental and facility operating conditions.

Over 200 Miles of Underground Pipelines in DoD

The Army, Air Force and Navy have over 10,000 underground storage tanks (USTs) for storage of gasoline, diesel fuel, and jet fuel. Associated with these USTs are over 200 miles of underground pipes of with diameters ranging from 2 to 20 inches. In addition to these fuel supply systems, the Navy and DoD have several hundred miles of underground steam and high temperature hot water lines. Fuel line contents and additives present in steam/hot water lines are environmental hazards that present expensive cleanup problems to field facilities when UST/steamline leaks occur. Such leaks are inevitable and occur continually.

Cleanup costs associated with long-term leaks are prohibitively expensive. One gallon of fuel will render one million gallons of groundwater non-potable. While leaks are common, their impact on the environment and cleanup budget can be kept low if the leaks are detected early after occurrence, thereby reducing the volume of contaminant leaked into the environment and limiting the expanse of soil contaminated. The Environmental Protection Agency (EPA) seeks to minimize the environmental hazard associated with leaks in underground pipelines by imposing leak detection and location regulations on these lines.

The regulations require one of the following leak detection activities:

- (1) annual tank tightness tests with monthly inventory reconciliation or
- (2) monthly monitoring tests.

If annual tank tightness tests are performed, the leak test protocol must be able to detect leaks of 0.1 gallon per hour with a probability of detection (PD) of 95% and a probability of false alarm (PFA) of less than 5%. If monthly monitoring tests are done, the test protocol must be capable of detecting leaks of 0.2 gallons per hour.

There are commercially available technologies that are capable of detecting leaks of these magnitudes, but they are expensive, are influenced by soil and groundwater conditions and have poor leak location resolution measured in several 10s of feet.

Large Underground Pipeline Systems Present Difficult LDL Problems

Current LDL technologies were developed for the private sector, primarily for gas stations. Gas stations are small confined systems that typically contain three USTs and a few hundred feet of underground pipelines of 2 or 3 inch diameter. A typical Navy facility such as a Naval Air Station will have several USTs and a few thousand feet

of underground pipelines. Applying current LDL technology to fueling systems at these larger Navy facilities stresses the technology.

Navy facilities will have pipelines with diameters up to 20 inches, pipeline lengths up to 18 miles long; pressures up to 100 psig and fuel supply rates up to 10,000 gallons per hour. The primary fuel used at Navy facilities is JP5 rather than gasoline although gasoline and diesel fuel distribution systems will be in place.

Navy pipelines may be constructed from any one of several materials such as stainless steel, aluminum or fiber reinforced plastic. The larger size and capacity of the Navy fueling systems requires a critical review of the subject fueling system, soil conditions, water table, and facility operations to select an appropriate LDL technology. These issues are expanded upon in the "Underground Pipeline Detection and Location Technology Application Guide".

Point of Contact

If you have questions or comments regarding the use of LDL technologies, please contact:

NFESC
(805) 982-1672
DSN 551-1672

Conference Announcement

1999 Navy and Marine Corps Site Cleanup Conference



20-22 April 1999

**Combs Auditorium, Building 1444
Port Hueneme, California**

The purpose of the conference is to promote information exchange and fast track cleanup of the Navy's past hazardous waste sites.

Our target audience is remedial project managers and their supervisors involved in the cleanup of Navy and Marine Corps installations (BRAC and non-BRAC).

If you are giving a presentation at the conference, please forward a master of your presentation handout by 9 April 1999

so copies can be made for conference attendees. You can submit hard copy, a file on disk, or a file via email.

For further information, or to submit your presentation handout, contact:

*Naval Facilities Engineering Service
Center
Code 413
1100 23rd Avenue
Port Hueneme, CA 93043-4370
(805) 982-4852 voice,
(805) 982-3694 fax, DSN 551*

TechData Sheet

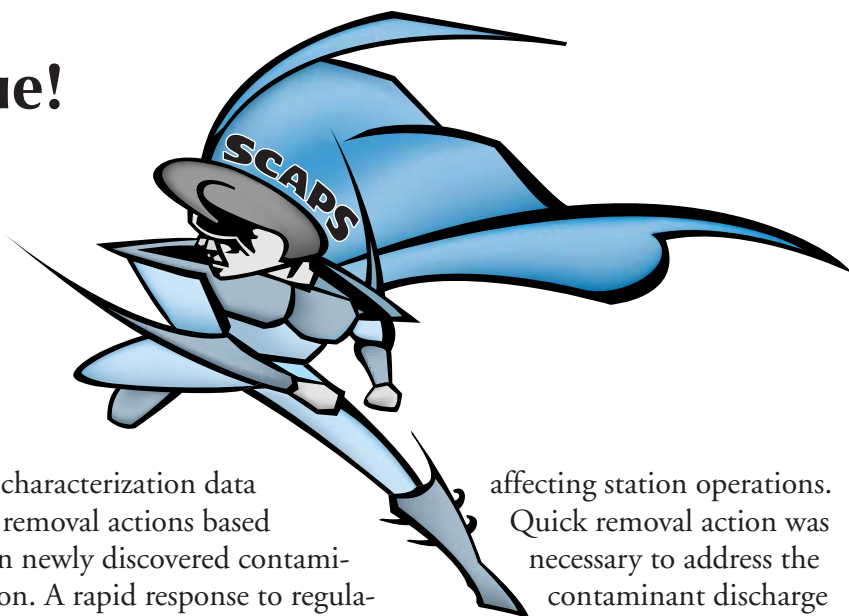
by Joey Trotsky

Alternative Landfill Capping (TDS-2059-ENV)

Having problems with your landfill or other types of buried waste? Get help from the Naval Facilities Engineering Service Center (NFESC's) Landfill Team. The team specializes in alternative covers and has partnered with the Department of Energy (DOE), Army Corps of Engineers, academia, and private industry to install demonstration covers and demonstrate their effectiveness.

For more information on alternative landfill covers please see the inserted Tech Data Sheet. For more information on the NFESC demonstration please call (805) 982-1795 regarding the report EES-MCBH-98-1 entitled "DEMONSTRATION AT MARINE CORP BASE, HAWAII INFILTRATION CONTROL COVER TECHNOLOGY" November 1998.

SCAPS To The Rescue!



INTRODUCTION

Over the past four years, the Navy's Site Characterization and Analysis Penetrometer System (SCAPS) provided customers with an effective tool to help detect and delineate petroleum, oil, lubricant (POL) contaminant plumes in subsurface soil and to characterize geologic conditions. Several ways SCAPS proved to benefit its customers are by:

- reducing site intrusion
- measuring in-situ
- reducing cost and saving time over conventional characterization methods
- facilitating rapid site closures
- promoting on-site decision making flexibility through real-time data
- detecting contamination otherwise overlooked by conventional characterization methods
- optimizing remedial design and approach
- gaining regulatory approval
- meeting ASTM standard practice D6187-97

In addition to SCAPS's technical capabilities, other advantages include using SCAPS's rapid procurement and deployment capabilities and timely issuance of characterization data. Rapid characterization service is paramount when regulatory agencies are demanding comprehen-

sive characterization data and removal actions based upon newly discovered contamination. A rapid response to regulatory concerns over a site's contamination problem(s) is usually necessary to avoid added costs/work associated with the adherence to official regulatory cleanup orders.

NEX Service Station

One site that illustrates SCAPS's quick response advantage is located at the Naval Exchange (NEX) Service Station, San Diego Naval Station (NAVSTA). The station, in operation since 1953, is located on 32nd Street. Site contamination consists of diesel and gasoline fuels in both the soil and groundwater. The need for a quick response characterization of the site was realized after observing contamination residing on a bank of an adjacent waterway known as Chollas Creek. The regulatory concern stemmed from the possibility of groundwater contamination flowing into the creek. It is believed that the source of this contamination was a release from a former underground storage tank located at the NEX station site. The primary objectives were to characterize and terminate this contaminant discharge into the creek, and conduct removal/remediation activities without

affecting station operations.

Quick removal action was necessary to address the contaminant discharge emergency and prevent the Regional Water Quality Control Board from issuing a Cleanup and Abatement Order (CAO). Issuance of a CAO usually results in bad publicity, onerous paperwork, and a regulatory agency imposed timetable to address the site's problems. Costs incurred when a CAO is not satisfied can reach as high as \$25,000/day.

SCAPS Investigation at NEX Service Station

Immediate measures to address the emergency were to install a containment boom and a pump truck to remove the contaminant discharge into the creek. Once PWC San Diego obtained a request for services from the customer, a SCAPS truck was quickly deployed, arriving on location within a few days after receiving the required well permit approvals. SCAPS was brought in to the NEX Service Station to provide a more comprehensive and detailed characterization of the site's geology. From the detailed geologic characterization and Laser Induced Fluorescence (LIF) data, it was hoped that a better understanding of the site's contaminant migration could be obtained. By the end of three days,



The SCAPS platform consists of a 20-ton truck, equipped with a cone penetrometer and Laser Induced Fluorescence (LIF) system used to detect and delineate petroleum, oil, and lubricant plumes in subsurface soil, and to characterize geologic conditions. SCAPS was developed to employ a variety of tools and sensors. Many of these instruments can be 'pushed' into the ground to detect petroleum hydrocarbons in situ and in real-time. SCAPS is available through the Navy's San Diego, Jacksonville (before March 1999), and Norfolk (after February 1999) Public Works Centers.

SCAPS conducted approximately twenty pushes at the NEX station site. A similar effort by conventional push and drilling/auger methods would require approximately six days or double the amount of time to complete the fieldwork. During the implementation of SCAPS, the station's normal everyday activities were allowed to proceed without interruption.

Results/Benefits of Using SCAPS at the NEX Service Station

At the end of the first day of conducting pushes, SCAPS identified a previously undetected free product zone coinciding with a sand layer overlaying a clay unit. Two free product recovery wells were designed and installed within a period of one

week. The quick design and installation of the wells was due in part to the real time geology and contaminant data output produced by SCAPS. Conventional characterization methods, on the other hand, would require waiting for laboratory results to be returned before the design and installation process could begin. Extraction well screen design and placement were determined using SCAPS's high vertical-resolution results. SCAPS's 1-inch vertical soil classification resolution and 2" vertical resolution of the LIF techniques allowed for precise placement of the well screens within high permeability (sand) or contaminated zones. Consequently, SCAPS's relatively high vertical resolution helped to avoid "guessing" at the stratigraphy between conventionally

spaced sample intervals, typically spaced in feet.

Procurement of SCAPS' Services

SCAPS's services are offered through the Navy's San Diego, CA; Jacksonville, FL (before March 1999), and Norfolk, VA (after February 1999) Public Works Centers. Acquiring SCAPS's services is relatively quick and easy. In the case of the 32nd Street Service Station, services were obtained by preparing a brief description of work and a subsequent issuance of a funding document (such as Form 2275) addressed to PWC San Diego. In most instances, PWC will assist the customer with the work description preparation. Therefore, SCAPS's services normally require little procurement effort by the customer. In contrast, it may take up to several weeks before a contractual agreement can be drawn up to acquire comparable services outside of the Navy.

Conclusion

In response to customers' requests for services, SCAPS has proven itself to be easily procured and subsequently deployed in a rapid manner. In the case of the NAVSTA NEX Service Station, SCAPS was on site within a couple of days after receiving the required permits and approved work plan for on-site drilling. SCAPS has shown that it contributes to the success of a site's remedial activities almost immediately after arriving on site. Within the first day of the NEX Service Station site investigation, SCAPS discovered the existence of a free product layer that was initially overlooked by conventional characterization techniques. SCAPS also helped to assess the extent and distribution of free

product with a resolution that would not be possible using conventional drilling methods. In most instances, SCAPS has also shown it can perform a site investigation without interrupting a site's everyday operations.

The real-time aspect of SCAPS allows for complete delineation of a contaminant plume in one deployment. In the case of the NEX Service Station, SCAPS real-time capabilities helped to design and install two free product extraction wells within a period of one week.

Because of SCAPS's quick response and effective site characterization, the customer initiated a quick removal action, thereby avoiding issuance of a potentially costly and embarrassing CAO from the local regulatory agency(s).

For more information about SCAPS or its scheduling into your process, please contact:

West Coast

██████████
PWC San Diego, CA
(619) 556-9506

East Coast

██████████
PWC Norfolk, VA
(757) 445-4885 x400
After February 1999

██████████
PWC Jacksonville, FL
(904) 542-4548 x8323
Before March 1999

*"Life Cycle Design"
continued from page 2*

for several quarters. If the monitoring data shows that not enough mass has been removed, then the bioslurper system can be turned back on. This method allows flexibility at minimal cost. If the monitoring data shows results below the required regulatory level for several quarters, the bioslurper system can be demobilized. Monitoring on an annual basis may be required to satisfy long-term worries of any type of possible recharge of contaminants, but this is a minimal cost for the insurance of protecting human health and the environment.

To make this process work, all of the organizations involved with the project must first agree on the objectives of each portion of the project. This can be worked out by brainstorming a list of objectives. Then, determine how you plan on meeting the objectives listed and how you will measure each objective (see Table 1).

The life-cycle design approach involves the selection of cost-effective treatment equipment and the ability to modify system components to meet any changes in site-specific conditions. The treatment systems should be selected based on short-term operation and the average, not maximum, recovery and contaminant loading. Also, the treatment equipment can be leased rather than purchased, resulting in significant cost savings to the project when reduced concentrations allow for the discontinuation of aqueous and off-gas treatment components. Plan your next environmental restoration project using a life-cycle design approach.

For more information on life-cycle design, bioslurping, or natural attenuation contact:

Naval
Facilities Engineering Service Center,
Code 414, (805) 982-4890,
DSN 551-4890,

Table 1

Objective	How will we meet?	How will we measure?
Reduce contaminant concentrations (mass removal)	Bioslurping	Decrease in hydrocarbon contaminant loading
Minimize capital cost	Lease equipment for water treatment and off gas treatment	Cost of leasing compared to cost of purchasing
Close out site	Monitor for Natural Attenuation**	Reduction in contaminant concentration to requirements

**Follow Alternative Restoration Technology Team's (ARTT) Technical Guidelines for Evaluating Monitoring Natural Attenuation of Petroleum Hydrocarbons and Chlorinated Solvents in Groundwater at Naval and Marine Corps Facilities, September 1998.

Looking For A New, Innovative Technology To Try?

The Broad Agency Announcement (BAA) Program has Hundreds to Choose From!

Are you looking for an innovative technology to use for site cleanup? Something that will speed up the cleanup or reduce the cost? Maybe even do a better job? The NFESC Broad Agency Announcement program has over 300 innovative technologies from over 200 contractors available under this contracting option. The BAA program is easy to use (ESC does most of the work for you). The BAA program gives you access to innovative technologies and vendors of your choice that are not available under the Remedial Action Contracts. And you don't have to go through a sole source or competitive contracting process to access them.

Now going into its third year, the Naval Facilities Engineering Service Center's (NFESC's) Broad Agency Announcement program continues to be a flexible and effective contracting vehicle for military activities and Remedial Project Managers (RPMs). Operated through NFESC's Environmental Department, the BAA program targets and identifies a wide range of innovative environmental technologies and methodologies that are in the advanced development stage. These new technologies and methodologies are available for field application and have the potential to be on-line in less than two months.

Using a uniquely effective contracting approach, the BAA program has a continuous solicitation for abstracts published in the Commerce Business Daily. Rolling cutoff dates occur every six months, in June and December. Abstracts submitted by contractors and vendors are required to address environmental problems in pollution prevention, compliance, natural resources conservation, or cleanup. NFESC's Technical Evaluation Board of scientists and engineers thoroughly evaluate each abstract according to the criteria established in the BAA. The technologies and methodologies believed to have potential benefit to the Navy are then made available to any DoD activity. Since each technology and vendor is pre-screened, a scope of work, an independent government estimate, and sole source/competitive solicitation are not required. Contracts can be quickly awarded and fieldwork can begin soon after. Currently, there are over 300 cutting-edge technologies and methodologies and over 200 vendors directly accessible on-line to RPMs.

*For more information (DoD only), call:
(805) 982-4826*

(805) 982-1488

(805) 982-6258

*Web: www.nfesc.navy.mil/enviro/esc414/baa/
DENIX: www.denix.osd.mil/*

*For contractors interested in the BAA program, call:
BAA Hotline at (805) 982-1592
Email: gbaa@nfesc.navy.mil*

So, how do you go about selecting a technology to use on your site?



1 Call NFESC to start process

Contract NFESC employees to help you get the process started. Points of contact are listed at the end of the previous column.

2 Select a technology or methodology

Just go to the Defense Environmental Network and Information Exchange (DENIX) website at www.denix.osd.mil/. DENIX is a controlled-access website. You need a password. DoD personnel can obtain a password by following the instructions under the "Registration" link found on the DENIX homepage. The website contains 4-page abstracts for each available technology and methodology. The website is searchable by keywords such as contaminant, media, site type, technology type, vendor, and other keywords. If you do not have internet access, the abstracts are available in a book. Books are sent to the EFD/As. If you want a copy, contact the NFESC people listed at the end of the previous column. Or, ask one of them to do the DENIX search for you.

3 Work with NFESC to identify your project requirements

NFESC can help narrow the field of choices or help you select the best technology options for your site. You do not need to do a scope of work or an independent government estimate. The contract can be awarded without sole source or competitive solicitation.

4 Provide funding for the project to NAVFACCO

Send funding for the project to NAVFACCO in Port Hueneme. Use a NAVCOMP Form 2276. NFESC employees can help with the funding process.

5 Participate in negotiations with NFESC and NAVFACCO

This can be done by conference call.

6 Execute the project!

Calendar Of Events

DATE	COURSE NAME	LOCATION	PHONE	EMAIL
Mar 29-Apr 1	25th Environmental Symposium & Exhibition	Denver, CO		
Apr 19-22	In Situ an On-Site Bioremediation	San Diego, CA	(800) 783-6338	conferencegroup@compuserve.com
Apr 19-23	1999 N&MC Site Cleanup Conference	Port Hueneme, CA	(805) 982-4852	
Jun 29-Jul 1	Annual N&MC Clean Air Act Conference	New Orleans, LA		
Jul 27-29	Annual Navy Pollution Prevention Conference	Pentagon City Arlington, VA	(805) 982-4899	

DEPARTMENT OF THE NAVY

Commanding Officer
 NFESC Code 413/ [REDACTED]
 1100 23rd Avenue
 Port Hueneme, CA 93043-4370



Summary of Performance Characteristics of Pipeline Leak Location and Detection (LDL) Technologies

None of these techniques are appropriate for all pipeline installations. They are influenced to varying degrees by external conditions such as soil type, water table, pipeline condition, and facility operations. They produce varying detection and location results as determined by temporal monitoring (continuous or snap shot), resolution of the location of the leak (several feet to a few inches), and the size of the leak that can be detected. The various methods also present different installation costs associated with retrofitting them into pipeline systems. These attributes are summarized in the Table below.

(805) 982-1672; DSN 551-1672;

Table. Performance Characteristics of Pipeline Leak and Detection Technologies

Leak LDL Technologies

Parameter	Temperature Compensated Pressure Test	Tracers	Pigging	Sensitive Cable	Fiber Optic Cable	Acoustic Emission	Pressure Point Analysis
Soil Conditions	No Effect on LDL Performance	Works Best in Highly Permeable Soils	No Effect on LDL Performance	No Effect on LDL Performance	No Effect on LDL Performance	Sensitive to Soil Acoustic Propagation Properties	No Effect on LDL Performance
Water Table	No Effect on LDL Performance	Not Effective in High Water Tables or Wet Soils	No Effect on LDL Performance	Sensitive to Water Intrusion to Cable	Sensitive to Water Intrusion to Cable	Sensitive Soil Moisture Content	No Effect on LDL Performance
Condition of Pipeline	Poor Valves Prevent Accurate Testing	No Effect on LDL Performance	No Effect on LDL Performance	No Effect on LDL Performance	No Effect on LDL Performance	No Effect on LDL Performance	No Effect on LDL Performance
Operations	Sensitive to Fueling Operations at the Facility	Inoculates May Influence Vehicle Performance	No Effect on LDL Performance	No Effect on LDL Performance	No Effect on LDL Performance	Sensitive to Noise Generated by Facility Operations	Sensitive to Vibrations and Fuel Operations at the Facility
Time Monitoring	Snap Shot	Snap Shot	Snap Shot	Continuous	Continuous	Snap Shot	Continuous
Spatial Resolution	Poor	Dependent on Monitoring Well Spacing	High	High	High	High	High
Leak Rate Resolution	High	Poor	Poor	Poor	Poor	Poor	High
Retrofit	Easy	Moderate	Easy	Difficult	Difficult	Easy	Easy

Insert (1)

Temperature Volumetric Pressure Test

The temperature compensated pressure test permits the accurate measurement of fluid volume over time and discriminates between the fluid volume changes due to temperature and volume changes due to a leak. Movement of fluid in the pipeline must be stopped during a test but testing can be completed in a matter of hours. This test permits accurate measurement of leak flow rates but does not provide leak location data.

Marker Gas Inoculation

Marker gas inoculation places a unique chemical compound inside the fueling system to be tested. If the marker gas is detected outside the fueling system, there is a leak. This leak detection technique can be used to detect leaks in any geometry system including underground pipelines. This technique is widely used and has been approved for leak detection in all 50 states. The test procedure involves inoculating the pipeline contents with a chemically stable and volatile marker chemical such as one of the freons. The marker chemical is permitted to mix with the pipeline contents and distribute throughout the pipeline. If a leak is present, the marker gas will migrate through the soils external to the leak site. Several days to a few weeks may be needed to insure that the marker gas migrates through tight soils with high clay content. Soil samples are taken along the length of the pipeline, typically at 20-foot intervals. If the marker gas is detected in some of the samples, it shows that a leak is in the vicinity of the site where the samples were taken containing the marker gas. This technique is effected by soil type and ground water levels. High water tables may negate the use of this technique.

Pigging

A pig is an instrumented plug that is drawn through an evacuated pipeline. The pig generates a magnetic flux that interacts with the pipeline. Instruments in the pig monitor and record the magnetic field as it passes through the pipeline. Anomalies in the pipe wall interrupt the magnetic field and these changes in magnetic flux are monitored and recorded in the pig as a function of distance along the pipeline. The site of an anomaly may or may not be a leak site. Pigs detect magnetic anomalies caused by corrosion, mechanical damage, mill defects, wrinkle bends, changes in composition and hydrogen blisters. These anomaly sites may or may not be a leak site.

Product Sensitive Cable

Product sensitive cables are fabricated from materials that have varying response to different chemicals in terms of their physical-chemical response to the presence of different substances. Cables have been developed to detect fuels, solvents and aqueous solutions. Cables are composed of single wire conductor, a continuity monitoring wire conductor and semi-conductive sensors enclosed in polymer braid. When exposed to hydrocarbon liquids, the sensors swell and make contact with the conductive cable. This electrical short is detected by monitoring devices that locate the station of the violated cable. This may or may not be the leak site. When a cable is contaminated with fuel, that length of cable must be replaced because it will continue to alarm. Also, water can often cause false alarms in product sensitive cable systems.

Fiber Optic Cable

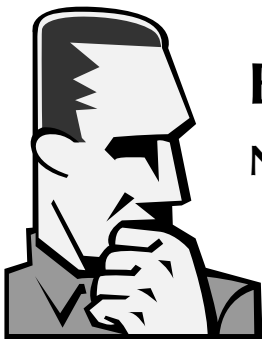
Fiber optic cables consist of a fiber core with optic coatings, cladding contained within a protective jacket. Sections of the cable have reactive coatings that chemically or physically react with a given contaminant such as fuel. The presence of the contaminant changes the coating's refractive properties and this moderates the light passing through the fiber core. The resulting change in intensity of the light signal propagating through the fiber provides a means of detecting the location of the contaminated fiber. Fiber optic systems on the market today can be very expensive to implement and the sensing coatings can become unstable over time negating their usefulness. These systems rely on sophisticated electronic signal processing techniques (optical time domain reflectometry) and sensitivity is proportional to cost. Costs must be considered with the potential cost of cleanup of a hydrocarbon leak.

Acoustic Emission

A passive acoustic leak detection and location system is made up of acoustic sensors, a signal conditioning and data acquisition system, and a user interface. The sensors are attached to the outer wall of the pipelines usually with epoxy. Acoustic signals are picked up by the sensors, passed through the data processing system and are analyzed by the leak location software. The data is analyzed in real time. If a leak is present in an instrumented section of pipeline, the location of the leak can be determined in 30 seconds to 2 minutes. The passive acoustics leak detection technique is attractive because it can be easily and inexpensively retrofitted to existing underground lines. The technique may be used during normal operations and it is not necessary to shut down the pipeline during tests. It has been shown to be effective in detecting and locating leaks in fuel and hot water/steam lines. Within the last five years, passive acoustics has shown significant improvements in leak location resolution due to improvements in sensor design, refined signal analysis and improved software. Also, the cost to implement the technique has dropped because the required number of sensors to perform passive acoustic detection activities has been reduced. Sensors may be placed at intervals of a few hundred feet and still achieve leak location resolutions of a few feet.

Pressure Point Analysis

Pressure point analysis involves measuring the pressure and mass flow variations associated with a leak. It has been used to detect leaks in pipelines with diameters ranging from 3 to 42 inches. This technique is sensitive to the size of the pipeline because it is more difficult to locate leaks in the larger lines. The technique monitors flow internal to the pipeline and is not effected by conditions outside the pipeline such as groundwater levels, soil type, and environmental noise or contamination. However, pipelines near the ocean may be influenced by tidal variations that may impact internal pressures in the pipeline. Such tidal influences can be incorporated into the data analysis to neutralize the effect on internal line pressure. This technique is sensitive to hydraulic noise generated by pumps and the noise generated by the flow. The size of the leak that can be detected is influenced by these factors.



Environmental Cleanup Issue Got you Stumped?

Need a little advice? Where in the world can you go for help?

There are a number of support offices within the Department of the Navy that are available to help you with those tough environmental cleanup issues.

The Naval Environmental Specialty Offices are organized under the umbrella of the Naval Environmental Protection Support Service (NEPSS). There are four NEPSS specialty offices:

AESO Aircraft Environmental Support Office
MESO Marine Environmental Support Office
OESO Ordnance Environmental Support Office
SESO Ships Environmental Support Office

These offices can provide support in pollution control, prevention and cleanup for their particular area of expertise. More details are provided in the following paragraphs. Several other Department of the Navy organizations, not under NEPSS, are also sources of assistance such as:

RASO Radiological Affairs Support Office
NEHC Naval Environmental Health Center
NFESC Naval Facilities Engineering Service Center

On a related topic – SAFETY. For those tough safety problems where your local

safety office or contractor's safety people are stumped or in disagreement, try calling the Naval Safety Center for advice or clarification:

*Naval Safety Center, Shore Safety Program
 Phn: (757) 444-3520, ext. 7167*

*For Navy activities - email:
 shore@safecen.navy.mil*

*For Marine Corps activities - email:
 usmcgrd@safecen.navy.mil*

Web: www.norfolk.navy.millsafecen

Here's the scoop on these places!

AESO

The Aircraft Environmental Support Office, AESO, provides Navy-wide support for environmental protection involving air emissions and noise levels from aviation operations and related maintenance functions. Their capabilities include:

- measuring, managing, and issuing air emissions and noise level data from naval aviation operations and related maintenance functions
- developing computer models for air dispersion and risk assessment
- performing air and noise emission inventories at installations
- participating in determining emissions from jet engine test cells and ways to control the emissions
- providing leadership and coordination on environmental compliance solutions for aviation air and noise problems
- analyzing air regulations for impacts on aviation operations, and providing consultation assistance with air regulatory agencies

In support of environmental cleanup programs, AESO can:

- provide advice on JP5 fuel cleanups
- provide advice on how to measure air emissions

Currently, AESO is conducting an ambient air monitoring program in support of the cleanup of napalm canisters at Fallbrook Naval Ordnance Center, Pacific Division Detachment, Fallbrook, California

AESO Point of Contact

Naval Aviation Depot, Code 09212, Bldg 810

Naval Air Station North Island

P.O. Box 357058

San Diego, CA 92135-7058

Phn: (619) 545-2914/2915, DSN 735-2914/2915

Fax: (619) 545-2910, DSN 735-2910

Web: <http://midway.nfesc.navy.mil/envirol/nepss/aeso.htm>

MESO

The Marine Environmental Support Office, MESO, provides technical and scientific support on marine environmental science, protection and compliance issues. Their capabilities include:

- developing marine analytical methods
- assessing marine ecological risk

- hydrodynamic mapping of water quality parameters and pollutants
- technology transfer

In support of environmental cleanup programs, MESO can:

- review and consult on marine studies documents
- perform laboratory and field studies and comprehensive environmental assessments of marine environments
- conduct toxicity evaluations of military-specific chemicals using a prototype multi-test bioassay facility

MESO has conducted an evaluation of sediment contamination at Puget Sound Naval Shipyard using benthic contamination flux sampler; conducted a marine ecological Risk Assessments at several naval installations; and has provided a quick-response, real-time monitoring of a warship oil spill; San Diego, California, sewage spill, and water quality in San Francisco Bay (California).

MESO publishes a newsletter, the Marine Environmental Update, which is available on-line at <http://environ.spawar.navy.mil/Programs/MESO/Newsltr/>

MESO Point of Contact

Marine Environmental Support Office

SPAWARSYSCEN D3621

53475 Strothe Road

San Diego, CA 92152-6326

Phn: (619) 553-2906/5330/5331, DSN 553-2906/5330/5331

Fax: (619) 553-6305

Web: <http://environ.spawar.navy.mil/Programs/MESO/aboutmeso.html>

OESO

The Ordnance Environmental Support Office, OESO, provides technical support for environmental issues involving ordnance, munitions, and chemical agents. Their capabilities include:

- providing information and guidance on regulatory issues, and impact of new requirements;
- support for producing, handling, recovering, maintaining and destroying ordnance; and
- assisting with environmental permits, air pollution, waste disposal, site restoration, and hazardous materials/waste minimization for ordnance related operations

In support of environmental cleanup programs, OESO can:

- conduct ordnance-related environmental studies
- provide emissions data on the open detonation and open

- burning of Pyrotechnics, Explosives, and Propellants (PEP)
- characterize hazardous waste constituents of military unique equipment and supplies
- assist with identifying potential cleanup technologies

OESO Point of Contact

Naval Surface Warfare Center, Indian Head

Code N5

101 Stauss Avenue

Indian Head, MD 20640-5035

Phn: (301) 743-4534/4906, DSN 354-4534/4906

Fax: (301)744-6749

Web: <http://midway.nfesc.navy.mil/enviro/nepss/oeso.htm>

SESO

The Ships Environmental Support Office, SESO, provides technical services for implementing and executing environmental protection regulations and programs applicable to ships. This support includes:

- collecting, developing, and disseminating of information on shipboard/ship-in-port emissions
- maintaining inventory of shipboard oil pollution control equipment
- maintaining inventory of waste generation and pollution control and pollutant effects, and Inventory of shipboard hazardous materials
- assisting with permit applications and regulatory negotiations
- providing Spill Contingency Plans and Monitoring Plans
- conducting homeporting studies, Environmental Impact Statements and Environmental Assessments
- performing research and data collection studies of ship-related contaminants

SESO does not get as involved with cleanup programs as much as the other NEPSS offices do. SESO might be able to help with information on what is used on ships, and how it is disposed of under current regulations. For example, they have a list of PCB-containing components currently used on ships.

SESO Point of Contact

Naval Surface Warfare Center, Carderock Division

Code 632, Bldg 60

9500 MacArthur Blvd

West Bethesda, MD 20817-5000

Phn: (301) 227-5245, DSN 287-5245

Fax: (301) 227-5359, DSN 287-5359

Web: www.dt.navy.mil/code60/code63/code632/SESO/index.htm

RASO

The Naval Sea Systems Command Detachment, Radiological Affairs Support Office, RASO, is the technical support center for the Radiological Affairs Support Program (NAVSEA 04N). RASO is responsible for:

- handling all radiological matters within the IR and BRAC environmental cleanup programs, excluding Naval Nuclear Propulsion Program (NNPP) matters
- issuing instructions and guidance for all non-NNPP low-level radioactive waste (LLRW) disposal actions

In support of the environmental cleanup programs, RASO can:

- provide recommendations and consultation on management and control of environmental radiological contamination
- conduct on-site evaluations, sampling and analysis and remedial actions
- review and evaluate environmental radiological assessments, surveys and remedial action plans for completeness, technical accuracy, safety, and compliance with Federal and state regulations
- provide technical evaluation and support for the radiological release and decommissioning of facilities
- provide presentations and expert consultation at regulatory, government and citizen meetings and Restoration Advisory Boards (RABs)
- coordinate the disposal of all non-NNPP LLRW generated at IR, RCRA-CA and BRAC sites

RASO Points of Contact

NAVSEADET RASO, Code 23

Naval Weapons Station,

Yorktown, VA 23691-5098

Phn: (757) 887-4692, DSN 953-4692

Fax: (757) 887-3235

Web: www.raso.navy.mil

Naval Message: NAVSEA DET RASO YORKTOWN VA//00//

RASO has assigned Environmental Protection Managers (EPMs) for each EFD/A.

EFD / EFA

Atlantic Division, Norfolk, VA

North Division, Lester, PA

EFA West, San Bruno, CA

Southwest Division, San Diego, CA

EFA Chesapeake, Washington, DC

EFA Midwest, Great Lakes, IL

EFA Northwest, Poulsbo, WA

Pacific Division, Pearl Harbor, HI

Southern Division, Charleston, SC

EFA Mediterranean, Naples, Italy

If your EPM is unavailable, you should contact [REDACTED]. RASO's POC for LLRW matters is [REDACTED]. Both these individuals can be reached at the numbers listed above.

All project managers with environmental cleanup projects in the IR, RCRA Corrective Action and BRAC programs must notify RASO immediately of any site they suspect of having radiological contamination. RASO is responsible for tracking all LLRW sites within the Department of the Navy, including those listed in the NORM database.

NEHC

The Navy Environmental Health Center, NEHC, is responsible for providing medical consultation in all health-related action for all environmental cleanup within the IR and BRAC programs. NEHC was established in May of 1991 as a result of a Memorandum of Understanding between NAVFAC and the Bureau of Medicine and Surgery (BUMED). In June 1995, the BUMED Claimancy Compliance Program was transferred to NEHC.

NEHC can provide the following support for environmental cleanups:

- provide health/medical evaluation of risk assessment and other documents (work plans, sampling and analysis plans, quality assurance plans, draft and final risk assessment reports)
- provide assistance in developing Applicable, Relevant and Appropriate Requirements (ARARs) for sites where human health risks are an issue
- revise the current exposure level criteria used for remedial action, if warranted by acceptable scientific evidence
- conduct quick-response risk assessments (risk screening, data evaluation, exposure and toxicity assessments, medical effects data, and health risk evaluations)
- support and coordinate during Agency for Toxic Substances and Disease Registry's (ATSDR's) legally mandated health related activities, including Public Health Assessments (PHA), public health consultations, health surveys and investigations, toxicology profiles and data bases, emergency response and health education process on Navy NPL installations
- provide risk communication and other health-related training
- provide technical assistance on public health and safety issues, health and safety training, risk communication to the public, Community Relations Plans, and during public meetings

NEHC Points of Contact

Director

Naval Environmental Health Center

2510 Walmer Avenue

Norfolk, VA 23513-2617

Phn: (757) 363-5548, DSN 864-5548

Fax: (757) 444-7261

Web: www.nehc.med.navy.mil

NFESC

The Naval Facilities Engineering Service Center, NFESC (ESC), Environmental Department, provides cost effective, responsive solutions to Navy and Marine Corps environmental cleanup, compliance, pollution prevention and conservation requirements. ESC can assist in using innovative technologies, information management and data access, equipment procurement and unique environmental technology applications. The ESC specializes in providing capabilities to the NAVFAC Engineering Field Divisions and Activities and Navy Public Works Centers and Departments.

In support of environmental cleanups, the ESC can:

- provide information on innovative cleanup technologies and help with the technology transfer from research/bench scale tests to full scale pilot studies. Technical Application Teams (TATs) have been formed to provide assistance. New TATs are added as needed. Currently ESC has the following TATs:

- Air Sparging
- Alternative Landfill Capping
- Biocells
- Biopiles
- Constructed Wetlands
- DNAPL Characterization and Remediation
- Ecological Risk Assessment (ERTAT)
- General Broad Agency Announcement (BAA)
- In-Situ Bioslurping and Bioventing
- Low Temperature Thermal Treatment
- Monitored Natural Attenuation
- National Test Site
- PCB Cleanup
- Remedial Action Operations & Long Term Monitoring
- Small Arms Ranges
- Solvated Electron Destruction

- provide contract support for access to innovative technologies
- provide laboratory quality assurance oversight

NFESC Points of Contact

(805) 982-1661, DSN 551-1661

(805) 982-4842, DSN 551-4842

(805) 982-1600, DSN 551-1600

NFESC Code 41

1100 23rd Avenue

Port Hueneme, CA 93043-4370

Phn: (805) 982-1146, DSN 551-1146

Fax: (805)982-4304

Web: <http://nfesc.navy.mil>

The ESC has established a Technical Service Representative(s) for each field activity.

All phone numbers are prefixed by (805) 982-XXXX , DSN 551-XXXX

EFD/A	TSR phn	Alternate TSR
Northern Division	x1556	x1741
Chesapeake Activity	x4798	x 4847
Atlantic Division	x1653	x1668
Southern Division	x4890	x5270
Northwest Activity	x165	x 6586
West Activity	x 2636	x 5560
Southwest Division	x 1753	x 5844
Pacific Division	x 1556	x 2194



TechData Sheet

Naval Facilities Engineering Service Center
Port Hueneme, California 93043-4370

TDS-2059-ENV

August 1998

Alternative Landfill Capping

Problem

The Navy and Marine Corps have over 450 landfills that require remediation. Over 200 of these landfills do not have a final remedy. Surface covers or caps are one of the most cost-effective methods to manage the human and ecological risks associated with these landfills. They will most likely be the chosen method of remediation, either alone or in combination with other technologies. The most common landfill covers currently being used are the Environmental Protection Agency (EPA) Resource Conservation and Recovery Act (RCRA) C or D caps. These multi-layered cap systems are usually very expensive when compared to alternative solutions.

As an alternative to the expensive RCRA caps, a variety of less costly caps have been developed. However, regulatory agencies are often reluctant to approve alternative landfill designs based on a lack of evidence that the technology will effectively limit the infiltration of water into the waste.

Solution

Research has led to a variety of alternative landfill caps which are being field tested to gain regulatory approval. There are many designs and components for these caps, including capillary breaks, geosynthetic clay liners (GCL), geo membranes, vegetative caps, enhanced runoff, soil or evapotranspiration (ET) caps, or combinations of these.

The Naval Facilities Engineering Service Center (NFESC) has been comparing the performance and costs of practical soil-based covers to the RCRA design. These soil-based covers enhance surface runoff and store precipitation in the soil until it is removed by evapotranspiration.

The risk manager now has cost-effective design alternatives to match the need for hydrologic control at a site.

Demonstration

To demonstrate the effectiveness of alternative caps, NFESC teamed with Los Alamos National Laboratory and Colorado State University to investigate the performance of a variety of vegetative caps. Demonstration caps were installed at Marine Corps Base Hawaii (MCBH) Kaneohe Bay in 1994 (Figure 1). The study used an innovative but simple concept to manipulate the fate of rain water falling on waste sites with moderate to high precipitation. The infiltration of water through the soil cap was controlled by combining the powerful forces of ET with engineered structures that limited infiltration of precipitation into the soil. This approach relied on diverting a sufficient amount of precipitation to controlled runoff so that any water that infiltrated into the soil was easily removed by ET. The study demonstrated three infiltration designs; one having a 20 percent enhancement of runoff, the other a 40 percent enhancement, and a conventional ET cap (control) to serve as a basis of comparison.



Figure 1. Landfill study at MCBH Kaneohe Bay, Hawaii.

The performance of the three designs was evaluated by comparing the field monitoring data with the predicted performance of the RCRA design using the EPA HELP model. After 16 months of performance monitoring, the data have supported the concept of infiltration control by increasing runoff and reducing percolation. The relative amount of percolation, as a percentage of the precipitation, averaged 2 percent and 5 percent for the enhanced runoff and control plots, respectively.

Technical Description

Vegetative caps or ET caps, combined with runoff control, govern the fate of precipitation falling on the surface of a landfill, which can be measured by determining the water balance of the site with the following equation (see Figure 2):

$$\Delta S/\Delta t = (P - Q - ET - L) / \Delta t$$

- $\Delta S/\Delta t$ = Time rate of change in soil moisture
- P = Precipitation per unit area
- Q = Runoff per unit area
- ET = Evapotranspiration per unit area
- L = Percolation below root zone per unit area
- t = Unit of time used in solving the equation

Application of the concept of water balance in designing landfill caps takes advantage of the fact that there are strong interactions between the various components of the equation. For example, a reduction or elimination of the runoff term, Q, increases infiltration of water into the soil, resulting in increased soil moisture storage followed by an increase in evapotranspiration, ET, and/or percolation, L. The coupled nature of the processes comprising the water balance can be used to design landfill caps that minimize or eliminate leachate (percolation) by enhancing evapotranspiration and runoff.

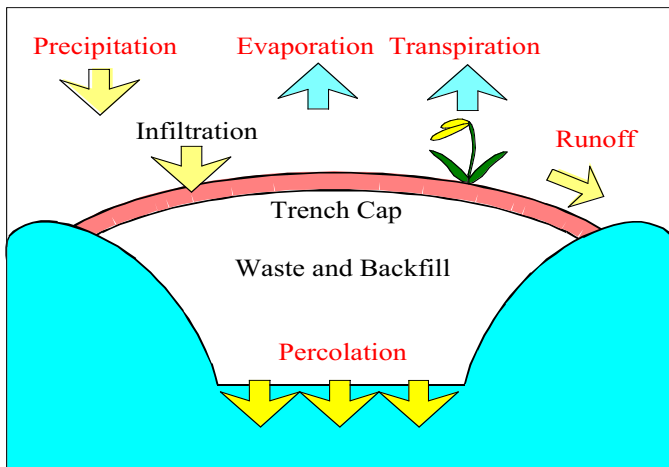


Figure 2. Water balance diagram.

Benefits

Vegetative caps can provide the following anticipated benefits:

- Significantly lowers capital costs:

RCRA C Cap	\$0.5 - 1M/Acre
RCRA D Cap	\$0.2 - 0.5M/Acre
Vegetative Cap	\$0.05 - 0.1M/Acre
- Lower operation and maintenance costs compared to the conventional RCRA cap.
- Maintains integrity if land settlement occurs.
- Does not use clay layers which can provide a short circuit for percolation by drying, freezing, and cracking.

Will This Work at My Site?

The study at MCBH Kaneohe Bay supports the concept of using a vegetative cap with enhanced runoff in humid regions, where rainfall exceeds approximately 25 inches per year. There has also been much research in using alternative caps in semi-arid regions, where rainfall is approximately 10 to 25 inches per year. Therefore, alternative landfill caps can be designed for use in a wide range of climates. With the studies demonstrated at MCBH Kaneohe Bay and at various other Department of Defense (DoD) sites, evidence is now available to show regulators the effectiveness of these alternative landfill caps.

The EPA allows an alternative landfill cap to be used for a RCRA D cap under 40 CFR 258.40. The EPA also allows an alternative cap to be used for a RCRA C cap, if the design is approved by the regional administrator under 40 CFR 264.301.

For more information about **alternative landfill capping technology**, contact:

Restoration Development Branch, ESC 411
(805) 982-4991, DSN: 551-4991

- or -

Technical Application Branch, ESC 414
(805) 982-1600, DSN: 551-1600