

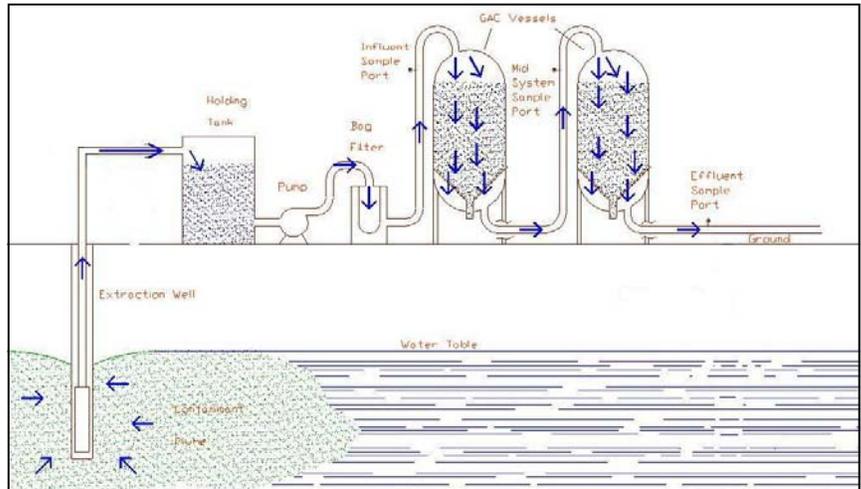


## Zone B Groundwater Treatment System

The construction of the Zone B groundwater treatment system was completed over the summer of 2003. The treatment system was installed as part of the final remedy for Zone B, Operable Unit 8, Landfill 5 in accordance with the Final Record of Decision for Zone B: Operable Unit 8, Landfill 5. Specifically the treatment system was installed to treat trichloroethylene (TCE) contaminated groundwater resulting from past operations of Landfill 5b. The objective of the treatment system is to restore the contaminated groundwater originating from the former Landfill 5b to drinking water standards within a reasonable timeframe.

The selected remedy for the Zone B groundwater includes a groundwater extraction and treatment system to

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The schematic above shows the groundwater extraction and treatment system being used at Zone B

## Zone C Direction

Treatment of the trichloroethene (TCE) groundwater plume at Zone C has changed direction. The original treatment choice of full-plume extraction and treatment has been reevaluated. Due to variations in pumping rates and hydrogeologic characteristics, it has been determined that extracting and treating the entire TCE plume is not feasible.

The results of a Supplemental Feasibility Study were studied and it was concluded that the new remedy will be in-situ (i.e. in place) potassium permanganate injection combined with monitored natural attenuation (MNA).

In-situ treatment with MNA would consist of introducing a chemical oxidant (potassium permanganate [KMnO4]) into the contaminated groundwater to destroy the contaminants or convert them to innocuous compounds commonly found in natural settings. A treatability study was conducted at Zone D and the results are encouraging. In-situ chemical oxidation appears to be a feasible technology to treat the TCE-contaminated groundwater in Zone C.

In-situ treatment with MNA was not originally selected as the course of

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## Zone C Direction

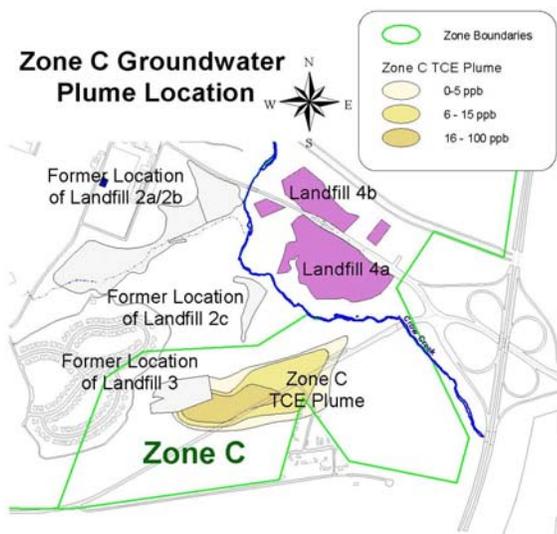
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action for the plume at Zone C. During the original Feasibility Study (FS) and Record of Decision (ROD) in 2001 and 2002, various alternatives for treatment of the plume were evaluated. Full-plume extraction and treatment seemed to be the best option, and pre-design of the system started in March 2001.

During the pre-design investigation, two test wells were installed and pumping tests were conducted. Significant variations in pumping rates and hydrogeologic characteristics were observed, and it was recommended that additional data be collected before proceeding with design of the entire system.

During a Supplemental Investigation in May 2002, 11 test wells were installed and 13 pumping tests were conducted. The data collected confirmed that there were significant variations in pumping rates and hydrogeologic characteristics throughout the Zone C plume. Given the new data, a full-plume extraction and treatment system was modeled, and it was determined that this type of treatment was not feasible. The hydrogeology in the deeper zones is such that groundwater is not easily extractable.

A Draft Supplemental Feasibility Study for the plume at Zone C was completed in early 2003 and was reviewed by WDEQ and the EPA.



There were four alternatives considered, including:

1. Monitored Natural Attenuation (MNA) only
2. In-situ potassium permanganate (KMnO<sub>4</sub>) injection combined with MNA
3. Full Plume Groundwater extraction and treatment
4. Groundwater extraction and treatment combined with MNA

As stated previously, the full-plume groundwater extraction and treatment is not feasible for the plume at Zone C. The three feasible alternatives are summarized in Table 1.

After consideration of the various parameters, in-situ treatment combined with MNA was selected as the new remedy.

The revised Supplemental Feasibility Study was submitted to EPA and WDEQ in May 2003. Because the remedy to be implemented at this site is different than the remedy selected in the original ROD, a revised Proposed Plan and a ROD amendment is required to formally change the remedy. Once the ROD is finalized, plans will proceed to begin the injection, which is scheduled to occur in Summer 2004. ❖

**Table 1**

Alternative	Time to Reach Cleanup Goals (Years)	Estimated Cost* (\$)
MNA	50	2.4 million
In-situ treatment with MNA	30	2.6 million
Extraction and treatment with MNA	30	2.8 million

\*Cost shown is net present value

## Base Environmental Cleanup Team Spotlight: Alvin Young (RAB Community Co-Chair)

Alvin L. Young was born and raised in Laramie, Wyoming. He attended the University of Wyoming and earned a Bachelor of Science in Agricultural Sciences in 1964 and a Master of Science in Physiology/Biochemistry in August 1965. Al then attended Kansas State University, where he earned a Doctorate in Environmental Toxicology in 1968. Al then joined the U.S. Air Force.

### Al's Background

Al has worked environmental and public health issues during a career in public service that spans 34 years and five Federal Agencies of the United States Government.

From 1968 to 1971, Al was a Project Officer at Eglin AFB, Florida. He was an Associate Professor of Biological Sciences and Director of Research at the U.S. Air Force Academy from 1971 to 1977 and an Environmental Science Consultant and Special Assistant, Occupational and Environmental Health Laboratory, and School of Aerospace Medicine, respectively, at Brooks AFB, Texas from 1977 to 1981. Al retired from the U.S. Air Force as a Colonel in 1989.

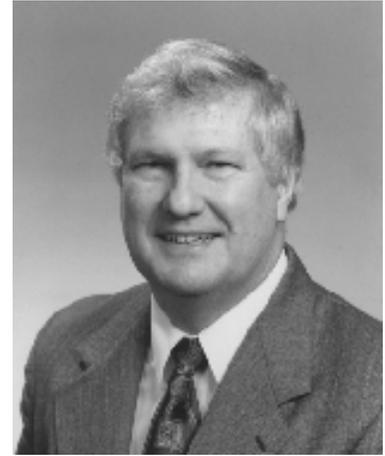
In 1980, Al was an Associate Professor at the Air Force Academy, teaching in the pre-medicine and environmental programs prior to completing an assignment in epidemiology and molecular biology at the Department of Defense's School of Aerospace Medicine. He spent the

next 18 years in Washington, DC where he served two years with the Department of Veterans Affairs, establishing their Environmental Medicine Program. From 1983 to 1987, Al was the Senior Policy Analyst for Life Sciences for the Office of Science and Technology Policy, Executive Office of the President. He was chairman of the White Committee on Interagency Radiation and Policy Coordination from 1984 to 1994. In 1987, as Science Advisor with the United States Department of Agriculture (USDA), Al established the Office of Agricultural Biotechnology. As Director, he provided oversight of USDA's biotechnology research programs for nine years.

From 1998 to 2002, Al was Director of the Center for Risk Excellence, U.S. Department of Energy (DOE). He had responsibility for providing risk and public health expertise to DOE's Office of Environmental Management for a \$6 billion annual program tasked with the cleanup of the nuclear wastes from the Cold War.



*Mr. Young's expertise helps to direct environmental restoration at F. E. Warren AFB*



*Alvin Young, RAB Community Co-Chair*

### Al Comes to F. E. Warren

Since January 2002, Al has been a Visiting Professor and Senior Fellow with the Institute for Science and Public Policy, Sarkeys Energy Center, at the University of Oklahoma. In alternate years, he teaches a graduate course in "Risk Assessment and Management" and guest lectures in biotechnology. He is also engaged in research into the role of science in establishing credible public policy on controversial environmental issues.

Al has authored four books and more than 200 articles on topics related to toxicology, environmental fate, human epidemiology, animal and plant biotechnology, genetically modified organisms, food irradiation, and public policy. He is an advocate and practitioner for communicating science and risk information to the public. ❖

## Long Term Monitoring Update

F. E. Warren AFB currently has five Long Term Monitoring (LTM) Sites. Zone A contains Landfill 6 and the Groundwater Monitored Natural Attenuation (MNA) area. Zone B contains the Waste Co-Location Area and the Northern Groundwater Plume, and Zone D contains Spill Site 7.

The objectives of the LTM Program are to evaluate effectiveness of remedial systems, provide recommendations for remedial system optimization, and provide a basis for five-year reviews. Following are the monitoring results and recommendations for four of the five LTM sites. An update on the Northern Groundwater Plume will be provided at a later time.

### Landfill 6

The LTM results at Landfill 6 show trichloroethene (TCE) concentrations greater than 5 micrograms per liter (ug/L) in monitoring well (MW)-OE1-001. There are no consistent detections of metals exceeding groundwater standards. Methane is not being produced at significant levels and methane is not migrating from the landfill. Vegetation has been adequately established on the landfill cover and no erosion has been observed.

It is recommended that monitoring wells be installed to investigate the elevated TCE concentrations at Landfill 6. The installation of dedicated sampling pumps at the



*Low flow sampling is performed as part of the long term monitoring effort*

site will optimize the sampling program. It is also recommended that the methane monitoring frequency be reduced.

### Groundwater Monitored Natural Attenuation Area

LTM results in the groundwater MNA area show that TCE concentrations are remaining generally constant, with levels in MW-334S ranging from 19 ug/L to 24 ug/L between June 2002 and May 2003. Low concentrations of *cis*-1,2-DCE (dichloroethene) confirm that some degree of biodegradation is occurring. The plume is not impacting Crow Creek and has not migrated north of Crow Creek.

It is recommended that quarterly groundwater and surface water monitoring be continued in the MNA area. It is also recommended that alternative approaches be

investigated to optimize remediation.

### Waste Co-Location Area

LTM Results in the Waste Co-Location Area show no consistent detections of volatile organic compounds (VOCs) and no consistent detections of metals exceeding groundwater standards. Methane is not being produced at significant levels and methane is not migrating from the landfill. The landfill cover has low vegetation density, but no erosion has been observed.

It is recommended that dedicated sampling pumps be installed in the Waste Co-Location Area to optimize the sampling program, and that the frequency of methane monitoring be reduced.

*(Continued on page 9)*

## Spill Site 7 Removal Action Update

A removal action is underway at Spill Site 7 (SS7) to remove surface soils containing elevated levels of metals and subsurface soils contaminated with trichloroethene (TCE) that is contributing to the groundwater contamination in the area.

Surface soils of the drainage ditch at SS7 were removed and stockpiled on-site. After removal, soil samples were collected from the stockpiled soils for characterization and disposal purposes. The results of the sampling indicated that the level of metals in the soils did not pose any threat to the environment, therefore the soils were used as fill material at SS7.

The initial scope of the subsurface soil removal action included excavating soils to the depth of the water table, approximately 20 feet below the ground surface and treatment of the removed soils in an

above-ground treatment cell. The soils were to be removed in three different phases with approximately 4,000 cubic yards removed and treated during each phase. As each removal phase is underway, the excavated soils are transported to the on-site treatment cell where the soils are treated with a vapor extraction system. During initial excavation work it was determined that the excavation could be extended to a depth below the water table. Therefore, the excavations were completed to a depth of approximately 23 to 24 feet below the ground surface. This resulted in an increased volume of soil to be excavated and treated, which in turn requires the removal phases to be increased from three to four. After excavation samples are collected from the sidewalls to confirm that the lateral limits of the soils contaminated with TCE above action levels have been reached.

The onsite treatment cell consists of an area 140 feet long by 80 feet wide that is contained within a five foot high soil berm and lined with a 60 millimeter plastic liner. Four-inch diameter, slotted polyvinyl chloride pipe is located in the base of the treatment cell. The excavated soils are on top of the slotted pipe in the treatment cell to a height of 8 to 10 feet; the slotted pipe is connected to a 60 horsepower vacuum pump to pull air through the soil in order to volatilize and remove the TCE contamination in the soil. The vapors that are removed from the soil in the treatment cell are passed through a 5,000-pound carbon unit to remove the TCE contamination from the air stream. The air stream that is removed from the soils in the treatment cell is tested on a periodic basis before it passes through the carbon unit. When the TCE level in the air stream is reduced to a predetermined level, soil samples are collected from the soils in the treatment cell to determine if TCE removal goals have been met. If the sampling results indicate that treatment goals have been met, the soil is removed from the treatment cell and placed back in the excavation from which it was removed. Then the next phase of soil excavation and treatment can begin.

To date, a total of 8,120 loose cubic yards of soil have been removed and undergone treatment in the above-ground treatment cell. The estimated total to be removed and treated at the site is approximately 15,000 loose cubic yards of soil. ❖



*Soil piles at SS7 are covered before treatment to protect them from wind and rain*

## Upcoming Projects

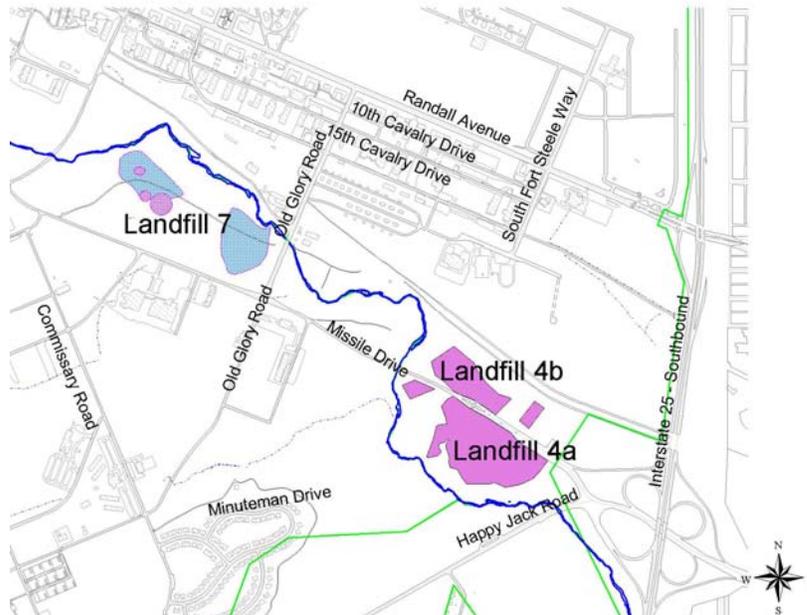
### Landfill 4 and Landfill 7 Update

#### Landfill 4

LF4 is located in the southeastern portion of F. E. Warren Air Force Base (FEW) near Gate 2. LF4 is bounded by railroad tracks to the north and Crow Creek to the south and covers an area of about 28 acres. Missile Drive divides LF4 into two areas with Landfill 4a (LF4a) on the south side of Missile Drive and LF4b on the north side. An area previously identified as LF4c was also investigated; however, no waste disposal activities were identified in the LF4c area.

LF4 is currently an open field and is not used for Base operations. The landfill was operated as a sanitary landfill from 1947 to 1959. During this time, household, light construction and industrial wastes from operations at the Base were burned, placed in the landfill, and covered with topsoil. Since that time, concrete rubble and other construction debris were deposited along the southern portion of the landfill. A soil cover was placed on the site from 1988 to 1990 and the site is currently covered with grass and other native vegetation.

A detailed soil and groundwater investigation was completed at LF4 and the results of the investigation indicated that the site poses no risk to the environment. Therefore the final remedy selected for the site is localized site improvements that will limit the potential for ponding of storm water; reduce the potential for erosion; limit the potential for contact with landfill materials and groundwater; and restore groundwater to beneficial use, which in this case is restoration of



*The site investigation and study phases have been completed for Landfill 4 (LF4) and LF7 and the final remedies have been selected. The Record of Decision for these landfills is expected to be signed by March of 2004.*

iron and manganese to background conditions.

The selected remedy for LF4 also includes removing approximately 14,000 cubic yards (CY) of unburned waste for proper disposal and consolidation and recycling of approximately 12,000 CY of surface debris. After the waste removal is completed approximately 6,000 CY of fill material will be brought in and the area will be regraded to reduce ponding, leveled to create positive drainage across the site, and revegetated.

#### Landfill 7/Fire Protection Training Area 1

LF7 and Fire Protection Training Area 1 (FPTA1) is located in the southeastern portion of FEW just north of Burger King, northwest of the intersection of Old Glory and Missile Drive and south of Crow

Creek. LF7 covers an area of approximately 13 acres and is currently an open field not used for Base operations. The landfill was operated as a sanitary landfill from the late 1930's to the early 1950's and is comprised of two disposal cells, LF7a and LF7b. Household, shop, and hospital waste was placed in the landfill, burned and covered with topsoil as part of landfill operations. FPTA1 was used for fire protection training after the landfill was closed.

A thorough investigation was completed at the LF7/FPTA1 site and the results of the investigation indicated that the site poses not risk to the environment. Therefore a limited action final remedy was selected. The limited action remedy will reduce potential leaching through the landfill materials by minimizing infiltration from storm water that

## Landfill 4 and Landfill 7 Update (Continued from previous page)

may pond on the landfill surface; improve the long-term stability of the landfill by controlling surface water runoff and erosion; minimize contact with landfill materials and groundwater; and restore groundwater to beneficial use, which in this case is restoration of iron and manganese to background conditions.

The selected remedy for the LF7/FPTA1 area includes adding 1-foot of additional cover soil where there is less than 1-foot of existing cover. This will require the addition of approximately 38,000 CY of fill material at the site. The site will be regraded to develop positive drainage over the area and the site will be revegetated. Currently a portion of the LF7 waste is exposed along a small section of Crow Creek. This section of Crow Creek bank will be stabilized to prevent any further erosion of the Crow Creek bank material and exposure of additional waste material.

After the construction is completed, a groundwater monitoring program will be instituted. Additionally, institutional controls which limit access and future development of the area will be enforced.

A public comment period was held from September 9 through October 9, 2003. In addition, a public meeting was held on September 23, 2003 to present the Proposed Plan. No comments were received from the public during that time. The Final Record of Decision is expected to be signed in early 2004. ❖

## Range Reconnaissance Kickoff

Since the late 1800's, portions of FEW have been used for munitions and weapons training activities. Various ranges were used, including small arms ranges, anti-tank and grenade launching range, pistol ranges, grenade training areas, and a transitional (multi-use) firing range. These firing range activities occurred primarily on the north side of the installation. These former ranges are all classified as "closed". Historic records show areas defined as former ranges, however, aerial photos and unexpected unexploded ordnance (UXO) discoveries suggest that areas outside the defined boundaries of ranges were also used for training exercises and firing practice. Therefore, the entire northern portion of the base, approximately 3,000 acres, must be explored to determine if UXO are present.

A Firing Range Remedial Investigation (RI) began in September 2003. The RI is required to define UXO and explosive residue at the range. The project

began with a Range Reconnaissance field effort. The purpose of the reconnaissance effort is to determine the areas requiring detailed investigation.

One part of the RI is the Firing Range Work Plan (WP), which must be approved by EPA and WDEQ before any investigatory fieldwork can begin. Additionally, the Defense Safety Submission Board (DSSB) must approve a portion of the WP dealing with explosive disposition and safety. Results of the range recon will be used in developing the RI WP. The WP will guide the investigation field work. Results of the field work will determine whether further clean up activities are required at the site.

There are two active ranges remaining on the installation: the newly constructed small arms baffled range, and the explosive ordnance disposal (EOD) range. These active ranges will not be addressed within the upcoming RI.

❖



*A 45-caliber projectile removed from the Small Arms Range, shown against a pen for scale*

## Base Environmental Cleanup Team

**G**len D. Verplancke, a Project Manger/Environmental Engineer at F. E. Warren AFB, was born and raised in Saratoga, WY. His family has lived in Wyoming for four generations. Glen attended the University of Wyoming, and graduated in 1996 with a BS degree in Civil Engineering with an Environmental Emphasis.

### Glen's Early Career

Glen enlisted in the U.S. Air Force in 1987. He was stationed at Aviano AB, Italy for 3 years and stationed at Luke AFB, Arizona for 2 years. Glen served as an Aircraft Electro/ Environmental Specialist, and worked on F-16A&B and F-15C&D Aircraft. He left the Air Force in 1992 and began attending the University of Wyoming.

After college, Glen worked as a Well Site Engineer in Casper, WY. He performed hydraulic fracturing and cementing services on oil and gas wells, covering a region from Southern Colorado to Northern North Dakota.

Glen then worked as a Civil/Environmental Engineer in Laramie, Wyoming. He provided



*Glen Verplancke, P.E.  
Project Manger/Environmental  
Engineer*

environmental services for oil refineries, hydrocarbon recycling operations, coal gasification sites, and landfills.

### Glen Comes to F. E. Warren

In 2002, Glen came to F.E. Warren as the Base Water Quality Manager. He later accepted a position as a Project Manager/Environmental Engineer in the Environmental Restoration section, which is where he is today.

Glen is married to Paula Verplancke, and has three children, Krizia, Troy, and Kiana. ❖

## Zone B Groundwater Treatment System

*(Continued from page 1)*

remove and treat the existing contaminated groundwater. The system consists of eight groundwater extraction wells, a treatment plant, and a surface discharge system for the treated groundwater. Contaminated groundwater is recovered at a rate of approximately 10 gallons per minute (gpm) through the system of eight extraction wells equipped with submersible pumps. The groundwater is then pumped to the treatment plant through an underground piping system. Once the groundwater reaches the treatment plant it will flow through a series of filters to remove sediments and particulate matter before it is pumped through granular activated carbon (GAC) units. As the contaminated groundwater flows through the GAC units, the carbon will remove the TCE from the groundwater. The groundwater flowing out of the GAC units will meet drinking water standards and will be directed to the Unnamed Tributary of Crow Creek. Based upon the total pumping rate of approximately 10 gpm and the estimated volume of contaminated groundwater present, the estimated time for cleanup of the TCE-contaminated groundwater at LF5b is calculated at eight years. ❖

### Access Information on the Internet

**I**nformation about cleanup activities at F. E. Warren, as well as other environmental information, is available from many sources on the Internet. Visit these sites to learn about what's going on at F. E. Warren and the community:

#### U.S. Environmental Protection Agency

<http://www.epa.gov>

#### Wyoming Department of Environmental Quality

<http://www.deq.state.wy.us>

#### F. E. Warren AFB Environmental Restoration Team

<http://www.warren.af.mil/enviro/few/>

## Upcoming RODS

Within Fiscal Year 2004 (FY04), F.E. Warren AFB is working towards finalizing Records of Decisions (RODs) for many of the remaining sites. Upcoming RODs include the following:

1. Zone E will include the Open Burn/Open Detonation Area (OBODA), and groundwater associated with Spills Sites SS1, SS3 and SS5
2. Zone D Sources will include Operable Unit (OU) #13 (Sources of Plume A, Plume B, Plume C, and Plume E)
3. Landfill 4
4. Landfill 7 & Fire Protection Training Area (FPTA) #1
5. Zone D Groundwater will include Landfill 2 and the groundwater associated with SS2, SS4, SS6, SS7, FPTA2, Plume A, Plume B, Plume C, and Plume E

Upon finalization of these RODs, final decisions will be complete for all sites except the firing ranges. The final ROD for the firing ranges is currently scheduled to be completed in FY06.



## Long Term Monitoring Update

*(Continued from page 4)*

### Spill Site 7

Long Term Monitoring (LTM) results at Spill Site 7 confirm that the permeable reactive barrier (PRB) is working as intended. Chemicals of concern (COCs) are below treatment goals in the monitoring wells within and immediately downgradient of the PRB. COC concentrations 30 to 50 feet downgradient of the PRB show decreasing trends. There are no indications of reduction in PRB permeability, indicating that the barrier is not becoming clogged with byproducts of the reaction process. Additionally, the PRB does not appear to be affecting groundwater flow paths.

COC concentrations are also decreasing in Diamond Creek, and COC byproducts are not impacting the creek. Overall, the site is in good condition.

It is recommended that semi-annual monitoring be continued at Spill Site 7. LTM can be optimized by

reducing the number of wells upgradient of the PRB, and screened wells below the PRB, as well as redundant wells downgradient of the PRB. These recommendations were presented to EPA and WDEQ and have been approved. The recommendations will be implemented.

LTM can also be optimized by reducing the analytical testing suite. Water-quality indicator parameters should be sampled annually at the PRB only, and COCs should be sampled semi-annually at all locations.

We will continue to keep you informed of the results of LTM. The Project Manager for LTM is Glen Verplancke. ❖



*Monitoring wells (left and above) and an artesian well (right) are among the SS7 sites included in the Long Term Monitoring effort*

## For Additional Information...

Information about the F. E. Warren environmental cleanup program is available for review in the Administrative Record File—the official collection of documents, data, reports, and other information that supports EPA's and WDEQ's decisions on cleanup at a site. You may review the Administrative Record File at the following location:



**Laramie County Library**  
2800 Central Avenue  
Cheyenne, WY 82001

For additional information about the F. E. Warren environmental restoration management program, please contact one of the following Remedial Project Managers:

## RAB Contacts

For information about the Restoration Advisory Board meetings or membership, please contact:

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## Inside: Information on F. E. Warren AFB Environmental Restoration



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