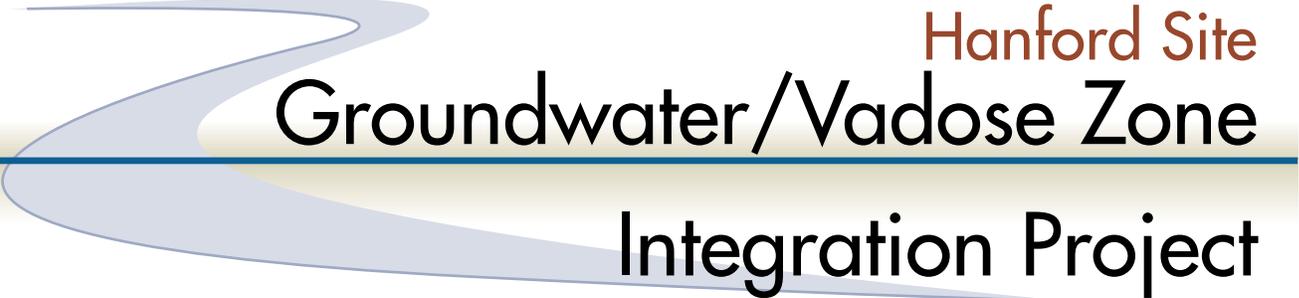


February 2000

SEMI-ANNUAL REPORT

October 1998 - November 1999



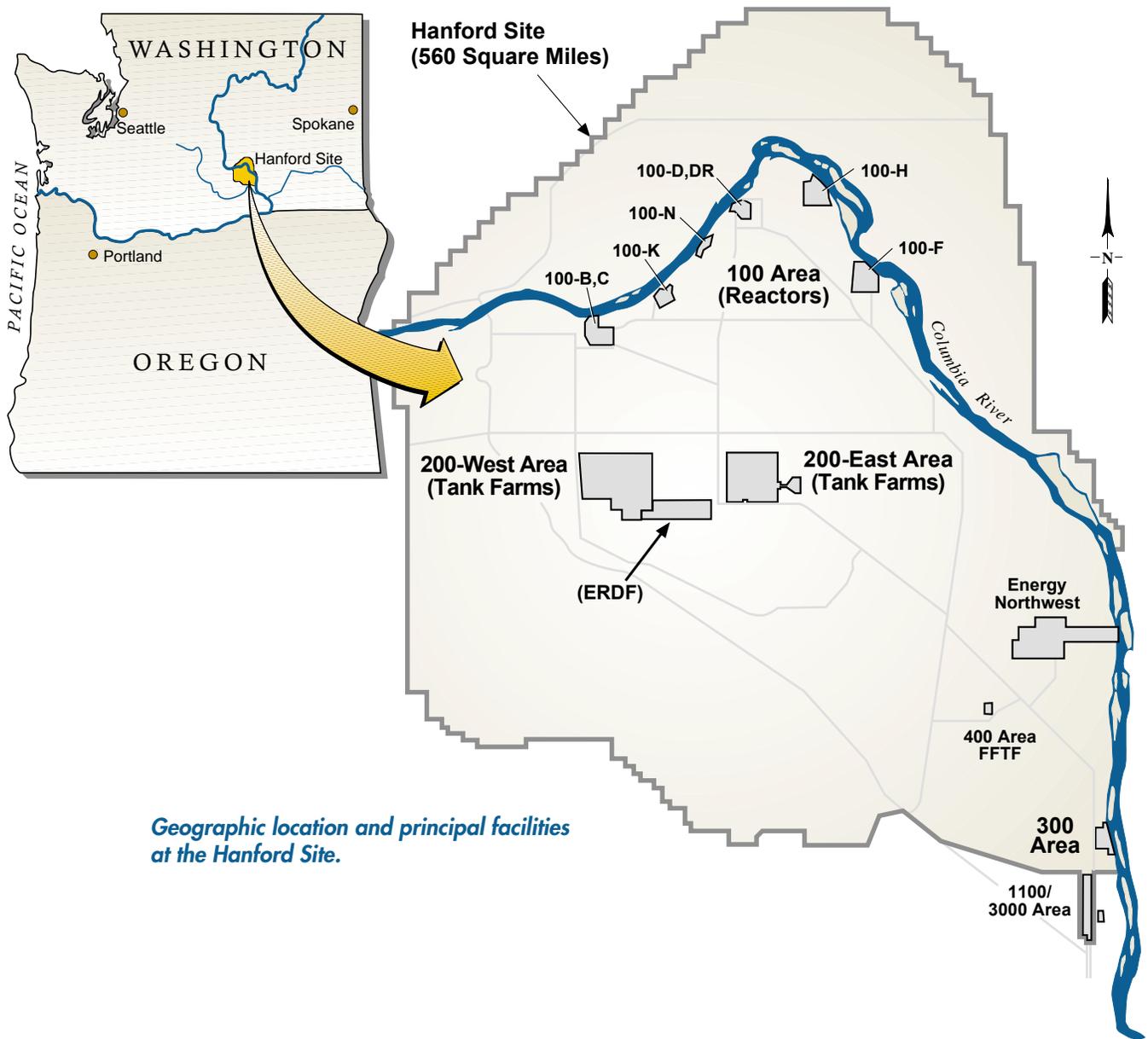
Hanford Site
Groundwater/Vadose Zone
Integration Project

U.S. Department of Energy
Richland Operations Office



Bechtel Hanford, Inc.
Environmental Restoration Contractor





Geographic location and principal facilities at the Hanford Site.

The Hanford Site is located in a large tract (approximately 560 square miles) of arid land in southeastern Washington. The Columbia River flows through the site, and eventually to the Pacific Ocean. The principal features and facilities of the Hanford Site are shown in the above figure. The arid climate and isolated character of the region made it a particularly attractive site for World War II plutonium production activities, which subsequently continued throughout the Cold War. These activities left a legacy of large volumes of wastes that include toxic chemicals and radioactive substances. Some of these wastes were intentionally (or otherwise) introduced to the vadose zone (the soil above the groundwater), the groundwater, and the Columbia River. The Hanford Site is now committed to an ambitious environmental cleanup mission.

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PURPOSE OF THIS REPORT

Section I

This is the second *Semi-Annual Report* prepared by the Groundwater/Vadose Zone Integration Project (Integration Project). The report is intended to inform U.S. Department of Energy (DOE) decision-makers, stakeholders, the State of Oregon, Tribal Nations, and regulators (including the Environmental Protection Agency and Washington State) on the progress and findings of the Integration Project. This report covers all of FY99 (October 1998 - September 1999) and the first two months of FY00.

This *Semi-Annual Report* discusses the status of Integration Project activities, and provides information on recent changes to the DOE management structure, including the establishment of the DOE Office of River Protection (ORP), the FY00 budget, and new science and technology (S&T) initiatives.

This report also recognizes issues addressed in the March 1998 General Accounting Office (GAO) report, *Understanding of Waste Migration at Hanford is Inadequate for Key Decisions*. This GAO report focused on the importance of the vadose zone to the protection of the Columbia River, and summarized actions that DOE committed to take in creating the Integration Project and establishing its mission and objectives. This *Semi-Annual Report* explains how the DOE continues to work to respond to issues contained in the GAO report.

Mr. Wade Ballard, Assistant Manager at the DOE-Richland Operations Office (RL), is the point of contact for the Integration Project. His telephone number is (509) 376-6657.



The Integration Project was established by the DOE in late 1997 to provide an innovative, new approach for protecting the Columbia River. Dr. Ernest Moniz, the Under Secretary of Energy, directed the Integration Project to be science-based, to include strong participation from DOE's national laboratories, to incorporate rigorous technical reviews, and to engage diverse stakeholders in a meaningful way in Integration Project decisions.

The Integration Project brings together all activities that impact Hanford's subsurface, and ultimately, the Columbia River. Many of these activities are part of multiple cleanup projects that report to different managers and contractors (these are referred to as "core" projects).

In March 1998, a report was issued by the GAO entitled *Understanding of Waste Migration at Hanford is Inadequate for Key Decisions*. This report concluded that the DOE's understanding of how wastes move through the vadose zone to groundwater was inadequate for making key technical decisions on how to clean up wastes at the Hanford Site in an environmentally sound and cost-effective manner. The resulting inability of the DOE to credibly estimate Hanford's long-term risk to the public was also highlighted by this report. The need for investigation of vadose zone conditions, DOE management and funding coordination regarding subsurface requirements, and technical support of key decisions (such as tank waste retrieval) were underscored in the report. Both the DOE and the Integration Project have made significant progress in meeting the challenges voiced in the GAO report. Details about this progress are discussed in subsequent sections of this *Semi-Annual Report*.

Another significant focus of the Integration Project involves preparation of a cumulative impact assessment of Hanford Site radioactive and hazardous contaminants that have affected, or may impact, the uses and users of the Columbia River. The basis for this type of holistic assessment was established in the *Columbia River Comprehensive Impact Assessment (CRCIA) Part II* report. The Integration Project is continuing work on the design of a System Assessment Capability (SAC) to meet the assessment

needs identified in the CRCIA report. The SAC will also support cleanup decisions and actions, such as the eventual completion of the final *Record of Decision* for the overall cleanup of the Hanford Site.

The Integration Project works to ensure the protection of all of the Hanford Site's water resources (vadose zone/soils and groundwater), and all of the users of the Columbia River. To be successful, the Integration Project must:

- Adopt a site-wide approach to project planning, funding, and data and information management to support cleanup decisions.
- Ensure that management attention is maintained on the subsurface and river resources.
- Be recognized for technical and scientific excellence in all products.
- Establish and ensure effective two-way communications with diverse project participants.

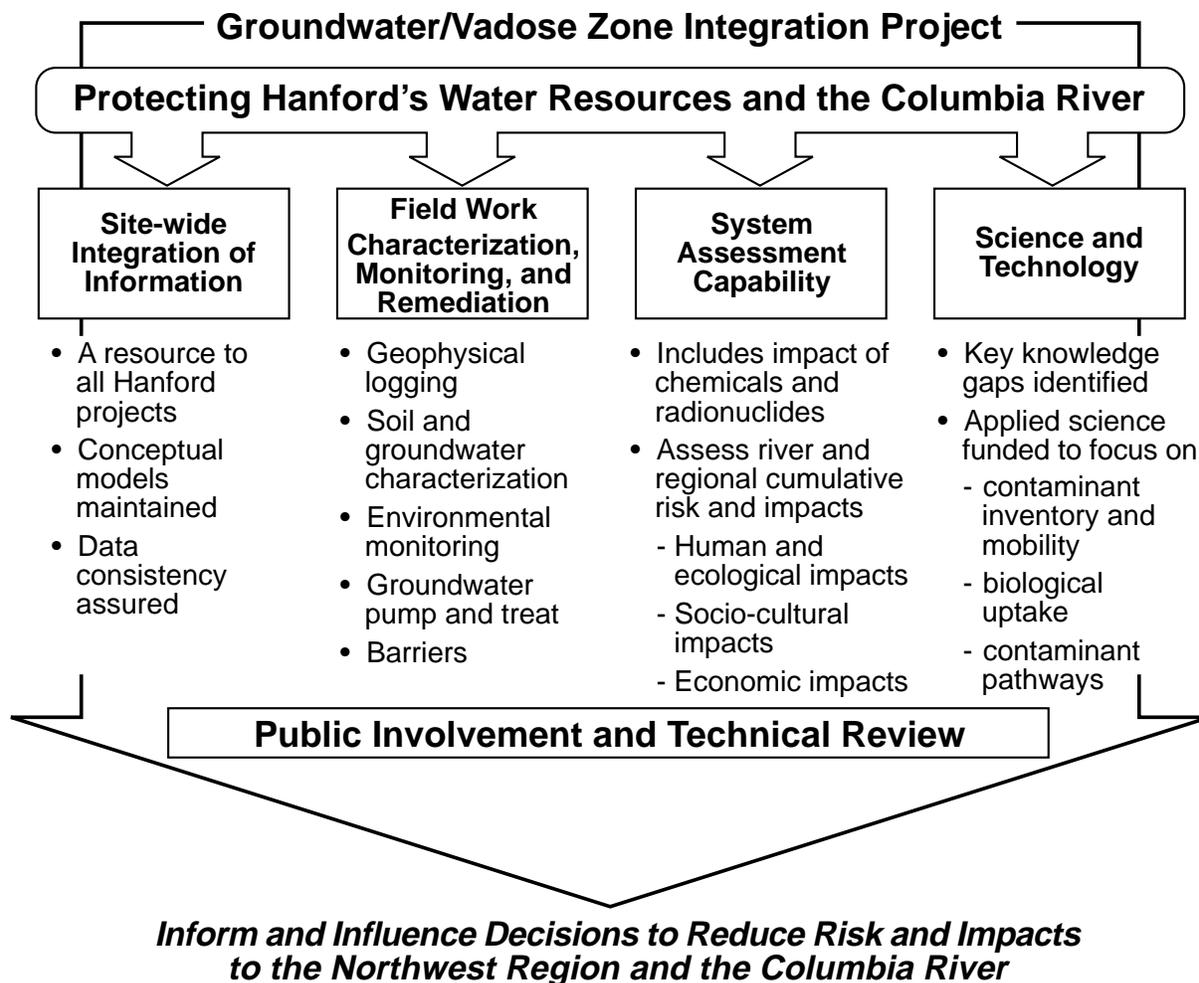
The Integration Project is focused on six endeavors: site-wide integration of information; conduct of field work; the System Assessment Capability (SAC); Science & Technology (S&T); public involvement; and technical review. These endeavors are briefly explained below. Additional information about each endeavor is provided in Section 6.

1. Site-Wide Integration of Information

Integration of information is necessary to ensure the best possible use of existing information and data resources at the Hanford Site. This information has been collected by the core projects at Hanford over time, and exists in different formats, reports, and mathematical models. (The "core projects" include multiple Hanford Site projects that conduct project work. The core projects include site-wide groundwater and vadose zone monitoring, vadose characterization within the high-level waste tank farms, groundwater remediation, and other projects.)

As new data are planned and collected, opportunities for integration will be identified. Often, new data can meet information needs of multiple projects.

The Integration Project Approach



Integration of information will put the management systems in place to accomplish the following:

- Consolidate and make accessible all of Hanford's technical knowledge about the subsurface and river.
- Reduce or eliminate overlaps between multiple projects.
- Reconcile technical inconsistencies among the core projects.
- Maximize future data collection opportunities through well-coordinated work planning.

Regulatory requirements and their related cleanup project milestones are also being evaluated and integrated to improve upon existing cleanup

schedules and plans. The regulators, stakeholders, and Tribal Nations representatives are working with the Integration Project to examine the existing *Hanford Federal Facility Agreement and Consent Order (Tri-Party Agreement)* milestone logic, and to recommend improvements.

2. Conduct of Fieldwork in the Vadose Zone, Groundwater, and Columbia River

The Integration Project is responsible for the integration of all *field work related to the subsurface and river*. This includes performance assessments, characterization of soil and groundwater, monitoring, remedial/interim actions, and closure. Regulatory requirements and S&T needs are being factored into

Section 2

the planning and conduct of all field work related to protection of the Columbia River and Hanford Site water resources in order to gain efficiencies wherever possible.

In August 1999, a new borehole was drilled in the SX tank farm to learn more about the nature and extent of tank leaks to the soil and groundwater. The characterization of the complex 200 Area soil sites was initiated, and a new innovative technology to protect the Columbia River from chromium-contaminated groundwater was implemented.

3. Develop a **System Assessment Capability** to determine the cumulative long-term impacts of Hanford-derived contaminants on the Columbia River and the Northwest.

The SAC is being designed to provide a cumulative assessment of the impacts and risks associated with Hanford Site contaminants. The SAC begins by studying the complex waste "inventory" (chemical and radioactive) that will remain at Hanford after site closure, and which may impact the Columbia River and its users.

The SAC involves an expanded evaluation and method to communicate "risk," which includes human, ecological, socio-cultural, and economic health factors.

4. Apply **Science & Technology** to critical Hanford Site vadose zone, groundwater, and Columbia River information and remediation needs.

The objective of the S&T endeavor is to provide new knowledge, data, tools, and the scientific understanding required to make technically excellent cleanup decisions; and to protect water resources, including the Columbia River. These cleanup decisions involve remediation and closure of the tank farms and contaminated soil sites. The S&T activities are being integrated with the SAC and the Hanford Site core projects.

5. Provide opportunities for early and meaningful **Public Involvement**, in order to build trust and understanding, and to move toward

consensus on the Integration Project path forward. Continue to seek out effective ways to involve regulators, Tribal Nations, the State of Oregon, and other stakeholders.

This effort will help create and maintain routine, open, and inclusive ways for all project participants to share information and provide input on Integration Project direction and products. The public involvement component of the Integration Project will continue to support work groups that focus on such project issues as a regulatory path forward and the SAC.

The Integration Project will bring all of the Hanford Site's vadose zone, groundwater, and Columbia River related public involvement opportunities together into a common forum, which will better serve the stakeholders and Hanford Site projects. The Integration Project web site (www.bhi-erc.com/vadose) will link with the core projects, to allow easy access to documents during public review periods.

6. Build **Technical Review** capabilities to support all Hanford Site vadose zone, groundwater, and Columbia River work.

The Integration Project Expert Panel (IPEP) was established in 1998, and is advising the Integration Project and core projects. The IPEP meets three or four times per year.

The Hanford Site-wide Groundwater Model Peer Review was conducted in FY99, with a report expected in early 2000. The National Academy of Sciences (NAS) will begin its review of the Integration Project S&T program in FY00.

Key Hanford Cleanup and Disposal Decisions

The Integration Project will provide the technical and scientific basis required to inform and influence important Hanford Site cleanup decisions. These decisions support the *Resource Conservation and Recovery Act (RCRA)*, *Comprehensive Environmental Response, Compensation and Liability Act (CERCLA)*, *Atomic Energy Act (AEA)*, and *National*

Environmental Policy Act (NEPA) regulatory processes, and are implemented by the core projects. These decisions are often included in the *Tri-Party Agreement*.

The Integration Project will also provide the technical and scientific basis for completion of a periodic site-wide assessment supporting continued and new disposal of low-level radioactive waste. This assessment (the composite analysis) is required by DOE Order 435.1. The order includes authorizations for the continued operation of existing disposal facilities (e.g., solid waste burial grounds) and the design, construction, and operation of new facilities, (e.g., the immobilized low-activity waste disposal required for the Hanford Site's 177 single- and double shell tanks).

The Integration Project will provide the core projects with defensible cumulative long-term assessments of the public health, environmental, socio-cultural, and economic impacts of cleanup decisions. Integration Project assessments will evaluate the

cumulative impacts of all Hanford Site cleanup activities. Other factors that are considered in cleanup through closure decisions -- such as worker risk, cost, schedule, technical feasibility, and regulatory compliance -- are the responsibility of the core projects.

Key Hanford Site cleanup decisions that the Integration Project will influence include:

- Groundwater remediation
- Interim actions (such as barriers) to protect groundwater and the river
- 200 Area waste site remediation (soil sites)
- Composite analysis and impacts (including disposal of low-level radioactive waste)
- Single shell and double shell tank waste retrieval
- Single shell and double shell tank closure
- Disposition of canyon facilities
- Final remediation of the 100, 200, and 300 areas which are on the EPA National Priority List.



Historical construction photo of the Hanford Site's underground waste tanks.

Section 3

KEY ACCOMPLISHMENTS



Dr. Ed Berkey, Chair, Integration Project Expert Panel (standing).

and for Hanford Site contractors, were redefined and clarified. Advances were made in science and technology, in the collection of critical field information, and in deployment of new technologies to protect the Columbia River.

In 1999 the new DOE-RL Manager, Keith Klein, realigned the DOE organization to more effectively address Hanford Site cleanup in an integrated fashion. One result is that the Integration Project now reports to the RL Planning and Integration organization. "I want the Integration Project reporting to a higher level in the organization, and involved in the setting of priorities and the strategic direction of the entire site," says Klein. An immediate outcome of this has been the re-prioritization of needed repairs to leaking water lines. For example, water leaks near the waste sites can result in thousands of gallons of water driving contamination through the vadose zone and into the groundwater. Before the Integration Project was formed, infrastructure repairs such as these were not viewed as important to the environmental protection mission at the Hanford Site.

The Integration Project also made significant strides in developing a cumulative risk assessment approach, through the development of a SAC. The SAC is patterned after a Tribal Nations and stakeholder endorsed approach, which is documented in the *Columbia River Comprehensive Impact Assessment*. The SAC will predict the long-term movement of radioactive and chemical contaminants from all of

In the first full year of the Integration Project, significant progress was made in elevating the importance of understanding conditions in the vadose zone and applying this understanding to Hanford Site cleanup actions and decisions.

Leadership roles within the DOE,

Hanford's waste sites to points along the Columbia River. The SAC will then evaluate the potential effects that contamination in these areas might have on ecological resources, as well as any socio-cultural, economic, and human health impacts. SAC data and models are being quickly assembled, so that cleanup efforts can be better focused on long-term protection of the Columbia River.

"I want the Integration Project reporting to a higher level in the organization, and involved in the setting of priorities and the strategic direction of the entire Site."

- Keith Klein

A site-wide S&T Roadmap has been developed to align and prioritize scientific efforts to close critical knowledge gaps. The S&T Roadmap was used as the basis for funding approvals of \$25 million (over three years) for new projects awarded by DOE-EM. The projects being funded under this new program

ACCOMPLISHMENTS

- ✓ DOE management realigned
- ✓ Cumulative risk assessment approach defined
- ✓ Science and Technology Roadmap completed and funding identified
- ✓ Groundwater and soil characterized in the Tank Farms
- ✓ New groundwater remediation technology deployed to protect Columbia River from toxic chromium
- ✓ Open public involvement process established
- ✓ Integration Project Expert Panel convened

explore the way in which contaminants move through the vadose zone and into the groundwater. This knowledge will help scientists understand and predict contaminant transport times from the vadose zone, to groundwater, and toward the Columbia River.

Following an effective and integrated planning process, new vadose zone characterization activities in the 200 Area are now underway. The characterization is focused around high-level waste tanks that have leaked, and around the waste sites where contaminated liquids were once discharged to the soil (e.g., cribs, ditches, ponds). A new borehole was drilled inside the tank farms complex, to assess and monitor contamination. The recent data from this borehole, and from decommissioning of another hole, provide important insights on unexpected levels of technetium-99 contamination from one of the largest leaks. Test pits and wells were also installed, for the purpose of collecting samples from old cooling water ponds. This information is being used to determine the actions that are required to clean up these sites. Through the Integration Project, all characterization work is now coordinated through a common planning process to improve overall quality, efficiency, and consistency.

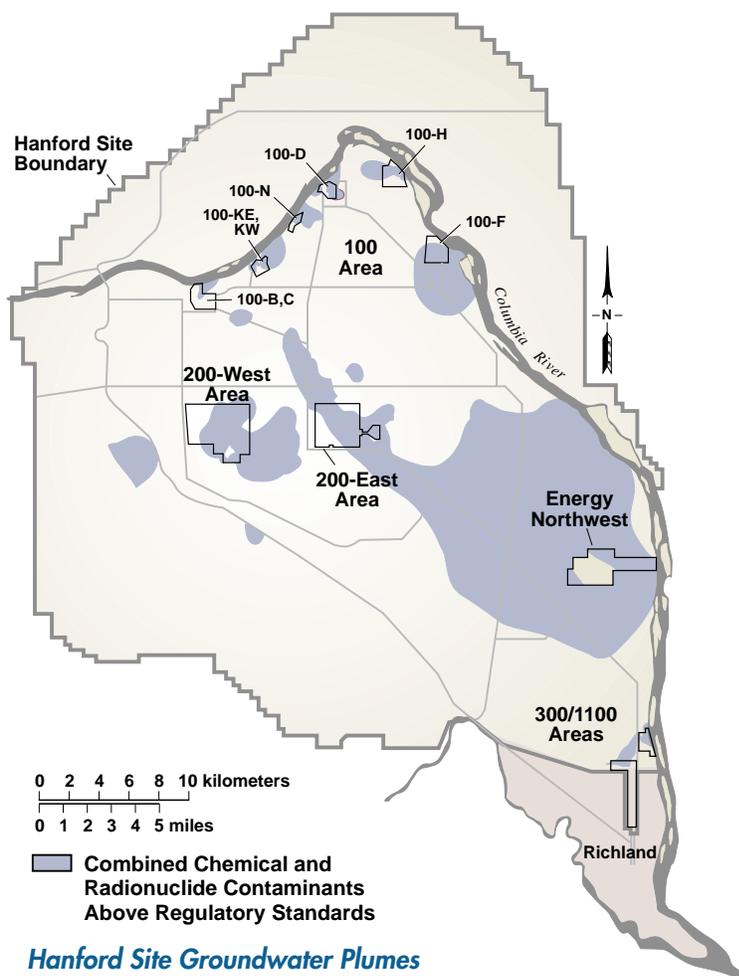
For the long-term, effective groundwater remediation solutions are being promoted and applied by the Integration Project. Interim cleanup solutions, such as groundwater pump-and-treat systems, are being challenged by new state-of-the-art technologies. In partnership with the regulators, the first segment of a chemical barrier was installed around a “hot spot” of chromium contamination, to prevent chromium in the groundwater from reaching the Columbia River. This chemical barrier wall is being extended to provide further protection to the ecologically sensitive river.

The issues revolving around the credibility of DOE and its contractors are being directly addressed.

“We are trying to set a new standard for openness at Hanford, and the Integration Project has really benefited from this inclusive approach.”

- Michael Graham

From the inception of the Integration Project, a commitment to openness has been maintained. Open meetings are being held on a regular basis. Workshops and other ways to involve interested stakeholders, Tribal Nations, regulators, and the State of Oregon are ongoing. An Integration Project website (www.bhi-erc.com/vadose) is being maintained and constantly upgraded. “We are trying to set a new standard for openness at Hanford, and the Integration Project has really benefited from this inclusive approach,” says Michael Graham, who is the Bechtel Hanford, Inc. (BHI) Integration Project Manager. An IPEP, with eight subject matter experts, is in place to work with the Integration Project. The IPEP provides broad oversight and feedback on all facets of the Integration Project.



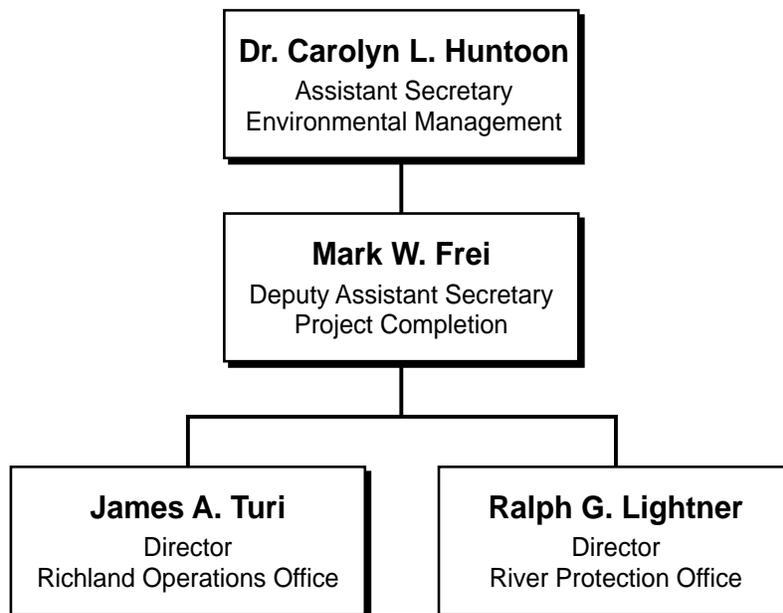
ORGANIZATION AND LEADERSHIP

Section 4

During FY99, significant organizational changes were enacted within the DOE. At DOE Headquarters (HQ), Dr. Carolyn Huntoon was confirmed as the Assistant Secretary for Environmental Management. Dr. Huntoon has realigned her organization to provide improved management of the EM sites. Within Dr. Huntoon's organization, Mark Frei has responsibility for oversight of RL and the ORP. The organizational chart for EM is shown below.

In response to Congressional direction, the ORP was formed in December 1998 to increase focus on the management and treatment of high-level tank waste at the Hanford Site. Richard French is the manager of this office, and he reports to Dr. Carolyn Huntoon.

Keith Klein became the new RL Manager in June 1999. He has realigned the Richland Office to more effectively clean up the Hanford Site in an integrated fashion. Keith Klein also reports to Dr. Huntoon at HQ. The Integration Project now reports to RL Planning and Integration, in order to more effectively provide input to site-wide cleanup work, and to future cleanup decisions.

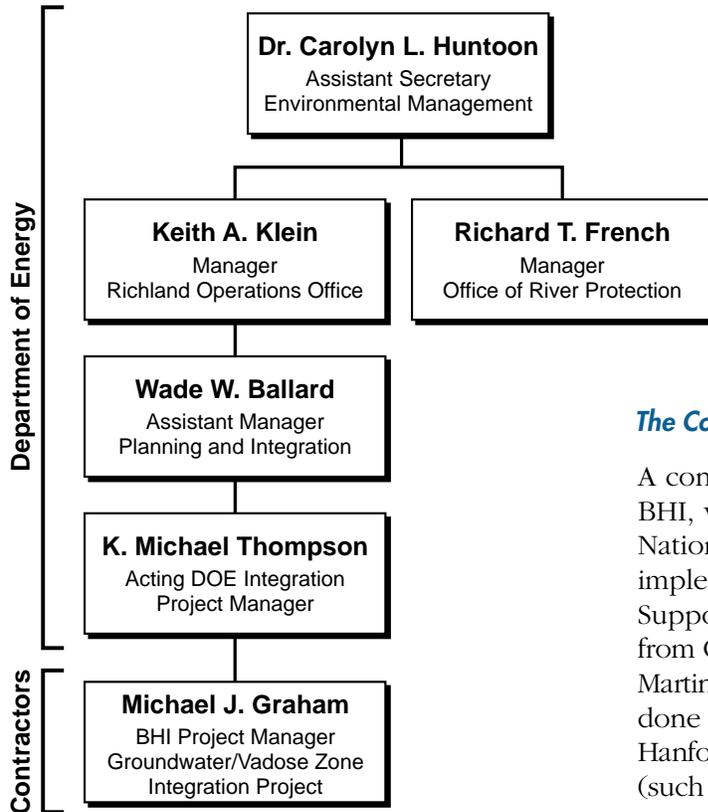


*DOE Headquarters
Organization*

Section 4



Pictured from left to right are Keith Klein, Michael Graham, and Wade Ballard.



The Contractor Integration Project Team

A contractor team, led by Michael Graham of BHI, with support from the Pacific Northwest National Laboratory (PNNL), is responsible for implementation of the Integration Project. Support for the Integration Project also comes from CH2MHILL (which procured the Lockheed Martin Hanford Co. in late 1999), for work being done in the tank farms, and from Fluor Daniel Hanford, Inc. (FDH), for other site-wide activities (such as waste and infrastructure management).

FUNDING PROFILE FOR FY99 AND FY00

Section 5

The FY99 and FY00 funding for the Integration Project, for the core projects at the Hanford Site, and for the S&T Projects are shown below. Funding categories relevant to the recommendations of the 1998 GAO Report are identified in the left column.

The funding for activities identified in the 1998 GAO Report have increased significantly between FY99 and FY00. Most notably, vadose zone characterization increased by 33%, and S&T funding increased by over 400%.

Integration Project Fiscal Year Data (dollars in millions)

Funding Category (see table below)	FY99 Funding	FY00 Funding	DOE Responsibility
Integration Project			
	\$1.82	\$0.83	RL
M Project Management			
M System Assessment Capability	\$1.90	\$2.85	RL
S&T Science and Technology	\$1.33	\$4.70	RL
Technical Review	\$1.03	\$0.99	RL
Public Involvement	\$0.30	\$0.33	RL
Data Management and Issues Resolution	--	\$1.62	RL
Integration Project Subtotal	\$6.38	\$11.32	
Core Projects - Field Sampling and Analysis			
	\$11.65	\$10.94	RL
M Groundwater and Vadose Zone Monitoring			
M Groundwater and Composite Modeling	\$1.08	\$0.72	RL
Well Installation and Maintenance	\$1.68	\$0.72	RL
C Vadose Characterization	\$6.17	\$7.36	ORP
C Tank Farm Geophysical Logging	\$1.81	\$0.83	ORP
C Immobilized Low Activity Waste (ILAW) Characterization	\$1.34	\$2.04	ORP
M ILAW Performance Assessment	\$0.17	\$0.46	ORP
Cone Penetrometer Development & Demonstration	\$1.51	--	ORP
Columbia River Monitoring	\$0.39	\$0.39	RL
C 200 Area Waste Site Characterization	\$1.99	\$3.53	RL
Core Projects - Groundwater Remediation			
	\$5.06	\$5.35	RL
100 Area Pump and Treats			
200 Area Pump and Treats	\$1.02	\$1.51	RL
200 Vapor Extraction	\$0.43	\$0.25	RL
Core Projects Subtotal	\$34.29	\$34.10	
Integration and Core Projects Total	\$40.67	\$45.42	
Science and Technology Projects			
S&T Environmental Management Science Program (\$25 over 3 years - FY00, 01, & 02)	--	\$10.00	HQ

Funding Categories of Interest (per GAO Report)

Funding Category	FY99 Funding	FY00 Funding
M Enhanced Modeling Capabilities	\$3.48	\$4.03
C Characterization of the Vadose Zone	\$10.37	\$13.76
S&T Groundwater/Vadose Zone Science and Technology	\$2.84	\$14.70

1998 GENERAL ACCOUNTING OFFICE (GAO) REPORT

In March 1998, the GAO released a report entitled *Nuclear Waste: Understanding of Waste Migration at Hanford Is Inadequate for Key Decisions*. This report focused on wastes that have leaked from Hanford's single-shell tanks (and other waste sites, to a lesser extent), and on the adequacy of DOE's understanding of contaminant movement and vadose zone conditions. The GAO report recommended preparation of a comprehensive "vadose zone" strategy for the Hanford Site, and noted that DOE had previously committed to prepare such a strategy. The Integration Project will assume the lead for a number of actions identified in the GAO report.

The GAO report provided three recommendations:

1. "Address the importance of understanding conditions in the vadose zone to ongoing cleanup activities, and to future decisions on cleaning up

the Hanford Site."

2. "Define leadership roles within DOE and its contractors."
3. "Identify steps to ensure the credibility of the process, and the information that is collected, such as review by stakeholders and subject matter experts."

The FY99 and FY00 budgets to support specific activities specified in the GAO report (enhanced modeling capabilities, vadose zone characterization, and S&T) are presented in Section 5. The level of funding has increased for each of the three categories.

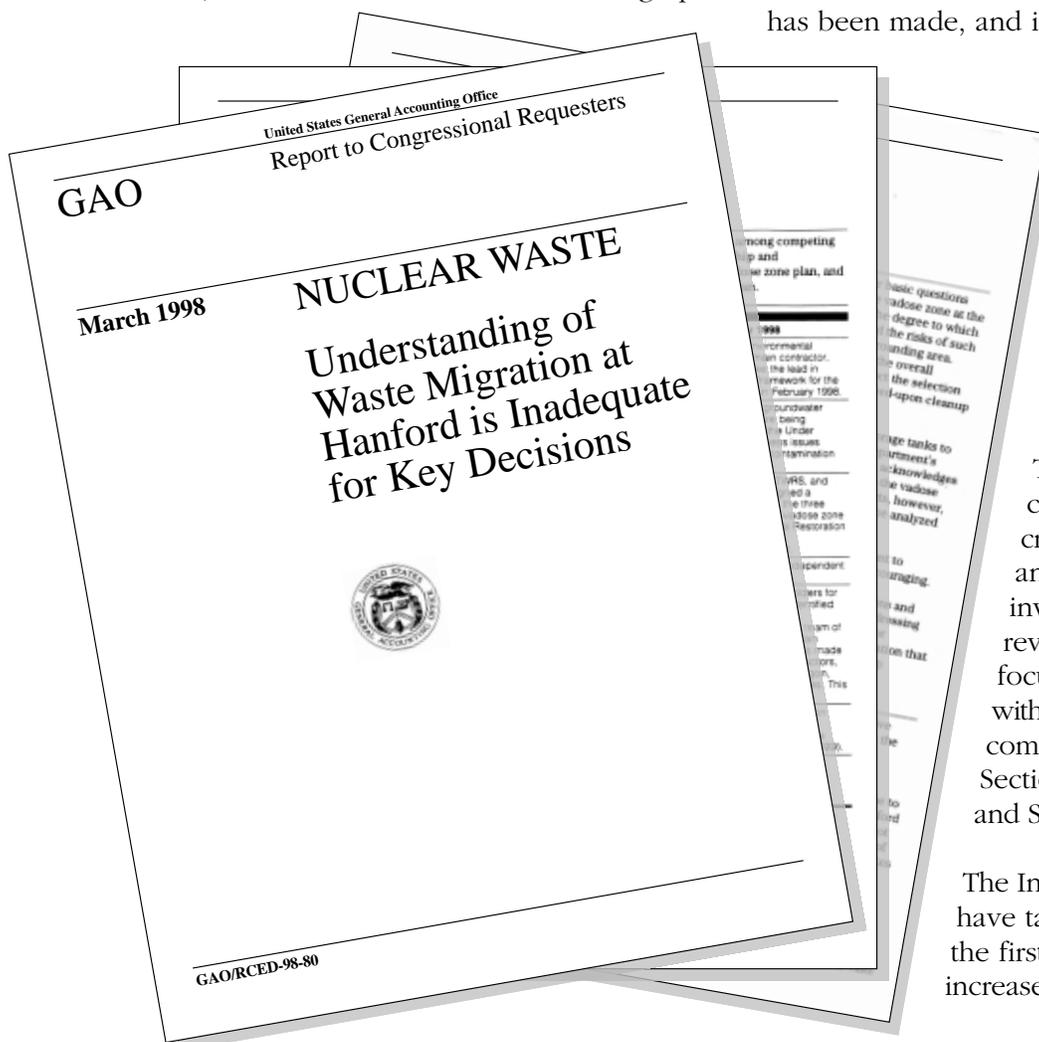
ORP Characterization in FY99

The first recommendation focuses on the need to understand the conditions in the vadose zone, and their relevance to cleanup plans. Significant progress has been made, and is outlined below.

The second recommendation calls for definition of leadership roles within DOE and its contractors. The DOE organization at Hanford, and the multi-contractor makeup of the Integration Project Team, is presented in Section 4.

The third recommendation calls for action to ensure credibility in terms of processes and data quality. Public involvement and technical reviews, both of which are focused on gaining credibility with stakeholders and the scientific community, are discussed in Section 11 (Public Involvement) and Section 12 (Technical Review).

The Integration Project and the ORP have taken a proactive response to the first recommendation, involving increased scientific and management



Section 6

attention to the vadose zone. Budgets have increased; regulatory requirements have been agreed to; planning assumptions have been formalized and documented.

As noted in the GAO report, the FY99 budget for the Tank Farm Vadose Zone was projected to be \$4 million. However, the budget was increased to \$8 million for FY99, and \$8.2 million in FY00. This increase in budget allowed significant work to proceed, and this work is summarized below. Formal reports are now being prepared to present data and findings. (A map showing the S-SX Tank Farm can be found on page 16.)

- Soil samples were collected in the region around tank SX-108 in July 1999, as recommended by the SX Vadose Zone Expert Panel (and, as referenced in the GAO report). These samples have the highest radiation dose of any subsurface samples ever taken during characterization at Hanford.
- A new borehole (near tank SX-115) was drilled in September 1999, and soil samples were collected from the surface to the groundwater. The groundwater samples showed the highest levels of Tc-99 (technetium) ever recorded at the Hanford Site. Samples revealed that groundwater exceeded 30,000 pico Curies per liter (the EPA drinking water standard for Tc-99 is 900 pico Curies per liter). DOE is working with the regulators to take the actions necessary to understand the extent of this problem and to mitigate impacts. Access and use of the groundwater beneath Hanford is controlled to protect workers and the public.
- In December 1999, the first cycle of spectral gamma measurements were completed by the DOE-Grand Junction Office (again, as mentioned in the GAO report), and new instruments were developed and deployed. Spectral gamma measurements detect the concentration of gamma-emitting radionuclides (e.g., cesium-137, cobalt-60, potassium in tank farm soils, etc.). Such information is useful in locating areas for further characterization.
- Gamma measurements taken from 1974 to 1994, at the same locations as the recent spectral gamma measurements, continue to be analyzed, thereby allowing historical trends to be determined.
- Boreholes and near-surface characterization activities in the tank farms are being planned for areas where groundwater impacts are suspected.

During FY99, the DOE-ORP, the Washington State Department of Ecology (Ecology), and the U.S. Environmental Protection Agency (EPA) agreed to a draft set of eight regulatory milestones that now drive the Tank Farm Vadose Zone Program within the ORP. Although not yet formally approved, all eight milestones due in FY99 or early FY00 have been completed. These milestones lay out requirements for specific parts of the program (for example, capping boreholes). More importantly, they also specify a regulatory process (the RCRA Corrective Action Program) that allows Ecology regulatory control over the planning and implementation of these important characterization activities.

Program plans have been published for the Tank Farm Vadose Zone and Single-Shell Tank Programs. The latter document shows how the information from the Tank Farm Vadose Zone Program will be used in performing corrective actions (such as infiltration control), retrieval, and making closure decisions. The Single-Shell Tank Program Plan clearly documents the extreme importance of understanding conditions in the vadose zone, to enable technically sound cleanup decisions.

SITE-WIDE INTEGRATION OF INFORMATION

The *integration of information* endeavor is enabling the Integration Project to better control and manage the technical information needed to support Hanford Site decision making. While a wealth of information has been collected throughout Hanford's history, this knowledge has not been maintained in a consistent and easily accessible format. This lack of integration can lead to an inefficient sharing of knowledge between projects, incomplete or inadequate work planning, and sub-optimal decision making.

The Integration Project has identified several immediate opportunities to bring the Hanford Site core projects together, in order to share information and jointly plan their data collection activities. This process was particularly successful in planning for the characterization and monitoring of boreholes, and in linking the core projects with the Integration Project S&T work. (Note: A borehole is similar to a well and is drilled into the subsurface to characterize conditions and record contamination.)

The Integration Project is also focused on integration of project planning and scheduling. The characterization of liquid disposal soil sites around the B- and T-Tank Farms was integrated with other tank farm vadose zone characterization work, and a change to *Tri-Party Agreement* milestones was negotiated with the regulators. By integrating planning efforts, the core projects can sometimes eliminate workscope overlaps and improve the consistency of data collection and interpretation activities.

Work is beginning to “lock down” the existing amount of technical knowledge, and to make that information accessible and useful across the Hanford Site. Databases are being developed to capture the current state of knowledge regarding subsurface and related technical information. These databases will provide the basis for consolidated conceptual models that describe the best and most current understanding about Hanford-derived contaminants,

and how they interact and move in the subsurface. These conceptual models will eventually describe how contamination is transported in the groundwater, and to the Columbia River. This information, in turn, will be useful to all of Hanford's core projects, and is central to the mission of the Integration Project.

KEY ENDEAVOR

Ensure that Hanford Site's wealth of technical information and data are well integrated, controlled, and easily accessible, to support cleanup decision-making.

ACCOMPLISHMENTS

- ✓ **Coordinated planning and identification of data needs on several characterization projects.**
- ✓ **Negotiated a change in Tri-Party Agreement milestones to improve coordination of soil characterization in and around the tank farms.**
- ✓ **Initiated work to consolidate technical databases, and to integrate planning.**
- ✓ **Began development of site-wide conceptual models.**

CONDUCT OF FIELD WORK



KEY ENDEAVOR

Ensure an adequate understanding of the subsurface, and take effective action to remediate contaminated soil and groundwater.

ACCOMPLISHMENTS

- ✓ **SX Tank Farm characterization yields new data**
- ✓ **Baseline spectral gamma logging in single-shell tank farms completed**
- ✓ **200 East Area vadose logging completed**
- ✓ **200 Area waste site characterization plan approved**
- ✓ **Hanford prototype surface barrier testing progressing**
- ✓ **Groundwater chromium removal project underway**

During the past year, there has been a strong commitment to move from job planning into field work. Renewed emphasis on fieldwork has resulted in significant new data. The new data are critical to support an adequate understanding of the subsurface and its contamination, and potential and existing impacts to the Columbia River.

Of equal importance is the fact that there has been an accompanying culture change in how DOE, the regulators, and contractors work together to identify and address the subsurface data needs of multiple projects (and S&T). Project areas of particular note include the following:

SX Tank Farm Characterization

Two major field characterization projects were accomplished in the SX tank farm during FY99: 1) the decommissioning and sampling of borehole

41-09-39; and 2) the drilling of a new borehole near tank SX-115.

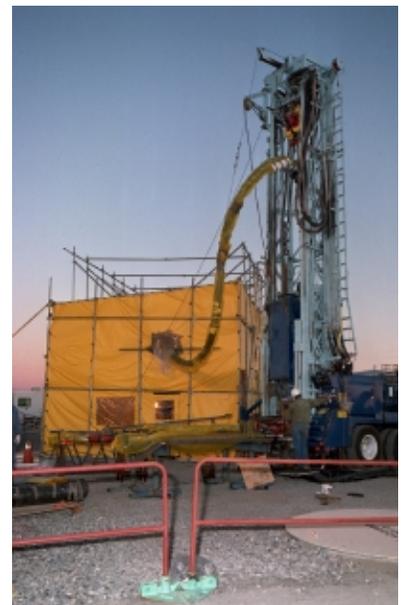
These efforts are part of a regulatory corrective action process, and also support the planning necessary to retrieve wastes from tanks.

- Decommissioning of Borehole 41-09-39

Borehole 41-09-39 in the SX tank farm was installed in 1996, based on a recommendation from the SX Tank Farm Vadose Zone Expert Panel. The borehole was extended to groundwater in 1997. No contaminants attributable to tank wastes were found in the groundwater taken from this borehole. In the summer of 1999, the borehole was decommissioned (to comply with state regulations) and soil samples were collected (with an emphasis on the region showing the highest gamma radiation readings). Gamma radiation measurements are consistent with soil concentrations of cesium-137. The cesium-137 was not found as deep as the mobile radionuclide technetium-99. Materials normally thought of as mobile (technetium-99, sodium, chromium, nitrate) have shown similar depth concentrations, and are concentrated in the vadose zone above a well-cemented rock unit at ~130 to 150 feet below the surface.

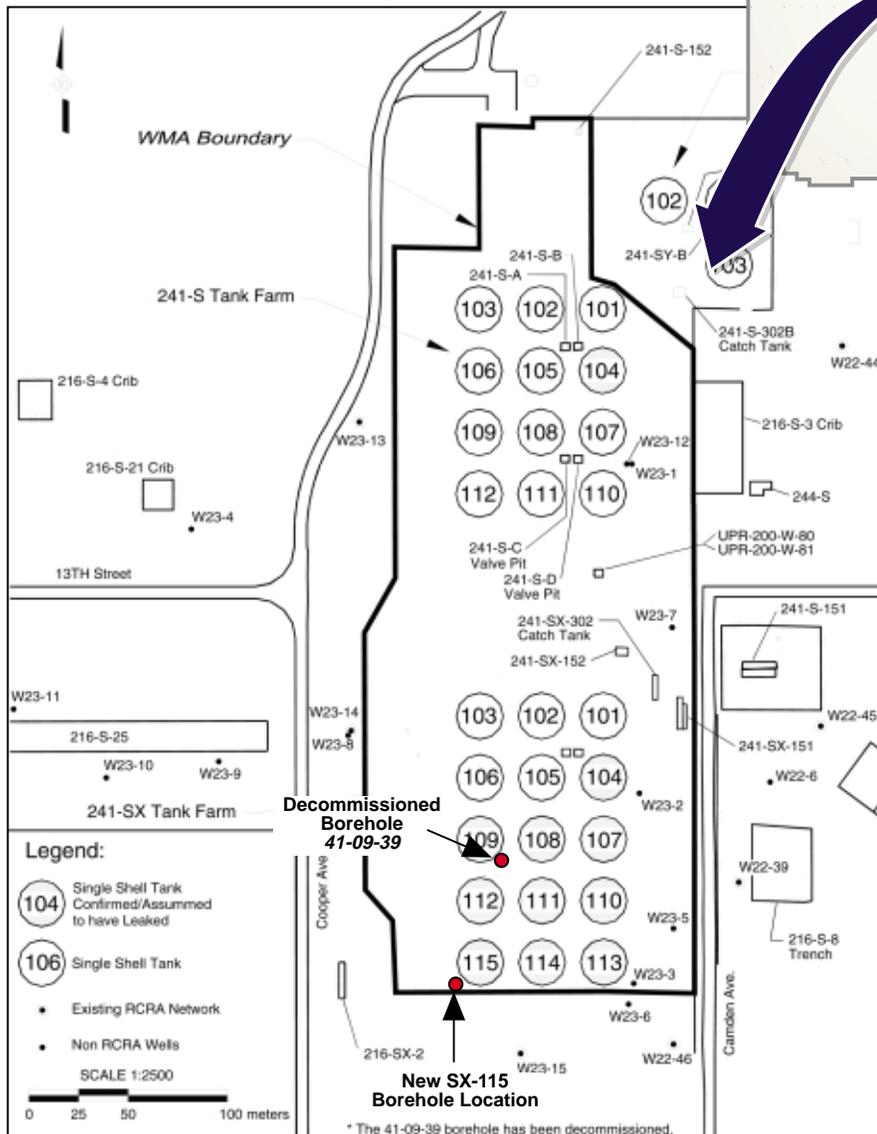
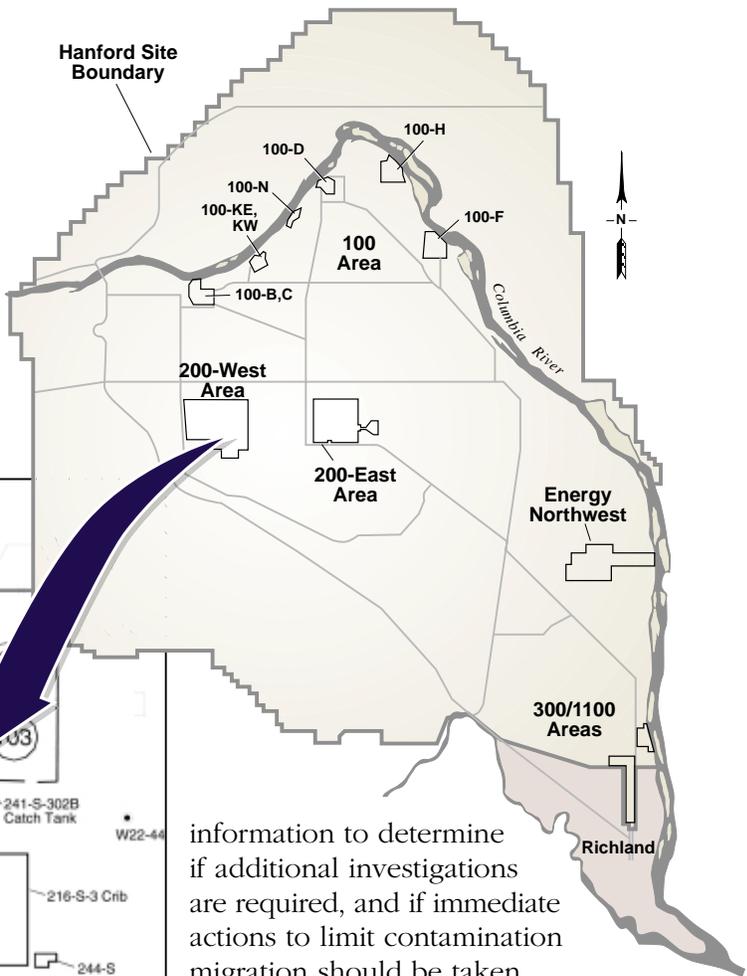
- SX-115 Borehole

The SX-115 tank has the largest measured leak in the SX tank farm. The new borehole was continuously sampled from the surface down to the calcium-rock unit described for borehole 41-09-39. Three samples were collected between that area and the groundwater. Field measurements of the soil samples showed no gamma radiation beyond that expected from natural materials. However, groundwater samples showed technetium-99 readings that were more than 35 times the groundwater standard that is applied at the Hanford Site. These



SX-115 Drill Rig

readings are the highest ever observed in Hanford Site groundwater. Other typical tank waste contaminants were not found at such high levels. No near-term threat to the public or workers is foreseen, because DOE controls access to the groundwater beneath the Hanford Site. The original plan was to immediately decommission the borehole. Based on these findings, however, the borehole has been converted to a RCRA-compliant groundwater monitoring well. Samples from this borehole, as well as those nearby, will be collected periodically since past experience has shown that groundwater contamination concentrations can vary significantly with time. DOE and the regulators will use this



information to determine if additional investigations are required, and if immediate actions to limit contamination migration should be taken.

The sampling program at the SX tank farm is being coordinated by the Integration Project. Information about the groundwater and vadose zone will advance the understanding of the cumulative effects of Hanford wastes and travel times to the Columbia River.

Spectral Gamma Logging in Tank Farms

Gamma-emitting radionuclides, which are the result of surface spills and/or tank leaks, have been found in all tank farms.

The DOE Grand Junction Office and their contractor (MACTEC-ERC) have completed the baseline spectral gamma

Location of S-SX Tank Farm, with the decommissioned 41-09-39 borehole, and the new SX -115 borehole.



Test pit characterization at Gable Mountain Pond.

logging of drywells in the single-shell tank farms. Except for the B tank farm, tank farm reports have been issued for all the single-shell tank farms. A high-rate gamma-logging tool was used. Because the high-rate gamma-logging tool is calibrated to be very sensitive, it is of little use in areas where contamination levels are found to be very high. In the 200 East Area, where the previous discharge of tank waste to the ground resulted in high contamination levels, the drywells will be re-measured with geophysical tools appropriate to measure existing contaminant levels.

200 Area Waste Site Characterization

An integrated plan for the characterization of over 700 waste sites in the 200 Area was approved by the regulators in April 1999. Under the plan, the

waste sites were organized into 23 waste groupings, based on similar chemistry and disposal practices. Field work on the “cooling water” waste grouping began in August 1999. Samples have been collected at 15 test pits. Laboratory results of the samples will be reported in FY00. Twelve additional test pits, and two characterization boreholes, are planned for additional work in this waste grouping in FY00. One of the boreholes has been planned to meet the data needs of two projects (CERCLA characterization, and RCRA groundwater monitoring). This integration of work will save time and reduce overall costs.

The vadose logging in the 200 East Area included neutron moisture and spectral gamma logs, and was

Section 8

completed in FY99. These data will be used to evaluate potential impacts to groundwater.

Hanford Site Prototype Surface Barrier

A four-year treatability test of surface barrier performance is nearing completion. The testing included evaluation of barrier performance under both ambient and extreme precipitation (3 times normal annual rainfall and 1,000-year storms). The study concludes that the barrier meets, or exceeds, design specifications for hydrologic performance, water and wind erosion, plant growth, root intrusion, animal intrusion, and barrier stability. Some additional monitoring activities are underway.

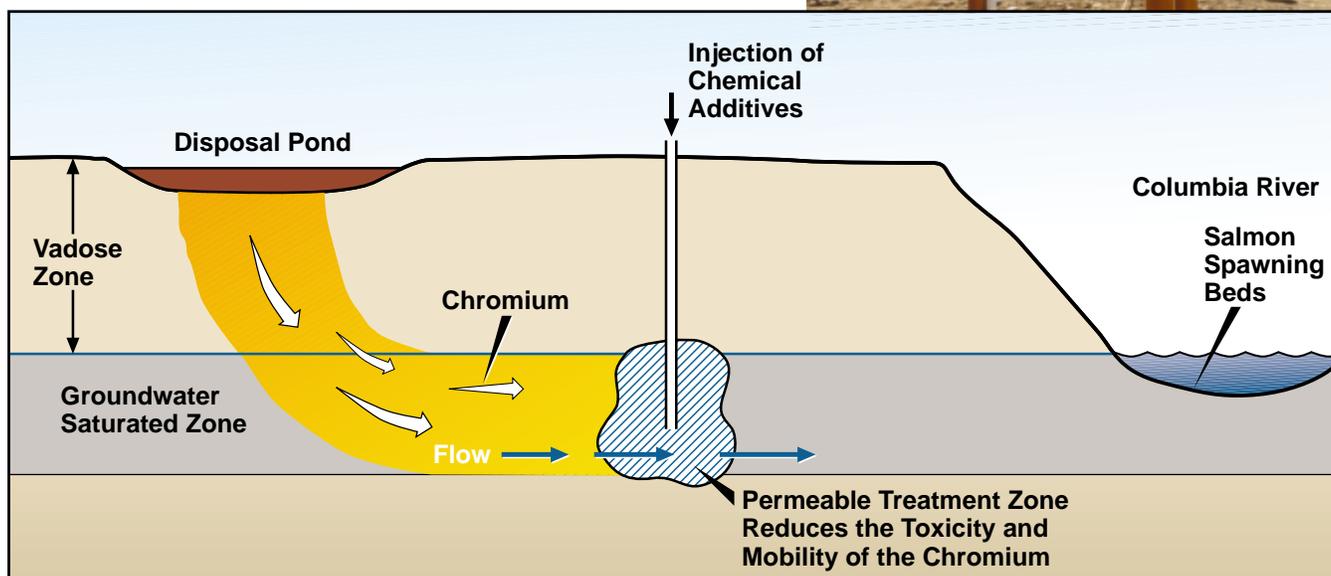
In Situ Redox Manipulation (ISRM)

An innovative technology, ISRM is being used to remove chromium from groundwater before it reaches the Columbia River. This technology presents a cost-effective alternative to the current practice of groundwater pump-and-treat, because it requires minimal operating costs. ISRM involves creating a permeable subsurface treatment zone (sometimes called the “chemical barrier”) to intercept the groundwater and remove the hexavalent chromium that is toxic to fish. Regulatory agencies have agreed

to use ISRM to remediate chromium-contaminated groundwater in the 100-D Area, near the Columbia River. The first segment of the treatment zone has been installed there to treat a "hot spot" of groundwater contamination containing the highest known concentrations of hexavalent chromium detected on the Hanford Site.



In Situ Redox Manipulation



Permeable treatment barrier removes chromium from groundwater.

SYSTEM ASSESSMENT CAPABILITY

Section 9



The SAC will provide a cumulative assessment, using predictive tools and models, to increase the understanding of the ecological, economic, socio-cultural, and human health effects resulting from Hanford contaminants. The SAC will provide the information needed to guide and complete Hanford Site cleanup, including the preparation of a site-wide *Final Record of Decision*.

The SAC will be developed and improved through iterative cycles. The first iteration (called Revision 0) is due for completion in FY01. The overall approach to be used in the first iteration has been documented in the *Preliminary System Assessment Capability Concepts for Architecture, Platform, and Data Management* document, which is available on the Integration Project internet web page (<http://www.bhi-erc.com/vadose>). Conceptual models showing waste inventory, contaminant release from waste sites, movement of contaminants through the environment, and the impact of contaminants on living systems and cultures are presented in appendices to the document identified above.

Impacts to human and ecological health, as well as socio-cultural and economic systems, are being evaluated. A “dependency web” approach that communicates the importance of water resources and river dependent uses at key geographic locations has been used to obtain stakeholder and Tribal Nation input. Development of an approach to assess cultural impacts involves close interaction with the Tribal Nations technical staff. The task of preparing metrics to measure these comprehensive impacts is now underway. This is an area where the Integration Project is sometimes “out in front” of existing scientific methods.

A SAC work group has been established to provide an open forum for regulators, Tribal Nations, and stakeholders to work with the Integration Project team on an ongoing basis. The initial task of the group was to review the *Columbia River Comprehensive Impact Assessment (CRCIA) Part II* document with those who helped create it. This information served as a starting point for planning the SAC.

KEY ENDEAVOR

Assess the potential long-term effects of Hanford-derived contaminants on the Columbia River and all of its users.

ACCOMPLISHMENTS

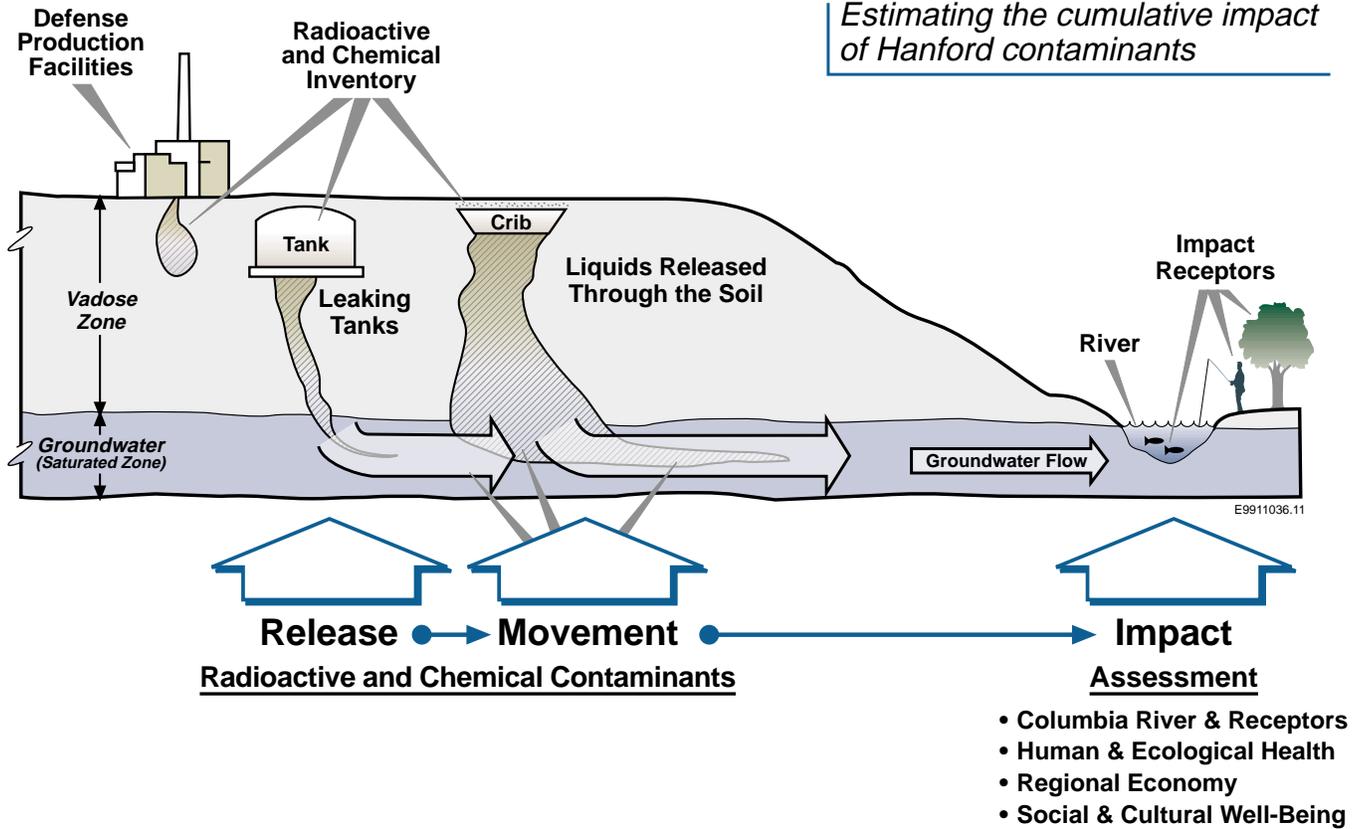
- ✓ **Developed a cumulative impact assessment approach**
- ✓ **Began work on the first iteration of the SAC (to be completed FY01)**
- ✓ **Partnered with the Tribal Nations, to expand risk assessment to include socio-cultural and economic impacts**
- ✓ **Use of a "dependency web" approach to gain early input on impacts**
- ✓ **Ongoing SAC work group activities**

The Defense Nuclear Facilities Safety Board, in Recommendation 94-2, also advised DOE to evaluate the impacts of contributing source terms to long-term performance of the existing low-level waste disposal operation. This analysis (the *Composite Analysis*) was completed in March 1998, and contributes to the understanding of site-wide effects.

The SAC work group has met throughout 1999 to exchange information on conceptual models for the SAC, and on the approach to be taken during the initial assessment. A related workshop was conducted in October 1999 to bring DOE decision-makers together with the CRCIA Team, in order to discuss issues regarding assessment management, independence, and credibility.

System Assessment Capability

Estimating the cumulative impact of Hanford contaminants



The Hanford Reach of the Columbia River.

Section 10 **SCIENCE AND TECHNOLOGY**

The objective of the S&T endeavor is to provide new knowledge, data, tools, and the scientific understanding required to make technically defensible cleanup decisions; and to protect the Columbia River and living systems.

S&T is focused on resolving key technical issues that influence cleanup decisions, including remediation, closure of tank farms, contaminated soil sites, and disposal of low-level radioactive waste. The S&T activities are conducted in partnership with the SAC and Hanford Site core projects.

The Environmental Management Science Program (EMSP) is administered through the DOE - EM's Office of S&T, under the direction of Gerald Boyd, and invests in basic and applied science. In FY99, the EMSP awarded 31 new grants (worth \$25 million in work scope over three years) based on the Integration Project S&T Roadmap. The EMSP researchers are now working closely with the Integration Project.

In FY99, two new S&T activities were initiated to gain new knowledge and data: the Soil Inventory Task, and Vadose Zone Transport Field Study. The Soil Inventory Task will develop a methodology for estimating a mass-balanced inventory for four waste site types at the Hanford Site, with associated uncertainty factored into the inventory. The Vadose Zone Transport Field Study will collect data under controlled conditions at uncontaminated vadose zone sites. The outcome will result in an improved understanding of the migration of water and contaminants in the vadose zone, as well as an improved assessment of several advanced characterization tools.

In FY00, three additional S&T tasks will be initiated: Field Investigations at Representative Sites, Vadose Zone Transport Modeling, and Groundwater/River Interface Study.

The Field Investigations at Representative Sites will conduct studies around contaminated vadose zone sites, which will complement sampling and analysis by the Hanford Site core projects. The outcome will be an enhanced understanding of vadose zone flow

and transport, which can be used to guide characterization, remediation, and monitoring.

The Vadose Zone Transport Model is a tool being used to integrate existing data and new knowledge. The outcome will be an advanced set of vadose zone contaminant transport models, which will be used in site-specific and site-wide applications.

The Groundwater/River Interface Study will enhance the current understanding of contaminant transport through the "zone of groundwater/river interaction" (exploring how contaminants enter the Columbia River). The study will provide a better understanding of how variations in river stage (i.e., the amount of water flowing in the river) impact the concentrations and locations of contaminants that enter the Columbia River.

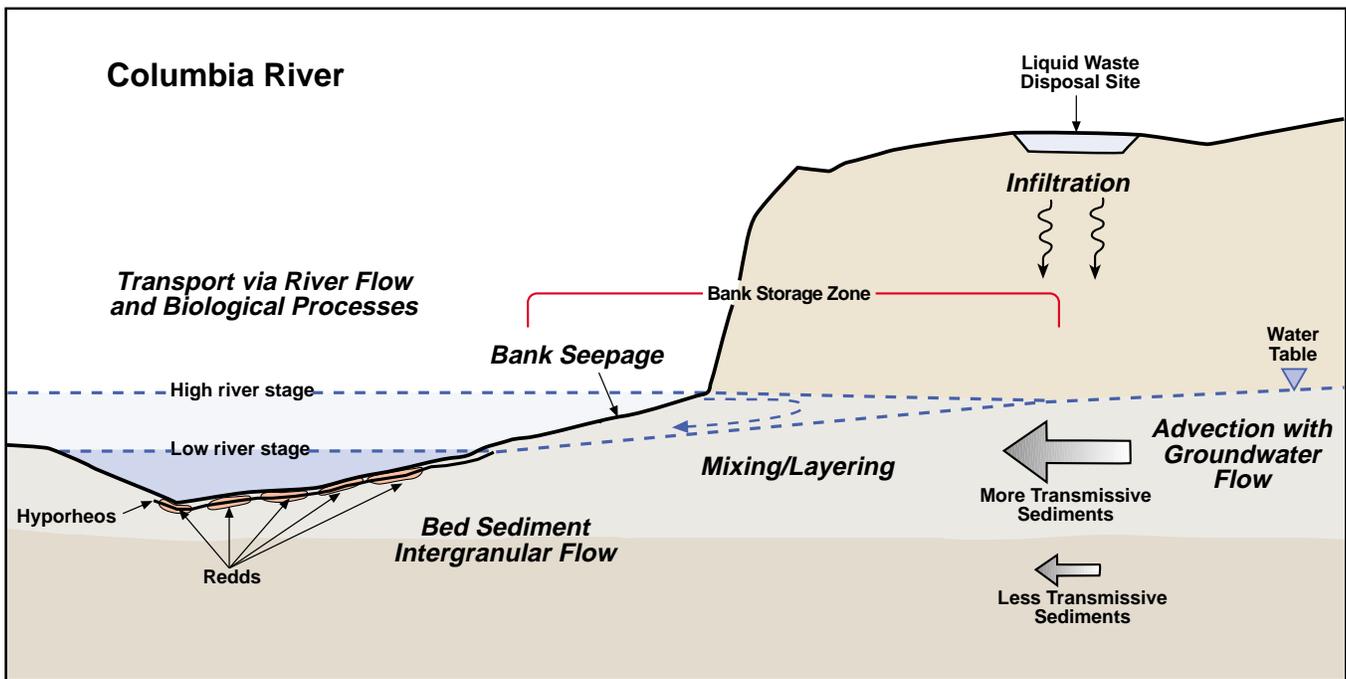
KEY ENDEAVOR

Use science and technology as the basis for making informed cleanup decisions, and to enable completion of a scientifically credible SAC.

ACCOMPLISHMENTS

- ✓ **DOE-HQ Environmental Management Science Program (EMSP) funding of Hanford research needs (\$25 million)**
- ✓ **Ongoing coordination and collaboration between the EMSP and Integration Project researchers**
- ✓ **Initiation of Soil Inventory work**
- ✓ **Development of a Vadose Zone Transport Field Study**
- ✓ **Initiation of a Groundwater/River Interface Study, Field Investigations at Representative Sites, and Vadose Transport Modeling**

Work is underway to complete scoping regarding risk S&T needs. The Integration Project has completed a series of meetings with representatives from the DOE, the national laboratories, universities, regulators, Tribal Nations, and stakeholders in order to provide input to revisions to the risk-related components of the S&T Plan and Roadmap.



Contaminant transport into the river will be explored in the Groundwater/River Interface Study.

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Hanford's community of affected people is large, passionate, diverse, and geographically dispersed; however, they are all united by a common desire to protect the Columbia River. A fully open, accessible, and inclusive involvement process is needed to build the trust and support necessary to move ahead.

Opportunities for involvement include sharing information, consultation, and collaboration. Examples are described below.

Tribal Nations. Technical discussions and ongoing involvement on an informal basis are conducted with Tribal Nations representatives. Consultations, including a more formal interface with the Tribal Nations, are conducted in conjunction with RL's Office of External Affairs (OEA).

Hanford Advisory Board (HAB). Information is provided to the HAB's Environmental Restoration (ER) Committee, and the HAB Public Involvement Committee. The ER Committee determines when project information should be presented to the full HAB for consideration.

One-on-One Outreach Meetings. Discussions with interested individuals and organizations are encouraged. Meetings with regional stakeholder groups, the Oregon Office of Energy, regulators, and Tribal Nations have been conducted. Presentations at related conferences are given whenever possible. This venue has been very effective in gaining input and insight into stakeholder values.

Project Team Meetings. Open project team meetings will continue to be held twice monthly to encourage effective two-way communication. Meetings are open to everyone, and meeting minutes are provided. An internet project web site is also maintained, with up-to-date information and documents (<http://www.bhi-erc.com/vadose>).

Working Groups. Focused working groups are used to bring project participants together with the project team to address critical project issues. These work groups are expected to be of limited duration,

and will target technical and policy issues. These meetings are open and inclusive. Work groups that are currently active are the SAC Work Group and Regulatory Path Forward Work Group.

Interested individuals and organizations are encouraged to contact the Integration Project Team,

KEY ENDEAVOR

Provide effective, real-time project involvement for all interested participants.

ACCOMPLISHMENTS

- ✓ **Set new standards for public involvement and openness at the Hanford Site.**
- ✓ **Implemented working groups involving regulators, stakeholders, and Tribal Nation representatives.**
- ✓ **Established an Integration Project internet web site, with current project information (<http://www.bhi-erc.com/vadose>).**
- ✓ **Provided information and support to the Hanford Advisory Board and its committees.**



Open project team meeting: December 6, 1999.



Dr. Ernest Moniz and Dr. Carolyn Huntoon at the IPEP Meeting, September, 1999

TECHNICAL REVIEW *Section 12*

The objective of technical review is to assure that the appropriate level of management and independent technical review is applied to all Hanford Site vadose zone, groundwater, Columbia River, and related workscope. The technical review activities, which support the Integration Project, include the IPEP, NAS, the consolidated groundwater project, and other project-specific reviews.

KEY ENDEAVOR

Provide DOE with independent technical review to improve decisions, project effectiveness, and technical credibility in achieving the Integration Project mission.

ACCOMPLISHMENTS

- ✓ **Five Integration Project Expert Panel (IPEP) meetings were held in Richland between September 1998 and September 1999 to provide oversight and guidance for the Integration Project.**
- ✓ **Three IPEP subpanel meetings were held to review field characterization, peer review, and risk components of the project.**
- ✓ **The Hanford Site-wide Groundwater Peer Review Panel held two meetings in Richland between November 1998 and June 1999 to complete the initial technical review of the proposed Hanford Site-Wide Groundwater Model.**
- ✓ **A Washington Advisory Group review of the policy and management structure for the Science & Technology program was completed in June 1999.**
- ✓ **The National Academy of Sciences panel will begin a technical peer review of Science & Technology in FY00.**

The IPEP has been established to provide broad oversight of the Integration Project. The IPEP focuses on problem resolution and technical reviews. The IPEP was selected by DOE-HQ from a field of over 80 names that were submitted by regulators, stakeholders, the DOE, and Tribal Nations. The IPEP has expertise in the areas of environmental management, geophysics, ecological health, radiochemistry, and hydrology. Members of the IPEP are listed below.

- Dr. Edgar Berkey, Chair (Engineering Physics)
- Prof. Randy L. Bassett (Geochemistry)
- Dr. John G. Conaway (Geophysics)
- Prof. James R. Karr (Fish and Wildlife Biology)
- Dr. Michael C. Kavanaugh (Civil, Chemical, and Environmental Engineering)
- Dr. John Matuszek (Geochemistry)
- Mr. Ralph O. Patt (Hydrology)
- Dr. Peter J. Wierenga (Vadose Zone Hydrology)

During FY99, the IPEP focused on four primary aspects of the Integration Project:

- Project Overview and Status
- The Long Range Plan for the Integration Project
- System Assessment Capability
- Groundwater/Vadose Zone Integration Project Summary Description report.

The IPEP continues to emphasize that the broad benefits from integration at the Hanford Site can be considerable, but will require management and technical perseverance to achieve.

The DOE has requested that independent, external peer reviews be conducted by the NAS on a periodic basis. These reviews will be coordinated with IPEP work. In accordance with NAS standards, the NAS review will be conducted by nationally recognized technical experts. During FY00, the NAS review will focus on S&T. Dr. Moniz and Dr. Huntoon, who both attended the September 1999 meeting, endorsed the efforts of the IPEP in helping the Integration Project succeed in meeting its goals.

Section 12

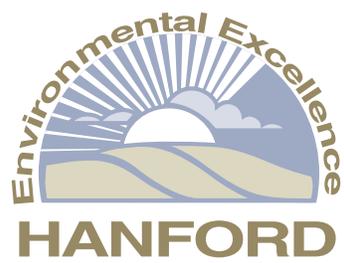
The Hanford core projects use various technical and peer review methods to ensure quality and technically sound products. For example, vadose zone characterization data to be used in support of the *Immobilized Low-Activity Tank Waste Performance Assessment* will be reviewed by external peer reviewers in FY2000. A Hanford Site-wide Groundwater Model Peer Review Panel also worked throughout FY99, and a report is expected in FY2000.

Recommendations and feedback received from numerous technical experts and panels are used to ensure the quality of products and accuracy of direction for the Integration Project and the core projects.

PROJECT DOCUMENTS

Listed below are several significant reports and documents produced by the Integration Project. These reports and documents are accessible through the Integration Project web site (<http://www.bhi-erc.com/vadose>), or they can be obtained by contacting the Integration Project at 509-372-9236. In addition to these documents, many important core project reports can be accessed through the web site.

- GW/VZ Integration Project Preliminary System Assessment Capability Concepts for Architecture, Platform, and Data Management (letter report)
 - Sept. 30, 1999
 - Appendix A - Inventory Conceptual Model
 - Appendix B - Release Conceptual Model
 - Appendix C - Vadose Zone Conceptual Model
 - Appendix D - Groundwater Conceptual Model
 - Appendix E - Columbia River Conceptual Model
 - Appendix F - Risk and Impact Conceptual Model
 - Appendix G - Uncertainty Analysis Alternatives
 - Appendix H - FY00 Plans and Schedule for Development
- Groundwater/Vadose Zone Project Summary Documents, Rev. 0 (DOE/RL-98-48) - June 1999
 - GW/VZ Integration Project Summary Description (Vol. 1, Rev. 0)
 - GW/VZ Integration Project Background Information and State of Knowledge (Vol. 2, Rev. 0)
 - GW/VZ Integration Project Science and Technology Summary Description (Vol. 3, Rev. 0)
- Groundwater/Vadose Zone Integration Project Long Range Plan - June 1999
- The Management and Integration of Hanford Site Groundwater and Vadose Zone Activities (DOE/RL-98-03) - April 1998



www.bhi-erc.com/vadose