

## **Expediting Groundwater Sampling at Hanford and Making It Safer - 13158**

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### **ABSTRACT**

The CH2M HILL Plateau Remediation Company (CHPRC) manages the groundwater-monitoring programs at the Department of Energy's 586-square-mile Hanford site in southeastern Washington state. These programs are regulated by the Resource Conservation and Recovery Act (RCRA), the Comprehensive Environmental Response Compensation and Liability Act (CERCLA), and the Atomic Energy Act (AEA). The purpose of monitoring is to track existing groundwater contamination from past practices, as well as other potential contamination that might originate from RCRA treatment, storage, and disposal (TSD) facilities. An integral part of the groundwater-monitoring program involves taking samples of the groundwater and measuring the water levels in wells scattered across the site. Each year, more than 1,500 wells are accessed for a variety of reasons.

Historically, the monitoring activities have been very "people intensive." Field personnel or "samplers" have been issued pre-printed forms showing information about the well(s) for a particular sampling evolution. This information is taken from two official electronic databases: the Hanford Well Information System (HWIS) and the Hanford Environmental Information System (HEIS). The samplers traditionally used these hardcopy forms to document the groundwater samples and well water-levels. After recording the entries in the field, the samplers turned the forms in at the end of the day and other personnel posted the collected information.

In *Automating Groundwater Sampling at Hanford* (HNF-38542-FP Revision 0, Presented at Waste Management 2009 Conference, March 1 – March 5, 2009, Phoenix, AZ), we described the methods, tools, and techniques that would be used in automating the activities associated with measuring water levels. The Field Logging and Electronic Data Gathering (FLEDG) application/database that automates collecting the water-level measurement data has now been implemented at Hanford. In addition to eliminating the need to print out documents, the system saves three-to-four man days each month for the field personnel taking the measurements and the

scientists and administrators managing the data and the documentation. After the information has received technical review, FLEDG automatically updates the database for water-level measurements and loads the document management system with the completed sampling report.

Due to safety considerations, access to wells is conditional. A spreadsheet with appropriate data not only lists the wells that are cleared for work, but also the safety personnel who must be present before work can start. This spreadsheet is used in planning daily activities. Daily plans are structured to ensure that the wells to be sampled are cleared for work and the appropriate safety personnel have been assigned and are present before the work starts.

Historically, the spreadsheets have been prepared manually, and as a result, are potentially subject to human error. However, a companion database application has been developed to work with FLEDG — making the entire sampling process more efficient and safer for personnel. The Well Access List – Electronic, WAL-E, is a database that contains much the same information that was previously manually loaded into the spread sheet. In addition, WAL-E contains a managed workflow application that shows the access requirements and allows for appropriate reviews of the compiled well. Various CHPRC organizations, including Industrial Hygiene, RADCON, and Well Maintenance and Sample Administration are able to enter and review the wells added or deleted from the WAL-E database. The FLEDG system then accesses this database information to identify appropriate support personnel and provide safety requirements to field personnel. In addition, WAL-E offers the assurance that wells have appropriate locks and are correctly labeled and electrically grounded as required, before well activities begin. This feature is an extremely important aspect of the FLEDG/WAL-E system because it adds another safety check to the work evolution and reduces the potential for unsafe conditions to exist that would lead to a stop-work situation.

This paper will further describe the technical aspects of both electronic programs/databases and their successful application at Hanford.

## **BACKGROUND**

The Hanford story has been written over several generations of stakeholders and during changing regulatory environments. At the same time, our knowledge of the waste and the regulations governing its storage, treatment, and disposal have also evolved.

Established in the 1940s to produce material for nuclear weapons as part of the Manhattan Project, Hanford is often referred to as the world's largest environmental cleanup project. The Site covers more than 586 square miles in a relatively remote region of southeastern Washington state in the U.S. (Figure 1). The production of nuclear material at Hanford has left a legacy of tremendous proportions in terms of hazardous and radioactive waste. From a waste-management point of view, the task is enormous: 1,700 waste sites; 500 contaminated buildings; 450 billion gallons of liquid waste discharged to the soil column; 270 billion gallons of contaminated groundwater that exceeds drinking-water standards; 53 million gallons of highly radioactive liquid waste stored in 177 underground tanks; 9 reactors; 5 million cubic yards of contaminated soil; 22 thousand drums of mixed waste; 2,300 tons of spent nuclear fuel; and 20 tons of plutonium-bearing material...for just a partial listing.

### Hanford Site Setting

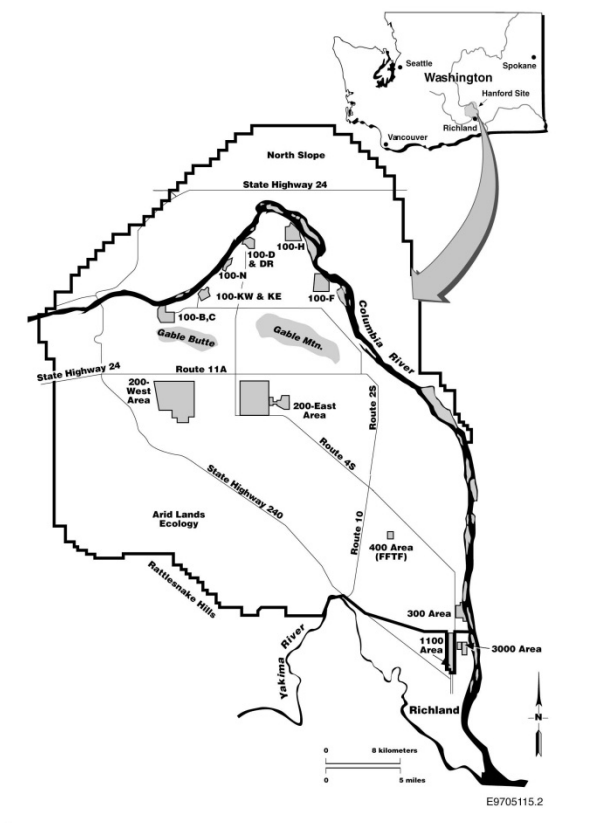


Fig. 1. Hanford is a 586-square-mile reservation bordered by the Columbia River in southeastern Washington state.

### Operational Overview of the Hanford Site

In 1943, under the auspices of the Manhattan Project, the U.S. Army Corps of Engineers selected Hanford to produce plutonium for national defense. This objective required a large complex that included multiple facilities: fuel manufacturing, nuclear reactors, chemical processing, waste management, and research.

By 1944, two of nine production reactors had been constructed, and were irradiating uranium to produce plutonium. Eight of the reactors, which ran until 1971, were graphite-moderated and used water from the Columbia River for once-through cooling. The ninth reactor, a dual-purpose unit (N Reactor), used recirculating water coolant and produced plutonium for defense applications, as well as steam for electricity. N Reactor, now deactivated, operated until 1987.

Two test reactors and one commercial unit were also built and operated at Hanford: the Plutonium Recycle Test Reactor (PRTR), the Fast Flux Test Facility (FFTF), and a unit owned

and operated by Washington Public Power Supply System, respectively. The PRTR, now deactivated, was a heavy-water-moderated test reactor. FFTF, also deactivated, was a sodium-cooled reactor used to test fuel and material for advanced commercial nuclear power plants. The commercial nuclear power plant, WNP-2, is a boiling water reactor that is still operating today.

Chemical-processing operations during nuclear production generated highly radioactive liquid wastes. About 245 million liters (65 million gallons) of high-level waste are stored at the Hanford Site in 177 large single- and double-shelled underground tanks.

The solid waste generated from past operations consists of low-level radioactive waste, low-level mixed waste, transuranic waste, and hazardous chemical waste. A commercial low-level radioactive waste disposal facility, operated by US Ecology, is located on the Site on land leased to Washington State.

## **INTRODUCTION**

In *Automating Groundwater Sampling at Hanford*, Reference 3, we introduced Field Logging and Electronic Data Gathering (FLEDG). FLEDG is an application that automatically updates the database with water-level measurements. The system saves many man hours each week for both the field personnel making the measurements and the scientists and administrators managing the data and the documentation. Generally, the samplers like using new tools that make their job easier and more interesting.

When field personnel arrive at a well to perform work, one of the first considerations before removing the well cap is to determine if all the appropriate safety measures are in place. Safety measures for well access must address radiological and chemical concerns. Some wells, such as those used for sampling groundwater, may also use an electrical pump. For this situation, electrical safety is a factor and the grounding status of a well must be evaluated. Multiple organizations are involved in evaluating the safety measures for a well. Radiological concerns are evaluation by radiation control personnel. Chemical aspects are addressed by Industrial Health (IH) personnel and Electrical safety is evaluated by personnel in the Well Maintenance organization.

For any well needing access, all three organizations must be involved to ensure that all well access safety measures are addressed and that safety personnel are provided to support field personnel when required. A hard-copy spread sheet called the Well Access List (WAL) was created to provide the personnel in the field the necessary information on the safety personnel who must be present at the well and ensure that appropriate electrical grounding measures have been implemented.

An electronic version of WAL was maintained in a shared folder and could be accessed from a web page by all three organizations. However, this approach lacked the necessary controls to prevent incorrect data from being entered and potentially lead to a “stop-work” condition. It became apparent that a more robust system had to be developed that would help ensure that the appropriate and accurate data was made available to personnel in a timely manner. This led to the development of a new system called Well Access List Electronic (WAL-E).

The WAL-E system minimizes the potential for data errors, allows multiple users to manage and view the data simultaneously, and provides a clear audit trail of the data throughout the review process.

The WAL-E is a multi-component software system consisting of data administration software installed on desktop computers of key personnel in affected organizations. WAL-E also has a web-based component that is used to distribute updated and verified WAL data to personnel across the Hanford site. In addition, the WAL-E database provides an interface for other systems such as FLEDG to access current and verified data for inclusion on reports.

So what is the relationship between FLEDG and WAL? Well up to now, there hasn't been any and they operated independently. Events have occurred where FLEDG was used to send samplers (a sample team of two personnel) to a well to conduct water-level measuring, but since WAL wasn't used the samplers didn't know what safety measures were required. This situation, of course, was a safety concern to the samplers and could also result in a "stop work."

#### **WAL-E DATA ADMINISTRATION AND FLEDG INTERFACE**

Figure 2 illustrates the architecture of WAL-E, which is a system used to contain, view, and administer data/information for managing and communicating controls required for well access. The system consists of a Microsoft SQL Server database that holds the data, a read-only Web interface that allows the data to be viewed and printed, and a Microsoft Windows Forms desktop application to administer the data.

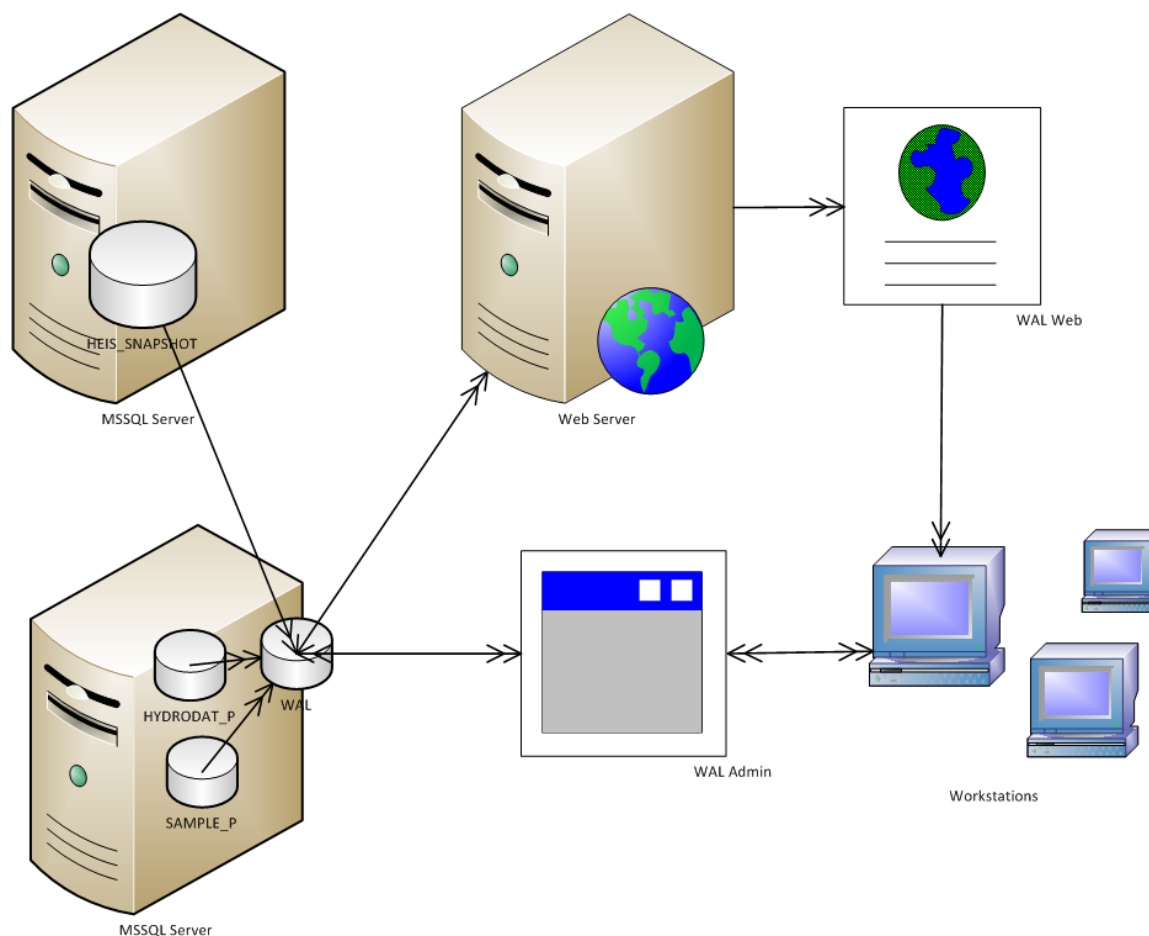


Fig. 2. Architecture for WAL-E allows the system to contain, view, and administer data/information.

The WAL-E database provides relationally linked table structures for storing data regarding decisions that have been made that affect well access requirements. Using MS SQL Server database coding techniques, such as code objects (e.g., triggers, functions, procedures), various data business rules are implemented. These rules are designed to help ensure that data integrity complies with the site business processes.

The WAL database is managed with the WAL-E administrative desktop application (WAL-E Admin). WAL-E Admin uses role-based authentication to facilitate the business flow of WAL-E data through the system from the addition of a new well through required reviews — from Industrial Hygiene (IH), Radiological Control (RC), and Grounding Status to verification of Lock and Label status and approval for display on the Web and through FLEDG.

Using the WAL-E Desktop administrator, the WAL administrator begins the process by adding a valid well to the system. This action triggers an email notification to representatives of all other roles that a well has been added and requires an access determination. Once IH, RC, and Grounding Status personnel have completed their determinations, well maintenance personnel are dispatched to the well for Lock and Label verification. Appropriate Lock and Labels are then

installed for the well and then the well returns to the WAL administrator for final approval of well access information.

A Data Determiner role can set a determination expiration date on a well. On that date, the well will reappear in the queue of outstanding determinations for that particular role. Once the determination is made, if the determination has changed from the previous determination, the well will again be sent to Lock and Label for verification and then onto the WAL administrator for approval. If the new determination is an Upgrade from the previous determination, an email will be sent to the WAL administrator.

Personnel assigned to the WAL administrator role can approve the well data that is displayed or made available to WAL data consumers. This role may also reject one or more of the determinations, in which case an email is sent to representatives of the appropriate Data Determiner role(s).

The set of information available for display to data consumers will not change until the WAL administrator approves the change(s). The WAL administrator has the option of immediately publishing approved data changes or waiting until the nightly automated task performs the update. Immediate data publication is at the discretion of the WAL administrator and would be necessary to make the data changes available to consumers sooner than the automated process would accommodate. This work flow process is illustrated in Fig. 3, WAL-E Application Work Flow.

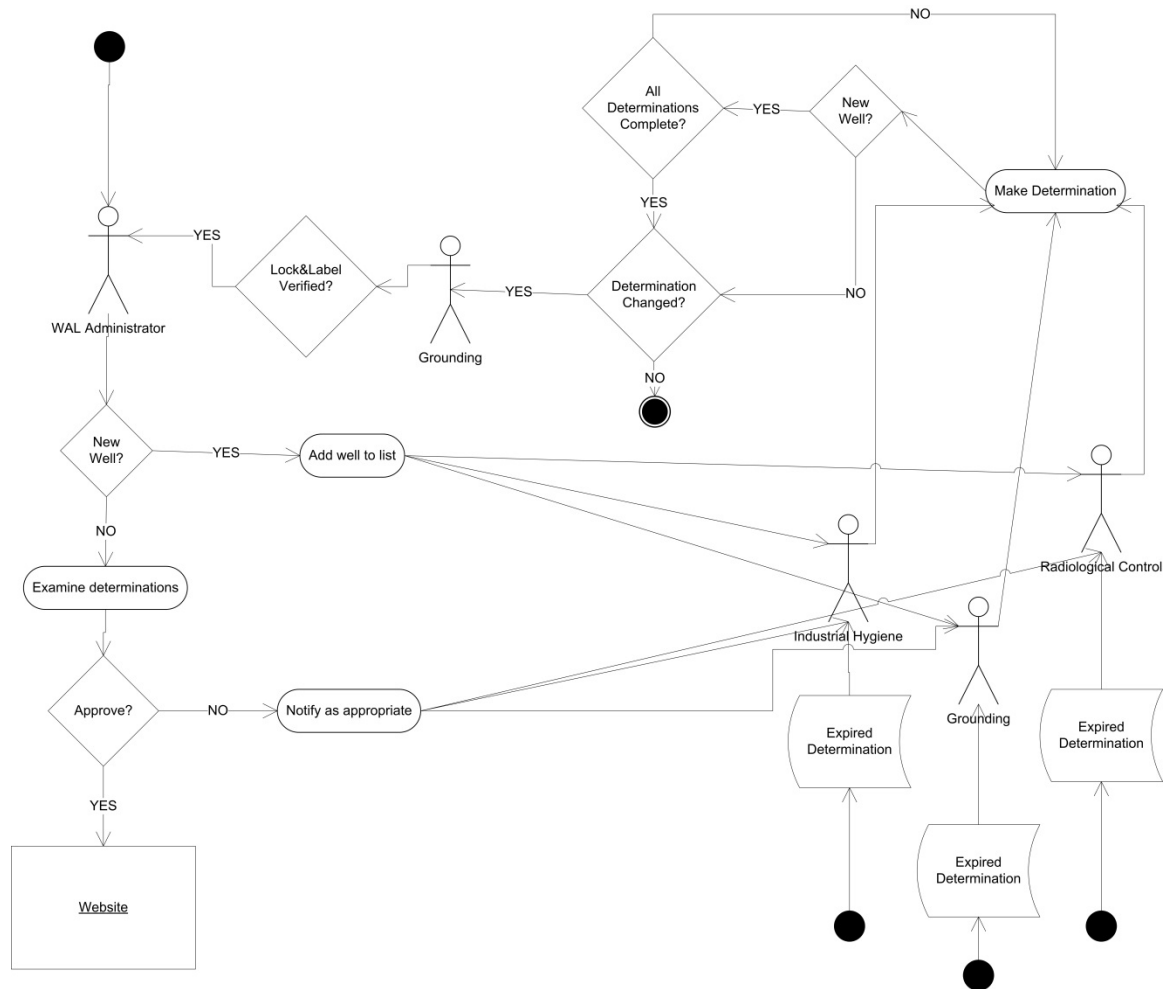


Fig. 3. WAL-E Application Work Flow

Where data already exists in a managed database, the WAL-E database makes use of that data instead of storing it redundantly. Data is consumed from HEIS\_SNAPSHOT for well data, HYDRODAT for water level information, and SAMPLE\_P for well sample scheduling data.

Now that we have WAL data in the WAL database, we can share it with other applications. The FLEDG application “queries” the WAL database to determine which wells to be measured need access restrictions and provides that information when the FLEDG schedule is published to the field notebook computers. In the publishing process a field supervisor reviews the FLEDG schedule before releasing it to the field PCs.



### **WAL-E WEB COMPONENT**

Whereas the WAL-E Administration software provides strict workflow controls that result in verified and validated well access information, the WAL-E Web provides the mechanism for making that information publicly available to all Hanford site personnel.

Using a link provided on the ‘Soil and Groundwater Remediation Project’ website, personnel can launch the WAL-E Web component. This component provides up-to-date and verified Well Access information. Personnel are allowed to select wells of interest and can then print out the ‘Well Access List’ report if desired. Among other things, this report contains the information necessary to determine if RC or IH personnel are required and the ‘Grounding Status’ of a well. Instructions that provide a concise explanation of the data presented are also provided on the report.

### **SUMMARY**

The systems supporting the activities involved in monitoring wells at Hanford have been revamped and upgraded to improve efficiency, assure accuracy, promote safety, and facilitate availability of data. Processes for providing access to wells, taking and recording measurements and ensuring its correctness, maintaining and integrating the data, and making it readily have been automated and integrated. It is too early to calculate the tangible cost benefits of this newly implemented interactive, interdependent suite of electronic applications and databases. However, the inclusion of sign-offs by discipline-specific organizations as well as detailed pre-job requirements reduces the potential for complacency and ensures safety in the field – all of which translate to lower costs and better performance. During the development of these applications, users were consulted to ensure their needs were being met and the resulting system would be user friendly and compliant.

### **ACKNOWLEDGMENTS**

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### **REFERENCES**

1. Resource Conservation and Recovery Act (RCRA). 1976. Public Law-580, as amended, 42 USC 6901 et seq.
2. Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). 1980. Public Law 96-150, As Amended, 94 Stat. 2767, 42 USC 9601 Et Seq.
3. *Automating Groundwater Sampling at Hanford*, HNF-38542-FP Revision 0, Presented at Waste Management 2009 Conference, March 1 – March 5, 2009, Phoenix, AZ.