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Revision 0

Automating Groundwater Sampling at Hanford, The Next Step

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

Contractor for the U.S. Department of Energy
under Contract DE-AC06-08RL14788

CH2MHILL
Plateau Remediation Company

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ABSTRACT

Historically, the groundwater monitoring activities at the Department of Energy's Hanford Site in southeastern Washington State have been very "people intensive." Approximately 1500 wells are sampled each year by field personnel or "samplers." These individuals 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 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 onto a spreadsheet that was then printed and included in a log book. The log book was then used to make manual entries of the new information into the software application(s) for the HEIS and HWIS databases.

A pilot project for automating this extremely tedious process was launched in 2008. Initially, the automation was focused on water-level measurements. Now, the effort is being extended to automate the meta-data associated with collecting groundwater samples. The project allowed electronic forms produced in the field by samplers to be used in a work flow process where the data is transferred to the database and the electronic form is filed in managed records ─ thus eliminating manually completed forms. Eliminating the manual forms and streamlining the data entry not only improved the accuracy of the information recorded, but also enhanced the efficiency and sampling capacity of field office personnel.

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

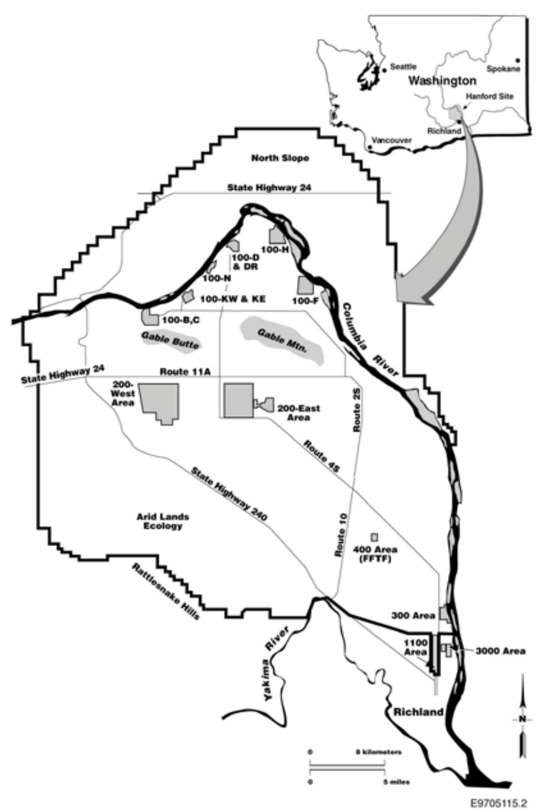


Fig. 1. Hanford is a 586-square-mile reservation bordered by the Columbia River in southeastern Washington State.

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 was a heavy-water-moderated test reactor. The PRTR has been deactivated. FFTF, a sodium-cooled reactor, was used to test fuel and material for advanced commercial nuclear power plants. In 1993, FFTF began transitioning towards permanent shutdown. 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. Of the original 149 single-shell tanks, 67 have leaked, or are assumed to have leaked, about 3.8 million liters (1 million gallons) of contaminated liquid to the soil column – recent estimates push the number even higher. The 28 double-shell tanks built since 1968 have a tank-within-a-tank design and have not leaked.

The solid waste generated from past operations consists of low-level radioactive waste, low-level mixed waste, transuranic waste, and hazardous chemical waste. The current inventory of solid waste buried or stored in underground trenches and above-ground facilities is about 87,000 cubic meters (114,000 cubic yards) in the 100 Area; 379,000 cubic meters (495,000 cubic yards) in the 200 Area; and 159,000 cubic meters (208,000 cubic yards) in the 300 Area. 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 *Environmental Sampling and Analysis, Getting It Right!*, Reference 4, we presented the background on the Hanford Site, the regulatory framework, and the Environmental Databases and applications. That paper focused on automating the sample data management process with the Sample Data Tracking (SDT).

In *Automating Groundwater Sampling at Hanford*, Reference 3, we presented the plan, risk, assumptions, and constraints of the water-level measuring project. We also described the methods, tools, and techniques that would be used in automating water-level. The Field Logging and Electronic Data Gathering (FLEDG) application and automated water-level measurement are operational at Hanford today and the system saves many man hours per week for both the field personnel making the measurements and the scientists and administrators who manage the data and the documentation. The use of FLEDG has increased the number of measurement per team, per day and increased the accuracy and reliability of the data collected. Additional training is needed and samplers need to qualify in the use of FLEDG. Also, extended absence from performing the task requires some re-training. Aside from the development cost, the additional costs come in the procurement of the rugged laptop computers. Generally, the samplers like using the new equipment as it make their job easier and more interesting. In this paper, we discuss the next step in this evolution – automating the collection of Meta- and field data as part of the environmental sampling process.

Generally, the information that would be recorded on forms used to keep track of the sampling is handled as electronic information/data. For this application, the start of the process is at the Hanford Environmental Information System (HEIS) database. The SDT application is used to complete the Sample Authorization Form (SAF) and the Sample Analysis Request (SAR) and the content of these documents will be contained in the HIES database. As required for the sampling process by Field Operations personnel in the Soil & Groundwater Project (SGRP), a request to upload the electronic information, which would have been used to create the forms, is loaded into the FLEDG database. This step begins the automation of the collection of the Meta data and field data.

AUTOMATED SAMPLING

As shown in Exhibit 1, a CHPRC CHAIN OF CUSTODY/SAMPLE ANALYSIS REQUEST (SAR) is currently used to initiate work on a particular sampling project. The SAR is backed by a Data Quality Objective (DQO) for the remediation project, a Sample Authorization Plan (SAP) that has been approved by the regulators, and a Sample Authorization Form (SAF) authorizing the environmental sampling. The SAR and Chain-of Custody (COC) are printed and sent to the Field Operations personnel to perform the sampling. Instead of printing the forms and then filling them in as the sampling proceeds, the equivalent electronic form will be used to log the values on a hardened laptop and the Samplers will record the information as they proceed through the process of collecting samples.

Exhibit 2, FLEDG2 CONCEPTUAL DESIGN illustrates the concept being developed for automating collecting both field and Meta data associated with environmental sampling. The goal is to eliminate as much paper as possible. The process starts with a request to upload the information/data associated with a sample event. [Note that scheduling the sampling event and other upfront activities is not addressed as part of the process being described.] As the information is uploaded to the FLEDG database, an email is sent to the analytical laboratory for which the samples are intended. After the SAR has been loaded into the database and processed, including setting flags as to current status, the job is downloaded to the field laptop being used to track the sampling event.

Depending on what is being sampled, the process could be repeated many times in a single day or over a period of days as would be the case for well drilling. Typically, samples are stored before being shipped to the analytical laboratory. The process recognizes this phase and allows for storage and an update to the COC. The current concept is that the COC will be housed in a database and updated through formatted e-mails as possession changes. The formatted e-mail would typically contain the COC identification number, the person or organization relinquishing the sample, and the entity receiving the sample. Security issues associated with updating the COC may require some additional measures. The formatted e-mail (message) will be sent to an e-mail account that is monitored by an application associated with the FLEDG database. That application will read the e-mail and update the COC. The status of the COC would be available for review/inspection at any time through a query to the database.

Following whatever storage may occur, the sample(s) are shipped to the analytical laboratory and the COC is updated at the time of shipment and again at the time of receipt by the laboratory. The laboratory tracks the sample(s) with their internal COC until the analysis is complete and an electronic data deliverable (EDD) is prepared and uploaded to the Hanford EDD Processor. The EDD Processor is described in Reference 4, *Sampling and Analysis, Getting It Right!*

At completion of the sampling event, the information and data collected on the field laptop is uploaded to the FLRDG database. The status of the job is updated, correctly formatted data is uploaded to HEIS and a Groundwater Summary Report (GSR) or equivalent is prepared

SUMMARY

The work described in this paper is directed at increasing the efficiency, accuracy, and reliability of logged Meta data to support groundwater sampling and water-level measurements. Such data logging with portable computers and other "hand-held" devices has been used for years in many industries, such as the Oil and Gas industry where field data was overwhelming them. Field-sampling of environmental data at Hanford has historically been by hand-written logs that are entered by a third party into an application used to load the Meta data. By making the initial data entry in the field with built-in checks in the recording device is a major step in preserving the integrity of the data. The next step will be loading the actual data measured directly into the recording device *via* connected sensors.

ACKNOWLEDGMENTS

The work described herein has been, and continues to be funded by the DOE *via* the Plateau Remediation Contract.

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.

4. *Environmental Sampling and Analysis, Getting It Right!*, HNF-34859-FP Revision 0, Presented at Waste Management 2008 Conference, February 24 – February 28, 2008, Phoenix, AZ.

EXHIBIT 1 – CHPRC CHAIN OF CUSTODY/SAMPLE ANALYSIS REQUEST

CHPRC CHAIN OF CUSTODY/SAMPLE ANALYSIS REQUEST		C.O.C. No.
		Page of
Collector	Contact/Requestor	Telephone No. MSIN FAX
SAF No.	Sample Origin	Purchase Order/Charge Code
Project Title	Logbook No.	Ice Chest No. Temp.
Shipped To (Lab)	Method of Shipment	Bill of Lading/Air Bill No.
Protocol	Data Turnaround	Offsite Property No.

Sample No.	Lab ID	*	Date	Time	No./Type Container	Sample Analysis	Preservative

POSSIBLE SAMPLE HAZARDS/REMARKS (List all known wastes) MSDS ◯ Yes ◯ No	SPECIAL INSTRUCTIONS	Hold Time

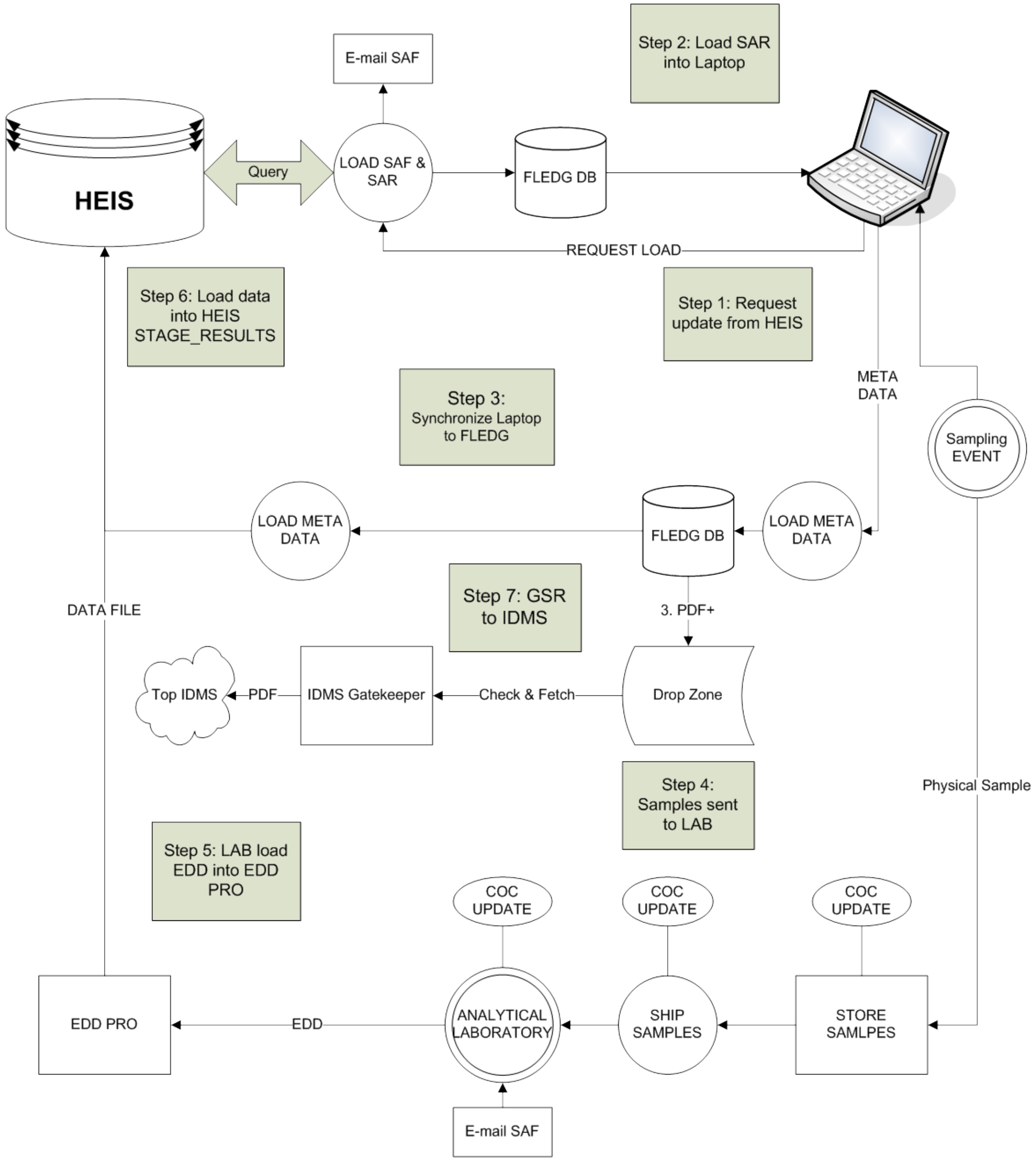
Relinquished By Print Sign Date/Time	Received By Print Sign Date/Time	Matrix*
Relinquished By Date/Time	Received By Date/Time	S = Soil; SE = Sediment; SO = Solid; SL = Sludge; W = Water; O = Oil; A = Air
Relinquished By Date/Time	Received By Date/Time	DS = Drum Solids; DL = Drum Liquids; T = Tissue; WI = Wipe; L = Liquid; V = Vegetation; X = Other
Relinquished By Date/Time	Received By Date/Time	

FINAL SAMPLE DISPOSITION	Disposal Method (e.g., Return to customer, per lab procedure, used in process)	Disposed By	Date/Time

All samples containing hazardous materials shall be picked up by requestor and returned to parent container or site of origin.

A-6004-842 (REV 0)

EXHIBIT 2 – FLEDG2 CONCEPTUAL DESIGN



Automated Meta Data Collection For Environmental Sampling