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COMPREHENSIVE ENVIRONMENTAL MANAGEMENT SYSTEM APPROACH: THE RIGHT TOOL FOR STEWARDSHIP

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ABSTRACT

Expertise, methodologies and equipment from separate programs at the large Department of Energy sites can be combined to produce a powerful risk-based planning tool for stewardship. Modeling expertise has been developed while conducting required Performance Assessments and Composite Analyses. Data management and display capabilities of modern Geographical Information Systems can make the modeling results useful tools for planning and stewardship.

INTRODUCTION

The currently accepted approach for evaluating risk from DOE actions; whether it is siting a new mission, decommissioning a building, closing a waste site or operating a Low Level Waste (LLW) disposal facility, is to evaluate the risk from each action in isolation, without regard to cumulative effects. These actions are designed to meet performance objectives or regulatory guidelines which are quite different depending upon the rules which are being followed.

The Defense Nuclear Facility Safety Board (DNFSB) recognized the need to integrate risk from interacting sources of contamination in evaluating LLW disposal operations in 1994 (1). The DOE Implementation Plan for DNFSB Recommendation 94-2 (2) called for a "comprehensive environmental management systems approach" in considering risk from all DOE operations that can contribute to the dose to a future member of the public from LLW operations at a site. The result was a series of reports from the large DOE site called Composite Analyses, which consider residual radioactivity that might interact with releases from currently active LLW disposal facilities. However, this approach does not 1) integrate the risk across an entire site, 2) factor in all present and future activities, or 3) account for all contaminants of concern.

Stewardship is defined as "the conducting, supervising, or managing of something; especially : the careful and responsible management of something entrusted to one's care" (3). At the large DOE sites, stewardship involves a variety of activities done by a number of organizational units. These include operation of disposal facilities by the Waste Management organizations, remediation and closure activities by the Environmental Restoration groups and decontamination and decommissioning work by those in the Facilities Decommissioning area. Actions taken by each of these groups will impact future monitoring and land use. No program currently exists that integrates risks from present and future activities at a site for use in making decisions affecting stewardship. A management tool that can integrate and evaluate the cumulative effects of all these actions is needed.

The management tool should operate on existing data, but the data must be in an organized and useable form. Therefore, relational database methods, Geographic Information System (GIS) display techniques and automated evaluation tools developed at DOE sites can be used to organize and manage data. The methodology, models and presentation tools can be developed for an entire site. Model results can be compared to results from environmental monitoring programs to "calibrate" the models.

Over the past decade, SRS and other large DOE sites have developed computer modeling and data analysis methodologies that can be used as a management tool for stewardship. These techniques were developed for the performance assessment, composite analysis and environmental restoration programs. A management tool of this kind is needed because every programmatic decision made today will have an effect on stewardship in the future.

DISCUSSION

Composite Analysis

Each of the five major DOE sites, the Savannah River Site (SRS), Oak Ridge National Laboratory, Las Alamos National Laboratory, Idaho National Engineering Laboratory and Hanford, has completed at least one Composite Analysis. The work at Savannah River (4) will be used to demonstrate both the process and the results.

There are two currently active radioactive waste disposal facilities at SRS, located in E-Area and Z-Area. Both of these are in the central part of the site, known as the General Separations Area (Fig. 1). This name arises because two large chemical separations plants are located there.

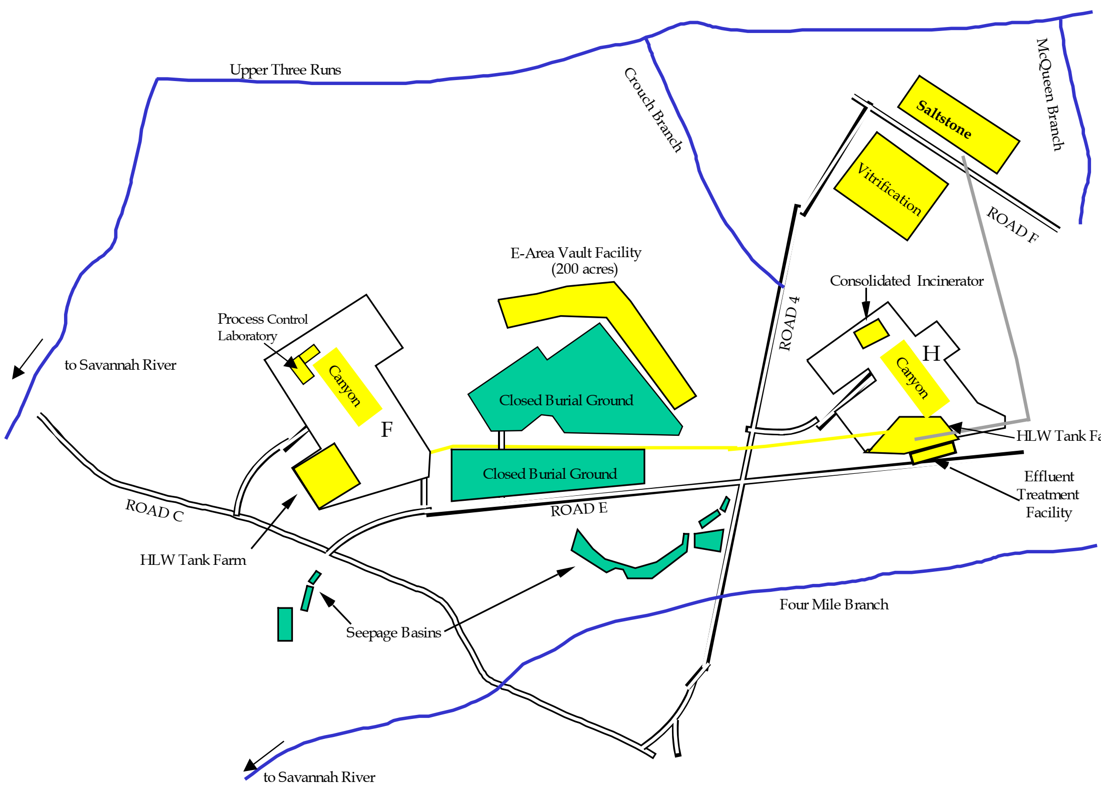


Fig. 1. Schematic of the SRS General Separations Area

In conducting the Composite Analysis, a total of 114 facilities were found to have the potential for residual radioactivity. These were investigated more thoroughly, leading to the elimination of many buildings where materials were stored in a manner that complete removal of radioactivity was considered plausible. Table I lists the facilities that were analyzed in detail, and gives an indication of the range of facility types that had to be studied.

Table I. List of Facilities Analyzed in the Composite Analysis

Facility Location	Facility Name	Facility Location	Facility Name
F-Area Separations	Canyon	E Area (cont'd)	Old Solvent Storage Tanks
	New Sand Filter		Naval Reactors KAPL CB/TS
	Old Sand Filter		Naval Reactors KAPL Head
F-Area Tanks	Tanks 1-8		Naval Fuel Waste
	Tanks 17-20		E-Area Trenches
	Tanks 25-28, and 44-47		Vaults LAW
	Tanks 33-34		Vaults ILV
F Area	772-F Lab	S Area	DWPF
	772-1F Lab		Low Point Pump Pit
H-Area Separations	Canyon	Z Area	Saltstone Vaults
	New Sand Filter	Various Spills	Spill at Tank 13
	Old Sand Filter		Spill at Tank 9
H-Area Tanks	Tanks 9-12		Spill at Tank 16
	Tanks 13-16		Spill at Tank 37
	Tanks 21-24, 29-32, and 35-37		Spill at B281-3F
	Tanks 38-43		Spill at 200-F
	Tanks 48-51		Spill at Tank 3
H Area	ETF Receipt Tank		Spill at Tank 8
	Tritium Processing		Spill at B281-3H
E Area	Old Burial Ground	RCRA/CERCLA Units	
	Lysimeters	F Area	Seepage Basin Operable Unit
	Saltstone Lysimeters		Inactive Process Sewer Lines
	MWMF 643-7E and 643-28E	H Area	Seepage Basin Operable Unit
			CIF Solvent Storage Tanks
			Inactive Process Sewer Lines

Examination of records and interviews with knowledgeable personnel resulted in a list of 115 radionuclides that could be in these facilities. This process was carried out using the seven steps outlined in the Data Quality Objective process (5) Of course, not every radioncuilide was thought to be in each facility. A screening methodology was used to reduce the number of radionuclides actually modeled to 31. While this is considerable fewer that the original list, it still represents a formidable task.

The release of the residual inventory from each facility was modeled to calculate an annual flux to the water table over a one-thousand year time interval. For the active low-level waste disposal facilities this was done using a two-dimensional numerical code, PORFLOW (6). The remaining facilities were modeled using a one dimensional analytical code, PATHRAE (7). Each of the individual flux curves was input into a three dimensional saturated flow code, FACT (8) and transport code, PORFLOW (6). The results of the modeling work gave the curies per year in to the bounding streams for each radionuclide from each facility over a thousand-year time period.

The methodology used in the Site's Annual Monitoring Report (9) was used to calculate the projected dose to a member of the public and at other locations of potential interest (Fig. 2.). In effect, the overall process can be thought of as a way to predict what the Envirinmental Monitoring Report will say in future, with respect to contributions from the General Separations Area.

Geographical Information System

A computer data base and display technology known as a Geographical Information System (GIS) has proven to be a very effective way to manage and present a wide variety of spatially distributed data. At SRS the a system has been developed to support the Environmental Restoration program. It contains a vast amount of data resulting from waste site characterization, hydrogeologic studies, and the results from the site-wide environmental monitoring program. The locations and properties of every surface feature of the site is also part of the data base.

The information can be combined, sorted, layered and presented in an almost infinite number of ways. This allows the presentation of a great deal of complex informatiuon to be displayed in a way that is much easier to interpret than traditional figures, graphs and tables.

Figure 3 is a GIS plot of tritium monitoring data from SRS at a single point in time. Locations of both surface water and groundwater sampling points and the magnitude of the analytical result are shown. The locations of stream, roads and facilities on the same plot make it a simple matter to visualize the overall distribution of the tritium.

Stewardship Planning Tool

By linking the Composite Analysis modeling methodology with the data management and display capabilities of the GIS system, the foundation of a tool for making risk-based decisions for stewardship can be laid, but some further development of each part is needed.

The Composite Analysis considered a large number of facilities and materials at SRS, but not all of them. To be most useful the process must be expanded to include the entire 300 square mile site. At SRS the major facilities that would be brought in are five inactive reactor areas. In addition, residual chemical contaminants need to be included in the process

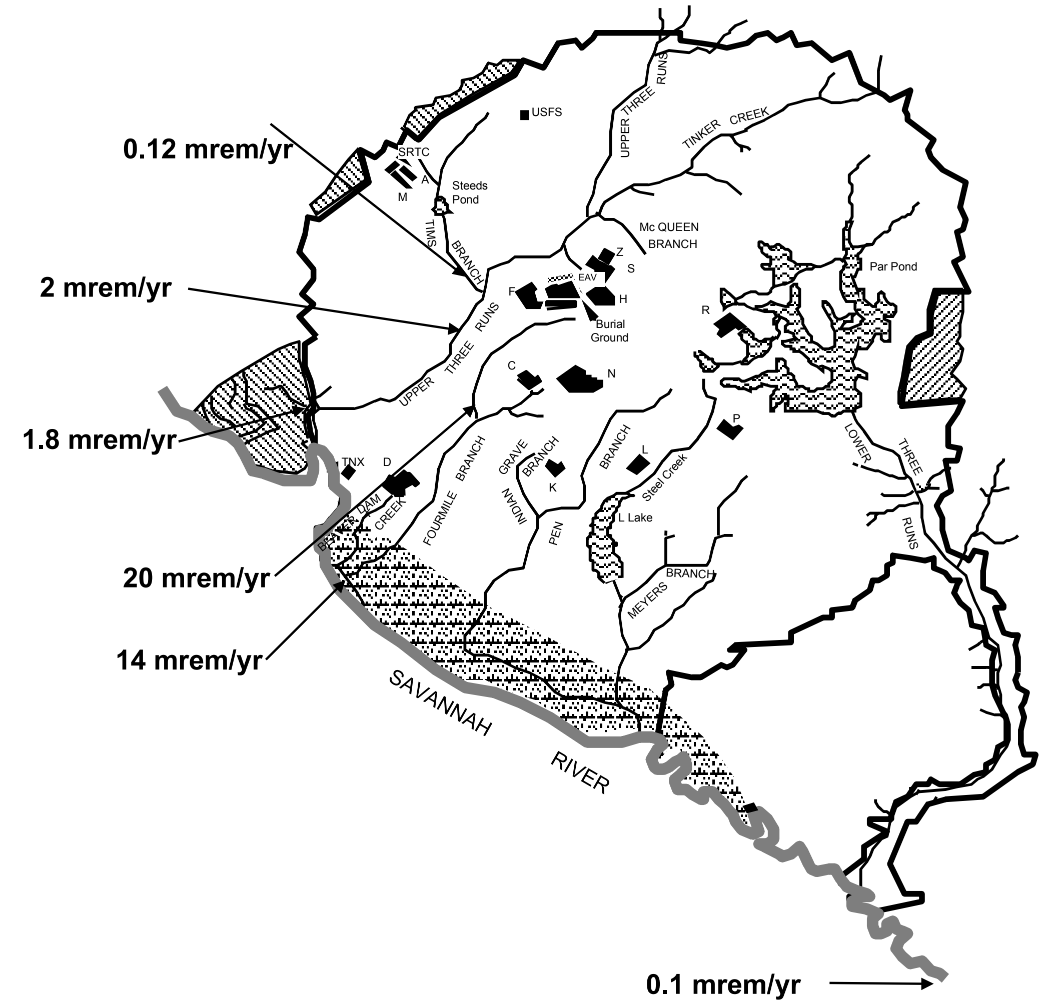


Figure 2. Maximum calculated doses from SRS Composite Analysis

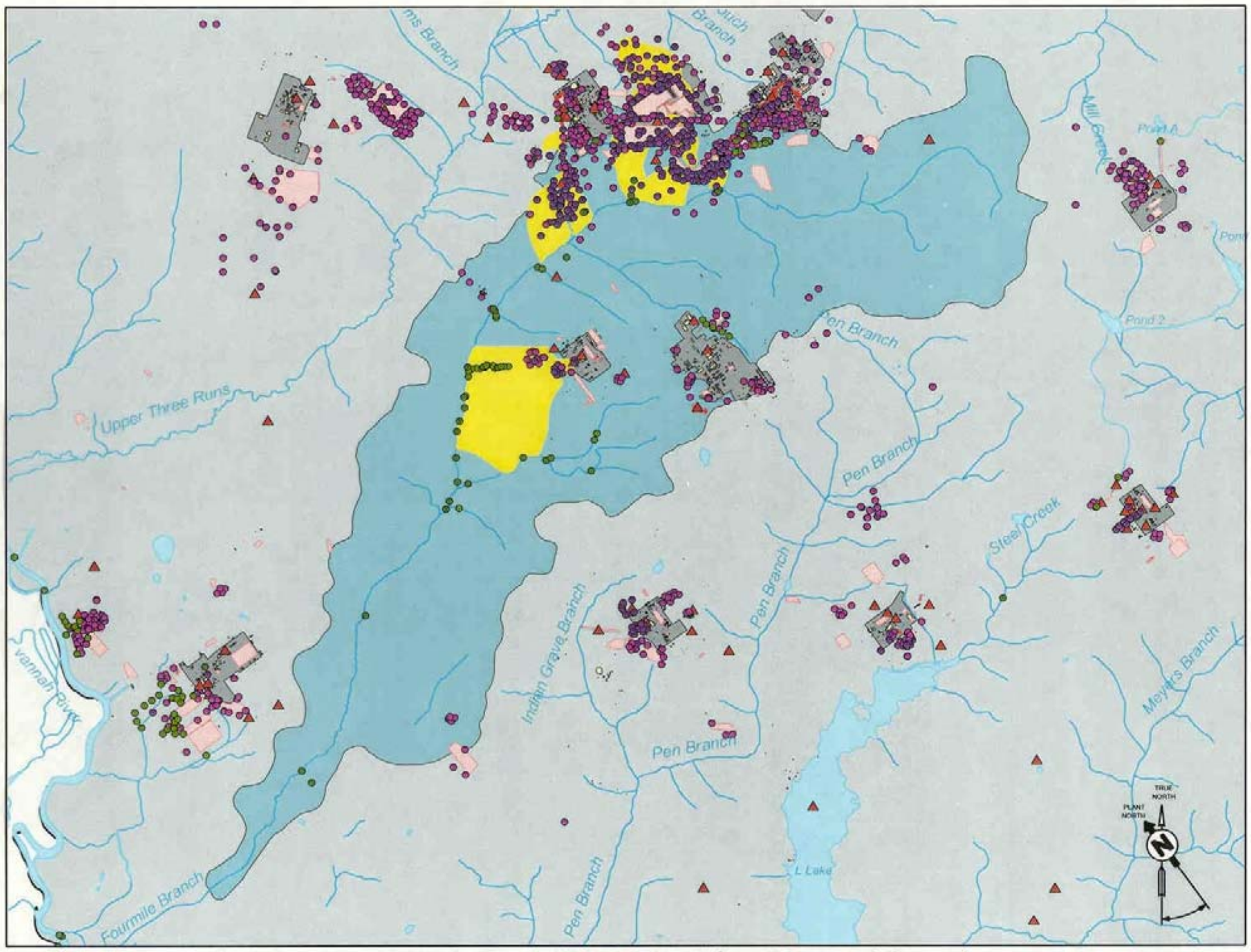
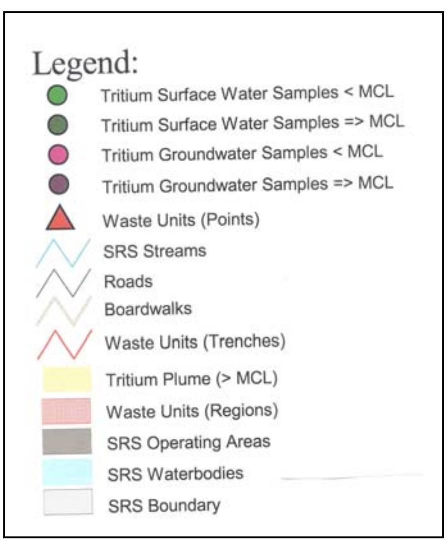


Fig. 3. GIS map of SRS monitoring data



The major improvement needed in the GIS system is the ability to display three-dimensional model results showing environmental concentrations of contaminants and their associated doses, exposures and risks, and show how they change over a thousand-year time frame.

Once these improvements have been made, a “base case” would be defined consisting of the current best estimate of the end state of each and every facility on the site. This would include the final physical configuration as well as the chemical and radiological residuals. The data would be put into the model and the resulting distribution of contaminants through time would be transferred to the GIS system for interpretation (converting concentrations to risk, for example) and display.

Once the base case has been established a wide variety of useful things can be done. The base case itself can be used to rank each of the facilities and their associated contaminants to show present the greatest (or least) risk to the population. The effect of any number of operational, clean-up and closure alternatives can be quantified. When combined with cost data for each alternative, a true risk-based decision tool for stewardship is the result.

CONCLUSION

The major USDOE sites have developed the capability to model the integrated long-term effects of residual contamination from a large number of individual facilities through their Composite Analysis programs. These sites have developed Geographical Information System programs to display and interpret a wide variety of spatially distributed data. Combining integration and predictive power of the modeling techniques with the presentation graphics possible with the GIS system would result in a valuable tool for making decisions today to minimize risks and cost in the long-term.

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