Activity Profile

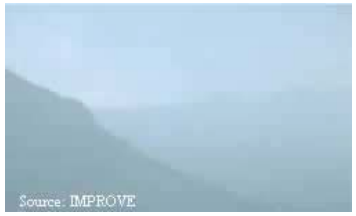
Geospatial Science at The Department Of Energy

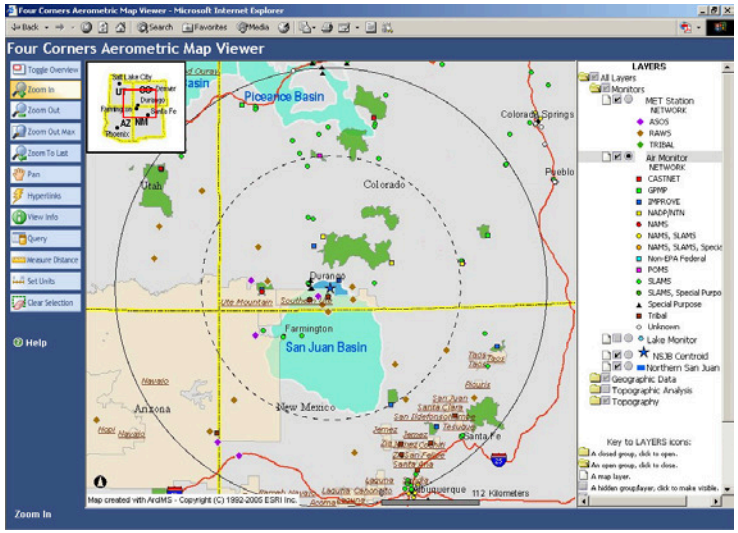
Mapping The Mission

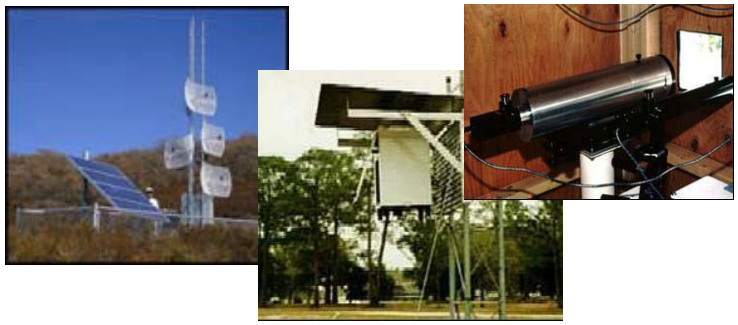
- Defense
- Energy
- Science
- Environment

Aerometric and Hydrometric Monitoring Data Interactive Web Access for Adaptive Decision Management

Geospatial Science Program







Need

Haze and cumulative air quality impacts in Four Corners Region from regional energy development and power demand. Ready access and analysis of air quality monitoring data to identify and fill data gaps. Necessary in support of cumulative assessment of coal-bed-methane production in San Juan Basin and from other new energy sources (e.g., new coal fired power plants).

Approach

DOE's Office of Fossil energy tasked Argonne to develop an interactive web-based mapping site with links to live weather and visibility monitoring data and historical trends in these measurements. Data from hundreds of monitoring sites in the four-state area (UT, CO, AR and NM) and their spatial distribution can be mapped and visualized with the aid of an interactive mapping system.

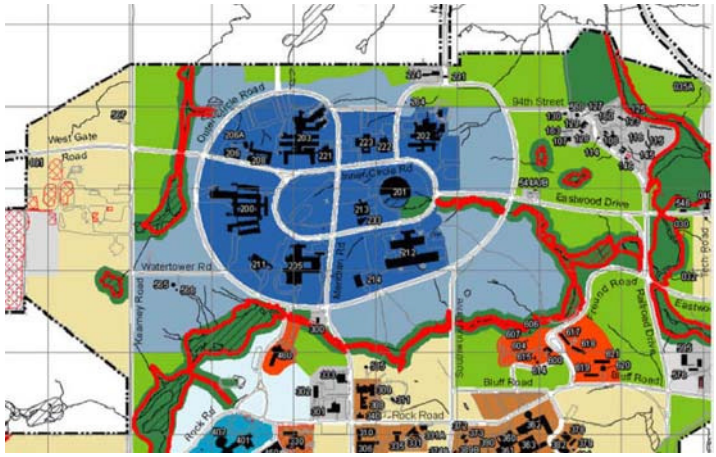
Benefits

The system will enable stakeholders gain timely and comprehensive access to data they need and can use in making informed decisions on future energy growth and environmental protection.

POC: Mike Lazaro, mlazaro@anl.gov

Argonne Geographic Information System

Geospatial Science Program



Need

Argonne's operations, planning, and environmental activities need efficient databases and tools to manage their spatial data.

Approach

In 1995, Argonne established a site-wide GIS to manage, analyze, visualize, and model spatial data to support many activities and groups.

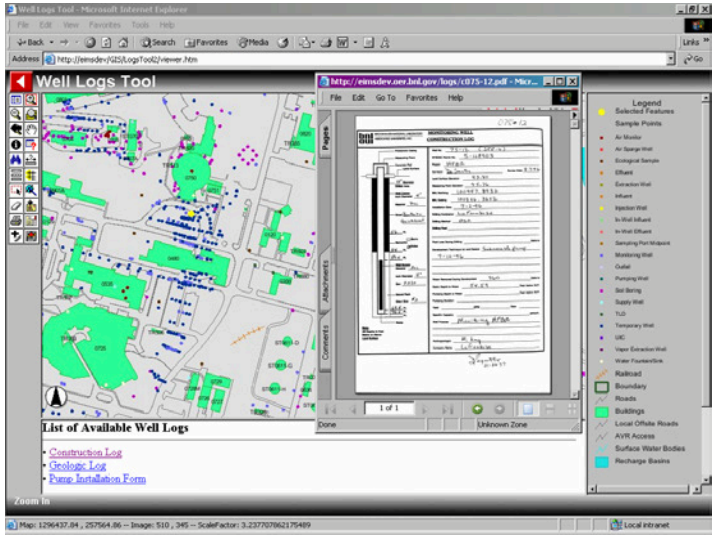
Benefits

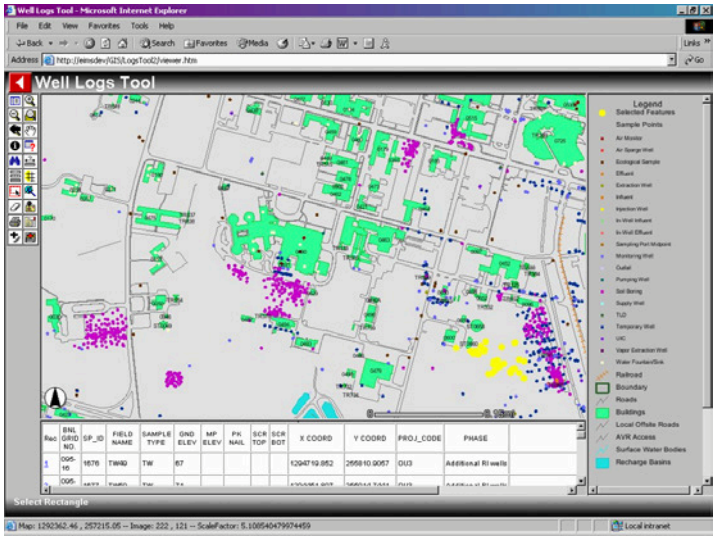
Up-to-date information from diverse sources is available for operations, planning, environmental, and emergency response personnel throughout Argonne. Combining information from many diverse sources enables more advanced uses.

POC: Jim Kuiper, jkuiper@anl.gov

GIS Based Access Tool for Environmental Data

Geospatial Science Program





Need

Thousands of samples were generated as part of the Environmental Cleanup program both on and off-site. There was a need to store and access data via an interactive map tool.

Approach

An internet page was created that provides the user with the ability to access well construction, geological, and environmental sampling data by linking a map to the environmental database and scanned versions of various well construction and geological logs.

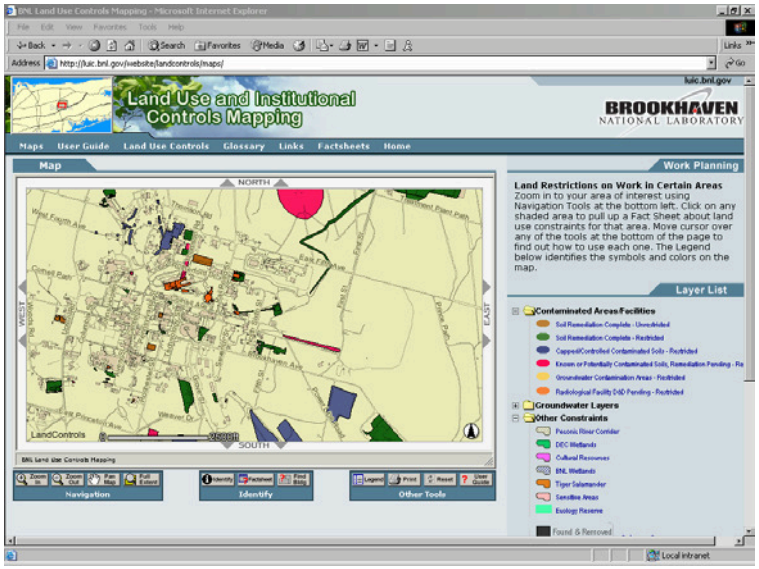
Benefits

The site allows quick access to all available logs as a PDF. Sample locations can be selected on the map and sent to a query tool to retrieve analytical results. The user has the ability to print PDF files. The site is user friendly and does not require special training. The need for paper copies of logs is eliminated.

POC: Jennifer Higbie, higbie@bnl.gov

Land Use and Institutional Controls at Brookhaven National Laboratory

Geospatial Science Program



Need

Land Use and Institutional Controls (LUICs) were developed by BNL, USEPA, and NYSDEC to minimize the potential for exposure to residual contamination and protect the integrity of the remedies.

Approach

Fact Sheets were created for each cleanup area consisting of historical and current information, specific land use and institutional controls and links, and references to related documents, maps, etc.

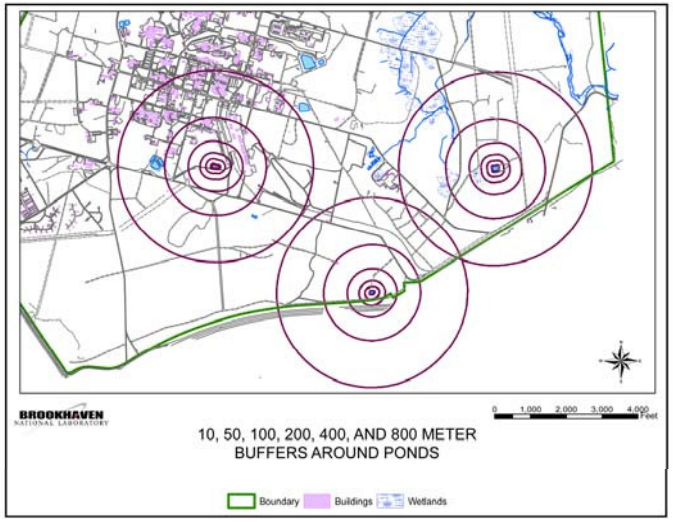
Benefits

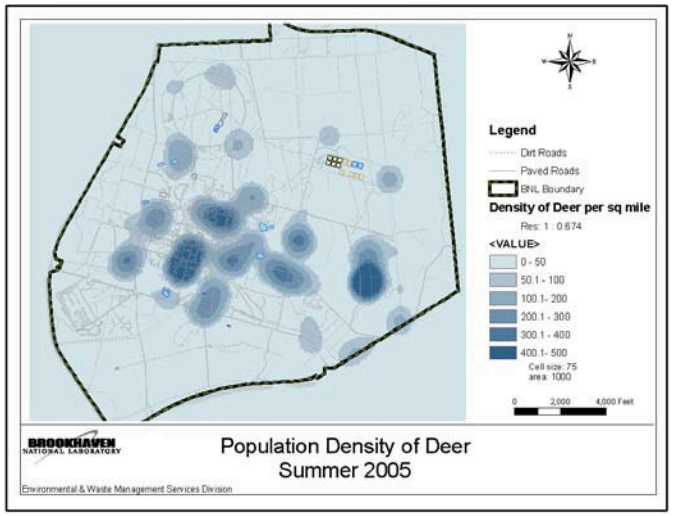
The central storage of information provides an easy mechanism to access, manage, and update LUIC information and assist in the implementation of work planning.

POC: Jennifer Higbie, higbie@bnl.gov

Monitoring Natural Resources

Geospatial Science Program





Need

Flora, fauna, and sensitive habitats must be monitored to ensure their protection, compliance with regulations, and effectiveness of management actions using an adaptive management approach, while allowing science and Lab activities to continue.

Approach

GIS is used to store, display and analyze data collected on flora and fauna. GPS and hand-held computers are used in the field to collect ecological data. GIS layers are also shared between local agencies.

Benefits

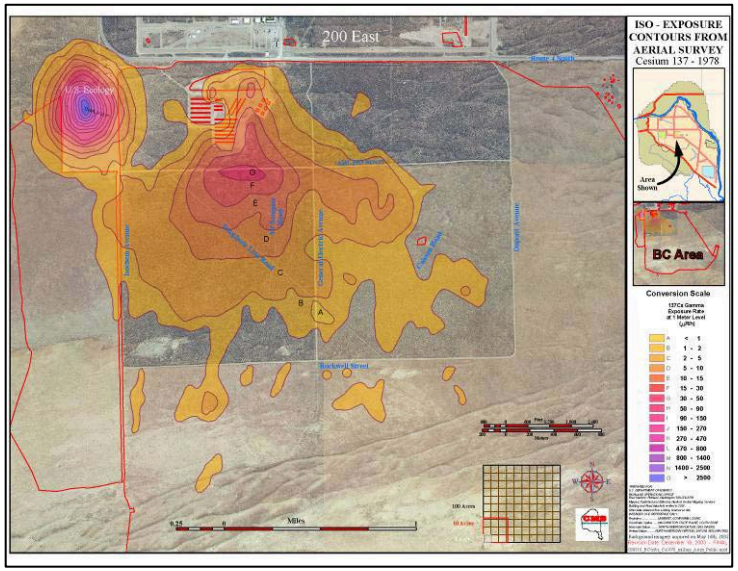
Maps are used to review all work permits to ensure breeding seasons of sensitive species are avoided.

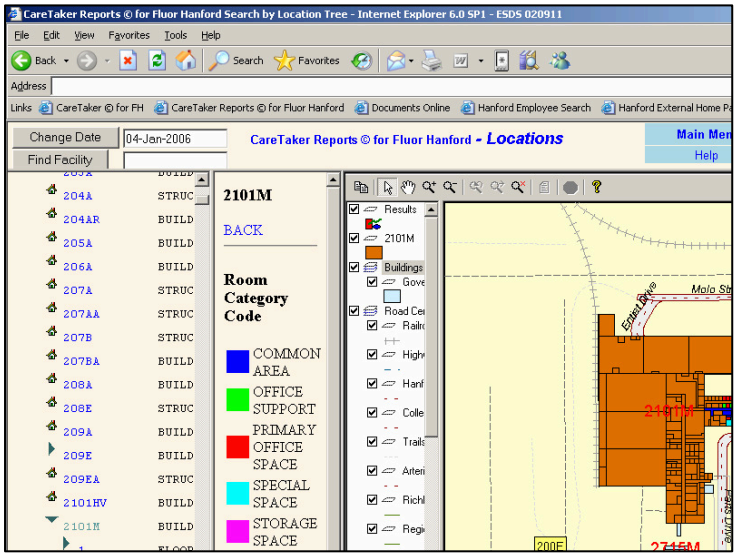
Changes can be tracked over time and interactions between components of the ecosystem can be detected and adaptive changes to management can be implemented.

POC: Jennifer Higbie, higbie@bnl.gov

Central Mapping Services

Geospatial Science Program





Need

Collect, manage, analyze and access an integrated set of core data needed to support site cleanup activities and legacy management needs.

Approach

Collect geospatial data and link to textual data for planning and analysis.

Publish records of site configuration.

Support GIS analysis.

Deliver maps to the desktop.

User level query of GIS data.

Benefits

Core data supports generation of custom maps such as contamination plumes.

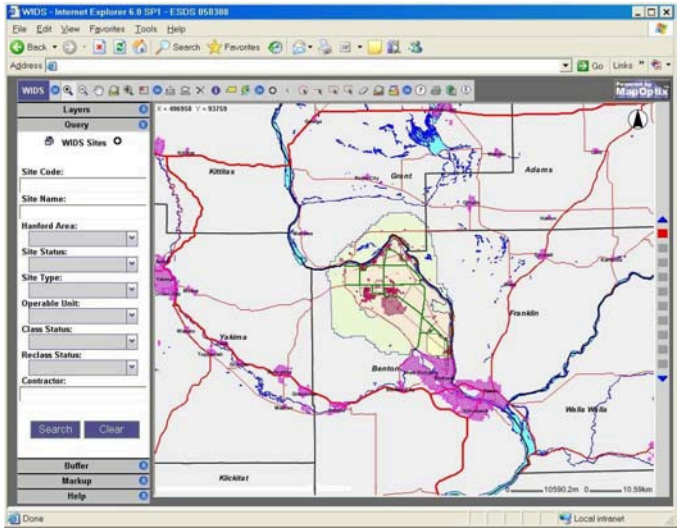
Allows generation of an integrated site atlas.

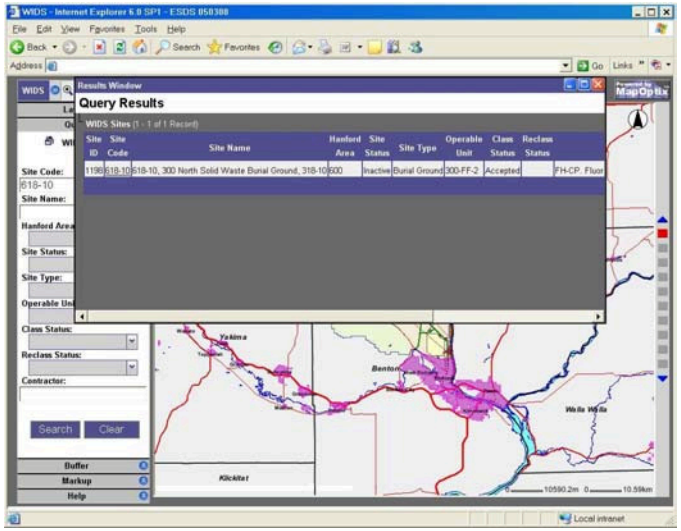
Supports facility management tools such as CareTaker.

POC: Scott Bennion, Scott_I_Bennion@rl.gov

Hanford Map Portal (QMAP)

Geospatial Science Program





Need

The need is to provide user friendly access to environmental information.

Approach

QMAP combines the GIS spatial information with the information from the other databases using a variety of presentation tools so that users may browse to, or query, and analyze information such as waste sites or wells of interest.

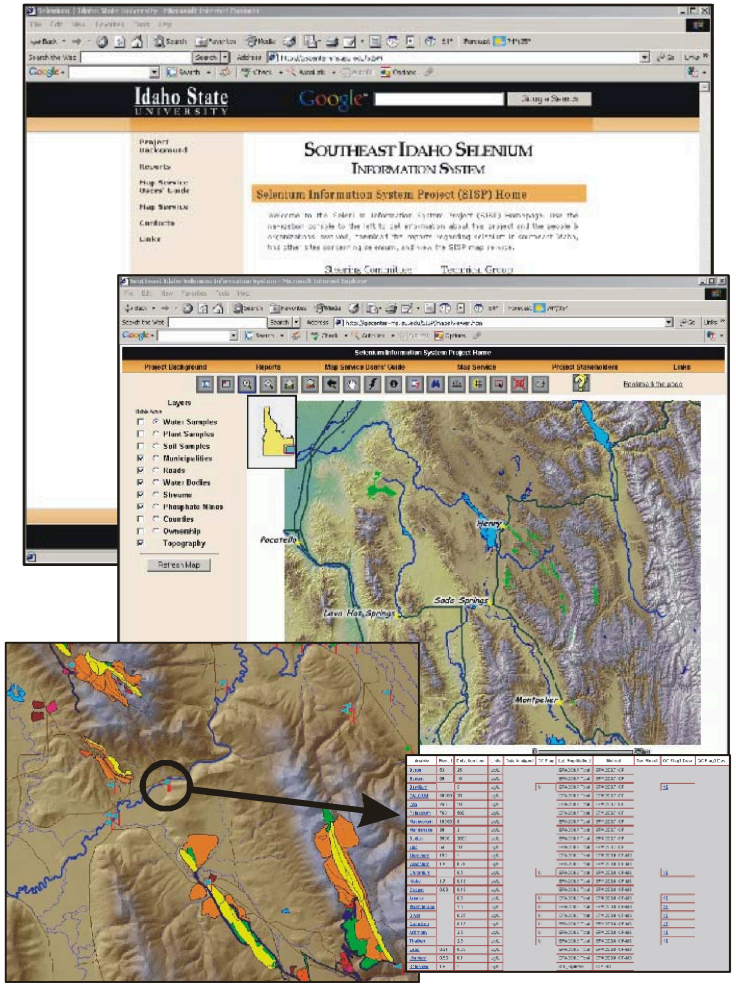
Benefits

A query of a waste site or well engages QMAP to find the object and then the user may access the appropriate integrated information and analysis tools.

POC: Carl Connell, carl_w_connell@rl.gov

Selenium Information System

Geospatial Science Program



Need

Consolidate Selenium contamination information for Southeast Idaho and make it accessible from an intuitive map-based interface.

Approach

Garner support and buy-in from State and Federal agencies. Develop a map server which meets the needs of all end-users and provides a single location from which to access Selenium contamination information.

Benefits

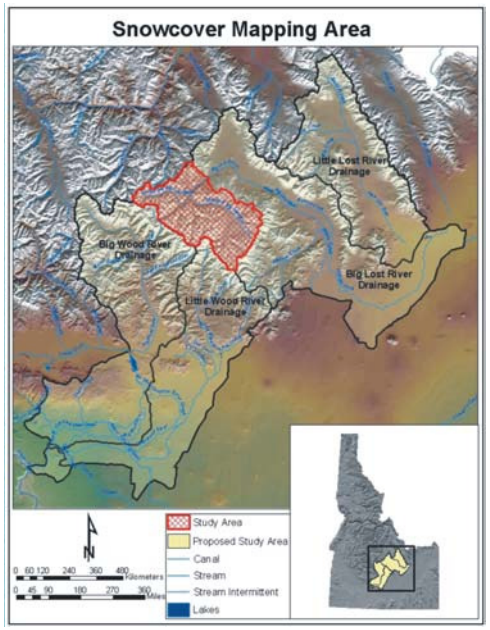
Provides a single location where end-users (Federal, State, Tribes, & general public) can access Selenium contamination information in the Southeast Idaho phosphate mining region.

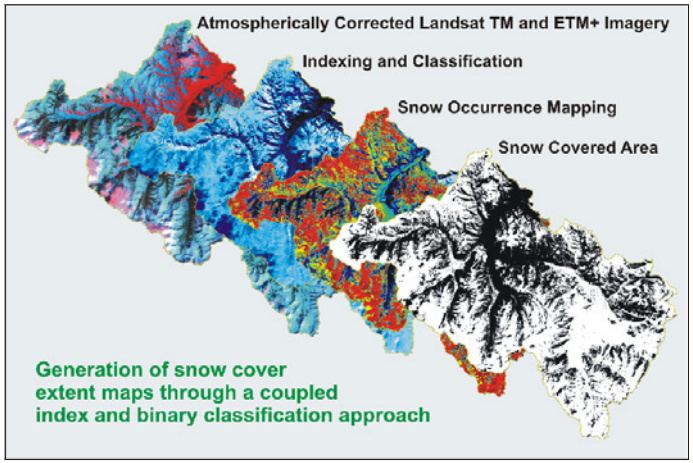
Provides a non-contentious venue/platform for organizations to make decision and agree on how sensitive information should be made available.

POC: Randy Lee, Randy.Lee@inl.gov

Stream Flow Forecasting in Snow Dominated Basins

Geospatial Science Program





Need

A method for measuring snow cover on a daily basis for input into snow run-off models.

Approach

Collect daily MODIS and AQUA imagery.

Predict snow cover beneath clouds.

Output binary grid of snow cover for input into Snow Runoff Model (SRM).

Benefits

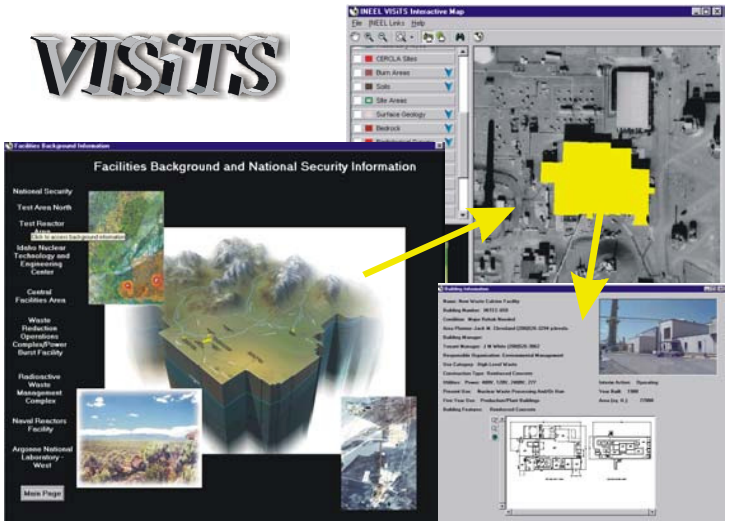
Provides snow-melt and runoff models with another data point for estimating when peak run off from snow will occur and whether there will be more than one peak. This information is crucial to farmers in the arid west for knowing when to plant, and what types of crops they should grow for the season.

POC: Randy Lee, Randy.Lee@inl.gov

VISiTS

Virtual Infrastructure and Site Tour System

Geospatial Science Program



Need

Demonstrate to potential customers the physical attributes of the Idaho National Laboratory Critical Infrastructure Protection Test Range.

Approach

Develop a stand-alone GIS application that clearly and efficiently presents the capabilities of the CIP Test Range including a broad overview of the INL site.

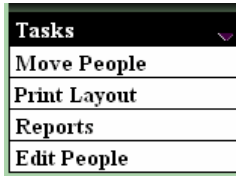
Benefits

Allows potential customers of the test range to see what types of features (e.g., power infrastructure, roads, buildings, etc.) are available and what the physical geography of the site looks like.

POC: Randy Lee, Randy.Lee@inl.gov

FAST (Facility Asset/Space Tool)

Geospatial Science Program



Need

Directorate assets such as people, space and data need to be managed efficiently. Coupled with that is the growing need to reduce infrastructure costs.

Approach

The GIS team at LLNL created a web-based toolset that automates the current manual system by integrating disparate databases into a GIS system to aid decision making, tracking, evaluation and allocation of office and lab space in the directorate.

Benefits

Rapid evaluation of moves and planning scenarios and assesses logistical impacts.

Calculate costs of lab or office space by square foot.

Update databases for real-time display, analysis and printing.

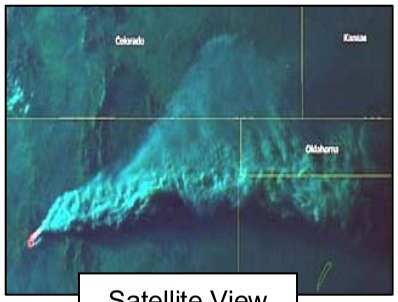
This work was performed under the auspices of the U.S. Department of Energy by the University of California, Lawrence Livermore National Laboratory under contract No. W-7405-Eng-48. UCRL-PRES-218029

POC: Lee Neher, neher1@llnl.gov

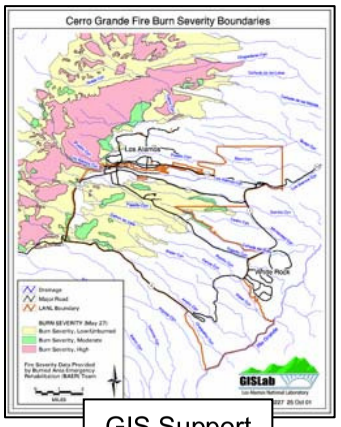
Cerro Grande Rehabilitation Project GIS

Geospatial Science Program

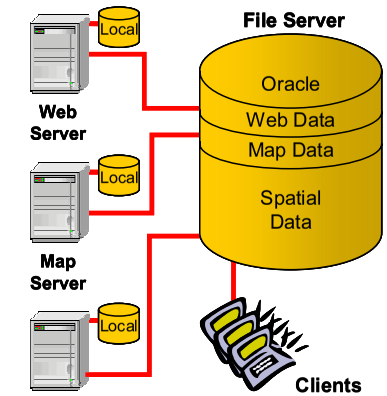
Los Alamos Burning



Satellite View



GIS Support



Enterprise GIS

>42,000 Acres Burned

Need

GIS support during and after the Cerro Grande fire at Los Alamos National Laboratory.

Approach

Enterprise GIS access to data and tools.

GIS support (cartography, analysis, data management) for recovery efforts (flood model, forest management maps, emergency response maps, etc.).

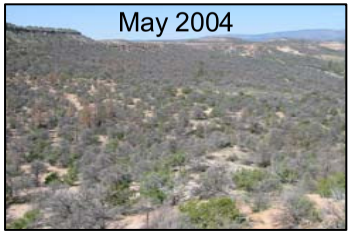
Benefits

Protect LANL site from future disasters.

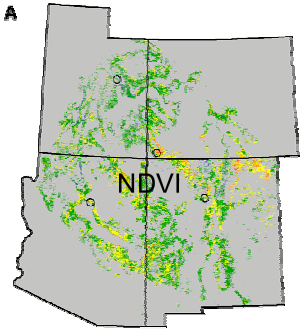
POC: Paul Rich, pmr@lanl.gov

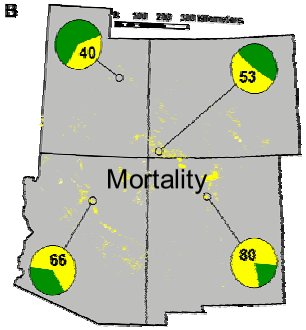
Drought Impacts

Geospatial Science Program

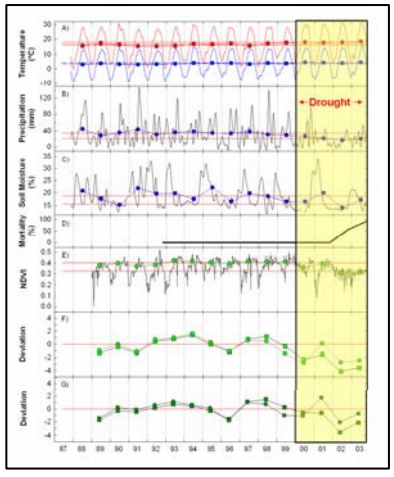


Site and Regional Analyses





Piñon Bark Beetle
(*Ips confusa*)



Need

GIS-based analysis of local and regional patterns of tree die-off due to drought.

Approach

Analyze cross-scale data (site, region).

Document rapid die-off of piñon pine (*Pinus edulus*) and other conifers across region (>12,000 km^2) due to drought-induced pathogen (bark beetle) outbreak.

Participate in DIRENet R&D consortium (*Drought Impacts on Regional Ecosystems Network*).

Publish results *(Proceedings of the National Academy of Science 102:15144-48).*

Benefits

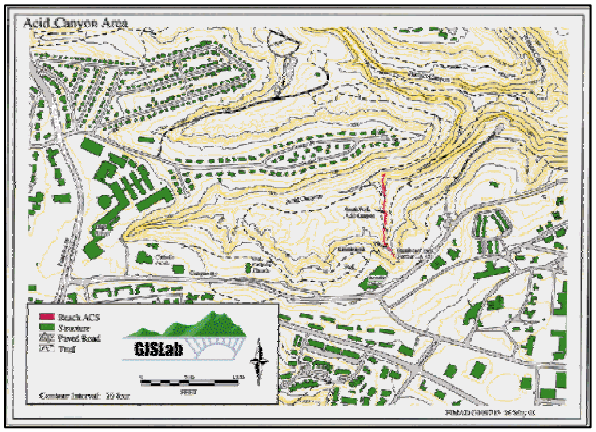
Understand cross-scale consequences of extreme weather events, in particular warm droughts.

http://www.mpcer.nau.edu/direnet

POC: Paul Rich, pmr@lanl.gov

Environmental Restoration (ER)

Geospatial Science Program



Need

GIS support for cleanup of legacy waste sites at Los Alamos National Laboratory.

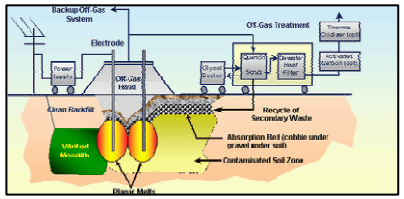
Approach

Stewardship of key databases concerning legacy waste.

Professional cartography to support remediation efforts.

Benefits

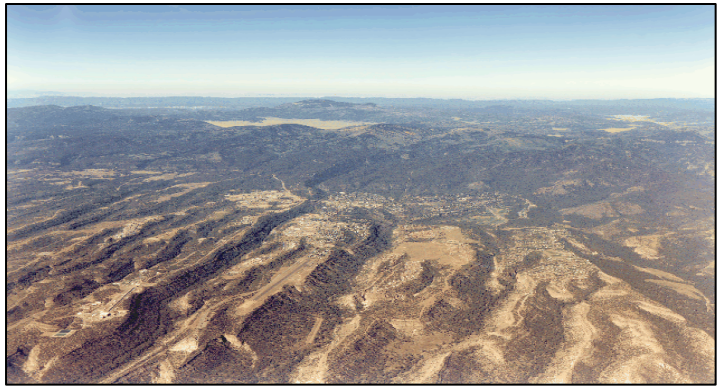
Minimize risk of contaminant transport.

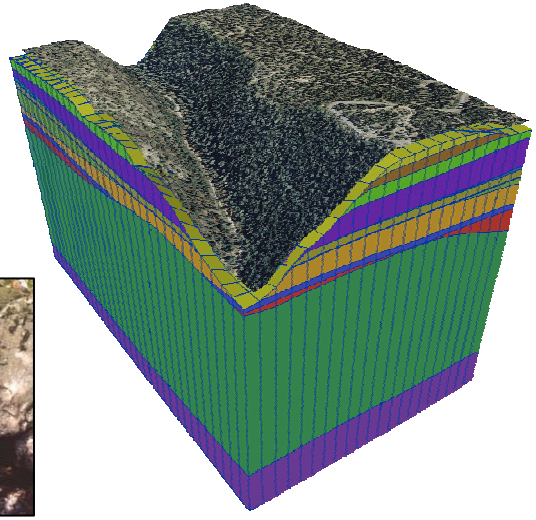


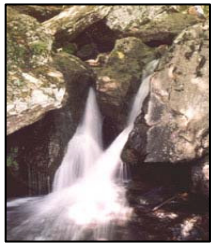
POC: Steven Koch, skoch@lanl.gov

Groundwater Protection Program

Geospatial Science Program







Need

Model water resources and contaminant transport for aquifer surrounding Los Alamos National Laboratory.

Approach

3D geologic model of LANL site

Integration of water quality monitoring data and contaminate transport models

Visualization of results.

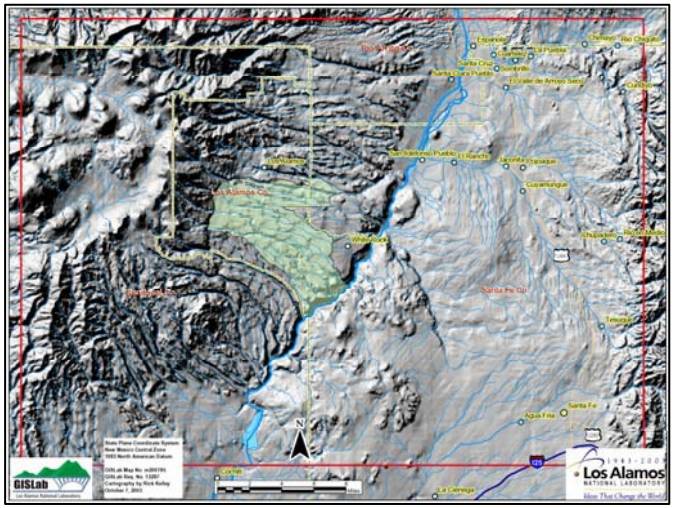
Benefits

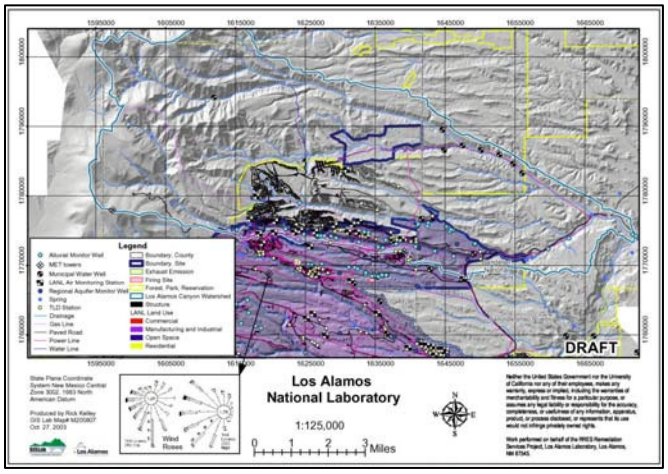
Minimize risk of groundwater contamination.

POC: Marc Witkowski, witk@lanl.gov

Risk-Based End-State (RBES)

Geospatial Science Program





Need

Cleanup of environmental contamination at Los Alamos National Laboratory based on risk analysis.

Approach

Graphical depiction of environmental hazards and exposure controls expected after cleanup (200+ publication quality maps).

Sustained dialog with stakeholders.

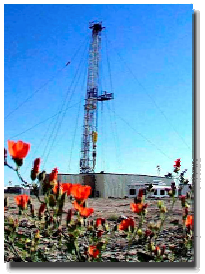
Benefits

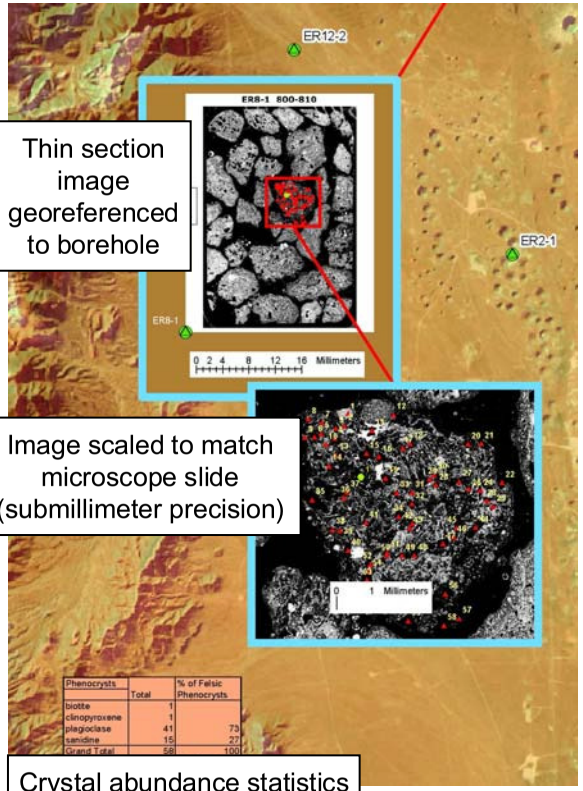
End-state based on risk, not just presence of contaminants.

POC: Rick Kelley, rekelley@lanl.gov

Underground Test Area (UGTA)

Geospatial Science Program

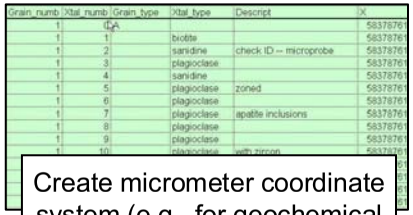




Thin section image georeferenced to borehole

Image scaled to match microscope slide (submillimeter precision)

Crystal abundance statistics



Create micrometer coordinate system (e.g., for geochemical analysis by microprobe)

Need

GIS support for geologic analysis using well bores at Nevada Test Site.

Approach

Micro-GIS tool for georeferencing thin-section data.

GIS links from micro to site scale.

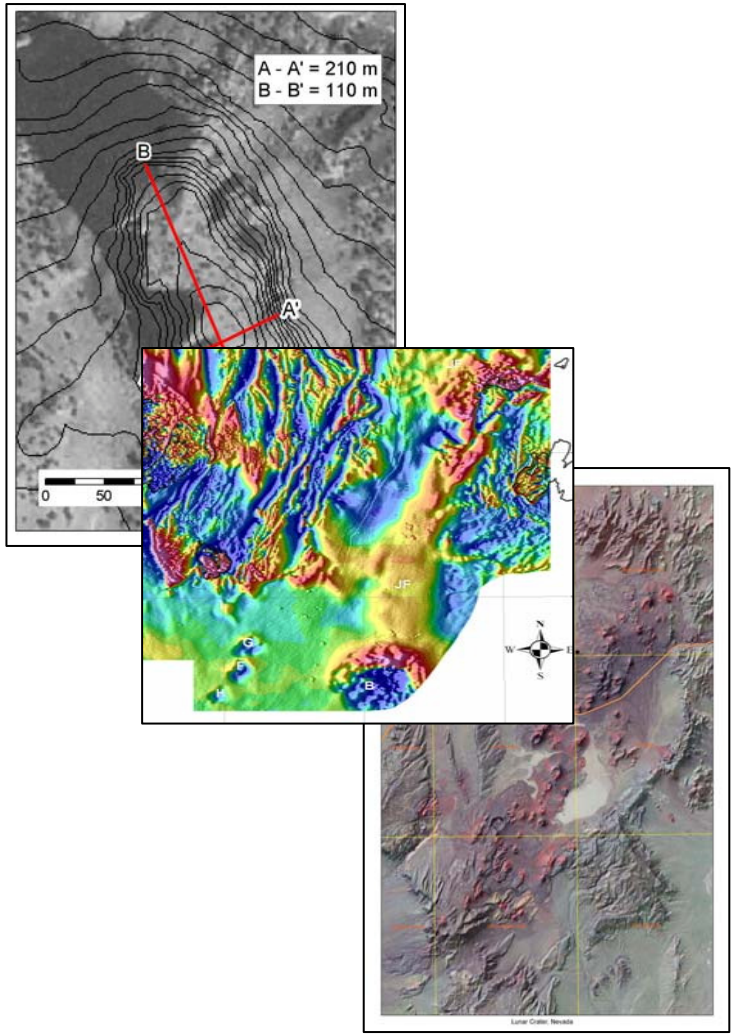
Benefits

3D geologic model of Nevada Test Site.

POC: Gordon Keating, gkea@lanl.gov

Volcanic Hazards Assessment

Geospatial Science Program



Need

GIS support for Probabilistic Volcanic Hazards Assessment (PVHA) of Yucca Mountain.

Approach

Spatial analysis of volcanic conduits.

GIS reconnaissance for volcanic conduits field work.

Geophysical surveys (analysis, cartography, and planning).

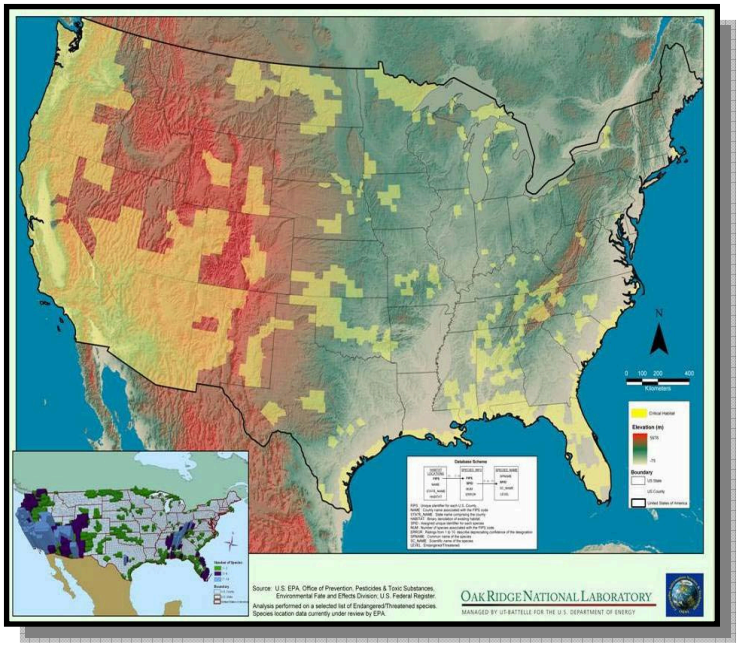
Benefits

Assess long-term risks of high-level waste storage.

POC: Rick Kelley, rekelley@lanl.gov

Critical Habitat Designation for Endangered and Threatened Species

Geospatial Science Program



Need

Establishing biological reserves or “hotspots” on a county level for 472 EPA-specified species within the United States.

Approach

Critical habitat location information for all the species was interpreted from the federal register. To accommodate the different tiers of information associated with a species, an appropriate database schema was designed. The confidence of designation at each location was included.

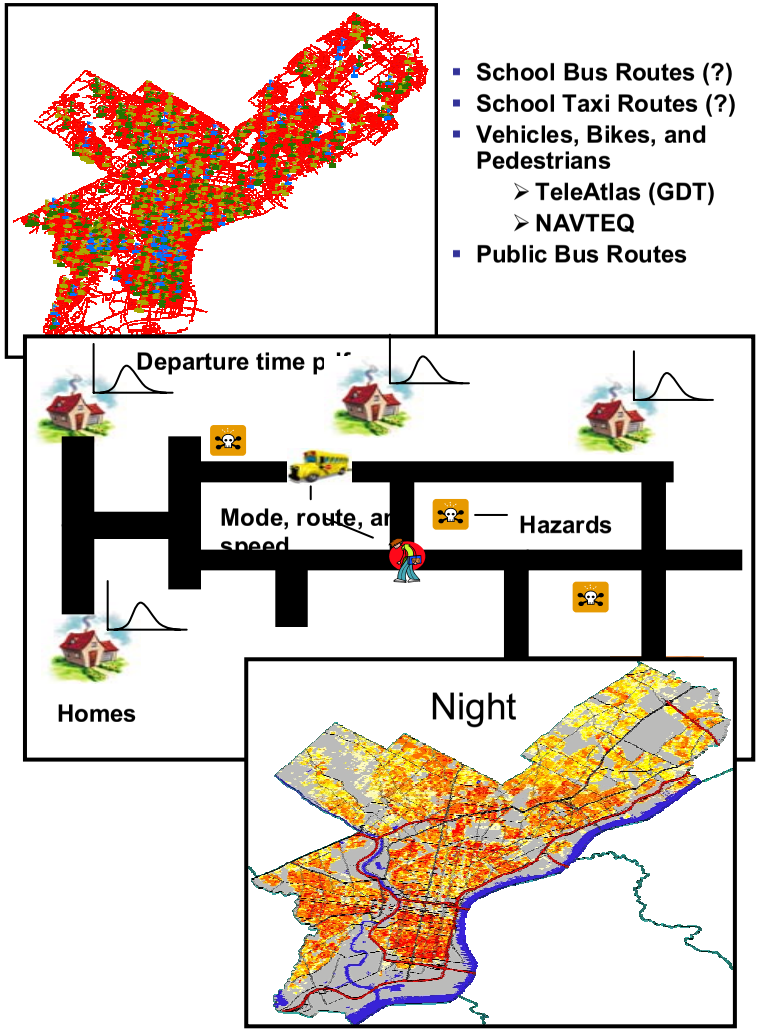
Benefit

Spatial datasets representing the critical habitat designations were developed.

POC: Budhendra Bhaduri, bhaduribl@ornl.gov

High-Resolution Social Dynamics

Geospatial Science Program



Need

The U.S. EPA is analyzing the exposure of K-12 students to common pollutants to assess environmental equity in Philadelphia, PA.

Approach

Using a variety of data sources, apply discrete event simulation techniques to spatially express the movement of K-12 students from home to school. Apply appropriate coefficients including method of transport (school bus, public bus, bike, and walking) to determine environmental exposure of the student population.

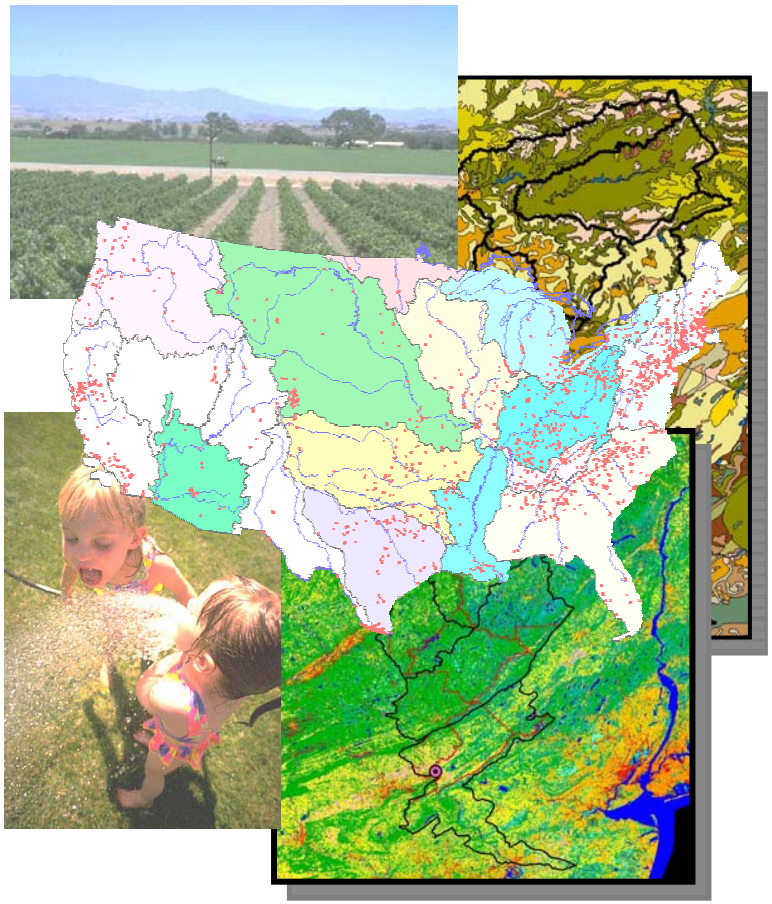
Benefit

Environmental exposure and environmental assessment may be better understood to ensure a safer, cleaner environment for K-12 student travel to and from school. A similar approach is being applied to other demographic groups such as workers.

POC: Budhendra Bhaduri, bhaduribl@ornl.gov

Pesticide Usage and Drinking Water

Geospatial Science Program



Need

There are thousands of surface drinking water intakes in the nation. Drinking water quality concerns need to be evaluated with respect to agricultural pesticide applications.

Approach

Georeferencing Community Water System (CWS) intakes to the National Hydrography Data (NHD), delineating upstream contributory watersheds from the intake locations, and characterizing upstream contributory watersheds with pesticide usage data.

Benefit

Assessment of agricultural pesticide applications upstream of surface drinking water intakes that will allow further modeling of pesticide transport to evaluate water quality impacts.

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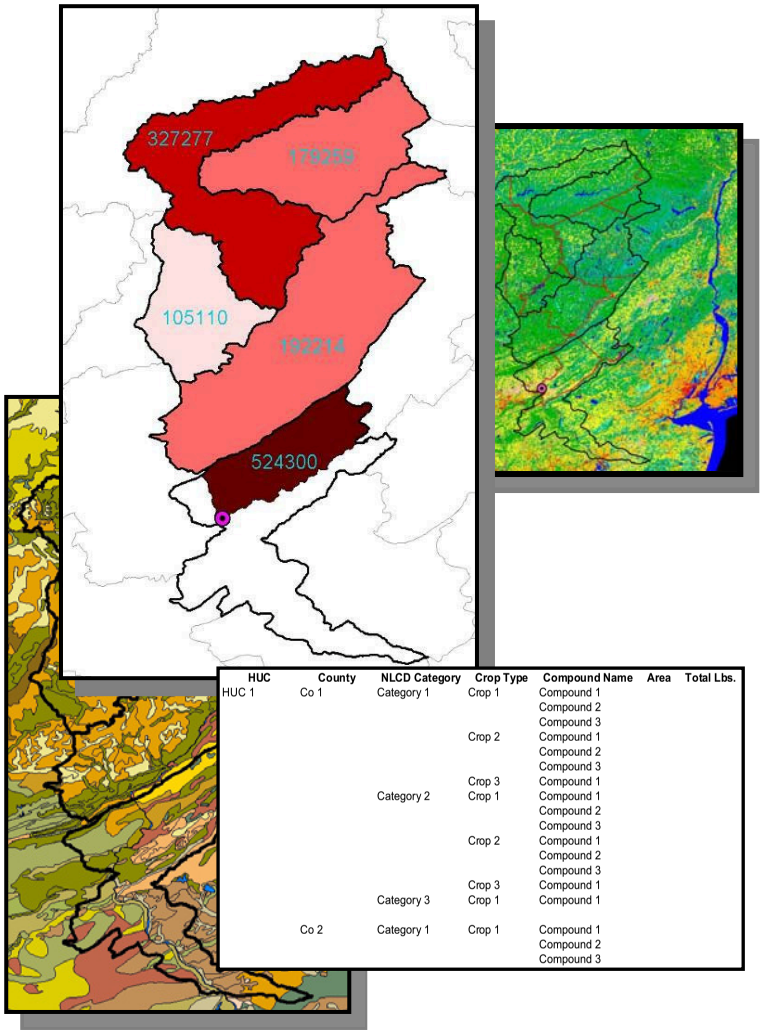
Watershed Characterization

Geospatial Science Program



HUC	County	NLCD Category	Crop Type	Compound Name	Area	Total Lbs.
HUC 1	Co 1	Category 1	Crop 1	Compound 1		
				Compound 2		
				Compound 3		
			Crop 2	Compound 1		
				Compound 2		
				Compound 3		
			Crop 3	Compound 1		
		Category 2	Crop 1	Compound 1		
				Compound 2		
				Compound 3		
			Crop 2	Compound 1		
				Compound 2		
				Compound 3		
			Crop 3	Compound 1		
		Category 3	Crop 1	Compound 1		
	Co 2	Category 1	Crop 1	Compound 1		
				Compound 2		
				Compound 3		

Need

Watershed characterization requires input of massive, misaligned spatial datasets for analysis of infrastructure security of water intakes and impacts to watershed hydrology from human activities.

Approach

Using a variety of spatial analysis tools, surface water intake locations are indexed to the National Hydrography Data, characterized, and linked to land cover data cross-referenced to county locations.

Benefit

Visualization and characterization tools suitable for application to massive datasets, particularly watershed classification and impacts from human activities.

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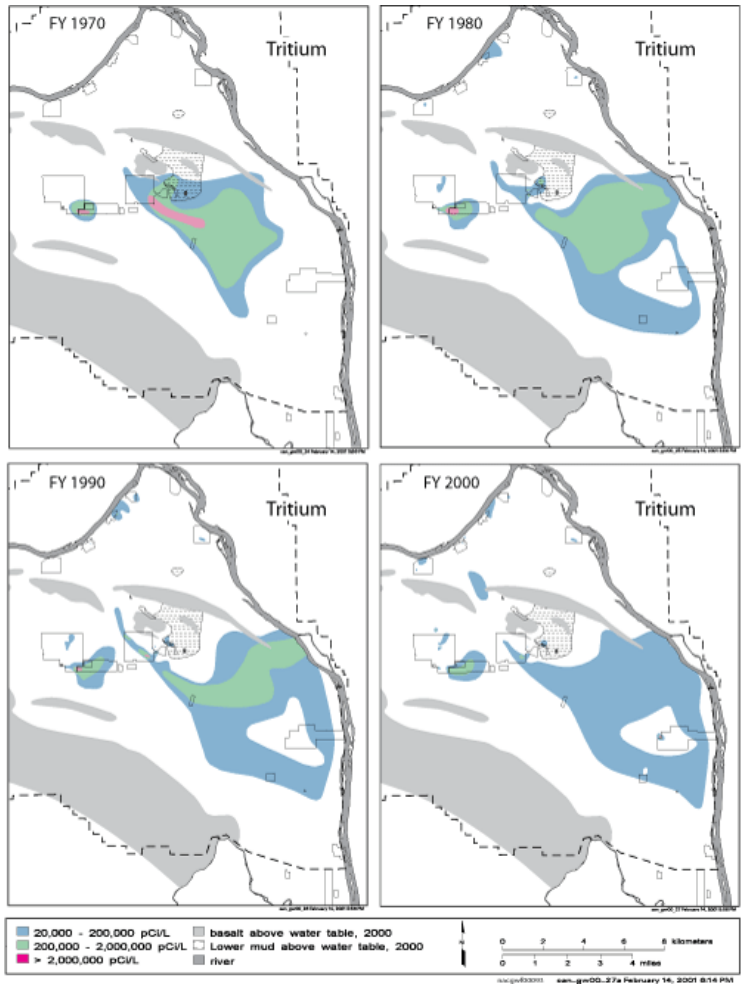
GIS and Groundwater Monitoring

Geospatial Science Program



Need

Groundwater Investigations often involve hundreds to thousands of groundwater data values that must be evaluated in a common spatial context with information for various themes from multiple sources.

Approach

Geographic Information System (GIS) software provides a common tool set for generating, managing, and displaying groundwater data in spatial context with relevant information from other subject areas such as geology, hydrology, and facilities.

Benefits

Facilitates the rapid display and evaluation of new groundwater data. Use of a common format facilitates both spatial and temporal evaluation of groundwater conditions.

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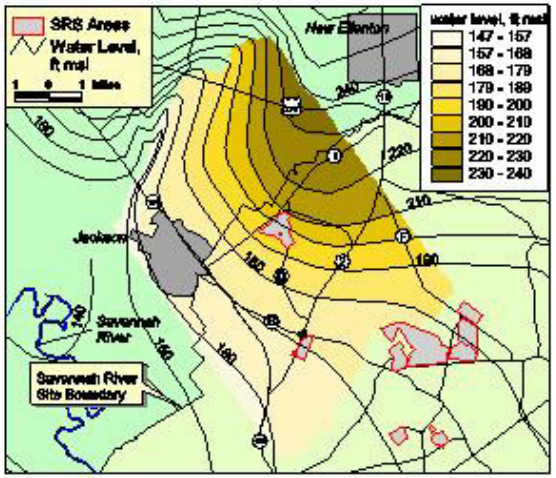
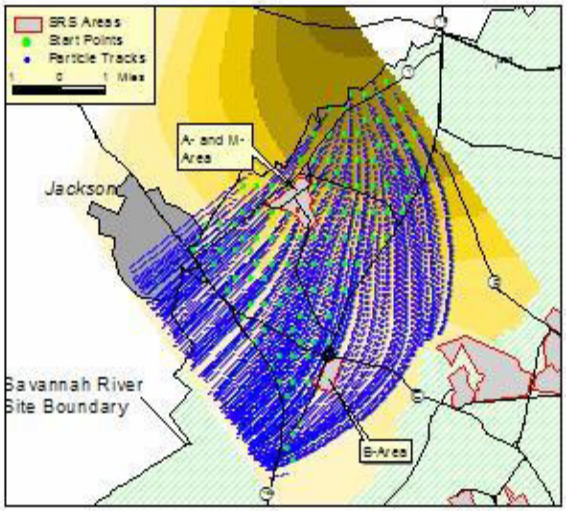
2-D Groundwater Flow Modeling in a Geospatial Framework

Geospatial Science Program





Need

Rapid and precise 2-D groundwater flow modeling capability in a geospatial environment.

Approach

Develop potentiometric contours, groundwater hydraulic properties in GIS.

Create 3-D surface grids of hydraulic values.

Compute 2-D groundwater flow trajectories using an algorithm to solve flow equations.

Benefits

Groundwater flow results can be obtained in hours vs. weeks or months with other modeling.

Extensive parametric analyses can be conducted quickly to understand groundwater flow system.

Groundwater flow results are an almost exact representation of potentiometric contours.

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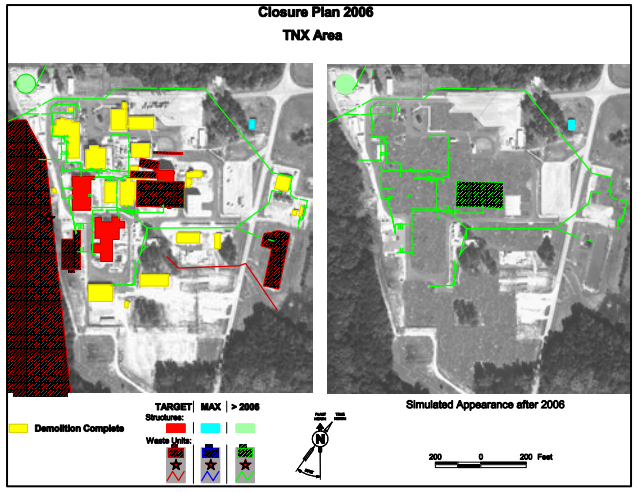
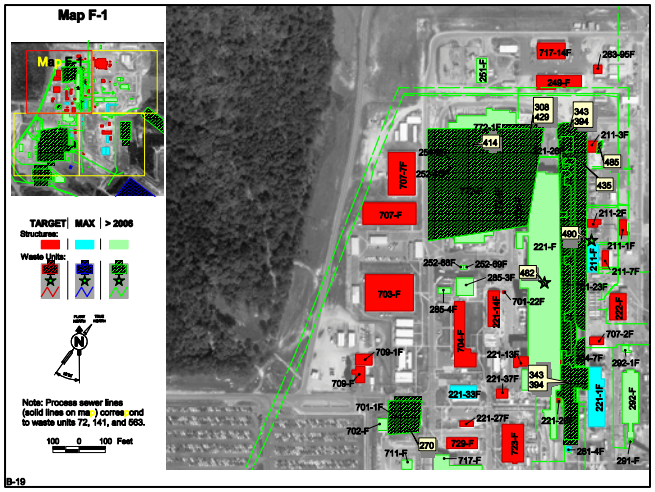
SRS Deactivation & Decontamination Program

Geospatial Science Program





Need

Systematic approach to SRS deactivation and decontamination (D&D).

Approach

Engineering surveys to assess all facilities.

Analysis to determine D&D risks and costs on a facility basis.

Facility D&D prioritization based on geospatial and engineering analyses.

Benefits

Cohesive and systematic approach to D&D.

Program plan optimized to minimize cost/risk.

Coordination with all other SRS Environmental Management Programs.

Communication of D&D plan priorities to all levels: technical and managerial.

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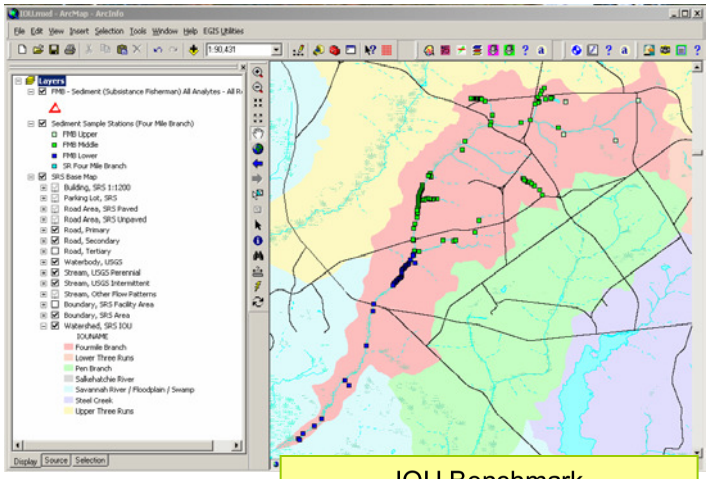
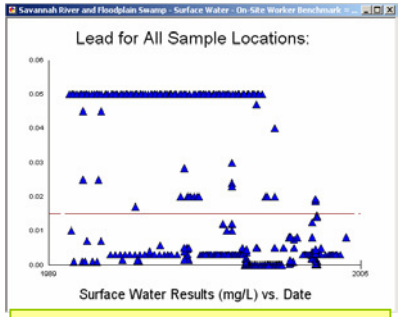
Watershed Risk Assessments using GIS

Geospatial Science Program



IOU Benchmark Evaluation Tool Results

IOU Statistical Summary



IOU Scatterplot Chart

Need

To analyze large amounts of geochemical data on a watershed-basis using human health and ecological risk assessment processes. An automated means of conducting these assessments was needed.

Approach

To develop the IOU (Integrator Operable Unit) GIS Risk Utilities, along with the Soil and Groundwater Closure Program (SGCP) IOU database. Originally developed for ArcView 3x in 1999, these tools have now been migrated to the ArcGIS environment, using ArcObjects, Visual Basic and Crystal Reports.

Benefits

Sample points of geochemical data that exceed human health and ecological risk scenario benchmark values are geographically displayed.

Statistical reports and graphs can be generated

Input parameters provide users the ability to “drill down” to a specific dataset, time frame or geographic area of interest, such as a sub-watershed or individual sample station.

Output from the tools can be exported to Excel or Adobe Acrobat (.PDF) for further analysis, and/or for input into regulatory documents.

Modular programming design allows developers to reuse code from common .DLLs, instead of copying or rewriting similar code.

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