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APPLICATIONS OF GEOGRAPHIC INFORMATION SYSTEMS FOR DOCUMENTATION OF RADIOLOGICAL CLEANUP

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INTRODUCTION

In these times of dynamically changing regulations and movement towards standardizing cleanup criteria, one common thread remains constant for all licensees; cleanup and verification efforts require generation and documentation of tremendous amounts of data.

Data are of no use unless they can be assimilated, manipulated, and summarized, in such a way that meaningful and accurate conclusions can be drawn from them. This paper presents an approach to data management using a geographic information system or GIS (not to be confused with global positioning systems or GPS), which was implemented during cleanup and verification of a uranium mill and tailing site in the northwestern United States.

This system incorporated and manipulated data, to provide a visual summarization of the data in the form of maps. Use of this system allowed for real-time review of project progress and resulted in savings which exceeded several hundred man-hours.

SCOPE OF PROJECT

Prior to initiation of cleanup activities, a site characterization study was conducted. Based on this study, a number of technical issues were defined that impacted the scope of the verification program and therefore, the amount and type of data that had to be evaluated. A summary of some of these issues is given below:

Project Extent - The cleanup levels for this site are based on verification units of 100 square meters and; therefore, a grid system consisting of approximately 5,000 *10m x 10m* grids was established across the 247 acre site.

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Soil Types - The natural ^{226}Ra content of site soils was found to be dependent on the soil type. As such, the cleanup requirements, which are given in terms of acceptable concentrations above background, became soil specific.

Gamma Survey Methods - Two types of gamma surveys, each with a specific action level, would be used depending on the terrain. This factor coupled with soil types made cleanup levels dependent on both the soil type and gamma survey method.

Confirmation Sampling - It was determined that approximately 10% of the grids which were gamma surveyed also should be soil sampled to confirm that the external gamma radiation action level resulted in cleanup of all soils having a ^{226}Ra concentration at or above the regulatory limit.

Special Areas - It was recognized that some areas would require 100% soil sampling to demonstrate compliance due to contamination which could not be identified using gamma surveys.

Timeline - the short project timeline resulted in the collection of several hundred pieces of information in any given day.

Given a project of this scope and complexity, it can be seen that keeping accurate records which are current enough to direct project activities, and detailed enough to demonstrate regulatory compliance could be a formidable task.

The most desirable method of tracking project progress and directing field activities was the use of grid maps which were color coded to indicate areas which had been tested, the results of these tests, and the identification of areas yet to be tested. However, generation of such maps on a real-time basis, by hand, would have been an unrealistic goal due to the amount of data which needed to be processed daily.

GEOGRAPHIC INFORMATION SYSTEM

Simply stated, a geographic information system is any system which links geography and data. The most common method for doing this is to link a map to a database. The system developed for this project was composed of four elements:

1. a relational database - software for storing and managing data;
2. AutoCAD - software used to construct and modify drawings;

3. AutoCAD Data Extension (ADE) - software which connects information in the database with the AutoCAD drawings; and

4. queries - custom programs used by ADE to define and extract data from the database and automate AutoCAD commands to produce a desired visual result.

The database stored information such as gamma survey results, laboratory results, dates, etc., on a grid specific basis. AutoCAD was used to produce the base, or model, drawing of the site which consisted of the grid system and the information necessary to uniquely identify an individual grid. AutoCAD was linked to the database using ADE. Custom queries were then executed to extract specific data elements from the database and generate maps within AutoCAD.

Data Management

The database was developed to provide easy access to information and allow for management and storage of grid data. Each record in the database could contain the following information:

- Grid Identification
- Testing Procedure
- Date
- Lot Number
- Gamma Readings
- Laboratory Results
- Cleanup Record
- Grid status

Information was entered into the database on a daily basis using available data. Based on this information, grids were assigned a status as follows:

- Verified - grids which were tested and found to be in compliance based on gamma surveys or laboratory analyses;
- Failed - grids which were tested and found to be out of compliance based on gamma surveys or laboratory analyses;
- Pending - grids where some action, such as soil sampling, had been taken, however, further determination of verified/failed status could not be made until results were received; or
- Incomplete - grids where action was yet to be taken, or grids which had previously failed, were subsequently cleaned, and awaited re-surveying or re-sampling.

Data Review

ADE can be thought of as the "pipe line" through which information is allowed to flow from a database to AutoCAD. For this application, a unique identifier (the grid ID), was used by ADE to link each AutoCAD grid with all records in the database having the same identifier.

Since project progress depended on the ability to identify and distinguish between verified and unverified areas, ADE was used to execute queries which selected grids from the AutoCAD base drawing based on the current status of the grid as recorded in the database. Grids meeting the query criteria were then color coded; green for verified, red for failed, yellow for pending, and gray for incomplete, and posted to the progress drawing.

After all queries had been executed, the result was a progress map which was detailed and accurate. The progress map could then be used interactively on the computer by selecting a grid and obtaining a chronological grid history, similar to that shown below, or plotted to paper for use in the field.

Date	Grid Id	Standard Operating Procedure	Gamma	^{226}Ra	^{230}Th	Status
05\12\95	M1-464923S	RS-50 Integrated Count Method	2350			Failed
07\02\95	M1-464923S	Cleaned				Incomplete
08\12\95	M1-464923S	RS-50 Integrated Count Method	1218			Verified
08\22\95	M1-464923S	RS-20 Soil Sample				Pending
09\13\95	M1-464923S	Laboratory Analyses		1.96	2.03	Verified

For the purpose of final documentation, information was extracted from the database and imported into forms which summarized the history of each grid. These forms were designed within the database package and linked to the database using the grid identification code. A grid activity form was then printed for each grid and included in the final verification report.

CONCLUSION

The GIS developed for this project assimilated and managed data and automated the generation of color-coded progress maps which reflected the status of each grid based on the most current data contained in the database. The result was a data management system which was both functional and reliable.

The applicability of this system reaches far beyond the project described in this paper. In essence, this system can be used to manage any information which can be queried from a database and visually represented based on geography. Examples include:

1. Groundwater maps
   Chemical and geological databases can be used to generate profiles, which in turn, can be linked to the geographic location and displayed on regional maps.

2. Parcel maps
   Parcel maps can be linked to databases containing information such as owner identification, acreage, mortgage lender, utility locations, etc.

3. Construction QA/QC
   Site maps can be generated to display QA/QC locations which can be color coded based on pass/fail status of QA/QC testing. Such QA/QC maps would also provide an indication of locations where testing has not been completed.

4. Building cleanup and release.
   Structure maps showing walls, floors, and ceilings could be created with superimposed grids for the purpose of building release surveys.

This type of data management system provides a real-time method for reviewing project progress, directing field activities, and a simple means of accurately establishing both long-range objectives and day-to-day goals using up-to-date working drawings or site maps. Additionally, documentation of activities can be automated by linking forms with the database to rapidly generate report quality data summary sheets.