
Appendix B

DATA MANAGEMENT (GIS)

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All digital data collected or generated and validated throughout the study are stored and managed in a centralized Geographic Information System (GIS) database system. The GIS was developed to facilitate storage of both spatial and non-geographic data. The GIS was developed in ArcSDE using an Oracle 9i spatial database. The GIS was used for data analysis, data conversion, data validation, data management and creation of maps and animations for the study. This system contains relevant spatial and tabular information for use during the study and possible use in future investigations. The information stored within the database includes topographical, hydrological, geological, ecological, stream height, groundwater elevation and analytical GIS layers. The system is used to organize, store, manage, analyze, and present pertinent study data. Additional tools were also developed for the import of data, data management and export into various formats for use in analysis, reports and presentations. These tools include a data import wizard, data importer, document viewer and graph manager.

Determining Applicable Data Themes

This portion was conducted to determine the applicable data themes for this study. The results of this effort are presented in the *Final Technical Memo No. 1 Determine Applicable Data Themes* (MWH 2002).

This report identified various data themes to be procured as a part of the study. The following is a summary of various data themes identified:

- Water features (e.g.: Watersheds, Rivers, Streams, Lakes)
- Transportation (e.g.: Roads, Railways)
- Topographic features (e.g.: Contours, Bathymetry)
- Aerial Photography
- Census Tracts
- Geological Information
- Flood Plains
- Land Use (Commercial, Industrial, Residential etc.)
- Data source (image, CADD, cov/shp/geodatabase)
- Method for integrating that data within GIS

GIS System Specification

A needs assessment was undertaken to first review and then recommend a GIS software system appropriate for the study. The specifications of the GIS system are presented in

detail in the *Final Technical Memo No. 2 User Needs Assessment* (MWH 2002). The main objectives of this report are presented below.

- Compilation of information regarding the current use of mapping technologies
- Review and recommendation of GIS software
- Preparation of a Work Plan and flow chart for phased implementation of the GIS
- Data transfer and digitizing procedure recommendations
- Selection of a standard datum and coordinate system
- Data management recommendations
- Quality assurance/quality control (QA/QC) procedures for data validation
- Development of strategy for distributing this information in an easy-to-use way

The results of this task were a work plan showing phases involved in implementing data conversion or generation of applicable data layers, GIS development, and a report containing analysis of results of the needs assessment and recommendations.

Data Conversion

The next stage of the study was to compile an appropriate “warehouse” of topographical, facility, hydrological, geological, ecological and analytical GIS data layers in a common system for use as a stand-alone GIS. This task involved conversion of the collected data to GIS compatible data. A summary of various types of data encountered is listed below.

- Existing GIS data
- CAD drawings
- Scanned images
- Geo-referencing raster images (e.g.: satellite / aerial photographs)
- Loading appropriate tabular information, creating spatial links. (e.g.: sample results)
- Field data (e.g.: boring logs, ground water measurements)
- Spatial location and attribute data (e.g.: ‘time-varying’ data such as flow records, changes in water levels, etc.)

GIS Development

The main features of the GIS development and data management phase was to convert and load appropriate data into a common data/GIS platform, validate data, integrate with different types of data, and above all manage the flow of data throughout the course of the study. The structure of the tables and spatial files was designed to allow easy access to the data while minimizing storage space and duplication.

The following were the key components for this task:

- Implementation of the database schema
- Methods to normalize data to minimize data storage
- Integration of existing spatial and attribute data imported in the GIS
- Implementation of version control procedures
- Customization of data viewing and querying tools
- Development of Federal Geographic Data Committee (FGDC) compliant Metadata for GIS layers

GIS Tools

These additional tools were developed for import of data, data management and export into various formats for use in analysis, reports or presentations.

Data Import Wizard

This tool was developed to import data into the GIS. It creates a template for a particular kind of data imported, which always follows the same data structure. For example, the monitoring station equipment always stores water level data in the same format. Once a template was created for importing this water level data into the database, it could be used to import water level data at different times in the study and from different stations that use the same equipment. This tool uses a sample data file to create the template. The various types of data that can be used are structured data (fixed width or delimited). Fixed width data always have the same width for each of the fields, while delimited data have each field separated by an identifier such as a comma or a semicolon. The import wizard is also capable of getting information about the header field to go along with the data itself (e.g.: Date, Rain). It then stores information about each field so that no erroneous values are stored (e.g.: 'Date' data type will store "10/12/2002" but not "3.45"). The import wizard also has capabilities of filtering out unwanted data, removing blank lines and handling null values.

Data Importer

Once the template is created using the 'Data Import Wizard', the data importer uses it to import the data. It is capable of importing multiple tables at one time. It uses the template to check the data to verify that various data types in the data matches those in the

template. It then flags up an error message to point out problems in the data. Once it goes through this procedure of checking the data, it writes the data into the GIS database.

Document Viewer

This tool was developed to display data. This can be used to view pictures, graphs, reports, and any other non-GIS document associated with a GIS feature (e.g.: well boring log, photographs etc.). This tool is available off a menu and toolbar to allow a user to click on a GIS feature and to then display a list of all the documents associated with that feature, including associations via relationship classes. The user would then be able to select the document to view and that would cause the host application to start up and to display the document (e.g. a photograph would be opened in “Microsoft Photoeditor” or any other imaging program).

Graph Manager

This tool was developed to display data. This can be used to display a data form/ multiple data forms with data and graphics displayed for the selected GIS feature and then display results graphically. This is a tool available off a menu and a button to allow the graphing and comparison of data imported via the importers previously.

The main features of the Grapher are detailed below:

- Graphical view of single data parameter display for one location (e.g.: Groundwater Elevation)
- Graphical view of up to three different data parameters for one location (e.g.: Groundwater Elevation, Perchlorate Concentrations, and Rainfall)
- Graphical view of up to three different data parameters for multiple locations (e.g.: Groundwater Elevation, Perchlorate Concentrations, and Rainfall for two locations)
- Allow multiple date periods to be compared (i.e. Week 1 plotted on top of Week 2)
- Data range such as a start and end time
- Simple Statistics of the selected parameter (e.g.: Minimum, Maximum and Average)
- A simple data grid displaying text
- Querying out data from the GIS based on a particular criteria
- Exporting data into other programs like Excel for further manipulation

Theme Manager

This tool was developed to display data. This tool allows the user to select from a menu the type of predefined display class he/she would like to see on screen. Upon selection of a display class (e.g.: Study Area), the tool turns on the layers, which makes up the selected display and adds and displays the required themes.

Animations

Animations were created on an as-needed basis at various stages of the study. One of the animations that was created was a three-dimensional image of the Lake to study the current bathymetric data with the original thalweg of the lake for determining flow patterns.