

Implementing Enterprise GIS for Soquel Creek Water District Using ArcIMS, ArcMAP Server, and Geodatabase

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Assets and the associated data is a key component in making planning and capital improvement decisions for a water district. This paper describes the implementation of the Soquel Creek Water District's Enterprise GIS system using ArcIMS, ArcMap Server, Geodatabase, and the .NET technology. ArcIMS Web Services are used to provide a common interface to different class of users (e.g., Customer Service, Operations, Engineering, Planning) to construct their own view into the spatial and tabular data, which is collected by the District. The role of Enterprise GIS as the data integrator is demonstrated using examples from data collected and maintained in the system.

Project Background

The Soquel Creek Water District (SCWD), founded in 1961, is a nonprofit, local government agency that provides water resources management within its service area to deliver a safe and reliable supply of high-quality water to more than 45,000 customers with over 13,500 connections in Aptos, Capitola, Soquel, and La Selva Beach. While originally the District provided flood control and water conservation services, today the district serves a community of over ninety percent residential users. The service area of the District encompasses seven miles of shorelines and extends from one to three miles inland into the foothills of the Santa Cruz mountains. [Figure 1](#) shows the location map of the District.

The District currently sells approximately 5,400 acre feet of water annually. The supply sources of the water are the Purisima and Aromas Red Sands aquifers. The District operates 17 production wells with an estimated production capacity of 15 million gallons per day. The distribution system includes 130 miles of pipelines and 18 water storage tanks. SCWD maintains an extensive monitoring and management program which includes monitoring of the groundwater quality and levels in anticipation of the threat of salt water intrusion.

In April of 1999 the District expressed an interest in contracting with a qualified firm to provide services to complete a needs assessment/analysis and to develop an implementation plan for a

comprehensive Geographic Information System (GIS). The District had compiled the following preliminary list of needs to be considered during the analysis:

Needs Assessment - Phase I

- Address Departmental needs through surveys and interviews
- Inventory existing hardware and software
- Inventory maps, databases, and other tabular information
- Evaluate County of Santa Cruz GIS in relationship to District's Needs

Needs Analysis - Phase II

- Identify and prioritize departmental needs
- Identify available information that can be incorporated into a GIS
- Identify available hardware and software that can be incorporated into a GIS
- Identify County GIS information that has been acquired by the District and can be incorporated into GIS
- Identify County GIS Information that has not been acquired by the District and can be incorporated into GIS.
- Research other water utility agencies developments with GIS and incorporate additional uses that could be applicable to the District.

Implementation Plan - Phase III

Develop an Implementation Plan based on the Assessment and Analysis (Phases I and II) which shall:

- Include itemized objectives with “deliverables” in a Flow-Chart or “Cookbook Recipe” layout
- Include recommendations on hardware and software requirements
- Include database development and usage applications
- Include recommendation on consulting needs and/or personnel needs
- Include data maintenance and/or conversion schedule
- Include recommendation for training schedule
- Include costs and scheduling for budgeting purposes
- Include recommendations and prioritization to a Phased-Approach on system implementation and capital outlay

The District had already obtained data from the County of Santa Cruz that can be used towards the development of the GIS. Further anticipated needs identified in the analysis included:

- Seamlessly linking the District's Customer Service Accounts to the GIS to get service size, meter size, etc.
- Seamlessly linking to the District's SCADA system
- Incorporating main breaks and pipe leak history
- Producing notifications to residents for construction projects
- Incorporating production and monitoring well data with graphical representations
- Integrating GPS field data when the District proceeds with GPS data collection
- Integrating parcel data from the County's Assessor's Department into the GIS with the capability to update parcel data on a regular maintenance schedule

The District selected DCSE on Tuesday, June 15, 1999. DCSE further recommended the following tasks to be added to those identified above:

- Visiting other water agencies with similar goals and responsibilities
- Developing a limited prototype application based on findings of this project. The purpose of the prototype will be to show the capabilities of the GIS under the target District's environment together with data obtained from other sources
- Develop a conceptual database design as an entity relationship diagram based on the prototype above.

The needs assessment was carried out and a prototype was developed using ESRI's MapObjects and Microsoft Access technology. [Figure 2](#) shows the prototype interface with sample tabular and GIS data. The prototype was used to identify additional requirements and to finalize the GIS Implementation Plan.

GIS Implementation Plan

The GIS Implementation Plan was finalized in February 2000. The main goal of the plan is to develop a road map to meet the GIS needs of SCWD and to expand access to GIS throughout the District by distributing data and applications to staff that use them on a day-to-day basis. The model for achieving this goal will be the Enterprise GIS. In this model everyone in the District will have access to any data in the system they are authorized to use. Each data set will be collected and maintained by the Department in the best position to do so. The Enterprise GIS model will allow the District to preserve historical data and knowledge, realize major gain in consistency and availability of data, and obtain considerable savings in the cost of acquiring and maintaining data.

The implementation plan served as a blue print for the GIS team to identify the resources and the requirements for developing a system to meet the needs of the District. The resources include an

integration of the people, software, hardware, data, and applications. The GIS requirements of the District are expressed in terms of these elements. The GIS Implementation Plan outlined a task-based approach to setting up of the Enterprise GIS. These tasks included:

- User Group Formation
- Tabular Data Automation
- Spatial Data Automation
- Potential QA/QC Issues and Data Refinements
- Base Map Maintenance
- Synchronization with Santa Cruz County Datasets
- Financial Business Services Department Data Linkage
- SCADA System Linkage
- Document Management Linkage
- GIS Application Development

The above tasks were grouped together into various phases. The key GIS applications that were identified for the first phase included:

- Creation of General Map Making Environment and Associated Tools
- Facility Data Viewing Tool
- Linkage of as-built drawings to Facility GIS Layers
- Customer Information Viewing Tool
- Historical Project and Construction Work Order Tracking GIS Based Index Tool

Enterprise GIS Model

The Enterprise GIS model is comprised of a shared database system, referred to as the Data Warehouse coupled with GIS software to view and share this data spatially. The intent of this model is to create a framework that supports improved management and sharing of common enterprise information. The key features of this model are:

- Data is organized by natural relationships instead of their use in an application.
- Users own data for operational purposes and are custodians for the interest of the organization.
- Users maintain databases (or data components) by doing their daily activities.
- Data may be replicated but it is maintained using an automated tool to simplify the synchronization process.
- The Data Warehouse element would reduce impact and simplify the security issues required to providing data to the different departments.
- Meta data (data about data) standards will be developed/adopted and communicated to

others to increase the understanding while making use of the data.

- Supports distributed computing so many individuals can share the data in different applications.

[Figure 3](#) shows the elements of the Enterprise GIS Data Warehouse Database at SCWD. In this model a Data warehouse is used to store the data from many other systems. This database also houses the attributes of the spatial data. The spatial and tabular data are linked together using common key values.

Implementation Environment

The implementation environment consisted of the following products:

- Tabular Data – maintained in Microsoft SQL Server
- Spatial Data – managed using ArcGIS, maintained in Geodatabase format
- Web GIS – GIS data served using ArcIMS and ArcMap Server

The functionality needed to support the applications identified in the first phase was provided using Mapplet.NET from DCSE. Mapplet.NET provided a portal view for different users to customize their view of the Enterprise GIS and the related data. The parcel shape files from the County of Santa Cruz GIS department and water system data is stored in a geodatabase. SCWD's construction drawings were scanned and linked to the system features and organized into a document management system through Microsoft Sharepoint software in July 2002.

Enterprise Application Usage

The Engineering, Conservation, Customer Service and Operations Departments have appreciated the many tools offered by the Enterprise GIS and the Mapplet.NET viewer to provide them with information that has never before been so readily available. The Engineering and Operations Departments have most often used the document management system connectivity tool where the mains are hyperlinked to the scanned construction project drawings of the water system that date from 1964 to present day. The ease of viewing fire hydrant pressure and flow data with the click of the mouse has improved the efficiency of data delivery to customers planning construction or remodeling of houses.

The Conservation Department has used the meter consumption graphs to send to high use customers to make a visual impact. The map creation tool has been used to give school presentations about the school's water supply and water consumption trend. Customer Service has been able to easily verify address to APN (Assessor Parcel Number) matching and has used the map to show prospective customers that there is a water main in front of their parcel and issue

will-serve letters.

The SCWD is in the second phase of Enterprise GIS development and is looking forward to the many future tools that will be readily accessible on all employees' computers through their intranet, serviced by ArcIMS and Maplet.NET software. The second phase of Enterprise GIS development includes implementation of ArcSDE as a replacement for the personal Geodatabase. It also includes a number of new tools for leak tracking and shutdown notice generation for the Operations and the Engineering departments. With the proper infrastructure in place, these tools will make it easy to provide access to interdepartmental data through a common GIS interface. The additional efficiency and the gain in productivity brought about by the Enterprise GIS is welcomed by all at SCWD.

[Figure 4](#) shows some of the sample views created by the SCWD users in the different departments.

Conclusions

Water utilities across the country have determined that access to their assets and information using GIS is critical to their function. Creating the information and gaining easy and reliable access to it has proved, in many cases, to be a challenge. Furthermore, enabling all users to access data using their personalized view through GIS has been another challenge.

The Enterprise GIS at SCWD was designed to address these challenges. SCWD enjoys a scalable, reliable, and easy to use system which can incrementally grow to meet the present and future needs of their District users. ESRI software tools in combination with Maplet.NET have enabled the use of GIS in everyone's daily activities without requiring extensive training.

Enterprise GIS facilitates access to data across many different departments, and provides a graphical interface for the retrieval of tabular data and supporting documents. Interdepartmental data exchange and sharing has never been so easy.

References

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