



Memorandum

TO: HONORABLE MAYOR
AND CITY COUNCIL

FROM: Katy Allen
Randall Murphy

SUBJECT: GEOGRAPHIC INFORMATION
SYSTEM (GIS) UPDATE

DATE: September 24, 2007

Approved

Ray Wines

Date

9/27/07

COUNCIL DISTRICT: City-Wide

RECOMMENDATION

Acceptance of the attached Report on City of San José Geographic Information Systems.

OUTCOME

The City Council will be apprised of staff's progress in developing the City's Geographic Information System capabilities.

BACKGROUND

At its November 16, 2006 meeting, the Making Government Work Better Committee accepted a detailed report and presentation from staff on the City's progress in developing its Geographic Information System capacities and requested that an abbreviated version of the presentation be given to the full City Council.

The term Geographic Information System (GIS) refers to the technology that links tables of database information to geographical features, such as streets, parcels or pipe lines that may be represented on a map. A printed map provides a way to visualize tabular data by using colors and symbols to represent the database information. A digital map is even more versatile in that it can be linked to a database containing detailed information specific to locations on the map and allows for data analysis not possible with a printed map. The attached Report on City of San José Geographic Information Systems outlines the history of GIS in the City of San José beginning with the first digital map, obtained from PG&E in 1979, through early department-focused mapping efforts and the beginning of inter-departmental cooperation around the development of the Integrated Development Tracking System (IDTS) in 1998, and on to today's cooperative efforts at the departmental and inter-agency levels.

The Report also discusses staff's vision for an "open, interoperable, and efficient data-centric system that provides quality data to our user community;" provides capsule summaries of 10 completed, 19 current or pending, and 5 unfunded GIS projects; and can be used as a reference guide to the various GIS products that are available to the Council and City staff.

A visual presentation illustrating some of the new GIS technologies, tools and maps being employed across the City organization will be presented to Council at the October 16th meeting.

ANALYSIS

The creation of an accurate and useful GIS requires a great deal of behind-the-scenes work. Staff identifies data to be acquired, defines database structures and interrelationships, collects and inputs data from many sources, checks the database for errors, provides data to enterprise applications and ensures that it works with those applications. For quality control, feedback is collected from users to correct errors and determine how to make GIS better and more useful. Staff also shares data with other local, state and federal agencies and works with GIS vendors and software developers to identify products that will improve operational efficiency and to ensure that the City's needs are incorporated into the next software versions.

The original City GIS user community was limited to a few departmental applications that needed maps. In recent years, a number of factors have greatly expanded the role of GIS, including:

- Technology advancements in computer hardware, graphics, and data storage capacities
- Advancements in database technology
- Development of theories of spatial processes in economic and social geography, anthropology, and regional science
- Increasing social awareness, education levels and mobility
- Awareness of environmental and safety challenges

A 2006 study shows that 80% of U.S. Government data now has a spatial component. In the City of San José, GIS is now integrated in the operations of public safety, transportation, environmental, land use planning, and infrastructure maintenance services.

As the demand for GIS data increases, more attention is being given in government agencies to the questions of how data should be disseminated, whether system users should pay a fee for the data, and how system costs can be allocated appropriately.

Data Dissemination – Some government entities are setting up data dissemination websites to provide GIS data files to the public. A good example of such a website is the one set up by the State of Arkansas (<http://www.geostor.arkansas.gov/Portal/index.jsp>), where a user can identify an area of interest on the website and download available related GIS files. A City of San José GIS data dissemination website would become the main source of City GIS data and be used by many public and private entities. San José residents, businesses and visitors would benefit from readily-available highly-accurate maps, aerial photos (orthophotos) and other GIS data. Even if the data is provided at

no charge, benefits to the City would include the goodwill of customers and cost savings generated when users are able to serve their own data needs without impacting limited staff resources. In return for this free data, users would be asked to report any errors they discover in the data and to acknowledge the City's contribution in any published document that uses the GIS data.

Funding for GIS – Historically, GIS efforts in the City of San José have been supported by special funding sources from programs that are receiving direct benefits from GIS work including Capital Funds, Development Fees, and Sewer Service Fees. The funding that is available is invested, almost entirely, in positions. Beyond funds allocated for server maintenance and software licenses, there is no ongoing GIS non-personal funding.

If appropriate funding sources can be identified, the GIS program would benefit greatly from having some ongoing non-personal funds that could be used to research new technology (GIS+WiFi), acquire new software and software upgrades, or allow the City to participate in County-wide initiatives (such as orthophotos and contours). Each of these investments would have potential benefits for the community as well as for operational efficiency. The highest priority unfunded system enhancement projects identified by staff are:

- **Address Re-engineering Project** - Development of a single Citywide location-enabled address database that could support all enterprise applications.
- **Enterprise GIS Architecture Enhancements** – Another server, data flow enhancements and increased storage capacities are needed to stabilize/optimize the GIS environment and accommodate the voluminous orthophoto and LiDAR (Light Detection and Radar) data sets.

The City's GIS staff receive numerous requests for services from other programs, Council Offices, Council Appointees, the Redevelopment Agency, and from residents. These requests can consume a significant amount of staff time for work that is usually unrelated to available funding sources. In addition, the underlying costs of maintaining the GIS base map, infrastructure layers, and system hardware are not being allocated to all users. Maximum benefit from GIS is derived when data from a single GIS data source is shared with all programs for which the data is relevant. The shared use of GIS data maximizes efficiency by eliminating duplication of effort. In the coming months, staff will track GIS-related costs and services provided and propose (for consideration in the 2008-2009 budget process) an appropriate allocation of the costs of maintaining a robust and up-to-date citywide GIS capability and strategic investments in the system.

PUBLIC OUTREACH/INTEREST

- Criteria 1:** Requires Council action on the use of public funds equal to \$1 million or greater. **(Required: Website Posting)**
- Criteria 2:** Adoption of a new or revised policy that may have implications for public health, safety, quality of life, or financial/economic vitality of the City. **(Required: E-mail and Website Posting)**

- Criteria 3:** Consideration of proposed changes to service delivery, programs, staffing that may have impacts to community services and have been identified by staff, Council or a Community group that requires special outreach. **(Required: E-mail, Website Posting, Community Meetings, Notice in appropriate newspapers)**

This item does not meet any of the criteria above.

COORDINATION

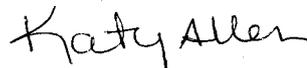
This memo and the attached Report have been coordinated with the Airport, Environmental Services, Parks Recreation and Neighborhood Services, Planning, Building and Code Enforcement, and Transportation Departments, and the City Manager's Office.

CEQA

Not a project



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For questions please contact Philip Prince, Public Works Deputy Director for Business Services, at 535-8300.

Report on City of San José Geographic Information Systems

September 2007

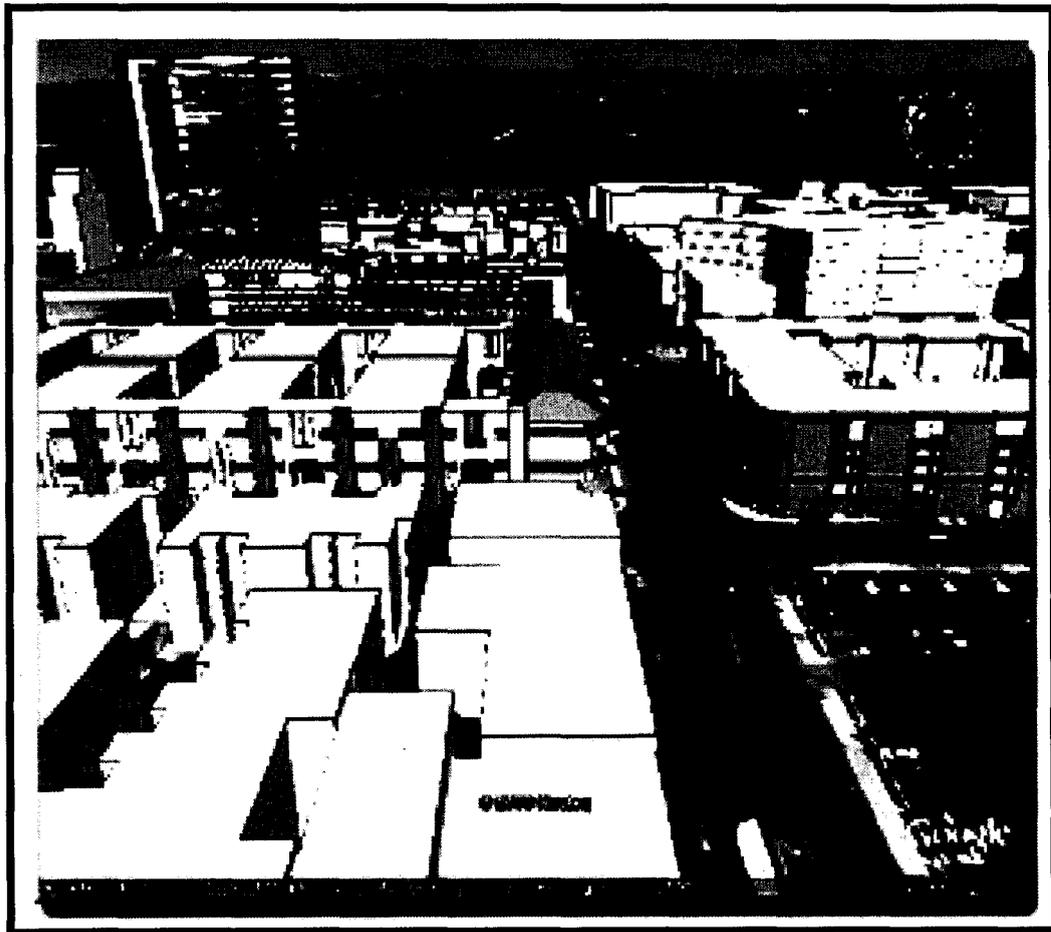


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1 Introduction

What is GIS? The term Geographic Information System (GIS) refers to the technology that links tables of database information to geographical features, such as streets, parcels or pipe lines that may be represented on a map. The City's GIS consists of an interdepartmental framework of computer hardware, software, and databases. GIS data manifests itself in many map-based business and customer service applications such as the Intergrated Development Tracking System (IDTS), Computer-Aided Dispatch (CAD), the Capital Project Management System (CPMS), as well as other digital mapping products such as eMap and iMap, and eOrtho - the City's electronic collection of aerial photos.

The creation of an accurate and useful GIS requires a great deal of behind-the-scenes work. Staff identifies data to be acquired, defines database structures and interrelationships, collects and inputs data from many sources, checks the database for errors, provides data to enterprise (City-wide) applications, and ensures that it works with those applications. For quality control, feedback is collected from users to correct errors and determine how to make the GIS better and more useful. Staff also shares data with other local, state and federal agencies and works with GIS vendors and software developers to identify products that will improve operational efficiency and to ensure that City's needs, recommendations, and requests are incorporated into the next software versions.

This report details the development of GIS in the City of San José, recent efforts to integrate the work of various departments and their applications, current and ongoing projects, and challenges to enhancing the City's GIS capacities.

2 Early San José GIS

The City of San José began its digital mapping program in the late 1970's when it acquired a PG&E map of the City. In the ensuing years, this base map was updated and used to create other maps for many City programs. This included maps representing the City's General Plan, Zoning, master plans and utility infrastructure. While the PG&E map was a good representation of the City, it was not created with modern digital technology. Nearly all of the lines of the map were too short or too long and the accumulated error in these lines caused points on the map to deviate from 50 feet to as much as 800 feet from their true locations.

The early GIS program was established for very limited purposes. Initially, the maps only showed public streets and utilities. The information collected for the early database was very job specific and limited in nature. Over time, departments with conflicting priorities and funding capabilities created their own mapping groups and began capturing their own data, often duplicating the efforts but not the results of other departments. From an enterprise perspective, GIS efforts were disjointed and contained in department "silos". (See Figure 1.) A number of efforts to adopt a single Citywide GIS software package failed because each department had gravitated toward and become familiar with the software package that it determined best met its operational needs and was reluctant to sacrifice the financial and training investments already made.

Development of the Integrated Development Tracking System (IDTS), beginning in 1998, brought together the technical staffs of four departments – Fire, Information Technology (IT), Planning, Building, and Code Enforcement (PBCE) and Public Works – to create a web-based private development permitting process that utilizes maps to retrieve and view data. During this project, discussions were held on data ownership, data compatibility and data accuracy and many GIS challenges were identified.

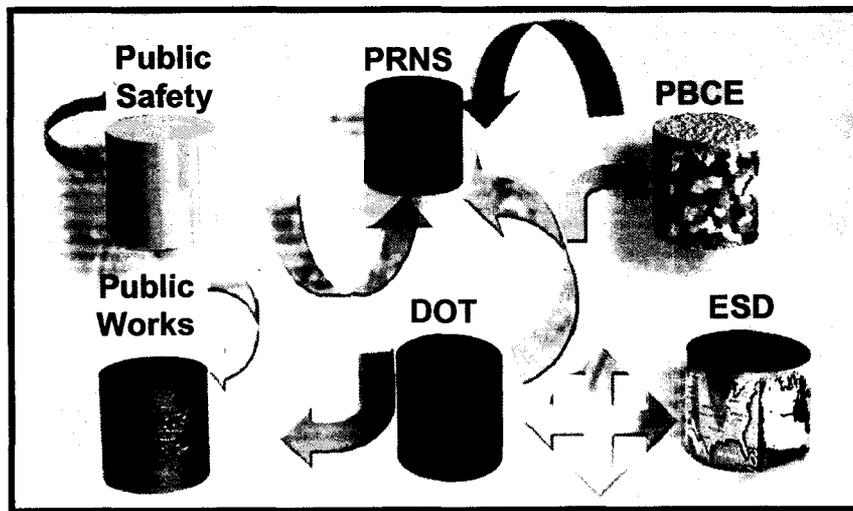


Figure 1: Pre -IDTS Organization of GIS in Silos

3 Vision

As work on the IDTS project began, staff realized that a significant number of projects, both large and small, would need to be undertaken in order to create a state-of-the-art GIS and developed a vision statement to help focus the various efforts. The vision statement endorsed the *“development of an open, interoperable and efficient data-centric system that provides quality data to our user community.”* By embracing this vision, GIS staff has expanded their departmental project focus to include a wider-angle enterprise perspective.

- **Open, Interoperable, and Data-Centric** – To facilitate wider access to data and to increase its usability, Public Works staff developed GIS data standards and guidelines with feedback from IT and other departments. Staff also created metadata that meets federal standards. Metadata is background information on GIS data explaining when the data was created and last updated, and whom to contact about the data. By establishing a data-centric model with associated standards and sharing ideas to keep the collective program on track, departments have been able to continue using the software that they determined best meets their operational needs.
- **Efficient** – To become more efficient at sharing data, staff created a data model for Public Works-related applications with input from IT and other departments that might use the data. A data model helps define user needs, both current and future, defines the data sources and accuracies, and simplifies the data update process for programs using enterprise data. Efficiency was also improved by identifying redundant data sources and determining where ownership should reside. For example, in maintaining a list of street names used by their dispatchers, the Fire and Police Departments were considering a \$10,000 purchase of privately compiled data. After determining that Public Works and PBCE also maintained street name data, the lists were compared and differences resolved. Public Works now maintains a commonly used public and private street name database and the \$10,000 data purchase was rendered unnecessary. Due to the success of this effort, the data modeling effort has expanded to include the GIS datasets of PBCE, the Environmental Services Department (ESD), and Parks Recreation and Neighborhood Services Department (PRNS).
- **Quality Data** – There were two major challenges to providing higher quality data for the GIS community: the offset of geographic data and the lack of efficient error handling processes. The spatial adjustment (rubber sheeting) project (see project description on page 20) has improved the horizontal accuracy of the City’s base map from a variance range of 50 to 800 feet in any direction to a variance that is within two feet. Most PBCE and utility map layers, except the storm and streetlight layers, now overlay this more-accurate base map. (“Layers” are GIS data with common attributes.) In addition, error reporting websites have been created to allow users to report data problems and GIS staff to provide feedback when corrections have been made. A website was created specifically for use by Public Safety’s Computer-Assisted Dispatch (CAD) System dispatchers during the recent deployment of their mobile mapping software. Confirmation that reported errors have been corrected has gone a long way toward raising user confidence in the maps.

3.1 Implementing the Vision

In pursuit of implementing this vision, staff formed a GIS Standards Committee and a GIS Technical Advisory Committee (TAC) to support the Information Technology Planning Board (ITPB). Staff was encouraged to share information on their current projects and to provide any input that might add value to other departments' projects. Among the larger, high-profile multi-department projects with GIS components are Public Safety's Computer-Aided Dispatch (CAD) system, the Capital Projects Management System (CPMS), and the development services partners' Integrated Development Tracking System (IDTS) and its public interface, San José Permits On-Line.

Staff realized some time ago that any effort to standardize on a specific GIS software product would require a great deal of time, as well as investments in additional software licenses and training. Staff determined – and the TAC and ITPB concurred - that a data-centric GIS environment that focused on a standardized GIS database was preferable to and could be implemented more easily than a standardized GIS software product. To that end, staff agreed to use Oracle Spatial as its core standard database. This approach offered a number of advantages: 1) Oracle is currently installed on the City's Enterprise GIS servers; 2) all major commercial GIS software can read-write directly from an Oracle database which allows each department to use the off-the-shelf GIS software product that works best for its program; 3) Oracle currently provides the best response times for large data sets; and 4) Oracle Spatial has the best GIS data security currently available.

4 User Community

The original City GIS user community was limited to a few departmental applications that needed maps. Developments over time have expanded the types of data being captured and their use. Major factors that have expanded the role of GIS include:

- Computer technology advancements - especially in hardware and graphics
- Database technology advancements
- Development of theories of spatial processes in economic and social geography, anthropology, regional science
- Increasing social awareness, education levels and mobility, awareness of environmental and safety challenges

The result is that 80% OF U.S. GOVERNMENT DATA NOW HAS A SPATIAL COMPONENT! (See Figure 2)

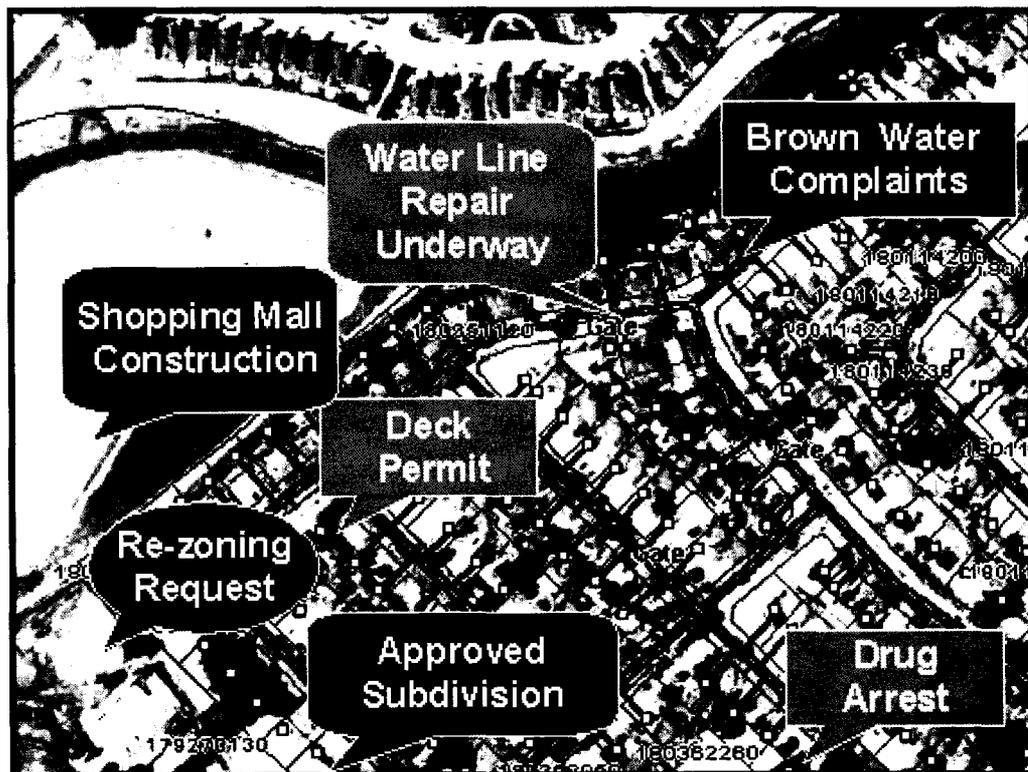


Figure 2: Examples of Spatial GIS Data Being Captured

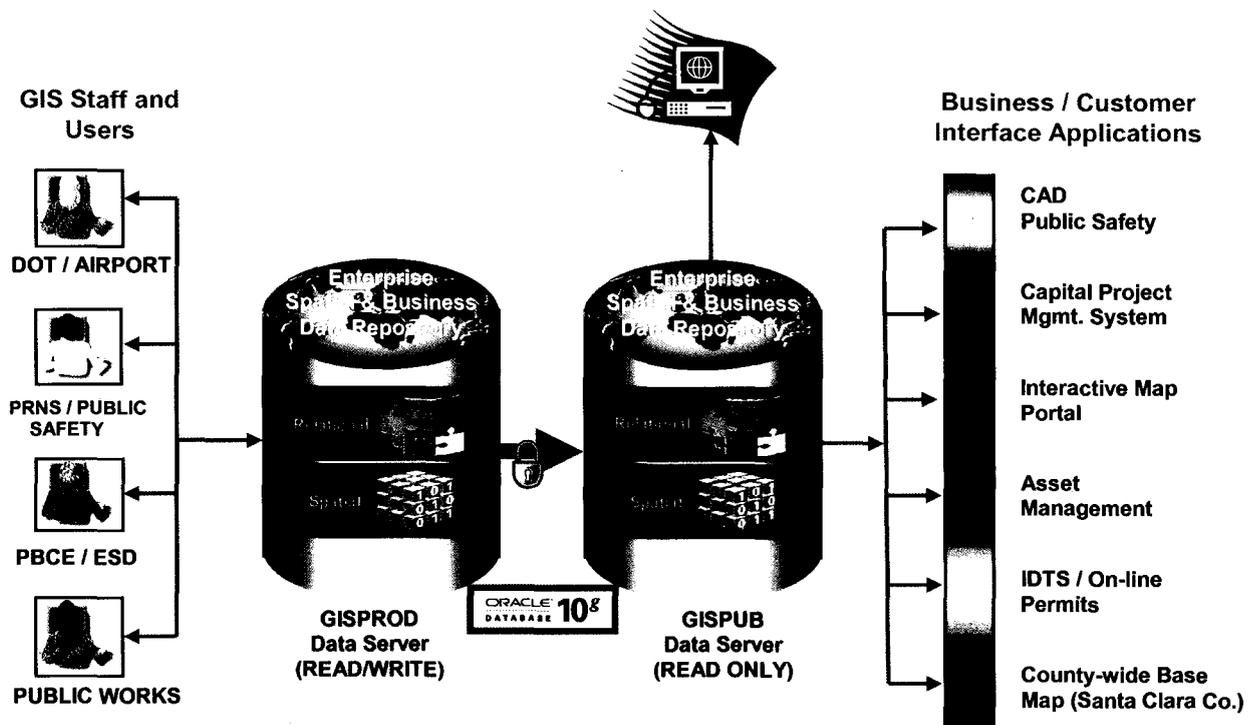


Figure 3: City of San José Enterprise GIS Environment

Figure 3 illustrates the City's GIS user community, which now operates in an enterprise (organization-wide) environment. It is anchored by two data servers, to which users send data and from which they receive data. Most important, business applications transform the data into effective customer interface applications like those shown above.

The beneficiaries of the City's GIS program are not limited to internal customers. Staff has worked with the County of Santa Clara (County), Santa Clara Valley Water District (Water District) and local cities to develop the County-wide orthophoto (aerial photo) program, the LiDAR / contour layers and the County-wide base map. In addition, staff has recently provided GIS information to:

- US Census Bureau to provide better 2010 Census data
- FEMA to support its DFIRM update project. In the future, orthophoto and LiDAR / contour data will be provided to the USGS for dissemination to all interested agencies and the general public
- BART for consultant studies along the proposed route through San José
- San José / Silicon Valley Chamber of Commerce for making maps of Downtown
- Brake Pad Partnership for estimates of the amount of copper deposited on local roads
- Adult Parole Operations to comply with California State Assembly Bill 113
- County Sheriff's Office for Crime Scene Investigation
- Evergreen School District for school bus routing
- Consultants working on City projects
- The South Bay Salt Pond Restoration Project, one of the largest wetland restoration projects currently underway in the United States

The City realizes significant benefits from data sharing. A County-wide map increases everyone's ability to share data because graphics match and agencies can import data files without a need to redraw them. There is greater opportunity for errors to be discovered, reported and corrected with more eyes on the data, so data quality and reliability are enhanced. There is greater buy-in from consultants and developers who are asked to submit map changes in a digital form that simplifies staff data input efforts. And finally, there is greater citizen / business satisfaction with local government because they realize a direct benefit from their tax dollars.

Staff also supports requests for data from external, non-governmental agencies. However, this support is very limited due to the demands of on-going projects and limited available resources.

5 GIS Project Update

5.1 Capital Projects

CURRENT OR PENDING PROJECTS

Capital Project Management System GIS Upgrade

The Capital Project Management System (CPMS) provides users with information about the City's Capital Improvement Program projects. The development of an enhanced GIS interface for the CPMS is nearing completion. A development-level view of the site is shown in Figure 4. With these improvements, new search and filter capabilities will enable users to graphically locate their projects.

Outcome/Who Benefits: This project will enable the CPMS' map-based website to facilitate easier identification of capital improvement projects. This will be useful for City staff and residents who are aware of a project location but not its name, or, conversely, are aware of a project but not its location.

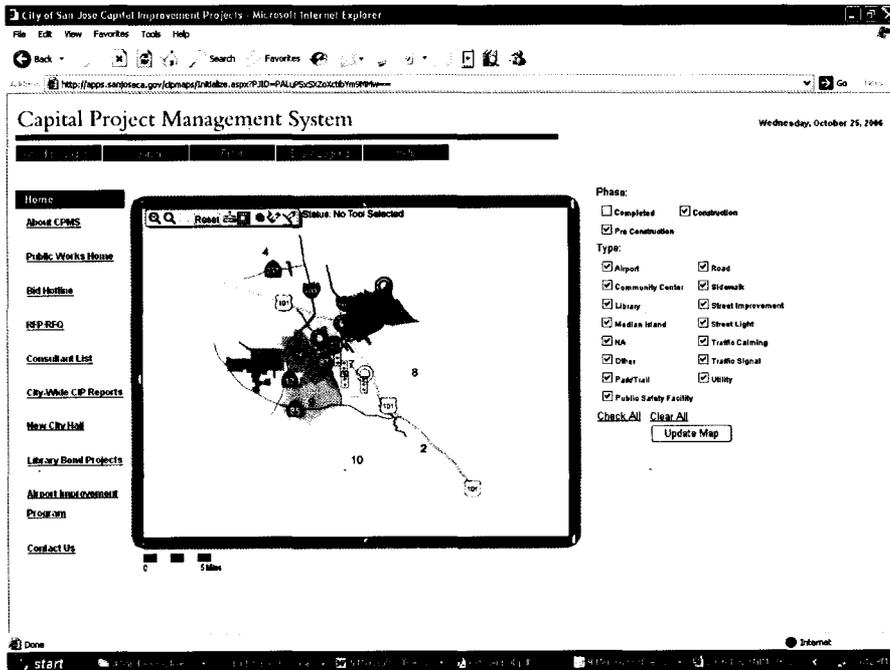


Figure 4: View of the CPMS GIS Search Page (Under Development)

Enhanced Hydraulic Data for Flow Models and Master Plans

The GIS database provides a centralized source of information on hydraulic infrastructure of sanitary sewer, storm drain, and Municipal Water infrastructure. GIS data have been provided to staff and consultants for their use in the development of master plans and flow models of these facilities. Existing GIS data will be enhanced by incorporating elevation information which can be obtained by future GPS data collection projects (see “Asset Management Using Global Positioning Systems (GPS)” in Section 5.3). In addition, condition assessment information will be linked in from other Infrastructure Management System sources (see “IMS / GIS Integration – Sanitary Sewers” in Section 5.3).

Outcome/Who Benefits: The capital improvement (as well as private development programs) will benefit from accurate and comprehensive flow models and master plans. Expanded hydraulic GIS data, in concert with real-time flow data, will enable staff to calculate flow volumes and identify service areas with hydraulic deficiencies. Staff and consultants will use this information to develop master plans that identify the necessary capital improvements, set program and project priorities, and develop budget strategies. Flow models will also be used to analyze local and regional levels of service. This will serve as a foundation for the requirement of private developers to construct or contribute funds toward the construction of hydraulic infrastructure improvements when warranted.

5.2 Land Use Planning / Private Development

CURRENT OR PENDING PROJECTS

Online Permits Enhancements

The private development Integrated Development Tracking System (IDTS) and its San José Permits Online public interface use GIS maps to help locate property, track documents and query the enterprise database for information about properties within San José. This application currently utilizes older versions of software and maps most of which have been superseded by horizontally-adjusted maps and are no longer updated. Software and maps must be upgraded and the data updating process simplified. Staff is also considering enhancements to web-enable the map display.

Outcome/Who Benefits: Up-to-date property information will be available online to staff and the development community – as an easy-to-use application. Direct web access will eliminate the need for periodic software installations and upgrades on individual desktop computers. On-line Permits will link to the base map stored on the Enterprise server, rather than relying on its own.

Google Earth / Google SketchUp

This GIS-related project involves early experimentation with Google products (Google Earth and Google SketchUp) to create three-dimensional (3D) visualizations that incorporate planning data. PBCE staff has:

- Created a website of transit-oriented “smart growth” housing projects in San José (http://www.sanjoseca.gov/planning/smartgrowth/tod_map.asp).
- Imported computer-aided drafting and design (CADD) drawings of Downtown buildings into Google SketchUp for 3D rendering within Google Earth. (See Figure 5.) A similar process is underway using CADD data from private parties in connection with various development proposals in North San José.
- Imported its GIS data into Google Earth for brief videos illustrating the relationships between existing land uses/topography and General Plan designations. These videos are anticipated to be used at City Council meetings and for Council Study Sessions and public meetings to discuss the guiding principles/major strategies of the General Plan.
- Partnered with Google to add the San José 3D CADD files to Google’s 3D warehouse under a new, San José “Cities in Development” section. Google has committed its staff time to help PBCE staff optimize the 3D CADD file for better display in Google Earth. Google has also committed staff time to take pictures of Downtown buildings in the hope that members of the public will add the photos to the 3D CADD buildings to create photo-realistic buildings.

Outcome/Who Benefits: These Google products are excellent tools for presentations and decision making. Planners, designers, managers and policy makers benefit from having a better visual picture of existing and proposed conditions.



**Figure 5: Downtown Buildings in Google SketchUp
For 3D Rendering Within Google Earth**

County Island Annexations Program

The City is utilizing spatially-adjusted GIS data to analyze annexations of County “islands” of unincorporated land. This work was precipitated by recent changes to State law that allow cities to annex unincorporated islands through a streamlined process, and subsequent action by the City Council in April 2006 initiating a three- to five-year program to annex County islands of less than 150 acres (<http://www.sanjoseca.gov/planning/annex/default.asp>). GIS data is allowing City staff to analyze such islands on the basis of numerous criteria, including island size; population and housing units, existing infrastructure, historic resources, and natural hazards/constraints, and also more efficiently coordinate with the County’s Local Agency Formation Commission.

Outcome/Who Benefits: GIS will maintain accurate spatial information concerning new additions to San José. This has numerous benefits to the City, including more-effective land-use planning, infrastructure management, and dispatch of personnel.

5.3 Infrastructure /Asset Management

COMPLETED PROJECTS

Asset Management – South Bay Water Recycling Program

This infrastructure mapping project created a coherent system to monitor and track the location and conditions of reclaimed water utility infrastructure within the City. Environmental Services staff used Global Positioning System (GPS) and Geographic Information System (GIS) Technology to map the locations and document the existing conditions of reclaimed water infrastructure (valves, meters, pipes, etc.). The project was completed September 2006.

Outcome/Who Benefits: The program now has an accurate and complete recycled water data set and map books. As a result of this project’s success and the resulting cost savings, the methods associated with this project have been adopted by other divisions within the Environmental Services Department (ESD), including the City’s Municipal Water System and the San José-Santa Clara Water Pollution Control Plant. Maintenance and operations staff now has very good tools to accurately locate and repair facility problems. All meter and customer locations are now identified and permitted in accordance with the State of California Department of Health Services. Customers connected to the system can be notified of service interruptions in a matter of minutes; previously it took several days to notify customers. The Cities of Santa Clara and Milpitas also benefit due to their partnership/involvement in the recycled water program.

CURRENT OR PENDING PROJECTS

Asset Management Using Global Positioning Systems (GPS)

Staff from ESD is using GPS equipment to better locate and map potable and recycled water facilities and aboveground and underground infrastructure at the San José-Santa Clara Water Pollution Control Plant. High-precision GPS equipment is also being used by the Public Works' Survey Section.

Outcome/Who Benefits: Accurate locations of City facilities. Providing accurate locations of water meters, valves, other buried facilities, and aboveground infrastructure makes operations, routine maintenance, nearby construction and emergency response activities more efficient.

Street Tree Management System

In an effort to support the Street Tree Management System, GIS staff has identified the need for a street tree data layer. Data might include items such as the tree species, health, trunk diameter, proximity of utility lines to the canopy and date that it was last trimmed. The first phase is proposed to identify the data that staff needs for street tree work-related processes and to create a graphical point with an identification number for each street tree in San José. At a future date, as tree maintenance crews work on each tree, data about that tree can be collected and entered into the database efforts will be coordinated with tree maintenance staff and planning permit staff. City staff will also contact Our City Forest to ensure that these GIS efforts are compatible with any progress that it has made with GIS.

Outcome/Who Benefits: The street tree database and graphic layer can be used with the street tree maintenance system. Planners, maintenance crews, environmental program staff, engineers, landscape architects, and other City staff will have access to a database that identifies each street tree within the City of San José.

IMS / GIS Integration – Sanitary Sewers

Staff has initiated a pilot project to integrate GIS maps with the software used for the Sanitary Sewer Management System, one module of the City's Infrastructure Management System (IMS). The project will reduce data entry backlogs, address error reports, incorporate the sanitary sewer master plan and flow model, and ensure compatibility with the software. Funding from the Sewer Service and Use Fund is available for the integration of the Sanitary Sewer IMS and GIS database.

Outcome/Who Benefits: IMS/GIS integration will enhance the sanitary sewer management system. The project will enable staff to utilize maps to depict service history and outstanding maintenance needs and to plan crew activities. Maintenance and engineering staff will be better able to visualize patterns related to reported problems and to dispatch maintenance crews in the most efficient and beneficial manner.

5.4 Public Safety

COMPLETED PROJECTS

CAD Phase I

Public Safety's Computer Aided Dispatch system was upgraded and now operates with street centerline maps and other supporting GIS data maintained by GIS staff in various departments. On average, CAD dispatchers have reported finding fewer than 4 map errors for every 10,000 times that they access the GIS maps in response to an emergency call. Map updates, including error corrections and modifications due to new developments, etc., are posted to the system every 30 to 60 days.

Outcome/Who Benefits: Public Safety staff has come to rely on enterprise GIS base map layers and address database for dispatch purposes. Public Safety staff and the general public benefit from GIS data that is reliable, efficiently maintained, and updated on a regular basis. A large number of staff uses the enterprise GIS data and reports on errors, so the data are reliable and the overall quality of the data outstanding.

SJPD and CrimeReports.com

San José Police Department (SJPD) partnered with CrimeReports.com (a Public Engines, Inc. company) to customize and deploy an online police data mapping and reporting service. A data access and transfer application, CrimeReports Connector, based on Global Justice XML Data Model, was refined so that automated, once-daily updates are reliably managed between SJPD and the online mapping site. Each day, CAD calls-for-service (CFS) for the prior twenty-four (24)-hour period are uploaded to CrimeReports.com so that data for the most recent thirty days-to-date is available. CrimeReports.com combines the value of the near-real-time CAD-based CFS data with the ease-of-use of Google-based mapping and an analytics module so that members of the public can view police data in a high-impact map or summary descriptive format. Members of the public may also sign up to receive free email alerts based on user-defined parameters, e.g. geography, crime or disorder categories, frequency, etc.

Outcome/Who benefits: Members of the community and SJPD staff can access the site from a browser anytime, anywhere to visualize and learn about when and where different types of events (crime and disorder) are occurring throughout the community. CAD was chosen as the data source since it is the most comprehensive source of police-community contacts (as compared to the majority of online police department applications that leverage only reported incident data). Community crime watch groups and individuals can work in a more synchronous fashion with neighborhood level officers (and other City staff, e.g., SNI) with this tool. The application service provider model offers several important benefits to SJPD and the City, given that there is no proprietary software to purchase and no year-to-year maintenance or technical contracts required. In addition, the mapping functionality (including map view, satellite, and hybrid) provided by Google is familiar, intuitive, flexible and robust. SJPD is the first major police agency in the nation to utilize the CrimeReports.com service with the Connector application and to leverage the high-volume CAD-based CFS data on a near-real-time basis.

CURRENT OR PENDING PROJECTS

CAD Phase II

As described previously, the Computer-Assisted Dispatch Phase I project has become an invaluable tool for the dispatching of Public Safety staff. A system upgrade, planned for mid-2008, will provide more flexibility and enhancements to the overall system. Significant effort will be needed to add the orthophotos (see Section 5.7) and location by address point functionality to the system. These additions will give dispatchers an alternative means to pinpoint the location of incoming emergency calls and increase their accuracy when dispatching response teams for the call. There is also a desire to add all of the streets in the County to the CAD basemap. This would provide location assistance for emergency events that are responded to as a result of mutual-aid agreements with other jurisdictions.

Outcome/Who Benefits: The CAD system will be maintained with the latest versions of software and GIS mapping tools. With this system upgrade, Public Safety staff will have better tools to locate incoming calls and respond to emergencies. The public will see emergency response teams with a better understanding of the immediate area when they arrive on scene.

5.5 Transportation

CURRENT OR PENDING PROJECTS

Traffic Signal and Intelligent Transportation System GIS

GIS has been used to assist in the operation, management, and maintenance of the City's traffic signal and other transportation assets since 2000. The system now allows planning, operation, and maintenance staff to view and analyze several aspects of the system at their desktops. Recent advances in GIS technologies have even allowed staff to view asset information with common programs like Google Earth. Planned system enhancements would allow other department staff easy access to system information, include additional asset information, and make the system even more accessible to staff through an improved interface that is much easier to understand.

Outcome/Who Benefits: This system allows staff to quickly access accurate traffic management spatial information and easily share information with other departments. Analyzing information derived from spatial queries results in better "data-driven decisions" including more effective identification of work, efficient allocation of work resources, and more precise allocation of funding. Higher quality visual presentations have enabled staff to complete system maps and compile data for various traffic management grant applications which have earned the department more than \$2,000,000 in the last five years.

Pavement Management System GIS

GIS is being used to manage approximately 2,100 miles of paved streets in the City. The pavement management system identifies and prioritizes road segments that need resurfacing by grading and categorizing surface conditions and using estimated life cycles. This information is then used to identify annual pavement maintenance project and repair locations. Enhancements are planned to allow other department staff easier access for maintenance and project planning and coordination. The planned upgrade will also improve identification of pavement condition limits.

Outcome/Who Benefits: This system improves planning of the City's pavement projects, with enhanced ability to provide public outreach to residents of the City. Coordination will be improved with other major infrastructure projects to minimize the degradation of pavement surfaces and maximize the use of available funding.

DOT GIS Master Plan

The Department of Transportation is currently developing a GIS Master Plan that will identify the Department's spatial information needs and develop a plan to provide this information to improve and support the delivery of the department's services. The goals of the Master Plan are to understand and assess user needs across the department; identify the relationship to other City GIS systems; identify cross cutting activities; recommend new and enhanced GIS systems (emphasizing the storing, analyzing, and accessing of data); and identify the hardware, software, and staffing resources necessary for Master Plan implementation.

Outcome/Who Benefits: The master plan will improve the coordination and sharing of GIS data between DOT and other City staff. Building a better and more comprehensive GIS will improve delivery of the department's services.

Garbage Hauler Pickup Scheduling and Truck Routing

In concert with GPS, GIS allows trucks to be viewed on their routes, real-time, via an interactive map. It logs the truck speed and bin location at the time of pickup, in addition to the exact time the bin was emptied. Any problems are identified in a matter of minutes and sent to the appropriate route manager or City staff for resolution. ESD GIS staff provides critical technical assistance to each of the residential haulers in order to assure they utilize GIS to the maximum efficiency. None of this would have been possible without the successful efforts of the City to develop an Enterprise GIS.

Outcome/Who Benefits: Transitions to new waste haulers will be smoother, avoiding many of the problems that occurred during the 1993 and 2002 transition periods. GIS has led to dramatic improvements in the efficiency of identifying routes and schedules for garbage, recycling, yard waste pickup, and street sweeping, as well as public outreach by targeting geographic areas within the City where bin cross-contamination occurs.

Airport GIS Program

The Airport Department is taking full advantage of its GIS program established in 2001. Current applications that are supported by GIS include the Terminal Area Improvement Program Project Tracking, Property Lease Management, Acoustical Treatment, Noise Monitoring Reports, Roadway/Terminal Signage, and Underground Infrastructure Inventory. (See Figure 6.) The GIS program is actively preparing to support the new Facilities Maintenance Management program.

Outcome/Who Benefits: There continue to be tangible benefits as the Airport GIS program expands its data collection across the Airport's campus. The GIS program provides staff with the tools to easily access accurate information that supports operational needs.

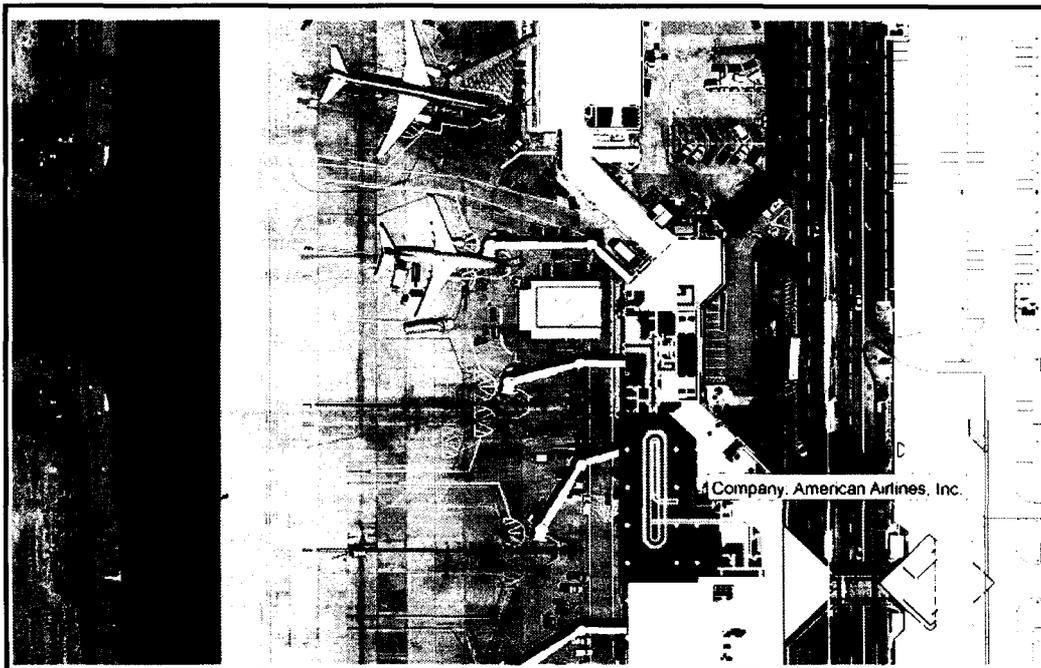


Figure 6: Airport GIS Data Superimposed on Aerial Photos

5.6 Citywide GIS Integration

COMPLETED PROJECTS

Internal Coordination Project

A number of formal and informal groups met to discuss GIS database definitions, guidelines and standards and agreed upon the guidelines and standards for an open and interoperable GIS program.

Outcome/Who Benefits: The City's GIS program now focuses on data rather than software and can be used effectively throughout the City. All staff that uses GIS data has benefited from participation in these meetings.

Data Model – The Foundation

Staff from several departments and program(s) met to discuss their data needs. Discussion items included data ownership, interrelationships, standards, and efforts to decrease manual input and increase data accuracy.

Outcome/Who Benefits: The City now has an efficient and effective data model adopted by all departments making it a City-wide effort. (See Figure 7.) All staff and programs that participated in the discussions benefit because their data needs are now reflected within the GIS data model. In addition, the City's data model is sought by other agencies for their GIS programs.

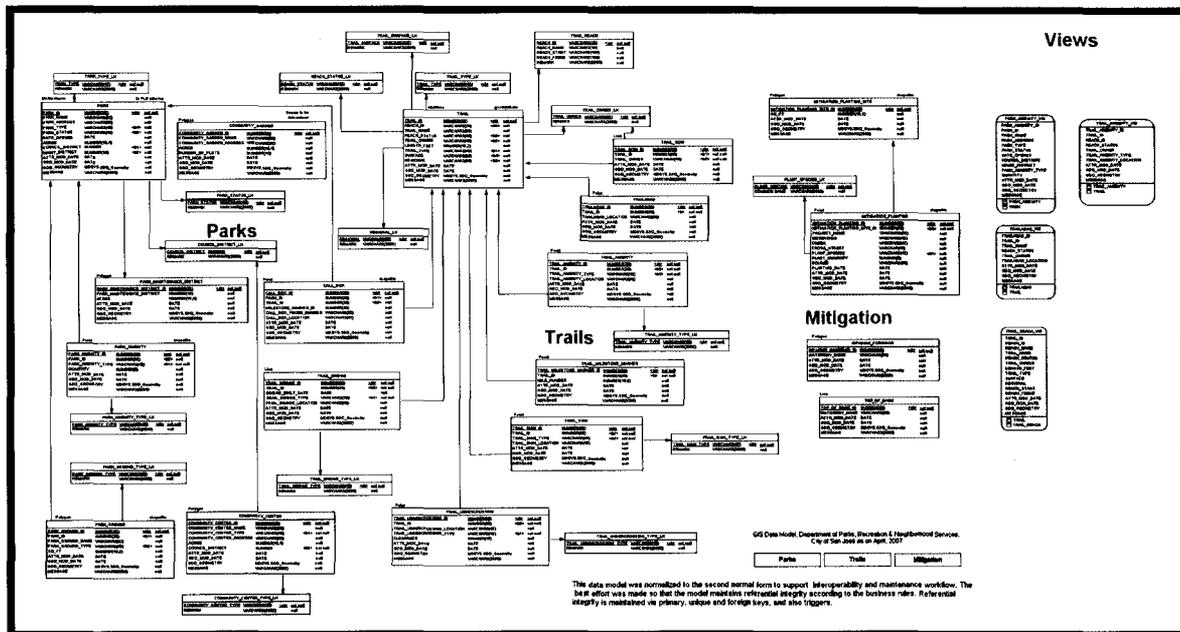


Figure 7: Sample GIS Data Model for Park, Recreation & Neighborhood Services

Enterprise Servers

It is essential that GIS data be accessible and secure. To meet these dual objectives, two data servers have been acquired. Together, they will (1) allow City staff to utilize and review up-to-date GIS data on demand and (2) edit the data they are responsible to maintain in a secure environment. These servers are maintained by IT staff in the City Hall network operations center, where data are backed up on a regular basis.

Outcome/Who Benefits: There will be a heightened awareness that GIS data are enterprise assets to be freely shared. In addition, data will be more-accessible and -secure. Every user of the data benefits by having better access to the latest GIS data.

Interactive Maps (iMap)

An interactive maps page (iMap), available on the City intranet at <http://dev.pw.csj.gov/imap>, has been developed to provide staff with a robust and user-friendly GIS interface. A user can

select GIS layers for viewing and zoom to an appropriate level of detail. If interested in a particular feature on the map, the user can click on that feature and view details about it. For example, if a street centerline is selected, a box opens with information that includes street name, segment ID number, street width, street general plan designation, public or private status, and so on. If a sewer segment is selected, a box opens with information on sewer segment ID number, pipe diameter, pipe material, and so on. Future plans for the iMap site include access to construction drawings and manufacturer’s details for items shown on these maps. An early version of the iMap website is shown in Figure 8.

Outcome/Who Benefits: iMap is an easy-to-use intranet website for viewing GIS maps and data. All City employees have access to GIS data through iMap.

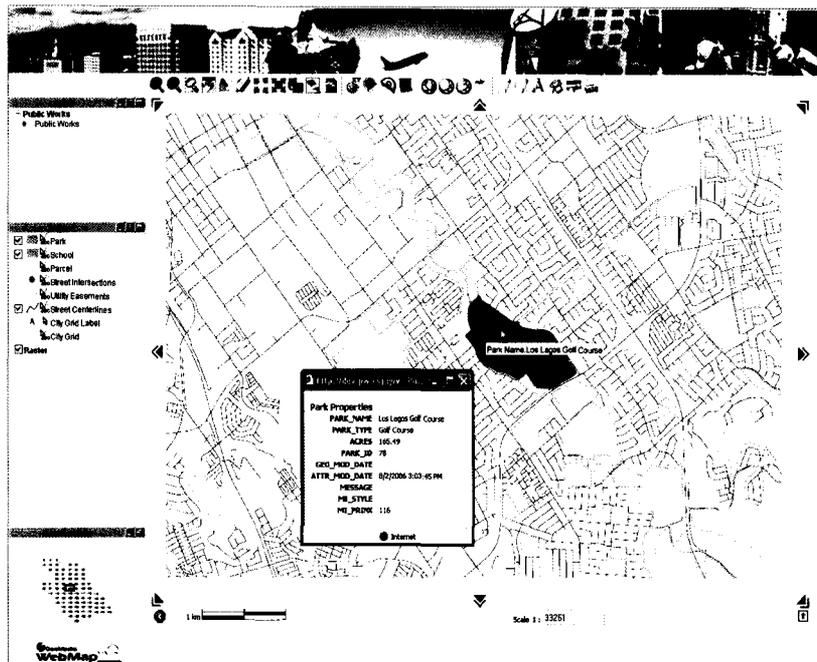


Figure 8: View of the Interactive Maps Website

CURRENT OR PENDING PROJECTS

Spatial Adjustment

Spatial adjustment, also known as rubber sheeting, is the horizontal adjustment of GIS graphics to a specified accuracy. City of San José maps were known to be mislocated by as much as 800 feet in areas furthest from Downtown. Some properties and facilities on the map were shortened or lengthened in a disproportionate manner because the original PG&E map had accumulated errors that created a space that was either too small or too big. The base map and the sanitary sewer, Municipal Water, and major planning layers were adjusted. The storm sewer and streetlight layers have not yet been adjusted.

Outcome/Who Benefits: The base map and GIS data layers will be accurate to within two feet of their actual location and overlays on the orthophotos with no visible offset. Everyone who uses GIS benefits by having more-accurate maps. For example, Public Safety is able to track vehicles on maps using Automated Vehicle Location (AVL) technology – vehicles

follow streets and don't wander across private property or through buildings because the maps are accurate representations of the real world. GIS data that better depicts area extents can be used to better calculate fees. Accurate GIS data can be used in flow models as it better reflects pipe lengths and elevations.

5.7 Remote Sensing and Mapping Tools

COMPLETED PROJECTS

Orthorectified Aerial Photos and Satellite Images

The City, County and Water District entered into a cooperation agreement to provide high-resolution orthorectified aerial photos of the County. (Orthorectified aerial photos, or orthophotos, are aerial photos that have been corrected for variations in elevations between the ground surface and the plane or satellite taking the photographs.) Additional partners who were willing to contribute towards this effort joined the County-wide effort after delivery of the orthophotos. A website was created to provide intranet access to these 2001 orthophotos and lower resolution 2003 and 2005 satellite images, and most recently, the 2006 high resolution updates. The orthophoto website may be viewed at: <http://pw.csj.gov/gis/e-ortho/> High-resolution orthophotos provide very good detail for quick verification of a site's physical condition and facilities. Lower-resolution satellite images provide an inexpensive update of the image library for reference purposes. Commercial satellite photography will improve with the scheduled launch of new satellites, but will not attain the high resolution of orthophotos for many years yet. An example of a high resolution image from 2006 is illustrated in Figure 9 on the following page.

Outcome/Who Benefits: The City now has a high-resolution set of orthophotos that can be used for planning, design, presentations and emergency response activities, as well as serve as the basis for horizontally adjusting the City base map. Orthophotos are used by staff as a ready reference tool when speaking with customers and clients and in lieu of time-consuming site visits. They are used for presentations and as background for plans, exhibits and submittals. Specific examples of uses include attorney's exhibits, site selection and property acquisition and council presentations. They are also used by Public Safety and emergency response staff.

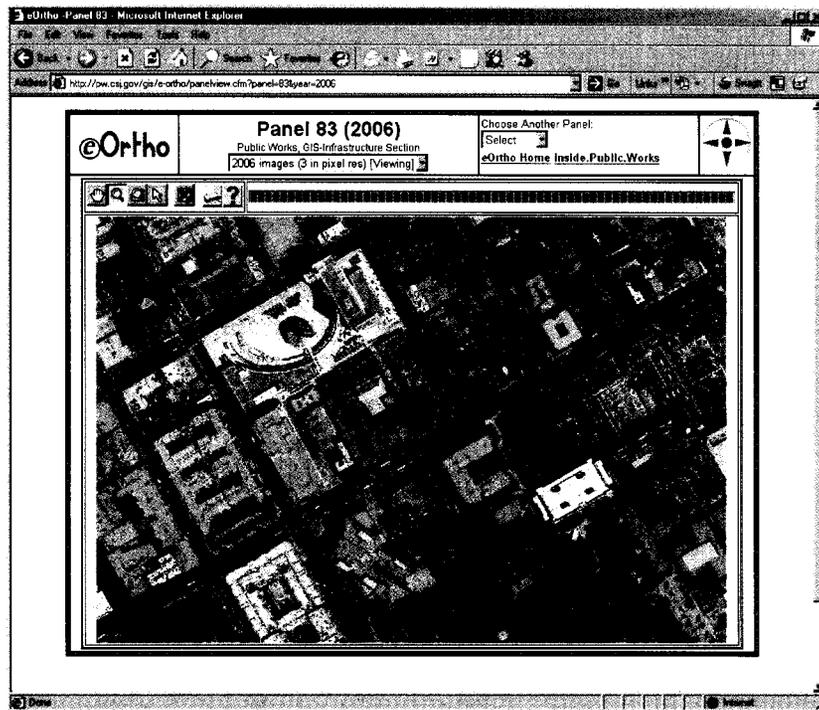


Figure 9: 2006 High-Resolution Image View of City Hall and the MLK, Jr. Library Sites

Mapbooks

The City base map (Fig. 10 on the following page) and maps of Municipal Water, sanitary sewer, and storm drain facilities (Figure 11) are available on an intranet and internet eMap website. Access to water facility maps is restricted due to Homeland Security concerns. Staff has been working on enhancements to the website that simplifies the map update process and expands map printing capabilities using the Adobe file format. This format also provides search capabilities that make it easier to locate features on the maps. The eMap website may be viewed at: <https://cpms.sanjoseca.gov/emap/>

Outcome/Who Benefits: Users can easily print a page or an entire map book comprising personally-selected map layers. These map books are used extensively by engineering staff and field crews for reference and by non-GIS professionals who need a quick and convenient source for meetings and presentations.

Fig 11: A portion of eMap Panel Page 83 Storm Drain Facilities Layer

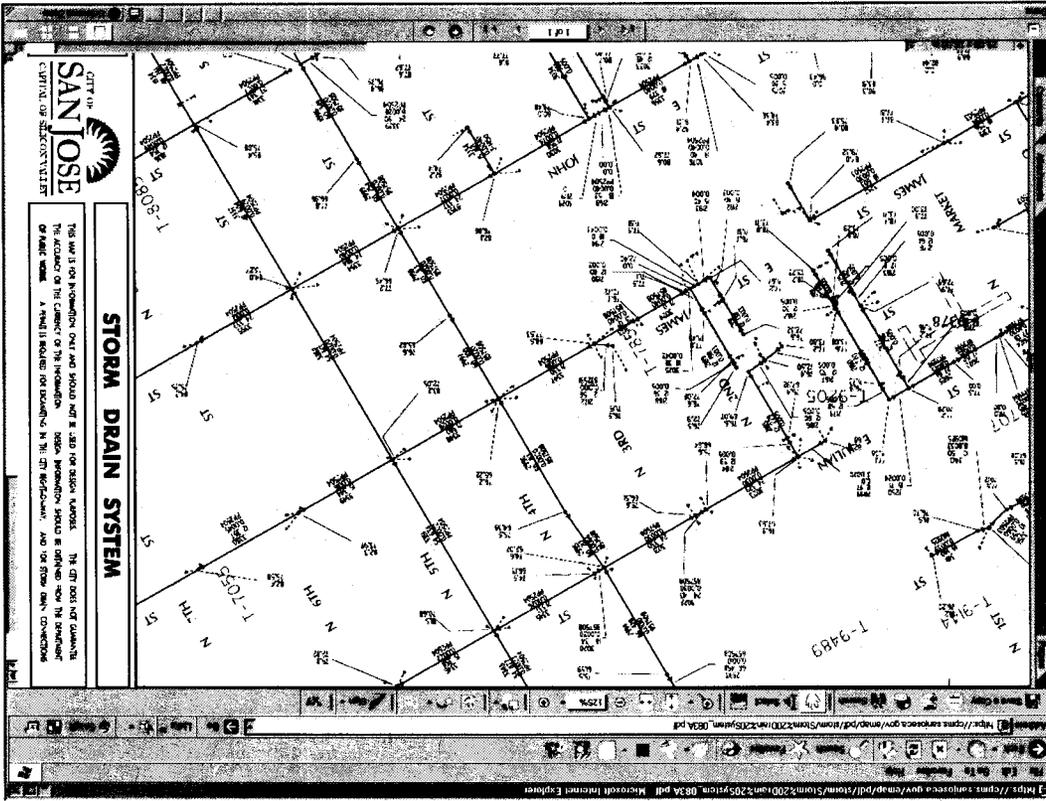
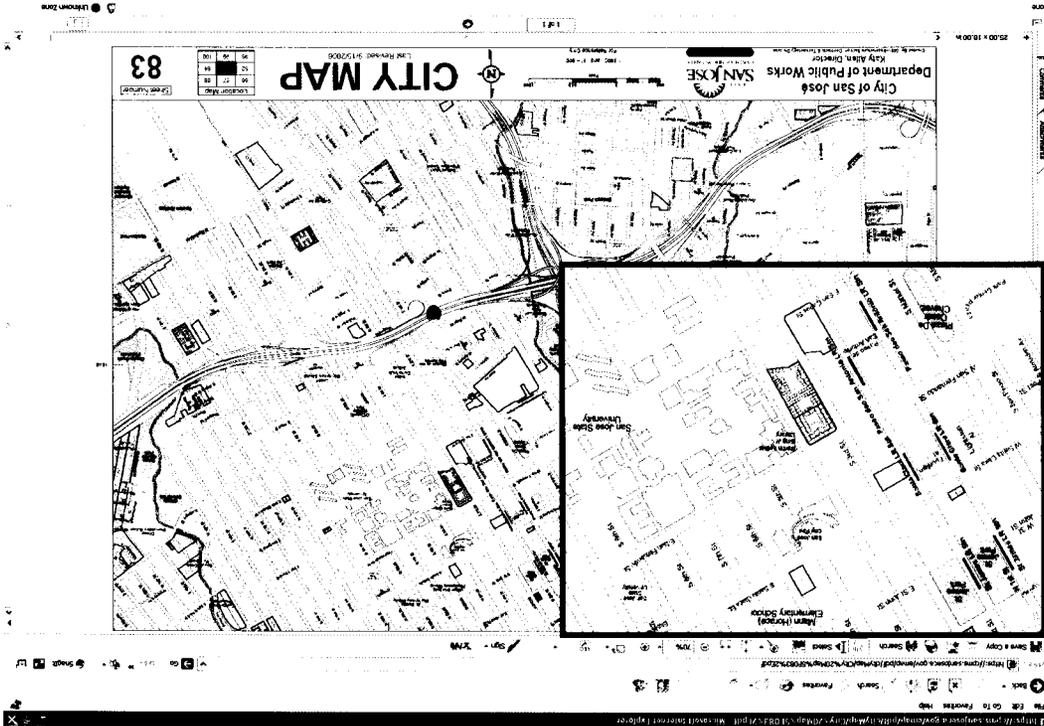


Fig 10: eMap Panel Page 83 Base Map in Adobe Format



CURRENT OR PENDING PROJECTS

2006 Orthophotos

As previously noted, the City, County and Water District entered into a cooperation agreement to provide high-resolution orthophotos of the County in 2001. -Staff from each agency has come to rely on these tools for conducting day-to-day business. After five years, staff needed newer orthophotos of the same high accuracy. A contract for high resolution orthophoto updates was awarded by the County. This contract is funded by local agency contributions and supplemented with a federal grant. These images are now being delivered by the County and being made available for City use.

Outcome/Who Benefits: Orthophoto updates are now being made available on the City eOrtho website. Staff from many departments and programs benefit by having up-to-date orthophotos readily available for reference.

LiDAR-Derived Topographic Data

Accurate elevation data is essential for many uses, such as environmental and conceptual planning, flood plain delineation, mapping of buildings and their heights, topographic contour generation, and numerous other engineering and GIS applications. The City, County and Water District entered into a cooperation agreement to acquire County-wide contour and elevation data using airborne LiDAR (**L**ight **D**etection **A**nd **R**adar) technology. This technology measures the amount of time that it takes for a beam of light from an airplane to bounce off the ground and return to the airplane. It also measures the intensity of the returning light beam to help determine if the beam hit a hard surface, vegetation, bare earth or water. The result is a set of points that contain geographical locations and highly-accurate elevations. These point data can be processed to create other datasets, such as contours, building outlines, and 3D surfaces.

Outcome/Who Benefits: Data from this effort will provide one-foot contours of the valley floor and five-foot contours of the hills. Contour data for the entire County are expected to be available by the end of 2007. (The City's cooperative effort was instrumental in having this deadline accelerated by one year.) It will also identify the top of creek banks and provide a graphical layer of building rooflines. Elevation data will support conceptual planning, preliminary engineering, emergency response projects, and enable 3D GIS. Dissemination of this data is pending the availability of appropriate computer hardware.

Samples of the contour data from North San José are shown in Figure 12 on the following page. Even more powerful than contours are impressive three-dimensional surface images that LiDAR data can produce, as in Figure 13, which shows the view from Piedmont High School looking east toward the foothills.

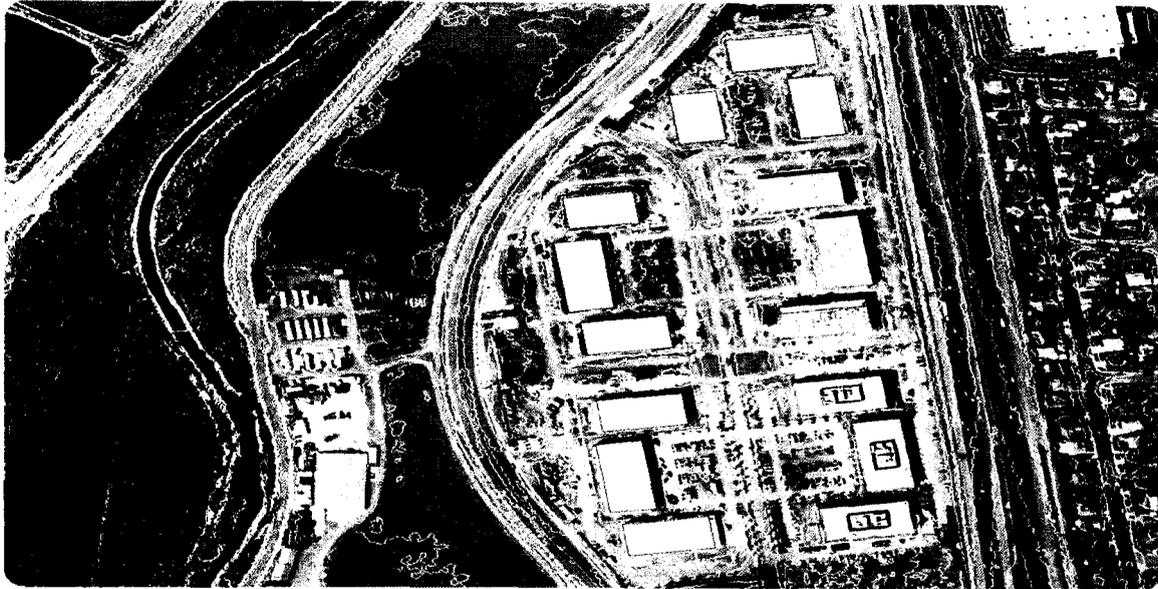


Figure 12: 2006 LiDAR-Derived Contours, Top of Bank and Building Rooflines at McCarthy Ranch

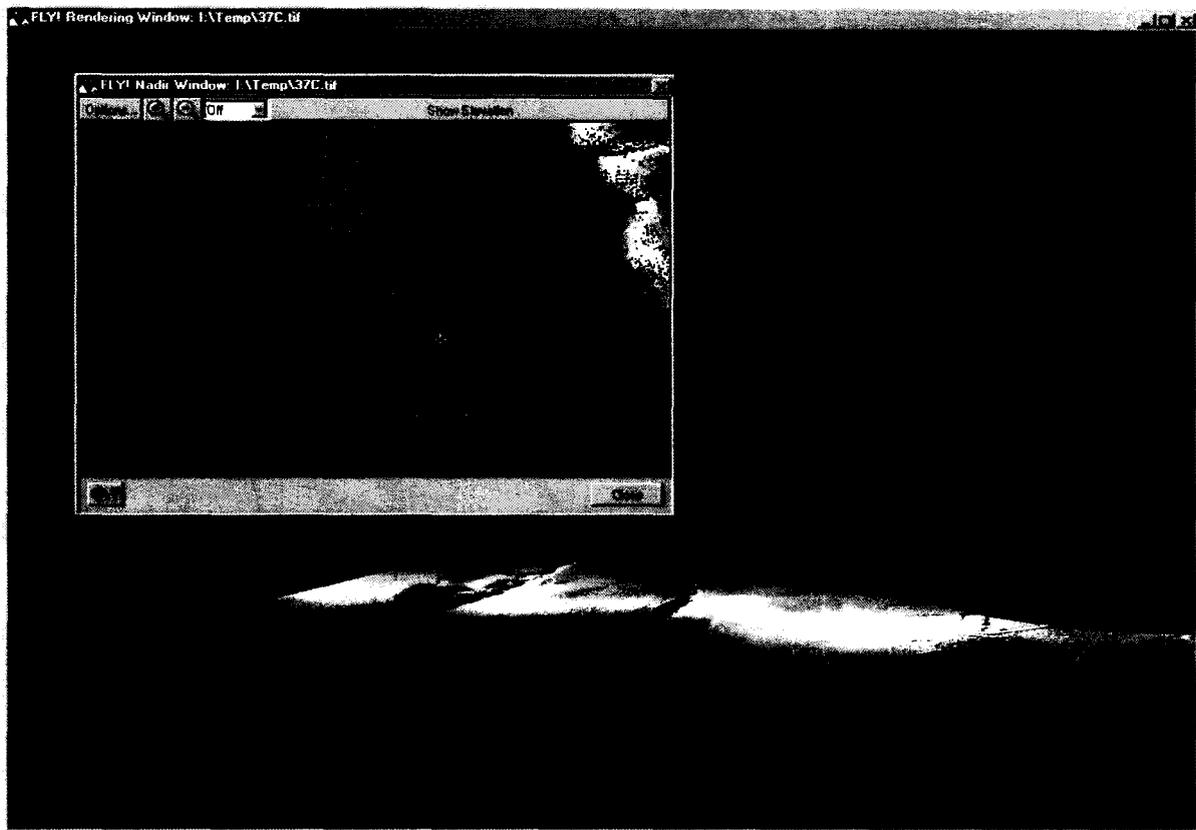


Figure 13: LiDAR-Derived 3D Imagery with Simulated Fly-Through Capability View Taken from Piedmont High School Looking East Toward Foothills

Use of Satellite Imagery for Environmental Monitoring

As part of a monitoring program required by the San Francisco Bay Regional Water Quality Control Board, the City of San José commissioned a detailed study of the marshes potentially affected by the freshwater discharge from the Water Pollution Control Plant (WPCP). This study, commissioned annually since 1989, documents changes in the distribution and geographic extent of salt, brackish and freshwater marsh. GIS plays a critical role in these studies by providing the capability to analyze the changes occurring in the various wetlands and plant communities. Until 2003, the mapping for this project was done using aerial photography. Thereafter, ESD switched to using satellite imagery. The use of satellite imagery proved to be more cost effective and, because of its higher quality, reduced the amount of field work. Combined, these two factors have reduced the project costs by approximately 15% annually thereafter.

Outcome/Who Benefits: Since 2003, over \$40,000 has been saved by using satellite imagery versus aerial photography. ESD staff has now identified additional uses for the satellite imagery data, such as incorporating the imagery into the WPCP Master Plan and using it for land use planning, environmental compliance, and infrastructure improvements. A sample of the Satellite Imagery is shown in Figure 14:



Figure 14: June 17, 2007 Satellite Image of the San José-Santa Clara Water Pollution Control Plant

5.8 Inter-Agency Partnerships

COMPLETED PROJECTS

County-Wide Base Map

During preliminary discussions for the orthophoto cooperation agreement, staffs from the City, County, Water District and many other local agencies began discussing the potential for creating a County-wide base map. The City's approval of a contract to adjust its existing base map, including all parcels within the City sphere of influence, to a horizontal accuracy of two feet was a catalyst for this County-wide effort. With slightly more than fifty percent of the parcels within Santa Clara County being adjusted under City contract and with a commitment from the Water District and other local agencies to supplement funding the adjustment of the remaining parcels, the County agreed to create a County-wide base map. A City / County data sharing agreement was executed in July 2005 and the inaugural version of the County-wide base map was released on September 27, 2005.

Outcome/Who Benefits: The County-wide basemap is updated every three months at a minimum. A County-wide map is beneficial because staff will be able to use map information for streets and parcels adjacent to the City limits for activities such as planning notifications, airport noise and sanitary sewer studies, mutual-aid (CAD), and so on. Staff can obtain data and updates from outside agencies, such as FEMA flood maps and Water District creek layers without a need for internal maintenance of those map layers.

CURRENT OR PENDING PROJECTS

County-Wide Base Map - Update Process Improvements

Although updates are scheduled for every three months at a minimum as described above, County-wide basemap updates are pending efforts to simplify the data sharing and update process. City and County are working together to utilize existing off-the-shelf software to make the basemap update process more efficient.

Outcome/Who Benefits: The County-wide map updates process has been simplified. The County will have a much simpler data update process and the City will have a County-wide map file in a format that is accessible to all map users.

5.9 Unfunded Future Projects

Address Reengineering Project (ARP)

Address and property information is a key data element in several enterprise applications, including the City's Integrated Billing System (IBS), Public Safety CAD, Capital Project Management System (CPMS) and On-line Permits. City staff and consultant Bering Point recently completed an analysis of these applications and found opportunities to reengineer the address and property database. The Address Reengineering Project (ARP) will develop a single City-wide GIS-enabled address database. Staff conducted a cost-benefit analysis and found that the City will recover its initial investment in ARP in approximately two years.

Outcome/Who Benefits: The ARP will develop a complete, consolidated GIS-enabled address database for City-wide usage. The City will no longer need to keep redundant address databases. Some benefits are described below. Currently, CAD relies on address ranges to respond to an emergency. Public Safety can leverage the single address database to further improve its emergency response time and accuracy of location. On-line Permits will be able to provide better customer service to the public with improved accuracy of addresses. The ongoing redundant address clean-up effort within IBS may be eliminated or greatly minimized. ESD's Environmental Enforcement Inspection Program will be made more efficient by providing its inspectors with accurate maps depicting the locations of businesses to be inspected and where violations occur.

GIS Enterprise Architecture Enhancements

In order to improve the environment for GIS enterprise data management, additional storage is needed for the huge volume of data acquired from recent projects such as the 2006 Orthophotos and LiDAR. Data flow between the two existing servers is required to further synchronize and optimize the data flow with minimum downtime. Another server is required to test and develop database improvements prior to implementation on the Enterprise servers.

Outcome/Who Benefits: Secure data will be provided seamlessly to City users without the need to translate for a variety of uses. These enhancements provide one-stop GIS information, address future needs, comply with City enterprise GIS standards, and align with the GIS industry's best practices.

Enabling GIS Data for Computer Aided Drafting Users

A large segment of City engineers and architects use MicroStation or AutoCAD software to perform their regular work activities. Currently, the enterprise GIS environment does not provide direct data access to these users. New technology must be adopted that will allow them to connect directly to the data.

Outcome/Who Benefits: MicroStation and AutoCAD users will have seamless access to the enterprise data. Primary beneficiaries will be the Airport Department, DOT, Public Works, ESD, and the San José Redevelopment Agency.

City-Owned Property Website

Staff from Public Works and Information Technology have begun an effort to update and enhance a GIS-based website that was created in 2000 to access data about City-owned and -leased properties. The proposed site will provide links to property related documents, such as title reports, appraisals, and photos. The website may also contain links to information about facilities located on the property, including site manager contact information, environmental documents and facility construction drawings that could be used for reference or for emergency purposes.

Outcome/Who Benefits: This easy-to-use website will provide staff with a comprehensive source of data about all City-owned property. Real-property staff, and other staff interested in City-owned property will be able to easily locate properties and related information.

Wireless Technology and Mobile Devices

Staff is monitoring efforts to create a South Bay WiFi network and to deploy mobile technology to City staff. As mobile technology is deployed and resources become available, GIS staff will support these mapping and database needs.

Outcome/Who Benefits: Using mobile technology within a future WiFi network, City staff, residents and those doing business within the City limits will have easy access to City maps and database information.

6 GIS Enhancement Issues

As the demand for GIS data increases, more attention is being given in government agencies to the questions of how data should be disseminated, whether system users should pay a fee for the data, and how system costs can be allocated appropriately.

6.1 Data Dissemination

Some government entities are setting up data dissemination websites to provide GIS data files to the public. A good example of such a website is the one set up by the State of Arkansas (<http://www.geostor.arkansas.gov/Portal/index.jsp>), where a user can identify an area of interest on the website and download available related GIS files. A City of San José GIS data dissemination website would become the main source of City GIS data and be used by many public and private entities. San José residents, businesses and visitors would benefit from ready availability of high accuracy maps, orthophotos and other GIS data.

Even if the data is provided for free, benefits to the City would include the goodwill of customers and cost savings generated when users are able to serve their own data needs without impacting limited staff resources. In return for this free data, users would be asked to report any errors they discover in the data and to acknowledge the City's contribution in any published document that uses the GIS data.

Examples of companies that have requested map data in the past and would benefit from this website include Underground Service Alert North and map producers Rand-McNally / Thomas Brothers, CSAA, and Barclay's.

6.2 Error Reporting

In order to track the status of GIS mapping errors reported by Public Safety dispatchers, staff created a website that notes the error, the action taken to correct the error, and the acceptability of the corrective action to the person who reported the error. This has helped to maintain the GIS street centerline data at better than 99.96% error free. The website has led to increased Public Safety staff confidence in the reliability and accuracy of the map data. Website access is restricted to authorized Public Safety and Public Works staff. A view of the site is shown in Figure 15 on the following page.

Considering the success of the Public Safety error reporting site, an internet website has been created to track errors related to all Public Works maintained GIS data layers. Although not extensively used to date, error reports originating from this site may become frequently used as GIS data becomes more accessible to the general public. With more eyes on the data, this process should also reduce the number of map errors discovered by Public Safety dispatchers. This website can be viewed at: https://secure.sanjoseca.gov/gis/gis_err.asp.

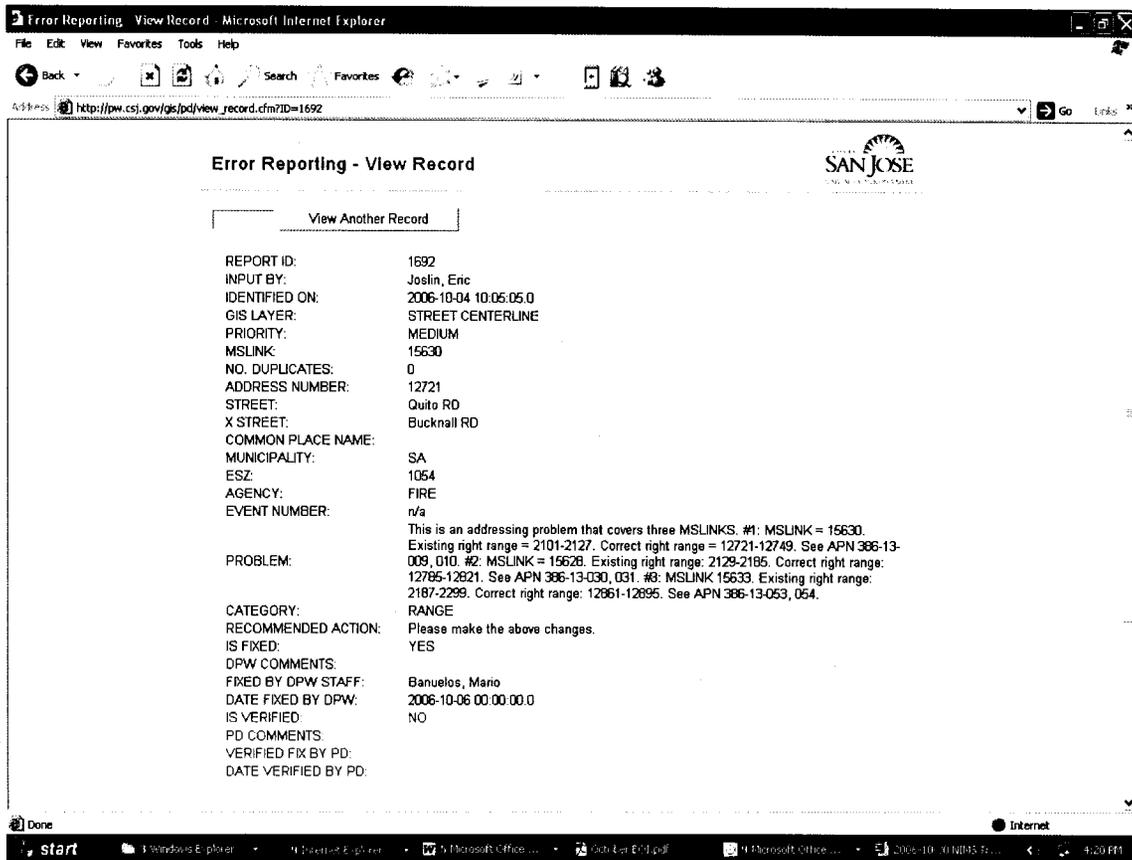


Figure 15: View of the CAD Error Reporting Website

6.3 Appropriate Funding

Historically, GIS efforts in the City of San José have been supported by special funding sources from programs that are receiving direct benefits from GIS work including Capital Funds, Development Fees, and Sewer Service Fees. The funding that is available is invested, almost entirely, in positions. Beyond funds allocated for server maintenance and software licenses, there is no ongoing GIS non-personal funding. If an appropriate funding source can be identified, the GIS program would benefit greatly from having some ongoing non-personal funds that could be used to research new technology, acquire new software and software upgrades, or allow the City to participate in county-wide initiatives (such as orthophotos and contours). Each of these investments would have potential benefits for the community as well as for operational efficiency.

The City's GIS staff receives numerous requests for services from other programs, Council Offices, Council Appointees, the Redevelopment Agency, and from residents. These requests can consume a significant amount of staff time for work that is usually unrelated to available funding sources. While residents may be charged a cost-based fee as stipulated in the Fee Resolution, the underlying costs of maintaining the GIS base map, infrastructure layers, and

system hardware are not being allocated to all users. Maximum benefit from GIS is derived when data from a single GIS data source is shared with all programs for which the data is relevant. The shared use of GIS data maximizes efficiency by eliminating duplication of effort. In the coming months, staff will track GIS-related costs and services provided and propose (for consideration in the 2008-2009 budget process) an appropriate allocation of the costs of maintaining a robust and up-to-date citywide GIS capacity.

7 Awards / Presentations / Publications

The City of San José has been an active participant in the local and national GIS community for many years. As noted below, staff has received a number of awards, made presentations at GIS forums, and published articles in professional journals. Additionally, the City organized and hosted the annual CalGIS (California state-wide GIS) Conference in 2004. In the academic arena, some City GIS employees have volunteered their time at local community colleges as instructors and guest speakers. Also, the City is a member of various regional professional organizations, including BAAMA (the Bay Area Automated Mapping Association) and the Northern California Intergraph Users Group.

Awards

- **Intergraph's 2005 Geospatial Achievement Award – Government Solutions Category**
Awarded at the Intergraph GeoSpatial World conference in San Francisco.
- **Oracle Spatial's 2005 Integrated Enterprise Award for Excellence**
Awarded at the conclusion of the Geospatial Information & Technology Association conference in Denver.

Presentations

- **“Incorporating LiDAR Data into City of San José’s Workflows,”** presented by Vicky Gallardo of Public Works, at the CalGIS (California GIS) Conference in April 2007.
This presentation described the LiDAR project (see Section 6.2.5 of this report), which will provide highly-accurate elevation data for locations within the City of San José and the County of Santa Clara. Highlighted were the value of LiDAR and some of the challenges and issues related to the incorporation of voluminous data.
- **“Integrating GIS Data with Computer-Aided Dispatch in the City of San José,”** presented by Marsha Lynch and Earl Harris of the Information Technology Department at the 2007 Urban and Regional Information Systems Association (URSA) Conference in New Orleans.
This presentation focused on how the City is leveraging its Enterprise GIS Data to support Public Safety’s E-911 (CAD) application and lessons learned from the implementation.
- **“Street Centerlines Can Save Lives,”** presented by Mario Bañuelos of Public Works, at the BAAMA Conference in San Mateo in July 2007.
This presentation on street centerline workflows focused on one very critical application that relies heavily on centerline data: The needs of Public Safety (Police and Fire) for accurate addressing when lives are literally at stake.

- **“Streetlight-Enhanced Workflow Using GIS and Web Technologies,”** presented by Roberto Molina of Public Works, at the Intergraph Users Conference in Nashville, TN, in May 2007.
This presentation showcased the City’s project to streamline the streetlight data maintenance process. The project transformed streetlight system data into a more user-friendly system using the power of GIS and web technologies.

Publications

- **“ArcGIS Integration Improves the Workflow in the South Bay Water Recycling Program,”** Spring 2007, Water Writes Newsletter.
This article, written by ESD staff, explains the benefits to the City’s recycled water program obtained from the development of the South Bay Water Recycling Program Web-based GIS.
- **“Double Duty: The City of San José Municipal Water System Combines Regular Valve Maintenance With Collection of GPS Data That Supports Long-Term Strategic Objectives,”** October 2007, Municipal Sewer and Water Magazine.
This article, written by ESD staff, explains the benefits of integrating GPS and GIS technologies into the regular valve maintenance and rehabilitation work of the Municipal Water System.
- **“GIS Streamlines Recycled Water Management,”** October 2006, Opflow Journal.
This article, written by ESD staff, explains the benefits of integrating GPS and GIS technologies into the operations and maintenance of the South Bay Water Recycling Program.
- **“Wetlands Analysis: Monitoring Change in South San Francisco Bay,”** August 2006, Earth Imaging Journal.
This article, written by ESD staff, explains the cost-benefit of using satellite imagery to monitor wetland changes as part of the San José-Santa Clara Water Pollution Control Plant’s Discharge Permit.