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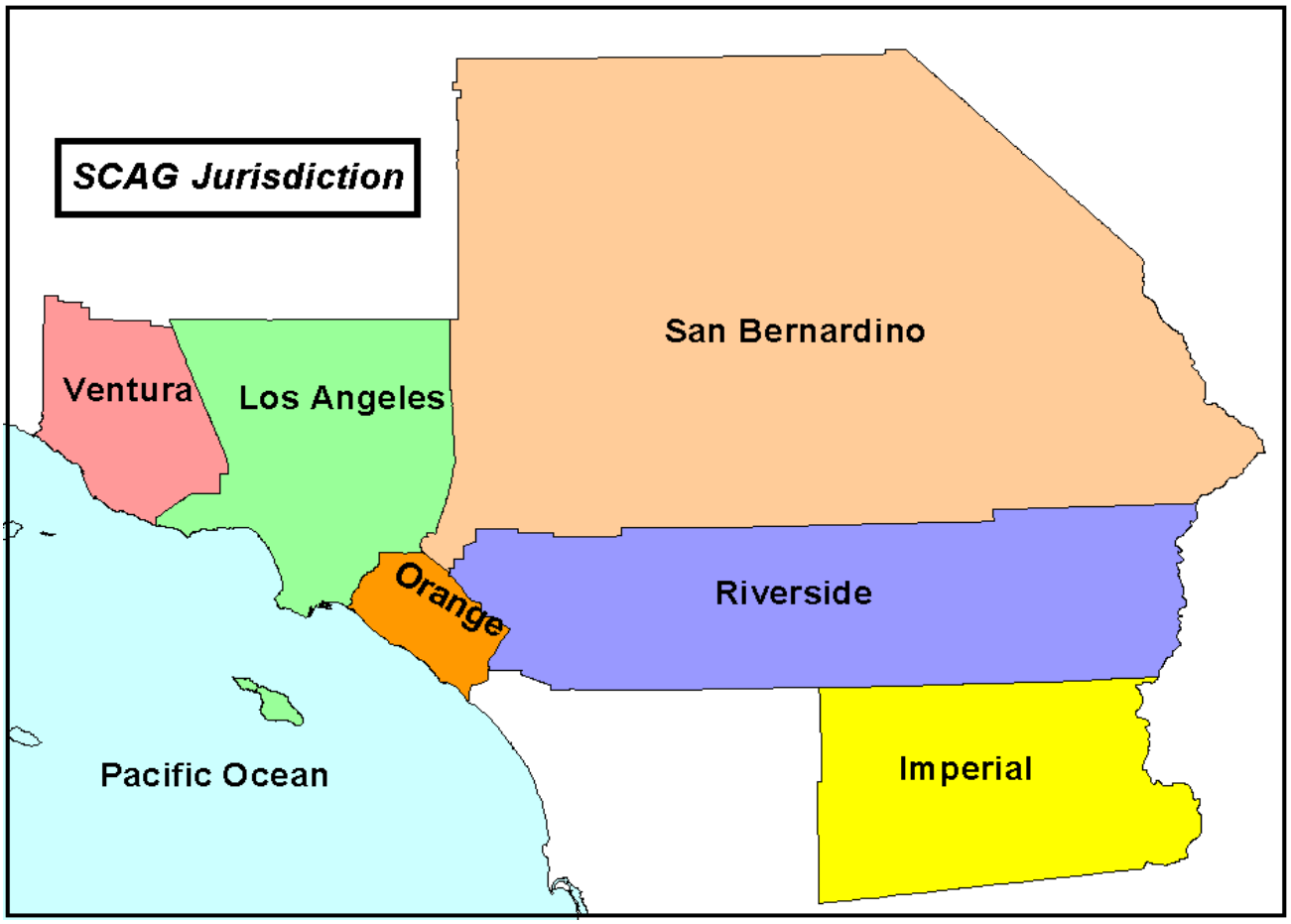
Transportation Case Studies in GIS

Case Study 1: Southern California Association of Governments Access Project



Project Summary

Southern California Association of Governments (SCAG) initiated an ambitious project called "ACCESS" with the goal to make Southern California the "most information accessible region in the world". GIS was used as the core technology to support this decision-making framework. ACCESS project provided local jurisdictions uninhibited access to many different data sources to encourage participation in the regional planning processes. ACCESS project has been recognized by agencies in the U.S. and abroad for its success in enhancing regional cooperation and participation.

Project Benefits

- Enhanced cooperation and coordination among local jurisdictions
- Project selection for Transportation Improvement Plan (TIP) with a regional perspective
- Comprehensive approach to Land Use, Transportation, Environmental Planning
- Better communication between planners and decision makers because GIS could present project alternatives in visual format
- Better data sharing
- Increased GIS literacy
- Complete GIS system at each local jurisdiction

Policy Background

The Southern California Association of Governments (SCAG) is the largest Metropolitan Planning Organization (MPO) in the United States. SCAG's jurisdiction includes the counties of Los Angeles, Orange, Riverside, Ventura, San Bernardino, and Imperial in Southern California. The entire SCAG planning area encompasses more than 38,000 square miles and is divided into thirteen sub-regions. This area includes 184 cities and a total population of approximately sixteen million. As the regional planning organization, SCAG is responsible for the preparation of the long range Regional Transportation Plan (RTP), for the transportation control strategies in the Regional Air Quality Management Plan (AQMP), and for the creation of the Regional Comprehensive Plan (RCP). SCAG is also responsible for developing the regional long-range growth forecasts for population, housing and employment.

SCAG has long held the view that better regional planning is possible only through full participation and cooperation of local jurisdictions. To that end, SCAG has undertaken a "bottoms-up" approach to regional planning in order to engage the local agencies in SCAG's long-range planning process.

Case Study and Problem Definition

In trying to implement the "bottoms-up" regional planning approach, SCAG has been faced with several problems/issues:

- Difficulty in involving local agencies in SCAG's regional planning process due to lack of a regional perspective, appropriate tools, and resources at the local level
- Local jurisdictions can no longer operate in a vacuum and need cooperation and coordination among the constituent governments
- Need for a comprehensive approach to Land Use, Transportation and Air Quality issues among local jurisdictions, subregions and SCAG, to share ideas on subregional and regional planning issues.

To overcome these and other problems, the directive from the SCAG management was to make Southern California the "most information accessible region in the world". In response, SCAG initiated the ambitious project called "ACCESS". The underlying theme of this effort was that Project ACCESS would provide uninhibited access to information, techniques and tools in order to foster participation of local jurisdictions in the regional planning process. SCAG also decided that Geographic Information Systems was ideal for this decision-making framework.

The following are the goals and design criteria for the ACCESS system, which were identified at the onset of the project:

ACCESS Project Goals

- Facilitate Decision Making
- Enhance coordination among jurisdictions and within sub-regions
- Encourage and simplify information/data sharing
- Increase communication between SCAG and local jurisdictions, and among jurisdictions themselves
- Set regional standards in terms of tools, data bases, and software
- Strategically leverage GIS technology to meet these goals

ACCESS System Design Criteria

- Develop a turn-key GIS solution
- Provide a complete package to the jurisdictions, that includes hardware/software, tools, databases and training
- Make the system user friendly and aim it to the non-technical users
- Keep it low cost and with minimal on-going maintenance
- Utilize existing capabilities, data and resources at SCAG, as much as possible
- Complete the project in two years

This case study will discuss the different components of the ACCESS system, with special emphasis on customized GIS applications and data that were developed to aid local subregional planning processes. This report also discusses the costs and benefits of GIS in this effort.

Existing GIS-T Technical Capabilities

Existing GIS capabilities at the local jurisdictions that are SCAG members are scattered at best. They range from cities and sub-regional agencies with no GIS capabilities to experienced GIS users, such as, the Western Riverside Council of Governments (WRCOG) and LA City. Local jurisdictions had avoided GIS mainly due to unfamiliarity with the technology and the hardware, software, data, and training costs associated with GIS implementation. Through the ACCESS project SCAG wanted to overcome these misperceptions and also provide the local jurisdictions with GIS tools, databases and training.

As the regional MPO, SCAG maintains a vast amount of spatial, socio-demographic, and transportation model output data for the entire region. Over the years, SCAG has created or compiled more than 15 gigabytes of data. Datasets that SCAG has developed and maintained over the years can be broadly grouped into four major categories:

- Land-use data
- Socio-economic data
- Transportation data
- Environmental data

Out of this, each local jurisdiction received roughly 500 megabytes of data pertaining to their subregion with the ACCESS system. The table below provides a sample list of the GIS Data layers that were provided to the jurisdiction.

SCAG GIS Data Layers provided with the ACCESS system

GIS Data Layers	Description
Census Blocks	1990 census block boundaries with demographic attributes.
Census Partial Tracts	1990 census partial tract boundaries with demographic attributes.
City Boundaries	1990 city boundaries with demographic attributes.
Transportation Analysis Zones (TAZ)	SCAG forecast data for TAZ
Population Forecast Data	SCAG forecast data (2000-2020) for population, households, and employment by census tract and city.
Employment Data	1990 employment and employers by SIC code.
Subregions	SCAG subregion boundaries.
Land use	1990 and 1993 general land use.
General Plan Land use	General plan land use from jurisdictional maps.
Earth Quake Faults	Alquist-Priolo fault zones and epicenter data.
GAP	Ecological zones and habitats.
Regional Mobility Element (RME) Projects	RME projects include highway, urban rail, and Metrolink projects.
Transportation	Street networks from TBM (Thomas Brothers Maps).
Zip Codes	Zip code boundaries from TBM.
Landmarks and Ownership Areas	Landmark and ownership data from TBM.
Hydrologic Features	General hydrologic features from TBM.

Source: ACCESS project: Jurisdictional Information Booklet, SCAG, August 1995.

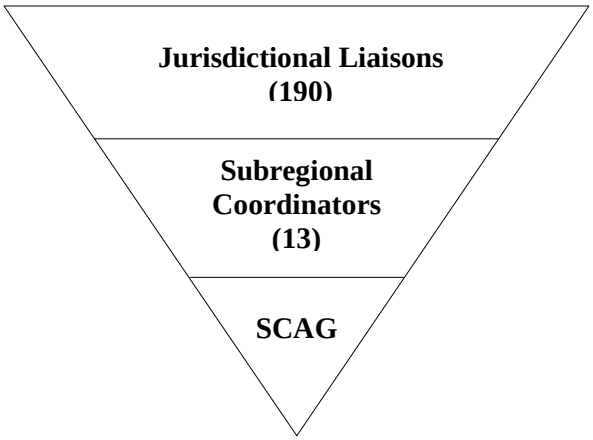
ACCESS System Components

- Project Organization
- Computer System
- Application Programs
  - GIS Applications
  - Communication Applications
- Geographic Databases
- Comprehensive Training

Each of these components is discussed briefly below. However, the focus of this case study is on the GIS applications.

Project Organization

Since the Project was envisioned to be a one-time turnkey type effort, the jurisdictions were organized in a manner so that they could continue to support each other and make optimal use of the system after the initial implementation. ACCESS project participants were organized into three levels. The end users of the ACCESS system were the 190 jurisdictions, which were grouped into 13 subregions. Each subregion would act as the coordinating forum for the jurisdictions in that subregion. SCAG's role in the project was to coordinate "subregions", lead application development and provide training to the jurisdictions.



Each subregion had a sub-regional Technical Advisory Committee (TAC), to facilitate implementation and provide a platform for mutual technical support and exchange of ideas, information, and application examples. Each jurisdiction would be represented by a "Jurisdictional Liaison" in the TAC.

Computer System

To ensure successful installation and operation of ACCESS, the computer system was standardized and supplied to all jurisdictions. The computer system package included hardware, software, and network connections. The hardware component included a powerful personal computer equipped with high-resolution display monitors to display intensive graphical outputs from GIS applications, and necessary communication cards for standard modem and Integrated Services Digital Network (ISDN) connections. The computer system also included three software packages that were required to run the ACCESS applications:

- Environmental Systems Research Institute's ArcView GIS software to analyze, map, and view spatial and attribute data
- Standard Microsoft Office suite for word processing and spreadsheet analysis
- Netscape Internet browser

ACCESS Initial User Interface

GIS Applications

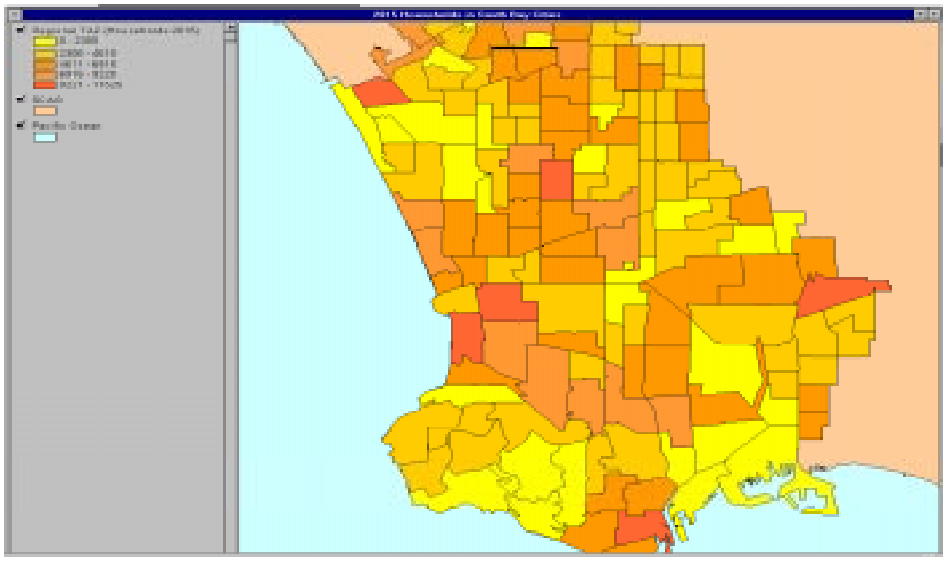
ACCESS applications can be divided into two major classes: GIS applications and Communication applications. While GIS applications provide the necessary transportation planning tools to the jurisdictions, communication applications allow sharing of GIS data and results in order to maintain communication and coordination among local jurisdictions and SCAG.

More than twenty-five potential GIS applications were considered for development. From that complete set, a specific suite of eight GIS applications were prioritized by the jurisdictions. ACCESS GIS system initiates with a welcome screen that lets the users choose the application they wish to use.

Growth Forecasts

One of SCAG's responsibilities, as the MPO, is to develop long-range growth forecast for the region. These forecasts form a key input to the regional plans. This module allows the user to view the forecasts graphically and analyze the forecasts at a local level of geography. It was believed that this would improve participation and review from he jurisdictions.

The application allows display of growth forecasts for data categories, such as population, households, and employment for the years 2000, 2010, 2015, and 2020 at various levels of geography. The application also allows for statistical and map-based analysis of growth patterns and growth rates. The user selects data cat-



Growth Forecast for South Bay Cities: Number of Households in 2015

Demographic Categories Displayed by ACCESS

CATEGORY	SUBCATEGORY
Housing	· Cost of renting · Housing numbers · Occupancy rate · Owner occupancy rate · Persons per unit · Property values
Ethnicity/Race	· Percent Asian · Percent black · Percent Hispanic · Percent non-Hispanic white · Population density
Households	· Number of households · Percent married w/ children · Percent married wo/ children · Percent single household · Percent single parent
Age/Sex	· Females 65 and over · Females under 1 · Males 65 and over · Males under 1
Income/Education	· Median household income · Per capita income · Percent foreign born · Percent households w/ public assistance income · Percent households w/ social security income · Percent no high school diploma · Percent unemployed

egory (employment, households, or population), forecast year (1990, 2000, 2010, 2015, or 2020), data classification type, and the geographic area of interest to display the data. ACCESS can perform calculations including percent increase/decrease of employment, households, and population from a selection of customized buttons.

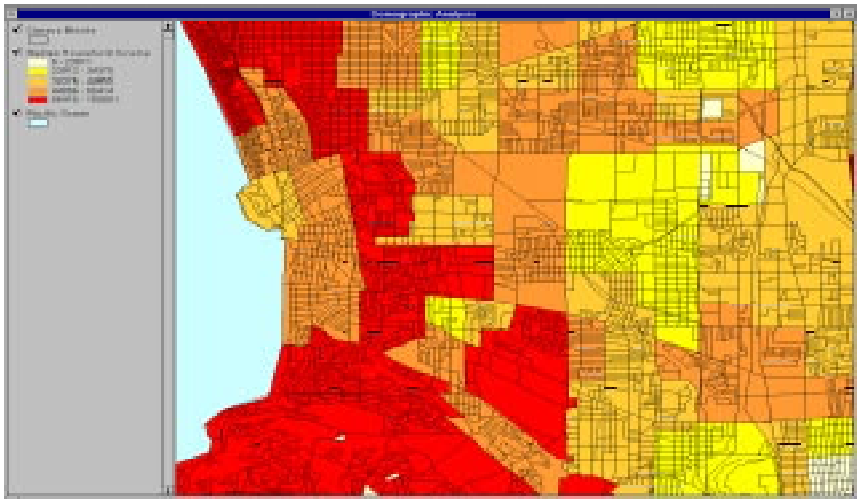
Demographic Analysis

The application allows for display and analysis of census data by city, census tract, or census block. The user can produce maps, charts and reports on any one of the demographic characteristics.

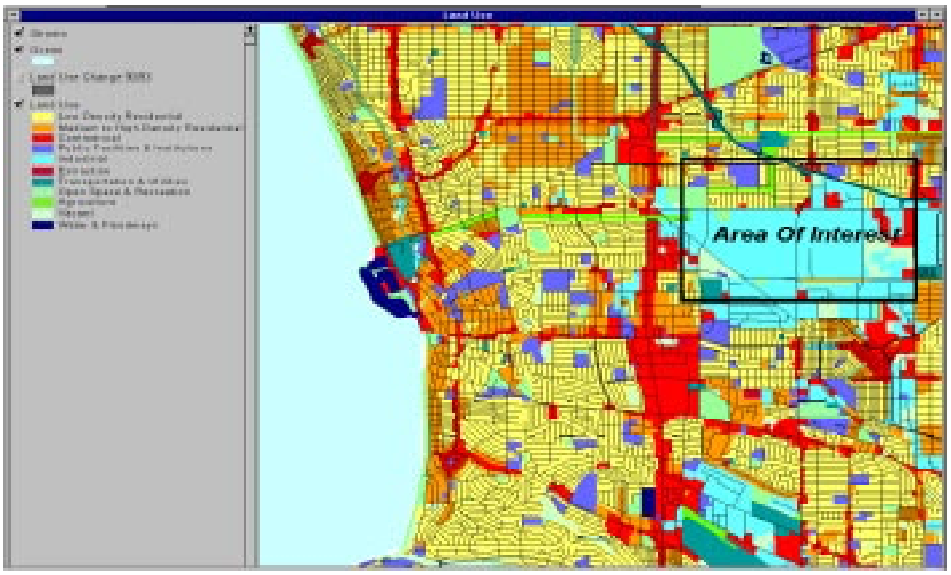
Land Use Analysis

SCAG's 1990 and 1993 land use data layers for the entire region were provided with the application. Users can define a rectangular 'Area of Interest (AOI)' using a customized tool. Land use data of the tiles that fall, partially or entirely, within the AOI can then be displayed.

Land use data for the entire region is arranged into a four level hierarchical classification. Level I includes Urban and Non-Urban land use. Level II further classifies the data into 9 major land use categories. Each Level II land use category is subdivided into detail categories in Level III and Level IV with 105 different categories. ACCESS can display a custom land use view by selecting any number of data categories from a desired level of detail in order to display the land uses.



South Bay Cities: Median Household Income



South Bay Cities: Existing Land Use

The application also allows analysis and display of land use changes between 1990 and 1993.

Transportation Analysis

This application was developed to allow users to view the current and projected traffic volumes and also be able to evaluate alternatives from a regional perspective. The application allows the users to view current and forecast year traffic volumes in relation to the transportation network capacity.

Another purpose of the application was to provide the transportation model network so that future modeling alternatives could be easily down loaded and displayed by the jurisdictions.

The application displays freeway segments in different colors based on the Volume-to-Capacity (V/C) ratio. The example shows V/C ratios for the Los Angeles County 2020 baseline and 2020 planned transportation network. These two views allow the user to compare how the planned transportation system improvements meet the projected travel demand.

2020 Base V/C Ratio for South Bay Highways

2020 Plan V/C Ratio in South Bay Highways

Employment Analysis

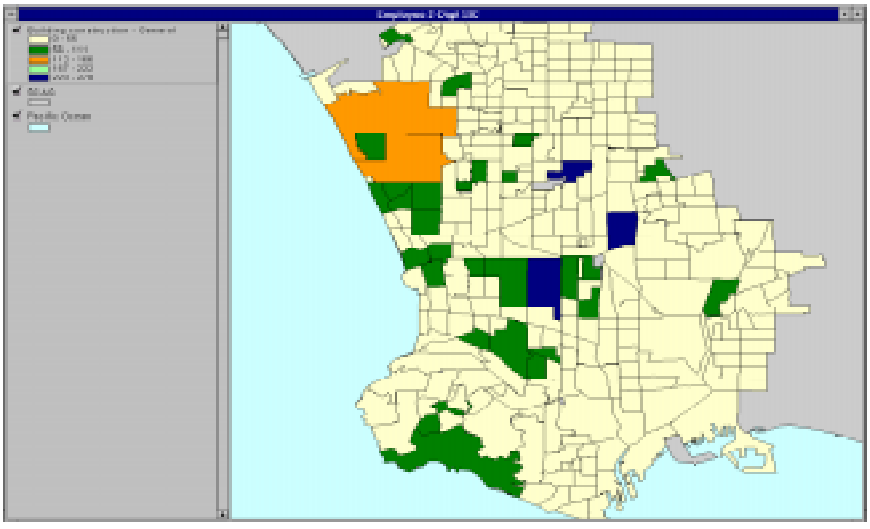
The employment analysis application is quite similar to the demographic analysis application in function. Employment data, provided at the census tract level, can be displayed as maps, charts and reports. The application displays data based on employers or employees. The employment data is classified as per Standard Industrial Classification (SIC) codes, which support detailed sectoral analysis for employers and employees. This application allows the jurisdictions to understand the strengths of their local economy and design suitable economic development strategies.

There are two levels of SIC code available – 1-Digit and 2-Digit. 1-Digit SIC codes contain a general listing of 10 different employment types. 2-Digit SIC codes contain greater detail classification of each 1-Digit SIC code.

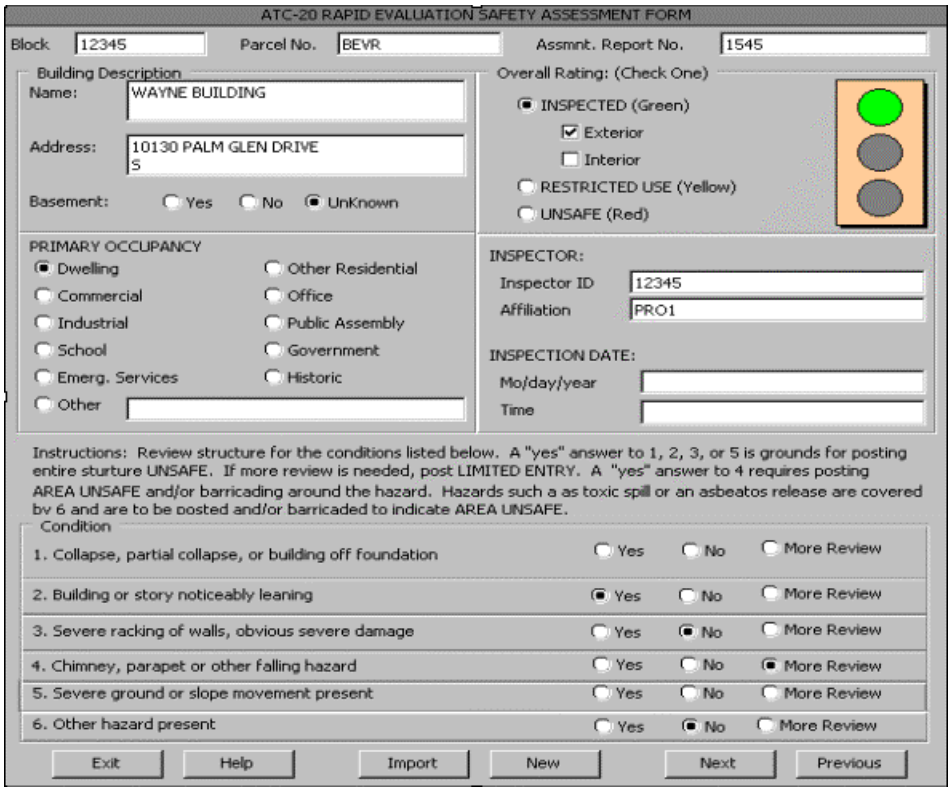
1-Digit SIC Code Classifications:

- Agriculture, Forest, Fish
- Mining
- Construction
- Manufacturing
- Wholesale
- Retail
- Finance, Insurance, Real Estate
- Transportation, Communication, Utilities
- Service
- Public Administration

Example below shows the 'General Building Construction' employee distribution for 'South Bay Cities' subregion.



South Bay Cities: Employee Distribution General Building Construction



Electronic Data Entry Form for Damage Assessment

Damage Assessment

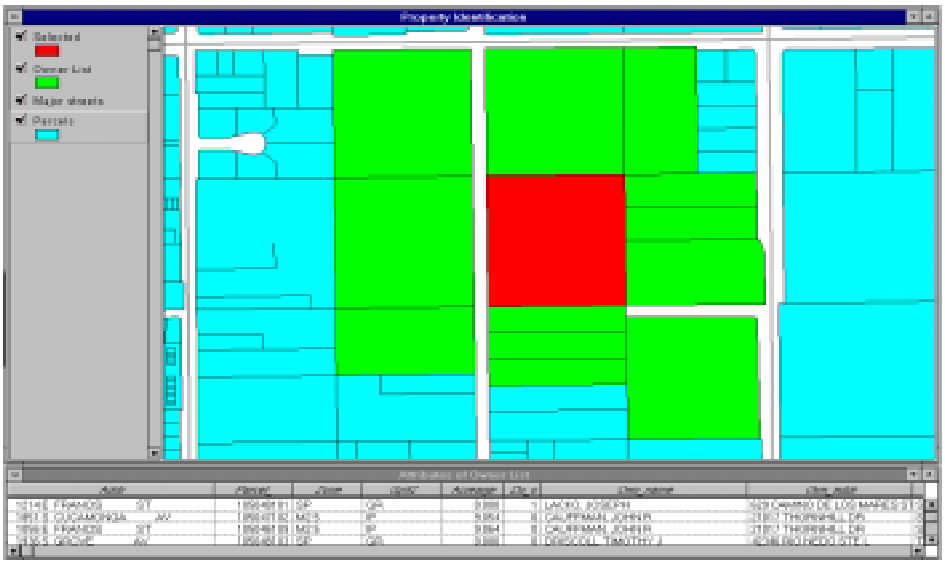
This application automates an electronic form similar to that used by Federal Emergency Management Agency (FEMA) for reporting infrastructure damage. In the past, the response time was greatly improved if the damage information was delivered to FEMA or California Governor's Office of Emergency Services (OES) in electronic format. The application allows users to complete a standard FEMA form electronically for each damaged property while simultaneously populating an excel spreadsheet with the data.

Property Identification

The local jurisdictions are legally required to notify the property owners affected by a proposed infrastructure improvement project. This application was developed to make the property notification effort by the local jurisdiction more efficient. In the past, the property notification effort took up vast amount of resources. This application provides a simple interface to select the project area and then search for all affected parcels within a specified distance.

The application allows the user to specify a buffer distance to search for neighboring parcels. The project area can be selected graphically or through query. Queries can be performed on owner name, parcel number, address or any other parcel attribute available in the parcel database. After the desired parcel(s) is selected, the user can create a buffer around the selected parcel with the previously specified distance. This process creates a table of names and addresses of the owners for all parcels within the specified buffer distance.

These attribute tables can be exported to an Excel spreadsheet, which then can be used with any 'Mail Merging' program to create mailing labels for notification. The application also generates a customized map of the affected parcels.



Identified Parcels with Owner List Around Selected Parcel

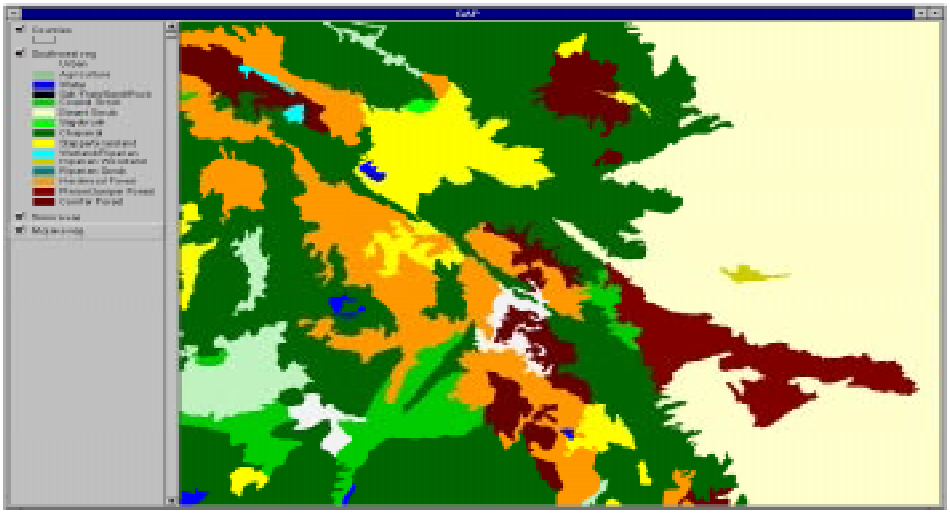
GIS Data Viewer

This application was developed to aid users to display and create maps of various spatial data sets. The ACCESS system came with ecological, general plan, and political boundary data. At the moment the users can select from three data choices, (1) Ecoregions (GAP), (2) General Plans, and (3) Political Districts.

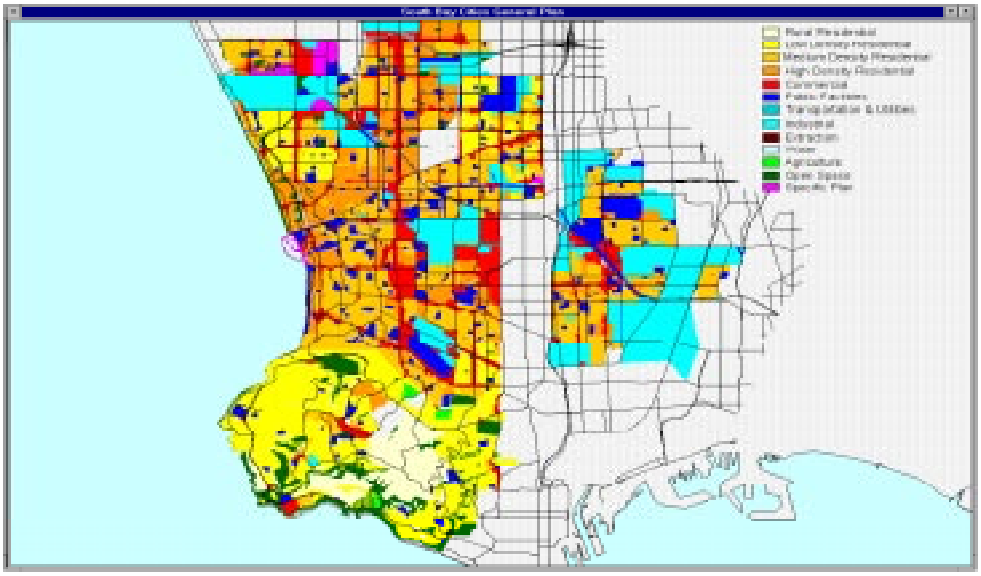
GAP analysis is a proactive approach to protecting biodiversity, seeking to identify gaps in the biological reserve network that may be filled through the establishment of new reserves or changes in land management procedures. The GAP database contains the primary vegetation cover as analyzed from remotely sensed satellite data. This data can be classified on different levels of detail.

The 'General Plans' allows the user to display the general plan data for local jurisdictions and SCAG subregions. Example shows the general plan data for South Bay region.

The 'Political Districts' view includes themes for California State Senate, California State Assembly, and US Congressional Districts.



GAP Data for a Portion of Riverside County

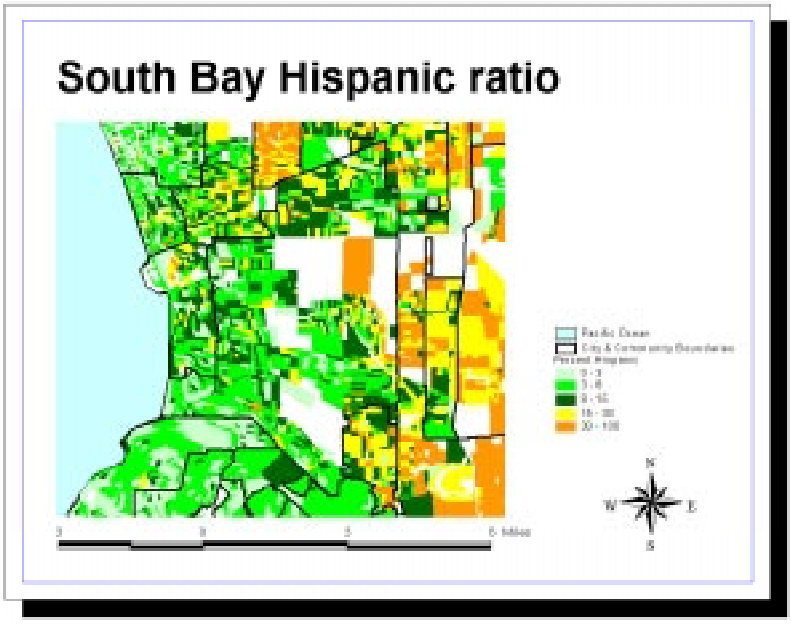


General Plan for South Bay Cities

Address Matching

An address-matching tool was provided with Growth Forecasts, Demographic Analysis, and Land use Analysis applications to allow for mapping of any event data with a street address. The tool allows the user to match the event (permits, surveys, complaints etc.) street addresses to the Thomas Brothers Maps (TBM) street network address database in order to create a point map of the events.

The ACCESS system was designed to allow for easy addition of new applications and GIS data. Each application included a rapid map creation tool to allow users to be able to create maps. With a few click of the mouse the users can easily create maps of their displays. Example below shows such a map created from the rapid map creation tool.



Sample Map generated by Rapid Map Creation Tool

Communication Applications

While the GIS applications provided a tool for analysis, interpretation, display, and mapping of attribute data, the communication applications provided a way for quick and easy electronic communication among jurisdictions and with SCAG. Communication tools that were provided with ACCESS system included:

- World Wide Web (WWW) home pages for each jurisdiction
- Information posting, including agendas, telephone lists, reports, and maps
- News groups for discussion of issues of regional and local significance
- File Transfer Protocol (FTP) for transferring and accessing data files
- Electronic mail (e-mail) service

Individual "Home Pages" for jurisdictions, subregions, and SCAG were developed and an Internet web browser was supplied with the ACCESS system. Some jurisdictions have utilized the web page to not only enhance communication and participation in regional efforts, but also to provide up to date information to the public. Jurisdictions have posted their general plans, permitting regulations, and other plans on the web page to invite comments from the public.

News groups allowed for many people to share comments and discuss issues of common interest. They provide a forum to discuss "draft" regional plans, and local news groups on different issues were established to respond to project participant needs. Examples of issues/subjects on which news groups could be established include legislative analysis, economic development, military base closure, subregional issues, planning director's forum, and regional forecasts. ACCESS system allows for additional news groups to be established

Geographic Databases

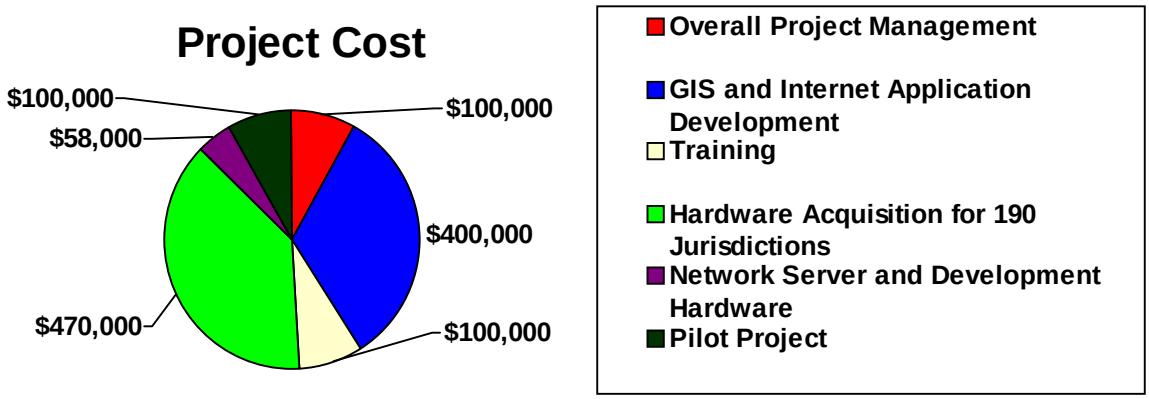
Geographic databases from three different sources were utilized by the ACCESS applications. These include databases created by SCAG; database licensed from Thomas Brothers Maps for the entire region; and databases available from other public and private organizations.

Comprehensive Training

SCAG realized that the key to successful implementation and use of the GIS applications was training. Level of computer literacy and GIS knowledge of the targeted users varied widely. A goal of the project was to conduct the training immediately after the systems were delivered, so that the users would get hands-on training on their own system and would immediately start using the application for their day-to-day activities.

A comprehensive training program was designed for ACCESS system users. Initially, at the time of the system delivery, users were introduced to the basics of the Windows environment and the Internet tools in a hands-on framework. This was followed by a two-day training course on the basics of GIS, with special emphasis on the ACCESS GIS applications. All this training was provided to the jurisdictions at no charge.

After allowing for a familiarizing period, further training on advanced GIS topics and database constructions and management is planned. These advanced training sessions are to be organized by each subregion for its mem-



Project Costs

The total cost of implementing the ACCESS system was about $1.2 million. That included the costs for developing the GIS applications, procuring the hardware and software, providing the training and overall project management. However, this does now include SCAG's staff time/costs.

Project Results and Benefits

The project has been extremely successful in introducing GIS as a decision making tool to the local communities and enhancing the communication/cooperation among the jurisdictions. Some examples are:

- The implementation of the GIS tools has brought about a change in the way projects are submitted for inclusion in the Transportation Improvement Plan (TIP). Some regions, such as the South Bay Cities, have expressed interest in prioritizing the projects and submitting a list of projects for the whole subregion, instead of the jurisdiction by jurisdiction submissions that were made earlier. The GIS tools provided by the ACCESS project allow the subregions to cooperatively analyze and prioritize their projects based on the needs of the subregions as a whole.
- For the Regional Transportation Plan (RTP), the GIS tools have allowed the planners to analyze a large number of alternative options for the projects. The use of GIS tools has also enhanced the communication of the planners and the decision makers, since the planners are now able to present alternative options to the decision makers in an easy to understand graphical format.
- The project has encouraged a comprehensive look at Land Use, Transportation and Environment issues. Several jurisdictions are cooperating with one another to develop common Long-Range Transportation Alternatives (e.g. Westside Cities, South Bay Cities, Gateway Cities Association, San Gabriel Valley Association, Western Riverside Council of Governments, San Bernardino Association of Governments), Open Space Plans (e.g. the city of Arroyo Verdugo, South Bay Cities), Multi-Species Habitat Plans (e.g. Riverside County, Western Riverside Council of Governments, Orange County), among others.
- Access to demographic data for the entire subregion together with the GIS analysis tools, has allowed sub-regions to gain understanding of the needs and strengths of the whole subregion. Several subregions, such as San Gabriel Valley, South Bay Cities, and Gateway Cities, are utilizing the GIS tools for economic development planning and analysis of different economic strategies.
- Some jurisdictions have taken the GIS data and tools a step further, in order to provide up-to-date information to the public through their internet home pages. For example, the cities of Ontario, Redondo Beach and Laguna Beach, are providing maps of their general plans, zoning, permitting regulation over the internet.

The project also realized other intangible benefits:

- Set regional standards in terms of GIS data, software and tools. Setting these standards will also result in future cost savings in terms of data conversion and translation, and will encourage data sharing among jurisdictions
- Eliminate the misperceptions of GIS and increase GIS literacy among users
- Organizational structure to support GIS activities in the long term, and promote sharing of data and ideas.

The project also recognized some tangible benefits for the participating local jurisdictions. Direct benefits for the local jurisdictions included:

- Computer hardware (high end personal computer)
- Desktop GIS software (ArcView)
- GIS data layers
- Customized GIS applications
- Comprehensive GIS training

Not only did ACCESS project provide a unique opportunity for the jurisdictions to implement GIS technology and make GIS data accessible to the users, the GIS applications allowed jurisdictions to accomplish tasks that would otherwise take them a long time. There were significant economies of scale, as SCAG and local jurisdictions were able to negotiate with private and public vendors to acquire additional GIS data layers and advanced training at reasonable costs.

Lessons Learned

The following lessons were learned by this strategic large-scale GIS implementation effort:

Lessons Learned

- The need for on-going training cannot be over-emphasized. Regular training is the only way to keep pace with the technology and reinforce the reasons for using the technology.
- The GIS applications need to be made as user-friendly as possible to encourage use by non-technical users.
- Tackling the organizational issues is very critical for implementing GIS. GIS will not succeed without the support of the higher management.
- Advance planning and adequate resource allocation are key to successful implementation of GIS. SCAG's experience has been that "almost always, it will involve more work than what you anticipate". Therefore, it is important to build in flexibility into the implementation process.
- It is extremely difficult to fully consult and draw participation from 190 different jurisdictions at every stage of system development.
- Two year timeline was ambitious - taking into account training and other local factors, a three year timeline is more realistic.
- It is extremely difficult to fully consult and draw participation from 190 different jurisdictions at every stage of system development.

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