Computers and Preservation

Meeting the Callenges of the 1990s

Dana E. Supernowicz
United States Forest Service, Placerville, California

E. Steve McNiel
University of California, Davis, California

Fundamental changes are occurring in the field of historic preservation. These changes are a product of shifts in the structure of communities, urban growth patterns, preservation law, the demand for more public-oriented interpretation, multicultural awareness, and the focus of this paper—advancements in technology. While the field of historic preservation continues to expand, the appropriate technology, resource base, and issues have become more complex. While this paper describes the use of appropriate technology for studying and managing historic properties and landscapes in California, its application and use are equally appropriate in other regions where similar resource management issues exist.

For the past two decades historic preservation professionals in California have struggled with the state's expanding economy and urbanization, which until recent years has gone unabated. During this period challenges to the state's historic resources have presented increasingly complex issues for the public sector, as well as local, state, and federal agencies. As public agency budgets decrease, campgrounds, public parks, and interpretive sites are being pushed to not only remain open, but to further preservation efforts for endangered buildings and sites. These financial, legal, and environmental challenges to historic preservation should send a clear signal to the preservation community that the old ways of doing business are in need of change.

Awareness of these challenges and some possible solutions were already being articulated at the federal level in the mid-1980s. Between December 1985 and April 1986 the Federal Office of Technology Assessment, better known as OTA, met in a series of workshops where a wide variety of technological issues were discussed. Several of the major findings presented at the workshops spelled out basic issues and directions for research.

1. Preservationists in all the associated disciplines share problems of obtaining access to information about technologies, training, and coordinating research.
2. New technologies can extend the scope of our understanding and care of the U.S. cultural heritage by improving the quality, quantity, type, and usefulness of data gathered.
3. A variety of educational, institutional, managerial, and cost barriers inhibit the broad application of new methods, techniques, and equipment to preservation.
4. If advanced technologies are to assume a greater role in preservation, it is important to find more effective means of transferring technology developed in other fields to prehistoric and historic preservation.
5. Documentary research conducted at the outset of a project helps define the approach and focus of preservation efforts.
6. The vast amount of information available suggests preservation professionals need to gain intellectual and technological control over the knowledge base.

These findings articulated the importance of technology transfer, its importance in the understanding of cultural resources, and barriers to obtaining and adapting technologies to preservation problems and projects. However, despite this and other evidence of awareness, until recently the federal government has only modestly fostered the implementation of new preservation technologies. As OTA remarked, "the greatest single need is to improve the transfer and adaptation of technologies from other disciplines into preservation" (OTA page 135). The work presented here illustrates this principle by adapting tools used by landscape architects to address preservation issues.

The California Experience

For over a century, California's urban growth has spread throughout rural areas of the state, introducing issues that affect the social, economic, and physical structure of communities and their natural and cultural resources. Because of the dispersed nature of the changing landscape, potential historic resources are widely separated in space, quality, and significance. In addition, recent natural disasters have required immediate assessment of large numbers of historic resources under strained circumstances. Of critical importance in meeting these challenges are the methods used by professionals and lay people to document, evaluate, and manage. Traditional methods that considered sites and structures individually or in small clusters can no longer keep up with the breadth and speed of change.

During the late 1980s and early 90s, computer technology made good on the promise of general tools appropriate for inventory, analysis, and evaluation applications. However, during this period, the process of technology transfer and adoption remained linked to policy and pragmatic considerations and far too much time was spent haggling over mundane issues, such as which technologies to adopt and when. Time was spent arguing about the relative number of high end capabilities promised in a particular computer platform or software application rather than in developing methods and techniques for inventories and interpretation. The truth is that almost any off-the-shelf application, running on any platform can provide significant advantages over doing the job by hand and often it is more important to change fundamental working habits and develop new methods than to procure or develop the "killer" computer system. In addition, standards for data transfer have evolved to a point where we can be confident that what is developed on one system will be extensibly compatible with all other systems. Certainly this has been true for the major desk top computer systems (DOS/ Windows and MAC) for several years.

The following case studies reflect the application of advancements in technology, historical research, and communication to preservation issues faced in California. One of the goals of these studies has been to integrate historic preservation concepts and techniques from other disciplines. Each of the case studies described in the body of this paper have been undertaken in the spirit of researching appropriate methods and redefining the nature of specific analyses that lead to intelligent decision making about the management of cultural resources.

Over the past seven years the United States Forest Service and the University of California, Davis, have engaged in a series of joint research projects, testing the viability of emerging computer applications. During this period our approach changed from using computers to improve upon traditional preservation methods to the development of more advanced inventory and analytic techniques using some of the newest computer software available on the market (Figure 1).

Projects	Inventory and Measurement		Graphic Format	
	Hand measure	Computer measure	Line drawings	Scanned photos
87 • Gold Country Commercial Architecture	■		■	
88 • Gold Lakes Recreation Areas	■	■	■	
89 • Northfork Administrative Compound		■	■	
90 • Glen Alpine–Bernard Maybeck Site		■	■	■
90 • Jesse Blakely Ross Log Cabin		■		■
91 • Recreational Housing Studies		■		■
91 • Vahalla Modification Analysis				■
93 • Cleveland Wildfire Visual Data Base				■

Figure 1. Matrix illustrating the shift in methodology from hand measurement to computer measurement and from using line drawings to using only scanned photographs as documentation.

Several early studies focused on recording historic buildings to Historic American Building Survey (HABS) standards. Traditional drawings were created with on-screen digitization using a Computer Aided Design (CAD) system to create line drawings from digital, parallax corrected photographs. However, the time spent to develop these drawings, although much improved over doing it with pen and ink, was too much for the amount of information represented in the final product. Because of this awareness we completely modified our approach and all case studies subsequent to 1990 utilized digital photography as the primary documentation media, improving accuracy, speed and expanding the amount of information available. It no longer made sense to produce a line drawing of a building when a digitized photograph, costing much less to produce and store, could communicate a full range of materials, textures, and colors, as well as the information about form and size available from line drawings.

In a similar example, field measurement of building features no longer required several people to spend up to a day in intensive hands-on activity. The newly adopted techniques utilized scanned photographs that were scaled using two field measurements, typically the height of a door and the overall width of a building, and then used a CAD system to make all subsequent measurements. This system proved so efficient that for Victorian storefronts, twenty-five measurements could be made in eight minutes with an accuracy of ±3%. The same work done in the field took two people four to six hours, with only slightly improved accuracy.

A wide range of software applications were tested to develop the methods described. They generally fall into three categories, graphic production, data storage and analysis systems, and documentation/communication systems. Graphics, in the form of maps, drawings, and digital photographs were developed and manipulated using scanning, raster image processing and computer aided design (CAD) software. The second category related to information storage and analysis and included GIS, statistics, and charting applications. The third class of applications was used to produce documentation and included slide presentations, word processing, and page layout applications. The majority of current computer users are familiar with graphic, word processing and page layout applications; however, many are just beginning to understand GIS. Because of this, there has been more focus on GIS in this paper.

Geographic information systems (GIS) were used in the case studies to combine historical documentation, field evaluation, and measurements with visual information in a computer data base linked by common symbols and terms. In essence, a GIS is a computer based application that has three characteristics. The first is that it will store many kinds of information including text, numbers, and images. The second characteristic is an ability to maintain linkages between the stored information and a graphic, usually a map, where each object on the graphic or map acts as a virtual button that, when pushed, retrieves the information attached to it. For example, the map for North Fork, a Forest Service administrative compound near Yosemite Valley had 46 buildings on it. When the on-screen cursor is placed on any of these buildings and the mouse button is pressed, a form holding information about that building, called a record, fills the screen. In reverse order, if we consulted the data in the records for all of the buildings on the map and asked for those evaluated as contributing to a National Register district, the GIS would print a customized map of just those parcels, or it could shade those parcels a particular color. The third characteristic of a GIS is an ability to store and work with topology, or spatial measurement. Topological structures allow one to measure areas, distances and to locate features according to Cartesian coordinates such as latitude and longitude.

Early discussion between the university team and the Forest Service historian outlined the requirements for a data base system. (Figs. 2 and 3.) Two software applications were tested, FileVision IV™, a flat file intelligent mapping system and GeoNavigator™, a more complex relational GIS. Neither computer application was specifically designed for preservation, but were easily adapted and customized to assist in land use and preservation planning studies. While FileVision IV™ is an inexpensive, user friendly software package, GeoNavigator™ is a more sophisticated, fully relational data base.

Requirements for a Computer Inventory and Analysis System
(Geographic Information System)

- Accuracy in measurement
- Flexibility to add and update information
- Ease of use for non-technical users
- Ability to perform summaries and print reports
- Ability to use existing inventory formats
- Ability to customize formats for each resource type
- Low cost per resource
- Ability to exchange data with other systems
- Ability to publish results in a variety of formats

Figure 2. Criteria established by USDA Forest Service and the University of California, Davis, team for choosing a GIS

Dimensions of Data Storage and Analysis System
(Geographic Information System)

- **TEXT**
  a. Inventory forms
  b. National Register form
  c. Bibliography
  d. Narrative History
- **GRAPHICS**
  a. Maps (Thematic maps)
  b. Drawings (vector graphics)
  c. Photographs (raster images)
  d. Archival images & documents (scanned raster images)
- **NUMBERS**
  a. Inventory forms
  b. Tables
  c. Calculated fields
  d. Statistical summaries
- **DATA STRUCTURE**
  a. Heirarchial
  b. Thematic
  c. Linked files

Figure 3. Structure and data types accommodated in the GIS systems used in case studies.

Case Studies

Four case studies are presented in this paper: A Gold Country Regional Data Base; Rural Farmland Preservation in Ventura County; A Visual Information Data Base for the Cleveland Wildfire; and a Model for Inventorying and Evaluating Historic Properties within the National Forests of California. They range in scale from regional analysis to historic districts and individual sites. In each case the computer is used as both an organizational and an analytical tool.

Live demonstrations of several of the case studies have been presented at the following conferences: the West Coast Conference on Land-use Planning sponsored by the Local Government Commission, San Francisco (1994); University of Calgary Rural Preservation Conference in Edmonton, Canada (1993); National Trust Annual Conference, San Francisco (1991); National Main Street Town Meeting, National Trust for Historic Preservation, San Francisco, (1991); The Third Global Congress of Heritage Interpretation International, Honolulu, Hawaii (1991); Association for Preservation Technology International (APTG) Meeting, New Orleans (1991); the Association for Preservation Technology International (APT Meeting in Chicago, Illinois (1989); and The Arizona State University Conference on Built Form and Culture Research, Tempe (1989).

A Gold Country Regional Data Base

During the past four decades the loss of rural farmland and historic landscapes has affected the fundamental social and economic framework of American society. This has been especially evident in California which has experienced extreme and uncontrolled growth. Expanding suburbs, wildfires, and a lack of cultural awareness, all contribute to the demise of both natural and cultural resources. Urban sprawl and rural development are compromising both the physical setting and surrounding landscape of historic sites and buildings. When debating the effects of urban sprawl on this nation's historic properties, National Trust for Historic Preservation President Richard Moe remarked that "forces beyond the control of designers and developers–especially those that influenced retail centers–have to be anticipated" (Moe December 1993-January 1994 Preservation News; page 36). Moe's proactive stance is well taken, particularly in rural areas that are undergoing the greatest urban sprawl.

The development of a regional data base for the California's gold country was to serve as a repository for those doing research in the region, provide local planning agencies with a mechanism to analyze the effect on historic properties, assist in long-range planning efforts, and serve as a catalyst for the preservation of the historic rural landscape. It was generated in response to a 1986 demographic projection conducted by McNiel and his students which showed growth rates of over 1000% in the next forty years.

The data base encompasses seven years of study in a geographical area that extends from Mariposa County on the south to Nevada County on the north. The study focuses on communities that developed following the discovery of gold at Coloma in January of 1848. The vast majority of the communities in the seven county area were built alongside streams or rivers where rich deposits of gold were once plentiful. The historic environment of the gold country includes commercial and residential buildings, widely scattered homesteads and ranches, hardrock and placer mining landscapes and sites, and hundreds of miles of stacked rock walls, earthen ditches, and old emigrant, freight, and stage roads.

Many of the buildings and features within the gold country region have been neglected and are in need of repair. In other cases development has encroached on the boundaries of historic properties, impacting the visual setting of the historic landscape. Virtually all of the important historic resources directly associated with the Gold Rush Era are privately owned and there are few strong public or private preservation efforts underway that provide incentives or even education as to the importance of individual structures and landscapes. Moreover, many of the local residents fail to acknowledge the positive economic impact created by tourism.

In order to address these issues, a geographic information system (GIS) was developed as a repository for a wide variety of information collected during individual research projects, each of which has been aimed at a particular problem or opportunity. The GIS in this case acts as an organizational tool, ensuring that all data is correlated with maps that can be printed at a common scale. The GIS system also facilitates comparisons that often reveal correlations that might otherwise go unnoticed. For example, when the 1900 census was entered into the data base from its hand written form, it became possible to understand the ethnic affiliations of various builders and helped to identify the differences in masonry styles that, in turn, helped to identify areas within the community associated with various immigrant groups such as the Italians and the Chinese.

The GIS data base currently contains detailed information on two communities, including architectural drawings and measurements of all the commercial buildings. Another block of studies contributed information on the morphological expansion and physical growth patterns of six additional communities. These data bases include the development of circulation networks and land use over time, starting in the 1850s. Other studies have contributed information about current visual quality along a major tourism highway, and the identification of cultural resources throughout the entire region.

All of these individual studies have developed digital documentation that was entered directly into the data base. The GIS currently being used is the topologically based application GeoNavigator™, which differs from the flat file intelligent mapping product used in the majority of the other case studies. GeoNavigator™ is a relational data base, with mapping in real world coordinates. For a project as large and as varied as the gold country study, it was felt that a true GIS would serve the project best because of the sheer volume of information and its relational qualities. Unfortunately, the benefit of more power is tempered by increased cost and difficulty of use. Although GeoNavigator™ is relatively inexpensive and easy to learn compared to GIS products like ArcInfo™, it requires a firm knowledge of data base structures in order to get the most out of its capabilities. In addition, the software currently costs approximately 18 times more than FileVision IV™, the flat file mapping system described below. It is also important to note that more powerful software requires a more efficient and upgraded computer system.

Rural Farmland Preservation in Ventura County

A project undertaken in 1992 illustrates the use of intelligent mapping in the planning and preservation of large tracts of threatened agricultural lands in Ventura County. The project also lays the foundation for examining rural historic landscapes or and agricultural landscapes for their importance to social and economic change.

Ventura County, located northwest of Los Angeles in Southern California, is blessed with a thriving agricultural economy, influenced by a Mediterranean climate, rich fertile soils, and the county's close proximity to urban markets. However, the area's close proximity to Los Angeles has encouraged major population growth and urbanization in the past few decades. In an attempt to track the rate of farmland loss and to predict where threatened farmlands exist, a trial geographic information system was developed jointly between the University of California, Davis, the California Coastal Conservancy and Ventura County. The Geographical Information System model was implemented at two levels. The first level illustrates large scale planning information in juxtaposition to agricultural resources, natural landscapes, and historic urbanization patterns. The second level of mapping includes each parcel over ten acres, as well as detailed information on the legal and economic characteristics of each parcel. This second level also has environmental information included for those systems important to farmland preservation or urbanization, such as the location of greenbelts, wetlands, biodiversity corridors and flood zones.

The intent of the trial data base was to develop and test an information system that would facilitate the detection of conditions under which farmland will have a high probability of being converted to other uses and to direct the purchase of development rights, easements or other proactive mechanisms designed to preserve threatened parcels. Historic farmsteads, barns and structures associated with agriculture are key to this process of preservation, and are often the most threatened elements. The data base is currently being tested by Michael Moore, a consulting economist from Northern California. Moore hopes that the model will help predict potential conversion, and with the assistance of Peter Brand of the California Coastal Conservancy, policy proposals will be developed that may affect all coastal agricultural counties in California.

By using two levels of mapping, the loss of rural farmscapes can be viewed in two contexts, from the standpoint of the county as a whole (macro-level) and from the scale of individual parcels (micro-level), where ownership and specific site characteristics are important. While the data base does not include a topological component, area specific modeling is possible because exact parcel acreages have been entered into the data base along with other information from the County Assessor's records.

One of the initial analyses revealed a distinct zone of conversion associated with the Sphere of Influence boundaries of several communities. By plotting individual parcels that have terminated their inclusion in the Williamson Act, an agricultural tax benefit program, it was possible to predict the extent of development that will occur ten years from now when the liability for converting will no longer be applicable. By plotting individual parcels with similar indicators of imminent conversion, isobars are being constructed on maps to illustrate critical zones that in turn can be used to develop and calibrate county planning policies.

In the case of the Ventura GIS, base maps were converted via DXF files from the county's existing CAD maps and assembled into searchable polygons. Data from federal, state, and local maps were scanned and traced to provide information on geographical characteristics and planning designations. Finally, information from the Ventura County Assessor's Office was entered into records attached to each parcel at the detailed mapping level to provide ownership value, land use, taxation rate, and zoning information. New data was developed in response to suspected economic indicators such as proximity to roads or types of crops planted, and this information was added to each parcel record.

The prototype was very successful in terms of cost and time to completion and many things were learned about the potential loss of farmlands, rural landscapes, and the availability and quality of data required to adequately predict and act to preserve threatened lands. A planned second phase will extend detailed, parcel-level mapping and analysis to the entire south county area. To accommodate this increase in scope, the prototype developed using FileVision IV™ will be transferred to GeoNavigator™ and eventually to the county's own GIS, which is in early stages of development. Working in this way allowed a quick and economic prototype to be developed without fear of loosing valuable time in redundancy. It provided an opportunity to move forward during the two years it took for the county to choose, fund and begin to implement their own GIS system. Working in this way can counteract the common administrative argument that prefers deferment until a unit of government thoroughly evaluates GIS and assembles the funds for the purchase and development of a complete system. Our experience in this case leads to a conclusion that it is advantageous to start small and expect immediate returns in real, though limited, analysis capabilities, and large returns in experience and institutional education and acceptance.

A Visual Information Data Base for the Cleveland Wildfire

Using FileVision IV™ software, a visual information data base prototype was developed for the Cleveland Wildfire which swept through the western edge of the Eldorado National Forest during October 1993, destroying over 24,580 acres of timber and range land. During the conflagration, over 5,312 firefighters were dispatched to the wildfire, 71 of whom received some injury and two of whom lost their lives in a plane crash. The total fire suppression costs amounted to a staggering $16,427,000.

Not only did the fire consume thousands of acres of mature and young timber, but it destroyed 41 privately owned dwellings, a wide variety of Forest Service improvements, including a steel fire lookout tower, and resulted in damage to numerous historic and prehistoric archaeological sites. Many of the private homes consumed by the fire were historic, built between 1910 and 1940.

FileVision IV™ was chosen for its ease of use, low cost, and versatility in integrating visual images consisting of photographs, maps, and text, into a data base linked by custom-designed buttons. While the model focused on the Cleveland Fire, its implications are much greater and may eventually result in the creation of a land use model for the entire forest. In order to store the data a Bernoulli Drive was purchased, with a maximum storage capacity of up to 90 megabytes of memory per disk. Storage was, in fact, the greatest challenge since each photograph and map could absorb over 1 Mb. of memory. The data storage obstacle may be overcome in the future by purchase of a CD ROM drive using Kodak CD™ technology, dedicated hard drive, or a magnetic-optical drive.

FileVision IV™ had a number of advantages when compared to expensive and sophisticated GIS software in this application. The advantages include a cost under $300 and its ease of use. The program has been designed so even a novice with limited or no computer skills can quickly master the system. The software's drawback is its flat file structure and limitation of only running on the Macintosh™. However, in reality this poses little problem since data and graphics can be freely imported and exported from other PC systems.

While the Cleveland Fire was initially viewed as a natural disaster for the forest, for many the fire's aftermath provided an excellent testing ground for "ecosystems management," today a primary focus of the United States Forest Service. Ecosystem management, however, remains more of a philosophical concept for many resource agencies, with hope for practical application dependent on good research and planning.

Viewing the fire area as an integrated ecosystem with natural and human attributes, suggests that past land use was in part responsible for the behavior of the wildfire. Land use history clearly has implications for management of the remaining natural and cultural resources within the burn area. While standard GIS applications were applied to the fire area, FileVision IV™ provided a user-friendly visual model linking data to photographs. The system offers an efficient tool for time series studies, monitoring land use changes, and linking information from a wide variety of sources. As monitoring occurs during the area's recovery, the visual data base provides a structured receptacle for new information and will facilitate easy recall of before and after conditions.

A Model for Inventorying and Evaluating Historic Properties within the National Forests of California

The final case study represents a series of projects that involved both inventory and evaluation of Forest Service administrative buildings and recreational residences under special use permit. Because the Forest Service is required by law to consider the effects of its actions on historical properties, both administrative buildings and recreation residences are subject to Section 106 of the National Historic Preservation Act (1966 as amended).

The Pacific Southwest Region 5 of the Forest Service is unique in that the region contains the majority of both pre-1950 administrative buildings and the largest numbers of summer homes, over 6,000 across the entire state. The sheer volume of older properties presents a challenge, not to mention the complexity of the resource and its context within local, state, and national history.

Another concern was the similarities between individual historic properties in both context and design. Between 1933 and 1937 the United States Forest Service took a bold step and with Emergency Conservation Work (ECW) funding, hired the San Francisco architectural firm of Blanchard and Maher to design virtually all its new administrative buildings. Well over half the standing administrative buildings in California today were built from designs created by Blanchard and Maher. Many of these buildings have been dramatically altered, while others remain intact. Clearly, many of the buildings are in need of maintenance, as well as structural rehabilitation.

The need for a complete inventory of its properties, an evaluation of historical significance, and a management plan, was required for the old supervisor's headquarters of the Sierra National Forest at Northfork, California. Northfork is located on the western slopes of the Sierra Nevada Mountains in Madera County northeast of Fresno. Using FileVision IV™, a team of students recorded each building, structure, and object at the Northfork compound and entered that data into the computer, which generated an accurate data base of each property and a current typology of site and building characteristic that serve as a guide for preservation activities within the compound.

As with other graphic models, the compound buildings and landscape features were linked through a schematic map to data sheets. Therefore, facility managers had the ability to immediately access data through visual mapping and determine the status of a particular building or landscape, its significant fabric, and the management objectives necessary to meet the needs of the property.

The same approach was applied to recreation residences in California, although in the case of these summer homes, qualitative as well as quantitative rating schemes were developed to determine the relative significance of an individual building, its integrity, and potential for listing as an individually eligible property or as a contributing property within an historic district.

Again, FileVision IV™ was utilized and a data base developed for each tract. Analyses of building elements led to the development of graphic typologies of architectural characteristics as was done for Northfork. A quantitative approach proved useful in determining the uniqueness or representativeness of a wide variety of architectural styles and features. Because virtually all summer homes fall into the category of vernacular architecture, each building has unique characteristics, yet shares certain similarities in massing, fenestration, roof pitch, color, location of porch, and roof cladding. These architectural similarities appear to be based upon climatic considerations, popular architecture styles of the day, the modest capital outlay to build the home, and most importantly, beginning in 1915, guidelines established by the Forest Service.

The data base developed for summer homes serves several purposes. First, it serves as a repository for current and past inventory information. Second, it has facilitated detailed qualitative and quantitative analyses of historic integrity and significance. Third, and possibly the most important function, is as an on-going monitoring and management system, providing instant access to historical information and providing a means by which continued deterioration or rehabilitation and restoration of the resource can be monitored and controlled.

Conclusion

In each case study we have found that simple GIS applications have given us an ability to inventory, analyze and manage large amounts of data for relatively little outlay in time or money. Familiar applications for working with text, graphics and digital photography work in tandem to provide a set of tools available for solving preservation problems. In most cases these tools offer new methods for working with data sources and provides a level of consistency and integration unavailable before. For those just setting out on the path to computerization we highly recommend starting small and moving up only when currently used applications run out of room or power. Being able to reap instant and visible returns on initial efforts has proved invaluable for us in both analytical power and for conveying the message to a wide audience. Clearly, there is a need for more computer training the schools offering degrees in both history and historic preservation and other disciplines have e much to offer in this regard.

Although computers do provide some of the tools, there is still a need for preservationists to maintain and develop the traditional skills necessary to carry out diverse preservation projects. However, clinging slavishly to these methods will not address the needs of scale and numbers that are beginning to characterize preservation. In another ten years we will be evaluating the hundreds of thousands of resources developed in the boom period following the Second World War and as preservationists, we must begin to adjust our methods now or the challenges of the future will not be met.

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