

Use of GIS in the Development and Maintenance of Statewide Voter Registration Systems

A number of states are currently looking at either upgrading or creating a statewide voter registration system in response to the requirements of HAVA (Help America Vote Act of 2002). Vendors have a variety of systems that have a great number of features. But the heart of any system is the street file that determines which precinct and districts in which a voter is eligible to vote. All vendors have developed computer programs designed to automate the creation of the street file. These programs use the information in the voter file to sort voters by their street address, and then determine where precincts or districts change. At that point of change, a new street file record is created. However, the accuracy of this crucial component is only as good as the base information and data that is provided to the vendor. If a voter has been incorrectly assigned to a precinct beforehand, then the resulting street record will be wrong.

Several state requests for proposals (RFPs) have placed geographic information system (GIS) mapping functionality in the category of “desired possible future capability.” A GIS mapping function to provide information to voters on polling place locations is an important system enhancement, but only a limited application of GIS capabilities. If a GIS is used at the very beginning of the development of the statewide system, the accuracy of the initial street file will be assured. With a database of up-to-date street and precinct and district information, a GIS can provide a more accurate means for generating street indexes to update voter assignments to precincts and districts. And by pinpointing voter addresses on a digital map, a GIS can provide a reliable means for verifying the accuracy of precinct assignment information in a Registered Voter File. The use of GIS in the development and maintenance of a statewide voter registration system will help ensure that voters are directed to the correct polling places and that they will be casting ballots for the right sets of candidates on Election Day.

Crosschecking Precinct Assignments in Building a Statewide Voter Registration Database

A GIS provides a map of geographic areas, political subdivisions, the network of street addresses, and digital representations of voting precincts and electoral districts for managing certain types of voter data. Through geocoding and address matching processes, address information in a Registered Voter File can be pinpointed on the map. The capability to see where registered voters reside is useful not only for precinct management decisions, but also for a process called “voter cross-checking” that should be an early step in developing a statewide voter registration database.

The geocoding process standardizes address formats and attaches latitude and longitude coordinates to each address in a Registered Voter File. Voter addresses are matched against

street attributes on the digital map for placement on the map. Each voter point has an attribute table that describes the point's location by latitude/longitude coordinates. The attribute table also identifies the street address that the point represents, as well as the precinct and districts to which the address was assigned in the Registered Voter File. By color-coding each voter point according to its precinct assignment in the Voter File and by displaying voter points with precinct boundaries, invalid precinct assignments can be quickly identified. If a point is located inside the boundary of the precinct to which it was assigned in the voter file, the color of the point will be the same color as the precinct boundary on the digital map. If a point is located *outside* the boundary of the precinct to which it was assigned in the voter file, the point will have a contrasting color and point style to indicate that the precinct assignment code is *invalid*. Invalid assignments can be resolved by correcting coding errors in the voter file or, in some cases, by correcting the attributes of street features (e.g., address ranges) on the map. Identifying and correcting “invalid precinct assignments” *before* county Registered Voter Files are converted and merged into a statewide database will improve the integrity of the statewide voter file as well as the street index files to be generated from the voter registration system.

Using GIS to Maintain the Statewide Voter Registration System

A GIS generates a street file by spatially analyzing relationships among street features and precinct and district boundaries to define unique district combinations for individual precincts. From this analysis, a ballot information code (BIC) is applied to all address ranges on the map. This information is then extracted in the form of a street index to update voter assignments to precincts and districts. If interfaces are developed to link a GIS to a voter registration system, street index files can be imported directly to the voter registration system to automatically update precinct and district assignment codes in voter records.

After employing a GIS in the development of a voter registration database, the GIS can be used to maintain and update databases of precinct and district boundaries and to produce maps and reports providing information to voters about precincts and polling places. Precinct and district databases can also be used in the development of Web-based precinct mapping programs to provide voter information to citizens.

PRECIS Precinct Information System

The PRECIS[®] Precinct Information System was developed by Election Data Services for ArcView[®] GIS from ESRI (Environmental Systems Research Institute, Inc.) and is currently used by election jurisdictions at both the state and local governmental levels. ArcView is the world's most popular desktop mapping software. Widespread use of ArcView by state and local governments will facilitate data exchanges, minimize compatibility issues, and provide a broad base of technical support resources.

PRECIS provides election administrators with mapping tools and a census TIGER base map for creating digital representations of precinct and district boundaries. There are also tools for adding streets to the base map and correcting street names and address ranges to maintain an accurate street grid. The street layer and the precinct and district boundary layers are used in

the generation of a street index file to update voter assignments to precincts and districts. To generate a street file, users will create a “ballot style” that defines the unique district combination for specific precincts and applies a ballot information code (BIC) to address ranges on the census TIGER map. Custom interfaces enable street files to be imported to a voter registration system to update precinct and district assignment codes.

Voter Point Feature

PRECIS data sets contain a layer of points for each address record in a registered voter file. The voter addresses are imported to PRECIS and pinpointed on the census TIGER map through a geocoding and address matching process. The voter point feature allows users to display voter addresses for reference while mapping precincts and districts. The voter point feature also allows users to monitor dynamically updated, precinct-level voter counts as precinct boundaries are moved or precincts are created, split, or combined. A third use of the voter point feature is to cross-check the accuracy of precinct assignment codes in a registered voter file with the locations of voter addresses in relation to precinct boundaries on the digital map.

Voter-crosschecking with PRECIS

Voter-crosschecking is a unique feature of PRECIS. From our experience working with voter files, we have found that small, but significant numbers of voters invariably are assigned to the wrong precincts. Errors tend more often to involve entire streets or street segments as opposed to individual voter addresses. Error rates of two or three percent in circumstances may seem relatively insignificant, but in a jurisdiction with 300,000 registered voters, that’s 6,000 to 9,000 voters. If uncorrected local voter registration files are merged into a statewide master file, the numbers will be considerably higher. Several voter-crosscheck examples are attached to this document.

Voter crosschecking services could be provided independently, whether or not a GIS component was incorporated into the development of a statewide voter registration and election management system. Voter cross-checking services would be implemented as follows:

- 1) Create census TIGER data sets for individual counties that would include layers of current precinct boundaries.
- 2) Standardize address records in local Registered Voter Files with USPS-certified CASS (coding accuracy support system) software; geocode the standardized addresses by attaching x,y coordinates to each address; and match the addresses with the attributes of street features to pinpoint voter addresses onto the digital map.
- 3) Produce maps and reports for local election officials to identify invalid precinct assignments, and work with those officials to correct coding errors in local voter registration databases. Maps would display precinct boundaries, the underlying street grid, and points representing voter addresses. Each voter point would be color-coded according to its precinct assignment in a

registered voter file. Each voter point that is located outside of the precinct to which it was assigned in the voter file would be highlighted as invalid with a contrasting color and point style. A separate report listing this information would also be produced.

- 4) After all invalid precinct assignments are corrected, a new, corrected street file would be generated for a statewide voter registration and election management system.

Because of the voter-crosschecking feature, PRECIS can play an important role in improving the quality of voter information as statewide voter registration systems are developed in response to requirements of the Help America Vote Act (HAVA). In addition to voter cross-checking, PRECIS provides other options for enhancing the reprecincting/redistricting, data management, and reporting capabilities of a voter registration system. An important advantage of the PRECIS solution is its compatibility with any voter registration system that will be selected for your state.

Redistricting and Reprecincting

PRECIS provides users with a full complement of mapping tools, plus district boundary overlays, points representing voter addresses, and reference to the street grid and other geographic features for creating, modifying, combining, splitting, or deleting precincts on the digital map. Mapping and geographic editing tools will enable PRECIS users to maintain an up-to-date street layer and boundaries for precincts, electoral districts, and a variety of user-defined districts. PRECIS users can also import files of district boundaries obtained from redistricting authorities.

Address Management

PRECIS provides a variety of editing tools for adding new streets to the census TIGER base map and modifying the attributes of street features, including street names and street ranges, to maintain an accurate street grid. Groups of street addresses assigned to the wrong political unit can easily be moved to another political unit by editing the appropriate district plan and reassigning the territory in which the streets are located from one district to another.

When voter addresses are imported to PRECIS to create the voter points layer, the address data is standardized with USPS-certified CASS (coding accuracy support system) software. In the geocoding and address matching process that pinpoints voter addresses on the census TIGER map, any address that cannot be matched to a TIGER street attribute is placed in a file of Unmatched Voters. If an address in the Unmatched Voter file cannot be automatically pinpointed on the map after corrections to address elements or TIGER street attributes, the address can be manually placed onto the map.

In a statewide PRECIS configuration, local election officials would have access only to their own county data sets. The BIC (ballot information code) that PRECIS applies to address ranges in a street file would include a county identifier to distinguish among local voter registration databases.

Street file reports

PRECIS provides capabilities for generating custom reports and ASCII-formatted files of the entire street and address file and user-specified subsets of that file (such as all addresses in a precinct, state legislative district, or city). A street index report provides precinct and district assignments for all address ranges on the census TIGER map. Those assignments are reflected in a BIC (ballot information code) that identifies the unique district combination for the precinct in which each address ranges is located.

Defining the unique combination of districts for individual precincts for a specific election in PRECIS is a function of the “ballot style” feature that determines the BIC (ballot information code) that is applied to each address range in a street file. By maintaining a current database of district boundaries, system users can easily create “ballot styles” for a specific election simply by choosing the appropriate district boundary layers for district offices to be voted at an election.

Other Features

Other features of PRECIS include:

- District boundary overlays to aid precinct and district mapping
- Tools for importing local geographic files—e.g., street centerlines or local district boundaries such as fire, water, library, sanitary, and other tax districts
- Tools for mapping local districts, such as fire, water, and other tax districts
- Tools for splitting census blocks for more accurate precinct and district mapping
- Error checks for ensuring that all geography on the map has been assigned.
- Auto-generated “ballot styles” (unique district combos) for street file generation, ballot design, and logistical planning for upcoming elections
- Templates for the production of voter, ballot style, and street index reports
- Layouts for the production of Precinct Map Books and full-color maps in sizes ranging from 8½ x 11 in. to 34 x 44 in.

A four-page flyer describes the features of PRECIS in more detail. A short Microsoft® PowerPoint presentation on PRECIS can be downloaded from the Internet (www.electiondataservices.com/content/newprecis.php).

Prices

Price estimates for PRECIS mapping services for voter cross-checking activities in the conversion of local voter registration databases to build a statewide voter registration and election management system cover (1) TIGER file processing to build a statewide base map, (2) file conversion or map digitizing to create precinct boundary layers, (3) geocoding and address matching of Registered Voter Files to create a voter points layer; (4) production of maps and reports for county clerks to identify and correct invalid precinct assignments; and (5) onsite work with county election officials, if necessary.

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Price estimates for PRECIS installations for maintaining a statewide voter registration and election management system may include (1) software licensing fees for copies of PRECIS and ArcView GIS for state and county election directors; (2) training in software operations and installation of software and data sets; (3) technical software support; (4) development of interfaces linking PRECIS to the voter registration system for import Registered Voter Files and export of street index files; (5) equipment costs, primarily medium and large format plotters for the production of maps.

Representatives of Election Data Services Inc. would be happy to provide concrete price estimates based on the number of registered voters in your state, as well as the number of precincts. They can be contacted at 1-800-337-2004 or info@electiondataservices.com.

About Election Data Services

Election Data Services Inc. is a Washington, D.C.-based consulting firm that specializes in redistricting and election administration. The firm was founded by Kimball W. Brace in 1977 and was incorporated in the District of Columbia in 1982. The firm maintains a ten-member staff of consultants, GIS and database programmers, GIS specialists, and technical writers that provide redistricting software, databases, and consulting and litigation support services, studies on voting equipment and voter registration systems, and other election-related products and services. Election Data Services also maintains nationwide databases of election returns, voting statistics, statistics on voting equipment usage, and contact information for state and local election officials.

Qualifications and Experience

Election Data Services has more than 25 years of experience with GIS, database management, geocoding and address matching, and the use of census TIGER and demographic data. For redistricting clients, Election Data Services has constructed databases, developed GIS software, and provided consulting services. GIS software products, in addition to PRECIS, include applications for states and localities participating in the Census 2000 Redistricting Data Program and the 2000 Census Transportation Planning Package (CTPP) to map precincts, electoral districts, and TAZ's (transportation analysis zones) in preparation for the decennial census. Most software products were developed with GIS technology from ESRI (Environmental Systems Research Institute, Inc.). PRECIS, for example, was developed under ESRI's business partner program. Election Data Services has been an ESRI business partner since 1995.

Election Data Services has also worked verified precinct and district assignment codes in registered voter files and conducted studies on centralized voter registration systems for several state boards of elections and the Federal Election Commission (FEC).

PRECIS Installations/Current Users

Election Data Services began work on a GIS solution for the management of voting precincts just after the 1990 census and the conclusion of congressional, legislative, and aldermanic redistricting projects for several state and local government clients. An ArcView®-based pre-

cinct management program was installed in Cook County (suburban Chicago), Ill., in 1993. That program was upgraded in 1995 with the first version of PRECIS. Since 1995, PRECIS has been installed in county election offices around the country as well as one state election office. Election Data Services also provides precinct mapping services to jurisdictions that are either too small or not growing rapidly enough to justify the cost of maintaining a GIS for precinct management full-time. These services include voter cross-checking to verify precinct and district assignment codes in registered voter files.

The following is a list of software installations, reprecincting projects, and voter file verification projects using PRECIS:

PRECIS software installations — 1995 to present (sample list). Cook County (suburban Chicago), Ill.; Chatham County (Savannah), Ga.; Woodbury County (Sioux City), Iowa; Franklin County (Columbus) and Hamilton County (Cincinnati), Ohio; and Multnomah County (Portland), Ore. The Election Division of the Iowa Secretary of State also uses PRECIS.

Boundary verification/new voter file — District of Columbia, Board of Elections and Ethics, 2003. Verified ward, Advisory Neighborhood Commission (ANC), and Single-Member District (SMD) boundaries, identified ANC/SMD assignments for street segments and voter addresses in a street locator file, and produced a new street locator file with updated ANC and SMD assignments. A similar project was conducted in 1993.

Geocoding/addressmatching — Cook County, Ill., 2002. Geocoded voter addresses, matched voter addresses to street attributes, and produced maps for verifying precinct assignments in a registered voter file.

Reprecincting — Ten local governments, Connecticut and Rhode Island, 2002–03. Constructed geographic and voter databases; and provided technical assistance for the development of new voting district (precinct) plans in the cities Pawtucket, Providence, East Providence, Warwick, and Woonsocket, R.I.; and the towns of Bridgeport, Conn., and Charlestown, Lincoln, North Providence, and Westerly, R.I. Also, Westerly, R.I. in 1993.

Other GIS and Voter Registration Projects

The following is a list of GIS, redistricting, and voter registration projects that Election Data Services has conducted for state and local government organizations around the country over the past 25 years:

Redistricting — Fifteen state and local governments, 2001–02. Constructed geographic, demographic, and election databases; and provided strategic, technical, or administrative assistance for the development of congressional, senatorial, representative, or aldermanic redistricting plans in the states of Arizona, Connecticut, Illinois, Iowa, Massachusetts, and Rhode Island; Cook County, Ill.; the cities of Bridgeport, Conn., Chicago, Ill., Virginia Beach, Va., and Pawtucket, Providence, East Providence, and Warwick, R.I.; and the town of North Providence, R.I.

GIS Development — U.S. Department of Transportation, 1998–99. Develop GIS software for distribution to 50 state transportation departments and 400 metropolitan planning organizations (MPOs) for mapping traffic analysis zones (TAZs) under the 2000 Census Transportation Planning Package (CTPP). Also provided technical software support.

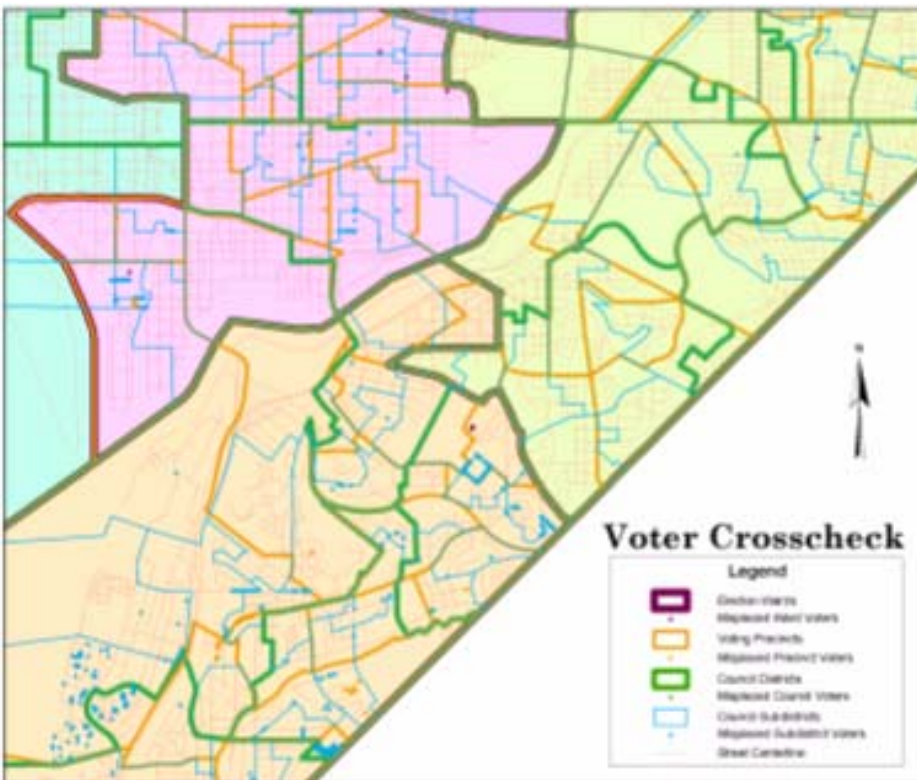
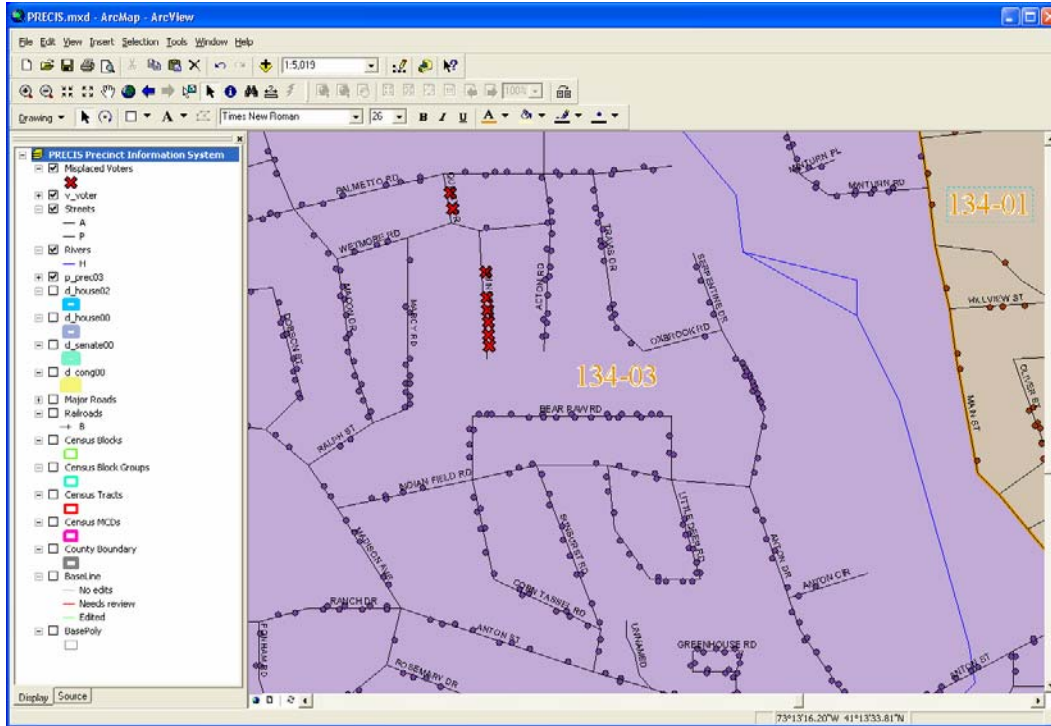
GIS Development — Seven state governments, 1995–99. Developed GIS software, construct geographic databases, and provided technical support for precinct and district mapping under the Census 2000 Redistricting Data Program—Block Boundary Suggestion Project (Phase 1) and Voting District Project (Phase 2), in the states of Alaska, Connecticut, Illinois, Indiana, Iowa, New Mexico, and Rhode Island.

Redistricting — Sixteen state and local governments, 1991–93. Constructed geographic, demographic, and election databases; and provided strategic, technical, or administrative assistance for the development of congressional, senatorial, representative, or aldermanic redistricting plans in the states of Colorado, Connecticut, Florida, Illinois, Iowa, Michigan, Massachusetts, and Rhode Island; Orange County, Calif., and Cook and Lake Counties, Ill.; and the cities of Chicago and North Chicago, Ill., New Rochelle and New York, N.Y., and Virginia Beach, Va.

Four statewide voter registration studies, 1994–97. Conducted needs assessments and systems requirements analyses for the development of central voter registration systems for the Illinois and North Carolina State Boards of Elections, the Secretary of the Commonwealth of Pennsylvania, and the Federal Election Commission (FEC). The final report of FEC study was published: William Kimberling, ed., *Developing a Statewide Voter Registration Database: Procedures, Alternatives, and General Models*, by Kimball W. Brace and M. Glenn Newkirk (Washington, D.C.: Federal Election Commission, Office of Election Administration, Autumn 1997).

Redistricting — Four state and local governments, 1979–84
Constructed geographic, demographic, and election databases; and provided strategic, technical, or administrative assistance for the development of congressional, senatorial, representative, or aldermanic redistricting plans in the states of Illinois and Michigan; and the cities of Houston, Tex., and Norfolk, Va.

Voter Cross-checking Examples



PRECIS crosschecking the accuracy of precinct and district assignment codes in Registered Voter Files. Voter addresses are geocoded and then pinpointed on the map. Contrasting point styles show which addresses are located within the boundaries of precincts to which they were assigned and which invalid because they are located outside precinct boundaries.