# PLANNING EMERGENCY RESPONSES
# FOR PERSONS WITH SPECIAL NEEDS

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# ABSTRACT

In 2006, a joint U.S. Department of Homeland Security/U.S. Department of Transportation report concluded, based on the inadequate response to Hurricane Katrina, that "substantial improvement is necessary to integrate people with disabilities in emergency planning and readiness." In 2007, the Federal Emergency Management Agency released more stringent guidance on emergency planning for persons with special needs. Special Population Planner (SPP) is an ArcGIS-based emergency planning system developed by Argonne National Laboratory for the Alabama Emergency Management Agency and released as a free, open-source product. This paper will first discuss some of the current emergency planning community methods for gathering and using information on special needs populations. Second, our methods and lessons learned in developing a registry for persons with special needs will be discussed, along with statistics characterizing the participants. Third, aspects of SPP's functionality will be described, including the mapping, reporting, editing, and analytical tools; linkage to models and other dynamic information sources; the documentation; and the demonstration database. Lastly, examples of how to reconfigure SPP for new sites will be discussed.

## BACKGROUND

In 2006, a joint U.S. Department of Homeland Security (DHS)/U.S. Department of Transportation (DOT) report concluded, based on the inadequate response to Hurricane Katrina, that "substantial improvement is necessary to integrate people with disabilities in emergency planning and readiness" (DHS/DOT 2006). In 2007, the Federal Emergency Management Agency (FEMA) released more stringent guidance on emergency planning for persons with special needs (FEMA 2007). This was amplified by the August 2008 release of FEMA's *Interim Emergency Management Planning Guide for Special Needs Populations*, which declared that:

> Emergency management takes into consideration planning for the safety of every person in the community during and following a disaster. Taking into consideration populations historically considered "vulnerable," "at risk," or "special needs" ultimately improves the overall community's post-disaster sustainability. . . . Planning for special needs populations is fundamental to the development of an [Emergency Operations Plan]. . . . (FEMA 2008)

Despite the considerable challenge, the increasingly-stringent federal guidance and the experience of Hurricane Katrina have led to greater awareness of, and, progress in, the emergency planning community to address special needs populations. For example, during the recent floods in North Dakota, Lt. General (retired) Russel Honoré, who commanded U.S. military forces responding to Hurricanes Katrina and Rita, was interviewed by CNN about evacuations (CNN 2009). General Honoré stated, "The first thing you do is start with the most vulnerable population and get people to start moving

now," and "They need to start going door to door now and start seeking out the elderly and the disabled to make sure they have gotten all of them out of town," and "Everybody who has a car is not an issue. The issue is with the elderly, the disabled and the poor who may not have vehicles." In the case of the North Dakota floods, there was clearly an awareness of the unique challenges of special needs populations, but knowing in advance the locations and numbers of special needs individuals in the community, and their unique needs, would have made response efforts more effective and efficient than going door to door to seek them out.

General Honoré's remarks highlight the importance of defining which populations have "special needs" for emergency planning purposes. The term has been used to include:

- Persons with disabilities,
- Pregnant women,
- Persons on kidney dialysis,
- Persons who are morbidly obese,
- Young children,
- The elderly,
- Persons with limited English proficiency,
- Members of minority groups,
- Persons without vehicles, and
- Residents of institutions such as nursing homes and correctional facilities.

"Given this demographic data, it is clear that *special needs* can cover much more than 50% of the nation's population, rendering the term meaningless" (Kailes and Enders 2007). The *Interim Emergency Management Planning Guide for Special Needs Populations* narrows this planning focus by stating that: "Populations whose members may have additional needs before, during, and after an incident in functional areas, including but not limited to:

- Maintaining independence,
- Communication,
- Transportation,
- Supervision, and
- Medical care" (FEMA 2008).

In FEMA's guidance for **individuals** with special needs, the central message is **individual responsibility** for being prepared; it also suggests that persons register with available support organizations. The guidance includes the following statement: "If you have special needs: Find out about special assistance that may be available in your community. Register with the office of emergency services or the local fire department for assistance so needed help can be provided" (FEMA 2007).

In FEMA's guidance for **disaster relief planners and service providers**, a key focus is the legal responsibility to provide **equal access** for people with disabilities. "Federal civil

rights laws […] require accessibility and prohibit discrimination against people with disabilities in all aspects of emergency mitigation, planning, response, and recovery" (FEMA 2007). One requirement listed is to be familiar with the demographics of the population of people with disabilities who live in the community being served. Lawsuits alleging violations of the federal Americans with Disabilities Act and the Rehabilitation Act have succeeded against both a private firm and a public school system that failed to provide sufficient emergency plans for persons with disabilities (*Savage v. City Place Limited Partnership* 2004; *Shirey v. City of Alexandria School Board* 2000).

Recently, the Association of State and Territorial Health Officials (ASTHO) studied state and local planning efforts for at-risk populations, particularly from the perspective of pandemic influenza. In its report (ASTHO 2008), examples are listed of innovative and sound practices and tools, including Internet-based communication tools to connect stakeholders, public health messaging systems that span multiple media types and languages, guidebooks and workbooks for individuals and service organizations, drills and training, community surveys, distribution plans for distributing supplies. Table 1 summarizes promising practices for communications with, and education of, at-risk populations reported by the organizations that ASTHO surveyed.

**Table 1: Percentage of organizations surveyed by ASTHO reporting pandemic influenza–related promising practices**

| Type of activity | Percentage reporting promising practice |
|---|---|
| Collaboration with, and engagement of, the at-risk community | 47% |
| Locating and quantifying at-risk populations | 41% |
| Responder training | 26% |
| Testing and exercising preparedness of at-risk populations | 24% |
| Measuring and improving preparedness of at-risk populations | 21% |
| Provision of resources and services | 15% |

Source: (ASHTO 2008).

In the ASTHO survey,12 states and territories described efforts to identify their special populations, including Arizona, Delaware, Florida, Hawaii, Iowa, Maine, New Mexico, Ohio, Puerto Rico, South Dakota, Vermont, and West Virginia. Of these, Hawaii, Iowa, Kansas, and Puerto Rico, indicated that they are using a geographical information system (GIS) in this work. Local areas with identification efforts included Linn County, Iowa; Clark and Kittitas Counties, Washington; Fort Worth and Tarrant Counties, Texas; and Polk County, Wisconsin.

Linn County is the site of Iowa's only nuclear power plant, and its Emergency Management Agency (EMA) has been implementing a special needs registry and using GIS to map locations of special needs individuals since 2000 (American City and County 2000, Linn County 2009). In 2000, the Linn County EMA had about 1,100 people enrolled in the program, each located within 10 miles of the power plant. The Kansas Association of Local Health Departments (KALHD) has a variety of

activities and resources for special populations, including a Web-based GIS system for emergency planning for vulnerable populations, questionnaires, and toolkits for service providers (KALHD 2009). Fort Worth and Tarrant Counties in Texas have a Special Needs Assistance Program (SNAP) that maintains a registry and makes the data available to emergency response agencies (Fort Worth-Tarrant County 2009). Addresses are geocoded to provide locations. The data are used in a hazard analysis model, and the system can determine the nearest emergency facilities and shortest routes to reach them. This work was presented at the Environmental Systems Research Institute (ESRI) International User Conference in 2008; however, only the abstract was published (Moss 2008). Other examples of Web-based sites for collecting registry information include the State of Utah (State of Utah 2009); Okanogan County, Washington (Okanogan County 2009), and Fairfax County, Virginia (Fairfax County 2009a), which also has a registry for organizations that can provide services (Fairfax County 2009b).

On the basis of these examples, it is clear that planning for special needs individuals is increasing and improving in the emergency planning community; however, it is not yet a comprehensive and standardized program.

## DEVELOPING A REGISTRY IN THE PROJECT AREA

Our project involved development of a special needs registry and a GIS-based emergency planning system for the six-county area around Anniston Army Depot in northeastern Alabama (Figure 1). It was sponsored by the Alabama Emergency Management Agency as part of the Chemical Stockpile Emergency Preparedness Program (CSEPP). CSEPP aids emergency planning and preparedness in the communities that surround U.S. military installations where chemical weapons are stored pending their ongoing destruction under federal statute and a corresponding international treaty.

In Metz et al. (2002), the methods used to develop a registry in the project area are described, with information on relative costs and effectiveness, a description of the characteristics of the special needs population in the project area, and discussion of the assistance options that were available. Before our project started in 1999, efforts to identify individuals in the area around the Depot involved postcards distributed with emergency planning calendars in one county, and with a phone number in another county. The postcard method identified 632 persons over a 5-year period, while the telephone method identified only one person. The data collection effort was strengthened as part of our project and included five identification methods in the Immediate Response Zone (IRZ): (1) a random-sample survey, (2) saturation mailing of self-registration packets, (3) targeted distribution of self-registration packets, (4) list acquisition, and (5) referrals. By 2001, the broader data collection effort resulted in the registry size increasing to 2,337 in the IRZ. Metz et al. (2005) provides more information on the emergency preparedness services provided in the project area, with statistics on
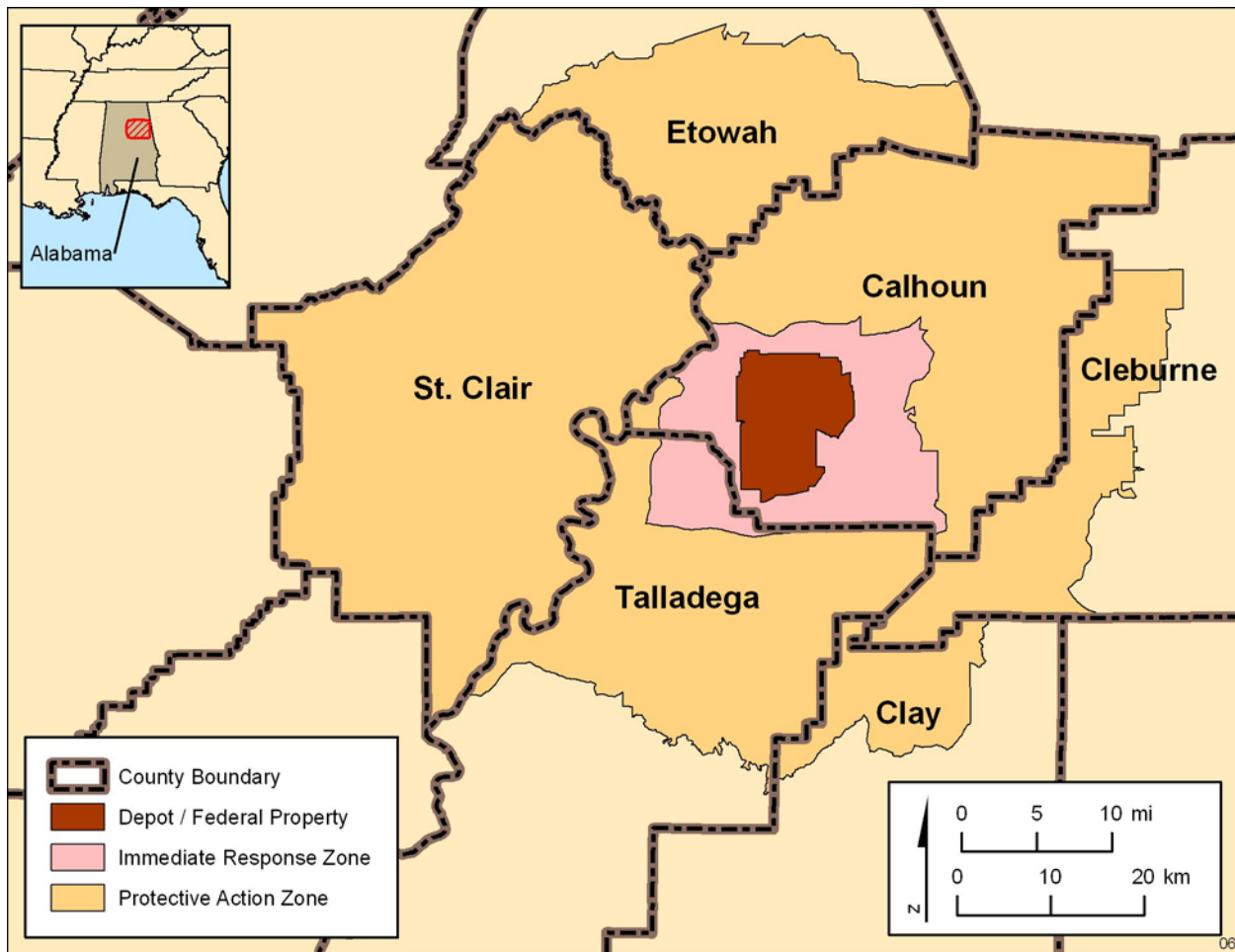
**Figure 1. Project location with the Anniston Army Depot, the IRZ, and the Protective Action Zone**

the number of individuals with special needs in the registry and the services provided to them. In the course of the work, the counties closest to the Depot made substantial adjustments to the protective-equipment distribution process, and training provided to residents with special needs. The statistics also show a substantial turnover of persons with special needs over time (Table 2).

**Table 2. Registration turnover of persons with special needs in the IRZ**

| Year of registry update | Total number of registered persons | Number of first-time registrants | Inactive records[a] | Turnover (%) |
|---|---|---|---|---|
| 2001 | 2,337 | 736 | 1,693 | 51 |
| 2002 | 2,859 | 998 | 1,092 | 37 |
| 2004 | 2,213 | 378 | 730 | 28 |

[a] Records were removed from the registry when previously registered persons stated that they were no longer living independently, stated that they no longer needed assistance, requested that their records be removed from the database, could not be reached, were reported as deceased, etc.
Source: Metz et al. (2005).

## SPECIAL POPULATION PLANNER

Another major activity in the project was the design, development, and deployment of Special Population Planner (SPP), a GIS-based emergency planning extension to ESRI ArcGIS 9.x. SPP was initially coded in 2001 using ESRI ArcView 3.x, ported to versions 8.x and 9.x as they were introduced by ESRI, and released as an open-source product in 2007. The SPP was selected as a Community Preparedness Resource in FEMA's *Interim Emergency Management Planning Guide for Special Needs Populations* (FEMA 2008).

The open-source version of SPP, including the source code, full documentation, and an example database, is distributed through SourceForge.net (https://sourceforge. net/projects/spc-pop-planner). Copying, distribution, and development of derivative works, with some minor constraints, can be performed under the General Public License-style license. SPP has been downloaded nearly 1,850 times as of May 19, 2009.

Five main activities are supported by the SPP tools:

- Creating and updating a voluntary special needs population registry of key personal data;
- Creating and updating regional GIS information, including assigning map locations to registered persons on the basis of their street addresses (address geocoding);
- Automatically generating reports and maps;
- Analyzing data in the context of planning zones and scenarios for preparing response plans; and
- Organizing emergency response plans for quick retrieval and update.

The interface is implemented as an additional custom menu and toolbar (Figure 2) in the ESRI ArcMap program (Figure 3). The standard tools in the toolbar, from left to right, are Open Event, Zoom to Cluster Extent, Open Plan, Open Report/Export Data, Add SPP Map Layers, Select by Attributes, Select by Location, Clear Selected Features, Define Wedge, D2-Puff Plume, User-Defined Event, Location Editor, Add Evacuation Route, Delete Evacuation Route, Add Alert Route, Delete Alert Route, Show Coordinates, and Hyperlink. Once it is populated with location-specific data, the table of contents shown on the left side controls the map content, including which themes are drawn, symbolization, labeling, and many other properties. All the standard GIS tools are available and enabled, or they can be hidden if desired to simplify the interface for new users.
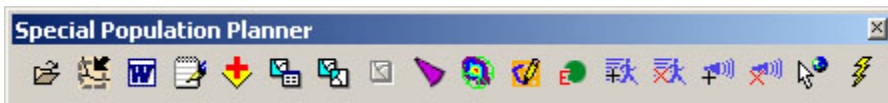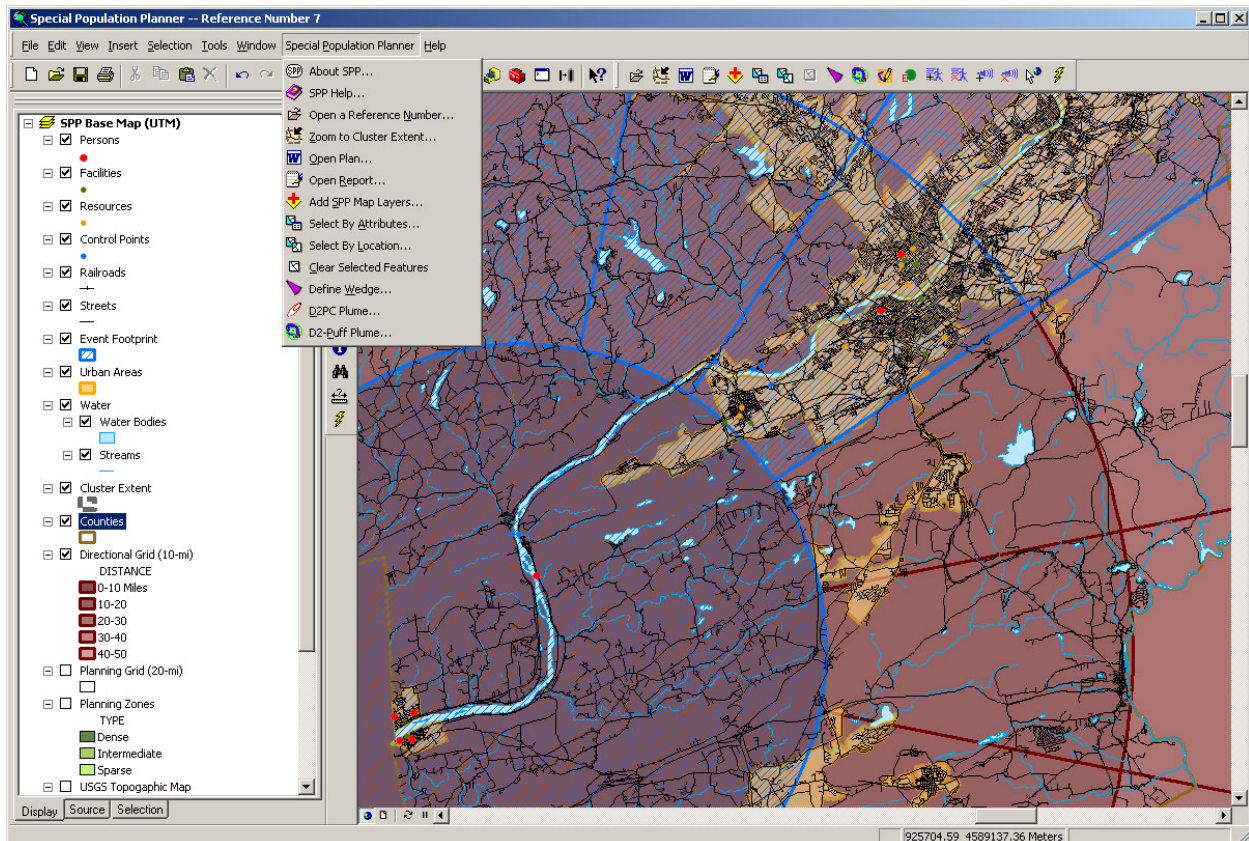


**Figure 2. SPP toolbar**

**Figure 3. SPP interface with map showing hypothetical zones and locations of special needs individuals**

One of the fundamental concepts in SPP is the use of emergency planning zones to characterize and organize responses. It supports multiple, independent zone configurations, such as both a hazard direction and distance grid and fire districts. Zones are used in the system in many ways, including for map display, as a basis for organizing emergency response plans, and in system reports. Zone identifiers are automatically populated in special needs and other database tables when records are added or edited. This approach provides automated direct links among the ways emergencies are tracked, the jurisdictions of responding organizations, and the locations of special needs populations.

In SPP, the combinations of the choices of zones, the tools for defining events in many ways, and the open access to standard GIS tools allow it to be effectively used for all-hazards planning. Examples are shown in Figure 4 for analyzing a flood event and Figure 5 for analyzing a forest fire. Locations of emergency events can be brought into the system by any means supported by GIS, including, but not limited to:

- Global positioning system (GPS) data,
- Aerial observations,
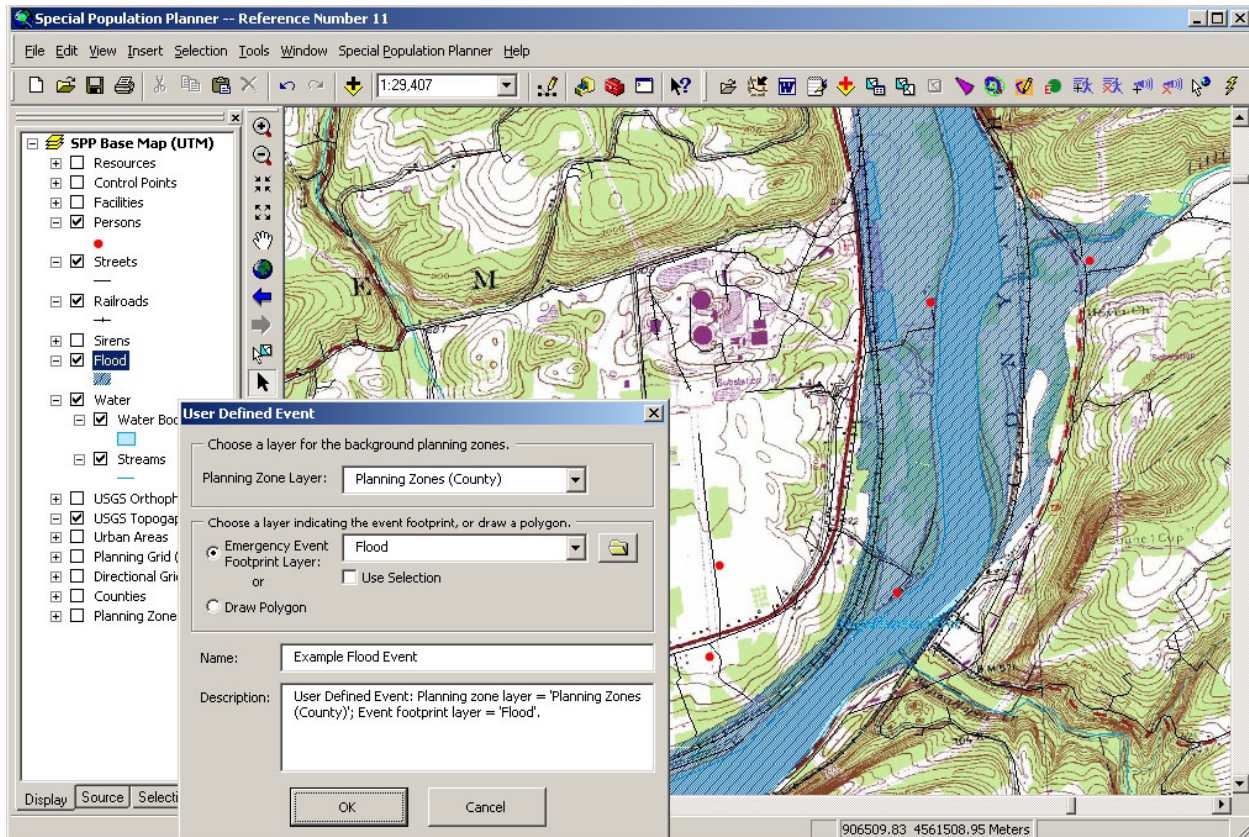- Live map services from the Internet (e.g., a weather overlay),
- Model results,

**Figure 4. Map display in SPP depicting a hypothetical flood**

- Processing of elevation or other geospatial data, and
- Screen digitizing of boundaries on the basis of user knowledge.

Once the emergency is characterized in one of these ways, the SPP tools automate many of the steps needed to plan and execute emergency response, including:

- Identifying and mapping special needs households within the emergency area and the associated planning zones,
- Visualizing and publishing maps,
- Generating reports,
- Accessing existing emergency plans,
- Linking to Internet information based on map locations (e.g., a school's Web site), and
- Designating evacuation or alert routes.

A key system component is the Open Report/Export Data tool. The system has been provided with some example reports that tie to various items in the database, particularly the special needs persons table. Figure 6 shows an example report as viewed in the software. Reports can be printed or exported to a variety of formats,
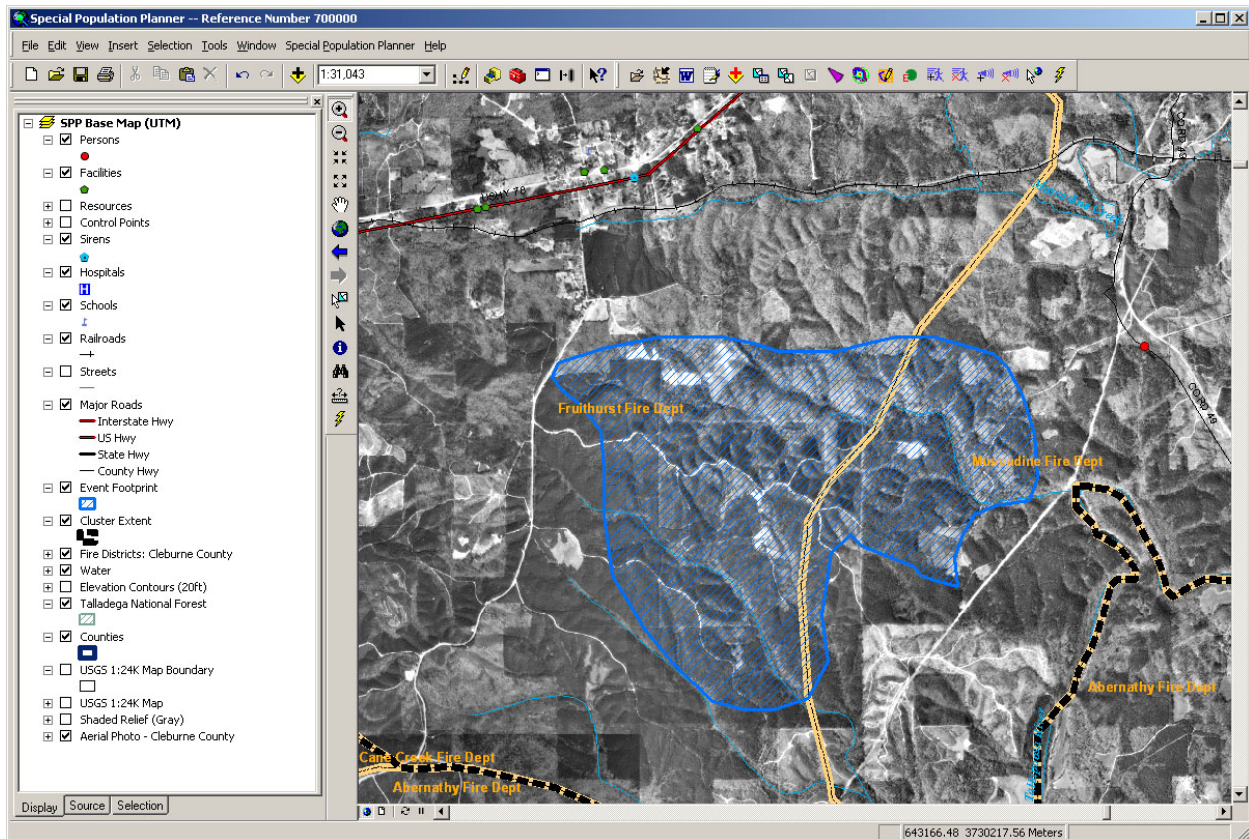
**Figure 5. Map display in SPP depicting a hypothetical forest fire**

including Adobe portable document format (PDF). The same SPP tool allows any tabular database information stored in SPP to be exported for use in other systems if needed. Contents of reports and exported data files can be limited to subsets pertaining to a particular emergency event, a user-defined subset, or all the data. Reports are designed with Crystal Reports software, and new reports can be easily designed and added to the system.

The system includes an easy-to-use capability for maintaining special needs registry data and other data layers (e.g., facilities, resources, and traffic control points) in the system. These core tables can be customized by system administrators; the necessary instructions are provided in the manual.

The Location Editor tool is used to make edits to individual records and is designed to automatically configure itself on the basis of the database table structure, and drop-down lists and other customizations can also be added through configuration tables in the database. Locations can be specified or revised by clicking on the map, entering coordinates in the coordinate system of choice, or address geocoding. The address geocoding capability uses (and requires) a GIS layer of streets that is populated with street name, address, and zipcode information. The tool uses the specified address and the street layer to locate the address on the map. Attributes are
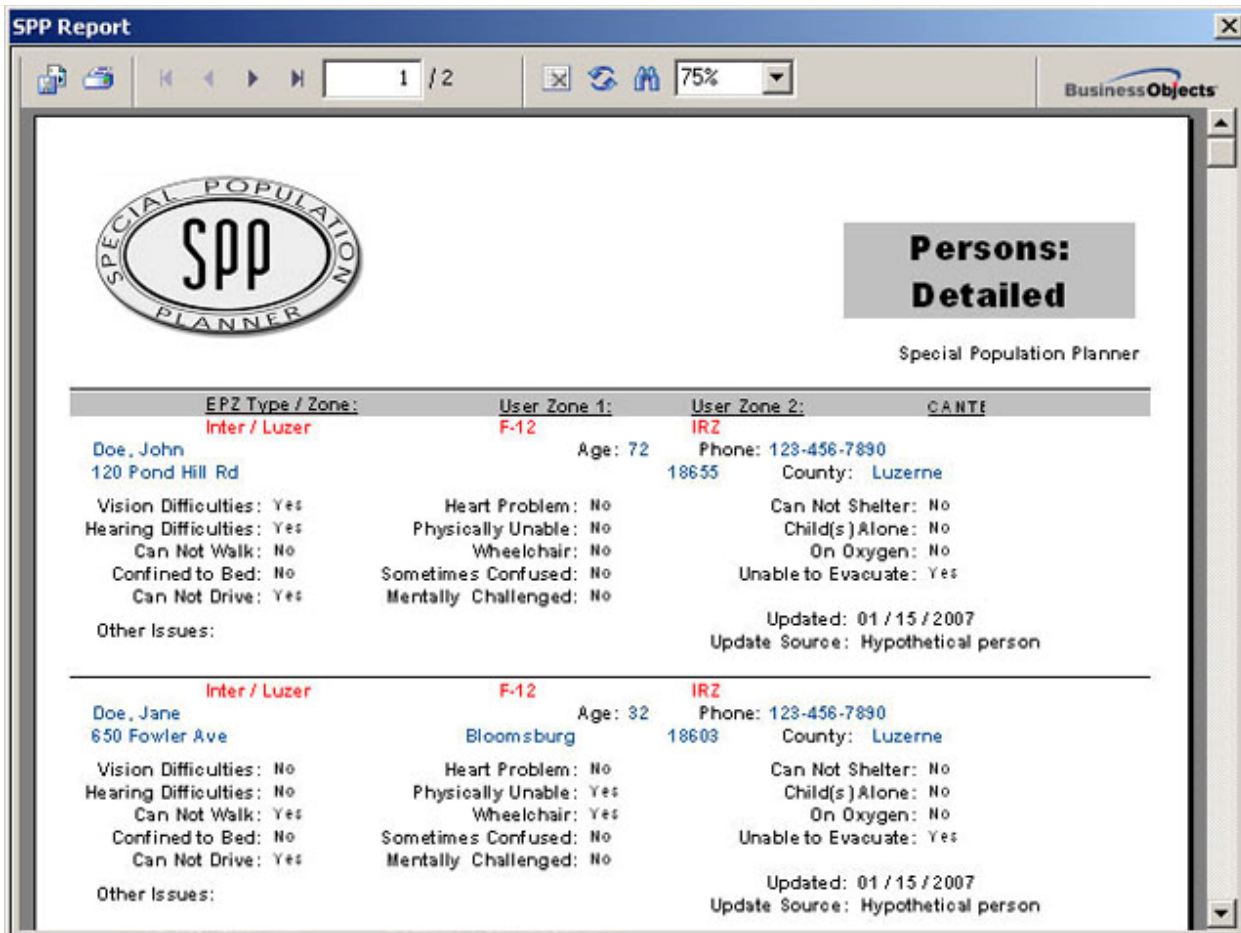
**Figure 6. Example of detailed persons report, showing hypothetical data, including zones, contact information, and details on special needs**

edited in a second tab that is automatically populated with editing fields based on the table structure, plus optional configuration settings controlled by a database table. Depending on the user's choice when opening the Location Editor, records can be added, changed, or deleted from the specified table.

The SPP tools add easy-to-use functionality to the GIS interface for managing, visualizing, and analyzing special needs and other planning data, without changing or limiting the extensive capabilities of the GIS software. More information about the architecture and features of SPP is presented in Kuiper et al. (2008) and in the software documentation.

## RECONFIGURING SPP FOR A NEW SITE

The open-source version of SPP includes an example database populated with GIS layers and some hypothetical special needs person records. Once it is installed, the system can be reconfigured for a new site by replacing the GIS database and adapting the database tables and reports. The required steps include:

- Changing the GIS database to a new geographic area,
- Installing new data layers,
- Updating or replacing the street layer used for geocoding, and
- Updating location-dependent values.

Optional steps include:

- Adding or changing user planning zone layers,
- Modifying existing or adding new reports,
- Configuring the Location Editor, and
- Configuring extra location-dependent values.

First, a few required layers must be set up for the new location, beginning with the main planning zone layer. This layer should cover the full extent of the region of interest and be divided into a set of uniquely-identified zones. Two additional zone layers may optionally be added at this step, or at any time later. For example, fire districts may represent the primary zone organization, but secondary zone layers could include a square grid, direction/distance grid, census tracts, or any other set of areas useful for planning.

At least one point layer is required for many of the SPP tools, and several are included in the example database, including Persons, Facilities, Control Points, Resources, and Sirens. Aside from some standard fields, the attribute tables for these layers can be customized to fit the needs of the users.

A geocodable street layer is needed for the Location Editor to locate points on the map by their street address. Each license of ESRI ArcGIS includes data suitable for this purpose. It is also available commercially, and some organizations will prefer to use their own data.

The above layers are required for all the SPP tools to function. Typically, a variety of other map layers are added to the system to provide a complete base map and other contextual information. Such layers can be included in the GIS by using the standard tools, or more closely integrated with SPP by storing them in a centralized location and adding them to the system configuration tables.

Next, the system's Microsoft Access database is opened, and configuration tables are updated to fit the new installation as detailed in the manual. Once the configuration tables and GIS data are ready, the system is ready to run, although the core data are not yet populated.

If registry data already exist, they can be batch loaded into the database, and the table can then be configured to fit SPP. The key fields needed for SPP are a unique identifier, X and Y coordinate fields, and zone fields. Some additional fields will be used if they are present, or ignored if they are not. SPP is designed for registry data residing in a single

table. If the registry is designed as a set of related tables, a query can be designed to simulate a single table; however, editing using the SPP tools may not be possible. But since SPP manages registry data as standard database tables, the registry can be edited through standard database forms as is typical in many organizations. If records in the registry are not already geocoded, typically street addresses are used at this stage to assign locations. These locations must be stored in the SPP table as X and Y coordinates. Once the points are geocoded, they will appear on the map in SPP, and a tool is used to automatically update all points with location-dependent values such as zone, county, etc.

Reports in the example database are associated with the example tables and their structures. If the tables are changed, the reports must be modified similarly, and additional reports can be added if desired. Crystal Reports software is necessary to edit and display the reports. Reports in SPP require (1) a data source, (2) a report template, and (3) configuration in the ConfigReports table. When running a report, the SPP software creates a temporary file of the data used in the report, and uses the report template to format it. Modifying a report involves running it in SPP, editing the Crystal Reports template file, and replacing the previous version. Adding a new report is similar except that an example of the supporting data is manually created, the report is made from scratch, and a record must be added to the ConfigReports table.

The attributes tab of the Location Editor can be customized to hide fields, make them read-only, assign a tool tip, and/or configure a combo-box with a list of values.

**CONCLUSION**

Emergency planning for individuals with special needs is a considerable challenge, yet one that is essential from both a legal and ethical perspective. Awareness of the need is increasing, and many organizations are making progress with innovative solutions. One of the needed activities is identifying the unique needs in local communities, often to the level of identifying individuals and keeping a registry. Argonne National Laboratory's Alabama CSEPP project is one of the earliest examples of a multi-county scale registry and an associated GIS.

Using multiple active approaches to identify special needs individuals is far more effective than a more passive approach but is also more expensive. Because the special needs population is dynamic, ongoing data collection and verification are needed. Many of the useful statistics and lessons learned from this work have been published for the benefit of the emergency planning community (e.g., Metz et al. 2002, 2005; Kuiper et al. 2008). (The authors can be contacted for additional information and publications).

SPP is also available for downloading and is designed to be flexible for adaption to the unique data and needs of an organization. This paper briefly discusses its features and the ways it can be adapted to a new site.  More specific details can be found in the software manual.

As a word of caution, a key aspect of the SPP system is that it uses a registry to identify persons with special needs. Registry-based emergency planning is one way to enable emergency planners to address the special needs of individuals or groups. However, registries can also raise significant privacy, confidentiality, ethical, legal, and liability concerns (FEMA 2008). SPP users should consider these issues carefully before initiating a special needs population registry or database. (The authors can provide more information about experiences in this area and contacts for other organizations that have implemented similar registries.)

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