

GIS Automates Utility One Call Process

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Abstract

Contractors, public works employees, and utility companies are all very familiar with the one call system. Anyone planning to excavate on public or private property calls the one call center. The center notifies utility companies so they can mark out asset locations.

The rapid growth of the City of Sioux Falls, South Dakota, made it difficult for city utility personnel to keep up with the large number of one call requests (tickets). As the workload increased the City had to either hire additional staff or find a more efficient way to handle the work-requests. City staff worked together to develop a process to geocode the tickets, buffer utility locations, and forward information to the field personnel. ArcInfo, ArcSDE, ArcIMS, and GPS technology transformed the process to make it more accurate, more efficient, and easier to use in the office and out in the field.

Introduction

A few years ago one call systems were established by all the states to help prevent the loss of life and avoid damage to underground utilities. Each state developed the necessary one call center to provide the public and contractors with a single contact to alert utility companies before digging. South Dakota State law requires all public and private utility owners to field mark the location of underground utilities when they are in conflict with proposed excavation. South Dakota statute 49-7a defines specific requirements for anyone who is planning on digging or excavating and also requires utility owners to follow specific procedures as described:

- An excavator must notify the one call notification center of the proposed excavation. The excavator shall notify the one call center by telephone, facsimile, or in person at least forty-eight hours prior to the commencement of the excavation.
- The one call center will notify local utilities and companies who operate underground facilities about the project.
- The companies take the information provided by the one call agency to determine if the project is near their operations.

- If the project is in close proximity to underground facilities, the affected utility or company will send a representative to the work site to clearly mark the route and location of their appurtenances. The response time shall be no later than forty-eight hours after the receipt of the notice.

Background

The City of Sioux Falls, South Dakota is approximately sixty-four (64) square miles in area with an estimated population of 136,000. The City maintains hundreds of miles of underground public facilities including 890 miles of water main, 715 miles of sanitary sewer, 335 miles of storm sewer, and 450 miles of underground electrical and traffic signal conduit.

The rapid growth of the City made it increasingly difficult for utility personnel to keep up with the large number of one call requests (tickets). The City of Sioux Falls often receives more than 200 locate requests per day in the summer construction season. As the workload increased, the City had to either hire additional staff or find a more efficient way to handle the work-requests.

The Old Method

The State of South Dakota has been contracting with a company, One Call Systems, Inc. (OCS) for a number of years to provide one call operational services. The initial process was:

- Excavator calls designated South Dakota one call phone number which is a connection to OCS
- OCS would record all the necessary information and determine if the excavation was within Sioux Falls underground utility areas. The areas were defined by City staff
- OCS faxed the appropriate tickets (requests) to City staff
- Office staff and locators for each city utility would sort through every ticket to determine if the excavation is near their underground facility
- Locators from each of the public works divisions (Lights, Traffic, Water) would locate and mark their utility if necessary

The City began to receive the locate requests electronically about five years ago. Additional functionality became available with electronic ticket transfers.

The timeline for changes to the one call process:

- June 1, 2000 – City requests OCS to switch to electronic transfer and discontinue the faxed tickets.
- July 11, 2001 – OCS installs Screen N Go software on City computers and trains personal. The software purchased from OCS provides a ticket viewer and mapping component.
- August 18, 2003 – City requests OCS to perform a pre-screen of each ticket within the Sioux Falls area. Each of the public works divisions would only receive tickets within predefined areas, based on the location of each utility, eliminating the need for each utility to sort all Sioux Falls tickets.
- August 18, 2003 to September 1, 2005 The City's one call system operated under an agreement with OCS requiring OCS to screen tickets for each utility based on the geographic location of each utility.

The service of pre-screening significantly reduced City staff time in reviewing tickets but cost became a big concern. The cost to the City was significantly higher to have OCS prescreen every ticket. In an effort to reduce the cost without significantly increasing staff time, City staff decided to explore alternative methods to screen and sort tickets.

The New Method

City staff from GIS, Engineering, and several Public Works Divisions met and defined specific criteria necessary for an application to sort the tickets and store all processed data on a local server. The program should:

- Have the ability to read the tickets (text files) sent to the City's FTP server by OCS.
- Deposit the tickets into a table record format, preferably a table in the existing GIS SDE Database (SQL Table).
- Address match (address geocode) the tickets and create a point for every ticket in the GIS database.
- Buffer the existing utility locations to create one zone for each utility.
- Intersect the ticket locations with the buffer of each utility to determine which utility should receive the ticket.
- Create a separate view of the data for each utility to allow them to access only the tickets in the specific utility buffer zone.

- Have reporting capability to query or tabulate data statistics.
- Provide the ability for the locators to respond to the tickets and store their response in the ticket table.
- Be accessible from computers out in the field, or in other words, implement a mobile mapping and work request system.

Who is involved and how was it designed?

Initially the question became “How can we build the application and implement it in a short period of time?” The contract renewal with OCS was approaching soon. The City had to develop a new process and test it within a few months or it would be at least another year before the opportunity to change course would be an option. Engineering staff asked GIS staff to build a prototype to make sure the address matching and ticket data viewing portion would work as proposed.

Two weeks later GIS staff demonstrated the geocoding process and a ticket mapping interface with a ticket data viewer using ArcMap. Staff from the Engineering Department and Public Works Divisions were very happy with the application but wanted to know how quickly the application could be designed, programmed, and implemented with the specifications identified above. GIS staff recommended the City investigate the possibility of contracting with a GIS consultant to complete the entire project design and implementation.

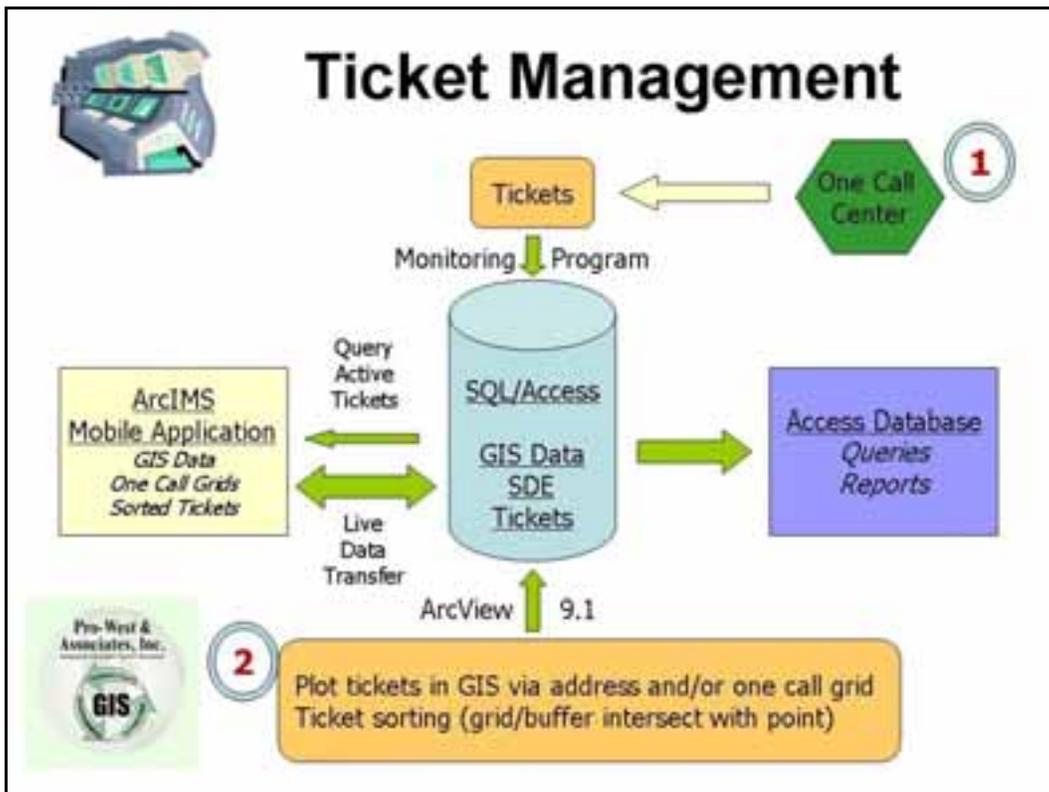
Pro-West and Associates from Walker, Minnesota, was selected to proceed with the application design and programming. The staff from Pro-West worked very closely with City staff to develop an excellent program designed to receive and process the locate requests.

Procedures

The following slides and screen shots show the flow and actions applied to process each ticket as it is received from the one call center.

Ticket Management Flow Diagram - The diagram in figure 1 is a flow chart of the ticket management system developed by Pro-West and approved by City staff.

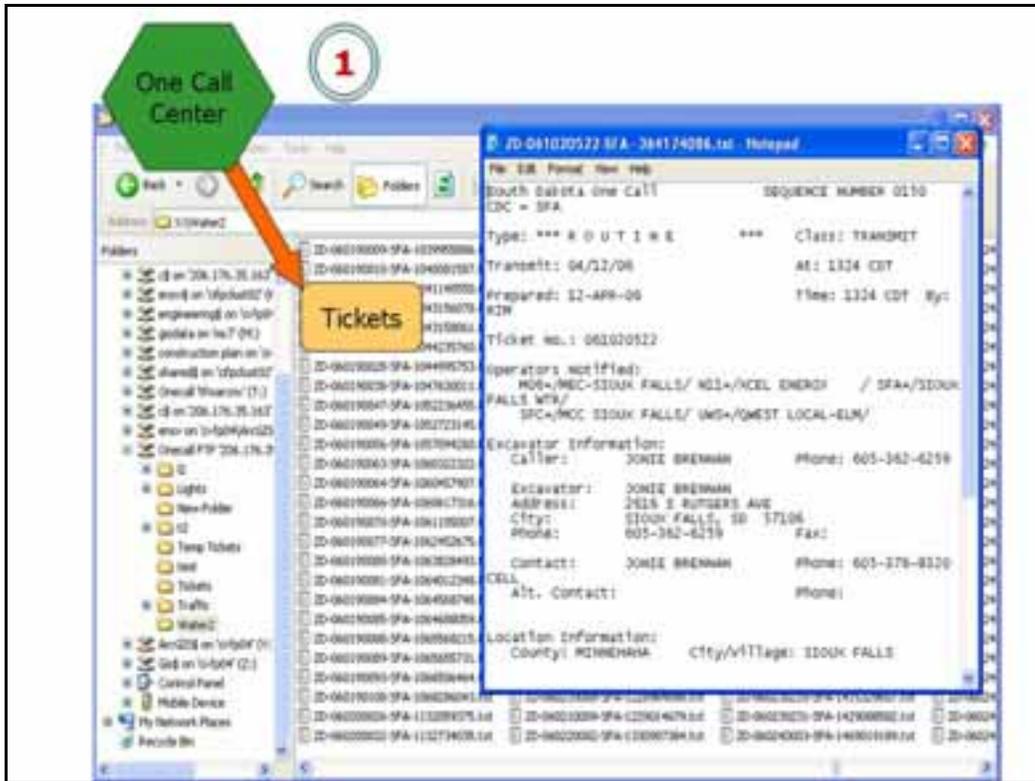
Figure 1. Sioux Falls Ticket Management Flow Diagram.



(Pro-West and Associates 2005)

Ticket Monitoring Program - The first step in the process occurs when the one call center sends a work request (ticket) to the City's FTP server. The ticket monitoring program reads the file and transfers the data to a SQL table in the GIS ArcSDE Geodatabase.

Figure 2. One Call Center sends text file to City's FTP server.



(City of Sioux Falls 2006)

Loading Ticket Data into Geodatabase - The monitoring program does an excellent job of reading the tickets and distributing the data to various fields. There are many important fields of information transferred from the text tickets to fields in the SQL tickets table including the ticket number, ticket type, date received, date of required work, contractor name, and address. The information, now in a table format, can more easily be used to address match or geocode each record. Several other fields are used in various stages of the ticket management process.

Figure 3. The data in the SDE ticket table.

The screenshot displays the 'Data in Table: TICKETS' window in Microsoft SQL Server Enterprise Manager. The table contains the following columns: TICKETNUMBER, TICKETNAME, MPID_CODE, CLASSIFY, RECDATE, RECDTIME, WORKDATE, and ADDR. The data rows show various ticket records with their respective numbers and details.

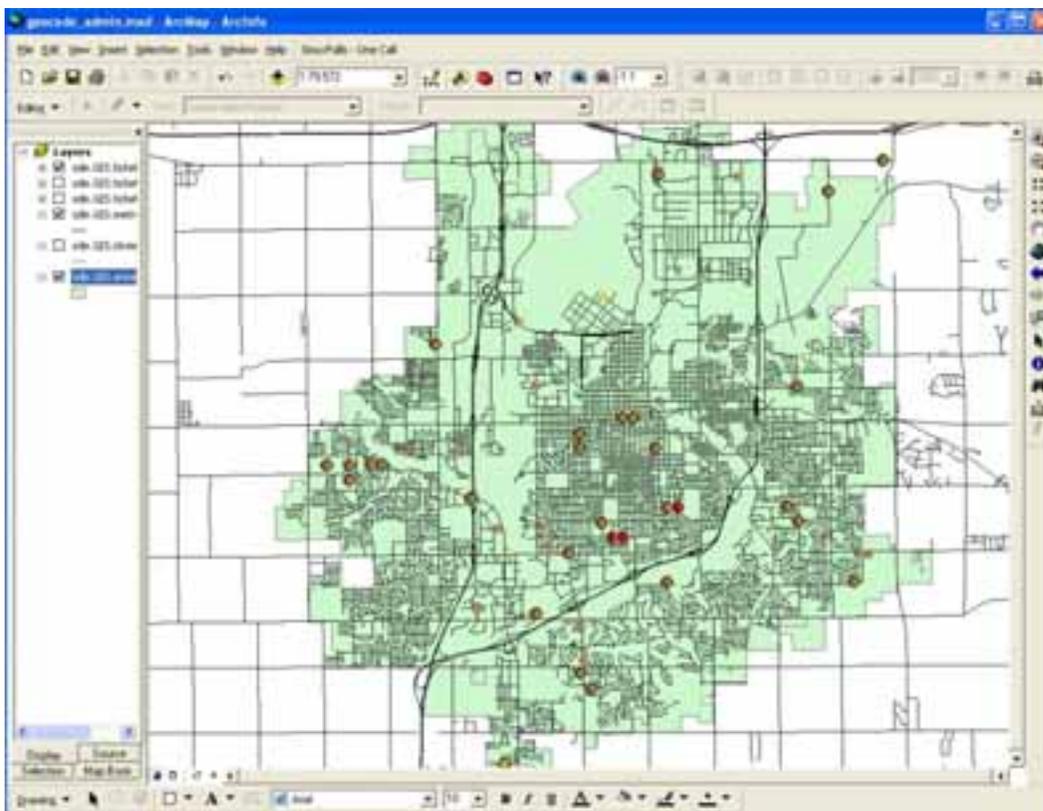
TICKETNUMBER	TICKETNAME	MPID_CODE	CLASSIFY	RECDATE	RECDTIME	WORKDATE	ADDR
051890042	T0707043.030	11	TRANSPET	7/7/2006	1408 CDT	07/11/06	1825 C
051890064	T0707043.030	11	TRANSPET	7/7/2006	1408 CDT	07/11/06	1833 C
051890053	T0706005.440	11	TRANSPET	7/6/2006	1408 CDT	07/11/06	1802 C
051890070	T0706005.512	5	TRANSPET	7/6/2006	1402 CDT	07/11/06	0826 C
051890077	T0706005.518	11	TRANSPET	7/6/2006	1402 CDT	07/11/06	0826 C
051890078	T0706005.522	11	TRANSPET	7/6/2006	1402 CDT	07/11/06	0826 C
051890080	T0706005.527	11	TRANSPET	7/6/2006	1402 CDT	07/11/06	0826 C
051890082	T0706005.530	11	TRANSPET	7/6/2006	1402 CDT	07/11/06	0826 C
051890081	T0706005.536	11	TRANSPET	7/6/2006	1402 CDT	07/11/06	0826 C
051890084	T0706005.540	11	TRANSPET	7/6/2006	1402 CDT	07/11/06	0844 C
051890086	T0706005.545	0020	SPF	7/6/2006	1402 CDT	07/11/06	0845 C
051890088	T0706005.550	0030	SPF ROUTINE	7/6/2006	1402 CDT	07/11/06	0847 C
051890090	T0706005.554	0031	SPF ROUTINE	7/6/2006	1402 CDT	07/11/06	0846 C
051890092	T0706005.559	0032	SPF ROUTINE	7/6/2006	1402 CDT	07/11/06	0849 C
051890094	T0706005.600	0033	SPF ROUTINE	7/6/2006	1402 CDT	07/11/06	0850 C
051890095	T0706005.608	0034	SPF ROUTINE	7/6/2006	1402 CDT	07/11/06	0851 C
051890097	T0706005.611	0035	SPF ROUTINE	7/6/2006	1402 CDT	07/11/06	0818 C
051890100	T0706002.238	0037	SPF ROUTINE	7/6/2006	1402 CDT	07/11/06	0824 C
051890106	T0706002.221	0038	SPF ROUTINE	7/6/2006	1402 CDT	07/11/06	0828 C
051890120	T0706002.225	0039	SPF ROUTINE	7/6/2006	1402 CDT	07/11/06	0908 C
051890134	T0706002.214	0036	SPF DAMAGE	7/6/2006	1402 CDT	07/11/06	1115 C
051890059	T0706111.009	0040	SPF APPOINTMENT	7/6/2006	1308 CDT	07/11/06	0900 C
051890144	T0706111.111	0041	SPF	6/7/2006	1308 CDT	07/11/06	0900 C

(City of Sioux Falls 2006)

Address Matching - ArcView 9.1 is used to geocode the address of each ticket applying the City of Sioux Falls street centerline address locating service. The City's street centerline is continuously updated with new street information because the address locating service is also used for E-911. Consequently, the ticket locations are very good if the data is entered accurately at the one call center. The geocoding portion of the application is set up as a scheduled task running every 15 minutes and it only geocodes new tickets delivered since the last time the task ran.

The program also runs a process for addresses not found in the address matching process. If an address is rejected the point is placed in the center of a location grid (another field in the ticket file) and is given a different symbol so it is apparent to utility employees.

Figure 4. The tickets address matched in ArcMap 9.1.

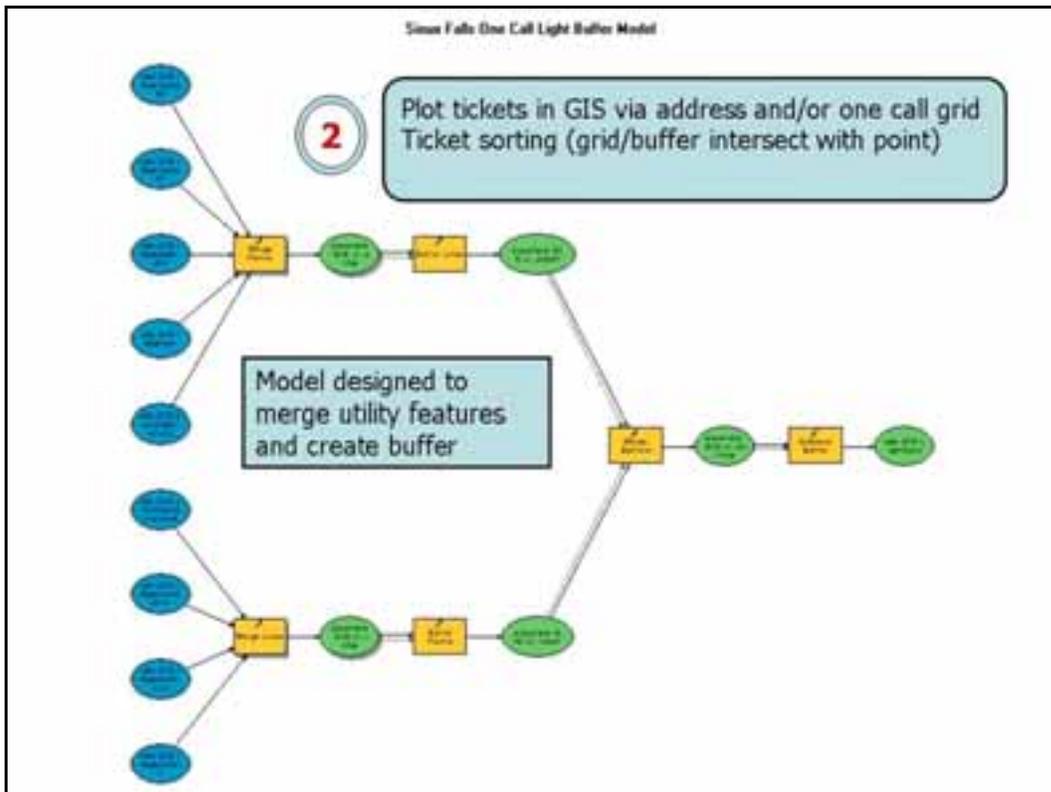


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Utility Buffer - The next step in the process makes it possible to sort the tickets based on the proximity of the proposed excavation to each of the City's underground utilities. For instance, the Traffic Department locator will only receive tickets located within a predefined distance from any underground traffic conduit.

ESRI Model Builder was used to develop a model for each utility. Each model merges the various subtypes of underground features for each specific utility. The remaining steps of each model create final buffer zones for each public utility. The buffered utility feature classes are loaded into the GIS ArcSDE Geodatabase making them available for the next step required to sort tickets.

Figure 6. Sioux Falls Light Buffer Model.

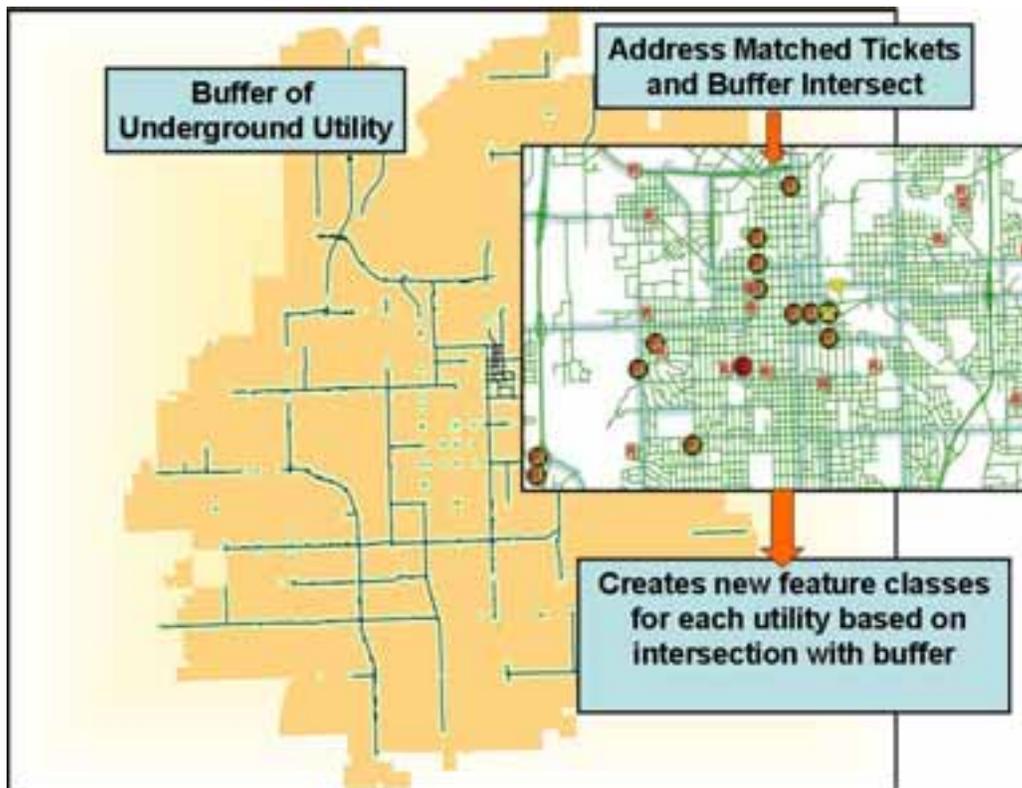


(City of Sioux Falls 2006)

Ticket and Buffer Intersection - ArcIMS is used to complete the ticket sorting process (Figure 7). An ArcIMS service runs continuously and monitors the SQL Tickets table and Ticket point features created in the previous steps. If a new point is created in the Ticket feature class the ArcIMS service intersects the location with each buffer zone. If the ticket point intersects a buffer of a utility the point is added to a feature class of the corresponding utility.

The type of ticket is also used as a criterion to decide if the ticket will be selected and a point created. For instance, all emergency tickets are created without applying a buffer intersection and are made available to all utility divisions.

Figure 7. Ticket Sorting based on buffer of each utility.

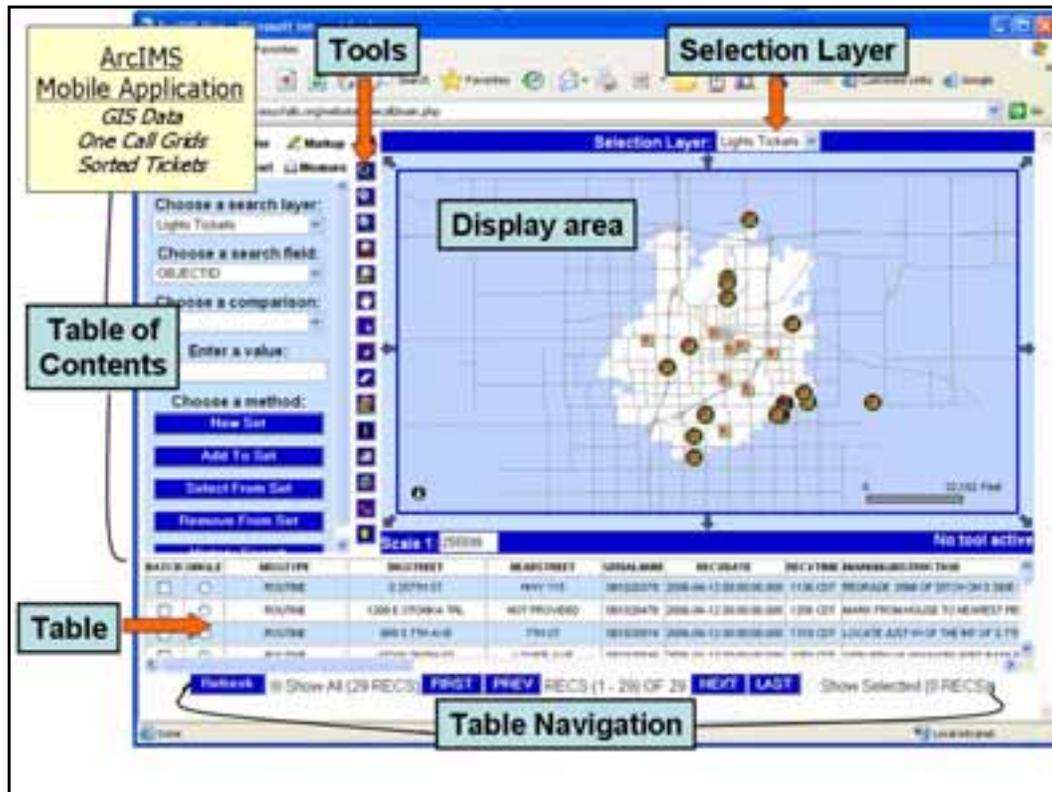


(City of Sioux Falls 2006)

Final Interface - The final Mobile interface is available to locate staff using a WEB browser in the office or out in the field. ArcIMS is the application software used for the interface with additional programming provided by Pro-West. The interface provides all the necessary information to City locate personnel including ticket locations and utility locations. The ticket information is displayed in a map view (point features) and table view (attributes). The table navigation, layer selection, and map display tools provide additional functionality including zoom, pan, select, and identify.

City employees have personal logins required to access the interface and the IMS service displayed contains only their respective utility information. A separate IMS service was developed for each utility. The locator can respond to the ticket and mark the work request as cleared, located, canceled, or other and the ticket will be cleared from the interface but remain in the SQL Tickets table. All ticket responses from each utility are stored in the SQL Tickets table so the history of the work request is always saved in the main table.

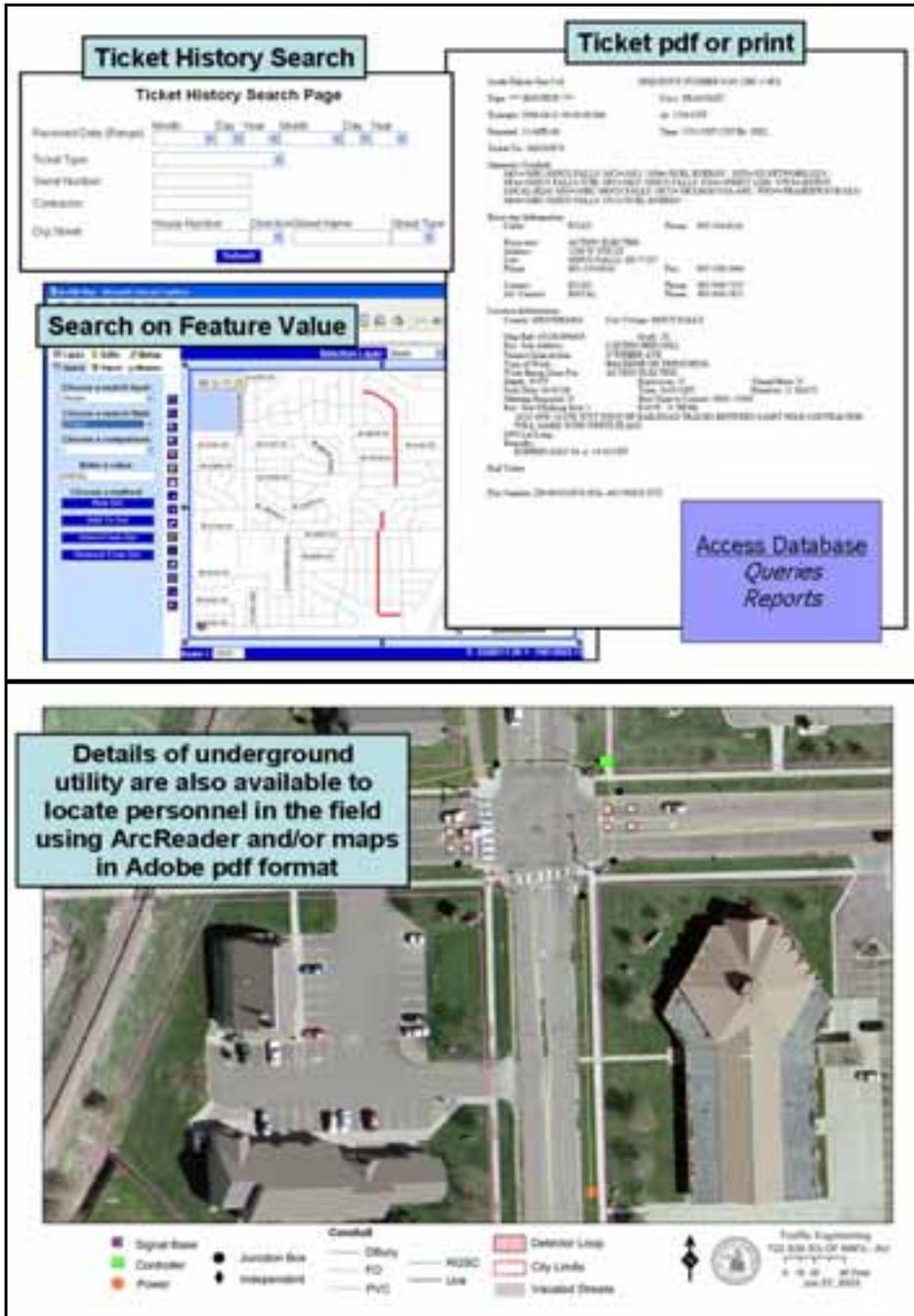
Figure 9. The IMS interface as viewed by locate personnel.



(City of Sioux Falls 2006)

Additional Functionality - History searches, feature item searches, ticket prints, and utility details are all functions included in the final application.

Figures 10 and 11. Additional application functionality .



(City of Sioux Falls 2006)

Results

City staff worked closely with Pro-West and Associates to develop a final application designed to meet the City's needs. The application geocodes one call tickets, buffers utility locations, sorts the tickets, and forwards all the necessary information to office staff and field personnel. ArcInfo, ArcSDE, and ArcIMS technology transformed the process to make it more accurate, more efficient, and easier to use in the office and out in the field.

- One obvious benefit is the accessibility from the office with a standard Internet connection or in the field with a wireless connection.
- The cost savings is significant. The City's cost per ticket was much higher when the one call center sorted the tickets based on the location of the utilities. The cost savings from September 1, 2005 through April 30, 2006 totaled \$26,737.50 in ticket costs alone.
- The new application doesn't require an annual maintenance fee in contrast to the OCS ticket viewer.
- Loading the ticket information into a SQL table in ArcSDE provides a much more efficient storage container but also provides orderly approaches to sort and query the data.
- The new interface gives much more information to utility locators in the field without copying the data to their laptops. The IMS application provides access to any of the GIS Geodatabase features including utility features, high resolution aerial photography, parcel information with property ownership, and address location capabilities.
- The new interface also gives City employees more control of the one call sorting process. Modifications can easily be made to the application including the utility buffer width, selection of available features, ticket monitoring frequency, and data query definitions.

Conclusion

GIS has been at the core of many applications and programs in Sioux Falls in the last fifteen years, but the new One Call Ticket Management System really emphasizes the great technology available to local government organizations. The combination of ArcMap, ArcSDE, ArcIMS and additional programming by Pro-West produced an excellent tool for City staff and made the business function more efficient, more effective, and more economical.

Acknowledgments

The contributions of the project team comprised of Pro-West staff and City personnel made the project a profound success. These included Noel Ahl, Shannon Ausen, Laurie Sohl, and Randy Waits from the City; Rose Erickson, Galen Neste, and Karen Scharenbroich from Pro-West, and others who contributed in a collaborative manner to assure the best results for this project.

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