

Highway Department Integration with Noble County's Enterprise GIS

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Abstract

Noble County's GIS is an enterprise system containing 73 layers with the majority of these layers stored in an ArcSDE Microsoft SQL server. The county Commissioners considered the GIS project applicable for streamlining local government. In 2003, the GIS project was launched with purchase of digital orthophotography and various planimetric layers. During 2004 and into the early part of 2005, the majority of the GIS layers were created. By March 2005, the GIS was supporting Phase II enhanced 9-1-1. The Highway Department devised several practical applications utilizing the GIS. This paper will show how use of the GIS will benefit local government by streamlining the search for driveway permits and maintenance of infrastructure inventories in a county's Highway Department. This is accomplished by the creation of Sign inventory, Line Striping, Culvert, Speed Limit, and Driveway GIS layers.

1.0 Introduction

Noble County's GIS system has been a dynamic evolving entity over the last two decades. The Surveyor's Office envisioned the need for a GIS and later became the driving force behind an Enterprise GIS. Starting in the mid 1980's, the Surveyor's Office began work towards a GIS for internal use. The vision for a GIS culminated in the creation of a county-wide digital tax map by the late 1990's. The digital tax map was maintained with additional layers added. In 2003, the County Commissioners appropriated funds for the creation of an Enterprise GIS to promote Economic Development. The GIS is available for use by various county offices with the intent of increasing efficiency in work flows. This paper presents the Noble County Highway Department's (NCHD) use of GIS to assist with infrastructure inventories involving driveways, highway signs, culverts, speed limits and line striping.

2.0 The GIS Working Environment

The County uses ArcGIS Desktop to maintain the layers within the GIS. ArcEditor is the software of choice used to modify the majority of the GIS layers stored within the enterprise geodatabase. The enterprise geodatabase is stored within Microsoft SQL and accessed through ArcSDE. The majority of layers used in the GIS are stored within the enterprise geodatabase with other layers stored in shapefile format. The NCHD uses both ArcView and ArcEditor to maintain the layers presented in this paper using the shapefile format. The shapefile format was chosen for creation of the NCHD layers since storing

the features in the enterprise geodatabase would have required an extra ArcEditor license. A seat of ArcView was available for use by the GIS technician located at the NCHD. The shapefile format allows the NCHD layers to be edited by GIS users utilizing either ArcView or ArcEditor.

Information relating to infrastructure features is stored within layers as attribute data with the exception of the driveways layer. Driveway features are depicted in a shapefile with attribute data stored externally within Microsoft Access 2000 databases. Microsoft Access 2000 allows for data to be retrieved by NCHD staff without the need for ArcGIS desktop software. Also, modifying and/or adding data using data entry forms, queries for searching and sorting driveway records, and the generation of driveway permit reports are all possible through Microsoft Access 2000. Microsoft Access 2000 tables can be used for retrieving driveway information by establishing OLE DB connections in ArcCatalog. The Identify tool is then used to display associated driveway information.

3.0 Noble County Highway Department GIS Implementation

Noble County Highway Department (NCHD) had kept paper documents and maps for all the recording needs during its entire history. When GIS was first introduced to Noble County, the NCHD could see many ways GIS could be used for data recording and management. Over the years paper maps had been lost, damaged or the passage of time has caused fading and uncertainty. The time it took to look up information from paper records could take from hours to days depending on the information needed. GIS opened up new ways to not only record the information but to give a graphical representation that was as quick as a click of the mouse.

3.1 Driveway Permit Management

Before a GIS was started at Noble County, the NCHD had started organizing their driveway permits. Driveway permits had begun being used in 1987 and had evolved from a one page form to a two page form with back up documentation including drainage forms, copy of the plat map and sometimes deed records. The NCHD had started by scanning all the permits and appropriate documentation for each permit since their inception. This involved over 3000 permits and over 10,000 documents in total. A form was then drawn up in Microsoft Access to mirror the driveway permit form but to automatically save all new permits to the computer and into the new driveway Access database. The older driveway information was then entered manually in this database. While this was a time consuming effort, it has since allowed all driveways that are permitted, to be part of a searchable database. This table was then attached to the scanned images. This was all done before the GIS had been implemented. When the GIS was made available for county use, the NCHD started using the hyperlink feature to attach the scanned documents to the GIS so that now when a lookup for a driveway is needed, the driveway is clicked and all forms are brought up including any pictures.

3.1.1 File Management System Implementation

In order to utilize the functionality of hyper linking within ArcMap, a file management system was implemented for storing the scanned driveway permits along with other supporting documentation (deeds, copies of tax maps, faxes, etc.) The best location for storing the file management system is on a central server where users have access to server resources. Since the main users viewing this information are located within the NCHD, the Highway department's server (hdserver) was the appropriate location. On this server a directory hierarchy was implemented. One main directory—Driveway Permits—contains folders representing each year driveway permits have been issued. Within each year's folder resides a folder labeled with an individual driveway permit number. The individually numbered folders contain a copy of the scanned driveway permit along with scanned copies of supporting documents. Figure 1 below shows the directory hierarchy of the file management system. Within the folder labeled “NCD-003-93” resides four scanned documents, with the document displayed representing the driveway permit.

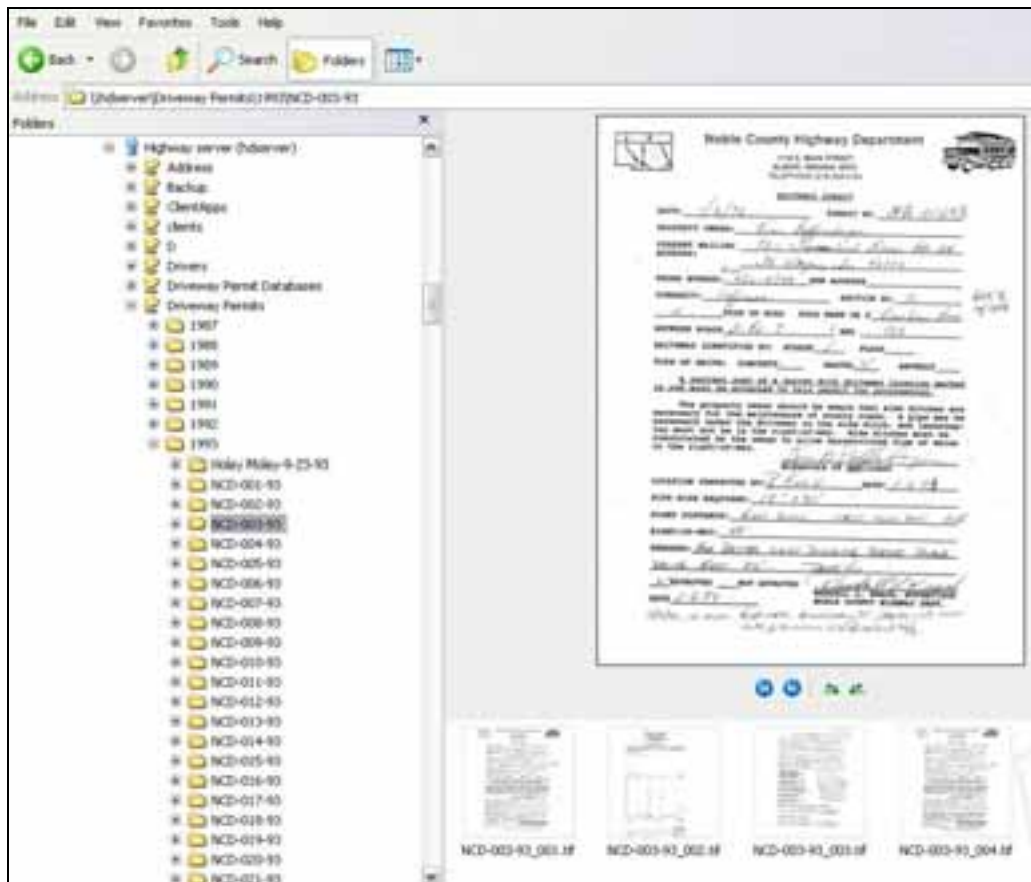


Figure 1—Driveway Permits File Management System

Each scanned document is saved using the TIFF format. The TIFF format was chosen because it is considered a standard graphic format that is stable and non-proprietary. For these reasons, the NCHD is confident that the scanned documents will continue to be

used well into the future.

3.1.2 Field-Based Hyperlinks Linking Driveway Features to the File Management System

With a file management system strategy in place, the next step is to create hyperlinks between the folders and the driveway features. ArcMap provides three options for creating hyperlinks: 1) linking to a document, 2) using a URL to launch a web page, and 3) sending an attribute field value to a macro. The NCHD wants to link to scanned driveway permits, so the first option is being used. Also, hyperlinks can be defined by using one of two methods: 1) field-based hyperlinks or 2) dynamic hyperlinks. The NCHD uses the field-based method. Field-based hyperlinks can be constructed using the full pathname to a document stored as an attribute field value in a layer's attribute table. An alternative method, used by the NCHD, stores a value representing the document name in a layer's attribute table and the pathname stored in the Hyperlink Base.

Field-based hyperlinks have two components: a unique identifier (target document) and a pathname to the scanned documents. The unique identifier is a value stored in a text field in the driveway layer's attribute table. Figure 2 shows a screen shot of the Driveways attribute table. The attribute field containing the unique identifier value is the "Permit_No" column.

RoadName	RoadNumber	RoadDirection	House Number	House Direction	Permit_No
Hopewell Road	125	South	1521	East	2004WCD-225-04
	100	North	0		2004WCD-196-04
Allen Chapel Rd	1000	East	1254	South	2004WCD-185-04
	1000	East	4317	North	2004WCD-148-04
	1000	East	3884	North	2004WCD-105-04
	1000	East	0		2004WCD-090-04
	100	South	0		2004WCD-056-04
	1000	North	8818	West	2003WCD-140-03
	1100	North	2718	West	2003WCD-139-03
	1000	West	2712	North	2003WCD-114-03

Figure 2—Driveways layer's attribute table

The "Permit_No" attribute value guarantees a one-to-one relationship between the driveway feature on the map and the corresponding folder in the file management system. The NCHD depicts driveway features using line segments known as polylines. Each driveway feature's unique identifier consists of the driveway permit number prefixed with the 4-digit year number—the year the permit was issued. For instance, the unique value stored in the driveway's attribute table for the driveway permit in Figure 1 would be "1993\NCD-003-93."

The second hyperlink component, the pathname to the scanned documents, is the pathname value stored in the Hyperlink Base. The Hyperlink Base is found under Map Properties in the File menu. Figure 3 shows the Map Properties dialog box where the

hyperlink base value is entered.



Figure 3—Map Properties dialog box for SHOOKViewer3C.mxd

The hyperlink base allows for storing the pathname to the location of the driveway folders on the server. The hyperlink base pathname for the driveway folders shown in Figure 1 would be "\\hdserver\Driveway Permits\". Storing the pathname as the hyperlink base eliminates the need for storing this value along with the unique identifier attribute value for every driveway feature, reducing redundancy. The main advantage with using the hyperlink base is in updating this value once if there is ever a need to relocate the driveway permit folders to another location on the server. The downside to this methodology is that folders containing documents for other layers that have their hyperlinks relying upon the hyperlink base must be stored under the driveway directory.

Once the unique identifiers are stored as an attribute for each driveway feature and the hyperlink base is established, the attribute field storing the unique identifiers needs to be recognized as storing hyperlinks. The attribute field storing the hyperlinks for the Driveways layer is "Permit_No." Establish this field as supporting hyperlinks by using the Display tab of the Layer Properties dialog box for the Driveways layer, shown in Figure 4.

In the Layer Properties dialog box under the Display tab, check the check box labeled "Support Hyperlinks using field." Next, select the "Permit_No" field name in the dropdown arrow list. Finally, click on the radio button next to "Document" to specify what type of hyperlink is being used. Click Apply and close the Layer Properties dialog box.

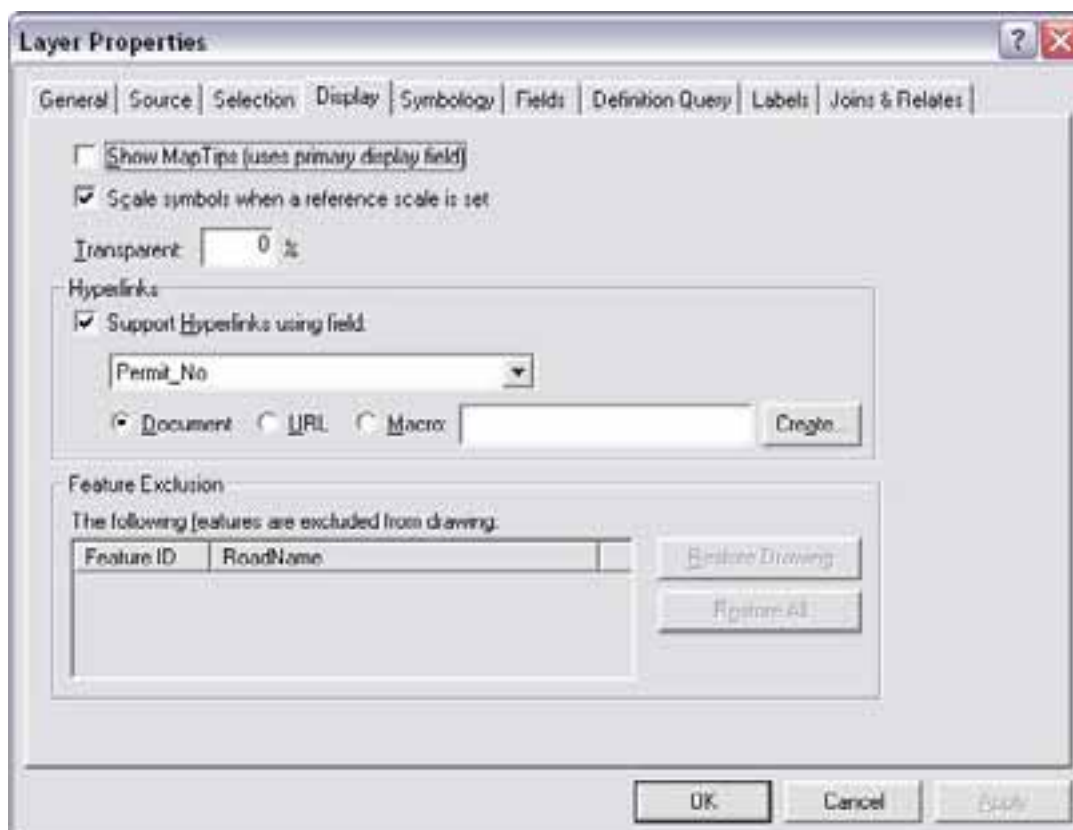


Figure 4—Driveways Layer Properties dialog box

Retrieving scanned driveway permit documents is performed using the Hyperlink button on the Tools toolbar. Figure 5 shows the Hyperlink button on the Tools toolbar.



Figure 5—Hyperlink button circled in red on the Tools toolbar

Clicking on the Hyperlink button will cause driveways that have an associated hyperlink value in the “Permit_No” attribute field to be drawn in blue. Placing the mouse pointer over a driveway feature having a hyperlink will display a popup tip containing the pathname of the target. Figure 6 shows an example popup tip for the driveway in blue. Simply click the driveway feature to open the linked folder. The contents of the folder are now accessible.



Figure 6—Driveway Popup Tip showing the folder's pathname

3.1.3 Displaying Driveway Permit Information from Related Microsoft Access Databases

The NCHD prefers to review driveway permit information that is stored in the Microsoft Access databases while viewing the driveway feature in ArcMap. A read-only link exists between the driveway features and the Access databases by creating a Relate. A Relate associates data with a layer by choosing a layer's attribute field containing a unique value that is contained in a similar field within an Access database. A Relate does not physically join the columns from the Access database to the Driveways' attribute table. A Relate simply defines a relationship between the two tables. Use a Join instead of a Relate to append the fields of a joined table to an attribute table. Relate and Join definitions will be saved to the map document and should be available the next time the map is opened.

The NCHD has a separate Access Database for each year permits were issued. However, since there are many databases, a Relate exists with each one. The process of linking the Access databases to driveway features requires three steps. The first step involves creating object linking and embedding database (OLE DB) connections in ArcCatalog. In ArcCatalog, create the connections by using the "Add OLE DB Connection" option under Database Connections. The Data Link Properties dialog box opens and the "Microsoft Jet 4.0 OLE DB Provider" option is selected from the Provider tab as shown in Figure 7.



Figure 7—Provider tab of the Data Link Properties dialog box

On the Connection tab, enter the path to the Access database in the “Select or enter a database name” field. In Figure 1, the directory displayed is the 1993 folder. For example, the pathway to enter for the database containing 1993 driveway permits would be: \\Hdserver\Driveway Permit Databases\1993 Driveway Permitsxp.mdb. See Figure 8 for a screen shot of the Connection tab of the Data Link Properties dialog box.



Figure 8—Connection tab of the Data Link Properties dialog box

Once the OLE DB connection is made, rename the new database connection to something meaningful. Double clicking on this new database connection will show the tables residing in the 1993 Driveway Permits Access database. See Figure 9 for a screen shot showing the database connection created and the tables belonging to the 1993 Driveway Permits Access database.

Company Name	Date Applied	Permit Number	First Name of Owner	Last Name of Owner
	11/01/1993	WCD-140-01	Bob	Prater
	11/01/1993	WCD-140-01	Robert	Donahue
	11/01/1993	WCD-140-01	Mark & Leah	Kelley
	11/01/1993	WCD-140-01	Theresa	Marin
	11/01/1993	WCD-140-01	David	Walt
	11/01/1993	WCD-140-01	Mark & Vickie	Murphy
	11/01/1993	WCD-140-01	John & Brenda	Cooper
	11/01/1993	WCD-140-01	Kenneth	Walsh
	11/01/1993	WCD-140-01	Jerry	Schroeder
	11/01/1993	WCD-140-01	Tim & Linda	Schwartz
	11/01/1993	WCD-140-01	Joe & Nancy	Frederick
	11/01/1993	WCD-140-01	Robert	Northen B. Public Service Co.
	11/01/1993	WCD-140-01	John	Cooper
	11/01/1993	WCD-140-01	James	Wagner
	11/01/1993	WCD-140-01	Michael & Jonathan	Ward
	11/01/1993	WCD-140-01	Thomas	Spelling
	11/01/1993	WCD-140-01	Edwin	Patton
	11/01/1993	WCD-140-01	Mark & Vickie	Murphy
	11/01/1993	WCD-140-01	Mark	Anderson
	11/01/1993	WCD-140-01	James & Kate	Johnson
	11/01/1993	WCD-140-01	Jerry	Watts
	11/01/1993	WCD-140-01	Lisa	Full
	11/01/1993	WCD-140-01	David	McIntosh
	11/01/1993	WCD-140-01	John	Green
	11/01/1993	WCD-140-01	Harold	Wade
	11/01/1993	WCD-140-01	Richard	Fry
	11/01/1993	WCD-140-01	Mike	Ward

Figure 9—1993 Driveways Access DB @ hdserver.odc database connection

The second step involves adding the table from the 1993 Driveway Permits Access database containing the driveway information to the ArcMap document containing the driveway features. In ArcMap, using the Add Data button, navigate to the database connection created in step one and select the appropriate table “1993 Permits.” Highlight the table name and click the Add button. The Access table will be displayed under the Source tab of the Table of Contents.

The third step involves creating the Relate between the Access table and the Driveways layer. This procedure is performed by right clicking on the Driveways layer in the Table of Contents. On the content menu that appears, choose the Joins and Relates option. The Relate dialog box is displayed. Figure 10 shows how the four fields in the Relate dialog box are filled out, creating the Relate between the “1993 Permits” Access table and the Driveways layer.

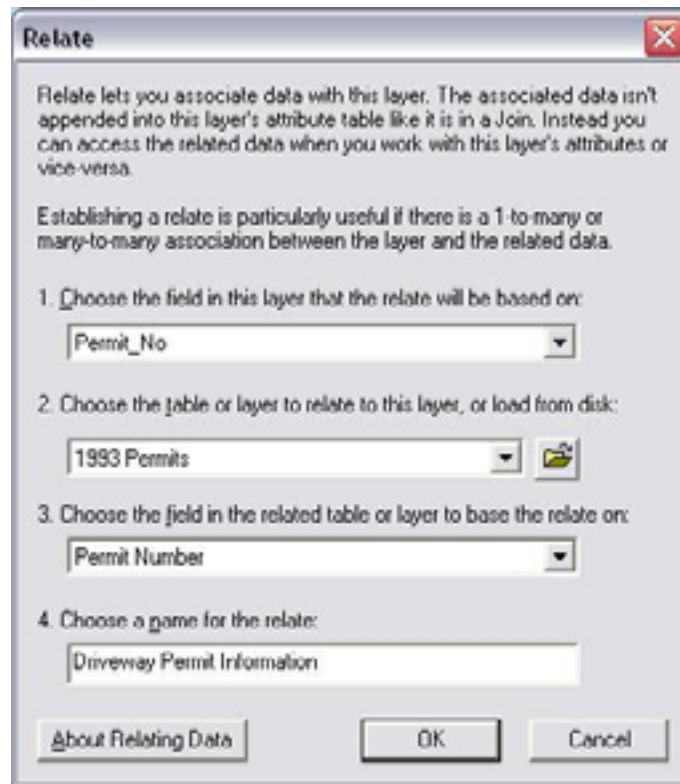


Figure 10—Relate dialog box showing linking criteria

The Relate between the 1993 Driveway Permits Access database and the Driveways layer is based upon the driveway permit number that is present in both tables. The fields in both tables do not have to be the same name, but the data must be of the same data type. In this case, both fields are text fields.

Viewing related driveway permit information can be performed by using the Related Tables option under the Options button on the Driveways attribute table. Use this method after a record in the attribute table has been selected (highlighted). An alternate way of displaying related information is by using the Identify button on the Tools toolbar. The Identify button will open the Identify Results dialog box. In the Layers dropdown box, select the Driveways layer—this will limit selection to only the Driveway features. In Figure 11, the Identify Results dialog box displays a selected driveway feature.

On the left-hand side of the dialog box, the value of the “Permit_No” field is displayed. This field is set as the Primary display field that was selected from the “Primary display field” dropdown box under the Fields tab of the Driveways Layer Properties dialog box. The right-hand side of the Identify Results dialog box displays the attributes residing in the related 1993 Driveway Permits Access database.

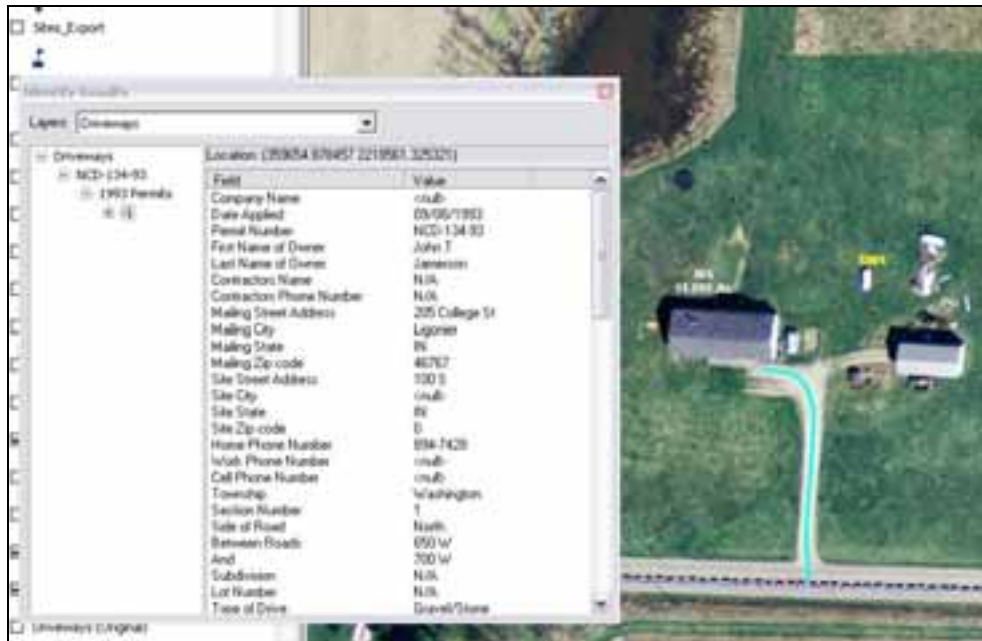


Figure 11—Identify Results selected driveway feature

3.2 Highway Ordinance Management

The NCHD has used Field-based hyperlinks to organize ordinances related to street signs, speed limits, and other regulatory information.

3.2.1 Field-Based Hyperlinks Relating Map Features to Speed Limit Ordinance Documents

All ordinances for speed limits or regulatory signs are kept at the courthouse with copies on file at the NCHD. Over the years, it has been discovered that many stop signs, speed limits and other regulatory signs were never legally put into place with an ordinance. Many times a resolution was used by the county commissioners. A resolution, however, has no legal backing. The NCHD wanted to have easy access to the locations with appropriate ordinances.

First, a speed limit layer was placed on the GIS. Figure 12 shows a screen shot of the speed limit layer. Each speed limit was designated a color to represent the speed. Fifty-Five miles per hour was left unmarked, as this is the default speed limit and would be designated by no markings. Polygons were chosen to represent these areas so that they were easily seen from a larger scale. After the polygons were placed, the appropriate ordinance was scanned and linked to the individual attribute polygon. The polygons are hyperlinked so that the scanned paper ordinances can be seen with a click. Other ordinances for regulatory signs also have been linked the same way. This allows for easy access to all ordinance documentation.

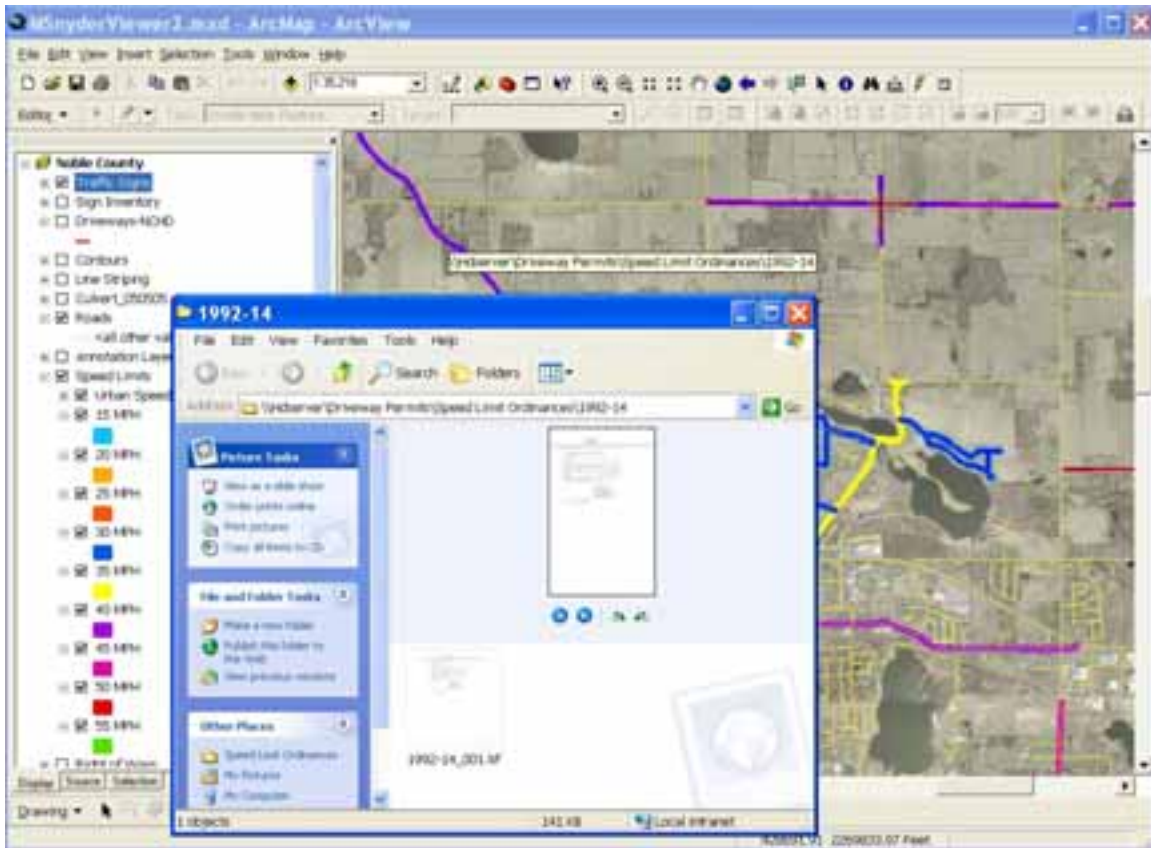


Figure 12—Speed limits have their own designated color. Ordinances can be retrieved using field-based hyperlinks.

3.3 Highway Sign and Culvert Management

One of the greatest assets to the NCHD from the GIS is the ability to store and retrieve data of physical resources throughout the county. While many items can be tracked this way, the first two items tracked by Noble County were Highway Signs and Culverts.

3.3.1 Managing Highway Sign Infrastructure

When Noble County started the GIS project, each department was asked what they would like to see in it. The NCHD had the choice of requesting funding for an outside source to do these inventories; however, it was felt by the county engineer, that the purchase of the equipment, coupled with part time seasonal help would cut costs greatly. It was anticipated that the work would take longer than with an outside consultant doing the work, but the cost savings was thought to be great enough to offset the delay in having data.

Two Trimble GeoXT's were purchased with TerraSync software. The NCHD was informed that the XT's would be precise to approximately three feet with one-foot accuracy after post-differential correction. This was found, however, to be not quite the fact, as the final points were coming within about 3 inches in some cases. This accuracy was needed as some intersections could have many signs within ten feet of each other. A data dictionary was set up to allow for all pertinent information to be entered at the sign location while the GeoXT gathered the location points. A minimum of five readings was taken at each location, which was averaged by the GeoXT. The more readings you take with the GeoXT, the more accurate the location position given in the output. Twenty-two commonly used highway signs were placed in the dictionary with one "Other" sign.

The signs throughout the county were then gathered with the GeoXT, this information was then transferred from the GeoXT to a desktop PC using Trimble's GPS Pathfinder Office software. Information was post-differentially corrected using the software and then exported as an ESRI shapefile to the highway GIS map. All traffic signs were done in this manner.

Every few days, signs that had been collected from the GeoXT were transferred to the highway GIS map, which was then combined with the existing file using the "Merge" tool from the ArcEditor toolbox. After all the signs had been gathered, the "Append" tool from the ArcView toolbox was used to gather all the sign shapefiles into one master Sign Inventory shapefile. The signs are now in one database, which is searchable by any required field. Age, sign type and size are all items that are looked at on a regular basis and are now available in one location at a moment's notice. Many times signs are stolen or destroyed. An exact location, size, and type sign are now easily found in seconds with appropriate materials taken out for replacement. Retro-Reflectivity will be added in the future. This information can also be used to be proactive in replacement as opposed to being reactive. Budgeting is now a more precise estimate due to the number of signs along with age now being known in one table. Figure 13 shows a screen shot of the Traffic Signs layer.

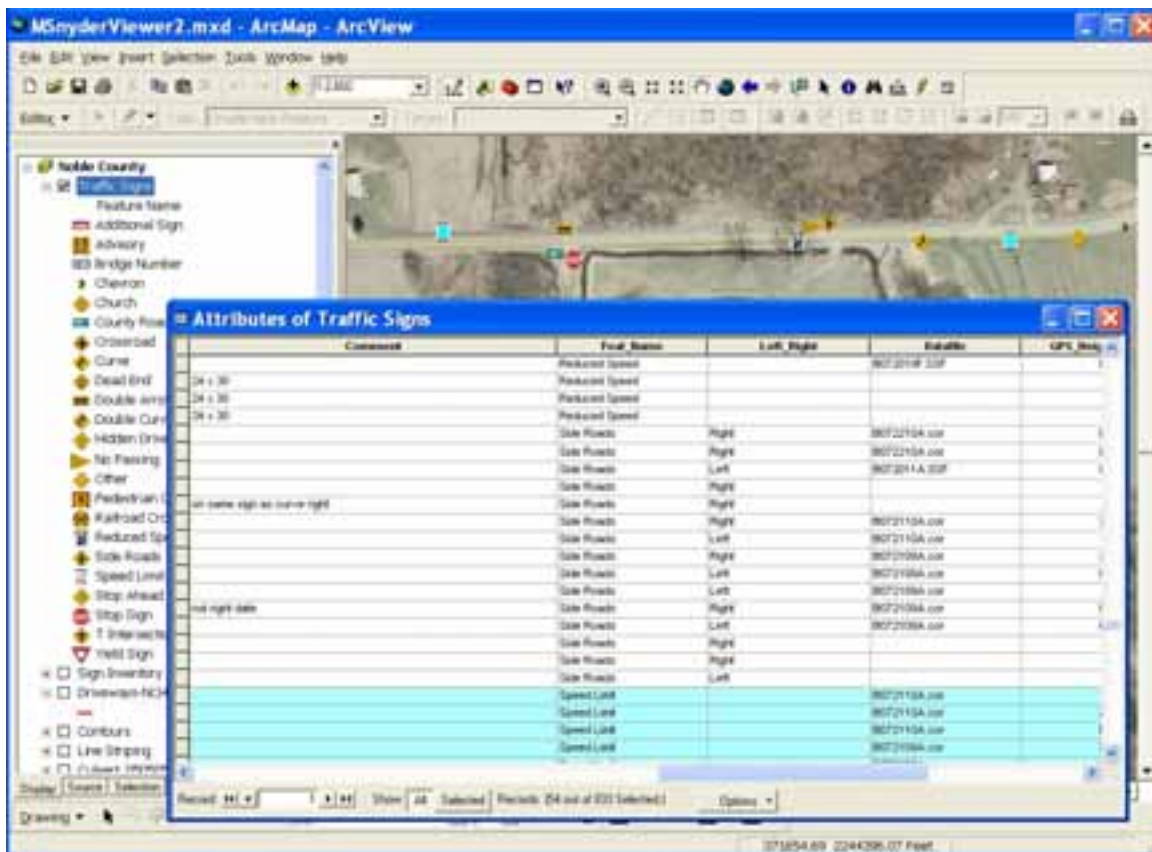


Figure 13—Traffic signs are easily found by selection or performing a query

3.3.2 Managing Highway Culvert Infrastructure

Noble County has many thousands of culverts as most of our waterways are too small to require bridges. Culvert replacement is an ongoing effort that is on a need to replace basis, instead of a planned program and the culverts in Noble County hadn't been inspected county wide in over twenty years. The GeoXT's were again used for the collection of this data. A data dictionary was set up with information needed for the culverts, including pipe size, material, length, date placed (if known) and condition. The culverts were located and the information of each culvert input at the site or added later if need be. The same process was used as with the county signs. Data was collected, downloaded into a PC, differentially corrected, exported as an ESRI shapefile and added to the county map. The map was updated every few days and merged together to the existing file so that all culverts would be included in the same shapefile. No appending was needed as one shapefile was used for this data from the start. Figure 14 shows a screen shot of the culverts layer.

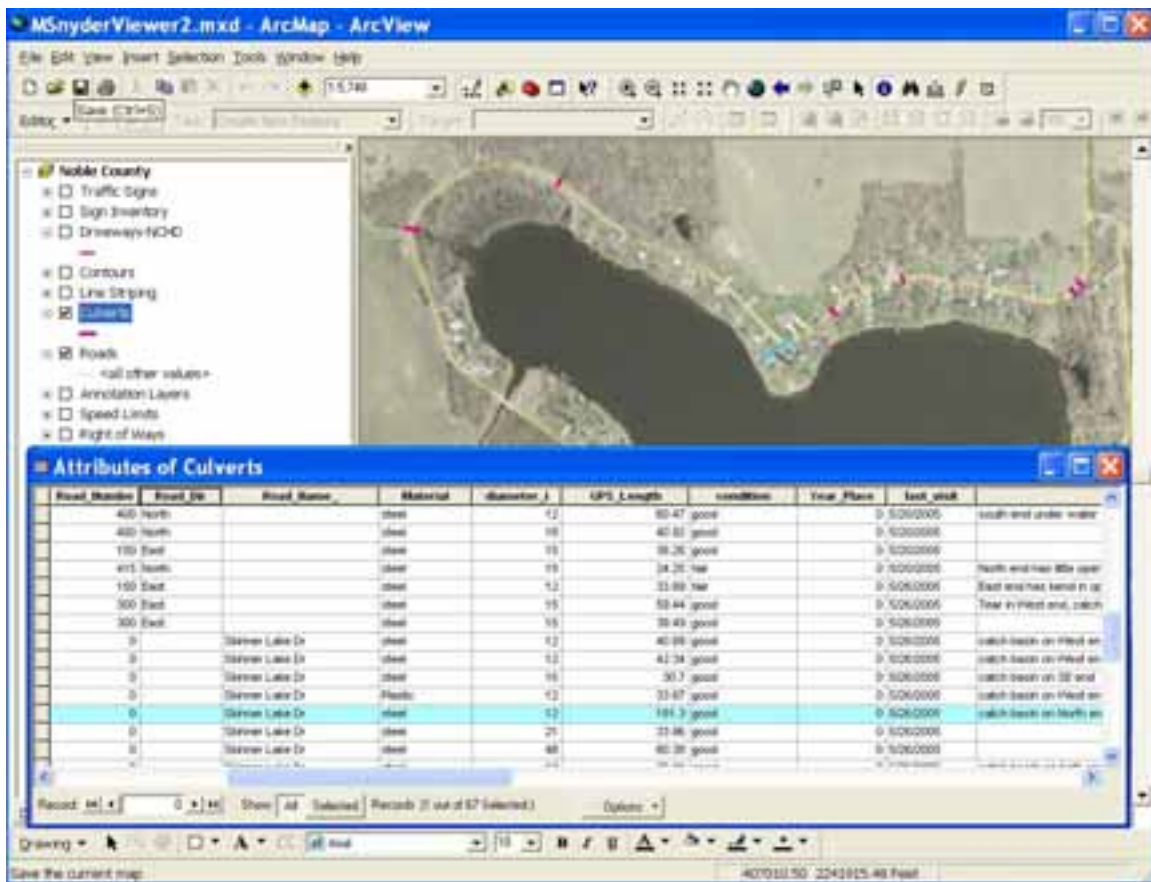


Figure 14—Culverts can be selected by performing a query or using the Identify button to select individual culvert features.

Every year with new roadwork, culverts are examined, and replaced as necessary. While Noble County continues to respond to calls on culvert issues when needed, with the culvert inventory being done, the NCHD now knows before they leave the yard, what pipes are at what locations, what sizes, how old they are and in what condition. Pipe replacements can be planned in advance which allows for better budgeting, better allocation of time and more efficient planning of men and materials.

3.4 Line Striping Management

Every year a line-striping contract is let for the miles of roadway that needs repainted in Noble County. This usually covers up to 35 different roadways or sections of these roadways. The roads to be re-painted are chosen on an as needed basis with the exception of roads that had work done the previous year. Any previously striped roadway that has had a new surface placed is automatically scheduled for repainting. The county engineer will then choose the remaining roads that fall into the category of most needed while staying within the remaining line striping budget. The county has, at four different times, had different roadways analyzed and detailed for line striping. The NCHD, for this reason, has four different books detailing these striped roadways. After

the list of roads to be re-striped has been chosen, the line stripe books were examined and each individual roadway is checked and totals added manually to allow for yellow skip line, yellow solid line and any specialty marking. The total footage for each contract usually falls between 500,000 to 750,000 feet of striping. This process would usually take several days as the books list start and stop footages and contain hundreds of sections of skip and solid striping for each roadway. These sections then had to be added individually. The NCHD felt that linear referencing could be used to make this a simpler process.

3.4.1 Establishment of Linear Referencing in Conjunction with Routes and Route Events

Linear Referencing provides the NCHD with a way to reference and display geographic data along an existing linear feature.

Implementing Linear Referencing is a three-step process involving the creation of Routes, Route Events, and using Dynamic Segmentation to display the route events on the map. Routes are simply polyline features that have a unique identifier (i.e., road name) and a measurement system accompanying the geometry. The measurement system is represented in the attribute table as an m value, listed as “Polyline M” in the Shape attribute field. The measurement system used for routes can be different than the coordinate system used for the map. The NCHD created a routes shapefile using road names as the unique identifier and feet as the system of measurement. The direction used for the routes start on the west moving east and start south moving north. This shapefile was generated from the existing Roads layer using the Create Routes tool in the Linear Referencing toolbox in ArcToolbox. The Create Routes tool combines road segments having the same name and generates individual routes features contained in one shapefile. The measures for the routes are generated by using the geometric lengths of the input road segments. At this point, the NCHD has not calibrated the measures along the routes using information that would contain more precise field road measures. Figure 15 shows the Create Routes dialog box.

ArcMap provides a way to symbolize measures along routes using Hatching. Hatching is a process that creates labeling and tic marks displayed and placed at a specified interval. Hatching provides a visual way to determine lengths between road stations. The roads reference line was set to one foot line spacing; however, since this took so much time to redraw, it was chosen to use 100 foot sections, then to change it to one foot when the area where the line striping needed to start or stop on was located. In Figure 16, a screen shot shows the route line for a portion of W 900 N. Hatching along the route represents stations at intervals of 50 feet. Solid and skip line striping events are displayed along the route. Each event segment is labeled with its lineal length in feet.

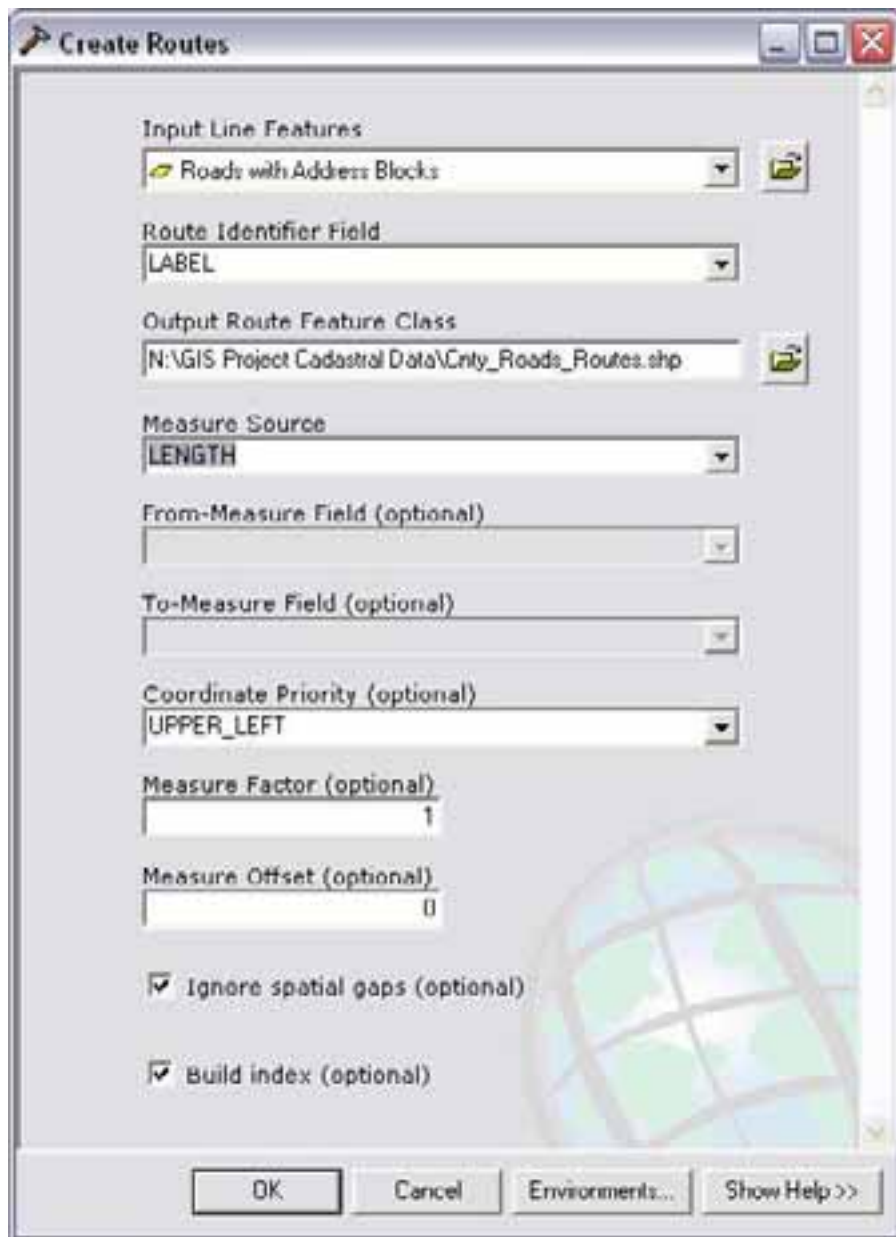


Figure 15—Create Routes dialog box

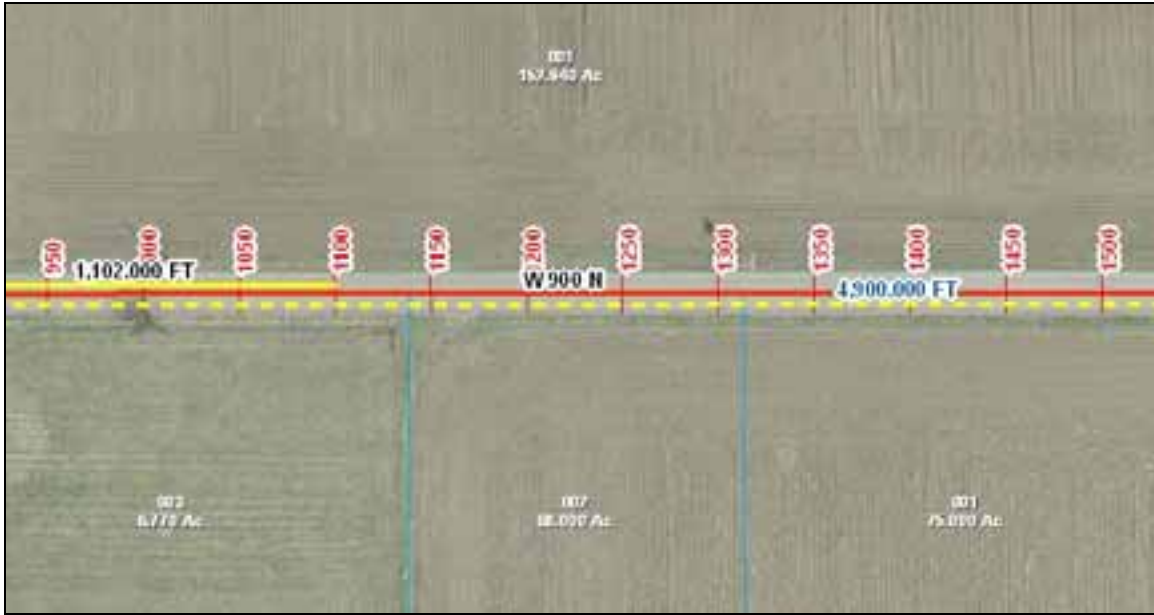


Figure 16—A route with associated line events

The second step in implementing Linear Referencing is the creation of Route Events. Route Events represent a geographic location (point event) or a linear segment (line event) referenced to a route. The NCHD represents solid and skip line striping by line events. These line events are stored in separate route event tables. The tables contain, at a minimum, attributes describing a route identifier (road name), measure values indicating a location, and one or more descriptive attributes. The NCHD took the start and stop points for each section of line from the line striping books and made each skip or solid stripe section a separate polyline shapefile with attribute data. The line event tables were created from these existing solid and skip line shapefiles using the Locate Features Along Routes tool under the Linear Referencing Tools in ArcToolbox—see Figure 17.

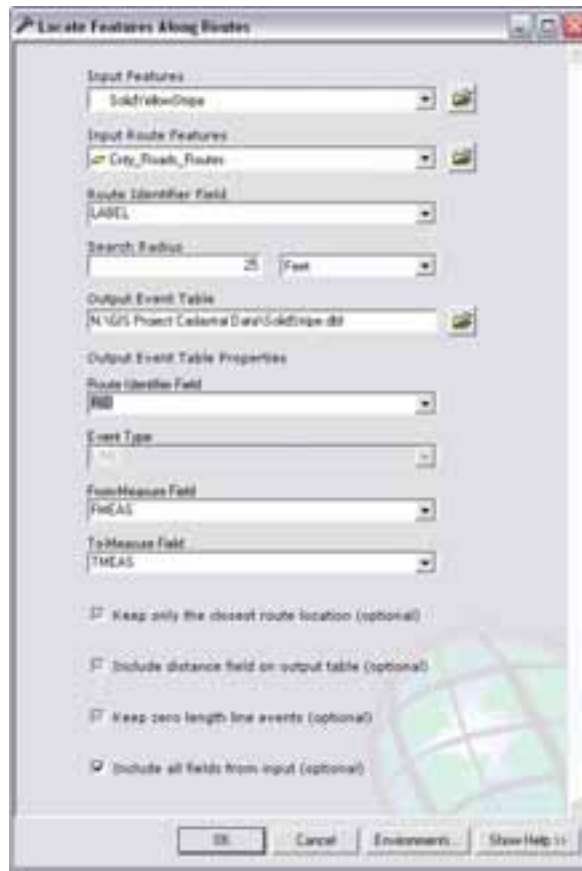


Figure 17—Locate Features along Routes using the Solid Strip shapefile

One additional attribute field was added to the line event tables for providing an offset distance. The offset distance allows the route event features to be placed at a distance from the route line. Plus or minus values determine what side of the route line the events are drawn. Another additional attribute was added for listing the feature length. This attribute value was calculated using a script that updates the length value for polylines stored in a shapefile. The feature length for the solid line striping is the actual length needed for calculating the total amount of solid line striping. However, the feature lengths for the skip line striping are not the actual length needed since the feature length is the total length of the line. The feature length column needs to be recalculated by dividing each feature length by four. Perform this operation by right-clicking on the feature length column of the skip line event attribute table and selecting “Calculate Values...” from the context menu. In the Field Calculator dialog box, set the equation to $\text{Length}=\text{Length}/4$.

The third step in implementing Linear Referencing is performing Dynamic Segmentation—the placement of route events along a route. This process creates a layer based upon the line event tables. Route events were placed on the map using the Add Route Events under the Tools menu—see Figure 18. The layer properties for the skip line are set up so that the line actually shows up as a skip line with the proper proportions of 1:3. This was done by opening the layer properties and clicking the Symbology tab. The

symbol button was clicked, followed by the properties. The template tab was chosen and the directions were followed. Colors were chosen to follow normal standards. The skip line needed one more specific difference as the total line shown would still show the line marked and unmarked.

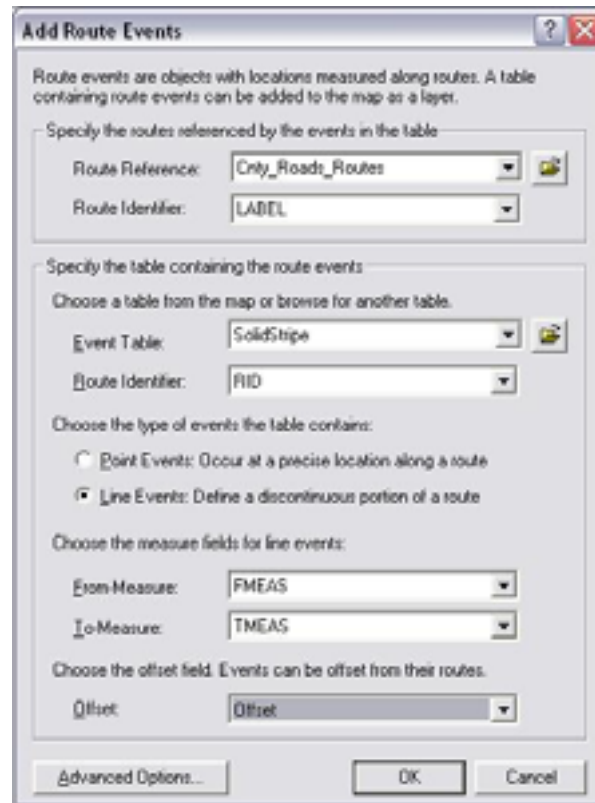


Figure 18—Add Route Events dialog creating the SolidStrip.dbf events table

The process of adding, deleting, or modifying route events is performed similar to working with other layers in ArcMap. What is different is that no polylines are physically drawn on the map by a mapping technician. All editing is done via the attribute table. The dynamic segmentation process automatically places polyline features on the map.

The event tables for both solid line and skip line striping can be used for determining footages of both solid and skip line-striping features. Feature lengths can be added together for selected event table records by showing only the selected records, right-clicking on the length column and selecting the statistics option. This box shows the sum of the selected records. To find the total length of line striping for a portion of a route, first select a portion of a route. Create a buffer on the route segment. Use the Clip tool under ArcToolbox to clip out the portions of solid or skip line striping features one at a time. Only those portions of line striping features intersecting the buffer will be selected. The clipped portions of line striping can be saved in a shapefile. Update the length column by following the procedure in the help menu for updating lengths of polylines in a shapefile. Finally, use statistics to calculate the sum.

In summary, the NCHD uses Linear Referencing in conjunction with Routes and Dynamic Segmentation to display solid and skip line-striping features along routes that were created from existing road centerlines. Solid and skip line striping features are stored in separate line event tables and drawn on the map as events along a route—each route representing a road with a unique name. The solid and skip line-striping features have attribute data residing in the event line tables specifying the unique route, starting and ending measures along the route, and one or more descriptive attributes. When the roadways are now chosen for the latest line-striping contract, the roadways can be called out per the linear referencing and the totals of each roadway totaled immediately for significant time savings.

4.0 Conclusion

The NCHD has many things that are being planned for the future. Utility permits have been used in Noble County for many years. Utility permits would be set up on the computer the same way the driveway permits are now utilized. The NCHD is also planning on all drawings to be submitted in an electronic format, as opposed to the paper drawings that are still being sent in. As-built location plans will also be required to show utility locations using GPS.

The utilities in Noble County, although interested in GIS, have not started any programs that locate their lines with GIS. The NCHD has started this process. When a work job is called in, the lines are marked by Holy Moley. When the highway goes to the jobsite, before work begins and if the manpower allows, these utilities are located with the Trimble GeoXT. While this process will take a long time to complete, and it is not a replacement for Holy Moley calls, it can give a work crew a heads up during planning stages as to what possible conflicts exist.

A county bridge inventory is performed every two years as required by law. The books are sent to the NCHD. These books are now available on CD. The files will be linked to bridge features in the GIS so that inspection forms and associated pictures can be retrieved from a selected bridge feature.

The NCHD is in the process of doing new traffic counts for the new county comprehensive plan. These are also needed to examine our road classification system to see if updates or changes are needed. These traffic counts will be placed on a GIS layer.

The limits are fairly well boundless. Any data that is on paper can be placed on our GIS, either by linking documents or creating an individual layer. The NCHD will begin to explore using personal geodatabases as this seems to offer more flexibility. The GIS is the future of the NCHD and it is anxiously explored. With budgets being cut and dollars at a premium, any task that can be made more efficient is only a plus to the department and the public we serve.

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