Finding It Fast

Deploying better map books for emergency responders

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For many years, emergency responders and public service field personnel have relied on paper maps to guide them to both emergency and nonemergency locations. These maps are often indexed and bound in a book. As computer-aided dispatch and location services have been adopted for public safety applications, the focus is shifting from static paper maps to easily updated digital mapping.

This exercise introduces the DS Map Book, an ESRI ArcObjects developer sample available from the ArcGIS Developer Online Web site, and uses a different study area from recent articles, northern Whatcom County, Washington, and Fire District (FD) 21, a recently consolidated rural/urban district, that protects more than 145 square miles. It follows the United States-Canadian border from the Puget Sound shoreline at the border community of Blaine eastward to rural farmlands around the community of Lynden. In this area of rapid suburban and rural growth, three of the district's stations are staffed by career staff and seven stations are staffed by volunteers.

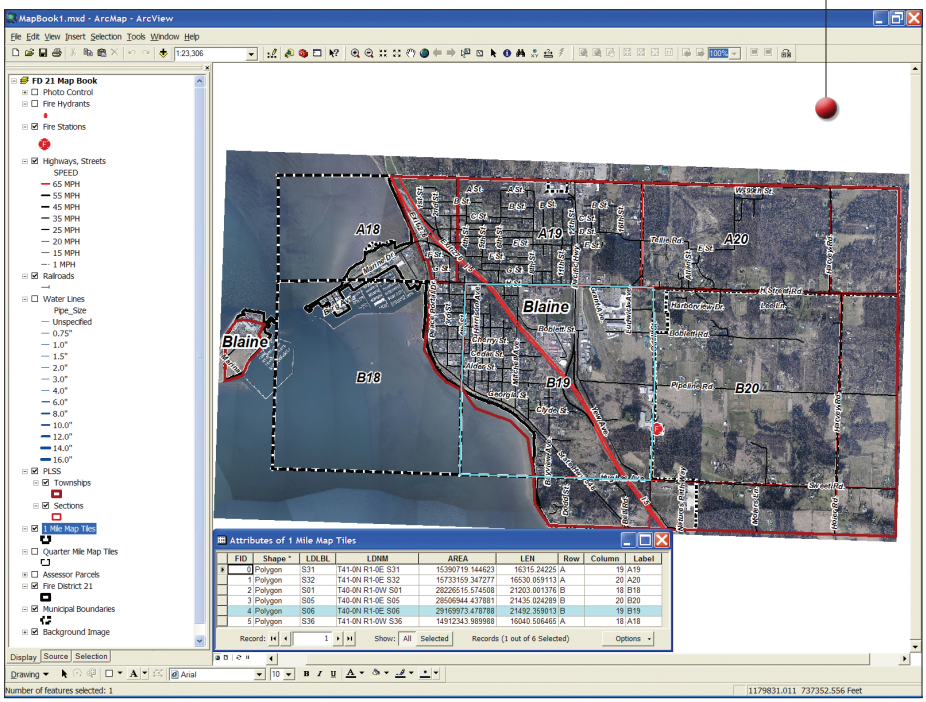
This exercise will build a map book layout, using one-mile square mapping tiles, include a reference grid on each page, and export pages as JPG files for display and printing. Using the new layer-based PDF export format, interactive pages will be created that can be loaded onto a rugged computer for field use. A similar map series can be built for half-mile square tiles for creating high-resolution map pages depicting more highly developed areas.

Getting Started

This exercise requires downloading two items from the ESRI Web site: the sample dataset and the DS Map Book utility from the from *ArcUser Online.* The DS Map Book utility, along with other helpful scripts and utilities, is also available from the ESRI Support site (support.esri.com).

What You Will Need

- ArcGIS Desktop (ArcView, ArcEditor, or ArcInfo license)
- Sample dataset and DS Map Book utility from *ArcUser Online*
- A zipping utility such as WinZip



The 1-Mile Map Tiles layer supplies a consistent tiling system that the Map Book utility can use to generate map pages. Open the attribute table for the 1-Mile Map Tiles layer to highlight individual tiles.

1. Visit www.esri.com/arcuser, look at the table of contents for this article, and look for the links to the sample dataset and DS Map Book utility.
2. Click on the Download sample data link to download the 5 MB zipped sample dataset. Unzipping the archive will generate a directory called FD21_MapBook. Place this folder at or near the root directory. The directory structure includes a Utility folder that contains two completed Map Book map files that can be used for reference. Project data, obtained from Fire District 21 and Whatcom County GIS, has been simplified and standardized for training purposes.
3. The next step will get the developer's sample. Create a Utilities folder in the project directory.
4. Return to *ArcUser Online* for this issue, locate this article, and click on the link to download the DS Map Book utility. Extract the archive file to the FD21_MapBook folder. This is an important step. The archive will create a folder called Visual_Basic.
5. Click INSTALL.BAT to install the utility. Click Yes in the message box that asks if you want to edit the Register. A simple message stating that the registry has been edited should be displayed.

Setting Up a New Map Book

1. Start a new ArcMap session. Choose Tools > Extensions and turn off all extensions.
2. Navigate to \FD21_MapBook\SHPFiles\WASP83NF. Notice that shapefiles have associated Layer files. Save the document in the FD21_MapBook folder and name it MapBook_1.
3. Use the Layer files to load the data. Locate all 12 Layer files, then load them into the map document.
4. Go to \FD21_MapBook\JPGFiles\WASP83NF and load Background Image.lyr. Rearrange the Table of Contents

SUMMARY

Time and location are critical and interrelated issues for emergency response personnel. In recent issues of *ArcUser*, a series of articles has demonstrated how to create service areas for existing and proposed fire stations in southern King County, Washington. This article uses data from an area farther north in the state of Washington—Whatcom County—and the DS Map Book utility to make digital and paper map books. The map book developer's sample was featured in an earlier *ArcUser* article, "ArcGIS Software Simplifies Map Book Generation," written by Nathan Shephard, Melanie Baker, and Larry Young of ESRI.

(TOC) with layers using the order shown in Table 1. This table also summarizes the data layers used in this exercise. Explore these data layers and study the labels and symbology.

5. Rename Data Frame to FD21 Map Book.

The toughest part of building a map book is creating meaningful display items that can be efficiently viewed and interpreted by responders in the field. Although it is not directly addressed in this exercise, it was part of the earlier *ArcUser* articles on Standards of Cover.

Layer Name	Description
Photo Control	The Photo Control layer is used to register the background image and reference data collected in the field. Control is optional and could be provided by the Public Works department or the County Surveyor.
Fire Hydrants	Fire hydrant locations are extracted from Public Works CAD maps or collected in the field. Their position relative to street edge is critical. Include information on tested static pressure and flow volume if possible.
Fire Stations	This layer can include information about status, apparatus, staffing, and available resources.
Highways, Streets	Typically, this layer is symbolized by travel speed. Streets could also include geocoding address ranges if they will be displayed at a large scale.
Railroads	This layer is very important for rail transportation emergencies and identifying intermittent blocking of travel routes by slow freight trains.
Water Lines	Water lines are often considered nonessential for emergency response, but what if one breaks? Public Works staff can use the map book too.
PLSS	The Public Land Survey System (PLSS), where available, subdivides the jurisdiction into one-mile squares (sections) and quarter-mile aliquots (i.e., standard subdivision of an area of a section), ready for building pages.
1-Mile Map Tiles	These tiles were built directly from the jurisdiction's PLSS. Be sure and include a unique label field to assign map book page numbers.
Quarter-Mile Map Tiles	Again, these are from the jurisdiction's PLSS. There are typically four quarter sections for each section. A separate map book series may be built around these objects in dense areas.
Assessor Parcels	This huge dataset provides lot boundaries, occupancies, and more. A sophisticated parcel set might show building footprints on each lot.
Fire District 21	Boundaries for the home district and neighboring jurisdictions are essential for out-of-area responses and mutual-aid calls. Expand the map book to include the neighboring values and hazards. Cooperation is the key!
Municipal Boundaries	Municipal boundaries help define jurisdictional requirements and responsibilities.
Background Image	A detailed background image provides great visual confirmation but be sure that it is a current image. For many map book applications, especially for night operations, an image might detract from the map's readability. One solution might be to print two map books.

Table 1: Order and description of data layers

It's All in the Layout

The toughest issue handled in this exercise is creating individual pages. It requires considerable time and testing to build and deploy an effective map book. This section provides an overview of this challenge, which has three aspects—content, frame, and scale—and they all come together in a layout.

Content

Content for this exercise has been largely handled by using the Layer files, which use premap and symbolized data. While completing this exercise, study the training data and think of other similar data that could be included.

Frame

Every great map book has a consistent tiling system. To see the tiling system for this map book, turn off the busy layers—Assessor Parcels; Water Lines; Railroads; Highways, Streets; Fire Hydrants; and Photo Control. Also turn off the Quarter-Mile Map Tiles layer.

Open the attribute table for 1 Mile Map Tiles. It contains six contiguous polygons, arranged in an array coded by letters (rows) and numbers (columns). The Label field contains a unique identifier for each. Ideally, each polygon is one-mile square, but because the northern row follows the Canadian border, these polygons are half the size of the other tiles. These polygons represent the Public Land Survey System (PLSS) sections, and borders for these polygons often follow major streets and are consistent in size. Land survey information in PLSS is available for most of the western and central United States. If it is available for a desired area, it supplies a tiling grid that requires only a unique labeling matrix. If PLSS data is not available, a tiling grid must be created. That grid can use squares or rectangles.

Turn on the Quarter-Mile Map Tiles layer, open its table, and select a record. These are smaller tiles, labeled with the same Row and Column designators with an additional letter that identifies the tile. The strings (names) in the label field are unique so these smaller tiles can be mapped at a larger scale to provide greater detail in developed areas.

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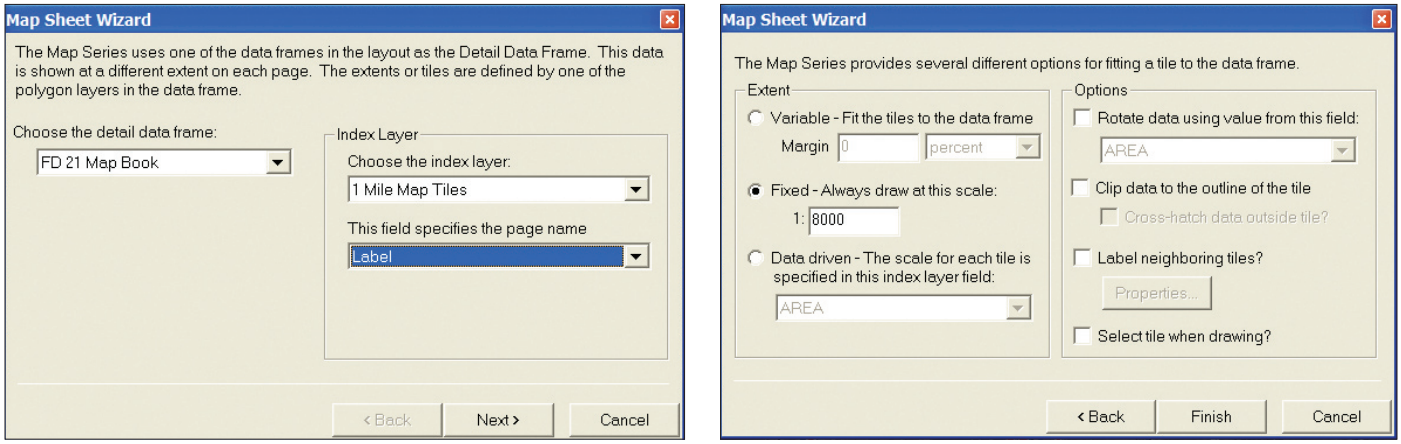


Right-click on the Map Book header in the TOC to access the Map Sheet Wizard and create a map book series.

Scale

Now to decide on the scale. These maps must contain enough data to be useful in the field and map features must be carefully labeled to show just enough information. Map extent must cover a reasonable area, slightly overlapping neighboring tiles; adjacent tiles are labeled and referenced.

This map book will print on letter-sized paper with a portrait orientation. Because most map tiles are square, not all the page will be used for mapping. The upper portion of the page will contain a title, reference map, and other information. Using a proportional scale of 1:8,000 will map a square mile on a page 8.5 inches wide. The scale for the quarter-mile tiles will be 1:5,000.

Starting a Layout

1. Turn all layers back on and switch to Layout View.
2. Open the 1 Mile Map Tile attribute table, select tile B19 in the table. From the Standard menu, choose Select > Zoom to Selected.
3. Stretch the Data Frame to the page margins and set the proportional scale to 1:8,000.
4. Save the map document.

This map is too busy for an emergency responder in a hurry. Experiment with turning data layers off and on individually and in groups. Wouldn't it be nice to have a digital map book that contained interactive layers? Actually, this is possible with the DS Map Book utility and a PDF export capability in ArcGIS Desktop 9.2. It would take several hours to build an effective layout for these one-mile tiles and several more hours to create a quarter-mile tile layout. To save time, the sample dataset includes prebuilt ArcMap documents for these scaled tiles. *But before opening these documents,* ***turn off all other ArcGIS extensions before activating the Map Book utility as described in the next section.***

Loading and Testing the DS Map Book Utility

Return to Data View and deselect all objects. Locate an empty spot in the toolbar area and right-click. Locate Map Series and select it. Verify that a three-button toolset and a fourth tab labeled Map Book (located at the lower right of the TOC) have been added to the interface. If the Map Book tab does not load, choose Tools > Options in the ArcMap menu, locate the TOC tab, check the Map Book tab, and click OK. (To remove the Map Book tab, just reverse this process.) Save the map again.

To test the Map Book utility, build a preliminary map set using the 1 Mile Map Tiles.

1. Open the TOC Map Book tab, right-click on the Map Book header, and select Add Map Series. Alternatively, use the Create Map Book tool on the new toolbar. Click on the tool and accept the default data frame.
2. Choose 1 Mile Map Tiles as the index layer. Select Label to specify page name. Click Next.
3. In the second window, accept all defaults and use all tiles. Click Next.
4. In the third window, click the radio button next to Fixed—Always draw at this scale and specify a scale of 1:8,000 but leave all other options unchecked.
5. Click Finish to build the pages. Save the map document.

Six map book pages should be listed in the TOC. Locate B19 and right-click on its name (not its icon). Select View Page, and ArcMap will switch to Layout view, rescale the map, and display the map book page for this tile. View other pages and notice the pages will print exactly the information presented in the data layers in the TOC. Click on the Display tab to change the presentation. When finished, close ArcMap.

Loading and Exporting Map Book Pages from Templates

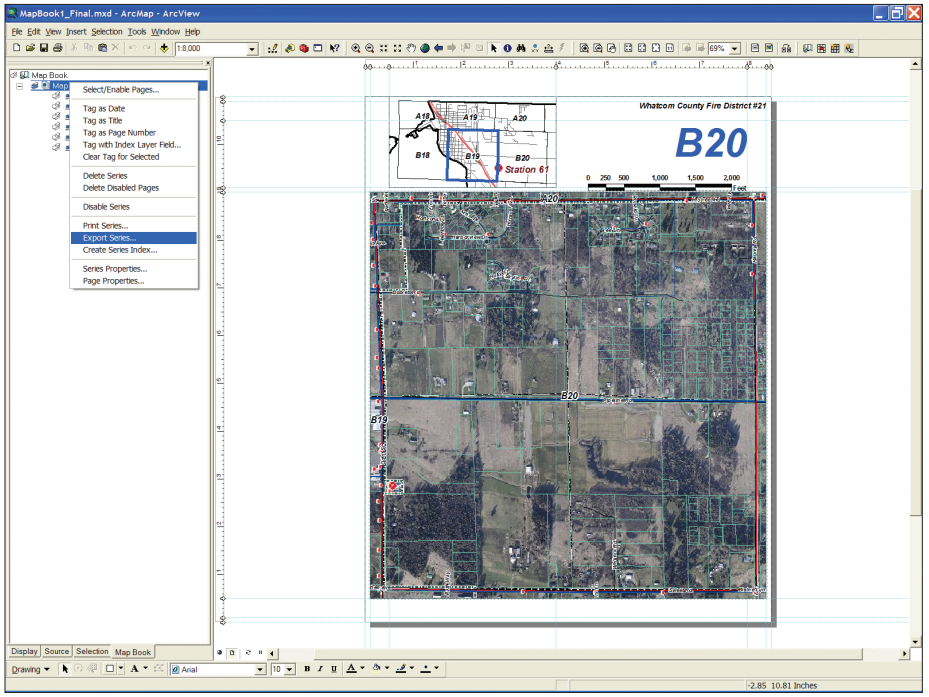
In the interest of saving time, these next steps explore the functionality of the Map Book utility using two prebuilt ArcMap documents.

1. Open Windows Explorer and navigate to \FD21_MapBook\Utility. Locate the MapBook1_Safe and MapBook2_Safe map documents. Copy them to the \FD21_MapBook\ directory.
2. Look at the Map Book Generation document for additional technical assistance on using the Map Book utility.
3. Navigate back to \FD21_MapBook\ and rename each copied MXD file, changing Safe to Final.
4. Open an ArcMap session and open MapBook1_Final.

This document builds the 1 Mile Map Tiles. It should open in Layout view, and the MapBook TOC tab should be visible. Open this tab and notice six map book pages. View each one and study its page header, map label, and scale. The reference map for each page is stored in the Global Indicator data frame of the MapBook1_Final document. These elements are built into the map template and conform closely to the district's previous paper maps. Right-click on the Map Series header in the TOC and review the map production and management options. Pages can be printed individually or as a group.

To take full advantage of PDF layers, use Export Series to send each map to its own PDF file.

1. Select Export Series and set the Save as Type to PDF.
2. Browse to the \FD21_MapBook\MapBook\ folder and set the file name to FD21. The utility will name each page.



Open the MapBook1_Safe.mxd and rename it MapBook1_Final.mxd. It contains six map book pages that are very similar to the district's previous maps. Notice the reference map in the header highlights the area shown on each map page.

3. Open the PDF Options and locate the General tab. Set the resolution to 300 dpi and slide the Output Image Quality selector to Best.
4. Open the Format tab and check Embed All Document Fonts. This is especially important if the PDF map will be sent to someone who does not have current ArcGIS font sets.
5. Click OK to apply changes and close options. Return to the Export window and click OK to create the PDF Map Book pages. Watch the bottom of the Export window as all six maps build. Because these maps include a JPG image, assessor parcel outlines, and haloed labels, it will take several minutes to create them all.

In Windows Explorer, locate the \FD21_MapBook\MapBook\ folder. It should contain six PDF files, ranging in size from 600 KB to 1.3 MB. Open FD21_B19. This page should look just like the ArcMap layout. Now for the best part—locate and select the PDF Layers tab in the upper left to see the 18 separate layers associated with the primary map and the index. Experiment turning layers off and on by clicking on the eye-shaped visibility icon

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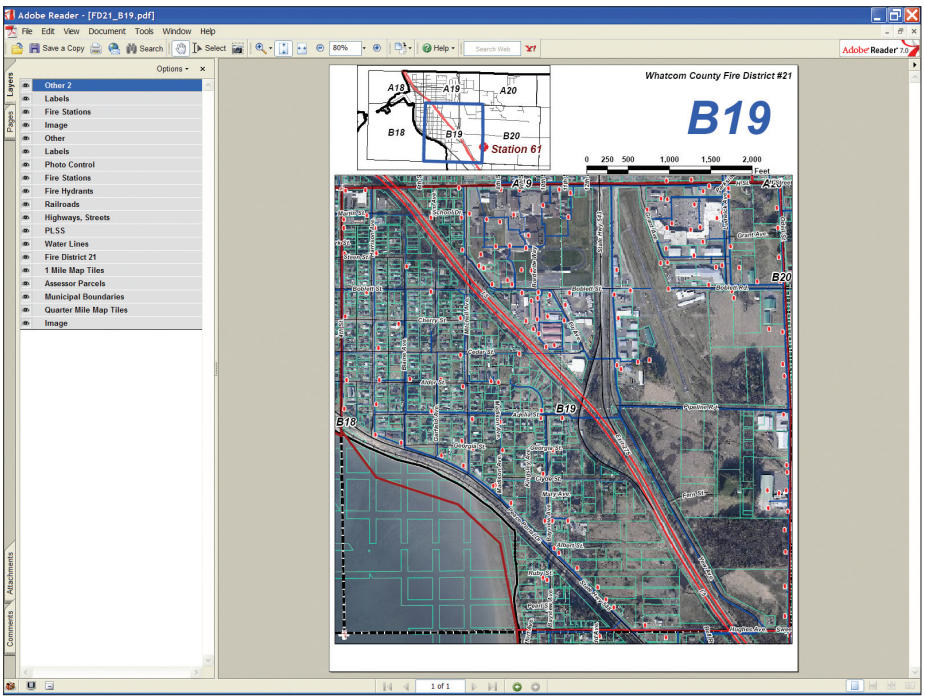
and try printing several maps with different layers turned off. The ability to control layer visibility makes this complex map more comprehensible.

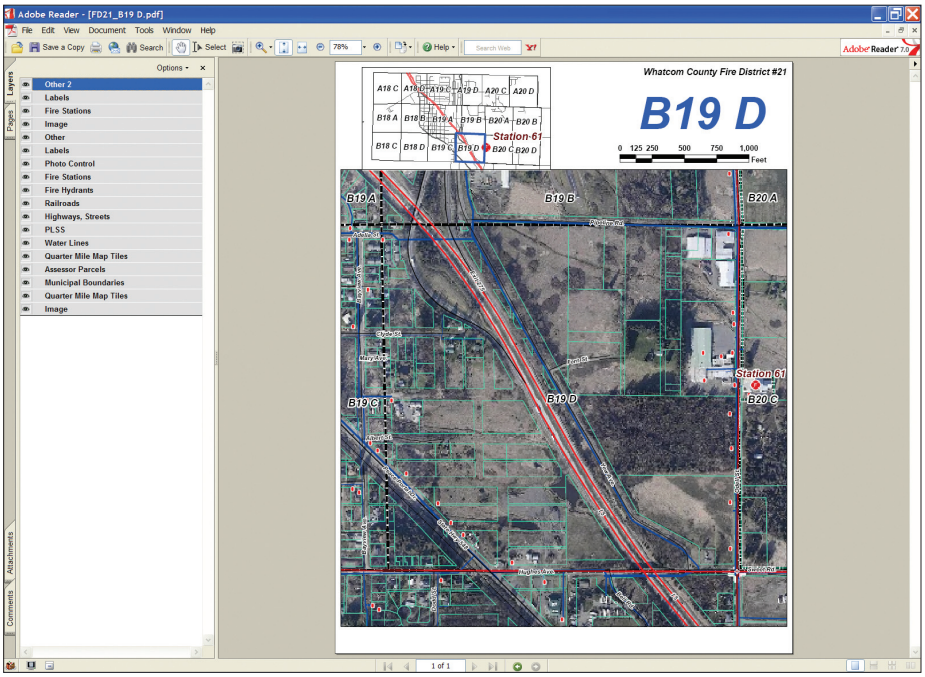
Build Quarter-Mile Map Tiles

Only one map series can be created per ArcMap document. Consequently, the quarter-mile tiles reside in a separate, but similar, document called MapBook2_Final.

1. Save any changes to MapBook_1 and close it. Open MapBook2_Final. Verify that there are now 18 pages, mapped at a scale of 1:5,000.
2. Export all 18 pages to PDF, using the process employed for the 1 Mile Map Book series. The DS Map Book utility will manage the file names. Be patient as this process will take several minutes.
3. When it is finished, open the PDF files. A larger scale is helpful in congested areas but results in approximately four times as many maps. Imagine how these maps will display on a rugged field computer or a computer on an apparatus on scene.



The PDFs should look just like the ArcMap layout, but the PDF can be turned off and on by clicking on the eye-shaped visibility icon.



MapBook2_Final.mxd generates 18 map pages for quarter-mile map tiles covering the same area that provides greater detail.

Summary

The data for these map book pages is continually updated as communities in the area grow and data quality is improved. In the past, updating a map book was a difficult and time-consuming process. FD 21 personnel continually field validate speed limits, hydrant locations, and new construction. Now incorporating field-validated data to update existing data layers, add new layers, and rebuild the PDF maps is a very quick and painless task. New PDF maps can be quickly transferred to field personnel to replace versions. It is so easy to update digital pages, it is hard to go back to paper alone!

This exercise will be used in continuing national training sponsored by ESRI and the National Alliance for Public Safety GIS. It will also be modified to use Corpus Christi and Nueces County, Texas, data as part of the GIT-TECH Fire Responder training, sponsored by Del Mar College and funded by the National Science Foundation.

Acknowledgments

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