NFPA Firewise ArcView
Lessons Learned Report

Prepared for

The National Fire Protection Association

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Between 2000 and 2004, the National Firewise Communities Program worked with 27 communities across the United States to train their staff in the use of GIS—specifically ESRI's ArcView™ software—as a tool for mapping wildfire risk. The objective of the program, called the Firewise ArcView Program, was to help local communities use mapping technology to identify and reduce wildfire risk or manage wildfire emergencies.

This report is designed to help the National Wildfire Coordinating Group's Wildland/Urban Interface Working Team and other stakeholders better understand program participants' experiences with the program. The report highlights implementation issues, lessons learned, and recommendations for future communities interested in using GIS software as a tool to map wildfire risk for mitigation or to manage wildfire emergencies.

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This introductory section has three parts:

- **Purpose and methodology** describes the purpose of this report and the methodology used to conduct this evaluation.

- **Organization of the report** provides an overview of the remaining chapters in this report.

- **Overview of the Firewise ArcView program** provides program background and history. It also describes, in broad terms, the variety of communities that administered the program.

PURPOSE AND METHODOLOGY

This report presents a program evaluation that focuses on lessons learned. Its goal is to provide detailed documentation of the Firewise ArcView program's objectives and implementation process, and to make recommendations about how communities might change their approach to using GIS software to document and reduce risk in the future.

The research in the report uses surveys and case studies to illustrate key lessons learned. This methodology recognizes that the communities themselves are the best source of information about the benefits and limitations of the training and the use of the ArcView GIS™ software provided through the Firewise ArcView program, and the effectiveness of the program at meeting its objectives. To this end, the data-gathering steps of this project rely heavily on surveys and interviews with community program administrators, and take a primarily

qualitative approach to defining and describing the lessons learned through program implementation.

This research utilized three key steps to arrive at its conclusions:

1. **Describe the program's goals.** The program goals are described using a *logic model*. A logic model is a graphic representation of the relationships and linkages between program inputs, outputs (activities and outreach efforts), and outcomes. In short, the logic model establishes the conceptual framework for the program: it documents the program background and process as well as the outcomes that were expected at implementation.

2. **Gather data that assess how the program was implemented**. In this step, researchers assessed how well the program met the goals and objectives outlined in the logic model. The research relied on two primary data sources:

   a. **A written survey.** This survey was distributed electronically to all 27 communities that participated in the Firewise ArcView program. Nineteen community administrators completed the survey (a 70% response rate).

   b. **Interviews.** Six in-depth interviews were conducted with program administrators in: Butte County, California; Sedona, Arizona; Venetie, Alaska; Castle Valley, Utah; Swan Ecosystem Center – Condon, Montana; and Ozark Scenic Riverways – Van Buren, Missouri. The communities were selected to provide more detailed information about the issues that all 27 communities faced when implementing the program. They are diverse in size, geographic location, administrative resources, and wildfire vulnerability. Interviews were also conducted with NFPA staff responsible for implementing the program.

3. **Analyze data to describe lessons learned.** Based on the results of the surveys and interviews, researchers found and described common themes. The analytical focus was on describing the technical, administrative, political, legal, and economic obstacles and opportunities that the program administrators faced.

ORGANIZATION OF THE REPORT

The report is designed to provide information to two audiences with very different information needs:

- *Those interested in detailed program documentation.* These stakeholders include the National Wildfire Coordinating Group's Wildland/Urban Interface Working Team, Federal Emergency Management Agency, ESRI, and others. The main body of this report (Sections 2 through 5) provides detailed research results that meet the needs of these stakeholders.

- *Those interested in summary information and key lessons learned.* These stakeholders include Firewise communities and others interested in the practical applications of ArcView GIS as a tool for reducing wildfire risk. Appendix A provides research results in a format that meets these needs: a series of lessons-learned case studies that highlight the opportunities and obstacles that the communities faced while implementing the program.

The remainder of the report has the following sections and appendices:

- **Section 2: Program goals and objectives** describes the program's goals, objectives, and expected results as they were conceived at the beginning of the program.

- **Section 3: Implementation** describes in detail the steps that were taken to implement the program, including dissemination of the software and/or hardware, training procedures and technical assistance, and support provided to communities as they used the software.

- **Section 4: Survey and Interview Results** presents the results of the survey and interviews of community participants. The section describes the key obstacles and opportunities from the perspective of community-level program administrators.

- **Section 5: Lessons Learned** highlights the key findings from the program evaluation and describes steps that program implementers and administrators might take related to continued administration of this and other similarly-focused programs.

- **Appendix A: Case Studies** describe the lessons learned in four ArcView Firewise communities [Castle Valley, Utah; Sedona, Arizona; Swan Ecosystem Center, Condon, Montana; and Ozark Scenic Riverways – Van Buren, Missouri]. Each case study:

  - Describes the community (its location, wildfire vulnerability, and demographic and economic makeup)

  - Presents obstacles and opportunities faced during program implementation

  - Presents the key lessons learned about use of GIS and other software in wildfire risk reduction.

- **Appendix B: Survey Responses** contains the question-by-question responses to the electronic survey.

- **Appendix C: Interview Responses** contains the question-by-question response to the interviews.

OVERVIEW OF THE FIREWISE ARCVIEW PROGRAM

The Firewise ArcView program was designed to facilitate the use of GIS[1] software in local communities to map wildfire risk to enhance local wildfire risk reduction efforts to the geographic areas where it is most needed. For example, the mapping software can be used to identify areas where population or infrastructure coincides with areas of heavy fuel load and might therefore be at greater risk. Mitigation efforts can then be targeted to these locations that are most likely to experience wildfire damage.

While many researchers and technicians recognize the benefits of GIS software for risk reduction efforts, the program is typically out of reach for many jurisdictions—especially small, rural jurisdictions. The software is expensive, and the data sets needed to use it can be difficult (and sometimes impossible) to acquire. Fire scientists are constantly improving knowledge about the factors that add to wildfire risk: creating accurate databases of fuel load, prevailing wind patterns, water sources, etc. is an overwhelming task. Data maintenance presents a further problem. To be fully accurate, databases of residential and public infrastructure, and wildland-urban interface areas must be kept current.

The Firewise ArcView program sought to help communities overcome these barriers to the use of GIS technology. Communities were given a GIS software tool referred to as ArcView GIS™[2] that enabled them to create maps that display community characteristics related to wildfire management to determine which areas would face the greatest risk from wildfire. Community administrators were trained in and provided technical support for the use of the software, including the acquisition and maintenance of appropriate data.

PROGRAM BEGINNINGS

The Firewise ArcView program began with a related program, called the *Firewise Community Workshops*. The Firewise Community Workshops initiative is dedicated to educating people who live and vacation in wildland-urban interface areas about reducing risk from wildfires. Both programs seek to reduce community-level risk from wildfires, and both are overseen by the National Wildland-Urban Interface Working Team (the *Working Team*), a partnership between the National Fire Protection Association and the USDA Forest Service, US Department of the Interior, and non-profit organizations concerned with wildfire safety. The Firewise ArcView program, however, is much more specific in its approach to risk reduction than is the Firewise Community Workshop initiative: rather than broad educational goals, the Firewise ArcView program

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[1] *GIS (geographic information systems)* is a tool that allows users to analyze spatial data to better answer geographically-specific questions.

[2] ESRI has developed a series of software packages that make GIS tools available for desktop users interested in analysis of spatial data. The communities that participated in program were all given copies of ESRI's ArcView GIS™ (versions 3.2 or 3.3, depending on when the community joined the program). Some of the communities have subsequently upgraded to ArcGIS 9.0 or 9.1 (a later version of the same program). For simplicity's sake, in the remainder of this report, the software is referred to as *ArcView GIS™*.

seeks to build local capacity for risk analysis using GIS software to better define and reduce risk.

In 1999, the Working Team began a series of Firewise workshops for local communities, designed to discuss strategies for reducing risk from wildfires. The Firewise Communities program partnered with ESRI starting in 1999 to use ArcView software to demonstrate Firewise principles in the fictional community of Falls County. Workshop participants all received a CD-ROM that included this module and could then run the module to train others. It was not ArcView software that communities could install and use for other purposes. They could not permanently change any of the data in the module. The Falls County module was part of a software license agreement between ESRI and Firewise that stipulated that its use was only for national workshop participants who could use it to train others.

Beginning in 2001, Firewise and ESRI partnered to provide the ArcView software to communities participating in the workshops. ESRI required communities that received the software to demonstrate that they had (1) local support for the use of the software, (2) a focus in use of the software for wildfire risk mapping and mitigation, and (3) the community's agreement to provide articles or data for publication by ESRI and Firewise. The first successful applicants were Frenchtown, Montana, and Groom Creek, Arizona, both in 2001.

In the early stages of the program, some recipients experienced great success. Without a program to track the use of the software and provide administrative and technical support, however, other communities floundered. Communities lacked access to appropriate data, or, if they had the data, were uncertain about how to use it to map wildfire risk. Some copies of the software were lost, or the license for the use of the software was inappropriately shared.

THE PROGRAM SINCE 2002

The developments described above prompted the Working Team to try another approach. The Firewise ArcView program officially began in 2002, when the Working Team: (1) set up a process by which communities could apply to receive the software, (2) assigned staff to provide training and ongoing support to communities who had the software, and (3) broadened their outreach efforts to seek program applications from communities of all sizes across the United States.

In 2003, the Federal Emergency Management Agency (FEMA) also began contributing to the program with a donation of HAZUS software. HAZUS is based on an ArcView GIS™ platform and is more specific to hazard-related risk identification and mapping efforts. It is designed to help communities create FEMA-approved risk assessments as part of required hazard mitigation planning efforts. Some communities received the HAZUS software and accompanying training in addition to the ArcView GIS™ software.

OVERVIEW OF COMMUNITY PARTICIPANTS

Between 2002 and 2004, the Firewise ArcView program provided copies of ArcView GIS™, training, and support to a total of 27 communities across the nation. These communities were selected on the basis of their demonstrated capacity in each of the following areas:

- Supportive involvement of community decision-maker(s)

- Administrative capacity (both time and money) to implement the program

- Availability of a technician, preferably with some GIS or mapping skills, or, at the very least, someone willing to learn

- A back-up contact for the program

The communities' locations are shown in Figure 1-1, along with a timeline that shows when each community joined the program. Most of the communities are located in the rural West where many communities are at risk from large-scale, damaging wildfires. The largest share is in California, Colorado, and Wyoming.

Figure 1-1. Firewise ArcView and Firewise USA Program community participants, 2000 - 2004
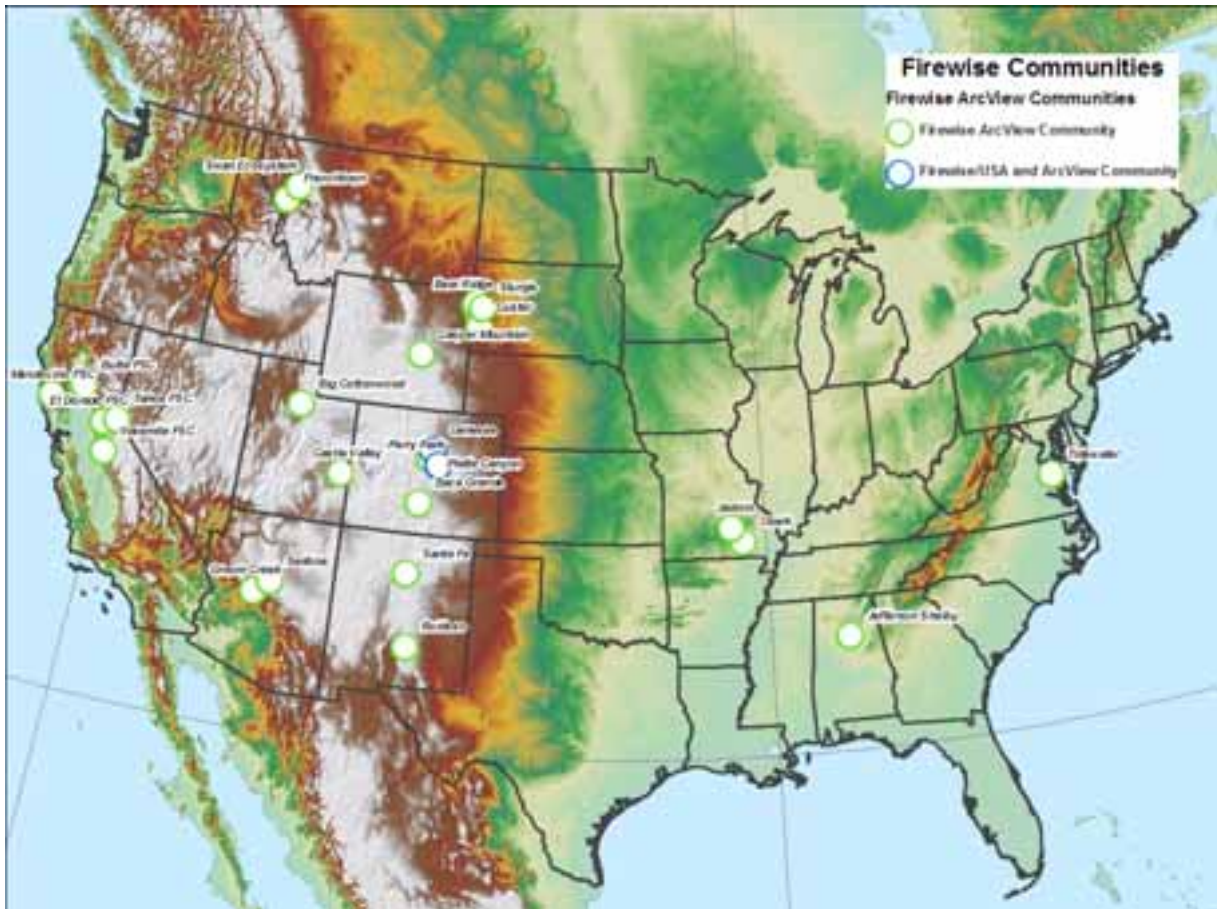
Source: Mike Price, Firewise Technology Coordinator, Entrada/San Juan, Inc., 2006
Note: This map excludes two participating communities, one in Hilo, Hawaii, and another in Venetie, Alaska.

The participating communities' populations range from towns with less than 500 residents to counties with over 200,000 residents. Some of the communities have extensive wildland-urban interface areas (where human development mixes with forestland), while others have only small portions of their population at risk. The communities' experiences with past wildfires are varied: some communities are located in arid areas where wildfires are a nearly annual event, while others have rarely experienced fires. In most communities fire departments administered the Firewise ArcView program.

Program Goals and Objectives

This section provides a description of the Firewise ArcView program's goals and objectives as they were conceived at the time of project implementation. In other words, it describes how the program implementers expected program administrators (communities) to benefit from participation. The section has two parts:

- **The Firewise ArcView program logic model.** In this section, a logic model will be presented and described.

- **Analysis of logic model.** This section looks carefully at the assumptions behind the logic model and discusses their validity.

LOGIC MODEL

A logic model is a graphic representation of the relationships among program inputs, outputs (activities or products), and outcomes. It is a useful tool for analyzing a program and identifying areas that might be strengths or weaknesses in the program's implementation.

Figure 2-1 shows the logic model for the Firewise ArcView program. It was developed based largely on conversations with program staff and others familiar with the program. The top part of the logic model, shaded in gray, describes the program as it was proposed: its goals and the assumptions upon which its implementation is based. The bottom part of the logic model describes the program as it was implemented: how participant communities were selected, what type of work the implementers did with the participant communities (program inputs), and the range of possible products that could have resulted from program implementation (potential program outputs).

Figure 2-1. Logic Model for Firewise ArcView Program
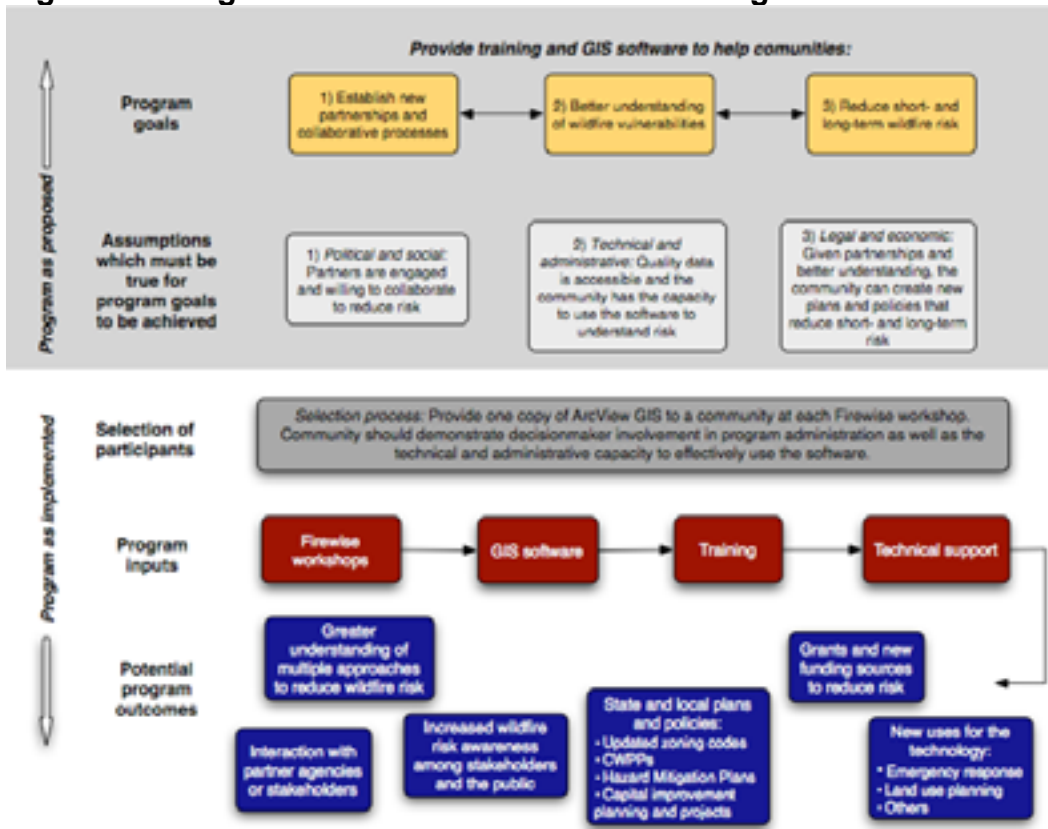
Source: ECONorthwest, 2006

ANALYSIS OF LOGIC MODEL

THE PROGRAM AS PROPOSED

PROGRAM GOALS

The program's designers and implementers provided GIS software and training to participant communities to help them achieve the following interdependent goals:

- **Establish new partnerships and collaborative processes.** One of the key benefits of maps and other forms of visual data representation is that they can be used as the basis of a shared understanding of risk. They can be a powerful tool for communicating the geographic overlap among vulnerable infrastructure, populations, and threats, which in turn can motivate organizations and individuals to find new ways to work to reduce risk. The program's implementers hoped that the Firewise ArcView program could serve as a catalyst for organizing new partnerships and other forms of collaborative processes to reduce risk.

- **Improve understanding of wildfire vulnerabilities.** Given accurate and accessible sources of data, GIS software is an excellent tool for spatially locating the areas of greatest vulnerability.

- **Reduce short- and long-term wildfire risk.** Program implementers hoped that improved understanding of wildfire vulnerabilities, combined with new partnerships and collaborative processes, would lead ultimately to reduced wildfire risk.

ASSUMPTIONS

In order for the goals described above to be achieved, certain factors must be in place in the participant communities. The program implementers assumed that each of the communities would have these factors in place:

- **Partners are engaged and willing to collaborate to reduce risk**. Before new partnerships and collaborative processes can be formed, people must be motivated to reduce risk. The community must have the political will and social capacity in place to work together.

  This is a reasonable assumption to make about many communities, especially those that have experienced recent losses from wildfire. Most communities have agencies (fire departments, emergency management agencies, planning departments) with an obvious stake in risk reduction. These agencies are, at a minimum, engaged with the concept of risk reduction. Their willingness to collaborate and ability to encourage the public to participate in risk-reduction activities, however, is dependent upon a variety of political and social forces, including history of collaboration, hierarchy, and fiscal resources. These factors vary widely from community to community and greatly influence the success of attempts at collaboration toward risk reduction.

- **Quality data is accessible and the community has the necessary capacity.** Providing training and GIS software to communities will not lead to the achievement of any goals unless the community has the technical and administrative capacity to use the tools.

  Of the three assumptions described here, this one is most problematic. Quality GIS data is still largely unreliable or completely unavailable in many parts of the country. Further, GIS can be complicated to use without substantial training and the commitment of staff resources.

- **The community can use the data to implement risk-reduction measures.** Ultimately, the data and analysis that communities gain as a result of the program is intended to be used to create change: that change can come in the form of new plans and policies that reduce exposure to both short- and long-term risk. The community must have the legal authority and mechanisms to enact new policies and realize any economic benefits that come from the implementation of risk-reduction measures.

  This assumption is related to the assumption regarding data availability. Without quality data, maps of vulnerabilities may not be accurate enough

to use as a basis for risk-reduction measures, especially for specific measures such as new ordinances that rely on a fact base.

THE PROGRAM AS IMPLEMENTED

SELECTION OF PARTICIPANTS

In the initial stages of program implementation, some communities struggled because they did not have the factors described above in place at the time that they received the new software. As the program matured, program implementers designed an application that gave them a better indication of a community's technical and administrative capacity to administer GIS mapping for wildfire planning.

PROGRAM INPUTS

The program implementers envisioned that the Firewise workshops would be used as a means of distributing the Firewise ArcView software to eligible communities. To ensure that communities had adequate support to use the software in their planning and decision making applications, training and technical support was provided. The program's implementation strategy is described in more detail in Section 3.

POTENTIAL PROGRAM OUTCOMES

The program as implemented was designed to provide a number of benefits to participating communities as they addressed wildfire issues. While the program implementers did not expect all communities to produce all of the following outcomes, they did expect some combination of the following outcomes:

- **Interactions with partner agencies and stakeholders**. Program implementers anticipated that the planning process and map products produced using the software would encourage participating entities to interact with other agencies and stakeholders on a more frequent and efficient basis.

- **Increased wildfire risk awareness among stakeholders and the public.** Maps and plans can be effective education and outreach tools to increase public and stakeholder awareness of wildfire threats, and of assets at risk from wildfire damage in communities.

- **Improved state and local plans and policies.** Improved state and local plans and policies may result from program participation, especially if new maps better represent wildfire risks and characteristics. These plans and policies would be based on the best available data and the software provided.

- **Greater understanding of the factors contributing to wildfire risk.** Designers expected that as communities used the various data layers in the software, they would have a better understanding of the

characteristics that increase the community's risk of wildfires, including topography, response time, housing construction and materials, and water supply.

- **Greater understanding of multiple approaches to reduce wildfire risk**. The design of the software allows communities to run various scenarios that map potential fuel reduction treatments in specified areas to test the degree to which risk is reduced. Completing such exercises can allow communities to gain a better understanding of the activities that can reduce wildfire risk.

- **Grants and new funding sources to reduce risk.** The process of completing mapping exercises, along with the maps that the software produces, might give communities new tools for seeking mitigation funding sources.

- **New uses for the technology.** Although the software was designed to map the characteristics of wildfire risks, the program designers expected that communities would find additional uses for the technology. Additional uses might include enhanced emergency response capabilities or better information for making land use decisions.

The software provides communities an opportunity to visually display complex data in a way that is understandable for agencies and stakeholders with varying vocabularies. This common data platform provides opportunities for communities to capitalize on the potential outcomes listed above. For instance, providing opportunities for partner agencies and stakeholders to interact through the use of the software may lead to the development of improved local plans and policies that take the diverse needs and issues into account.

Implementation

This section describes in detail the steps that were taken to implement the program, including dissemination of the software, training procedures and technical assistance, and support provided to communities as they used the software to reduce wildfire risk. It has the following parts:

- Software
- Training and materials provided
- Ongoing technical support

SOFTWARE

All Firewise workshop participants were eligible to apply for the Firewise ArcView software package. The workshops were offered in over 30 locations from 1999 through 2003. In all, over 3,000 people from 1,080 communities in 47 states participated in these landmark workshops.[3] Upon development of the Firewise ArcView program in 2002, one copy of the software package was made available at each workshop through an application process. The application required that communities have the technical and administrative capacity to administer GIS mapping for wildfire planning. Communities were also asked to address the following concepts:

- Description of project area
- Project sponsors
- Project goals and the role of GIS
- Project tasks
- Project timeline

- Existing GIS networks
- State mandates
- Existing hazard assessments
- Existing forestry related programs
- Partner agencies

Once awards were made, the community received a letter explaining the award and providing instructions for technical support. It is important to note that software was not awarded at every workshop because in some cases, no communities applied for the award. Many of the participating communities are located in California because of the number of workshops that were held in that state.

TRAINING AND MATERIALS PROVIDED

The Firewise workshop gave participating communities their first look at the Firewise ArcView software package. During the workshops, participants could

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[3] Firewise webpage, www.firewise.org

manipulate the data for a fictional community and began to understand how the software works. Firewise staff conducted site visits with a majority of participating communities to provide assistance in setting up the software, and also provided some basic training on the use of the software. Communities were also encouraged to participate in free on-line and low-cost regional trainings sessions offered through ESRI. Additional hands-on training was provided at the November 2004 Backyards and Beyond WUI Conference in Denver, Colorado. This training session will also be held at the Firewise 2006 Conference.

A startup book, "Getting to know ArcView", was provided to all ArcView 3 Communities. Communities using later versions of the software (ArcView 8) were provided with appropriate written materials and with special materials for ArcGIS extensions. Sample data for the US and the world came with all software. Many communities also received software upgrades to either ArcGis 8 or 9 depending on their previous systems.

TECHNICAL SUPPORT

To assist communities in the use of wildfire mapping software, Firewise offered communities ongoing technical support. Participating communities were instructed in their award letter to contact the Firewise Technology Coordinator or other participating communities for technical support. Once communities were awarded the software, they were immediately contacted by Firewise technical staff to set up individual site visits and to establish lines of contact should the community need technical support beyond the initial site visit. Two consultants retained by Firewise, Mike Price of Entrada/San Juan, Inc. and/or Ron Montague of Firewise 2000, Inc. visited all communities at least once. Additional hands-on training was provided on an as requested basis based on the availability of Firewise staff.

Firewise established a website that provided supporting material, a message board, and presentations from other communities. The Firewise Web site contained a special page for ArcView Communities at www.firewise.org/communities/arcview. This page included a "What's New" area, a Community Spotlight, Message Board, Support Network link, Conference Call schedule, minutes, notes, and a presentation archive. Some communities visited the Firewise ArcView Web site regularly; others did not. Users were also referred to the extensive ESRI Web site and to ESRI technical services, if they had subscribed to maintenance/technical support[4]. This website is a key resource for communities utilizing the software to network and share information with other communities.

In addition to the website, Firewise staff and participating communities conducted monthly teleconferences to keep communities up to date on the latest information about the software. These calls also helped Firewise staff get

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[4] ESRI offers two maintenance programs, the basic annual package costs $400 and an advanced package that includes upgrades and technical support for $1,000.

feedback from participating communities. Between 2002 and the 2004 staff made a total of 18 monthly phone calls.

Section 4   Survey and Interview Results

This section provides detailed results from the survey and interviews of the communities that participated in the Firewise ArcView program. It has the following parts:

- **ArcView Software Usage** describes the GIS software and extensions that participants used, how often the software was used, and who benefited from its use.

- **Community Training** identifies the training communities received and provides feedback on the effectiveness of the training.

- **ArcView Software Application** examines participating communities' use of GIS software for natural hazard mitigation planning and other tasks.

- **Implementation Obstacles and Opportunities** describes the obstacles and opportunities participants encountered in implementing the program.

- **Conclusions** ties together the findings of the survey and interviews with the potential outcomes identified in the logic model.

The survey and interviews questions had three overlapping themes: community training, software applications, and implementation obstacles and opportunities. The findings of the survey and the interviews are provided together. The findings in the section on ArcView software usage reflect specific questions that were only asked during the participant survey.

Results from both activities are presented side by side where possible. The term "respondents" will be used to indicate a response from a survey participant and "interviewee" will be used to indicate an interview participant. Nineteen of the 27 communities that participated in the Firewise ArcView Communities Program responded to the survey, a 70% response rate. ECO conducted in-depth interviews with six of the communities that responded to the survey, including the following communities: Castle Valley, Utah; Sedona, Arizona; Butte County, California; Venetie, Alaska; Ozark Scenic Riverways – Van Buren, Missouri; and Swan Ecosystem Center – Condon, Montana. Figure 4-1 identifies the location of the communities that participated in the surveys and interviews.

Figure 1-1. Firewise ArcView and Firewise USA Program community participants, 2000 – 2004

Source: Mike Price, Firewise Technology Coordinator, Entrada/San Juan, Inc., 2006

ARCVIEW SOFTWARE USAGE

The following section provides survey and interview results on how the program was implemented and includes information about the type of software provided and information on the training the communities received. Table 4-1 shows the version of GIS that responding communities were sent and the version that they were using at the time of the survey. The table shows that 16 of the 19 communities were sent ArcView GIS 3.x and 7 of the nineteen communities were sent ArcGIS 8.x. At the time of the survey, nine communities used ArcGIS 9.x and seven used ArcView GIS 3.x. Note that some communities were sent and used multiple versions of GIS software.

Table 4-1. Version of GIS received and version in use at the time of the survey

	Version received	Current version
ArcView GIS (3.x)	16	7
ArcGIS (8.x)	7	2
ArcGIS (9.x)	1	9
Total	**24**	**18**

Source: Firewise ArcView Communities Program Survey, 2006
Note: Some respondents indicated that they received or use multiple versions of GIS.

There are a variety of software extensions used in GIS that are designed to simplify specific mapping tasks. Some of the GIS extensions are free and some must be purchased. Thirteen of the 19 responding communities did not use GIS extensions. Table 4-2 shows the use of GIS extensions by the remaining six communities: five communities used FEMA's HAZUS, five communities used 3-D Analyst, and four communities used Spatial Analyst. None of the responding communities used Network Analyst, ArcPublisher, or other extensions.

Table 4-2. GIS extensions used

	Number
FEMA's HAZUS	5
3D Analyst	5
Spatial Analyst	4
Network Analyst	0
ArcPublisher	0
Other	0

Source: Firewise ArcView Communities Program Survey, 2006

Loss estimation software can also be paired with ArcGIS programs for use in wildfire plan development. Table 4-3 shows that most communities did not use loss estimation software. Four communities indicated they use HAZUS software and one community used HPAC/CAMEO/ALOHA.[5] In some communities, HAZUS software was provided along with the ArcView Firewise software.

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[5] HAZUS® is a natural hazard loss estimation methodology implemented through PC-based Geographic Information System (GIS) software developed under agreements with the National Institute of Building Sciences. HPAC (Hazard Prediction and Assessment Capacity) software predicts the effects of hazardous material releases into the atmosphere and its collateral effects on civilian and military populations. CAMEO ® (Computer-Aided Management of Emergency Operations) is a system of software applications used widely to plan for and respond to chemical emergencies. ALOHA (Areal Location of Hazardous Atmospheres) is an atmospheric dispersion model used for evaluating releases of hazardous chemical vapors. RHAVE stands for Risk, Hazard and Value Evaluation. It is a set of tools and methods to help the fire service and community leaders make objective, quantifiable decisions about their fire and emergency services needs. Vision replaced the RHAVE software. CATS (Consequences Assessment Tool Set) is an analysis system for Natural and Technological disasters. CATS includes hazard prediction, data creation, data management and analysis models for data fusion analysis that supports disaster and other emergency management.

Table 4-3. Type of loss estimation software used

	Number
HAZUS Software	4
HPAC/ CAMEO/ ALOHA	1
RHAVE/ Vision	0
CATS	0
We are not using any loss estimation software	5
Other	2

Source: Firewise ArcView Communities Program Survey, 2006
Note: Some respondents indicated that they received or use multiple versions of GIS.

Table 4-4 shows the frequency of GIS use in general within the respondents' department. Nearly all respondents (74%) indicated that their department used GIS frequently, with eight respondents indicating weekly usage and six respondents indicating daily usage. The information in Table 4-5 may not reflect GIS use by all staff members within the community because GIS may have been used by other departments in the community.

Table 4-4. Frequency that respondents' department used GIS

	Number
Daily	6
Weekly	8
Monthly	3
Less than monthly	2

Source: Firewise ArcView Communities Program Survey, 2006

The survey found that most communities had only a few staff members who used GIS and very little technical support from staff to help run GIS. While the number of staff using GIS ranged between zero to 14, an average of just over two staff used GIS in the participating communities. .

Most responding communities had few, if any, staff supporting GIS use, such as a systems administrator. The number of staff supporting GIS use ranged between zero and three with a mean of less than one staff supporting GIS use. Four communities had zero staff providing GIS support.

Table 4-5 shows a breakdown of the departments that benefited from the use of GIS. These responses may also include the department that received the software package. The most frequently cited departments were emergency operations or 911, and planning and development, with about 68% of respondents citing that each of them benefited from the use of GIS.

**Table 4-5. Departments that benefited
from the use of GIS**

	Number
Emergency operations or 911 system	13
Planning and development	13
Public works	7
Transportation	7
Environmental services	6

Source: Firewise ArcView Communities Program Survey, 2006

COMMUNITY TRAINING

All participating communities were provided with training either through Firewise or through ESRI. Table 4-6 shows survey respondents' opinions about the usefulness of the training received through the Firewise ArcView Communities program. Respondents most frequently found site visits, printed materials, and the initial Firewise workshop to be helpful. Relatively few respondents found the monthly conference calls and website to be helpful.

Table 4-6. Respondents' opinion of the usefulness of the training received through the program

	Very Useful	Somewhat Useful	Not Useful	Did not receive the training
Initial Firewise Workshop	10	6	1	2
Follow-up Firewise Workshop	5	3	0	8
Monthly ArcView conference calls	3	13	2	1
Website	3	14	1	0
Printed Material	10	7	0	1
Site Visits	11	4	1	2

Source: Firewise ArcView Communities Program Survey, 2006

When asked whether or not the training they received was sufficient, most interviewees indicated that it was sufficient in providing staff with knowledge about what was possible and what was needed to get it off the ground. The majority of communities indicated that the Firewise staff's assistance was instrumental in getting the programs established locally.

Interviewees were then asked what aspects of the program they would liked to have received more training on. The responses fell into two main categories: 1) basic operation of ArcView, and 2) advanced uses of ArcView such as: how to incorporate local data into HAZUS and vegetative layers into ArcView; technical training on data acquisition and data/file maintenance; and how to integrate fire models. This split in responses relates directly to the size of the community and the level of GIS capabilities that exist within the communities. Those communities who already had robust GIS systems in place wanted more training on the more advanced uses of the software, while communities with less staff and less technical capability just needed more training on the basic uses and functions of the software.

When asked how they would improve the training in the future, the majority of interviewees focused on the way in which the training was delivered rather than the content of the training. Interviewees had the following suggestions:

- Increase the frequency of training and/or on-line tutorials.

- For communities with limited GIS capabilities, focus more on the basic uses and operation of the software.

- For communities with more robust GIS capabilities, provide a weeklong immersion course focused on the multiple uses of the software.

- Partner with appropriate state agencies to have a Firewise liaison so that there is someone close by who can provide assistance.

ARCVIEW SOFTWARE APPLICATIONS

In both the survey and the interviews, participants were asked to describe how the community used the software for wildfire mitigation and other activities.

Before participating in the program, responding communities mapped wildfire risk in a variety of ways. Table 4-7 shows that five communities used ArcView GIS prior to participating in the program and three used paper maps. The majority of respondents, ten communities, *did not assess wildfire risk before participating in the program,* indicating that participation in the program greatly increased the understanding of risk in many communities.

Table 4-7. Method of assessing wildfire risk before participating in the program

	Number
ArcView GIS	5
Map info	0
Auto Cad	0
Paper maps	3
We did not assess wildfire risk	10
Other	5

Source: Firewise ArcView Communities Program Survey, 2006
Note: "Other" includes: other computer programs such as ArcInfo or Arcplot, maps prepared by other agencies, and combinations of Mylar map overlays on a paper base map.

Of the communities interviewed, the majority had mapped wildfire risk prior to participating in the program. These communities either used paper maps or already had other GIS programs available. Only one community had not mapped wildfire risk prior to participating in the program. All communities interviewed indicated that participation in the program improved their community's wildfire mitigation efforts.

Nearly all communities surveyed (about 90%) thought that the use of GIS software had been very or somewhat beneficial to their community's wildfire mitigation program, indicating that the program achieved some success in improving wildfire mitigation efforts. Eleven communities found the use of GIS very beneficial and six communities found it somewhat beneficial.

**Table 4-8. Software benefited
the wildfire mitigation program**

	Number
Very beneficial	11
Somewhat beneficial	6
Not beneficial	0
Not applicable	1
Total	**18**

Source: Firewise ArcView Communities
Program Survey, 2006

A majority of communities (15) indicated that participation in the program had increased their ability to assess wildfire risk. The remaining four communities said that participation in the program had somewhat increased their ability to assess wildfire risk. Importantly, no communities indicated that the program did not increase their ability to map risk.

**Table 4-9. Community's ability
to map wildfire risk increased**

	Number
Yes	15
Somewhat	4
No	0
Not applicable	0
Total	**19**

Source: Firewise ArcView Communities
Program Survey, 2006

Interviewees were asked how the program has changed and improved the way the community addresses wildfire mitigation. In most of the communities interviewed (five of six), the participants had used or were planning to use the software to complete Community Wildfire Protection Plans[6] and/or wildfire components of all-hazard mitigation plans. In one case, the use of the software led to a wildfire mitigation program in a community that otherwise would not have had one. In general, the program has allowed communities to:

- be better equipped to talk to the public about wildfire risk

- be able to run scenarios to assist with pre-planning activities

- partner with other local, state and federal partners to address wildfire risk

Respondents used GIS to perform natural hazard mitigation tasks and other planning and public safety related tasks. Table 4-10 shows the tasks in which

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[6] Community Wildfire Protection Plans (CWPP) assist communities clarify and refine its priorities for the protection of life, property, and critical infrastructure in the wild-land urban interface. CWPPs address three main themes: (1) collaboration, (2) prioritized fuel reduction, and (3) structural ignitability.

responding communities use GIS. The most common of the natural hazard mitigation tasks included: production of wildfire risk assessments by 15 communities, development of a community wildfire protection plan by 13 communities, and production of hazard risk assessments by 10 communities.

The majority of communities used GIS for tasks not directly related to natural hazard mitigation planning. The most common uses of GIS included: public safety and emergency preparedness (15), land use planning and management (14), natural resource planning and management (12), and roads and highway maintenance (11).

Table 4-10. Tasks that respondents use GIS to perform

	Number
Natural hazard mitigation uses of GIS	
Production of wildfire risk assessments	15
Development of a community wildfire protection plan	13
Production of all hazard risk assessments	10
Development of a natural hazard mitigation plan	8
Other natural hazard mitigation uses	5
Other uses of GIS	
Public safety and emergency preparedness	15
Land use planning and management	14
Natural resources planning and management	12
Roads and highway maintenance	11
None yet but we plan to use ESRI's GIS in the future	4
Other uses of GIS	2
None and we have no plans to use ESRI's GIS	0

Source: Firewise ArcView Communities Program Survey, 2006

The interviews provided an opportunity for communities to describe in detail the ways in which they had used the program software. Interviewees indicated that the communities used the software in a number of unique ways beyond wildfire mitigation activities, including:

- Documenting and updating local transportation system information in an effort to collect state transportation funds.

- Supporting holistic watershed-based community planning looking at issues including landownership, wildfire risk, endangered species, and water quality.

- Supporting real-time fire suppression efforts including mapping the location of fire boundaries, availability and location of suppression resources, and traffic plans.

- Facilitating individual home site assessments that had multiple benefits including the identification of potential structural ignitability reduction activities as well as increased emergency medical services capabilities and decreased response times.

- Assisting in community development, land use and tourism projects.

- Creating maps and assessments of geologic hazards for an all-hazard mitigation plan.
- Improving emergency response capabilities through the identification of low water crossings and pre-planning for swift water rescues.

IMPLEMENTATION OBSTACLES AND OPPORTUNITIES

To identify lessons learned from participating communities, participants were asked about the obstacles and opportunities they faced when implementing the program. The following section summarizes those obstacles and opportunities. It should be noted that the survey only asked respondents to identify obstacles, while the interviews asked interviewee to identify both obstacles and opportunities when possible. This section is organized by the following areas:

- Administrative and legal obstacles and opportunities
- Technical obstacles and opportunities
- Political obstacles and opportunities

ADMINISTRATIVE AND LEGAL OBSTACLES AND OPPORTUNITIES

Table 4-11 shows the administrative and legal obstacles that communities encountered in implementing the program. Communities experienced administrative obstacles more frequently than they experienced legal obstacles. Overall, however, the table shows that most of the issues identified in the survey were not obstacles for communities administering the program.

Table 4-11. Obstacles to implementing the program

	Issue was a major obstacle	Issue was a minor obstacle	Issue was not an obstacle
Administrative obstacles			
Insufficient local staff	6	5	7
Lack of time for staff to learn to use ArcView	8	5	4
Staff turnover	2	5	11
Financial constraints	5	7	6
Other administative obstacles	3	0	3
Legal obstacles			
Concerns about community liability	1	3	15
Legal challenges	2	1	16
Lack of political support	2	5	12
Resistance from department managers	0	3	16
Other legal obstacles	2	0	5

Source: Firewise ArcView Communities Program Survey, 2006

Communities experienced the following administrative obstacles:

- *Staffing issues were the most frequent major obstacle to implementing the program.* Eight communities indicated that their staff lacked the time necessary to learn to use ArcView and six communities had insufficient local staff to implement the program. However, staff turnover was *not* an obstacle for 11 communities.

- *Financial constraints were obstacles for twelve respondents.* Five communities indicated that financial constraints were a major obstacle in implementing the program and seven communities indicated that they were a minor obstacle. Only six of the 19 respondents indicated that they subscribed to ESRI's maintenance and support.

Findings from the interviews also indicated that staffing and funding were the greatest administrative obstacles faced by most participating communities. An example of the financial obstacle is the cost of the ESRI maintenance and support program[7]. The financial burden of continued maintenance is greater for smaller communities. For example, in one rural community the annual cost per capita of maintaining the software program is $2.86, while in one of the larger communities interviewed, the per capita cost is about $0.09. In several of the communities, an administrative opportunity was that the community's administration was financially supportive of the programs. In one small, rural community, staff noted that a potential opportunity to address lack of staffing was to partner with the Boy Scouts to train them on the use of the software.

The majority of communities (14) did not experience major legal obstacles in implementing the program. The most common legal constraint was a lack of political support for implementing the program, with five communities indicating that it was a minor obstacle and two communities indicating it was a major obstacle. Findings from the interviewees echoed the survey findings. For the most part, the communities did not face any legal obstacles. In one instance, where individual home assessments had been made, the community was concerned with privacy issues and who had access to that data. Another community had not experienced any legal issues, but felt that there might be one on the horizon. The community is using the software to generate a wildland-urban interface map that will be used to implement an urban interface code requiring more stringent construction methods, which may result in increased constructions costs.

TECHNICAL OBSTACLES AND OPPORTUNITIES

Installing and maintaining GIS software can be problematic, especially since most respondents lack adequate staff support to help solve technical difficulties in running GIS software. Table 4-12 shows that the majority of respondents faced no technical problems. However, for those who did encounter problems, the most common minor problems were obtaining GIS software updates and running GIS on client hardware.

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[7] ESRI offers two maintenance programs, the basic annual package costs $400 and an advanced package that includes upgrades and technical support for $1,000.

Table 4-12. Technical problems with installing or maintaining GIS

	Major problem	Minor Problem	No problem	Not applicable
Installing ESRI GIS software	1	2	12	3
Installing ESRI GIS software updates	0	2	12	4
Obtaining ESRI GIS software updates	0	4	9	5
Running ESRI GIS on PC (client) hardware	0	4	10	4
Running ESRI GIS on server hardware	0	1	5	12
Other	0	1	2	4

Source: Firewise ArcView Communities Program Survey, 2006

Respondents encountered technical obstacles related to hardware somewhat more frequently than they software problems. Table 4-13 shows that the majority of respondents did not encounter any problems related to hardware. However, for those who did encounter problems the most common problem was related to internal networking, computer performance, and data storage.

Table 4-13. Hardware problems when using GIS

	Major problem	Minor Problem	No problem	Not applicable
Computer performance	0	7	10	1
Internal network	1	1	9	7
Internet connection	0	1	14	3
Software compatibility	0	3	12	3
Data storage	0	5	11	2
Other	0	0	2	1

Source: Firewise ArcView Communities Program Survey, 2006

Table 4-14 shows that most communities did not experience major problems with data but a number of communities did experience minor data problems. The most common problem that communities experienced was maintaining, manipulating and acquiring data.

Table 4-14. Data problems when using GIS

	Major problem	Minor Problem	No problem	Not applicable
Accessing data	1	6	9	2
Aquiring data	1	7	8	2
Sharing data	0	7	8	3
Manipulating data	3	6	6	3
Maintaining data	1	11	4	2
Other	1	1	1	3

Source: Firewise ArcView Communities Program Survey, 2006

The results of the interviews support the survey findings about technical obstacles. The interviewees identified a number of opportunities regarding technical implementation issues. Most interviewees indicated that Firewise staff was very available and able to provide assistance when communities faced

technical obstacles. One community indicated that the development of ESRI's data clearinghouse might assist communities overcome data acquisition barriers. In several communities, GIS capabilities had already been developed, so technical issues were more of a minor problem than a major problem.

POLITICAL OBSTACLES AND OPPORTUNITIES

Very few interviewees had faced political obstacles or opportunities. One community indicated that it has an extensive interface risk and its use of wildfire maps had assisted the community in leveraging additional fuel reduction dollars. In another case where the program was implemented by a non-profit organization, the software facilitated the development of partnerships between federal, state and local entities which helped in making the local political system function more effectively.

CONCLUSIONS

For the most part, the findings of the surveys and in-depth interviews supported the Potential Program Outputs that were identified in the Logic Model. The key findings that can be drawn from these inputs are:

- Participants found the Firewise Workshops, printed materials, and site visits to be the most useful training and technical assistance components of the program;

- Staffing was an obstacle to implementing the program;

- Most technical implementation problems were relatively minor;

- Communities benefited by being able to address broad-based community issues;

- Needs and uses differ significantly between large incorporated communities and small, rural communities; and

- Program created opportunities to partner with other entities and share information with the public.

The following table illustrates with specific examples how these potential outputs materialized in participating communities. The most significant finding from this evaluation was that communities did not necessarily use the software as was intended by the Firewise program, but the ways in which they did use the software provided multi-objective community benefits that far exceeded the program's expected outcomes.

Table 4-15. Community examples of program's logic model outputs

Potential Program Outputs	Community Examples
Interactions with partner agencies and stakeholders	Swan Valley Ecosystem partnered with various public and private agencies to complete interdisciplinary watershed level planning efforts including wildfire risk assessment.
Increased wildfire risk awareness among stakeholders and the public.	Sedona Fire District uses map products to make local politicians and decision makers aware of wildfire risk.
Improved state and local plans and policies	Sedona Fire District uses software to develop a Wildland Urban Interface (WUI) Map that will support a WUI Code that applies more stringent building codes in WUI zones.
Greater understanding of the factors contributing to wildfire risk.	Ozark Scenic Riverways used the software to complete individual home assessments that identified structural ignitability risk factors.
Greater understanding of multiple approaches to reduce wildfire risk	Castle Valley Fire Department used the software to identify different ways to reduce the community's risk of wildfires.
Grants and new funding sources to reduce risk.	Sedona Fire District used maps of fuel treatments to document match and to justify additional grant funding for fuel reduction projects.
New uses for the technology	Nearly every community interviewed used the software for more than wildfire mapping. Example uses include: • Emergency response mapping; • Watershed planning; • Land-use and community development; • Public outreach.

This section describes in detail the key findings from the various project inputs and provides recommendations to accompany each of the key findings.

KEY FINDINGS AND RECOMMENDED ACTIONS

The use of GIS systems and technology can greatly enhance the wildfire mapping and risk assessment process by allowing the end user to spatially visualize the risks. The map outputs ultimately assist communities to direct limited mitigation dollars to the most vulnerable areas, ensuring that mitigation dollars are being spent effectively. More accurate risk assessments can also assist communities make better decisions about where future development should take place.

The following is a summary of the key findings about the implementation of the Firewise ArcView Program based on the results of the program logic model, documentation of program implementation, survey, and stakeholder interviews. Beneath each key finding are several recommended actions that can be taken to improve upon obstacles or take advantage of opportunities regarding implementation of the Firewise ArcView Program. The recommendations are aimed at either participating communities or the Firewise program in general.

FINDING: Staffing was an obstacle to implementing the program. Survey respondents averaged 2.3 staff members using GIS and 0.93 staff members supporting GIS use. Respondents most frequently cited insufficient staffing or staff time as an obstacle to implementing the program. Eight communities indicated that their staff lacked of time to learn to use ArcView and six communities had insufficient local staff to implement the program.

RECOMMENDATION(S):

1. *Communities*: Identify and partner with state agencies that have existing GIS capabilities that could provide assistance to communities when local staffing is limited.

2. *Firewise*: Identify existing jurisdictions and local, regional and state departments or entities with existing GIS capabilities that might be able to provide Firewise ArcView mapping services for communities with limited staff and GIS capabilities.

3. *Firewise*: Work with participating communities to identify potential "mentor communities" that could provide assistance to other participating communities.

4. *Firewise*: Continue to provide Firewise staff support for participating communities to assist local communities with limited staff resources.

FINDING: Most technical implementation problems were relatively minor. Communities experienced few major technical implementation problems. The most common minor technical problems with implementation were related to data, such as maintaining, acquiring, accessing, manipulating, and sharing data.

*RECOMMENTATION(S)***:**

1. *Firewise*: Establish a Users Group for the Firewise ArcView program that would be organized similar to HAZUS Users Groups and could be hosted and implemented through the existing Firewise website. This Users Group would provide a platform for communities to share information and resources on commonly experienced technical problems.

2. *Firewise*: Provide resources and training on data acquisition, maintenance, and storage through Firewise website using webcast technologies when available.

FINDING: Communities benefited by being able to address broad-based community issues. The logic model predicted that communities would experience a number of potential wildfire related outcomes. The interviews indicated while not all communities utilized the software the way in which it was intended, outcomes exceeded expectations because it provided communities with a tool to address multiple community issues such as community development, watershed planning, and emergency response. Communities were able to utilize the software to increase their local capacity for emergency response activities including structural fire protection and emergency medical services. Access to local data on home location and condition has allowed several communities to decrease their average response times in emergency situations. Additional information about the unique ways in which communities utilized the software is provided in individual Case Studies found in Appendix A.

RECOMMENDATION(S)

1. *Communities*: Identify ways in which the software could be utilized to address additional community issues beyond wildfire mitigation.

2. *Firewise*: Advertise the software's versatility as a selling point in future workshops or marketing efforts on the Firewise webpage.

3. *Firewise:* Utilize the Community Case Studies in marketing efforts to highlight the multi-objective value of the software.

4. *Firewise:* Provide training to communities with existing GIS capabilities on the uses of the software beyond wildfire mapping. Connections can be made with existing federal natural hazard planning initiatives such as the Pre-Disaster Mitigation program,

the National Flood Insurance Program, and the Healthy Forest Restoration Act.

FINDING: Needs and uses differ significantly between large incorporated communities and small, rural communities. The interviews highlighted an important key finding about local capabilities and community size. Training needs and the actual use of the software varied dramatically between communities that had existing GIS capabilities and those that lacked those capabilities. These diversified needs make flexibility and creativity in the implementation of the program important. Smaller jurisdictions have much greater financial burdens when it comes to paying for continued technical support and maintenance through ESRI.

RECOMMENDATION(S):

1. *Communities*: Where communities have limited staff and financial resources available, develop regional partnerships with neighboring jurisdictions or regional entities, such as Council of Governments or Watershed Councils to share one software license in an effort to spread the maintenance costs across several agencies.

2. *Firewise*: Encourage communities with greater capabilities and knowledge of the program to provide assistance and training to those communities who need additional assistance.

3. *Firewise:* Provide specialized training geared towards community's capabilities – more basic operations content for smaller communities, and more robust training on extensions for those with greater capabilities.

4. *Firewise*: Provide a quarterly training series to communities on a step-by-step basis so that in the first quarter, communities learn a basic skill and then go back and put that skill to use. In the second quarter, communities would receive training on a new skill set and so on and so forth.

5. *Firewise*: Provide training on loss estimation software such as HAZUS, CAMEO, or CATS to communities developing all-hazard mitigation plans or other risk reduction related plans.

FINDING: Program created opportunities to partner with other entities and share information with the public. Communities interviewed shared details about how the software became a tool to create partnerships with federal, state, and local agencies and private/non-profit organizations. In many cases these partnerships lead to better products and the identification of issues that would not have been generated by one entity alone.

RECOMMENDATION(S)

1. *Communities*: Partner with community organizations to identify strategies to better community with the public and stakeholders about wildfire risk utilizing the map products developed with the program software.

2. *Firewise*: Develop and provide training on how to use mapping products to talk to the public and/or elected officials about risk.

3. *Firewise*: Develop community-based best practices for using ArcView products to communicate risk to the public.

4. *Firewise*: Distribute best practices to communities interested in participating in the program.