Title: Dynamic GIS-Based Integrated Planning Template for Communities at Risk

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Abstract

Communities and counties throughout the United States face a growing challenge of preserving their community values, watersheds, property and infrastructure from unpredictable and potential threats including terrorism, disasters and global climate changes. Federal, state and regional governments and agencies seek collaboration, coordination and community based solutions, however existing planning and reporting processes often lack the dynamic, multi-jurisdictional, integrated planning, and community consensus-building required to maintain a consistent and sustainable planning process.

This paper will identify a GIS-based planning template that promotes collaboration and integration at the community, county level to produce an integrated planning process that blends these various challenges into a coordinated planning process that empowers community involvement and consensus-building. The core features of this approach requires the use GIS for effective visualization, constraint analysis and spatial assessment, in addition to the use of ArcIMS to establish a community geography node for information dissemination, distribution and sharing.

Technology changes often radically changes how our government, businesses, and communities interact, however this transition is not always as dynamic in the short term as the technology change supports due to entrenched and accepted processes of interaction. The cumulative benefits of web-based communication, GIS technology and explosion of available geospatial data, hardware, and software resources available to a wider community of users radically alters the baseline information needed to manage our natural resources, land use and communities. Web-based information centers, data warehouses, geography networks and nodes have created a virtual and dynamic library of information resources. Geographic Information System technology is required to manage this wealth of information, conduct complex spatial analysis and translate this information into site-specific, and easily to understand visualizations. Just as language translation software allows users of various languages to interact, GIS technology allows various disciplines and levels of expertise to interact.

Purpose of Template

The primary objective of emergency, disaster and fire response agencies or first responders is typically to protect life and property. A few land management agencies with wildland fire protection responsibilities

such as the U.S. Forest Service (USFS), Bureau of Land Management (BLM), Bureau of Indian Affairs (BIA) or National Parks Service (NPS) add the protection of resources to their mission statement. The Federal Emergency Management Agency (FEMA) bases its recovery and pre-disaster mitigation funding on benefit-cost ratios that are heavily weighted towards the protection of human life, business operations and community infrastructure. Most state, county or local fire agencies or fire districts are primarily response agencies and not land managers, effectively separating the fire suppression objectives ("protection of life and property") from the land management objectives ("resource protection, land use, community values").

Our countries emergency response agencies benefited greatly from the communications, technology and crisis management advancements of the twentieth century that can be attributed primarily to our military organizations and challenges. Often our emergency response is so effective that we do not see the unintended consequences or potential conflicts with individual rights, resource protection or community values. Following many devastating conflagrations, response agencies often point at resource management considerations as obstacles of effective fire protection.

In wildland fire response most agencies are effective in suppressing 98% of wildland fires during initial attack or controlling within the early stages of extended attack operations. Fire agencies have learned to cooperate, communicate and coordinate during fire incidents. The public education campaigns have been effective in reducing potential ignitions while providing tools to assist homeowners establish defensible space areas around their homes that provide fire fighters the necessary space to be effective in protecting structures. However, most of the structure losses occur during catastrophic events that reflect the remaining 2% of incidents. During the Blue Ribbon Commission hearings following the 2003 Southern California Firestorm, one fire expert stated that the agencies are successful in their mission over 98% of the time, however the remaining 2% of wildland fires represent the catastrophic fires that are unpredictable and uncontrollable due to high intensity fire behavior and rapid rates of fire spread.

What is predictable about wildland fire conflagrations are that they usually occur under extreme fire weather conditions where fire control is difficult or beyond the initial attack response capabilities of the local resources. Any additional ignition under these extreme conditions has an even greater potential to exceed the local initial attack resources as resources are stretched thin. Fire agencies are very proficient at mobilizing additional resources from adjacent areas or regions, however this draws down available resources over a wider area. Large conflagrations can often fully deplete available resources. In addition to the initial attack, extended attack and catastrophic fire responsibilities that deplete available resources, the high intensity and rapid rates of spread of these fires overwhelms not only fire control but also places extreme pressures on the evacuation process of the community. Resources dedicated for wildland fire

control may be further challenged to protect lives, while the clogged roads limit the accessibility to structures at risk or slow the access to key areas for wildland fire control. In addition, even homes with defensible space are placed at increased risk as the numbers of structures at risk far outnumber the availability of engines or fire suppression resources. Large conflagrations expose inadequate land use planning considerations when roads prevent effective evacuation (egress) or fire suppression access (ingress), structures are located too close to areas where high intensity fire behavior will occur, or where land management on adjacent properties or land contributes to the intensity, spread and high resistance to control of the conflagration. Under these scenarios, the protection of resource values such as watersheds, sensitive habitat, riparian drainages, and other values becomes problematic, a lower priority or even unfeasible.

The protection of watersheds, habitat, resources and other community values may not be feasible during these conflagrations and will therefore require an approach that looks for solutions before the incident occurs. This type of proactive planning does not have to be limited to just fire management planning and greatly benefits from a more comprehensive collaboration process. Due to the vast amount of information available and necessary to integrate the wide array of land management, land use, resource management, recreational or community development planning, information management systems become critical and spatial analysis becomes vital to the process.

Planning and GIS Resources in the Rural Landscape

While this paper's concept is applicable to any integrated planning process or wide variety of planning, the untapped power of this technology advancement can best be illustrated by the issues facing the wildland fire planning process. Fire is the natural agent of change on our landscapes, yet fire management plans are often produced in a separate vacuum from related planning processes such as land management plans, watershed management plans, resource management plans, disaster mitigation plans, land use plans, general plans, development plans, recreational plans that all directly impact the risk, hazard and threats from wildland fire. Jurisdictional boundaries often serve as planning boundaries, however wildland fire does not respect these boundaries. The most appropriate planning boundaries for fire management are watersheds or topographic in nature that require a multi-jurisdictional approach.

While GIS-based systems have played a significant role in fire planning the primary benefits to date have been focused primarily on providing fire and emergency management agencies or districts with tools that enhance deployment and dispatching policies or strategies, predict incident patterns and emergency response timeframes and effectiveness. An watershed based template must identify planning boundaries where wildland fire control can be expected, and sub-boundaries based on natural barriers to wildland fire,

thresholds of control or other areas where wildland fire control is feasible effectively establishing compartments within the planning area.

The vast amount of information required to minimize terrorism and maximizing Homeland Security protection since September 11, 2001 has contributed to the increased need for GIS-based software and information databases. While heavily weighted towards emergency response and deployment, much of this assessment also identifies values (physical, economic, historical, cultural, environmental) that require additional levels of protection. Utilization of GIS within large urban centers or communities with considerable GIS resources, skilled expertise or information databases can make the most cost-effective use of these resources, however a commonly expressed concern is how to deploy, maintain and support similar processes for rural communities or across our rural landscapes. The protection of our nation's natural, physical, recreational and cultural resources require a multi-disciplinary, integrated process supported by a similar investment in GIS data collection, inventory, analysis and warehousing.

While the benefits of GIS technology has been heavily focused towards large urban centers where GIS technology is both available and cost-effective, the increasing investment of geographic information relating to our rural landscapes provides the foundational or necessary baseline information to develop similar assessment processes and information databases resulting in a spatial inventory of our nation's values. In recent years, there have been significant advancements in the use of GIS to map, assess and analyze the topography, fuels and arrangement of our landscapes to enhance fire behavior and fire spread modeling. Increased access to seamless and higher resolution satellite imagery and datasets significantly enhance the topography and vegetation dependent assessments.

Rural landscapes are often an intermix of federal, state, county and private landholdings that vary in regulatory requirements, land management plans, and fire management planning significantly increasing the potential conflicts between dramatically different lands management objectives sharing a common boundary. This mix of ownership, direct protection areas (often assigned by land ownership), differing management strategies increases the complexity of collaboration, while stretching limited resources beyond their capabilities.

Federal funding often is directed to the state level and then allocated down to county or community levels, however rural communities often struggle in competition for this funding. County governments face increasing challenges to stay eligible. For example, Pre-disaster mitigation grants require the completion of a Disaster Mitigation Fund, Healthy Forest Act and National Fire Planning grants require approved Community Wildfire Protection Plans, Homeland Security Funding, Environmental, Habitat Management, Watershed and other planning processes require similar planning processes to be eligible for funding.

Some of these rural counties are struggling to stay current on their land use or General Planning processes. County Boards of Supervisors or rural community districts must choose selectively which of these objectives can be effectively accomplished.

Comprehensive Approach to Meet Rural Planning Objectives

The development of an internet-based template integrated with web-based GIS mapping and analytic tools is intended to offer rural communities a dynamic tool to organize and integrate this wide array of planning requirements that will transition into a dynamic planning document for assessing current land use decisions and enabling a multi-disciplinary reporting function to meet the variety of existing reporting requirements.

The development of this template starts with a baseline template that organizes existing planning guides, GIS data warehouses, codes, regulatory requirements and web-based resources that help organize the wide array of information available to almost all communities. The web-based template stores or links to all local information that may be utilized during the planning process. In **Phase I** two teams (Community Planning Infrastructure Team, GIS Infrastructure Team) are formed. The Community Planning Infrastructure team is charged with identifying all existing local planning or relevant state and federal mission statements, regulations, codes, plans, guiding documents, and value to be protected within the identified planning landscape. The GIS Infrastructure Team should have at least one representative from every local agency or entity that utilizes GIS. The team will identify all local GIS data and analysis available to the integrated planning process. In Montana the GIS group was formed first and was invited to showcase this collaboration (Seeley-Swan) at the 2003 Western Governor's Conference. A similar planning and governmental coalition was then developed to build on the success of the GIS led collaboration. ESRI was a key partner in this collaboration effort. This model has been utilized to initiate collaborative planning processes in other states. In many cases these additional collaborative efforts work primarily at the agency level ignoring the strength of the original model, the community and local planning processes where land use decisions are made. The steps integrated in the template help to ensure the maximum amount of partnerships. The local Firewise Community, Fire Safe Council, Resource Conservation District or other community organizational structures can also be utilized to facilitate and identify all the necessary partnerships.

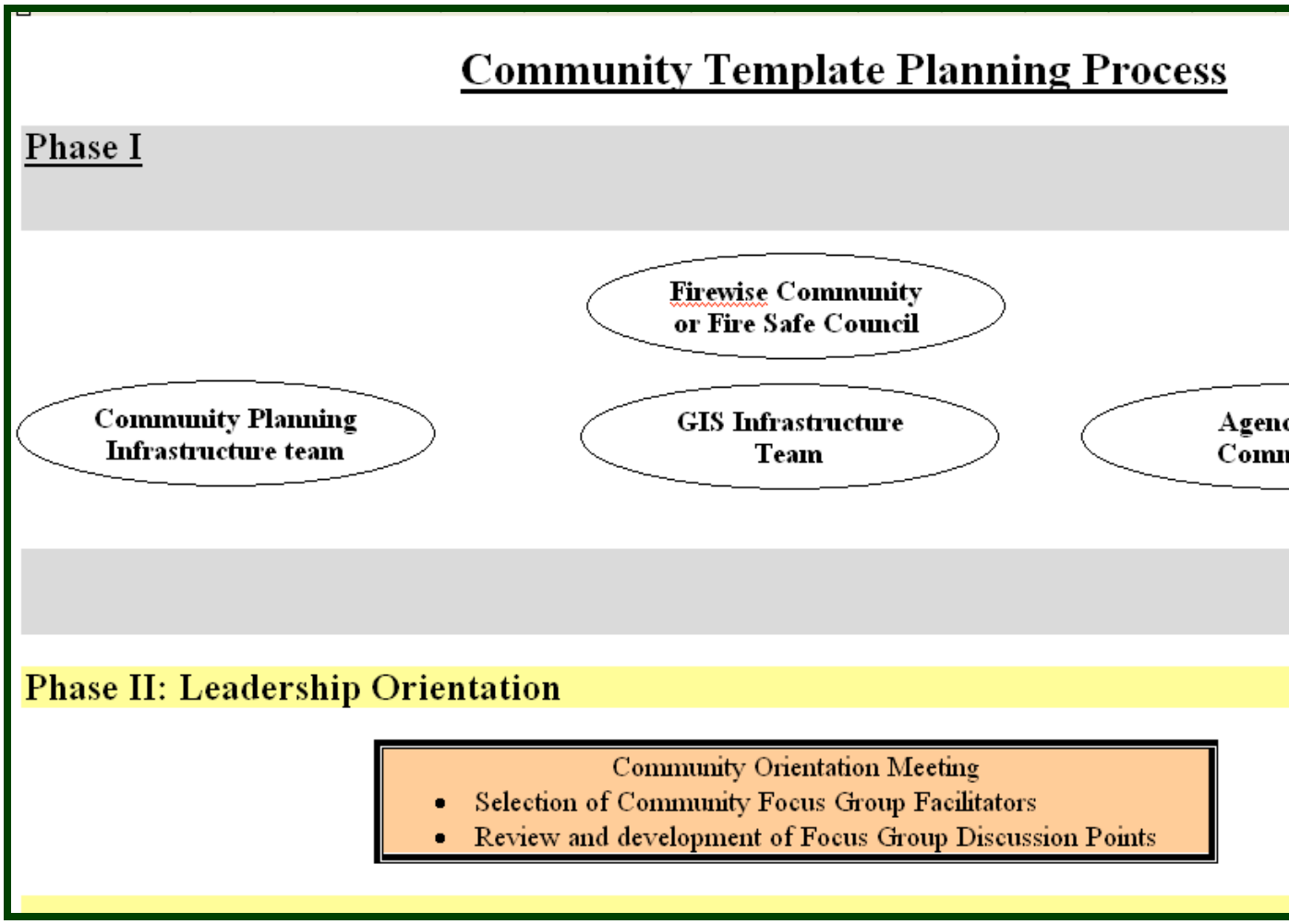

Figure 1:

The planning process is designed to be dynamic and utilized with an adaptive management approach. Updates evaluate only the significant changes or areas that have been impacted by a major disturbance such as a wildland fire, flood, earthquake or regulatory change. **Phase I** and **Phase II** are the most difficult steps in the initial planning process; however once the planning process is established future applications of the planning process only have to consider the new information or impacts from the disturbance. The final phase of this planning process assigns monitoring responsibility of keeping this information current to the most appropriate agencies or entities. This last stage serves as a feedback loop to **Phase I** for future planning applications.

The information is stored in a drop-down menu format where resources can quickly be accessed for each step of the planning process (See Figure 2). When integrated with a local community web-server this drop down menu can be more easily negotiated with an interactive web site and hyperlinks that expedite movement through the document.

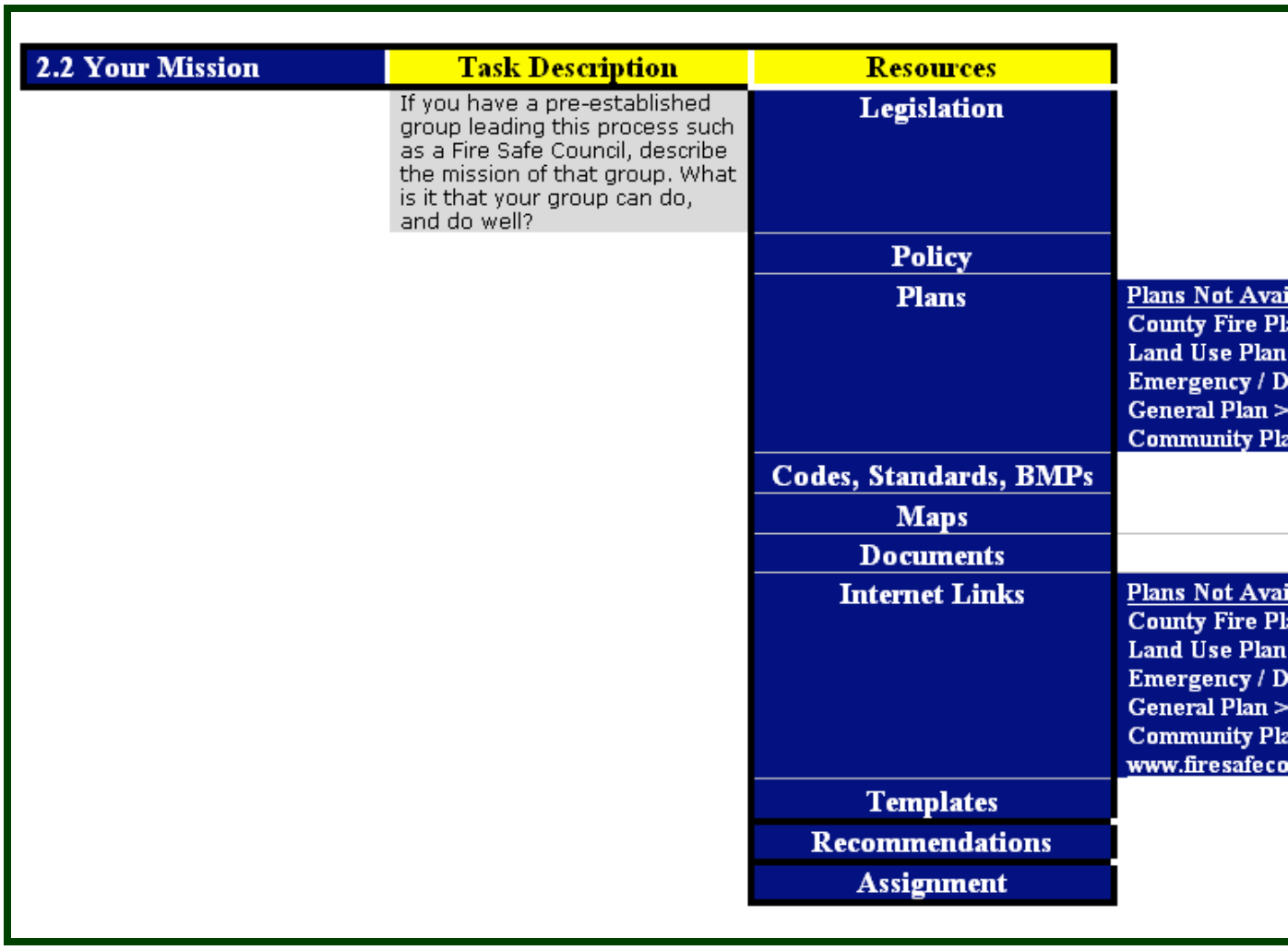

Figure 2

The information stored in this document goes through three stages baseline, planning and implementation. The baseline stage stores key links to websites, documents, planning guides, codes and relevant sources of planning information. The baseline model also includes examples of model plans for each of the planning steps. In **Phase I**, the Community Planning and GIS Infrastructure teams utilize the baseline model to identify where this information can be enhanced or replaced with more site-specific or local planning resources or can be more effectively displayed by GIS mapping. Once this information is collected and integrated both teams meet with key community leadership or planning workgroups in **Phase II** to modify the baseline task descriptions and evaluate if all the relevant information has been collected. During the implementation stage, all relevant information sources are identified as assigned to the appropriate jurisdiction to monitor and maintain this information. This protects the autonomy of the agencies, utilities or planning processes responsible for producing this information and analysis.

By this point in the planning process the amount of relevant planning information and mapping resources should be extensive and beyond the assessment capabilities of an individual workgroup consisting of

agency representatives. GCS Research located in Missoula, Montana has developed a .NET application called **Landview** that consumes dynamic geospatial Web services across the internet, and compliments these services with user-friendly web-based mapping functions and specific data layers from external servers. This product can serve as a valuable framework-mapping tool for an Internet based planning template serving as an organization tool in Phase I and a user-friendly mapping resource for the remaining planning Phases.

The second step in **Phase II** is to identify Focus Group classifications for **Phase IV: Community Workshop** and assignments of template tasks for each Focus Group (See Figure 3). Multiple groups may be assigned the same individual task. A set of planning questions or considerations will be developed and assigned to each Focus Group for consideration. Additional information or mapping needs to complete each of the assigned tasks are identified and assigned to the relevant contacts. In **Phase III: Leadership Orientation** the Community Planning Group gathers together key land managers, agency representatives and community leaders to verify that each Focus Group is properly established, questions appropriate and the information necessary has been collected. This step protects the autonomy of other local planning and agency land management processes based on an Incident Command System planning process. Facilitators are selected for each Focus Group.

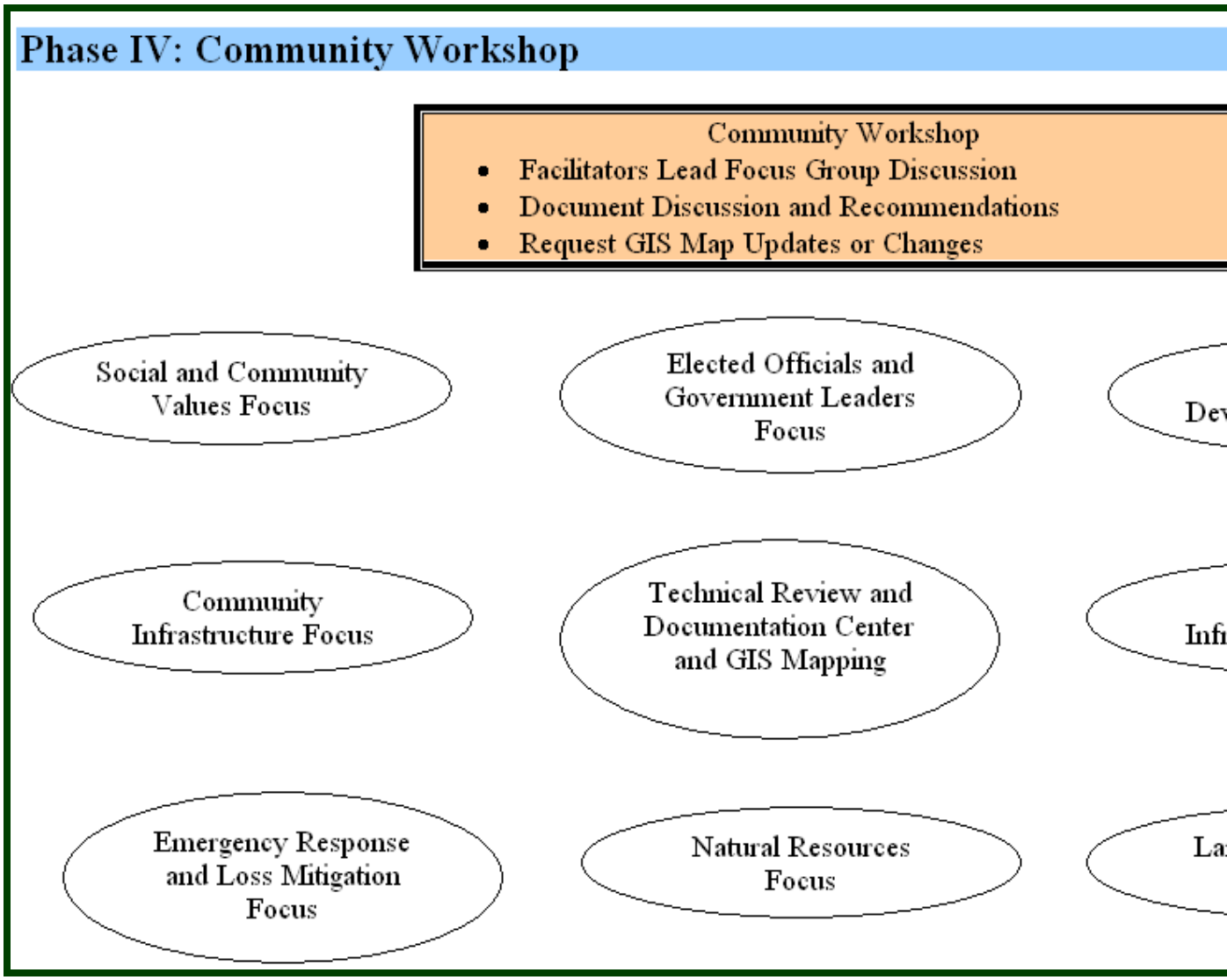

Figure 3:

During **Phase IV**, the community workshop process the Infrastructure Groups established in **Phase I** serve as the nucleus for the collection and distribution of communication, exchange and mapping needs between Focus Groups. During **Phase IV** the examples within each Planning Template Tasks will be replaced by the proposed documentation developed during the community workshop.

The collaboration process expands rapidly in the first four Phases and reaches its peak during **Phase IV Community Workshop**. Following this stage the process is narrowed down to develop strategies, agreements and complete the planning process. To ensure maximum exposure and collaboration, this process can be linked to the web to allow the entire community to monitor the process and add comment. Each Focus Group can develop representatives to participate in the final stages (Figure 4).

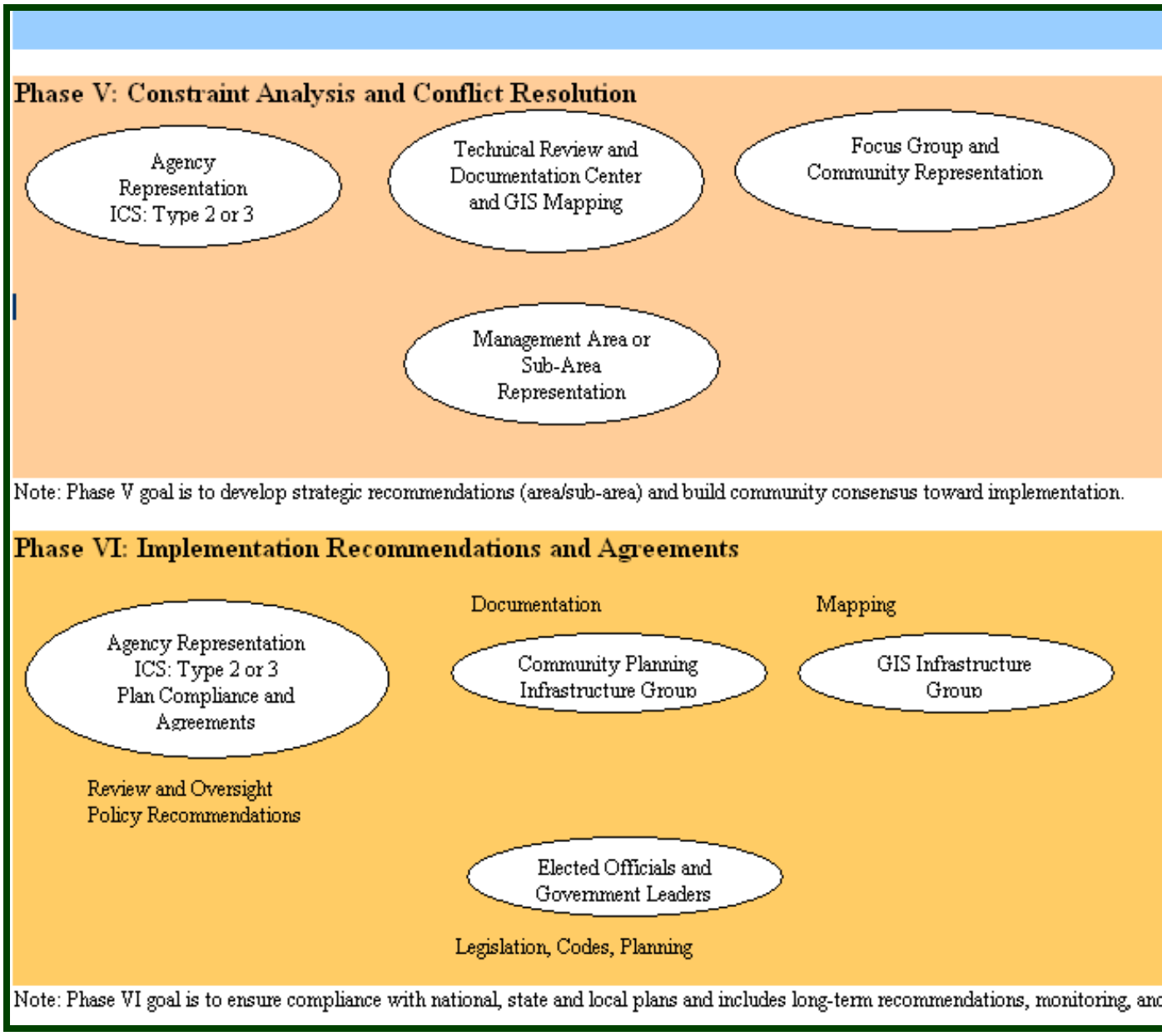

Figure 4

The Focus Group recommendations combine with GIS mapping and analytic tools to serve as the framework-planning document to negotiate through the final Phases of the planning process. **Phase V** serve to rectify and develop consensus building strategies that address the unresolved issues surfacing from the community workshop process.

Phase VI will vary dramatically dependent on the structure of the local land ownership, management and political infrastructure.

As the focus of this process is multi-jurisdictional the planning boundary and recommendations should be watershed based. Fire management strategies can be integrated into this style of planning by developing watershed and topographic based compartments with boundaries consistent with wildland fire control. This will allow for various resource management prescriptions, strategies or direction for each compartment.

The overarching goal an integrated watershed based planning process is for the purposes of achieving long-term protection these watersheds. Five major objectives for achieving this goal are to:

1) Respect the management autonomy, regulatory requirements, mission statements and vision of the participating entities and local land and resource managers.
2) Develop community consensus, policy and technical collaborative planning guidance to be utilized by local entities, planning groups, land managers or community decision makers while preserving the relevant management autonomy.
3) Developing a comprehensive community/watershed planning document that interlinks all local planning documents, community and watershed assessments, and develops a consistent and common community vision.
4) Ensure a commitment to a dynamic long-term collaborative planning process using an adaptive management approach for short-term adjustments.
5) Reevaluate planning process for effectiveness.

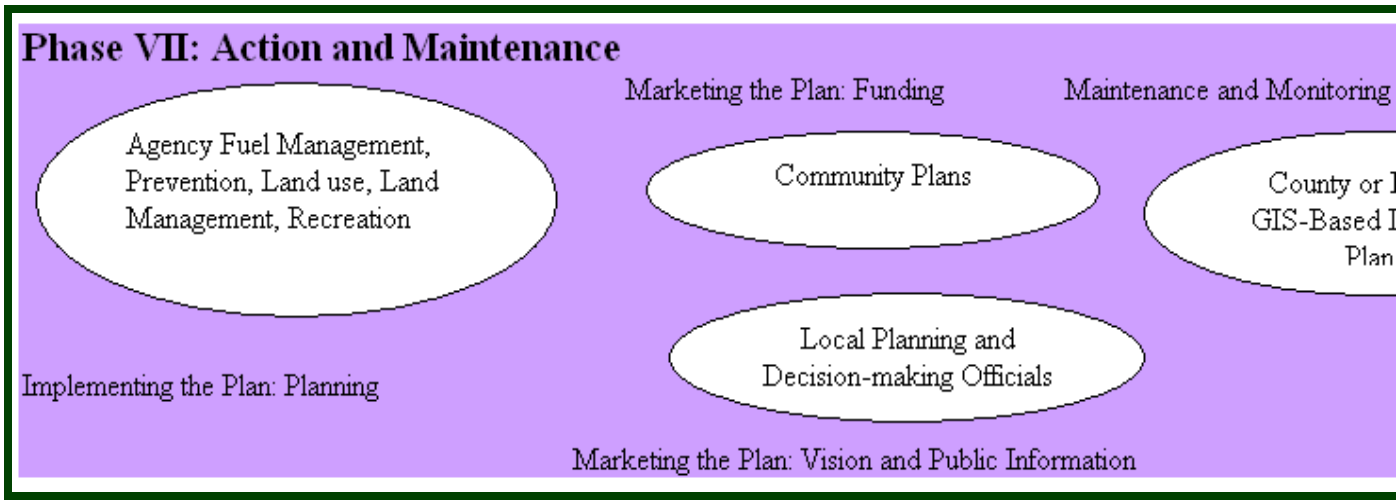

Figure 5

When the template tasks are completed, documented and mapped for each of the identified tasks in the comprehensive planning process and implementation strategies developed the web-based template framework serves as the dynamic plan. Individual task items can be assigned as core elements for various grant and management report processes. Individual elements of the plan can be dynamically updated as appropriate. The planning process can be repeated periodically when significant planning considerations, a major disturbance or a new reporting function is required.

Rural communities and counties struggling to make decisions on which planning requirement to bring consistent would be empowered by a dynamic process that allows them to meet all objectives (Homeland Security, Disaster Mitigation, Healthy Forest, Watershed Planning, Habitat Management, Community Development, etc.) in a single collaborative effort. Local decision-makers using the baseline mapping

This system also serves as a “Field of Dreams” approach to grant eligibility, “If you build it…they will come” as the community maintains maximum eligibility for any type or source of of grant funding.

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