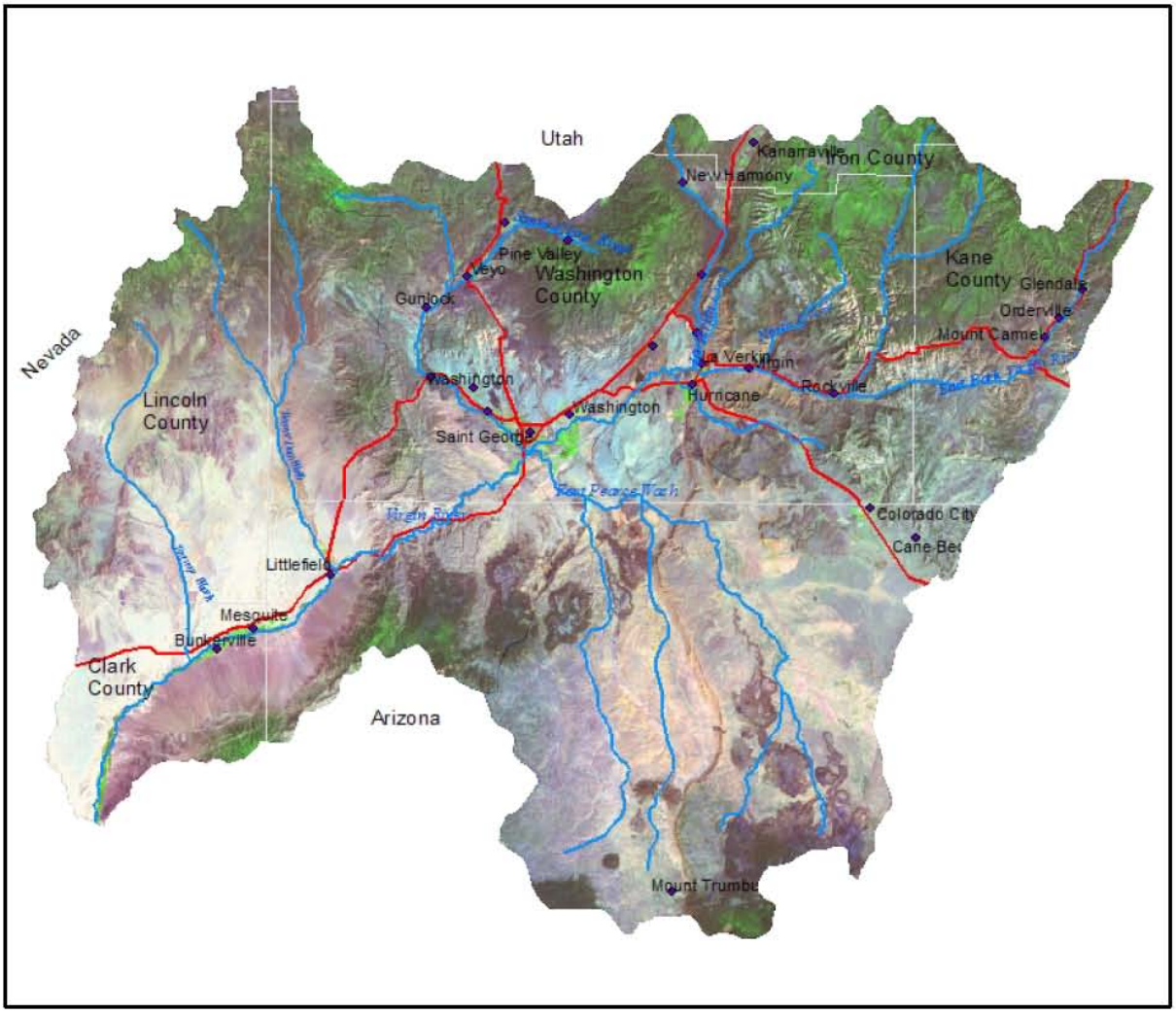
VIRGIN RIVER WATERSHED - UTAH, ARIZONA AND NEVADA

COMPREHENSIVE WATERSHED ANALYSIS



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1. INTRODUCTION

The 2006 Energy and Water Development Appropriations Act (PL 109-103) directed the Secretary to conduct, "at full federal expense, comprehensive analyses that examine multi-jurisdictional use and management of water resources on a watershed or regional scale". The Comprehensive Watershed Analysis of the Virgin River Watershed in Utah, Arizona, and Nevada is one of five federally funded watershed studies conducted in response to that legislation.

In carrying out the analysis, the U.S. Army Corps of Engineers (USACE) worked in close partnership with local and county governments, tribal, state and federal agencies, municipalities, landowners, citizen groups, nongovernmental organizations and the public to produce a watershed plan that assists stakeholders in successful management of the Virgin River and tributaries and related resources.

This document describes the watershed and findings of this watershed analysis. It includes a summary of watershed issues and planning objectives as defined with stakeholders, describes the study results, and products developed. It also includes a description of lessons and challenges from this watershed planning effort.

2. WATERSHED DESCRIPTION

The Virgin River's headwaters are in Washington, Kane, and Iron Counties of Utah. The lower watershed includes portions of Mohave County, Arizona and Clark and Lincoln Counties, Nevada. Figure 1 displays the watershed vicinity in Southwest Utah, Northwest Arizona, and Southeastern Nevada. Major tributaries to the Virgin River include: East Fork Virgin River, North Fork Virgin River, North Creek, La Verkin Creek, Ash Creek, Santa Clara River, Fort Pearce Wash and Beaver Dam Wash.

Figure 1 Watershed Vicinity

Forty eight percent (48%) of the watershed is in Utah, thirty four percent (34%) in Arizona and eighteen percent (18%) in Nevada. The entire watershed covers approximately 5,900 square miles. The study area is defined by three 8 digit hydrologic units (HUC) including the Upper Virgin

River (15010008), Lower Virgin River (15010010), and Fort Pearce Wash (15010009).

2.1. Land Ownership

Most of the watershed is under public management. This includes lands managed by the Bureau of Land Management (BLM), National Park Service (NPS), U.S. Forest Service (USFS) and Bureau of Reclamation (BOR). Table 1 below displays land ownership and acres. While the majority of lands in the Arizona and Nevada portions of the watershed are BLM managed, Dixie National Forest includes the northern most portion of Washington County, UT and Zion National Park is near the headwaters of the Virgin River in eastern Washington County.

Table 1 Land Ownership within the Watershed

Ownership	Acres	%
Bureau of Land Management	2,565,721	67%
Private	535,002	14%
US Forest Service	295,112	8%
State Trust land	217,867	6%
National Parks/Monuments	149,329	4%
Tribal	33,697	<1%
Bureau of Reclamation	13,856	<1%
State Park/Recreation Area	7,535	<1%
State Wildlife Reserves	578	<1%
Total	3,818,697	

The BLM manages sixty seven percent (67%) of the lands in the watershed, followed by USFS, State Trust, and National Parks, respectively. Merely fourteen percent (14%) of the lands within the watershed are privately owned as depicted by the purple in Figure 2.

2.2. Population

The watershed has been experiencing a significant level of development and population growth. Much of this development is occurring in lowland areas adjacent to floodplains and high flood hazard areas, which are also critically important habitats for protected and sensitive wildlife species. From 2000 to 2007, Nevada, Arizona and Utah had the top three population growth rates in the nation.

Current population in the watershed is approximately 200,000 and is projected to grow significantly in the future. The population in the Utah portion of the watershed was approximately 100,000 in the 2000 Census and is projected to be 425,000 by 2030 and 877,000 by 2060. In the lower watershed it is estimated that the current population of 17,000 could grow to 60,000 by 2021.

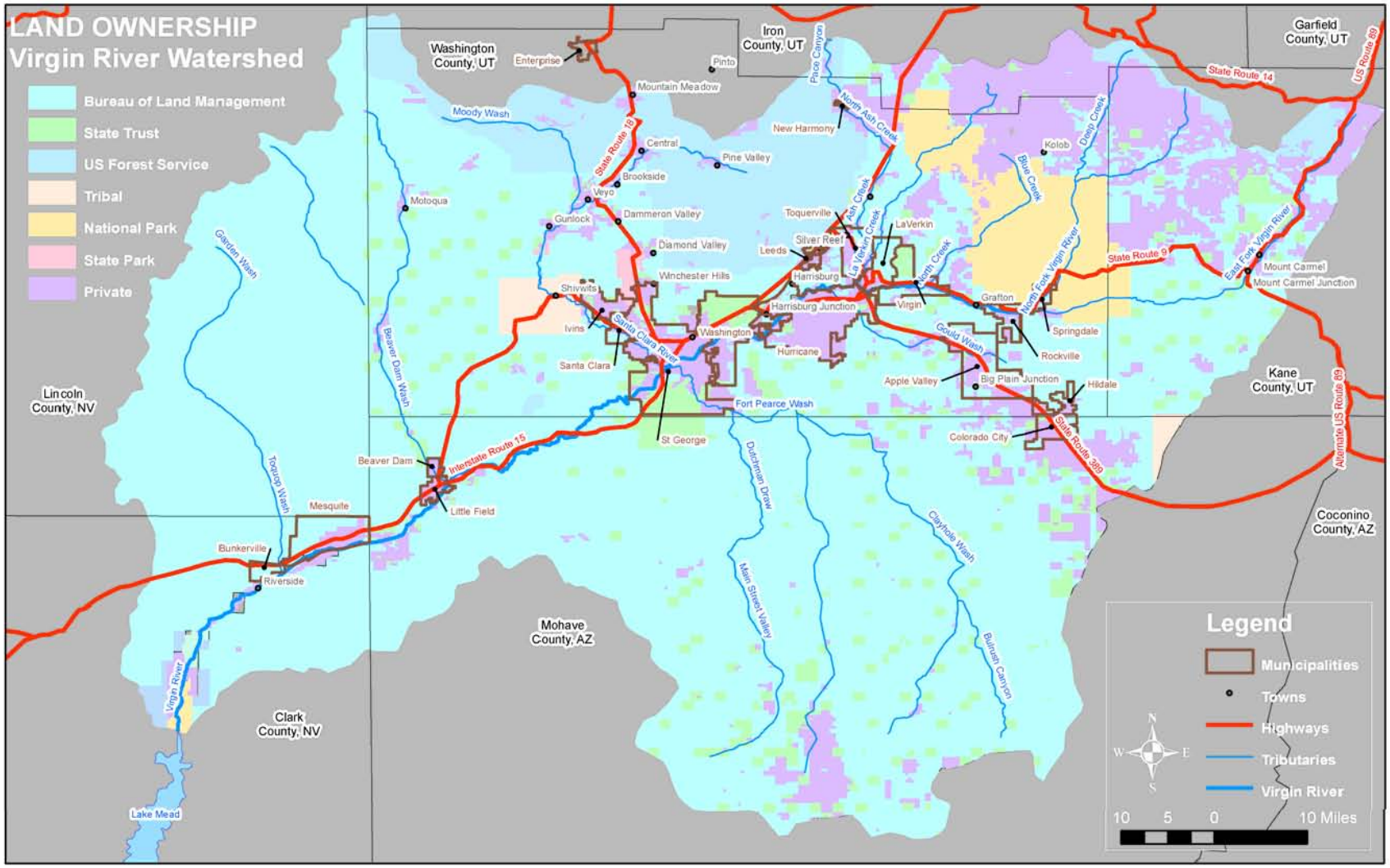

Figure 2 Land Ownership in the Virgin River Watershed

2.3. Landscape

The watershed spans a diverse range of elevations and land cover from over 10,000 ft. high mountains in Southwest Utah to the Mohave Desert at nearly 1,200 ft. Higher elevations receive from 25 to 35 inches of precipitation annually and support conifer and aspen Forests. Middle elevations support both mountain shrub lands and Pinion/Juniper forests. Figure 3 is a photo of forested mountains and grass pastures in the vicinity of Pine Valley, Utah.

Figure 3 Vicinity of Pine Valley, UT

Lower elevations within the watershed are semi arid to hot desert rangelands and receive as little as 4 inches of precipitation annually. Figure 4, taken near Beaver Dam, Arizona depicts the Mohave Desert ecosystem with Joshua tree forest and creosote shrub lands.

2.4. Ecosystem

This arid watershed spans the intersection of three physiographic regions including the Colorado Plateau, the Great Basin, and the Mojave Desert. The Virgin River crosses nearly 150 miles uninterrupted from the mountains above Zion National Park to Lake Mead and is the only intact river in the Mojave Desert in Nevada.

Figure 4 Vicinity of Beaver Dam, AZ

As one of the largest riparian corridors in the desert southwest the Virgin River is home to more than 200 species of wildlife, which utilize the corridor as a residence or seasonal migration route. It is important habitat for several federally endangered species including the woundfin, Virgin River chub, southwestern willow flycatcher and Yuma clapper rail. With its relatively good remaining habitat

and service as a migration corridor, the Virgin River in Nevada is designated as an Important Bird Area by Audubon.

3. WATERSHED ISSUES

Watershed issues were prioritized and defined in meetings with stakeholders and focus primarily on issues that affect the watershed as a whole. Although there are efforts ongoing throughout the watershed, most are usually restricted within state or other jurisdictional borders and do not generally apply a watershed perspective. Likewise, there are issues within the watershed that are beyond the scope of a single study or jurisdiction to adequately address. This analysis applies a watershed perspective to analyzing the Virgin River watershed, while recognizing that jurisdictional and political boundaries exist.

3.1. Defining Issues

Stakeholders were asked to help focus and prioritize watershed issues during the study kickoff meeting in St. George, Utah in August, 2006. Nearly seventy people participated in that meeting which included presentations and discussion of issues. A planning exercise was conducted to facilitate discussion and focus the analysis on priority issues. The exercise asked questions of the audience, prioritized answers, and the group summarized and discussed responses. The first question was "*What are the biggest problems facing the watershed*?". Responses were counted to give an estimate of the number of responses for any one issue area and are presented in Table 2.

Table 2 Significant issues facing the watershed.

Issue	Responses
Floodplain management, development, flooding and erosion	31
Invasive species (tamarisk, cheat grass)	29
Development pressure, general land use planning, and sustainability	27
Endangered species habitat	15
Water supply, quality, drought	14
Wildfire and its effects	12
Communication/cooperation (or lack of)	7
Channel maintenance (ability to carry out)	7
Water quality, salinity, storm water runoff	6

Participants listed those responses that were the most important to them and broke into groups to discuss and summarize the numerous issues identified. Following group discussion the top five issues were decided upon: Floodplain Management, Land Use Planning, Invasive species, Water Availability, and River Function (includes habitat, endangered species, channel maintenance).

Those watershed issues as identified with stakeholders and confirmed in review of the numerous reports are listed in Table 3.

Table 3 Top Five Issues Listed By Stakeholders

Issue	Description
Floodplain Management	Floodplain regulations are in place and studies and projects underway throughout the watershed. However, multiple flood risks remain and management of that risk is an ongoing issue with technical, regulatory, environmental, communication, and education needs identified.
Land Use Planning	Communication among agencies and the public has room for improvement, inconsistencies occur across jurisdictions, lack of watershed wide plans, and lack of recognition of the relationships between uplands and floodplains. Rural communities have expressed a need for useful planning tools and data.
Invasive Species	Invasive species include Tamarisk, cheat grass, Red shiner. Although numerous individual efforts to address tamarisk are underway, and some collaboration is occurring, there is no comprehensive watershed scale coordination or sharing of data.
Water Availability	Water supply and water quality are important aspects of the watershed and needs are described in numerous reports. With growing populations and drought the pressures for the finite water supply will only continue to grow. Water conservation, additional water sources, and evaluation of existing sources are discussed as needs. Groundwater and surface water interaction and salinity have also been expressed as areas of concern within the watershed.
River Function	River function is a balance of sediment and water transport that results in channel morphology and associated biotic communities. It includes unusual events and is dynamic. The issue includes habitat, channel maintenance and endangered species, some of which are currently being addressed.

3.2. Overarching Issues

Several common themes pertaining to all of the key issues were also revealed in the course of the analysis, including these:

- Effective watershed management requires better communication and cooperation.

- Improved watershed management requires useful tools and information.
- Borders and jurisdictions can be barriers to collaboration.
- Current funding is insufficient to address watershed issues.

4. STUDY PRODUCTS

Two major products from this study include a Floodplain Management Strategy and Watershed Strategy. Both are strategic plans that describe priorities and recommend various activities to address watershed planning objectives. Implementation of the actions to address the watershed issues may be carried out by any of the multiple jurisdictions, private or non government organizations. It is intended that this overall watershed strategy be the basis for prioritizing and bringing resources together to seek solutions.

4.1. Floodplain Management Strategy

A stand alone report was prepared to address floodplain management, the *Virgin River and Tributaries Floodplain Management Strategy*. It includes evaluation of lessons learned from recent flooding, identification of hazards, existing policies and constraints, and recommends floodplain management measures and tools to be applied within the watershed. Flooding in Beaver Dam, AZ during January 2005 is shown in Figure 5.

Figure 5 Beaver Dam Arizona January 2005

Floodplain regulations are in place and local projects are being implemented to reduce flood risk. However, the risk of flooding is an ongoing issue and changes in the watershed (e.g., development, sedimentation, invasive species, and wildfire) show that there is a need for additional analysis of flood risks and potential damages. Expanding populations also contribute to flood risk with changes to the watershed and possible development in flood prone areas.

Needs and Opportunities

Flood risks and Issues were discussed with stakeholders and needs and opportunities for improved floodplain management in the watershed identified. Those have been categorized as the five topics summarized in Table 4. More detailed description of the issues below is provided in the *Floodplain Management Strategy* document itself.

Table 4 Floodplain Management Needs and Opportunities

Technical Floodplain Delineations Erosion Hazard Zone Delineations Design Standards/Guidelines	**Environmental** Watershed/Habitat Management Fire Management Invasive Species Control Environmental Compliance-Regional
Regulatory Floodplain Regulations Drainage/Erosion Hazard Ordinances Permitting/Regulatory Streamlined Land Use Planning	**Education** GIS Database Public Education Materials Community Outreach Presentations
Communication Contacts Database GIS Database Communication Protocols/Tools Flood Response Plans	

Strategic Plan

Strategic goals were developed from the needs and opportunities listed above. They fall under two primary categories: Improved Communication and Improved Floodplain Management. Risk Mitigation Action items have been developed and are intended to provide floodplain administrators, regulators, agencies, municipalities and engineer a basis for floodplain management decision making.

Table 5 summarizes the mitigation action items, goals/benefits, potential funding assistance and partners. A Compact Disc accompanies the report, and contains several of the items recommended. This includes GIS data, reference data for action items, contact database, model ordinances, scopes of work for hazard delineations, etc.

Table 5 Flood Risk Mitigation Recommendations

What - Mitigation Action	Why – Goal/ Benefit	How – Potential Funding Mechanism
Handbook	Communication – Non-Emergency/ Information Resources	FEMA Pre-Disaster Mitigation Grant Local Jurisdiction operating budget
Public Information Brochure	Communication – Non-Emergency Information Resources	USACE FPMS Local Jurisdiction operating budget
Contacts Database	Communication – Non-Emergency & Emergency/ Information Resources	Provided in Appendix E Local Jurisdiction operating budget
Flood Response Plan	Communication – Emergency/ Flood Warning System	USACE (Section 205) FEMA Pre-Disaster Mitigation Grant
GIS Database	Communication & Management Non-Emergency & Emergency/ Information Resources	Baseline data in Appendix F
Flood Detection Network	Management – Physical System/ Basic Data/ Flood Warning System	USACE (Section 205) FEMA Pre-Disaster Mitigation Grant
Post-Fire Hydrologic Assessment	Management – Physical System/ Basic Data	USACE FPMS, BLM, USGS, NRCS, States
Floodplain Delineations	Management – Physical System/ Technical Resources	FEMA Map Modernization USACE FPMS Local Jurisdiction operating budget
Erosion Hazard Delineations	Management – Physical System/ Technical Resources	USACE FPMS Local Jurisdiction operating budget
Channel Conveyance Conservation	Management – Physical & Regulatory Channel Conveyance	Local Jurisdiction operating budget
Ordinance/ Regulations	Management – Regulatory System/ Regulatory Toolbox	Local Jurisdiction operating budget
Design Standards/ Guidelines	Management – Regulatory System/ Regulatory Toolbox	Local Jurisdiction operating budget
Maintenance	Management – Regulatory System/Toolbox	Local Jurisdiction operating budget
Floodplain Management Steering Committee	Communication & Management/ Non-Emergency & Emergency/Info	Operating budgets: Local, State, Federal

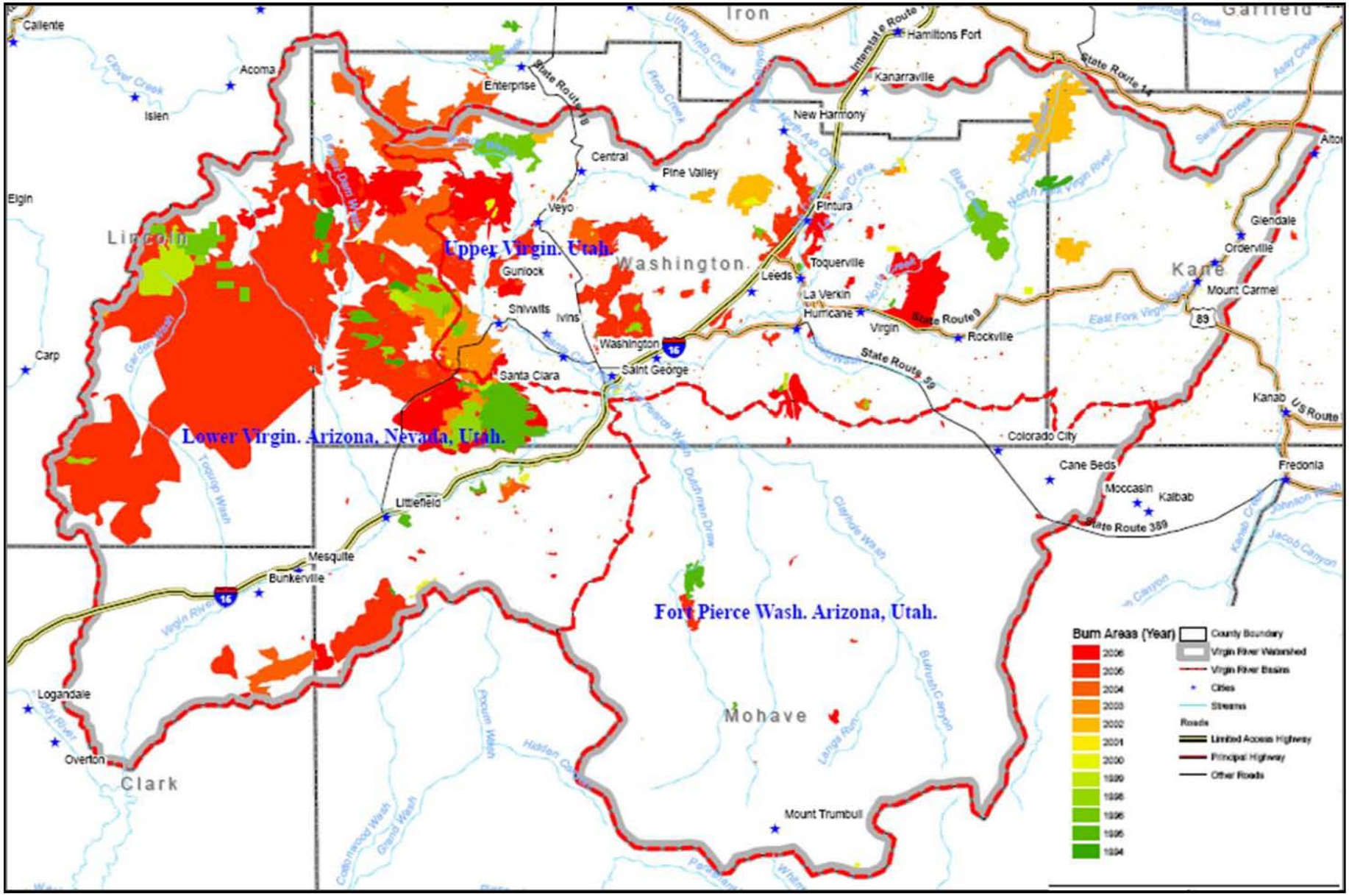

Figure 6 Recent Wildfires in the Watershed (1994-2006)

Flood Risk Mitigation Priorities

Four of the fourteen mitigation actions were listed by stakeholders as priority for implementation in the watershed. The four are described below, with efforts underway to address post wildfire issues and evaluate a flood warning system.

Steering Committee: It is recommended that a steering committee of stakeholder representatives be convened on a regularly recurring basis for the purpose of maintaining effective communication and implementation of floodplain management activities. This could be at a local level, although communication across the watershed with shared issues is necessary to maintain and improve multi jurisdictional communication. State and Federal agencies also need to participate in this steering committee to improve communication of shared issues across the watershed.

Post Wildfire Evaluations: Figure 6 depicts recent wildfires that have burned hundreds of thousands of acres within the watershed. The impacts of wildfire on watershed hydrology are numerous and include: higher peak flows and associated flood risk, debris flow and increased sediment yield, landslides, increase in soil erosion, water quality impacts, etc. The effect of these wildfires on watershed hydrology has not been quantified, although qualitatively there is a potential for increased runoff and erosion.

Under existing authorities and funding Federal land management agencies complete Burned Area Emergency Response (BAER) and Emergency Stabilization and Rehabilitation (ESR), to the extent possible. However, quantification of downstream watershed impacts, including flood hazard assessments, is not a routine a part of this. Communication of post wildfire conditions, data and report availability have been raised as issues on several occasions. Although Federal agencies disseminate reports and data following fires, it is apparent that they are often not reaching those entities that need them.

Beaver Dam Wash, Arizona – Beaver Dam Wash watershed provides the perfect example of the need for improved communication and a watershed perspective. Beaver Dam Wash originates in Utah and Nevada and joins the Virgin River in Arizona. In the January 2005 flood a bridge was destroyed and numerous homes flooded. Wildfires in the summers of 2005 and 2006 burned nearly 45% of the watershed in Utah and Nevada.

In 2007 the Mohave County Flood Control District was in the process of updating a flood risk assessment for the vicinity of Beaver Dam, Arizona but was unable to obtain wildfire data pertinent to their study. The Corps obtained that data and provided it to the County for incorporation into the hazard assessment. Results of including that data in the assessment are significant. Under normal watershed conditions, and assuming adequate flood warning facilities and plan are in place, the maximum available lead

time is 6 hours. With the burned watershed that time could be reduced to 3 hours, which could result in a life threatening situation. The County has updated a flood response plan and has been installing additional flood warning gages into Beaver Dam Wash watershed.

Flood Warning/Response: Real-time flood data can help reduce injuries, prevent death and decrease property damage. For these reasons it is recommended that communities and agencies operating within the Virgin River watershed establish and maintain a seamless flood detection network. Currently only Clark and Mohave Counties have existing flood detection networks, and there are significant portions of the watershed that are ungaged. Once flood information has been collected, assessed and disseminated, a Flood Response Plan should be executed. It is recommended that the Flood Response Plan be developed as part of the communities' overall Emergency Action Plan (EAP).

An initial evaluation is currently underway, and will describe the scope and estimated costs associated with evaluating the feasibility of a regional system, instrumentation siting, and flood response planning. That evaluation will include a needs assessment, existing gaging and flood response plans, data gaps, institutional information and constraints. This product will be completed by early September 2008 and the Corps will provide it to local and state jurisdictions for their use.

Public Information: Although floodplain management publications are available through various agencies there is a continued need for public education. Many available publications are provided on the Floodplain Management Strategy CD. Information within these publications could be filtered, with the most relevant portions being compiled and published in a Floodplain Management Handbook that is applicable for use within the Virgin River watershed. Readily available brochures that educates the general public about flood control, erosion control, and water quality management issues is a cost effective, proactive approach to floodplain management.

4.2. *Watershed Strategy*

The Watershed Strategy describes issues as defined with stakeholders, includes a review of existing studies and projects, and includes planning objectives with actions to address them. Implementation of the actions in the Strategy may be carried out by any of the multiple jurisdictions, private or non government organizations. It is intended that this Strategy be the basis for prioritizing and bringing resources together to seek solutions. It may be the basis for an implementation plan.

Planning Objectives

The issues described earlier in this report were used to develop a set of Watershed Planning Objectives. Planning objectives state a desired outcome, and in doing so help to define what could be accomplished to address an issue or seize an opportunity. Objectives were reviewed, refined and developed through discussions with stakeholders in several watershed meetings.

Goals, objectives and actions have been organized into categories that address the issues described previously. One addition was made to the original five categories to address the need for improved communication and collaboration across jurisdictions and among agencies and the public, as well as funding constraints. The following six goals have been established. Related objectives, action items and brief summary of related information are found on Table 6.

GOAL 1: Improve Watershed Management, to include communication and collaboration among agencies and the public.

GOAL 2: Develop a comprehensive approach to floodplain management which will increase public safety and awareness, reduce flood damages, and protect natural and beneficial uses of floodplains.

GOAL 3: Support and improve Land Use planning efforts throughout the watershed.

GOAL 4: Manage (monitoring, removal, restoration) Invasive Species to acceptable levels.

GOAL 5: Maintain a suitable and sufficient water supply for the watershed.

GOAL 6: Establish, maintain and support a functional river system throughout the watershed.

Table 6 Watershed Strategy: Goals, Objectives and Actions

GOAL	OBJECTIVES	ACTIONS	WHAT	INFO
1	Establish a mechanism for ongoing collaboration.	Establish a partnership agreement for a watershed steering committee.	Tri state oriented, Not an oversight group, May serve as a funding/ organizing mechanism. Tech and administrative levels	Sept 19, 2008 first regular watershed meeting.
	Improve communication between and among stakeholders and agencies.	Hold Regular Watershed wide meetings.	Regular forum for sharing of information across the entire watershed, potential work on specific issues.	
		Utilize Web based tools	Calendar, List Serve, Google Earth	
2	Fourteen risk mitigation actions are identified in the floodplain strategy. Table 5.	Establish Watershed Steering Committee	Part of watershed meetings, or separate sub groups	Watershed wide focus required.
		Post Wildfire evaluations	Improve understanding of effects, consistency of evaluations, and communication of risk	Arid Regions Demo
		Flood warning/response	Implement flood warning system	Preliminary scope (USACE)
		Public Information	Provide flood risk information to public and decision makers	VRFPMS CD
3	Develop planning toolbox for use by local entities.	Model Ordinances, guidelines, data updated and coordinated	Some tools in the Floodplain Strategy. Data and information is also available from various agencies.	EPA, FEMA, NRCS, etc
	Incorporate non-point source reduction efforts into local land use planning.	Underway, but can be increased and expanded	Means to reduce pollution from diffuse sources, info and resources available from EPA.	Local, State, EPA
	Encourage a watershed approach in large scale planning efforts.	*Guideline*	Apply a watershed perspective to land use decisions.	Land managers

Table 6, Continued

GOAL	OBJECTIVES	ACTIONS	WHAT	INFO
4	Identify priority geographic areas and species.	Establish priorities and develop plan	Watershed based plan mapping and prioritizing treatment needs/options.	Development of a watershed wide restoration plan would contribute to invasive species management.
	Coordinate invasive species activities across the watershed with other activities.	Include in other projects, Comprehensive Weed Management Area	Incorporate invasive species efforts into watershed meetings. Early detection and rapid response incorporated into monitoring efforts.	
	Involve the public in restoration efforts.	*Guideline*	Project specific.	
5	Evaluate surface/ground water interaction	Modeling and evaluation	Develop basin wide model Evaluate groundwater (wells)	Not likely feasible.
	Consider system wide water supply	Modeling and systemic evaluation	Increased storage Conservation strategies Improve efficiency Identify new water sources Water rights within the system	Not currently a desire to visit water supply across the watershed.
	Protect/Improve water quality	Occurring, specific actions could be expanded.	State water quality/ drinking water criteria, Biological requirements. Pollutant sources (point/nonpoint)	Ongoing
6	Identify areas for potential habitat preservation, enhancement and restoration.	Planning and implementation	Within existing management plans. Ties to a watershed plan for invasive species management.	Watershed plan
	Develop a streamlined permitting process for river maintenance and restoration.	404/ESA Related	Proponents need to apply for permits, and further discussion on this topic will be necessary with regulatory agencies (State and Federal).	
	Maintain natural river channel and dynamics where feasible.	*Guideline*	Guideline for consideration in development of other plans.	
	Integrate conservation planning for sensitive species.	Currently occurring	Virgin River HCRP, Clark County MSHCP, Virgin River Program.	Ongoing

Associated Products

Reports - Activities throughout the watershed have resulted in development of numerous reports and plans. Appendix A of the Watershed Strategy provides a summary of over 60 reports pertaining to the issues identified within the watershed. It includes five categories; floodplain management, invasive species, land use planning, water supply, and watershed planning. In addition to title, author and date, a brief synopsis of the report is provided. Report availability is cited either by agency or website location where they may be accessed.

Tamarisk Toolbox – Also an appendix to the Strategy, the toolbox is being developed to assist in addressing Tamarisk removal/control efforts. It will provide a summary of current removal/control efforts in the watershed, treatment options and description of the associated pros and cons, typical costs associated with those treatment options, and review of lessons learned from local and regional efforts. It also includes guidelines for items that should be included in planning tamarisk removal. These guidelines include technical, policy and regulatory considerations. Lastly the toolbox will discuss criteria useful to prioritization of removal efforts and a summary of potential funding options.

Watershed Plan Implementation

Actions identified in Table 6 are a major step toward watershed planning, but need to be expanded upon with detailed planning and implementation. That implementation plan would identify tasks, lead parties and partners, costs, funding mechanisms, and milestones. Recommended short (<1yr) and mid term <3 yrs) priorities include the following:

- Hold regular and recurring watershed meetings.
- Develop a formal mechanism for watershed collaboration that includes participation from stakeholders from all 3 states (UT, AZ, and NV).
- Implement a floodplain management steering committee to maintain effective communication and implementation of flood risk management.
- Conduct post wildfire hydrologic evaluations to include assessment of flooding and related risks.
- Evaluate feasibility of a implementing a flood warning system, and related flood response plans for the watershed.
- Complete an implementation plan for invasive species management and restoration activities, throughout the watershed.

5. Study Outcomes

There have been several outcomes related to this study beyond the reports produced and data collected. The outcome of increased communication and collaboration appears to be resulting in additional focus and multijurisdictional collaboration.

Communication: Bridging communication gaps and breaking down barriers to collaboration are challenges in any setting, but especially across jurisdictional boundaries. The August 2006 kick off meeting is reportedly the first time that stakeholders from the entire watershed met to discuss issues. Without a specific study or goal in mind, it may have been impossible to bridge the various jurisdictions and entities.

Over the past two years communication among jurisdictions and discussion of shared issues has increased within the watershed. Part of this is attributed to having a forum to discuss issues, finding shared interests, the opportunity to meet. Collaboration on some projects/studies is reported to have arisen from meetings, or "parking lot" discussions.

Floodplain Management Strategy: The toolbox provided in the Floodplain Management Strategy is being utilized. This includes model ordinances and regulations, model scopes for hazard delineation studies, information brochures, and GIS data. The local fire committee in Washington County, Utah which was established to coordinate wild land urban interface fire issues is now incorporating flood plain management into their coordination. This is a result of flood risk discussions related to this study.

Post Wildfire Watershed Hydrology: Issues encountered in relation to post wildfire conditions and related risks highlighted needs that extend beyond this individual watershed. An ongoing Corps demonstration program focused on urban flood damage reduction and channel restoration in the arid and semi-arid Southwest provided opportunities for technical experts to assist. (The program's full title is the Urban Flood Damage Reduction and Channel Restoration Development and Demonstration Program for Arid and Semi-Arid Regions (UFDP)). ERDC and HEC are currently collaborating with Desert Research Institute (DRI) of Nevada and University of New Mexico (UNM) and various regional stakeholders through this program. Research on the hydrologic impacts of wildfire had already been initiated under the program, and the Virgin River Watershed Study represented an ideal demonstration opportunity. The workshop and the technical report discussed below were both sponsored by UFDP.

Wildfire Effects Workshop - A meeting of practitioners, researchers and experts in post wildfire hydrologic processes was convened at DRI in June, 2008. The presentations and discussion from the "Wildfire Effects on Watershed Hydrology Technical Workshop" are being documented and will be

released as proceedings through the program. Technical information pertaining to useful models, research needs, and possibly policy recommendations will be included in the meeting proceedings. The workshop was sponsored as part of the Corps arid regions demonstration program (UFDP).

Risk Communication – Stakeholder discussion and the Mohave County experience demonstrate the need for improved risk communication following fires. A report drafted through the UFDP program mentioned above has been shared with stakeholders and several meetings and teleconferences have taken place. "*Wildfire Effects on Watershed Hydrologic Processes: an Introduction for Hydraulic Engineers, Watershed Managers and Planners*" summarizes issues and describes effects of wildfire on watershed hydrology. Communication among land managers and local officials is improving.

6. STUDY PARTICIPATION

Study Team

The Corps' Los Angeles District, Planning Division led this study and the study team included participation from the Albuquerque and Sacramento Districts, as well as contractors. Team members included planning, project management, engineering, environmental, regulatory, and public affairs. And as mentioned the UFDP sponsored the post wildfire workshop and provided technical expertise. Collaborating on the study at various degrees were tribal, Federal, state, county and local entities as well as non-government organizations.

Although the Corps was funded specifically to complete this study, participation from other entities has not been reimbursed. Data, reports and expertise have been provided by numerous organizations. Stakeholders contributed both time and information in discussing issues, formulating goals and objectives, and for completion of the study.

Federal agencies participating included: Bureau of Land Management, National Park Service, Natural Resources Conservation Service, U.S. Fish and Wildlife Service, U.S. Geological Survey, and USDA Forest Service. With the exception of State of Utah agencies, participation at a state level was limited. Representatives from the Kaibab Paute Tribe, local and county entities, non government organizations, and several private individuals participated throughout the two year study. Significant support in coordination, meeting facilitation, and expertise has been provided by the Virgin River Conservation Partnership and Washington County Water Conservancy District.

7. LESSONS LEARNED

Boundaries – It is of no surprise that political and jurisdictional boundaries pose barriers to collaboration and are a major challenge to applying a watershed approach. Federal agency jurisdictions often follow State boundaries which inconsistent with addressing issues at a watershed scale. At a Federal level this watershed has: 6 BLM District Offices, 2 Corps Districts, 2 EPA Regions, 2 FEMA Regions, 3 NRCS State Offices, and 3 USFWS Field Offices.

Although issues cross jurisdictional boundaries communication often breaks down at State boundaries, and collaboration is minimal. Communication among, and within, agencies was a larger challenge than anticipated when starting this study. Those boundaries need to be overcome and communication improved in order for achieve integrated solutions.

Synergy with Active Groups - Prior to initiation of this analysis Corps involvement in the watershed was primarily a Regulatory role. Civil Works Planning presence and the associated relationships were minimal. Therefore we have relied heavily on existing groups and the synergies associated for collaboration. Existing watershed efforts, although they often don't cross state lines, are very beneficial in addressing challenging issues. This analysis has attempted to contribute to existing watershed efforts, and the Strategy will rely on them to be continued and implemented.

Bottom Up Approach – A grassroots approach to addressing watershed issues is important both for identifying issues and forming sustainable solutions. We have used a bottom up approach throughout this study by working with existing groups and willing interests from different jurisdictions. This has relied on the time and ability of participants within their already busy schedules and heavy workloads.

While this was successful in developing a strategic plan and made strides toward improved communication the bottom up approach has drawbacks. Without agency and decision maker support, a watershed plan cannot be implemented. Therefore a combination of the bottom up planning and top down support need to be sought for successful integrated solutions.

Participation and Funding - As mentioned previously the Corps was the only agency funded specifically to complete this watershed effort, and others were not reimbursed for their participation. Agencies that did participate were able to within existing funding for related projects or operating budgets. If similar watershed studies are to be funded in the future, the coordination of funding from Federal, State and Local agencies, and NGO's is recommended. Funding for dedicated staff time and coordinated work within individual agency missions would be beneficial.

Stakeholders have expressed that Corps participation in ongoing watershed meetings, and locally led efforts is beneficial and desired. However, there is little funding available for ongoing participation without an authorized study or project.

8. Conclusion

In collaboration with numerous stakeholders this study has successfully completed a comprehensive analysis of water, and related resources in the Virgin River Watershed. We were able to establish priorities for planning and investment and draft a strategy for addressing those priorities has been identified.

The major findings of the study confirm the statement by Brigadier General Joseph Schroedel in his testimony to the House Subcommittee on Water resources and Environment (Committee on Transportation and Infrastructure) in March 2008: "*If any of the agencies - whether federal or state, industry or the public - are to successfully manage water, we must find a way to work more closely and cooperatively across boundaries, missions and jurisdictions*."[1]

An immediate result of the Comprehensive Watershed Analysis of the Virgin River Watershed has been increased and improved communication across jurisdictional boundaries and among agencies. Stakeholders agree that continued communication and collaboration across the watershed is necessary and beneficial, and have planned the first of the future regularly scheduled watershed meetings for September 19, 2008.

[1] Quoted by Mr. Steven L. Stockton, PE in his own testimony before the Subcommittee on 24 June 2008 (http://www.usace.army.mil/cw/cecw-cp/news/stockton_testimony.pdf)