Workshop for Watershed Planning in the Upper Gila:
Summary and Outcomes

February 18, 2015
Discovery Park Campus, Eastern Arizona College
Safford, Arizona

The intent of this workshop was to consolidate everything we have learned about the challenges in the region to support the creation of watershed planning goals and to work toward specific actions regarding how we can address these challenges. After considering a summary of the project accomplishments to date and reviewing the Problem Statement (included below), the participants worked in theme-specific groups to draft goals and next steps regarding actions to support broad-based watershed planning. A few examples of these goals included addressing erosion and sedimentation issues tied to the San Simon subwatershed (infrastructure theme), retaining and increasing youth contributions to the watershed (community engagement), expanding the water supply with reuse projects (water supply theme), protecting farmland from urbanization (farming theme), and evaluating fire as a tool for riparian habitat management (riparian health theme). The entire list of goals for each Theme is included in the report below. At the end of the conference, participants reviewed the proposed next steps and signed up to receive information relating to future meetings of the specific Themes in order to build on the accomplishments of the Workshop. Participants also made recommendations regarding expanding connections with stakeholder groups not represented at the Workshop. These groups will be invited to participate in small group meetings or interviews to ensure that their perspectives and concerns will be included in the planning process.

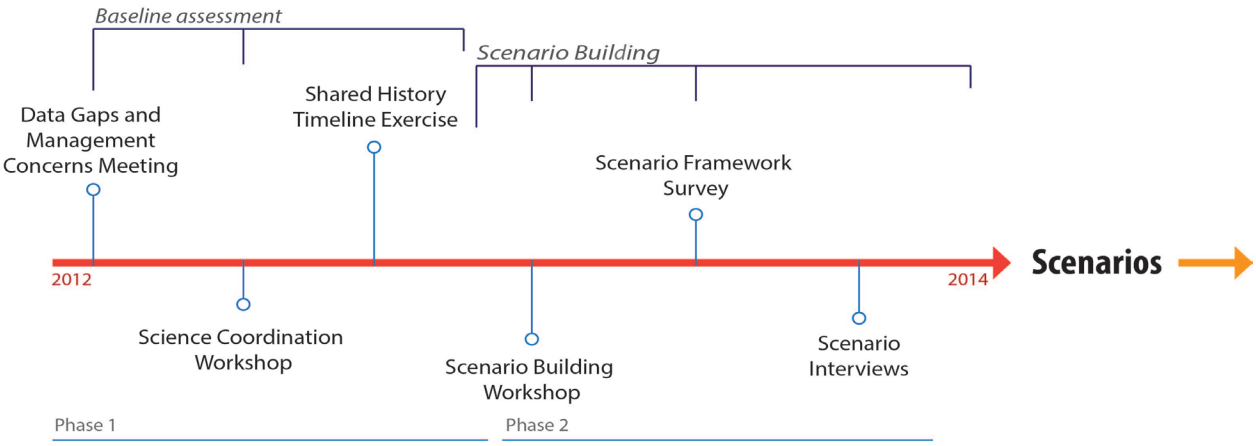
Quick Links:

Watershed Planning: Background and Overview

The first half of the workshop focused on setting the stage for watershed planning through a series of presentations on recent efforts in the watershed. A brief overview of the presentations is provided

below. A more detailed description can be found in Attachment A. Figure 1 below offers a visual explanation of these watershed studies over time.

Figure 1: Timeline of where we have been leading up to the Watershed Planning Workshop.



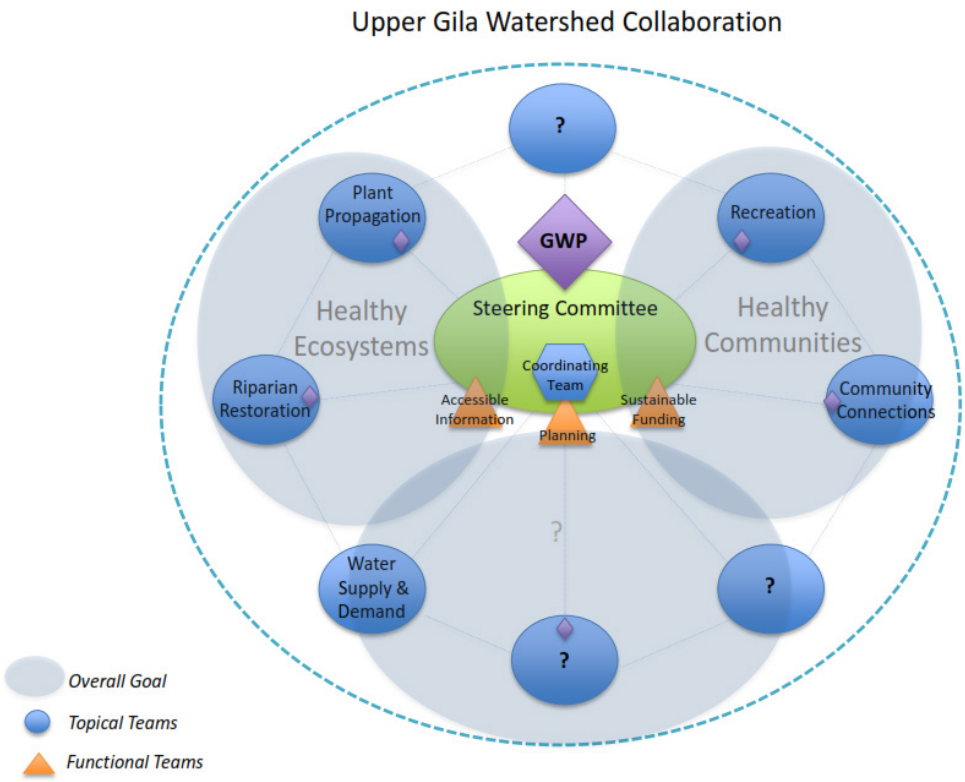
Scenario Planning: *In order to know where you're going you must know where you've been.*

To lay the groundwork for the next phase of Watershed Planning, Kelly Mott Lacroix of the Water Resources Research Center from the University of Arizona (WRRC) offered an overview of completed efforts over the past two years. She explained the creation the watershed baseline assessment, which was completed in January, 2014. This assessment report has previously been distributed to participants, and an electronic copy of it is available on the WRRC's website (https://wrrc.arizona.edu/Gila-Watershed-Assessment). This work informed the next phase of the project, which focused on Scenario Planning in the context of the Upper Gila Watershed of Arizona. An electronic copy of the scenarios is also available on the WRRC's website: (https://wrrc.arizona.edu/sites/wrrc.arizona.edu/files/RAPIDS/PDF/Scenarios_UGW.pdf). For a more detailed description of the presentation at this workshop see Attachment A.

The Larger Context of Watershed Planning and Watershed Planning Steps

Tahnee Robertson of Southwest Decision Resources (SDR) and Rachel More-Hla of the Gila Watershed Partnership (GWP) provided a summary of the strategic planning process underway with the Gila Watershed Partnership. (Refer to Figure 2.) They provided details regarding the role of the GWP in enabling the collaborative work of the Steering Committee and the Coordinating Team in relation to the work of the various topical and functional teams. Because this process remains dynamic and is intended to be responsive to the needs and recommendations of various stakeholders in the region, there will be opportunities for creating additional Topical Teams to meet emerging concerns or new developments.

Figure 2. The GWP and Collaborative Efforts in Broad-based Watershed Planning

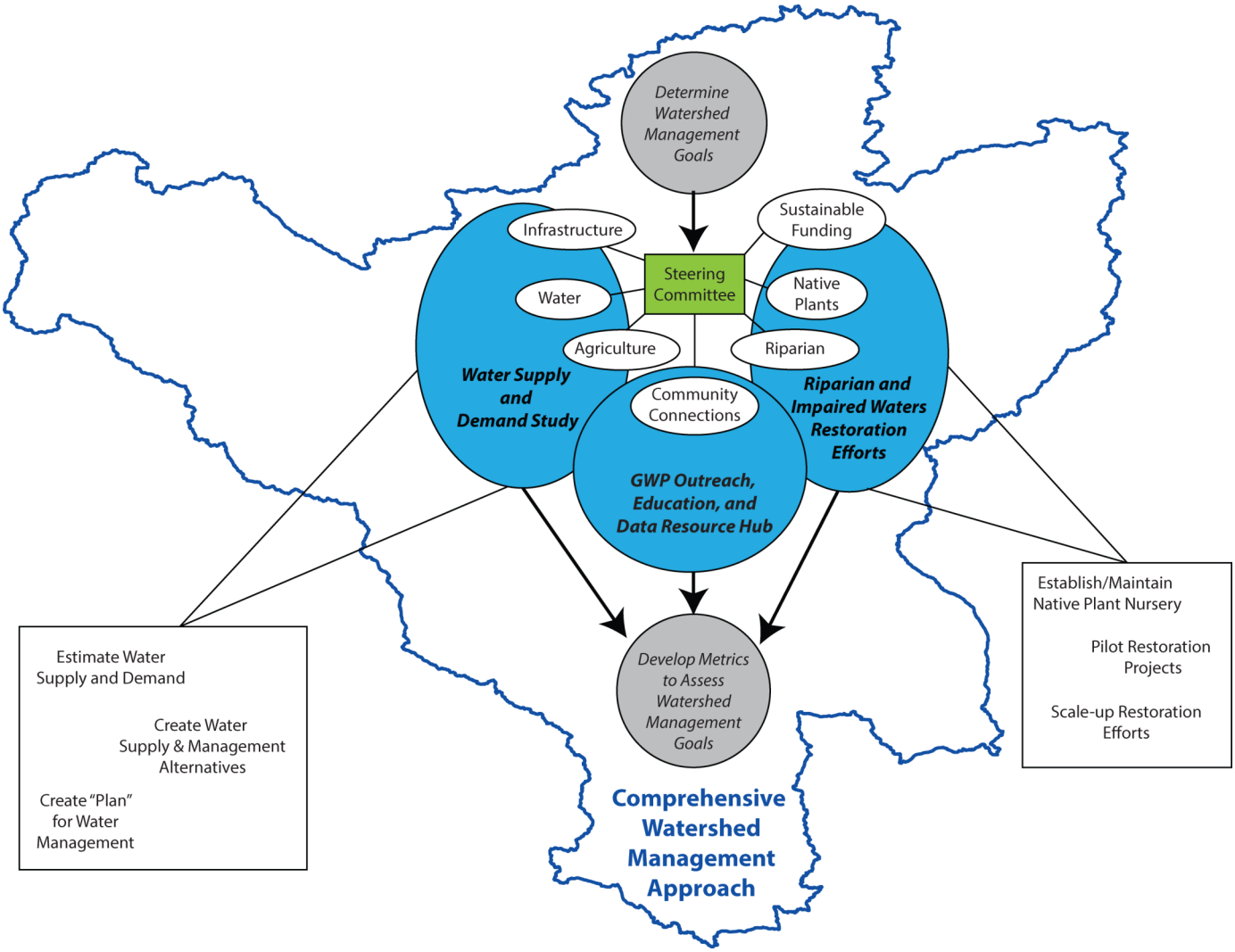


Moving Forward: A Proposal for Watershed Planning. This diagram depicts the relationships, range of issues, and goals currently being considered by the working groups (or topical teams and functional teams) in connection with the GWP. The question marks signify themes and goals that were yet to be assigned at the beginning of the workshop.

Kelly then offered an overview of the proposed Watershed Planning Next Steps (Figure 3). The workshop was convened to assist in determining Watershed Management Goals. Meeting participants were invited to be part of the existing Working Groups in the watershed, as well as future Working Groups that may develop as a result of the Watershed Planning process. Four of the existing initiatives discussed at the workshop related to the Watershed Planning process were the Water Supply and Demand Study (led by the WRRC), Riparian and Restoration Efforts (led by the GWP), Community Connections (led by the GWP), and Data Management (led by the GWP). Each of these initiatives will rely on the input from the working groups to make decisions about the initiatives. An example of the importance of connectivity amongst the existing initiatives is the need of the Water Supply and Demand Study effort for input on effectively estimating water supply and demand, creating water supply & management alternatives, and eventually developing a "plan" for water management.

As each of these initiatives moves forward, the Water Supply and Demand Team will be working on developing a series of metrics to assess the Watershed Management Goals developed in part at this workshop. Ultimately the goal of all of these initiatives is to develop a comprehensive, and coordinated, approach to watershed management.

Figure 3: Overview of Proposed Watershed Planning Steps.



Watershed Planning Mission Statement

Before breaking into working groups, participants revised the *Problem Statement* that was created in the Scenario Planning Workshop in March, 2014. One of the most significant revisions made was to change the *Problem Statement* to a *Mission Statement*, marking the movement from identifying challenges to now identifying goals and steps to address those challenges. Another major change to the original problem statement was the addition of the second bullet point, "preserve the ability for the watershed to produce food, fiber, and minerals". This addition to the mission statement reflects the scope of watershed planning to consider and link the important economic strongholds of the region with social and environmental goals.

The revised Mission Statement reads as:

In the face of uncertain physically and legally available water supplies, we will:

- *Provide reliable long-term water supplies for a resilient community;*
- *Preserve the ability for the watershed to produce food, fiber, and minerals;*
- *Maintain the rural lifestyle; and*
- *Sustain and enhance the health of the Upper Gila River Watershed.*

Working Group Outcomes

To develop goals, workshop participants were asked to select one of five theme areas to break into working groups:

1. Infrastructure and Fire/Flood Management
2. Community Engagement, Recreation, and Economic Development
3. Physical Water Supply (Quantity and Quality) and Water Demand
4. Farming and Uplands/Range Management
5. Riparian Area Health

Before beginning the working group discussions, all participants were asked to consider their theme(s) within the framework of the mission statement. With this in mind, working groups then reviewed respective theme fact sheets (see Attachment B), drafted by the Water Resources Research Center, that summarize the theme in the context of the watershed, as well as the challenges, critical questions, and knowledge gaps that have been identified in two years of stakeholder feedback. Working groups were given the opportunity to clarify or make additions to the theme fact sheets. This review process and discussion of challenges, along with successes and opportunities, led to the decision of goals and next steps for addressing those challenges or acting upon opportunities. The goals produced by each working group are summarized in the following sections.

Back to Quick Links

1. Infrastructure and Fire/Flood Management

This group explored issues and possible goals for the themes of Infrastructure and Fire/Flood Management. The working group for these themes framed their discussion around planning for the mitigation of, as well as response to, fires and floods within the watershed. This discussion links to the potential impacts on infrastructure from water management approaches and intense weather events. In discussion of flood management, a significant challenge discussed was vegetation management in riparian areas. The main priority identified for the specific theme of flood management was to restore the natural geomorphology of the river channel while protecting critical infrastructure. The overall priority for fire management was **to** restore natural fire regimes to minimize damage from catastrophic burns. Infrastructure priorities centered upon providing support for land management plans, such as BLM, RMS, and USFS Forest Management Plans. The infrastructure discussion also prioritized upland vegetation, riparian vegetation, and infrastructure maintenance in view of a watershed-scale management.

DRAFT GOALS BASED ON GROUP DISCUSSION
Flood Management
• Retire flood-prone agricultural lands in favor of "upland" fields • Use diverse funding mechanisms, such as the NRCS conservation reserve program • Modify irrigation diversion structures/dams to facilitate the use of flood flows for river channel restoration
Fire Management
• Vegetation management and thinning around bridges/other infrastructure to reduce damage from riparian fires • Appropriate use of fire in tamarisk removal in riparian areas, e.g. south of Socorro, NM, and on the Pecos • Increase the capacity for post-fire remediation • Use tools including: management for multiple CBJ, prescribed burning, thinning, active wildfire management, etc.
Infrastructure
• Have GWP serve as an information and issues repository to inform agency planning processes • Use periodic review processes, such as Federal Resource Mgt Plans (RMPs), to highlight the issue of sediment control structures and to promote a prioritization program for maintenance • Address vegetation management in upland areas, including woody plant management and fire regime restoration, to reduce soil erosion and help increase water infiltration • Address erosion/sedimentation of the San Simon subwatershed • Establish public-private partnerships to support Civilian Conservation Corps (CCC) type work force to implement the interim goals • Reform 1) transparency and 2) distribution of extraction/excise/revenues (e.g., mining and utilities) to more equitably benefit source regions like the Upper Gila, to maintain/improve impacted infrastructure • Install defensible space near bridge structures regarding riparian fires • Improve coordination and joint training between and among intergovernmental firefighting units in preparation for riparian fires

Back to Quick Links

2. Community Engagement, Economic Development, and Recreation

This working group considered three closely related theme areas: recreation, economic development, and community engagement. Workshop participants considered topics relating to the actions of the communities within the watershed to promote economic vitality in the region. Recreation in the watershed is consequential for economic development, conservation, and quality of life of residents. Economic development and recreation, as well as other themes, are integrally tied to effective community engagement to achieve real solutions to the challenges facing the watershed. This group identified a number of successes and opportunities, along with challenges, that were foundational in forming goals for these themes. Some of the major opportunities cited by group members were:

- Education of residents about water supplies
- Use lessons learned from similar communities
- String of Pearls effort

- Chamber of Commerce could message economic trends to business community
- Providing accessible information on actions that would draw in outside money
- Providing a place to "get away" from urban environments
- Connecting trails system between Safford, Thatcher, Pima
- Integrating youth and recreation (reference to EAC's efforts)

DRAFT GOALS BASED ON GROUP DISCUSSION
Recreation, Economic Development, and Community Engagement

• Enable a better informed public
  ○ Issues affecting economic development
  ○ How to draw recreation money
  ○ Existing recreational opportunities and their benefits
• Market the Gila Valley as a recreation destination
  ○ Define its attraction(s)
  ○ While supporting local community, businesses, and environment
• Become more economically resilient
  ○ Diversify economic base and become less vulnerable to fluxes in mining
  ○ Prepare for economic cycles
• Establish a clear link between water and economic development
  ○ Provide incentives for more efficient agricultural water use
  ○ Reclaimed water to replace groundwater use, possible use for landscaping
• Foster good relationships between agricultural and federal communities
  ○ Direct agricultural input into federal land policy
  ○ Build trust between those groups
  ○ Learn from and utilize best practices of successful models
  ○ Collaborative processes and planning (BLM, RMP, etc.)
  ○ GWP catalyzes and convenes stronger relationships and increases engagement
  ○ More engaged and supportive ag community in the watershed
• Retain and increase youth contribution to the watershed
  ○ Develop mechanism for retaining youth skills/talents (e.g., business incubator)

Back to Quick Links

3. Physical Water Supply (Quantity and Quality) and Water Demand

This working group considered the amount of water needed for municipal, industrial, and agricultural needs, both currently and moving forward in light of major challenges. Group members considered how to counter water scarcity and the governance of our water resources. To have a fuller perspective, physical water supply was discussed as a significant factor in addressing water demand in the watershed. The major challenges discussed in this working group centered upon the obstacles related to supplementing water supplies with desalination, as well as how to support greater conservation or efficiency efforts in the watershed.

DRAFT GOALS BASED ON GROUP DISCUSSION
Water Supply and Water Demand

• Expand water supply with water reuse projects
• Lower GPCD (gallons per capita per day)
• Increase efficiency and conservation
  ○ Keeping in mind that water provides for municipal, agriculture, college, prison, and other uses
• Augment water supplies
  ○ Thinking outside of the box
• Create opportunities for regional coordination
  ○ Water association/district involving all users
• Multiple benefits, e.g., municipal supply saved and used for recreation
• Education/research underlie these issues, e.g., climate change, conservation, water systems
• Coordinated water management
• Stop looking to the farmers in times of shortage; take a more holistic view of water shortage
• Enforced water restrictions
• Monetary assessment of conservation vs. infrastructure expansions/additions
• Better representation of rural communities
Next Steps
- Lower GPCD in the watershed (from 150 GPCD to 80-100 GPCD)
  ○ Conservation education
  ○ Changes to water rights
  ○ Target perception/attitudes on reused water
  ○ Regulations – create incentives and promote conservation/reuse
  ○ Identify key players to participate

Back to Quick Links

4. Farming and Uplands/Rangeland Management

This working group considered a number of issues and challenges related to the themes of farming and uplands/rangeland management in the watershed. One issue discussed by the group was the need for stability. Given the substantial costs tied to equipment and agricultural infrastructure, for instance, high levels of uncertainty make long-term investments increasingly risky. With cotton prices effectively dropping by a dime per pound a year, for instance, farmers face difficult choices regarding long-term options. Diversification may offer some hedge against such problems; however, there are significant barriers to overcome. Farmers also must deal with loss of farmland to urbanization as well as challenges associated with slow, bureaucratic governmental permitting processes. Group members discussed how the rigid system associated with the decrees created disincentives to conserve water, with little room for new scientific research to inform water management efforts.

DRAFT GOALS BASED ON GROUP DISCUSSION

Farming

- Stability (water quantity, litigation, money, and continued conflict create uncertainties and drive people out):
    - We need open, legitimate dialogue among all of the community
    - Look at the reality of water availability and reevaluate current decrees that dictate use of water, considering the most recent findings in science as well
    - Use this knowledge to inform community conversation
    - Define water thresholds for land use
- Diversify production (local food market); related to water availability and labor demand
- Protect farming from urbanization
    - Need ag water/soil protection
    - Look at the draw of large corporations to Arizona
- Address government regulation
    - Reassess
    - Permits are excessive, complex, time-consuming, and limiting
    - Look at best use for lands with both the farmer and community's input
    - Federal agencies need to unify systems of assessment and management
    - Establish a coordinated forest management framework

Next Steps

- Protect farming from urbanization, need ag water and soil protection. At the same time, must start with governance and regulation
- Look at why people move to AZ – climate, welfare?
- Dialogue between the different interests.
- We need metrics.

Upland/Rangeland Management

- Maintain/improve site function through biotic integrity (already in place) as well as hydrologic functioning, soil stability. Holistic landscape management within scope of all activities that can be sustainably managed
- Set realistic goals for land use – can't change what currently exists too much, have to look at the broad scale
- Integrate land use goals into local priorities (no single-use management)

Next Steps

- Continued engagement of diverse backgrounds
- Education about available Best Management Practices (BMPs) for entire community (Quivira Coalition as example)
- Consider recreation with landscape management
    - Hunting, birding (local recreation niche)
    - Identify local recreational value (salsa trail and others) to define local identity; this way we could have more say about management
    - Maintain roads to select environmental areas, hunting, etc. with the goal of specifying best use; basic improvements will be attractive to visitors and lead them to areas that we choose

5. Riparian Health

Participants in this Working Group considered knowledge gaps that complicate planned restoration efforts in riparian areas of the watershed. These challenges include the nature and status of erosion and sediment transport in the valley. While the fluvial geomorphology study assisted in increasing understanding of some of these processes, significant gaps still remain. More robust spatial information would be particularly helpful as restoration sites are selected and monitoring occurs over the next several years. Wildlife issues also represent a notable area of uncertainty in regard to riparian management going forward. In particular, questions arise out of efforts tied to habitat protection for migratory birds, pollinators, and the recovery of threatened and endangered ("T & E") species. Further, there is an unknown degree of vulnerability of riparian areas in relation to the consequences of regional climate change or the arrival of the tamarisk leaf beetle.

DRAFT GOALS BASED ON GROUP DISCUSSION

Riparian Health

- Management:
  - Target recreation access
  - Address upland erosion control
  - Carry out post-fire restoration
  - Identify likely zones for fire breaks
  - Evaluate fire as a tool
  - Activate community collaboration
    - Receive buy-in for restoration
    - Involve private landowners
    - Involve stakeholders down river
    - Support and contribute to an informed community
- Habitat and Ecosystem:
  - Protect and restore populations of native fish
  - Increase groundwater supply
  - Positive use by threatened and endangered species in the watershed
  - Restore 200 acres of riparian habitat in 5 years
  - Implement proactive responses to the Tamarisk Leaf Beetle:
    - Outline plans
    - Obtain funding
  - Continue and increase youth involvement
  - Create and expand easily accessible education programs pertaining to:
    - Water use
    - Impacts of vegetation changes and water quantity
    - Tamarisk vs. Native vegetation and impending consequences of defoliation by the Tamarisk Leaf Beetle
  - Adapt technology to fill knowledge gaps

Back to Quick Links

Watershed Planning Next Steps

At the end the workshop the group discussed next steps and provided feedback on the workshop and indicated working groups they would like to participate in.

Working groups will be organized around the Topical Themes to continue the discussion beyond the Workshop. These groups will begin meeting in the next two months. Efforts will also continue in reaching out to stakeholder groups that were unable to attend the Workshop or have been underrepresented in previous collaborative efforts. Small group meetings and interviews will be scheduled with these stakeholders in order to gather their views and recommendations regarding watershed planning. For more information on the working groups, the workshop, or the goals drafted at the workshop please contact Kelly Mott Lacroix (klacroix@email.arizona.edu) or Rachel More-Hla (info@gwpaz.org).

Back to Quick Links

Attachment A

Scenario Planning Summary Notes from Workshop

In 2014, based on multiple sets of interviews and a workshop, a series of scenarios were developed for understanding how drivers of change and critical uncertainties in the watershed could shape future of water resource management alternatives. The scenarios can be used to shape the next two years of the project by finding different answers to the questions asked by the scenarios. These answers will allow for a broader and more detailed understanding of water management needs and objectives across the region. This in turn will lead to the discernment of water supply alternatives, and to develop a water management "plan" that will be useful and usable in assisting water managers across different water-using sectors as decision support tools. A critical component in guiding this process will be an active and involved steering committee. Participants in today's Workshop are encouraged to consider joining the steering committee.

To provide further background, Kelly provided an explanation of scenarios and the process of creating them. Scenarios are intended to serve as tools to help stakeholders explore what might happen in the future as a way to make more informed decisions today. These scenarios are not an attempt to predict what the future will bring. Instead, they are intended to reflect an acceptance of uncertainty, and offer a way to prepare for the wide range of events that may come to pass.

Why scenario planning? By thinking about the future before it arrives, water users can help make decisions today that will perform better over time. This decision-making process is informed by gathering insight into the forces that shape the watershed, revealing implications of following the status quo, exploring possible futures, and illuminating options for action.

Scenarios show us what <u>might</u> happen – not what we <u>want</u> to happen or <u>will</u> happen. Developing the scenarios specific to the Upper Gila Watershed was an intensive process involving many rounds of information-sharing and discussions in different venues. After considering the breadth of possible challenges in the watershed, stakeholders crafted a Problem Statement. In light of this statement, the following twelve Major Drivers were chosen, based on shared consensus in meetings and workshops. The way these Drivers interact with and impact the events of each scenario would become a major focus of the scenario planning process in order get a fuller view of how events could unfold under the pressure of different factors.

1. Informed Populace
2. Cooperation
3. Catastrophic Fire
4. Infrastructure
5. Population Growth
6. More Intense Storm Events
7. Drought
8. Fluctuation in Copper Prices
9. Federal Involvement
10. Physical Water Supply Availability
11. Legal Availability of Water
12. Commodification of Water

Once these Drivers had been identified and critical uncertainties were understood, these components were further developed through a series of meetings, interviews, and surveys in order to craft the scenarios themselves. This feedback was supported and augmented by economic research and

historical and projected climate data, including information from the Watershed Baseline Assessment. These scenarios were determined to be the issues that would have the most potential to bring about change in the watershed. In brief, the Four Scenarios are:

1. The Fate of New Mexico's CAP Allotment
    a. NM Diverts
    b. NM Conserves
2. Impacts from the Tamarisk Leaf Beetle
3. Local to Federal Control
    a. Increasing Local Control
    b. Increasing Federal Control
4. Fluctuation in Cotton Prices
    a. Average Low Cotton Prices
    b. Average High Cotton Prices

Back to Quick Links

Attachment B

Theme Fact Sheets: Table of Contents

Each working group reviewed these fact sheets and revisions have been made based on comments received from participants. Each fact sheet follows the same format of 1) providing a definition of the theme, 2) providing background on the theme, and 3) outlining challenges within the theme based on previous workshops and interviews, which includes critical uncertainties for the future and key knowledge gaps.

The following fact sheets are included here:

1. Infrastructure
2. Fire and Flood Management
3. Community Engagement
4. Recreation
5. Economic Development
6. Physical Water Supply (Quantity and Quality)
7. Water Demand
8. Farming
9. Uplands and Range Management
10. Riparian Area Health

Back to Quick Links

1. Infrastructure

Infrastructure: This theme includes the public and private built environment in the Upper Gila Watershed such as roads, bridges, irrigation ditches, diversion dams, wells, fences, and water treatment facilities. This theme reviews the potential impacts on Infrastructure from water management approaches and intense weather events, based on sources such as historical records, scenario planning, and construction/maintenance issues raised by stakeholders in the valley.

Background: Infrastructure construction and maintenance are critical components of sustaining the economic health of the communities in the Upper Gila Watershed. Census information indicates that roughly 70% of the population in the region lives within five miles of either the mainstem of the upper Gila or the San Francisco Rivers. Much of the built infrastructure supporting these residents is therefore also proximate to the river and its floodplain. Most of the largest municipalities are in this narrow band, excepting San Carlos and Peridot.

Further, roadways and rail lines play integral roles in allowing for the shipping of agricultural crops, mining materials, and other products in and out of the valley. Certain types of traffic, such as heavy trucking associated with mining operations, can increase the wear and tear on such infrastructure and lead to increased maintenance costs. Bridges for these roads and rail lines criss-cross washes and riverbeds, and these bridges have been negatively impacted by major flood events. The closure of a bridge has serious economic consequences for the valley, but repair or replacement is generally time-consuming and costly.

Other types of critical infrastructure in the watershed include waste water treatment plants, potable water storage facilities, water delivery works, fire suppression systems, wells, sediment control structures, and the irrigation canals operated by irrigation ditch companies. These structures represent major investments over decades; however, many of them are nearing the end of their functional life span. Substantial funds will be needed to maintain and/or improve this infrastructure to adapt to changing conditions in the watershed.

Challenges:

Generally

- Infrastructure is costly to build and maintain. Federal and state funds have historically been vital in supporting these efforts, but outside funds are becoming increasingly harder to obtain.
- While stabilization and reconstruction funding can sometimes be obtained from federal agencies (such as the Federal Emergency Management Agency) following a natural disaster, like a flood, restrictions regarding the use of those funds can result in maladapted replacement infrastructure that is not designed to address changed conditions in the watershed.
- Federal and/or state restrictions on water quality or quantity or for environmental priorities like the protection of endangered/threatened species can impact the ability and costs of local governments in protecting infrastructure.
- Decreasing groundwater levels can result in the loss of existing wells, such as for agriculturalists and municipal water providers. There are often high costs association with drilling and developing new wells, depending on how placement is affected by legal restrictions (such as limitations arising out of the Arizona Water Settlements Act of 2004), location (which can increase delivery costs), and treatment requirements (such as poorer water quality).

Specifically

- The region has an extensive infrastructure "legacy" in the form of thousands of sediment control structures, many of which are nearing their useful life expectancy. Repair and maintenance for these structures is costly, but funding sources are limited.
- The expected arrival of the tamarisk leaf beetle around 2018 will potentially result in significant effects to riparian plant communities, and therefore would impact erosion control, sedimentation, and flooding outcomes.
- Further sedimentation issues affecting the San Carlos Reservoir may trigger actions by downstream irrigators, water negotiations with the San Carlos Apache Tribe, and opportunities for diversion in New Mexico.

Critical uncertainties

- How will technological developments regarding desalinization affect the accessibility and affordability of this augmentation option for at least some water users?
- Will more intense precipitation events affect the ability of irrigation ditch companies to provide adequate maintenance for their irrigation canal networks?
- How will residents respond to the option of direct potable reuse, should such an option become legally sanctioned by the State of Arizona?
- What ultimate choice will be made by the State of New Mexico regarding whether and where to build a diversion project?

Knowledge Gaps

- To what extent will changes in precipitation result in significant changes in the extent of the floodplain – and the related impacts of flooding on infrastructure?
- How would the construction of a diversion project in New Mexico affect downstream flows and groundwater recharge in Arizona?

Questions from Scenarios:

- How would the construction of a diversion project in New Mexico affect floodplain management and infrastructure in Arizona?
- Will changes in mining activity affect the wear and tear on infrastructure?
- Will infrastructure repair and improvement funds be made available from federal or state governments, or will these costs fall mostly on area residents?

Back to Quick Links

2. Fire and Flood Management

Fire and Flood Management: This theme addresses planning for the mitigation of, as well as response to, fires and floods within the watershed. Fires and floods are regularly recurring events in area's natural system, and they are also powerful forces that can have social, economic, and ecological implications for the watershed. In interviews with stakeholders, "floods" were mentioned most often as the largest threat of the last 30 years while "fires" were mentioned as one of the threats facing the watershed today.

Background: Fires and floods are historically the most prevalent landscape-scale emergencies known to the Upper Gila Watershed. The wide-scale, sometimes devastating effects are a concern for both human and ecological purposes. Further, the severity of the impacts of these events are projected to increase in this region due to the effects of climate change.

Fall and winter storms can bring large amounts of precipitation, and usually affect rivers and larger streams. These storms have been known to cause catastrophic floods, which are brought on by several days of intense regional rainfall, sometimes combined with snowmelt. High flow that is maintained for several days can cause major erosion damage as a river can move hundreds of feet laterally, undercutting buildings and irrigation works and destroying bridge foundations and pipelines. Regional floods generally happen between September and March in drainage basins larger than 200 square miles, such as the Upper Gila Watershed. On the other hand, summer storms usually affect smaller washes. These storms are caused by intense surface heating that results in moisture being drawn into Arizona from the Pacific Ocean and Gulf of Mexico. Characteristics of intense summer storms include three inches or more of rainfall in an hour over small areas and flash floods that travel many miles.

Fire has been an integral part of the Watershed for millennia, although its role has been significantly altered by one hundred years of fire suppression efforts by land managers both in the Upper Gila and across the Western United States in general. Fire, particularly in the upland forested areas, functioned as a mechanism for maintaining ecosystem health in a fire-adapted landscape. The removal of fire for such a long period of time has caused a substantial change in the composition of these forests. The absence of relatively frequent, low-intensity fires has led to the accumulation of a high level of combustible biomass in these areas. As a result, these regions are exposed to an increased risk of catastrophic fires that are very difficult to extinguish and can rapidly engulf very large areas, especially in comparison with average fire sizes of only twenty years ago.

Challenges:

<u>Generally</u>

- Fires and floods that impact infrastructure and farmland are aggravated by loss of vegetation; however, riparian health is a concern because fire has direct and immediate impacts on water quality and habitat.
- Restrictions on the use of disaster relief funds, such as "replace, not improve" infrastructure, inhibit resiliency planning and preparedness for disasters.
- Decreased precipitation and increased temperatures, such as in the current drought, combined with factors such as early snowmelt, can increase the risk of catastrophic crown fires in the upland forests as well as frequent burns in the riparian area.
- Riparian fires could alter the species diversity, especially if there are repetitive fire events.
- Fires will result in decreases in water quality, including a likely increase in pH, salt, and potash, which would complicate the use of surface flows for agriculture.
- Fires will also contribute to a deterioration of air quality and create public health problems.

- Destruction caused by flooding events is exacerbated by the increase in detritus and plant matter from uprooted trees or from building fragments. Infrastructure, such as bridges and diversion dams, can be heavily damaged during such events.
- While flood flows can be very destructive to human infrastructure along the river they are also an important part of life cycles for riparian and aquatic species in the Gila River.
- Management, mitigation, and relief strategies for these events are varying depending on location. Drainage design manuals, resources, education, and incentives to implement are not coordinated.
- Fire-adapted non-natives, such as a buffelgrass species tolerant to higher-altitudes/lower-temperatures (currently under development elsewhere), can increase the risk of fires, which can lead to a regime shift in desert plant communities and impacts on forage availability (positive and negative) for ranchers.
- Increases in severe fires and loss of cover vegetation in several parts of the watershed can contribute to higher runoff and sedimentation of the river.
- Floods and fires can result in damage to infrastructure, including fencing. Loss of fencing can lead to water quality issues and land management problems from free-roaming cattle.
- Floodplain management approaches have led to increased vegetation, which results in an increased extent of flood risk.
- Use of fire in managing riparian areas can be problematic, since non-natives like tamarisk can have greater resiliency in response to burns.
- The expanded ranges of non-natives like tamarisk in tributaries and certain upland areas can serve as germplasm reservoirs, leading to reestablishment of these species along the mainstem in areas targeted for native species restoration efforts if upstream/upland populations are not also treated.

Critical Uncertainties

- Full suppression vs. fire management or fuel reduction
- The effects of passive vs. active restoration land management efforts on uplands and rivers
- Single species vs. ecosystem management
- What are quantitative indicators to predict the amount of vegetation and its related impacts on the movement of sediment in case of floods?
- How would urbanization of land in a compact vs. dispersed development pattern affect the likelihood of damaging fires and floods?
- How might changes in the Clean Water Act (CWA) level of implementation impact how fires and floods are managed?

Knowledge Gaps

- Riparian data for southwest “flashy” systems
- Riparian quantitative monitoring for baseline measurements in case of fires or floods
- What is the current distribution of vegetative cover and what are the associated implications for fire and flood management?
- What is the current riparian area cover and what are the associated implications for fire and flood management?
- How will the loss of tamarisk contribute to fire and flood management decisions?

Scenario Planning Questions

1. In a future with flooding driven by extreme weather events and functionally impaired riparian areas, what steps should be taken for floodplain management?

2. What groundwater monitoring programs could be put into effect in the short-term in order to develop a better understanding of the relationship between drought, flood flows, and groundwater recharge?
3. What kinds of coordination and cooperative resource management strategies will be necessary among different entities like the federal government, counties and tribes to address the downstream impacts of fire and extreme floods?

Back to Quick Links

3. Community Engagement

Community Engagement: This theme addresses the opportunity to create a water-awareness ethos that encourages residents across the Upper Gila Watershed to be informed about their water resources and to take individual and collective actions in support of water conservation and judicious water management and land use decisions.

Background: This theme is based on feedback from participants at the Scenario Planning Workshop, where the category "Uninformed Populace" was ranked as a significant driver of change, based on opinions that water as a natural resource is largely not understood within the larger natural system. Successful water conservation efforts generally involve public outreach campaigns and initiatives to make residents aware of the water consumption habits. Changes in these behaviors in communities like Tucson, Denver, and Las Vegas have resulted in substantial decreases in per capita daily water consumption even while the local economy and population grows. Conservation can promote greater appreciation of the value of water in the community and the benefits of arid-adapted plant species. Cost savings can also occur due to the reduced pressure to build new infrastructure or drill new wells as part of a water augmentation effort. Water education and awareness initiatives can also serve as a mechanism for promoting community engagement efforts that reach across town lines in efforts to create regional benefits.

Challenges:

Generally

- The actions and membership levels of the Gila Watershed Partnership support community engagement across jurisdictions, economic livelihoods, and interest groups.
- Demonstrating effective community engagement methods can be problematic, depending on the choice of metrics in evaluating types of behavior changes regarding water conservation and water use generally.
- Many communities institute or adjust various levels of stepped-rate water pricing as a way of promoting conservation. Depending on the level of community engagement and public involvement in the deliberation process, the response from water consumers can vary, however. (Compare the negative response in Tucson in the 1970s with recent generally-accepted increases in pricing in Clarkdale.)
- The Upper Gila Watershed includes certain groups of residents who are likely to have a short-term presence in the region, such as mine workers, seasonal farm workers, or snow birds. Special engagement efforts may be necessary in order to encourage them to adopt water conservation practices.
- Public understanding concerning the effects of drought is lacking.
- Some water users within the watershed maintain a perception of the GWP as "environmentalists," which limits coordination.
- Restrictions on water by utilities receive negative press.

Critical uncertainties:

- What types of actions or events will serve as adequate motivation to spur widespread, sustained community engagement efforts?
- How will community engagement across jurisdictions be initiated and cultivated?

Knowledge Gaps:

- What examples of previous efforts involving public engagement can serve as templates for future actions?

- What information regarding community engagement over water conservation could be gathered using surveys? What types of surveys (e.g., phone, in-person, email/online) would be most effective in different communities in the watershed?

Questions from Scenarios:

- In what ways can residents become involved in water management by their local governments?
- How can opportunities for public involvement be advertised to the public?
- How can structured public engagement be sustained during the construction process of a New Mexico diversion project so that residents in Arizona will have opportunities to learn about the ongoing work – and express their comments and concerns?
- How can community members be effectively engaged in a participatory process for reviewing the role of direct potable reuse in water management?
- What role can community-supported agriculture and farmers' markets play in providing alternate revenue streams for the region's farmers and ranchers, in part to counteract the fluctuating demands of global markets for crops and livestock?

Back to Quick Links

4. Recreation

Recreation: This theme includes topics relating to the watershed as an attraction for its scenic and recreational value. Recreation in the watershed is consequential for economic development, conservation, and quality of life. In interviews with stakeholders, "recreation" was one of the top answers in response to what people wanted to see in the future economy of the watershed.

Background: The United States Forest Service (USFS) and Bureau of Land Management (BLM) allow free access to federally owned land for recreational use, sometimes with the requirements of special use permits and exceptions in the case of sensitive areas. Several small areas in the watershed are managed for wildlife and recreation by the Bureau of Reclamation, the Salt River Project, the National Park Service and the State's Department of Game and Fish. Recreation is enjoyed by local residents as well as visitors to the watershed and has a significant economic impact, falling just under farming and mining as the principal industries in the watershed. Visitors to Graham County spent $71.8 million in 2013, while Greenlee County saw $14.9 million in visitor spending.
Major recreation activities include:

Bird watching
Hiking and camping
River rafting
Fishing
Hot springs/mineral baths
Equestrian
Wilderness retreats
Rockhounding
Shooting/hunting
Motorized recreation
Mountain biking
Private event

Agricultural tourism (inviting visitors to a working farm or ranch to experience rural life) and eco-tourism are also popular industries in Arizona, of which there are examples in the watershed.
One of the goals from Graham County's comprehensive plan states "To conserve natural resources, preserve scenic beauty and to promote recreational opportunities," and recreation is listed under the section "Environmental Assessment" as a way to improve the overall appearance of the County.

Challenges:

Generally

- Drought impacts the amount of time that the Gila River can be used for water recreation.
- Water recreation has been criticized for potentially affecting habit.
- Private landowners own only about 10% of land in the watershed, but this land is concentrated along the river and is off limits for recreational use.
- People visit the watershed for its quiet and scenic nature. However, with more visitors, it can become more crowded and take away from the experience, especially for residents of the watershed.
- Federal involvement can lead to major consequences for the watershed considering the reserved rights regarding the Gila Box Riparian National Recreation Area and the San Carlos Apache Reservation, as well as enforced regulations (i.e., Clean Water Act and Endangered Species Act). Additionally, forest management policies affect recreational opportunities.
- Tourist spending in the watershed is beneficial to the economy, but tourism-related activities can sometimes be a nuisance for residents.
- Lack of access points to recreational areas.
- Lack of awareness about the river as a resource.
- Trail system is not connected.
- Media sources have emphasized catastrophes in this region, which can impact visitor interest.

Critical Uncertainties

- How could recreation help diversify and strengthen the economy of the watershed?
- How would changes to implementation of the Endangered Species Act (single-species vs. multi-species management) impact recreation opportunities in the watershed?
- How can public outreach utilize recreational opportunities within the watershed to educate the populace about conservation and riparian concerns?
- What are practical examples of balancing recreation and habitat so that neither would be affected too adversely?

Knowledge Gaps

- How many visitors come to the watershed each year for recreation?
- What is the cost-benefit assessment of recreational activities in the watershed, in terms of habitat conservation, public awareness, and economic benefits?
- What resources currently exist or need to be produced to accurately measure the economic impacts of recreation and tourism in the watershed?

Scenario Planning Questions

4. In a future with flooding driven by extreme weather events and functionally impaired riparian areas, how would recreation be affected?
5. How can the area prepare for possible population and economic activity increases as a result of enhanced recreational and eco-tourism based activities?
6. What steps could be taken now to encourage a regional economic partnership (including New Mexico) in promoting the growth of recreation, birding, and tourism generally in the Upper Gila River Watershed?

Back to Quick Links

5. Economic Development

Economic Development: This theme explores the policies and actions of communities to promote the quality of life and economic vitality of the region, which is all dependent upon a reliable water supply. Generally economic development stimulates conditions for economic growth, aiming to create opportunities for greater access to services by all citizens, as well as increase income that flows into the community from outside the market area through diversified industries.

Background: The major economic activities in the watershed are associated with farming, ranching, and mining. Farming and ranching have relatively small impacts on population changes in recent years, but are considered major economic inputs to the area overall. These two industries are notable for their multi-generational aspects, in that most farmers and ranchers are part of family operations with deep roots in the area. Between 2001 and 2006, an average of 91% of the surface water diversions and groundwater pumping were committed to agricultural water needs.

Mining contributed an estimated $90.6 million to the economy of Gila Valley in 2013. Growth in mining activity promotes mine investments that spill over into the local economy. The type of investments have changed over time, however, as mining has become more technology and capital intensive. The size of the mining labor force in relation to the amount of mining activity has decreased as new machinery has been brought online. Mine employees are much more likely to relocate to the watershed from elsewhere, and also may leave upon reaching retirement or when work opportunities in mining end. The current boom in mining has led to a population surge in several places in the valley, including Clifton and Safford. Hotel occupancy rates have remained high as mine workers fill empty rooms. Mining is therefore the activity most likely to have a notable impact on shifts in the population and economy of the region over the short- to medium-term. Water demand for industrial purposes, predominantly mining, makes up 5% of the demand in the watershed. An acre-foot of water for mining uses may, however, be used many times over.

The federal government is the largest landowner in the watershed with lands falling under the management of various agencies and departments. Federal actions can have significant impacts on the regional economy. Forest management policies affect timber sales, logging jobs, beef production, and recreational opportunities. Forestry management is also related to water quantity and quality through its impacts on watershed planning, percolation of runoff, and mitigation of catastrophic fire risk. The government is also a major employer (e.g., prisons), and can support an economic sector by distributing subsidies.

Other areas of substantial economic significance to the watershed include recreation/tourism, education, retail/trade, and the Mt. Graham Regional Medical Center. Visitors to Graham County spent $71.8 million in 2013, while Greenlee County saw $14.9 million in visitor spending.

Challenges:

Generally

- Federal agencies control the allocation and restrictions placed on grazing allotments, which are largely outside the control of the watershed but strongly impact the ranching community.
- Ongoing negotiations in water rights through the adjudication process may impact water users, such as farmers and municipalities, although the Arizona Water Settlements Act of 2004 already serves to guide the exercise of water rights at present.

- Enforcement of federal laws like the Clean Water Act (CWA) and the Endangered Species Act (ESA) can have major effects on the actions of private landowners and local government operations. The listing of new species as endangered or threatened can create new requirements for how land and water are managed in the region.
- Seasonal shifts in population can be difficult to estimate and housing options are limited. How do we address housing in case of short-term spikes in new residents working for the mine? How can we prepare for possible mine retirees who must leave the company housing in Morenci upon retirement?
- The temporary nature of many of the mining positions and the skewing of the labor force toward young, unmarried workers causes particularized demands on government services such as public schools.
- Technology-driven businesses could be possible in the watershed, but building codes need to be updated (e.g., to allow grey water, low water use technologies).
- There is a lack of public awareness about economic patterns at the local, national, and international scale.
- There is a lack of unique cultural restaurants and other social amenities.
- Media sources have emphasized catastrophes in this region, which can impact visitor interest and possible investment in the area.
- With the advancement of technology, more jobs have become automated, which means fewer job opportunities in the future.

Critical Uncertainties

- How might government actions to reallocate water affect farming in the valley – and, in turn, affect the economy of the region?
- How would more laissez faire or stringent business regulations affect the health of the watershed and its communities?
- How will the economies of local communities react to mine closures or dramatically decreased mining activity?

Knowledge Gaps

- What resources currently exist or need to be produced to accurately measure the economic impacts of recreation and tourism in the watershed?

Scenario Planning Questions

1. What planning activities are necessary to prepare for increases in temporary workers, as well as the impacts on roads and other infrastructure from increased heavy-duty tractor trailer trucks and other traffic?

2. How can public officials and the business community work together to prepare for the increase in demand for accommodations, food, and retail during the construction phase of the New Mexico diversion infrastructure?

Back to Quick Links

6. Physical Water Supply

Physical Water Supply (Quality and Quantity): This theme includes the quality and quantity of groundwater and surface water resources available for today and tomorrow. Water quantity was the most commonly indicated (27% of attendees) driver of change in the Upper Gila Watershed during the March 2014 Scenario Planning Workshop.

Background: Surface water supplies in the watershed are heavily dependent on precipitation. The bimodal precipitation regime in this semi-arid region results in the concentration of snowfall and rainfall into winter and summer monsoon periods, with long intermediate periods of dryness. Surface flows in the Gila River are strongly tied to snow melt in higher elevations, such as in the headwaters in neighboring New Mexico. The prolonged drought conditions, combined with the predictions of climate change, contribute to ever decreasing flows. Warmer temperatures earlier in the year result in more rapid snow melt and decreased flows during the summer months, when downstream irrigators are most in need of water. Higher temperatures also increase evapotranspiration rates, causing increased loss of soil moisture and greater stress on crops and native vegetation alike.

Various aquifers underlie the basin, each with differing water quality attributes. Salts and total dissolved solid concentrations can differ substantially, and affect the intended uses of the groundwater. The City of Safford currently draws its drinking water from aquifer-based sources, and the quality of the water is such that minimal treatment is needed at present. Decreasing groundwater levels have forced several municipal wells to go off-line on a regular basis. While water is available from a deeper aquifer, the poorer water quality would require higher levels of treatment, at a notably higher cost than under current practices. Further, extended drought conditions result in minimal surface flows in the Gila River itself, with the result that farmers turn to groundwater supplies for crop irrigation. Heavy use of water for such purposes can result in further decreasing groundwater levels, which then can lead to higher costs for well users (e.g., drilling new wells, higher fuel costs) as well as related problems, such as subsidence.

Challenges:

Generally

- Complicated subsurface geology creates challenges to understanding regional groundwater hydrology. Because there are few wells extending into the Lower Basin Fill, there are very limited data sources on geologic material below the Upper Basin Fill.
- Effluent is a potential source of “new” supply, however, some areas need help with figuring out how to re-use effluent given that the volume is generally small and there may be public perception issues.
- Desalinization is also a source of new supplies. What are the costs to treat the water and deliver it?
- How should the different jurisdictions in the watershed deal with contamination of groundwater and surface water (e.g., urban runoff and spills from mining or other industrial activities)?
- Stormwater could contribute to additional supply, however, many areas have codes that encourage developers to install conventional methods of stormwater drainage instead of Low Impact Development.
- The New Mexico portion of the watershed is upstream of the Arizona portion. Changes in New Mexico can impact the watershed in Arizona.

- Many stream gages have been discontinued due to insufficient funding. Without historic and current data, it can be difficult to identify long-term trends in streamflow.
- Climate change is predicted to alter the frequency and severity of storms resulting in fewer, more intense rainfall events. Streams may experience more flooding events and fewer perennial flows as a result.
- The principal water quality concern for groundwater is total dissolved solids.
    - For example: "There is decent water in the valley, but if you take a sample from anywhere in the valley, and it will come back as "not for ag". If it is mixed with surface water, not bad, but it's starting to affect soil quality. Could be an issue for ag, or the towns. Pima doesn't have to worry about it much, but everywhere else. Artesian wells have too much mineral content for ag (stakeholder comment)."
- More frequent and consistent testing of surface water chemical data is necessary to better characterize waters, particularly those designated 'inconclusive' by ADEQ in their 2012 report
- Desalination offers a means of supplementing water supplies, but with many challenges including:
    - Disposal or reuse of brine
    - Need for an adequate, cost-effective energy source
    - Exorbitant costs of implementation
    - Long-term development requirements

Specifically

- Surface water quality is designated impaired on the Gila in two places: just upstream of the confluence with the San Francisco and just downstream of the confluence with Bonita Creek. A smaller surface water drainage from the burned Chiricahua Mountains in the southern portion of the watershed is also designated impaired.
- Wells have been running dry in Duncan, in some cases they have had to extend wells to the deepest aquifer at 250 ft.
- Without recharging aquifers in the next five years, some water providers will have to drill deeper.

Critical uncertainties:

- What will happen with precipitation?
- How long will the drought continue?
- How does continued drought impact groundwater recharge and availability of surface water supplies?

Knowledge Gaps:

- How does the hydrology of the watershed change in response to vegetation change and vice versa?
- What are the long-term, downstream effects of fire in the watershed?
- How much water does the river produce over time?
- What are the contribution of ephemeral streams to water quality and sediments?
- Updated hydrologic data are needed for a better understanding of current conditions. Including updated well depth data, which would also be useful for assessing how groundwater pumping might impact the future availability of groundwater and surface water.

Scenario Planning Questions

- What groundwater monitoring programs could be put into effect in the short-term in order to develop a better understanding of the relationship between drought, flood flows, and groundwater recharge?
- What incentives, from an Arizona perspective, would be sufficient to partner with New Mexico to protect base flows in the Gila?
- What public-private partnerships exist that could be expanded or modeled to create more sustainable solutions to problems that affect everyone, such as water availability?
- What are the largest hurdles facing the development of direct potable reuse in communities of the Gila Watershed? What kind of steps can be taken now to help prepare for that possible eventuality?

Back to Quick Links

7. Water Demand and Governance

Water Demand: This theme includes the amount of water needed for municipal, industrial, and agricultural water users in the watershed. It also includes consideration of water used by domestic well users. Generally this theme focuses on how we "deal" with water scarcity, aka, the governance of our water resources.

Background: Water use in the Upper Gila River Watershed is dominated by agricultural activities. Between 2001 and 2006, an average of 91% of the surface water diversions and groundwater pumping were to meet agricultural water needs. Depending on the irrigation method, much of this water can return to the river or infiltrate through the soil into the aquifer. The more efficient the irrigation method, the less water will return to the river or aquifer. Water demand for industrial purposes, predominantly mining, makes up 5% of the demand in the watershed, the remaining 4% is used for municipal demand. In contrast to agriculture, industrial and municipal water uses are generally considered consumptive, as they return less water to the river or aquifer. An acre-foot of water for mining uses may, however, be used many times over. The number of domestic wells in the watershed has increased significantly over the last 60 years. Overall, in the Upper Gila River Watershed water demand did not change significantly between 1991 and 2009. There is, however, year to year variability in the water demand by agricultural and mining users in particular. The proportion of groundwater versus surface water used in the watershed has fluctuated over time, with increased surface water use when it is more available and increased groundwater use when surface water is scarce.

Challenges:

Generally

- While water use by one party does not necessarily mean the water is unavailable to another, water is increasingly scarce at the price and quality we are accustomed to paying for it.
- If water use in the watershed continues to grow, there will be significant gaps between the amount of water demand versus the water supply available.
- Closing the gap between water supplies and demands can be accomplished in many ways. Determining a path forward for the watershed will require cooperation.
- The sentiment "I don't have to worry about water, I have a well" is somewhat common with little public awareness about the compounding effect of many straws in the same glass of water.
- Denial that there is a water problem. It is difficult to get past today's problem and look at what might come tomorrow. Heat waves and the ends of the growing season can produce states of emergency and are dealt with on a reactionary basis.
- Wet and dry cycles: most people have been here for their entire lives, which was during the wet period years ago. Community members might have a hard time adjusting to this drought still.
- An uninformed populace was the number 3 of the top 4 most significant drivers of change in the watershed through the March 2013 Scenario Planning Workshop.
- There are some people in the watershed who can't afford to care.
- Conservation means a drop in use and therefore a drop in revenue, and utilities would need a rate increase just to break even. And even then, you don't have enough to make improvements.

- Economic development is inhibited by a lack of water resources. Businesses are hesitant to locate in the watershed if a reliable source of water is not guaranteed. Need to link conservation efforts to business attraction/development/infrastructure.
- Commodification of water: What happens if water is delivered by private companies and not being maintained the same as a public?
- Farmers want to conserve, but the system in place in Arizona does not reward farmers for their conservation efforts. If a farmer pays for and installs drip irrigation, he can be re-evaluated upon a 10 percent gain in efficiency system-wide and then his water allocation can be cut. "Use it or lose it" system, which means there's no incentive to get better or more efficient.
- Ongoing education opportunities are lacking for the general public to learn about conservation and water systems.

Critical uncertainties:

- What is the willingness to pay for water?

Knowledge Gaps:

- What are the connections between demographics and natural systems?

Back to Quick Links

8. Farming

Farming: This theme includes topics related to crop production and practices in the Upper Gila Watershed as concerned with water and land management. In interviews with stakeholders, agriculture (farming and ranching) was mentioned the most times as a major economic driver in the region and was ranked in the top five economic drivers in the Scenario Planning Workshop.

Background: Water use in the Upper Gila Watershed is dominated by agricultural activities. Between 2001 and 2006, an average of 91% of the surface water diversions and groundwater pumping were to meet agricultural, predominately farming, water needs. In the Safford groundwater basin, 181,700 acre-feet of water per year is used on average for agriculture as compared to 3,300 acre-feet per year for municipal uses and only slightly more for industrial uses, including mining. Depending on the irrigation method, much of this water can return to the river or infiltrate through the soil into the aquifer. More efficient irrigation methods utilize less total diversion overall. Agricultural water demand has not changed significantly between 1991 and 2009, but there has been year-to-year variability, particularly in the source of water. The proportion of groundwater versus surface water used in the watershed has fluctuated over time, with increased surface water use when it is more available and increased groundwater use when surface water is scarce.

Specifically, cotton farming is an important cultural and economic element in the towns within the Upper Gila Watershed. In 2012, 14% of the population in Graham County and 48% of the population in Greenlee County were employed by agriculture, forestry, fishing and hunting, and mining. Statewide, only 1.4% of the population is employed in agriculture, forestry, fishing and hunting and mining. Cotton production requires, consumptively, about 2.5 acre-feet of water per acre.

Challenges:

Generally

- The complexity and changes in agricultural policy create hurdles for farmers and barriers to coordination between farmers and other interest groups.
- The general population understands little about the inner workings of this industry.
- Arizona Water Settlements Act creates disincentives to prompt farmers to conserve water; the current “use it or lose it” system in Arizona does not reward farmers for their conservation efforts. If a farmer pays for and installs drip irrigation, he can be re-evaluated upon a 10 percent gain in efficiency system-wide and then his water allocation can be cut.
- Fluctuating fuel, energy, and utility costs can have a significant impact on associated costs of producing crops.
- Cooperation is necessary, but there are roadblocks to communication and friction that exist between different sectors that keep people from working together.
- Farm consolidation has occurred over the last 50 to 60 years in the watershed – will this trend continue and how will it affect the watershed?
- There is a demand for food grown locally, but acquisition of local commodities by non-locals creates a situation in which goods must be imported instead of supporting and relying on the local economy.

- The price of cotton internationally and within the United States fluctuates based on weather, consumer demand, and speculation on the commodities market, which are all largely out of the control of local forces.
- The loss of farming land could have far-reaching impacts on the ecology of the region.
- Government restrictions make water management difficult: lawsuits are a roadblock; the Endangered Species Act prohibits farmers from touching the river for even aesthetic reasons; there is frustration over not being able to change their property in the way they see fit; air quality is a becoming a big issue.
- There is an existing infrastructure for cotton in the watershed, not other crops – farming equipment is exorbitantly expensive and you can't just switch a crop easily.
- The amount of uncertainty makes people leave and go where there is certainty – we need stability, as well as a way to build a long-term stability in.
- Most recently, cotton prices are decreasing by a dime a year. If this trend continues, farming and the economic health of the region could be affected.
- Urbanization threatens farming land.
- Government regulation and disjointed management styles among various agencies are cumbersome; everything takes a permit and slows time with bureaucratic hurdles.
- Litigation among water users is widespread – everyone is fighting for water.

Critical Uncertainties

- How might government actions to reallocate water affect farming in the valley – and, in turn, affect the economy and culture of the region?
- How will climate change and the potential for more intense and frequent storms affect farming in the watershed?
- How could the loss of agricultural lands and/or different irrigation practices affect the return flows to the river and aquifer and what are the associated consequences?
- How will agricultural tourism affect traditional farming in the valley?

Questions from Scenarios:

- What could be done to support farmers when prices are low for prolonged time periods?
- What proactive steps could be taken to reduce air quality concerns? Are there more local solutions to supporting farming in the watershed?
- What are the drawbacks and benefits associated with diversifying agricultural production in the Valley?
- How can creative solutions be encouraged among the agricultural industry with the high level of risk involved with yearly production rates and crop prices?

Back to Quick Links

9. Uplands and Range Management

Uplands and Range Management: The theme involves discussion of the land outside of the watershed's riparian and flood plain areas. Land uses include grazing mostly in lower elevations and forestry in higher areas that receive greater average annual precipitation. This theme is associated with recreation and other topics including access and transportation.

Background: Livestock grazing and forestry-related activities have been integral components of the regional economy for well over a century. Ranching in particular is a major component to historical and contemporary livelihood and regional identity. A majority of the land in the region is owned by federal or state agencies; however, grazing allotments have historically been issued on these lands to local ranchers for livestock. While domesticated sheep once had a notable presence in the valley, cattle are the primary livestock raised commercially at present. Changes in federal land management guidelines, such as due to non-native species or to long-term drought conditions, can affect allowed Animal Unit Months per allotment during renegotiations.

Lumber activity has declined over time, but renewed interest in improved timber management on forest lands is being driven by watershed health issues generally and particularly for fire management. Decades of fire suppression, combined with a decrease in cutting and increased litigation in more recent years, has led to the growth of dense forested areas with greater potential for catastrophic crown fires. Large-scale burns have occurred in the last fifteen years in the watershed, and the loss of forest cover has resulted in increases in erosion and sediment load in rivers and streams, with negative impacts on water quality and riparian health for the following year or two years but with a net decrease in erosion over time. Selective thinning as well as controlled burn strategies have become more common, although the many years of drought and limited funds for such efforts have curtailed the extend of these efforts.

Based on the results of the Scenario Planning Workshop, the combination of "Land Use and Environmental Regulations" and "Legislative Action (local, state, and federal)" represented single most important driving force in the minds of most participants. Further, "Landscape Management" was added as the fourth most important driver on the final list, given the view of participants in its highly influential role in relation to the quality and quantity of water in the Upper Gila Watershed.

Challenges:

Generally

- Thousands of sediment control structures have been built over several decades to reduce sediment loads in the region's rivers and the San Carlos Reservoir downstream. Many of these structures are overdue for extensive maintenance. Some are facing serious structural integrity problems and are in danger of failure. Funding for such efforts is difficult to obtain.
- Long-term drought (encompassing most of the past fifteen years) has stressed even drought-adapted native vegetation. The arrival of non-native plant species has increased competition for the existing vegetation, and the drought-induced stress has left plants more susceptible to pests. Die-offs have been noted in different areas, including in forested lands, and the resulting combustible dead plant material can contribute to the potential fuel load.

- Drought can reduce the resiliency of plants used as forage for cattle, reducing the capacity of the land to support livestock. This can force ranchers to sell cattle and further reduce the economical operating margins of this business model.
- Decreasing groundwater levels may affect the ability of ranchers to access water of suitable quality for supporting stockponds as well as of exurban/ranchette residents in finding economically viable potable water supplies for home use.
- There has been increasing interest in harnessing solar power as a renewable energy source in Arizona generally and specifically within the Safford Valley. Water usage associated with most commercial-grade solar installations can be substantial, however.
- Public perception of burns are often negative – NIMBY (Not In My Backyard).

Critical uncertainties

- How will changes in federal regulations, such as the EPA's proposed rules on "water of the United States", affect land management related to washes and other ephemeral streams?
- If the long-term drought continues, how will it affect existing plant and animal communities in upland areas?
- Will continued heavy use of groundwater pumping lower the water tables sufficiently to alter plant communities in upland areas?
- How will permit restrictions regarding grazing allotments be changed in response to drought or other changing climactic conditions?
- Will there be ways of increasing active upland restoration efforts through controlled burns or tree thinning?

Knowledge Gaps

- What areas of the Upper Gila Watershed might be best suited for commercial-scale solar energy arrays?
- What would the water requirements be for such large-scale solar installations?
- What is the vegetative cover of the watershed?
- How much burn in the watershed is catastrophic?
- What types of restoration efforts would be most effective in the short-term in addressing upland areas affected by catastrophic fires, especially if drought conditions continue?

Questions from Scenarios

- How can groundwater monitoring be facilitated in the coming years so that complex interactions between pumping, surface flows, and recharge, along with their impacts on the resilience of plant communities, be better understood?
- What kinds of coordination and cooperative resource management strategies should be developed among different upland land managers, including ranchers, government entities, and Tribal authorities, in order to address downstream impacts of fire and erosion?

Back to Quick Links

10. Riparian Area Health

Riparian Areas: This theme focuses on maintaining the health of areas along rivers that are dependent on shallow groundwater and streamflow. Riparian area health includes vegetation and the animals that depend upon/use the vegetation. Healthy riparian areas may have any combination of trees, shrubs, grasses, depending on the local conditions. They support a broader diversity of vegetation than the surrounding dry land because of better soils and water availability.

Background: Riparian areas are important because they act as a buffer for streams and lakes from the surrounding landscape. Important aspects of riparian areas include:

- Trapping sediment and reducing erosion through slowing the flow of water;
- Filtering the water by trapping nutrients and microscopic pathogens that are present in runoff;
- Building and maintaining streambanks by slowing sediment and anchoring soils with root systems;
- Storing floodwater:
- And maintaining biological diversity - in Arizona, it is estimated that 70% of wildlife spend some portion of their lifecycle in riparian areas (even though riparian areas account for only 1% of the total area of the state). A substantial portion of the riparian areas of AZ have been lost or degraded.

A healthy riparian area is able to carry out the ecological functions described above. In the Upper Gila Watershed, many of the riparian areas have been invaded by non-native Tamarisk. Tamarisk is problematic because it out-competes native species, which may reduce biological diversity and can spread farther on the floodplain than most native riparian species, therefore, using more water.

Challenges:

Generally

- Perennial flow is required to sustain healthy aquatic communities and is important for the health of riparian vegetative and animal communities. Shallow groundwater (with or without perennial flow) is also required to sustain healthy riparian communities. There have been more zero-flow days in the last decade which negatively affects riparian health.
- Only ten percent of the region is privately owned; however these tracts are concentrated along the rivers of the watershed. Riparian restoration work often necessitates work on private land.
- Anytime you have riparian habitats, there are federally listed endangered, threatened or candidate species that you have to be aware of.
    - Permitting timeframes will influence a variety of riparian-related efforts.
    - Most consideration to date has been to benefit southwestern willow flycatchers, but management likely needs to be broadened to consider other species.
    - Timing will become more complex when working with other species; for example, garter snakes hibernate in winter and the habitat requirements are not the same for the yellow-bill cuckoo as they are for the flycatcher.
    - It is a difficult balancing act to continue to preserve species and maintain a good human environment.
- Around 2018 it is expected that an introduced tamarisk leaf beetle will arrive in the watershed.

    - The beetle causes defoliation and tamarisk mortality over time, and which may provide opportunities for re-establishing a more resilient mixture of native plant and animal species or could result in a wholesale shift in plant and animal communities and a heavily degraded landscape that has lost much of its ecological functionality. This situation could include the establishment of other non-native species more pernicious than tamarisk.
- Fire is a concern because it has direct and immediate impacts on water quality and habitat.
- While flood flows can be very destructive to human infrastructure along the river they are also an important part of life cycles for riparian and aquatic species in the Gila River.

Critical uncertainties

1. What are the differences between more vegetation vs. less vegetation in riparian areas and the movement of sediment?
2. How will the tamarisk beetle impact the riparian areas?
3. How will climate change impact riparian areas?

Knowledge Gaps

- What is the status of the Southwestern Willow Flycatcher, Yellow-Billed Cuckoo (YBCU) and garter snakes in the watershed?
- Lacking riparian data for southwest "flashy" systems and monitoring of those systems.
- The detail in the mapping of riparian cover varies.
- Lack of monitoring programs to track the movement of sediment and the status of erosion.
- Geohydrology studies in the area could provide valuable spatial information.
- Incomplete knowledge of threatened and endangered species of birds and pollinators, related to how many and their vulnerability to climate change and defoliation of tamarisk.

Scenario Planning Questions

1. In a future with flooding driven by extreme weather events and functionally impaired riparian areas, what steps should be taken for floodplain management?
2. Will New Mexico using its allocation impact restoration efforts?
3. What groundwater monitoring programs could be put into effect in the short-term in order to develop a better understanding of the relationship between drought, flood flows, and groundwater recharge?
4. How can groundwater monitoring be facilitated in the coming years so that complex interactions between pumping, surface flows, and recharge are better understood?

Back to Quick Links