VERDE WATERSHED RESTORATION COALITION

Strategic Restoration Plan
Final 2019

Verde Watershed Restoration Coalition

Friends of the VERDE RIVER

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STRATEGIC RESTORATION PLAN

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I. EXECUTIVE SUMMARY

The Verde Watershed comprises 4.2 million-acres (6,640 square miles) in the geographic middle of Arizona, part of the Mogollon Highlands Ecoregion. The Verde River is one of Arizona's last free flowing rivers, home to one of the largest remaining native Fremont cottonwood and Goodding's willow mixed broadleaf riparian forests. The watershed provides habitat for 16 threatened and endangered species, and many more migrating and resident species. Concerns in the watershed are habitat degradation, invasive species, reduced water flows, and impaired water quality. In order to address these concerns, the partners of Verde Watershed Restoration Coalition (VWRC) developed and adopted this five-year plan to identify conservation objectives, listed below, and priority areas that will have the most significant conservation impacts. VWRC identified four main conservation objectives and developed key tracks that describe 3-, 5-, and 10-year desired outcomes (Appendix A). The conservation objectives support VWRC's vision for a healthy, flowing Verde River system, with a healthy, sustainable environment and vibrant economies for future generations. The main conservation objectives and their tracks include:

1. Restore and maintain ecosystem functions and habitat connectivity for fish and wildlife to facilitate self-sustaining natural processes and linkages between terrestrial and aquatic systems. Key tracks are:

    a. Riparian invasive plant management
    b. Habitat connectivity and corridors

2. Reduce accelerated erosion and associated landscape drivers along perennial river floodplains, ephemeral washes, upland gullies, and springs. Key track is:

    a. Reduce sediment loading

3. Address water quality drivers to maintain and improve water quality to attain state clean water standards for healthy fish and wildlife and sustainable recreation. Key track is:

    a. Water quality monitoring and evaluation

4. Provide volunteer and educational opportunities to assist in river conservation efforts and develop people who are stewards of watershed health. Key track is:

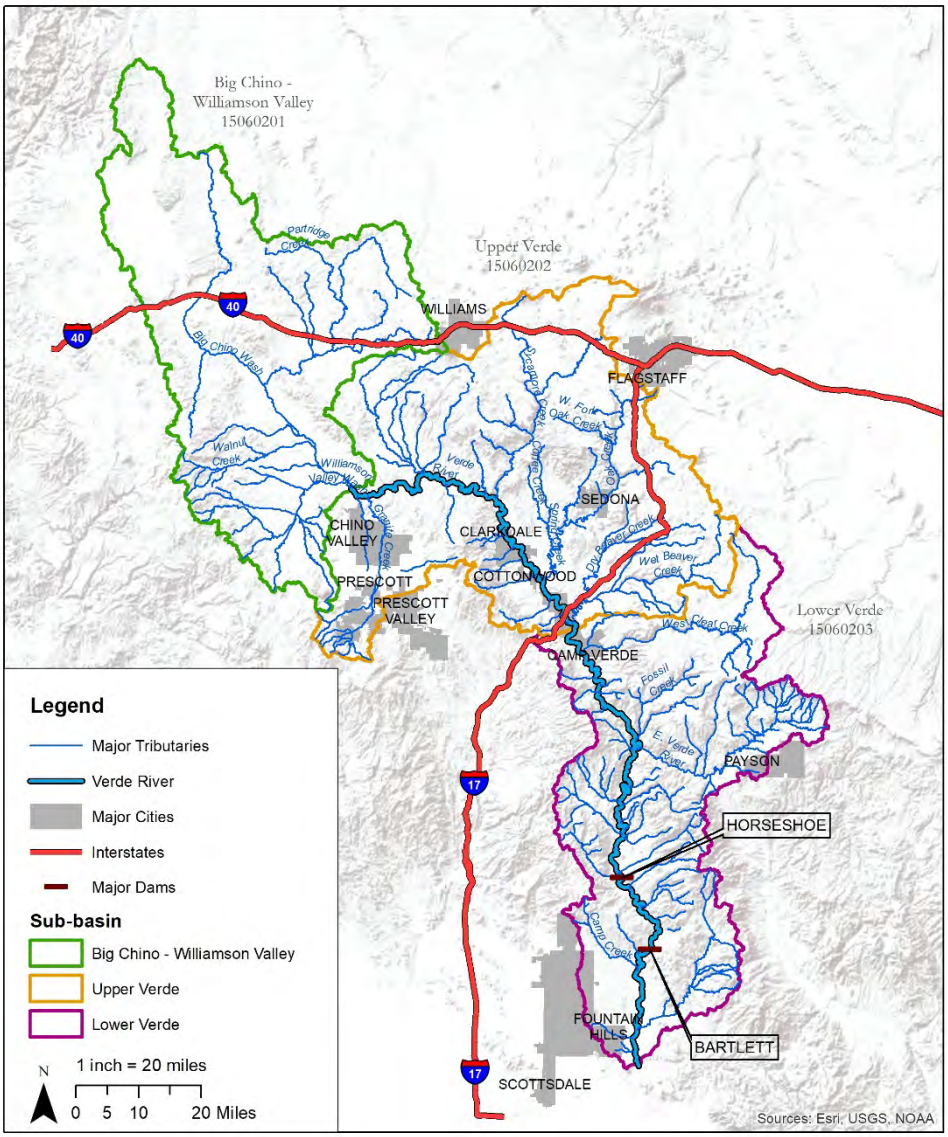
    a. Watershed stewards development

The success of this plan will depend on stakeholders' and partners' focus on high priority actions. To identify where high priority actions should be initiated, environmental planners modeled riparian vegetation departure from properly functioning condition and erosion risk for the watershed. The results of the modeling identified close to 70 miles of tributaries where erosion, vegetation change, floodplain disconnection, and land use have negatively affected riparian conditions. The initial results can start to focus efforts but additional

evaluation to pinpoint areas of most concerns to maximize the potential restoration to improve ecological function.

The Verde River Watershed overlaps with Yavapai, Coconino, Gila, and Maricopa Counties in central Arizona. For this planning effort and for consistency with other planning efforts, the Verde River watershed is subdivided into three surface water sub-basins as defined by the U.S. Geological Service and U.S. EPA. These sub-basins include: 1) the Big Chino-Williamson Valley at the headwaters of the river; 2) the Middle Verde running through the Verde Valley and Clarkdale, Cottonwood, and Camp Verde; and 3) the Lower Verde, extending south of Camp Verde to the river's confluence with the Salt River (Figure 1). The boundaries were obtained from the USGS National Water Information System (www.maps.waterdata.usgs.gov) using the 8-digit HUC surface water sub-basin divisions for the Verde River. The Arizona Department of Water Resources has also developed ground water sub-basin designations that partners use for hydrology and flow analyses. For the purposes of this study, however, surface water sub-basins were used as they correspond with existing water quality monitoring efforts and additional terrestrial issues.

Figure 1. Verde Watershed Restoration Coalition Plan Coverage



I. INTRODUCTION

The Verde River is one of Arizona's last perennial flowing rivers and home to one of the largest remaining native Fremont cottonwood and Goodding's willow mixed broadleaf riparian forests. The watershed comprises 4.2 million-acres (6,640 square miles) in the geographic middle of the state (Figure 1), part of the Mogollon Highlands Ecoregion. With about 72 percent of the land in public ownership (62% federal and 10% state), the watershed provides native habitat and migratory corridors with high diversity of wildlife and plant communities. The watershed supports 16 federally listed threatened and endangered species, including one mammal, three birds, two reptiles, one amphibian, eight fish, and one plant, and includes proposed or designated critical habitat for eleven of these species (Appendix B). Under the Wild and Scenic Rivers Act, 40.5 miles of the Verde River and 16.8 miles of Fossil Creek are federally designated as wild, scenic, or recreational. In addition, 37 miles of the upper Verde River is eligible for Wild and Scenic designation. Oak Creek, West Fork Oak Creek, and Fossil Creek are designated Outstanding Arizona Waters. The Verde River corridor is a recognized geo-tourism destination, with fishing, rafting, hiking, and bird and wildlife-watching opportunities, providing important revenue to the Verde Valley's rural economy.

Habitat degradation, invasive species, reduced water flows, and impaired water quality are concerns for the unique attributes of the Verde River Watershed. Invasive plant species contribute to habitat degradation by displacing native vegetation, decreasing biodiversity, increasing sedimentation, and risk of fire. They can promote plant community monocultures, disrupt the natural hydrologic regime, alter the natural fire regime, and decrease wildlife habitat quality. Destabilized soils, development, poorly designed roads, social trails, and over-grazing contribute to sedimentation, habitat fragmentation and degradation. Pollutants enter streams through stormwater runoff and windblown dust from construction sites, agricultural fields, unpaved parking lots and roads, disturbed vacant lots, and paved road dust.

The Arizona Department of Environmental Quality (ADEQ) has designated 97.9 miles of stream in the Verde Watershed as Not Attaining/Impaired for *Eschrichia coli* or Dissolved Oxygen (DO). An additional 44.5 miles within the watershed are deemed impaired due to exceedances for E. coli, arsenic, and/or DO (ADEQ 2016). Several lakes and reservoirs are listed as Impaired or Not Attaining/Impaired (ADEQ 2016). These conditions affect migratory and resident wildlife species, recreation, and the ecosystem function of the watershed.

1. Collaborative Approach to Watershed Restoration

The Verde Watershed Restoration Coalition (VWRC) was formed in 2010 as an initiative of the Friends of the Verde River (FVR) to collaboratively implement restoration projects that benefit the Verde River and its tributaries. The partners wanted to address the spread of

invasive plants in the watershed's riparian forests – an issue that requires a holistic, watershed-level approach with broad participation. With over 25 agency and organization members, listed in Table 1 (description of roles in Appendix C), VWRC implements voluntary conservation and management actions on state, federal and private lands in the watershed.

As a group, VWRC meets quarterly to coordinate conservation projects through identification and review of priority projects, provide technical expertise and assistance, and support funding for project implementation. Some of the partners are themselves funders of projects that other members then implement.

Over the past nine years, VWRC partners and grantors have invested greater than $4 million to improve over 9,000 acres of riparian habitat by removing priority invasive species and engaging private landowners in river conservation. The strength of VWRC's success lies in the collaboration and diversity of its partners, which enables VWRC to effectively overcome key challenges to project implementation.

Table 1. Verde Watershed Restoration Coalition Partners

Arizona Conservation Corps (AZCC)
Arizona Department of Environmental Quality (ADEQ)
Arizona Game and Fish Department (AGFD)
Arizona Department of Forestry and Fire Management (DFFM)
Arizona State Parks (ASP)
Arizona Wildlife Federation
City of Cottonwood
Coconino National Forest (CNF)
Friends of the Verde River (FVR)
Kaibab National Forest (KNF)
National Park Service (NPS)
Natural Resources Conservation District (NRCD)
Natural Resource Conservation Services (NRCS)
Northern Arizona University (NAU)
Oak Creek Watershed Council (OCWC)
Prescott National Forest (PNF)
RiversEdge West (REW)
Salt River Project (SRP)
The Nature Conservancy (TNC)
The Vetraplex
Tonto National Forest (TNF)
Town of Camp Verde
Town of Clarkdale
U.S. Fish and Wildlife Service (USFWS)
Verde River Institute (VRI)
Yavapai-Apache Nation (YAN)
Yavapai College

FVR is a 501(c)(3) non-profit conservation organization that works collaboratively to restore habitat, sustain flows and promote community stewardship to support a healthy Verde River system. For VWRC, FVR serves as the facilitator and convener, fundraiser, and project manager. FVR builds relationships with private landowners that enable habitat restoration in otherwise inaccessible lands. As a non-profit, FVR can leverage federal and state funds to secure grants to further support implementation of river conservation projects. FVR has been the leader in invasive plant removal projects on private, state, and federal land with support from VWRC partners. Finally, because of its active presence in the Verde Valley community, FVR plays a unique role in engaging private landowners in river conservation activities. FVR, along with the VWRC partners, works to establish a holistic and cooperative vision for river conservation in the Verde River watershed.

In 2015, the members of VWRC initiated planning for a five-year strategic plan, 2016 - 2020. That plan has guided work over the past almost five years. In 2018, the partners determined there was a need to continue the work and began the process of envisioning and strategizing for the next five years with expanded focus beyond the river floodplain to the stream itself, its tributaries, and surrounding uplands. This plan is a result of that planning effort.

2. Verde Watershed Restoration Coalition Vision and Mission

The members of the Verde Watershed Restoration Coalition envision a healthy, flowing Verde River system that sustains the natural environment and its communities with vibrant economies.

VWRC, functioning as a collaborative, ensures that conservation efforts are effectively implemented by being strategic and focused on project development and adaptive management.

Within the collaborative, projects are evaluated and prioritized, and lessons learned are shared across the watershed. VWRC focusses on the projects that are most effectively implemented by this group of stakeholders and coordinates its efforts with other conservation work in the watershed, such as sustaining flows and recreation.

The values that inform and guide this vision and mission include the use of sound science, professional judgement, expert knowledge, collaborative partnerships, and solutions-oriented problem solving to accomplish on-the-ground projects that lead to sustainable land and water management.

3. Conservation Objectives

The Verde River Watershed is a diverse landscape with many challenges and stakeholders. We will base the success of this plan on our ability to identify and focus conservation efforts on high priority actions. Based on local stakeholders' professional judgement and past planning efforts, we identified four conservation objectives as the highest priority as listed below.[1] Assumed in these conservation objectives are needs for project implementation, effectiveness monitoring, environmental response, stewardship, and sustainable funding. General guidance about how the objectives are coordinated and implemented within VWRC is described in the "Collaboration and Partnerships" section.

Each of the four conservation objectives has key tracks identified to ensure the overall goal is met with clear benchmarks along the way. These tracks describe 3-, 5-, and 10-year outcomes. The 3-year outcome would be accomplished by the end of 2022 and is therefore

[1] VWRC partners also recognize that conservation objectives relating to restoring and protecting streamflow are a high priority and area of concern. These objectives, however, are being addressed by other stakeholders and VWRC recognizes that it is not best suited to manage water rights and streamflow management challenges.

generally more detailed and actionable. The 5-year and 10-year outcomes serve as the general direction of workflow to allow planners to project how shared goals and actions would impact watershed condition. These outcomes will be updated in future planning efforts. Key strategies for each of these tracks are defined and are needed to achieve the 3-year outcomes. To provide clarity in the roles, additional sections describe the roles of FVR and other partners, specifically, along with VWRC as a coalition. All stakeholders, of course, have specific and individual roles that must be understood and agreed upon in specific implementation of strategies. The key tracks tables can be found in Appendix A.

Conservation Objectives

1. Restore and maintain ecosystem functions and habitat connectivity for fish and wildlife to facilitate self-sustaining natural processes and linkages between terrestrial and aquatic systems. Key tracks are:

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II. PROJECT IMPLEMENTATION

To accomplish the conservation objectives and implement projects, collaborative project planning and implementation strategies are necessary. Project prioritization and focus areas will be determined by VWRC partners. VWRC project implementation and prioritization will be guided by and built off completed VWRC partner efforts that focus on identifying priority needs, actions, and techniques and results from the erosion risk and vegetation departure models. Implementation requires shared funding and use of the most effective best management practices for successful restoration projects. This section specifically addresses previous partner efforts that can aid in VWRC project implementation,

implementation and funding strategies, and restoration strategies that can be used to successfully complete projects.

Additional resources to assist with project implementation include project ranking, project planning, and restoration strategies. Project ranking can assist with refining and prioritizing specific sites for implementation. For a proposed list of criteria that can be used to rank project sites see Appendix G. Detailed project planning is essential to provide successful grant proposals, clear guidance to project goals and implementation strategies, and determine success criteria and monitoring activities. For more information on project planning see Appendix H. The restoration strategies implemented at a site are considered during project planning, achieve the conservation objectives, and should be self-sustaining over the long-term. For a list of restoration strategies refer to Appendix I.

1. Collaborative Efforts Guiding Implementation

Collaboration and partnership are the foundation of VWRC and are essential to successfully implement habitat conservation projects in the watershed. There are several VWRC partner efforts that have been completed or are in progress in the watershed that can direct collaborative efforts and priorities and support this plan's implementation. This plan integrates those planning efforts with a focus on implementing some of the identified projects, strategies, and needs. The most related and notable efforts include a) the Verde Watershed Report Card, b) National Forest Watershed Restoration Action Plans (WRAPs), c) ADEQ Verde Watershed Water Quality Initiative and d) Verde Front.

a. Verde Watershed Report Card

The Watershed Report Card is led by FVR and The Nature Conservancy with input from VWRC partners and others to create a framework to evaluate watershed condition. While not finalized as of this writing,[2] the indicators of watershed health are categorized in eight categories: water quality, water quantity, riparian zone, terrestrial habitat, aquatic habitat, community vitality, civic engagement, and recreation. The process of evaluating each indicator analyzes and synthesizes available data. The metrics in the report card will be evaluated over time to determine both status and trends in watershed health. The report card and this current plan are complimentary efforts that identify the same stressors with respect to water quality and habitat condition in the watershed. While the report card will grade the selected watershed condition variables, this effort provides an implementation strategy to improve those variables.

b. National Forest Watershed Restoration Action Plan (WRAP)

In 2011 and 2012, the Coconino, Prescott, and Tonto National Forests completed a watershed assessment of managed lands in the Verde Watershed using the Watershed Restoration Action Plan (WRAP) approach (Potyondy and Geier 2010). The WRAP is a

[2] The Watershed Report Card will be completed by early 2020.

nationally consistent approach to identify priority watershed restoration projects for lands managed by the National Forests. The planning approach involved Forest Service resource experts to identify and rank sites in the watershed based on several variables related to soil erosion, plant communities, stream bank stability, and anthropogenic impacts. The result of the WRAP process was a list of priority projects and a restoration implementation strategy. The identified WRAP projects can serve as a focal point of collaborative efforts achieved through this current plan. Additionally, the WRAPs serve as a foundational document for the Verde Watershed Report Card.

c. ADEQ Verde Watershed Water Quality Initiative

Arizona Department of Water Quality (ADEQ) has designated the Verde River as an impaired waterway due to the exceedance of arsenic, *E. coli*, dissolved oxygen in 50.7 stream miles and lakes in the watershed (ADEQ 2018). In 2018, ADEQ identified the Verde River and its tributaries as one of the top three priority watersheds to implement monitoring and restoration projects to address water quality issues. Currently, ADEQ is sampling water quality in Upper Oak Creek with a focus on identifying exceedances of *E. coli* and their sources and implementing regulatory and restoration actions. To have a broader impact on addressing water quality issues, ADEQ is looking for collaborative projects to complete with VWRC and other collaborators in the watershed.

d. Verde Front

Verde Front[3] is a collaborative effort of federal, state, county, city, and non-profit partners that was established to address sustainable recreation in the Verde Watershed. The Verde Front is a broadly supported regional effort to ensure a collaborative approach to recreation and tourism coordination, planning, and implementation across the Verde Valley. This cross-jurisdictional, multi-stakeholder effort is developing a long-term, comprehensive sustainable recreation approach to link communities through the Verde Valley including Camp Verde, Cottonwood, Clarkdale, Jerome, Sedona, and unincorporated communities of Yavapai and Coconino counties. The Verde Front is fostering a regional sustainable recreation plan to ensure ongoing support and coordination. This group is seeking to expand its collaboration beyond recreation and tourism and engage in a conversation around river management, as the river provides the core of the recreational opportunities in the Verde Valley. The concepts developed through this planning process will be integrated into VWRC's watershed education and stewardship goals.

2. Project Collaboration

Funding restoration and conservation projects is a shared obligation by VWRC partners. Landowners and managers can contribute to projects through financial support or in-kind matches such as hands-on activities and technical support. FVR can supplement project funding provided by VWRC partners by securing grant funds from federal, state, and private foundation conservation grant programs. A useful resource for locating grant funding

[3] https://sites.google.com/site/verdefront/

opportunities that support river restoration and conservation projects can be found at the following website: https://www.riversedgewest.org/funding. Many of the funding programs require support letters and funding to match grants; VWRC partners can provide both to support this work.

III. MEASURES OF SUCCESS

Monitoring has been embedded in all the conservation objectives as a necessary component to evaluate project success, influence adaptive management, and provide metrics to help highlight VWRC accomplishments. Monitoring techniques and metrics will be developed per the conservation goals and objectives for each project. System-wide and consistent monitoring techniques should be considered for implementation at all restoration projects within the watershed. FVR uses a standard data collection format (currently Esri Collector) to collect and upload data electronically to a project database in real time. Still under development is a centralized database that would be available to project partners to house the data. Monitoring can be incorporated into volunteer stewardship and educational programs. Cooperative data collection towards common monitoring metrics across the watershed will be a powerful tool for grant procurement, evaluating project success, adjusting restoration and management techniques, and communicating VWRC's success story.

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APPENDIX A. VWRC DESIRED OUTCOMES

Conservation Objective	**Restore and maintain ecosystem functions and habitat connectivity for fish and wildlife to facilitate self-sustaining natural processes and linkages between terrestrial and aquatic systems.**
Track	**Track 1. Riparian Invasive Plant Management**
10-year Outcomes	- Eighty percent of all previously treated plant community composition monitoring plots will meet goals for relative canopy cover of greater than 90% relative cover by native woody species and show evidence of natural recruitment. - For public lands, there will be no expansion of priority invasive plant populations in the river corridor from the 2020 levels.
5-year Outcomes	- Mapping of 100% the watershed for priority invasive species in the 100-year floodplain will have been completed - For public lands, there will be no expansion of priority invasive plant populations in the river corridor from the 2020 levels.
3-year Outcomes	- Mapping of the watershed for priority invasive plant species in the 100-year floodplain will have begun, assuming funding has been secured. - Monitoring and re-treatment will ensure that there is no net expansion of priority invasive plant populations in previously treated areas. - Initial treatment of new priority sites will reduce the amount of invasive plant populations.
Strategies	- Use the vegetation departure model to identify areas for mapping invasive species and selecting priority areas for initial treatment. - Improve mapping tools using remote sensing such that we have coverage of 100% of the watershed to assist in setting goals for invasive plant treatment and monitoring. - Identify priority areas for initial treatment, retreatment, and monitoring throughout the watershed and annually update priority areas utilizing available funding and resources. - Complete initial treatment of two additional priority sites and annually monitor and re-treat 25% to 33% of previously treated sites. - Develop conservation measures with USFWS for treatment and maintenance within occupied and suitable Threatened and Endangered Species habitat. - Develop site-specific restoration plans that provide achievable goals, invasive species removal techniques, native planting material and techniques, monitoring techniques, and success metrics (e.g., % invasive species cover removed, percent survivorship of planted native species, number of acres/species removed, etc.). - Update the monitoring and maintenance plan and secure funding to ensure

	that the 100-year floodplain of the watershed is monitored for invasive species every three to five years to determine the success of management activities and re-treated as needed. - Develop relationships with partners for growing and providing native plants needed for revegetation. - Implement active restoration techniques including revegetation in highly degraded sites or where structural diversity is minimal. - Design, fund, and implement a private landowner education and outreach strategy. - Develop and implement a program to educate and train volunteers to collect monitoring data and assist with active restoration.
Key Challenges	- Volunteer training and management. - Capacity to treat the whole watershed. - Maintaining donor interest and support. - Maintaining relationships with private landowners. - Sustained availability of funds from partners and donors.
Friend's Role	- Lead for on-the-ground invasive plant work, coordinating and facilitating with VWRC - Ensure coordination with watershed partners to implement strategies - Manage and oversee crews and volunteers for on-the-ground work - Maintain and apply the mapping and monitoring protocols – track indicators and metrics - Implement invasive plant mapping and removal projects - Maintain relationships with private landowners
VWRC Role	- Disseminate messages regarding treatment and monitoring - Share data related to progress towards watershed goals. - Review and prioritize projects - Provide support for grants proposals and match funding as necessary
Key Partner Roles	- National Forests, USFWS, AZGFD, ASP - Coordinate, provide shared funding, as available, and information needed to complete projects; assist with necessary permit and compliance; support long-term monitoring and maintenance - SRP - provide shared funding, as available, and information needed to complete projects; assist with necessary permit and compliance - Private Landowners - provide access to land, assist with in-kind work and/or shared funding

Conservation Objective	**Restore and maintain ecosystem functions and habitat connectivity for fish and wildlife to facilitate self-sustaining natural processes and linkages between terrestrial and aquatic systems.**
Track	**Track 2. Habitat Connectivity and Corridors**
10-year Outcomes	- Have secured protection of one identified wildlife management corridor through land purchase, conservation easement, or completed strategic restoration on sites to ensure high quality habitat.
5-year Outcomes	- Land managers and landowners within the highest priority corridor are implementing BMPs and completing active restoration in areas of critical habitat.
3-year Outcomes	- Adopt shared lands conservation strategies between state, federal, local, and NGO partners that prioritizes conservation objectives related to the highest priority wildlife linkages. - Confirm mapping & identification of high priority corridors is up-to-date and supported with data. - Reach out to private landowners of high priority parcels for a corridor
Strategies	- Use erosion and vegetation departure models to prioritize restoration activities for key sites in corridors. - Identify aquatic and terrestrial wildlife corridors locally and prioritize conservation based on threats to loss of connectivity (i.e. what corridors are most likely to be lost due to development), habitat quality, and opportunity. - Inventory wildlife available waters within the watershed, tanks and spring sources, quantifying flow and tank volume, and riparian vegetation available for wildlife. - Ensure that federal funding request are coordinated and that requests from the watershed are not competing in counterproductive ways. - Develop Best Management Practices (BMPs) for landowners in wildlife corridors, including wildlife friendly fencing techniques and active revegetation. - Meet with private landowners and discuss conservation easements and implementing wildlife corridor BMPs. - Work with state and federal agencies to update maps of wildlife corridors.
Key Challenges	- Land values are high - Landowners cooperation, coordination, and participation is required - This is land conservation work
Friend's Role	- Partner on wildlife corridor identification and assessment with TNC and agencies - Provide letters of support for priority areas upon request. - Include land conservation techniques and wildlife corridor BMPs as part of public outreach and education efforts.
VWRC Role	- Collaboratively identify and confirm key wildlife corridors. - Track metrics related to progress towards watershed goals. - Develop shared funding strategies to secure wildlife corridors and ensure that funding requests do not compete.

Key Partner Roles	- TNC – Support development of conservation easements - AZGFD - provide data on existing corridors and assist with funding opportunities for private landowner conservation easements. - National Forests - provide shared funding as available for enhancement projects on National Forest land, technical support, and protection of identified restoration lands. - ASP - provide shared funding for enhancement projects on State Park lands and protection of identified lands. - Ecological Services (USFWS) - assist with data on corridors. - NRCS - assist with funding opportunities. - Private landowners - provide site access and cost share on private lands. - ADOT - provide data on existing corridors.

Conservation Objective	**Reduce accelerated erosion and associated landscape drivers along perennial river floodplains, ephemeral washes, upland gullies, and springs.**
Track	**Track 3. Reduce Sediment Loading**
10-year Outcomes	- Streambank and upland erosion areas in three additional high priority HUC6 watersheds have been mapped and ground-truthed. - Projects in five HUC6 watersheds that improve sites watershed condition to the next level have been completed.
5-year Outcomes	- Streambank and upland erosion areas in three high priority HUC6 watersheds have been mapped and ground-truthed. - Projects in two HUC6 watersheds that improve watershed condition to the next level have been completed.
3-year Outcomes	- Complete watershed-wide project prioritization and develop a plan for implementing one priority project. - At least one priority project that reduces accelerated erosion has been implemented in one HUC6 to improve watershed condition to the next level - Success has been widely disseminated in the watershed to encourage private landowners to implement BMPs on their lands.
Strategies	- Use erosion risk and vegetation departure models to identify areas with high levels of streambank erosion. - Obtain and analyze LIDAR data to further identify priority areas. - Use drones to map and quantify landscape changes and sediment alteration. - Identify specific restoration sites that have multiple co-benefits that can be launched before 2020 to improve understanding of projects. - Annually prioritize projects watershed-wide to implement and develop site specific implementation plans focusing on key projects that build success and support for this work.

	- Develop project plan and implement Wickiup Mesa restoration project as a shared VWRC priority to learn from this project and find solutions for scaling up in the watershed. - Work with federal land managers to manage cattle in sensitive areas such as riparian areas to reduce erosion. - Work with state and federal agencies to understand the impacts of these projects on water quality, quantity and other resource concerns such as road and trail maintenance. - Work with federal and state allotment holders where priority projects are identified to understand management concerns and how to encourage management that reduces causes of erosion. - Educate partners, stakeholders and landowners on what Proper Functioning Condition is and how to determine and apply this methodology. - Establish a set of BMPs for private landowners that would reduce anthropogenic erosion. - Develop concepts for irrigation companies to divert their water while reducing streambank and upland erosion.
Key Challenges	- Need to evaluate and be responsive to cost-benefit analyses for implementation. - The overall causes of erosion can be wide-scale and multi-jurisdictional. - Funding for project planning can be difficult to obtain. - State and federal funding can be unpredictable. - Permits may be difficult to obtain. - May have public opposition in some locations as some sites serve as popular Off Highway Vehicle areas and restricted vehicle access is often needed to effectively resolve underlying concerns or grazing may have to managed differently. - Implementation of projects can be cost prohibitive. - Fence maintenance is an ongoing challenge
Friend's Role	- Assist with ground-truthing high erosion risk sites. - Develop and maintain reach-based restoration plans. - Lead development and implementation of restoration plans on private lands and aid with plan development and implementation on public lands. - Develop and maintain list of high priority sites. - Monitor restoration projects after implementation.
VWRC Role	- Ensure funding requests are coordinated and do not compete. - Prioritize restoration actions to improve water quality. - Collaboratively evaluate project success and develop plans to scale up work. - Public outreach when impacting recreation sites and roads.
Key Partner Roles	- National Forests - provide coordination, shared funding on FS land, as available, and information needed to develop projects; assist with necessary permits and compliance; provide site access, rehabilitation materials, and long-term monitoring and maintenance. - Private landowners - provide site access and cost share on private lands.

Conservation Objective	**Address water quality drivers to maintain and improve water quality to attain state clean water standards for healthy fish and wildlife and sustainable recreation.**
Track	**Track 4. Water Quality Monitoring and Evaluation**
10-year Outcomes	- All reaches in the Verde are being monitored as directed in the monitoring plan. - The monitoring program engages citizen scientists, local universities, and state and federal agencies to quickly identify water quality concerns and their causes and mitigate their causes. - A list of solutions has been compiled and is being implemented for Impaired and Not Attaining reaches in the Verde Watershed
5-year Outcomes	- The monitoring program engages citizen scientists, local universities and state and federal agencies to characterize water quality along impaired reaches of the Middle Verde watershed, per the plan. - The monitoring program is being implemented and 75% of all reaches are being monitored.
3-year Outcomes	- Develop a shared water quality monitoring program that identifies management questions to be answered, methodology, partners, and costs, leading to progress towards meeting clean water conservation objectives. - Engage partners and apply for funding to implement the program.
Strategies	- Annually review water quality data and develop or update specific reach action plans to improve water quality and fill data and information gaps. - Align findings from Watershed Report Card with the water quality monitoring program. - Proactively identify pollution sources such as high-density septic systems, effluent discharge and other point and non-point source discharges. - Develop specific-reach and contributing watershed action plans for reaches of the river that are not attaining water quality standards. - Complete predictive *E. coli* model for Oak Creek using environmental variables in two impaired reaches and other models that may be available for evaluation of specific water quality concerns. - Inform and educate the public on water quality challenges and what they can do to maintain water quality. - Work with the FVR Sustaining Flows Manager and other partners on water quantity goals to reduce impact of *E. Coli* pollution by having more water in the river.
Key Challenges	- Portions of the watershed are private and can be difficult to access. - Water quality is impacted by many factors. - Data collection requires trained, committed people. - State and federal funding can be unpredictable and inadequate. - Modeling is expensive and can be difficult to maintain.

Friend's Role	- Work with ADEQ and other partners on developing and implementing a shared water quality monitoring program. - Facilitate annual water quality data review. - Communicate key findings related to water quality through the Watershed Report Card.
VWRC Role	- Review and comment on annual water quality report findings. - Review and comment on water quality monitoring plan. - Provide data to ADEQ's quality database.
Key Partner Roles	- ADEQ is the water quality lead; it manages and host Water Quality Database, provides funding opportunities for water quality monitoring, prioritizes sampling focus areas, and develops an *E. coli* predictive model. - National Forests - provide access to FS lands, provide shared funding opportunities, assist with data collection. - Yavapai-Apache Nation - complete water quality sampling on their lands.

Conservation Objective	**Provide volunteer and educational opportunities to assist in river conservation efforts and develop people who are stewards of watershed health.**
Track	**Track 5. Watershed Stewards Development**
10-year Outcomes	- Citizen scientists are contributing data in water quality and habitat conservation topics - An online web portal allows the visualization and analysis of data collected, including providing opportunities for high school and college students to use data for education and research.
5-year Outcomes	- Diverse and successful watershed stewardship network with trained volunteers that contribute high quality data through data collection, monitoring, and mapping, and participate in invasive species control. - Active participation in the citizen science movement to ensure we are using best practices in programming.
3-year Outcomes	- Become involved in groups that support and foster the practice of citizen science.
Strategies	- Develop five-year plan for incorporating and expanding citizen science in water quality, habitat monitoring, mapping, and invasive species control, incorporating volunteer activities (one-off, low level of commitment) - Identify and secure funding for volunteer and citizen science management. - Develop contact list of current and perspective volunteer coordinators and other interested in citizen science. - Design and implement an annual Bioblitz, beginning with an iNaturalist

	project, to engage people in the concept of citizen science. - Identify, plan, and fund specific projects, working with the universities and agencies. - Identify volunteer experts that can assist with higher level volunteer activities. - Set up training opportunities for volunteers and citizen scientists. - Contact organizations that are already involved in or may want to participate in volunteer, citizen scientist, or educational programs (e.g., Grand Canyon Youth, Yavapai Community College, Verde Valley residents, NRCD Ed Center, teachers). - Provide support for existing environmental education and volunteer activities. - Develop protocols for volunteer monitoring data collection and reporting; train leaders in the protocols. - Following best practices (see https://www.citizenscience.org/) and working with established groups, develop and begin implementing a plan that identifies how and where to incorporate citizen science into habitat and water quality monitoring.
Key Challenges	- Citizen science and volunteer management require dedicated staff to manage - Coordination is expensive and can be difficult to fund - We need to engage local universities in the citizen science program
Friend's Role	- Friends has a key, lead role - Lead on development and implementation of plan for citizen science and volunteerism. - Develop capacity to host and manage the citizen science/volunteer management staff. - Design and implement mini-bioblitzes; work with National Park Service and others on an official BioBlitz in the Verde Valley. - Manage volunteer calendar with watershed volunteer events, assuming funding. - House web portal for citizen science-collected data and volunteer event data, assuming funding. - Lead on certain volunteer and education activities.
VWRC Role	- Provide volunteer opportunities and information - Assist with collecting volunteer data at events - Collaborate on planning and implementing of citizen science programs - Provide shared funding and support for applications for funding
Key Partner Roles	- National Forests - Provide volunteer program information, share volunteer event data, provide shared funding opportunities - ADEQ - Provide leadership on citizen science for water quality monitoring; assist with development of plans; provide shared funding opportunities

	- Oak Creek Watershed Council - coordinate volunteer events and share in planning and data reporting - Yavapai College, Embry Riddle University - assist with higher learning curricula, program development, and higher education participation - NRCD Ed Center - curricula and school participation

APPENDIX B. THREATENED AND ENDANGERED SPECIES AND CRITICAL HABITAT IN THE VERDE RIVER WATERSHED.

Common Name	Scientific Name	Status	Critical Habitat	Location in Watershed
Mammals				
Mexican Wolf	*Canis lupis baileyi*	Endangered/ EXPN*	No	Big Chino – Williamson Valley, Upper Verde, and Lower Verde
Birds				
Mexican Spotted Owl	*Strix occidentalis lucida*	Threatened	Yes	Big Chino – Williamson Valley, Upper Verde, and Lower Verde
Southwestern Willow Flycatcher	*Empidonax traillii extimus*	Endangered	Yes	Big Chino – Williamson Valley, Upper Verde, and Lower Verde
Yellow-billed Cuckoo	*Coccyzus americanus*	Threatened	Proposed	Big Chino – Williamson Valley, Upper Verde, and Lower Verde
Reptiles and Amphibians				
Northern Mexican Gartersnake	*Thamnophis eques megalops*	Threatened	Proposed	Big Chino – Williamson Valley, Upper Verde, and Lower Verde
Narrow-headed Gartersnake	*Thamnophis refipunctatus*	Proposed	Yes	Big Chino – Williamson Valley, Upper Verde, and Lower Verde
Chiricahua Leopard Frog	*Rana chiricahuensis*	Threatened	yes	Upper and Lower Verde
Fish				
Colorado Pikeminnow	*Ptychocheilus Lucius*	EXPN*	No	Upper Verde and Lower Verde
Gila Chub	*Gila intermedia*	Endangered	Yes	Big Chino – Williamson Valley and Upper Verde
Gila Topminnow	*Poeciliopsis occidentalis*	Endangered	No	Lower Verde
Gila Trout	Oncorhynchus gilae	Threatened	No	Upper Verde
Loach Minnow	Tiaroga cobitis	Endangered	Yes	Upper Verde and Lower Verde

Razorback Sucker	Xyrauchen texanus	Endangered	Yes	Big Chino – Williamson Valley, Upper Verde, and Lower Verde
Spikedace	Meda fuligida	Endangered	Yes	Big Chino – Williamson Valley, Upper Verde, and Lower Verde
Woundfin	Plagopterus argentissimus	EXPN*	No	Lower Verde
Flowering Plants				
Arizona Cliffrose	*Purshia subinegra*	Endangered	No	Big Chino – Williamson Valley, Upper Verde, and Lower Verde

EXPN= experimental population. An experimental population is a special designation in the Endangered Species Act that allows the U.S. Fish and Wildlife Service to reintroduce populations of endangered and threatened species outside of the species' current range, but within its historical range.

APPENDIX C. VWRC PARTNER ROLES AND RESPONSIBILITIES

Arizona Conservation Corps assists with implementing invasive species removal and mapping projects.

Arizona Department of Environmental Quality (ADEQ) works collaboratively with landowners and managers to implement water quality monitoring, pollution source identification, and water quality improvement projects. ADEQ houses and manages the water quality database for the entire state of Arizona. They also provide funding to implement water quality related projects.

Arizona Department of Forestry and Fire Management (DFFM) provides technical and project specific funding for planning and river conservation projects within the planned area.

Arizona Game and Fish Department (AGFD) provides technical and funding assistance for VWRC conservation projects and implements restoration projects for fish and wildlife. They house the Wildlife Linkages database that identifies main wildlife migratory corridors in the Verde Valley.

Arizona State Parks (ASP) is the land manager of Rocking River State Park, Verde River Greenway, Dead Horse Ranch, Red Rock State Park, Slide Rock State Park, Jerome State Historic Park, and Fort Verde State Historic Park in the Verde Watershed. They implement conservation projects and promote sustainable recreation for State Park Land. For VWRC they provide technical support and project review.

Arizona Wildlife Federation (AWF) provides a volunteer base to help support monitoring, mapping, and data collection for conservation projects in the Verde Watershed.

Coconino, Prescott, Tonto, and Kaibab National Forests (CNF, PNF, TNF, and KNF) manage significant portions of the land in the Verde Watershed. As one of the primary land managers, the National Forests set priority actions and projects on USFS managed lands. Their role also includes providing technical support and guidance for project implementation, project funding, and review of proposed actions.

City of Cottonwood assists project implementation, provides volunteers, and provides funding for sustainable recreation, volunteer events, and environmental education.

Friends of the Verde River (FVR) is a 501(c)3 non-profit that serves as the facilitator and convener of VWRC. They bring staff capacity and outside funding to achieve VWRC projects. They are the primary connection between VWRC and private landowners. Friends works collaboratively for a healthy Verde River system.

National Park Service (NPS) is a land manager for Tuzigoot National Monument, Montezuma Well, and Montezuma Castle located in the Verde Valley. NPS provides technical support and funding to achieve proposed actions. They implement river conservation projects, monitoring, and scientific studies on their land to contribute to the information base of the Verde Watershed.

Natural Resource Conservation District (NRCD) helps landowners within its boundaries make more productive us of soil and water resources by promoting sustainable use and conservation of natural resources by facilitating technical and financial assistance to district cooperators.

Natural Resource Conservation District Environmental Education Center (NRCD Ed Center) educates area youth about agriculture, water management, and invasive plants through classroom teaching and other events.

Northern Arizona University (NAU) provides technical support and resource studies (endangered species, water flow) that support the resource status in the Verde Watershed.

Oak Creek Watershed Council (OCWC) is a 501c3 nonprofit dedicated to protecting Oak Creek and the habitat that it supports. OCWC works through stewardship engagement; partnering with local agencies and interest groups; outreach and education; and scientific monitoring.

RiversEdge West (REW) is a 501c3 nonprofit that promotes riparian restoration, including hosting an annual conference in the west. REW assists with facilitation and note-taking at VWRC meetings. They provide technical support and document review related to conservation projects.

Salt River Project (SRP) is a landowner in Camp Verde Riparian Preserve with the goal to protect habitat for listed species. They assist VWRC by providing technical support, project data, and funding support. They team with Friends to achieve conservation goals on their property.

The Nature Conservancy (TNC) is working toward conservation actions related to water quantity and flow. TNC provides technical assistance, review, and private landowner connections to implement VWRC conservation projects.

The Vetraplex has a military veteran field crew that assists VWRC and FVR to implement invasive species removal and mapping.

Town of Camp Verde assists with project implementation, provides volunteers, and provides funding toward sustainable recreation, volunteer events, and environmental education.

Town of Clarkdale assists with project implementation, provides volunteers, and provides funding toward sustainable recreation, volunteer events, and environmental education.

U.S. Fish and Wildlife Service (USFWS) – Ecological Services and Partners for Fish and Wildlife Programs: The USFWS provides technical assistance regarding compliance with the Endangered Species Act and technical support and funding opportunities for projects on private land.

Verde River Institute (VRI) provides a volunteer base to support monitoring, mapping, and data collection for conservation projects in the Verde Watershed. VRI is currently collecting water quality data and aerial imagery for reaches on the Verde mainstem and Oak Creek.

Yavapai-Apache Nation (YAN) has reservation land along the Verde River near Camp Verde and in Clarkdale. They engage in river conservation projects such as native species planting, water quality monitoring, and have established a greenhouse to grow native plant material. They assist VWRC by reviewing projects and providing data.

Yavapai County assists with project implementation, provides volunteers, and provides funding toward sustainable recreation, volunteer events, and environmental education. Yavapai County hosts the Yavapai County Interactive Map that displays data related to residential parcels and maps for Yavapai County.

Yavapai College provides educational development to support watershed education and volunteer training.

237 Private Landowners own land along the Verde River within the Verde Valley. They have participated in VWRC by completing conservation actions on their land (invasive weed removal, monitoring, and conservation easements).

APPENDIX D. VWRC STRATEGIC RESTORATION PLAN DEVELOPMENT AND MEETINGS

This five-year plan has been developed by the partners of VWRC to identify goals and priority areas that will have the most significant conservation impacts. With the decision to expand the vision and goals of VWRC partners, in 2018 VWRC members recommended adopting three habitat-specific focus areas: in-stream, riparian, and upland. Members of each work group self-selected during a steering committee meeting on July 3, 2018. Each work group met once between August 6-18, 2018, to review and revise the VWRC vision and goals, identify issues or stressors in the watershed, and discuss priority areas of focus (Appendix D).

From these meetings, members refined goals and established groups to include VWRC partners with expertise, funding opportunities, or organizational data that could contribute to developing measurable objectives and an action plan for each goal. Each group met once between October and December 2018. The data and expertise collected in these meetings were combined with input from one-on-one stakeholder meetings and data gathered as part of a watershed report card process being facilitated by The Nature Conservancy and FVR and synthesized into key areas. Additionally, modeling provides an assessment of erosion risk and riparian vegetation shifts for the watershed and to assist with site prioritization and project planning (Appendix E). Modeling identified a list of degraded areas as sites in need of immediate evaluation.

Over 2018 and 2019, members of the partnership worked together to prioritize additional conservation areas and actions, identify new critical partners, develop additional tools to facilitate greater analysis and understanding of key areas, and commit to ongoing collaboration and shared funding. While work over the past four years has focused on removing invasive plants in the riparian, this current plan focuses the vision and goals to areas of need: invasive species management, wildlife corridors, human-caused sedimentation and soil stabilization, water quality improvement and watershed stewardship.

The full plan was reviewed and vetted by VWRC stakeholders in May 2019. Appendix D lists the meetings completed as part of the planning process and includes attendees, dates, and a brief summary of each meeting.

Below is a list of the 12 Steering Committee, habitat group, and goal group meetings that were conducted over an eight-month period to engage VWRC partners in the planning process. The date, participants, meeting summary, and high-level outcomes are included in the description. All suggested revisions were considered for inclusion in the revised plan; however, only the revisions that aligned with the mission and vision of VWRC were included in the plan. Contact Friends of the Verde River for complete copy of meeting notes.

Steering Committee Meeting

Date: July 3, 2018

Participants: David Lewis (YAN), Ron Tiller (ADEQ), Kyle Dutro (AZGFD), Matt Wilson (FVR), Melissa McMaster (REW), Amina Senna (CNF), Ben Kowalewski (FVR), Francisco Anaya (PNF), Vivian Stevens (YAN), Jennifer Kaplan (USFWS), Carrie Eberly (SWDR), Tahnee Robertson (SWDR, facilitation), Chelsea Silva, Heidi Trathnigg (EnviroPlan Partners)

Summary: The purpose of the meeting was to provide an update of partner projects, select representative partners to join the habitat groups, and discuss the purpose of the habitat groups. The habitat groups include in-stream, riparian, and upland. The group decided that the purpose of the habitat groups is to provide a clear vision of restoration needs for each habitat area, discuss opportunities, identify data needs to share, and provide input on long-term goals and how to restructure VWRC. Finally, this meeting discussed modeling needs for the plan to help with project prioritization, project planning, and project management. The three models identified were a watershed-wide erosion model, vegetation or SWFL model, and *E. coli* predictive model.

In-stream Working Group Meeting

Date: August 6, 2018

Participants: Matt O'Neill (Coconino NF), Jessica Latzko (ADEQ), Karen Modesto (ADWR), Selena Pao (TNC), Albert Sillas (Prescott NF), Matt Wilson (FVR), Heidi Trathnigg (EPP)

Summary: The purpose of this meeting was to review and revise the VWRC vision, goals, and objectives that were created during the CPIMP planning process in 2010 and revised in 2016. The meeting commenced with the background of VWRC as new partner representatives were present. The group reviewed, discussed, and suggested revisions to the vision, goals and objectives of VWRC looking through the lens of the in-stream habitat. A mapping exercise was also completed for VWRC partners to place past, current, and future projects on maps of the watershed to identify the potential for collaboration. Friends was looking toward VWRC partners to be co-conveners of VWRC habitat group meetings. In-stream group would like to include water quality, streambank stabilization, install fish barriers in West Clear Creek, and flow restoration. *E. coli* is a concern for ADEQ and they would like to identify sources and implement restoration starting from the top of the watershed down. Prescott NF has Watershed Restoration Action Plans that have priority projects and why they selected them.

Riparian Working Group Meeting

Date: August 9, 2018

Participants: Erika Nowak (NAU), Catherine Gullo (ADEQ), Heather English (SRP), Selena Pao (TNC), Ben Kowalewski (FVR), Francisco Anaya (PNF), Deborah Crisp (CNF), Albert Sillas (PNF), Rex Bergamini (EcoRx), Melissa McMaster (REW), Matt Wilson (FVR), Heidi Trathnigg (EPP)

Summary: The purpose of this meeting was to review and revise the VWRC vision, goals, and objectives that were created during the CPIMP planning process in 2010 and revised in 2016. The riparian group was discussed as the core habitat of VWRC. The revisions to the vision suggested by VWRC partners included providing explicit mention of wildlife in the vision statement and implementing a watershed-wide approach. The watershed boundary was suggested to include the HUC 4 boundary and include the confluence with the Salt River. Important goals that were suggested as additions to the plan included flow restoration, streambank stabilization, monitoring, volunteerism, sustainable funding, wildlife species recovery, native pollinators, and watershed education. Partners suggested that the plan should incorporate grazing allotments and permittees into the upland goals. Suggestions on revisions to the thresholds for invasive species, included no new growth of *Arundo* and tree-of-heaven. Some resources for invasive species removal and restoration projects was suggested from wildlife-focused groups such as Trout Unlimited, Turkey Foundation. Prescott NF has a landscape scale erosion model specific to Prescott NF.

Upland Working Group

Date: Monday, Aug 13th, 1-4pm

Participants: Wade Gurley (NPS), Ron Tiller (ADEQ), Molly McCormick (USGS), Melissa McMaster (REW), Matt Wilson (FVR), Heidi Trathnigg (EPP), Ben Kowalewski (FVR), Jennifer Kaplan (USFWS), Kyle Dutro (AZGFD), Albert Sillas (PNF), Francisco Anaya (PNF), David Moore (PNF), Chad Yacom (PNF)

Summary: The purpose of this meeting was to review and revise the VWRC vision, goals, and objectives that were created during the CPIMP planning process in 2010 and revised in 2016. The upland working group is new, and the vision, goals, and objectives will be considered with an upland lens. Concerns for the uplands in the watershed were identified as rangeland condition, soil contamination, climate change, and resiliency. AZGFD restoration projects are driven by permittees or land owners and management for wildlife. Grassland restoration focus has come from the Central Arizona Grassland Report and the Regional Conservation Partnership Program (RCPP). Restoration projects should consider climate change when selecting resistant and resilient vegetation. Some characteristics of a healthy watershed as defined by partners included biodiversity, persistent annual and perennial species, cryptobiotic soils, stabilized soils, responsible recreation, <15% invasive species, and natural soil retention. The vision should include sustainable water flow, equilibrium in sediment production, functional upland ecosystem services. Additional goals suggested included invasive plant management, native plant materials, streambank stabilization, stable and productive soils, volunteerism, youth engagement/watershed education, sustainable funding, local economy (engage ranchers), sustainable recreation, sustainable grazing, diverse plant communities, water storage, resilient ecosystems, and maintaining open spaces.

Steering Committee Meeting

Date: September 24, 2018

Participants: Matt Wilson (FVR), Heidi Trathnigg (EPP), Selena Pao (TNC), Matt Johnson (NAU), Erika Nowak (NAU), Harry Sweet (FVR), Albert Sillas (PNF), Ron Tiller (ADEQ), Tom Runyon (CNF), Debbie Crisp (CNF), Doug Von Gausig (VRI), Ben Kowalewski (FVR), Lloyd Barnett (AWF), Melissa McMaster (REW), Jessica Latzko and Catie Gullo (ADEQ), Heather English (SRP), Sabrina Kleinman (EPP), Jennifer Kaplan (USFWS)

Summary: The goal of this meeting was to develop the action plan and desired outcomes to achieve the plan goals, identify the responsible partner(s), and how actions would be funded. This meeting reviewed the results from the habitat group meetings including in-stream, riparian, and upland that focused on updating VWRC's vision, guiding principles, and goals included in the 5-year restoration plan. The goals selected from the goal group meetings included 1) habitat restoration, 2) improved 3) aquatic resource, 4) soil stability, 5) monitoring, 6) volunteerism, 7) watershed education, and 8) sustainable funding. VWRC partners volunteered to participate in a goal group to refine tasks. The models selected for the plan by the group included the erosion risk model, vegetation departure (using Joe Wheaton's (USU) model, and *E. coli* predictive model). Partners provided information on the data available to support the models.

Watershed Education Goal Meeting

Date: Monday, October 29, 1:00-3:00pm

Participants: Matt Wilson (FVR), Ben Kowalewski (FVR), Erin Cody (NRCD), Emma Wharton (GCY), Linda Buchanan (Yavapai College), Heidi Trathnigg (EPP)

Summary: The goal of the meeting was to develop subgoals/strategies, steps, timeline and a financial plan for the Watershed Education Goal for the Verde River Watershed Restoration Plan. Strategies that were suggested as a part of this goal was to continue the State of the Watershed Conference, develop a youth engagement program (stackable certificate program within Yavapai Community College) to provide hands-on training; and assist with K-12 programming that NRCD already implements. Measure success of these programs by determining how many individuals participated, how many contacted, and information to connect their experience with a career in natural resources or pursuing a degree in higher education. Another objective includes conducting a Needs and Asset Assessment to determine if a program exists and the demand exists.

Habitat Restoration Goal Meeting

Date: November 15, 2018

Participants: Melissa McMaster (REW), Matt Wilson (FVR), Jessica Latzko (ADEQ), Heather English (SRP), Matt Johnson (NAU), Deborah Crisp (CNF)

Summary: The goal of the meeting was to develop subgoals/strategies, steps, timeline and a financial plan for the Habitat Restoration Goal for the Verde River Watershed Restoration

Plan. Achievable metrics discussed for invasive species removal included 10% of woody invasives and 20% understory with tree-of-heave and Arundo as no new populations. Friends is developing a volunteer monitoring protocol to determine removal success and map invasives every 1-4 years. Side boards for removing tamarisk are being developed with the USFWS. Consider using lower elevation native genotypes (native species) to provide more resistant and resilient strains. Woody debris should be considered for restoration sites. Prioritize restoration sites in wildlife corridors looking at AZ wildlife linkages (AZGFD). Should consider goals that have no net loss of endangered species by ranking sites.

Aquatic Resource Goal Group Meeting

Date: Thursday, November 15, 1:00-3:00pm

Participants: Matt Wilson (FVR), Albert Sillas (PNF), Jessica Latzko (ADEQ), Heidi Trathnigg (EPP), Selena Pao (TNC)

Summary: The goal of the meeting was to develop subgoals/strategies, steps, timeline and a financial plan for the Aquatic Resource Goal for the Verde River Watershed Restoration Plan. Strategies suggested from VWRC partners included: improving water quality, achieve target flows, implement management actions in reaches with *E. coli* exceedances, identify *E. coli* sources and develop shared conservation strategies to reduce concentrations, identify opportunities at ditch diversion sites to partner with TNC and ditch companies to address flow concerns, identify sites to reduce sediment loading, and improve native fisheries. Objectives that were suggested included: compile available data on *E. coli* to develop a predictive *E. coli* model on high use recreation sites, develop a ranking framework to determine where projects have co-benefits with other projects, monitor water quality in impaired reaches, and establish a citizen scientist program to assist with data collection. Other objectives include identifying impaired reaches by increasing sampling sites, inventory sites that contribute to sedimentation, and determine if IBI has been established for the Verde.

Monitoring Goal Group Meeting

Date: November 16, 2018

Summary: The goal of the meeting was to develop subgoals/strategies, steps, timeline and a financial plan for the Monitoring Goal for the Verde River Watershed Restoration Plan. The group discussed creating a monitoring table that identifies all the monitoring efforts conducted in the watershed by agency/organization. Another important monitoring task is to determine sustainable funding for long-term monitoring and potentially hiring someone to manage a monitoring database. A monitoring goal is to develop monitoring plans that can be used watershed wide. Some monitoring frequency includes every two years for Prescott NF. Resources that should be monitored as suggested by partners, includes functional soils and grasslands, riparian condition, invasive plant populations, water quality, recreation, and endangered and threatened species.

Soil Conservation Goal Group Meeting

Date: November 27, 2018

Attendees: Lloyd Barnett (VRI), Sabrina Kleinman (EPP), Matt Wilson (FVR), Molly McCormick (USGS), Jessica Latzko (ADEQ), and Heidi Trathnigg (EPP)

Summary: The goal of the meeting was to develop subgoals/strategies, steps, timeline and a financial plan for the Soil Stability Goal for the Verde River Watershed Restoration Plan. A strategy suggested included using an erosion model to rank priority areas for soil stabilization techniques. There is no consistent method for classifying soils (NRCS and FS have different classification schema) available for the soil erosion model. Soil stabilization projects should commence in the top of the watershed. Many of the soil layers down cut naturally even though there is not human disturbance. The erosion model will use 500 ft buffers. Proper Functioning Condition (PFC) should be considered for measuring soil erosion, which can be done with volunteers. Actions should consider closing roads, maintaining sustainable grazing practices, plant eroded habitats with diverse plant species. Partners suggested that the outcome of the plan should include identification of 10 priority sites to restore proper functioning condition. USFS has used PFC on FS lands so should start with those evaluations. Look at WRAPS and existing inventories to evaluate available data on erosion issues. MIM protocol could be implemented to monitor success of bank stabilization. Engage ranchers and NRCD in VWRC.

Sustainable Funding Goal Group Meeting

Date: November 27, 2018

Participants: Melissa McMaster (REW), Ron Tiller (ADEQ), Matt Wilson (FVR), Heidi Trathnigg (EPP)

Summary: The goal of the meeting was to develop subgoals/strategies, steps, timeline and a financial plan for the Sustainable Funding Goal for the Verde River Watershed Restoration Plan. Strategies that were proposed for sustainable funding were to expand new funding sources, work collaboratively, expand funding opportunities to the city, county and tribe, and maintain and enhance current relationships. Objectives discussed included: develop grant language about VWRC, attend sustainable funding workshop with Rivers Edge West, engage local partners, and provide a list and contact information for potential funding sources.

Volunteerism Goal Group Meeting

Date: November 28, 2018

Participants: Elaine Nichols (FVR), Ben Kowalewski (FVR), George Christenson (AZSP), Megan Smart (ADEQ)

Summary: The goal of the meeting was to develop subgoals/strategies, steps, timeline and a financial plan for the Volunteerism Goal for the Verde River Watershed Restoration Plan.

The strategies discussed include identifying priority projects within VWRC to accomplish with volunteers/citizen scientist groups. Friends would like to provide training for volunteers so that they can provide more higher-level tasks such as data collection, entry, and analysis. Provide more collaboration among VWRC partner volunteer activities. Develop a cooperative volunteer database that lists all volunteer activities across the watershed. Expand volunteer recruitment opportunities across organizations and jurisdictions. Develop an incentive program for volunteers. Suggested objectives include: develop a list of volunteer coordinators of VWRC partners, assess strengths, needs and opportunities, develop a centralized calendar of volunteer events for different partners, and collect information on volunteer events.

APPENDIX E. SUMMARY OF INITIAL ANALYSIS

The goal of ecological geospatial modeling is to identify areas where vegetation and soil may be susceptible to degradation from anthropogenic causes. For this plan, environmental planners on behalf of VWRC undertook vegetation shift and erosion rate analysis modeling to assess and identify areas that are highly degraded in the watershed.

We completed a vegetation departure and condition analysis using geospatial tools to evaluate vegetation cover, land use intensity, and floodplain connectivity in the Verde Watershed. Utah State University developed this approach to evaluate the overall condition of riparian systems and identify areas where active restoration may be needed to improve ecological function (Gilbert et al. 2016, MacFarlane et al. 2016, MacFarlane et al, 2018). The resulting dataset indicates areas where native, riparian vegetation has been reduced and where riparian conditions may be affected by anthropogenic use and fragmentation of riparian ecosystems. Additional analysis of upland soil erosion was included to assess its potential influence on the ecology of the watershed. EnviroPlan Partners developed the modeling technique based on the USDA's Revised Universal Soil Loss Equation to estimate the average annual soil erosion rate for stream segments based on soil class, slope, vegetative cover, land use, and how rainfall affects soil runoff.

Finally, we took an initial look at existing water quality data to determine if it would be possible to develop a predictive model for the concentration of *E. coli* contamination and exceedances of standards. For more details on modeling methodology and results see Verde River Watershed Modeling Methodology Report.

The modeling analysis represents an initial step to assess the overall condition of the riparian ecosystems in the Verde River watershed. The results indicate broad-scale areas where vegetation, land use and erosion may have significant impacts on the ecological health of the river and its associated tributaries. For all segments identified in the following tables, additional analysis and evaluation is warranted through field surveys, model refinement, and evaluations of land management practices. For a list of degraded sites identified by VWRC partners that were not specifically identified by the modeling see Appendix F. Stream segments that were classified as "Poor" or "Very Poor" in the Riparian Condition Assessment (RCA) analysis are recommended for examination due to the high degree of effects they may be experiencing in relation to land use intensity, vegetation shifts, and/or floodplain disconnection. Stream segments that had erosion rates higher than 1 megaton/hectare/yr and at least a "Moderate" RCA condition or worse were also included.

Big Chino-Williamson Valley

Stream Segment	Stream Length (km)	Reasoning
Horse Wash	4.43	High erosion rate and Confined Impacted riparian condition

Walnut Creek @ Quartz Lead Wash	3.52	High erosion rate and Moderate to Poor riparian condition
Walnut Creek @ 125/68 Interchange	2.83	High erosion rate and Poor riparian condition
Eight mile Creek near Burlington Northern Santa Fe Line	1.88	High erosion rate and Confined Impacted riparian condition
Indian Springs Wash near FS Road 103	1.18	Very high erosion rates and Confined Impacted riparian condition
Butte Creek @ Saddle Butte	4.56	High erosion rate and Confined Impacted riparian condition
Pine Creek @ Big Chino Wash	3.02	Poor riparian condition
Ash Fork Draw @ Partridge Creek	3.44	Poor riparian condition, impacted confined streams, and segments with high erosion rates.
Ash Fork Draw @ Ash Fork	0.61	High erosion rate and Poor riparian condition.
Pineveta Wash near Coconino and Yavapai County borders	3.99	High erosion rate and Confined Impacted riparian condition
Williamson Valley Wash	9.18	Long stretches of Poor riparian condition
Big Chino Wash north of Verde River confluence	10.93	Long portions have Poor riparian condition
Johnson Creek south of Corva Hill	2.95	High erosion rate and Confined impacted riparian condition

Middle Verde

Stream Segment	**Stream Length (km)**	**Reasoning**
Wet Beaver Creek between Long Canyon and Hog Hill	1.44	High erosion rates and Poor riparian condition
Little Chino Wash	2.02	High erosion rates and Poor to Very Poor riparian conditions
Wet Beaver Creek at Lake Montezuma	3.65	Poor to Very Poor riparian condition
Oak Creek near Cathedral Rock	2.96	Poor to Very Poor riparian condition
Oak Creek near Crescent Moon Ranch	2.63	Very Poor to Poor riparian condition
Oak Creek near Page Springs Hatcher	0.85	Very Poor to Poor riparian condition
Dry Creek at Sterling Canyon	1.03	Poor to Very Poor riparian condition
West Fork @ Harding Point	1.97	Poor riparian condition
Verde River between Clarkdale and Cottonwood	2.06	Poor to Very Poor riparian condition
Black Canyon Creek near East Ogden Ranch Road	2.67	High erosion rates and Confined Impacted riparian condition

Cherry Creek near Camp Verde	3.36	Poor riparian condition
Oak Creek at Cornville	6.42	Poor riparian condition

Lower Verde

Stream Segment	**Stream Length**	**Reasoning**
Davenport Wash near Table Mountain	1.73	High erosion rate and Confined Impacted riparian condition.
Bear Creek – Davenport Wash Confluence	1.61	High erosion rate and Confined Impacted riparian condition.
Tangle Creek	1.97	Poor riparian condition
East Verde River from City Creek to Rock Creek	4.20	Poor riparian condition
East Verde River near Polles Mesa	4.20	High erosion rate and Confined Impacted riparian condition.
West Clear Creek at Wickiup Creek	6.31	Poor riparian condition
West Clear Creek at Blodgett Basin	1.99	High erosion rate and Confined Impacted riparian condition.
Mud Spring Creek	3.18	High erosion rates and Confined Impacted riparian condition.
American Gulch	1.26	Poor riparian condition

APPENDIX F. PRIORITY AREA RECOMMENDATIONS

Several VWRC partner efforts have been completed or are in the process of completion to guide priority actions and identify priority sites. These efforts should be considered when identifying priority projects. Once the Watershed Report Card is completed some of the objectives and timelines may be revised to include the ecosystem health priorities identified by the ranked indicators. Below is a list of example projects identified by VWRC partners to support specific conservation goals. This list of projects provides a suggested starting place for collaborative project implementation to work toward accomplishing conservation goals and objectives. The projects are not listed in order of priority nor as obligated projects for VWRC partners. This list does not constitute a comprehensive list of projects identified or conducted by VWRC partners, but rather an illustration of the current work being engaged in the Verde River Watershed to address the stated issues. Also, proposed projects are not listed for all conservation goals and objectives, which are represented below.

a. *Conservation Objective 1.a. Riparian invasive plant management*
    - Invasive species mapping of priority species across the watershed. This work will be completed by Friends of the Verde River pending available funding. Invasive species mapping of the watershed is anticipated for completion as 3-year goal.
    - Re-treatment and monitoring of treatment acres primarily in the Upper Verde sub-basin. This work will be completed by Friends of the Verde River and is funded through 2021.

b. *Conservation Objective 1.b. Habitat connectivity and wildlife corridors*
    - Arizona Game and Fish Department (AGFD) is involved in providing connectivity for wildlife across large barriers including Interstate 40 and U.S. Route 93. AGFD focuses on habitat restoration treatments and methods to connect habitats across roads and highways. AZGFD has tracked antelope to identify these wildlife corridors to find specific crossing locations.
    - Coconino NF is proposing to provide nonmotorized access to Oak Creek and West Fork of Oak Creek in hardened, rock-armored locations. Decommission unauthorized trails in the confluence and critical gartersnake habitat. Remove the 71C trail from official trail system and maps.
    - Coconino NF is proposing to prohibit glass within 300 feet on either side of Oak Creek to protect habitat for narrow-headed gartersnakes.

c. *Conservation Objective 2. Reduce accelerate erosion*
    - Wickiup Project (West Clear Creek) – The Wickiup project area is located at Wickiup Bridge on FS Road 618. Erosion problems that include 20ft head cuts due to poor grazing management, poor stock tank management, unstable stream banks, and recreational dirt roads. The Coconino National Forest is concerned

that the bridge that crosses FS Rd. 618 will fail because of the erosional problems. The project consists of completing streambank stabilization by lying back of the streambank and planting.

- Spring Creek Project- Spring Creek is a tributary of Oak Creek. A side channel upstream of the fish barrier on Spring Creek is causing erosion and sedimentation downstream of the fish barrier. Coconino National Forest is proposing to remove the existing structure at the crossing of Spring Creek and System Road 796. They are considering constructing aquatic organism passage, realigning the road, and improving drainage.
- Road decommissioning in Oak Creek Watershed- Coconino NF is proposing to decommission approximately 12 miles of roads by placing boulders, using vegetative slash, camouflaging entrance points, ripping, and seeding. Use gap fencing or gates to prevent public use on administrative National Forest System roads. This may include closing some roads which are currently not designated for public motor vehicle use.

d. Conservation Objective 3. Water quality drivers

- Arizona Department of Environmental Quality (ADEQ) is funding projects and are completing regular monitoring at impaired reaches within the Verde River Watershed. Monitoring is occurring along Oak Creek, mainstem Verde, Fossil Creek, and West Clear Creek. Other impaired reaches should be monitored.

- Arizona Department of Environmental Quality (ADEQ) is focused on achieving EPA standards for the entire Verde Watershed, commencing with sites higher up in the watershed and working down. Currently, ADEQ and Coconino National Forest are working in upper Oak Creek and Fossil Creek to monitor *E. coli* and turbidity levels, identify pollution sources, and implement water quality improvement projects. ADEQ uses canine sniffing to determine sources of *E. coli* (human or other) and genetic testing. ADEQ is interested in using volunteer citizen scientist and school groups to assist with water quality testing.

- Coconino NF are proposing to install pet waste stations at the following trailheads: West Fork/ Call of the Canyon, Bootlegger, Cave Springs, Manzanita, Encinoso, Banjo Bill, Pine Flat, Half Way, Huckaby, Crescent Moon day-use area, Chavez Campground, Bell Rock, Bell Trail, Cathedral Rock, Chapel Cross, Baldwin Trailhead, intersection of the Verde Valley School Road and access road to Turkey Creek Trailhead, and Chavez Ranch Road.

- Coconino NF proposes to design two designated parking areas, install a toilet outside the 100-year floodplain, and restore areas adversely impacted by unmanaged vehicle and camping uses at the Angel Valley 89B Oak Creek day-use site and toilet installation. Gate the section of road beyond the parking area

and close to public use. Retain road for administrative and permittee access, as well as foot access to Oak Creek.

APPENDIX G. PROJECT RANKING

Project implementation relies on several factors including willingness of land owners and managers to implement projects, funding availability, feasibility, and staff capacity. When selecting projects to implement, the following ranking criteria should be considered to determine if the project will provide the highest ecological value to the watershed. The weight of each variable is based on its significance to achieve project success and address conservation objectives. Project permitting and compliance may be accomplished within the project scope of work, however projects that already have secured permits and completed compliance are ready to implement, and therefore, have a higher priority. Also, while land owner/manager approval is necessary for project implementation and VWRC partners should consider working with private landowners to gain project support in ecologically important sites, such approval carries limited weight in determining the ability of a project to meet the stated conservation objectives. Therefore, a project that does not have initial land owner/manager support should not necessarily have low ranking. Projects that have low scores should be evaluated to determine if they will meet conservation objectives.

1. **Ecological** – Does this project provide the highest ecological value for the watershed by addressing more than one of the conservation objectives and synergistic impacts to the watershed? Does this project lead to further information of the ecological status of the watershed? Rank 1-5 based on the project's ability to achieve the conservation objectives.
2. **Funding availability** – Is the project fully funded through planning, implementation, and monitoring by diverse funding sources? Rank "0" if no funding is available to the project, "1" if half of the project is funded, and "2" if the entire project is funded.
3. **Land owner/manager approval** – Is the land owner or manager on board with the project? Are the land owners/managers contributing technical, in-kind, or financial assistance to indicate their commitment to the project? Rank "0" if landowner does not approve, "1" if land owner/manager approves, but does not offer support, "2" if land owner/manager approves and offers support.
4. **Permits and compliance** – Have the permits been acquired and the environmental compliance completed? Rank "0" if permitting and compliance has not been completed, "1" if permitting or compliance have been completed, and "2" if permitting and compliance have been completed.
5. **Site location** – Is this project located higher up in the watershed to prevent further downstream disturbance and potential for upstream impacts? Rank "0" if project is lower in the watershed and "1" if higher up in the watershed based on where the impacts are identified.

APPENDIX H. PROJECT PLANNING

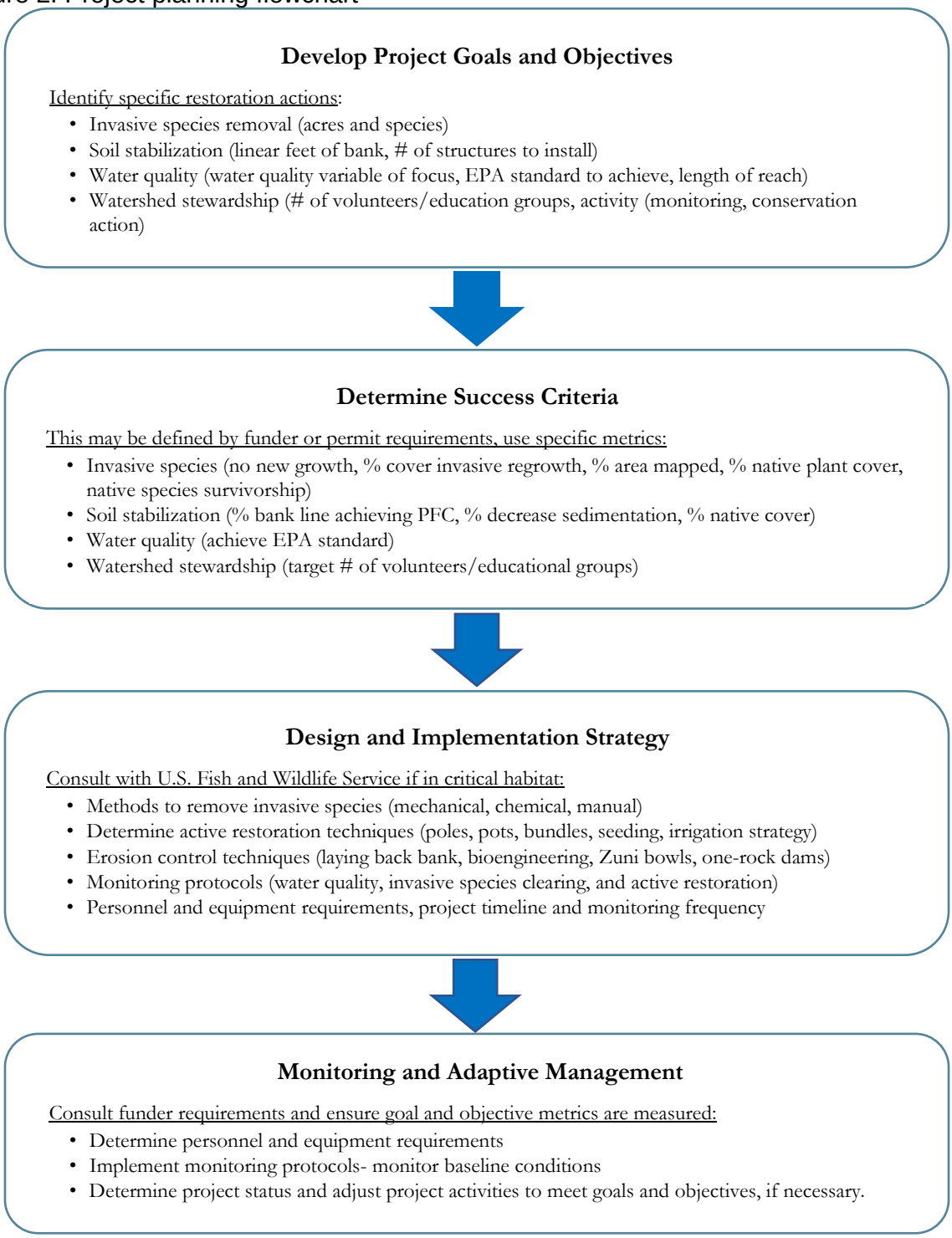
Conservation project planning for grant proposals or implementation requires thoughtful consideration of four main components:

1) project goals and objectives,
2) success criteria,
3) implementation strategy, and
4) monitoring and adaptive management.

The weight given to each of these components may be determined by funder requirements, land owner or manager desires, and endangered and threatened species objectives and should be described in any project plan. The project planning flowchart can be used when developing project plans to ensure that project goals and objectives are clearly defined, project implementation strategies are in place, and proper monitoring techniques are identified to measure the necessary variables to evaluate project success, and adaptively managed if necessary.

Friends has an invasive plant mapping and monitoring protocol, which should be consulted in the development of any project plan.

Figure 2. Project planning flowchart



Appendix I. Restoration Strategies

The restoration strategies used to achieve the conservation objectives should be self-sustaining over the long-term. The dominant native habitats and natural hydrologic regime in much of the Verde River riparian corridor promote self-sustaining actions. Passive restoration, allowing natural recruitment of native species, has been the primary restoration strategy used by VWRC partners for invasive species removal efforts. Passive restoration should remain the priority form of habitat restoration in native-dominated habitats and when ecosystem processes can be restored without actively planting native species.

Active restoration should be considered when invasive species dominate a site or the natural processes are compromised (i.e. river is not connected with the floodplain) to reconstruct natural ecosystem processes. Active restoration techniques are useful for projects involving large-scale invasive weed removal; restoring habitat connectivity and wildlife corridors; implementing site-specific water quality improvement projects; and reducing erosion on streambanks, streambeds, ephemeral washes, and springs. Invasive species removal and native species planting are active restoration techniques that can be implemented when removing large-scale invasive weeds and restoring habitat connectivity and wildlife corridors. There are standardized protocols (ADEQ and EPA protocols) for collecting water quality, and Coconino and Prescott National Forests are implementing site specific water quality improvement projects targeting *E. coli* and turbidity issues. However, to implement site specific water quality improvements that addresses increased turbidity from stream bank erosion and ephemeral wash erosion, stream bank stabilization, head-cutting and gully erosion techniques could be employed. The determination of whether or not to implement active restoration techniques will depend on the goals and objectives of the project, materials available, cost, and significance of the disturbance, which should be determined during project planning. Below is a summary of techniques that could be used for active restoration projects, invasive species removal techniques, native species planting, stream bank stabilization, and head cutting and gully restoration, within the Verde River Watershed.

1. Invasive Species Removal Techniques

VWRC partners, led by Friends, have implemented and refined integrated riparian weed management methods over the past six years from techniques outlined from the United States Department of Agriculture (USDA), Forest Service, Southwest Region Field Guides. In areas with large stands of invasive species, particularly tamarisk in critical habitat of endangered species, invasive species clearing techniques should be completed on an individual site basis with the guidance of the U.S. Fish and Wildlife Service. FVR has developed protocols to help field crews determine the best course of action for tree cutting and biomass management, identify priority weeds, select the appropriate herbicide and chemical mixes, and troubleshoot re-colonizing treated weeds (Appendix J). The best time of year to conduct weed treatments, especially when using herbicide, is during the fall/winter (August – February) when the plants are directing their nutrients to the roots in preparation for the dormant season. For more information on specific weed treatment methods consult the specific weed management guides for tamarisk (USFS 2010), tree-of-

heaven (USFS 2014), Russian olive (USFS 2014a), giant reed (USFS 2014b), and fountain grass and other grasses (USFS 2014c).

2. Native Species Planting

Native plant revegetation is an important technique for bank stabilization, for restoring native riparian forest structure, and in areas where native species recruitment is minimal. Native species planting should be completed with a variety of genotypes for biodiverse species to create heterogeneous and climate resistant and resilient habitat. Some planting methods to consider include planting cottonwood, Goodding's and coyote willow poles (Tamarisk Coalition 2014); deep pots for riparian vegetation in sites with shallow ground water (Tamarisk Coalition 2014); wetland plugs to restore bank line toe and wetland habitats (Hoag 2000); and seeding to establish diverse communities of native forbs and grasses.

3. Stream Bank Stabilization

Many factors can cause stream bank erosion, such as previous sand and gravel mining operations, lack of deep-rooted vegetation along the banks, upstream disturbance, water confinements (dams, diversions, etc.), over-grazing, and/or recreational activities. As banks erode, turbidity of the water increases, topsoil is lost, vegetation may become destabilized, habitat may be lost, and the river can be cut off from the floodplain. While this process happens over time, large rain and flood events can expedite the process. The unstable sandy sediment characteristic of the Verde River contributes to the high susceptibility of destabilized banks, especially when vegetation is lacking or declining. High cut banks contribute to further soil erosion, inaccessibility to the river, and disconnection with the floodplain. Also, as vegetation management proceeds, particularly on bank lines, banks may become more de-stabilized if the deep-rooted invasive vegetation is not replaced. Bank lines should be stabilized with wetland vegetation or coyote willow at the toe of the slope and willows on the bank. Wetland plugs, either harvested from local native stock or grown in a local nursery, should be planted at the toe of the slope where the roots are saturated during the lowest water table of the year. Willow and cottonwood poles should be harvested during dormancy or when buds are just formed, but before bud break. Poles should be planted in the water table. For more specific bank line planting instructions see Tamarisk Coalition 2014.

In areas where vertical cut banks cannot sustain vegetation, the banks could be pulled back to a 2:1 slope and planted with native vegetation. Bank stabilization work occurring above the ordinary high-water mark will require a county grading permit, while work occurring below the ordinary high-water mark will require a Section 404 permit from the Army Corps of Engineers and consultation with the USFWS for compliance with the Endangered Species Act. Surveys for gartersnakes should be conducted prior to any dirt moving and bank stabilization.

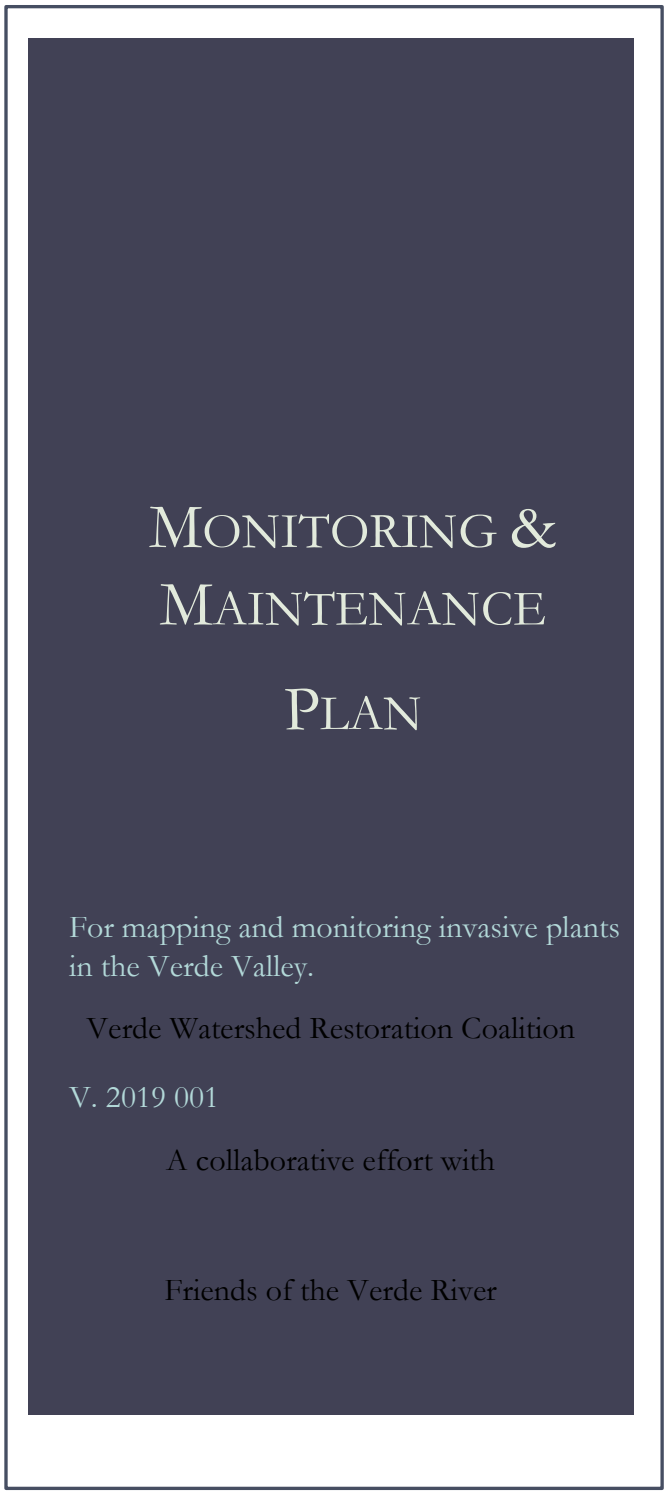
4. Head cutting and Gully Restoration

Several methods can be used to stabilize active erosion from head-cutting and gully erosion in ephemeral washes. Many of these techniques use natural materials found on-site (rocks). Projects can be completed with volunteers or a trained work crew. For more information on head-cutting and gully restoration techniques see Sponholtz and Anderson (1993).

Table 2. Erosion control techniques to use for head cutting and gully erosion (Sponholtz and Anderson 1993)

Condition	**Stabilization Technique**
Low grade head-cutting	One rock dam planted with native seed
Small head-cut with medium to high energy flows	Zuni bowls and one rock dams
Sheet flow with braided channel	Media Luna
Low energy head-cuts not in the channel	Rock mulch run down

Appendix J. Friends of the Verde River Monitoring and Maintenance Plan



Contents

Monitoring and Maintenance Plan

The Verde Watershed Restoration Coalition (VWRC) is a coalition of diverse private landowners, public land managers, agencies, and non-profits working collaboratively in a coordinated effort to improve and restore habitat in the Verde Watershed.

This plan is designed to be used and updated annually[4] to implement the complete cycle of treatment to remove invasive plants, monitor areas that have been treated in prior years, and re-treat areas with re-growth of invasive species. It is also designed to determine if native plants are returning to treatment sites naturally or if active restoration is required. In this way, we protect our investments in healthy habitats for fish and wildlife and an accessible, enjoyable river for outdoor enthusiasts.

Target Species

These non-native invasive species have been identified as a threat to the Verde River.
Salt Cedar - *Tamarix ramosissima*
Giant Reed - *Arundo donax*
Tree of Heaven - *Ailanthus altissima*
Russian olive - *Elaeagnus angustifolia*

Monitoring Season

In the spring, Friends staff identifies which project areas will be monitored and potentially treated the following treatment season. Both initial treatment and potential retreatment sites are defined each spring by Friends staff and VWRC partners based on project funding, infestation severity, high priority invasive species infestation, secondary weed infestations, native plant restoration opportunities, partner priorities, and landowner access. These sites are prioritized for monitoring in the following way:

a. Sites that were treated two treatment seasons (or more) prior that have not been monitored and mapped.
b. Sites where we plan to begin initial treatment in the upcoming treatment season.
c. Sites where we have secured a grant to treat a specific area.
d. Sites that have been treated and monitored more than two years ago that we plan to retreat in the upcoming treatment season.
e. Sites that were treated within the last year and have not been monitored and mapped.

The monitoring season typically spans 8-12 weeks, from early April to mid-June. Crews are trained at the beginning of the season, with continuing education as needed. The monitoring protocol includes annual landmark photo point monitoring, invasive plant mapping, plant

[4]This protocol was developed and is regularly updated by Friends of the Verde River, working in consultation with other members of VWRC. This protocol is a deliverable of grants from the Walton Family Foundation.

community composition monitoring plots, and both pre-treatment and post-treatment rapid assessments of public and private lands. All tabular and spatial data is collected in the field using Collector for ArcGIS, a free application from ESRI that is compatible with ArcGIS for Desktop, on Samsung Galaxy tablets (and/or cell phones or other compatible mobile devices).

-

Short-Term Monitoring

The following short term monitoring and maintenance techniques are used to record the effects of treatment in the time immediately following treatment. This data is used for planning retreatment, grant reporting, assessing techniques to allow for adaptive management and determining the success of treatments. The short-term monitoring and maintenance techniques include 1) Rapid Assessment; both pre and post treatment, 2) Mapping Invasive Species.

-

Rapid Assessment

At each project site, crews conduct a rapid assessment to record the status of the riparian area both pre- and post-treatment. Crews conduct a pre-treatment rapid assessment on all sites that are slated for initial treatment in the upcoming treatment season. Within two years after treatment, monitoring crews return and conduct post-treatment rapid assessments for the same areas.

-

Pre-treatment Rapid Assessment

Our crews conduct pre-treatment mapping at each site using the established protocols and methods described in Appendix A. Data recorded includes the location, canopy cover, and extent for each target invasive plant species at a site.

Information collected during the pre-treatment site visit can be used for initial treatment project planning and to establish a base level for the status of the riparian area.

Data collected includes the following information.

Target species infestation

Are there target species present at the site? What is the percent cover of these species relative to the total vegetation cover?

Bank erosion

Is there existing bank erosion or is there the potential for bank erosion due to treatment (i.e. removal of target invasive species)?

Secondary infestation

Are there invasive plant species on the site other than target species that could result in a secondary infestation after treatment?

Access issues/site accessibility

Are there impediments to access the site for treatment purposes? Is there the potential to damage native vegetation and cause more disturbance during treatment?

Hazard/contaminants concerns

Is there evidence of contamination by hazardous materials or other contaminants at the site?

Evidence of herbivory

Is there evidence of livestock grazing at the site or other heavy herbivory that is affecting vegetation composition? Could this be an issue for revegetation after treatment or for any potential restoration activities?

-

Post-treatment Rapid Assessment

Within two years of initial treatment, crews will monitor all work sites. The crew will complete Rapid Assessment Monitoring Forms for each project site. The crew will collect similar information to that which was collected pre-treatment, as well as document whether any damage was done by crews during treatment.

See Appendix A for more information on Monitoring Assessments.

-

Mapping Invasive Species

Crews will map the four target invasive species at each project site both before and after treatment.

Post-treatment mapping will occur within two years of initial treatment. Crews will map any pre-existing or new growth of target invasive plants in the project area. They will enter data into the mapping forms along with creating a polygon for each invasive species stand they find. Each stand of a single species will be mapped as one polygon and an associated form will be completed and submitted. A stand is defined as a group of a single species that are no further than 10 feet from each other.

See Appendix A for more information on Invasive Species Mapping.

-

Native Recruitment Transects

In the past, native recruitment transects have been used as a short term monitoring technique to measure composition and structure of passive recruitment at a treatment site. We are currently supplementing this data collection with our long-term plant community composition monitoring (PCCM) plots. The data collected in the past native recruitment transects can still be analyzed and compared, however, we will be transitioning our future monitoring to include PCCM plots instead of native recruitment transects. After the first implementation season, we will evaluate the PCCM plots to see if they meet our data standards and will make any necessary adjustments for the following season.

- ## Long-Term Monitoring and Maintenance

Long term monitoring and maintenance allows Friends to analyze the impact restoration activities will have on the ecosystem for decades to come. This also allows Friends to protect the investment made in initial treatments and ensure that invasive species do not reoccur. The protocols in place for long-term monitoring and maintenance include native recruitment monitoring plots and permanent photo point monitoring. This information will be used to determine the long term success of treatments.

- ## Plant Community Composition Monitoring

Assessing restoration sites after invasive plant treatments have been employed is essential to determine if treatments have been successful, if there is secondary weed infestation, and if native plant recruitment is observed. Natural native recruitment is important in the restoration process to understand if the system has the potential to restore itself after the site has been cleared from tamarisk and other invasives, or if active restoration is needed.

The goal of this data collection is:

a. To determine the plant community composition at a site after invasive plant removal.
b. To assess relative plant cover.
c. To determine if natural recruitment of indicator native species is occurring.

Sixteen native recruitment plots have been established in previously treated areas. These plots will be monitored into the future and new plots will be added as monitoring continues.

See Appendix B for more information on Plant Community Composition Monitoring.

- ## Permanent Landmark Photo Points

Purpose: Photo points are a qualitative method that provide a landscape-scale view of changes over time. Photo point locations are established in a manner that allows the picture to be taken from the same location, filling the same frame, so that differences between and among years can be identified and compared. Ideally, photographs should be taken at the same time of year (spring) to eliminate differences due to seasonal changes in vegetation. **It is critical for photos to be taken from the same location, season, and angle year to year.**

Locations: Photo point locations are established at permanent landmarks, such as bridges and overlooks, from the Tuzigoot Bridge to Beasley Flats on the main stem of the Verde River and from Red Rock State Park to the confluence on Oak Creek. Additional points may be added in the future as needed. Photo point locations are collected in Collector for ArcGIS. These locations and associated data will be integrated into a VWRC Field Photo geodatabase at the end of the season (GIS Laptop C:\Workspace\GIS\Photos\FieldPhotos.gdb).

Photos are also stored as stand-alone files for viewing outside of GIS (GIS Laptop C:\Workspace\GIS\Photos\Monitoring_Photos\Permanent_Photo_Monitoring_Sites).

An overview map of permanent photo point sites can be found in Appendix C.

Frequency: Photographs will be taken every year for the first three years, (see Appendix D for current status) then every other year - or after a 100-year flood event or riparian forest fire to document changes. VWRC may choose to modify this frequency depending on site conditions, timing of weed treatments (before and after), or logistical reasons. Photos will be taken during the growing season (April – June) and all repeat photos will be taken as close to the initial photo date as possible.

Photo Analysis: Photos will be compared from year to year to detect changes in vegetation and geomorphology. After major disturbance events, photos will be taken and analyzed with archived photos.

See Appendix C for more information including maps of permanent photo points and photos from previous years.

See Appendix D for more information including the photo point monitoring protocol.

- ## Before and After Photos

Friends staff identified ten sites where photographs from treatment seasons plan to be continued into the future. Each photograph is a sample of a treatment site showing a stand of invasive species before treatment and after treatment. These areas have been recorded spatially and the photographs can be continued through time to visually measure changes within the treatment area.

Name	**Original "Before & After" photo**	**Second "after" photo**
Verde River Greenway	2017	2019
Oak Creek Valley Property Owners Association	2018	2019
Thousand Trails	2017	2019
Oak Creek Confluence River Right	2018	2019
Black Bridge	2018	2019
River's Living Trust	2018	2019
Erck Property	2017	2019
Verde Village	2014	2019
Parsons Park	2018	2019
White Bridge	2017	2019 (area significantly altered by flood damage)

Data Analysis

The data that is collected during the monitoring season is analyzed and then used to measure treatment success and aid in the prioritization of retreatment sites.

Measuring Treatment Success:

A site can be labeled restored when it meets the following criteria:

- Sites where the occurrence of all tamarisk (*Tamarix sp*.) and Russian Olive (*Elanthus angustifolia*) are reduced to less than 10% of the treatment area AND
- Sites where there are no new populations of giant reed (*Arundo donax*) or Tree of Heaven (*Alianthus altissima*) AND these species make up less than 20% of the overall vegetative cover on the site AND
- Sites must meet woody passive recruitment threshold (see below for details) OR
- Sites labeled as 'NA'; 'Site does not have potential to meet cottonwood/willow and mixed broadleaf passive recruitment threshold' BUT has met other land manager objectives

Native Woody Natural Recruitment Threshold: Over 20 stems of indicator species in the appropriate size class (>1 meter in height) were counted when either Native Recruitment Transect monitoring or PCCM Monitoring occurred. And the relative cover of native woody species was measured as greater than 90%.

The indicator species are any of the Native Broadleaf Tree or Shrub species listed in the PCCM protocol.

Prioritization of Retreatment Areas:

Retreatment areas are determined with the help of the above label of "restored" or "not restored." Areas that cannot be labeled restored due to failure to meet the above criteria are subsequently given a higher prioritization during site selection for the following treatment season. Along with land access and funding opportunities, Friends staff use this distinction to aid in determining the most important areas to send the treatment crews.

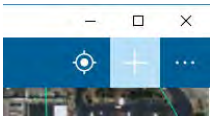
Planned Retreatment Areas for 2019-2020 Treatment Season:

Site Name	**Riparian Acreage**
Oak Creek Confluence	275
White Bridge	14
S. Oak Bend	18
Upper Cloverleaf (pending permitting)	76
Ryan - Dolores (pending permitting)	1.5
Clarkdale (potentially more, pending landowner agreement)	10
Fossil Creek (pending funding)	269
Total Acres	653.5

Appendix A: Short-term Monitoring

Invasive Species Mapping

To begin mapping invasive species infestations,
Turn on the Tablet.
Open Collector.
Open the VWRC Mapping and Monitoring map for the area where you are working (Upper, Middle, or Lower Verde or other subsections within).
You will create a polygon AND complete a form for each patch of target invasive species.
When you are ready to map an area and fill out a form at your worksite, you will begin by adding a feature to a map.
Click the plus (+) sign on the blue bar at the top of the screen to get started. If there are more than one feature types available, select the correct one in the Table of Contents window that opens (for example, choose either New Native Recruitment, New Rapid Assessment, or Map



Invasive Species) to add a new feature on the map.
A form should appear on one side of the screen. Tap in a blank space on the form to complete it. Some spaces will require you to type to fill it in. Others will have a list that you can scroll through to choose your response.
When you are ready to map an infestation, tap on Start Streaming at the top of the screen.
The GPS will begin collecting points to create a new feature. Immediately walk slowly around the area staying as close to the infested area as possible. If you need to stop moving, or go around an obstacle, press Pause Streaming, then Start Streaming before you begin moving again.
When the polygon is mapped, click Pause Streaming. Complete the form noting the target species and other details including:

• Invasive Species Mapping Form 2017-2018

Date	11/1/17
Ownership	The Nature Conservancy
Data Collector (you)	Elaine Smith
PLANT CODE	TARA
COMMON NAME	SaltCedar
SPECIES NAME	Tamarix Ramosissima Ledeb
COVER	20-30%
Size Class- Diameter of Largest	Over 4 Inches
BANK SLOPE	10-20%
Site Name	Shield Ranch
NOTES	some tamarisk are in the pond
SECONDARY INVASIVE	
Public_Land	N
FieldYear	2017-2018
Distance to Water (ft)	5

PLANT CODE/COMMON NAME/SPECIES NAME
drop down options:

ARDO4	ARDO4 Giant Reed- Arundo L donax
ELAN	ELAN Russian Olive - Elanthus Angustifolia
TARA	TARA Salt Cedar- Tamarix Ramosissima Ledeb
AIAL	AIAL Tree of Heaven- Ailanthus altissima

COVER - relative vegetative cover of the selected target invasive species within the polygon.
drop down options:

Class	%
1	0-5%
2	5-10%
3	10-20%
4	20-30%
5	30-40%
6	40-50%
7	50-60%
8	60-70%
9	70-80%
10	80-90%

11	90-95%
12	95-100%

SIZE CLASS - diameter at breast height of the largest tree of this species within the polygon
drop down options:

0_4	0-4 Inches
4	Over 4 Inches

BANK SLOPE - the slope of the stream bank nearest the polygon
drop down options:

<10%	Flat <10%
10-30%	Low 10-30%
30-60%	Moderate 30-60%
60-80%	Steep 60-80%
80-90%	Vertical 80-90%

Secondary Invasive drop down options: (only to be used if this is a secondary species mapping polygon)

PECI	Buffelgrass - *Pennisetum ciliare* (PECI)
CASP	Catalpa Tree- *Catalpa speciosa* (CASP)
BRTE	Cheatgrass - *Bromus tectorum* L. (BRTE)
LUPE5	Creeping Waterprimrose - *Ludwigia peploides* (LUPE5)
LIDA	Dalmatian Toadflax - *Linaria dalmatica* (LIDA)
MYSP2	Eurasian Watermilfoil - *Myriophyllum spicatum* (MYSP2)
PESE3	Fountain grass - *Pennisetum setaceum* (PESE3)
RUAR9	Himalayan Blackberry - *Rubus armeniacus*
CEME2	Malta Starthistle - *Centaurea melitensis* (CEME2)
BASC5	Mexican Fireweed/Kochia - *Bassia scoparia* (BASC5)
MOAL	Mulberry Tree - *Morus alba*
BRRU	Red Brome- *Bromus rubens* L. (BRRU)
VIMI	Primrose Blue Periwinkle - *Vinca miner*
LOAR	Tall Fescue- Lolium arundinaceum (LOAR)
ACRE3	Russian Knapweed - *Acroptilon repens* (ACRE3)
BRTO	Sahara Mustard - *Brassica tournefortii* (BRTO)
ULPU	Siberian Elm –*Ulmus pumila* (ULPU)
CEST8	Spotted Knapweed - *Centaurea stoebe* (CEST8)
NYAD	Water Lily - *Nymphaea* spp. (NYAD)
CESO3	Yellow Starthistle - *Centaurea solstitialis* (CESO3)

• Pre- or Post-treatment Rapid Assessment Monitoring Form

Method: Monitors walk entire site and complete mapping of invasive species before filling out a rapid assessment form. The goal is for at least two monitors to assess the entire site. After the walk-through, monitors come up with individual numbers for each cover class, discuss, and reach a consensus estimate.

Create a Point
Complete the Form
Verde Watershed Restoration Coalition

Monitoring Assessment Form 2017-2018

Invasive_Species_1	TARA
Relative_Cover_Invasive_1	10-20%
Invasive_Species_2	
Relative_Cover_Invasive_2	
Invasive_Species_3	
Relative_Cover_Invasive_3	
Invasive_Species_4	
Relative_Cover_Invasive_4	
Invasive_Species_5	
Relative_Cover_Invasive_5	
Invasive_Species_6	
Relative_Cover_Invasive_6	
Invasive_Species_7	
Relative_Cover_Invasive_7	
Monitoring_Year	2017-2018
Native_Species_1	Goodding's willow
Native_Species_2	
Native_Species_3	
Native_Species_4	
Monitoring_Date	10/31/2017 8:20
Absolute_Veg_Cover	60-70%
Relative_Cover_Native	90-100%
Land Use	public_land
Initial_Treatment_Year	
Data Collector (your name)	Edith
Form Type	Post-Treatment
Evidence of Bank Erosion?	Y
Evidence of Channel_Incision?	Y

Are there hazardous materials?	N
Evidence of heavy livestock grazing?	N
Evidence of damage incurred by crews?	N
Does the landowner participate in continued management?	
Is the site easily accessible?	
Notes	
Ownership	Arizona Game and Fish
Public Land	Y

Native Species Drop Down List Options:	
big tooth maple	big tooth maple
Arizona alder	Arizona alder
boxelder	boxelder
netleaf hackberry	netleaf hackberry
desert willow	desert willow
velvet ash	velvet ash
Arizona walnut	Arizona walnut
Arizona sycamore	Arizona sycamore
velvet mesquite	velvet mesquite
narrowleaf/coyote willow	narrowleaf/coyote willow
Goodding's willow	Goodding's willow
western soapberry	western soapberry
catclaw acacia	catclaw acacia
cottonwood	cottonwood
other	other unlisted Native spp

Same cover classes and secondary invasive species drop down list options as the Invasive Species Mapping Form 2017-2018

- ## Native Recruitment Transects Protocol

This process aims to track passive recruitment of cottonwood/willow and/or representative mixed broadleaf species by determining if recruitment of these species have met the determined threshold. Passive recruitment data will be collected in the following way:

o How to Collect Data on Site = To measure woody species recruitment a minimum of one 6-foot wide, 726-foot long belt transect will be established for each site. If the site has greater than 1 mile of stream length an additional transect will be established for each additional 1 mile

of stream length. The belt transect will be established in the most active channel of the floodplain. The sampler(s) uses a 6-foot pole that has the center marked. Datum is collected by walking a total of 726 feet, with the marked pole centered over the center line of the transect. Field crews will mark both the start and end points of each transect using Collector. This width and distance will result in sampling 0.1 acre (363' x 12' = 4,356 sq ft) as described in A. Winward (2000). Both the start and end points will be recorded using UTMs on the Strider Form, to ensure that the same transect is measured during future monitoring efforts. Measurements are made by walking the transect line with the center of the pole held directly over the line, recording each woody plant species that occurs within the 6-foot parameter, and its corresponding size class. Data will be tallied to determine if the site meets a set threshold. Ideally, however, crews would be answering this question, "Does the Site Meet Woody Species Passive Recruitment Threshold?" with one of three answers: (1) Yes (20 or more stems of indicator species in the appropriate size class were counted), (2) No, but site has potential to reach it, or (3) NA = Site does not have potential to meet woody species recruitment threshold (mesic or otherwise not suitable for recruitment), and will not be further monitored for this metric. The belt transect(s) shall be repeated during annual/biennial rapid monitoring assessment until management objectives have been met.

• Appendix B: VWRC Plant Community Composition Monitoring Protocol

Overview

Assessing restoration sites before and after invasive plant treatments are employed is essential to determine if treatments are successful, if there is secondary weed infestation, and if native plant recruitment is observed. Natural native recruitment is important in the restoration process to understand if the system has the potential to restore itself after the site has been cleared from tamarisk and other invasives, or if active restoration is needed. This process will be implemented in sites where pretreatment monitoring is occurring and will be utilized in retreatment monitoring as funding and capacity allows.

Goals of data collection

a. To determine the plant community composition at an invasive plant removal site.
b. To assess relative plant cover.
c. To determine if natural recruitment of indicator native species is occurring.

Equipment needed:
Meter tape (2),
pin flags,
tablets,
plant press,
string roll,
densiometer, and
range finder

Plant Community Composition and Natural Recruitment Plots

Sampling plots will be rectangles that are 50 m by 8 m (400 m^2 or ~0.1 acre) and will run along the river.

<u>Site Selection:</u>

For property that has pre-existing PCCM plots, you will use the collector map to locate the plot and recreate it using GPS and photo points from previous years.

New plots at sites will be selected using a ratio of the number of river miles within the work area to the number of required plots. For every 0.25 river miles of a worksite, one plot will be established. If the site is on both sides of the river, alternate river sides when possible. The exact location will be determined by estimating the river mileage using the map with river miles on the tablet and then surveying the entire area within the .25 mile to determine the best location.

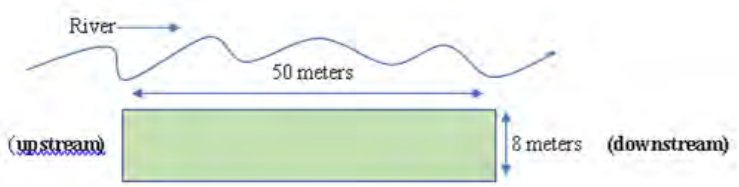
Every plot should meet the following criteria::

1) **the area will be entirely in the mesic riparian area (cottonwoods, willow, tamarisk or arundo dominate the site).**
2) the two corners of the plot nearest the river will be 2-20 meters from the waters' edge.
3) there are *at least* 10 plants/stumps of either arundo or tamarisk within the plot. (prioritize tamarisk sites if given the option)
4) there will be one plot for every .25 river mile on the project site.
5) if there are multiple plots in a site, make sure plots are spaced at least 200 meters apart.

If there is not an area matching these criteria within the .25 mile river section, do not sample at the site and record that there was no suitable location and document what criteria was lacking.

Setting up a Plot

The goal is to have a perfectly rectangular plot that is 50 x 8 meters, as close to 2m from the river's edge as possible and entirely within the mesic riparian zone. Look at your site prior to installing the plot to determine the best placement. To start setting up the plot, place a pin flag a measured amount of meters from the river's edge (within 2-20 meters). The idea is to get the plot as close to the river's edge while still meeting all the other criteria listed above. From the first pin flag, measure 8 meters perpendicular to the river and place a pin flag, use a compass and record the direction you walk from the river. Returning to the first pin flag closest to the river, take a separate compass bearing and run the transect tape downriver 50 meters and follow that bearing in a straight line. Once you reach 50 meters, turn around and make sure the compass back bearing is accurate and if so, place the third flag. Then measure 8 meters from the third flag perpendicular to the river and use the bearing from the first flag to ensure you are going the same direction, then place a pin flag. This should create a 50 m by 8 m rectangle.. The middle of the plot can be further from the waters' edge, but be sure the river does not cut *into* the plot. Once all the flags are placed, use the string to create straight lines from each flag to maintain your lines by sight.



Data Collection

Priority Plant Species Data

For this project, we are concerned with a few select species and how they are responding to the treatments. Below is a list of the priority native and invasive plant species:

Native Tree and Shrub Species:
Coyote Willow – Salix exigua
Goodding Willow – Salix gooddingii
Arizona Sycamore – Platanus wrightii
Fremont Cottonwood – Populus fremontii
Arizona (velvet) Ash – Fraxinus velutinia
Arizona Boxelder – Acer negundo
Arizona Walnut – Juglans major
Arizona Alder – Alnus oblongifolia
Netleaf Hackberry – Celtis laevigata
Mesquite – Prosopis spp.
Desert Willow – Chilopsis linearis
Western Soapberry – Sapindus saponaria
Catclaw Acacia – Acacia greggii
New Mexico Locust – Robinia neomexicana
Big-tooth Maple – Acer grandidentatum

Invasive Trees, Shrub and Grass Species
• Tamarisk
• Tree of heaven
• Giant reed
• Russian olive

If you find ANY of the tree species listed above in the plot, record the following data:

1. Species (once you find a species, collect the following data and add tallies as you find more within the same size class)
2. Height (in size classes: >1m, 1-2m, 2-4m, and <4m) This is the height of the individual tree or shrub you are looking at
3. Stem count (in count classes: <20, 20-50, 50-100, 100+): collect a stem count of how many stems within the plot in each size class of each species.
4. Aerial cover (in size classes: >1%, 1-5, 5-10, and then in increments of 10% up to 100%) For these plots, 1% cover = $2m^2$. Estimate the cumulative cover for each species within the plot.

   a. How to determine cover: Imagine you are a bird hovering above the plant, when it is fully leafed out, how much space would it occupy? You will have some empty spots as the canopy cover is not 100% complete.
5. Tamarisk: you will count the stumps of tamarisk within the plot. Also, if there is any regrowth you will count the stems of that as well.

- # Canopy Cover Data:

1. Record three densiometer readings within the plot. These data should be collected in the center of the plot at 12.5 meters from the upstream edge, 25 meters from the upstream edge (center of the plot) and 12.5 meters from the downstream edge of the plot.
2. Carefully follow the instructions on the densiometer to ensure accurate data. Below is an excerpt from the densiometer owners manual
3. The spherical densiometer consists of a concave mirror with twenty-four ¼ ″ squares engraved on the surface. Each square of the grid is then equally subdivided mentally into 4 smaller squares (1/8″ x 1/8″) and represented by an imaginary dot in the center of each of the smaller squares. Thus a total of 96 dots representing smaller square areas can then be counted within the grid. Once the representative forest site has been selected for measurement, the user holds the instrument level and far enough away from his/her body such that the operator's head is just outside the grid. The operator can then count the number of dots, representing the smaller (1/8″ x 1/8″) square areas of canopy openings (no vegetative cover), up to a total of 96 (count the number of imaginary dots with NO vegetation). Then multiply that number (X out of 96) by 1.04 to obtain the percent of overhead area not occupied by canopy. The difference between this percentage and 100% is the estimated overstory density in percent. Four readings are taken facing North, South, East, and West and averaged to determine the cover in that spot.

- # Herbaceous Species Data

This section of data collection is focused on the percent cover of forbs and grasses on the plot and particularly secondary invasives species.

Secondary Weed Species of interest

• Kochia (aka Mexican fireweed; *Bassia* spp.)
• Himalayan blackberry (*Rubus armeniacus*)
• Dalmatian toadflax (*Linaria dalmatica*)
• Russian knapweed (*Rhaponticum repens*)
• Spotted knapweed (*Centaurea maculosa*)
• Diffuse knapweed (*Centaurea diffusa*)
• Yellow starthistle (*Centaurea solstitialis*)
• Malta starthistle (*Centaurea melitensis*)

• Pampas grass (*Cortaderia selloana*)
• Fountain grass (*Pennisetum setaceum*)
• Siberian elm (*Ulmus pumila*)
• Sahara mustard (*Brassica tournefortii*)

Record the following data for ANY herbaceous, shrub, or vine species that covers more than 5% of the plot and ALL secondary weed species, regardless of cover:

1. Species (list the species)
2. Cover (in size classes: >1%, 1-5, 5-10, and then in increments of 10% up to 100%)
3. For these plots, 1% cover = $2m^2$

• Photopoints

Take permanent photopoints of each plot. Photos will be taken facing downstream from the upstream corner closest to the river. Photos will *center* (left-right and up-down) on the diagonal corner pin flag of the plot downstream (the point downstream and furthest from the river's edge) and be taken from 5 feet above the ground (typically at or slightly below eye-level).

• Native Species Cover

Once you have surveyed the entire plot you will determine whether not 90% of the cover throughout the plot consists of native species. This will be a yes or no question on your form.

Species list – these are the most common species, but others could be found.

Trees:
Coyote Willow – *Salix exigua*
Goodding Willow – *Salix gooddingii*
Arizona Sycamore – *Platanus wrightii*
Fremont Cottonwood – *Populus fremontii*
Arizona (velvet) Ash – *Fraxinus velutinia*
Arizona Boxelder – *Acer negundo*
Arizona Walnut – *Juglans major*
Arizona Alder – *Alnus oblongifolia*
Netleaf Hackberry – *Celtis laevigata*
Mesquite – *Prosopis spp.*
Desert Willow – *Chilopsis linearis*
Western Soapberry – *Sapindus saponaria*

Catclaw Acacia – *Acacia greggii*
New Mexico Locust – *Robinia neomexicana*
Big Tooth Maple – *Acer grandidentatum*

Shrubs and Vines:
Seep Willow – *Baccharis salicifolia*
Desert Broom – *Baccharis sarothroides*
Virginia Creeper – *Parthenocissus vitacea*
Arizona (Canyon) Grape - *Vitis arizonica*

Herbaceous:
Deergrass – *Muhlenbergia rigens*
Alkali Sacaton – *Sporobolus airoides*
Sand Dropseed – *Sporobolus cryptandrus*
Western Wheatgrass – *Pascopyrum smithii*
Tobosa – *Pleuraphis mutica*
Alkali Muhly (Scratchgrass) – *Muhlenbergia asperfolia*
Sedges – *Carex spp.*
Spikerush – *Eleocharis spp.*
Bulrushes – *Scirpus spp.*
Cattail – *Typha spp.*
Rushes – *Juncus spp.*
Bentgrass – *Agrostis spp.*
Foxtail – *Alopecurus spp.*
Blue Grama – *Bouteloua gracilis*
Red Brome – *Bromus rubens*
Johnsongrass – *Sorghum halepense*
Globemallow – *Sphaeralcea spp.*
Dock – *Rumex spp.*
Milkweed – *Asclepias spp.*
Sunflower – *Helianthus spp.*
Snakeweed – *Gutierrezia sarothrae*

<u>Recording Data:</u>
Worksheet: You will be provided with a worksheet to keep track of your data. This will be for your personal use just to make it easier to enter data into the tablet and save tablet battery in the field.

Survey123: Once you have all the numbers you will fill this data into a survey123 form in your tablet. The form in survey123 will ask you questions and you will fill out information for each species you encounter in the plot. You will also drop a point within the plot in survey123 so the data has a spatial reference.

Collector: Also during data collection you will create a polygon around your plot. This polygon will be created in the collector app in the PCCM map. Also, to record the photos required for each plot you will drop a photo point using collector.

Other species:
If you are unsure of the species, label it in the format UNKGRASS50R1 where:
UNK = unknown
GRASS = growth form (GRASS, FORB, SHRUB, TREE)
5
0R (L) = site name
1 = unknown number (1 for the first unknown, 2 for second, etc)
Take a photo or make a collection of any unknown plants so you can identify it later. Be sure to label your collection or photo so you know exactly which plant correlates to the unknown label following this naming.

Example Data Collection Sheet:

Herbaceous Species:

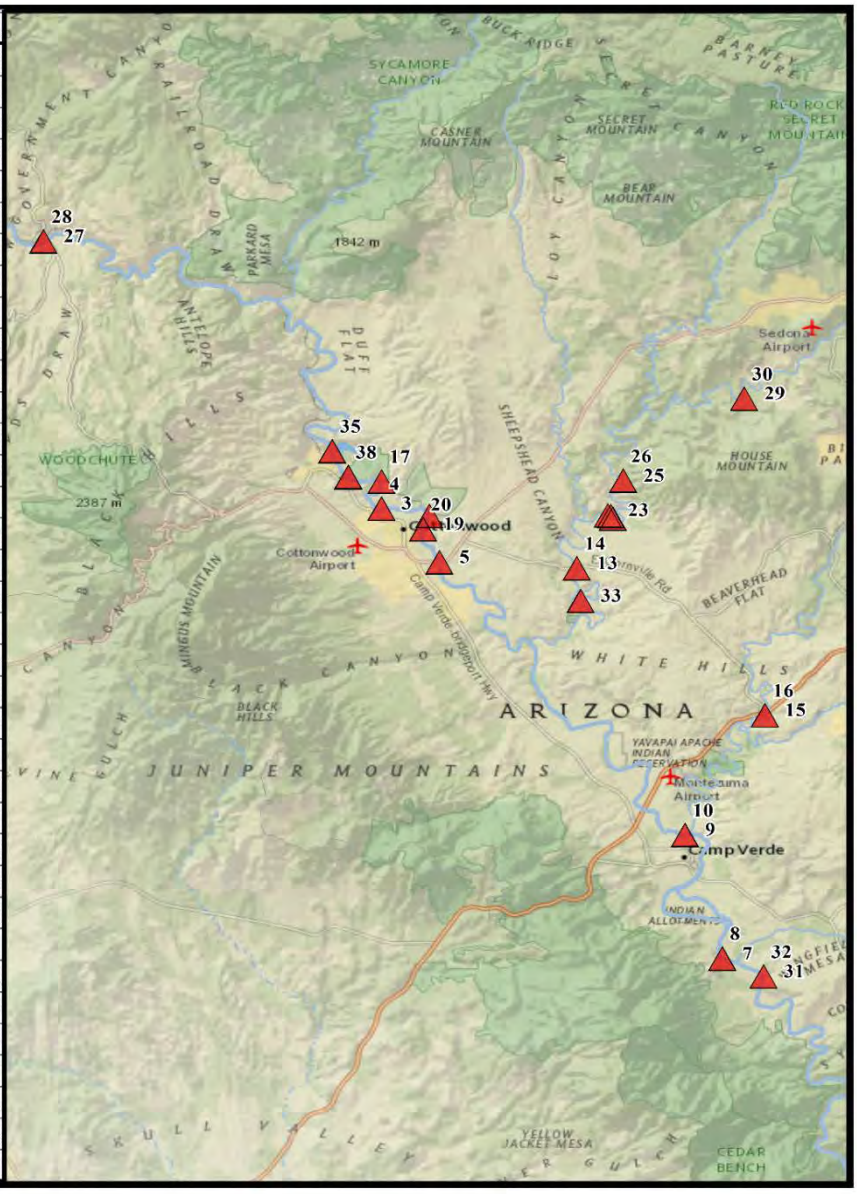
Site Name:	Surveyors:	% Canopy Cover:	1._____ 2._____ 3._____
# of TARA with new growth:	# of TARA stumps	is over 90% of the cover native woody species?	YES OR NO
Herb/Shrub/Vine Species	% Cover (first sighting)	% Cover (2nd sighting)	est. % cover for entire plot --in incriments of 5

Tree Species

	total stems in incriments as follows: under 20, 20-50, 50-100 or over 100				
Tree Species	0-1M	1-2M	2-4M	>4M	% Cover of plot

-
-

Appendix C: Landmark Photos Map Book



Overview Map of Landmark Photo Sites

Appendix D: Landmark Photo Point Monitoring Protocol

Photo Point Accomplishments Table

No.	Photo Point Station	Monitored 2014	Monitored 2015	Monitored 2016	Monitored 2017	Monitored 2018	Same vantage point/ zoom level ?	Total # Years in a row	First 3 years photos done
1	10th St. Bridge 1		20150603	20160526	20180531	20180531		4	Y
1	10th St. Bridge 2		20150603		20180531	20180531		2	
2	89A Bridge 1		20150603	20160519	20170417	20180531	No	4	*
2	89A Bridge 2		20150603	20160519	20170417	20180531	No	4	*
3	Beasley Flat Put-In 1	20140425			20170417	20180515		2	
3	Beasley Flat Put-In 2	20140425			20170417	20180515		2	
4	Black Bridge 1	20140425		20160526	20170417	20180515		3	
4	Black Bridge 2	20140425		20160519	20170417	20180515		3	
5	Blue House 1		20150518	20160526	20170410	20180520	No	4	*
5	Blue House 2		20150518	20160526	20170410	20180520	No	4	*
6	Cornville Bridge 1	20140421	20150518	20160526	20170410	20180520	No	5	*
6	Cornville Bridge 2	20140421	20150518	20160526	20170410	20180520		5	Y
7	Dry Beaver Creek 1	20140425		20160526	20170417	20180531		4	
7	Dry Beaver Creek 2	20140425		20160526	20170417	20180531	No	4	
8	Flycatcher Road 1		20150518	20160519	20170417	20180531		4	Y
8	Flycatcher Road 2		20150518	20160519	20170417	20180531		4	Y
	I-17 Bridge 1			20160519	(stopped)			2	
	I-17 Bridge 2			20160519	(stopped)			2	
9	Mingus Extension Bridge 1		20150518	20160519	20170417	20180520		4	Y
9	Mingus Extension Bridge 2		20150518	20160519	20170417	20180520		4	Y
10	Mormon's Crossing Overlook 1		20150518	20160519	20170417	20180522	No	4	*
10	Mormon's Crossing Overlook 2		20150518	20160519	20170417	20180522	No	4	*

11	Mormon's Crossing Bridge 1		20150518	20160519	201704 17	201805 22	No	4	*
11	Mormon's Crossing Bridge 2		20150518	20160519	201704 17	201805 22	No	4	*
12	Page Springs Bridge 1	20140425	20150603	20160519	201704 17	201805 31	No	5	*
12	Page Springs Bridge 2	20140425	20150603	20160519	201704 17	201805 31		5	Y
13	Perkinsville Bridge 1			20160614	201705 15	201805 28		3	
13	Perkinsville Bridge 2			20160614	201705 15	201805 28		3	
14	Red Rock SP Kingfisher Bridge 1	20140425		20160614	201705 08	201805 30		3	
14	Red Rock SP Kingfisher Bridge 2	20140425		20160614	201805 08	201805 30		3	
15	Shield Ranch Overlook 1				201704 17	201805 22		2	
15	Shield Ranch Overlook 2				201704 17	201805 22		2	
16	Sugarloaf Rd 1	20140421	20150518	20160614	201704 17	201805 20		5	Y
16	Sugarloaf Rd 2	20140421	20150518	20160614	201704 17	201805 20		5	Y
17	Sycamore Canyon Road 1		20150518	201610526	201704 17	201805 20	No	4	*
17	Sycamore Canyon Road 2		20150518	20160526	201704 17	201805 20	No	4	*
18	Tuzigoot Bridge 1				201704 17	201805 31		2	
18	Tuzigoot Bridge 2				201704 17	201805 31		2	
19	West Clear Creek 1					201805 29		1	
19	West Clear Creek 2					201805 29		1	

The 2014 Monitoring Protocol states that photos will be taken every year for the first three years, and every other year after that- or following major events such as floods. We've created this table to document which areas have been monitored during which years from 2014-2017. Some photo points were established in the fall of 2013, but they were taken during the wrong time of year, (Oct-Nov) so they are not viable for photo point monitoring.

Previously, at times, a year was skipped; for example, we have photos from 2014, 2016, and 2017. These are not three consecutive years of photo monitoring, so we need to monitor again in 2019. It's possible that photos were taken but we don't know where they were stored, so again, they are not viable. It is critical that we label photos and store them in an appropriately labeled directory moving forward (C:\Workspace\GIS\Photos\Monitoring_Photos\Landmark_Photo_Sites).

In other cases, we've found that while photos were taken during three consecutive years, the photos are not aimed at exactly the same area, or the zoom levels are so different that it would be difficult to compare changes in vegetation across the photos (marked with an *). In those cases, we plan to continue to photo monitor the point until we have three consecutive years of comparable photos. **It is critical for photos to be taken from the same location, season, and angle year to year.**

• Instructions for Photographing Landmark Sites using Collector for ArcGIS

When you visit a permanent photo point, you will take two photos, one facing upstream, and one facing downstream, from the established point. It is important to capture the exact same area that has been captured in the past, from the same vantage point, so that the photos look identical, except for any changes over time that may be evident. You can use previous photos as a reference (See the Photo Point Map Book for previous photos).
To take photos using Collector for ArcGIS

- Turn on the tablet or mobile device
- Swipe screen to unlock
- Tap on the Collector icon to open Collector
- In the Map Gallery, tap to open the Photo Point map
- Click the plus (+) sign on the top right corner of the screen to start creating a new point
- Collect a GPS point of your location. Tap on the 'Current Location' icon that looks like a person with a point in front of them. 

This should drop a point at your current location. If the point on the map does not appear to be in the correct location, you can use your finger to tap on and move the point to the correct location.

• Complete the form.

- To add a photo: 
- Click the Add Attachment icon at the top right corner of the screen
- The Add attachment from panel opens.
- Select Camera to add a new item using the device's camera.
- When the camera starts, use it to take a photo. (You may need to remove the cover if it is attached to the back)
- On the preview page of the photo, select Save to attach the created item,
- or select Discard if you need to retake the photo.
- Select Done, Submit, or the checkmark to save your edits.

• To Rename a Photo:

Rename the photos taken in Collector to reflect the data and location of the photo. This may be easier to do on a laptop or desktop computer than on a mobile device in some cases.

- Turn on the computer or device
- Click on the Collector icon to open Collector
- Click on the Photo Points map to open it
- Select a point with a photo that needs to be renamed by clicking on the point
- Select 'Edit'

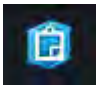
- Scroll through the form to get to the photo attachment
- Tap on the grey arrow in the lower right of the photo to access the extended menu.
- Click on Rename.
- Name the photo with the name of the permanent photo point, number (1 or 2), and the date in the form YYYYMMDD (ie PerkinsvilleBridge1_20180415).
- Click Save
- Click Done/Submit/Checkmark to finish your edits.
- Repeat for all the photos that need to be renamed.

Appendix E: Data Management

Sync Data from the Tablets to ArcGIS Online

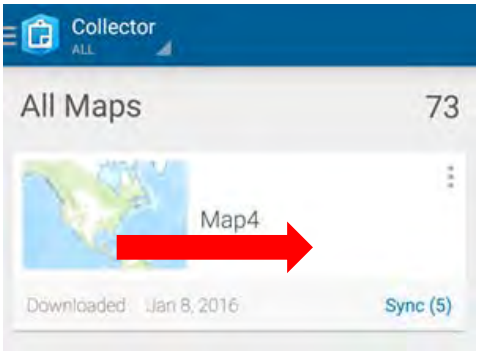
Turn on the tablet.
In Settings, Make sure that Wifi is On
and Airplane Mode is Off.

Click the blue Collector icon to Open Collector for ArcGIS



Log in to the ArcGIS Online field crew account (if needed):
username: vwrccrew
password: verde222

In the Map Gallery page that opens,
Find the icon for map that you want to sync.



Look for the word 'Sync' in the lower right corner of the Map icon.

It may be followed by a number that represents the number of new features that have been created and are waiting to be synchronized.
Tap 'Sync'

On some devices there is a cloud icon instead of the word sync.
Tap the cloud icon to begin syncing.

You'll see a progress bar that appears until the syncing is complete.

To verify that new features have been synced, you can Open the App in our ArcGIS Online account, open the table, and verify that new records have been added based on the dates and locations of field work. Do NOT make any changes to the map in ArcGIS Online. This webmap may be linked to more than 1 tablet at a time and making changes to the webmap while it is connected to other devices can cause data loss and other problematic issues. Submit any requests for changes to the map to the GIS Specialist.

- ## View and Edit Data in Collector for ArcGIS

You can use Collector for ArcGIS on a Desktop to view and edit data.
Open Collector, sign in, and select the project you with to view.

Tap on any feature to select it, then use the Drop down to select either View Details, Edit, or Delete.

When you choose to edit a feature, you can view and change any data on the form, as well as alter the location of the feature.

- ## Rename Photos in Collector for ArcGIS

In the field, Collector assigns a random name to any photos you attach to features. For easier data management, it is a good practice to rename these photos with a relevant name.

Inside of Collector, click on the feature you'd like to edit, and select Edit.
Scroll to the photo attachment.
Click on the drop-down arrow on the bottom of the photo and select Rename.
Rename the photo with the Location Name and Date. Do not use any spaces. Use this format LocationName#_yyyymmdd, for example TuzigootRAP1_20180320.

Click Save and Submit.

- ## Export Edited data from ArcGIS Online to File Geodatabase.

Log into ArcGIS Online as a Publisher or Administrator (not crew member)
username: verdewrc222
password: verde222

Click Content on the Menu Ribbon across the top

Scroll through the Folders on the Left Side of the Screen and open 'Collector Feature Services Field Season 20XX"

Click on a Feature Layer (hosted) that you want to download such as:

- Collect Photo Points
- Collect Invasive Species Mapping
- Collect Invasive Species Treatment
- Collect Rapid Assessments

In the Tab that opens,
Select **Export Data** on the Menu on the Right.
For data, Select **Export to File Geodatabase (or FGDB).**
Save to the **'Exports'** Folder.
Name the file based on the Layer Name and the Current Date
(Ie Collected Invasive Species Mapping 20180401)
In the window that appears, **Download** the file.

Save Data on the Desktop / GIS Drive
Right Click on the Zipped folder you downloaded and select Extract All
Extract to **GIS/Data/RawData**/(Field Year)/ Create a new folder with the Data type and date.

Store Re-named photos taken at Permanent Photo Points in GIS Drive…\
C:\Workspace\GIS\Photos\Monitoring\Permanent Photo Monitoring Sites\ VWRC 2018 Photo Monitoring

• Merging Data to the VWRC Geodatabase and the WFF Geodatabase

Data needs to be processed, formatted, and merged or appended to bothe the VWRC geodatabase and the Walton geodatabase in these locations respectively

C:\Workspace\GIS\VERDEWATERSHEDCOALITION.gdb
C:\Workspace\GIS\WALTON_GDB (Create a copy with the appropriate field season year/date)

Merge Mapping polygons to…
C:\Workspace\GIS\VERDEWATERSHEDCOALITION.gdb\InvasiveSpecies\VWRCInvasiveSpeciesInventoryPatches

And

C:\Workspace\GIS\WALTON_GDB\Verde_2016_2017\Verde_20170905.gdb\Invasive_Species\Invasive_Species_Inventory

Merge Monitoring **Rapid Assessments** to...
C:\Workspace\GIS\VERDEWATERSHEDCOALITION.gdb\Monitoring\VWRC_Monitoring_Assessments

And

C:\Workspace\GIS\WALTON_GDB\Verde_2016_2017\Verde_20170905.gdb\Invasive_Species\Monitoring

Merge Native Recruitment Transects to...
C:\Workspace\GIS\VERDEWATERSHEDCOALITION.gdb\NativeRecruitment\VWRC_Native_Recruitment_Transects

• Criteria to determine whether restoration metrics have been met

Metric Reporting to WFF = The 'Acres Restored' that can be reported to WFF moving forward are the following:

- Sites where the occurrence of all tamarisk (*Tamarix sp.*) and Russian Olive (*Elanthus angustifolia*) are reduced to less than 10% of the treatment area AND

- Sites where there are no new populations of giant reed (*Arundo donax*) a or Tree of Heaven (*Alianthus altissima*) AND these species make up less than 20% of the overall vegetative cover on the site AND

- Sites must meet woody passive recruitment threshold (see below for details) OR

- Sites labeled as 'NA'; 'Site does not have potential to meet cottonwood/willow and mixed broadleaf passive recruitment threshold' BUT has met other land manager objectives

Native Woody Natural Recruitment Threshold:

Over 20 stems of indicator species in the appropriate size class (>1 meter in height) were counted when either Native Recruitment Transect monitoring or PCCM Monitoring occurred.

The indicator species are any of the Native Broadleaf Tree or Shrub species listed in the PCCM protocol.

Greater than 90% relative cover by native woody species.