



Verde River



Cooperative Invasive Plant Management Plan

April 27, 2011



Verde River
Cooperative Invasive Plant
Management Plan

Submitted to:
Friends of the Verde River Greenway
P.O. Box 2535
Cottonwood, AZ 86326



Prepared by:
Fred Phillips Consulting
401 South Leroux Street
Flagstaff, AZ 86001



Acknowledgments

We would like to thank the following people for their contributions to this project:

- Chip Norton, for the incredible work and information that he has volunteered to initiate and sustain this important coordinated effort
- The Walton Family Foundation, for funding this document, which will help propel the removal of invasive plant species on the Verde River
- Laura Moser, for providing information, background, and inspiration for successful invasive plant removal efforts and monitoring
- Yavapai County, the Salt River Project, the Arizona State Land Department, and The Nature Conservancy for providing GIS materials
- All the participating stakeholders for providing important information to aid in this cooperative effort

Table of Contents

Executive Summary	1
Project Background.....	1
Principal Vision and Guiding Principles.....	1
Five-Year Goals	1
Recommendations	2
Introduction.....	4
Project Background.....	4
<i>Purpose of This Plan</i>	4
<i>Related Work</i>	5
<i>About This Plan</i>	6
<i>Stakeholders</i>	6
Vision & Guiding Principles.....	7
Five-Year Goals	8
<i>Ecological</i>	8
<i>Social</i>	9
<i>Economic</i>	10
<i>Management</i>	10
Invasive Species in the Watershed.....	10
High-Priority Species.....	10
Lower-Priority Species	11
Project Area Features	12
<i>Reach 1: Headwaters (near Paulden) to Clarkdale</i>	12
<i>Reach 2: Clarkdale to Beasley Flats</i>	13
<i>Reach 3: Beasley Flats to Sheep's Bridge</i>	14
Plan Components	15
System Stressors & Proposed Actions.....	15
<i>Ornamental Plants</i>	16
<i>Secondary Weed Invasions</i>	16
<i>Bank Erosion</i>	17
Approach for Prioritizing Actions & Sites.....	17
2011 Implementation Strategy.....	19
<i>Ecological Goal</i>	20
<i>Plan Implementation Structure</i>	20
<i>Adaptive Management</i>	21
Demonstration Projects	21
<i>Project Areas</i>	21
<i>Goals</i>	22
<i>Scope</i>	22
Estimated Total Project Costs.....	24
References	25

Figures

- Figure 1: Location Map
- Figure 2: Overall Map of Watershed
- Figure 3: Map of Reach 1
- Figure 4: Map of Reach 2
- Figure 5: Map of Reach 3
- Figure 6: Flow Chart Species Prioritization
- Figure 7: Location Map of Demonstration Project 1
- Figure 8: Location Map of Demonstration Project 2
- Figure 9: Location Map of Demonstration Project 3

Tables

Table 1: Related Studies & Plans in the Verde Watershed.....	5
Table 2: Criteria for Site Prioritization	18
Table 3: Estimated Project Costs	24

Appendices

All appendices are included on the attached CD.

- Appendix A: Status of Invasive Species in the Watershed
- Appendix B: Best Management Practices
- Appendix C: Species Prioritization Methods
- Appendix D: Example of Project Monitoring Plan
- Appendix E: Current Capacity of Stakeholders
- Appendix F: Inter-Land Owner and Manager Collaboration Form Examples
- Appendix G: Labor and Funding Sources
- Appendix H: Cost Estimate Explanation
- Appendix I: List of Plan Coordination Meetings
- Appendix J: Meeting Notes and Comments

Executive Summary

Project Background

The Verde River is treasured for its wildlife habitat, water supply, recreational opportunities, and natural beauty. It is one of the most substantial free-flowing rivers in Arizona. Although the river corridor primarily supports native riparian vegetation, invasive species — particularly saltcedar (*Tamarix* spp.), Russian olive (*Elaeagnus angustifolia*), tree of heaven (*Ailanthus altissima*) and giant reed (*Arundo donax*) — threaten the health and sustainability of these communities.

This Cooperative Invasive Plant Management Plan (CIPMP) was initiated in 2010 to bring together federal and state agencies, private companies, nonprofit managers, and landowners. Its purpose is twofold:

- To develop a strategic approach for controlling invasive plants in the riparian corridors of the Verde River watershed — an approach that will enable stakeholders to prioritize, develop, and implement restoration actions
- To increase the level of collaboration and communication among stakeholders, thereby enhancing information transfer, adaptive management, and basin-wide success

Principal Vision and Guiding Principles

CIPMP's principal vision is:

The Verde River and its tributaries comprise a diverse, self-sustaining and resilient riparian ecosystem in which invasive plant species are controlled through cooperative stakeholder participation.

The Guiding Principles for the execution of the Vision include: 1) approach this work collaboratively, 2) select techniques and management practices that will provide successful results, 3) provide education and outreach for the local community and public, and 4) implement a system-wide approach.

Five-Year Goals

This plan establishes ecological, social, economic, and management goals for the next 5 years:

- **Ecological:** Reduce invasive woody and herbaceous plant species through various control methods within the Coconino, Maricopa, and Yavapai County FEMA floodplain
- **Social:** Educate the local community and public about the economic and social value of a healthy river system, and the prevention and removal of invasive species, their detrimental effects, and the services and funding that are available to remove invasive species on their land
- **Economic:** Give the local community economic incentives and employment opportunities for removing invasive plant species on their own property
- **Management:** Establish a multi-stakeholder group to accomplish the ecological, social, and economic goals and to monitor the project's success over the long term

Several ecological and anthropogenic stressors — ornamental plants, secondary weed invasion, and bank erosion — may challenge the ability to remove invasive species. This plan proposes several actions to ensure that the 5-year goals can be met despite these stressors.

Recommendations

Site and species approaches should be used to prioritize areas within the floodplain for removing invasive plants. Efforts should focus on eradicating Russian olive and giant reed, reducing saltcedar and tree of heaven to less than 10 percent of the canopy cover, removing or remediating biomass, removing priority invasive herbaceous and grass species, controlling secondary weeds, and revegetating (if necessary). Specific recommendations for 2011 follow.

- Conduct a workshop to determine how and where to initiate mapping and inventory efforts and to consolidate existing mapping efforts
- Prioritize actions using the site and species approaches and the information gained from the inventory and mapping effort
- Define the total acreage of priority sites for invasive plant control within the Verde watershed
- Remove sites where invasive plant removal is infeasible due to accessibility, landowner approval, funding, permits, or capacity issues
- Determine how many acres per year must be treated to achieve the 5-year goals

- Initiate processes for implementation, including permit acquisition, landowner access agreements, fundraising, and capacity building
- Formalize the Verde River Watershed Partnership with a Memorandum of Understanding (MOU) by all stakeholders
- Implement demonstration projects
- Create a multi-stakeholder steering committee to develop the structure for implementing future projects
- Develop an education and outreach strategy
- Develop a site monitoring and maintenance strategy

Introduction

The Verde River is treasured for its wildlife habitat, water supply, recreational opportunities, and natural beauty. It is one of the most substantial free-flowing rivers in Arizona. Although the river corridor primarily supports native riparian vegetation, invasive species — particularly saltcedar (*Tamarix* spp.), Russian olive (*Elaeagnus angustifolia*), tree of heaven (*Ailanthus altissima*) and giant reed (*Arundo donax*) — threaten the health and sustainability of these communities. Other invasive plant species persist in the system with the threat of expanding their range; in some cases, there are no known effective control methods for wildland settings.

Project Background

The Verde River Greenway extends from Clarkdale to Beasley Flat, below Camp Verde. Since 2008, the Friends of the Verde River Greenway (FVRG) has organized and managed river cleanup and invasive plant removal projects along this reach. During 2009–2010, FVRG focused on cooperative management projects that involved partnerships between various agencies, communities, and organizations. After realizing that improving riverside habitat within the Greenway would best be accomplished under a broad, watershed-wide cooperative effort, FVRG sought and secured funding.

The first Verde River Habitat Improvement Workshop was held on July 20, 2010, in Camp Verde. Stakeholders included federal and state agencies, private companies, and nonprofits. The goals of this workshop were to:

- Initiate a cooperative effort for identifying priority invasive species
- Develop methods for site and species prioritization
- Unify the best management practices (BMPs) for coordinating the management of invasive plant species within the Coconino, Maricopa, and Yavapai County FEMA floodplain areas of the Verde River watershed

This Cooperative Invasive Plant Management Plan (CIPMP) originated from that meeting. FVRG has also begun formulating a strategy for working with private landowners to remove invasive plant species and initiate land conservation.

Purpose of This Plan

- To develop a strategic approach for controlling invasive plants in the riparian corridors of the Verde River watershed — an approach that will

enable stakeholders to prioritize, develop, and implement restoration actions

- To increase the level of collaboration and communication among stakeholders, thereby enhancing information transfer, adaptive management¹, and basin-wide success

Related Work

Although this Plan was developed primarily to control invasive plant species, the stakeholders recognize that other factors also threaten the health and sustainability of the Verde River system. These factors include invasive invertebrate and vertebrate species, water flow, secondary weed introduction, and erosion. Without a holistic approach to managing all the issues overall ecosystem health cannot be sustained. Other efforts and plans within the Verde River watershed focus on the issues discussed above. This Plan is designed to complement and augment these projects, which are summarized below.

Table 1: Related Studies & Plans in the Verde Watershed

Group	Study or Plan
U.S. Fish & Wildlife Service (FWS), Arizona Ecological Services Office	Verde River Focus Area Plan
Salt River Project	Horseshoe and Bartlett Reservoirs Habitat Conservation Plan
FWS	Arizona Partners for Fish and Wildlife Program (focus areas)
Coconino, Prescott, & Tonto National Forests	Land & Resource Management Plan
Arizona Game & Fish Department (AGFD)	Comprehensive Wildlife Conservation Strategy
Coconino and Tonto National Forests	Verde River Wild and Scenic River Comprehensive River Management Plan
Arizona State Parks	Greenway Management Strategy
The Nature Conservancy (TNC)	Conservation Action Plan for the Verde River
Various	Interagency Fossil Creek Native Fish Repatriation Plan
FWS and AGFD	Stillman Lake Renovation & Native Fish Sanctuary Plans
FWS	Functions and Values of the Verde River Riparian Ecosystem and an Assessment of Adverse Impacts to these Resources
Yavapai-Apache Indian Community	Special Report on Water Supply Sources
Verde Watershed Association, Big Sandy, Chino Winds, Coconino, East Maricopa, Tonto, Verde Natural Resource Conservation Districts	Verde Cooperative River Basin Study
Various	Conservation agreements, assessments, strategies, and recovery plans for individual candidate species

¹ Adaptive management is defined as a systematic process using monitoring and research to inform and adjust resource management, plans and approaches.

About This Plan

This Plan was developed as a resource for land managers and owners. It presents BMPs for invasive species control and native species planting, criteria for prioritizing sites, and resources for funding and labor; it also provides example of a holistic monitoring plan to obtain comparable results. In addition, it helps to promote partnerships between land managers and owners to initiate contact and discuss their collective invasive species management efforts.

This Plan is a “living document” that should be adjusted periodically based on results of ongoing efforts. The momentum of this partnership should continue through annual meetings to share techniques, successes and failures, and results.

Stakeholders

- Coconino National Forest
- Tonto National Forest
- Prescott National Forest
- U.S. Department of Agriculture Natural Resource Conservation Service
- AGFD, Region II, III and VI
- U.S. Fish and Wildlife Service
- National Park Service
- Arizona State Parks, Verde River Greenway
- Yavapai-Apache Nation
- Freeport McMoRan Copper and Gold, Wildlife Habitat Council
- Northern Arizona University
- Terra Foundation
- Verde Natural Resource Conservation District
- TNC
- Salt River Project
- Verde Valley Land Preservation Institute
- University of Arizona Cooperative Extension, Yavapai County
- Community Forest Trust
- Army Corps of Engineers
- Taylorbird Enterprises
- Fred Phillips Consulting
- Kimmel Consulting Services
- Walton Family Foundation

Vision & Guiding Principles

Vision

The Verde River and its tributaries comprise a diverse, self-sustaining and resilient riparian ecosystem in which invasive plant species are controlled through cooperative stakeholder participation.

This statement encompasses not only ecological components but also social, economic, and management ones to reflect the stakeholder's broader vision of this multi-use system. The issues informing these components are discussed in the "Goals" section (page 8), and should be considered when implementing invasive species removal.

Guiding Principles

The guiding principles for executing this vision describe a collaborative, system-wide approach for developing and implementing BMPs that will provide successful results. They also address the need for education and outreach to the local community and public.

- **Approach this work collaboratively.** Incorporate the knowledge and priorities of landowners, managers, and stakeholders into actions chosen for managing invasive species. In addition, incorporate adaptive management practices to respond to monitoring results and "lessons learned."
- **Select techniques and management practices that will provide successful results.** Where possible, use known techniques and management practices that have been successful in controlling invasive species within the floodplain of the Verde River and its tributaries. For invasive species within these floodplains that have not yet been subjected to successful controls, use methods and management practices that have worked in other riparian systems. For all other invasive species, experiment with techniques that have worked in nonriparian systems — agriculture settings or roadsides, for example.
- **Provide education and outreach for the local community and public.** Use education and outreach to help involve the local community and public. These programs should explain the need to remove invasive species, to restore ecological function, to limit invasive weed introductions (including ornamental plants), and to limit human disturbances to project areas.

- **Implement a system-wide approach.** Because seeds and vegetative materials disperse via water, wind, and animals, they will affect invasive plant removal in project sites that lie upstream and downstream. Therefore, remove invasive species throughout the system to control them on a watershed scale and promote more sustainable results.

Five-Year Goals

These goals incorporate a holistic approach to invasive plant removal within the Verde River watershed and address ecological, social, economic, and management issues. They account for system stressors, use the site and species prioritization approach, and advance the Plan's vision.

- **Ecological** — Over the next 5 years, reduce invasive woody and herbaceous plant species through various control methods within the Coconino, Maricopa and Yavapai County FEMA floodplain. Eliminate seed sources to prevent further invasive plant species infestation, prevent new species from invading, allow native plant species to thrive, and allow the riparian and wetland areas to become more naturally functioning, sustainable, and resilient to change.
- **Social** — Over the next 5 years, provide education and outreach to the local community and public. Provide information on the prevention and removal of invasive species, their detrimental effects, and the services and funding available for removing invasive species on their land.
- **Economic** — Over the next 5 years, give the local community economic incentives employment opportunities for removing invasive plant species on their own property.
- **Management** — Over the next 5 years, establish a multi-stakeholder group to accomplish the ecological, social and economic goals and to monitor the project's success for the long term.

Ecological Actions

To accomplish the ecological goals of this Plan the following actions are suggested.

- Inventory and map invasive plant species infestation within the watershed.
 - Conduct a workshop to establish an approach to inventorying and mapping.

- Compile information on known existing invasive species infestations and create location maps.
- Completely remove Russian olive and giant reed from the watershed using mechanical and/or herbicide control methods. See Appendix B for a discussion of the BMPs.
- Reduce all woody invasive species to less than 10 percent of the total canopy cover within riparian areas and all herbaceous and grass species to less than 20 percent of the total canopy cover within the floodplain. See “Criteria for Site Prioritization” and “Flow Chart for Species Prioritization” (pages 18 and 19) to identify which species or sites to address first.
- Eradicate small, isolated populations of aggressive invasive plant species that pose the greatest threat of spreading. Identify these “Class A” species using “Flow Chart for Species Prioritization.”
- Experiment with methods for controlling invasive herbaceous and grass species in wildland settings or fallow agricultural lands to find the most effective technique for control.
- Prevent new invasive species (not currently occurring in the Verde River watershed) from infesting the watershed or establish a plan to keep them from invading.

Social

To accomplish the social goals of this Plan, the following actions are suggested.

- Develop effective educational and outreach materials (pamphlets, school programs, invasive species informational cards, field trips, workshops, local television, etc.) to distribute to the local community and public.
- Contact local community leaders and private landowners to initiate management strategies for controlling invasive ornamental plants that are providing a seed source for areas downstream.
- Include community members and stakeholders in educational events to promote the health of the Verde River system.
- Educate and train local conservation crews, agencies, and contractors in technical skills to promote their professional growth.
- Improve aesthetic enjoyment for the public; promote their involvement and interaction with project sites by holding volunteer invasive species removal events in sites that are frequented by the public.

Economic

Consider the following when creating economic implementation plans:

- Employ and support the local youth conservation corps to remove invasive species along the Verde River and its tributaries.
- Provide economic opportunities to private landowners through grants and technical resources to remove invasive species on their land.
- Increase employment opportunities for local agencies, contractors, and businesses in the Verde River watershed.

Management

To accomplish the management goals of this Plan, the following actions are suggested.

- Practice adaptive management by considering the lessons learned during restoration efforts and the long-term monitoring of treated areas to maintain invasive species cover at or below 10 percent.
- Develop an approach for working with local communities to limit or eradicate invasive ornamental plants and enhance the public's understanding of invasive plant removal.
- Develop a management strategy for secondary weeds that may include:
 - An action plan for identifying and treating new invasive species, including a watch list for potential species that could invade the watershed.
 - A rapid response approach for removing invasive plants when conditions are most favorable for certain species — for example, after a flood event.

Invasive Species in the Watershed

High-Priority Species

The stakeholders identified four invasive species — saltcedar, tree of heaven, Russian olive, and giant reed — as high priorities for control within the Verde River riparian corridor. They impact ecosystem function significantly, altering wildlife habitat, flow and fire regimes, vegetation structure, and biodiversity (see Appendix A for a more detailed discussion). Saltcedar and tree of heaven

infest the riparian corridors of the Verde; controlling them will require an extensive, coordinated effort. The ecological goal will be to keep these two species at an infestation level of less than 10 percent of the total canopy cover, thus allowing the river system to sustain ecosystem function and integrity. Russian olive and giant reed occur in lower densities along the riparian corridor; however, these species are highly invasive and have the potential to rapidly expand in range and outcompete native vegetation given the appropriate conditions — cleared areas, catastrophic fire, flooding events. Therefore, Russian olive and giant reed were identified as “no-tolerance” species, and efforts will be focused to remove all individuals within the Verde River watershed.

Lower-Priority Species

Several other invasive species (listed below) were identified as lower priority and/or secondary weeds; it was essential to include these species for control in this Plan. Their effects on ecosystem function include altering wildlife habitat, fire regimes, vegetation structure, and biodiversity. The aquatic species also deplete oxygen within the water column. These invasive species have the potential to expand in range given the appropriate conditions; they may become secondary weeds in restoration project areas, invade areas cleared by flooding or fire events, and spread by construction activities. Some species, such as kochia, are the primary invasive species of concern in a project area. Because proven, effective control methods have not been established for many of them in wildland settings, experimentation will be required. The other invasive species of concern identified by the stakeholders include:

- Siberian Elm (*Ulmus pumila*)
- Uruguayan Pampas grass (*Cortaderia selloana*)
- Himalayan Blackberry (*Rubus armeniacus*)
- Yellow Star Thistle (*Centaurea solstitialis*)
- Malta Star Thistle (*Centaurea melitensis*)
- Dalmatian Toadflax (*Linaria dalmatica*)
- Yellow Sweet-Clover (*Melilotus officinalis*)
- Mexican Fireweed or Kochia (*Bassia scoparia*)
- Russian Knapweed (*Acroptilon repens*)
- Spotted Knapweed (*Centaurea stoebe*)
- Sahara Mustard (*Brassica tournefortii*)
- Cheat Grass (*Bromus tectorum*)
- Red Brome (*Bromus rubens*)
- Creeping Waterprimrose (*Ludwigia peploides*)
- Eurasian Watermilfoil (*Myriophyllum spicatum*)
- Water Lily (*Nymphaea* spp.)

Project Area Features

This Plan covers the Verde River from its headwaters to Sheep's Crossing above Horseshoe Dam, where flow decreases or ceases. In total, it includes 459.2 miles of the Verde River and its major tributaries (Figures 1 and 2) — 336.1 miles of federal land, 20.8 miles of state lands, 4.2 miles of Tribal land, and 98.1 miles of private land. It delineates the river into three major reaches:

- Reach 1: Headwaters (near Paulden) to Clarkdale (Figure 3)
- Reach 2: Clarkdale to Beasley Flats (Figure 4)
- Reach 3: Beasley Flats to Sheep's Crossing (Figure 5)

Reach 1: Headwaters (near Paulden) to Clarkdale

Ownership. Reach 1 contains lands that are primarily managed by TNC, AGFD, and Prescott National Forest, as well as state trust lands. It lies primarily within Yavapai County, although a portion of Sycamore Creek is in Coconino County. Populated areas include Chino Valley, Paulden, Perkinsville, and Clarkdale. Most of the land is publicly owned, primarily by Prescott National Forest.

Listed Species. Because of its unique and irreplaceable nature, AFGD considers this reach a resource Category 1. It supports the following:

- Three federally listed endangered species
- One federally listed threatened species
- One federal candidate species
- Four state endangered species
- Six state threatened species
- Eight state candidate fish and wildlife species

Geology. The geology of this Reach is characterized by mostly sedimentary rocks. They include Tertiary sedimentary rock overlain in places with volcanic rocks and alluvium in the Chino Valley, Redwall limestone and Martin Formation west of Perkinsville, Coconino Sandstone and Supai Formation between



Perkinsville and Sycamore Canyon, and the Verde Formation downstream of

Sycamore Canyon (Krieger 1965, Owen-Joyce and Bell 1983, Sullivan and Richardson 1993). The permeable nature of these sedimentary rocks facilitates groundwater flow to the river. The active channel through this reach is confined primarily by steep, narrow basalt and limestone canyons, with a narrow floodplain that widens around Perkinsville and at the confluence of Sycamore Creek (Sullivan and Richardson 1993).

Hydrology. The Verde River originates at the confluence of Big Chino Wash and Williamson Valley Wash. Sullivan Lake was created at the confluence of these washes for use as a stock-watering pond. Other inflow sources into the river include Sycamore Creek, various intermittent streams (Granite Creek, Hell Canyon, M.C. Canyon, Bear Canyon, and small ephemeral drainages), and springs (Sullivan and Richardson 1993). Riffles are short and shallow, except during flood events, and the stream gradient is low.

Vegetation. The dominant vegetation in the wider floodplain areas includes Fremont cottonwood (*Populus fremontii*), Goodding willow (*Salix gooddingii*), velvet mesquite (*Prosopis velutina*), desert willow (*Chilopsis linearis*), and saltcedar. The dominant vegetation in the narrow canyon includes velvet ash (*Fraxinus velutina*), Utah juniper (*Juniperus osteosperma*), box elder (*Acer negundo*), seep willow (*Baccharis salicifolia*), and desert willow. The prominent invasive species of concern in this reach include saltcedar, Russian olive, Himalayan blackberry, and Siberian elm. Siberian elm is not found within the Verde River floodplain below this reach.

Reach 2: Clarkdale to Beasley Flats

Ownership. Reach 2 includes lands primarily owned or managed by private entities, the Yavapai-Apache Nation, the Coconino and Prescott National Forests, the National Park Service, and The Nature Conservancy; it also includes state trust and state park lands. It occurs within Yavapai County. Reach 2 has the highest density of private lands within the project area and includes the towns of Clarkdale, Jerome, Cottonwood, and Camp Verde. Beaver Creek, a tributary to the Verde, includes a designated wilderness area. Surface water is diverted during the summer months, reducing flows.

Listed Species. The area that includes Peck's Lake, Tavasci Marsh, and the main stem Verde River adjacent to these areas has been designated as an "important bird area" by the Arizona Audubon Society. This reach supports a diversity of neo-tropical and resident nesting birds, including the federally listed endangered southwestern willow flycatcher, the federally listed threatened species bald eagle, and the state-listed threatened species common Blackhawk, osprey, and yellow-billed cuckoo.

Geology. This reach is characterized by a broad floodplain with broad low terraces of coarse gravel. The close proximity of the active channel, make sand the primary substrate for riparian vegetation (Sullivan and Richardson 1993).



Hydrology. Reach 2 includes some of the major tributaries that contribute to the Verde River's instream flow — Oak Creek, Dry and Wet Beaver Creeks, and West Clear Creek. The floodplain is broader than in Reaches 1 and 3. The river has low water velocities with shallow riffles that increase during flooding. The primary substrates in the active floodplain are primarily sand and small cobble. Peck's Lake is the only natural oxbow lake along the Verde River.

Vegetation. The dominant vegetation along the floodplain includes Fremont cottonwood, Goodding willow, velvet ash, Arizona sycamore (*Platanus wrightii*), box elder, saltcedar, and tree of heaven. The primary invasive species of concern include saltcedar, tree of heaven, Russian olive, and giant reed. In the fallow agricultural fields or other disturbed areas, the invasive species of concern include kochia, yellow star thistle, malta star thistle, Uruguayan pampas grass, Russian knapweed, spotted knapweed, Sahara mustard, cheat grass, and red brome. Eurasian milfoil and water lily are priority invasive species for Peck's Lake.

Reach 3: Beasley Flats to Sheep's Bridge

Ownership & Designations. Reach 3 is managed primarily by the Coconino, Prescott, and Tonto National Forests. Private lands include the small towns of Strawberry and Pine in the Fossil Creek watershed. The reach from Beasley Flats to Red Creek above Sycamore Creek, including Fossil Creek, is designated as Wild and Scenic under the authority of the 1968 Wild and Scenic Rivers Act; the Scenic area extends from Beasley Flats to below Childs, and the Wild area extends from Childs to Red Creek. The Wild section flows through the Mazatzal Wilderness. Fossil Creek, one of the tributaries in this Reach, has a designated wilderness area.

Listed Species. Reach 2 provides nesting habitat for the bald eagle, a protected species under the Migratory Bird Treaty Act and the Bald and Golden Eagle Protection Act, and for the common Blackhawk and osprey, which are state-listed threatened species. Five bald eagle breeding areas occur along the Verde River and are closed to vehicular and foot traffic.

Geology. The terrain in this reach becomes more rugged, and basalt cliffs and steep mesas are the primary geologic features (Sullivan and Richardson 1993). Cobble and sand are the dominant substrate type within the active floodplain, but large cobbles and boulders become more prevalent downstream. The floodplain is narrow, limiting the width of the riparian corridor.



Hydrology. Fossil Creek and the East Verde River contribute flow to this reach. Other intermittent creeks include Houston Creek, Gap Creek, Coldwater Canyon, Red Creek, Wet Bottom Creek, Tangle Creek, and Sycamore Creek. The gradient of the river increases in this reach and riffles become more frequent.

Vegetation. The dominant plant species occurring within the riparian corridor in this Reach include Fremont cottonwood, velvet mesquite, Goodding willow, seep willow, burrobush (*Hymenoclea monogyra*), broom baccharis (*Baccharis sarothroides*), desert willow, giant reed, and saltcedar. The primary invasive species of concern in this stretch include saltcedar, Russian olive, and giant reed.

Plan Components

System Stressors & Proposed Actions

It is important for this Plan to consider existing and potential system stressors, which include ornamental plants, secondary weeds, and bank erosion. Many system stressors, such as groundwater pumping, vertebrate and invertebrate invasive species and surface water diversions are being addressed through other projects in the Verde watershed (see the “Related Work” section). This Plan identifies additional system stressors which can realistically be addressed

during Plan implementation. The additional stressors include ornamental plants, secondary weeds, and bank erosion. These stressors, which have both ecological and anthropogenic origins, influence whether native or invasive plant species will dominate the Verde watershed. Nevertheless, restoration goals may still be achieved if appropriate steps are taken to address these stressors. These stressors may also help guide site prioritization.

Ornamental Plants

Many of the invasives within the Verde watershed, particularly in Reach 2, have originated from ornamental plants on surrounding private and municipal lands. They will continue to persist unless measures are taken to control them.

■ PROPOSED ACTIONS

- Organize a steering committee or subgroup to develop a procedure for education and outreach in the public and private sectors.
- Discuss removing invasive ornamental plants with local community leaders, residents, and nurseries and provide alternative native plant options.
- Provide information on funding and labor options for invasive plant removal.

Secondary Weed Invasions

Many plants, particularly herbaceous and grass species, can invade a site after a natural or anthropogenic disturbance — a flood, the removal of other invasive species, or development activities. Seeds may be brought in through equipment, floods, animals, and wind. Disturbed areas provide an opportunity for rapidly colonizing species to invade. Such species include yellow star thistle, malta star thistle, Dalmatian toadflax, yellow sweet-clover, kochia, Russian knapweed, spotted knapweed, Sahara mustard, cheat grass, and red brome.

■ PROPOSED ACTIONS

- Organize a steering committee or subgroup to develop a procedure for secondary invasive species prevention at restored or disturbed sites.
- Identify the invasive plants most likely to be secondary weeds and work with weed scientists to identify the most effective methods to control them or prevent their introduction.

- During site-specific restoration efforts, consider planting native herbaceous or grass species to outcompete secondary weeds.

Bank Erosion

Some invasive plant species, primarily saltcedar, were introduced to the Verde watershed to prevent bank erosion where land was cleared for agriculture, pasture, development, or recreation. If these invasive species are targeted for removal, bank erosion may occur.

■ PROPOSED ACTIONS

- Organize a steering committee or subgroup to work with landowners on potential bank line erosion and prevention.
- Identify native plants that will quickly colonize to stabilize banks and establish these plants when bank erosion is minimal, during low flows.
- Provide information on funding and labor options for invasive plant removal and bank line stabilization.

Approach for Prioritizing Actions & Sites

A two-pronged approach was developed to prioritize actions for invasive species removal. This approach entails first prioritizing sites (Table 2) and then prioritizing the species within the site (Figure 6). The criteria for prioritizing sites and species are primarily driven by the ecological goal; the social, economic, and management goals will influence how this work is implemented and how the sites are managed.

Five criteria dictate whether a site can be successfully restored. For restoration to proceed, these criteria must be met at any of the sites prioritized by the site or species approach.

- **Funding is available** to complete the project, including monitoring and maintenance.
- **The landowner/manager is willing.** Commitment, cooperation, and common goals with the landowner/manager are required to implement actions, monitoring, and long-term maintenance.
- **Permits are obtained.** Permits are required on all public lands where invasive plant species will be removed to comply with the National Environmental Policy Act (NEPA), Section 404 of the Clean Water Act, Section 106 of the National Historic Preservation Act (NHPA), and

Section 7 of the Endangered Species Act (ESA). Landowner access agreements are also needed. Some activities on private lands may require permitting.

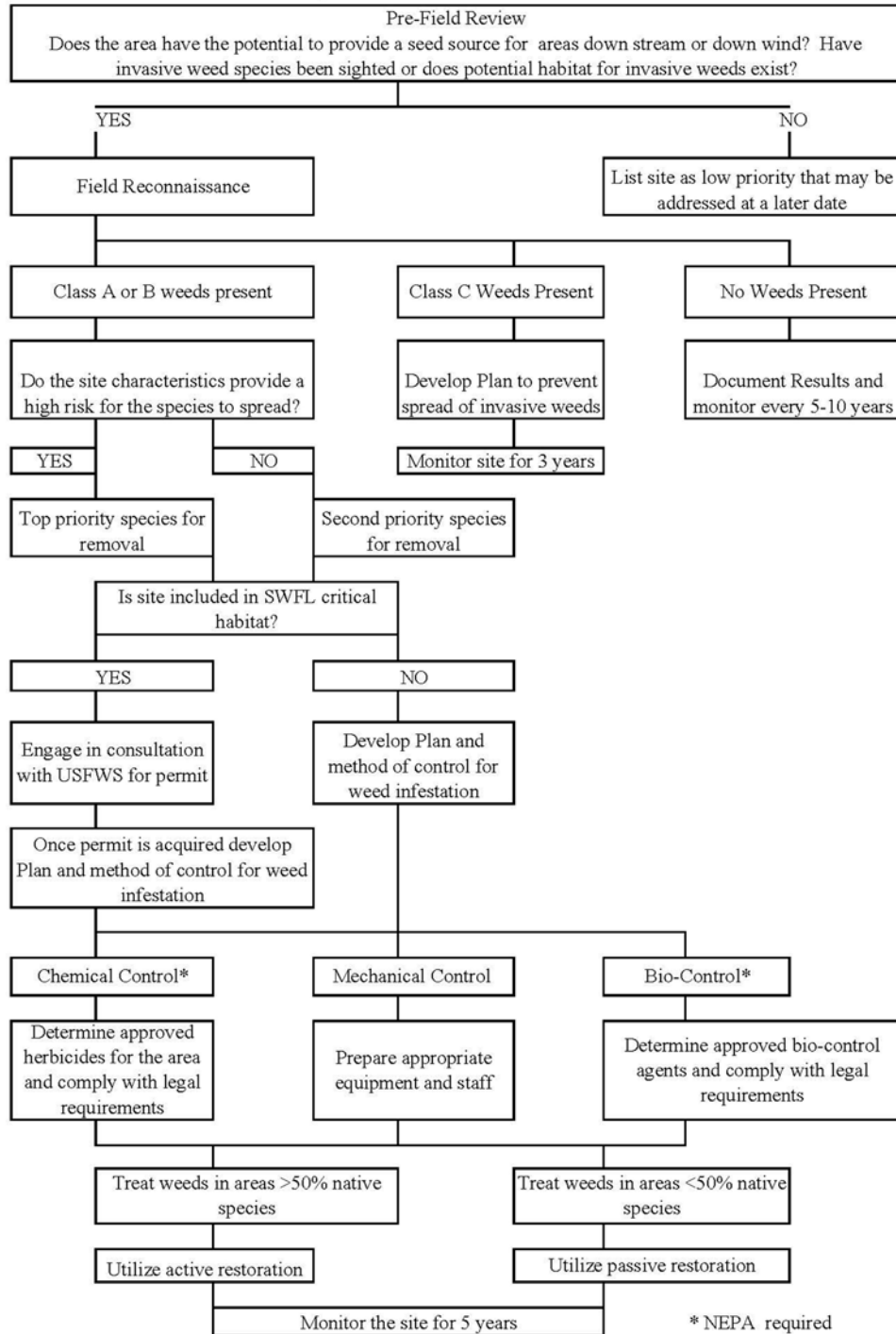
- **Capacity is available** to conduct the work. A trained work force and logistic plan is necessary to implement a successful, timely invasive species removal effort.
- **The site is accessible.** Site accessibility will affect the cost of restoration. The difficulty or ease of accessing the site to remove invasive species, conduct monitoring, and maintain it over the long term must be considered.

Table 2: Criteria for Site Prioritization

Criterion	Objective
A. Sites higher up in the watershed; tributaries to the main stem	Prevent seed or vegetative source from infesting downstream sites.
B. Sites with high wildlife value	Removal efforts can be focused in these areas or if invasive plant species are compromising habitat.
C. Presence of Russian olive and/or giant reed	Russian olive and giant reed have the highest priority for removal. These species occupy minimal habitat and are feasible to remove. They should be prevented from further infestation within the watershed.
D. Greater than 10% total canopy cover of woody invasive plants	Maintain woody invasive plant cover below 10%.
E. Greater than 20% total canopy cover of herbaceous and grass invasive species	Maintain herbaceous and grass invasive plant cover below 20%.
F. Presence of isolated small populations of Class A or B species	Isolated populations of Class A or B weeds are feasible to remove to prevent further infestation. Priority Class A or B weeds should be identified using the Species Prioritization Flow Chart.
G. Potential for wildfire	Reduce wildfire risk for potential damage to property, human safety, and wildlife habitat.
H. Herbaceous weeds interfere with passive or active revegetation	Control invasive herbaceous species if they have the potential to serve as secondary weeds when woody invasive species have been removed.

Appendix C proposes a methodology for prioritizing actions using the species approach based on the A, B, and C classifications. The following flow chart for species prioritization supplements the methodology outlined in Appendix C.

**Figure 6. Flow Chart
Species Prioritization**



2011 Implementation Strategy

Ecological Goal

The tasks outlined below for 2011 represent the first step in launching a successful restoration effort. Once these tasks are completed and their success is determined, implementation strategies for the social, economic and management goals can then be initiated.

Task 1: Map and inventory invasive species. A workshop should be conducted to establish an approach for how and where to initiate this work and to consolidate existing mapping efforts.

Task 2: Apply the site and species approaches. Actions should be prioritized using the site and species approaches, along with data from the inventory and mapping effort.

Task 3: Define the total acreage of priority invasive plant control efforts. The mapping information will be important to this task.

Task 4: Remove sites that are not feasible for restoration. The results of Task 1 will include the feasibility criteria outlined in Table 2. Areas where restoration is infeasible should then be removed from the estimated acreage of priority invasive plant control efforts.

Task 5: Determine how many acres per year must be treated to achieve the 5-year goals. This can be calculated once Task 4 is complete. Removal costs can be roughly estimated based on site accessibility, density of infestation, and methods.

Task 6: Initiate implementation processes. When Task 5 is complete, work to acquire permits, develop landowner access agreements, raise funding, and build capacity can begin.

Task 7: Initiate three distinct demonstration projects in the Verde Valley. These projects should be selected by the stakeholders to provide public outreach and educational opportunities, obtain public support for the broader goals of the Plan, and employ and train youth corps. The demonstration projects will also yield information about the distribution of invasive species, removal methods, project costs, and monitoring protocols.

Plan Implementation Structure

The following actions are also recommended for 2011.

- **Formalize the partnership.** Formalize the Verde River Watershed Partnership with a Memorandum of Understanding (MOU) by all stakeholders involved in this restoration effort. Example MOUs can be found in Appendix F.
- **Create a steering committee.** Create a multi-stakeholder steering committee to develop the structure for implementing future projects.
- **Develop an education and outreach strategy.** The steering committee should develop a strategy for public education and outreach that targets the Verde watershed community.
- **Develop a site monitoring and maintenance strategy.** The steering committee should develop strategies for monitoring treated sites and for long-term maintenance. These strategies should address:
 - Short- and long-term monitoring to provide information that will inform adaptive management.
 - Long-term maintenance to ensure that goals are being met.
 - Planning to control secondary weeds and prevent the spread of newly introduced invasive plants to the system.

Adaptive Management

Adaptive management is a systematic process using monitoring and research to inform and adjust resource management, plans, and approaches. As lessons are learned from completed projects, methods can be adjusted to improve the effectiveness and efficiency of future removal efforts. Stakeholders should continue to share information to prevent replicated failures and promote exponential success.

Demonstration Projects

Project Areas

Three demonstration areas have been identified to test the invasive species removal process and serve as a model for future projects. These areas were selected for several reasons. They are each owned by multiple entities with established, functioning partnerships, and the required compliance, permitting, and access agreements have been completed. In addition, they are easily accessible and visible to the public.

- **Area 1** covers 160 acres. It includes Tavaschi Marsh (NPS-Tuzigoot), Dead Horse State Park, the Verde Greenway (Arizona State Parks), and privately owned lands (Figure 7).
- **Area 2** covers 196 acres. It includes the Rockin' River Ranch (Arizona State Parks), TNC's Shield Ranch, Prescott and Coconino National Forest lands, and privately owned lands (Figure 8).
- **Area 3** covers 168 acres. It includes TNC's Otter Water property, Coconino National Forest lands, and privately owned lands (Figure 9).

Goals

The goals of these demonstration projects include:

- Providing public outreach and education by encouraging local volunteers to participate.
- Obtaining public support for the broader goals of the CIPMP.
- Employing and training the local youth conservation corps to remove invasive plants.
- Gathering data to inform the adaptive management process, especially to refine methods for
 - Mapping and inventories
 - Interagency cooperative management
 - Private landowner participation
 - Invasive species removal
 - Project cost estimation
 - Monitoring

Scope

The priority invasive species for these demonstration projects include saltcedar, tree of heaven, giant reed and Russian olive. In total, these species comprise an estimated 10–15 percent of the canopy cover. A more accurate estimation of canopy cover for these species will be determined after the mapping and inventory efforts are completed.

These plants will be removed primarily using the “cut-stump method,” which entails cutting the individual as low to the ground as possible and immediately applying herbicide to the cut stump. A local contracted crew will be used to cut the stumps and remove vegetation material from the riparian area and an Arizona State–certified applicator will immediately apply the herbicide to the

stumps. Local volunteers, under experienced supervision, will be used for mapping, retreatment, and monitoring. The habitat in these project areas consists primarily of native vegetation; therefore, passive revegetation can occur once the invasive plants have been removed.

This work will be conducted only within the riparian corridor, not along the fallow agricultural fields or upper terraces.

Future projects may involve experimentation to determine the most effective removal efforts for difficult-to-control invasive grass and herbaceous species or the removal of other invasive plants detected during the inventory and mapping.

Funding

Funding has been sought for the demonstration projects. This funding does not cover the adjacent private lands whose owners have agreed to participate in this effort. Securing funding so private landowners can participate will be essential to the long-term success of these restoration projects.

The funding will cover invasive plant mapping and inventorying, initial and follow-up treatment of the priority invasive species, and monitoring. The cost of restoration is estimated to be \$270/acre; this does not include project management and administration.

Estimated Total Project Costs

The Verde watershed has a variety of site conditions, such as steep canyons, limited road access, open floodplain, and minimal to dense invasive plant infestations, which require different logistics and methods for accessing and removing invasive plants. Because of these varying site conditions a single per acre cost for invasive plant removal in the Verde watershed is difficult to estimate. The table below breaks down costs based on density of invasive plant infestation and remoteness of the site. These estimated costs are an average of costs from current invasive plant removal efforts being conducting in the Verde and Colorado River watersheds. Estimated costs include: accessing sites, equipment, transportation, a project foreman or supervisor, hiring crews, and field time to conduct the removal efforts. Other costs that should be considered for project implementation, but are not included in the following estimates, include compliance and permitting; site-specific plan and design; grant writing; mapping and inventory; project manager; long-term maintenance; and monitoring. Once the invasive plant mapping and inventory effort has been completed the following costs can be further refined to reflect more realistic costs for the Verde River system. For a further discussion on invasive plant removal costs see Appendix H.

Table 3: Estimated Project Costs

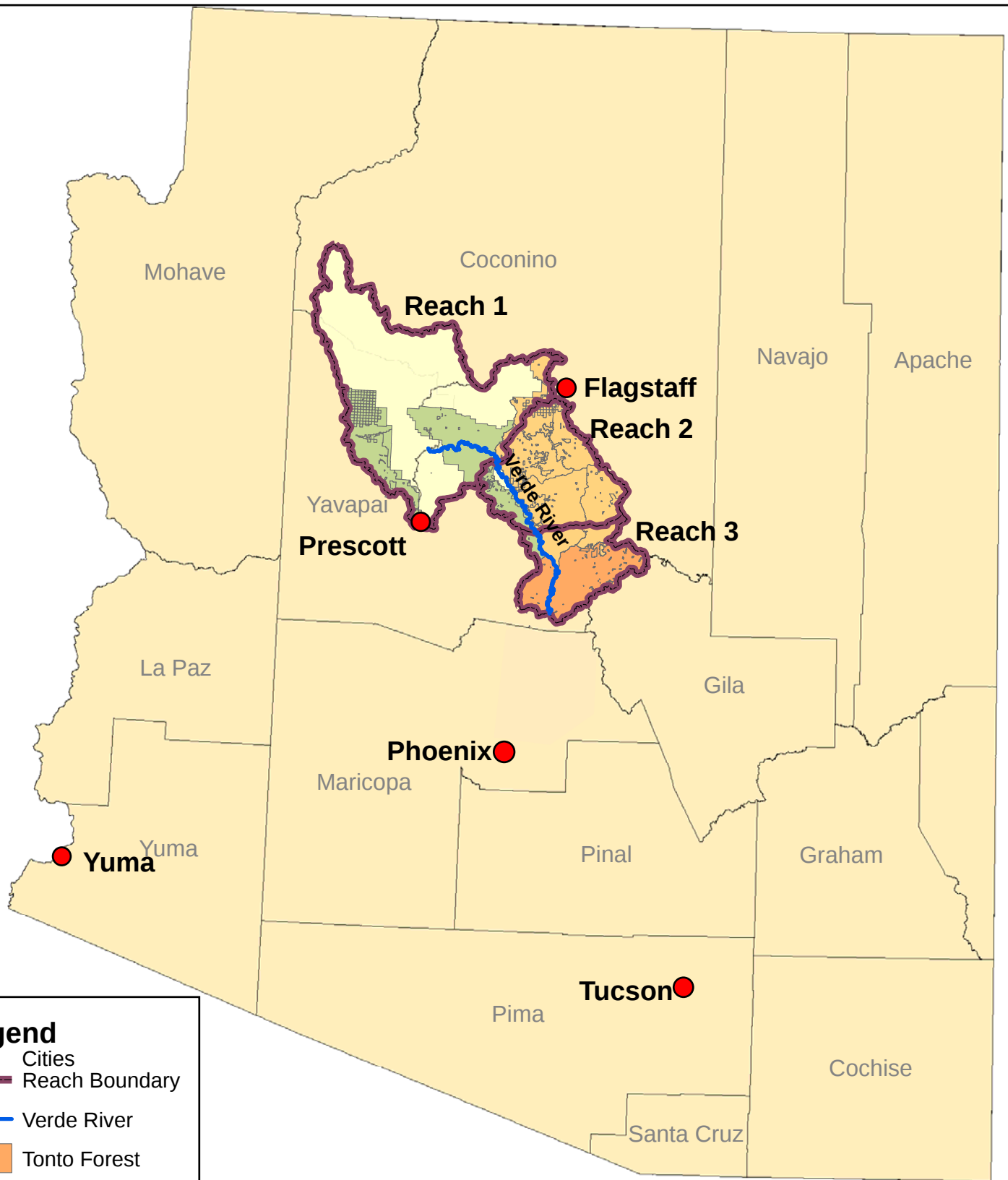
Invasive Plant Removal Type	Cost per acre for accessible sites	Cost per acre with follow-up treatment	Cost per acre with follow-up treatment in remote sites
Hand clear stands dominated by native plants (>80% native)	\$400	\$480	\$575
Hand clear stands with 50% invasive and 50% native plants	\$3,000	\$3,600	\$4,320
Hand clear monotypic stands of invasive plants	\$5,000	\$6,000	\$7,200
Mechanically clear monotypic stands of invasive plants	\$1,000- \$2,500	NA	NA

References

Kreiger, M.H. 1965. Geology of the Prescott and Paulden Quadrangles. Geological Survey Professional Paper 467. 127 pp. plus maps.

Owen-Joyce, S.J. and C.K. Bell. 1983. Appraisal of water resources in the Upper Verde River Area, Yavapai and Coconino Counties. Prepared by the Department of the Interior, Geological Survey for Arizona Department of Water Resources Bulletin 2. 219 pp.

Sullivan, M.E. and M.E. Richardson. 1993. Functions and values of the Verde River riparian ecosystem and an assessment of adverse impacts to these resources. U.S. Fish and Wildlife Service, Arizona Ecological Services Office, Phoenix, Arizona. 364 pp.



Legend

- Cities
- Reach Boundary
- Verde River
- Tonto Forest
- Prescott Forest
- Coconino Forest
- Counties



Designed By:
Fred Phillips
 Consulting, LLC
 401 S. Leroux St.
 Flagstaff, AZ
 86001
 (928) 773-1530



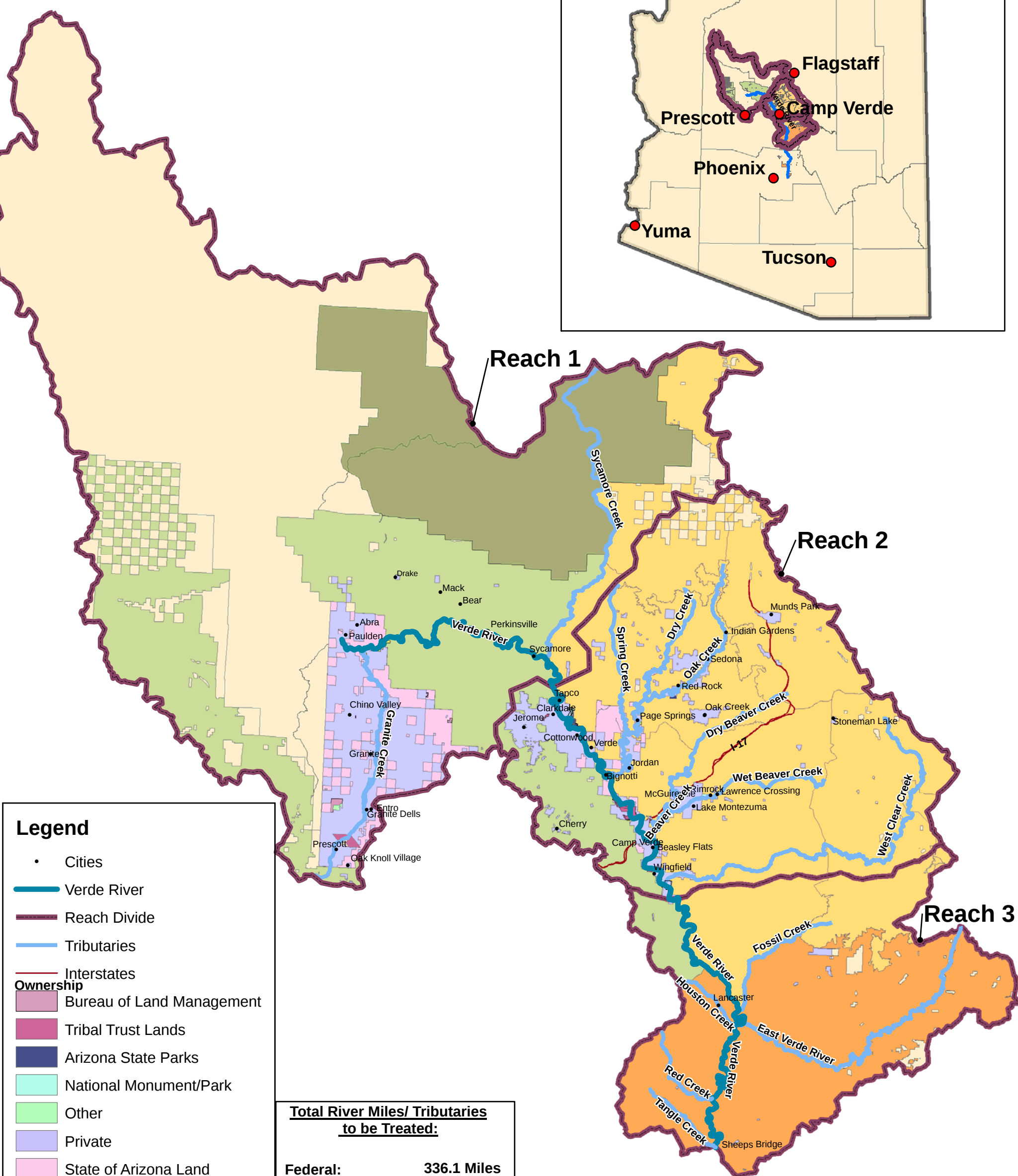
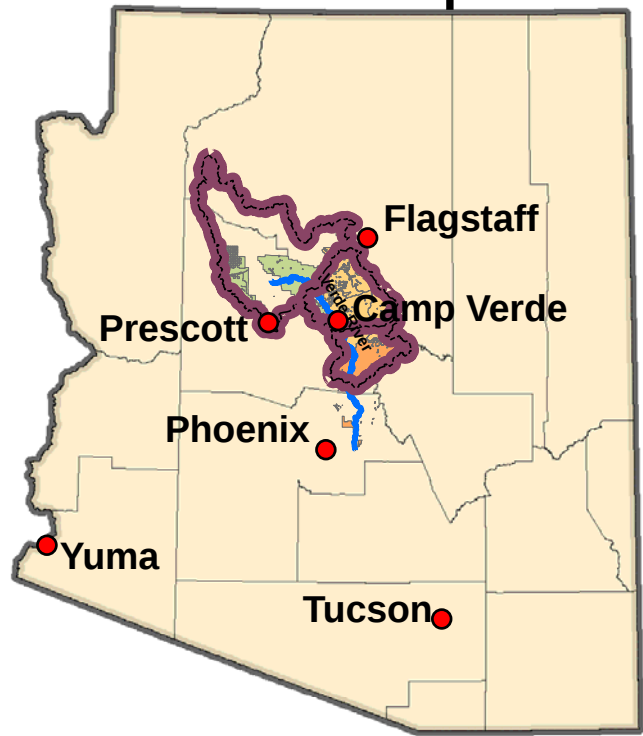
Designed For:
Friends of the
 Verde River
 Greenway
 PO Box 2535
 Cottonwood, AZ
 86326

VERDE RIVER RESTORATION PLAN LOCATION MAP



APRIL 2011
 CONCEPT PLAN
 LOCATION MAP
 FIGURE 1

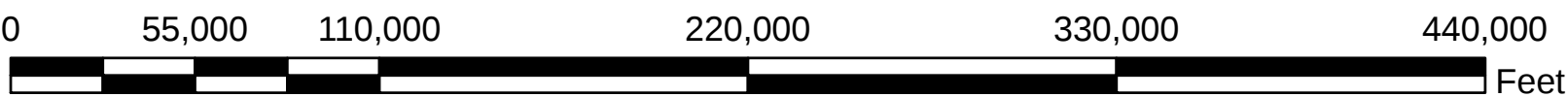
State of Arizona Map



Legend

- Cities
- Verde River
- Reach Divide
- Tributaries
- Interstates
- Ownership**
 - Bureau of Land Management
 - Tribal Trust Lands
 - Arizona State Parks
 - National Monument/Park
 - Other
 - Private
 - State of Arizona Land
 - Kaibab National Forest
 - Coconino National Forest
 - Tonto National Forest
 - Prescott National Forest
 - Arizona Game and Fish

Total River Miles/ Tributaries to be Treated:	
Federal:	336.1 Miles
State:	20.8 Miles
Tribal:	4.2 Miles
Private:	98.1 Miles
Total River Miles:	459.2 Miles



Designed By:
Fred Phillips Consulting, LLC
401 S. Leroux Street
Flagstaff, AZ 86001
(928) 773-1530

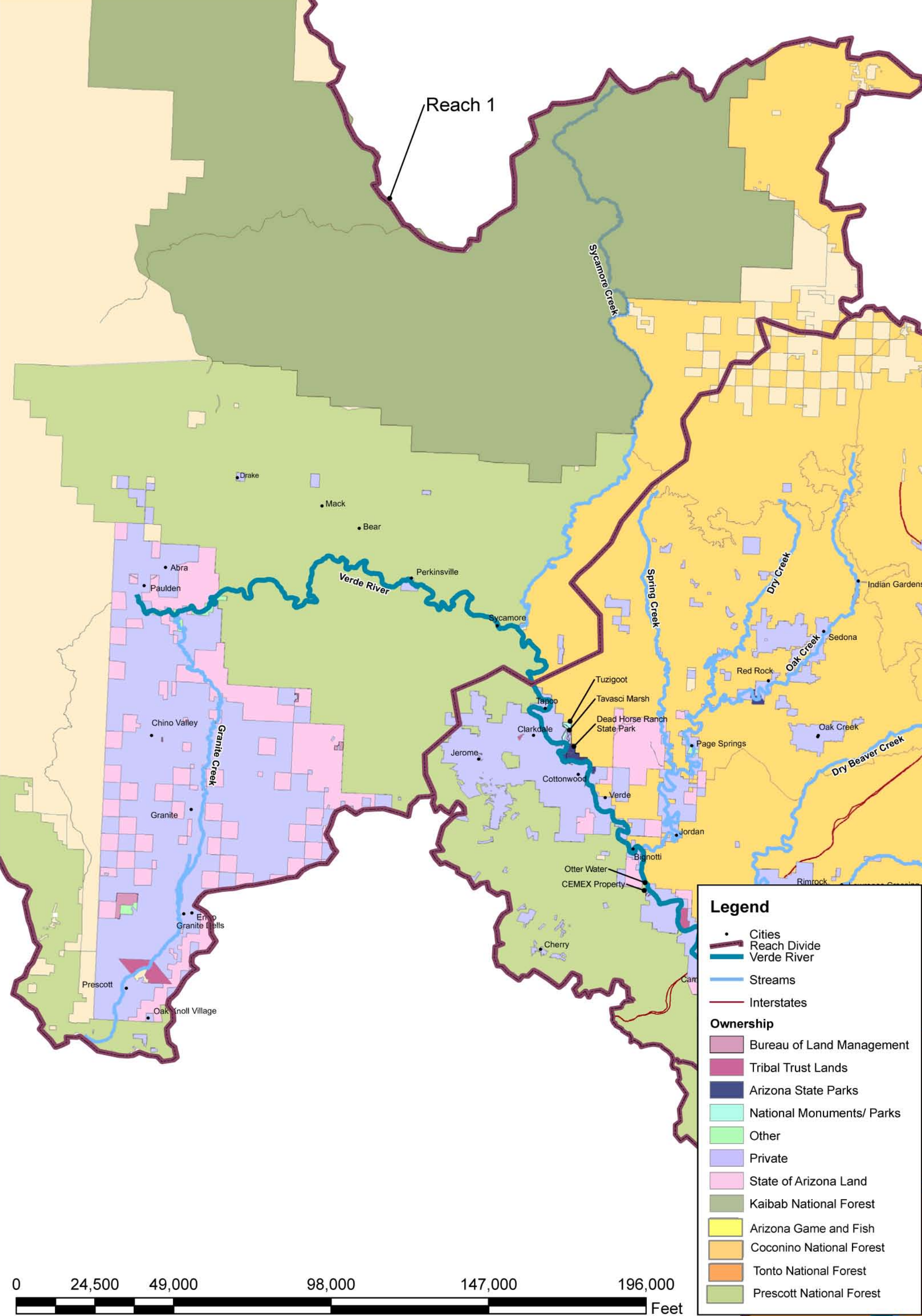


Designed For:
Friends of the
Verde River Greenway
PO Box 2535
Cottonwood, AZ 86326

VERDE RIVER
RESTORATION PLAN
OVERALL MAP



APRIL 2011
CONCEPT PLAN
LOCATION MAP
FIGURE 2



Legend

- Cities
- Reach Divide
- Verde River
- Streams
- Interstates

Ownership

- Bureau of Land Management
- Tribal Trust Lands
- Arizona State Parks
- National Monuments/ Parks
- Other
- Private
- State of Arizona Land
- Kaibab National Forest
- Arizona Game and Fish
- Coconino National Forest
- Tonto National Forest
- Prescott National Forest



Designed By:
 Fred Phillips Consulting, LLC
 401 S. Leroux Street
 Flagstaff, AZ 86001
 (928) 773-1530

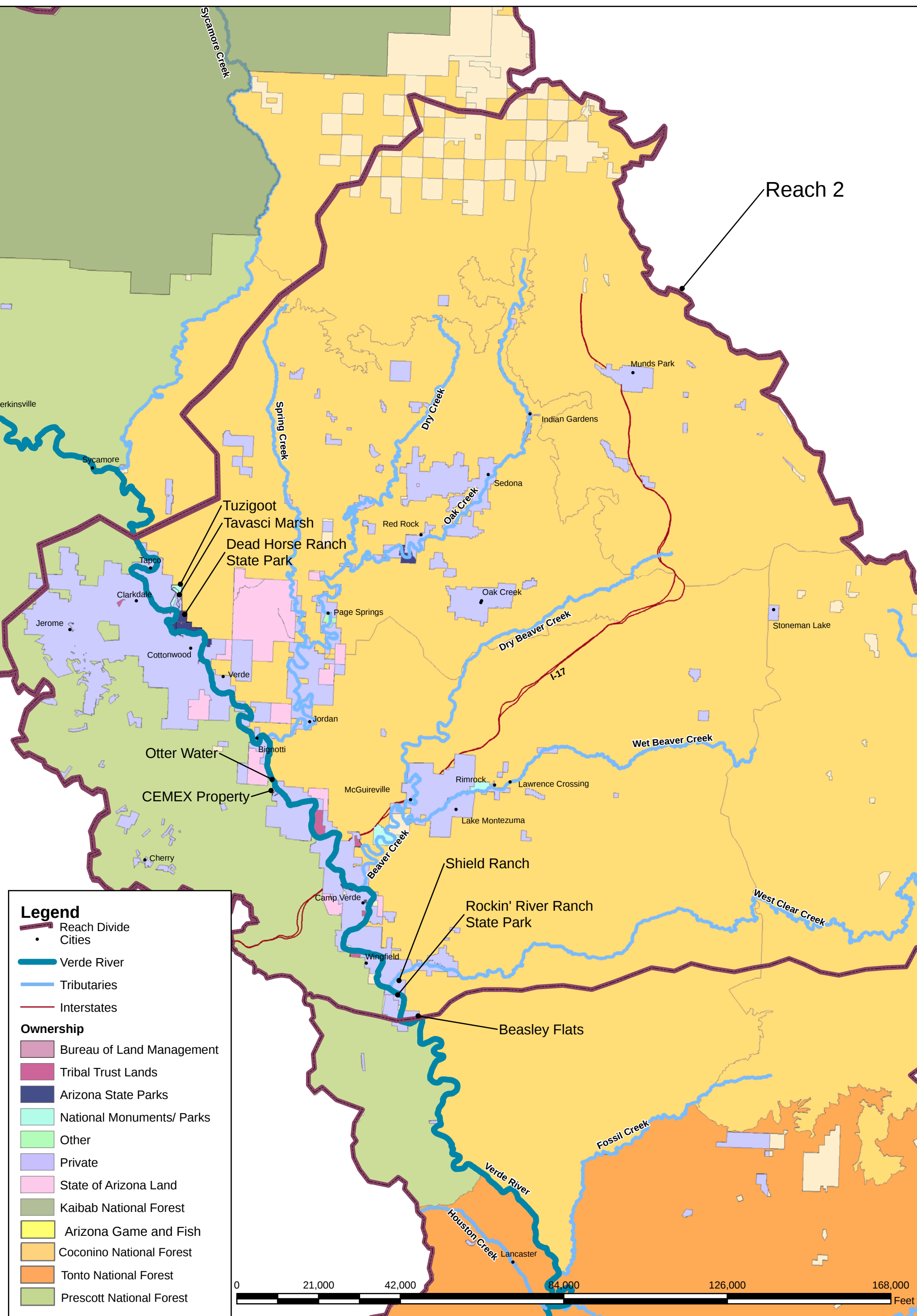


Designed For:
 Friends of the
 Verde River Greenway
 PO Box 2535
 Cottonwood, AZ 86326

VERDE RIVER RESTORATION PLAN REACH 1



APRIL 2011
 CONCEPT PLAN
 FIGURE 3



Legend

- Reach Divide
- Cities
- Verde River
- Tributaries
- Interstates

Ownership

- Bureau of Land Management
- Tribal Trust Lands
- Arizona State Parks
- National Monuments/ Parks
- Other
- Private
- State of Arizona Land
- Kaibab National Forest
- Arizona Game and Fish
- Coconino National Forest
- Tonto National Forest
- Prescott National Forest



Designed By:
Fred Phillips Consulting, LLC
401 S. Leroux Street
Flagstaff, AZ 86001
(928) 773-1530

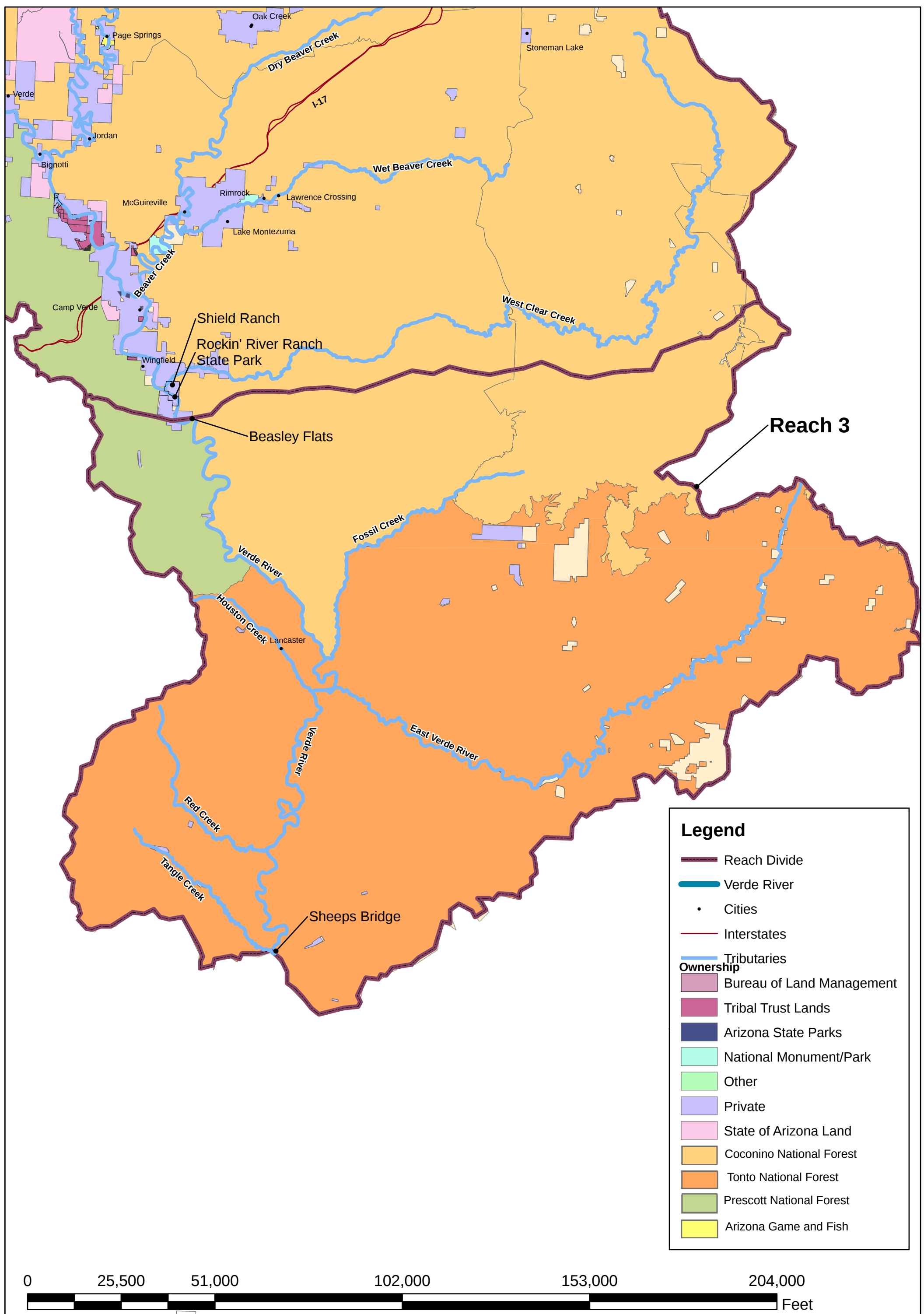


Designed For:
Friends of the
Verde River Greenway
PO Box 2535
Cottonwood, AZ 86326

**VERDE RIVER
RESTORATION PLAN
REACH 2**



APRIL 2011
CONCEPT PLAN
FIGURE 4



Designed By:
Fred Phillips Consulting, LLC
401 S. Leroux Street
Flagstaff, AZ 86001
(928) 773-1530



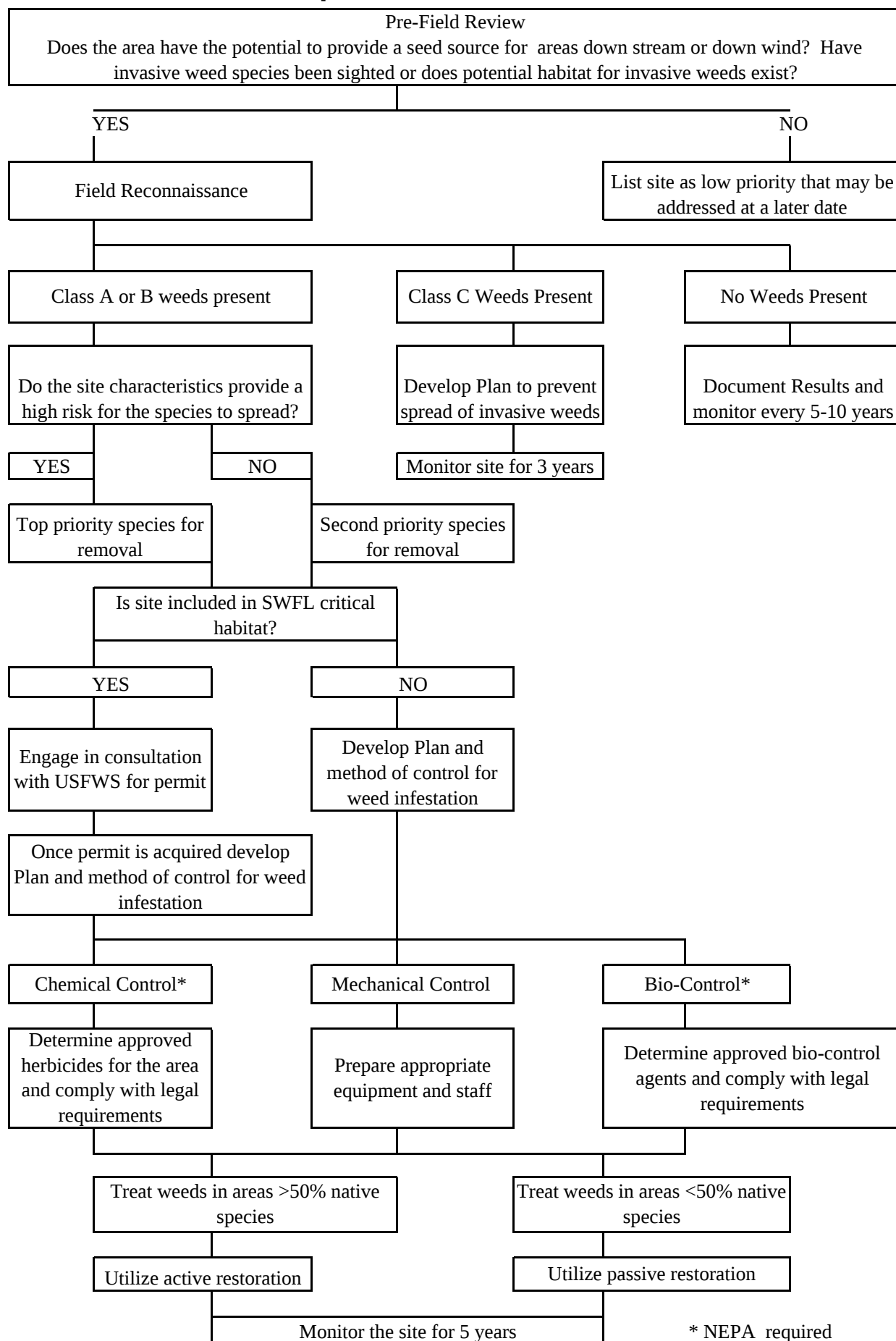
Designed For:
Friends of the
Verde River Greenway
PO Box 2535
Cottonwood, AZ 86326

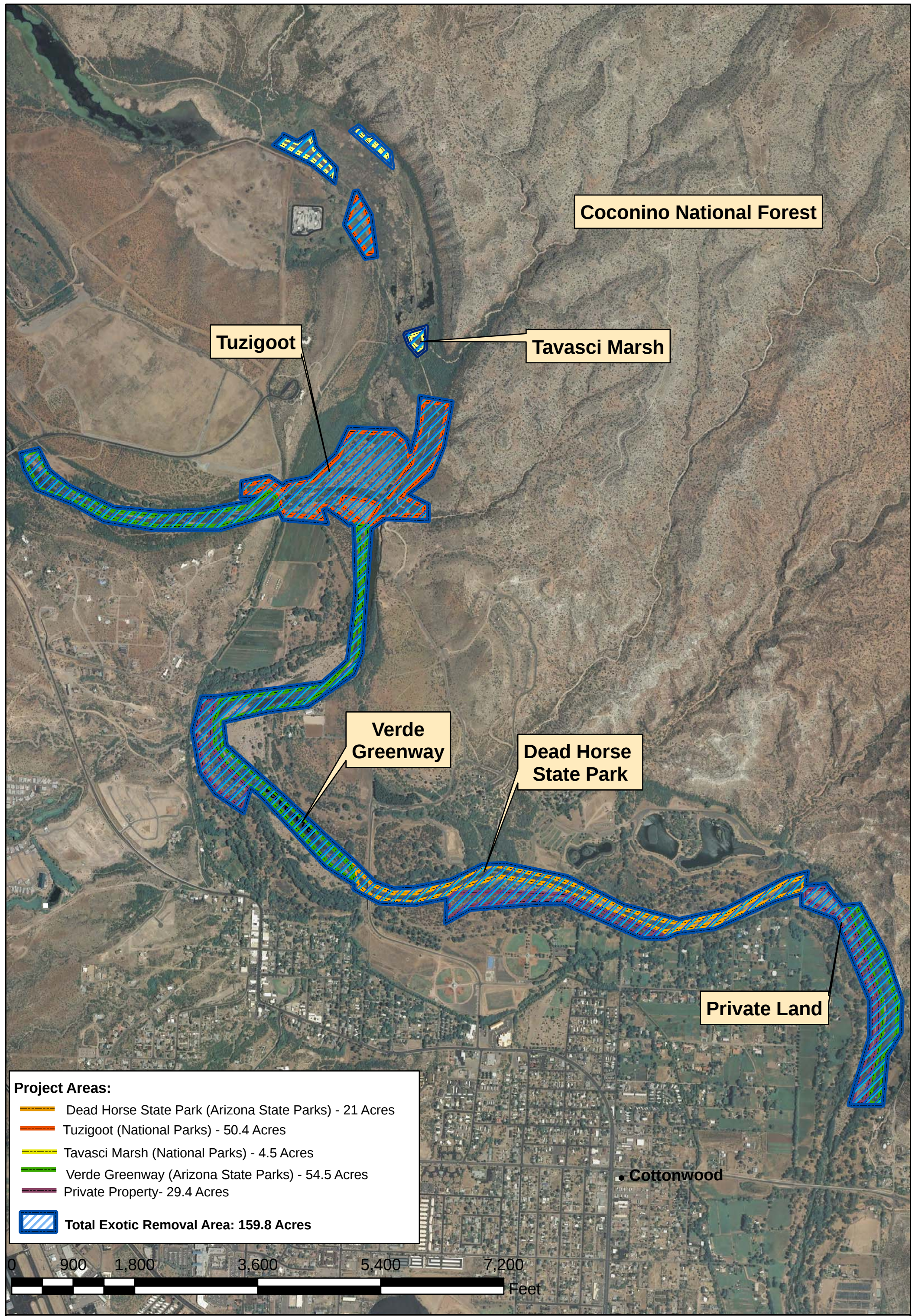
VERDE RIVER RESTORATION PLAN REACH 3



APRIL 2011
CONCEPT PLAN
FIGURE 5

**Figure 6. Flow Chart
Species Prioritization**

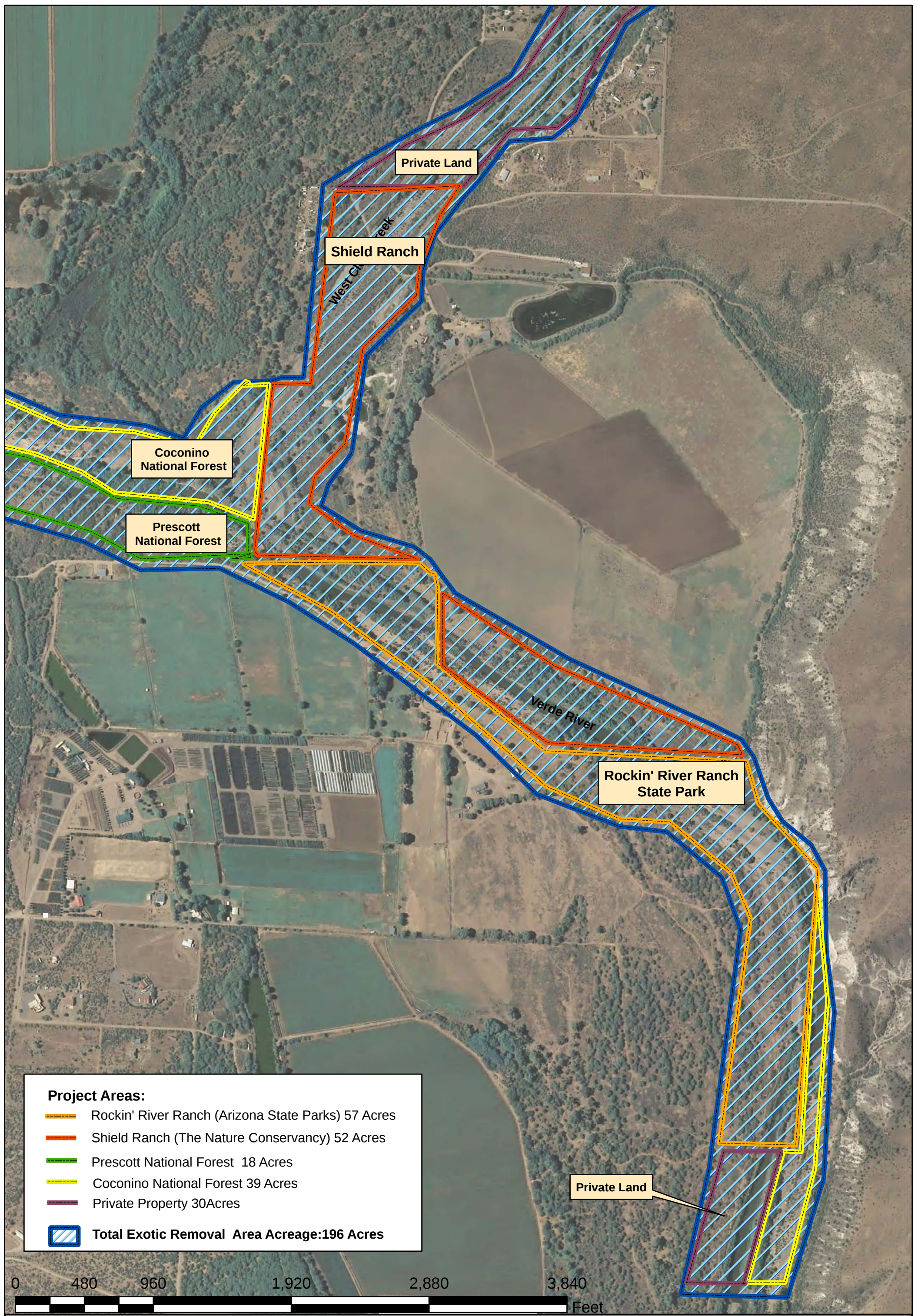




Project Areas:

- Dead Horse State Park (Arizona State Parks) - 21 Acres
- Tuzigoot (National Parks) - 50.4 Acres
- Tavasci Marsh (National Parks) - 4.5 Acres
- Verde Greenway (Arizona State Parks) - 54.5 Acres
- Private Property- 29.4 Acres

Total Exotic Removal Area: 159.8 Acres



Project Areas:

- Rockin' River Ranch (Arizona State Parks) 57 Acres
- Shield Ranch (The Nature Conservancy) 52 Acres
- Prescott National Forest 18 Acres
- Coconino National Forest 39 Acres
- Private Property 30 Acres

Total Exotic Removal Area Acreage: 196 Acres



Designed By:
Fred Phillips Consulting, LLC
401 S. Leroux Street
Flagstaff, AZ 86001
(928) 773-1530

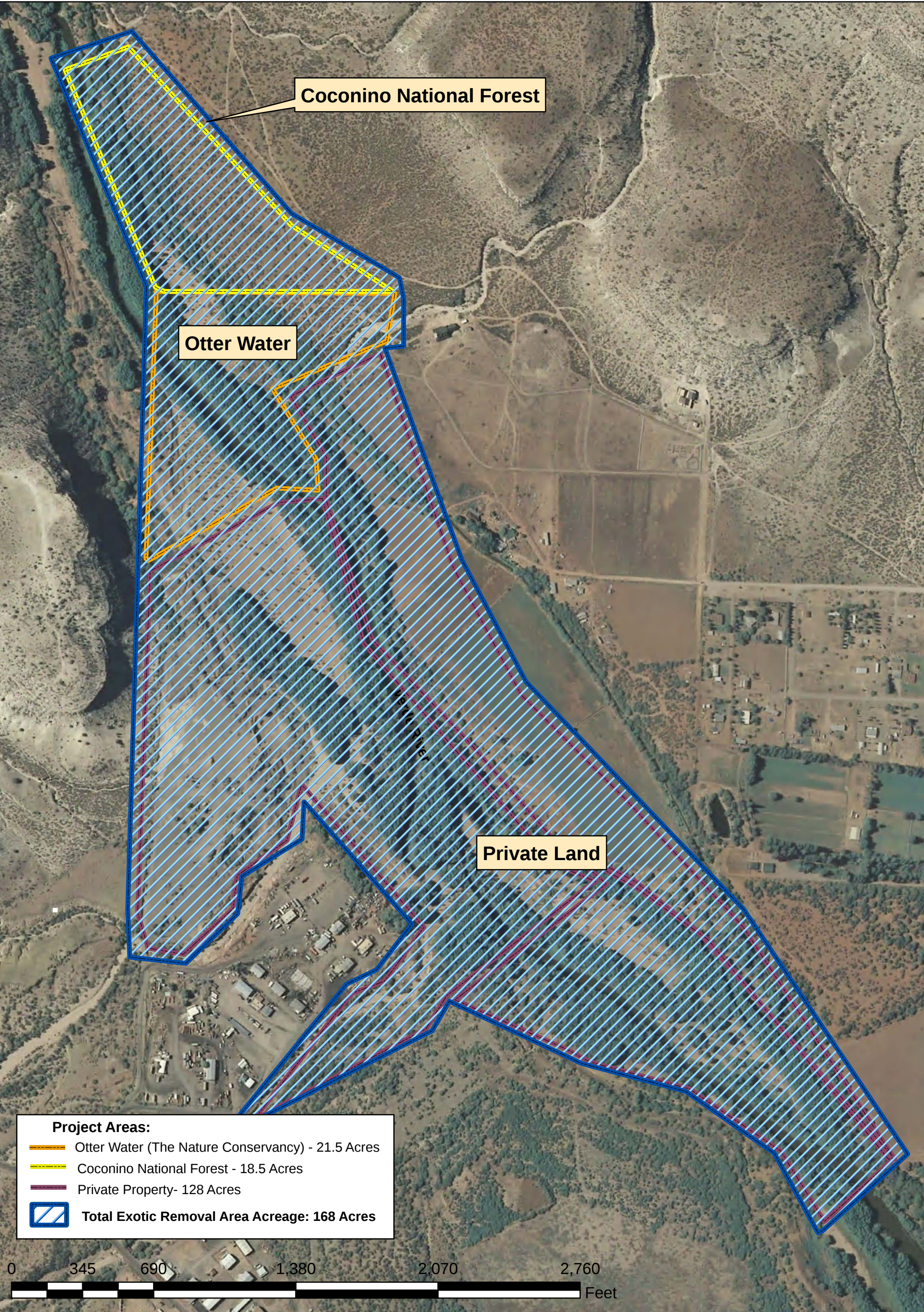


Designed For:
Friends of the
Verde River Greenway
PO Box 2535
Cottonwood, AZ 86326

**PROPOSED
VERDE RIVER
RESTORATION PLAN
DEMONSTRATION
PROJECT 2**



APRIL 2011
CONCEPT PLAN
FIGURE 8



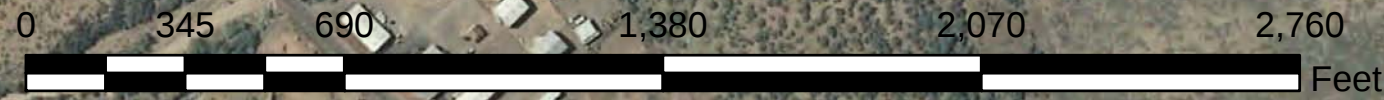
Coconino National Forest

Otter Water

Private Land

Project Areas:

-  Otter Water (The Nature Conservancy) - 21.5 Acres
-  Coconino National Forest - 18.5 Acres
-  Private Property- 128 Acres
-  **Total Exotic Removal Area Acreage: 168 Acres**



Designed By:
Fred Phillips Consulting, LLC
401 S. Leroux Street
Flagstaff, AZ 86001
(928) 773-1530



Designed For:
Friends of the
Verde River Greenway
PO Box 2535
Cottonwood, AZ 86326

**PROPOSED
VERDE RIVER
RESTORATION PLAN
DEMONSTRATION
PROJECT 3**



APRIL 2011
CONCEPT PLAN
FIGURE 9