Verde River Watershed Conservation Plan

The Nature Conservancy
Protecting nature. Preserving life.

September 2009

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Stillman Lake on the Verde River.

Executive Summary

The Verde River watershed covers 4.2 million acres in central Arizona and includes about 500 miles of perennial streams. The Nature Conservancy has conducted a year-long planning exercise to identify the most effective actions for maintaining or restoring this watershed's native aquatic and riparian biodiversity. During a structured planning process, 64 individuals from 21 organizations contributed data, analyses, and ideas about the priority conservation needs and opportunities. We identified nonnative fish, crayfish, and frog species as the most critical sources of stress basin-wide, followed by groundwater pumping and climate change. Other threats were also ranked highly for particular natural communities in some parts of the watershed, including surface water diversions and large impoundments. Key strategies identified include the need for integrated management of groundwater and surface water, developing more efficient surface water management that meets both human needs and those of the natural systems, and watershed-scale planning to integrate native fish conservation with the demand for recreational fisheries. These results will guide the Conservancy's work for many years to come, and may be useful for other organizations that share similar goals.

Verde River Watershed Conservation Plan

The Verde River Watershed Conservation Plan is an effort by The Nature Conservancy to identify the most effective actions for maintaining or restoring the native plants and animals of this watershed. The primary motivation was to guide the Conservancy's actions over the next decade, but the results of our analyses may be valuable to other organizations that share similar goals.

In developing this plan, we chose to look at the whole watershed, including tributaries, with an emphasis on the region upstream of the Verde River Wild and Scenic reach. We included areas outside the surface watershed which contribute groundwater to the system. We focused on riparian and aquatic systems, due to their biological importance in this arid region and to the many threats to those systems, but recognizing that healthy uplands can be critical to viability of those targets. And we involved key partners in the planning process, gaining vital insights from them.

The Planning Process

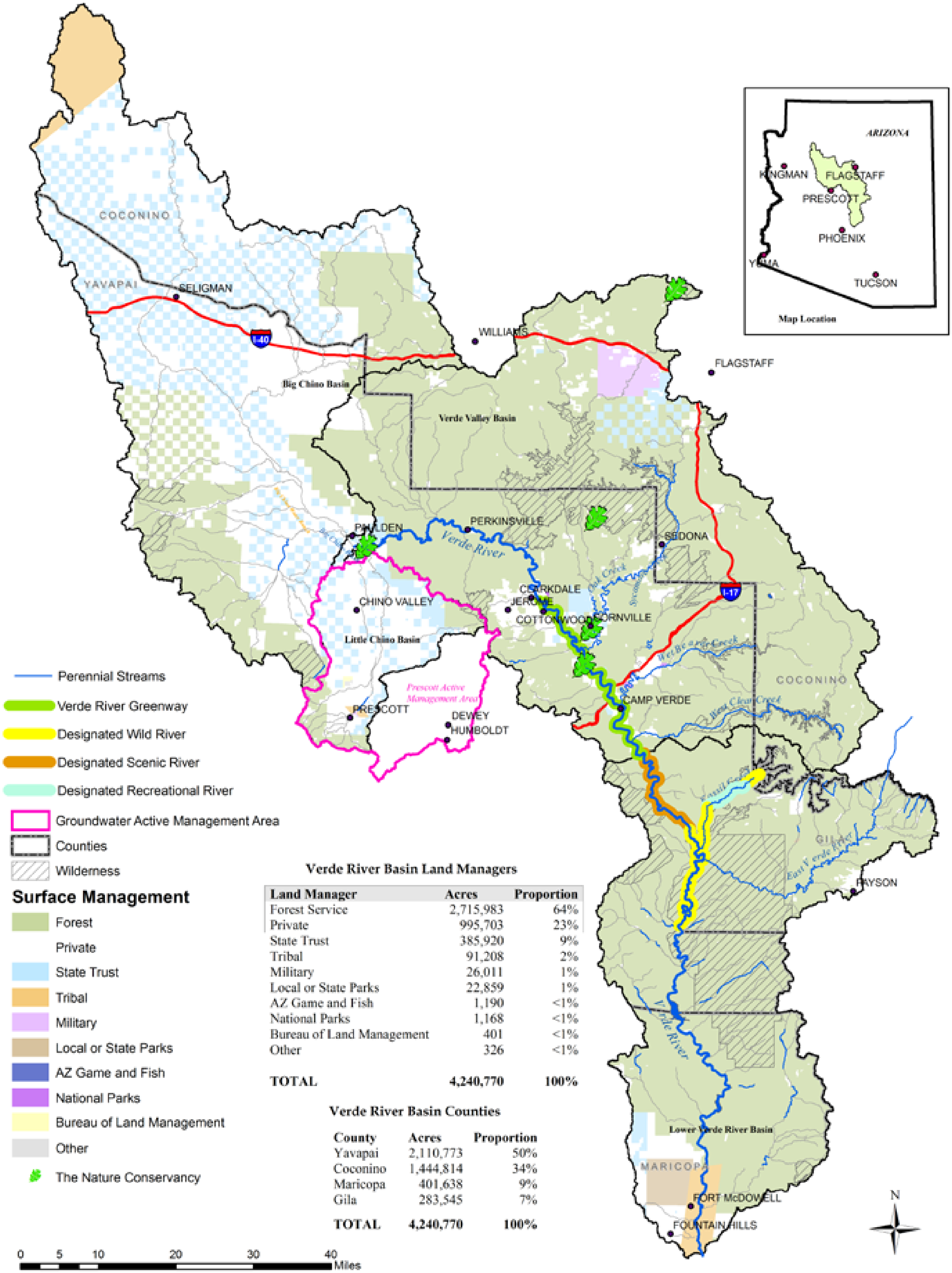
This plan was developed using The Nature Conservancy's Conservation Action Planing process (Figure 1). This is a structured process that has evolved over several decades, through application at sites around the world. Additional details on the process are available at: www.conserveonline.org/workspaces/cap/

Figure 1. The Nature Conservancy's process for conservation action planning.

Some of the information used in this plan came out of two earlier efforts, one with the Arizona State Parks Department, focused on management planning for the Verde River Greenway, and a second for the analysis of ecological flow needs of individual species (Haney et al. 2008).

Much of this plan was developed in two large workshops, both held in Prescott, along with associated meetings. The first workshop was held Oct. 27-28, 2008, and included 30 participants. It focused on identifying the most important species and natural communities for conservation effort, describing key indicators of viability for those conservation targets, and identifying critical threats to their persistence. Several smaller follow-up meetings completed that effort. The second workshop was held April 13-14, 2009, and included 39 participants. It served to identify and prioritize conservation goals and strategies, and to identify the most important measures of conservation status.

Over the course of this process, 64 individuals from 21 organizations (Appendix 1) helped shape and refine the information presented here. While they deserve great credit for the breadth and depth of these analyses, no other group was asked to endorse the outcomes so the responsibility rests solely with The Nature Conservancy.



Verde River Basin Land Managers

Land Manager	Acres	Proportion
Forest Service	2,715,983	64%
Private	995,703	23%
State Trust	385,920	9%
Tribal	91,208	2%
Military	26,011	1%
Local or State Parks	22,859	1%
AZ Game and Fish	1,190	<1%
National Parks	1,168	<1%
Bureau of Land Management	401	<1%
Other	326	<1%
TOTAL	4,240,770	100%

Verde River Basin Counties

County	Acres	Proportion
Yavapai	2,110,773	50%
Coconino	1,444,814	34%
Maricopa	401,638	9%
Gila	283,545	7%
TOTAL	4,240,770	100%

Figure 2. Verde River watershed land and water management.

Conservation Values in the Verde

The Verde River is among the largest streams in Arizona, providing about 40% of the surface water delivered to the Phoenix metropolitan area by the Salt River Project. It is central to the way of life for residents of towns such as Clarkdale, Cottonwood, and Camp Verde, and is part of the ancestral home for Native Americans such as those belonging to the Yavapai-Apache Nation and the Fort McDowell Yavapai Nation. Tributaries of the Verde also support vibrant communities, including Prescott, Sedona, McGuireville, and Cornville.

The Verde and its perennial tributaries also support a great diversity of wildlife. Historically, at least thirteen native fish species lived in the watershed, including seven that are now considered threatened or endangered. The Verde supports one-third of the breeding areas for the desert nesting bald eagle, some of the best remaining populations of southwestern willow flycatcher and yellow-billed cuckoo, and more than 200 other bird species that use the riparian areas. Its mammals include river otter, a species that has been lost from most of Arizona.

The Verde River and its tributaries contain some of the most extensive acreage of Fremont cottonwood-Goodding willow and mixed broadleaf riparian forest remaining in Arizona. Riparian forests are critically important for wildlife, and Fremont cottonwood-Goodding willow forest is globally rare. A 1993/1994 aerial survey by the Arizona Game and Fish Department found that the Verde and major tributaries contained 599 acres of cottonwood-willow, 2,688 acres of mixed broadleaf, 1,044 acres of mesquite, and 423 acres of emergent wetland. This survey was completed after the 1992/1993 winter floods that scoured out substantial portions of the floodplain through the Verde Valley, so the amount of riparian and wetland habitats may be much higher.

Verde River Watershed

The surface watershed of the Verde River comprises about 4.2 million acres in central Arizona (Figure 2). It includes portions of four counties: Yavapai (50% of the watershed), Coconino (34%), Maricopa (9%), and Gila (7%).

The Verde River flows for 189 miles from below Sullivan Dam, near the town of Paulden, to its confluence with the Salt River. Its tributary streams include more than 300 miles of additional perennial surface flow (Table 1).

Perennial flow for the upper 26 miles of the Verde is largely fed by springs draining the Big Chino and Little Chino aquifers, which underlie grasslands to the north, west, and south. In the Verde Valley, the river's major tributaries are largely fed by springs that drain the C and Redwall-Muav aquifers, which collect water above the Mogollon Rim and flow underground to outlets both north and south (Springer and Haney 2008).

Throughout its length, the Verde depends on steady supplies of groundwater to create the surface flow,. Thus, conservation of aquatic and riparian species requires attention to both surface water and groundwater management.

Conservation Goals for the Verde River Watershed

Participants in the second workshop helped identify and refine overall goals for the planning process and its outcomes:

<u>Process Goal</u>
Develop a comprehensive vision for conservation of aquatic and riparian biodiversity in the Verde River watershed, by using a collaborative process involving a diverse group of stakeholders to create a sustainable water management framework that meets the long-term needs of people and natural systems.

Conservation Goals

1. Work with partners to maintain or improve stream flow in the Verde River and perennial tributaries, with quality, quantities, and timing adequate to support native aquatic and riparian communities.

2. Work with partners to maintain or improve key floodplain processes needed to support native riparian communities.

3. Work with partners to maintain or improve the historic complement of native aquatic species to the upper and middle Verde River and priority tributaries.

4. Work with partners to identify priority wetland and spring sites, and maintain or restore the critical hydrologic processes that support them.

5. Develop community commitment and stewardship conditions that will lead to the sustainability of Verde River ecological functions.

Table 1. Perennial stream reaches in the Verde River watershed. Letters after stream names refer to unique names used in the Conservancy's statewide GIS data layer (see www.azconservation.org). Multiple entries for a particular stream represent either disjunct perennial reaches or reaches with different flow status.

NAME	MILES	STATUS	NAME	MILES	STATUS
Alder Creek D	2.3	Perennial	Pumphouse Wash	0.0	Perennial
Beaver Creek A	9.3	Formerly perennial	Red Creek A	2.4	Perennial
Black Canyon Creek A	2.8	Perennial	Red Creek A	1.9	Perennial
Camp Creek B	2.7	Perennial	South Fork Deadman Creek	1.4	Perennial
Cart Cabin Tank Creek	2.0	Perennial	Spring Creek I	3.3	Perennial
Chase Creek B	1.9	Perennial	Sycamore Canyon Creek B	0.9	Perennial
Clover Creek B	3.7	Perennial	Sycamore Creek D	1.5	Perennial
Clover Creek B	2.6	Perennial	Sycamore Creek E	6.0	Perennial
Deadman Creek	7.9	Perennial	Sycamore Creek E	5.9	Perennial
Deadman Creek	1.9	Perennial	Sycamore Creek E	2.8	Perennial
Dry Beaver Creek	2.7	Perennial	Sycamore Creek I	2.0	Perennial
East Verde River	53.3	Perennial	Tangle Creek	1.9	Perennial
Ellison Creek B	1.9	Perennial	Tangle Creek	0.9	Perennial
Fossil Creek	16.1	Perennial	Unnamed Aqueduct	8.4	Aqueduct
Granite Creek	1.4	Perennial	Verde River	138.7	Perennial
Granite Creek	2.3	Effluent dominated	Verde River	50.6	Regulated
Lime Creek	4.7	Perennial	Webber Creek	1.4	Perennial
Mint Wash	2.4	Perennial	West Clear Creek	35.2	Perennial
Moore Creek	3.7	Perennial	West Clear Creek	1.4	Formerly perennial
Oak Creek A	50.4	Perennial	West Fork Oak Creek A	9.6	Perennial
Patton Spring Draw Creek	0.4	Perennial	West Webber Creek	3.0	Perennial
Payson North 1	2.2	Perennial	Wet Beaver Creek	21.2	Perennial
Payson North 2	1.5	Perennial	Wet Bottom Creek	2.5	Perennial
Perley Creek	2.0	Perennial	Williamson Valley Wash	5.1	Perennial
Pine Creek B	4.1	Perennial			
Pine Creek B	0.8	Perennial			

Table 2. Verde River Watershed - Conservation Targets*

Native fish community
Nested targets:

- Desert sucker
- Sonora Sucker
- Razorback Sucker
- Longfin Dace
- Gila Chub
- Headwater Chub
- Roundtail Chub
- Spikedace
- Colorado Pikeminnow
- Speckled Dace
- Loach Minnow
- Gila Topminnow
- Gila Trout

Aquatic community - Native aquatic animals in the Verde River besides fish
Nested targets:

- American beaver
- North American river otter
- Northern leopard frog
- Lowland leopard frog
- Chiricahua leopard frog
- Narrow-headed garter snakes
- Mexican garter snake
- Fossil Springsnail
- Maricopa Tiger Beetle
- California floater (mussel)
- *Anacroneuria wipukupa* (stonefly)
- *Apatania arizona* (caddisfly)

Natural marsh community - Tavasci Marsh, Greenwell Slough, Williamson Valley Cienega, Del Rio Springs
Nested targets:

- Least bittern
- Virginia rail
- Sora

Broadleaf deciduous riparian forest
Nested targets:

- Fremont cottonwood/Goodding willow association
- Arizona sycamore
- Box elder
- American beaver
- Common black hawk
- Western yellow-billed cuckoo
- Southwestern willow flycatcher
- Bald eagle
- Zonetailed hawk
- Northern cardinal
- Red bat

Mesquite bosque community
Nested targets:

- Lucy's warbler
- Bell's vireo

Springs – Springs other than stream-channel
Nested targets:

- Page springsnail
- Balmorhea Saddle-case Caddisfly
- Brown Springsnail
- Montezuma Well Springsnail
- Page Spring Micro Caddisfly
- Page Springsnail
- Parker's Cylloepus Riffle Beetle
- Verde Rim Springsnail

*A detailed list of species names and conservation status is provided in Appendix 2.

Figure 3. Conservation Target Distribution by Planning Reach

Target	Upper Verde River	Verde River - Verde Valley Reach	Verde River - Wild & Scenic Reach	Verde River - Horseshoe through Bartlett Reservoirs	Verde River - Bartlett Dam to Salt River	Verde River Tributaries
Native fish community	X	X	X	X	X	X
Aquatic community	X	X	X	X	X	X
Marsh community		X				X
Broadleaf deciduous riparian forest	X	X	X	X	X	X
Spring community	X	X	X			X
Mesquite bosque community		X	X	X	X	X

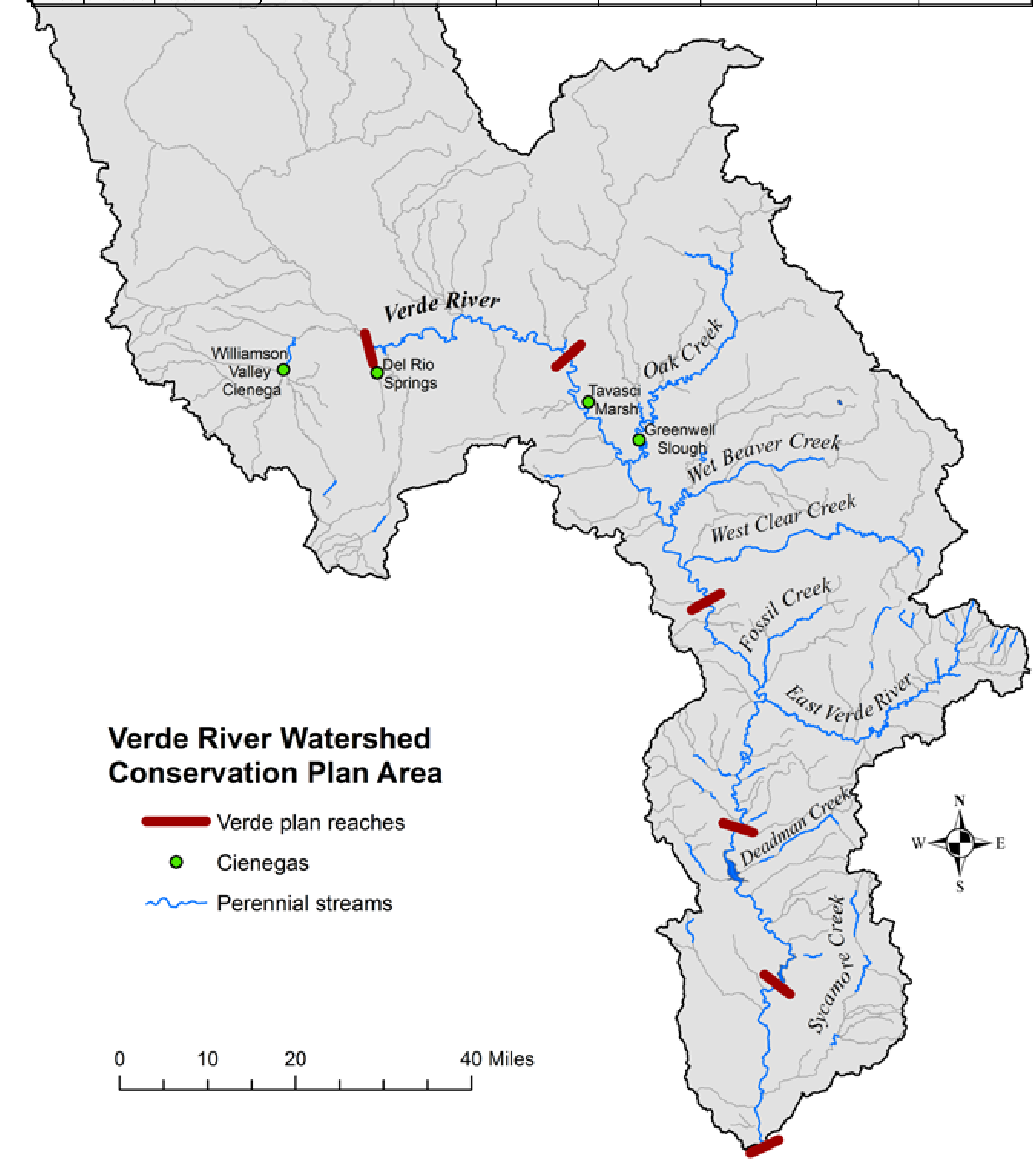
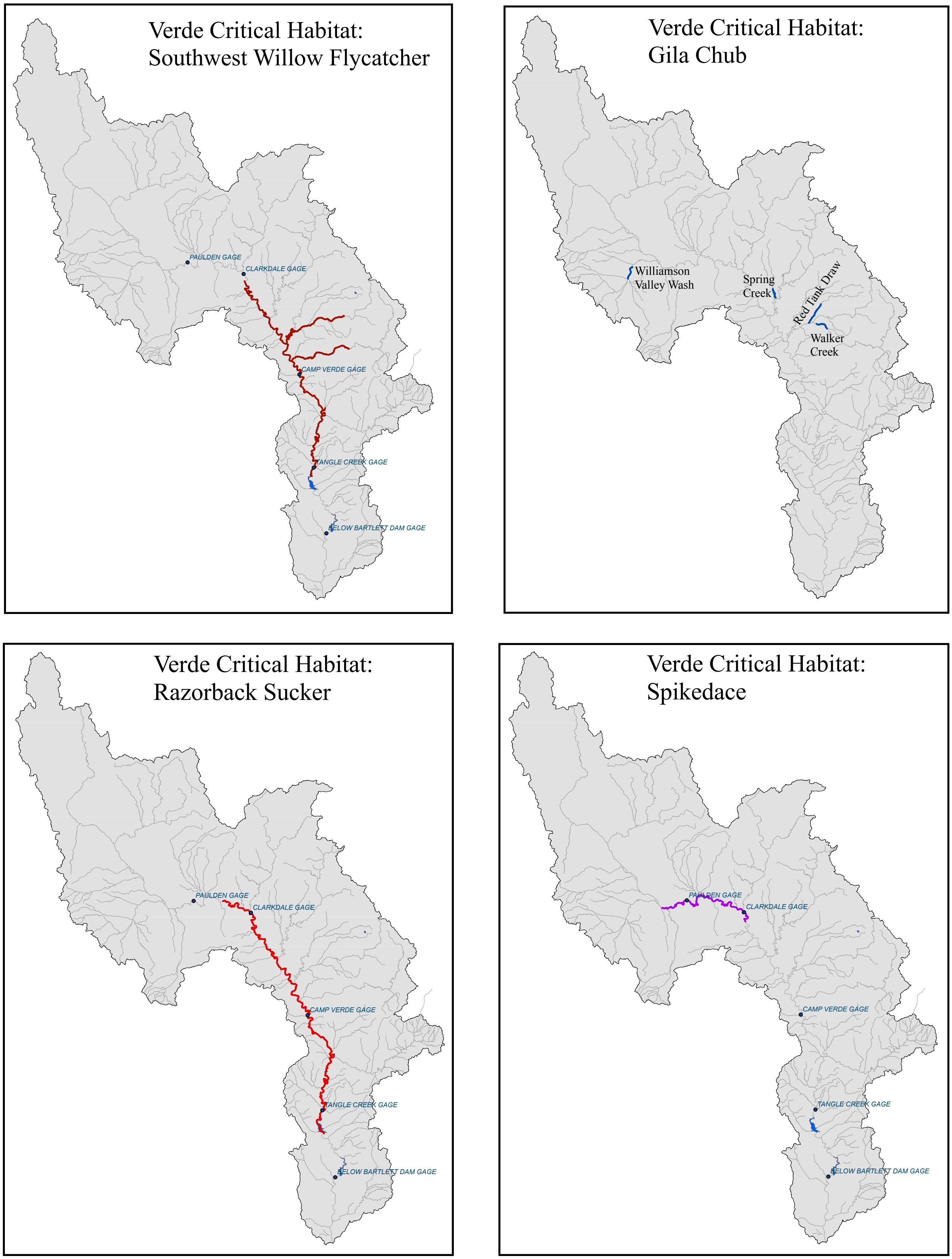


Figure 4. Critical Habitat in the Verde River Watershed.
There are many species of conservation concern in the watershed, but only four have designated Critical Habitat under the Endangered Species Act.



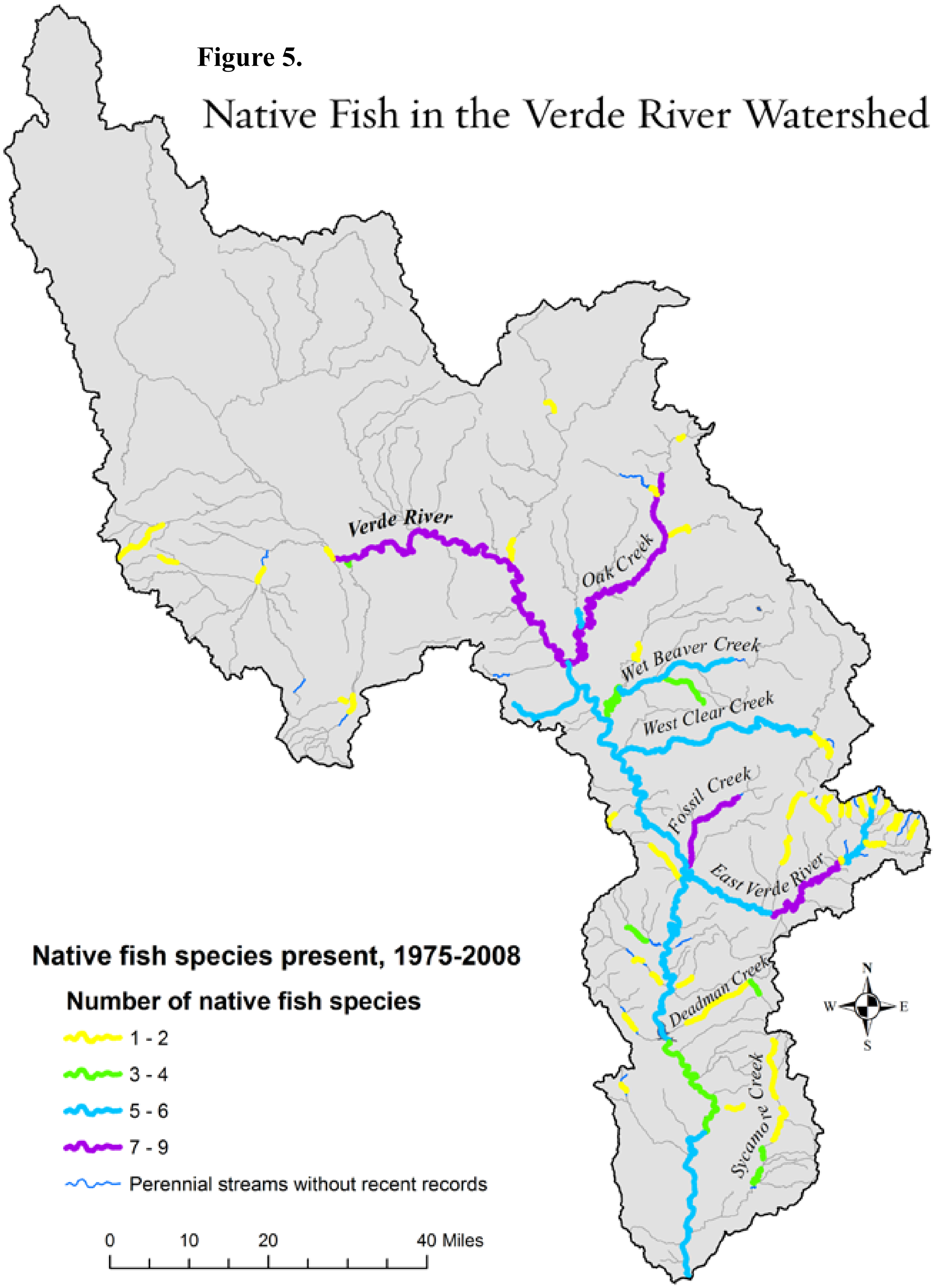


Figure 5.

Native Fish in the Verde River Watershed

Conservation Targets

The work on this plan was targeted on the conservation needs of six natural communities: native fish, the aquatic community (besides fish), marshes ("cienegas"), springs, broadleaf deciduous riparian forests, and mesquite bosques. While the discussions were aimed at maintaining or restoring the viability of those whole communities, we also identified a few individual species within each (Table 2, Appendix 2). Those "nested targets" were species of special conservation concern, such as federally protected species, or ones which serve as good indicators of community health.

The experts gathered at our workshops found that they could not reasonably assess the viability and threats for those conservation targets when considering the watershed as a whole, so we broke it into six smaller analysis units (Figure 3). Those comprised five separate reaches of the mainstem Verde River, along with the major tributaries grouped as the sixth unit. We then conducted the analyses separately for each unit.

Viability Assessment

We assessed the viability of our conservation targets with the help of experts at the first workshop and in several follow-up meetings. For each target, we identified key ecological attributes, measurable indicators of status, and current condition of those indicators using the best available data (Figure 6, Appendices 3-5). In some cases, there was no data available for an indicator; those are still included here to indicate the need for new data collection.

The viability assessment showed that conditions vary widely across the watershed. Among the conservation targets, indicators for condition of native fish appear to be in the worst shape, ranked Fair or Poor in all reaches due to the apparent loss of some species or their failure to recruit young fish into the population. Base flow levels were also ranked Fair or Poor for some reaches, due to diversions which reduce or eliminate stream flow in some areas.

The indicators developed in this process provide useful pointers to degraded ecological conditions, and thus suggest one avenue for prioritizing conservation action. They may also be useful as guidance for future monitoring efforts, with the current ratings as a baseline for comparison.

Threat assessment

We assessed threats to the persistence of our conservation targets with the help of experts at the first workshop and in several follow-up meetings, in a manner similar to the viability assessment.

Individual threat ranks represent a combination of stress (an altered key ecological attribute) and source of stress (the proximate cause of the stress). Ranks for each stress were derived by ranking its severity and scope. Ranks for each source of stress (threat) were derived by ranking its contribution to a stress and the ease with which it can be reversed. The resulting ranks allow comparison of the various sources of stress in terms of their likelihood to eliminate or degrade the viability of conservation targets (Table 3).

Experts were asked to assign these ranks based on the level of impact that can reasonably be expected within the next ten years, under current circumstances and trends. In addressing groundwater pumping in the upper Verde and Verde Valley reaches, we considered a longer time period. This is justified due to the delayed response time of groundwater systems - pumping occurring during this decade can be expected to affect streamflow many decades into the future.

Following the threat assessment tables are several figures that display aspects of particular sources of stress. These include urban growth by subwatershed (Figure 7). Growth is significant because of the increased water demand that accompanies increasing population size. Rapid growth in the Prescott area and around the town of Chino Valley has led to proposals for removing

Figure 6. Verde River in flood at Sullivan Dam. A natural flood regime was identified as important for the viability of native fish, the rest of the aquatic community, and broadleaf deciduous riparian forest.

groundwater from the Big Chino Valley. That pumping is expected to reduce flows in the upper Verde River (Figures 10-12), and thus was identified as a high or very high threat to several of our conservation targets (Table 3).

Drought and climate change were other sources of stress identified by experts as a high or very high threat to our targets, since it reduces water available to the streams. Climate change was included with drought because the current predictions of climate change include higher temperatures which increase evaporation from soil and snow pack, along with more evapotranspiration from plants, also reducing water in the streams. Weather records from the past century in the watershed show increases in maximum, minimum, and mean temperatures (only maximum temperatures are displayed here, Figures 8-9). For the same time period, there was no significant change in precipitation levels, so the net effect was less water available. A detailed study of predicted effects of climate change on the Verde and Salt River basins found a high probability of reduced flow in both rivers (Ellis et al. 2008).

Groundwater pumping in the Verde Valley has affected the depth to water, with levels in several wells having dropped by more than 100 feet in the past 60 years (Figure 13). Near the river, water levels appear to have remained relatively constant in areas investigated. Farther from the river, water levels have varied with time, especially at distances greater than ½ mile from the river (Masek-Lopez and Springer 2001). Because the top of the water table has dropped from higher than the river to far lower than the river, it may affect stream flow in the river, and will certainly make groundwater supplies more expensive to use.

A more immediate effect is the diversion of surface water for transport in irrigation ditches. This was demonstrated on the Verde River through the Verde Valley by a series of stream flow measurements taken over several days in June 2007 by the U.S. Geological Survey (Figure 14) (Bills 2008). Without diversions, the river would have an increasing base flow through the valley, with increases after each of the perennial tributary streams and additions from groundwater in gaining reaches. Instead, the river shows a significant loss in flow after each diversion point, reduced to nearly-stagnant ponds during low flow conditions below the larger diversion dams. A portion of diverted water returns to the river downstream, either through return ditches or as shallow groundwater, but the habitat for fish and other aquatic organisms is degraded in many places. Similar conditions have been observed on Oak Creek, Beaver Creek, and West Clear Creek, with dry reaches resulting from diversions on some tributaries. There are 42 diversion ditches in the Verde Valley, with diversions off the Verde River main stem and those three tributaries, diverting at their heads an estimated total of 283 ft^3/sec (Table 4; data from Alam 1997).

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Table 3. Threat Assessment - Verde River Watershed

Threats Across Stream Reaches		Target	Native fish community					
		Reach	Upper Verde River	Verde River - Verde Valley Reach	Verde River - Wild & Scenic Reach	Verde River - Horseshoe through Bartlett Reservoirs	Verde River - Bartlett Dam to Salt River	Verde River Tributaries
1	Nonnative animal species (sport fish)		Very High	Very High	Very High	Very High	Very High	Very High
2	Impoundments		Low	Low	-	Very High	Low	High
3	Drought and climate change		High	Medium	Medium	Medium	Medium	Medium
4	Groundwater pumping		High	High	Low	Low	Low	Medium
5	Surface water diversions		Medium	Medium	-	Low	Low	Low
Threat Status for Target and Reach			High	High	High	Very High	High	High

Threats Across Stream Reaches		Target	Aquatic community					
		Reach	Upper Verde River	Verde River - Verde Valley Reach	Verde River - Wild & Scenic Reach	Verde River - Horseshoe through Bartlett Reservoirs	Verde River - Bartlett Dam to Salt River	Verde River Tributaries
1	Nonnative animal species (sport fish, crayfish, bullfrogs)		Very High	Very High	Very High	Very High	Very High	High
2	Drought and climate change		High	High	Medium	Medium	Medium	Medium
3	Groundwater pumping		High	High	Low	Low	Low	Medium
4	Surface water diversions		Medium	High	-	Low	Low	Medium
5	Urban/suburban development		-	Medium	-	-	-	Low
6	Impoundments		-	-	-	Medium	-	-
7	Grazing		Low	Low	-	-	-	Low
8	Wastewater treatment plant, septic systems		Low	Low	-	-	Low	Low
9	Off-road vehicle use		Low	Low	-	-	-	-
Threat Status for Target and Reach			High	High	High	High	High	Medium

Threats Across Stream Reaches		Target	Broadleaf deciduous riparian forest					
		Reach	Upper Verde River	Verde River - Verde Valley Reach	Verde River - Wild & Scenic Reach	Verde River - Horseshoe through Bartlett Reservoirs	Verde River - Bartlett Dam to Salt River	Verde River Tributaries
1	Drought and climate change		Very High	Medium	Low	Low	Low	Medium
2	Groundwater pumping		Very High	Medium	Low	-	Low	Low
3	Grazing		High	Low	Low	Low	Low	Low
4	Surface water diversions		Medium	Low	-	Low	Low	Medium
5	Recreation		Medium	Low	Low	Low	Low	Low
6	Off-road vehicle use		-	Low	Low	Low	Low	Low
7	Urban/suburban development		-	Low	-	-	Low	-
8	Sand and gravel extraction		-	Low	-	-	Low	-
Threat Status for Target and Reach			Very High	Medium	Low	Low	Low	Medium

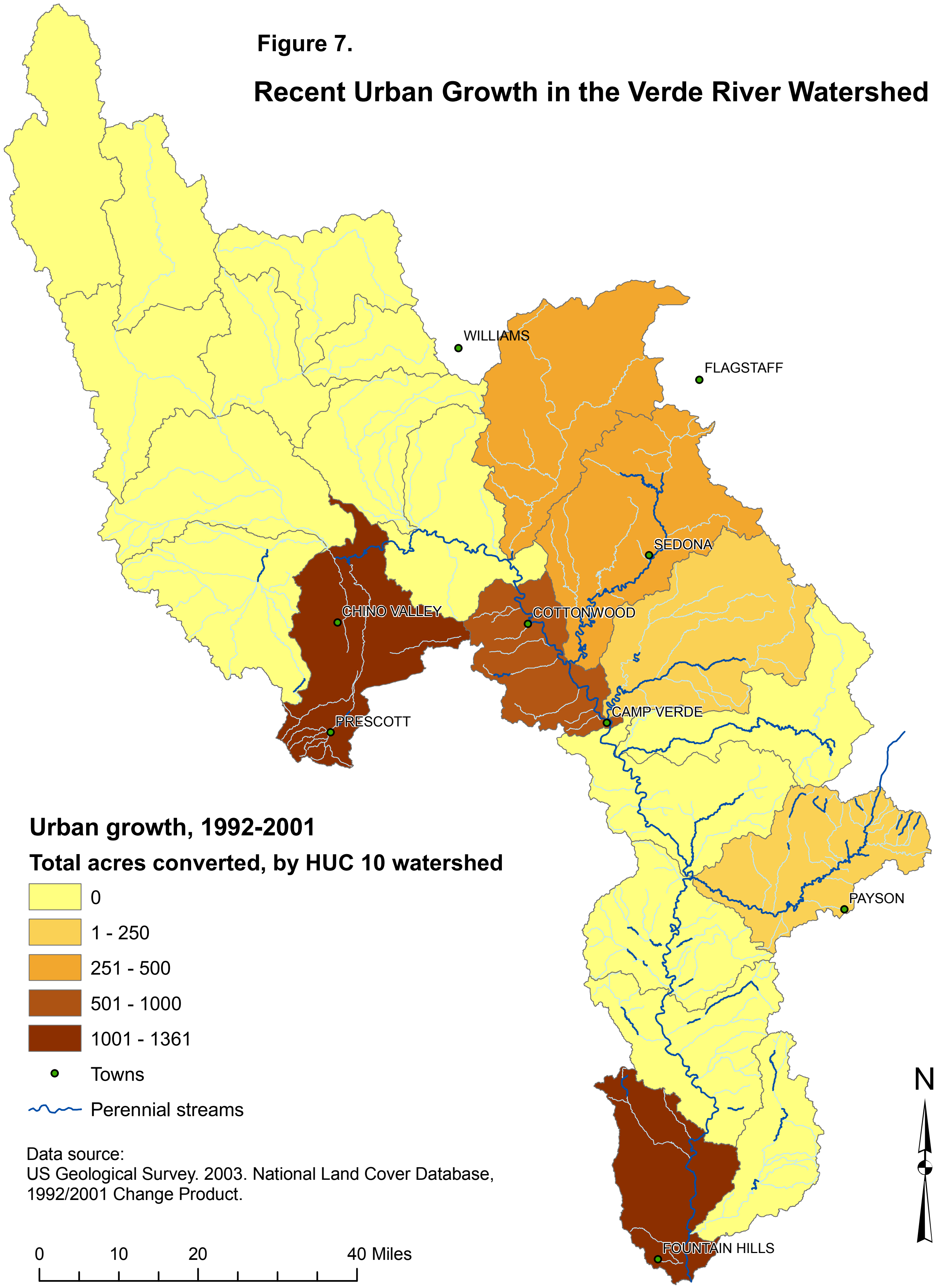
Threats Across Stream Reaches		Target	Mesquite bosque community					
		Reach	Upper Verde River	Verde River - Verde Valley Reach	Verde River - Wild & Scenic Reach	Verde River - Horseshoe through Bartlett Reservoirs	Verde River - Bartlett Dam to Salt River	Verde River Tributaries
1	Urban/suburban development		-	High	-	-	Medium	Medium
2	Recreation		-	Medium	Low	Medium	Medium	-
3	Nonnative plant species (grasses)		-	Medium	Low	Low	Medium	-
4	Grazing		-	Medium	-	-	Medium	-
5	Wood cutting		-	Medium	Low	-	-	-
6	Sand and gravel extraction		-	-	-	-	Low	-
Threat Status for Target and Reach			-	Medium	Low	Low	Medium	Low

Threats Across Stream Reaches		Target	Spring community					
		Reach	Upper Verde River	Verde River - Verde Valley Reach	Verde River - Wild & Scenic Reach	Verde River - Horseshoe through Bartlett Reservoirs	Verde River - Bartlett Dam to Salt River	Verde River Tributaries
1	Recreation		Low	Low	Medium	-	-	Low
2	Grazing		Low	Low	Low	-	-	Medium
3	Groundwater pumping		High	Medium	Low	-	-	Low
4	Drought and climate change		High	Low	Low	-	-	Low
5	Surface water diversions		-	-	High	-	-	Medium
Threat Status for Target and Reach			High	Low	Medium	-	-	Medium

Threats Across Stream Reaches		Target	Marsh community					
		Reach	Upper Verde River	Verde River - Verde Valley Reach	Verde River - Wild & Scenic Reach	Verde River - Horseshoe through Bartlett Reservoirs	Verde River - Bartlett Dam to Salt River	Verde River Tributaries
1	Nonnative plant species (Tree of heaven, tamarisk, Russian olive)		-	Medium	-	-	-	Low
2	Surface water diversions		-	Medium	-	-	-	-
3	Groundwater pumping		-	High	-	-	-	High
4	Urban/suburban development		-	Medium	-	-	-	Medium
5	Nonnative animal species (sport fish, crayfish, bullfrogs)		-	Medium	-	-	-	-
Threat Status for Target and Reach			-	Medium	-	-	-	Medium

Figure 7.

Recent Urban Growth in the Verde River Watershed



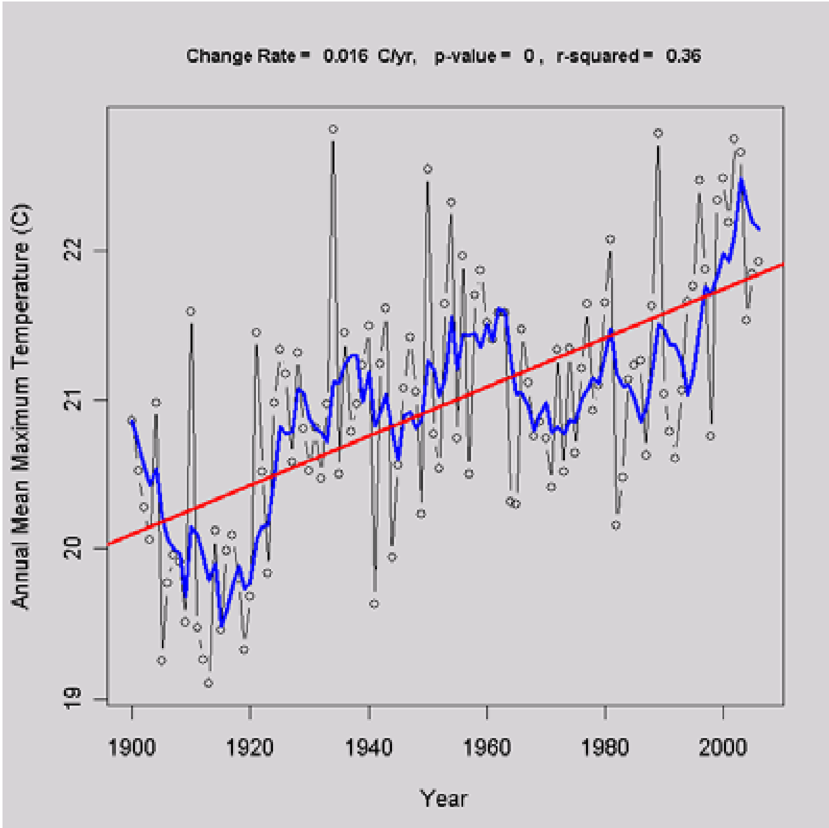


Figure 8. Effects of climate change, as shown by the maximum temperature trend, Verde watershed, 1900-2006. Data points represent the annual mean maximum temperature for the whole watershed. The blue line represents a 5-year rolling average. The red line represents a linear regression trend for the rolling average.

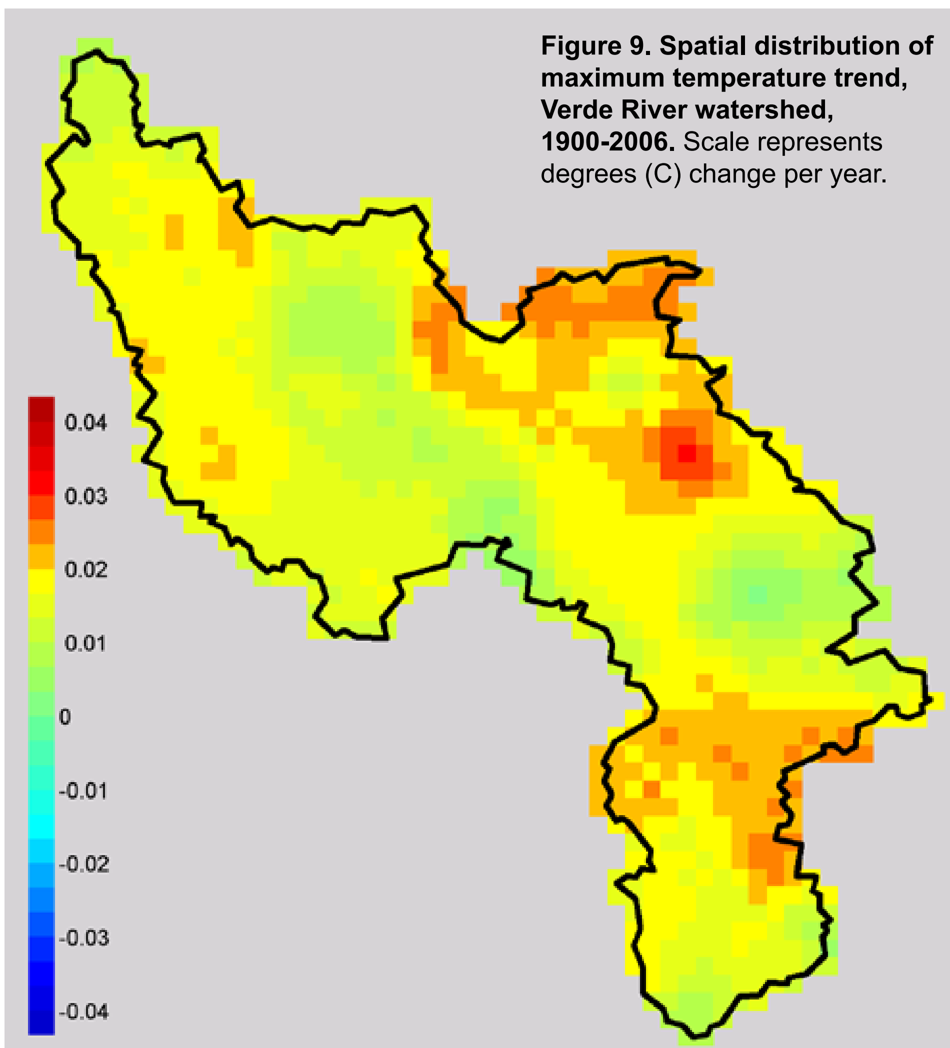


Figure 9. Spatial distribution of maximum temperature trend, Verde River watershed, 1900-2006. Scale represents degrees (C) change per year.

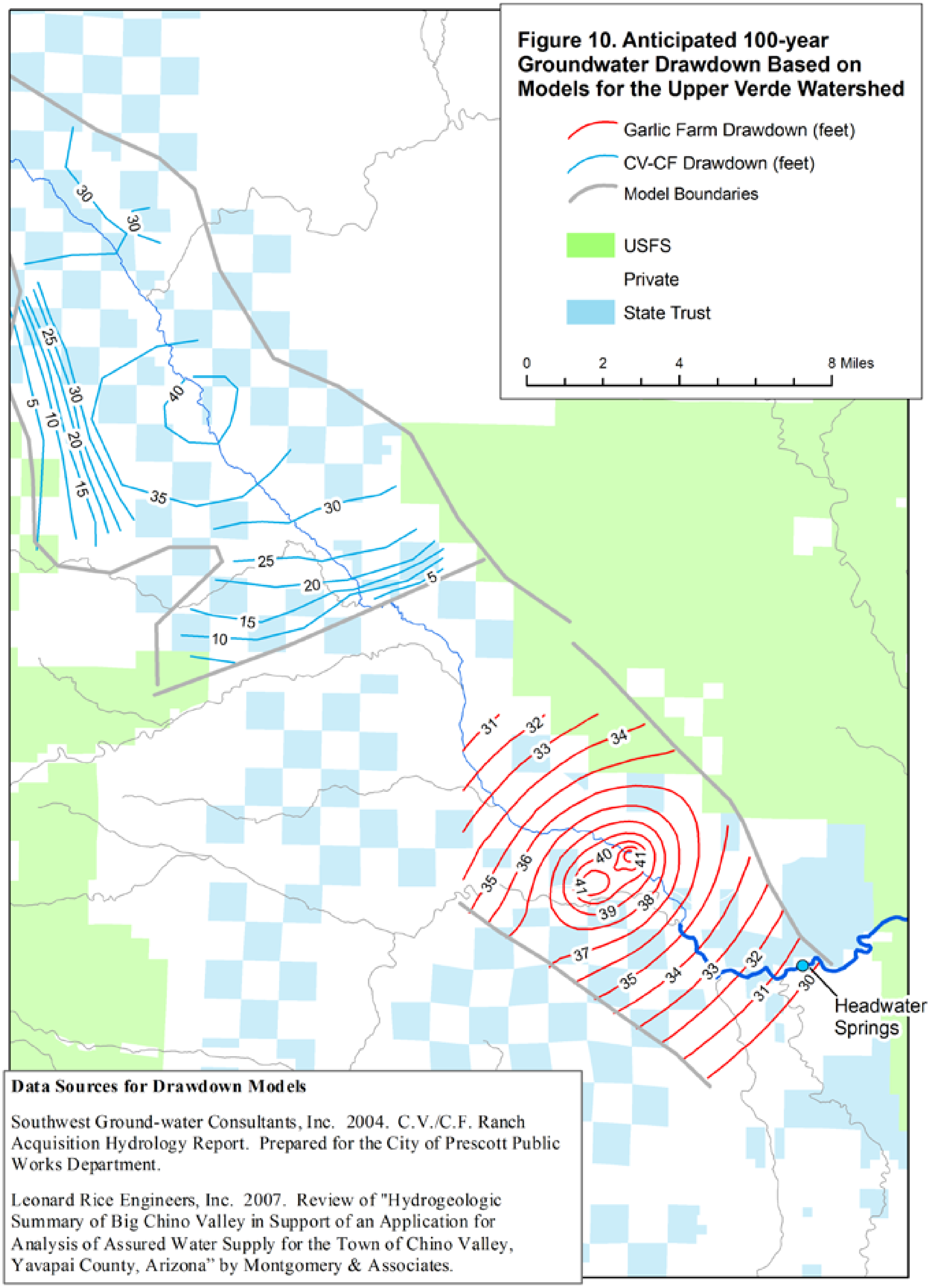


Figure 10. Anticipated 100-year Groundwater Drawdown Based on Models for the Upper Verde Watershed

Data Sources for Drawdown Models

Southwest Ground-water Consultants, Inc. 2004. C.V./C.F. Ranch Acquisition Hydrology Report. Prepared for the City of Prescott Public Works Department.

Leonard Rice Engineers, Inc. 2007. Review of "Hydrogeologic Summary of Big Chino Valley in Support of an Application for Analysis of Assured Water Supply for the Town of Chino Valley, Yavapai County, Arizona" by Montgomery & Associates.

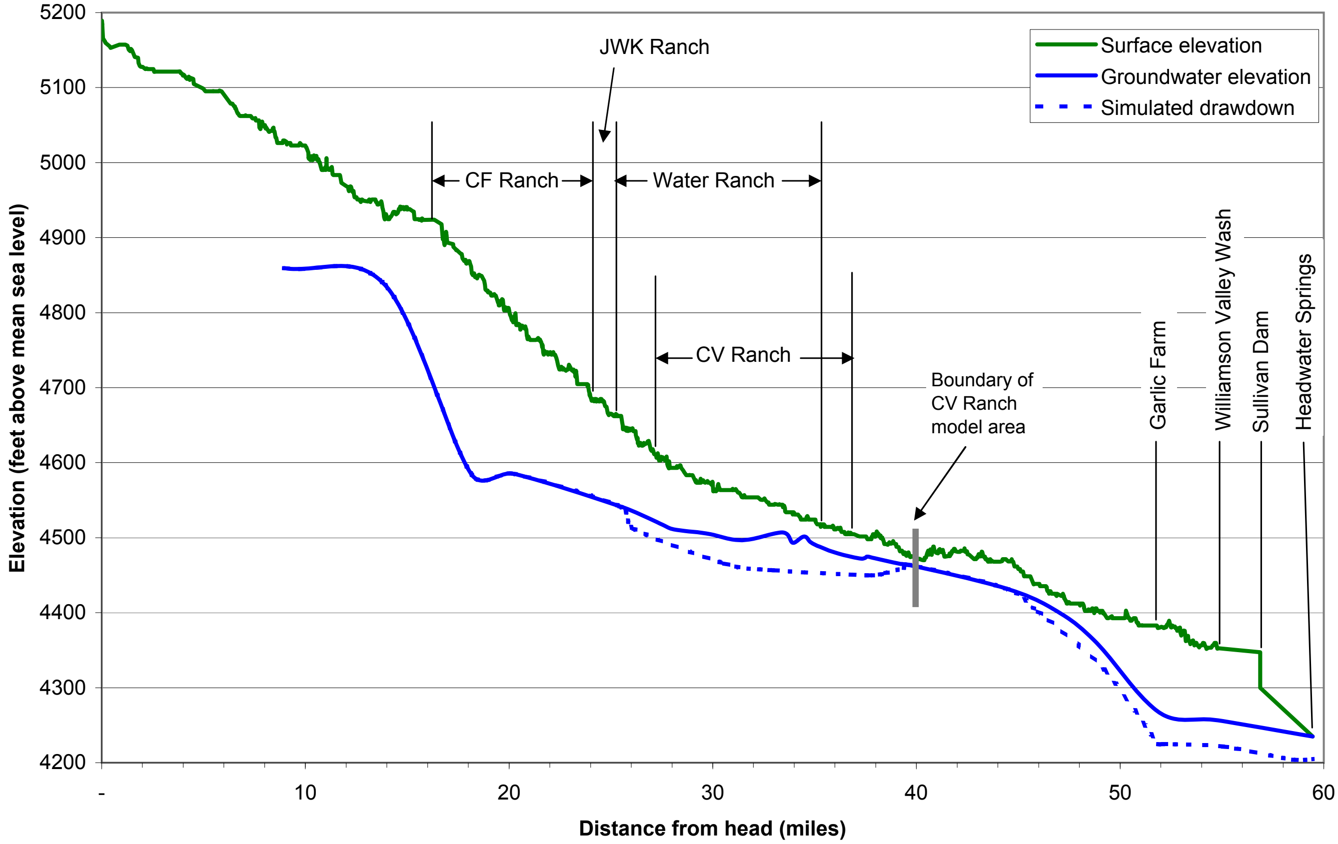


Figure 11. Cross-section view of groundwater drawdown models along Big Chino Wash from previous page.

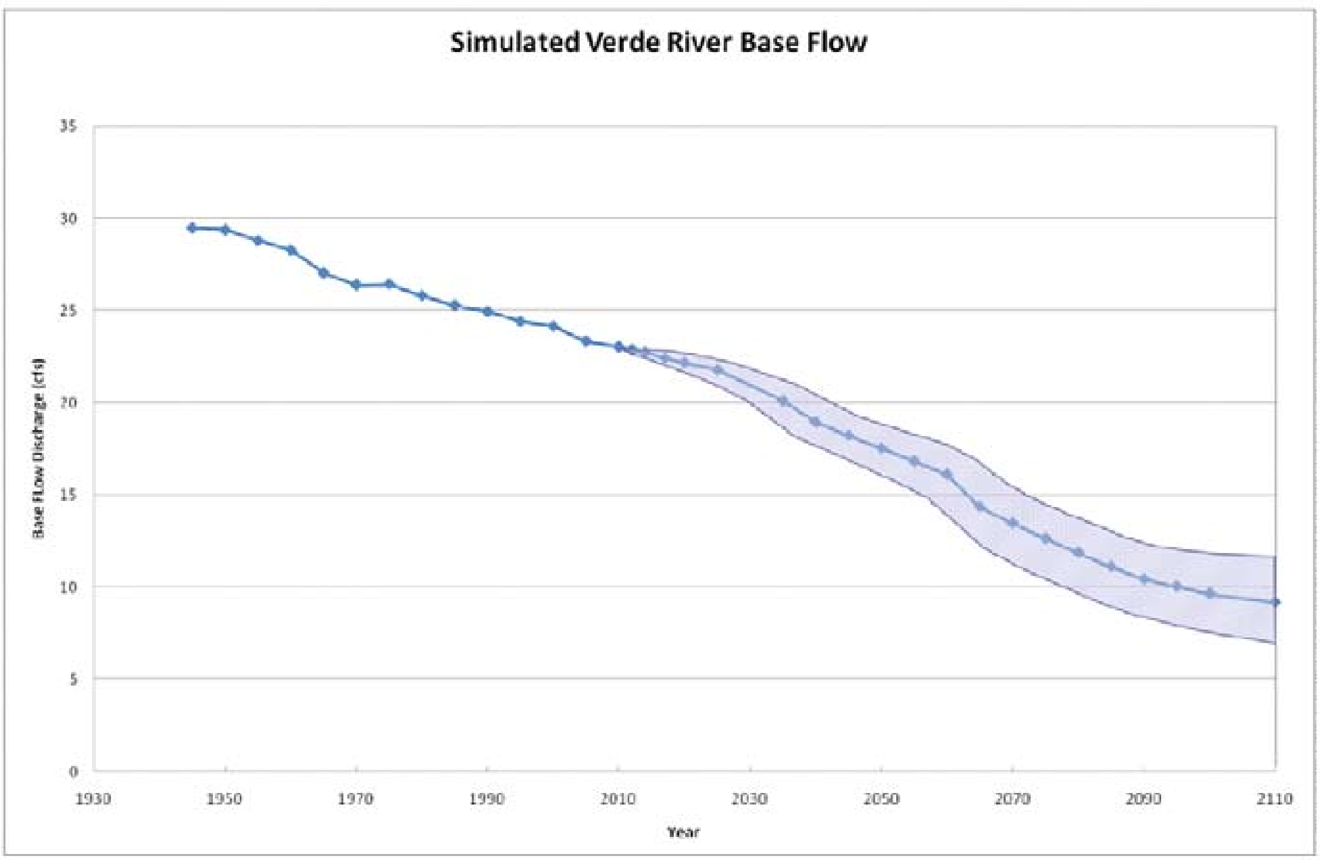


Figure 12. Simulated 100-year effects of groundwater pumping at Big Chino Water Ranch on Verde River base flow. Reprinted from: Ford, J. 2009. Current Big Chino Model Status and Preliminary Results. January 29 memo.

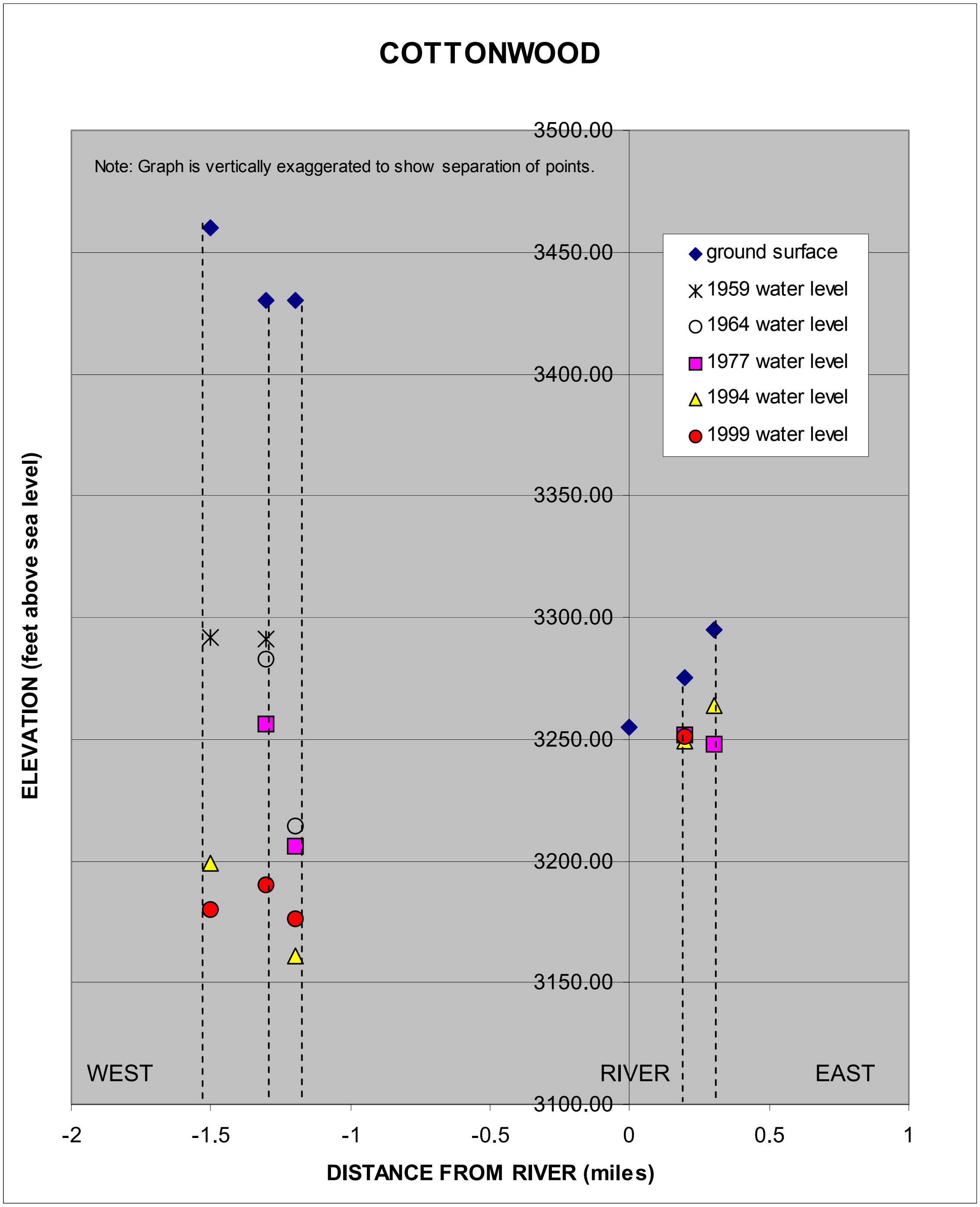


Figure 13. Measured impacts of groundwater pumping, 1959-1999, on groundwater elevation. The horizontal axis represents a cross-section through the Verde Valley in the vicinity of the Town of Cottonwood. Each dashed line represents a single well, with the points showing groundwater levels at different times.Water levels in some wells have dropped by more than 100 feet. Reprinted from: Masek Lopez, S. and A. Springer. 2001.

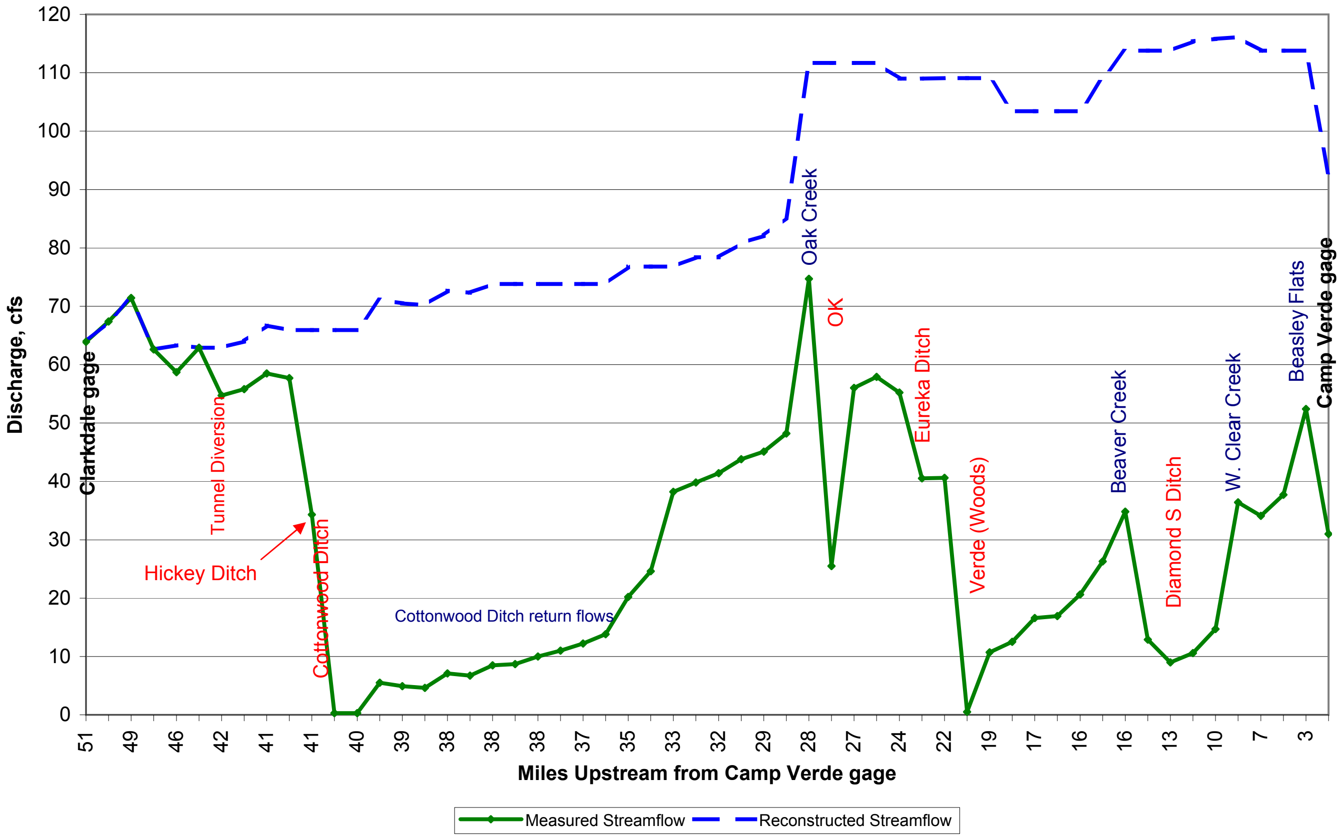


Figure 14. Measured effects of Verde River surface water diversions in the Verde Valley. The green dots and line show streamflow measurements made by the U.S. Geological Survey, June 2007. The dashed blue line shows expected streamflow rate if there were no diversions, as reconstructed by the USGS. Labels show approximate points of diversion for the major ditches (in red type), along with inflow points for major tributary streams (in blue type). Because there had been no rainfall for some weeks prior, these measurements represent base flow - that portion of river flow contributed by the groundwater system. Some diversions remove essentially all the water from the stream during base flow conditions. Reaches of increasing flow that are not at tributary streams represent return flows from the ditch systems. (Discharge data and non-diverted flow reconstruction data from Bills 2008.)

Water Source	Sum discharge (cfs) at Head	Sum Ditch Length (miles)	Number of Ditches
Verde River	209	48	11
Oak Creek	60	30	20
Beaver Creek	10	10	9
West Clear Creek	5	3	2
TOTAL	283	91	42

Table 4. Diversion ditches in the Verde Valley, by source. Revised from Alam 1997.

Strategies for Conserving Verde River Aquatic and Riparian Systems

Participants in the second workshop identified and ranked a suite of possible conservation strategies to address four major threats to the viability of the aquatic and riparian systems: groundwater pumping, surface water diversion, invasive animals, and invasive plants. The strategies were then ranked according to their importance for effectively protecting the conservation targets. The top-ranked strategies are indicated by arrows (➡). All the strategies identified are presented here, in approximately declining order of importance for each category, to inform future discussions. These will also inform The Nature Conservancy as it develops its priority activities.

<u>Groundwater pumping, exacerbated by climate change</u>

➡ Public policy changes to correct the disjunction of surface- and groundwater management.
➡ Water district for Verde Watershed would create framework for integrated water resource management.
➡ Design and implement purchase of development rights program.
➡ Integrate land and water management for sustainability.

- Support watershed management practices that provide improved runoff and recharge conditions.
- Educate the public regarding water issues.
- Enhance recharge of treated effluent and storm water runoff.
- Redirect Prescott Valley recharge to the Verde watershed.
- Supply augmentation.
- Water conservation.
- Growth management.
- Develop direct potable re-use of effluent.
- Legislate xeriscaping.
- Restrict outdoor water use associated with new exempt wells.
- Passage of state lands initiative would reduce new developments on state lands and decrease pressure on groundwater.

<u>Surface water diversion and contamination</u>

➡ Alternative ditch management with incentives for creative water management with ecological benefits. Creation of a funding system to improve the management.
➡ Find money to fund/encourage adjudication of Verde water rights.
➡ Purchase lands with water rights and sever and transfer rights.
➡ Define target flows for the Verde through development of ecological flows model with USGS.

- Create fallowing and forbearance agreements with farmers.
- File for instream flow permits (see Figure 14).
- Pursue alternative water supplies.
- Community outreach/education to educate about surface water diversion and climate change.
- Develop better wastewater treatment facilities for communities.
- Pharmaceutical companies need infrastructure to take and dispose leftover medications.
- Research, education, and public awareness on emerging contaminants in effluent.
- Change golf courses to effluent.
- Control nitrogen discharge from fish hatcheries.
- Focus on improving river below irrigation dams.
- Develop incentives to use Best Management Practices for irrigation.
- Prioritize actions relative to climate change – ecosystem management vs. single species.
- Manage ditches and Pecks Lake as native fisheries.
- Continue synthesizing information for decision makers.

- Apply simple spring management techniques to improve ecological condition (e.g. perf. pipe vs. box).
- Evaluate operations of Bartlett and Horseshoe Dams.
- Develop mitigation for urban runoff.
- Encourage more permeable surfaces in cities.

<u>Invasive animals</u>

- ➡ Secure instream flow rights for fish & wildlife.
- ➡ Develop & implement watershed plan to manage native species & sport fish.
- ➡ Education: low impact recreation, OHV use, livestock management, road construction & maintenance, invasive species, native species.
- ➡ Research & develop novel methods for removal of non-native vertebrates.
- Protect & restore riparian areas.
- Create central database for watershed management.
- Map sensitive habitats/ sites of high ecological sensitivity for conservation (see Figure 15).
- Develop plan for renovation of streams & reintroduction of native fish.
- Develop native sport fishery.
- Inventory crayfish distribution in watershed.
- Develop stronger outreach to ranching community.
- Follow process of "Hazard Analysis and Critical Control Point" program.
- Use partnerships to fund grassland restoration & control of woody species.
- Increase law enforcement.
- Develop list of expertise to promote collaboration.
- Reduce grazing pressure in riparian zone in upper Verde.
- Study effect of removing Sullivan Dam at headwaters.
- Determine role of otters relative to fish and crayfish populations.
- Determine functional equilibrium between natives & non-natives.
- Determine beaver distribution & abundance.
- Determine aquatic herpetofauna distribution & status.
- Develop & implement a cooperative management agreement between agencies to streamline & more effectively manage the riparian corridor (ASP, USFS, AGFD).

<u>Invasive plants</u>

- ➡ Prevent use of invasive plants in landscaping.
- ➡ Protect instream flow rights.
- ➡ Regulate groundwater use.
- ➡ Identify & protect sensitive native riparian community areas.
- ➡ Public education & outreach on invasives & best practices.
- ➡ Develop joint management plan between agencies.
- Develop planning & zoning regulations to protect riparian zone.
- Increase funding for treatment & monitoring efforts.
- Work with ditch companies to improve diversion & ditch system management.
- Revive effort to develop weed management areas.
- Increase law enforcement to prevent unauthorized recreation (OHVs, equestrian, mtn. bikers, hikers).
- Prevent additional dams & impoundments.
- Modify flow releases from dams.
- Elevate as a priority with the governors office through invasive species council.
- Reinstate state weed coordinator position.

Figure 15. Instream flow water rights provide some legal protection for water used by wildlife. In the Verde River watershed, there are currently 11 instream rights with certificates from the Arizona Department of Water Resources, and another 15 that are in progress.

Measures of Conservation Success

Participants in the second workshop were asked to identify the most important measures for the status of riparian and aquatic communities. The following are presented in no particular order, grouped by several overall questions.

<u>Are we maintaining or improving biodiversity in the river and the riparian community?</u>

- Fish surveys by reach to insure that we are not losing species.
- Population studies needed on native fish.
- Amphibian and reptile surveys.
- Bird population trends, looking at presence/absence.
  Riparian bird monitoring within the Verde is part of a statewide program.
  Important Bird Areas are getting monitored, marsh bird surveys for Tavasci.
  Christmas Bird Count held annually.
- Survey health of spring communities.
- Beavers – Count dams, bank dens, number of cuttings.

<u>Are we maintaining adequate flow levels in the river?</u>

- Meeting a flow target – percent of river miles with flow that meets ecological needs.
- Streamflow at gages (baseflow by reach).

<u>Are we maintaining adequate groundwater levels to support springs and streams?</u>

- Depth to groundwater (ADWR is doing a well level sweep starting June).
- Amount of water being used by exempt wells.
- Number of new wells drilled.
- Number of households served by water providers.
- Annual overdraft in the Prescott AMA (data is publically available).
- Springs – number of springs inventoried.
- Size of wetlands.

<u>Are we reducing threats to species and habitat?</u>

- Community survey to see if social change has occurred.
- Amount of land managed for conservation.
- Management of the ditches.
- Number of diversion points.
- Amount of water diverted.
- Amount of ditch water returned to river.
- Number of successful agreements with ditch companies.
- Number or length of river reaches with instream flow rights.
- Acres of protected riparian community.
  Riparian monitoring occurs on USFS land depending on projects.
- Total of ungrazed stream miles.
- Crayfish distribution, relative abundance.
- Macroinvertebrate community characteristics as measure of water quality.
- Amount of floodplain encroachment – number of bridges, acres, length.
- Area of tamarisk dominance, or river miles affected.

Information Needs

Participants in the workshops and meetings identified a variety of significant gaps in our current understanding. These were recognized as information needed to support better management of aquatic and riparian resources in the watershed.

- Identify and fill critical data gaps about groundwater systems, e.g. aquifer properties
- Develop coupled surface water – groundwater model for Verde Valley
- Define target flows for conservation by completing USGS ecological flows study
- Collect data on tributary flows: gages or regular measurements
- Apply spring assessment methodology to springs
- Dead Horse Ranch State Park has data on ditch diversions and consumptive use – can scale up to watershed scale to better understand ditch water use
- Analysis of riparian ecological conditions on ditches
- Research & develop novel methods for removal of non-native vertebrates, including species-specific piscicides, genetic modification
- Create central database for watershed management, including watershed info, species distribution and abundance, who is working on what, include metadata
- Map sensitive habitats/ sites of high ecological sensitivity for conservation plan
- Develop list of expertise to promote collaboration
- Study effect of removing Sullivan Dam at headwaters
- Determine role of otters: impact on crayfish, impact on native fish
- Determine functional equilibrium between natives & non-natives
- Determine beaver distribution & abundance
- Determine aquatic herpetofauna distribution & status
- Identify sensitive native riparian community areas
- Inventory exotic distribution & assess threat level
- Determine ecological impact of tree-of-heaven on native riparian plants and wildlife

Workshop 1 participants noted the growing presence of two grass species, Giant reed (*Arundo donax*) and Pampas grass (*Cortaderia selloana*), as potential threats to the riparian community. They compete with native plants for space, water, and nutrients, and could alter the fire frequency of the community. There is little information on their current distribution, little quantitative information on their extent in the places where they are known, and little knowledge of their actual impacts. Plant surveys using 10-meter radius plots at Dead Horse Ranch State Park and the Verde River Greenway found Giant reed at 1.0% and Pampas grass at 2.0% of 199 survey plots (Kingsley and Gaiennie 2008).

It was suggested that the presence of an ant species, *Formica propinqua*, be used as a measure of viability for the broadleaf deciduous riparian forest. The available information on this (Wimp and Whitham 2001) suggests that this ant significantly affects the presence and abundance of other arthropod species, greatly reducing the invertebrate biodiversity present on individual trees. However, it appears that where they are present, they do not occupy all trees, thus creating a mosaic of trees with and without their impact. It is not clear from this study how variability in ant populations affects overall riparian community health, so the use of this species is premature until further study clarifies its role in these ecosystems.

Existing sampling of springs is not sufficient to detect trends in flow, or to adequately characterize the biological values present at most springs in the basin. Seasonal or continuous monitoring of outflow on a set of springs representing a range of aquifers would show how climate change affects spring communities, aquifer conditions, and the sustainability of groundwater supplies (Bills et al. 2007, Rice 2007). A list of six good candidate sites for monitoring is provided by Rice (2007: Table 20).

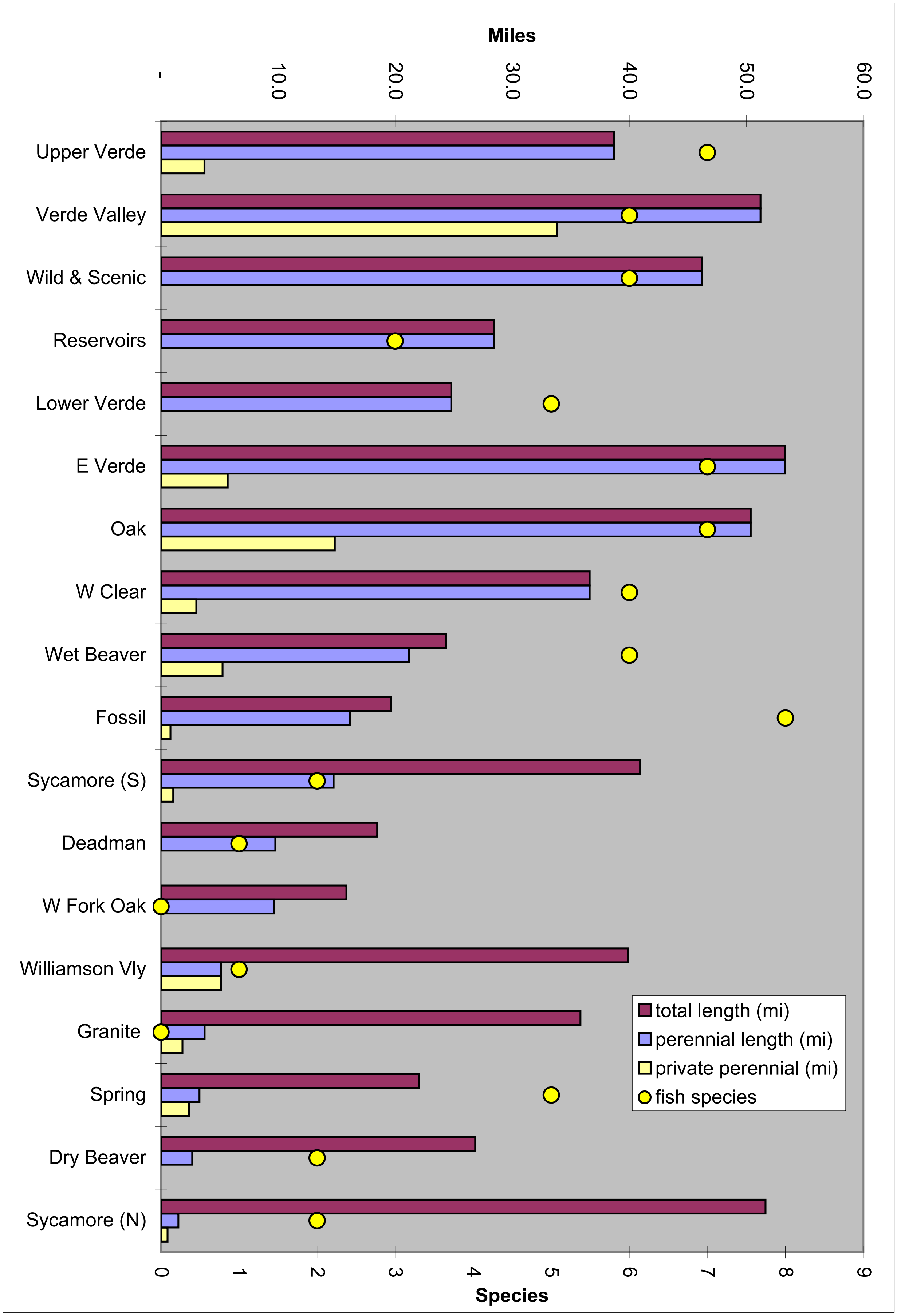


Figure 16. Stream length and native fish species richness for Verde River reaches and major tributaries. These are several factors that might guide conservation action. The length of perennial flow suggests the amount of current or potential aquatic habitat. Private ownership suggests opportunities to work with land owners on conservation projects.

Conclusion

The Verde River Watershed Conservation Plan has provided a framework for integrating and analyzing a wide range of information relevant to conserving the native plants and animals of this watershed. This report provides results of those analyses, with the hope they may inform conservation actions by a wide variety of agencies, jurisdictions, and other organizations.

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Appendix 1. Contributors to the Verde River Watershed Conservation Plan.

The following people generously contributed their time and knowledge of Verde River systems, species, and processes. Names and affiliations are presented for information only, and do not represent endorsement of this plan.

name	organization
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Brent Bitz	City of Sedona
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Jean Calhoun	The Nature Conservancy
Dan Campbell	The Nature Conservancy
Steve Cann	The Nature Conservancy
Bob Casavant	Arizona State Parks
Max Castillo	Arizona State Parks
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Chris Coder	Yavapai-Apache Nation
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Larry Stevens	Museum of Northern Arizona
Tice Supplee	Audubon Arizona
Blake Thomas	US Geological Survey
Dale Turner	The Nature Conservancy
Ruth Valencia	Salt River Project
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Scott Wilbor	Arizona Important Bird Area Program
Ken Wiley	The Nature Conservancy
Ed Wolfe	Verde River Basin Partnership
Kelly Wolff	Arizona Game & Fish Dept.
Brian Wooldridge	US Fish & Wildlife Service

Appendix 2. Aquatic and riparian conservation targets in the Verde River watershed.

Taxonomic Group	Scientific Name	Common Name	Global Rank	ESA Status
Amphibian	*Rana chiricahuensis*	Chiricahua leopard frog	G3	LT
	Rana pipiens	Northern leopard frog	G5	
	Rana yavapaiensis	Lowland leopard frog	G4	
Bird	*Buteo albonotatus*	Zone-tailed hawk	G4	
	Buteogallus anthracinus	Common black-hawk	G4	
	Cardinalis cardinalis	Northern cardinal	G5	
	Coccyzus americanus occidentalis	Western yellow-billed cuckoo	G3	C
	Empidonax traillii extimus	Southwestern willow flycatcher	G2	LE
	Haliaeetus leucocephalus	Bald eagle	G4	LT
	Ixobrychus exilis	Least bittern	G5	
	Porzana carolina	Sora	G5	
	Rallus limicola	Virginia rail	G5	
	Vermivora luciae	Lucy's warbler	G5	
	Vireo bellii	Bell's vireo	G5	
Fish	*Agosia chrysogaster*	Longfin dace	G4	SC
	Catostomus clarki	Desert sucker	G3	SC
	Catostomus insignis	Sonora sucker	G3	SC
	Gila intermedia	Gila chub	G2	LE
	Gila nigra	Headwater chub	G2	C
	Gila robusta	Roundtail chub	G2	SC
	Meda fulgida	Spikedace	G2	LT
	Poeciliopsis occidentalis	Gila topminnow	G3	LE
	Ptychocheilus lucius	Colorado pikeminnow	G1	LE
	Rhinichthys osculus	Speckled dace	G5	SC
	Tiaroga cobitis	Loach minnow	G2	LT
	Xyrauchen texanus	Razorback sucker	G1	LE
Insect	*Anacroneuria wipukupa*	Redrock stone fly	G1	
	Apatania arizona	A caddisfly	G1	
	Cicindela oregona maricopa	Maricopa tiger beetle	G3	
	Cylloepus parkeri	Parker's cylloepus riffle beetle	G1	
	Metrichia volada	Page Spring micro caddisfly	G5	
	Protoptila balmorhea	Balmorhea saddle-case caddisfly	G2	
Mammal	*Castor canadensis*	American beaver	G5	
	Lasiurus blossevillii	Western red bat	G5	
	Lontra canadensis	North American river otter	G5	
Mollusk	*Anodonta californiensis*	California Floater	G3	
	Pyrgulopsis glandulosa	Verde Rim Springsnail	G1	
	Pyrgulopsis montezumensis	Montezuma Well springsnail	G1	
	Pyrgulopsis morrisoni	Page springsnail	G1	C
	Pyrgulopsis simplex	Fossil springsnail	G1	
	Pyrgulopsis sola	Brown springsnail	G1	
Reptile	*Thamnophis eques megalops*	Mexican garter snake	G5	
	Thamnophis rufipunctatus	Narrow-headed garter snake	G3	
Vascular plant	*Acer negundo*	Box elder	G5	
	Platanus wrightii	Arizona sycamore	G4	
	Populus fremontii	Fremont cottonwood	G5	
	Salix gooddingii	Goodding willow	G5	

Appendix 3. Viability Assessment Table

In the following table, each row represents a particular key ecological attribute, its indicator and its indicator ratings for a specified conservation target.

Key Ecological Attributes

A key ecological attribute is a critical component of a conservation target's life history, physical processes, community interaction, habitat or interaction with other species. At its most basic, a key ecological attribute is an aspect of a target's biology or ecology that if present, defines a healthy target and if missing or altered, would lead to the outright loss or extreme degradation of that target over time.

Indicators

Although key ecological attributes are specific descriptions of an aspect of a target, they are generally still too broad to measure or assess in a cost-effective manner over time. To this end, it is important to develop indicators that can be used to assess the attribute over time.

Indicators for the hydrologic regime were developed by Jeanmarie Haney, and are presented in Appendix 4.

Indicators using bird guilds were developed by Scott Wilbor and Tice Supplee, and involve the presence of expected species as found (or not) in recent surveys. The detailed tables for these indicators are provided in Appendix 5.

Ratings

The status indicator ratings are defined as:

Very Good: The indicator is functioning within an ecologically desirable status, requiring little human intervention for maintenance within the natural range of variation.

Good: The indicator is functioning within its range of acceptable variation, although it may require some human intervention for maintenance.

Fair: The indicator lies outside of its range of acceptable variation and requires human intervention for maintenance. If unchecked, the target will be vulnerable to serious degradation.

Poor: Allowing the indicator to remain in this condition for an extended period will make restoration or prevention of extirpation of the target practically impossible (e.g., it will be too complicated, costly, and/or uncertain to reverse the alteration).

Any target's key ecological attributes (and therefore their indicators) will vary over time in a relatively undisturbed setting. This variation is not random, but limited to a particular range that we recognize as either:

a.) natural and consistent with the long-term persistence of each target, or

b.) outside the natural range because of human influences (e.g., fire suppression in fire maintained systems).

We consider managing for an acceptable range of variation for each target's key ecological attributes to be the soundest strategy for biodiversity conservation at any scale.

Appendix 3. Viability Assessment (continued)

#	Conservation Target	Category	Key Ecological Attribute	Indicator	Poor	Fair
1	Native fish community	Landscape Context	Hydrologic regime - (timing, duration, frequency, extent)	Suitable hydrologic regime for native fish	Little to no seasonal flow pattern; absent flooding; no base flow.	Some seasonal flow pattern, rare flooding, minor base flow.
		Condition	Population structure & recruitment	Appropriate population structure for native fish	Few native fish species present and recruiting but community is lacking in most species.	**Some native fish species present and recruiting but community is lacking in some species.**
2	Aquatic community	Landscape Context	Hydrologic regime - (timing, duration, frequency, extent)	Base flow level on perennial streams (see Appendix 3 for details on classification)	<17 cfs to Perkinsville, <57 cfs to Tapco, **<63cfs Tapco to Oak Crk, <96cfs Oak Crk to Beaver Crk, <126cfs Beaver Crk to Beasley,** <171 cfs Beasley to Horseshoe, need data below Horseshoe, <25 cfs Oak Crk, <5 cfs Beaver Crk, <13 cfs W Clear Crk	17-21 cfs, 57-71 cfs, 63-78 cfs, 96-119 cfs, 126-156 cfs, 171-212 cfs, need data below Horseshoe, 25-31 cfs Oak Crk, 5-6 cfs Beaver Crk, 13-15 cfs W Clear Crk
			Hydrologic regime - (timing, duration, frequency, extent)	Flood flows during appropriate season		Dams or watershed modifications that significantly alter flood regime.
		Condition	Presence / abundance of key functional guilds	Aquatic obligate bird guild	<33% of guild	30-49% of guild
			Presence / abundance of key functional guilds	Presence of native leopard frogs		**frogs absent**
			Presence / abundance of keystone species	Presence of beaver dams		Beavers absent
			Species composition / dominance	Macroinvertebrate community structure	<30%	30-50%
3	Marsh community	Landscape Context	Landscape pattern (mosaic) & structure	Diverse successional mosaic of open water and expected plant types	Little or no diversity of vegetation types and species. Dominated by 1 species throughout. Provides minimal habitat diversity	**Diversity well below expected levels. Dominated by 2-3 species throughout. Some diversity of habitat is present but does not meet all needs.**

Good	Very Good	Upper Verde	Verde Valley	Verde – Wild & Scenic	Verde - Reservoirs	Verde - Lower	Tributaries
Mostly natural hydrograph, some flooding.	Natural hydrograph for flow & flooding.	Good	Fair	Good	Fair	Fair	Good
All appropriate native fish species present but not all recruiting.	All appropriate native fish species present and recruiting.	Fair	Poor	Poor	Poor	Fair	Fair
22-25 cfs, **72-84** cfs, 79-91 cfs, 120-140 cfs, 157-200 cfs, **213-272 cfs,** need data below Horseshoe, 32-39 cfs Oak Crk, 7-8 cfs Beaver Crk, 16-20 cfs W Clear Crk	26-30 cfs, 85-89 cfs, 141-153 cfs, 201-223 cfs, 273-295 cfs, 273-295 cfs, need data below Horseshoe, 40-47 cfs Oak Crk, 9-10 cfs Beaver Crk, 21-22 cfs W Clear Crk	Good	Poor	Poor			Fair
Some alteration of natural flood regime, but basic pattern still appears natural.	Natural flood regime	Good	Good	Good	Good	Good	Good
50-74% of guild	**75% or greater of guild**	Very Good	Very Good				
frogs present		Fair	Fair	Good	Good	Good	Good
Beavers present		Good	Good	Good	Good	Good	Fair
50-75%	75% or greater of reference site macroinvertebrate community						
Diverse mosaic of vegetation with some missing components. Provides high quality habitat to most wetland dependent species	Diverse mosaic of vegetation with minimal invasive species. Provides high quality habitat to most wetland dependent species		Fair				Fair

Appendix 3. Viability Assessment (continued)

#	Conservation Target	Category	Key Ecological Attribute	Indicator	Poor	Fair
	Marsh community (continued)		Water chemistry	Water quality standards	Does not meet standards for 2 or more identified pollutants	Does not meet standards for 1 identified pollutant
		Condition	Presence / abundance of key functional guilds	Marsh bird guild	<33% of potential guild species occurrence	33 - 49% of potential guild species occurrence
		Size	Size / extent of characteristic communities / ecosystems	Area of marsh communities is being sustained	Annually decreasing in size, <50% of 1990 area remains	Periodic decrease in size, 50-75% of 1990 area remains
4	Broadleaf deciduous riparian forest	Landscape Context	Depth to groundwater	Depth to groundwater	Deeper than 5 meters	3 - 5 meters deep, or annual fluctuations >1 m
			Hydrologic regime - (timing, duration, frequency, extent)	Flood flows during appropriate season		Dams or watershed modifications that significantly alter flood regime.
			Hydrologic regime - (timing, duration, frequency, extent)	Flow permanence	Permanently dry reaches	Seasonally dry reaches, may be below diversions
		Condition	Population structure & recruitment	Population demographics	Even aged, decadent stand with no recruitment; or missing	Certain age classes missing, little recruitment
			Presence / abundance of key functional guilds	Riparian obligate canopy bird guild	<33% of potential guild species occurrence	33 - 49% of potential guild species occurrence
			Presence / abundance of key functional guilds	Riparian obligate mid-story bird guild	<33% of potential guild species occurrence	33 - 49% of potential guild species occurrence
			Presence / abundance of key functional guilds	Riparian obligate understory bird guild	<33% of potential guild species occurrence	33 - 49% of potential guild species occurrence

Good	Very Good	Upper Verde	Verde Valley	Verde – Wild & Scenic	Verde - Reservoirs	Verde - Lower	Tributaries
Meets standards for all identified pollutants	Meets standards for all identified pollutants and potential emerging contaminants (nearly natural water quality)						Good
50 - 74% of potential guild species occurrence	**>74% of potential guild species occurrence**		Very Good				
Maintaining >75% of 1990 size with human intervention	Maintaining 1990 size without human intervention		Good				Fair
0 - 3 meters deep, with annual fluctuations 0.5-1 m	**0 - 3 meters deep, with annual fluctuations <0.5 m**	Very Good	Good	Very Good	Very Good	Very Good	Fair
Some alteration of natural flood regime, but basic pattern still appears natural.	**Natural flood regime, with floods during seed dispersal period for native riparian trees.**	Very Good	Very Good	Very Good	Good	Good	Very Good
Continuous flow for full length of river, with diversions operating.	Continuous natural flow for full length of river	Good	Fair	Good	Good	Good	Good
Most age classes present and evidence of recruitment	**Diverse age structure in appropriate habitat, recruitment after spring flood events**	Very Good	Very Good	Very Good	Very Good	Very Good	Very Good
50 - 74% of potential guild species occurrence, with highly habitat sensitive species present	**>74% of potential guild species occurrence, with highly habitat sensitive species present**	Very Good	Very Good				Good
50 - 74% of potential guild species occurrence, with highly habitat sensitive species present	**>74% of potential guild species occurrence, with highly habitat sensitive species present**	Very Good	Very Good				Poor
50 - 74% of potential guild species occurrence, with highly habitat sensitive species present	**>74% of potential guild species occurrence, with highly habitat sensitive species present**	Very Good	Very Good				Good

Appendix 3. Viability Assessment (continued)

#	Conservation Target	Category	Key Ecological Attribute	Indicator	Poor	Fair
5	Mesquite bosque community	Condition	Presence / abundance of key functional guilds	Mesquite bosque bird guild	<33% of potential guild species occurrence	33 - 49% of potential guild species occurrence
			Species composition / dominance	Structure and composition of plant community	No understory, low species diversity	**Some structural diversity, low species diversity**
		Size	Size / extent of characteristic communities / ecosystems	Area of bosque	>5% loss over past decade	**0-5% loss over past decade.**
6	Spring community	Landscape Context	Hydrologic regime (groundwater)	Minimum flow level from perennial springs	dry	seasonally dry
		Condition	Level of unnatural disturbance	Presence and nature of structures	All flow captured and diverted	Significant impairment of flow or impaired support of biotic community

Spring community viability

We analyzed an extensive database of springs around the middle Verde River watershed (Flora 2004) for descriptions of human development and spring outflow conditions, assigning each to one of four condition classes (Figure 17). Out of the 67 springs classified as perennial, 16 were undeveloped (= very good condition), 27 were modified but still wildlife accessible and support natural vegetation (good), 19 had significant impairment of flow or impaired support of the biotic community (fair), and 5 had all flow captured and diverted (poor). This averages to an overall "good" condition, though clearly there are significant opportunities for restoration.

One key attribute of springs is the persistence of flow needed to support the biotic community. We sought data to evaluate trends in spring flow and found it to be both limited in geographic scope and sufficiently complex to resist simple summaries. According to a study by Rice (2007) of springs in the middle Verde River watershed, year-to-year comparisons for 16 springs showed contradictory trends, and most were not statistically significant.

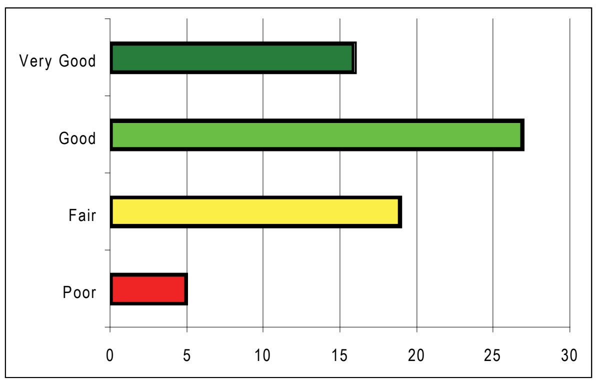

Figure 17. Spring community viability, for 67 springs in the middle Verde watershed, based on level of unnatural disturbance.

Rice (2007) did show that some springs rely on localized aquifers for their source water, which caused them to respond quickly (i.e. seasonally) to changes in precipitation and generally meant short transit times between infiltration and emergence. In contrast, springs associated with regional aquifers showed little response to precipitation changes and consistently long transit times. Winter precipitation was the dominant source of recharge for all the springs studied. The implication is that springs with local aquifers are the most vulnerable to drought or local groundwater pumping, and that reduced winter precipitation due to climate change would have greater effects than reduced summer precipitation.

	Good	Very Good	Upper Verde	Verde Valley	Verde – Wild & Scenic	Verde - Reservoirs	Verde - Lower	Tributaries
	50 - 74% of potential guild species occurrence, with highly habitat sensitive species present	**>74% of potential guild species occurrence, with highly habitat sensitive species present**		Very Good				Good
	Some structural diversity, some species diversity	High structural diversity, high species diversity		Fair				
	Current extent equal to 10 years ago.	Slight increase over past decade.		Fair	Good	Good	Fair	Fair
	reduced flow	historic flow levels, within natural range of variation						
	Modified but still wildlife accessible and supports natural vegetation	Natural outflow with no modification	Very Good	Good	Poor			Good

Appendix 4. Base flow levels used for viability assessment.

Reach Description	Current base flow[a]	7-day min flow (year)[a]	Poor	Fair	Good	Very Good
Paulden to Tapco						
- headwaters to below Perkinsville	24	17 (1964 &1972)	<17	17-21	**22-25**	26-30
- below Perkinsville to Tapco	79	59 (2004)	<57	57-71	**72-84**	85-89
Tapco to Beasley						
- Tapco to above Oak Creek	0.3 to 60 summer; 80 to 150 winter	9 (2009)[b]	**<63**	63-78	79-91	92-100
- above Oak Creek to above Beaver Creek	0.5 to 117 summer; 150 to 220 winter		**<96**	96-119	120-140	141-153
- above Beaver Creek to Beasley	192	27 (2004)	**<126**	126-156	157-200	201-223
Beasley to head of Horseshoe Reservoir		56 (2004)	**<171**	171-212	213-272	273-295
Head of Horseshoe Reservoir to Bartlett Dam		REGULATED				
Bartlett Dam to Salt		REGULATED				
Perennial Tributaries						
Oak Creek	41 (winter)	9.4 (1944)	**<25**	25-31	32-39	40-47
Beaver Creek	7	4.3 (1994)	<5	**5-6**	7-8	9-10
West Clear Creek	18	12 (1981)	**<13**	13-15	16-20	21-22

All units in cubic feet per second.

[a] Data obtained and interpreted from Bills 2008, Blasch et al. 2006, and Fisk et al. 2006.

[b] Measured by J. Haney, The Nature Conservancy, July 2009.

Verde River Base Flow Reach Ranking, for the Verde Conservation Action Plan
J. Haney September 15, 2009

NOTE:
"Good" is the current base flow *without* irrigation diversions.
"Very Good" is the base flow that I believe would exist without irrigation diversions and without consumptive use from ag and municipal (e.g. "capture" of 5 cfs of streamflow has already occurred due to groundwater export from the Little Chino Valley (Nelson 2006); however, I have no way of calculating the amount of "capture" that has already occurred due to municipal use in the Verde Valley, so that is not factored into the "Very Good" rating).

REACHES:

Headwaters to below Perkinsville: USGS gage #9503700 Verde River near Paulden
Good = ranges from the mean of the 10th percentile flows (22) to the mean of the monthly 50th percentile flows (25).
Very Good = "Good" + 5 cfs added to the high range [ADWR/USGS estimate 5 cfs depletion has

already occurred due to consumptive groundwater use in Little Chino Valley = 5(LC)]
Fair = the Good rating range reduced by about 20%
Poor = Less than the minimum Fair rating

17 cfs in 1963 and 1972 is the smallest 7-day minimum low flow for the Paulden gage

Perkinsville to Tapco: USGS gage #9504000 Verde River near Clarkdale
Good = ranges from mean of the monthly 10th percentile flows (72) to the mean of the monthly 50th percentile flows (84)
Very Good = "Good" + 5 cfs(LC) added to the high range *(Note: Examination of irrigation consumptive use in Perkinsville indicated only about 300 AF/yr = 0.4 cfs.)*
Fair = the Good rating range reduced by about 20%
Poor = Less than the minimum Fair rating

59 cfs in 2004 is the smallest 7-day minimum flow for the Clarkdale gage

Tapco to above Oak Creek: USGS gage #9504000 Verde River near Clarkdale
Good = ranges from mean of the monthly 10th percentile flows(72) + 7cfs (**79**) to the mean of the monthly 50th percentile flows(84) + 7 cfs (**91**). [The plus 7 cfs is for **natural gains** in the river (Bills 2008)].
Very Good = "Good" + 9 cfs added to the high range [5(LC) + 4(ag here) = 9 cfs] *natural gains for this reach accounted for in the "Good" range
Fair = the Good rating reduced by about 20%
Poor = Less than the minimum Fair rating

Reconstructed, non-diversion, discharge ranged from 63 cfs at Tapco to 85 cfs above Oak Creek (Bills 2008)

ADWR irrigated ag layer indicates about 900 acres between Tapco and Oak Creek. Water duty 3.15 AF/ac = 2,835 AF/yr = 4 cfs

9 cfs measured in this reach in July 2009; J.Haney, The Nature Conservancy, unpublished data

Oak Creek to abv Beaver Creek: USGS gage #9504000 Verde River near Clarkdale *plus* gage #9504500 Oak Creek near Cornville *(Used full year for Clarkdale and Nov-Dec only for Oak Creek-Cornville gage)*
Good = ranges from sum of mean of 10th percentile [Clarkdale(72+17cfs)+Oak Creek(31)]=(**120**) to sum of mean of 50th percentile Clarkdale(84+17cfs)+OakCreek(39)] =(**140**).
(NOTES: 1) 17 cfs is added for natural gains below the Clarkdale gage (7 cfs in reach abv and 10 cfs in this reach); 2) I used winter months (Nov-Feb) only for Oak Creek because this gage is strongly impacted by irrigation diversions during the summer months.)
Very Good = "Good" + 13 cfs added to the high range [5(LC) + 4(ag abv) + 4(ag here) = 13 cfs]
(Note: I'm not adding back any ET because I'm using the full year for Clarkdale gage data, which accounts for ET.)
Fair = the Good rating reduced by about 20%
Poor = Less than the minimum Fair rating

ADWR irrigated ag layer indicates about 954 acres between Oak Creek and abv Beaver Creek. Water duty 3.15 AF/ac = 3,005 AF/yr = 4 cfs

68 cfs is the smallest 7-day minimum flow for the two gages
[59 Clarkdale (2004) + 9 Oak Creek (1944)].

Abv Beaver Creek to Beasley: USGS gage # 9506000 Verde River near Camp Verde (Nov-Feb only); *subtracted 20 cfs to account for riparian vegetation ET - this is a very undocumented number!*
Good = ranges from mean of the winter monthly 10th percentile flows (177)-20 cfs ET (**157**) to mean of the winter monthly 50th percentile flows (220)-20 cfs ET (**200**).
Very Good = "Good" + 23 cfs added to the high range. [5(LC) + 8(ag abv) + 10(ag here) = 23 cfs]
Fair = the Good rating reduced by about 20%
Poor = Less than the minimum Fair rating

ADWR irrigated ag layer indicates about 2,193 acres between abv Beaver Creek and Beasley. Water duty 3.15 AF/ac = 6,908 AF/yr = 10 cfs

ADWR 2000 uses Anderson 1976 estimate of riparian vegetation ET = 29,000 AF/yr Clarkdale gage to Camp Verde gage. That's 60 cfs spread for an 8-month growing season; for this lower reach, I'm estimating 20 cfs.

27 cfs in 2004 is the smallest 7-day minimum flow for Camp Verde gage
113 cfs is the reconstructed discharge (Bills 2008)

Beasley to head of Horseshoe Res.: USGS gage #9508500 Verde River below Tangle Creek (Nov-Feb only); *subtracted 20 cfs to account for riparian vegetation ET - this is a very undocumented number!*
Good = ranges from mean of the winter monthly 10th percentile flows (233)-20 cfs ET (**213**) to mean of the winter monthly 50th percentile flows (292)-20 cfs ET (**272**)
Very Good = Good + 23 cfs added to high range (for consumptive use in the upstream reaches).
Fair = the Good range reduced by about 20%
Poor = Less than the minimum Fair rating

56 cfs in 2004 is the smallest 7-day minimum flow for Tangle Creek gage

Head of Horseshoe Res to Bartlett Dam: Regulated; haven't figured out yet what pre-dam natural flow was.

Bartlett Dam to Salt: Regulated; haven't figured out yet what pre-dam natural flow was.

TRIBUTARIES

Oak Creek: USGS gage #9504500 Oak Creek near Cornville (Nov-Feb only)
Data are not available to estimate ET losses
Good = ranges from mean of the winter monthly 10th percentile flows (32) to mean of the winter monthly 50th percentile flows (39).
Very Good = add 20% to Good range
Fair = the Good range reduced by about 20%
Poor = Less than the minimum Fair rating

9.4 cfs in 1944 is the smallest 7-day minimum flow recorded for Oak Creek-Cornville gage

Beaver Creek: USGS gage # 9505200 Wet Beaver Creek near Rimrock (Nov-Feb only)
Good = ranges from mean of the winter monthly 10th percentile flows (7) to mean of the winter monthly 50th percentile flows (8).
Very Good = add 20% to Good range
Fair = the Good range reduced by about 20%
Poor = Less than the minimum Fair rating

4.3 cfs in 1994 is the smallest 7-day minimum flow recorded for Wet Beaver Creek gage

West Clear Creek: USGS gage # 9505800 West Clear Creek near Camp Verde (Nov-Feb only)
Good = ranges from mean of the winter monthly 10th percentile flows (16) to mean of the winter monthly 50th percentile flows (20).
Very Good = add 10% to Good range
Fair = the Good range reduced by about 20%
Poor = Less than the minimum Fair rating

12 cfs in 1981 is the smallest 7-day minimum flow recorded for West Clear Creek gage
This gage is far upstream from any of the surface water diversion; West Clear Creek is dry during much of the summer at its confluence with the Verde River

Appendix 5. Bird guild indicators used for viability assessment.

VERDE RIVER: Section 1 (Sullivan Dam to Clarkdale gage)

Species italics= highly habitat sensitive in Arizona (Southwestern US), related to habitat quality, patch size, structure, or components.

Very Good: 75% and above of potential species guild occurrence, plus the occurrence of any denoted highly habitat sensitive species. If highly habitat sensitive species is not present (but denoted), then rank drops to "Good".

Good: Equal to or greater than 50% to 74% of potential species guild occurrence. If highly habitat sensitive species is not present (but denoted), then rank drops to "Fair".

Fair: Equal to or greater than 33% to 49% of potential species guild occurrence.

Poor: Below 33% of potential species guild occurrence.

** These rank terms are reversed for non-native species, but same percentages will apply.*

	Upper Verde WA IBA	Upper Verde River	Summary VR Sec. 1
C/W/S Canopy	**6**	**6**	**6**
Yellow-billed Cuckoo (foraging)	1	1	1
Brown-crested Flycatcher	1	0	1
Yellow Warbler	1	1	1
Summer Tanager	1	1	1
Hooded Oriole	1	1	1
Bullock's Oriole	1	1	1
PERCENTAGE	100%	83%	100%
RANK	Very Good	Very Good	Very Good
C/W/S Mid-story	**4**	**4**	**4**
Yellow-billed Cuckoo (forage & nest)	1	1	1
Willow Flycatcher	0	0	0
Bell's Vireo	1	1	1
Black-headed Grosbeak	1	1	1
PERCENTAGE	75%	75%	75%
RANK	Very Good	Very Good	Very Good
Understory	**4**	**4**	**4**
Black Phoebe	1	1	1
Bewick's Wren	1	1	1
Common Yellowthroat	1	1	1
Abert's Towhee (Sec. 2, 3, 4, & 5 only)	NA	NA	NA
Song Sparrow	1	1	1
PERCENTAGE	100%	100%	100%
RANK	Very Good	Very Good	Very Good

Mesquite Bosque	**7**	**7**	**7**
Yellow-billed Cuckoo	1	1	1
Ladder-backed Woodpecker	1	1	1
Phainopepla	1	1	1
Bell's Vireo	1	1	1
Lucy's Warbler	1	1	1
Yellow-breasted Chat	1	1	1
Blue Grosbeak	1	1	1
PERCENTAGE	100%	100%	100%
RANK	Very Good	Very Good	Very Good
Aquatic (foraging)	**7**	**7**	**7**
Great Blue Heron	1	1	1
Green Heron	1	1	1
Wood Duck (Sec. 1, 2, & Trib. only)	1	0	1
Common Merganser (Sec. 1, 2, & Trib. only)	1	1	1
Common Back-Hawk (Sec. 1, 2, & Trib. only)	1	0	1
Belted Kingfisher (Sec. 1, 2, & Trib. only)	1	1	1
Bald Eagle	0	0	0
PERCENTAGE	86%	57%	86%
RANK	Very Good	Good	Very Good
Non-native (or not regionally endemic)	**6**	**6**	**6**
Ring-necked Pheasant	0	0	0
Rock Pigeon	0	0	0
Eurasian Collared-Dove	1	0	1
European Starling	1	0	1
Brown-headed Cowbird	1	1	1
House Sparrow	0	0	0
PERCENTAGE	50%	17%	50%
RANK	Fair	Very Good	Fair

VERDE RIVER: Section 2 (Clarkdale gage to Camp Verde gage)

Species italics= highly habitat sensitive in Arizona (Southwestern US), related to habitat quality, patch size, structure, or components.

Very Good: 75% and above of potential species guild occurrence, plus the occurrence of any denoted highly habitat sensitive species. If highly habitat sensitive species is not present (but denoted), then rank drops to "Good".

Good: Equal to or greater than 50% to 74% of potential species guild occurrence. If highly habitat sensitive species is not present (but denoted), then rank drops to "Fair".

Fair: Equal to or greater than 33% to 49% of potential species guild occurrence.

Poor: Below 33% of potential species guild occurrence.

** These rank terms are reversed for non-native species, but same percentages will apply.*

		Based on E-bird >1	bird detection>1	
	Tuzigoot, VRGW Tran. 1	Tuzigoot, Tavasci Marsh	Tuzigoot NM, UA	Summary VR Sec. 2
C/W/S Canopy	**6**	**6**	**6**	**6**
Yellow-billed Cuckoo (foraging)	1	0	0	1
Brown-crested Flycatcher	1	0	1	1
Yellow Warbler	1	0	1	1
Summer Tanager	1	1	1	1
Hooded Oriole	1	0	1	1
Bullock's Oriole	1	1	1	1
PERCENTAGE	100%	33%	83%	100%
RANK	Very Good	Fair	Very good	Very good
C/W/S Mid-story	**4**	**4**	**4**	**4**
Yellow-billed Cuckoo (forage & nest)	1	0	0	1
Willow Flycatcher	0	0	1	1
*Bell's Vireo **	0	0	1	1
Black-headed Grosbeak	1	0	1	1
PERCENTAGE	50%	0%	75%	100%
RANK	Good	Poor	Very good	Very good
Understory	**5**	**5**	**5**	**5**
Black Phoebe	1	0	1	1
Bewick's Wren	1	1	1	1
Common Yellowthroat	1	1	1	1
Abert's Towhee (Sec. 2, 3, 4 & 5 only)	1	1	1	1
Song Sparrow	1	1	1	1
PERCENTAGE	100%	80%	100%	100%
RANK	Very good	Very good	Very good	Very good

Mesquite Bosque	**7**	**7**	**7**	**7**
Yellow-billed Cuckoo	1	0	0	1
Ladder-backed Woodpecker	1	0	1	1
Phainopepla	1	1	1	1
*Bell's Vireo **	0	0	1	1
Lucy's Warbler	1	1	1	1
Yellow-breasted Chat	1	1	1	1
Blue Grosbeak	1	0	1	1
PERCENTAGE	86%	43%	86%	100%
RANK	Very good	Fair	Very good	Very good
(Bell's vireo Getting close to edge of elevational distribution , Perkinsville)*				
Marsh	**Marsh not present**	**10**	**10**	**10**
Ruddy Duck		1	0	1
Pied-billed Grebe		0	1	1
Least Bittern (Sec. 2, 3, 4, & 5 only)		1	0	1
Black-crowned Night-Heron		0	1	1
Virginia Rail		1	1	1
Sora		1	1	1
Common Moorhen		1	1	1
American Coot		1	1	1
Common Yellowthroat		1	1	1
Red-winged Blackbird		1	1	1
PERCENTAGE		80%	80%	100%
RANK		Very good	Very good	Very good
Aquatic (foraging)	**7**	**7**	**7**	**7**
Great Blue Heron	1	1	1	1
Green Heron	0	1	1	1
Wood Duck (Sec. 1, 2, & Trib. only)	1	1	0	1
Common Merganser (Sec. 1, 2, & Trib. only)	0	1	0	1
Common Back-Hawk (Sec. 1, 2, & Trib. only)	1	0	0	1
Belted Kingfisher (Sec. 1, 2, & Trib. only)	1	1	1	1
Bald Eagle	0	0	0	0
PERCENTAGE	57%	71%	43%	86%
RANK	Good	Good	Fair	Very good

VERDE RIVER: Section 2 (continued)

Non-native (or not regionally endemic)	**6**	**6**	**6**	**6**
Ring-necked Pheasant	0	0	0	0
Rock Pigeon	0	0	0	0
Eurasian Collared-Dove	1	0	0	1
European Starling	1	1	0	1
Brown-headed Cowbird	1	1	1	1
House Sparrow	1	0	0	1
PERCENTAGE	67%	33%	17%	67%
RANK	Fair	Good	Very Good	Fair

VERDE RIVER: Tributaries of Section 1 (Sullivan Dam to Clarkdale gage)

Species italics= highly habitat sensitive in Arizona (Southwestern US), related to habitat quality, patch size, structure, or components.

Very Good: 75% and above of potential species guild occurrence, plus the occurrence of any denoted highly habitat sensitive species. If highly habitat sensitive species is not present (but denoted), then rank drops to "Good".

Good: Equal to or greater than 50% to 74% of potential species guild occurrence. If highly habitat sensitive species is not present (but denoted), then rank drops to "Fair".

Fair: Equal to or greater than 33% to 49% of potential species guild occurrence.

Poor: Below 33% of potential species guild occurrence.

** These rank terms are reversed for non-native species, but same percentages will apply.*

	IBA & E-bird >1 Sycamore Creek	Summary VR Tribs. of Sec. 1
C/W/S Canopy	**6**	**6**
Yellow-billed Cuckoo (foraging)	0	0
Brown-crested Flycatcher	1	1
Yellow Warbler	1	1
Summer Tanager	1	1
Hooded Oriole	1	1
Bullock's Oriole	0	0
PERCENTAGE	67%	67%
RANK	Good	Good

C/W/S Mid-story	**4**	**4**
Yellow-billed Cuckoo (forage & nest)	0	0
Willow Flycatcher	0	0
*Bell's Vireo **	0	0
Black-headed Grosbeak	0	0
PERCENTAGE	0%	0%
RANK	Poor	Poor
(Getting close to edge of elevational distribution , Perkinsville)*		
Understory	**4**	**4**
Black Phoebe	1	1
Bewick's Wren	0	0
Common Yellowthroat	0	0
Abert's Towhee (Sec. 2, 3, 4, & 5 only)	NA	NA
Song Sparrow	1	1
PERCENTAGE	50%	50%
RANK	Good	Good
Mesquite Bosque	**7**	**7**
Yellow-billed Cuckoo	0	0
Ladder-backed Woodpecker	0	0
Phainopepla	1	1
*Bell's Vireo **	0	0
Lucy's Warbler	0	0
Yellow-breasted Chat	1	1
Blue Grosbeak	0	0
PERCENTAGE	29%	29%
RANK	Poor	Poor
Aquatic (foraging)	**7**	**7**
Great Blue Heron	0	0
Green Heron	0	0
Wood Duck (Sec. 1, 2, & Trib. only)	0	0
Common Merganser (Sec. 1, 2, & Trib. only)	0	0
Common Back-Hawk (Sec. 1, 2, & Trib. only)	0	0
Belted Kingfisher (Sec. 1, 2, & Trib. only)	0	0
Bald Eagle	0	0
PERCENTAGE	0%	0%
RANK	Poor	Poor

VERDE RIVER: Tributaries of Section 1 (continued)

Non-native (or not regionally endemic)	**6**	**6**
Ring-necked Pheasant	0	0
Rock Pigeon	0	0
Eurasian Collared-Dove	0	0
European Starling	0	0
Brown-headed Cowbird	0	0
House Sparrow	0	0
PERCENTAGE	0%	0%
RANK		

VERDE RIVER: Tributaries of Section 2 (Clarkdale gage to Camp Verde gage)

Species italics= highly habitat sensitive in Arizona (Southwestern US), related to habitat quality, patch size, structure, or components.

Very Good: 75% and above of potential species guild occurrence, plus the occurrence of any denoted highly habitat sensitive species. If highly habitat sensitive species is not present (but denoted), then rank drops to "Good".

Good: Equal to or greater than 50% to 74% of potential species guild occurrence. If highly habitat sensitive species is not present (but denoted), then rank drops to "Fair".

Fair: Equal to or greater than 33% to 49% of potential species guild occurrence.

Poor: Below 33% of potential species guild occurrence.

** These rank terms are reversed for non-native species, but same percentages will apply.*

	Lower Oak Creek, RRSP Tran. 1	Based on E-bird >1 Page Springs Fish Hatchery	Based on E-bird >1 Oak Creek-low elevation	Based on E-bird >1 Oak Creek-mid elevation	Summary VR Tribs. of Sec. 2
C/W/S Canopy	**6**	**6**	**6**	**6**	**6**
Yellow-billed Cuckoo (foraging)	0	1	0	0	1
Brown-crested Flycatcher	1	0	0	0	1
Yellow Warbler	1	1	0	0	1
Summer Tanager	1	1	1	0	1
Hooded Oriole	0	1	0	0	1
Bullock's Oriole	1	1	0	0	1
PERCENTAGE	67%	83%	17%	0%	100%
RANK	Good	Very good	Poor	Poor	Very good

C/W/S Mid-story	**4**	**4**	**4**	**4**	**4**
Yellow-billed Cuckoo (forage & nest)	0	1	0	0	1
Willow Flycatcher	0	0	0	0	0
Bell's Vireo	0	0	0	0	0
Black-headed Grosbeak	0	0	0	1	1
PERCENTAGE	0%	25%	0%	25%	50%
RANK	Poor	Poor	Poor	Poor	Good
Understory	**5**	**5**	**5**	**5**	**5**
Black Phoebe	1	1	1	1	1
Bewick's Wren	1	1	1	0	1
Common Yellowthroat	0	1	0	0	1
Abert's Towhee (Sec. 2, 3, 4, & 5 only)	1	1	0	0	1
Song Sparrow	1	1	0	0	1
PERCENTAGE	80%	100%	40%	20%	100%
RANK	Very good	Very good	Fair	Poor	Very good
Mesquite Bosque	**7**	**7**	**7**	**7**	**7**
Yellow-billed Cuckoo	0	1	0	0	1
Ladder-backed Woodpecker	1	1	1	0	1
Phainopepla	1	1	0	1	1
Bell's Vireo	0	0	0	0	0
Lucy's Warbler	1	1	0	0	1
Yellow-breasted Chat	1	1	0	0	1
Blue Grosbeak	0	0	1	0	1
PERCENTAGE	57%	71%	29%	14%	86%
RANK	Good	Good	Poor	Poor	Very good
Aquatic (foraging)	**7**	**7**	**7**	**5**	**7**
Great Blue Heron	0	1	1	0	1
Green Heron	0	1	1	0	1
Wood Duck (Sec. 1, 2, & Trib. only)	0	0	0	NA	0
Common Merganser (Sec. 1, 2, & Trib. only)	1	1	1	NA	1
Common Back-Hawk (Sec. 1, 2, & Trib. only)	1	1	0	0	1
Belted Kingfisher (Sec. 1, 2, & Trib. only)	1	1	1	0	1
Bald Eagle	0	0	0	0	0
PERCENTAGE	43%	71%	57%	0%	71%
RANK	Fair	Good	Good	Poor	Good

VERDE RIVER: Tributaries of Section 2 (continued)

Non-native (or not regionally endemic)	**6**	**6**	**6**	**6**	**6**
Ring-necked Pheasant	0	0	0	0	0
Rock Pigeon	0	0	0	0	0
Eurasian Collared-Dove	0	0	0	0	0
European Starling	0	1	1	0	1
Brown-headed Cowbird	1	1	0	0	1
House Sparrow	0	1	1	0	1
PERCENTAGE	17%	50%	33%	0%	50%
RANK	Very good	Fair	Good	Very good	Fair