



A Working Water Conservation Plan

Adopted

February 12, 2003

Partnership Advisory Commission

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INTRODUCTION

The Partnership

In 1998, the Upper San Pedro Partnership (USPP or Partnership) was formed through a Memorandum of Understanding (MOU) to facilitate and implement sound water resource management and conservation strategies in the Sierra Vista Sub-watershed. It is a consortium of agencies and organizations that (1) own land and/or (2) control land or water, and/or (3) make policy with regard to land or water use in the Sierra Vista Sub-watershed of the Upper San Pedro River Basin and will provide significant resources to help the Partnership accomplish its purpose; or agencies and organizations that will provide significant technical or financial resources to help the Partnership accomplish its purpose (USPP Organizational Structure, adopted May, 2002). The purpose of the Partnership is:

To coordinate and cooperate in the identification, prioritization and implementation of comprehensive policies and projects to assist in meeting water needs in the Sierra Vista Sub-watershed of the Upper San Pedro River Basin.

Membership in the Partnership is strictly voluntary and consists primarily of entities with the authority and/or resources to identify and implement reasonable, feasible, and cost-effective projects and policies (see member roster). Any party to the agreement may withdraw at any time, with a 30 day written notice. Nothing in the MOU limits or affects the legal decision-making authorities of any of the participants, nor requires expenditure of any funds. Some parties (Cochise County, Sierra Vista, The Nature Conservancy, Arizona Department of Water Resources, Fort Huachuca, and Bureau of Land Management) entered into separate agreements to provide funding to support the activities of the Partnership. To date, the Partnership is funding a number of activities and studies to support the collection and analysis of scientific data. The Partnership and its members will use this data to make informed decisions on the best projects and policies to accomplish the Partnership's purpose.

Structural Organization

A Partnership Advisory Commission (PAC or Advisory Commission) leads the Upper San Pedro Partnership. Operational committees carry out the purposes of the Partnership under the direction of the PAC.

The Staff Working Group Committee includes an appointed staff representative from each member agency. Its purpose is to coordinate Partnership activities and advise the Partnership Advisory Commission on the development and implementation of the Working Water Conservation Plan.

The Administrative Committee includes appointed representatives from each member agency that is funding the Working Water Conservation Plan, studies and outreach activities. Its purpose is to manage and direct the expenditure of Partnership funds used in the preparation of planning studies and options for the Partnership and to provide administrative and policy advice to the Advisory Commission. To date, the Partnership is funding a number of activities and studies to support the collection and analysis of scientific data. The Partnership and its members will use this data to make informed decisions on the best projects and policies to accomplish the Partnership's planning goal.

The Public Outreach Committee was established by the Partnership to assist in communicating with the public on the water issues the community faces and on the purpose, function and activities of the Partnership in its effort to resolve those issues. It will also assist in presenting the Working Water

Conservation Plan to the public and in soliciting public feedback.

The Technical Committee was established by the Partnership to provide technical reviews and advice to the Partnership, and to assist the Public Outreach Committee in getting technically correct information to the public. The Technical Committee is made of member agency representatives who are professionals in the fields of hydrology, engineering, geology, and riparian ecology.

Upper San Pedro Partnership Member Agencies

Land Owners And/Or Land Or Water Use Controllers

Cochise County *
Sierra Vista *
Huachuca City
Bisbee
Tombstone

Local Agencies

Resource Agencies

Hereford NRCD
(Natural Resource Conservation District)

State Land Department
AZ Dept. of Water Resources*

State Agencies

Dept. of Environmental Quality
AZ Assoc. Conservation Districts

Fort Huachuca *
Bureau of Land Management *
US Forest Service
National Park Service

Federal Agencies

US Geological Survey*
Agricultural Research Service*
US Fish & Wildlife Service

The Nature Conservancy *
National Audubon Society
Bella Vista Ranches/ Water

Non-Governmental Agencies

***Denotes current Funding Partner/Agency (member of Administrative Committee)**

Other Outside Contributing Entities

Congressman Jim Kolbe – US House of Representatives
National Fish and Wildlife Foundation
University of Arizona – SAHRA (Sustainability of semi-Arid Hydrology and Riparian Areas)

Working Water Conservation Plan

The Upper San Pedro Partnership has established the development of a Working Water Conservation Plan (the Plan) as its highest priority. The Plan's goal is to:

Ensure an adequate long-term groundwater supply is available to meet the reasonable needs of both the area's residents and property owners (current and future), and the San Pedro Riparian National Conservation Area (SPRNCA).

Traditionally, the development of a plan, whether a strategic plan, management plan or otherwise, is a one-time process resulting in a "final" document, with recommendations or policies to be implemented over a specific period of time, such as 5, 10, or 20 years. To effectively meet its goal, the Partnership realized that the Plan needed to be a dynamic document—a *working* plan that can be updated annually as new information, technologies and strategies become available. Overall, the purpose of the Plan is four-fold:

- To begin consolidating and integrating ongoing and completed studies;
- To communicate Partnership policies and objectives, along with member agencies' completed, ongoing and proposed projects to the public, member agencies, and other specific audiences;
- To assess member agency projects on a recurring basis as they relate to overall Partnership objectives and studies' results, and make adjustments to objectives and/or recommendations as appropriate; and
- To identify gaps in baseline information/projects, recommend future policies and activities, and recognize the important milestones for achieving Partnership objectives.

Public Outreach

As the result of the Partnership developing a working plan, a constructive dialogue between the Partnership, individual member agencies and the public should ensue. Public feedback on the working plan will be sought and reviewed for the next year's Plan. In addition to seeking feedback on the Plan, the Partnership will continue to educate and inform the public about its activities through a variety of tools, which could include, but not limited to:

- Newspaper articles
- An Upper San Pedro Partnership website with links to member agencies, calendars of events, studies, reports and the Plan
- Distribution of brochures, copies of the Plan and other pertinent documents
- Presentations, through a member-supported Speakers' Bureau, to schools, civic and interest groups

WATER ISSUES IN SIERRA VISTA SUB-WATERSHED

Geographic-Demographic Background

The San Pedro River begins in the mountains near the city of Cananea in northeastern Sonora, Mexico and flows north through Cochise County in the southeast corner of Arizona. It joins the Gila River near Winkelman, Arizona, approximately 125 miles north of the international boundary. The Upper San Pedro River watershed lies entirely within the Basin and Range physiographic province and extends from its headwaters in Mexico to a geologic formation known as “the Narrows” 11 miles north of the City of Benson, encompassing approximately 1,875 square miles. The Huachuca, Mustang, Whetstone, and Rincon Mountains form the basin's western boundary. The Mule, Dagoon, Little Dagoon, and Winchester Mountains form the eastern boundary. The watershed is further divided into three Sub-watersheds, as shown on the Map. Surface water and groundwater generally flow in a northeasterly and northwesterly direction from the mountains toward the river.

The Sierra Vista Sub-watershed is home to approximately 66,000 people (2000 census). However, over 2000 people outside of the Sub-watershed boundaries, namely portions of Bisbee, are served by a water company within the Sub-watershed, for a population total of 68,089 that currently depends on water from the Sierra Vista Sub-watershed. From 1990 to 2000, the population grew by approximately 2.15% per year. More than half the population of the basin lives in the City of Sierra Vista, a thriving regional center for employment, retail, education, and health care. The remainder of the population within in the Sub-watershed resides in the cities of Bisbee, Huachuca City, and Tombstone, and in the unincorporated areas of Cochise County, particularly those areas southeast of the City of Sierra Vista.

The U.S. Army’s Fort Huachuca is located in Sierra Vista and is one of the largest employers in southern Arizona, with approximately 11,580 military, civilian, and contractor employees (Appendix G, Fort Huachuca Programmatic Biological Assessment, July 2002). The Fort plays a critical role in national defense through its military intelligence and information missions, and is integral to the economic vitality of Cochise County and the State of Arizona. In FY 2000, the Fort’s total expenditures in Cochise County were over \$480 million (Fort Huachuca Directorate of Resource Management, 2001). Also located in Sierra Vista is Cochise County’s ninth largest employer, the Sierra Vista Regional Health Center, which has recently expanded its facilities and services. Residents of the area have access to higher education in Sierra Vista, home to a campus of Cochise Community College and the University of Arizona South. Many small and large retailers serve area residents, including the large enclosed Mall at Sierra Vista, housing approximately 50 retail outlets. The community also provides a wide variety of cultural and recreational amenities for area residents and visitors.

Residents and visitors alike are drawn to the area by abundant sunshine, mild climate, and the unique scenic beauty, especially the Huachuca, Dagoon, and Mule Mountains and the San Pedro River. A recent study by the University of Arizona’s Department of Agricultural Resource Economics showed that the annual increase in local economic output from June 2000 to May 2001 that is attributable to visitors to Ramsey Canyon in the Huachuca Mountains and the San Pedro River alone ranged from \$17 to \$28.3 million (Colby and Orr, 2002).

Hydrological-Environmental Background

The San Pedro River flows continuously in some areas (perennial), and only in response to storm events in others (ephemeral). Principal factors that affect where the river flows are geologic formations, evapotranspiration losses, human uses, and the amount of rainfall and runoff. Portions of the San Pedro

that are sustained by groundwater inflows have water all year round. These perennial reaches provide important habitat for migratory birds and animals. One of the most significant perennial desert river reaches in the United States lies within the Sierra Vista Sub-watershed of the San Pedro River. In 1988, the United States Congress designated this portion of the river as the San Pedro Riparian National Conservation Area (SPRNCA), which is a protected repository of the disappearing riparian habitat of the arid southwest. The Bureau of Land Management (BLM), under the Department of Interior, administers the conservation area in a manner that conserves, protects, and enhances its riparian values.

The SPRNCA serves as a primary corridor for the annual migration of approximately 4 million birds representing 250 species (BLM, 1996). The area also supports about 100 species of breeding birds, over 80 mammal species and 40 species of reptiles and amphibians. Many of these species rely on the diverse and productive riparian vegetation in the SPRNCA, which includes marshland, cottonwood-willow forest, mesquite forest, sacaton grassland, and various shrublands. The water stored in the alluvial aquifer supports these vegetation types and the perennial flow of surface water.

Average yearly rainfall in the Sub-watershed ranges from 14 inches in the valley (USGS, 1999) up to 36 inches per year in the western mountains and up to 24 inches in the mountains to the east (Oregon State University, 2000). Most of the precipitation falls as heavy, almost daily rainstorms between July and September. In winter gentler, more infrequent storms occur as snow in the higher elevations and rain in the valley. Periods between the summer and winter rains are very dry.

Area residents and the riparian vegetation all use portions of the groundwater resources in the basin. The combined demand is greater than the natural recharge. The groundwater system in the Sierra Vista Sub-watershed can support human uses for many generations to come, but removal of water from storage reduces the amount of water potentially available to the SPRNCA. This same situation has already occurred along other rivers such as the Santa Cruz, where substantial storage of water in the aquifer still remains, but perennial stream flows have disappeared.

The initial response to pumping from the aquifer is a decrease in the amount of groundwater stored in the vicinity of the well. This is true for the pumping of any groundwater well, regardless of its output. Generally, as a well pumps water a cone of depression is formed around the well resulting in a “draw-down” of the water level. When pumping stops, over time the water level can recover to the pre-pumping level. The recovery time depends on volume of water pumped, duration of pumping, and the physical characteristics of the aquifer. When a concentration of relatively large producing wells pump for an extended period of time, the result can be a larger, more regional cone of depression that will, under continual pumping conditions, extend outward until the amount of water captured equals pumping. As the depth to the water table increases, the distance water is lifted by a pump also increases. Wells may have to be re-configured or deepened and new wells drilled deeper, resulting in increased infrastructure and pumping costs. It is conceivable that water quality can degrade if wells are sufficiently deepened. Additionally, if the regional water table is sufficiently lowered, aquifer compaction and land subsidence can occur. Currently, there is no known evidence of subsidence or water quality problems in the Sub-watershed. However, our riparian vegetation is sensitive to any changes in the level of the water table. While wells can be deepened to capture additional water to compensate for lowering water tables, plant roots have finite limits.

Responsible use of groundwater involves managing it in a way that can be maintained for an indefinite period of time, without causing unacceptable environmental, economic, or social consequences. The definition of “unacceptable consequences” is largely subjective, and may involve a large number of criteria.

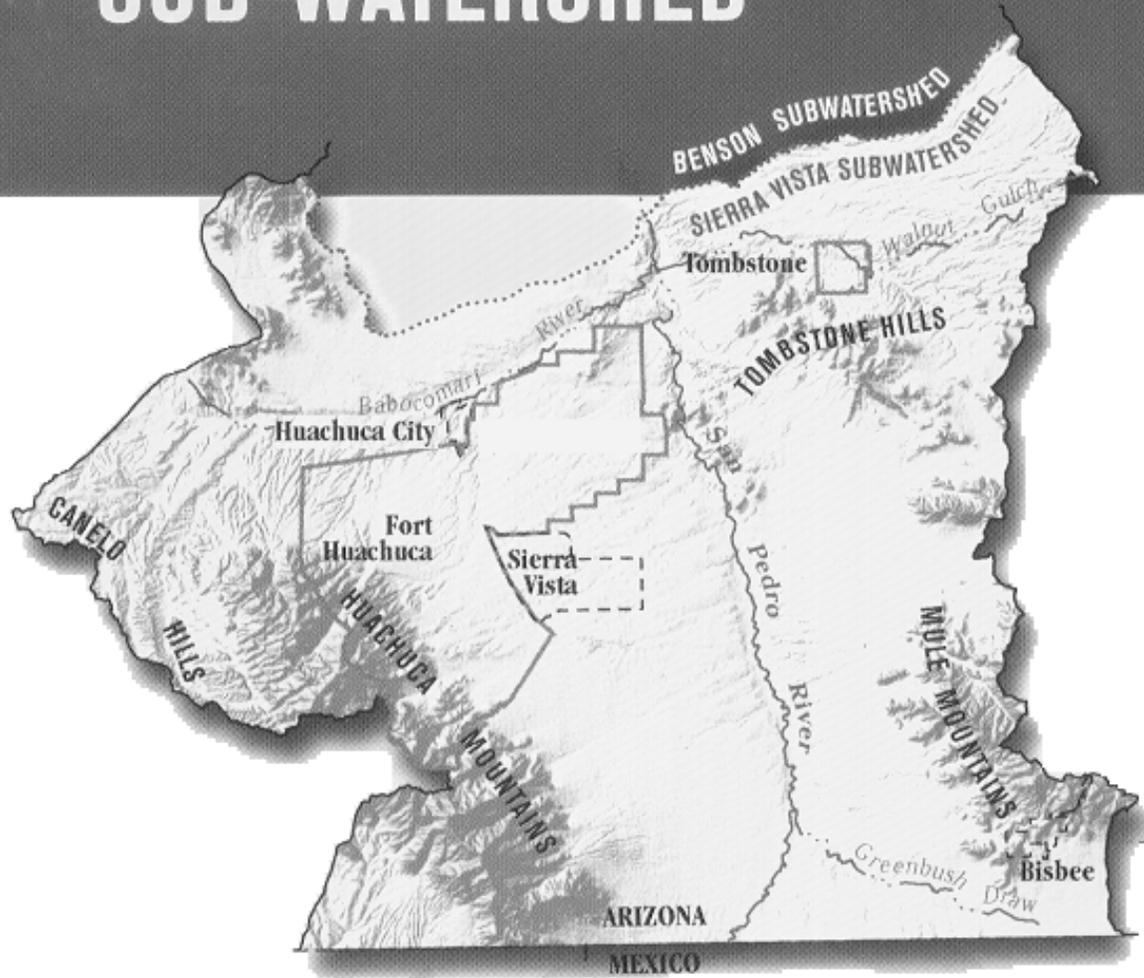
Legal Background

Balancing the needs of the San Pedro River with the needs of current and future residents must take into account the framework of state and federal legal issues that surround this challenge. The following is a summary list, for reference purposes only, of legal issues and statutes that are pertinent to groundwater withdrawals from the Upper San Pedro River Watershed:

- Gila River Adjudication and Sub-flow Technical Report: ADWR, Gila River Indian Tribe, Arizona Supreme Court
- Arizona Groundwater Management Act of 1980; Active Management Area (AMA) Petition Evaluation: Arizona Department of Water Resources
- Arizona Corporation Commission Certificates of Convenience and Necessity issued to private/investor-owned water utilities
- San Pedro Riparian National Conservation Area Enabling Act of 1988
- Endangered Species Act; Biological Opinion: Fort Huachuca, US Fish and Wildlife Service (2002)
- National Environmental Policy Act (NEPA)

Within the framework of these legal issues, the Partnership provides an opportunity for its members to take a pro-active role in planning and implementing water conservation policies and activities that may avoid the constraints that these legal issues could impose in the future.

SIERRA VISTA SUB-WATERSHED



Base from U.S. Geological Survey

Map 1

PLANNING OBJECTIVES

In November of 2001, PAC adopted the following objectives (not in any priority order), which will be used to guide the efforts of member agencies and the Partnership overall:

Partnership Objectives:

1. Develop a “working” conservation plan for the Sierra Vista Sub-watershed by 2003, which will be updated annually to incorporate the most recent strategies and scientific findings. The plan will identify strategies that can be implemented and verified as well as possibilities to be explored in the future.
2. Provide the necessary leadership to accomplish the following:
 - Leverage private, local, state and federal funding to implement projects in support of the Partnership goal;
 - Develop the political support necessary for effective water policy formation and project implementation;
 - Support member agencies in their efforts to conserve water resources.
3. Encourage collaboration with Mexican counterparts regarding water resources in the Upper San Pedro basin.
4. Encourage activities that ensure an adequate groundwater supply to support a diverse economy and meet the needs of the San Pedro Riparian National Conservation Area
5. Define an acceptable range of hydrologic conditions necessary to meet the Partnership goal-- including depth to groundwater, groundwater deficit, groundwater gradients and natural variability of river surface flows. Then recommend strategies to maintain favorable conditions and monitor to assess performance and to guide future actions.
6. Develop and implement a public education and participation plan that encourages citizens and businesses to conserve and use water wisely.

WATER SUPPLY AND DEMAND

The Water Budget and Groundwater Storage

As noted earlier in the *Water Issues* chapter, some of the rainfall and snowmelt that infiltrates into the ground recharges the groundwater system in the Sub-watershed. Many scientists currently think this occurs mostly near the mountains, where the basin-fill sediments tend to be the coarsest. This process is called mountain-front recharge. Recharge also occurs in the arroyos and channels that drain to the river when they carry storm runoff (channel recharge). Water also enters the system through underflow into the aquifer from the Mexican part of the basin. In areas where the sandy river alluvium is connected to the underlying regional basin-fill aquifer, recharge also can occur by leakage between these two under certain conditions. Some of the water applied to the ground for agricultural irrigation or from septic systems can recharge the groundwater system, as does much of the water applied in artificial recharge facilities.

Groundwater leaves the local system in several ways. Just as it flows into the aquifer from Mexico, it also flows down the valley toward Benson. Water is consumed by vegetation that transpires water vapor to the atmosphere, and water evaporates from the river and from wet soils where the water table is shallow. Combined, these processes are called “evapotranspiration.” Where hydrogeologic conditions enable it, groundwater also flows into the river, which is then carried out of the Sub-watershed. During large storms, water also enters the river in some locations as “run-off”, which flows downstream. Finally, water is pumped from the ground for human uses – residential, commercial, recreational, industrial and agricultural. While an important contributor to the overall pumpage in the past, irrigated agriculture has been declining and will likely continue to decline in the Sub-watershed.

These are the ‘ins’ and ‘outs’ of the hydrologic system (Figure 1). All of these flows are part of the area water budget. If one adds the ‘ins’ and subtracts the ‘outs’ of these flows, an idea of the balance or sustainability of the system is possible. If the total of the ‘ins’ is greater than that of the ‘outs’, water is being stored in the system over time and the overall volume of water in storage is increasing. If the ‘outs’ are greater than the ‘ins’, storage decreases and a deficit occurs. The latter is the current condition for the Sierra Vista Sub-watershed.

Estimates of the sizes of the various flows of water into and out of the Sub-watershed have varied by as much as 112 percent. This is partly due to the uncertainties associated with making the estimates. The best-known numbers are recorded pumpages, such as by water companies, and stream flows that are measured either continuously or periodically, such as the San Pedro River at the Charleston Road Bridge. Less reliable are estimates based on anticipated pumping from private and domestic wells in the Arizona Department of Water Resources well-registry database. Because evapotranspiration estimates are usually based on the approximate use of water per acre by different types of plants, these values also typically have large uncertainties. This is because the amounts and types of vegetation vary in natural settings, as do the their associated water uses. Similarly uncertain are estimates of groundwater underflow. Mountain-front recharge historically has been estimated as a percentage of the precipitation that falls on and near the mountains, supplemented by measurements of the flows of streams arising in the mountains. While these stream flow measurements commonly are good, the percentage of precipitation that falls on the mountains and reaches the aquifer is much more difficult to quantify, as is the amount of precipitation that is recharged in the washes and on the valley floor.

Taken all together, these uncertainties combine to yield a range of storage deficit values, rather than a precise quantity. Current estimates of the overall water budget indicate an annual deficit of between 2,000 and 10,000 ac-ft. It is important to recognize that this is an annual deficit, and that the total system deficit

is the cumulative sum of each year's storage change. This means that the total storage change in the Sub-watershed since about 1940 is about 100,000 to 200,000 ac-ft. This increasing change in storage is reflected in the continuing decline of the water table. If annual deficits continue, water levels generally will continue to decline.

Current Partnership Studies

Ongoing Partnership studies will improve our understanding of how the hydrologic system operates. We have learned that the aquifer system is more complex than has been assumed in the past, and that these complexities appear to explain variations in water levels and stream flow from year to year. Partnership studies are exploring these complexities, and are providing new data, information, and knowledge that will help us better quantify how the system responds to climate change, pumping, and riparian-zone changes. These studies are describing many aspects of the Sub-watershed: the physical characteristics of the aquifer and how they interact; the distribution and densities of vegetation types in the SPRNCA and quantification of how much water they respectively use and require to remain healthy; where, when, and how much recharge is occurring; and how the river, the aquifer system and the riparian vegetation are related.

The results of these studies will greatly reduce our existing information gaps, and will lead to more reliable water-budget estimates that will be used in an updated computer groundwater model of the upper basin. The model will serve several purposes. Most importantly, in conjunction with a Decision Support System (DSS) framework, it will enable stakeholders, planners, decision-makers and scientists to examine various specific groundwater management scenarios to determine how to best meet both human and natural groundwater needs. Additional research funded by the Partnership is also underway to estimate the relative economic cost and water yield for approximately 60 different water conservation alternatives. The physical, economic and technical implications of various combinations of these conservation alternatives will be evaluated using the groundwater model and DSS.

Future Demands

The population of Cochise County has increased steadily since 1950 from about 35,000 to 117,755 residents in 2002. Estimates of the population in 2050 range from about 175,000, by the Arizona Department of Economic Security (ADES), to about 205,000 using the growth rate from the 1990 to 2000 census data. While these estimates are uncertain, if they are within 20 percent of reality (the ADES estimate for 2000 was high by 3.5 percent), the number of new residents will be substantial, as will the accompanying demand for water. Because the residents of the Sierra Vista Sub-watershed comprise well over half of the County population, it is not unreasonable to assume the Sub-watershed will see the majority of population increases for some years to come. This is due in large part to a strong economic base and the attractiveness of the area.

Over the last decade, concerns have been raised regarding the increases in vegetation in the SPRNCA, and the impact this may have in the future on overall water demands. While there have been dramatic increases in the density of riparian vegetation in some areas of the SPRNCA since its establishment in 1988, satellite imagery reveals that the total acreage of riparian forest within the SPRNCA increased less than 5% during the period from 1973-1997 (EPA et al., 1997). As noted earlier in the *Current Partnership Studies* section, the extent of water consumption by riparian vegetation is being addressed by the Partnership. Land management member agencies are currently working to manage watershed conditions, including riparian vegetation. Their activities are discussed later in the Plan.

To adequately meet the combined demands of both human and natural water users in the future, it will be critical that several factors are adequately considered. First, we must better define the amount of water that has been and is being consumed by all combined uses – including residential, recreational, commercial, industrial, agricultural and riparian. This is water that will not return to the aquifer, water that is lost to the atmosphere through evaporation, or leaves the watershed through other means. Second, we must forecast the future groundwater needs of both our human population and the riparian corridor with more accuracy than we have had in the past. These needs must be considered not only in terms of how much total water is needed per year, but where it is needed within the watershed. For example, where we pump or recharge water affects how much water is available in a certain stretch of river. Also important to consider is climatic variability over time – anticipating drought conditions as well as periods of above-average precipitation. Our understanding of the interaction of these factors is essential for the development of comprehensive water conservation plans that are able to address all users’ needs within the Sierra Vista Sub-watershed.

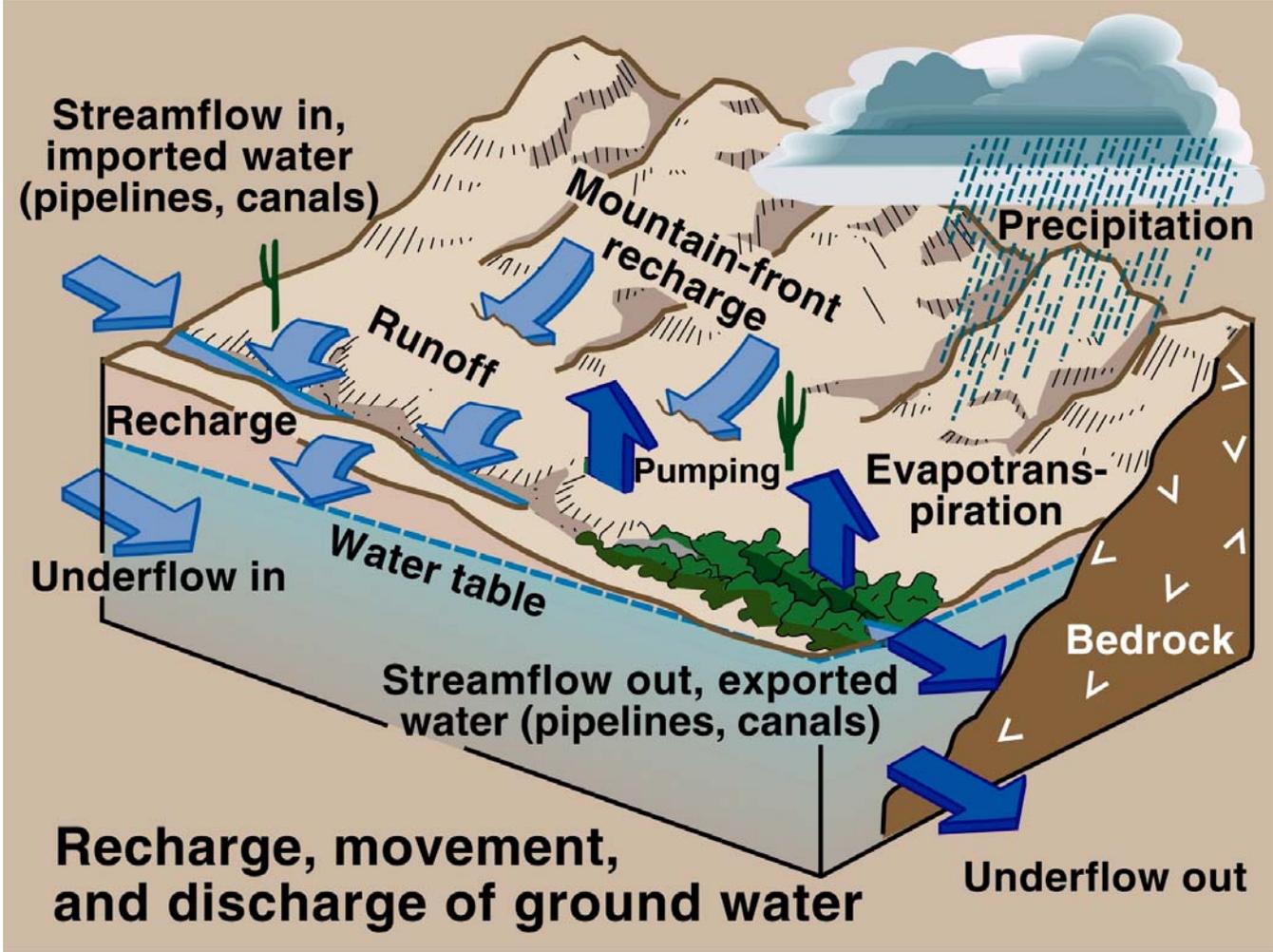


Figure 1
(from USGS)

WATER CONSERVATION STRATEGIES AND MEMBER AGENCY ACTIVITIES

From the onset, the Partnership identified three distinct strategies for addressing water conservation in the Sierra Vista Sub-watershed. They are:

**Reducing Consumption
Reclaiming or Re-using Water
Augmenting Existing Water Resources**

These strategies have provided guidance to member agencies in developing their own water conservation plans and the basis for awarding contracts to analyze the viability of different options under each of the strategies. In addition, they provide the basis for inventorying and evaluating ongoing and proposed member agency water conservation projects and activities in the Sub-watershed. To date, over 100 projects have been reviewed and catalogued by the Partnership. These are either completed, underway or proposed for the near future. A complete list of member agency projects is provided in the Appendix. The overall cumulative impact of these projects is to be determined, yet they give the Partnership the chance to identify gaps in conservation activities as well as funding and technical assistance opportunities. Following is a summary of those projects and activities characterized by the strategy they fall within, including summaries of projects that fall into areas that are meeting a Partnership objective and support the work of the Partnership. Projects that didn't meet these criteria are not reported in this chapter, but may be found in the Appendix. Although the activities and projects in the following tables were reviewed by the Partnership, they were not evaluated for effectiveness or their cost-benefit. A more detailed evaluation of these and other projects will be the work of the Partnership for subsequent working plans. At this point, these tables are simply an acknowledgment of the scope of work undertaken by the Partnership's members. The intent of this plan is not to diminish the potential or cumulative contribution of those projects but rather highlight and focus on member agency activities that seemed to meet an objective and/or support the work of the Partnership.

Activities by member agencies are summarized below by the name of the project, policy or program, a brief description, followed by a determination of yield, savings, or benefit. The fourth column notes whether the project was a one-time occurrence, or is a recurring, or future activity, and does not necessarily represent the status of the savings or yield. For example – the enforcement of codes or regulations is a recurring activity, whereas a survey for leaky infrastructure is a one-time event, yet both may represent savings on an annual basis if addressed. Finally, the agencies responsible for the activity are noted in column 5.

Note: Quantities summarized in the yield/savings/benefit column are estimates only and should not be construed as official tallies for the purposes of a water budget. Some of the yields/savings are projected, some are cumulative and yet others are one-time events. Therefore, it is difficult to quantify an absolute yield or savings. They were reported by member agencies as estimates and were intended for comparison purposes only. Member agencies should be contacted directly for questions, details or status of any project listed in this plan.

Reducing Consumption

The work of the Partnership includes taking an in-depth look at all the various water users (human, plant and animal) in the watershed, evaluating their minimum water needs, and suggesting how their needs may be met without excessive use of water. Activities under this strategy may include incentive programs like rebates for water-conserving appliances, new codes, policies and expanding public education opportunities. The majority of water conservation activities undertaken by member agencies to date fall under this strategy.

Name of Project, Policy or Program	Brief Description	Yield, Savings or Benefit (Projected or Actual)	Project Status	Responsible or Assisting Agency
Demolish excess real property	Phase 1: Demolish 1.38 million SF of old temporary buildings Remove/shut off leaky potable water Phase 2: Demolish excess/poor quality permanent construction	Approx 400 af/yr (project required by DoD, water savings was a bonus)	One Time	Fort Huachuca
Replace older, higher use fixtures to reduce water use	1) Replaced toilets, add aerating faucets 2) Replace over 2500 2.5 gpm with 1.5 gpm showerheads 3) Over 350 waterless urinals installed from 1997 to present. 4) 280 Horizontal axis washers 5) Others include 25 on-demand faucets and over 50 Purell dispensers.	110 ac ft/yr	One Time	Fort Huachuca
Survey for leaky infrastructure and repair	1) Potable lines surveyed in 1997, leaks repaired. 2) Reservoir repairs and adjustments in 1999, 2002 3) Sewer line leak detection began in FY2000.	Potable: 30 ac ft/yr WW: 50+ ac ft/yr	One Time	Fort Huachuca
Modify Native Grasslands Project	Modify irrigation activities related to restoration of retired irrigation fields at the City's EOP	200 ac/ft not used for the start-up year of this project	One Time	Sierra Vista
Code: Pool Covers for new pools	Requires new pools to have a cover	1-3 ac ft./yr (based on avg. of 37 permits/yr; and 479 sq. ft. avg. size)	Recurring	Cochise County
Code: Waterless urinals in new commercial development	Requires waterless urinals in new commercial development	1.4 to 2.0 ac ft/yr	Recurring	Cochise County Sierra Vista
Code: Golf Course Restrictions	Golf courses shall use low-water type turf; 5 acre turf limit per hole; ponds discouraged; special or conditional use permit required; landscaping with drought-tolerant species	To be determined	Recurring	Sierra Vista Cochise County
Code: Lakes, Ponds Restrictions/Retrofit and Outdoor Misters	All artificial lakes, ponds or other water features limited to 500 square feet in size and Prohibits the installation of water misters in commercial development.	To be determined	Recurring	Sierra Vista
Code: Car Wash Recycling/Retrofit	New commercial car wash facilities are required to recycle 75 percent of the water utilized.	To be determined	Recurring	Sierra Vista
Reduce non-essential water use by residents and employees.	Water Wise conservation education program on post. Publications and presentations tailored for Fort. Program began in October 1998.	20 ac ft/yr	Recurring	Fort Huachuca
Convert non-residential landscape to Xeriscaping	Reduce irrigation through re-landscaping with lower water use plants, less turf require desert landscaping in new construction.	30 to 50 ac ft/ year	Recurring	Fort Huachuca

Name of Project, Policy or Program	Brief Description	Yield, Savings or Benefit (Projected or Actual)	Project Status	Responsible or Assisting Agency
Reduce irrigation on Fort Huachuca	March 1994 (and updates) policy restricts all watering to low-evaporation times of day; Residential watering to two months per year.	300 to 400ac ft/yr	Recurring	Fort Huachuca
Air-cooling for new construction will be refrigeration.	Replacement will be during normal replacement cycle and renovations.	Approx. 100 ac ft/ year	Recurring	Fort Huachuca
Toilet Rebate Program	Provides cash incentive for residents to replace high-flow toilets with low-flow alternatives.	Total of 210 ac ft by 2011	Recurring	Sierra Vista
Home Retrofit Program	Free residential program to modify high-flow water fixtures into low-flow units.	Total of 196 ac ft by 2011	Recurring	Sierra Vista
Code: Turf Restrictions and Drought Tolerant Plant Requirement	Use of turf prohibited in new government, commercial and industrial development.	Approx 490 ac ft./yr per BBC/Fluid Solutions	Recurring	Sierra Vista Cochise County
Code: Irrigation Standards	Regulates watering on steep slopes, narrow medians, adjacent to curbs, etc.	Approx. 60 ac ft/yr per BBC/Fluid Solutions	Recurring	Sierra Vista
Code: Hot Water Recirculation Pumps	Pump required, time and/or temperature control required, pipes insulated, multi-family development independently metered or equivalent.	3.8 ac ft/yr (based on 250 res. Permits @ 5000 gal saved/year	Recurring	Sierra Vista
Water Wise	Conservation education outreach component administered by UofA Cooperative Extension	270 ac ft/yr per BBC/Fluid Solutions	Recurring	Sierra Vista Cochise County Bella Vista Ranches
Public Outreach	Water Conservation Guide Leak Detection Guide Watertight Calendar Creates water conservation awareness.	270 ac ft/yr per BBC/Fluid Solutions	Recurring	Sierra Vista
Fee Acquisition of Agricultural Lands	BLM and TNC work together to retire agricultural pumping through full fee purchase of tracts with a documented history of agricultural irrigation. Lands are purchased from willing sellers, and subsequently resold to BLM as additions to the SPRNCA.	20,500 ac ft/yr retired	Recurring	The Nature Conservancy BLM
Purchase of Conservation Easements (Retire Irrigated Ag)	DOD, TNC and BLM are working together to pay willing sellers to retire agricultural pumping on private lands through conservation easements that place restrictions on their deeds.	1139 ac ft/yr to date 2530 ac ft/yr that could be potentially retired	Recurring	The Nature Conservancy BLM Dept. of Defense (Fort Huachuca)
IGA and Joint Planning with Cities in SV Sub-watershed	Allows County to consult, through a joint planning committee with cities in Sub-watershed on potential new codes and policies related to water conservation in unincorporated areas of Sub-watershed	Potential savings to be determined	Recurring	Cochise County Sierra Vista Bisbee Huachuca City Tombstone
Water Watch Program Retrofit	Internal City water audit, use, and monitoring program.	Total of 8 ac ft by 2011	Future Project	Sierra Vista
Xeriscape Projects	Using xeriscape instead of traditional landscape techniques (on city projects).	Minimum 2-5 ac ft/ year	Future Project	Sierra Vista Cochise County

Name of Project, Policy or Program	Brief Description	Yield, Savings or Benefit (Projected or Actual)	Project Status	Responsible or Assisting Agency
Purchase of Conservation Easements (Precluding Future Ag or Subdivision)	BLM and TNC are working to limit future subdivision or irrigation on key habitats near SPRNCA on private lands through conservation easements that place restrictions on their deeds, using Land and Water Conservation Funds.	0.15 (residential) to 5 ac ft/yr (ag) per acre under easement	Future Project	The Nature Conservancy BLM
Purchase of Land or Conservation Easements- Mexico	Acquire key parcels working with Mexico partner agencies/organizations via land acquisition or conservation easements to conserve key habitats, and groundwater resources	Potential to increase base-flow in SPRNCA	Future Project	The Nature Conservancy
Close Pilot Wetlands	Closure of pilot wetlands and reuse project at wastewater treatment facility	109 ac ft./year	Future Project	Sierra Vista
Closure of treatment facility one at Charleston.	Will eliminate evaporative loss from facultative ponds no longer in use.	324 ac ft/ year	Future Project	Sierra Vista
Water Management Strategy in Support of Ft. Huachuca BA/BO	City staff working on a Water Mgmt. Strategy that should reduce the remaining water use burden within the Sub-watershed	1000-5000 ac ft/yr	Future Project	Sierra Vista Fort Huachuca

Reclaiming Used Water

The second strategy that the Partnership is pursuing is reclaiming water resources that have already been used. This involves re-using previously pumped groundwater, such as treated sewage effluent, in place of pumping new groundwater or recharging it into the groundwater system so it can be pumped and used again. The Partnership has encouraged all member agencies responsible for sewage disposal to consider reclaiming used water.

The Sierra Vista recharge project is completed and recharging about 2200 acre-feet per year. Fort Huachuca currently re-uses a significant portion of their effluent on their parade fields and golf course and is nearing completion of a recharge project that will bring the total reclaimed water up to 1000 acre-feet per year. Bisbee is currently looking at some major changes to their sewage collection and treatment system that will return all their effluent to the Sierra Vista Sub-watershed. The Partnership has applied for funding assistance to study the feasibility of including effluent from the Naco, Arizona and the Naco, Sonora treatment facilities in the Bisbee project and then reuse all the effluent on a nearby golf course or recharge it back into the aquifer. The Partnership is assisting Huachuca City in investigating the feasibility of partnering with Fort Huachuca's recharge project, to recharge their effluent.

The next iteration of the working plan will better address the progress of pending projects like Bisbee and Huachuca City. The following table summarizes member agencies' efforts related to the strategy of reclaiming used water.

Name of Project, Policy or Program	Brief Description	Yield, Savings or Benefit (Projected or Actual)	Project Status	Responsible or Assisting Agency
Use of treated effluent where irrigation required, if cost effective.	1) Effluent used for Chaffee Parade Field, outdoor sports complex, academic complex, and Golf Course. 2) New ET monitoring system to reduce watering	400-450 ac ft/yr	Recurring	Fort Huachuca
Reclaimed Water Aquifer Recharge	East Range Effluent Recharge Project, up to 750 ac ft of treated effluent annually in shallow recharge basins).	500 to 750 ac ft/yr	Recurring	Fort Huachuca
SV Water Reclamation Project	Treats and recharges City's wastewater.	2200-4000 ac ft /year	Recurring	Sierra Vista
Huachuca City Wastewater Reclamation Project	Transfer of wastewater from Town of Huachuca City to Fort Huachuca Recharge Facility for treatment and recharge	up to 170 ac ft/yr	Future Project	Huachuca City Fort Huachuca
Bisbee-Naco, AZ –Naco, Sonora Wastewater Reclamation Feasibility Study and Bisbee Wastewater Treatment Project	A study to investigate the feasibility of using treated effluent to irrigate Turquoise Valley golf course and recharge balance into the groundwater system	600+ ac ft./yr	Future Project	City of Bisbee Naco, AZ Naco, Sonora Partnership

Augmenting Existing Water Resources

The final strategy that the Partnership is pursuing is augmenting water resources through recharge of storm water and/or importing water from outside the watershed. This is the only strategy currently under consideration to generate “new” water to replace what is used within the watershed. Storm water recharge options are the only actions under this strategy that member agencies have embraced so far. A significant amount of water falls on the watershed as rain or snow, but most of it is lost as evaporation or transpiration by plants or leaves the watershed as floodwater. Increasing the amount that is recharged into the groundwater system is one objective of this strategy.

The Partnership identified three technologies that may increase recharge. One is detaining or retaining surface water to reduce flood flows and slow velocity. This causes more recharge within the detention/retention basins and slower discharge increases downstream recharge. Another is the construction of check dams to reduce velocity and allow more time for recharge. A third is construction of infiltration galleries (rock pits in the bottom of arroyos) to get the water underground sooner and minimize evaporation.

Pilot projects using two of these technologies (detention/retention basins and check dams) have been, or are being constructed where precise measurements can be made under various storm conditions to determine how much water actually reaches the groundwater system. Comparing these to natural recharge, and to each other, will provide valuable information on the potential water resource that could be developed if such methods were employed on a larger scale within the watershed.

Name of Project, Policy or Program	Brief Description	Yield, Savings or Benefit (Projected or Actual)	Project Status	Responsible or Assisting Agency
Erosion Control Project (North of Highway 82)	Used various erosion control methods to stabilize arroyos and bare land in highly erosive area. Monitor to test effectiveness of methods.	Increased infiltration, reduced run-off, reduced evaporation and reduced erosion.	One Time	BLM
Retirement and Restoration of Sand and Gravel Operation	BLM upon expiration of existing leases closed the SPRNCA lands to sand and gravel sales. This action created two retention basins (100-120 acres)	Reduced erosion and improved water quality, channel stabilization, reduced erosion	One Time	BLM
Aquifer Recharge	East Range Recharge Project, up to 150 ac ft of storm run-off annually (storm water recharge basins).	150 ac ft/yr	Recurring	Fort Huachuca
East Range Watershed Improvement	Improve storm water infiltration and recharge, reduce erosion - 5 year project, began in FY 2001 (check dams, basins, infiltration galleries)	Up to 850 ac ft/year, precipitation dependent	Recurring	Fort Huachuca
EOP Stormwater Recharge	Eliminate 30 acres of treatment basins at old wastewater facility capturing and recharging storm water run-off in addition to effluent	34 ac ft./year	Recurring	Sierra Vista
Code: Stormwater Detention	Detention or retention of the difference between pre and post development runoff is required for all commercial projects and subdivisions.	To be determined	Recurring	Sierra Vista Cochise County

Name of Project, Policy or Program	Brief Description	Yield, Savings or Benefit (Projected or Actual)	Project Status	Responsible or Assisting Agency
Surface Water Plan And Implementation	Delineates locations of regional detention/retention basins that serve to mitigate residential subdivision water runoff impacts. 5-6 basins are either completed or under construction	To be determined	Recurring	Sierra Vista
Check Dams	These slow runoff velocities and increase infiltration. Partnership is monitoring pre- and post construction to determine the potential increase in recharge	To be determined	Recurring	Sierra Vista Cochise County Tri-Core Engineering GeoSystems Analysis
Agricultural Field Berm	Retained 3 miles of berm on the west side of the abandoned ag. Fields	Retention of water, increased infiltration, stabilization of soils & sediments improvement	Recurring	BLM
Re-introduction of Beaver	Transplant up to 15 beaver from other locations to SPRNCA, allow natural reproduction. Monitor population using implanted radios, Monitor activities. Harvest of 1" to 6" DBH size cottonwoods/ willows	Increased infiltration into shallow aquifer, detention of pools of water, stabilization of soils and sediment, establishment of small natural dams, and improve wildlife habitat.	Recurring	BLM

Watershed Improvement Projects

As the Partnership evaluated member agency water conservation activities, it became clear that there were a number of projects that didn't fit neatly into one of the above strategies. These activities were characterized as actions that are managing future impacts through general watershed improvements– taking into account what could potentially occur to water resources if this activity were not implemented. These kinds of projects are largely undertaken by the federal land management agencies, and although difficult to quantify, are important to the health of the watershed as a whole. Natural recharge depends on a number of factors within a functional watershed system, including erosion control, vegetative cover, control of invasive species, infiltration, and improvements to mitigate past impacts. In essence, watershed improvements contribute to the overall amount of available water from precipitation for recharge – therefore are considered a type of augmentation to the water supply. The following tables summarize those types of projects that have already been completed or are ongoing.

Name of Project, Policy or Program	Brief Description	Yield, Savings or Benefit (Projected or Actual)	Project Status	Responsible or Assisting Agency
Re-vegetation of City of SV Sewer Plant Ag. Fields	Replace irrigated fields with natural grassland.	Increased grass cover, reduction in weed species, Eliminated need for irrigation. Provide wildlife habitat.	One Time	BLM
SPRNCA Boundary Fencing Project	Constructed and re-constructed 30 miles of SPRNCA boundary fence to reduce cattle and OHV trespass that potential would impact upland and riparian habitat and restoration.	Reduced erosion and improved water quality, channel stabilization, reduced erosion	One Time	BLM

Name of Project, Policy or Program	Brief Description	Yield, Savings or Benefit (Projected or Actual)	Project Status	Responsible or Assisting Agency
Riparian and Upland Vegetation Restoration	When BLM acquired the lands through the two major exchanges we closed the lands to mineral entry, designated OHV uses, and placed a moratorium on livestock grazing to restore riparian vegetation.	Improved & increased infiltration, reduced run-off and evaporation, reduced erosion, stabilization of channel & arroyo systems, improve wildlife habitat, increased retention of soils & sediments, & stabilization of upland habitats.	One time	BLM
Agricultural Field Restoration	Restoration of farm fields to native grass will promote proper upland watershed management reducing brush invasion and erosion. Use mechanic means & re-seeding of native plants	Increased grass cover, reduced weed and brush cover, improved and increased infiltration, reduced run-off and evaporation, reduced erosion, improve wildlife habitat.	Recurring	BLM
Prescribed Fires and fuels Reduction Project	Re-introduce controlled fire to allow natural processes that reduce brush invasion, lower the risk of catastrophic fire & increase grassland health, mown fuel breaks & remove dead & down materials	Increased cover and native grass cover, reduction in brushy, woody and invasive species, reduced water consumption by brush. Reduced run-off, improve and increased infiltration, reduced evaporation	Recurring	BLM
Watershed Restoration Projects- Mexico	Work with Mexico partner agencies/organizations to improve watershed condition through restoration projects with willing private landowners	Improved & increased infiltration, reduced run-off and evaporation, reduced erosion, stabilization of channel & arroyo systems, improve wildlife habitat, increased retention of soils & sediments, & stabilization of upland habitats.	Recurring	The Nature Conservancy
Manilla, Lyle Canyon and Canello Allotment Management Plans	Improved upland, riparian and T&E management of allotments in the Lyle canyon watershed. This project contains 17,850 acres of Lyle canyon that is part of the Upper San Pedro watershed. Project improved grazing practices on National Forest lands	Benefits include improved upland and riparian watershed conditions.	Recurring	Forest Service
Lone Mt. Allotment Management Plan	Improved upland and riparian management on the Lone Mountain Grazing allotment on 52,000 acres of the Upper San Pedro Watershed. Project includes improved grazing practices and riparian exclosures	Benefits include improved upland and riparian watershed conditions	Recurring	Forest Service
San Pedro Watershed Stewardship Project - ADEQ #00-0065AA - 319(h) Program	Improve Water Quality on San Pedro River from the Babocomari to Dragoon Tributaries near Benson AZ	Water Quality Improvements to turbidity, DO and vegetation	Recurring	ADEQ
Borderlands Storm Water Runoff Control Project - ADEQ #2-003 - 319(h) Program	Improve WQ on San Pedro and SPRNCA, buffer zone grass plantings & mesquite removal on conservation easement	Water Quality Improvements to turbidity and vegetation	Recurring	ADEQ BLM

Name of Project, Policy or Program	Brief Description	Yield, Savings or Benefit (Projected or Actual)	Project Status	Responsible or Assisting Agency
Fort Huachuca East Range Road Closure & Stream Crossing Mitigation - ADEQ #4-020 - 319(h) Program	Improve WQ on San Pedro by Road Closures and Erosion Controls where Roads cross streams	Water Quality Improvements to turbidity and vegetation	Recurring	ADEQ Ft. Huachuca
Protect Watershed by Upgrading Perimeter of Audubon-Whittel Research Ranch - ADEQ #4-005 - 319(h) Program	Improve WQ by protecting and allowing experimental ranch to rest, limit grazing and bring back natural fauna	Water Quality Improvements thru veg. enhancements & filtering	Recurring	ADEQ Audubon
Ramsey Canyon Preserve Parking Lot Runoff Reduction Project - ADEQ #4-025 - 319(h) Program	Improve WQ by limiting NPS from parking lot sheet flow runoff	Water Quality Improvements - NPS sheet flow runoff reduction, filtering	Recurring	ADEQ TNC

Partnership-Sponsored Studies

An important agreement established at the inception of the Partnership was that policies and recommendations would be based on sound science. In pursuit of data and understanding of the river and aquifer’s hydrologic characteristics, members such as the United States Geologic Survey (USGS) and the Agricultural Research Service (ARS) are conducting important studies. The Partnership and its members have also contracted with outside entities, such as consultants and academic institutions, to conduct additional critical studies.

Name of Study	Brief Description	Assisting Agency
Hydrologic Protection Areas Report (4/2001)	Partnership Open Space Committee identified, evaluated and prioritized washes draining into the San Pedro based on their capacity for recharging and suggested alternatives for protection through easements, setbacks, etc.	Partnership
Walnut Gulch Experimental Watershed near Tombstone	Basic and applied research to understand semiarid hydrology and the effects of watershed management and climate variability including intensive long-term monitoring of watershed, hydrology, and meteorology.	ARS
SPRNCA Water Needs	Objectives: 1) Determine the spatial and temporal water needs of riparian vegetation to ensure its long-term ecological integrity, 2) Quantify total consumptive water use of riparian vegetation, and 3) Determine the source of water consumed by key riparian plant species.	BLM ARS USGS Arizona State Univ SAHRA (UofA) Fort Huachuca
Walnut Gulch Experimental Watershed: Ephemeral Channel Recharge	Estimate runoff transmission losses, ephemeral channel evapotranspiration, and groundwater recharge in the lower reaches of the Walnut Gulch Experimental Watershed and conduct an initial scaling over the entire Upper San Pedro.	ARS Cochise County
Technical Feasibility Analysis of Storm Water Recharge Options	Apply AGWA runoff modeling system to estimate additional runoff water generated as a result of Sierra Vista urbanization and the amount of that water infiltrating into the channels as transmission losses.	ARS GeoSystems Analysis
San Pedro Community Monitoring Network	Production of annual maps showing spatial distribution of surface flows along the mainstem San Pedro at the driest time of the year, each year, along the mainstem of the San Pedro River in the US and Mexico	The Nature Conservancy
Stream flow Monitoring	Monitoring of surface flow in San Pedro and other major tributary streams (Greenbush Draw and Banning Creek)	BLM USGS
Summer Run-off Decline	Assess the cause of reduced run-off from watershed above Charleston	BLM USGS
Stream-Aquifer Interactions	Improve understanding of interactions between the San Pedro and the regional aquifer using monitoring wells, gravity stations and transects	BLM USGS
Groundwater Model	Using knowledge developed in USPP and earlier descriptive studies, develop dynamic tool that can be used to determine how the groundwater system will respond to resource development and management scenarios, and improve model with new information	BLM USGS Fort Huachuca

Name of Study	Brief Description	Assisting Agency
Preliminary cost/benefit analysis for water conservation, reclamation and augmentation alternatives for the Sierra Vista Sub-watershed.	An in-depth analysis of potential costs and yields of conservation measures that fall under public education, recreation, residential and commercial or irrigated agricultural categories.	BBC/Fluid Solutions
Decision Support System	A tool that can integrate the USGS groundwater model, information from other Partnership studies, and other approved data sources, and allow decision-makers to ask "what-if" questions regarding various water conservation alternatives.	SAHRA (UofA)

PRELIMINARY ASSESSMENT AND RECOMMENDATIONS

The quantitative assessment of potential or ongoing water conservation projects is the primary objective of the contracted study titled: *Preliminary cost/benefit analysis for water conservation, reclamation and augmentation alternatives for the Sierra Vista Sub-watershed*. A qualitative review of ongoing and proposed member agency projects gives the Partnership, on an annual basis, the opportunity to identify those promising activities where Partnership support would likely have the greatest impact. As more data regarding yields and cost-benefit ratios are obtained, a more quantitative evaluation of proposed projects will be possible.

Building on the synergy of the Partnership's agency membership and consensus-based agreement, support for a specific project may be realized in the following ways:

- Letters of endorsement to a member agency's leadership, urging increased funding, adoption or approval for a specific activity;
- Letter of request or support to state and federal legislators on behalf of a member agency for funding or approval of a water conservation project;
- Partnership funding/sponsorship of an agency's project
- Partnership provision of technical assistance for water conservation projects

The qualitative criteria used in reviewing potential Partnership-supported activities for this first working Plan are rooted in the belief that these projects are of a scale and feasibility to have a meaningful impact if pursued. By scale, it is meant that the potential water savings are large, and by feasibility, it is meant that the projects have a high potential for being approved or implemented by one or more agency.

The following six project areas, including the specific activities under each, are projects that the Partnership has identified for its support over the next calendar year. Their order does not reflect any prioritization at this time. The timing, implementation and degree of support will largely depend on the schedule of the implementing agency. These projects will begin to serve as the basis for evaluating progress towards meeting the Partnership's objectives in subsequent working plans. Some projects, such as the Bisbee and Huachuca City effluent recharge projects, have already received technical assistance and letters of support from the Partnership.

1. Maximize Effluent Reuse/ Recharge

- a. Bisbee/ Naco/ Naco Effluent Treatment/ Reuse/ Recharge Feasibility Study
- b. Huachuca City/ Ft Huachuca Effluent Treatment/ Recharge Project
- c. Golden Acres/ Sierra Vista Effluent Treatment/ Recharge Project
- d. Identify Future Opportunities (within and outside of city limits)

2. Increase Public Awareness and Action in Conserving Water

- a. Expand Water Wise program, i.e. funding, infrastructure (staff and space)
- b. Increase Implementation of Conservation Technology (identify methods and incentives e.g. increase funding for voluntary rebate/retrofit programs)

3. Assist in Implementation of Sierra Vista Water Management Plan in support of Ft Huachuca Biological Opinion

- a. Urban Runoff Detention/ Retention Basins
- b. Rebate and Incentive Conservation Programs
- c. Flood/ Erosion Control Structures (Check dams to improve recharge)
- d. Support adoption of Water Mitigation Ordinance

4. Assist in Implementation of Watershed Improvements by Land Management Agencies

- a. Prescribed Fire Programs
- b. Native Grass Restoration Programs
- c. Quantification of Hydrological Benefits of Programs
- d. Identify Others

5. Reduce Pumping

- a. Conservation Easement Programs (voluntary/ willing sellers)
- b. Fee Purchase Programs (voluntary/ willing sellers)
- c. Exploration of Irrigation Non-expansion Area (INA) Designation (or other methods of limiting expansion of agricultural irrigation)

6. Support Mexican Water Conservation and Quality Efforts

- a. Technical Information Exchange
- b. Cananea Sewage Treatment/ Effluent Reuse/ Recharge Project
- c. Other Watershed Improvement Projects

2003 PARTNERSHIP PLANNING TASKS

The work of the Partnership over the last several years has resulted in an array of objectives, strategies, studies (both recurring and completed), water conservation alternatives and recommendations for future involvement and support for member agency activities. When a group as large and dynamic as the Partnership is working toward a common goal and objectives, it's important to know what has been accomplished before it can know where it is headed. This working Plan has attempted to present an orderly synopsis of the Partnership's endeavors. This Plan can be used as the "yard stick" by which progress towards reaching the Partnership's goal and objectives is measured. Because of their complexity, water conservation issues cannot be resolved in a short-term timeframe. They must be approached in a logical, progressive manner. New information and technology will continually enhance the Partnership's ability to make informed decisions and recommendations. The overall intent of a working plan, and the annual process of updating it, is to identify those areas that need addressing immediately, identify opportunities, and map out a direction for the next years. As the previous chapter outlined recommendations and areas where the Partnership could offer support to member agencies, this chapter presents the specific tasks to be undertaken by the Partnership over the next year. They are as follows:

1. Prioritize water conservation alternatives presented in the report titled *Preliminary Cost/Benefit Analysis for Water Conservation, Reclamation and Augmentation Alternatives for the Sierra Vista Sub-watershed*, based on technical, public and political considerations. Conduct additional feasibility and/or design analyses for those high priority alternatives that lack sufficient information to begin implementation.
2. Develop an array of possible water management scenarios for subsequent evaluation by the Decision Support System (DSS) under development by SAHRA of the University of Arizona, and the new groundwater model under development by the USGS. Assess these scenarios with a preliminary version of the DSS model this year, and secure additional funds to refine the DSS model such that it can address more specific management scenarios utilizing the new USGS model in the coming year.
3. Establish a working dialogue with key scientists and decision-makers in Mexico regarding possible collaborative projects addressing conservation and effective management of groundwater resources across the international border. Secure funds and/or begin implementation of at least one "on-the-ground" collaborative cross-border project this year.
4. Incorporate preliminary findings from additional Partnership-sponsored studies, including the SPRNCA Water Needs Study, USGS studies and groundwater model development, detention basin improvements at the Mall and Fry basins, erosion control and recharge pilot projects, and the stormwater recharge technical feasibility analysis, into ongoing planning considerations and decision-making.
5. Develop an Outreach and Communication Plan, with associated budget and timeline, that will promote public understanding and support for the Partnership's Working Water Conservation Plan and encourage feedback to be incorporated into future working plans.
6. Update and revise the 2nd annual working Plan to include new findings and member agency project implementation and activities, and report on progress associated with current projects. Recommend additional new policies and conservation projects that merit support by the Partnership for the coming year.

REFERENCES CITED

- Arizona Department of Water Resources. 1991. "Hydrographic Survey Report for the San Pedro River Watershed, Volume 1: General assessment", Phoenix, AZ.
- BLM. 1996. "Birds of the San Pedro Riparian National Conservation Area and Upper San Pedro River Valley." Bureau of Land Management BLM/AZ/GI-96/006, Sierra Vista, Arizona
- Colby, B. and P. Orr. 2002. "Nature-Oriented Visitors and Their Expenditures: Upper San Pedro River Basin." Agricultural and Resource Economics. University of Arizona. Tucson, Arizona
- Jackson, W., T. Martinez, P. Cuplin, W.L. Minkley, B. Shelby, P. Summers, D. McGlothlin, and B. Van Haveren. 1987. "Assessment of water conditions and management opportunities in support of riparian values: BLM San Pedro River properties, Arizona, project completion report." Report No. BLM/YA/PT-88/004+7200. US Department of the Interior, Bureau of Land Management Service Center, Denver, CO.
- Pool, D.R. and A.L. Coes. 1999. "Hydrogeologic Investigations of the Sierra Vista Sub-watershed of the Upper San Pedro River Basin, Cochise County, Southeast Arizona." USGS Water Resources Investigations Report 99-4197.
- Oregon State University. 2002. Spatial Climate Analysis Service, Corvallis, OR
- US Army, Department of Defense. 2001. Annual Economic Impact Statement for Fort Huachuca for Fiscal Year 2000. Fort Huachuca, Arizona.
- US Army, Department of Defense. 2002. Fort Huachuca Programmatic Biological Assessment. Fort Huachuca, Arizona.
- US EPA, IMADES, University of Arizona, SALSA and Bureau of Land Management. 1997. "The Changing Watershed: A 25-Year History of Land Cover Change in the San Pedro River." US Environmental Protection Agency Office of Research and Development, National Exposure Research Laboratory. Las Vegas, Nevada.

APPENDIX
Member Agency Projects/Activities Catalogue

The following tables represent projects as reported by member agencies in the Partnership. They are presented here for cataloguing and reference purposes only. Questions regarding accuracy or substance should be directed to the specific agency reporting the project.

	Name of Project, Policy or Program	Brief Description	Capital Cost or Annual Expense	Annual Yield (AF/yr) or Intended Benefit	Timeframes Start/Finish	Geographic Area of Project/Impact
ADEQ	San Pedro Watershed Stewardship Project - ADEQ #00-0065AA - 319(h) Program	Improve Water Quality on San Pedro River from the Babocomari to Dragoon Tributaries near Benson AZ	Grant Award = \$69,947	Water Quality Improvements to turbidity, DO and vegetation	Jan-00	Sub-watershed
ADEQ	Borderlands Storm Water Runoff Control Project - ADEQ #2-003 - 319(h) Program	Improve WQ on San Pedro and SPRNCA, buffer zone grass plantings & mesquite removal on conservation easement	Grant Award = \$168,000	Water Quality Improvements to turbidity and vegetation	Jan-01	Sub-watershed
ADEQ	Fort Huachuca East Range Road Closure & Stream Crossing Mitigation - ADEQ #4-020 - 319(h) Program	Improve WQ on San Pedro by Road Closures and Erosion Controls where Roads cross streams	Grant Award = \$183,856	Water Quality Improvements to turbidity and vegetation	Jan-02	Sub-watershed
ADEQ	Audubon-Whittel Research Ranch Wisconsin Mound Septic System - ADEQ #4-026 - 319(h) Program	Improve WQ on Tributary to San Pedro by installing experimental septic system - Wisconsin Mound	Grant Award = \$13,650	Water Quality Improvements by reducing nitrates and bacteria to sub-flow of tributary	Jan-02	Sub-watershed
ADEQ	Protect Watershed by Upgrading Perimeter of Audubon-Whittel Research Ranch - ADEQ #4-005 - 319(h) Program	Improve WQ by protecting and allowing experimental ranch to rest, limit grazing and bring back natural fauna	Grant Award = \$18,967	Water Quality Improvements thru veg. enhancements & filtering	Jan-02	Sub-watershed
ADEQ	Ramsey Canyon Preserve Parking Lot Runoff Reduction Project - ADEQ #4-025 - 319(h) Program	Improve WQ by limiting NPS from parking lot sheet flow runoff	Grant Award = \$21,838	Water Quality Improvements - NPS sheet flow runoff reduction, filtering	Jan-02	Sub-watershed
ARS	Walnut Gulch Experimental Watershed near Tombstone	Basic and applied research to understand semiarid hydrology and the effects of watershed management and climate variability including intensive long-term monitoring of watershed, hydrology, and meteorology.	~\$250,000 / yr	Institutional Support	1953	Walnut Gulch

	Name of Project, Policy or Program	Brief Description	Capital Cost or Annual Expense	Annual Yield (AF/yr) or Intended Benefit	Timeframes Start/Finish	Geographic Area of Project/Impact
ARS/USGS/ASU	SPRNCA Water Needs	Objectives: 1) Determine the spatial and temporal water needs of riparian vegetation to ensure its long-term ecological integrity, 2) Quantify total consumptive water use of riparian vegetation, and 3) Determine the source of water consumed by key riparian plant species.	\$ 1,434,000 over three years (in addition ~\$700,000 in Univ. of Arizona SAHRA STC Center leverage support)	Quantify SPRNCA water needs	Dec. 2000	SPRNCA
ARS/UA	Walnut Gulch Experimental Watershed: Ephemeral Channel Recharge	Estimate runoff transmission losses, ephemeral channel evapotranspiration, and groundwater recharge in the lower reaches of the Walnut Gulch Experimental Watershed and conduct an initial scaling over the entire Upper San Pedro.	\$ 133,888 over two year supported by Cochise County, UA Water Resources Research Center, and in-kind contributions from ARS and UA	Unknown	April, 1999	Walnut Gulch
ARS	Storm Water Recharge Feasibility Study	Assist GeoSystems Analysis in applying the ARS developed AGWA runoff modeling system to estimate additional runoff water generated as a result of Sierra Vista urbanization and the amount of that water infiltrating into the channels as transmission losses.	Approximately \$ 50,000 in contributed time from ARS staff.	Not yet determined	Jan., 2002	Sierra Vista Sub-watershed
Bisbee	Wastewater Treatment Project	Option 1: Reroute and recharge effluent into Greenbush Draw area Option 2: Use effluent to irrigate Turquoise Valley Golf	\$26.4 million	560 ac.ft./yr	2005-	Greenbush Draw
BLM	Retirement Agricultural Land	When BLM acquired the lands through the two major exchanges BLM retired agricultural uses and placed 18,000 acre/feet of water per year into non-use	\$10 million/one-time	18,000 AF/yr	1986/87	SPRNCA
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BLM	Retirement and Restoration of Sand and Gravel Operation	BLM upon expiration of existing leases closed the SPRNCA lands to sand and gravel sales. This action created two retention basins (100-120acres)	\$20,000/one-time	Reduced erosion and improved water quality, channel stabilization, reduced erosion	1990	SPRNCA (south of Hwy. 92)
BLM	Land and Water Conservation Fund Acquisitions	Since 1991 BLM has acquired land in fee and conservation easements to retire high water consumptive uses and to reduce high density development	6 million/to-date	1,000 AF/yr cumulative	1991/ongoing	SPRNCA
BLM	Agricultural Field Restoration	Restoration of farm fields to native grass will promote proper upland watershed management reducing brush invasion and erosion. Use mechanic means & re-seeding of native plants	\$20,000/annually	Increased grass cover, reduced weed and brush cover. improved and increased infiltration, reduced run-off and evaporation, reduced erosion, improve wildlife habitat.	1994/ongoing	SPRNCA (south of highways 90 and 92)
BLM	SPRNCA Boundary Fencing Project	Constructed and re-constructed 30 miles of SPRNCA boundary fence to reduce cattle and OHV trespass that potential would impact upland and riparian habitat and restoration.	\$130,000/to-date	Reduced erosion and improved water quality, channel stabilization, reduced erosion	1998/ongoing	SPRNCA
BLM	Prescribed Fires and fuels Reduction Project	Re-introduce controlled fire to allow natural processes that reduce brush invasion, lower the risk of catastrophic fire & increase grassland health, mown fuel breaks & remove dead & down materials	\$40,000/annually	Increased cover and native grass cover, reduction in brushy, woody and invasive species, reduced water consumption by brush. Reduced run-off, improve and increased infiltration, reduced evaporation after grass recovery.	1999/ongoing	SPRNCA
	Name of Project, Policy or Program	Brief Description	Capital Cost or Annual Expense	Annual Yield (AF/yr) or Intended Benefit	Timeframes Start/Finish	Geographic Area of Project/Impact

BLM	Re-vegetation of City of SV Sewer Plant Ag. Fields	Replace irrigated fields with natural grassland.	\$10,000/one-time	Increased grass cover, reduction in weed species, Eliminated need for irrigation. Provide wildlife habitat.	1999	City of Sierra Vista's water treatment plant
	Re-introduction of Beaver	Transplant up to 15 beaver from other locations to SPRNCA, allow natural reproduction. Monitor population using implanted radios, Monitor activities. Harvest of 1" to 6" DBH size cottonwoods/ willows	\$20,000/annually	Increased infiltration into shallow aquifer, detention of pools of water, stabilization of soils and sediment, establishment of small natural dams, and improve wildlife habitat.	1999/ongoing	SPRNCA
BLM	Erosion Control Project (North of Highway 82)	Used various erosion control methods to stabilize arroyos and bare land in highly erosive area. Monitor to test effectiveness of methods.	\$500,000/one-time	Increased infiltration, reduced run-off, reduced evaporation and reduced erosion.	1999	SPRNCA (north of Hwy 82)
	Agricultural Field Berm	Retained 3 miles berm on the westside of the abandoned ag. fields	None	Retention of water, increased infiltration, stabilization of soils & sediments improvement	1986 on-going	SPRNCA (south of Hwy 90)
Cochise County	Code: Golf Course Site Development Standards	New golf courses and additions to existing golf courses -limits irrigated turf to an average of 5 acres per hole; prohibits ponds, lakes or artificial watercourses unless part of water recharge or reclamation; requires landscaping with drought-tolerant vegetation	0	Difference between regulated golf course water use and unregulated golf course water use- (SV estimates a new course would use 55 AF/yr less than PDS course)	2000 - ongoing	County -wide
	Code: Clearing Ordinance	Requires dust, erosion and run-off control measures for clearing of more than 1-acre	0	Better recharge through Best Management Practices	2000-ongoing	County-wide
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Cochise County	Water Wise Design-Developers' Guidelines	A booklet to inform developers of water conservation measures to consider - includes a requirement for developers to demonstrate measures in commercial applications involving a site area of 1 acre or more	Cost of printing	Education: Best Management Practices, reducing per capita water use	2000-ongoing	County-wide
Cochise County	Enforce specific provisions of the Arizona Water Efficient Plumbing Act of 1992	Requires low-flow plumbing in new residential development in designated building code areas around Benson and Sierra Vista	Cost of training inspectors	Difference between low-flow plumbing vs. conventional = water savings	1992-ongoing	County-wide
Cochise County	ADEQ/Health Dept. Regulation of Composting Toilets and Gray Water	Regulates the use of composting toilets and gray water in lieu of conventional septic systems.	Staff time for training and review	Reduce residential water demands	2001 -ongoing	County-wide
Cochise County	Code: Pool Covers for new pools	Requires new pools to have a cover	0	1-3 ac./ft. a year (based on 37 pool permits/yr., an avg. pool size of 479 sq. ft. and 65 gals. per sq. ft. lost per year	2002-ongoing	County-wide
Cochise County	Code: Drought-tolerant landscaping for commercial development	Requires new or expanding commercial development proposing landscaping to use plants from approved plant list and prohibits turf	Staff time for training and review of permits	Reduces commercial water demand for landscaping	2002-ongoing	County-wide
Cochise County	Code: Waterless urinals in new commercial development	Requires waterless urinals in new commercial development where required by the County Health Dept.	0	1.3 ac.ft./yr based on approx. 10 urinals/yr x 45,000 gals. per urinal saved	2002-ongoing	County-wide
	Name of Project, Policy or Program	Brief Description	Capital Cost or Annual Expense	Annual Yield (AF/yr) or Intended Benefit	Timeframes Start/Finish	Geographic Area of Project/Impact

Cochise County	IGA and Joint Planning with Cities in SV Sub-watershed	Allows County to consult, through a joint planning committee with cities in Sub-watershed on potential new codes and policies related to water conservation in unincorporated areas of Sub-watershed	Staff time	Potential to reduce overall residential and commercial water demands in Sub-watershed	2002-ongoing	SV Sub-watershed
Cochise County	Water Coordinator Position	Responsibilities include education, policies, code development and rebate program	\$100,000/yr. for 3 years	Potential to reduce overall residential and commercial water demands in Sub-watershed	2002-2004	County-wide
Cochise County	SAHRA Rural Residential Water-Use Study (County sponsored)	Will provide data pertinent to SV Sub-watershed regarding actual water use volumes (indoor, landscaping, etc.) for rural properties	\$20,000 - one time	More accurate data should lead to better decision-making on water policies and regulations	2001-2003	SV-Sub-watershed
Cochise County	Funding for USGS Groundwater Study	Provides basic data for ground and surface water hydrology	\$63,400/yr.	Institutional support - data should lead to better decision-making	1998-ongoing	SV-Sub-watershed
Cochise County	Funding for Stormwater Study and erosion & water augmentation projects	Intent is to partially mitigate groundwater withdrawals	\$326,000 to date	Institutional support - data should lead to better decision	1999-ongoing	SV-Sub-watershed
Cochise County	Funding for Water Wise Program	Provide public education	\$22,000/yr	Institutional support for water conservation education	1999-ongoing	SV-Sub-watershed
	Name of Project, Policy or Program	Brief Description	Capital Cost or Annual Expense	Annual Yield (AF/yr) or Intended Benefit	Timeframes Start/Finish	Geographic Area of Project/Impact

Cochise County	Funding for Historical Water Use Study	Provide the historical context of plan	\$15,000 one time	Institutional support - data should lead to better decision	2001-ongoing	SV-Sub-watershed	
	Forest Service	Lone Mt. Allotment Management Plan	Improved upland and riparian management on the Lone Mountain Grazing allotment on 52,000 acres of the Upper San Pedro Watershed. Project includes improved grazing practices and riparian exclosures	\$50-100,000	Benefits include improved upland and riparian watershed conditions.	Initiated during CY 2000 and is ongoing.	East side of Huachuca Mts.
		Manilla, Lyle Canyon and Canello Allotment Management Plans	Improved upland, riparian and T&E management of allotments in the Lyle canyon watershed. This project contains 17,850 acres of Lyle canyon that is part of the Upper San Pedro watershed. Project improved grazing practices on National Forest lands		Benefits include improved upland and riparian watershed conditions	Planned implementation CY 2002	East side of Huachuca Mts.
		Oversite Fire Rehab.	Rehabilitate the Oversite wildfire 3000 acres.	\$90,000	Stabilize trails and remove hazard trees	Spring 2002	East side of Huachuca Mts.
		Ryan Fire Rehabilitation	Rehabilitate the Ryan wildfire 38,000 acres of FS, BLM, State and private lands	\$30,000	Culvert protection and silt dam construction on FS lands.	Summer 2002	East side of Huachuca Mts.
Ft Hua	East Range Watershed improvement	Improve infiltration and recharge, reduce erosion 5 year project, began in FY 2001.	\$350K/year, FY2001-20055	Up to 750 AF/year, precipitation dependent	2002-2005	SPRNCA, Charleston to Fairbank	
Name of Project, Policy or Program		Brief Description	Capital Cost or Annual Expense	Annual Yield (AF/yr) or Intended Benefit	Timeframes Start/Finish	Geographic Area of Project/Impact	

Ft Hua	Demolish excess real property	Phase 1: Demolish 1.38 million SF of old temporary buildings Remove/shut off leaky potable water Phase 2: Demolish excess/poor quality permanent construction	\$8 million cap costs, no recurring	Approx 400 af/yr(project required by DoD, water savings was a bonus)	99% complete(1993-2000 for most of the work)	East Range and Main gate wells/cone
Ft Hua	Replace older, higher use fixtures to reduce water use	1) Replaced toilets, add aerating faucets 2) Replace over 2500 2.5 gpm with 1.5 gpm showerheads 3) Over 350 waterless urinals installed from 1997 to present. 4) 280 Horizontal axis washers 5) Others include 25 on-demand faucets and over 50 Purell dispensers.	Total of approximately \$500K1) \$5K2) \$15K3) ~\$300K plus recurring on waterless urinals4) \$198K5) \$7500	110 af/yr	Ongoing since: 1) 1997 2) 07/1999 3) 07/1997 4) 01/2001 5) 1999 as funding permits	East Range and main gate wells/cone
Ft Hua	Convert non-residential landscape to xeric	Reduce irrigation through re-landscaping with lower water use plants, less turf require desert landscaping in new construction.	Approximately \$50K/ year since 1997	30 to 50 acre feet per year	1997 and ongoing	Well areas
Ft Hua	Reduce irrigation on Fort Huachuca	March 1994 (and updates) policy restricts all watering to low-evaporation times of day; Residential watering to two months per year.	\$90K total, mostly for xeriscape	300 to 400af/yr	1994 to present	East Range and main gate wells/cone
Ft Hua	Effective 6/2000, air-cooling for new construction will be refrigeration.	Replacement will be during normal replacement cycle and renovations.	\$3 million(non-MCA)	Estimated 100 acre feet per year	Residential:2002 - 2010;other through 2025	East Range and main gate wells/cone
Ft Hua	Water Mitigation Policy	New actions on Fort Huachuca will be zero balance with respect to total water use, on and off post	\$1000 per position added, zero balance other actions	Status quo	Began in 1999	East Range and main gate wells/cone
	Name of Project, Policy or Program	Brief Description	Capital Cost or Annual Expense	Annual Yield (AF/yr) or Intended Benefit	Timeframes Start/Finish	Geographic Area of Project/Impact

Ft Hua	Survey for leaky infrastructure and repair	1) Potable lines surveyed in 1997, leaks repaired. 2) Reservoir repairs and adjustments in 1999, 2002 3) Sewer line leak detection began in FY2000.	average of \$50K per year	Potable: 30 af/yr WW: 50+ af/yr	1997, periodic thereafter	Cone if reducing pumping, East Range if increasing WWTP return
Ft Hua	Reduce non-essential water use by residents and employees.	Water Wise conservation education program on post. Publications and presentations tailored for Fort. Program began in October 1998.	approximately \$35K per year since FY 98	20 af/yr	1998 to present	East Range and main gate wells/cone
Ft Hua	Restrict charitable car washes	Only at 2 locations on post where drainage goes to WWTP	Minimal	Minimal	1999 to present	Cone , East Range for WWTP return
Ft Hua	Purchase conservation easements	Pay willing sellers to reduce agricultural pumping on their land and restrict their deeds.	\$760 K to date	630.8 af/yr to date	2001-2004(?)	Palominas Hereford Area
Ft Hua	Use treated effluent where irrigation required, if cost effective.	1) Effluent used for Chaffee Parade Field, outdoor sports complex, academic complex, and Golf Course. 2) New ET monitoring system to reduce watering	Operation and maintenance not tracked separately 2) \$40K	400-450 af/yr	1) 1969 for MVGC, 1994 for others 2) 1999	East Range and main gate wells/cone
Ft Hua	Aquifer Recharge	East Range Recharge Project, 1000 af or more of treated effluent and up to 250 af of storm runoff annually.	\$6 million(recurring costs not documented)	1250 af/yr	2002	East Range
Huachuca City	Wastewater Treatment Project	Potential transfer of wastewater from Town of Huachuca City to Fort Huachuca Recharge Facility		up to 400 AF/yr	2003-ongoing	Fort Huachuca Recharge Area
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Sierra Vista	EOP Stormwater Recharge	30 acres of recharge basins at wastewater facility capturing and recharging stormwater run-off in addition to effluent	\$0 (included in retrofit capital costs)	34 ac ft./year	2002-ongoing	Environmental Operations Park
Sierra Vista	Code: Stormwater Detention	Detention or retention of the difference between pre and post runoff is required for all commercial projects.	Developer funded	unknown	implemented in 1986	City of Sierra Vista
Sierra Vista	Surface Water Plan	Delineates locations of regional detention/retention basins that serve to mitigate residential subdivision water runoff impacts.	Partially developer funded; Facilities Imp. District may provide future funding option.	unknown	Implemented 1986	City of Sierra Vista
Sierra Vista	Recharge Project Retrofit	Treats and recharges City's wastewater for reuse.	\$7,500,000 Capital	2000-4000 a/f year	On-going	Environmental Operations Park
Sierra Vista	Close Pilot Wetlands	Closure of pilot wetlands and reuse project at wastewater treatment facility	\$10000 one time	109 ac ft./year	2003	Environmental Operations Park
Sierra Vista	Toilet Rebate Program	Provides cash incentive for residents to replace high-flow toilets with low-flow alternatives.	\$20,000 Annual	210 a/f by 2011	2003-2011	City of Sierra Vista
Sierra Vista	Home Retrofit Program	Free residential program to modify high-flow water fixtures into low-flow units.	\$20,000 Annual	196 a/f by 2011	2003-2011	City of Sierra Vista
Sierra Vista	Water Watch Program Retrofit	Internal City water audit, use, and monitoring program.	\$5,000/Annual	8 a/f by 2011	2003-2011	City of Sierra Vista
	Name of Project, Policy or Program	Brief Description	Capital Cost or Annual Expense	Annual Yield (AF/yr) or Intended Benefit	Timeframes Start/Finish	Geographic Area of Project/Impact

Sierra Vista	Xeriscape Projects	Using xeriscape instead of traditional landscape techniques (on city projects).	Approximately \$20,000/Annually	Minimum 2-5 a/f year	On-going	City of Sierra Vista
Sierra Vista	Water Wise	A contracted service the City uses as its water conservation education outreach component.	\$39,000/Annually	Increases water conservation awareness	On-going	City of Sierra Vista
Sierra Vista	Public Outreach	Water Conservation Guide Leak Detection Guide Watertight Calendar Creates water conservation awareness.	\$18,000/Annually	Increases water conservation awareness	On-going	City of Sierra Vista and Sub water shed
Sierra Vista	Area Water Use Baseline Study	Track local water use within Sierra Vista, places use in perspective. Provides annual comparison.	Staff time	Increases water conservation awareness	On-going	City of Sierra Vista
Sierra Vista	Charity Carwash Monitoring	Encourages sponsors to register events, creates water conservation awareness.	Staff time	Increases water conservation awareness	On-going	City of Sierra Vista
Sierra Vista	Closure of treatment facility one at Charleston.	Will eliminate evaporative loss from facultative ponds no longer in use.	\$500,000 Capital	324 ac/ft year	30-Jun-03	City of Sierra Vista
Sierra Vista	Established the City's Water Management Team	An internal working group established to address all water issues involving the City. Provides a central POC.	Staff time	Increases water conservation awareness	On-going	City of Sierra Vista
Sierra Vista	Member of Chamber Water Issues Committee	Provides water conservation assistance to chamber staff and members.	Staff time	Increases water conservation awareness	On-going	City of Sierra Vista
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Sierra Vista	Native tree nursery	Enables the City to set the example by providing drought tolerant trees for public projects.	Staff time & \$1,000	Increases water conservation awareness	On-going	City of Sierra Vista
Sierra Vista	Plant Sciences Center	Encourages the reuse of low-water use plants reducing water consumption.	\$3,000 Annually	Increases water conservation awareness	On-going	City of Sierra Vista
Sierra Vista	Code: Waterless Urinals	Waterless urinals are required for all commercial facilities utilizing urinals, including all remodels and retrofits.	Developer funded	Estimated ave. of 2.0 AF/yr	Implemented 5/99. On-going per site.	City of Sierra Vista
Sierra Vista	Code: Golf Course Restrictions	Golf courses shall use low-water type turf; 5 acre turf limit per hole; ponds discouraged/limited to 500 sq ft; CUP required	Developer funded	Estimate a new course would use 55 AF/yr less than PDS course	Implemented 5/99. No new courses to date.	City of Sierra Vista
Sierra Vista	Code: Lakes, Ponds Restrictions Retrofit	All artificial lakes, ponds or other water features limited to 500 square feet in size	No cost	Creates a disincentive to development of water-ski lakes, etc.	Implemented 5/99. No new lakes or ponds to date.	City of Sierra Vista
Sierra Vista	Code: Turf Restrictions	Use of turf prohibited in new government, commercial and industrial development. Multi-family 20%. Single-family max. 200 sq ft front/side yards. (no restrictions in back yard)	No cost	Unknown. Elimination of turf will save approx. 30,000 gal/ 1000 sq ft. annually.	Implemented 5/99. On-going per site.	City of Sierra Vista
Sierra Vista	Code: Drought Tolerant Plant Requirement	All landscape plants utilized at commercial sites shall be from city-approved plant list or accepted alternative.	Developer funded	Unknown. Use of xeriscape landscape is a proven water saver.	Implemented 5/99. On-going per site.	City of Sierra Vista
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Sierra Vista	Code: Native Plant Salvage	Native plant salvage is required for commercial and residential developments that are one acre or more in size.	Cost to city/PSC for inspection, storage, follow-up \$50-\$100 per salvage.	Unknown. Minor if plants relocated. Significant if re-used on site.	Implemented 5/99.	City of Sierra Vista
Sierra Vista	Code: Irrigation Standards	Regulates watering on steep slopes, narrow medians, adjacent to curbs, etc.	Developer funded; city project cost nominal.	Unknown. Prevents water waste.	Implemented 5/99.	City of Sierra Vista
Sierra Vista	Code: Outdoor Misters	Prohibits the installation of water misters in commercial development.	No cost	Unknown.	Implemented 5/99	City of Sierra Vista
Sierra Vista	Code: Hot Water Recirculation Pumps	Pump required, time and/or temperature control required, pipes insulated, multi-family development independently metered or equivalent.	Developer/Owner funded	3.8 AF/yr (based on 250 res. Permits @ 5000 gal saved/year	Implemented 5/00. Amended 4/02.	City of Sierra Vista
Sierra Vista	Modify Native grasslands project	Modify irrigation activities related to restoration of retired irrigation fields at the City's EOP	0	200 ac.ft.not used for the start-up year of this project	On-going	Environmental Operations Park
Sierra Vista	WATERtight New Home Program	Will recognize new homes constructed to strict water conservation standards. (Standards to be established)	Staff time	Increases water conservation awareness	In development	City of Sierra Vista
Sierra Vista	Code: Car Wash RecyclingRetrofit	New commercial car wash facilities are required to recycle 75 percent of the water utilized.	Developer funded	Unknown. Two facilities approved 2002 - under construction	Implemented 5/99. On-going per site.	City of Sierra Vista
Sierra Vista	Funding in Support of Partnership	Active member in the USPP, assigned to study and develop a regional water use plan	\$75,313 annually, \$301,253 to date	Institutional Support	1998-ongoing	City of Sierra Vista
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Sierra Vista	Water Management Strategy in Support of Ft. Huachuca BA/BO	City staff working on a Water Mgmt. Strategy that should reduce the remaining water use burden within the Sub-watershed	To be determined	1000-5000 ac/ft/yr	2002-2011	City of Sierra Vista
	Watershed Restoration Projects- Mexico	Work with Mexico partner agencies/organizations to improve watershed condition through restoration projects with willing private landowners	To be determined	Unknown	2001-ongoing	Within the Mexico Sub-watershed with potential hydrologic ramifications for the Sierra Vista Sub-watershed
	San Pedro Community Monitoring Network	Production of annual maps showing spatial distribution of surfaceflows along the mainstem San Pedro at the driest time of the year, each year.	\$7,000 / yr operational expenses	Benefit is increased knowledge of hydrologic conditions	Once per year (1999-ongoing)	Mainstem San Pedro within Mexico and U.S., north to St. David
	Ramsey Canyon Interpretive Displays	The Preserve's Visitor Center hosts approximately 20,000 guests each year. Interpretive displays have been installed describing the San Pedro and our associated collaborative USPP conservation efforts.	Approximately \$7000 capital cost for fabrication of displays.	Benefit is public outreach	2000-Ongoing	Messages reach visitors from all over the world
	Ramsey Canyon Conservation Projects	1)Water harvesting demonstration project at Visitor Center 2)Fire Demonstration Area: Comparisons between thinned, and thinned and burned forest stands with untreated stands 3)Community Outreach Program/home fire assessments in Ramsey Canyon	Variable	Visitor Center roof harvests approximately 10,000 gallons/yr, other projects not determined	1999-Ongoing	Localized within Ramsey Canyon, but with demonstration value for other locations
	Fee Acquisition of Agricultural Lands	BLM and TNC work together to retire agricultural pumping through full fee purchase of tracts with a documented history of agricultural irrigation. Lands are purchased from willing sellers, and subsequently resold to BLM as additions to the SPRNCA.	Generally \$500-\$3,000 per acre in Gap/Borderlands area.	Previous projects include: McDowell/Craig and Morman Farms totaling approx. 2500 af/yr	1991-ongoing	Palominas / Hereford area.
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TNC	Purchase of Conservation Easements (Retire Irrigated Ag)	DOD, TNC and BLM are working together to pay willing sellers to retire agricultural pumping on private lands through conservation easements that place restrictions on their deeds.	Capital costs range from 20-80% of the fair market value of unencumbered parcels, depending upon restrictions placed within each easement. \$978 K spent to date.	1139 af/yr to date 2530 af/yr that could be potentially retired	2001-2004 (?).	Palominas / Hereford area.
	Purchase of Conservation Easements (Precluding Future Ag or Subdivision)	BLM and TNC are working to limit future subdivision or irrigation on key habitats near SPRNCA on private lands through conservation easements that place restrictions on their deeds, using Land and Water Conservation Funds.	Capital costs range from 20-80% of the fair market value of unencumbered parcels, depending upon restrictions placed within each easement. \$1 million spent to date (Bill to verify).	Prevention of future water use only	2000-ongoing.	Palominas / Hereford area.
TNC	Purchase of Land or Conservation Easements-Mexico	Acquire key parcels working with Mexico partner agencies/organizations via land acquisition or conservation easements to conserve key habitats, and groundwater resources	Land acquisition costs consistently less than in U.S., but not yet well defined	Unknown	Start-up phase	Within the Mexico Sub-watershed with potential hydrologic ramifications for the Sierra Vista Sub-watershed
	Binational Water Conservation Planning	Collaborative land and water use planning across agency, institutional, and political boundaries	To be determined	Unknown	2000-ongoing	Within the Mexico Sub-watershed with potential hydrologic ramifications for the Sierra Vista Sub-watershed
TNC	Public Education Projects-Mexico	Establish and support community outreach and education projects with Mexico partner agencies/organizations	To be determined	Unknown	Ongoing	Within the Mexico Sub-watershed with potential hydrologic ramifications for the Sierra Vista Sub-watershed
USGS	Stream flow Monitoring	Monitoring of surface flow in San Pedro and other major tributary streams (Greenbush Draw and Banning Creek)	384,000 over 5 years	Water Resources Information	Ongoing	River and tributaries
	Name of Project, Policy or Program	Brief Description	Capital Cost or Annual Expense	Annual Yield (AF/yr) or Intended Benefit	Timeframes Start/Finish	Geographic Area of Project/Impact

USGS	Summer Run-off Decline	Assess the casue of reduced run-off from watershed above Charleston	300,000 over 5 years	Water Resources Information	Ongoing	Watershed
	Stream-Aquifer Interactions	Improve understanding of interactions between the San Pedro and thre regional aquifer using monitoring wells, gravity stations and transects	522,000 over 5 years	Water Resources Information	Ongoing	River and tributaries
	Groundwater Model	Using knowledge developed in USPP and earlier descriptive studies, develop dynamic tool that can be used to determine how the groundwater system will respond to resource development and management scenarios, and improve model with new information	410,000 over 5 years	Water Resources Information	Ongoing	River and tributaries