REGULATED RIPARIAN HABITAT OFFSITE MITIGATION GUIDELINES FOR UNINCORPORATED PIMA COUNTY

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1.0 INTRODUCTION

Chapter 16.30 of the Floodplain and Erosion Hazard Management Ordinance No. 2010-FC5 (Ordinance) stipulates that an applicant (private property owner, government agency, land developer, or builder) can mitigate for unavoidable impacts to regulated riparian habitat (RRH) through onsite mitigation. If onsite mitigation is investigated and deemed not feasible for the applicant, then offsite mitigation may be proposed, per Section 16.30.050.D of the Ordinance:

"Mitigation banking or other alternative mitigation measures as approved by the Board. At the request of the property owner, and with Board approval, the mitigation plan requirement under this chapter may be waived by contributing funds to an account established and administered by the District for the purpose of offsetting damage to riparian habitat."

As outlined in the Ordinance, an offsite mitigation proposal must be reviewed and approved by Pima County Regional Flood Control District (District) and the Flood Control District Board of Directors (Board). Currently, there are three offsite mitigation options available, including:

(1) Restoration of disturbed or degraded RRH on another parcel of land that provides comparable or superior biological function similar to the RRH proposed for disturbance, with appropriate long-term protection measures;

(2) Land transfer proposals; and

(3) Payment of an in-lieu fee.

Offsite mitigation opportunities become an option only after the applicant has shown that avoidance is not possible, impacts to RRH have been minimized, and the ability to mitigate entirely onsite has proven unfeasible. Compensation for RRH loss (in-lieu fee) is not meant to replace avoidance and minimization.

This document, hereafter referred to as the Guidelines, describes how the in-lieu fee (ILF) program will function and be administered and provides guidance for alternative offsite mitigation options.

2.0 MITIGATION IN-LIEU FEE

2.1 IN-LIEU FEE OPTION - BACKGROUND

One option to compensate for disturbance of RRH is a fee in-lieu of onsite riparian habitat mitigation. The ILF program has been updated and simplified for ease of use by applicants, and incorporates changes to the riparian protection regulations adopted under Ordinance 2005-FC2 and 2010-FC5. During the process of updating the Guidelines several options for assessing how to calculate the ILF were examined (Appendices B and C). The ILF option selected for use in the Guidelines is based on the amount and type of habitat disturbed, standardized costs for onsite mitigation (derived from representative real project costs), and an adjustment for inflation. Inflation rates will be reviewed and adjusted an average of every two to three years.

The fee structure is based on the cost to mitigate onsite, with standard costs determined by the District. A cost is assigned to each onsite mitigation component and is incorporated into a spreadsheet (Appendix F), whereby the user can input parameters, such as acreage of disturbance, resulting in an ILF cost output. The following mitigation components are incorporated into the spreadsheet:

- Plant material (container trees and shrubs);
- Labor for plant material installation;
- Hydroseed (seed, mulch, water, cost for machinery, and labor to apply seed) (cost/acre);
- Irrigation system (materials and labor for installation) (cost/acre). Irrigation costs are calculated as a percentage of the plant material costs;
- Five years of maintenance (removal of noxious/invasive plant species, water, replacement plants, etc.). Maintenance costs are calculated as a percentage of the plant material costs; and
- Five years of monitoring within Class H and/or IRA habitat and three years of monitoring within xeroriparian habitat. Monitoring costs were estimated based on actual projects.

A standard value is assigned to each mitigation component and is based on average cost estimates obtained from local vendors and consultants. An explanation for how costs were obtained is provided in Appendix F. The spreadsheet allows each component of the mitigation plan to be calculated separately so that total mitigation costs can be accurately assessed for each project. For example, a single-lot property owner will typically pay a smaller fee than the developer of a commercial or residential property since they have the ability to minimize installation, seeding, and irrigation costs.

Although use of the standard ILF calculation spreadsheet is encouraged, applicants may hire a qualified professional to prepare an ILF estimate. If a qualified professional is used, their estimate shall account for mitigation components, as listed above, and follow requirements in the ILF checklist provided in Appendix G.

2.2 PROJECT SPECIFIC IN-LIEU FEE CALCULATION OPTIONS

As discussed in Section 2.1, applicants have options when calculating the ILF. The option selected will depend upon the type of development and mitigation proposed. How options are applied to a given project are described below.

1. **Flat fee table**. Applicant shall use the flat fee table for calculating the fee for acreage of disturbed RRH not mitigated onsite. Flat fee costs were calculated using the ILF calculation spreadsheet and are based on cost per acre to mitigate onsite. When choosing the ILF option to satisfy a project's mitigation requirement the flat fee table is a simple way to determine the fee for RRH disturbed. The flat fee table accounts for all components of a mitigation plan.

   Table 1 provides cost per acre for single-lot development. Table 2 provides cost per acre for Development Projects.

Table 1. ILF Single-Lot Development Flat Fee Table - Cost per Acre for RRH Disturbance

	XA	XB	XC	XD	IRA/H, H	IRA/XA	IRA/XB	IRA/XC	IRA/XD
Cost per Acre	$8,500	$7,500	$6,500	$5,000	$17,000	$12,500	$11,000	$9,500	$8,000

Table 2. ILF Development Project Flat Fee Table - Cost per Acre for RRH Disturbance

	XA	XB	XC	XD IRA/H, H	IRA/XA	IRA/XB	IRA/XC	IRA/XD
Cost per Acre	$17,000	$16,000	$14,000	$12,000	$40,000	$30,000	$28,000	$25,000	$22,000

2. **ILF Calculation Spreadsheet**. The applicant may use the ILF calculation spreadsheet (Appendix F) when certain components of the mitigation requirement are not completed onsite. The ILF calculation spreadsheet allows an applicant to determine ILF costs for individual components of a mitigation plan (e.g., trees/shrubs, seeding, or irrigation, etc.). For example, an appropriate use of the ILF Calculation Spreadsheet would be when an applicant proposes planting only 50 percent of the required trees/shrubs onsite but placing 100 percent of the seeding requirement onsite.

   The "component" ILF would then represent the value of 50% of trees/shrubs and irrigation not implemented on the project site. Note, when calculating component values, percentages of the irrigation component must equal the percentage of trees/shrubs component.

3. **ILF Cost Estimate provided by a qualified professional**. If an applicant prefers, ILF cost estimates may be obtained from a qualified professional as an alternative to using the flat fee or spreadsheet calculations. Qualified professionals include: nurseries, landscape companies, landscape architects, biologist, botanist, or other qualified professionals that would design, supply, or install components required for onsite mitigation. Submittals shall follow requirements listed in the ILF checklist provided in Appendix G.

The applicant is responsible for selecting the option that is best suited to a particular project and incorporate into the mitigation proposal.

3.0 IN-LIEU FEE PROGRAM ADMINISTRATION

3.1 ADMINISTRATIVE PROCESSING OF IN-LIEU FEES

3.1.1 FEE COLLECTION

Single-lot Residential Development.

A single-lot residential development proposal disturbing more than 1/3 acre of RRH requires a Floodplain Use Permit (FPUP), which must be obtained prior to issuance of the building or grading permit. When onsite mitigation occurs, a Riparian Habitat Mitigation Plan (RHMP) is approved prior to issuance of the FPUP with mitigation occurring after construction is completed. When an ILF is proposed, fees are collected prior to issuance of the FPUP. This process ensures that a property owner compensates for disturbance of RRH prior to the impact occurring.

Collection Procedure

Fees will be collected prior to issuance of the FPUP. For projects that require a specific hold, such as Prior to Slab inspection (P2S) or Prior to Electrical inspection (P2E), submittal of the ILF may be delayed until the time of inspection. The applicant shall provide a written request to delay payment of the ILF, which will be reviewed on a case-by-case basis. Delayed ILF payments, if approved, must be received prior to the P2S or P2E inspection.

Commercial Development and Subdivisions

For projects following the development review process, ILF proposals are approved prior to Tentative Plat or Development Plan approval.

Collection Procedure

ILF payment must be received upon approval of the grading or paving plan, prior to issuance of the grading or paving permit. A note will be placed on the plat or plan that states that the ILF shall be paid prior to the authorization of any activity on the parcel.

Fines collected from RRH violations

On May 4, 2010, the Board adopted Ordinance No. 2010-FC5. The amended Ordinance allows the District to impose civil penalties for violations of the code, including violations related to the unpermitted disturbance of RRH. The District will pursue fines equal to the amount of the ILF value based on the amount of unpermitted disturbance. Fines obtained from violations resulting from RRH disturbance will be deposited into the ILF program bank account.

Administrative Processing

Payment of the ILF can be accepted via check or money order and shall be made payable to "Pima County Treasurer". When payment for the ILF is submitted, the applicant and/or property owner is issued a receipt, detailing the amount of the check/money order, check number, and project or FPUP number. This information is then placed into the ILF tracking database and deposited into the ILF program bank account.

3.1.2 ANNUAL REPORTING

An annual report, documenting the total amount of funds collected and disbursed throughout the year will be prepared at the end of each fiscal year. The report will document annual income deposited into the ILF program bank account, annual withdrawals for expenditures, a summary of property acquisitions by parcel number, and provide a brief section on funds spent for land stewardship activities and restoration.

3.2 DISTRICT EXPENDITURE OF IN-LIEU FEE PROGRAM FUNDS TO COMPENSATE FOR HABITAT LOSS

District priorities for expenditure of ILFs are:

Acquisition and Preservation

Preservation of high value habitat is best achieved through acquisition, which removes development pressure on riparian habitat. Acquisition-in-fee title of land containing riparian resources is an effective method for protecting and preserving intact habitat. Additional methods for the preservation of riparian resources is by protecting shallow ground water sources through acquisition or transfer of water rights, and protection of hydrologic functions and key features located in the watershed upstream of riparian areas.

Restoration and Enhancement

Restoration and enhancement of riparian vegetation can be a viable and desirable option for the use of ILF funds. The receiving area for restoration and/or enhancement of habitat must be able to support restoration efforts over the long term. Physical site characteristics, restoration objectives and design, and legal mechanisms that lead to long-term self-sustaining habitat must all be taken into account. Other restoration activities under this priority include land stewardship practices that allow degraded habitat to heal and naturally restoring processes that protect riparian habitat or water supply.

3.2.1 OPTIONS FOR EXPENDITURE OF IN-LIEU FEE FUNDS: ACQUISITIONS, LAND STEWARDSHIP, AND RESTORATION

Several options are available to the District for expenditure of ILF funds to compensate for impacts to RRH. Options include the following; acquisitions (land, water rights, conservation easements), land stewardship, and restoration.

3.2.1.1 ACQUISITIONS

Several types of acquisitions may be made with funds received through the ILF program and include land, water rights and/or conservation easements. All acquisitions are subject to Board review and approval.

3.2.1.1.1 *Land*. Land would be selected based upon the resource value as determined by the Riparian Acquisition Map (Section 5.0). Funds would be used to purchase land in fee-simple. Water, mineral, and other rights may or may not be included in the purchase. The land will additionally receive long-term protection through use of a conservation easement or restrictive covenant.

3.2.1.1.2 *Water Rights*. Water rights adjoining sensitive riparian areas may be purchased using ILF funds.

3.2.1.1.3 *Conservation Easements*. Conservation easements on lands containing high value riparian habitat may be purchased using ILF funds.

3.2.1.2 LAND STEWARDSHIP

In this option, funds would be distributed for stewardship of riparian habitat on existing Pima County-owned lands. Stewardship activities may include fencing to prevent unauthorized access by off-road vehicles and livestock, long-term monitoring, and invasive species control.

3.2.1.3 RESTORATION

Restoration techniques may be implemented on existing Pima County-owned lands. Restoration techniques may include hydroseeding disturbed areas, incorporating water harvesting features, installing check dams, or other low-cost methods to enhance and restore existing riparian habitat.

4.0 ALTERNATIVE OFFSITE MITIGATION OPTIONS

Several alternative offsite mitigation options are available to projects undergoing the development review process. Options include onsite mitigation occurring on an offsite parcel of land, a land transfer, or other offsite mitigation options. An alternative offsite mitigation proposal shall describe the relationship between the ecosystem functions being impacted on the project site and the functions which are compensated for by the proposed mitigation site.

Alternative offsite mitigation options available to single-lot property owners include (1) the option to mitigate on an offsite parcel of land in accordance with the onsite mitigation guidelines (Section 4.1.1) or (2) land transfer option (Section 4.2). Land transfer proposals will be reviewed on a case-by-case basis and are subject to the discretion and approval of the District and Board.

4.1 MITIGATION OF AN OFFSITE PARCEL OF LAND

4.1.1 ONSITE MITIGATION ON AN OFFSITE PARCEL OF LAND

Mitigation in accordance with the onsite mitigation guidelines may be performed on another parcel of land with approval of the District. The proposed parcel must contain comparable or superior riparian habitat or may only be used if the parcel is suitable for enhancement or restoration of degraded riparian habitat as determined by the District. A deed restriction that protects the mitigated area(s) in perpetuity must be recorded. Additionally, the parcel must adhere to the following mitigation standards[1]:

- If the proposed mitigation land will be split off from an existing parcel of land, the mitigation land shall be located and consolidated in the most biologically sensitive portion(s) of the property;
- Mitigation land shall be configured to minimize harmful edge effects;
- Mitigation land shall be contiguous with any conserved land on adjacent properties; Preferably, mitigation land should be located within the same watershed as that impacted by development;
- Mitigation land shall be free of all significant harmful land use practices that impair mitigation values (e.g., off-road vehicle use, livestock use/grazing, etc.), or if harmful land use practices have occurred in the past, the land may be restored and protected from future harmful land practices.

As an alternative to the onsite guideline requirement for providing mitigation on an offsite parcel of land, an applicant may propose mitigation through use of a Riparian Habitat Preservation Plan (RHPP).

[1]Adapted from standards drafted and approved by the Multi-Species Conservation Plan (MSCP) Implementing Agreement Committee

4.1.2 RIPARIAN HABITAT PRESERVATION PLAN

Mitigation of an offsite parcel of land for qualifying larger projects (those that are required to go through the platting, specific plan, comprehensive plan, and/or rezoning processes) may follow requirements of a Riparian Habitat Preservation Plan (RHPP). A RHPP is designed to support the success of onsite preservation of riparian areas and the mitigation of disturbed habitat, as well as serve the special needs of a given project within the context of its natural resources, both upland and riparian.

For qualifying projects, applicants may propose a RHPP as an alternative to the basic requirement. The minimum requirement for a RHPP is to meet the conservation goals and objectives of the Maeveen Marie Behan Conservation Land System (CLS). The RHPP must preserve, enhance, provide connectivity, overall function, and/or restore an impacted riparian system and/or its surrounding areas and is subject to the discretion and approval of the District and the Board.

A RHPP may be acceptable when traditional mitigation does not address unique ecological or project conditions, such as:

- Highly fragmented and/or degraded riparian habitat;
- Sites with other unique ecological functions where a blended preservation plan would be more functional or appropriate; and
- Linear projects, such as roadways and sewers, or linear portions of projects where avoidance is not possible and linear mitigation options would provide limited value.

A RHPP may include, but is not limited to:

- Alternative options for restoring degraded riparian habitat;
- Preserving or enhancing wash corridors containing riparian habitat and transition zones that were not mapped under the Riparian Classification Maps to increase connectivity;
- Conservation of adjacent uplands along riparian habitat to maintain diversity and watershed function;
- Combination of onsite and offsite conservation or mitigation; and
- Other conservation efforts that meet unique site ecological conditions including preservation of keystone species (e.g., ironwood and saguaro).

The RHPP must be equivalent to or exceed the ecological value of a traditional RHMP. Determination of equivalent ecological value will require an assessment of the offsite parcel(s) biological resources by a qualified professional and must reference and incorporate unique features identified by the Natural Resource Assessment Report (NRAR - Appendix D) into the RHPP. The NRAR must also address the overall connectivity and function of preserved riparian habitat on the offsite parcel(s) and how the proposed RHPP will enhance the overall function of riparian habitat.

Degraded habitats located on an offsite parcel can be restored in a number of ways, which may include direct restoration of degraded habitat or by restoring connectivity of habitat with techniques and land stewardship actions other than those outlined in the onsite mitigation guidelines. These techniques or actions may include:

- Cattle exclusion and/or regulation of grazing intensity or season,
- Noxious and/or invasive plant species control for the entire undeveloped RRH area and possibly upland areas. This option will depend upon the severity of the infestation, type of noxious and/or invasive species present, must be coincident with other restoration techniques, such as hydroseeding, and may not be used if a property owner has already been required to control invasive species,
- Short-term use of effluent for establishment of a mitigation area (i.e., spray fields to establish native seed mix),
- Abandonment of functioning wells in areas of shallow groundwater,
- Obtaining water rights for a particular property and transferring the rights to Pima County,
- Channel stabilization efforts,
- Water harvesting,
- Other restoration techniques that have also proven to have substantial riparian habitat benefits.

A condition for use of a RHPP is that a proposal must demonstrate long term sustainability. For example, effluent may be used to establish plants and/or the seed mix; however, long-term use of effluent may not be used to artificially increase the density of existing riparian habitat or to sustain high water use plant species that would require irrigating with effluent for the duration of the plant's life.

4.2 LAND TRANSFER

Applicants may propose transfer of land in-lieu of onsite mitigation. Land transfer proposals shall provide multiple benefits such as preservation of valuable habitat corridors, providing habitat connectivity and augmenting habitat preserved on public land, parks, preserves and habitat restoration projects.

To satisfy offsite mitigation requirements for disturbance to RRH, an applicant may choose to acquire land elsewhere in the County and transfer that land to the District for long-term protection of its riparian and biological resources. To assist the applicant in locating desirable parcels for land acquisition, the District has provided a land acquisition map indicating the general location of lands that may qualify for the land transfer option. This map is called the Riparian Acquisition Map (see Section 5.0). In addition to the map, a land acquisition checklist has been provided in Appendix H.

For land to qualify for RRH mitigation and transfer to the District, it must have biological and hydrological value that is of comparable or higher quality than the disturbed RRH. Values that must be considered include, but are not limited to, water availability, vegetation density, and biological productivity. An evaluation of these values by a qualified professional will be required as part of the applicant's land acquisition proposal. Selection of land appropriate for the land acquisition and transfer option shall be based on information provided by the applicant's NRAR (Appendix D).

Key points to consider when selecting land for transfer include the following:

- Preference will be given to land within the same watershed as the disturbed RRH. If land cannot be identified within the same watershed, transfer of land outside the watershed is an option;
- Land must have an equivalent or higher quality riparian habitat value (biological and physical) than the disturbed RRH;
- A biological evaluation of the land (NRAR), performed by a qualified professional is required;
- Include mechanisms to protect resources and conservation values in perpetuity; and
- All land acquisition proposals are subject to District and Board review and approval.

For applicants who are interested in the land transfer option, a **pre-submittal meeting with the District will be required prior to submittal of the mitigation proposal and NRAR.** Mitigation lands proposed for the land transfer option will be reviewed on a case-by-case basis and require **District pre-approval**.

The District will consider long-term management and monitoring costs for the transferred land and may at its discretion request a monetary donation or endowment from the beneficiary to cover management costs.

4.3 PROTECTION OF MITIGATION LAND

Long-term protection of mitigation land is critical to the success of the offsite mitigation program. Long-term protection can be achieved through transfer of mitigation land in fee title to the County or placement of a conservation easement or restrictive covenant on the mitigation land (Appendix E).

Proposals involving the setting aside of private land being utilized as mitigation under the Ordinance will require a restrictive covenant that is recorded with the property deed and runs with the land. These proposals will be evaluated individually based on the specific needs of each property and the covenants will include the following:

- The covenants will protect the mitigation area in perpetuity, restricting activities that negatively impact the natural resources or functions that support the mitigation area.
- Such a covenant would list specific stewardship activities and requirements for the property to protect the mitigation area in perpetuity.
- The land owner agrees that the County has rights of enforcement of the covenant conditions.

4.4 OTHER OFFSITE MITIGATION OPTIONS

A developer may purchase water rights that directly impact and/or support groundwater dependant riparian ecosystems. Acceptance of water rights for mitigation is subject to District and Board review and approval. This mitigation option requires District pre-approval and interested applicants are required to attend a **pre-submittal meeting with the District** to review proposed water rights acquisition(s).

5.0 LAND ACQUISITION CRITERIA

Land that may qualify for acquisition under the offsite mitigation program shall be selected based on the following criteria, which help to define inter-connected corridors associated with watercourses throughout the County:

Landscape Level:

- Landscape position (Maeveen Marie Behan Conservation Lands System (CLS) categories)
- Covered species habitat (Priority Conservation Areas)

Watershed/Project Site Level:

- Adjacency to existing preserves;
- Adjacency to major watercourses;
- Connectivity between riparian areas;
- Riparian Classification Maps – Riparian vegetation plant community (Class H vs. Xeroriparian) and density (Total Vegetation Volume);

- Water Availability (Class H, shallow groundwater/intermittent and perennial streams/springs);
- Hydrology/Hydraulics – Ability to support riparian vegetation (presence of FEMA floodplains or locally mapped floodplains);
- Adjacency to reaches of watercourses defined by the 2002 SDCP Report "Riparian Priorities" (available for viewing and downloading at http://www.pima.gov/CMO/SDCP/reports.html);
- Adjacency to existing District or County-owned property; however, this criterion is subject to verification of future uses of the land prior to being considered. Certain Pima County-owned land are set aside for future development;
- Within Habitat Protection Priority Areas or Private and state priority areas, pursuant to the Conservation Bond Program (2004 and 2010);
- Connectivity with parks, refuges, existing Pima County restoration projects, and undeveloped land;
- Adjacency to platted Natural Open Space (NOS);
- Special Elements (bosques, cottonwood/willow forests, springs, etc.);
- Historical perennial flows;
- Constructed vs. natural riverine systems; and
- Adjacency to or use of Transfer of Development Rights (TDR) Program Sending Areas. Development rights are severed from these lands, which allows for higher density development in receiving areas (growth areas). TDR Sending Areas must have comparable RRH values.

The Riparian Acquisition Map (RAM) may be used to assist a property owner or developer in assessing property(s) for the criteria listed above. The RAM is a GIS based map that incorporates information derived from reports and data developed in support of the Sonoran Desert Conservation Plan (SDCP). These reports spatially define biologically sensitive lands at a landscape level. Additional information regarding the RAM can be found in Appendix H.

APPENDIX A

MITIGATION OPTION MATRIX AND REVIEW PROCESS SUMMARY

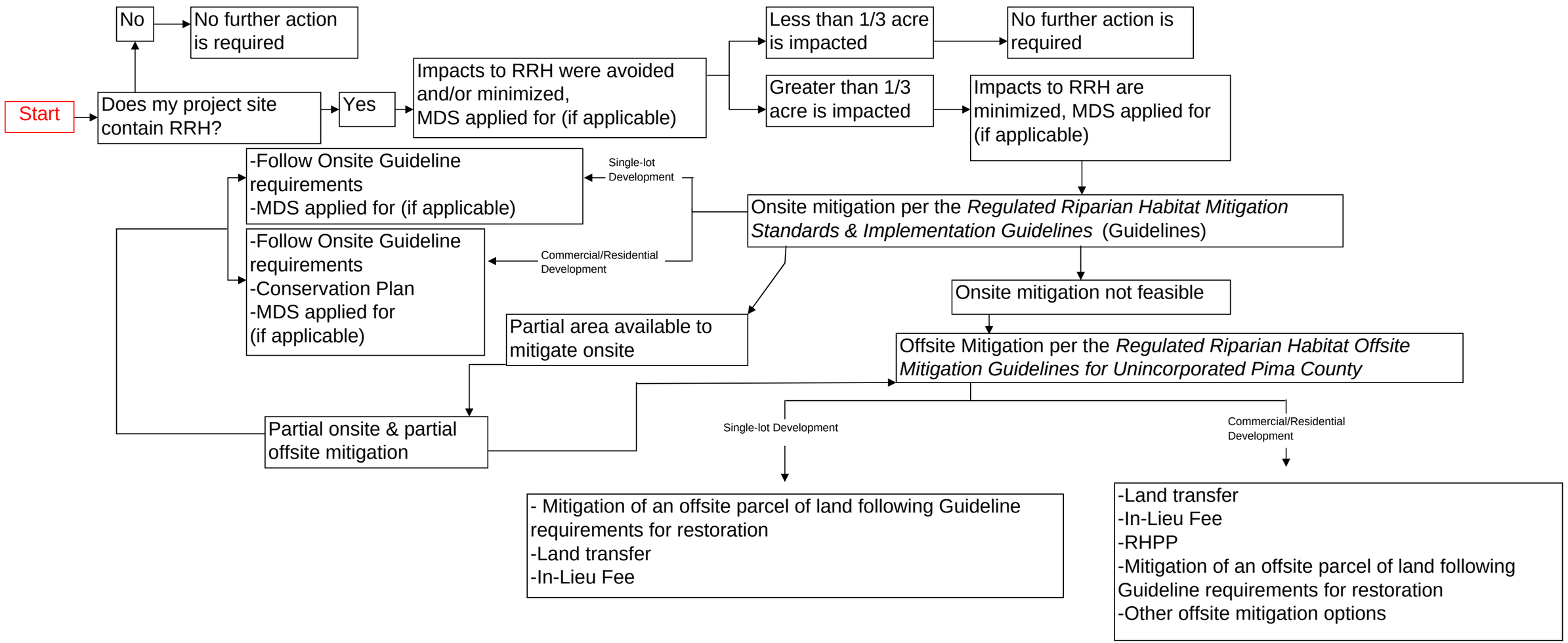
Mitigation Options Available for Disturbance of Regulated Riparian Habitat (RRH)

Mitigation Options	Single-lot Development		Commercial/Residential Development		Comments
	Onsite*	Offsite**	Onsite*	Offsite**	
Onsite mitigation	X		X		Enhancing or restoring onsite riparian habitat function by replanting with native vegetation
Partial onsite mitigation/partial offsite mitigation (see offsite mitigation options)	X	X	X	X	Allows more flexibility when riparian function can't be replaced entirely on the project site/subject parcel. See the "offsite" column to determine which offsite mitigation options would apply
Offsite mitigation		X		X	Includes mitigation at an "offsite" location for single lot development, or all the offsite mitigation options noted in the "offsite" column for commercial/residential development
Conservation Plan			X		Flexible tool to preserve the project site's (onsite) natural resources. Allows for alternative onsite mitigation measures such as: - stewardship to remove system stressors, such as invasive species - preserve unique ecosystem features - preservation of unmapped areas to provide buffer for high value riparian habitat - preservation of unmapped riparian habitat
In-lieu Fee		X		X	Monetary contribution used to preserve, protect, or restore habitat
Riparian Habitat Preservation Plan (RHPP)				X	Flexible tool offering opportunity to preserve offsite natural resources; offsite version of the "Conservation Plan", sharing many elements
Restoration of an offsite mitigation parcel		X		X	Enhancing or restoring riparian habitat function by replanting with native vegetation on a offsite parcel in accordance with onsite mitigation guideline requirements.
Land transfer		X		X	Additional tool for protecting riparian habitat function. Land containing riparian habitat is acquired and conveyed to the District in exchange for impacts to regulated riparian habitat.
Other offsite mitigation options				X	Additional options allowing for the preservation of riparian function through: - purchase of water rights - other options?

*"Onsite" = mitigation occurring within the project boundaries and/or subject parcel
**"Offsite" = mitigation occurring outside the project boundaries and/or subject parcel

Excerpted from the Regulated Riparian Habitat Offsite Mitigation Guidelines for Unincorporated Pima County

Regulated Riparian Habitat (RRH) Mitigation Options



MDS = Modified Development Standards per Zoning Code requirements
RHPP = Riparian Habitat Preservation Plan
RRH = Regulated Riparian Habitat

Excerpted from the Regulated Riparian Habitat Offsite Mitigation Guidelines for Unincorporated Pima County

Primer for Property Owners – Navigating Chapter 16.30 Regulatory Requirements

Overview

Permitting Process:

Step 1 – Site Planning
Step 2 – Avoid and/or minimize impacts to RRH
Step 3 – Calculate amount of RRH disturbed
Step 4 – Apply for a Floodplain Use Permit
Step 5 – Select mitigation option (onsite mitigation, combination onsite and offsite mitigation, or offsite mitigation)
Step 6 – Pima County Board of Supervisors (Board) review and approval, if required
Step 7 – Sign special covenant
Step 8 – In-Lieu Fee (ILF) or Land Transfer
Step 9 – Issuance of Floodplain Use Permit

Post-permitting obligations:

Onsite mitigation
Step 1 – Install mitigation area.
Step 2 – Maintain and monitor mitigation area for a period of five years
Step 3 – Mitigation area achieves 80% success criteria

Offsite Mitigation
Option 1: Pay In-Lieu Fee (ILF) Prior to Slab (P2S) or Prior to Electrical (P2E) inspection
Option 2: Onsite mitigation on an offsite parcel of land
    Step 1 – Install mitigation area on an offsite parcel of land
    Step 2 – Maintain and monitor mitigation area for a period of five years
    Step 3 – Mitigation area achieves 80% success criteria

Q: I own property within unincorporated Pima County and would like to obtain a permit for development (building permit, grading permit, etc.). My property contains mapped regulated riparian habitat (RRH). What steps do I take to comply with Chapter 16.30 of the Floodplain Management Ordinance (Ordinance)?

Permitting Process

Step 1: Site Planning. Gather initial information about the property. Begin by inventorying site constraints including but not limited to the location of:

- Washes (Title 16)
- Floodplains (Title 16)
- RRH (Title 16)
- steep slopes (Title 18)
- Property boundary setback requirements (Title 18)
- Rock outcroppings (Title 18)
- Other site constraints

Determine how each site constraint will impact development of the property by visiting Pima County Development Services Department to address site constraints regulated under Title 18 and Pima County Regional Flood Control District (District) to address site constraints regulated under Title 16. Once information is gathered, prepare a site plan (site plan requirements can be viewed at: http://rfcd.pima.gov/fpm/permits/). Show location of washes, steep slopes, RRH, etc. on the site plan. Locate development within the least hazardous area of the property.

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If the property owner disagrees with the location of RRH shown on the 2005 Riparian Classification Maps, they have the option to verify the location of RRH in the field. Requirements for field verification can be found in the Onsite Guidelines, Appendix F and G.

Step 2: Avoid and/or minimize impacts to RRH. Once development has been located in the least hazardous area of the property, avoid and/or minimize impacts to RRH, as feasible. This can be achieved in a number of ways, including but not limited to structure orientation, reducing setback requirements by obtaining a Modified Development Standard as outlined in Chapter 18.07, or other avoidance measures as outlined in Technical Policy 024, *Avoiding Riparian Habitat – Requirement*.

Step 3: Calculate amount of RRH disturbance. Follow Technical Procedure 107, *Calculating Riparian Habitat Disturbance*. If disturbance is less than 1/3 acre, RRH requirements have been met, no further action is required. Verify with Floodplain Management that compliance with floodplain and erosion hazard setback requirements has been met. Disturbance of less than 1/3 acre will be tracked and cumulatively applied toward future disturbance of RRH. If greater than 1/3 acre disturbance occurs, proceed to step no. 4

Step 4: Apply for a Floodplain Use Permit (FPUP). If an FPUP application has not already been submitted, submit an application at the District's customer service counter, located at 97 E. Congress Street, 3rd floor.

Step 5: Select Mitigation Option.
*Onsite mitigation***.** Onsite mitigation may occur within previously disturbed areas or areas that will be temporarily disturbed through construction. Proposed onsite mitigation areas will be reviewed for sustainability and ability to support native riparian vegetation at a density and vegetation volume similar to the disturbed habitat. Mitigated area shall replicate pre-disturbance riparian habitat within a period of five years. Riparian Habitat Mitigation Plan (RHMP) requirements for onsite mitigation can be found in the following sections of the Onsite Guidelines:

- Section 2,
- Appendix A, and
- Appendix B

Combination onsite and offsite mitigation. When the project site does not contain sufficient area to implement mitigation entirely onsite, a partial onsite and partial offsite mitigation proposal is allowed. Onsite mitigation will follow requirements outlined in the Onsite Guidelines, as noted above. Offsite mitigation will follow requirements outlined in the *Regulated Riparian Habitat Offsite Mitigation Guidelines for Unincorporated Pima County* (Offsite Guidelines). The property owner shall choose which offsite mitigation option is appropriate for the project. Options include:

- In-Lieu Fee (Section 2)
- Onsite mitigation on an offsite parcel of land (Section 4.1)
- Land Transfer (Section 4.2)

Offsite mitigation. When the property owner can show that onsite mitigation is not possible, offsite mitigation is allowed. Offsite mitigation will follow requirements outlined in the *Regulated Riparian Habitat Offsite Mitigation Guidelines for Unincorporated Pima County* (Offsite Guidelines). The property owner shall choose which offsite mitigation option is appropriate for the project. Options include:

- In-Lieu Fee (Section 2)
- Onsite mitigation on an offsite parcel of land (Section 4.1)
- Land Transfer (Section 4.2)

Step 6: Pima County Board of Supervisors (Board) review and approval. Board review and approval is required when disturbance of Class H habitat and/or Important Riparian Areas exceeds 1/3 acre <u>and</u> exceeds 5% of the total mapped RRH on the property or when offsite mitigation is proposed (Title 16, Chapter 16.30).

Step 7: Special covenant. Depending upon the mitigation option chosen, the property owner may be required to sign a special covenant. When required, the property owner will sign special covenants that run with the land to disclose the presence of mitigation area(s) to future property owners.

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Step 8: In-Lieu Fee (ILF) or Land Transfer. If the property owner chose either the ILF or Land Transfer option, payment of the ILF or conveyance of an offsite parcel of land to the District is required prior to issuance of the FPUP (Offsite Guideline, Section 3.1).

Step 9: Issuance of Floodplain Use Permit (FPUP). Once the steps above have been achieved, and compliance with all other applicable Ordinance requirements have been met (http://rfcd.pima.gov/fpm/permits/), the FPUP will be issued to the property owner, authorizing development in accordance with FPUP conditions.

Post-permitting obligations

Onsite mitigation

Step 1 – Install mitigation area in accordance with the Onsite Guidelines, Appendix C, *Installation and Maintenance Requirements* (p. C-2 thru C-9 and C-11).

Step 2 – Maintain and monitor mitigation area for a period of five years in accordance with the Onsite Guidelines, Appendix C, *Installation and Maintenance* (p. C-9 thru C-10 and C-12) and Section 3, *Mitigation Plan Components* (p. 46-50).

Xeroriparian habitat monitoring report submittal timeframe

- "As-built", submit when RHMP is implemented
- Year 1, submit first monitoring report
- Year 3, submit second monitoring report
- Year 5, submit third monitoring report

Class H and/or IRA habitat monitoring report submittal timeframe

- "As-built", submit when RHMP is implemented
- Year 1, submit first annual monitoring report
- Year 2, submit second annual monitoring report
- Year 3, submit third annual monitoring report
- Year 4, submit fourth annual monitoring report
- Year 5, submit fifth annual monitoring report

Step 3 – Mitigation area achieves 80% success criteria (Appendix C, *Installation and Maintenance*, p. C-12)

Offsite Mitigation

Option 1:

Pay In-Lieu Fee (ILF) after issuance of the FPUP, but Prior to Slab (P2S) or Prior to Electrical (P2E) inspection. Upon written request by the property owner, payment of the ILF may be delayed until the Prior to Slab (P2S) or Prior to Electrical (P2E) inspection (Offsite Guidelines, Section 3.1.1).

Option 2:

Step 1 – Install mitigation area on an offsite parcel of land in accordance with the Onsite Guidelines, Appendix C, *Installation and Maintenance Requirements* (p. C-2 thru C-9 and C-11).

Step 2 – Maintain and monitor mitigation area for a period of five years in accordance with the Onsite Guidelines, Appendix C, *Installation and Maintenance* (p. C-9 thru C-10 and C-12) and Section 3, *Mitigation Plan Components* (p. 46-50).

Xeroriparian habitat monitoring report submittal timeframe

- "As-built", submit when RHMP is implemented
- Year 1, submit first monitoring report
- Year 3, submit second monitoring report
- Year 5, submit third monitoring report

Class H and/or IRA habitat monitoring report submittal timeframe

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- “As-built”, submit when RHMP is implemented
- Year 1, submit first annual monitoring report
- Year 2, submit second annual monitoring report
- Year 3, submit third annual monitoring report
- Year 4, submit fourth annual monitoring report
- Year 5, submit fifth annual monitoring report

Step 3 – Mitigation area achieves 80% success criteria (Appendix C, *Installation and Maintenance*, p. C-12)

<u>References cited in this document</u>

Regulated Riparian Habitat Mitigation Standards and Implementation Guidelines (Onsite Guidelines)
Regulated Riparian Habitat Offsite Mitigation Guidelines for Unincorporated Pima County (Offsite Guidelines)
Title 16 – Floodplain Management Ordinance (Ordinance)
Title 18 – Zoning Ordinance (Title 18)
Technical Policy 024, *Avoiding Riparian Habitat – Requirement*
Technical Procedure 107, *Calculating Riparian Habitat Disturbance*

<u>Exhibits</u>

Exhibit A - Mitigation Options Available for Disturbance of Regulated Riparian Habitat (RRH)
Exhibit B - Regulated Riparian Habitat (RRH) Mitigation Options

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Primer for Developers – Navigating Chapter 16.30 Regulatory Requirements

Overview

Development review process:

Step 1 – Site Planning
Step 2 – Avoid and/or minimize impacts to RRH
Step 3 – Calculate amount of RRH disturbed
Step 4 – Meet with District Staff to discuss mitigation proposal
Step 5 – Select mitigation option (onsite mitigation, combination onsite and offsite mitigation, or offsite mitigation.)
Step 6 – Submit Development Review Package to Pima County Development Services Department (DSD)
Step 7 – District approves mitigation proposal
Step 8 – Pima County Board of Supervisors (Board) review and approval, if required
Step 9 – Land Transfer, other Offsite Mitigation options (transfer of water rights)
Step 10 – Tentative plat or development plan is approved
Step 11 – Pay In-Lieu Fee (ILF) prior to issuance of any permits
Step 12 – Improvement Plan is approved
Step 13 – Final Plat is approved

Post-development obligations:

<u>Onsite mitigation</u>
Option 1: Onsite mitigation in accordance with the Onsite Guidelines
- Step 1 – Install mitigation area
- Step 2 – Maintain and monitor mitigation area for a period of five years
- Step 3 – Mitigation area achieves 80% success criteria

Option 2: Conservation Plan
- Step 1 – Implement the approved Conservation Plan

<u>Offsite Mitigation</u>
Option 1: Onsite mitigation on an offsite parcel of land
- Step 1 – Install mitigation area on an offsite parcel of land
- Step 2 – Maintain and monitor mitigation area for a period of five years
- Step 3 – Mitigation area achieves 80% success criteria

Option 2: Riparian Habitat Preservation Plan (RHPP)
- Step 1 – Implement the approved RHPP

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APPENDIX B

DEVELOPMENT OF THE IN-LIEU FEE OPTION

APPENDIX B. DEVELOPMENT OF THE IN-LIEU FEE OPTION

INTRODUCTION AND BACKGROUND

Chapter 16.30 of the Floodplain and Erosion Hazard Management Ordinance No. 2010-FC5 (Ordinance) stipulates that an applicant (private property owner, government agency, land developer, or builder) can mitigate for unavoidable impacts to regulated riparian habitat (RRH) through onsite mitigation. If onsite mitigation is investigated and deemed not feasible for the applicant, then offsite mitigation may be proposed, per Section 16.30.050.D:

> *"Mitigation Banking, or other alternative mitigation measures as approved by the Board. At the request of the property owner, and with Board approval, the mitigation plan requirement under this chapter may be waived by contributing funds to an account established and administered by the District for the purpose of offsetting damage to riparian habitat."*

Previously, the offsite mitigation option was applied without guidance that specified how each proposal should be implemented. The goal of the Offsite Mitigation Guidelines (Guidelines) is to inform the regulated community on available offsite mitigation options, in-lieu fee (ILF) program administration, and expenditure of funds obtained through the ILF program. The following key topics were identified and addressed through the revision process:

- Understand the true cost of mitigation and long-term management of riparian habitat;
- Formulate a method for the valuation of RRH;
- ILF fee determination method should be easily understandable and costs defensible;
- Determine a process for obtaining sufficient ILFs;
- Process needs to be easy to use, implement, and manage;
- Establish an administrative process for expending ILF funds received;
- Develop site selection criteria for new mitigation or receiving areas; and
- Consider tools and opportunities for partnering and leveraging funds.

The Guidelines will provide an avenue for development interests, property owners, and public projects to allow offsite compensatory mitigation for impacts to RRH when preservation or other onsite mitigation is not feasible. ILFs obtained by the District will be used toward the purchase of property with high value riparian habitat, or towards District projects that may include restoration, enhancement, and/or preservation of RRH, with the overall objective of improving or establishing riparian habitat in one area to compensate for negative impacts to RRH that occur elsewhere in Pima County (the County). The ILF option is anticipated to provide a higher degree of permitting certainty and design flexibility while a development or public project is still in the planning stage.

This document describes steps taken to develop the ILF program.

PROCESS FOR DETERMINING MITIGATION IN-LIEU FEES

The District is proposing to revise the ILF portion of the offsite mitigation option allowed by the Ordinance. Revising the ILF program would allow the District to collect appropriate fees from projects impacting RRH and use these fees to purchase, enhance, restore, establish, and/or maintain riparian habitat elsewhere in the County. Under current guidelines, ILFs are assessed by estimating the cost of onsite mitigation for the project. The current ILF program has fallen short of expectations in the amount of fees collected and has not been effective in achieving the District's goal of offsetting impacts to RRH occurring from development, therefore, the District explored various methods for assessing ILFs to determine if an alternative method would better achieve the District's goals.

In order to address issues with the District's current ILF structure, an attempt was made to better understand actual mitigation costs (Appendix B – *SWCA Report: Options for Assessing In-Lieu Fees*). Cost data for completed riparian projects was compiled from a variety of sources, including County projects, online searches, and descriptions of existing projects. Data requests were also solicited from a number of entities including landscape architect and consulting firms, Southern Arizona municipalities, the Bureau of Land Management, and the U.S. Army Corps of Engineers. Requests were mailed to 24 entities, with a total of seven responses received. A literature search of 19 projects was conducted and data complied from the literature was used to explore calculation methods for assessing the ILF. Specific data gathered for each project included total project costs, acreage of the project, annual operations and maintenance (O&M) costs, and annual water costs. Annual costs were extrapolated to a period of five years, based on the current maintenance period requirement adopted by the Board.

SUMMARY OF OPTIONS EXAMINED FOR ASSESSING IN-LIEU FEE COSTS

During development of the Guidelines, a number of alternative methods were considered to determine an appropriate method for calculating the ILF, but were soon discarded due to various reasons. Some of those reasons included 1) because they were too complex to be usable; 2) they would not apply equitably to both large and small developments; 3) they were not scientifically or fiscally defensible; and/or 4) a number of other minor reasons. In general, most were simply not practical. Some of the alternative methods considered and the reasons for not considering them further are described below.

1. ***Traditional Mitigation Bank***: A method discussed in prior years was the use of a traditional mitigation bank (in contrast to an ILF). The mitigation bank would be comprised of protected riparian areas located in each watershed of the County in which developers and property owners would purchase banking credits to mitigate for impacts during the development review process. The purchase of banking credits would only be allowed once riparian habitat was avoided and disturbance minimized. However, the creation of a mitigation bank was deemed not feasible due to the initial cost outlay that would be required by the District. Additionally, it was determined that the District could not ensure that impacts and compensatory mitigation would coincide in a timely manner or fall within the same watershed and/or RRH type. Lastly, it would be impossible for the District to predict the classes of riparian habitat that would be impacted by development

and, consequently, provide available mitigation banking credits within each classification.

2. ***Simple, Across the Board ILF***: Another method considered was to simply charge the developer or property owner a certain set amount of money per square foot of riparian habitat impacts. While attractive for its simplicity, this method does not differentiate between various types of riparian habitat and thus does not discourage impacts toward higher-value riparian areas. It also fails to account for the natural resource value of a site (hydrology, priority vulnerable species, diversity of habitat (flora and fauna), etc.).

3. ***Biological Value Adjusted ILF***: One considered method started with a set fee per square foot of impacts based on RRH type, then adjusted for onsite ecological functions and values. This system allowed mitigation ratio adjustments for such factors as: streams (intermittent vs. perennial), flow regimes of washes (>2,000 cubic feet per second [cfs] vs. >10,000 cfs), the relative value of a particular watershed, land use intensity (i.e., high-intensity urban vs. medium-intensity rural), Harris Riparian Area designations, diversity of flora and fauna, diversity of adjacent habitat types, contributing area of the watershed, and SDCP zoning (i.e., biological core habitat, slated growth areas). It was quickly determined that 1) one could adjust for infinite factors; 2) a massive effort would need to be undertaken to understand the complexities and interactions of the various factors; 3) such a system would be far too complex; and 4) the Conservation Land System (CLS) already takes core factors into account in a scientific manner. Similarly, the use of the CLS mapping data and mitigation ratios was discussed but ultimately discarded given the method would inflate mitigation costs to such a degree to be seen as fiscally indefensible. Furthermore, the biological value of the RRH is already accounted for in the RRH classification types.

4. ***Real Estate Value-Based ILF***: There was also discussion of including the appraised value of impacted land in the ILF. However, it was decided that appraised value of one piece of land would not correlate well with land elsewhere in the County that could potentially be used for mitigation. Additionally, the value of riparian land could be interpreted anywhere between low-cost grazing land and high-cost land for development. Equity could not be achieved using this parameter; therefore, this option was discarded.

DEVELOPMENT OF THE OFFSITE MITIGATION IN-LIEU FEE OPTION

The District's goal in revising the method for determining ILFs was to create a simple, predictable, and structured process that would allow for collection of fees commensurate with the District's actual costs to offset damage to RRH. After examining several methods for calculating ILFs, four stood out as viable options from which the final ILF is based. Per the Ordinance, the mitigation ratios would remain the same as before; a mitigation ratio of 1:1 for Xeroriparian impacts and a ratio of 1:1.5 for Hydroriparian/Mesoriparian (Class H), or Important Riparian Areas (IRA) classifications. The options for ILF calculation methods examined are as follows:

1. *Property value method*: This method bases the ILF on the Full Cash Value (FCV) of subject, or nearby properties' FCVs if the subject property has no or nominal

FCV assigned. The applicant would divide the applicable FCV by the parcel size to get an FCV per square foot. Then the FCV would be multiplied by a 1.25 factor, targeted at 80 percent of market, to adjust the FCV to full market price per square foot. Lastly, the price per square foot would be multiplied by the size of the disturbed RRH area to get the price of the underlying land affected and the total to assign the ILF.

2. *Riparian Classification method*: This method bases the ILF solely on the assigned cost per square foot per RRH type (based on collected actual project data) as defined in Section 2.0 of Appendix A. The applicant would calculate the proposed square foot of impact to each RRH type, multiply each by the assigned cost per square foot, and then calculate the total to assign the ILF.

3. *Combination of the Property Value and Riparian classification methods*: This method is a combination of the first two proposed methods. The applicant would calculate costs based on both the first and second methods and then reduce by 50 percent to assign the ILF.

4. *Modified version of the current method, based on an estimated cost to mitigate onsite*: The revised method would standardize costs, provide disincentives for disturbing higher value riparian habitat (Important Riparian Areas and Class H habitat), and increase cost to mitigate as the percentage of RRH impacts increased by providing a sliding scale fee based on percentage of impacts to habitat.

Ultimately, method number 4 was selected as the preferred ILF option. This option was selected because it most closely met the goals outlined at the beginning of the revision process, i.e., that the ILF be simple, financially defensible, and provide adequate funds to mitigate for impacts to RRH. Further discussion of this option is provided in Section 2.0 of the Guidelines. For a complete review of the data and revision process please see Appendix B, *SWCA Report: Options for Assessing In-Lieu Fees*.

APPENDIX C

SWCA REPORT – OPTIONS FOR ASSESSING IN-LIEU FEES

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Options for Assessing In-Lieu Fees

Prepared for the

Pima County Regional Flood Control District

by

SWCA Environmental Consultants

July 2010

OPTIONS FOR ASSESSING IN-LIEU FEES

Prepared for the

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July 2010

1.0 INTRODUCTION AND BACKGROUND

Chapter 16.30 of the Floodplain and Erosion Hazard Management Ordinance No. 2005-FC2 (Ordinance) stipulates that an applicant (private property owner, government agency, or developer) can mitigate for unavoidable negative impacts to regulated riparian habitat (RRH) through the use of one of the following compensatory onsite mitigation options: preservation, enhancement, restoration, or establishment. If these onsite mitigation options are investigated and deemed not feasible for the applicant, then offsite mitigation may be proposed; however, approval by the Pima County Regional Flood Control District (District) and the Flood Control District Board of Directors (Board) is required. Currently, three offsite compensatory mitigation options are available for consideration, including (1) mitigation on another parcel of land with comparable riparian habitat and appropriate long-term protection measures; (2) if the project is large commercial or master planned community, then a land exchange proposal can be considered; and (3) an in-lieu monetary fee may be proposed. It should be noted and stressed the offsite mitigation opportunities become an option only after the applicant has shown that avoidance is not possible, impacts to RRH have been minimized, and the ability to mitigate entirely onsite has been proven infeasible. Compensation for RRH loss (in-lieu fee) is not meant to replace avoidance and minimization.

At this time, the District is proposing to revise the in-lieu fee portion of the offsite compensatory mitigation option that would be implemented to allow the District to collect appropriate fees from those projects impacting RRH and in turn allow the District to use these mitigation fees to purchase, enhance, restore, establish, and/or maintain riparian habitat elsewhere within Pima County (the County). Under current requirements, fees are assessed by estimating the cost of mitigation, had mitigation occurred onsite. This method leaves the burden of estimating cost on the property owner and results in variable cost estimates, based upon the person assessing the fee and where cost information is obtained from. The current program has fallen short of expectations and has not been effective in achieving the District's goal of applying mitigation fees toward creating and maintaining RRH elsewhere in the County. Reasons for the existing program's shortfalls are twofold. First, offsite mitigation fees are collected prior to approval of the floodplain use permit for single-lot development and tentative plat/development plan approval for residential and commercial development. Although the fee is collected prior to RRH impacts, many years may pass before sufficient funds are collected to acquire land, with RRH or to restore, enhance and/or establish riparian habitat on existing District owned property. This scenario results in impacts occurring at a much greater rate than mitigation. Second, the fees have been grossly insufficient to achieve meaningful mitigation goals. While some habitat has been restored under the existing system, the fees collected have not proven adequate to acquire an equal amount of land, let alone manage it at the level necessary to maintain habitat value in perpetuity.

Given these shortcomings, it has become evident to the District that new guidelines for offsite RRH mitigation are necessary. The goal of the new guidelines is to allow RRH to be mitigated in a timelier manner relative to when impacts occur and to be funded at a level that is commensurate with actual mitigation costs. To assist in the development of the new guidelines, the following issues were identified and addressed throughout this revision process:

- Understand the true cost of mitigation and long-term management of riparian habitat;
- Formulate a method for the valuation of RRH and appraisal methods;
- Revised method should be easily understandable and costs defensible;
- Determine a process for obtaining sufficient in-lieu fees;
- Process needs to be easy to use, implement, and manage;
- Establish an administrative process for expending in-lieu fee funds received;

- Develop site selection criteria for new mitigation or receiving areas; and
- Consider tools and opportunities for partnering and leveraging funds.

The goal of this revision to the RRH offsite mitigation guidelines is to provide an avenue for development interests, property owners, and public projects that will allow offsite compensatory mitigation for negative impacts to RRH when preservation or other onsite mitigation are deemed not feasible. Any in-lieu fees obtained by the District will be used toward the purchase of property with high value riparian habitat, or District projects that may include restoration, enhancement, and/or preservation of RRH, with the overall objective of improving or establishing riparian habitat in one area to compensate for negative impacts to RRH that occur elsewhere in the County. This process is anticipated to provide a higher degree of permitting certainty and design flexibility while a development or public project is still in the planning stage.

The following document describes how the components of the proposed RRH offsite mitigation guidelines, including the in-lieu fee program, were developed and how the process is proposed to function. Also, this document provides additional guidance for the land exchange offsite compensatory mitigation option. Finally, a discussion is included that summarizes the District's overall process to revise the offsite mitigation guidelines and other methods considered.

2.0 PROCESS FOR DETERMINING THE COST PER SQUARE FOOT MITIGATION IN-LIEU FEES

In order to address the issues with the inadequacy of the current in-lieu fees that the District was obtaining, an attempt was made to obtain data from multiple sources for a better understanding of actual mitigation costs and to facilitate with assigning new fees. Cost data for actual completed riparian projects were compiled from a variety of sources, including Pima County projects, online searches, and descriptions of existing projects. Data requests were also solicited from a number of entities including landscape architect and consulting firms, southern Arizona municipalities, the Bureau of Land Management, and the U.S. Army Corps of Engineers. Requests were mailed to 24 entities; of those we received seven responses. Appendix B contains the request letter that was sent by the District and also the responses received. In addition to the data request, a literature search was completed in order to identify other information on restoration projects (Appendix C). Data on a total of 19 projects were collected, then compiled to use as the basis for determining new fees. Specific data gathered for each project included the total project costs, acreage of the project, annual operations and maintenance (O&M) costs, and annual water costs. Annual costs were extrapolated to a period of five years, based on the current District Ordinance.

Much of the restoration cost data collected were insufficient for analysis, and were discarded. For example, one project cost provided was $4,400,000 for 850 acres. However without further details being provided, it was unknown if the costs included land acquisition or engineering and design costs, which often times can be the most costly part of a project. Also, the scope of the project was vague, and it was unknown whether the project included plantings and maintenance or simply preservation of riparian area. Another project was titled riparian restoration, but only involved fencing out livestock from the riparian zone; therefore, it was deemed inadequate data for use in this particular process. Thusly, the dataset was narrowed to 19 projects with useful cost information. It is unclear if land acquisition costs were included in the total costs for all 19 projects; costs for at least one project are known to have not included land acquisition. Nonetheless, it was decided to use the only available data with acknowledgment of this deficiency.

Eleven of the 19 projects that had otherwise useful data, were missing O&M and/or water costs. To correct for this deficiency, O&M and/or water costs were extrapolated from the other project data and used to complete the dataset. For example, annual costs for those 11 projects that provided O&M data range from $77 to $3,850 per acre, with an average O&M cost of $1,936 per year. This average O&M cost per acre was applied to the remaining 8 projects over the 5-year O&M period. Additionally, annual cost on the 9 projects that provided water data range from $214 to $4,400 per acre, with an average water cost of $1,643 per year. This average cost for water was applied to the remaining 10 projects over the 5 year period. Additionally, the District assumes that their restoration projects will require water and that water will not be free. Therefore, for projects with free water (i.e., onsite springs or wells), average water costs were added to their total costs to generate an accurate cost per square foot with water.

A per acre and per square foot cost, which includes the initial cost of the project as well as O&M and water for a 5-year period, was calculated for each project. Data for all 19 projects are presented in Table 1 and supplemental information regarding the projects is included in Appendix C.

Table 1. Actual riparian mitigation project costs obtained by the District.

Project Name	Acres	Total Cost	Includes Land Cost?	O&M (5 yrs)	Water (5 yrs)	Cost/Ac	Cost/Sq ft
Ed Pastor Kino	170	$12,000,000	No	$250,000	$1,325,000	$79,853	$1.83
El Rio Antiguo	284	$66,000,000	Unknown	$2,000,000	$4,260,000	$254,437	$5.84
Rillito River (Swan Wetlands)	40	$4,740,000	No	$770,000	$405,000	$147,875	$3.39
Paso de Iglesias	1098	$92,000,000	Unknown	$4,035,000	$5,500,000	$92,473	$2.12
Tres Rios del Norte	3000	$292,000,000	Yes	$31,500,000	$66,000,000	$129,833	$2.98
Esperanza Ranch	310	$600,000	Unknown	$3,000,209	$0	$11,614	$0.46
High Plains	18	$750,000	Unknown	$174,206	$140,000	$59,123	$1.36
Sweetwater (effluent wetlands)	17.3	$1,600,000	Unknown	$360,000	$0	$113,295	$2.79
San Xavier Indian Reservation	17.5	$670,000	No	$169,367	$143,790	$56,180	$1.29
Santa Fe Ranch	10	$70,000	Unknown	$96,781	$82,166	$24,895	$0.57
Yuma West	35	$4,400,000	Unknown	$338,733	$287,580	$143,609	$3.30
Rio Salado (Tempe)	150	$6,200,000	No	$1,150,000	$0	$49,000	$1.31
Va Shly 'ay Akimel	1712	$137,000,000	Yes	$655,000	$6,500,000	$84,203	$1.93
Bingham Cinega	285	$221,000	Unknown	$2,758,257	$2,341,723	$18,670	$0.43
San Pedro Reserve	850	$4,400,000	Unknown	$8,226,380	$0	$14,855	$0.53
Agua Caliente Spring	101	$5,150,000	Yes	$977,487	$0	$60,668	$1.58
Cortaro Mesquite Bosque	80	$1,838,000	No	$1,490,000	$110,000	$42,975	$0.99
Rio Salado (Phoenix)	595	$82,400,000	Yes	$9,500,000	$0	$154,454	$3.73
Tres Rios	5600	$99,300,000	No	$6,000,000	$6,000,000	$19,875	$0.46
						Average Costs:	**$1.94**

* - Highlighted values had no O&M and/or water data, and were extrapolated from average O&M and/or water costs of other projects.

The cost per square foot varies widely among the 19 projects; from one particularly expensive project at $5.84 per square foot to a low of $0.43 per square foot, a cost that presumably did not include all associated expenses. For the next step to normalize the dataset, the high and low "outliers" were then removed. As such, it was determined that projects with costs over $4.00 and under $1.50 per square foot

should be removed from consideration. The resulting dataset of 9 projects is presented in Table 2. Per square foot costs range from $1.58 to $3.73, with a median cost of $2.79 per square foot and an average cost of $2.63 per square foot. It should be noted, however, that actual costs are likely to be higher, as it is known that at least two of these projects, and likely others as well, did not include land acquisition costs.

Table 2. Riparian mitigation dataset after removal of the high and low outliers.

Project Name	Acres	Total Cost	Includes Land Cost?	O&M (5 yrs)	Water (5 yrs)	Cost/Ac	Cost/Sq ft
Ed Pastor Kino	170	$12,000,000	No	$250,000	$1,325,000	$79,853	$1.83
Rillito River (Swan Wetlands)	40	$4,740,000	No	$770,000	$405,000	$147,875	$3.39
Paso de Iglesias	1098	$92,000,000	Unknown	$4,035,000	$5,500,000	$92,473	$2.12
Tres Rios del Norte	3000	$292,000,000	Yes	$31,500,000	$66,000,000	$129,833	$2.98
Sweetwater (effluent wetlands)	17.3	$1,600,000	Unknown	$360,000	$0	$113,295	$2.79
Yuma West	35	$4,400,000	Unknown	$338,733	$287,580	$143,609	$3.30
Va Shly 'ay Akimel	1712	$137,000,000	Yes	$655,000	$6,500,000	$84,203	$1.93
Agua Caliente Spring	101	$5,150,000	Yes	$977,487	$0	$60,668	$1.58
Rio Salado (Phoenix)	595	$82,400,000	Yes	$9,500,000	$0	$154,454	$3.73
						Average:	**$2.63**
						Median:	**$2.79**

* Highlighted values had no O&M and/or water data and were extrapolated from average O&M and/or water costs of other projects.

Using the cost per square foot data range as calculate above and applying those costs to each of the RRH types, the cost per square foot of disturbed RRH were assigned as follows:

- Hydromesoriparian or Mesoriparian H $3.50
- Xeroriparian A $3.00
- Xeroriparian B $2.75
- Xeroriparian C $2.50
- Xeroriparian D $1.75
- Unclassified TBD by District and Board Approval

In summary, these amounts were designed to reflect the actual costs of riparian mitigation and were based on completed project costs as provided in the dataset. In addition, the cost per square foot for the various types of RRH was calculated to include all costs related to riparian restoration, including land acquisition, grading, planting, irrigation, operation and maintenance, periodic removal of invasive species, monitoring, and annual reporting costs since the previous in-lieu fees that were collected by the District were grossly deficient in covering the actual total cost. In the future, these costs may be reviewed and revised periodically by the District to reflect the cost of inflation, changing land values, program operating costs, and the actual costs of creating and maintaining riparian habitats. Finally, it should be noted that these fees are intended to cover the actual costs of riparian mitigation, and it is not the District's intent for these fees to create a net loss or profit but to adequately mitigate for the loss of RRH.

2.1 BASIS OF DEVELOPMENT FOR THE OFFSITE MITIGATION IN-LIEU FEES

The goal of devising a new method for determining offsite mitigation in-lieu fees was to have a simple, predictable, and structured process such that the District would collect an amount commensurate with the District's actual costs to purchase, create, and/or maintain RRH. Currently, the District is proposing three methods as options from which the final in-lieu fee will be chosen from or modified per appropriate suggestions. However, two stipulations will apply to the final option chosen, including (1) The mitigation ratio would be a direct 1:1 ratio, except for impacts to Hydromesoriparian, Mesoriparian H, or Important Riparian Area (IRA) classifications, the ratio would be a 1:1.5 as already stipulated in the current Ordinance; and (2) Applicants with disturbance to RRH on Single Family Residential (SFR) parcels would receive a further reduction in the in-lieu fee by 50% due to size limitations. The three options for in-lieu fee calculation methods are as follows:

1. The first method proposed involves basing the in-lieu fee solely on the Full Cash Value (FCV) of subject, or nearby properties' FCV's if the subject property has no or nominal FCV assigned. The applicant would divide the applicable FCV by the parcel size to get an FCV per square foot. Then the FCV would be multiplied by a 1.25 factor, targeted at 80% of market, to adjust the FCV to full market price[1] per square foot. Lastly, the price per square foot would be multiplied by the size of the disturbed RRH area to get the price of the underlying land affected and the total to assign as the in-lieu fee.

2. The second method entails basing the in-lieu fee solely on the assigned cost per square foot per RRH type as defined in Section 2.0 above. The applicant would calculate the proposed square foot of impact to each RRH type, multiply each by the assigned cost per square foot, and then calculate the total to assign the in-lieu fee.

3. The third method involves a two-step process, wherein the total in-lieu fee is a combination of the first two proposed methods. First, the applicant would obtain the FCV per square foot cost of the proposed impacted RRH area, as described in option #1 above. Second, the applicant would calculate the proposed per square foot RRH impact total, as described in option #2 above. This cost plus the FCV cost would then be tallied and further reduced by 50% in order to avoid over-estimating the in-lieu fee.

2.2 Example Projects for Calculating Offsite Mitigation In-lieu Fees

In order to compare the current in-lieu fees being obtained by the District to the newly proposed in-lieu fees, the District tabulated proposed projects, the disturbance by RRH type, and the in-lieu fee. Then the newly proposed Option #2 in-lieu fee calculation was assessed to those same projects for comparison. Table 3 presents that data and Table 4 provides a summary of averages.

Table 3. Previous and proposed Option #2 in-lieu fee data for actual projects.

Development Type	Year	RRH Type	Project Size	Disturbance	In-lieu Fee	$/sq ft of Disturbance	New In-lieu Fee per

[1] The market price is derived from the Assessor's Full Cash Value (FCV). The FCV is based on mass appraisal techniques used by the Assessor in accordance with State Department of Revenue guidelines. The FCV is multiplied by the 1.25 factor, and the result may be significantly higher or lower than market value if each parcel were appraised individually. The FCV is used as a starting point because it is a value of record already set by Pima County on which there is usually agreement between the County and property owners.

			(ac)	(ac)	(sq ft)	Amount ($)		Option #2†
SFR	1999	H	0.53	0.33	14,374.80	$1,426.00	$0.10	$37,733.85
SFR	2000	H	0.56	0.33	14,374.80	$1,335.00	$0.09	$37,733.85
SFR	2003	H	10.68	0.4	17,424.00	$1,761.00	$0.10	$45,738.00
SFR	2004	H	3.36	0.44	19,166.40	$5,639.00	$0.29	$50,311.80
Residential subdivision	2004	H	55.87	0.729	31,755.24	$33,451.00	$1.05	$166,715.01
Residential subdivision	2007	H	5.57	1.65	71,874.00	$65,986.00	$0.92	$377,338.50
Utility (gas pipeline)	2007	IRA/H	N/A	8.5	370,260.00	$357,000.00	$0.96	$1,943,865.00
Utility (waste water line)	2009	IRA/H	N/A	1.05	45,738.00	$33,172.00	$0.73	$240,124.50
Railroad	2009	IRA/H	N/A	0.34	14,810.40	$35,660.00	$2.41	$77,754.60
SFR	2009	IRA/H	1.22	0.41	17,859.60	$1,841.74	$0.10	$46,881.45
Resort entry road	2006	IRA/H	N/A	0.9	39,204	$37,468.00	$0.96	$205,821.00
Resort entry road	2010	IRA/H	N/A	0.67	29,185	$32,939.45	$1.13	$153,222.30
SFR	2008	IRA/XB	3.32	0.91	39,640	$7,270.05	$0.18	$81,756.68
SFR	2009	IRA/XB	1.03	0.15	6,534	$4,390.00	$0.67	$13,476.38
Residential subdivision	2008	IRA/XD	253.38	43	1,873,080	$111,000.00	$0.06	$4,916,835.00
Utility (gas pipeline)	2007	XA	N/A	0.494	21,519	$11,856.00	$0.55	$64,555.92
Utility (gas pipeline)	2007	XB	N/A	3.64	158,558	$72,800.00	$0.46	$436,035.60
Railroad	2009	XB	N/A	1.35	58,806	$63,360.00	$1.08	$161,716.50
PCDOT road project	2010	XB	N/A	1	43,560	$38,110.00	$0.87	$119,790.00
Utility (gas pipeline)	2007	XC	N/A	15.75	686,070	$236,250.00	$0.34	$1,715,175.00
S&G mining	2009	XC	144.30	17	740,520	$200,625.90	$0.27	$1,851,300.00
Residential subdivision	2004	XC	47.895	0.71	30,928	$10,522.00	$0.34	$77,319.00
Residential subdivision	2005	XC	45.2	16.12	702,187	$94,543.00	$0.13	$1,755,468.00
Residential subdivision	2006	XC	45.7	10.1	439,956	$67,672.00	$0.15	$1,099,890.00
Development plan (commercial)	2008	XC	3.86	1.36	59,242	$38,734.84	$0.65	$148,104.00
Development plan (residential)	2007	XC	22.04	3.86	168,142	$58,067.00	$0.35	$420,354.00
Development plan	2007	XC	4.16	0.39	16,988	$3,714.00	$0.22	$42,471.00

(commercial)								
Development plan (commercial)	2008	XC	46.73	1.93	84,071	$30,964.00	$0.37	$210,177.00
Commercial subdivision	2008	XC	129.6	10.41	453,460	$218,816.00	$0.48	$1,133,649.00
Development plan (commercial)	2008	XC	3.26	0.08	3,485	$1,147.00	$0.33	$8,712.00
Utility (gas pipeline)	2009	XC	N/A	0.72	31,363	$8,904.00	$0.28	$78,408.00
PCDOT road project	2010	XC	N/A	0.4	17,424	$14,785.00	$0.85	$43,560.00
Residential subdivision	2009	XC	130.8	4.19	182,516	$35,703.92	$0.20	$456,291.00
Utility (gas pipeline)	2007	XD	N/A	3.64	158,558	$21,840.00	$0.14	$277,477.20
Development plan (commercial)	2008	XD	3.26	0.7	30,492	$8,962.00	$0.29	$53,361.00

[†]Where applicable the 1:1.5 ratio or 50% reduction was applied in the calculation.

Table 4. A summary of average in-lieu fees per RRH type from actual projects.

Distrubed RRH Type	Number of Projects	Average In-lieu Fee Based on Current System	Average In-lieu Fee Based on Proposed Option #2	Percent Increase
Hydromesoriparian or Mesoriparian H (H)	6	$18,266	$119,262	553%
Xeroriparian A (XA)	1	$11,856	$64,556	445%
Xeroriparian B (XB)	3	$58,090	$239,181	312%
Xeroriparian C (XC)	14	$72,889	$645,777	786%
Xeroriparian D (XD)	2	$15,401	$165,419	974%
Important Riparian Area (IRA) and H	6	$83,014	$444,611	436%
IRA and XB	2	$5,830	$47,617	717%
IRA and XD	1	$111,000	$4,916,835	4330%

2.1 Additional Details Regarding Calculating Offsite Mitigation In-lieu Fees

The following information is presented to define additional guidance regarding possible scenarios that may arise during the process of calculating in-lieu fees:

- If the applicant desires to show how current site conditions are different from mapped site conditions (including RRH), the applicant may provide a Natural Resources Assessment report, prepared by qualified consultants, to the District documenting the discrepancy. Appendix D provides guidance on the content and qualifications required for the preparation of the Natural Resources Assessment report.
- Similar to the current system, fees would be requested at the time of final plat approval; however, the applicant may request to defer payment until the time of the grading permit issuance.

2.3 Methods of Calculating In-lieu Fees for Large Development Plans and Plats

Large-scale projects offer unique situations because they occasionally have the potential to affect relatively large areas of RRH. While protecting the RRH onsite is preferred and could well prove to be an asset to the development, the community, and the District's goals for long-term riparian protection, a need for offsite mitigation may still occur. To satisfy offsite RRH mitigation requirements for disturbance to RRH on large developments, a developer may choose to apply the option that will allow them to acquire land elsewhere in the County and transfer that land to the District for long-term protection of its riparian and biological resources. This option will be considered on a case-by-case basis for large developments only and is not available for small developments or single-lot properties. All land acquisition proposals shall be subject to District and Board review and full approval; however, to assist the applicant in locating desirable parcels for land acquisition, the District will have information on their website indicating the location of desirable lands that would be adequate in the land exchange compensatory mitigation option.

For lands to qualify for RRH mitigation and transfer to the District they must contain biological and hydrological value that is comparable to or better than the RRH that is being disturbed onsite. Values that need to be considered include, but are not limited to, water availability, vegetation density, and biological productivity. As such, an evaluation (Natural Resources Assessment) of the land proposed for transfer, performed by qualified professionals, shall be required as part of the developer's land acquisition proposal to the District (Appendix D). The purpose of long-term riparian protection is to promote stable flow conditions and natural functions along watercourses and floodplains County-wide by preserving and/or enhancing riparian vegetation and habitat. In order to meet the purpose and intent of protecting riparian habitat, selection of land appropriate for the land acquisition and transfer option shall be based on the information provided by the applicant's Natural Resources Assessment Report.

3.0 ALTERNATIVE METHODS CONSIDERED

During the District's revision process for these offsite mitigation standards, a number of alternative methods were considered for determining the appropriate method for calculating in-lieu fees for riparian impacts, but were discarded due to various reasons. Some of those reasons included 1) because they were too complex to be usable; 2) they would not apply equitably to both large and small developments; 3) they were not scientifically or fiscally defensible; and/or for a number of other minor reasons. In general, most were simply not practical. Some of the alternative methods considered and the reasons for not considering them further are described below.

1. ***Traditional Mitigation Bank***: A method discussed in prior years was the use of a traditional mitigation banks (in contrast to the existing bank of funds). The mitigation bank would be comprised of protected riparian areas located in each watershed of the County that developers fund when they purchase banking credits during the development review process. Banking credits are only purchased when onsite riparian habitat avoidance and disturbance minimization are inadequate. However, the creation of mitigation banks was deemed not feasible due to the initial cost outlay that would be required by the District. Additionally, it was noted that this process would not always allow for the impacts and compensatory mitigation to timely coincide or fall within the same watershed and/or RRH type. Lastly, it would be impossible for the District to predict the classes of riparian habitat that would be impacted by development and consequently provide available mitigation bank credits.

2. ***Simple, Across the Board In-lieu Fee***: Another method considered was to simply charge the developer a certain set amount of money per square foot of riparian impacts. While attractive for

its simplicity, this method does not differentiate between the values of various types of riparian habitat and thus does not direct impacts toward lower-value riparian areas. It also fails to account for any of the natural resource value (hydrology, vulnerable species, diversity of habitat for flora and fauna, etc.).

3. ***Biological Value Adjusted In-lieu fee***: One considered method started with a set fee per square foot of impacts based on RRH type, then adjusted for onsite ecological functions and values. This system allowed for mitigation ratio adjustments for such factors as: streams (intermittent vs. perennial), flow regimes of washes (>2,000 cubic feet per second [cfs] vs. >10,000 cfs), the relative value of a particular watershed, land use intensity (i.e., high-intensity urban vs. medium-intensity rural), 33 categories of Sonoran Desert Conservation Plan (SDCP) Harris Riparian Areas, diversity of flora and fauna, diversity of adjacent habitat types, contributing area of the watershed, and SDCP zoning (i.e., biological core habitat, slated growth areas). It was quickly determined that 1) one could adjust for infinite factors; 2) a massive effort would need to be undertaken to understand the complexities and interactions of the various factors; 3) such a system would be far too complex; and 4) the Conservation Land Systems (CLS) mapping work group had already taken the core factors into account in a scientific manner. Similarly, the use of the CLS mapping data and mitigation ratios was discussed but ultimately the District decided that the use of this data may highly inflate the mitigation costs, be unjustified, and ultimately prove non-enforceable. Furthermore, the biological value of the RRH is already accounted for in the RRH class types. Thus, this option was discarded.

4. ***Real Estate Value-Based In-lieu Fee***: There was also discussion regarding including the appraised value of impacted land into the in-lieu fees. However, it was decided that appraised values of one piece of land would not correlate well with land elsewhere in the County that would be used for mitigation. Additionally, the value of riparian land could be interpreted anywhere between low-cost grazing land and high-cost land for development. Equity could not be achieved using this parameter. Thus, the FCV method was developed.

4.0 CONCLUSIONS

The development of the offsite mitigation guidelines described in this report are a necessary tool that will allow RRH impacts to be more completely mitigated, mitigated in a timelier manner with impacts, and funded at a level that is commensurate with costs that are likely to be incurred by the District. This proposed system addresses the problems with systems used or contemplated in the past and meets the goals of the District with respect to an offsite mitigation program. Furthermore, this method has assessed and addressed the true costs of mitigation and long-term management of riparian habitat; it is easily understandable; easy to use, implement, and manage; and it is based on sound financial and scientific principles. This system provides an avenue for both development interests and public projects that will allow offsite compensatory mitigation for negative impacts to regulated RHH.

APPENDIX A
PROGRAM OPERATION PLAN BY THE DISTRICT

The District will provide the text for this section.

*part of Appendix C, SWCA Report

APPENDIX B
DATA REQUEST LETTER AND COST INFORMATION OBTAINED BY THE DISTRICT

*part of Appendix C, SWCA Report

PIMA COUNTY
REGIONAL FLOOD CONTROL DISTRICT
97 EAST CONGRESS STREET, THIRD FLOOR
TUCSON, ARIZONA 85701-1797

SUZANNE SHIELDS, P.E. **(520) 243-1800**
DIRECTOR **FAX (520) 243-1821**

February 25, 2010

Brian Linenlaub, Principal
Westland Resources
2343 E. Broadway, Suite 202
Tucson, AZ 85719

Subject: Costs Associated with Riparian Restoration Projects

Dear Mr. Linenlaub:

Pima County Regional Flood Control District (District) is in the process of revising their off-site mitigation policies for impacts to regulated riparian habitat. The District is compiling data to determine actual costs associated with riparian restoration projects in the arid West. Your help is greatly appreciated and will ensure that the new policies are fair, cost-effective, and based on sound data.

We have attached example cost data and we hope you will be able to provide similar cost breakdowns for some of your projects. Infrastructure improvements vary widely with each site (water harvesting basins to complex irrigation systems, flood protection, etc.) so descriptions of the project will be helpful in determining real costs. A short description of the restoration and irrigation methods used and project site conditions would allow us to compare restoration and maintenance costs for similar projects, thus comparing “apples to apples”.

For each project, please include the total acreage, as the District is exploring the feasibility of using a cost-per-acre basis for impact fees. We are seeking cost information for the following categories:

1) Planning and Design
2) Maintenance
3) Monitoring
4) Water Costs
5) Total Cost

Partial information is very helpful, include what is available. If possible, please return the information by March 24, 2010. The data will be discussed in a draft report presented to a stakeholders group which is providing oversight on our mitigation guideline development later this spring. The cost information may be mailed, faxed, or emailed to:

Carla Danforth
Pima County Regional Flood Control District
97 E Congress, 2nd Floor
Tucson, Arizona 85701

Email: carla.danforth@rfcd.pima.gov
520-243-1800 (phone) 520-243-1826 (fax)

Thank you for any information you may be able to provide.

Sincerely,

Carla F. Danforth
Environmental Planning Manager

Attachment

Contact List

Name	Title	Organization	Address	Address II	Email	Phone
Karen Caesare	President	Novak Environmental	4574 N First Ave, Ste 100	Tucson, Arizona 85718	karen@novakenvironmental.com	520-206-0591
John Hucko		Olsson Associates	3861 N. First Ave	Tucson, Arizona 85719	jhucko@oaconsulting.com	520-407-9071
Timoth Johnson	Project Landscap Architect	The Planning Center	110 South Church, Suite 6320	Tucson, Arizona 85701	tJohnson@azplanningcenter.com	(520) 623-6146
Brian Linenlaub	Principal	Westland Resources	2343 E Broadway, Ste 202	Tucson, Arizona 85719	blinenlaub@westland.com	520-206-9585
?	Landscape Architect	WLB Group	4444 E. Broadway	Tucson, Arizona 85711	msmith@wlbgroup.com	520-881-7480
Rich Underwood	President	AAA Landscape	4742 N Romero Road	Tucson, Arizona 85705	richardu@aaalandscape.com	520-696-3223
Lori Woods	President	RECON Consultants, Inc	1745 E River Road, Ste 101A	Tucson, Arizona 85718	ljwoods@reconaz.com	520-325-9977
Cindy Zisner	Secretary	AZ Riparian Council	Post to List Serve		Cindy.Zisner@asu.edu	
Eric Gardner	Nongame Branch Chief	AZ Game and Fish Dept.	500 W. Carefree Highway	Phoenix, AZ 85086		623-236-7507
?	?	Pima County Parks and Rec				
Leslie Liberti	Stormwater Management	City of Tucson Department of Transportation, Stormwater Management Section	P.O. Box 27210	Tucson, Arizona 85726-7210	karen.rahn@tucsonaz.gov	(520) 791-4251
Jane Bixler		City of Phoenix, Rio Salado Project	200 West Washington St., 12th Floor	Phoenix, AZ 85007	jane.bixler@phoenix.gov	602-495-3793
Armando Muñoz		City of Phoenix, Rio Salado Project	200 West Washihgton St., 12th Floor	Phoenix, AZ 85007	armando.munoz@phoenix.gov	602-495-3793
Debbi Radford	Tres Rios Project Coordinator	City of Phoenix, Tres Rios Project	200 West Washington St., 9th Floor	Phoenix, AZ 85007	debbi.radford@phoenix.gov	602-495-7927
Nancy Ryan	Rio Salado Project Manager	City of Tempe	PO Box 5002	Tempe, AZ 85280	nancy_ryan@tempe.gov	480-350-8096
Diana Stuart	Environmental Program Manager	Maricopa County Flood Control District	2801 W Durango St	Phoenix, AZ 85009	dms@mail.maricopa.gov	602-506-4766
Sam Kathryn Campana	VP and Executive Director	Audubon Society of Arizona	4250 East Camelback Rd., Ste. 310K	Phoenix AZ 85018	scampana@audubon.org	602-468-6470 x 1
Pat Graham	State Director	The Nature Conservancy - Phoenix Conservation Center	The Plaza at Squaw Peak III 7600 N. 15th St., #100	Phoenix, AZ 85020	pgraham@tnc.org	(602) 712-0048
Sherry Barrett	Assistant Field Supervisor for Southern AZ	USFWS	201 N Bonita, Suite 141	Tucson, AZ 85745	Sherry_Barrett@fws.gov	520-670-6144
Bruce D. Ellis	Env. Resource Mangement Division	Bureau of Reclamation	6150 West Thunderbird Road	Glendale AZ. 85306-4001		(623) 773-6250
Nancy Zierenberg	Vice President	AZ Native Plant Society	Post to List Serve		nzberg4@cox.net	
Karen Reichhardt	Botanist	Bureau of Land Management, Yuma Field Office	2555 E Gila Ridge Rd	Yuma, AZ 85365	karen_reichhart@blm.gov	928-317-3234

Summary of Restoration Cost Responses:

The Nature Conservancy: no data

City of Phoenix, Parks & Recreation Department: operations per year = $0.06/square foot, including water. Don't know if that includes monitoring, maintenance, etc.

Novak Environmental Inc.: planting & installation of irrigation system = $1.00 to $1.30 per s.f., planning and design costs can run between 10-20% of construction costs. Just design costs are typically 10% of construction costs.

Rio Salado: We had already included their info in our calculations. The info they provided roughly matched what we already had.

UA Extension Water Resources: no data

U.S. Bureau of Reclamation: fencing costs only: $0.07/sf. They don't do restoration/creation, only fencing, and nature does the rest.

U.S. Army Corps of Engineers: provided what they charge for a mitigation credit at an existing Tucson Audubon site, which is $0.34/sf ($15,000/ac). No further info, but presume land costs and design/construction are not included.

Eleanor Gladding

From: Carla Danforth [Carla.Danforth@rfcd.pima.gov]
Sent: Wednesday, March 31, 2010 9:53 AM
To: Eleanor Gladding
Subject: FW: Tempe & USACE Environmental Restoration projects
Attachments: USACE Phases Cost per acre.xls; IBW plan.jpg; Rio Salado Habitat Restoration map (12a).pdf

I will forward you all the responses I have received
Carla

From: Ryan, Nancy [mailto:nancy_ryan@tempe.gov]
Sent: Friday, March 26, 2010 4:19 PM
To: Carla Danforth
Subject: Tempe & USACE Environmental Restoration projects

<<USACE Phases Cost per acre.xls>>

Carla:

I am lacking some specific numbers but have provided an estimate. If I get detailed numbers I will update and send the .XLS again

There is a much greater amount of infrastructure in Phase 1 that is not a part of Phase 2. Also the density of planting in Phase 2 was reduced beyond what is shown in the concept drawing enclosed because of concerns that 1) the Salt River flows would destroy the area, and it was too heavy of a burden for Tempe to replace, and 2) significant concerns raised by PHX Sky Harbor - 2 miles west that it would attract too many birds and create a hazard to air navigation. That is why you see such different numbers for the cost per acre.

We treat the habitat areas with more of a hands-off approach to maintenance.
<<IBW plan.jpg>> <<Rio Salado Habitat Restoration map (12a).pdf>>

If you have questions, please call.

Nancy Ryan, AICP, CPM
Rio Salado Project Manager
Community Development
City of Tempe
480.350.8096
nancy_ryan@tempe.gov

AS OF MARCH 2010	Acres	Year	Design & construction Total Cost	Approx O&M ann	O&M since opening	Water annual (Acre feet)	Water since opening	Cost/AC (approx)
Phase I - Indian Bend Wash (inc well)	38.3	2005	$4,500,000	$35,000	175,000	37.89	189.43	$117,493.47
Includes 2 ac wetland, a non-potable								
well for irrigation and wetland water								
and 20 space parking lot & overlook								
Phase II - Downstream Salt River	93.4	2007	$1,000,000	$5,000	$15,000		3.91	$10,706.64
Drip irrigation extracted from Tempe								
Town Lake; Salt River flows sometimes								
cover the river channel for months								

Rio Salado Tempe Reach - Town Lake to Priest Drive

U. S. Army Corps of Engineers - Los Angeles District / City of Tempe McGann & Associates / Novak Environmental, Inc. Joint Venture Ocotober 2004

1" = 100'

100 0 100 200

SCALE IN FEET

Excerpted from the Regulated Riparian Habitat Offsite Mitigation Guidelines for Unincorporated Pima County

Rio Salado Tempe - Indian Bend Wash Reach

U. S. Army Corps of Engineers - Los Angeles District / City of Tempe • McGann & Associates / Novak Environmental, Inc. Joint Venture • December 2002

Eleanor Gladding

From: Carla Danforth [Carla.Danforth@rfcd.pima.gov]
Sent: Wednesday, March 31, 2010 9:56 AM
To: Eleanor Gladding
Subject: FW: Costs Associated with Riparian Restoration Projects

---

From: Kristine Uhlman [mailto:kuhlman@Ag.arizona.edu]
Sent: Monday, March 08, 2010 10:37 AM
To: Krista Osterberg
Cc: Carla Danforth
Subject: Costs Associated with Riparian Restoration Projects

Dear Carla - - I am in receipt of your letter dated February 25, 2010 requesting costs associated with riparian restoration projects. I understand that you are seeking data to generate an estimated cost-per-acre basis, and are requesting short descriptions of restoration methods and site conditions so as to allow you to compare restoration and maintenance costs for similar projects.

I have copied this email to Krista Osterberg with the Arizona Department of Environmental Quality (ADEQ) '319' grant program. The '319' grant program has been funding watershed restoration projects in the effort to reduce nonpoint source pollution. Many of these projects are riparian restoration projects. I believe ADEQ has compiled cost data that may be of use to you, but I don't know if those data are in a form that could readily sort between riparian vrs. upland-type projects. In any event, please coordinate with Krista (or her designee) to address your request. Thank you!

Kristine Uhlman, RG
Assistant Area Agent
Cooperative Extension
University of Arizona
Water Resources Research Center
350 N. Campbell Avenue
Tucson, AZ 85721
(520) 621-9591 ext. 51 NOTE PHONE # CHANGE!!!
fax: (520) 792-8518
kuhlman@ag.arizona.edu
www.cals.arizona.edu/azwater

Eleanor Gladding

From: Carla Danforth [Carla.Danforth@rfcd.pima.gov]
Sent: Wednesday, March 31, 2010 10:59 AM
To: Eleanor Gladding
Subject: FW: Costs Associated with Riparian Restoration Projects

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From: Annette Plicato
Sent: Friday, February 26, 2010 11:01 AM
To: 'Olson, Theresa M'
Cc: Carla Danforth
Subject: RE: Costs Associated with Riparian Restoration Projects

Theresa, we look forward to hearing from you.

Thanks, Annette

From: Olson, Theresa M [mailto:TOlson@usbr.gov]
Sent: Friday, February 26, 2010 10:40 AM
To: Annette Plicato
Subject: RE: Costs Associated with Riparian Restoration Projects

Hi Annette, Thank-you for your letter and interest. I have forwarded it to our Restoration manager and our Program manager to gather the information. Theresa.

From: Annette Plicato [mailto:Annette.Plicato@rfcd.pima.gov]
Sent: Thursday, February 25, 2010 1:53 PM
To: Olson, Theresa M
Cc: Carla Danforth
Subject: Costs Associated with Riparian Restoration Projects

Dear Ms. Olson:

Pima County Regional Flood Control District (District) is in the process of revising their off-site mitigation policies for impacts to regulated riparian habitat. The District is compiling data to determine actual costs associated with riparian restoration projects in the arid West. Attached is a letter from Carla Danforth explaining the information we are requesting from the Bureau of Reclamation. Your input will be valued in this endeavor.

Thank You, Annette Plicato

<<Teresa Olson.pdf>>

Eleanor Gladding

From: Carla Danforth [Carla.Danforth@rfcd.pima.gov]
Sent: Wednesday, March 31, 2010 9:56 AM
To: Eleanor Gladding
Subject: FW: Costs associated with riparian restoration projects/US Bureau of Reclamation

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From: Messing, Henry J [mailto:HMessing@usbr.gov]
Sent: Tuesday, March 16, 2010 10:10 AM
To: Carla Danforth
Cc: Ellis, Bruce D
Subject: Costs associated with riparian restoration projects/US Bureau of Reclamation

Carla,

We have received your February 25, 2010, request for costs associated with riparian restoration projects.
We have two projects that qualify as riparian restoration. However, please note that water costs are not associated with either project.

A. Tonto Creek Riparian Unit (TCRU)

This project was implemented on Tonto National Forest lands along the Tonto Creek inflow to Roosevelt Lake. In the 1989 Fish and Wildlife Service, Fish and Wildlife Coordination Act Report, Reclamation committed to the construction and monitoring of the TCRU to offset the losses of 460 acres of riparian habitat associated with the raising of Roosevelt Lake and the formation of New Waddell Reservoir. The Clean Water Act Section 404 Permit required Reclamation to improve riparian habitat conditions equivalent to 80 acres, the amount of riparian habitat to be inundated at Roosevelt Lake. The TCRU encompasses 18 miles of Tonto Creek and 9,483 acres. Tonto Creek was grazed year round and was highly degraded. Under the Rosgen stream classification system, Tonto Creek was a "D" channel, typified by a very wide "braided channel…with eroding banks…in broad valleys…{and an} abundance of sediment supply." We funded the Tonto National Forest to construct a fence around the area as well as water developments for livestock that would no longer have access to the creek. Grazing was permitted between January 1 and April 15. Every third year was a rest period with no grazing permitted.

Costs for fencing the TCRU and for alternative water developments were $591,202. We also contracted for a monitoring study to determine if we met our commitment. GANDA , Inc. concluded that we accrued 654 riparian habitat credits from the 1993 base year to the end of the 1998 study year and exceeded our 80 acre mitigation requirement. This study cost $990,000.

The TCRU is now managed by the Tonto National Forest. I have no information as to the condition of Tonto Creek as of 2010. I do know that we have endangered southwestern willow flycatchers breeding in habitat within the TCRU in areas where none existed in 1993.

B. **Agua Fria fencing project** - we fenced off an area of approximately 152 acres downstream of New Waddell Dam and where Morgan City Wash flows into the Agua Fria River. This was to meet a mitigation commitment for another 404 Permit. We constructed a fence around the area to exclude livestock, burros , and OHV use. Flows from seepage under the dam and from Morgan City Wash support a healthy cottonwood/willow community that was being degraded by these activities. The fence cost $144,000 to construct. Other than

occasional visits to assess the status of the fence, we do not have any plans to intensively monitor the recovery of the area. However, both AGFD and Reclamation biologists conduct bird surveys during migration and make note of any trespass activities or improvement in the habitat.

In general, we try and stay away from any restoration via pole plantings, etc. Our guiding philosophy is to get rid of or manage the limiting or degrading variables/factors. ….and with enough water, the habitat will recover.

If you have any questions about either of these two projects, please contact me at 623-773-6257.

Regards

Henry Messing
USBR
Glendale, Arizona

Eleanor Gladding

From: Carla Danforth [Carla.Danforth@rfcd.pima.gov]
Sent: Wednesday, March 31, 2010 10:58 AM
To: Eleanor Gladding
Subject: FW: Mitigation letter

-----Original Message-----
From: Blaine, Marjorie E SPL [mailto:Marjorie.E.Blaine@usace.army.mil]
Sent: Tuesday, March 02, 2010 2:50 PM
To: Carla Danforth
Subject: RE: Mitigation letter

Super. He probably has a better tracking system than I do :)

Marjorie
In the interest of the environment, please print only if necessary and recycle

-----Original Message-----
From: Carla Danforth [mailto:Carla.Danforth@rfcd.pima.gov]
Sent: Tuesday, March 02, 2010 2:48 PM
To: Blaine, Marjorie E SPL
Subject: RE: Mitigation letter

Thanks Marjorie, I have asked Kendall for info also.
Carla Danforth

From: Blaine, Marjorie E SPL [mailto:Marjorie.E.Blaine@usace.army.mil]
Sent: Tuesday, March 02, 2010 2:26 PM
To: Carla Danforth
Cc: Laurie, Jesse
Subject: Mitigation letter

Carla

I received your letter dated February 25, 2010 regarding mitigation. I do not recall any projects in Pima County we have authorized in the last several years that were permittee responsible mitigation. To my best recollection, the mitigation has been in-lieu-fee primarily to the Tucson Audubon Society at North Simpson Farm. The mitigation costs there are $15,000/acre.
Based
on this, we are not be able to provide you with a tabular response as your example indicated.

I hope this information helps you. Thank you very much.

Marjorie Blaine
Senior Project Manager/Biologist

U.S. Army Corps of Engineers
Tucson Project Office, Regulatory Division
5205 E. Comanche Street
Tucson, AZ 85707
(520)584-1684 (phone)
(520)584-1690 (fax)
In the interest of the environment, please print only if necessary and recycle

Eleanor Gladding

From: Carla Danforth [Carla.Danforth@rfcd.pima.gov]
Sent: Wednesday, March 31, 2010 11:00 AM
To: Eleanor Gladding
Subject: FW: Costs Associated with Riparian Restoration Projects

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From: Annette Plicato
Sent: Friday, February 26, 2010 10:04 AM
To: 'David Harris'
Cc: Carla Danforth
Subject: RE: Costs Associated with Riparian Restoration Projects

Dave, we look forward to hearing from you.

Thanks, Annette

From: David Harris [mailto:dharris@TNC.ORG]
Sent: Friday, February 26, 2010 9:37 AM
To: Annette Plicato
Cc: Carla Danforth
Subject: RE: Costs Associated with Riparian Restoration Projects

Hi Annette and Carla, we will pull some information together for you from our most recent restoration work and pass it on to you. Thanks for the opportunity to provide input into your process.
Best Regards
Dave Harris

David B. Harris
Director, Land and Water Protection
1510 E. Ft. Lowell Road
Tucson, Arizona 85719
520-547-3427

From: Annette Plicato [mailto:Annette.Plicato@rfcd.pima.gov]
Sent: Thursday, February 25, 2010 3:00 PM
To: David Harris
Cc: Carla Danforth
Subject: Costs Associated with Riparian Restoration Projects

Dear Mr. Harris:

Pima County Regional Flood Control District (District) is in the process of revising their off-site mitigation policies for impacts to regulated riparian habitat. The District is compiling data to determine actual costs associated with riparian restoration projects in the arid West. Attached is a letter from Carla Danforth

explaining the information we are requesting from the Arizona Nature Conservancy. Your input will be valued in this endeavor.

Thank You, Annette Plicato

<<Dave Harris.pdf>>

Eleanor Gladding

From: Carla Danforth [Carla.Danforth@rfcd.pima.gov]
Sent: Wednesday, March 31, 2010 10:38 AM
To: Eleanor Gladding
Subject: FW: Riparian Costs
Attachments: image001.gif

From: Karen Cesare [mailto:karen@novakenvironmental.com]
Sent: Monday, March 22, 2010 11:00 AM
To: Carla Danforth
Subject: Riparian Costs

Hi Carla,

I am responding to your request for cost information associated with riparian restoration projects you send last month.

While we don't have any specific projects I can use to provide detailed costs, I will offer some general information which I hope is helpful.

1. Planning and Design Costs

Can run between 10 -20 % of construction costs.

Typically straight design costs, which include design development and cd's, run about 10% of construction costs. Added costs for planning, public input, illustrative graphics and services during construction can increase this percentage.

In addition – a low budget project will have a higher ratio of design to construction cost. Public works projects will have a higher cost than private projects due to the additional requirements for plans and specs for public works.

2. construction costs – plant costs

Prices have not changed significantly in the last 10 years – or even longer. I was doing "reveg" work at La Paloma in the mid 80's and we figured our costs at about $1.00/sf for installation of plants, irrigation and seeding. This was at densities that are similar to riparian reveg. I think you will find costs are still in the range of $1.00 - $1.30 now – assuming small trees.

Biggest variable is water source costs – if needed. (new meters are expensive!)

Hope this helps.

Karen M. Cesare, RLA
President
Novak Environmental, Inc.
(520) 206-0591 p
(520) 882-3006 f
(520) 405-8035 c

Celebrating 12 Years in Business!
1998-2010

Eleanor Gladding

From: Carla Danforth [Carla.Danforth@rfcd.pima.gov]
Sent: Wednesday, March 31, 2010 9:53 AM
To: Eleanor Gladding
Subject: FW: Request for info
Attachments: ATT1349398.jpg

From: karen.williams@phoenix.gov [mailto:karen.williams@phoenix.gov]
Sent: Friday, March 26, 2010 3:39 PM
To: Carla Danforth
Subject: Request for info

Carla,

I received a request for us to e-mail you the operational costs for our Rio Salado Restoration Area, which is 600-acres, with 16 miles of trails, wetland ponds, mesquite bosques and thickets of cottonwoods and willows costs. The total costs of operations for 2009/10 budget year is $1,512,887, this includes water costs.

Karen Williams, Deputy Director
City of Phoenix
Parks and Recreation Department - Parks Development and Planning Division
200 W. Washington St, 16th Floor
Phoenix, AZ 85003-1611
(602) 534-1870 / Fax (602) 732-2333

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APPENDIX C
SUPPLEMENATAL INFORMATION ON THE PROJECTS USED FOR CALCULATING COSTS BASIS

*part of Appendix C, SWCA Report

Environmental Restoration Projects in Arizona: The U.S. Army Corps of Engineers' Approach
Final Report*
June 2005

Sharon B. Megdal, Ph.D. **
Director, Water Resources Research Center
University of Arizona, Tucson AZ

* This report is the fourth and final deliverable of Project Number W912PL04P0045, entitled "Ecosystem Restoration Projects in Arizona."
** Sharon Megdal thanks Jennifer Jones and Kelly Mott Lacroix for research assistance and numerous others for comments received on presentations related to this study.

Ed Pastor Kino Environmental Restoration Project

Location: Along Tucson Diversion Channel, Pima County, Tucson; north of Ajo Way and west of Country Club Road (141 acres).

Federal Sponsors and Contacts: USACE, Los Angeles District, Ed Louie, is currently the Project Manager for the Kino Environmental Restoration Project (213) 452-4002.

Non-Federal Sponsors and Contacts: Pima County Flood Control, Larry Robison (520) 740-6371

History: The Tucson (Ajo) Detention Basin, approximately 120 acres, was constructed in 1966 along the Tucson Diversion Channel. The Corps built the basin as a flood control element, which intercepted and reduced peak flows upstream from Tucson Arroyo and Railroad Wash drainage areas. Downstream, flows were released gradually into the Tucson Diversion Channel, which would then merge with the Julian Wash and down to the Santa Cruz River. The basin, not aesthetically appealing, had a flat earthen bottom and levee with scrub trees and grasses along the edges. In 1981, the Corps and Pima County developed a master plan for the Tucson Diversion Channel Recreation Development Program, (Corps Code 710 program -recreation at completed projects- with a cost sharing agreement of 50/50). In 1986, Sam Lena Park, adjacent the basin, was the only portion of the master plan constructed. The master plan was then updated in 1995 to include multi-use trails from Sam Lena Park to I-19. In 1997, baseball field and other public facilities (Kino Sports Complex) were constructed around the basin. The basin took on more runoff and became even more of an eyesore. In early 1997, the Corps initiated a Preliminary Restoration Plan (PRP) to determine the feasibility of modifying the basin features for restoration of riparian habitat. An Ecosystem Restoration Report (ERR) followed and was approved in April 1998. Plans and Specifications were initiated in June 1998. Construction was awarded in July 2000. Modifications were completed in 2002 and the original facility was expanded to 141 acres: 50 acres of wetlands within the basin, including freshwater marsh, riparian habitat. Twelve acres is made up of wildlife and open water areas, and 38-acres are mesquite bosque and ephemeral grassland. A golf course was also an idea at one stage, but was never implemented. [15]

Authority: Section 1135 of WRDA of 1986 - Project Modification for Improvement of the Environment

Planning Objectives: **"**Restore wetland and riparian vegetative communities representative of historical/optimal conditions in the region; restore habitats for target/beneficial fish and wildlife species; maximize the acreage of functional wetland habitat within limits of the golf course design; achieve an optimal mix of habitats that supports the greatest diversity of target/beneficial species while promoting the principal fish and wildlife objective proposed by a restoration alternative (balancing of objectives); minimize disturbance-type impacts to restored wetlands from the adjacent golf course and from pedestrian traffic; restore wetlands to be ecologically resilient and self-sustaining; minimize potential fro sediment and organic matter accumulation in restored wetlands (low maintenance design); protect restored wetlands from feral predation;

[15] U.S. Army Corps of Engineers, Los Angeles District, South Pacific Division. 1998. *Tucson (Ajo) Detention Basin, Pima County, Arizona, Final Ecosystem Restoration Report.* Los Angeles: U.S. Army Corps of Engineers.

Excerpted from the Regulated Riparian Habitat Offsite Mitigation Guidelines for Unincorporated Pima County

design for and maintain adequate vector control in restored wetlands; enhance water quality of the reclaimed water source (i.e., water treatment function of restored wetlands); maintain the existing flood protection capacity of the Tucson (Ajo) Detention Basin; accommodate incidental recreational values (e.g., interpretive centers, wildlife viewing, education and research)."[16]

Operation Objectives: "Maintain the Flood Control Capacity of the Basin; establish and maintain an ecosystem habitat in a US Corps of Engineers project as part of the Federal Requirements under Sec 1135; maximize use of harvested storm water, and minimize use of reclaimed water; utility reclaimed water as make-up water instead of groundwater; minimize mosquito population and avoid other vector nuisance; meet local, State, and Federal permit requirements; maintain water quality and ensure the public welfare; optimize ecosystem (plant and animals) establishment within an urban area."[17]

Current Phase: Operation and Maintenance - Constructed (2002)

Phases: PRP completed in January 1997, ERR May 1998

Cost: Total construction award cost approximately $8,215,444, awarded to Stronghold Engineering, Inc., Riverside, CA. Water cost is estimated to be $265,000 a year.[18]

Water Source: Project uses storm water runoff and reclaimed water. Total water demand is estimated to be 574 acre-feet per year.[19]

Public Outreach: The Collins-Peña Firm developed a school program at a local elementary school, where kids created a 9'x 9' model to present to local community.[20]

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[16] Ibid. p. 3-14

[17] U.S. Army Corps of Engineers, Los Angeles District, South Pacific Division. 2003. *Operation and Maintenance Manual: Ed Pastor Kino Environmental Restoration Project.* Tucson: U.S. Army Corps of Engineers. p. 14

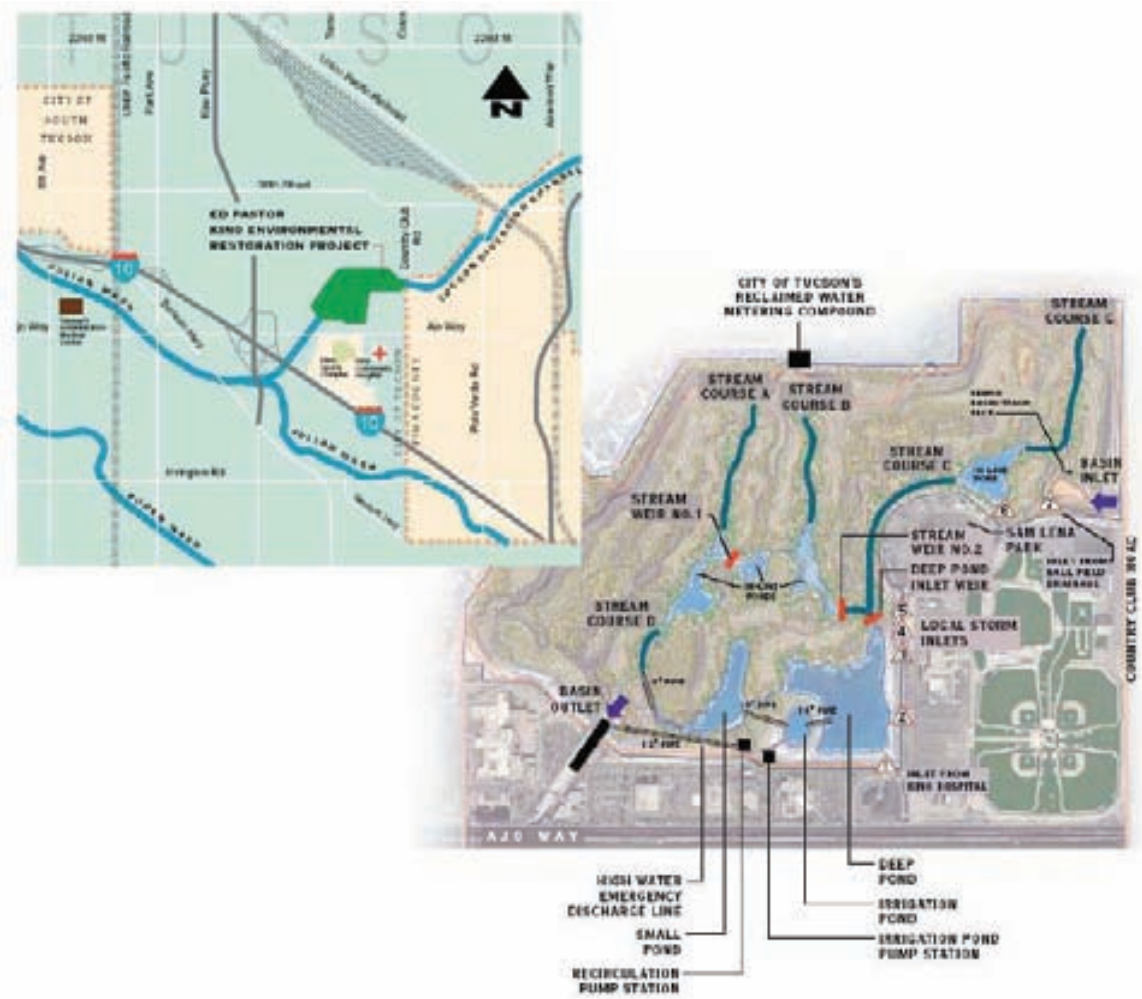
[18] This estimate assumes a cost of $462 per acre-foot. The water will be supplied by the Tucson Water Before the construction phase begins a signed interagency agreement between Pima County and City of Tucson will be required to assure the cost of the water and water availability for the life of the project. U.S. Army Corps of Engineers, Los Angeles District, South Pacific Division. 1998. *Tucson (Ajo) Detention Basin, Pima County, Arizona, Final Ecosystem Restoration Report.* Los Angeles: U.S. Army Corps of Engineers. p. 5-22

[19] Ibid.

[20] Bennet, Paul. 2000. "A New Friendlier Corps." *Landscape Architecture Magazine.* 01/00 Washington, D.C.

Excerpted from the Regulated Riparian Habitat Offsite Mitigation Guidelines for Unincorporated Pima County

Ed Pastor Kino Environmental Restoration



Ed Pastor Kino Environmental Restoration Cost Estimate	
Construction	$3,620,891
Contingency (12.5%)	$451,709
PED	$265,000
Supervision, Inspection and Overhead (6.5%)	$264,250
Total First Costs	**$4,594,633**
Annual OMRR&R	$50,000
Annual Cost of Water	$265,000

Final Ecosystem Restoration Report, p. 5-22

Excerpted from the Regulated Riparian Habitat Offsite Mitigation Guidelines for Unincorporated Pima County

Ed Pastor Kino Environmental Restoration

View to the Deep Pond

Cottonwood Tree at Kino Wetlands

Wetland Formation along a Created Pond

Example of an In Line Pond

Excerpted from the Regulated Riparian Habitat Offsite Mitigation Guidelines for Unincorporated Pima County

Agua Caliente Spring

Location: Roy P. Drachman Agua Caliente Regional Park 12325 E. Roger Road, Pima County, Tucson; Northeast corner of the Tucson Basin at the foot of the Catalina Mountains (101 acres).

Federal Sponsors and Contacts: USACE, Study Manager: William Butler, William.O.Butler@spl.usace.army.mil (213) 452-3873; Project Manager: Paul Kerl, Paul.A.Kerl@spl.usace.army.mil

Non-Federal Sponsors and Contacts: Pima County Flood Control District: Julia Fonseca (520) 740-6350

History: From 1935 to 1970's the project area went through a rotation of owners who utilized the property for ranching and farming (orchards and alfalfa fields). In the 1970's through mid 80's a development company planned to build lake-side homes, but the idea was never implemented. In 1985, Pima County Parks and Recreation purchased the property and opened the park to the public, which was named after Roy P. Drachman Sr., who donated $200,000.[21]

Authority: Section 206 - Aquatic Ecosystem Restoration

Planning Objectives: "Improve general ecosystem function; Increase the diversity of native vegetation structure and cover; Create habitat capable of supporting numerous rare native aquatic fish, amphibians, and reptiles; Restore the natural structure and function of the spring over at least a portion of the Park; Improve habitat for local native plant and animal species such as riparian birds; Create educational and recreational opportunities that improve public enjoyment of the Park; Facilitate a deeper public understanding of the plight of native aquatic species and their habitats in the southwest; Increase awareness of the impacts of non-indigenous species; Improve appreciation of biological diversity."[22]

Phases: Reconnaissance phase initiated in February 2000 and completed December 2000. After the reconnaissance report, project was then conducted under Sec 206 of WRDA 1996. Feasibility initiated September 2001. Final Detailed Project Report (DPR) October 15, 2002. Completed without recommendation to move forward at County's request due to lack of public support.

Recommended Plan: Alternative 2, One Pond and Cienega, (ponds 2 and 3 would be eliminated) was the tentatively selected plan because: "The plan has been determined to be a best buy, cost-effective plan; It represents high biological value and is estimated to result in 57.5 habitat units; It retains Pond 1, the existing spring flow channel and the entire upper Park area of lawn and picnic areas. This is the area most closely associated with the historic ranch buildings and is very popular with Park users. It represents the visual aesthetic that many Park visitors say is the defining character of the Park as they experience it—a restorative oasis in the desert." [23]

Cost: Total estimated costs of $5.15 million.[24]

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[21] Pima County. 2005. *Agua Caliente Ranch.* http://www.dot.co.pima.az.us/flood/AguaC/ranch/index.html
[22] U.S. Army Corps of Engineers, Los Angeles District, South Pacific Division. 2002. *Agua Caliente Spring Aquatic Ecosystem: Detailed Project Report.* Los Angeles: U.S. Army Corps of Engineers. p. 2-3
[23] Ibid. p. 3-60
[24] Ibid. Appendix A

Excerpted from the Regulated Riparian Habitat Offsite Mitigation Guidelines for Unincorporated Pima County

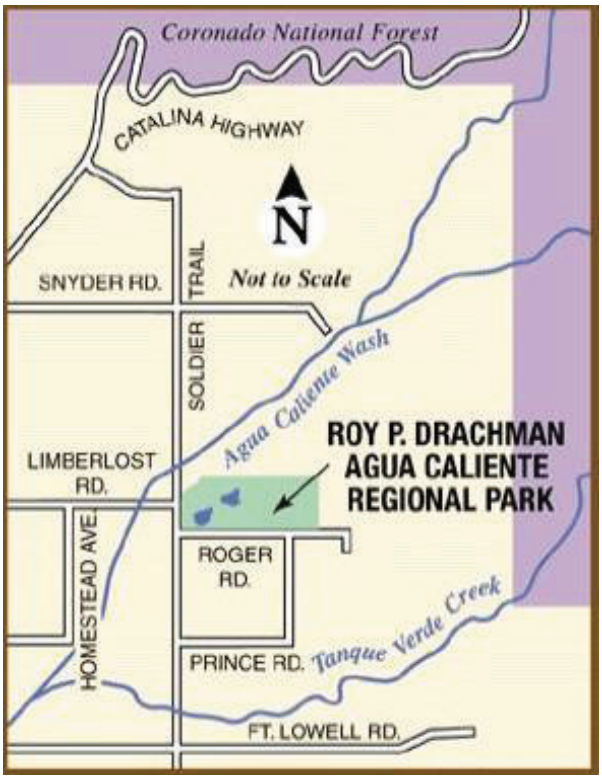
Water Source: Underground thermal spring.[25]

Public Outreach: Public outreach on this project was extensive.[26] A Citizen's Advisory Committee formed to communicate ideas between citizens, sponsors, and Corps. Three public meetings by Corps and Sponsors (January, April, and August of 2002), major concerns were: "limited future public access and recreation opportunities in the Park if restoration is to proceed; loss of Park aesthetics caused by conversion of open water habitats to native cienega-type wetlands; lack of public input into planning process; effect of system alteration on species currently using the Park; risk of increased mosquito populations with creation of native habitats and removal of non-native fishes; and lack of adequate spring discharge to maintain streams that can support the target habitats/species."[27]

[25] U.S. Army Corps of Engineers, Los Angeles District, South Pacific Division. 2002. *Agua Caliente Spring Aquatic Ecosystem: Detailed Project Report.* Los Angeles: U.S. Army Corps of Engineers.
[26] Ibid.
[27] Ibid.

Excerpted from the Regulated Riparian Habitat Offsite Mitigation Guidelines for Unincorporated Pima County

Agua Caliente



Agua Caliente Cost Estimate	
Construction	$4,500,000
Plans and Specifications	$300,000
ER Report	$350,000
Total	**$5,150,000**

Detailed Project Report, Appendix B

Excerpted from the Regulated Riparian Habitat Offsite Mitigation Guidelines for Unincorporated Pima County

Agua Caliente

Mesquite Bosque, Trail to Pond 2

Pond 2, Agua Caliente

Excerpted from the Regulated Riparian Habitat Offsite Mitigation Guidelines for Unincorporated Pima County

Rillito River Riparian Area (Swan Wetlands)

Location: Rillito River, Pima County, Tucson; South Bank of Rillito River - Craycroft Road (confluence of Tanque Verde Creek with Pantano Wash) to Columbus Boulevard (60.7 acres).

Federal Sponsors and Contacts: USACE: Project Manager: Paul Kerl (602) 640-2004 x 281 Study Manager: Tom Keeney

Non-Federal Sponsors and Contacts: Pima County Flood Control District: Project Manager: Andrew Wigg, 520-740-6350, andy.wigg@dot.pima.gov

History: In the past the Rillito River flowed perennially, meandering and supporting dense vegetation of cottonwood, willows, mesquite bosques, numerous beaver dams, and wetlands. Flows supported agriculture along the river. With growing agriculture, in the 1930's, Finger Rock Wash was cut off from Rillito River and riparian vegetation was removed. Urbanization, along with agriculture, increased and contributed to a loss in surface water flow, a decrease in the water table, and bank stabilization for flood control. Today much of the riparian habitat is degraded.[28]

Authority: Section 1135 of WRDA - Modification of existing USACE projects for Ecosystem Restoration: The Rillito River Bank Protection Project was completed in 1996 between USACE and PCFCD. [29]

Planning Objectives: "Restore riparian vegetative communities within the river corridor to a more natural state, increase the acreage of functional seasonal wetland habitat with in the study area, minimize the potential for sediment and organic matter accumulation in restored areas, increase habitat diversity..., increase recreation and environmental education opportunities within the study area." [30]

Current Phase: Contract between Corps and Pima County signed February 15, 2005, construction to begin summer 2005.[31]

Phases: Preliminary Restoration Plan approved June 1999; Environmental Restoration Report/ DPR and Environmental Assessment (ERR/EA) completed November 2003.

Recommended Plan: Alternative - 1, Riparian/Xeroriparian Terrace "The alternative emphasizes the creation of riparian woodland habitat along created linear wet areas. Xeroriparian habitat would be used in the remaining areas to buffer the riparian habitat from adjacent land uses. The site is divided into distinct areas based on the restoration effort that will occur."[32] "The major factor in selection of this alternative was the desire of the local sponsor to not have surface water conditions that may be a liability concern.

---

[28] U.S. Army Corps of Engineers, Los Angeles District, South Pacific Division. 2004. *Rillito River, Pima County, Arizona: El Rio Antiguo Draft Feasibility Study*. Los Angeles: U.S. Army Corps of Engineers.
[29] U.S. Army Corps of Engineers, Los Angeles District, South Pacific Division. 2003. *Rillito River Pima County Ecosystem Restoration Report and Environmental Assessment.* Los Angeles: U.S. Army Corps of Engineers.
[30] Ibid. p. 2-2
[31] Davis, Tony. 2005. "Rillito restoration green lighted." *Arizona Daily Star.* Feb. 16.
[32] See *Rillito River Pima County Ecosystem Restoration Report and Environmental Assessment.* p. 3-6 for more information.

Excerpted from the Regulated Riparian Habitat Offsite Mitigation Guidelines for Unincorporated Pima County

A contributing factor in the selection of this alternative is its design compatibility with the existing multi-use trail." [33]

Cost: Total first costs are $2.7 million.[34] Under the recommended plan of USACE needs 349 acre-feet of water per year, at approximately $230 per acre-foot, for costs of approximately $81,000 per year.[35]

Water Source: Reclaimed water from City of Tucson's Roger Road Wastewater Treatment Plant for temporary irrigation and two artificial streams. Water will also come from harvesting storm water runoff, mainly water from Alamo Wash and seasonal snowmelt.[36] Water use is estimated at 349 acre-feet per year.

Public Outreach: Public Workshop Jan 6, 2000; Draft of ERR/EA March 21, 2003 - April 21, 2003 for public comment; PCFCD Open House May 2004.

Notes: There is a landfill in study area, called Columbus Landfill; El Rio Antiguo ER project is adjacent to study area. Interest in El Rio Antiguo and Swan Wetlands were simultaneous, Swan Wetlands should be completed first as it is a CAP 1135. [37]

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[33] U.S. Army Corps of Engineers, Los Angeles District, South Pacific Division. 2003. *Rillito River Pima County Ecosystem Restoration Report and Environmental Assessment.* Los Angeles: U.S. Army Corps of Engineers. p. 3-24

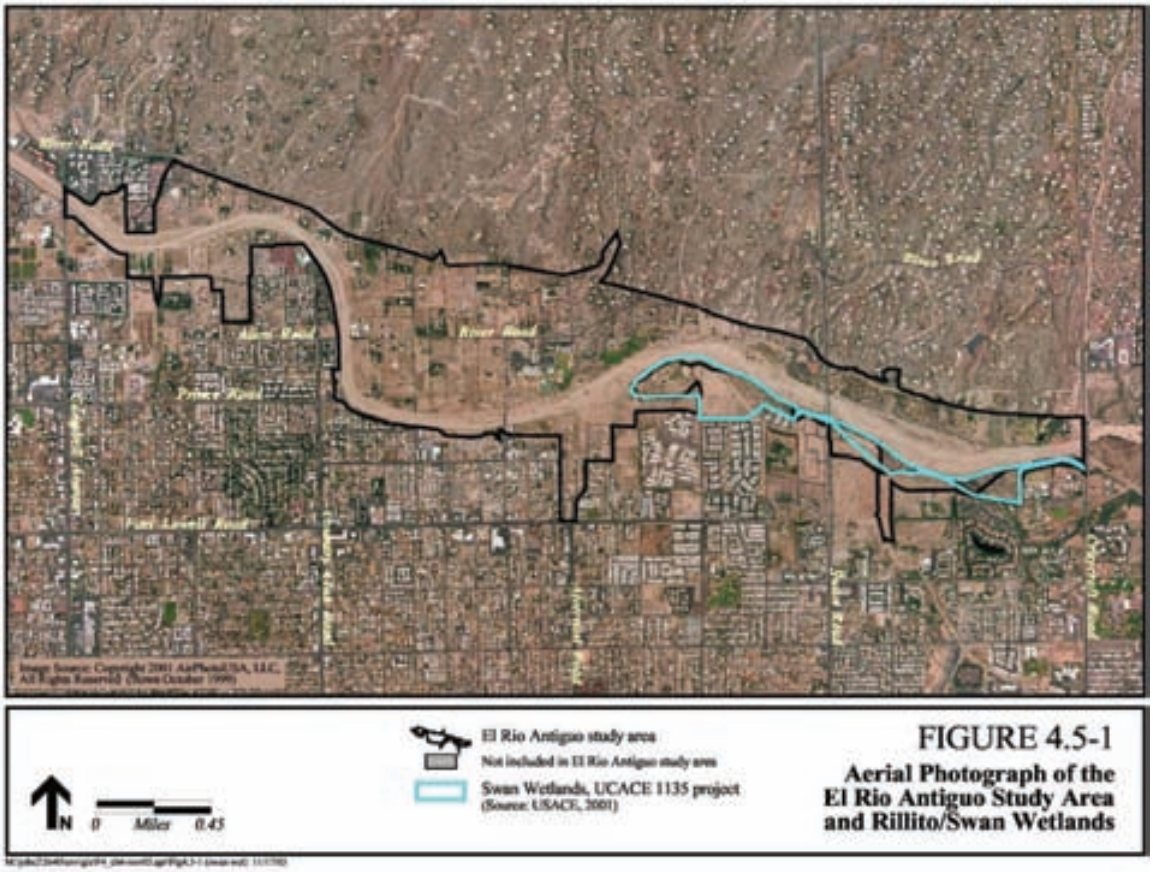
[34] Ibid. See table p. 3-29

[35] The $230 per acre-foot charge is based on the cost to obtain the water from the Tucson Water Department. Ibid. p. 3-14.

[36] Ibid.

[37] Bergmann, Kathy. 2004. Personal communication with the author, August, 23.

Rillito River Riparian Area (Swan Wetlands)



Swan Wetlands Cost Estimate	
DPR/EA	$400,000
Construction	$1,659,043
Contingency	$359,468
PED	$198,752
Supervision, Inspection and Overhead	$142,108
Total First Costs	**$2,759,370**
Total Annual OMRR&R	$124,000
Annual Cost of Water	$81,000

Rillito River ERR/EA, p. 3-14

Rillito River Riparian Area (Swan Wetlands)

South Bank of Rillito River, East of Swan Road.

South Bank of Rillito River, West of Swan Road.

Excerpted from the Regulated Riparian Habitat Offsite Mitigation Guidelines for Unincorporated Pima County

Paseo de las Iglesias

Location: Santa Cruz River, Pima County, Tucson; Los Reales Road to West Congress Street and West Branch of Santa Cruz River (7.5 miles and 5,005 acres) Name: "Walk of Churches" - adjacent San Xavier Mission, San Agustin Mission, to the Convento site at the base of Sentinel Peak.

Federal Sponsors and Contacts: USACE, Project Manager: John Drake, Study Manager: Kim M. Gavigan, Kim.M.Gavigan@usace.army.mil (602) 640-2015 x 251

Non-Federal Sponsors and Contacts: Pima County Department of Transportation and Flood Control District, Project Manager : Tom Helfrich, Tom.Helfrich@dot.pima.gov; Contact: Jennifer Becker, Jennifer.Becker@dot.pima.gov

History: Prior to degradation, the Santa Cruz (SC) River flowed year round at San Xavier del Bac and 10 miles north of downtown Tucson. SC River was a shallow stream with a wide flood plain, containing cottonwoods, willows, and mesquite bosques. A wetland at former confluence of West Branch and SC River was turned into a lake during the Spanish/Mexican period and in 1874 became Warner's Lake (approximately 50 acres) which was used was for a mill. Later the area was converted into a resort to named Silverlake. In the 1900's, the Tohono O'odham Nation at San Xavier and Tucson farmers diverted surface water, then later groundwater, for irrigation of crops. In 1915 the West Branch of SC River was diverted to the East Branch to prevent flooding of crops, leaving the current remnants of riparian habitat along the West Branch. In 1935 the WPA straightened the East Branch channel, known today as main channel of SC River, from San Xavier downstream to Congress Street. Between 1950 and 1960, one million tons of garbage was dumped in and around SC River, artificially narrowing the channel. Construction of I-10 and I-19 helped to further channelize the river, as did the addition of soil cement in portions of the SC River to reduce bank erosion and flood damages. Currently, the SC is an ephemeral river, little riparian habitat exists, banks are deeply incised, and groundwater levels are at 150 ft. below surface. Today 1/2 of the groundwater pumped in Tucson comes from wells near SC River.[38]

Authority: General Investigation - Ecosystem Restoration

Planning Objectives: "Increase the acreage of functional riparian and floodplain habitat within the study area; increase wildlife habitat diversity by providing a mix of riparian habitats within the river corridor, riparian fringe and historic floodplain; provide passive recreation opportunities; provide incidental benefits of flood damage reduction, reduced bank erosion and sedimentation, and improved surface water quality consistent with ecosystem restoration goal; integrate desires of local stakeholders consistent with Federal policy and local planning efforts." [39]

Current Phase: Corps is finalizing feasibility, PED in 2005, Construction 2008.

Phases: Draft Feasibility (AFB) Report December 2003; Draft Feasibility Report July 2004

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[38] U.S. Army Corps of Engineers, Los Angeles District, South Pacific Division. 2003. *Santa Cruz River, Paseo de las Iglesias Pima County, Arizona Draft Feasibility Study Report Alternative Formulation Briefing.* Los Angeles: U.S. Army Corps of Engineers.
[39] Ibid. p. V-I

Excerpted from the Regulated Riparian Habitat Offsite Mitigation Guidelines for Unincorporated Pima County

Recommended Plan: 3E (mesoriparin)[40] "Alternative 3E is characterized by irrigated plantings of mesquite and riparian shrub on terraces above the low flow channel and in the historic floodplain with small areas of emergent marsh and cottonwood-willow habitat located at water harvesting features scattered throughout the project. The construction and planting of subsurface water harvesting basins would occur at the confluences of 8 tributaries and upstream of 6 existing grade control structures. A variety of methods would be used to provide permanent irrigation systems for all planted areas including the basins."[41]

Cost: "The total first cost of the recommended plan is $92,058,546 and the total operation and maintenance costs including water are $1,906,221. The Federal share of the recommended plan is $59,666,768 and the non-Federal share is $32,391,778."[42] The cost of providing water for the project is an associated non-Federal cost, and 100 percent of these costs will be paid by the non-Federal sponsor. These costs are currently estimated at $1,099,175 annually.[43]

Water Source: Water harvesting and reclaimed water from the City of Tucson, "For as long as the project remains authorized, the non-Federal sponsor must provide sufficient water for construction, operation and maintenance of the project. Tertiary effluent accessed from reclaimed water mains will be distributed through an irrigation system in the restored areas. The annual water budget for the tentatively recommended plan is estimated at 1,925 acre-feet per year."[44]

Pubic Outreach: Notice of Intent April 2001; Public Scoping March 31, 2001 with tour of site; Open House by PCFCD January 22, 2004. "Public comments specific to the Old West Branch suggested: developing plans which serve multiple objectives; incorporating more permaculture techniques in water harvesting, planning, design, and implementation; and incorporating civic amenities such as a self-guided historic walk with benches and written information, shade and benches; trails, picnic areas and ramadas with BBQs.

None of the participants expressed support for flood damage reduction efforts in the study area. Because of the public interest evidenced during the initial meeting, further meetings were scheduled to establish a process for development of public involvement in planning for restoration of the Santa Cruz River in the study area. The principal participants in this public workshop planning process were representatives from federal, state, and local agencies, and citizens from the local area.

Two smaller workshops were held on March 21, 2002 and again on April 9, 2003. In each case, representatives of local agencies, citizens from the local area and other stakeholders were convened to solicit input regarding restoration measures and desired

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[40] Endorsed by Pima County, recommended plan by Corps was not acceptable to Pima County due to excessive amount of water used, therefore a change in alternative. The Corps are finalizing the Feasibility Study Report for public release in October 2004.

[41] U.S. Army Corps of Engineers, Los Angeles District, South Pacific Division. 2003. *Santa Cruz River, Paseo de las Iglesias Pima County, Arizona Draft Feasibility Report.* Los Angeles: U.S. Army Corps of Engineers. p. iii

[42] Ibid. p. iv

[43] Ibid. p. VI-4

[44] Ibid.

Excerpted from the Regulated Riparian Habitat Offsite Mitigation Guidelines for Unincorporated Pima County

outputs. In addition, a public open house to discuss preliminary findings was conducted by Pima County on January 22, 2004."[45]

[45]Ibid. p. II-4

Excerpted from the Regulated Riparian Habitat Offsite Mitigation Guidelines for Unincorporated Pima County

Paseo de las Iglesias

Paseo de las Iglesias Cost Estimate	
Construction and Real Estate	$72,828,371
Adaptive Management	$1,870,205
Contingency (15%)	$6,967,940
PED (10%)	$4,659,627
EDC (1%)	$465,863
Construction Management (6.5%)	$3,482,323
Monitoring	$623,304
Total First Costs	**$90,916,632**
Annual OMRR&R	$770,785
Annual Cost of Water	$1,099,175

Draft Feasibility Report, p. VI-5

Paseo del las Iglesias

View North to Silverlake Rd Bridge, Santa Cruz River

West Branch of the Santa Cruz, South of Silverlake Road

Recreation: Riding Along the Santa Cruz River

Mesquite Bosque Adjacent West Branch of Santa Cruz River, and South of Silverlake Road.

Excerpted from the Regulated Riparian Habitat Offsite Mitigation Guidelines for Unincorporated Pima County

El Rio Antiguo

Location: Rillito River, Pima County, Tucson; Craycroft Road downstream to Campbell Avenue (4.8 mile reach and 1,066 acres). El Rio Antiguo is the "Old River" in Spanish

Federal Sponsors and Contacts: USACE: Project Manager: John Drake, Study Manager: Kathleen Bergmann (602) 640-2004 x250

Non-Federal Sponsors and Contacts: Pima County Flood Control District: Project Manager: Carla Danforth, Caral.Danforth@dot.pima.gov

History: In the past the Rillito River flowed perennially, meandering and supporting dense vegetation of cottonwood, willows, mesquite bosques, numerous beaver dams, and wetlands. Flows supported agriculture along the river. With growing agriculture, in the 1930's, Finger Rock Wash was cut off from Rillito River and riparian vegetation was removed. Urbanization, along with agriculture, increased and contributed to a loss in surface water flow, a decrease in the water table, and bank stabilization for flood control. Today much of the riparian habitat is degraded.[46]

Authority: General Investigation - Ecosystem Restoration

Planning Objectives: "Restore riparian vegetative communities within the river corridor to a more natural state; increase the acreage of functional seasonal wetland habitat within the study area; increase habitat diversity by providing a mix of habitats within the river corridor including the riparian fringe and buffer; provide incidental flood control through ecosystem restoration to the extent that it does not impact the restoration object; increase recreation and environmental education opportunities within the study area." [47]

Current Phase: Feasibility Complete. In October 2004 under WRDA of 2004, Corps will ask Congress for funding for Pre-Engineering Design Phase.

Phases: Reconnaissance Report completed September 2001; Draft Feasibility Report Study published October 2003 and May 2004, Draft EIS Nov 2003.

Recommended Plan: Alternative 2H– 1 Terrace without buffer "A set of terraces in the area known as the "Bend;" Cottonwood/willow, mesquite, shrub and grasses planted in the channel, in tributary mouths, and in water harvesting basins on the tributaries; A culvert and pipeline from upstream will allow water to flow behind the soil cement in 2-year and higher events to provide water to riparian plant communities along the north bank in the upstream portion of the study area; A high and low flow channel created to support a mesquite community and connect the Finger Rock Wash to the Rillito River; Water harvesting basins at each upstream tributary mouth; and A distribution system for effluent supporting planted vegetation until established and in dry periods."[48]

Cost: Total First Cost is $66,657,000. Current annual water cost to Non-Federal sponsor is approximately $852,000.[49]

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[46] U.S. Army Corps of Engineers, Los Angeles District, South Pacific Division. 2004. *Rillito River, Pima County, Arizona: El Rio Antiguo Draft Feasibility Study*. Los Angeles: U.S. Army Corps of Engineers.
[47] Ibid. p. V-1
[48] Ibid.
[49] Ibid. p. VI-13

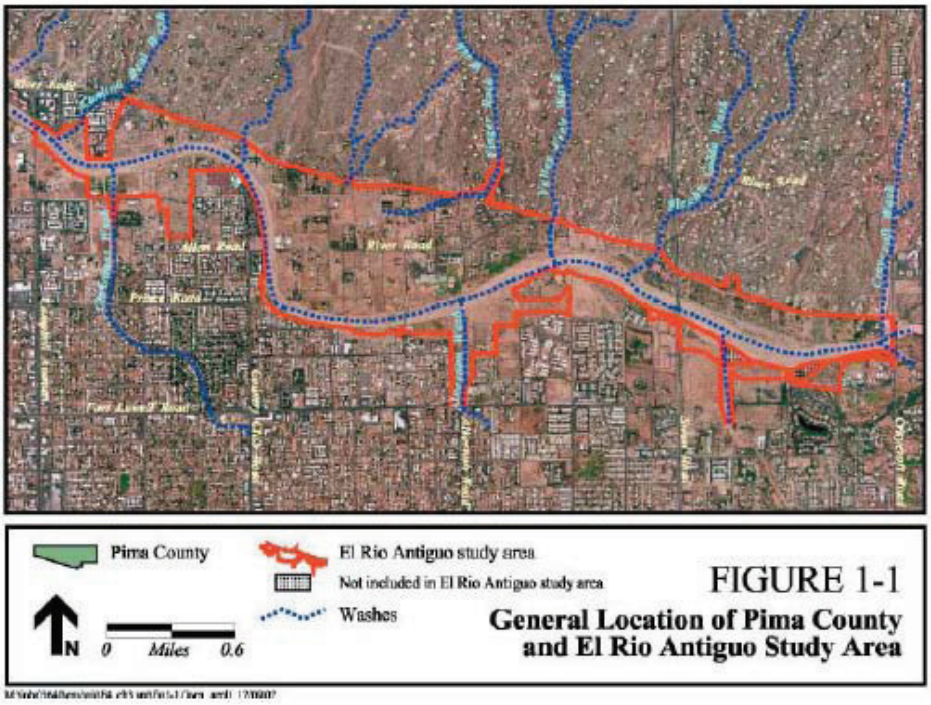
Excerpted from the Regulated Riparian Habitat Offsite Mitigation Guidelines for Unincorporated Pima County

Water Source: Water harvesting, temporary effluent irrigation (Roger Wastewater Treatment Plant) until vegetation established, and reclaimed water from existing waterlines for flood irrigation (terraces).[50] The recommended plan requires 1,490 acre-feet of water per year. [51]

Public Outreach: During the planning process, public opinion was solicited from a variety of sources. The El Rio Antiguo Work Group, facilitated by Novak Inc. and initiated on May 8, 2002, included 7 months of field trips and meetings. Concerns of group included: "access to Rillito River and existing trails; use of native vegetation for restoration; wise use of water; providing wildlife habitat; visual impact of project; using interpretive signage; and working with surrounding neighbors." [52] January 28, 2004 was final Corps public meeting on feasibility stage.

[50] Ibid.
[51] Ibid. Appendix C
[52] Ibid. p. VIII-2

El Rio Antiguo



Rio Antiguo Cost Estimate	
Construction and Real Estate	$48,546,500
Adaptive Management (3%)	$1,868,000
Contingency (25%)	$6,611,500
PED (10%)	$4,150,000
EDC (1%)	$527,500
Construction Management (6.5%)	$2,149,000
Recreation First Costs	$2,804,500
Total First Costs	**$66,657,000**
Annual Cost of Water	$851,932
Annual OMRR&R	$391,425
Total Annual Cost	**$1,243,357**

Draft Feasibility, p. VI-13

El Rio Antiguo

View of Rillito River from Swa

View of Rillito River from Campbell Road looking East

Existing Condition

Future with Implementation of the Recommended Plan

Excerpted from the Regulated Riparian Habitat Offsite Mitigation Guidelines for Unincorporated Pima County

Tres Rios del Norte

Location: Santa Cruz River, Pima County, Tucson; Prince Road to Sanders Road, West Moore Road, and West Avra Valley Road. (19 miles)

Federal Sponsors and Contacts: USACE: Project Manager: John Drake, Study Manager: Bill Miller

Non-Federal Sponsors and Contacts: Pima County Flood Control: Project Manager: Tom Helfrich, Tom.Helfrich@dot.pima.gov, Town of Marana: Jennifer Christelman (520) 382-2600 j.christelman@marana.com, City of Tucson: Ralph Mara from Tucson Water.

History: Prior to degradation, SC River flowed year round at San Xavier del Bac and 10 miles north of downtown Tucson. The SC River was a shallow stream with a wide flood plain, containing cottonwoods, willows, and mesquite bosques. Riparian forests were found near Marana. Agriculture previously dominated northern portion of Tres Rios del Norte, in Avra Valley west of SC River. Sand and gravel mining began in 1970's and 80's near Ina and Cortaro Roads and continues today. Due to past agriculture and current municipal use, groundwater levels today are approximately 100 to 250 feet below surface. Only effluent discharge from Roger and Ina Wastewater Treatment Plant (plus storm water runoff) supports vegetation. Currently, effluent water flow is variable and is not available throughout the entire study area. Future use of effluent discharge is currently not reliable as other purposes, such as irrigation of golf courses, may have a higher priority than discharge. (See Institutional Framework Studies: Basic Principles of Arizona JJ010.C)[53]

Authority: General Investigation: Ecosystem Restoration

Planning Objectives: "Restoring wetland and riparian vegetative communities within the river corridor to a more natural state; increasing the acreage of functional seasonal wetland habitat within the river corridor; minimizing disturbance-type impacts to restored wetlands; minimizing the potential for sediment and organic matter accumulation in restored wetlands; increasing habitat diversity by providing a mix of habitats both in the river corridor and along the riparian fringe and buffer; reducing potential flood damages in specified areas"[54] Current Phase: F4a milestone completed, waiting on funding to continue. City of Tucson may add to water supply/quality (constructed recharge in riverbed to get 100% credit) as a new project purpose/objective. Sponsors want to finalize water resource planning issues before public review.[55]

Phases: Reconnaissance Report initiated February 2000 and completed December 2000 (Sec 6 of Flood Control Act of 1938); Feasibility F4A Milestone (AFB) January 2004.

Current Phase: F5 – Draft Feasibility Report

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[53] U.S. Army Corps of Engineers, Los Angeles District, South Pacific Division. 2004. *Tres Rios del Norte – Pima County, Arizona Ecosystem Restoration Feasibility Study F4A Milestone - Alternative Formulation.* Briefing Report Los Angeles: U.S. Army Corps of Engineers.

[54] U.S. Army Corps of Engineers, Los Angeles District, South Pacific Division. 2003. *Preliminary Draft Environmental Impact Statement, Tres Rios del Norte Feasibility Study.* Los Angeles: U.S. Army Corps of Engineers.

[55] Christleman, Jennifer. (City of Marana). 2004. Personal interview with author, September.

Excerpted from the Regulated Riparian Habitat Offsite Mitigation Guidelines for Unincorporated Pima County

Tentative Plan: Alternative B – High Mesquite-Woodland habitat restoration[56] The Tentative Plan, referred to as "Plan B – High" in the report, is a comprehensive alternative designed to restore nineteen miles of degraded habitat along the Santa Cruz River and its adjacent floodplains. The restoration would vastly improve mesquite, cottonwood-willow, and emergent wetland habitats to a condition supportive of wildlife, and for the benefit of residents and visitors to the area.[57]

Cost: "The Tentative Plan is currently estimated at a construction cost of approximately $292 million. The Federal share of construction is currently estimated at approximately $170 million, and the non-Federal share at $117 million."[58] The annual cost of water is estimated to be $5,334,630.[59]

Water Source: Currently, effluent discharge flows perennially from Roger Road and Ina Road Wastewater Treatment Plant. Tentative Plan includes piped delivery of tertiary reclaimed water and in channel effluent flows, requires approximately 9,000 acre-feet in water annually.[60] "Supplemental water would be provided throughout the study area to nourish the restored vegetated areas. The water distribution system required for sustenance of the restored areas includes delivery of tertiary reclaimed water and the use of in-channel effluent. Site work would include micro-grading for individual tree basins, flood irrigation, bubblers, drip irrigation, and implementation of micro- and macro-scale storm water-harvesting features. The Tentative Plan requires approximately 9,000 acre-feet in water, currently planned to be obtained from effluent and/or tertiary-treated sources. This will result in over 3,000 acres of watered and storm water-nourished habitat."[61]

Public Outreach: Unknown, to be included in F5 report.

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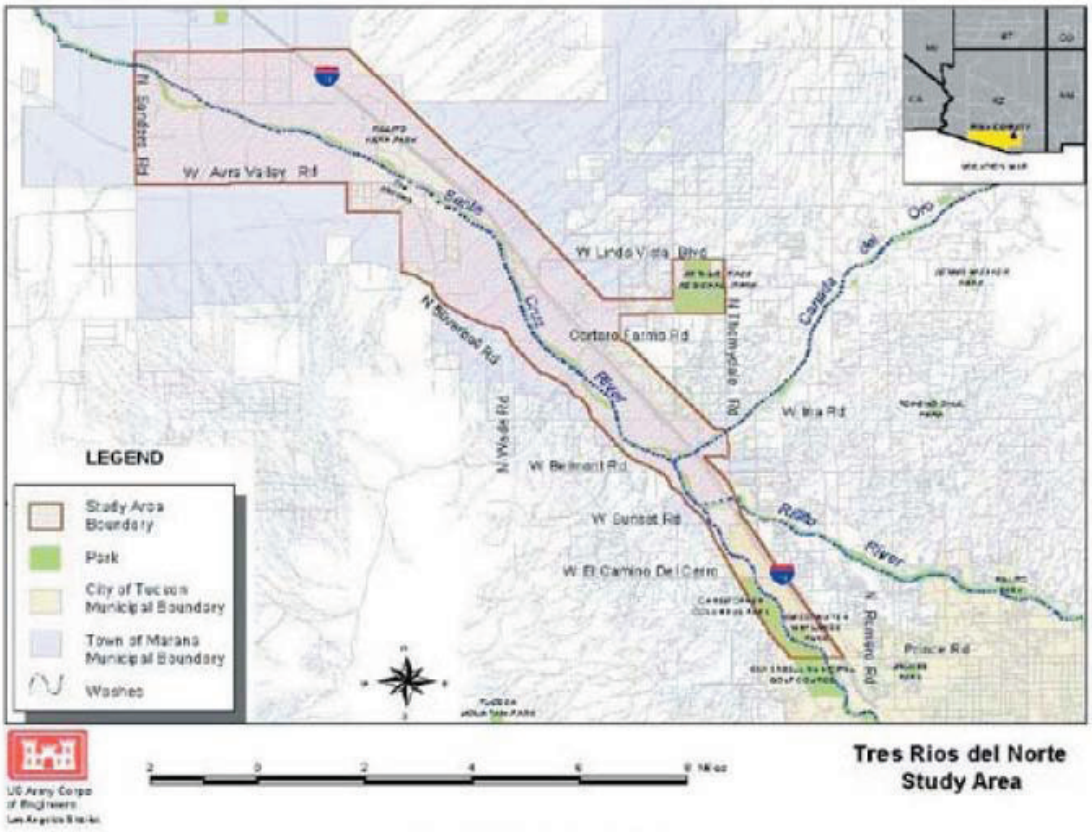
[56] The chosen alternative may change if new objective is added to project.
[57] U.S. Army Corps of Engineers, Los Angeles District, South Pacific Division. 2004. *Tres Rios del Norte – Pima County, Arizona Ecosystem Restoration Feasibility Study F4A Milestone - Alternative Formulation.* Briefing Report Los Angeles: U.S. Army Corps of Engineers. p. iii
[58] Ibid. p. iv
[59] According to the F4A Feasibility report water will cost $105 per acre-foot at the assumed source. Ibid. p. 6-14
[60] Ibid.
[61] Ibid. p. iv

Tres Rios del Norte

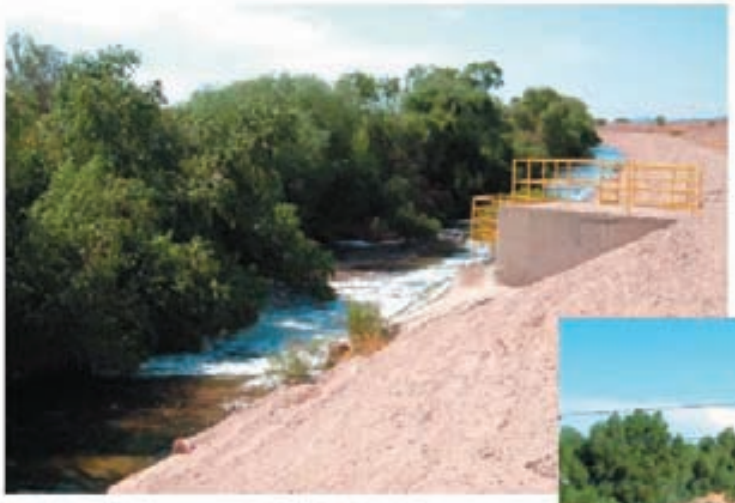


Tres Rios del Norte Cost Estimate	
Construction (Construction, S&A, PED/EDC, Contingency)	$224,948,000
Adaptive Management and Monitoring (1st yr.)	$115,000
Escalation	$36,831,000
Construction LERRDs (Lands, Easements, Rights-of-Way, Relocations, Disposal Sites)	$25,076,000
Total First Cost, Construction plus Real Estate (rounded)	**$286,970,000**
Interest During Construction	$25,295,000
Annual Investment Cost	$19,467,000
Annual Cost of Water Total Annual OMRR&R	$5,334,630 $11,661,000
Total Annual Cost	**$31,128,000**

F4A Feasibility January 2004, pg iv

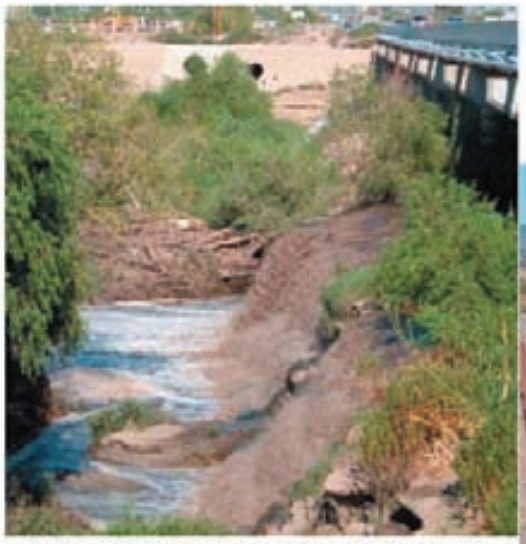
Excerpted from the Regulated Riparian Habitat Offsite Mitigation Guidelines for Unincorporated Pima County

Tres Rios del Norte



Roger Rd.Waste Water Treatment Plant Outfall into the Santa Cruz River.

Effluent Water from Roger Rd WWTP in the Santa Cruz River, looking South on Ina Road Bridge.



Ina WWTP Outfall in Background and Ina Rd. Bridge. Effluent Water From Roger Road WWTP.

Santa Cruz River: View to the North from Ina Rd. Bridge

Excerpted from the Regulated Riparian Habitat Offsite Mitigation Guidelines for Unincorporated Pima County

Va Shly 'ay Akimel

Location: Salt River, Maricopa County, Phoenix; Granite Reef Dam to Loop 101 Bridge (14 mile reach and 17,435 acres).

Federal Sponsors and Contacts: USACE: Project Manger: Mike Ternak, mike.ternak@usace.army.mil; Study Manager: Kayla Eckert (602) 640-2001

Non-Federal Sponsors and Contacts: City of Mesa: Senior Engineer: Gordon Haws (480) 644-3380, Assistant to City Manager Jim Huling 480-644-5796; Salt River Pima-Maricopa Indian Community (SRPMIC): Cultural and Environmental Services: Marilyn Ethelbah (480) 850 – 4157

History: "The Salt River is a major tributary to the Gila River in Arizona...Before agricultural development and urbanization of the Phoenix metropolitan area, the Salt River was a perennial stream fed by snowmelt from mountains in eastern Arizona. In the early part of the 20th century, major modifications to the river system occurred as part of the Salt River Project, which placed several dams along the Salt River to allow diversions of water for agricultural and urban uses. Sand and gravel mining operations and other activities along the river induced additional changes to the river channel and hydrology. As diversions of water increased, the perennial flows in the river ceased, causing the groundwater table to drop. These changes in hydrological conditions caused the natural riparian ecosystem to decline to the point at which only small, isolated fragments of this former habitat remain. The changes in hydrology have also allowed saltcedar, an invasive nonnative plant species with minimal habitat value, to become established in the region."[62]

Authority: General Investigation - Ecosystem Restoration

Planning Objectives: "Restore the riparian ecosystem to the degree that it supports native vegetation and wildlife through the Salt River from immediately downstream of the Granite Reef Dam to the Pima Freeway (SR 101); Establish a functional floodplain in unconstrained river reaches of the study area that is ongoing and mimics the natural processes found in other naturalized riparian corridors in Arizona; Provide passive recreation opportunities for visitors of all ages, abilities, and backgrounds that are in harmony with the SRPMIC's management of its culture and native ecology; Create awareness through ongoing educational opportunities of the significance of the cultural resources relating to the Salt River; Create awareness through ongoing education opportunities of the significance of the Salt River ecosystem; Create awareness through ongoing educational opportunities of the ecological connection between other ongoing riparian restoration projects along the Salt River." [63]

Current Phase: F7 Feasibility Review Conference

Phases: Reconnaissance initiated November 2000, Feasibility initiated August 2001, Final EIS submitted September 2004.

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[62] U.S. Army Corps of Engineers, Los Angeles District, South Pacific Division. 2004. *Va Shly' ay Akimel Salt River Ecosystem Restoration Feasibility Study, Final Environmental Impact Statement.* Phoenix: U.S. Army Corps of Engineers. p. 2-1

[63] U.S. Army Corps of Engineers, Los Angeles District, South Pacific Division. 2004. *Va Shly' ay Akimel Draft Salt River Ecosystem Restoration Study*. Los Angeles: U.S. Army Corps of Engineers. p. V-6

Excerpted from the Regulated Riparian Habitat Offsite Mitigation Guidelines for Unincorporated Pima County

Recommended Plan: Alternative O is the recommended plan and includes vegetation of large portions of the project area and minimal support for flood control structures. The restoration includes: Cottonwood-Willow (883.4 acres), Mesquite Woodlands (379.7 acres), River Bottom (425.1 acres), and Sonoran Desert Scrub Shrub (23.6 acres)." [64]

Cost: "The ecosystem restoration component of the Tentatively Recommended Plan would require $76,143,600 in construction costs, $19,035,900 in contingency costs, $7,614,400 in Pre-construction Engineering and Design, $761,400 in Engineering during Construction, and $4,949,300 in Supervision and Administration, for a total construction cost of $108,504,600." Operations, Maintenance, Rehabilitation and Repair for the ecosystem restoration component has been estimated at $131,000 per year. Associated costs for water supply are currently estimated at $1,283,000 per year.[65]

Water Source: Water for the project will be supplied by surface water and groundwater from the SRPMIC (30,000 acre-feet/year) and effluent from the City of Mesa Wastewater Treatment Facility.[66] Eight new irrigation diversion structures and one new well will be used to deliver the water to the project. Annual water demand is 8,550 acre-feet.[67]

Public Outreach: A series of six scoping meetings were held with SRPMIC and the City of Mesa between January 24, 2002 and April 1, 2003. The purpose of these meetings was to introduce the project to the public, give individuals and agencies an opportunity to identify issues for consideration in the EIS, and to solicit input on the project. News articles related to the project were also published. The draft EIS was also available for public review and comment.[68]

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[64] U.S. Army Corps of Engineers, Los Angeles District, South Pacific Division. 2004. *Va Shly' ay Akimel Salt River Ecosystem Restoration Feasibility Study, Final Environmental Impact Statement.* Phoenix: U.S. Army Corps of Engineers. p. 5-28

[65] U.S. Army Corps of Engineers, Los Angeles District, South Pacific Division. 2004. *Va Shly' ay Akimel Draft Salt River Ecosystem Restoration Study*. Los Angeles: U.S. Army Corps of Engineers. p. VI-6

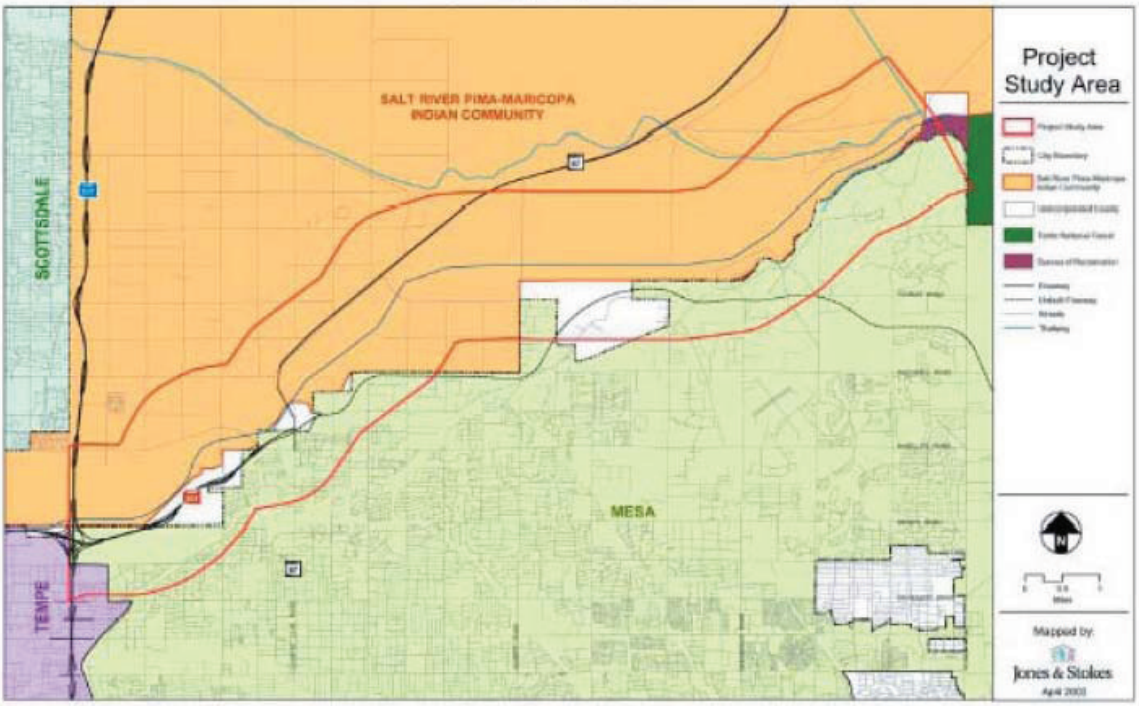
[66] U.S. Army Corps of Engineers, Los Angeles District, South Pacific Division. 2004. *Va Shly' ay Akimel Salt River Ecosystem Restoration Feasibility Study, Final Environmental Impact Statement.* Phoenix: U.S. Army Corps of Engineers. p. 3-7

[67] Ibid. p. 3-23

[68] Ibid. p. 11-2

Excerpted from the Regulated Riparian Habitat Offsite Mitigation Guidelines for Unincorporated Pima County

Va Shly ‘ay Akimel



Va Shly 'ay Akimel Cost Estimate	
Habitat Restoration	$76,143,600
Contingency Costs	$19,035,900
PED	$7,614,400
EDC	$761,400
Supervision and Administration	$4,949,300
Total Construction	$108,504,600
Monitoring and Adaptive Mgt	$4,340,000
Real Estate	$24,949,400
Total First Cost*	$137,794,000
OMRR&R (Habitat)	~$131,000
Water supply	~$1,283,000
*Cost estimates for recreation range from $1,351,000 to $3,217,000.	

Draft Feasibility Study, VI-6

Excerpted from the Regulated Riparian Habitat Offsite Mitigation Guidelines for Unincorporated Pima County

Va Shly 'ay Akimel

Water Seepage from Granite Reef Dam

Wetlands Downstream of Granite Reef Dam

Salt River at Alma School Road

Excerpted from the Regulated Riparian Habitat Offsite Mitigation Guidelines for Unincorporated Pima County

Rio Salado - Tempe Reach

Location: Salt River, Maricopa County, Phoenix; McClintock to Priest Drive (except Tempe Town Lake in the Middle) and McKellips Rd. south to Tempe Town Lake (150 acres)

Federal Sponsors and Contacts: USACE, Project Manger: Mike Ternak, mike.ternak@usace.army.mil

Non-Federal Sponsors and Contacts: City of Phoenix; Karen Williams (602) 262-4717; City of Tempe Chris Anaradain (City of Phoenix is not a contact for PED and Construction Phase)

History: In the past, the area encompassed by the Tempe Reach contained abundant mesquite trees and high quality mesquite bosque riparian habitat. At the confluence with the Salt River, Indian Bend Wash entered at an upper terrace of the river. Today the bed of the wash is nearly 30 feet higher in elevation than the Salt River.[69]

Authority: General Investigation - Ecosystem Restoration

Planning Objectives: "Restoration of threatened and endangered species habitat; Restoration of the Study Area to a more natural condition through the installation of plant species that are native to, and occurred historically, in riparian streams and washes in the region; an increase of recreation opportunities."[70]

Current Phase: Currently under Construction

Phase: Reconnaissance Study completed in 1994 for 33 mile reach, Feasibility Report and EIS completed April 1998.

Recommended Plan: Alternative T5 - mesquite, cottonwood willow, wetland, strand scrub, and open edge habitat. This alternative was selected because it closely follows the planning objectives. [71]

Cost: Total gross investment is $6,171,000 and total annual cost is $684,000, includes operation and maintenance which is approximately $230,000 per year.[72]

Water Source: Proposed source of water is 1 to 2 new water supply wells and water from Indian Bend Wash. A pump house upstream Tempe Town Lake will pump water downstream, just south of the town lake. Water demand is approximately 1,690 acre-feet per year.[73]

Public Outreach: Typical Corps public outreach process during reconnaissance and feasibility stages.

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[69] U.S. Army Corps of Engineers, Los Angeles District, South Pacific Division. 1998. *Rio Salado Salt River, Arizona Feasibility Report and Environmental Impact Statement.* Los Angeles: U.S. Army Corps of Engineers. p. IV-2
[70] Ibid. p. VI-1
[71] Ibid.
[72] Ibid. p. VI-4, Table 6.3
[73] Ibid. p. VI-2

Excerpted from the Regulated Riparian Habitat Offsite Mitigation Guidelines for Unincorporated Pima County

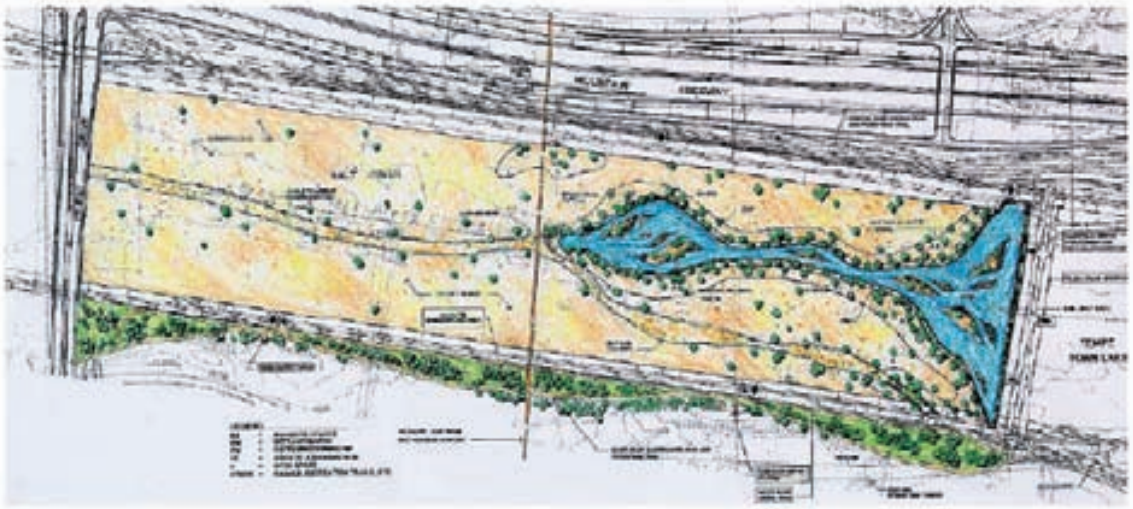
Note: There are 3 different "sections" of the Tempe Reach, two to the East of Tempe Town Lake and one to the west of Tempe Town Lake

Excerpted from the Regulated Riparian Habitat Offsite Mitigation Guidelines for Unincorporated Pima County

Rio Salado – Tempe Reach

Upstream

Downstream



Excerpted from the Regulated Riparian Habitat Offsite Mitigation Guidelines for Unincorporated Pima County

Rio Salado Tempe Reach Cost Estimate	
Infrastructure	$2,310,800
Habitat Restoration	$1,261,400
Water Supply (2.85 MGD)	$703,000
Contingency (20%)	$855,000
PED (7%)	$359,000
Supervision and Administration	$375,000
Total First Cost – Construction (Rounded)	$5,846,000
Monitoring and Adaptive Mgt.	$116,000
Real Estate	$0
Total First Cost	$5,962,000
Interest During Construction	$209,000
Annual Cost (50 yrs, 7 1/8%)	$454,000
Associated Non-federal Annual Cost	$154,000
Annual OMRR&R	$76,000
Total Annual Cost	$684,000

Feasibility Report, p. VI-4, Table 6.3

Indian Bend Wash Construction

Indian Bend Wash Restoration June 2004

Indian Bend Wash Restoration April 2004

Excerpted from the Regulated Riparian Habitat Offsite Mitigation Guidelines for Unincorporated Pima County

Rio Salado - Phoenix Reach

Location: Salt River, Maricopa County, Phoenix; I-10 to 19th Avenue (5 miles and 580 acres).

Federal Sponsors and Contacts: USACE: Project Manager: Mike Ternak

Non-Federal Sponsors and Contacts: City of Phoenix: Project Coordinator at City Managers Office: Karen Williams (602) 262-4717; City of Tempe Chris Anaradian (Note: Tempe is not a part of the PED and Construction Phase)

History: Dams, water diversion, groundwater pumping, sand and gravel mining has led to a degraded riparian system.

Authority: General Investigation - Ecosystem Restoration

Planning Objectives: "Restore riparian habitat in and around the Salt River within the Cities of Phoenix and Tempe; Create a complete and diverse riparian system...; The restored habitat areas should incorporate a diverse mix of riparian habitat types including mesquite, cottonwood/willow, wetland march, aquatic strand/scrub, open water, and open edges; Increase environmental education and passive recreation opportunities incidental to the restoration effort."[74]

Current Phase: Currently under Construction

Phases: Reconnaissance Study completed in 1995 for 33 mile reach of Salt River, Feasibility Report and EIS April 1998.

Recommended Plan: "Low-flow channel in river bottom, open-water, wetland marsh, cottonwood willow, open edges, and mesquite habitat in the river bottom and on the banks and over banks or the Salt River. Series of shallow pools in the low flow-channel connected by a perennially flowing stream. Three parking areas for public access to restoration project."[75]

Cost: Gross investment is $82,406,000 and total annual cost is $7,857,000 which includes operation and maintenance which is approximately $1,971,000 per year.[76] Current Estimated Total Cost by 2005 approximately $99 million.[77]

Water Source: Distribution of groundwater from 5 production wells with a capacity of one million gallons a day a piece. One well serves as a backup. There are two known contamination plumes in the area, currently monitored by City of Phoenix. The project also uses six irrigation pump stations, one at each well, for irrigation of specified areas.

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[74] U.S. Army Corps of Engineers, Los Angeles District, South Pacific Division. 1998. *Rio Salado Salt River, Arizona Feasibility Report and Environmental Impact Statement.* Los Angeles: U.S. Army Corps of Engineers. p. V-2
[75] Ibid. p. VI-5
[76] Ibid. p. VI-11
[77] Arizona Department of Water Resources. 2004. ADWR Brown Bag Luncheon, Fact Sheet. Phoenix, June.

Excerpted from the Regulated Riparian Habitat Offsite Mitigation Guidelines for Unincorporated Pima County

Water demand is approximately 6,519 acre-feet per year.[78] There is groundwater exchange for effluent recharge credits, as per conversation at ADWR brown bag luncheon.[79]

Public Outreach: Rio Salado Update Newsletter published by the City of Phoenix; Rio Salado Citizens Advisory Committee, established by the City of Phoenix as a way for the community to be informed and become an active part of the restoration process; Rio Salado Beyond the Banks Area Plan developed by the Citizens Advisory Committee to look at changing/halting negative types of developments beyond the Corps restoration project; Audubon Educational Center to be built in the next two years (located off Central Avenue) aimed at environmental education.[80]

Note: There is a study gap between this project (from Priest Drive to I-10) and the Rio Salado Tempe reach due to Airport interference. Rio Salado Phoenix is also subdivided into three phases.

[78] U.S. Army Corps of Engineers, Los Angeles District, South Pacific Division. 1998. *Rio Salado Salt River, Arizona Feasibility Report and Environmental Impact Statement.* Los Angeles: U.S. Army Corps of Engineers. p. VI-8

[79] Rossi, Steve. 2004. Comment at Arizona Department of Water Resources Brown Bag Luncheon. Phoenix, June.

[80] City of Phoenix. 2004. *Rio Salado Update Newsletter*. Phoenix, Arizona. Vol. 8, Issue 1.

Excerpted from the Regulated Riparian Habitat Offsite Mitigation Guidelines for Unincorporated Pima County

Rio Salado – Phoenix Reach

Rio Salado Phoenix Reach Cost Estimate	
Infrastructure	$37,145,400
Habitat Restoration	$3,441,000
Water Supply (5.82 MGD)	$13,332,500
Contingency (20%)	$10,884,000
PED (7%)	$4,571,000
Supervision and Administration	$4,542,000
Total First Cost – Construction (Rounded)	$74,416,000
Monitoring and Adaptive Mgt.	$1,488,000
Real Estate	$3,714,000
Total First Cost	**$79,618,000**
Interest During Construction	$2,788,000
Annual Cost (50 yrs, 7 1/8%)	$6,066,000
Associated Non-federal Annual Cost	$1,017,000
Annual OMRR&R	$774,000
Total Annual Cost	**$7,857,000**

Feasibility April 1998, VI-11

Excerpted from the Regulated Riparian Habitat Offsite Mitigation Guidelines for Unincorporated Pima County

Rio Salado – Phoenix Reach

Construction of Low Flow Channel

Tires in the River

Low-flow channel

Photos courtesy of Karen Williams, City of Phoenix

Excerpted from the Regulated Riparian Habitat Offsite Mitigation Guidelines for Unincorporated Pima County

Rio Salado Oeste

Location: Salt River, Maricopa County, Phoenix; 19th Ave. west to 83rd Ave. (8 miles)

Federal Sponsors and Contacts: USACE: Project Manager: Mike Ternack, Study Manager: Scott Estergard, Environmental Coordinator: Mr. Rey Favre (213) 452 - 3864; Planning Project Manager: Valerie Swick

Non-Federal Sponsors and Contacts: City of Phoenix: Karen Williams (602) 262-4717

History: Dams, water diversion, groundwater pumping, sand and gravel mining has led to a degraded riparian system.

Authority: General Investigation - Ecosystem Restoration

Planning Objectives: "Restore native riparian and wetland habitat, and adjacent vegetation communities between 19th Avenue and 83rd Avenues for a period of 50 years; Attract wetland and riparian avian species in the study area; Establish the presence of amphibian species, reptilian species, mammalian species, and avian species in the study area; Suppress undesirable fish and wildlife species; Manage undesirable invasive plant species in the study area; Increase passive recreational and environmental education opportunities for visitors, which are linked to the restoration project in the study area; Reduce flood damages to structures and infrastructure within the 100 and 500 year floodplain between 19th and 83rd Avenues."[81]

Current Phase: Pre F4 - Alternative Review Conference

Phases: Reconnaissance completed September 2000, F3 milestone May 2002.

Tentative Plan: TBD

Cost: Total cost is unknown until a recommended plan is chosen.

Water Source: Possible storm water runoff, flood flows, groundwater, effluent and reclaimed water from 23rd Ave Wastewater Treatment Plant.[82]

Public Outreach: Once the Rio Salado Project is near completion then the City of Phoenix and Community Advisory Committee will direct the public's attention toward Oeste.[83]

Note: "40% of feasibility study is related to flood control elements of the project." [84]

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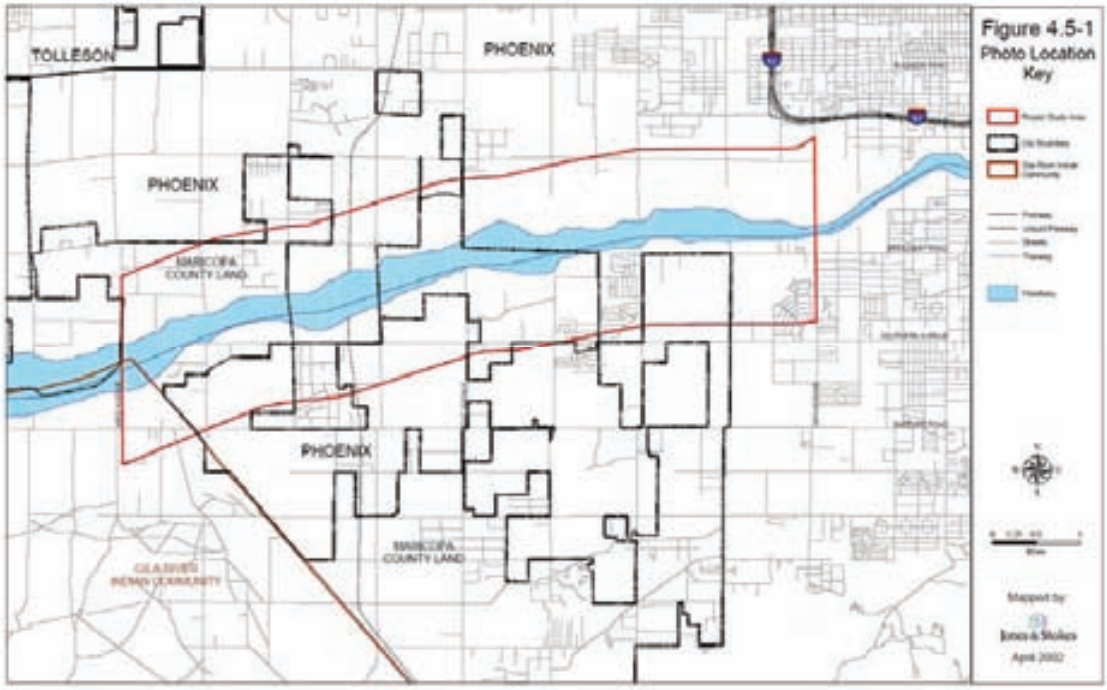
[81] U.S. Army Corps of Engineers, Los Angeles District, South Pacific Division. 2002. *Rio Salado Oeste, Salt River Arizona Interim Feasibility Report F3 Milestone-Without Project Conditions.* Los Angeles: U.S. Army Corps of Engineers. p. V-4
[82] Ibid.
[83] Williams, Karen. 2004. Personal communication with author, August.
[84] Maricopa County Flood Control Advisory Board. 2003. Meeting Minutes. Phoenix, AZ. October 22.

Excerpted from the Regulated Riparian Habitat Offsite Mitigation Guidelines for Unincorporated Pima County

Rio Salado - Oeste



Low flow channel with wetland vegetation, immediately upstream of 51st Avenue Bridge.

Excerpted from the Regulated Riparian Habitat Offsite Mitigation Guidelines for Unincorporated Pima County

Tres Rios

Location: Salt River and Gila River, Maricopa County, Phoenix; Beginning at 83rd Ave. to the confluence with Agua Fria River (9.2 miles and 5,600 acres).

Federal Sponsors and Contacts: USACE: Project Manager: Mike Ternak, Study Manager: Scott Estergard

Non-Federal Sponsors and Contacts: City of Phoenix: Project Manager: Alice Brawley-Chesworth alice.brawley-chesworth@phoenix.gov.

History: In the past, gallery forest of cottonwoods and willows covered hundreds of miles along the lower reaches of the Salt and the Gila rivers. Before Roosevelt Dam was constructed, the Lower Salt River was a perennial stream with an average annual discharge of approximately 1,250,000 acre-feet. At the confluence of the Gila and the Salt, the "Salt River's clear, streaming waters contrasted with the muddy, sluggish Gila River." The rivers had many channel meanders, sand bars and backwater that were conducive to riparian growth. Today the perennial and high winter flows that existed historically are no longer because of dams upstream and diversions for urban and agricultural use.[85]

Authority: General Investigation - Ecosystem Restoration

Planning Objectives: Provide sustainable and diverse native riparian habitat in and around the Tres Rios area; Reduce flood damages to the Holly Acres community, surrounding development, and agricultural areas; Increase environmental education and recreation in the study area." (Feasibility, April 2000, V-2)

Phases: Tres Rios Reconnaissance completed April 1, 1997; Feasibility Report and Final EIS April 2000.

Current Phase: 90% of Design done, project has been authorized with construction to begin January to March 2005, waiting on City of Phoenix to purchase remaining real estate.

Recommended Plan: Alternative 3.5 includes: "pump station facility; regulating wetland for treatment plan discharge; the creation of linear, constructed wetlands along the north over bank; a pipeline from the over bank wetland leading to Cottonwood/Willow corridors west of El Mirage Road; open water/marsh areas within the channel west of El Mirage Road; south side distribution of dewatering well water and large open water/marsh creation areas; a flood control levee to protect Holly Acres as well as other surrounding residential commercial, industrial buildings, and farmland."[86]

Cost: Total first cost is $99,321,000 with a total annual cost of $9,722,100 which includes operation and maintenance which is approximately $2,414,150 per year (includes annual cost of water at $1,221,150).[87]

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[85] U.S. Army Corps of Engineers, Los Angeles District, South Pacific Division. 2000. *Tres Rios, Arizona, Feasibility Report.* Los Angeles: U.S. Army Corps of Engineers. p. IV- 1-4.
[86] Ibid. p. VI-1
[87] U.S. Army Corps of Engineers, Los Angeles District, South Pacific Division. 2000. *Tres Rios, Arizona, Feasibility Report, Summary.* Los Angeles: U.S. Army Corps of Engineers. p. 3

Excerpted from the Regulated Riparian Habitat Offsite Mitigation Guidelines for Unincorporated Pima County

Water Source: Main sources are 91st Avenue Wastewater Treatment Plant effluent and existing dewatering wells from within the treatment plant. Water demand is 24,423 acre-feet per year.[88]

Public Outreach: 1995 Tres Rios Steering Committee (includes city, county, state and federal government officials) formed Tres Rios Public Involvement Subcommittee, which help to facilitate public involvement and dialogue with the Corps (for more info see Feasibility April 2000, VIII-3).

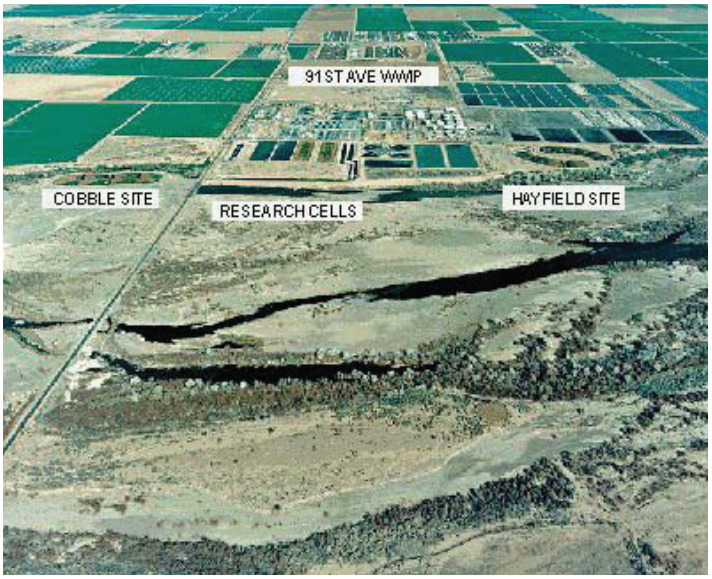
[88] U.S. Army Corps of Engineers, Los Angeles District, South Pacific Division. 2000. *Tres Rios, Arizona, Feasibility Report.* Los Angeles: U.S. Army Corps of Engineers. Table VI-2

Excerpted from the Regulated Riparian Habitat Offsite Mitigation Guidelines for Unincorporated Pima County

Tres Rios

Tres Rios Cost Estimate	
Construction (Construction, S&A, PED/EDC, Contingency)	$74,747,000
Construction LERRDs (Lands, Easements, Rights-of-Way, Relocations, Disposal Sites)	$19,214,000
Recreation Costs	$4,860,000
Cultural Resources Mitigation	$500,000
Total First Costs	**$99,321,000**
Interest During Construction	$6,055,000
Annual Investment Cost	$7,307,950
Annual Cost of Water Total OMRR&R Annual Costs	$1,221,150 $2,414,150
Total Annual Costs	**$9,722,100**

Excerpted from the Regulated Riparian Habitat Offsite Mitigation Guidelines for Unincorporated Pima County



Tres Rios Demonstration Wetland & Salt River

Tres Rios Demonstration Wetland

91st WWTP Outfall into Salt River

Tres Rios Demonstration Wetland

Wildlife at Tres Rios Demonstration Wetland
Pictures - (http://phoenix.gov/TRESRIOS/photogalmenu.html)

Riparian Restoration Efforts in the Santa Cruz River Basin

Description of the projects, analysis of the stakeholder issues and cooperation

Julie Fabre - Claire Cayla
March 2009
Water Resources Research Center, University of Arizona

Excerpted from the Regulated Riparian Habitat Offsite Mitigation Guidelines for Unincorporated Pima County

ED PASTOR KINO ENVIRONMENTAL RESTORATION PROJECT (KERP)

Multi purpose flood control facility with riparian enhancement

Location and Size:
Within an urban area of Tucson north of Ajo Way and west of Country Club Road, along the Tucson Diversion Channel. This project includes:

- 28 acres of riparian and open water
- 21 acres of grassland, mesquite bosque
- a 120 acre area with marsh.

Sponsors:

- Pima County Regional Flood Control District (PCRFCD)
- United States Army Corps of Engineers (USACE)
- Pima County
- Pima County Wastewater Management

History:
The Tucson (Ajo) Detention Basin was constructed in 1966 along with the Tucson Diversion Channel by the USACE. The basin was built as a flood control element, which intercepted and reduced peak flows from the Tucson Arroyo and Railroad Wash drainage areas. The basin had a flat earthen bottom and levee with scrub trees and grasses along the edges. In 1981, the USACE and Pima County developed a master plan for the diversion channel called The Tucson Diversion Channel Recreation Development Program. The plan called for improving the recreational opportunities on the land. With the exception of the construction on Sam Lena Park in 1986, little progress was made on the master plan between 1981 and 1995.
In 1999, the United States Congress authorized construction of the Ajo Detention Basin Environmental Restoration Project, to develop watercourses, marshes and riparian habitat under section 1135 of the Water Resource development Act.
Chris Bartos, MLB Complex Manager, Pima County Stadium District reports that the Army Corps of Engineers awarded the 2006 Chief of Engineers Award of Excellence to the Pima County Stadium District. This Environmental Category award cited the Ed Pastor Kino Environmental Restoration Project as an exceptional project. Judges summarized the project saying, "This is truly an exceptional project. It takes an existing mud flat in an arid area and creates aesthetic landscapes, recreation features, flood control, and is a prototype for water harvesting. It is technically sophisticated while appearing natural. It (also) has proved sustainable over the recent drought years."

Planning Objectives:
Turn the Ajo Detention Basin into a detention basin that was more environmentally sensitive and aesthetically pleasing to the community while maintaining its existing flood protection capacity:

- create native ecosystems (representing Arizona's southwest riparian environment)
- detain and store urban storm water and reclaimed water to reduce groundwater use
- preserve the basin's functionality as a flood control facility by controlling drain flow in the basin to minimize flood impact downstream.

Phases:
Early 1997: The Corps initiated a Preliminary Restoration Plan (PRP) to determine the feasibility of modifying the basin features for restoration of riparian habitat.
April 1998: An Ecosystem Restoration Report (ERR) was approved.
June 1998: Plans and Specifications were initiated.
1999: The United States Congress authorized construction of the Ajo Detention Basin Environmental restoration project under section 1135 of the Water Resource Development Act.
July 2000: Construction was awarded.
2002: Modifications were completed.

Current Phase and Future Plans:
Operation and maintenance, construction was complete in 2002.

Recommended or Implemented Plan:
The new KERP facility covers 125 acres, with a 50-foot deep lake covering 7 acres, 20 acres of water courses and hills. Areas have been planted with native species to create marsh habitats, mesquite bosques, grasslands and open water environment that will support wildlife and bird habitat.
The project also includes an extensive pumping and valve system designed to circulate and mix reclaimed and storm water within the basin.
A recharge element was originally considered, but was rejected due to issues with obtaining permits; since a large amount of runoff was derived from industrial areas, water quality became an issue.

Monitoring/Management:
Pima County is responsible for the operation and maintenance of the site.
The site is managed to achieve a series of objectives including:
- maintain the flood control capacity of the basin
- maintain an ecosystem habitat
- maximize the use of harvested storm water
- minimize the use of reclaimed water
- minimize the mosquito population
- maintain water quality.

Audubon Society is monitoring bird life. Arizona Game and Fish is monitoring the establishment of a Burrowing Owl population.

Funding and Cost:
Funding and authorization for this project came from the USACE Section 1135 of the Water Resource Development Act of 1986.
- Project Modification for Improvement of the Environment Total cost of this project was approximately $12 million (planning, design and construction costs). The two funding participants were USACE, who contributed a $5 million federal share, and Pima County. The local share match included $5 million in 1997 Sewer System Revenue Bonds and $1,282,459 in other funds from the wastewater Management Department and the PCRFCD.
- Total construction award cost: approximately $8,215,444.
- Operation and maintenance cost: $280,000 in FY 06-07, including approximately $180,000 in personnel costs.

- Water cost is estimated to be $265,000 a year.

Land Ownership:
The Basin is owned by Pima County.
A small parcel adjacent is owned by Pima County Regional Flood Control District.

Water:
From February 2003 to March 2004 the complex used 88,406,718 gallons of reclaimed water. During the same time, KERP harvested 28,313,282 gallons of storm water. With 1.35 inches of rain in February 2005, approximately 18,246,424 gallons of water were harvested. The entire complex was irrigated with that water until the end of May.

Total water demand is estimated to be 574 acre-feet per year.
The project provides the ability to harvest and store storm water as well as reclaimed water. Storm water is harvested from the highly urbanized watershed around the Davis-Monthan Air Force Base. KERP was designed to retain and store approximately 1,800 acre-feet of storm water.
The water is stored and circulated through the basin and then is moved into the irrigation ponds to be used to irrigate the basin's re-established vegetation, Kino Hospital grounds and the Kino Sports Complex ballpark and practice fields; approximately 84.5 acres are irrigated with water from KERP.

Harvested storm water provides a low cost alternative to purchasing and using groundwater or reclaimed water as well as the beneficial use of storm water that would otherwise have evaporated or infiltrated into the original Ajo Detention Basin.
During the dry seasons, the harvested water is used until it is gone. The habitat is kept alive with the use of reclaimed water, purchased from Tucson Water, until more water can be harvested.
Due to intergovernmental agreements between Pima County and the City of Tucson, the less costly operating rates apply to the effluent that is delivered through Tucson Water's reclaimed lines but treated by Pima County.
Strom water harvesting combined with reduced reclaimed water rates resulted in a 76% saving in water cost in 2004 and 97% in 2005.

Public Outreach:
A school program was developed at a local elementary school, where students created a model to present to the community. Audubon has provided outreach, as has Pima County Natural Resources, Parks, and Recreation.
Public access to the site is limited; however, teachers are allowed to take classes into the riparian areas. The site is also being used by Tucson Audubon for Saturday morning bird walks, and a jogging trail that goes around the basin is open to the public.

Lessons Learned/Challenges:
One challenge of this project was working through the regulatory issues surrounding the commingling of reclaimed water with storm water. At the present time changes in regulatory approaches to this issue continue. In addition the use of a "Waters of the U.S." posed challenging regulatory hurdles.

Several permits were required for activity within the basin, including:
- Arizona Pollutant Discharge Elimination System (AZPDES) permit (including a

Management Plan as well as current testing requirements)

- An Arizona Aquifer Protection Permit (APP) (including an Emergency Response Plan that necessitated training of personnel within several city and county agencies)
- A 401/404 permit for upkeep and reconstruction of the basin after flood events
- An Arizona Reclaimed Water Reuse permit for areas needing irrigation outside the basin
- A Pima County Industrial Wastewater Permit for any wet well sediment disposed of within the wastewater conveyance system
- Arizona Water Rights appropriation (for storm water harvesting and use)
- Fifra and TSCA regulations on the application of pesticides within "a Waters of the U.S."
- Meeting the retention of FEMA 100-year flood events.

Mosquito monitoring and management is still needed, but one of the lessons learned is that design can reduce the problem.
Vandalism of irrigation devices and of the Burrowing Owl nests has also been a problem in this urban environment.

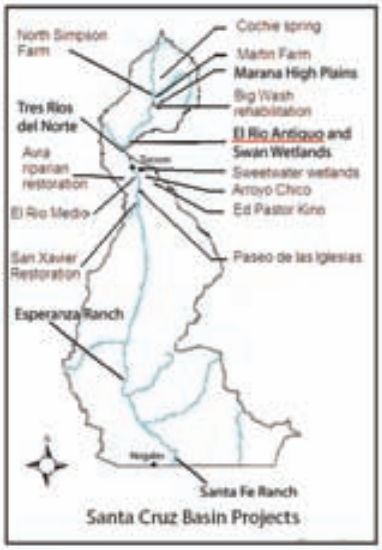
Drivers:
Create native ecosystems, harvest urban storm water and control flooding.

Sources:
http://rfcd.pima.gov/projects/kerp/

Contact:
Lawrence Robison (PCRFCD)

EL RIO ANTIGUO

Multi-purpose flood control facility with riparian enhancement



Location and Size :
On the Rillito River, Pima County, Craycroft Road downstream to Campbell Avenue. The study area for the project is 1,066 acres of land and 4.8 mile of the Rillito River. The project area will actually cover 284 acres of the study area.

Primary Sponsor(s):
- Pima County Regional Flood Control District (PCRFCD)
- United States Army Corps of Engineers (USACE).

History:
In the past, the Rillito River flowed perennially, meandering and supporting dense vegetation of cottonwood, willows, mesquite bosques, numerous beaver dams, and wetlands. Flows supported agriculture along the river. With growing agriculture in the 1930's, Finger Rock Wash was cut off from the Rillito River, and riparian vegetation was removed. Urbanization, along with agriculture, increased and contributed to a loss in surface water flow and lowering of the water table. Today much of the riparian habitat is degraded.

Planning Objectives:
- Restore riparian vegetative communities within the river corridor to a more natural state
- Increase the acreage of functional seasonal wetland habitat within the study area
- Provide incidental flood control through ecosystem restoration to the extent that it does not adversely impact the restoration objective
- Increase recreation and environmental education opportunities within the study area.

Phases:
September 2001: Reconnaissance Report completed
October 2003 and May 2004: Draft Feasibility Report Study published
November 2003: Draft EIS

Current Phase:
The project has been shelved for now.

Recommended or Implemented Plan:
A set of terraces would be constructed in the area known as the "Bend". Cottonwood, willow, mesquite, shrub and grasses would be planted in the channel, tributary mouths, and in rainwater harvesting basins along the tributaries.
Soil cement will be used to stabilize the stream bank with a culvert and pipeline from upstream to allow water to flow behind the soil cement during severe storm water events (larger then 2 year events).

The plan also includes a high and low-flow channel created to support a mesquite community and connect the Finger Rock Wash to the Rillito River.

Rainwater harvesting basins at each upstream tributary mouth will collect and detain storm water.
An effluent distribution system would also be installed to support the establishment of planted vegetation during dry periods.
A linear park will be constructed on both the north and south banks of the river

Monitoring/Maintenance:
Project is still in the planning phase. No monitoring or maintenance plan exists at the present time.

Funding and Cost:
The project is funded and authorized through USACE's General Investigation, Ecosystem Restoration. Total First Costs are $66,657,000.

It is estimated that annual operation and maintenance costs will be $1.26 million.
This project is funded through a cost share agreement between the USACE and PCRFCD, with the USACE covering 65% of the cost.

Water:
Current annual water cost to non-Federal sponsor is approximately $852,000.
The recommended plan requires a total irrigation need of 1,490 acre-feet of water per year.

Irrigation for the establishment and maintenance of new vegetation is provided by effluent, rainwater harvesting, and surface water diversions from tributaries of the Rio Antiguo.

Public Outreach:
- El Rio Antiguo Work Group, facilitated by Novak Inc. and initiated on May 8, 2002, included seven months of field trips and meetings.
- The final Corps public meeting for the feasibility stage was held on January 28, 2004.

Lessons Learned/Challenges:
Project is in early stages, none at this time.

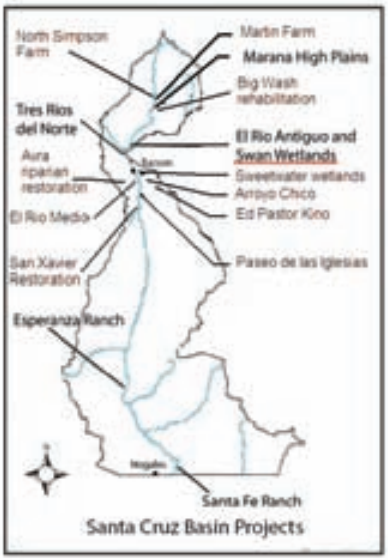
Drivers:
Habitat restoration, returning an area to its pre-World War II beauty.

Sources:
http://rfcd.pima.gov/projects/rillitoalvernon/

Contact:
Frank Postillion, Chief Hydrologist, Water Resources Division, Pima County Regional Flood Control District.

RILLITO RIVER RIPARIAN AREA (SWAN WETLANDS)

Multi purpose flood control facility with riparian enhancement



Location and Size:
This project encompasses 60.7 acres and 1.5 mile of the Rillito River, with a total of 36 acres of planting.
The site is located on the south Bank of Rillito River, between Craycroft Road (at the confluence of Tanque Verde Creek with Pantano Wash) and Columbus Boulevard.

Sponsors:
- Pima County Regional Flood Control District (PCRFCD)
- United States Army Corps of Engineers (USACE)

History:
In the past, the Rillito River flowed perennially, meandering and supporting dense vegetation of cottonwood, willows, mesquite bosques, numerous beaver dams, and wetlands. Flows supported agriculture along the river.
With growing agriculture in the 1930's, Finger Rock Wash was cut off from the Rillito River and riparian vegetation was removed. Urbanization also increased and contributed to a loss in surface water flow and a decrease in the water table.
Today much of the riparian habitat is degraded due to reduced water supply.

Planning Objectives:
- Restore riparian vegetative communities within the river corridor to a more natural state
- Increase the acreage of functional seasonal wetland habitat within the study area
- Minimize the potential for sediment and organic matter accumulation in restored areas
- Increase recreation and environmental education opportunities within the study area.

Phases:
June 1999: The preliminary Restoration Plan was approved.
November 2003: Environmental Restoration Report and Environmental Assessment (ERR/EA) were completed
February 15, 2005: A contract between the USACE and Pima County was signed
September to December, 2006: Construction in Area 1 and design of the second phase, Areas 2 and 3 (by USACE)
May, 2007 to January, 2008: Construction of the second phase with Area 3
December, 2007 to April, 2008: Construction in Area 2

Current Phase and Future Plans:
October 17, 2008: The Pima County Regional Flood Control District held a dedication ceremony for the Rillito River/Swan Wetlands Ecosystem Restoration Project.
Currently the site is in the one year warranty period, during which the contractor is still responsible for monitoring and maintenance.

Recommended or Implemented Plan:

The project plan consisted of land recontouring to enhance passive water harvesting and planting of native vegetation. Passive water harvesting is expected to occur during storm events in small, created basins and along drainage channels. A mix of plant species, grading from mesoriparian (i.e. Mesquite type) to upland species (i.e. Mesquite/Palo Verde type) was planted. After planting, each area was hydroseeded with a seed mix of local native plants. Supplemental irrigation with reclaimed water was provided to vegetation during the establishment period (five years).
For planning purposes, the project area was divided into four areas.

- Area 1: small water harvesting basins were created, near Craycroft Road north of the Hill Farm subdivision. Non-native plants and some invasive plants were removed to allow planted native species to become established. The entire area was hydroseeded with a native seed mix. Restoration of plant species is expected to increase habitat value. During construction, a biologist was on site to direct construction equipment so as to avoid damaging existing vegetation.

- Area 2: a small basin adjacent to Alamo Wash, minor surface recontouring of the basin will result in small water harvesting basins. Native vegetation was planted in the basin and irrigation with reclaimed water will be provided during the establishment period. The area was hydroseeded with a native seed mix after planting was completed.

- Area 3: at the north end of Columbus Boulevard, cement lining in the existing drainage channels was removed and the channels were recontoured to create a more sinuous alignment. This is expected to decrease the water velocity, which will allow more time for the water to move into the banks increasing soil water available to vegetation. The channel bank slopes were flattened and native vegetation was planted along the newly constructed channels. The channels were designed to convey the same amount of water as before construction. In the area away from the channels, small water harvesting basins were created to capture rain water and native vegetation will be planted. The area was hydroseeded with a native seed mix after planting was completed. Irrigation with reclaimed water will be provided during the establishment period. The Work Plan and drawings of the new channel alignments can be found under the subheading Reports and Brochures on the web page.

- Area 4: The current maintenance path along the bank protection, will receive additional vegetation plantings as part of a separate river park project that will be completed by Pima County Parks and Recreation Department.

Monitoring/Management:
The PCRFCD will take over monitoring and management activities when the warranty period ends.

Funding and Cost:
The project was funded and authorized through Section 1135 of WRDA - Modification of existing USACE projects for Ecosystem Restoration.
The Rillito River Bank Protection Project was completed in 1996 by USACE and PCRFCD.

- Project cost amounted to a little over $4 million. This type of ecosystem restoration project utilizes a cost sharing of local sponsor (Pima County) 25% and U.S. Army Corps of Engineers 75%. Pima County expects to pay for their portion of the costs through Flood Control District Tax Levy receipts.
- Under the recommended plan, the project requires 349 acre-feet of water per year, at

approximately $230 per acre-foot the total cost of water will be approximately $81,000 per year. The volume of water needed may have been overestimated.

Land Ownership:
Pima County

Water:
- Reclaimed water from the City of Tucson's Roger Road Wastewater Treatment Plant is used for temporary irrigation (five years).
- Water will also come from harvesting storm water runoff from Alamo Wash and other local tributaries.

Total annual water use for the project was estimated at 349 acre-feet. This use seems to have been overestimated, this year the project site used 35 acre-feet, with a good rainfall. The current estimate is approximately 100 acre-feet/year.

Public Outreach:
Jan 6, 2000: a public workshop.
March 21, 2003 - April 21, 2003: the Draft of ERR/EA was released for public comment.
April 17, 2003 and May 2004: PCRFCD held two open houses.

Lessons Learned/Challenges:
None at this time.

Drivers:
Habitat restoration, there are no public use elements in this plan.

Sources:
2003 U.S. Army Corps of Engineers Rillito River draft feasibility study, restoration report and environmental assessment
http://rfcd.pima.gov/projects/rillitoswan/

Contact:
Andrew Wigg (PCRFCD)

PASEO DE LAS IGLESIAS

Feasibility studies along the Santa Cruz River for urban riparian restoration

Location and size:
Santa Cruz River and West Branch, within the City of Tucson, from West Congress Street upstream to the San Xavier District. "Paseo de las Iglesias" means the "Path of the Churches". The referenced churches include Kino's San Xavier Mission, and Mission San Augustín del Tucson. The project encompasses 5,005 acres in area and 7.5 miles of the river.

Primary Sponsor(s):
- Pima County Flood Control District (PCRFCD)
- U.S. Army Corps of Engineers (USACE)
- City of Tucson

History:
Prior to degradation, the Santa Cruz River flowed year round past San Xavier del Bac to downtown Tucson, ten miles north. At that time, the Santa Cruz River was a shallow stream with a wide flood plain containing cottonwoods, willows, and mesquite bosques.

Today, a riparian habitat nourished by natural perennial river flows no longer occurs along the river within the project area. Due to past agriculture and current municipal use, groundwater levels today are approximately 100 to 250 feet below the surface contributing to reduced river flows. In addition, sand and gravel mining, which began in the 1970s and '80s near Ina and Cortaro roads and continues today, has further altered the characteristics of the river course.

Critical riparian and cienega habitats have been lost in the region due to water resource changes in Pima County. Congress authorized the US Army Corps of Engineers (USACE) to evaluate environmental restoration potentials along the Santa Cruz River, from the north boundary of the Tohono O'Odham Nation, north to Sanders Road, in Marana.
The USACE has divided this evaluation of the river into three separate feasibility studies: Tres Rios del Norte, Paseo de las Iglesias, El Rio Medio.

Planning Objectives:
- Ecosystem restoration : Increase wildlife habitat diversity by providing a mix of riparian habitats
- Flood control improvements
- Reduced bank erosion and sedimentation
- Improved surface water quality
- Recreational opportunities (river park trail development)

Phases:
2001: The Feasibility Study process began with a 2-day public meeting
July 2005: Final Feasibility Report (evaluating : ecosystem restoration/ flood control improvements/ river park trail development along a 7-mile reach of the Santa Cruz River from Congress Street upstream 7 miles).

2007: The study was authorized by the House and Senate as part of the Water Resources Development Act, enabling future federal fund appropriations for design and construction of the project.

At the numerous meetings, citizens and experts have provided ideas regarding desired plant communities, visions of what the river banks could look like, options for irrigation and water harvesting, and recreation needs. These ideas were combined in various ways to form "alternatives". The alternatives were screened based on environmental and cost-benefit analysis, and the Corps suggested several "best buys" alternatives.

Current Phase:
A recommended plan has been selected from an initial array of 47 alternatives based on the USACE's analysis and public input. Restoration work has not started yet.

Recommended or Implemented Plan:
- The Recommended Plan includes 1,100 acres of mesquite bosques on river terraces and floodplain, bordered by palo verde woodland and desert shrubs on both banks.
- A land re-contouring to enhance passive water harvesting.
- Supplemental irrigation will be provided to support establishment and as needed to maintain healthy plant communities. Irrigation is planned for mesquite and riparian shrub on terraces above the low flow channel and in the historic floodplain.
- Flood control improvements include erosion protection that will be limited to at-risk areas.
- Recreation elements will include trail linkages to complete the Santa Cruz River park trail throughout the study area. Trails will also link to the existing Julian Wash Trail. It was important to develop a passive recreation plan that would encourage enjoyment of the environment while recognizing the history of the area. The recreation elements will provide better access to the area for hiking, wildlife viewing, biking, and equestrian use. The plan includes construction of a portion of the 1,200 mile Juan Bautista de Anza National Historic Trail that is planned to eventually connect Nogales to San Francisco.

The plan features are consistent with the desires expressed by public involvement work groups.
Implementation of the plan is supported by : the U.S. Fish and Wildlife Service, Arizona Game and Fish Department, Center for Biological Diversity, Santa Cruz River Alliance, Tucson Herpetological Society, and others.

Monitoring/Maintenance:
The local sponsors are responsible for monitoring and maintenance, which will consist of periodic channel clearance, control of invasive plant species, pumps and irrigation maintenance, and periodic replanting of habitat areas damaged by flood.

Funding and Cost:
The feasibility study was funded by the USACE and Pima County through the USACE's General Investigation, Ecosystem Restoration funds.

Total project construction first cost: $92,058,546.
Total operation and maintenance costs excluding water: $807,046.
The Federal share of the recommended plan is $59,666,768 (65%) and the local cost share is $32,391,778 (35%). Of the $32 million non-federal share, $26 million is accounted for by the sponsor's land contributions, leaving $6 million as the local sponsor's cash commitment.

Existing local funds include $14 million in dedicated 2004 bonds.

Recreation elements are a 50/50 cost share.
100 percent of the costs of providing water will be paid by the non-Federal sponsor (Pima County). These costs are currently estimated at $1,099,175 annually based on the use of reclaimed water from Tucson Water.

Land Ownership:
City of Tucson, Pima County, State of Arizona and various private owners.

Water:
Rainwater harvesting and reclaimed water were the two sources of water looked at for the feasibility study; however, the local sponsor (PCRFCD) can use any water source(s) deemed most practical if the project is approved.
At this time no water source has been determined for the project.
The annual water budget for the tentatively recommended plan is estimated at 1,925 acre-feet per year. As the local sponsor, Pima County is responsible for providing the irrigation water.
As part of the cost analysis, the Corp's used a known water source with a known cost. They used the current market rate for reclaimed water from Tucson Water. Pima County is in no way obligated to use this particular water source. In fact, there are significantly less costly irrigation water sources including storm water harvesting, use of other secondary or tertiary effluent, leasing other water, or the use of groundwater, although that is not a preferred source.

Even though the region is in an eight-year drought, successful storm water harvesting has already been accomplished at the County's Kino Environmental Restoration Project near Tucson Electric Park.
The Paseo project could include a facility like this at the location of the retired S&G pit south of Valencia Road if that private property can be acquired. At this site water could be harvested from both the Santa Cruz River, and adjacent tributaries.

Public Outreach:
There have been a series of workshops and public meetings to solicit input regarding restoration measures and desired outputs, plus numerous stakeholders meeting to gather technical information and determine planning constraints.

April 2001: Notice of Intent.
March 30 and 31, 2001: Public Scoping Meetings.
April 1, 2001: tour of site.
March 21, 2002 and April 9, 2003: two smaller workshops were held.
January 22, 2004: open house by PCRFCD.
October 26, 2004: public meeting to present the feasibility study results and recommended plan overview.

Because of the public interest shown during the initial meeting, further meetings were scheduled to establish a process for development of public involvement in planning for restoration of the Santa Cruz River in the study area. Public concerns included loss of habitat & wildlife, water issues, invasive plants, stream bank erosion, other destructive influences, and inclusion of recreation elements in the final plan.

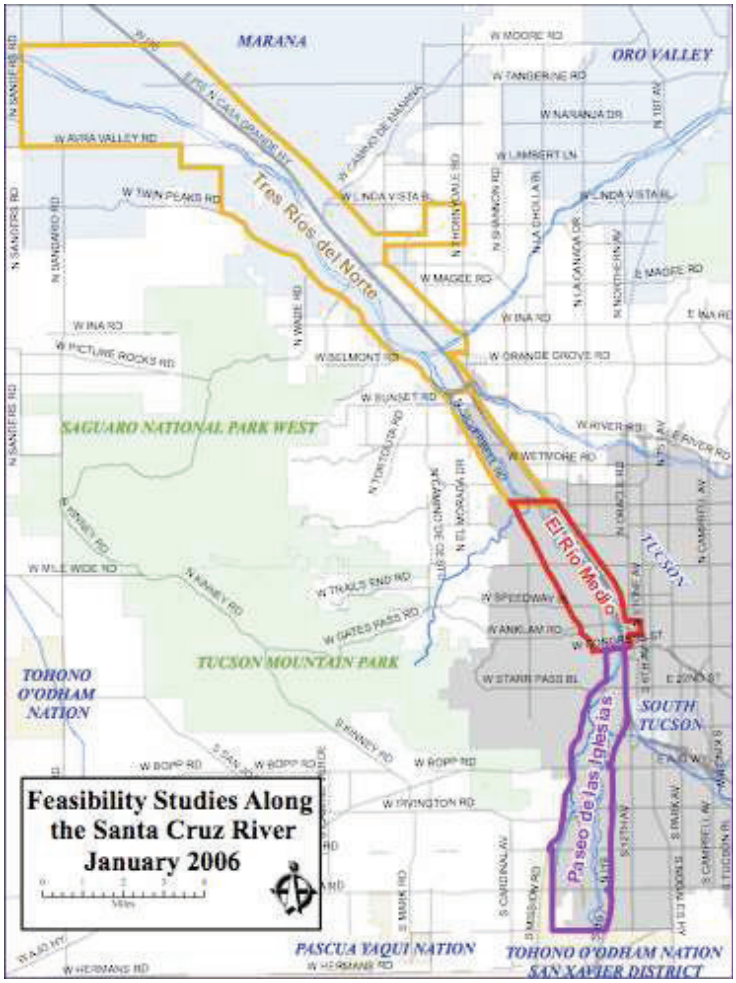
Lessons Learned/ Challenges:
Project is in early stages, none noted at this time.

Drivers:
Reversing the perception of the Santa Cruz River as a dumping ground, restoring both the cultural and ecological heritage of the area.

Sources:

- *Feasibility Studies Along the Santa Cruz River*, January 2006
- http://rfcd.pima.gov/largefiles/pdli2/index.htm
- http://rfcd.pima.gov/projects/paseoiglesias/
- http://rfcd.pima.gov/projects/paseoiglesias/outreach.htm

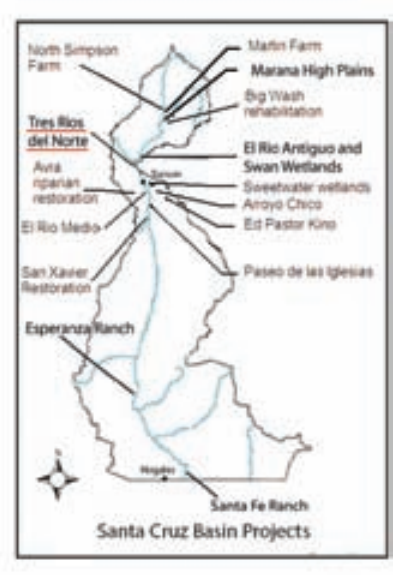
Contact:
Jennifer Becker, Principal Hydrologist, Pima County Regional Flood Control District



Excerpted from the Regulated Riparian Habitat Offsite Mitigation Guidelines for Unincorporated Pima County

TRES RIOS DEL NORTE

Feasibility studies along the Santa Cruz River for urban riparian restoration



Location and size :
Santa Cruz River, within the City of Tucson, from Prince Road (South) to Sanders Road (North), West Moore Road, and West Avra Valley Road.
The project encompasses approximately 3,000 acres of land and 19 miles of the river.

Primary Sponsor(s):
- Pima County Regional Flood Control District (PCRFCD)
- U.S. Army Corps of Engineers (USACE)
- City of Tucson
- Town of Marana

History:
Prior to degradation, the Santa Cruz River flowed year round past San Xavier del Bac to downtown Tucson, ten miles north. At that time, the Santa Cruz River was a shallow stream with a wide flood plain containing cottonwoods, willows, and mesquite bosques.

Today, a riparian habitat nourished by natural perennial river flows no longer occurs along the river within the project area. Due to past agriculture and current municipal use, groundwater levels today are approximately 100 to 250 feet below the surface contributing to reduced river flows. In addition, sand and gravel mining, which began in the 1970s and '80s near Ina and Cortaro roads and continues today, has further altered the characteristics of the river course.

Critical riparian and cienega habitats have been lost in the region due to water resource changes in Pima County. Congress authorized the US Army Corps of Engineers (USACE) to evaluate environmental restoration potentials along the Santa Cruz River, from the north boundary of the Tohono O'Odham Nation, north to Sanders Road, in Marana. The USACE has divided this evaluation of the river into three separate feasibility studies: Tres Rios del Norte, Paseo de las Iglesias, El Rio Medio.

Planning Objectives:
- Enhance riparian habitat for native species
- Minimizing the potential for sediment and organic matter accumulation in restored wetlands
- Recharging and recovering municipal groundwater supplies that also will facilitate vegetation restoration
- Flood damage reduction
- Recreation and protection of cultural resources

Phases:
February-December 2000: Reconnaissance Report (Sec 6 of Flood Control Act of 1938)
An array of alternatives describing different levels of restoration was prepared and evaluated

by the local jurisdictions. Several of these alternatives were being reformulated to better conform to current conditions and economic realities.
January 2004: Feasibility F4A Milestone (AFB)
Summer 2006: Draft feasibility report. Once the reformulation of alternatives was completed, they were passed through a series of screenings, including a cost-benefit analysis, which resulted in a final array of "best buy" alternatives. These best buy alternatives, along with the detailed technical analyses of how everything was evaluated and the recommended plan is presented in the Draft Feasibility Report and its companion Draft Environmental Impact Statement.

The TRDN planning process and timeframe are determined by the requirements of the National Environmental Policy Act (NEPA), the Water Resources Development Act (WRDA).

Current Phase:
Planning phase, no final plan yet. The project is pending for diverse reasons including lack of funding and stakeholder issues.

Recommended or Implemented Plan:
The Recommended Plan will likely be a combination of enhancements that provide for ecosystem restoration, water supply (recharge and recovery), and recreation.
Restoration goals are to improve mesquite, cottonwood-willow, and emergent wetland habitats to a condition supportive of wildlife, and for the benefit of residents and visitors to the area.
Additionally several new alternatives are being drafted including an alternative that reflects the possibility that all of the effluent currently discharged into the Santa Cruz River will be diverted from the channel for municipal water needs.

Monitoring/Maintenance:
Operations and maintenance will consist of:
- Regular monitoring of restoration performance
- Invasive species control
- Maintenance of water delivery system
- Replacement of non-surviving vegetation

The annual monitoring is estimated at $60 per acre with control of invasive species costing an additional $60 per acre.

Land ownership:
City of Tucson, State of Arizona, Pima County, Town of Marana, and private.

Funding and Cost:
Funding and authorization for this project is from the USACE General Investigation, Ecosystem Restoration.
Construction cost: approximately $292 million; Federal share of construction is currently estimated at approximately $170 million, and the non-Federal share at $117 million.
The annual cost of water is estimated to be $13,209,560.

Water:
The tentative plan includes piped delivery of tertiary reclaimed water and in-channel effluent

flows from the Roger and Ina Road Wastewater Treatment Plants. These flows of approximately 44,000 acre-feet per year would be used to sustain vegetated areas. Site work would include micro-grading for individual tree basins, flood irrigation, bubblers, drip irrigation, and implementation of micro- and macro-scale storm water-harvesting features.
The revegetated area will include over 3,000 acres of watered and storm water-nourished habitat.

Public Outreach:
Public involvement activities are an important aspect of the TRDN study and have been part of this restoration project from the beginning**.**
2001: One public meeting to determine the extent and type of work to be done.
2003: Two public meetings to obtain formal public input and feedback on proposed restoration elements of the project.
February 2006: Public Open House, to show the relationship of all of the ongoing USACE studies along the Santa-Cruz River : El Rio Medio, Paseo de las Iglesias and Tres Rios del Norte.

Planned for 2009: The Corps is also working on preparing a "Community Report" which will be a more user-friendly document for the public, with sufficient discussion of the alternatives and planning process to better explain how values for water use and costs were determined. The report will also highlight groundwater recharge benefits associated with the project so that the water use is put in correct context.

Public comments to date demonstrate strong support for riparian restoration along the TRDN stretch of the Santa Cruz River.

Challenges/Lessons Learned:
Project is in initial stages, none at this time.

Drivers:
Provide mitigation for lost riparian habitat.

Sources:
- http://www.marana.com/index.asp?NID=358
- http://rfcd.pima.gov/projects/tresrios/
- *Feasibility Studies Along the Santa Cruz River*, January 2006 (pdf)

Contact:
- Jennifer Becker, Principal Hydrologist, Pima County Regional Flood Control District
- Ann Audrey, Office of Conservation and Sustainable Development, City of Tucson

Excerpted from the Regulated Riparian Habitat Offsite Mitigation Guidelines for Unincorporated Pima County

ESPERANZA RANCH

Effluent flow and riparian enhancement

Location and Size:
Situated in northern Santa Cruz County, between Amado and Tubac off the I-19 at Agua Linda Road, the project encompasses 300 acres of land and both sides of the Santa Cruz River for 1 mile, and the land of the west side of the channel for another mile, ½ mile of the Chivas wash and a 10-acre pond area.

Sponsors:
- Tucson Audubon Society (TAS)
- Devon Energy Corporation
- partnership with the Sonoran Institute to get an EPA grant

History:
The land is adjacent to the Santa Cruz River. It is a migratory corridor that has been heavily disturbed through decades of development and ranching activity, which caused erosion and allowed invasive plants to thrive.
Devon Energy Corporation, the original owner, sold the 800 acres of land at Esperanza Ranch to local land owner Mr. Olson requiring, as a condition of the sale, to put 300 acres in a conservation easement, managed by TAS. Tucson Audubon is undertaking habitat restoration, monitoring and maintenance on the site.

US Representative Raul Grijalva applauded this innovative agreement saying "This type of partnership, where the private sector voluntarily bears the burden of conservation, is what will be necessary to achieve conservation goals in the next four years. I applaud the parties to this agreement for their leadership and foresight in this area."

The Esperanza Ranch Conservation Easement project is one of many environmental enhancement efforts Devon has undertaken. "We recognize this as a property with tremendous environmental potential. It's one of several non-producing properties Devon possesses that could benefit wildlife," said David Templet, manager of Devon's Environmental Health and Safety Department. "We are grateful for the Tucson Audubon Society's willingness to team up with us to see this project through…Tucson Audubon's commitment and dedication will fulfill Devon's primary objective, the preservation of this important wildlife habitat," Templet said.
The program has gained notice in several ways, most recently helping Tucson Audubon be a finalist for an Achievement Award from the Community Foundation for Southern Arizona. Ann Phillips accepted a plaque and a cash award on behalf of Tucson Audubon in recognition of having been a finalist in the foundation's "innovation" category.

The flow of the Santa Cruz River is intermittent through the reach that is being restored. Most of the year the flow comes from effluent released from the Nogales International Wastewater Treatment Plant about 20 miles upstream.
A pond in the restoration area was created by sand and gravel removal during construction of

Interstate 19 and has cottonwood and willow already growing on its banks.

Planning Objectives:

- Increase the diversity, density and sustainability of riparian habitat for the benefit of birds and other wildlife
- Stabilize erosion prone areas
- Engage the local and regional community in site activities and develop a long-range strategy for stewardship of the site as well as an endowment to carry out the plan.

Phases:

December 2004: beginning of the project, planning stage.
Spring of 2006: Restoration began, once the ungulate proof fencing was completed.
The project was scheduled to be completed in 2008, but the strategy was changed due to high plant mortality and high competition with non-native species.

Current Phase and Future Plans:

Restoration work is ongoing. About 20 more years should be needed to complete the work.

Mr. Olson, the new owner of the Esperanza Ranch, plans to construct a very low density residential development on the 500 acres of the Esperanza Ranch located adjacent to the easement. In conceptualizing his development, Mr. Olson worked closely with Tucson Audubon to ensure that his plans were compatible with the easement's conservation goals. His goal is to attract conservation-conscious residents to the land.
The joint transaction comprises 800 acres about 40 miles south of Tucson. About 500 acres will be developed as a low-density residential area bordering the 300-acre wildlife easement.

Recommended or Implemented Plan:

- The global plan for the site is to have a cottonwood and willow area along the river, a mesquite bosque-type area (xeroriparian species) higher up, and native grassland farther up along the west of the site. A mesquite forest should run along Chivas Wash.

- The first stage of work on this project was the installation of fencing around the 27,226 foot perimeter of the lands designated under the conservation easement, to exclude cattle.

- Once the fence was in place new vegetation was planted by seeding and planting around the river channel, in the ponds, along Chivas Wash, and in the broad floodplain west of the river. Planting techniques included pole planting of cottonwood and willow, seedling planting of riparian and uplands species, and seeding of the broad landscape. All plants were placed in water harvesting basins and swales to concentrate rainwater around them until they can access nearby elevated soil moisture.

- Non-native species are removed and suppressed by cutting and applying herbicides.

- Erosion around the pond perimeter and east end of Chivas Wash will be addressed through a combination of water harvesting and planting up gradient of erosion, and soil stabilization at the erosion points.

- Establishing both a plan for long-term stewardship and an endowment with contributions from the property owner and Tucson Audubon Society to fund long-term management of the site.

Monitoring/Management:

- Observing : seedling survivorship, wildlife and avian use (bird watching 9 times/year)
- Photo monitoring is used to document conditions before, during, and after restoration efforts.
- Online real-time data from stream gages and rainfall data are collected on the US Geological Survey website. USGS has a stream gage at Tubac and one at Amado (upstream and downstream of the site). Depth to groundwater (currently 20-35 feet deep) is also monitored in three locations: two in the easement, and one in a well at Agua Linda farm.
- The fencing will be monitored monthly throughout the project period, within 24 hours of significant river flows that could take out river crossing fencing, and within 24 hours of seeing vehicles, cows, or unauthorized people within the conservation. The agreement with the AWPF indicates that the project sponsors must maintain the fence for 15 years after installation and operate and maintain the site of revegetation for a minimum of 20 years.
- A conservation easement has been established on the property to protect the riparian area from development and encroachment in perpetuity.

Funding and Cost:

- $135,000 from Devon Energy Corporation (to establish an endowment for long-term stewardship, not for restoration work), in addition to the land
- $279,411 from AWPF
- $6,500 in-kind contributions from Stewart Loew and the Sky Island Alliance
- $151,270 matching and in-kind contributions from the Tucson Audubon Society
- $60 000 grant from Environmental Protection Agency (EPA) through the Sonoran Institute

Land Ownership:

Devon Energy Corporation, an Oklahoma City-based oil and natural gas producer, acquired the property through its acquisition of PennzEnergy Co. in 1999. At the time of the grant application, Devon Energy owned the Esperanza Ranch.

The 800-acre Esperanza Ranch property, including the 300-acre conservation easement portion, is now owned by Mr. James Olson of Green Valley, Arizona.

Water:

- The project takes advantage of intermittent effluent flows coming from the Nogales International Wastewater Treatment Plant. There is no contract or agreement in place which secures these flows and guarantees that they will continue to be delivered. The project is designed to be resilient and dynamic so that if the effluent flows are removed from the ecosystem, the vegetation will shift to more meso-riparian species but will survive with altered characteristics.

- No water will be pumped from groundwater wells nor diverted from surface water supplies at the Esperanza Ranch site to use in restoration activities due to an agreement entered into by previous owners that restricts pumping here (the FICO Agreement).

Public Outreach:

Esperanza Ranch is an area of sensitive habitat and its access is governed by a conservation easement agreement between Tucson Audubon and the landowner. Access to the conservation easement is strictly controlled and requires escort by a Tucson Audubon staff member. However there are opportunities to join Tucson Audubon staff members on birding trips, site

tours and volunteer work days. Public involvement also includes public lectures and community participation off-site.

Lessons Learned/Challenges:
The first plan had been done at a large scale, and turned out to be too ambitious. After seeding and planting over 3000 plants, a high mortality rate was observed. This plan did not allow native species to compete with non-native species.
A new strategy has been implemented, working on small, intensive areas, one area at a time.
The main obstacles to completing restoration work were the lack of funding and competition with non-native species.

Drivers:
Increase and restore habitat, then protect the area in perpetuity.

Sources:
www.tucsonaudubon.org/restoration/espintro.htm
http://www.tucsonaz.gov/ocsd/community/nature/OCSD%20CommOppsNatureFood2.

Contact:
Kendal Kroesen (TAS)

SWEETWATER WETLANDS

Wastewater treatment and effluent recharge with riparian enhancement

Location and Size:
The project encompasses 109 acres with 17.3 acres of constructed wetlands in Tucson, east of the Santa Cruz River.

Sponsors:
- City of Tucson

History:
In November 1993, the Arizona Department of Environmental Quality (ADEQ) issued the City of Tucson a letter of warning citing 24 violations of state drinking water laws and rules. ADEQ then filed suit in May 1994 and Tucson, which did not admit to any wrongdoing, settled in July 1994. As part of the settlement, Tucson agreed to pay between $300,000 and $400,000 to create a wetland utilizing backwash water used to clean filters at the Tucson Reclaimed Water Treatment Plant.
Construction began on the Sweetwater Wetlands in June 1996 and the facility was opened to the public two years later in March 1998.

Planning Objectives:
The consent agreement signed with ADEQ required 3 principal actions:
- Address the backwash issue
- Create wildlife habitat
- Provide public education.

Phases:
1984-1989: Demonstration phase, to determine the hydrologic feasibility of aquifer recharge and recovery, and the impacts of recharge on aquifer water quality and water levels. Construction of a group of 4 recharge basins.
1989-1997: Development phase, after the success of the first phase and granting of the necessary permits. As a condition of a judicial consent order issued by ADEQ, Tucson Water agreed to construct a wetland facility at the Sweetwater Recharge Facility. The wetlands were conceptualized to provide broad community benefits in addition to their core purpose of treating backwash water. In 1996, construction began on the wetlands as well as on four additional recharge basins (East bank).
1997-today: Full-Scale phase
The wetlands were completed and opened to the public in March 1998.

Current Phase and Future Plans:
Monitoring and maintenance. Recently, work was done for mosquito control.
Tucson Water evaluated operational changes to develop more recharge capacity out of the existing facility. By increasing the wet-cycle flooding depth, increasing basin delivery flow rates, and increasing the frequency of basin bottom ripping, a 35% increase in annual recharge capacity is projected.

A project to expand recharge facilities was also presented; it has been suspended for lack of funding.

Recommended or Implemented Plan:
The backwash water is filtered by cattail and bulrush colonies throughout the wetland. By design, the settling basins and wetland ponds are situated over a natural clay layer that minimizes infiltration during wetland treatment. However, recharge basins are placed on more permeable soils where infiltration rates are higher.
The various wetland components rely on gravity flow to convey water from one point to another along the various flow paths.

Monitoring/Management:
The principal focus of monitoring and management of Sweetwater Wetlands revolves around containment and control of the mosquito population. Mosquito management is conducted through the application of larvacide to the vegetated areas on a weekly basis for about 36 weeks per year. The larvacide used is rotated periodically to prevent the mosquitoes from developing a resistance. Adulticide is used only when the number of mosquitoes rises above a certain threshold. Mosquito counts are conducted regularly.

Vegetation management at the wetlands consists of controlling bulrush and cattail overgrowth. After a few seasons, both species will die out, causing a dense thatch to form in the wetland ponds which affects the wetland's ability to filter water. To remove the thatches of bulrush and cattail, Tucson Water has instituted a controlled burn program with a strategy of burning a third of the wetlands every third year. This strategy retains a balance between providing habitat for migratory birds and the maintenance of the system.

Water quality is measured at eight sampling points throughout the wetlands as well as at the source of water for the wetlands.

Funding and Cost:
- Project cost amounted to approximately $1.6 million which was paid for by bonds approved by the voters in the City of Tucson.
- Annual maintenance cost for the wetlands is $72,000.

Water:
The wetlands process approximately 1.2 million gallons per day of secondary effluent and filtered backwash water.
The adjoining recharge facility recharged about 57,000 acre-feet between October 1986 and May 2005. The recharge rate is approximately 1.5 feet/day. 8-10 percent is water from the wetlands. The remaining water used for recharge is secondary treated effluent.

Public Outreach:
The community was involved in the planning and designing of this project through the Citizens' Wetlands/Recharge Advisory Committee, with members appointed by the Mayor and Council of Tucson.
A Wetlands/Recharge Educational Outreach Program was established that produced an official wetlands logo designed by local students.

Lessons Learned/Challenges:
- Removal of the overgrown cattail and bulrush:

The maintenance team first tried to remove the vegetation using mechanical means. This process was problematic, however, because in order to get the equipment into the areas that needed to be thinned, the wetland area had to be completely dried out. Once the machines were in the area and had removed the vegetation, it was then necessary to remove and dispose of the material. Tucson Water found that it was much more efficient to burn about one-third of the wetlands each year to control overgrowth. Burning the vegetation eliminates the need for drying the ponds as well as hauling away debris. These burns do not require a permit from the Arizona Department of Environmental Quality and are used as wildland fire training for the Tucson Fire Department.

- Mosquito control:
Three different technologies have been employed to apply granular larvicide: using a land-based, truck-mounted hydro-seeder, a tracked, aquatic water craft with a seed spreader, and a remote controlled helicopter.
Tucson Water staff found that the truck-mounted hydro seeder was unable to broadcast the larvacide beyond 100 feet from the edge, and the wetlands were up to 400 feet across in some areas. The tracked aquatic water craft could traverse the cattail and bulrush but could only disperse the granular larvacide in a 30-foot swath. The best solution was a remote controlled helicopter that was able to cover the entire wetland area in less than two hours but it was removed by the Department of Homeland Security.

- Designing the ponds so that some of the pools can be drained while leaving others full has proved to be a valuable element of the design. For example, during an outbreak of avian botulism, operation crews contained the epidemic by draining the ponds in the areas most affected by the disease. At the same time, other ponds remained full in adjacent areas providing undisrupted habitat.

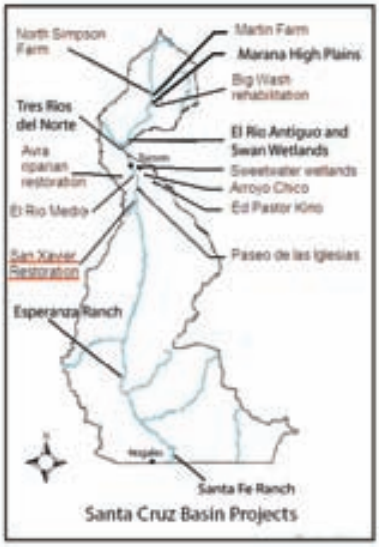
Drivers:
Multiple use wetland-treatment facility, research, public education, and passive recreation.
Initial funding and minimum project requirements for a wetlands project were established through a settlement between the City of Tucson and the Arizona Department of Environmental Quality over alleged drinking water quality violations.

Sources:
www.watereuse.org/files/images/Sweetwaterat20.pdf
http://www.ci.tucson.az.us/water/sweetwater.htm

Contact:
Joaquim Delgado (Tucson Water)
Bruce Prior (Tucson Water)

SAN XAVIER INDIAN RESERVATION RIPARIAN RESTORATION

Habitat restoration



Location and Size:
- Site 1: 12.5 acres, located on the west side of the Santa Cruz River, approximately 0.57 miles southeast of the intersection of San Xavier Road and the I-19 bridge in Pima County.
- Site 2: 5 acres, located 1.5 miles upstream from site one.

Sponsors:
- San Xavier District community
- Arizona Water Protection Fund (AWPF)
- Natural Resource Conservation Service (NRCS)
- Bureau of Reclamation (BOR)
- Sonoran Joint Venture
- U.S. Fish and Wildlife Service (USFWS)

History:
At the turn of the century, the Santa Cruz River flowed perennially through the restoration area, making it unique amongst the restoration projects studied on the Santa Cruz.
At this time, the water table was only 10-15 feet below the surface, and two springs flowed year round creating marshy areas. The vicinity supported a 3,200 acre mesquite bosque, cottonwood-willow groves, and other riparian vegetation.
Groundwater pumping began in earnest in the 1940s and over time has lowered the water table over 100 feet, killing mesquites and riparian vegetation.
In an effort to address growth and environmental concerns in their region, the San Xavier Reservation community adopted a Vision document in 1990 and Land Use Plan in 1992 that developed a long-term plan for riparian restoration on the reservation.
In the two restoration areas, the predominant prior land use was farming by the San Xavier Cooperative Farm.

Planning Objectives:
The overall objectives for riparian restoration on the San Xavier Reservation are:
- Develop an ecosystem approach to resource management for the Reservation and surrounding regions
- Conduct a feasibility study on riparian restoration possibilities on the Reservation
- Enhance and restore riparian vegetation along two arroyos on the Reservation
- Establish a grazing management plan to enhance and restore riparian vegetation

Restoration of the first site began with the process of selecting eligible sites. Objectives for the site selection process included: evaluate and compare the current ecological conditions of the five proposed sites; discuss the ecological changes that had occurred at the sites in recent years and the reasons for these changes; propose a preliminary plan to restore or at lease improve ecological conditions for each of the five sites; develop a budget for each of the proposed restoration plans; and provide a ranking of the five sites proposed for restoration activities.

Objectives for the restoration itself were:

- site 1:
    - Develop a resource management guide that identifies specific appropriate riparian restoration strategies and implement the selected strategies.
- site 2:
    - Re-establish a mesquite bosque plant community;
    - Establish a biologically significant area where tribal members can actively participate in the restoration and management of a desert riparian system;
    - Improve understanding of what restoration strategies can be most effective in bringing back bottomland habitat throughout the Santa Cruz River reach within the San Xavier District.

Phases:
Restoration of site 1, the Wa:k Hikdañ site, was conduced in four phases:
Spring 1999-Winter 2000: technical and community assessment and site selection between five potential bottomland restoration sites
Winter 2000-Summer 2002: pre-implementation phase
Summer 2002-Spring 2003: project implementation phase
The final phase is monitoring and maintenance (ongoing)

Site 2 will follow the same four phases with the exception of phase 1 which was completed at the time of Wa:k Hikdañ's restoration.

Current Phase and Future Plans:
Site 1: Restoration activities have been completed and monitoring and maintenance of is ongoing.
Site 2: Restoration is underway.

Recommended or Implemented Plan:
Five sites were reviewed and ranked according to nine ecological and three non-ecological parameters on a scale of 1 to 3 (three highest) with the parameter of meets restoration objective receiving twice as much weight as any other parameter. Examples of other parameters include: depth of saturated soils, livestock impacts, undesirable vegetation, restoration potential, distance to Central Arizona Project (CAP) line, community access, and budget.

Site 1:

- Pre-implementation phase :
    - Selection of the site
    - A thorough ecological assessment that included an assessment of channel morphology, hydrology, vegetation, and land use.
    - Sponsors installed 2,900 feet of cattle exclusion fence, as well as a rock revetment approximately 938 feet long along the eastern edge of the project site for bank stabilization.
    - Construction of a pipeline link from the main CAP pipeline to the project. The original plan was for a six inch diameter pipe; however in the spring of 2002, the San Xavier Cooperative Farm approached the AWPF about using the project pipe to convey water to their fields as well. They offered funding and technical assistance from the Bureau of Reclamation in return for increasing the size of the pipeline to make this possible.

- Implementation phase
    - Removal of undesirable plants (focusing predominantly on the non native tamarisk and tumbleweed)
    - Delineation of the areas to be revegetated according to riparian, mesquite bosque, and wetland zones
    - Installation of irrigation systems
    - Construction of the wetland and revegetation.

Site 2:

- Site preparation : Removal or treatment with herbicide of non-native, invasive vegetation, as well as cutting a small trench along the center portion of the floodplain for irrigation water and plant sites for riparian species
- Irrigation design and installation : irrigation will consist of a main delivery pipeline bringing water from the CAP pipeline to a drip irrigation system at the site similar to the Wa:k Hikdañ site
- Planting the vegetation: revegetation is divided into two zones for design purposes: terrace surfaces and floodplain surfaces. Terrace surfaces will be planted with mesic species such as mesquite, netleaf hackberry, and desert willow, which are plants that can survive in drier environments where depth to saturated soils can be considerable. Floodplain surfaces will be planted with riparian plants that are capable of withstanding frequent high flow events.

Monitoring/Management:

According to the AWPF agreement for both sites, grantee shall:

- develop monitoring and project site maintenance plans
- monitor the operation of the irrigation system for as long as it is in use
- monitor plant performance for at least five years

"The intensity of monitoring efforts will decrease over time until the fifth year after revegetation. The grantee shall fund monitoring and maintenance work conducted after the termination of this agreement."

Funding and Cost:

Site 1:

Funded by AWPF, NRCS, BOR, and the San Xavier District.

- The total cost of the site selection phase was $184, 260.
- Restoration of site 1 cost $413,432.

Site 2:

- $32,688 from AWPF and
- $37,555 matching funds which came from the San Xavier District Community, the U.S. Fish and Wildlife Service, and Sonoran Joint Venture.

Land Ownership:

The restoration sites are both located on reservation allotted land with a lease administered by the Bureau of Indian Affairs.

Before restoration could begin, permission had to be obtained from all of the allottees. No compensation was initially provided to landowners.

All but two allottees agreed without payment, and these two landowners were provided a one time payment of $500, an amount derived from an appraisal of an adjacent allotment.

Water:
Supplemental water for the project is provided by a diversion of CAP water. The CAP diversion is part of the Southern Arizona Water Right Settlement Act of 1983. The water flows through a created stream and wetland area, nourishing the riparian species and seeping into the aquifer.
The primary use of supplemental water is to recharge a perched aquifer under the site. Exploratory drilling during the feasibility phase showed that the perched aquifer was about 47 feet below the surface and extended to the area under both project sites. It is believed that recharge from the stream and wetland areas will create a mound within several years of implementation. It is feasible that this mound will eventually reach sufficient size to support the riparian plant community with scaled-back irrigation.

Under the agreement with the AWPF, supplemental irrigation and maintenance of the irrigation system is the responsibility of the San Xavier Reservation community.

Despite the long-term water requirement for the wetlands, the majority of the project was designed to survive without irrigation (after initial establishment). "A significant portion of the site is occupied by deciduous riparian and mesquite bosques plant communities, which will hopefully be able to survive with out long-term inputs of artificial water."

This project was the first to use CAP water in the Tucson basin for riparian restoration and laid the groundwork for the use of as much as 50,000 acre-feet of CAP water for restoration purposes on the Reservation in the years following project.

Public Outreach:
Quarterly project updates were published in the Wa:k Community newsletter as well as an annual project newsletter for the San Xavier District community members. "In the case of the San Xavier revegetation effort, the restoration project is considered critical to not only meeting documented goals, but also of tantamount importance to many elders and other community members who would like to see a semblance of how the Santa Cruz River used to be before it was affected by human impacts." "The [Citizen's Steering] Committee was particularly effective in obtaining information from community elders on past site conditions, the plant and water conditions that they saw along the Santa Cruz River in Wa:k Hikdañ, their youth, and their ideas as to how the Wa:k Hikdañ should look when completed."

Lessons Learned/Challenges:
- Formation of a citizen steering committee to guide the project's implementation was critical to its success. Initially, they encountered problems with attendance and achieving quorum for monthly meetings. This problem was remedied in part by providing stipends and dinner to attendees.

- When developing restoration efforts on allottee land, a considerable amount of time should be allocated to the pre-implementation phase to obtain the necessary signatures and permission from land allottees, many of whom no longer live near the Wa:k Hikdañ restoration site.

- Additional water provided for restoration attracted both desirable and undesirable animals.

- The significant time and money invested in the construction of the fence proved critical in realizing restoration objectives.

- Be careful to include everything from the official plan in the bid plans. The restoration team ran into problems when the final pipeline design did not include several design features that were included in the Standards and Specs, but not drawn on the pipeline plans, and the contractor did not include them in his bid.

- Planting during the hot months of June through September can cause the black plant containers to heat up to significant temperatures in the mid-day sun, potentially cooking the roots of the plants and killing the plant before it is put in the ground. They found that plant containers of one-gallon and five-gallon sizes were not as vulnerable to this threat as were seedlings grown in long and narrow tubex tubes that encourage the development of long tap roots, and skinny seedlings. Trees grown with the tubes in the nursery had a high rate of survival when planted in the ground; however, they will not survive if they are subject to extreme heat or sun prior to planting.

- Removing non-natives from the site is critical to overall project success, yet it is one of the most tedious and difficult activities to perform. Several strategies were useful in improving the effectiveness of weeding as well as maintaining the energy of maintenance staff. Examples of these strategies are: developing a schedule where groundskeepers focus on only one particular part of the restoration site during any given day, which helped to concentrate the work and maintain the focus of the groundskeepers; focus weeding only in planted areas with the goal of reducing competition, giving planted vegetation more of a chance to survive the critical first year following planting; and bringing in temporary laborers to assist groundskeepers in weeding parts of the site where weeds are particularly problematic.

- Another challenge faced was the large turnover of maintenance staff. To combat this problem, the restoration team has implemented several strategies designed to maintain the interest and energy of the groundskeeper team including field trips, training activities, and participation of other staff and technical consultants in various aspects of the work.
Conducting 'weeding days' where consultants and staff help groundskeepers to remove undesirable vegetation has been particularly helpful in maintaining a team spirit and interest of the groundskeepers.

- Finally, the project ran into problems when in June 2003, the controllers on the irrigation system all failed within a matter of days of each other. The irrigation system was down for several days before the problem was discovered, and close to 10% of the trees in the affected areas died. As a result, the irrigation maintenance schedule was altered to include performance checks of all irrigation programs and weekly tests of the controllers. The restoration team notes that providing additional training in irrigation maintenance after revegetation was finished may have prevented the irrigation system's failure from significantly affecting plantings.

- The restoration team also noted the importance of post-implementation maintenance, monitoring, and evaluation activities. They assert that the project would not have succeeded without diligent weeding, replacement of dead plants, and irrigation system maintenance. Mark Briggs of Briggs Restoration recommends that 20% of the entire budget of project be

devoted to these post- implementation activities.

Drivers:
San Xavier Community created a visioning document where one of the primary objectives was riparian restoration. "One of the other principal reasons for implementing this project [aside from restoration of habitat] was the San Xavier community's desire to create an area for residents to visit for low intensity recreational uses, such as walking, contemplation, and observing wildlife."

Sources:
1996 San Xavier Indian Reservation grant application to Arizona Water Protection Fund

THE BIG WASH REHABILITATION PROJECT

Habitat restoration

Location and Size:
The proposed Oro Valley Marketplace and adjacent rehabilitation site are located in the Town of Oro Valley, at the southwest corner of Oracle Road (Highway 77) and Tangerine Road.
The site is located in the Big Wash floodplain, just upstream of the Cañada del Oro Wash. Land use in the surrounding area consists of residential development to the west, a hospital to the north, and Catalina State Park and residential to the east.

Sponsors:
- Pima County
- Vestar corporation

History:
Oro Valley voters recently approved a proposal to build an 800,000 sq. ft. commercial development that will include a retail center and a movie theater. As part of a previous agreement, unrelated to the commercial development, the Vestar Corporation is required to restore a former farm field that is owned by Pima County.
Currently, the rehabilitation site is primarily retired agricultural land and degraded mesquite woodland. The farm field contains annual grasses and forbs. In the recent past, much of the site has been bladed or disked to reduce the fire risk the dried annuals present.

Planning Objectives:
The goal of the rehabilitation project is to replace the low diversity vegetation with a diverse mix of native vegetation based on characteristics of near-by natural reference sites.
The project proposes to create a self sustaining ecological system that will be similar in hydrology, topography and vegetation to what is found in the undeveloped portions of the Big Wash floodplain.

Phases:
No information available.

Current Phase and Future Plans:
Pending project

Recommended or Implemented Plan:
Transects across sections of Big Wash were used as reference plots to guide what might be appropriate vegetation and site contours for the rehabilitation area.
Plant species used in the project will be similar to the species found in the reference sites. Planted and preserved-in-place trees will include velvet mesquite, whitethorn acacia, palo verde, cat claw acacia, and others. A mix of mid and understory species will be used to create a diverse xeroriparian community.

Funding and Cost:

No information available

Land Ownership:
Pima County

Water:
- The project will contour the site to capture water from several small tributaries and from storm water runoff generated from the impervious surfaces of Oro Valley Marketplace. The water will flow through a network of streambed channels intended to encourage the establishment of similar topography naturally occurring in the reference sites.
- Initially, the vegetation will be irrigated; as the vegetation matures and is established, supplemental irrigation will no longer be necessary.

Lessons Learned/Challenges:
The Vestar Corporation plans on constructing a retail center adjacent to the rehabilitation site. As part of the commercial development, Vestar is allowed to remove some fill material from the site. The removal of material would allow more frequent inundation of the rehabilitation site by Big Wash. Plans have not been finalized for the fill removal, and the rehabilitation plans are on hold until the details are worked out.

Drivers:
Create a self sustainable native ecological system and enhance riparian habitat.

Sources:
PCRFCD projects: *« Sonoran DesertConservation Plan »Bigwash* pdf

Existing conditions: restoration area outlined in blue, Vestar development outlined in red.

View of retired agricultural field targeted for rehabilitation

View looking upstream of Big Wash

CORTARO MESQUITE BOSQUE

Habitat restoration

Location and size:
80-acre in northwest Tucson located along the west side of the Santa Cruz River near Continental Ranch (near the north end of the Tucson Mountains).

Sponsors:
Pima County Regional Flood Control District

History:
The river here has an effluent dependent strip of riparian vegetation, and the adjacent project area has the potential to widen existing habitat.

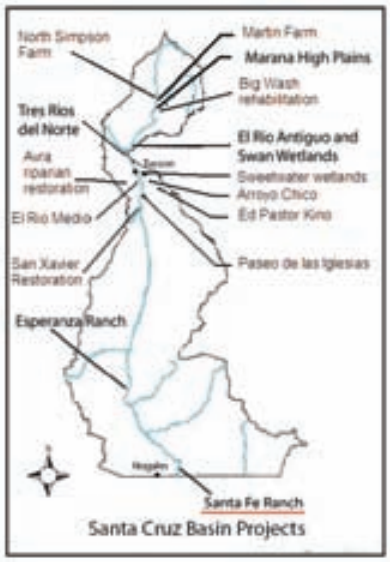
Planning Objectives:
The goal of the project is to increase vegetation structure and biological diversity of the floodplain and provide wildlife habitat, for- age, and nesting area for birds.

Phases:
No information available.

Recommended or implemented plan:
The plan involves islands of five planting zones of vegetation, separated by areas planted primarily in native grasses. The grassland areas separating the planting zones provide extended edge habitat preferred by many neo-tropical migrants and endemic birds. The planting zones consist of vegetation communities of cottonwood/willow, riparian mesquite bosque, riparian grassland/willow, xeroriparian mesquite bosque, and upland/grassland areas. Plant material is being grown for the project by the Pima County Native Plant Nursery from local seed sources.

SANTA FE RANCH RIPARIAN RESTORATION

Erosion control and riparian restoration from flood damage



Location and Size:
The project is located five miles north of Nogales in Santa Cruz County and encompasses 1,200 feet of river, through a 10-acre project area.

Sponsors
- Coronado Resource Conservation and Development Area, Inc.
- Arizona Water Protection Fund (AWPF)
- Arizona Department of Environmental Quality (ADEQ)
- Natural Resources Conservation Service (NRCS)

History:
In 1967 a flood destroyed mature cottonwoods and other riparian vegetation in the Santa Fe Ranch section of the Santa Cruz River. The storm left timber and large rocks piled in the river channel, causing storm water to flood out onto adjacent pasture, eroding tons of topsoil and removing vegetation from those areas that served as buffers and habitat. The project area continued along a downward trend in condition until the initiation of this restoration project.

Planning Objectives:
The goal of the Santa Fe Ranch Riparian Restoration project is to re-establish a corridor of historic vegetation on a segment of the Santa Cruz River that will create diverse habitat and reduce stream bank erosion.
The three objectives are:
- Erosion control
- Revegetation of the area
- Increased public awareness of riparian systems and values.

Phases:
2000: grant from ADEQ to install Kellner Jacks205 (Jetty Jacks) to stop further erosion and trap sediment.
March 2004: revegetation of the area through use of pole plantings.
Sept 2002 – Sept. 2005: monitoring, outreach and education to provide information to local schools and land users about the value of riparian areas and options in restoration and techniques for monitoring of such projects.

Current Phase:
Monitoring and outreach activities continue on the site.
The final project report for the AWPF was completed in September of 2005.

Recommended or Implemented Plan:
The fencing plan, implemented in October of 2001 included installing fencing between irrigated pasture and the revegetated bank stabilization area to exclude livestock access.

The project also implemented an irrigation plan to provide supplemental irrigation to approximately one acre of the site to establish riparian vegetation. The system was used during establishment of trees, shrubs forbs and grasses in a 60 feet wide 700 feet long area. The irrigation schedule during peak use (May and June) is to operate the system for 24 hours every 2.5 days.
The revegetation plan designated three planting zones: the floodplain, the scarp (which is the transition zone between upland area and floodplain), and the upland area.

Monitoring/Management:
Monitoring activities are focused on determining survivability of pole planting used for revegetation on severely eroded area and to determine the overall benefits of restoring riparian corridors. In order to determine this, the sponsors established a database of baseline conditions using survey and photographic methods. This database included information on plant counts, corresponding well data, and gauging station data from the Arizona Department of Water Resources and United States Geological Survey.

After revegetation, the project site was inspected at least on a weekly basis by Santa Fe Ranch personnel. Weekly inspections included: inspecting fencing for breaks or gaps, inspecting the irrigation system for breaks or malfunctions, and observations of plant materials for overall vigor and health.

Monitoring also included replacement of dead trees or shrubs and control of invasive species until the revegetated site was decided to be in fully functional condition.
According to the May 2005 report to AWPF, the survival rate of willow is 57% and mesquite 63% (35 plantings for each species were conducted originally).
Under the agreement with the AWPF, the operation and maintenance period for grant-assisted fencing construction is 15 years following completion of the structure; for all other grant-assisted structures, the operation and maintenance period is 20 years.

Funding and Cost:
-$49,008 from AWPF
-$13,996 from NRCS
-$5,063 in matching funds
-The project also received funding from an ADEQ 319(h) grant to install the Kellner Jacks and erosion control structures.

Land Ownership:
Private (Sedgewick family)

Water:
Competing land interests such as a County road on the west side and irrigated pastures on the east side of the river forced NRCS to propose a stream corridor that is less than ideal.
The ideal corridor would contain the stream, its banks, the floodplain, and the valley slopes. The proposed corridor will create a pattern of habitat that crosses the stream area and flood plain, connecting the riparian areas to the upland areas. The proposed corridor will also function to trap sediment and provide hydraulic storage during floods and will trap organic matter necessary for the health function of the stream system.

Irrigation of riparian plantings comes from a well that is currently being used to irrigate pasture adjacent to the site. Water table levels have not been conducive to pole planting

success at this site.
According to the irrigation plan, the estimated peak irrigation need for 70 trees, 130 shrubs, 1,800 grasses and forbs is 19,950 gallons per day.

Public Outreach:
The project included an Outreach Plan that outlined steps that the restoration team would take to reach individuals in the community. Examples of items in the plan are: a teachers guide to riparian education in desert ecosystems to be used in grades 3 – 8, technical team work with the Nogales High School science class to use the plant nursery at the high school to propagate plants for the project, fact sheets on riparian systems, a power point presentation, and an informational tour for the public and partner agencies of the project site.

Challenges/Lessons Learned:
In a later survey of plantings, other vegetation had grown up around plantings, making it difficult to find/identify them. It was suggested that in the future, all plantings be clearly flagged so that their survival rate could be more easily determined.
The number of cottonwood plantings was reduced during the project because of survival concerns caused by the drought and a lowering of the water table.
At the beginning of the project, the water table was 10- 15 feet below the surface and during the project dropped to 24 feet.

Drivers:
Previous flood events had decimated the system, the primary goal in restoration was to stabilize bank erosion and re-establish a riparian corridor in order to improve water quality.

Projects to Enhance Arizona's Environment: An Examination of their Functions, Water Requirements and Public Benefits*

May 2006

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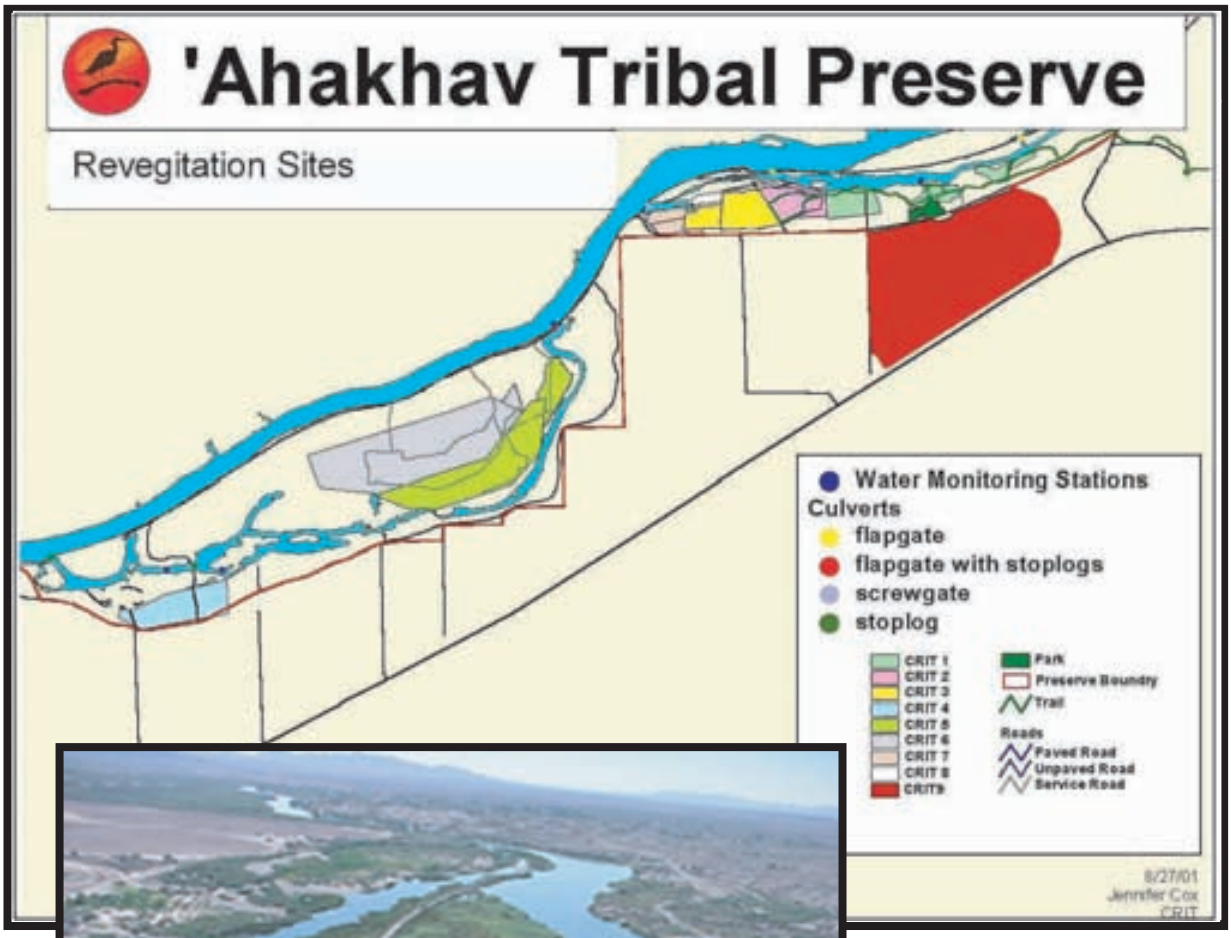
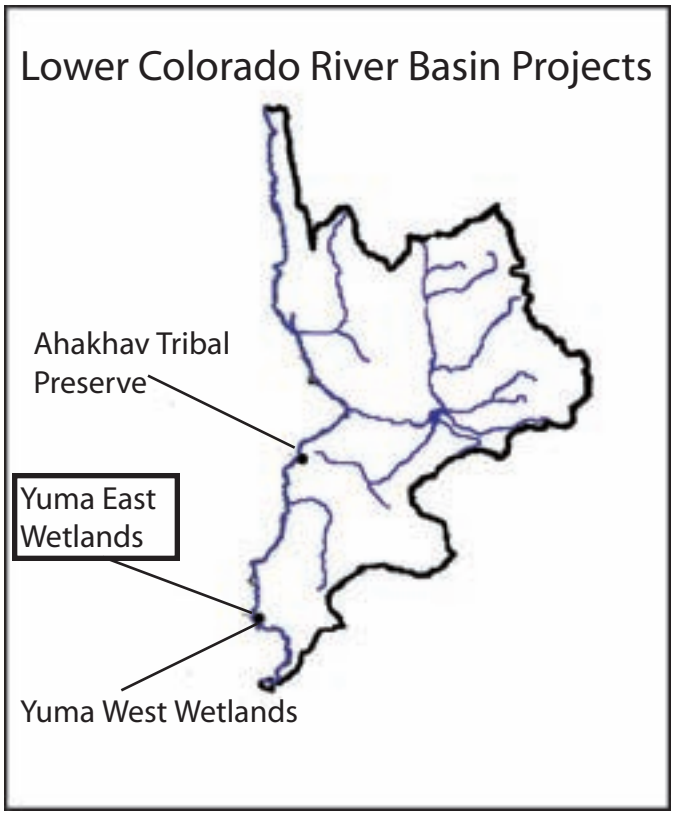
Excerpted from the Regulated Riparian Habitat Offsite Mitigation Guidelines for Unincorporated Pima County



Aerial view of the preserve

All photos courtesy of
'Ahakhav Tribal Preserve



Yuma East Wetlands

Primary Information Source: 2004 grant application to Arizona Water Protection Fund, 2004 Yuma Area Office of Bureau of Reclamation Environmental Assessment for Yuma East Wetlands Project, and 2001 Yuma East Wetland Restoration Plan.

Location and Size: The project area is along the Colorado River floodplain between river miles 29.0 and 34.0, bounded to the west by the Ocean-to-Ocean Bridge and to the west by the Gila and Colorado River confluence in the city of Yuma. The project encompasses 1,418 acres.[37] The restoration area includes 1,100 acres of riparian habitat, 148 acres of open water, 98 acres of marshland, and 20 acres of agriculture. To date 101 acres have received funding for restoration activities.[38]

Primary Sponsor(s): Yuma Crossing National Heritage Area, Quechan Indian Nation, and City of Yuma.

Other Sponsors: U.S. Army Corps of Engineers (USACE), Bureau of Reclamation (BOR), and Arizona Water Protection Fund (AWPF).

History: The Yuma East Wetlands (YEW) area has been home to the Quechan Indian Tribe for centuries. The Quechans depended on the river and its riparian area for all aspects of their livelihood. Their way of life, as well as the character of the Colorado River, began to slowly change in the 18th century with the exploration and then settling of the area by the Spaniards. The most drastic changes to the ecosystem came, however, in the 20th century and the era of large scale dams on the river. The combination of dams, agriculture and the introduction of exotic species such as tamarisk has radically altered the Yuma East Wetlands system. Today exotic plants and agriculture have replaced most of the once abundant mesquite bosques and cottonwood/willow gallery forests. Backwaters and beaches have in some places disappeared entirely and in others are deteriorating. In less than a century the area has been transformed from a wild, meandering river to a confined, impaired ecosystem.[39] In addition to vegetation and river flow changes, the project area also had at its inception at least 20 illegal dumpsites and between 10-15 transient encampments. [40]

Planning Objectives: According to the Environmental Assessment for the project "[t]he Yuma East Wetlands Restoration project aims to restore native riparian, wetland, and aquatic habitats

[37] Yuma Area Office, U.S. Bureau of Reclamation. (2004) Environmental Assessment: Yuma East Wetlands Restoration and Enhancement Project. Yuma: U.S. Bureau of Reclamation

[38] Quechan Indian Nation. (2004) Application to Arizona Water Protection Fund Quechan Indian Nation Yuma East Wetlands Restoration Project, Phase I. Yuma: Quechan Indian Nation.

[39] Phillips Consulting. (2001) Yuma East Wetlands Restoration Plan: Final Draft Concept Plan. Flagstaff: Phillips Consulting.

[40] Ibid.

along the lower Colorado River. This will be accomplished through; restoring water flow in degraded wetland and aquatic habitats, riparian re-vegetation activities, and conversion of existing non-native habitat to native cottonwood/willow habitat."[41]

Specific goals for the project are broken down into three areas: channel stabilization and wetland enhancement; revegetation; and cultural preservation, environmental education and low-impact recreation. Examples of channel stabilization and wetland enhancement goals are: enhance the natural river channel dynamics; manipulate sediment loads to decrease river maintenance requirements, while maximizing wildlife benefit and protecting existing valuable habitat; excavate historic channels to improve water quality and flow in the existing wetlands and improve hydrology and enhance wetlands and backwaters utilizing new and existing water control structures.

The revegetation goals include: enhance and manage existing native riparian vegetation; establish stands of native vegetation, including cottonwood, willow and mesquite, in areas currently of low wildlife habitat value; remove exotic plant species on the existing riverbank and revegetate this lower terrace with cottonwood, willow and native wetland plants; and design vegetation stands to minimize threat from wildfire.

Examples of cultural preservation goals are: establish Yuma East Wetlands interpretive/cultural center and nature park for community members; improve safety and aesthetic value by cleaning up illegal dumping sites in the project area; relocate homeless Yuma East Wetland residents in a respectful and helpful manner; involve the Quechan and Yuma communities in the restoration operations; and provide cultural, educational and economic opportunities for the Yuma and Quechan communities. [42]

Current Phase: The first 25 acres have been restored, and dredging of the river channel will begin in September 2005.[43]

Phases: The project will take place in three phases. Phase one included revegetation of a 25 acre pilot plot in the Ocean-to-Ocean Bridge area, the conversion of 13.7 acres of agricultural lands to cottonwood/willow habitat, and the beginning of channel restoration activities. Phase two will focus on channel restoration, including the continued restoration of 254.4 acres of marsh channels. Phase three completes the project by revegetating an additional 636 acres of land as well as developing the Yuma and Quechan Nature Parks. It is anticipated that phase three will be complete in 2010.[44]

Recommended or Implemented Plan: "The YEW is a 5-10 year phased implementation program that will include the following project features: creation of a 6-acre YEW park through riparian revegetation; conversion of existing non-native dominated habitat to native cottonwood/willow habitat; restoration of natural channel configuration resulting in restoration of water flow in degraded wetland and aquatic habitats (dredging/excavation activities); conversion of 77.5 acres of agricultural land to native riparian trees and shrubs; and sequential replacement of the remaining 1,318.5 acres of non-native saltcedar and giant cane habitats with native riparian trees and shrubs."[45]

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[41] Ibid. p. 78

[42] Supra note 39

[43] Volkmann, Michelle. 2005. "Trading spaces: Transformation of Yuma's East Wetlands from dumping area into environmental treasure beginning to take shape." Yuma Daily Sun, June 11.

[44] Phillips Consulting. 2003. Yuma East Restoration Project Biological Evaluation. Flagstaff: Phillips Consulting.

[45] Supra note 37. p. 2

Monitoring/Management: Monitoring of the site will include a post-construction topographic survey which will verify the total excavated quantities and serve as base for the long-term monitoring effort. It is anticipated that long-term monitoring activities will focus on determining the minimum maintenance schedule necessary to keep wetland inlet and outlet structures functional. The Yuma East Wetlands will also be monitored for aquatic and wetland ecosystem effectiveness which will begin within one month after the construction crew has completed their efforts.[46] Revegetation monitoring will include observation of plant species-specific percent survival and growth rates, determination of species survivability based on variation in depth to water table and salinity, and calculation of foliage volume and density.[47] After the first year of post-construction monitoring, a workshop will be held to develop a long-term plan for the aquatic and wetland monitoring and maintenance of the restoration site.[48]

Funding and Cost: Total estimated project cost for ten years is $9,920,953. Funding received to date: from AWPF (04 grant) $277,033, from EPA $60,000, City of Yuma $80,000, from AWPF (05 grant) $263,803, $15,000 from Quechan Nation, and $1,721,448 from BOR.

Land Ownership: Quechan Indian Tribe, U.S. Bureau of Land Management, Arizona State Land Department, City of Yuma and numerous private parties.[49]

Water: In order to assess the water needs for the Yuma East Wetlands restoration project, an analysis was conducted that examined the following elements: the amount of open water; the amount of water proposed to be used through revegetation, excavation, and channelization; the amount of water subject to evaporation and loss; a comparison of the proposed surface area waters to those originally identified in 1965; the current water entitlements and consumptive use amounts of the various landowners and stakeholders; and the potential return flow credits from the Main Outlet Drain Extension (MODE) canal,[50] City of Yuma filtered decant water, and/or future effluent discharge.

The results of the consumptive use analysis indicate that the restoration project will not increase the water use above current levels. Total consumptive use of water at the Yuma East Wetlands site prior to restoration was estimated at 6362.4 acre-feet per year. Estimates of consumption after restoration is complete, were initially expected to be 6275.2 acre-feet, or 87 acre-feet less than without restoration,[51] however, more recent estimates using the Bureau of Reclamation‘s table for water consumption by plant species have but the consumptive savings at 870 acre-feet per year.[52] The reduction of overall water consumption on the site is a result of changes in evaporative losses due to structural changes in channelization and open water elements as well as replacement of non-native vegetation with native vegetation.

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[46] Supra note 39

[47] Ibid.

[48] Ibid.

[49] Private property owners have been contacted, and all have indicated their initial support for the project. Supportive, private landowners in Phase 1, have been willing to discuss selling property within the project area or executing title transfer options, which might include quid pro quo considerations for other parcels, waiver of fees, or gifting of the land for tax benefits.

[50] The MODE canal is part of the Yuma Desalination Plant and is currently used to transport return flow agricultural water to Mexico.

[51] Supra note 39

[52] Eatherly, Kevin (City of Yuma, Department of Public Works). (2006) February. Review comments of draft report of this study.

Surface water diverted from the Colorado River, apportioned through the city's water right, will be used to irrigate revegetated areas during the first three seasons after planting. Filter backwash water from the city's water treatment plant will also be added to the system. The backwash water will be added to one of the backwater channels to supplement natural water in the channel but is not required to sustain any of the features of the project.

Pubic Outreach: "The goal of YEW public outreach is to educate the public on the Yuma East Wetlands Restoration Plan and generate increased citizen participation. Public outreach will primarily target local service clubs and organizations, church groups, civic groups, student councils and other environmental organizations. Additionally, considerable efforts will be made to cross over cultural barriers, reaching all ethnic groups in Yuma area."[53]

Challenges/Lessons Learned: Flexibility is a key element to the success of the project. No matter how detailed and well constructed the plan is, the ability to adapt to changing situations, while keeping the main goals of the project in focus, is required to see the project through all stages of development.

Project sponsors note that communication is a key to prevent fear of the unknown or past failures from killing the project. Involving the community is the key to long-term vitality and creates ownership of the project. Also respecting your stakeholders' needs and cultural differences is essential in identifying common goals and objectives, opportunities, and constraints. Impacts on adjacent landowners must also be taken into consideration and handled with the utmost care. According to Kevin Eatherly at the City of Yuma, "[Adjacent landowners] can become your best project proponents or your worst enemy".[54]

Drivers: Prior to restoration, the site was used as a dump and was a haven for illegal activities. The project is motivated by a desire to clean up and restore the natural and cultural beauty of the area. Yuma East Wetlands is a part of the City of Yuma's Yuma Crossing National Heritage Area project, which seeks to revitalize the waterfront area and "attract visitors, investment, and economic opportunity to Yuma to improve the quality of life for its residents."[55] The project sponsors also report that knowledge and research were drivers to the project.

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[53] Supra note 39

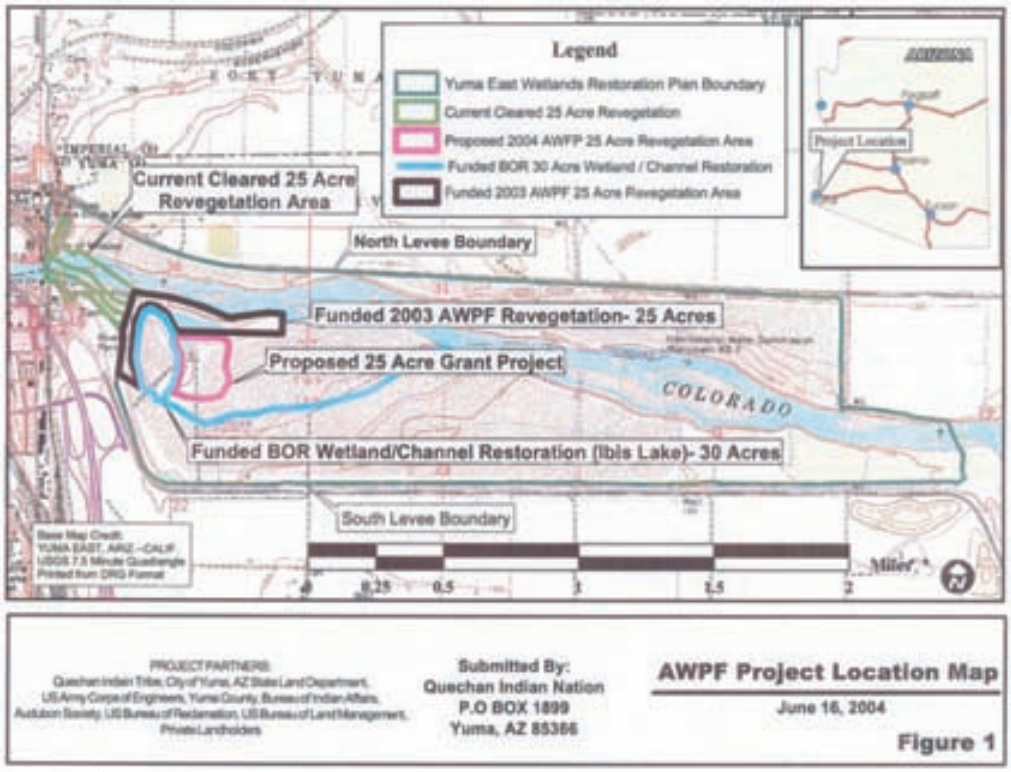
[54] Supra note 52

[55] Yuma Crossing Heritage Area. 2005. Goals of the Yuma Crossing Heritage Area. http://www.yuma heritage.com/ourproject.html

Areal view of project area
Yuma East Weslands

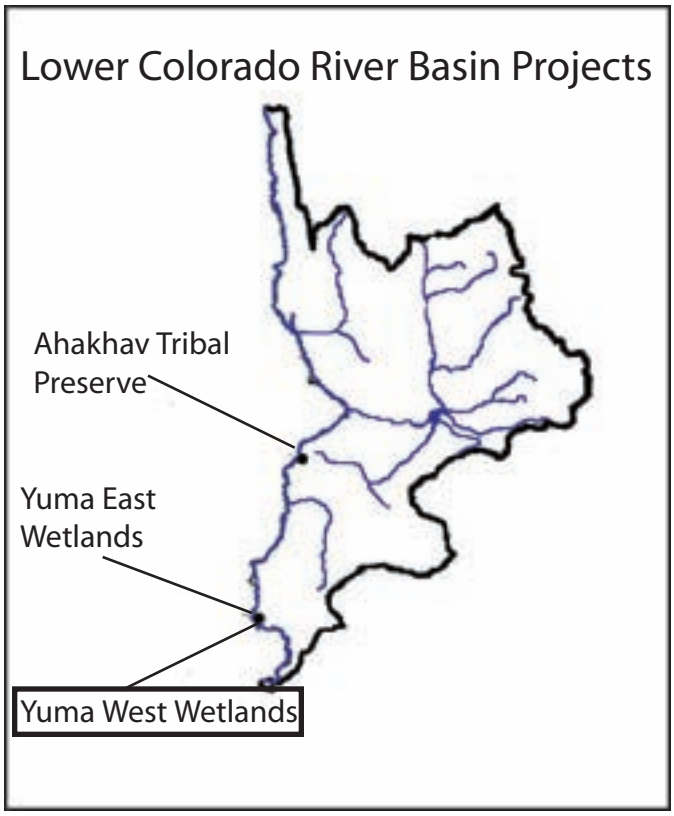
Existing cattail and bulrush habitat near Ibis Lake
Yuma West Wetlands

Prior to restoration the area was used by transients and as an illegal trash dump
Yuma West Wetlands



Map of project site
Yuma East Westlands

Photos courtesy of AWPF



Yuma West Wetlands

Primary Information Source: 2001 City of Yuma: West Wetlands Report 1999-2000 and 1999 Bureau of Reclamation, Yuma Area Office of Environmental Assessment.

Location and Size: North from Colorado Street to the Colorado River and between 12th and 23rd Avenues. The site is 110 acres with 35 acres of riparian restoration.

Primary Sponsor(s): City of Yuma.

Other Sponsors: Bureau of Reclamation.

History: Over the past century, the Colorado River has been dammed and diverted for agricultural, municipal, and industrial purposes. This project is part of a larger effort by the city of Yuma to reclaim the riverfront area. At around the turn of the 20th century, the city began to use this area as a landfill, a practice that continued until 1971. In 1998, the United States Environmental Protection Agency conducted a Brownfields Program Screening Site Inspection of the former landfill. This inspection revealed that the site could be released for use without any other remedial action other than a covering of new, clean fill.[56] The riverfront portion of the site was separated from neighboring residential areas by the Main Outlet Drain Extension (MODE, salinity canal), the Yuma Valley Levee, two maintenance roads, a railroad line, and a maintenance road leading to the gauge station on the river. The lower portion of this site had been overrun by invasive species and was subject to frequent flooding. In 1996 a fire caused by the extensive human encampment of the area burned native and non-native vegetation and caused the demise of much of the remaining native vegetation in the area. According to the Yuma West Wetlands sponsors, "[t]he 1996 fire was a wake-up call to the community that the resource along the river would continue to be lost and a hazard to local residents unless action could be taken to reclaim this section of the river."[57]

Planning Objectives: "The primary objective of the Yuma West Wetlands Revegetation Project is to establish and protect 35 acres of long-term, self-sustaining, native cottonwood and willow riparian habitat along the 100-year floodplain of the Colorado River."[58] The riparian corridor will serve as habitat for the willow fly catcher, an endangered species, and other native wildlife.

Current Phase: Revegetation of the lower terrace is complete. Phase one of the park construction is complete, including the boat ramp and irrigation infrastructure. Paving of the loop road around the park is also complete.

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[56] US Bureau of Reclamation-Yuma Area Office. (1999) Environmental Assessment Cooperative Agreement with the City of Yuma, Arizona for the Yuma West Wetlands Project. Yuma: Bureau of Reclamation.
[57] City of Yuma. (2001) West Wetlands Report 1999-2000. Yuma: West Wetlands. p. 9.
[58] Fred Phillips Consulting. (2004) Yuma West Wetlands 2004 Plant Monitoring Report. Flagstaff: Fred Phillips Consulting. p. 1

Phases: This project included improvements to both the upper and lower terraces along the river. The lower terrace improvements included: constructing a boat launch, re-vegetation with cottonwood and willow, construction of three snags (roosting spots) for ospreys and eagles, and construction of a handicapped-accessible walkway. Upper terrace improvements included clearing and re-vegetation of the area. On one-third of the upper terrace Sonoran desert species will be planted in higher densities as part of a hummingbird sanctuary. An access road, parking area, and handicapped accessible trail with restrooms and observation deck will also be built in the higher density restoration area of the upper terrace. Two trails will traverse the upper terrace to provide additional recreational opportunities to visitors.

Recommended or Implemented Plan: The restoration site is divided into two terraces, one close to the river and the other on the higher ground to the south of the river. Restoration activities in the river terrace included removal of non-native species and revegetation and reforestation with native species. Before developing the upland terrace of the site in the area that was a landfill, a geotechnical analysis was conducted so that the development plan could be shaped to avoid the need to dig up and remove large parts of the landfill.[59] The upper terrace, approximately 110 acres, will consist of irrigated turf grass for use as a park. The park will contain an interactive playground that has been donated by a local businessman.

Monitoring/Management: Prior to restoration, numerous analyses of the site were conducted to determine both baseline conditions and the areas best suited for revegetation. To monitor the site, photo monitoring stations were established, and Global Positioning System (GPS) and Geographic Information System (GIS) methods were used to develop and analyze species survival data. Six photo monitoring stations were established, and panoramic pictures were taken at monthly intervals throughout the growing season. The monthly monitoring began once revegetation was completed. As of the 2004 growing season, data has been collected from 22 transects located throughout 20 of the 35 acres.[60]

Funding and Cost: Funding for this project was put into place with several agreements between the Bureau of Reclamation and the City of Yuma through Title 28 and Wetlands Programs. Total BOR funding was $2,325,000.

An additional $1,000,000 in funding came from: Local State and Regional Parks $570,000; State Lake Improvement Fund $350,000; Heritage Trails $95,000; Arizona Game and Fish $25,000; Environmental Protection Agency, Border Area Wetlands Revegetation and Reforestation $25,000; BOR Title 28 MODE Enhancement $95,000; National Park Service Heritage Area Designation; and Bureau of Land Management $50,000. Local contributions include $25,000 from Caballeros de Yuma, $8,500 from Desert Verde Nursery, $10,000 from Riverfront Nursery, and $1000 from a Wal-Mart Mini-Grant.[61] A local businessman has also donated $100,000 for the construction of an interactive playground in the park.[62]

Land Ownership: Federal (BOR) and City of Yuma.

Water: The upper terrace component of the project will be irrigated park land. The area will require irrigation indefinitely which will be supplied by surface water from the Colorado River.

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[59] Ibid.

[60] Ibid.

[61] Supra note 57

[62] Eatherly, Kevin (City of Yuma, Department of Public Works). 2006, February. Review comments of draft report of this study.

The city holds a priority water right for Colorado River water and has allocated a portion of that right to the project. The lower terrace will consist of a 45 acre wetland which will require supplemental irrigation for only the first 3 years as vegetation is established.

The upper terrace component of the project will be constructed over a retired landfill. Water may also be needed to surcharge the landfill to insure that subsidence will not occur.

Pubic Outreach: Many actions for the West Wetlands are spearheaded by the Riverfront Task Force, a community-based group formed early in the planning process. This group organized the first site cleanup in 1997 that used 250 volunteers. Additional cleanup efforts were conducted in 1998 and 1999. Public outreach was conducted in 1999 to determine what park improvements were most needed. One citizen involvement picnic had over 200 people in attendance. Through these public outreach sessions, the Riverfront Task Force found that people wanted a park that would feature both active and passive uses and the park has since been designed to reflect this.[63]

Challenges/Lessons Learned: **"**It is very difficult to work in and around a closed landfill and ensure that it is not reopened." Complete understanding of the vertical and horizontal limits of the landfill are imperative to working in such close proximity to a hazard. In addition, the team must fully understand what constitutes "reopening" of the landfill and what remediation must occur in this situation. With complete information, the design of the project can be tailored to minimize the risks of interaction with hazardous or costly situations. Construction of elements on top of the landfill may need to be built in phases to evaluate how the landfill is reacting to the disturbance.[64]

Another important lesson from Yuma West Wetlands is the importance of involving the community in both the planning and construction process. The project sponsors suggest a good way to involve the public is through volunteer tree planting and trail construction. Doing so will create greater initial support for the project as well as momentum to keep the project moving.[65]

Drivers: This project is driven by the City of Yuma's need for recreation and aesthetic amenities with in the city, and the city's long-term goal of providing orderly growth and economic development. According to Kevin Eatherly at the City of Yuma, "It will change the look and feel of Yuma and be the catalyst for Yuma's redevelopment as an ecotourism destination."[66] The project site also contains BOR owned infrastructure in need of repair, facilitating some funding of the project.

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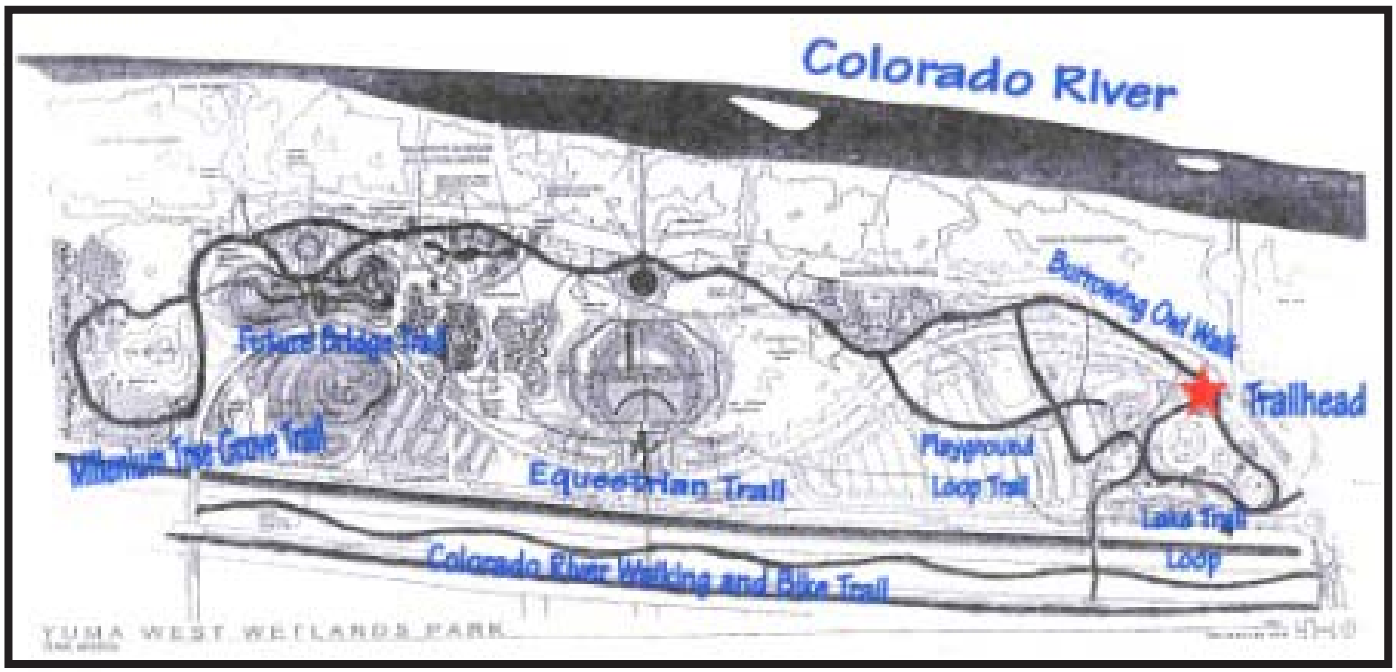
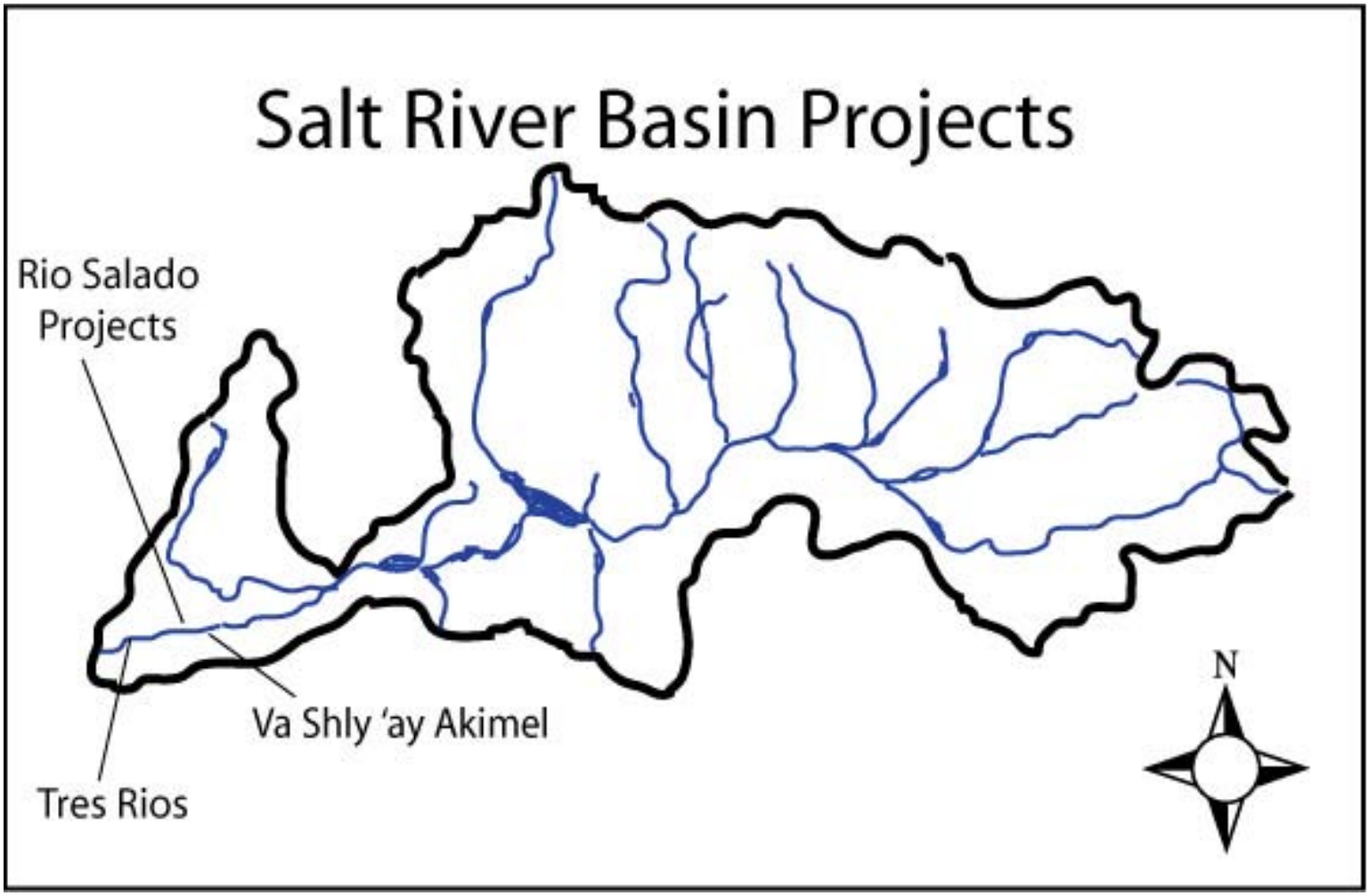
[63] Supra note 57
[64] Supra note 62
[65] Ibid.
[66] Supra note 57



Project site map
Yuma West Wetlands

Volunteer workers
Yuma West Wetlands

Photos courtesy of Yuma Parks and Recreation


Salt River Basin Projects
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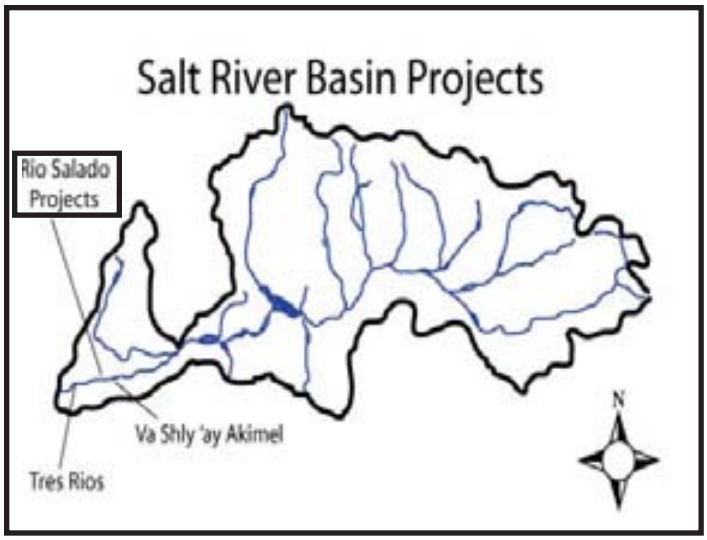

Rio Salado Oeste

Primary Information Source: Draft Interim 2004 US Army Corps of Engineers Feasibility Study and Environmental Impact Statement.

Location and Size: Salt River, Maricopa County, Phoenix; 19th Ave. west to 83rd Ave. The project encompasses eight miles.

Primary Sponsor(s): United States Army Corps of Engineers (USACE) and City of Phoenix.

History: Prior to urbanization and agricultural development in the Phoenix metropolitan area the Salt River, a major tributary to the Gila River was a perennial stream fed by snowmelt from mountains in eastern Arizona. The first major changes to the River system came in the early 20th century with dams constructed as part of the Salt River Project. These changes were exacerbated by sand and gravel mining operations and other activities along the river. Over time diversions from the river increased and eventually the River's perennial flows in the river ceased, causing the groundwater table to drop. As a result of these changes to the River system the natural riparian habitat declined to the point where only small, isolated pieces of habitat remain. These changes have also allowed saltcedar, an invasive non-native plant species with minimal habitat value, to become established in the region.[67]

Planning Objectives: "Restore native riparian and wetland habitat, and adjacent vegetation communities between 19th Avenue and 83rd Avenues for a period of 50 years; Attract wetland and riparian avian species in the study area; Establish the presence of amphibian species, reptilian species, mammalian species, and avian species in the study area; Suppress undesirable fish and wildlife species; Manage undesirable invasive plant species in the study area; Increase passive recreational and environmental education opportunities for visitors, which are linked to the restoration project in the study area; Reduce flood damages to structures and infrastructure within the 100 and 500 year floodplain between 19th and 83rd Avenues."[68]

Current Phase: Pre F4 - Alternative Review Conference

Phases: Reconnaissance completed September 2000, F3 milestone May 2002.

Recommended or Implemented Plan: Final USACE FS/EIS is anticipated in 2006 /2007.

Monitoring/Maintenance: TBD

Funding and Cost: The project is funded by the USACE General Investigation, Ecosystem Restoration. Costs will be shared between the USACE and the local sponsor. Total cost is unknown

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[67] U.S. Army Corps of Engineers, Los Angeles District, South Pacific Division. (2004) Va Shly' ay Akimel Salt River Ecosystem Restoration Feasibility Study, Final Environmental Impact Statement. Phoenix: U.S. Army Corps of Engineers. p. 2-1

[68] U.S. Army Corps of Engineers, Los Angeles District, South Pacific Division. 2002. Rio Salado Oeste, Salt River Arizona Interim Feasibility Report F3 Milestone-Without Project Conditions. Los Angeles: U.S. Army Corps of Engineers. p. V-4

until a recommended plan is chosen.

Land Ownership: City of Phoenix

Water: Storm water runoff, groundwater, effluent and reclaimed water from 23rd Ave Wastewater Treatment Plant are all possibilities for the eventual delivery of irrigation water to the project.[69] A final decision on water supply will not be made until the project design is finalized and approved.

Public Outreach: Initial public meetings were held in September 2000 with the community. Ongoing progress reports on the study have been presented to the Rio Salado Citizen Advisory Committee.

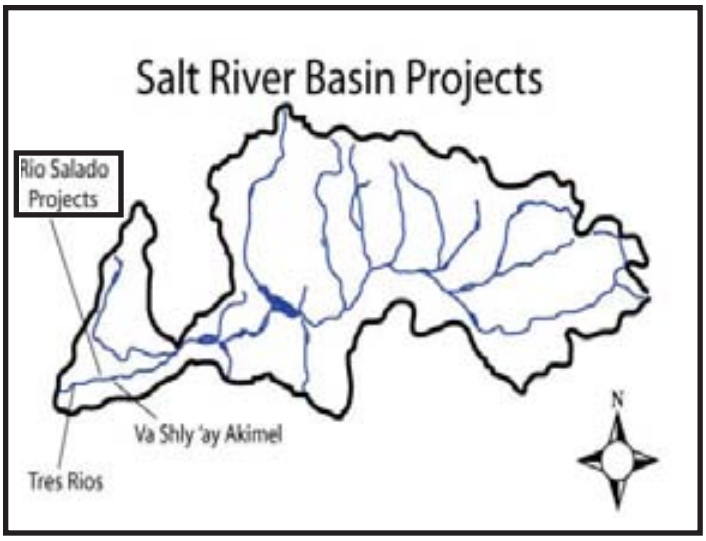
Once the Rio Salado – Phoenix Project is near completion then the City of Phoenix and Community Advisory Committee will direct the public's attention toward Oeste.[70]

Challenges/Lessons Learned: Project is in initial stages, no lessons learned reported to date.

Drivers: Improve habitat value within the Salt River corridor; improve urban landscape by replacing blighted river corridor with restored green space, flood management, environmental education opportunities, recreation, and draw visitors and interest to downtown increasing demand for redevelopment activities.

[69] Ibid.

[70] Williams, Karen. (2004) August. Personal communication with author (Mott Lacroix).



Rio Salado- Phoenix Reach

Primary Information Source: 1998 U.S. Army Corps of Engineers Feasibility Study and Environmental Impact Statement.

Location and Size: Salt River, Maricopa County, Phoenix; I-10 to 19th Avenue. The project encompasses five river miles and 595 acres.

Primary Sponsor(s): United States Army Corps of Engineers (USACE), City of Phoenix, and Flood Control District of Maricopa County

History: See Rio Salado - Oeste summary.

Planning Objectives: "Restore riparian habitat in and around the Salt River within the Cities of Phoenix and Tempe; Create a complete and diverse riparian system...; The restored habitat areas should incorporate a diverse mix of riparian habitat types including mesquite, cottonwood/willow, wetland march, aquatic strand/scrub, open water, and open edges; Increase environmental education and passive recreation opportunities incidental to the restoration effort."[71] The project also will provide increased flood control and protection to the area. It is also intended to be an attraction to businesses and individuals to bring them into the downtown area as part of a larger downtown revitalization project.

Current Phase: Currently, the last phase of the Phoenix construction is underway. The city of Phoenix celebrated the grand opening of the Project on November 5, 2005.

Phases: Reconnaissance Study completed in 1995 for 33 mile reach of Salt River, Feasibility Report and EIS April 1998. Construction of the low-flow channel began in June of 2000 and continued through 2001. Habitat construction and restoration activities followed completion of the low-flow channel in 2002 and is expected to be completed in 2007.

Recommended or Implemented Plan: The 595-acre project features two gateway plazas that lead to terraces with wetlands and native trees and shrubs. Ten miles of trails have been constructed, and an extensive water system comprised of supply wells and reservoirs is used to water the plants. There is also a 12-acre forest of 1,000 cottonwood trees and 140 acres of mesquite woodlands. Additionally, there are 51 acres of aquatic vegetation in the river channel and 16 acres of wetland marsh.

The Rio Salado Phoenix project was designed to provide maximum possible environmental benefits for wildlife while meeting flood control standards. The city worked closely with the Flood Control District of Maricopa County and the Army Corps of Engineers to design and construct the low-flow channel. 1.7 million cubic yards of sand and gravel were removed from the middle of the riverbed to create the low-flow channel. The channel was then reinforced with a series of guide dikes and concrete structures in the banks to maintain its alignment during the heaviest floods. The

[71] U.S. Army Corps of Engineers, Los Angeles District, South Pacific Division. 1998. Rio Salado Salt River, Arizona Feasibility Report and Environmental Impact Statement. Los Angeles: U.S. Army Corps of Engineers. p. V-2

low-flow channel is designed to contain flows of up to 12,200 cubic feet per second or nearly 5.5 million gallons of water per minute[72]. Flows in excess of this level will be conveyed through the wider river corridor between the second terrace on each side of the river.

Monitoring/Maintenance: Operated and Managed by Phoenix Parks and Recreation Department. For the first five years of the project, the cost of monitoring and maintenance will be shared between the USACE and the local sponsors. In each of the three habitats: mesquite, cottonwood/willow, and wetland marsh, monitoring will be conducted monthly for the first six months and every other month for another year. The area will be maintained to have no non-natives and 80% survival the first year and 100% survival the second and third years and/or attain 40% cover after five years of planted species. Ninety percent cover is expected after ten years. Surveys of wildlife will also be conducted as a measure of success.[73] After the five year period, monitoring and maintenance will become solely the responsibility of the local sponsors. The City of Phoenix is currently developing an adaptive management and monitoring plan for the future of the site.[74]

Funding and Cost: Securing funding for the Rio Salado Project has taken many years, involved many different agencies and ultimately has been supplied by a number of different funding sources. In 1999, the city succeeded in getting Congress to include the construction authorization for the project in the Water Resources Development Act bill. Construction of the project's flood control elements began in 2000 after an advance credit agreement with the Army Corps of Engineers and an Intergovernmental Agreement with the Flood Control District of Maricopa County. Construction was paid for using county funds.

A number of challenges arose along the way, including securing a letter of concurrence from the Federal Aviation Administration stating that the Project had addressed concerns about wildlife near Sky Harbor International Airport.

Total project funding secured to date totals $100 million: 65% from the Army Corps of Engineers-through General Investigation, Ecosystem Restoration funds, 19% Phoenix Voter-Approved 2001 Capital Improvement Bond Funds and 1999 Phoenix Parks, Preserve Initiative Funds, 14% Flood Control District funds and 2% grants and donations[75]. Annual operation and maintenance of the site is estimated at $1,971,000.

Land Ownership: City of Phoenix

Water: Water for the irrigation of the new riparian habitat will be supplied by five groundwater wells. The estimated average requirement for the project is about six million gallons per day. Because of seasonal variations in demand, and possible periodic disruptions in production from the wells, the actual design capacity of the wells will be 12 million gallons per day. Shallow groundwater will be used from an aquifer that lies close to the surface. This aquifer is not used for urban water supplies because it is contaminated by agricultural and urban pollutants. The water will require some wellhead treatment to meet water quality standards. (The city of Phoenix supplies effluent from the 23rd Avenue wastewater treatment plant to Roosevelt Irrigation District, allowing the District to reduce its use of groundwater. Phoenix receives water supply credits from the Arizona Department of Water Resources for this exchange, which are used to offset pumping

[72] Williams, Karen (City of Phoenix). (2005) January. Review comments on draft report of this study.

[73] U.S. Army Corps of Engineers, Los Angeles District, South Pacific Division. 1998. *Rio Salado Salt River, Arizona Feasibility Report and Environmental Impact Statement.* Los Angeles: U.S. Army Corps of Engineers. p VI - 13

[74] Supra note 72

[75] Supra note 73

at the Rio Salado supply wells.)[76]

The well water is used to feed three over bank reservoir ponds. Water from the ponds is then released as needed for irrigation via canals or underground pipes. The water is used to feed streams, ponds, wetlands, and other features of the restoration project and to supply high velocity sprinkler heads mounted on poles along the river banks to deliver water to trees and plant areas. A sprinkler system is being used instead of drip or flood irrigation because of the vulnerability of these systems to high flow events in the rivers flood canal.

It is estimated that 60% of the water delivered to the project area will be returned to the aquifer through infiltration and seepage. The remaining 40% will be lost to evaporation and transpiration. The riparian vegetation bordering the river will server to reduce erosion and filter contaminants from storm water drains that outflow into the river.

Public Outreach: According to Karen Williams at the City of Phoenix, "To keep the public informed, the city team produced a newsletter in Spanish and English and worked with the Mayor and Council to appoint a Rio Salado Citizens Advisory Committee. Additionally, the team worked with the City Council to develop a partnership with the National Audubon Society to lease four acres next to the Rio Salado to build an Audubon nature center. This will help to address the science-based education needs of school children and capture the interest of adults in environmental education subjects. Before the grand opening of Rio Salado, the team provided educational programs for 312 middle school students. The program was created through a partnership with Arizona State University and funded by Nina Mason Pulliam Trust. Additionally, the team held 515 public presentations on the project since April 1997, reaching over 18,700 people."[77]

Challenges/Lessons Learned: Karen Williams at the City of Phoenix notes the following challenges and lessons learned. "The River and the adjacent properties had been used for years as dumping grounds for unwanted materials through formal and informal landfills. The city team worked to develop creative ways to construct the project in this environment, using specialized techniques to protect structural facilities, specialized plant pits to protect vegetation, and selecting appropriate irrigation techniques.

The project had to obtain nearly 100 federal, state, county and city permits for various aspects of the project. Workers scooped 138,572 cubic yards of debris and waste from the River and removed 1,185 tons of tires. The city team created an innovative screening and recycling guideline that saved millions of dollars in waste removal to the projects bottom line. It also uniquely uses recycled items in the project as site furnishings and construction materials that are illustrative of the river's history and use, and provides recreational and educational opportunities for visitors."[78]

Drivers: Drivers include: improve habitat value within the Salt River corridor; improve urban landscape by replacing blighted river corridor with restored green space; flood management; environmental education opportunities; recreation; and to draw visitors and interest to downtown which will increase demand for redevelopment activities.

[76] Ibid.
[77] Ibid.
[78] Ibid.

Park walkway
Rio Salado Phoenix

Park Signage
Rio Salado Phoenix

Low flow channel at Central Ave.
Rio Salado Phoenix

Open water area at Central Ave.
Rio Salado Phoenix

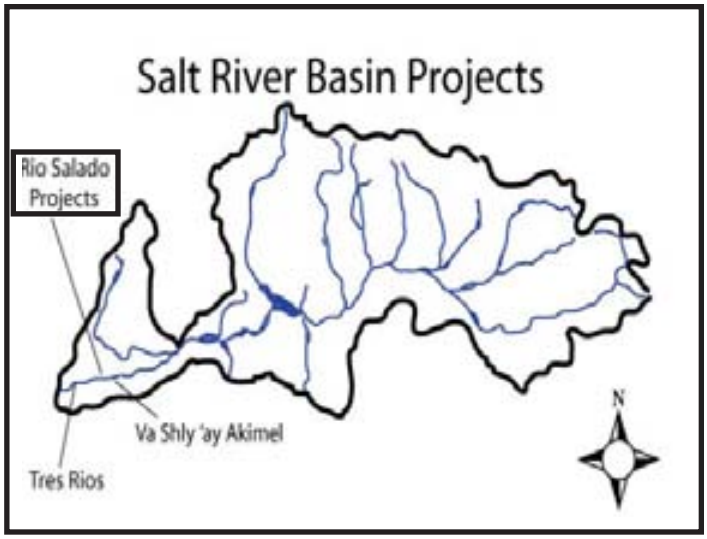
Photos by Kelly Mott Lacroix

Releasing wildlife
Rio Salado Phoenix

Rio Salado Phoenix

RIo Salado grand opening celebration November, 2005
Rio Salado Phoenix

All Photos by Kelly Mott Lacroix



Rio Salado- Tempe Reach

Primary Information Source: 1998 U.S. Army Corps of Engineers Feasibility Study and Environmental Impact Statement.

Location and Size: Salt River, Maricopa County, McClintock to Priest Drive (except Tempe Town Lake in the middle) and McKellips Rd. south to Tempe Town Lake. The project has two phases encompassing a total of 136 acres.

Primary Sponsor(s): United States Army Corps of Engineers (USACE), City of Tempe, and Flood Control District of Maricopa County.

History: Prior to urbanization and agricultural development in the Phoenix metropolitan area the Salt River, a major tributary to the Gila River was a perennial stream fed by snowmelt from mountains in eastern Arizona. The first major changes to the River system came in the early 20th century with dams constructed as part of the Salt River Project. These changes were exacerbated by sand and gravel mining operations and other activities along the river. Over time diversions from the river increased and eventually the River's perennial flows in the river ceased, causing the groundwater table to drop. As a result of these changes to the River system the natural riparian habitat declined to the point where only small, isolated pieces of habitat remain. These changes have also allowed saltcedar, an invasive non-native plant species with minimal habitat value, to become established in the region.[79] In the past, the area encompassed by the Tempe Reach contained abundant mesquite trees and high quality mesquite bosque riparian habitat. Large amounts of erosion and streambed incising have lead to the lowering of the Salt River bed by as much as 30 feet in places.[80]

Planning Objectives: "Restoration of threatened and endangered species habitat; Restoration of the study area to a more natural condition through the installation of plant species that are native to and occurred historically in riparian streams and washes in the region; and increase recreation opportunities."[81]

Current Phase: Phase 1 is currently under construction, phase 2 is in redesign. (High flood flows in the winter of 2005 required that the number of trees be reduces and relocated). Construction of phase 2 is anticipated to begin in March 2006.

Phase: Reconnaissance Study completed in 1994 for 33 mile reach, Feasibility Report and EIS completed April 1998.

Recommended or Implemented Plan: Alternative T5 - mesquite, cottonwood willow, wetland,

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[79] U.S. Army Corps of Engineers, Los Angeles District, South Pacific Division. (2004) Va Shly' ay Akimel Salt River Ecosystem Restoration Feasibility Study, Final Environmental Impact Statement. Phoenix: U.S. Army Corps of Engineers. p. 2-1

[80] U.S. Army Corps of Engineers, Los Angeles District, South Pacific Division. (1998) Rio Salado Salt River, Arizona Feasibility Report and Environmental Impact Statement. Los Angeles: U.S. Army Corps of Engineers. p. IV-2

[81] Ibid. p. VI-1

strand scrub, and open edge habitat. This alternative was selected because it closely follows the planning objectives. [82]

Monitoring/Maintenance: For the first five years of the project, the cost of monitoring and maintenance will be shared between the USACE and the local sponsors. After this time monitoring and maintenance becomes solely the responsibility of the local sponsors. In each of the three habitats (mesquite, cottonwood/willow, and wetland marsh) monitoring will be conducted monthly for the first six months and every other month for another year. The area will be maintained to have zero non-natives and 80% survival the first year and 100% survival the second and third years and/or attain 40% cover after five years. Ninety percent cover is expected after ten years. Surveys of wildlife will also be conducted as a measure of success.[83]

Funding and Cost: The project is funded by USACE General Investigation, Ecosystem Restoration. Costs will be shared between the USACE and the local sponsors. Total gross investment is $6,171,000 and total annual cost is $684,000, which includes operation and maintenance of approximately $230,000 per year.[84]

Land Ownership: City of Tempe and the Flood Control District of Maricopa County. Restoration activities on Indian Bend Wash were permitted by FCDMC through an intergovernmental Agreement and habitat easement.

Water Source: Proposed source of water is a new irrigation (non-potable) well. Water demand is approximately 1,690 acre-feet per year.[85] The water will be used to provide irrigation water for the establishment of new vegetation and will be used to provide a permanent source of replacement water for the wetland ponds. A contract is in place for the provision of this groundwater. Storm water flowing through Indian Bend wash is also transmitted to the site but there is no contractual agreement that guarantees the provision of this water.

Public Outreach: Typical USACE public outreach process during reconnaissance and feasibility stages. Public access is not permitted within the environmental restoration area; however, public access is provided along the western edge of the site by a multi-use path and observation ramada.

Challenges/Lessons Learned: Because of the project site's close proximity to developed urban areas, several concerns have been raised about possible management problems on the site.

Wetland ponds being a source of mosquito breeding, hydroseeded grasses causing wildfire danger, noxious weeds, homelessness, and vandalism have all been raised as concerns of adjacent businesses, path users, and nearby residents. Adaptive management will be an ongoing challenge for the project as managers address these issues.

Drivers: Improve habitat value for threatened and endangered species, flood management, environmental education opportunities, and recreation.

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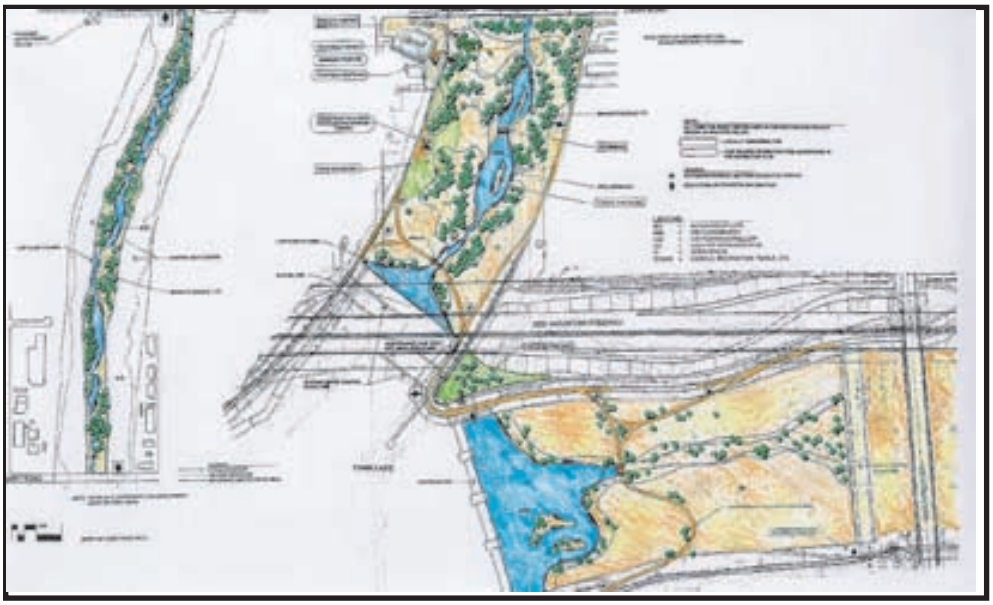
[82] Ibid.
[83] Ibid. VI - 13
[84] Ibid. p. VI-4, Table 6.3
[85] Ibid. p. VI-2

Indian Bend Wash restoration May 2004
Rio Salado Tempe

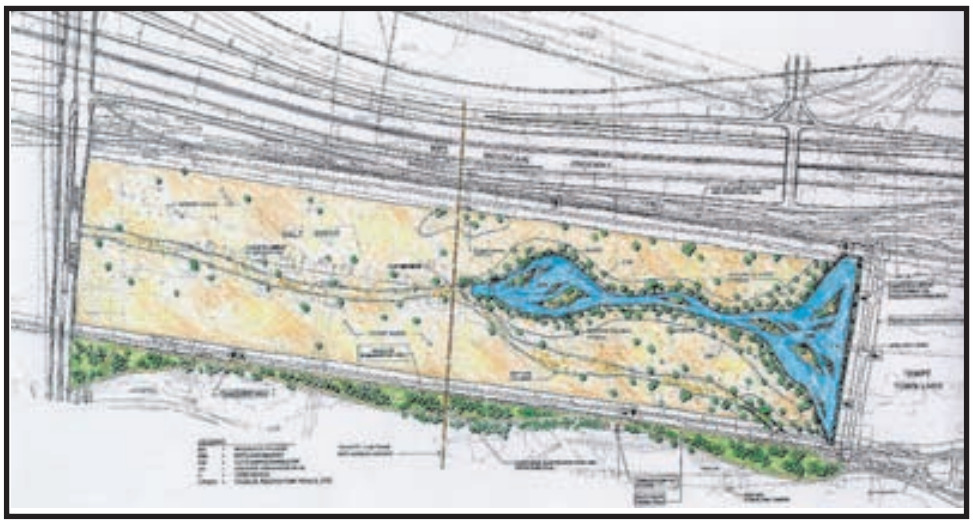
Indian Bend Wash Construction
Rio Salado Tempe

Indian Bend Wash restoration
April 2004
Rio Salado Tempe

Aerial photo with project area outlined Rio Salado Tempe

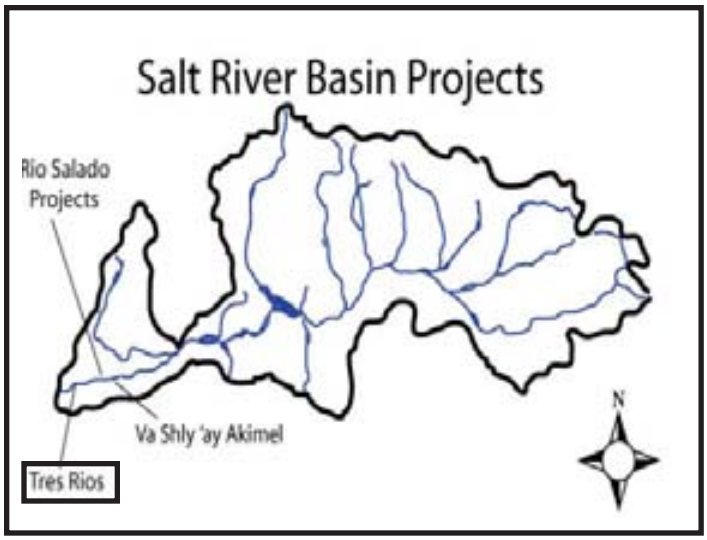


Rio Salado Tempe Upper Reach
Rio Salado Tempe



Rio Salado Tempe Lower Reach
Rio Salado Tempe

Photos and maps courtesy of City of Tempe



Tres Rios

Primary Information Source: 2000 U.S. Army Corps of Engineers Feasibility Study and Environmental Impact Statement.

Location and Size: Salt River and Gila River, Maricopa County. Beginning at 83rd Ave. to the confluence with Agua Fria River. The project study area included 9.2 river miles. The actual restoration project area includes approximately 7 river miles and 5,600 acres.[86]

Primary Sponsor(s): United States Army Corps of Engineers (USACE) and City of Phoenix (Tres Rios Restoration). United States Bureau of Reclamation and City of Phoenix (Tres Rios Demonstration Wetland).

History: In the past, gallery forests of cottonwoods and willows covered hundreds of miles along the lower reaches of the Salt and the Gila Rivers. Before Roosevelt Dam was constructed, the Lower Salt River was a perennial stream with an average annual discharge of approximately 1,250,000 acre-feet. At the confluence of the Gila and the Salt, the "Salt River's clear, streaming waters contrasted with the muddy, sluggish Gila River." The river had backwater and many channel meanders and sand bars that were conducive to riparian growth. Today, the historic perennial and high winter flows no longer exist because of dams upstream and diversions for urban and agricultural use.[87]

Planning Objectives: "Provide sustainable and diverse native riparian habitat in and around the Tres Rios area; Reduce flood damages to the Holly Acres community, surrounding development, and agricultural areas; and Increase environmental education and recreation in the study area."

Phases: Tres Rios Demonstration Wetland was authorized in 1992 and was constructed in 1995. Reconnaissance for the Tres Rios Restoration was completed April 1, 1997; and the Feasibility Report and Final EIS in April 2000.

Current Phase: The flood control levee is under construction, and environmental features for the rest of the project are at 60% design. Construction of the restoration project is expected to conclude in 2009, depending on yearly congressional appropriations.[88] Monitoring and maintenance continue on the Tres Rios Demonstration Wetland.

Recommended or Implemented Plan: Alternative 3.5 includes: "pump station facility; regulating wetland for treatment plan discharge; the creation of linear, constructed wetlands along the north over bank; a pipeline from the over-bank wetland leading to cottonwood/willow corridors west of El Mirage Road; open water/marsh areas within the channel west of El Mirage Road; south side distribution of dewatering well water and large open water/marsh creation areas; a flood

[86] Alice Brawley-Chesworth. (2006) January. Review comments on draft report of this study.

[87] U.S. Army Corps of Engineers, Los Angeles District, South Pacific Division. 2000. Tres Rios, Arizona, Feasibility Report. Los Angeles: U.S. Army Corps of Engineers. p. IV- 1-4.

[88] Supra note 86

control levee to protect Holly Acres as well as other surrounding residential commercial, industrial buildings, and farmland."[89]

Monitoring/Maintenance: For the first five years of the project, the cost of monitoring and maintenance will be shared between the USACE and the local sponsors. After this time, monitoring and maintenance becomes solely the responsibility of the local sponsors. In each of the three habitats, cottonwood/willow, wetland marsh and open water, monitoring will be conducted monthly for the first six months and every other month for another year. The area will be maintained to have zero non-natives and 80% survival the first year and 100% survival the second and third years and/or attain 40% cover after five years. Ninety percent cover is expected after ten years. Surveys of wildlife will also be conducted as a measure of success.[90]

Funding and Cost: The project is funded by the USACE General Investigation, Ecosystem Restoration. Costs will be shared between the USACE and the local sponsors. Total first cost is $99,321,000 with a total annual cost of $9,722,100 which includes operation and maintenance which is approximately $2,414,150 per year (includes annual cost of water at $1,221,150).[91] All costs are in 1999 dollars.

Land Ownership: City of Phoenix, Flood Control District of Maricopa County, Arizona Game & Fish Department, and Federal lands.

Water: The main sources of water are the 91st Avenue Wastewater Treatment Plant effluent and existing dewatering wells from within the treatment plant. Water demand is 24,423 acre-feet per year.[92] An agreement exists ensuring the continued flow of effluent to the project site.

Public Outreach: 1995 Tres Rios Steering Committee (includes city, county, state and federal government officials) formed Tres Rios Public Involvement Subcommittee, which helped to facilitate public involvement and dialogue with the Corps (for more info see Feasibility April 2000, VIII-3).

Challenges/Lessons Learned: The Demonstration Project has contributed significantly to the knowledge of wetlands treatment of effluent in the arid southwest. In addition to water quality data, research has also been conducted in mosquito control, non-lethal beaver management, vegetation sustainability, Salt Cedar control, public accessibility, and site security. The main lesson, however, was that a demonstration project is invaluable for large-scale wetlands projects. Much has been learned that will aid in the success of the full-scale project.

The most valuable information emerged from situations that had not originally been research focus areas. Beaver management and mosquito control were two areas of research that evolved out of "emergency situations" on the demonstration project and required additional research and problem solving.

For the full-scale project implementation, one of the main challenges has been increasing land costs in the area. This part of the valley is transitioning to residential development very rapidly. Development pressures have caused the costs of land to increase significantly over what was predicted in the initial studies. In addition, challenges remain in non-native plant control, multi-

[89] Supra note 87
[90] Ibid. VI - 13
[91] U.S. Army Corps of Engineers, Los Angeles District, South Pacific Division. (2000) Tres Rios, Arizona, Feasibility Report, Summary. Los Angeles: U.S. Army Corps of Engineers. p. 3
[92] Ibid.

jurisdictional coordination, vector control, and balancing wildlife and human needs. Negotiations continue for full participation of the sovereign Gila River Indian Community.[93]

Drivers: Drivers for this project include: restoration of riparian habitat, flood control, water quality improvement, and pre-treatment of effluent for groundwater recharge.

[93] Supra note 86

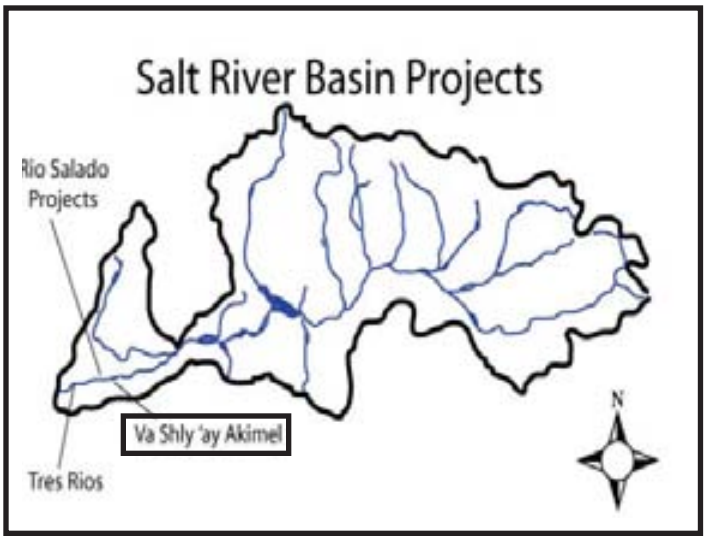
Demonstration Wetland
Tres Rios

Demonstration Wetland
Tres Rios

91st WWTP outfall into Salt River
Tres Rios

Map of project area
Tres Rios

Photos courtesy of City of Phoenix



Va Shly 'ay Akimel

Primary Information Source: 2004 U.S. Army Corps of Engineers Feasibility Study and Environmental Impact Statement.

Location and Size: Salt River, Maricopa County; Granite Reef Dam to Loop 101 Bridge. The study area encompassed a 14 mile reach of the Salt River and 17,435 acres. The final project area will encompass 4,130 acres.

Primary Sponsor: United States Army Corps of Engineers (USACE), City of Mesa, and Salt River Pima-Maricopa Indian Community (SRPMIC).

History: See Rio Salado - Oeste summary.

Planning Objectives: "Restore the riparian ecosystem to the degree that it supports native vegetation and wildlife through the Salt River from immediately downstream of the Granite Reef Dam to the Pima Freeway (SR 101); Establish a functional floodplain in unconstrained river reaches of the study area that is ongoing and mimics the natural processes found in other naturalized riparian corridors in Arizona; Provide passive recreation opportunities for visitors of all ages, abilities, and backgrounds that are in harmony with the SRPMIC's management of its culture and native ecology; Create awareness through ongoing educational opportunities of the significance of the cultural resources relating to the Salt River; Create awareness through ongoing education opportunities of the significance of the Salt River ecosystem; Create awareness through ongoing educational opportunities of the ecological connection between other ongoing riparian restoration projects along the Salt River." [94]

Current Phase: Feasibility study was completed in January 2005 and design agreement negotiations are currently on going.

Phases: Reconnaissance initiated November 2000, Feasibility initiated August 2001, Final EIS submitted September 2004, Feasibility study completed (Chief's Report) January 2005.

Recommended or Implemented Plan: Alternative O is the recommended plan and includes vegetation of large portions of the project area and minimal support for flood control structures. The restoration includes: cottonwood-willow (883.4 acres), mesquite woodlands (379.7 acres), river bottom (225.1 acres), wetlands (200 acres), and Sonoran Desert scrub shrub (23.6 acres).[95]

Monitoring/Maintenance: The USACE and local sponsors created biological goals and objectives for the restoration project. These objectives were used to create habitat value goals using HydroGeoMorphic Assessment of Wetlands (HGM). Performance targets were then established

[94] U.S. Army Corps of Engineers, Los Angeles District, South Pacific Division. (2004) Va Shly' ay Akimel Draft Salt River Ecosystem Restoration Study. Los Angeles: U.S. Army Corps of Engineers. p. V-6

[95] U.S. Army Corps of Engineers, Los Angeles District, South Pacific Division. 2004. Va Shly' ay Akimel Salt River Ecosystem Restoration Feasibility Study, Final Environmental Impact Statement. Phoenix: U.S. Army Corps of Engineers. p. 5-28

for both acreage of desired cover types and the functional capacity index (FCI) of those habitats.[96] During the course of the restoration, data will be collected on survival and health of the restored habits and entered into the HGM model. The model then outputs functional capacity indices for the habitats. For the restoration project to be deemed successful, the results must meet or exceed 80% of the projected results for each of the four Target Years. Should the project fall below the 80% threshold of predicted acreages and/or FCI values, adaptive management strategies will be implemented. Monitoring of insects will also be conducted annually during the Operations and Maintenance period to address concerns regarding disease vector control. The Corps, in cooperation with the local sponsors, will write an annual report at the end of each of the first five years post construction. This report will include a written description of current conditions as well as the results of any HGM runs; flora and fauna surveys conducted; geo-references and maps for the area covered in the report; topographic survey results identifying all significant features (planting sites, on-going mining operations, etc.); and a well documented photographic record including oblique photos from before, during, and after construction.[97]

Funding and Cost: The project is funded by a cost share agreement through the USACE General Investigation, Ecosystem Restoration program. "The ecosystem restoration component of the Tentatively Recommended Plan would require $76,143,600 in construction costs, $19,035,900 in contingency costs, $7,614,400 in Pre-construction Engineering and Design, $761,400 in Engineering during Construction, and $4,949,300 in Supervision and Administration, for a total construction cost of $108,504,600." Operations, Maintenance, Rehabilitation and Repair for the ecosystem restoration component has been estimated at $131,000 per year. Associated costs for water supply are currently estimated at $1,283,000 per year.[98]

Land Ownership: Salt-River Pima Indian Community and City of Mesa

Water: Water for the project comes from seven sources: Salt River Project water leaking from Granite Reef Dam, groundwater from existing and new wells, storm water, irrigation tail water, surface water and groundwater from the SRPMIC, and effluent from the City of Mesa Wastewater Treatment Facility. The construction of a well may require additional diversion structures. "This project will rely primarily on excess surface water from the SRPMIC and effluent from the City of Mesa Wastewater Treatment Facility. Groundwater is considered a secondary source of water."[99] Annual water demand is 17,100 acre-feet.[100]

Public Outreach: A series of six scoping meetings were held with SRPMIC and the City of Mesa between January 24, 2002 and April 1, 2003. The purpose of these meetings was to introduce the project to the public, give individuals and agencies an opportunity to identify issues for consideration in the EIS, and to solicit input on the project. News articles related to the project were also published, and the draft EIS was made available for public review and comment.[101]

Challenges/Lessons Learned: Project is in the early stages. No challenges or lessons learned were provided.

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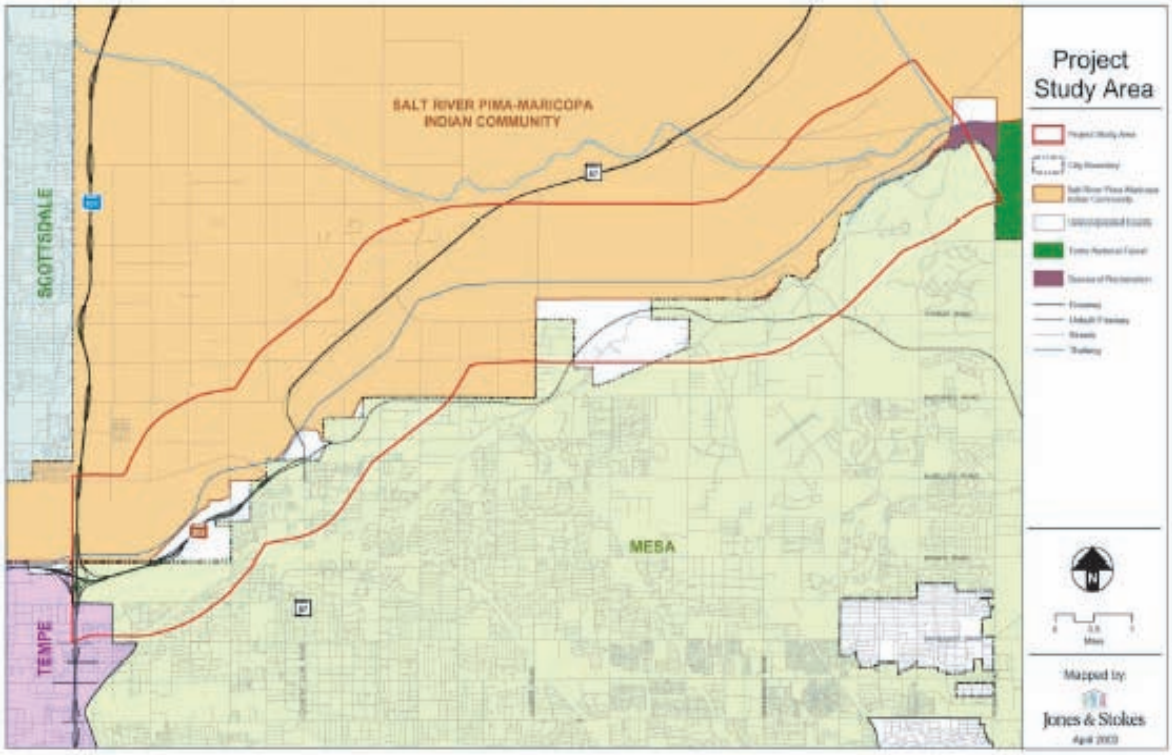
[96] Functional Capacity Indices are derived from field measurements taken from several different variables.
[97] Supra note 95
[98] U.S. Army Corps of Engineers, Los Angeles District, South Pacific Division. (2004) Va Shly' ay Akimel Draft Salt River Ecosystem Restoration Study. Los Angeles: U.S. Army Corps of Engineers. p. VI-6
[99] Supra note 97
[100] Ibid. Table 54
[101] Ibid. p. 11-2

Drivers: The drivers for this project were to restore a degraded system and connect with other restoration efforts along Salt River.



Map of project area
Va Shly 'ay Akimel

Down river of dam
Va Shly 'ay Akimel

Wetland created behind dam
Va Shly 'ay Akimel

Photos courtesy of USACE

Excerpted from the Regulated Riparian Habitat Offsite Mitigation Guidelines for Unincorporated Pima County

Bingham Cienega Natural Preserve Restoration

Primary Information Source: 2001 Bingham Cienega Restoration: Sonoran Desert Conservation Plan, 2000 Arizona Water Protection Fund progress report, and 2001 Pima Association of Governments Bingham Cienega Source Water Supply Final Progress Report.

Location and Size: Approximately 2000 feet west of the lower San Pedro River and 0.25 mile north of the settlement of Reddington in Pinal County. Bingham Cienega is on the western site of the San Pedro River Valley bounded by the Santa Catalina Mountains and Galiuro Mountains. The Bingham Cienega Natural Preserve occupies 285 acres.

Principal Sponsor(s): The Nature Conservancy (TNC) and Pima County Regional Flood Control District (PCRFCD)

Other Sponsors: Arizona Water Protection Fund (AWPF)

History: The Bingham Cienega was historically used for farming and ranching. The agricultural fields in the area were last cultivated in 1987. In 1989, the Pima County Regional Flood Control District purchased the cienegas along with 285 acres of surrounding land in order to restore natural ecological processes and to prevent floodplain development. In addition to the cienega, the Bingham Cienega Natural Preserve also contains deciduous wooded swamp, mesquite bosque, cottonwood/willow riparian forest, and sacaton grass areas. After Pima County purchased the land, they entered into a 25 year agreement with The Nature Conservancy to manage the preserve.[102] The Bingham Cienega project is part of a series of projects that The Nature Conservancy has implemented to preserve the San Pedro River which is on its list of "Last Great Places."

Planning Objectives: The restoration goals for the Bingham Cienega are to establish a diversity of riparian habitats in former agricultural fields and to plant species where the depth-to-groundwater and soil moisture are sufficient to maintain the plantings once established. Related to the restoration goals, the objectives of the project were to promote long term re-establishment of deciduous riparian woodland, sacaton grassland, and mesquite woodland in the fields and to develop practical techniques for promoting establishment of native plants that either do not require irrigation or that require infrequent irrigation.[103]

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[102] Pima Association of Governments. (2004) Riparian Areas: Restoration and Management in Eastern Pima County. Watershed Forum, December 3, 2003. Based on meeting minutes. p. 10

[103] Pima County Supervisors. 2001. Bingham Cienega Restoration: Sonoran Desert Conservation Plan.

Current Phase: Monitoring and maintenance of the site is ongoing. The initial restoration was completed in 2001.

Phases: Restoration began in 1998 with planting of sacaton seedlings and deciduous tree saplings. Mesquites were planted in 1999 and native grasses in 2001, and cottonwood/ willow poles were planted in 2000/2001.

Recommended or Implemented Plan: "Restoration habitat types were selected based on depth to groundwater. The deciduous riparian woodland planting area was located close to the wetlands where depth to groundwater was approximately three feet. Sacaton grasses were restored in areas with six to nine foot depth to water, and mesquite woodland was planted where depths to water exceeded nine feet." The project emphasized sacaton riparian grasslands restoration because the region has lost so much of this type of habitat over the last century. In three years a total of approximately 62,000 sacaton seedlings were transplanted to the site.

Monitoring/Management: Monitoring and maintenance was conducted throughout the course of the project. Separate monitoring tailored to each different riparian community type (deciduous riparian woodland, sacaton grassland, and mesquite woodland) was conducted. In each area, monitoring activities included hydrologic monitoring, vegetation monitoring on plots and transects, photo point monitoring, and a three-year bird monitoring study.

Funding and Cost: The total project cost was $221,024. Of this amount, $84,679 was funded by the Arizona Water Protection Fund. Other monies for the project came from U.S. Fish and Wildlife Service, Wallace Genetic, University of Arizona, The Nature Conservancy, and Tri-Community as well as in-kind donations from the Pima County Regional Flood Control District.

Land Ownership: Land is owned by Pima County Regional Flood Control District and operated by The Nature Conservancy.

Water: Cienegas are low- to mid- elevation spring-fed wetlands characterized by non-fluctuating shallow surface water.[104] In this project, the type of riparian system restored in each area was determined by the distance to the water table. Only riparian systems that could subsist on naturally present water were established. This strategy reduced the need for long-term watering and helped to ensure long-term viability of the site with minimal human management.

Water for the project, needed for the initial establishment of vegetation, came through an irrigation agreement with adjacent property owners which granted PCRFCD access to their irrigation pump well, canal, and underground pipe. The landowner's original irrigation pump was not functional at the beginning of the project so a new pump, purchased with grant monies, was required.

Pubic Outreach: Public outreach for this project included numerous field trips, about six a year, for the three-year duration of the AWPF grant. The participants included high school and university students, TNC members, other conservation groups, and local residents. Presentations were made at various conferences and the local newsletter, Reddington Resource Review, carried informational articles about the project. [105]

Challenges/Lessons Learned: During the course of this restoration effort, TNC learned that an interdisciplinary team is very important for project planning. In order to ensure the best possible

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[104] Pima Association of Governments. 2001. Bingham Cienega Source Water Study: Final Project Report. Tucson: Pima Association of Governments. p. 4

[105] Supra note 103

result, however, all of the team members needed to understand the project design and their roles in that design. They also found that continuity of the team was very important so that lessons learned in one stage of the project are carried on to the next stage.

One of the challenges that the project faced was ever escalating costs on project elements that were not considered when creating the initial budget. For example, the restoration team did not consider all of the costs associated with the irrigation lines, which resulted in unexpected expenditures. As a result, they recommend that a rigorous cost analysis be conducted prior to project implementation. Had they done this analysis in their project, they would have seen, for example, that it was cheaper to drill a well adjacent to the fields rather than depending on the existing well at the house site and irrigation lines from that well.

Management of non-native vegetation on the site was a significant problem. As a result, the restoration team recommends that weed management be a primary objective of any restoration project where invasive species are a concern. They also recommend that the project timeline be prolonged at least ten years in order to demonstrate success as well as to provide the flexibility to adapt to climactic conditions.[106]

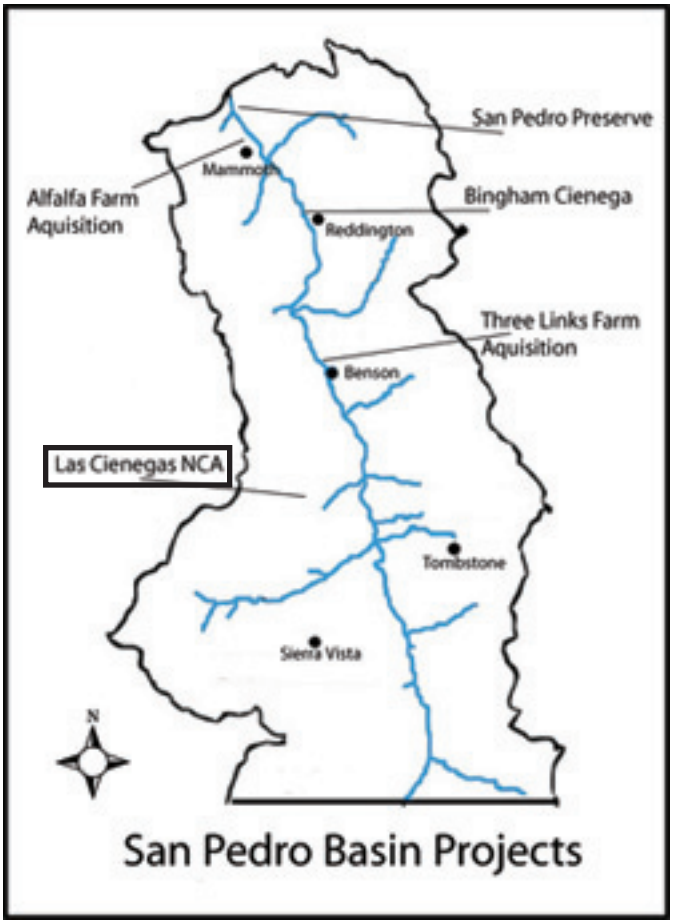
Drivers: Habitat restoration and floodplain protection.

[106] Supra note 102

Restoring farmland 1998
Bingham Cienega

Restored native grassland 2003
Bingham Cienega

Photos courtesy of Pima County
Regional Flood Control District



Las Cienegas National Conservation Area

Primary Information Source: 2002 Bureau of Land Management: Las Cienegas Resource Management Plan and Record of Decision.

Location and size: The Las Cienegas National Conservation Area is located 50 miles outside of Tucson between the Empire and Whetstone mountain ranges in Pima County. Two and one-half miles of creek were restored under an Arizona Water Protection Fund grant. (Much of the Las Cienegas National Conservation Area is also located in the Santa Cruz Basin.)

Primary Sponsor(s): Bureau of Land Management (BLM).

Other Sponsors: Arizona Water Protection Fund (AWPF).

History: "In 1988 BLM acquired, though a land exchange, 45,000 acres within the Empire Cienega, and Rose-tree ranches in northeast Santa Cruz County and southeast Pima County, Arizona. Later exchanges have brought in 4,000 more acres. These lands, which became the Empire-Cienega Resource Conservation Area, have extremely high social, cultural, and resource values for the local and national public. . . Two segments of Cienega Creek have been proposed to Congress for designation as scenic river segments in the Wild and Scenic Rivers System." [107] In September 1999 Congressman Jim Kolbe introduced legislation to create the Las Cienegas NCA. The area includes five of the rarest habitat types in the American Southwest: cottonwood willow riparian areas, cienegas, sacaton grasslands, semi desert grasslands, and mesquite bosques.

Planning Objectives: "Las Cienegas NCA was designated 'to conserve, protect, and enhance for the benefit and enjoyment of present and future generations the unique and nationally important aquatic, wildlife, vegetative, archaeological, paleontological, scientific, cave, cultural, historical, recreational, educational, scenic, rangeland, and riparian resources and values of the public lands . . . while allowing livestock grazing and recreation to continue in appropriate areas."[108] Among the stated planning area vision and goals are to: maintain and improve watershed health; maintain and restore native plant diversity and abundance; protect water quality; protect water quantity; and ensure sustainability and a complementary relationship of mineral resources to the protection

107 Tucson Field Office, Bureau of Land Management. 2002. *Proposed Las Cienegas Resource Management Plan and Final Environmental Impact Statement.* Tucson: Bureau of Land Management. p 1-5

108 Ibid 2-2

of water quality and quantity. [109] On BLM lands within the Empire-Cienega Planning Area, the objective is to achieve and maintain properly functioning condition on 100% of the riparian areas by 2005 and achieve and maintain potential natural vegetation community on 95% of the riparian areas by 2010.[110]

Current Phase: Maintenance

Phases: In September 1999, Congressman Jim Kolbe introduced legislation to create the Las Cienegas NCA. The NCA was designated by congress in December 2000. Soon after, the Environmental Impact Statement (EIS) process was initiated, and a final EIS and management plan was released in June 2002.

Recommended or Implemented Plan: "Alternative two emphasizes ecosystem management and the use of partnerships and collaboration during implementation to achieve desired resource conditions. Biannually, a Biological Planning Team would collaboratively evaluate monitoring data and issues relating to livestock grazing, recreation, and wildlife management for the primary goal of maintaining or achieving desired resource conditions. BLM would designate all public lands within the area as an area of critical environmental concern to protect sensitive riparian and wetland habitats. Livestock grazing would continue on public land allotments, but grazing operations would incorporate variable stocking rates and flexible rotations. BLM would designate two utility corridors and a corridor for the Arizona Trail and would close or restrict the use of some roads to provide a mix of motorized and non-motorized recreation while ensuring that desired resource conditions are met. Both mechanized and motorized vehicles would be restricted to designated routes."[111]

Monitoring/Management: "Riparian condition will be reassessed every five years at key riparian monitoring sties for segments currently in proper functioning condition. Segments that are not in proper function condition will be monitored every 2 – 5 years depending on the type of management change being implemented."[112]

Funding and Cost: Las Cienegas NCA is funded by the federal government for operations and maintenance. Restoration was conducted under a grant from the Arizona Water Protection Fund for $210,700.

Land Ownership: Most of the land within Las Cienegas NCA is owned by the federal government and managed by the BLM. The remaining land within the NCA is state- owned land.

Water: The Las Cienegas NCA encompasses most of the Upper Cienega Creek watershed, which is important for the Tucson area for flood control and aquifer recharge. The Upper Cienega Creek watershed has been estimated to provide 10% of the recharge to the Tucson Active Management Area. The maintenance of the undeveloped watershed in good condition protects Tucson from floods that might surpass the city's flood control channel design. If the basin were fully developed, flood peaks could increase by and estimated 25-50%.[113] Upper Cienega Creek below Gardner

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109 Ibid p. 2-5

110 Ibid. p. 2-7

111 Ibid p. xv

112 Tucson Field Office, U.S. Bureau of Land Management. 2003. Approved Las Cienegas Resource Management Plan and Record of Decision. Tucson: U.S. Bureau of Land Management. p. 78

113 Ibid 3-8

Canyon was designated as a Unique Water[114] by Arizona Department of Environmental Quality in early 2002.[115] Cienega Creek has a perennial flow for 8.3 miles and its tributaries Mattie Canyon and Empire Gulch have perennial flows for 1.1 and 0.9 miles respectively. About 18.5 miles of riparian habitat occur along Cienega Creek and its tributaries.

Pubic Outreach: "In January 1995, BLM brought together people from federal, state, and local agencies with an interest in the Sonoita area to discuss forming a partnership to work with the community on public land issues. . . In July 1995, the Sonoita Valley Planning Partnership held a community workshop to review the questionnaire results and discuss other Sonoita Valley issues." Working groups were formed and met monthly from August 1995 to February 1999. During this time, the group created and agreed upon the area of concern, objectives, and alternative management strategies and reached a consensus on a preferred series of management strategies. From March 1999 to February 2000 the Partnership met four times to develop a monitoring program for the Empire-Cienega Planning Area.

Challenges/Lessons Learned: "Participants state that moving the plan off paper and onto the ground is the biggest challenge, and that continuing to fund staffing and monitoring will remain a pressing need… BLM officials say that, as Tucson continues to grow, new pressures for recreational use will emerge." [116]

Drivers: Maintenance of an ecosystem and prevention of urban encroachment.

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[114] ADEQ defines a unique water as: "A surface water classified as an outstanding state resource water under Arizona Administrative Code R18-11-112". ADEQ website http://azdeq.gov/environ/water/assessment/download/305-02/aadef.pdf

[115] Supra note 112

[116] Red Lodge Clearinghouse. 2005. Stories: Sonoita Valley Planning Partnership. http://www.redlodgeclearinghouse.org/stories/sonoita.html

San Pedro Preserve

Primary Information Source: 1997 Arizona Water Protection Fund (AWPF) Application, 2000 AZWPF Award Amendment, 2003 Nature Conservancy-San Pedro Preserve Riparian Habitat Restoration Project Final Report, and 2001 AWPF Progress Reports.

Location and Size: Three river miles outside of Dudleyville in Pinal County. The restoration area is 850 acres.

Primary Sponsor(s): The Nature Conservancy (TNC).

Other Sponsors: Arizona Water Protection Fund and U.S. Bureau of Reclamation.

History: The San Pedro River Preserve was established by The Nature Conservancy in 1997 with funds from the Bureau of Reclamation for the mitigation of willow flycatcher habitat. The BOR provided these funds to mitigate impacts from the modification of Roosevelt Dam, which inundated willow flycatcher habitat. The area contains Sonoran desert scrub, river terraces, and primary floodplain on the San Pedro River. The uplands and terraces had been substantially modified for agricultural and aquaculture uses. A flood in 1993 severely damaged aquaculture ponds and the eroding banks in these areas created an unstable river shoreline.

For most of its history, the property was operated as a small livestock operation. The prior owners acquired the ranch in 1963 and operated it as the Sal Cattle Company from 1967 to about 1987. When cattle operations ceased, about 40 acres of bottomlands were converted to aquaculture ponds for production of channel catfish, large mouthed bass, and other exotic game fish. Aquaculture, pecan, and alfalfa cropping continued until early 1993 when a flood destroyed 15 acres of the orchard and many ponds. All but two ponds were allowed to dry up and the alfalfa operations ceased.[124]

Planning Objectives: The overall objective of the San Pedro Preserve is to protect and enhance willow flycatcher habitat. To this end, the restoration plan included: protect and enhance existing riparian forest habitat; restore native grassland communities on the river slopes and terraces; maintain these communities through a program of prescribed burning; stabilize banks and reestablish native riparian forest in areas where the old aquaculture ponds created unstable shorelines; and develop and demonstrate agricultural techniques for use in large scale habitat restoration.[125]

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[124] The Nature Conservancy. (1997) Application to Arizona Water Protection Fund, San Pedro River Preserve Riparian Habitat Restoration Project. Tucson: TNC.
[125] Ibid.

Current Phase: Monitoring and maintenance are the major activities proceeding on the property at this time. Continuous fence maintenance is required to maintain exclusion of cattle and unauthorized use (predominantly ATV's). The Nature Conservancy is also actively trying to manage invasive and non-native species on the property by depleting the seed bank within the soil. By successively irrigating the area until weeds germinate and then tilling them under before they go to seed, TNC hopes to eventually deplete the soil of its weed bank.[126] It is anticipated that this process will take several years. The AWPF grant was complete in July 2002.

Phases: Phases of the project included: draft revegetation and monitoring plans (Nov 2000); construct groundwater piezometers, conduct groundwater level monitoring, contour mapping, and install flow meters (Nov 1998 - May 2000); conduct groundwater flow modeling; fluvial geomorphic characterization study (May 2002); plant agricultural research plots (Nov1998 – May 2002); grade and restore ponds (Nov 99 – May 02); revegetate pond areas (Nov 2001); revegetate stream banks (Nov 2001); construct and maintain preserve fencing (Nov 98 – May 02); and photo point, floodplain, and vegetation monitoring (Nov 98 – Nov 02).[127]

Recommended or Implemented Plan: Restoration began with the installation of an ungulate exclusion fence to keep cattle and other unauthorized users out of the property. The fence was completed in 1999, and revegetation efforts began shortly after. Restoration planting zones were based on depth to groundwater. To gather information on hydrologic conditions, TNC installed piezometers, monitoring wells, flow meters, and stream flow monitoring transects. The information was then used to create a depth to groundwater map that was overlaid on a detailed contour map of the site. Restoration planning then proceeded based on the depth to groundwater in a given area.[128]

Restoration of abandoned agricultural fields and ponds consisted initially of repeated forced germination of weed seeds, tilling under of weeds, and drilling native seeds into tilled soil. Irrigation was used to supplement natural rains until vegetation was established.[129]

Monitoring/Management: "Monitoring will be done every fall for a minimum of three years beginning with the first fall after restoration sites have been planted. Approximately 10-15 permanent transects per site will be established perpendicular to the hydrological gradient using stratified random sampling. Plant species will be recorded at set intervals along each transect using the point intercept method, whereby the identity of the plant(s) intercepting a vertical line is recorded. This information can then be converted to percent cover. Monitoring will continue until the outcome of the restoration can be determined from the data collected and therefore may extend beyond the three-year minimum."[130]

Funding and Cost: Funding for this project came from the Central Arizona Project (CAP) Modified Roosevelt Dam under the authority of the Fish and Wildlife Coordination Act and the result of a Section 7 ESA consultation. Bureau of Reclamation funding totaled $4,422,804.00.

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[126] Harris, David (TNC- Director of Land and Water Protection). (2006) January. Interview with author (Schwarz).

[127] Arizona Water Protection Fund. (2000) Arizona Water Protection Fund Grant Award Contract Amendment No. 97-044 WPF-01. Phoenix: Arizona Department of Water Resources. pp. 3-13

[128] Harris, David and J. Douglas Sprouse. 2003. San Pedro Preserve Riparian Habitat Restoration Project Final Report Revised. Tucson: The Nature Conservancy. p 9

[129] Ibid.

[130] Ibid.

An "endowment" has also been established by BOR to fund management of the Preserve in perpetuity. The endowment funds are to be used for management of the riparian area aimed at directly benefiting the willow flycatcher.

Land Ownership: The Nature Conservancy (TNC obtained a grant from BOR in 1996 to acquire the land.)

Water: Twenty-five hundred acre-feet of groundwater pumping were retired from the property which had been used for ranching, alfalfa, cotton, and aquaculture. The water right is still exercised by application of groundwater for weed eradication. Groundwater was also initially used to irrigate new plantings during the revegetation stage.

Prior to implementation of restoration extensive hydrologic analysis was conducted. This analysis allowed the sponsors to divide up the area based on depth to groundwater and revegetate accordingly. The three area classes were: depth to groundwater less than eight feet, between eight and sixteen feet, and greater than sixteen feet.

Since groundwater pumping has been all but eliminated on the property, increased flows have been observed in the river. Beavers have also returned to the area and are especially active at times of higher flow.

Pubic Outreach: The group Volunteers for Outdoor Arizona helped TNC by setting up production of seedlings in the greenhouse and planting them in the field.

Challenges/Lessons Learned: Willow flycatcher habitat creation was one of the major objectives of the project and numerous breeding pairs live on the site. A strong link was observed between the presence of beaver and the presence of willow flycatchers. Willow flycatchers prefer a very specific riparian habitat with high vertical diversity. Action by beavers continuously changes the characteristics of the riparian zone supporting the continued formation of ideal willow flycatcher habitat.[131]

One of the objectives of this project was to determine the best way to facilitate re-vegetation of Giant Sacaton through seeding in a field setting. In the test plots used for this project, the restoration team found that germination times vary but that if the seeds are irrigated; there is a fair rate of germination. The plot that fared the best was one that received a post seeding treatment of herbicide. It was also found, in this case, that applying mulch to the seedlings did not increase the cover of Sacaton. [132]

The most challenging aspect of this project was weed control and "is possibly the most significant factor influencing the relative success of any restoration project." The project team learned an important lesson in the preparation of soil and fields. They intended to prepare a seed bed using tractor drawn discs and conduct multiple irrigations followed by disking to kill germinating weeds. The idea was that they would deplete the soil weed seed bank and thus effectively control weed growth. Due to funding restrictions, they could only go through this process twice. They found that it was not adequate to resolve the weed problems and that it created a seed bed as well suited for weed germination as for native seed. A better alterative turned out to be the use of a Truax no till range drill that cuts a series of one centimeter deep furrows into which native seed is introduced, this process minimized weed seed germination by reducing soil disturbance.

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[131] Supra note 126
[132] Supra note 128

They have also found at this site (and others) that extended post germination irrigation favors non-native weeds over native grasses. However, longer-term monitoring may lead to other conclusions.[133] In general, the restoration team recommends that future restoration projects: "1) Don't depend on irrigation water in the desert country to make a successful project. Irrigation water is an unnatural commodity and its use brings unnatural results. Drought is natural but it is also a major obstacle to successful restoration of native riparian grasslands. Pray for rain at just the right time and don't expect to get it. 2) Be flexible and prepared to adaptively manage the process as new information becomes available or new conditions arise. And 3) Try to design so that the restoration process doesn't depend on a particular team of workers or equipment to accomplish the work as they will change many times."[134]

Drivers: Part of TNC campaign to restore and preserve San Pedro River watershed with an emphasis on willow flycatche habitat.

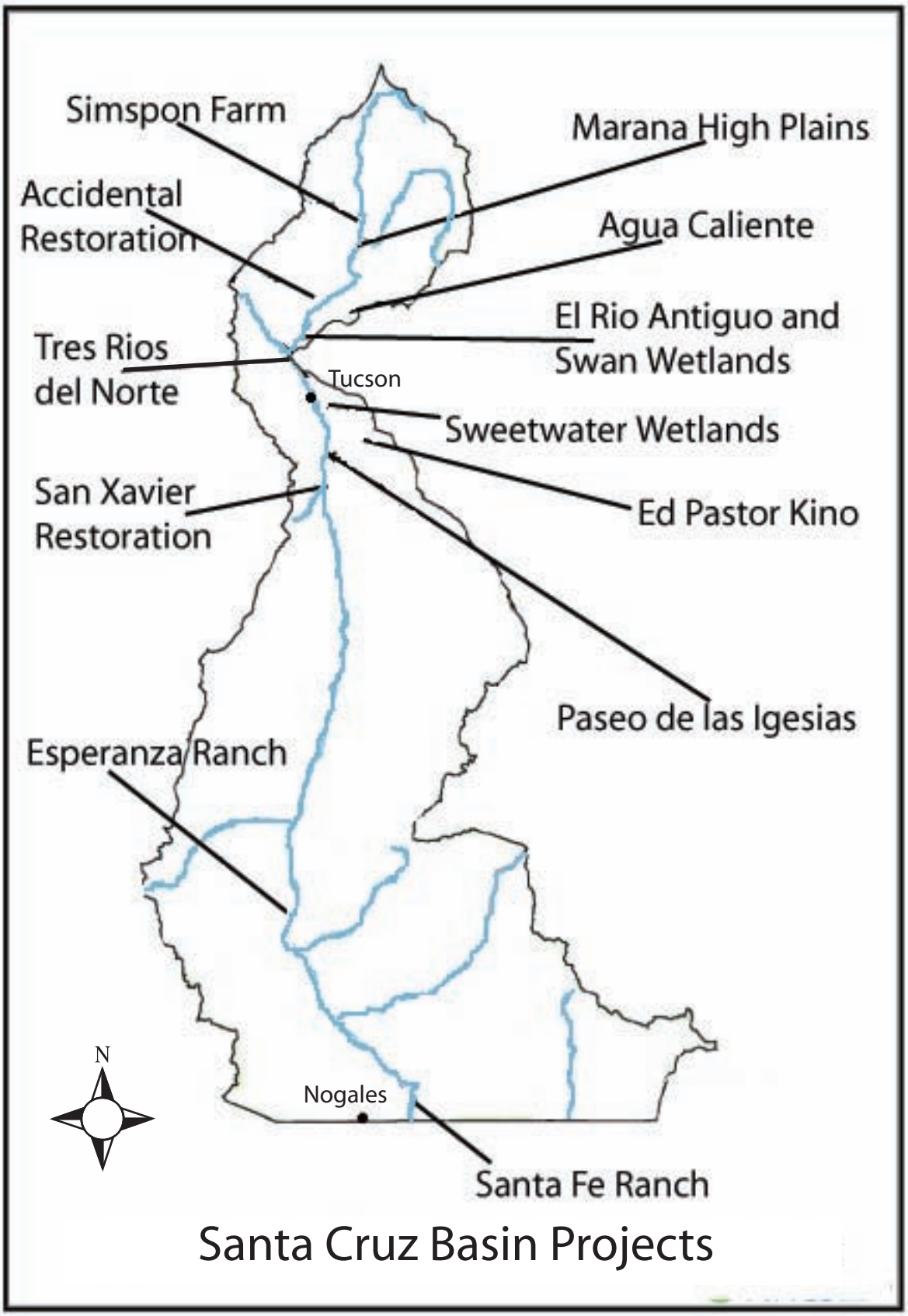
[133] Ibid. p 19
[134] Ibid. p 30

Aerial view of project site
San Pedro Preserve

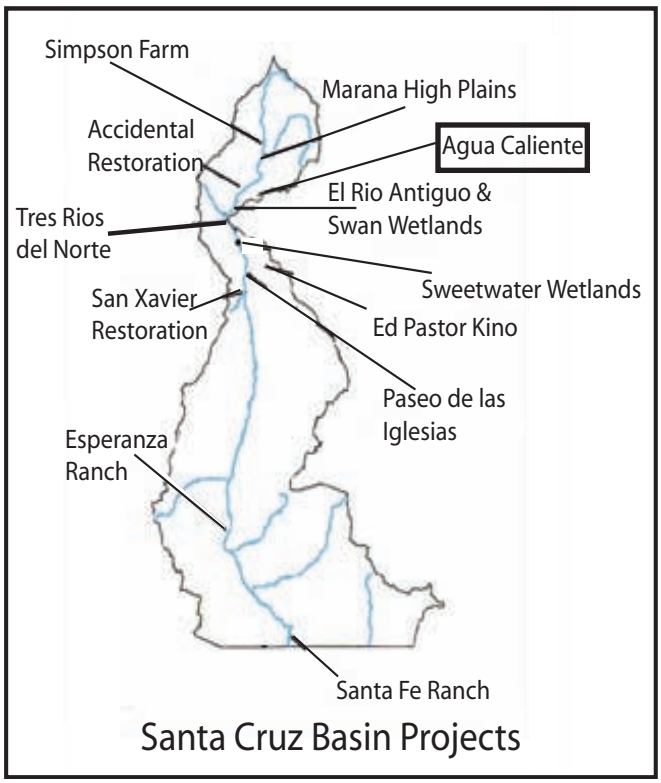
San Pedro Preserve

San Pedro River through preserve
San Pedro Preserve

Photos courtesy of AWPF



Santa Cruz Basin Projects



Agua Caliente Spring (Not Implemented)

Primary Information Source: 2002 U.S. Army Corps of Engineers Detailed Project Report.

Location and Size:: Roy P. Drachman Agua Caliente Regional Park 12325 E. Roger Road, Pima County, Tucson; Northeast corner of the Tucson Basin at the foot of the Santa Catalina Mountains. The site is 101 acres.

Primary Sponsor(s): Pima County Regional Flood Control District and U.S. Army Corps of Engineers.

Other Sponsors: Pima County Natural Resources, Parks, and Recreation Department.

History: From 1935 to the 1970's, the project area was utilized for ranching and farming (orchards and alfalfa fields). In the 1970's through mid 1980's, a development company planned to build lake-side homes, but the idea was never implemented. In 1985, Pima County Parks and Recreation purchased the property and opened the park to the public, which was named after Roy P. Drachman Sr., who donated $200,000 for the park.[136]

Planning Objectives: "Improve general ecosystem function; Increase the diversity of native vegetation structure and cover; Create habitat capable of supporting numerous rare native aquatic fish, amphibians, and reptiles; Restore the natural structure and function of the spring over at least a portion of the Park; Improve habitat for local native plant and animal species such as riparian birds; Create educational and recreational opportunities that improve public enjoyment of the Park; Facilitate a deeper public understanding of the plight of native aquatic species and their habitats in the southwest; Increase awareness of the impacts of non-indigenous species; and Improve appreciation of biological diversity."[137]

Current Phase: Due to lack of public support this project did not move beyond the planning stage.

Phases: Reconnaissance phase initiated in February 2000 and completed December 2000. Feasibility initiated September 2001. Final Detailed Project Report (DPR) issued on October 15, 2002.

Recommended or Implemented Plan: The alternative that was chosen for implementation includes the elimination of ponds two and three, the improvement of pond one, and the creation of a Cienega. The entire upper park area, including the open water in the upper pond and the lawn

136 Pima County. (2005) Agua Caliente Ranch. http://www.dot.co.pima.az.us/flood/AguaC/ranch/index.html
137 U.S. Army Corps of Engineers, Los Angeles District, South Pacific Division. (2002) Agua Caliente Spring Aquatic Ecosystem: Detailed Project Report. Los Angeles: U.S. Army Corps of Engineers. p. 2-3

and picnic facilities, will be maintained. The plan was considered to be the "best buy," the most cost effective alternative. [138]

Monitoring/Management: Project did not reach the monitoring and management phase because Pima County decided not to proceed with restoration. Flows from the spring, however, will continue to be monitored.

Funding and Cost: Funding and authority for this project came from Section 206 - Aquatic Ecosystem Restoration. Total estimated costs if the project had been implemented were $5.15 million, including the value of the land purchased to create the park.[139]

Land Ownership: Pima County.

Water: Agua Caliente is a thermal spring that has been impounded in a series of ponds.[140] Restoration of this ecosystem would have been achieved by allowing the water from the spring to flow naturally with fewer pond impoundments. Two of the three impoundments would have been removed and water from the spring would flow down a main channel and several secondary channels. The secondary channels would flow into the cienega and hummock habitats. The USACE anticipated that the restoration plan would reduce infiltrative and evaporative water losses for the area, and re-establish sites for aquatic and riparian plants and animals that have disappeared or are in the process of disappearing.

The channels were designed to maintain the minimum water depths required to support fish populations even during very low-flow periods and to convey large flows up to a 100 year event. Initially, it would have been required to divert water from the stream to irrigate emergent vegetation. There was no supplemental water requirement for this project. All water required to establish and support the restored vegetation would have been supplied by the spring as it meandered through the new riparian environment.

Pubic Outreach: Public outreach on this project was extensive.[141] A Citizen's Advisory Committee formed to communicate ideas between citizens, sponsors, and USACE. There were three public meetings by USACE and Sponsors (January, April, and August of 2002). Major concerns expressed at these meetings included: "limited future public access and recreation opportunities in the Park if restoration is to proceed; loss of Park aesthetics caused by conversion of open water habitats to native cienega-type wetlands; lack of public input into planning process; effect of system alteration on species currently using the Park; risk of increased mosquito populations with creation of native habitats and removal of non-native fishes; and lack of adequate spring discharge to maintain streams that can support the target habitats/species."[142]

Challenges/Lessons Learned: This project did not move out of the planning stage because there was not enough public support for it. The project sponsors believe that the project would have benefited from a much slower public input process. Public scoping and alternatives analysis was conducted for this project over the course of one year, at the end of which the community had to approve one of the alternatives. This timeline proved to be much too quick for the affected

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[138] Ibid. p. 3-60
[139] Ibid. Appendix A
[140] U.S. Army Corps of Engineers, Los Angeles District, South Pacific Division. (2002) Agua Caliente Spring Aquatic Ecosystem: Detailed Project Report. Los Angeles: U.S. Army Corps of Engineers.
[141] Ibid.
[142] Ibid.

community. A lesson learned from this is the value of early assessments of the community's concerns and wants before presenting them with alternatives to either accept or reject.

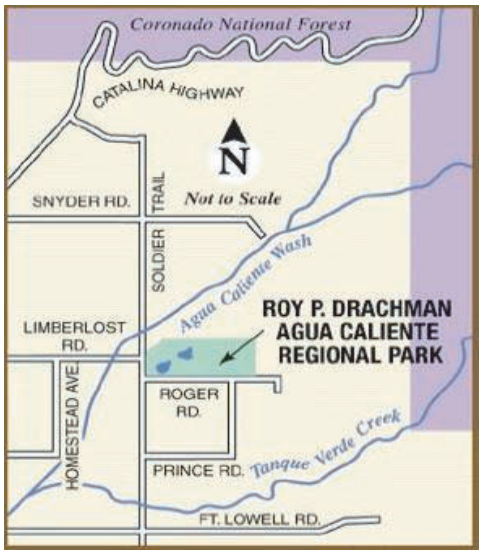
Another challenge created by the timing of the project was that the ecosystem appeared to be functioning fine at the time the scoping process for restoration was approved. The general public did not see the biological losses that were occurring because they had not reached a critical point. In fact, the summer after the restoration project was rejected, low stream flows caused two of the ponds to dry up. The project sponsors note that in retrospect it would have been better to initiate planning and public input in response to the drying ponds rather than beginning the project at a time when outwardly the ecosystem appeared to be fine.[143]

Drivers: Restoration for public use and enjoyment as well as to provide habitat for several priority species in the Sonoran Desert Conservation Plan.

[143] Pima Association of Governments. (2004) Riparian Areas: Restoration and Management in Eastern Pima County. Watershed Forum December 3, 2003. p. 6.

Agua Caliente pond in 2002
Agua Caliente Spring

Agua Caliente pond in 2004
Agua Caliente Spring

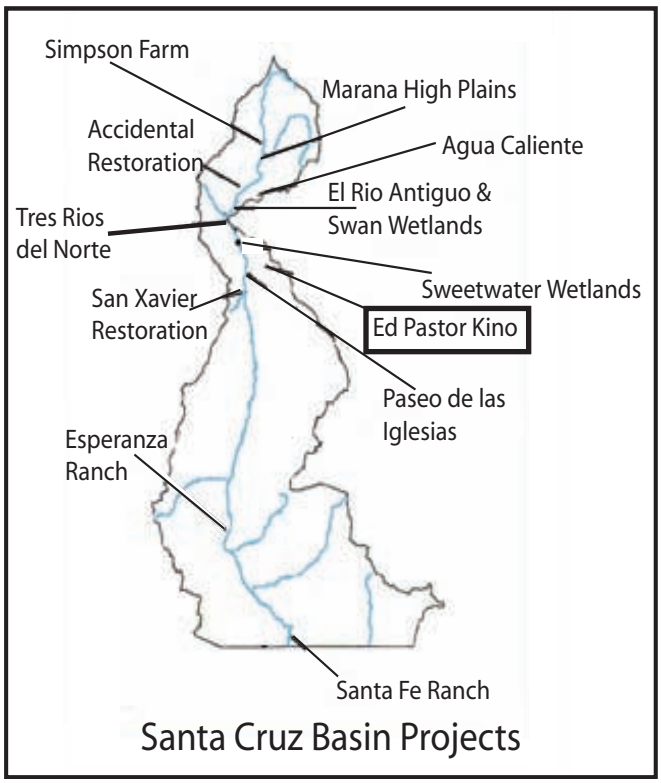


Map of project area
Agua Caliente Spring

Mesquite bosque with trail
Agua Caliente Spring

Photos courtesy of Jennifer Jones and USACE

Excerpted from the Regulated Riparian Habitat Offsite Mitigation Guidelines for Unincorporated Pima County



Ed Pastor Kino Environmental Restoration Project

Primary Information Source: 1998 US Army Corps of Engineers Final Ecosystem Restoration Report.

Location and Size: Along Tucson Diversion Channel, Pima County, Tucson; north of Ajo Way and west of Country Club Road. Project created 28 acres of riparian and open water and 21 acres of grassland, mesquite bosque and marsh in a 120 acre area.

Primary Sponsor(s): Pima County Flood Control District (PCFCD) and United States Army Corps of Engineers (USACE).

Other Sponsors: Pima County Wastewater Management.

History: The Tucson (Ajo) Detention Basin was constructed in 1966 along the Tucson Diversion Channel. The USACE built the basin as a flood control element, which intercepted and reduced peak flows from the Tucson Arroyo and Railroad Wash drainage areas. Downstream, flows were released gradually into the Tucson Diversion Channel, which would then merge with the Julian Wash and down to the Santa Cruz River. The basin had a flat earthen bottom and levee with scrub trees and grasses along the edges. In 1981, the USACE and Pima County developed a master plan for the diversion channel called The Tucson Diversion Channel Recreation Development Program. The plan called for improving the recreational opportunities on the land. With the exception of the construction of Sam Lena Park in 1986, little progress was made on the master plan between 1981 and 1995.

The master plan was updated in 1995 to include multi-use trails from Sam Lena Park to I-19 and additional recreational facilities around the Ajo Detention Basin. In 1997, a baseball field and other public facilities (Kino Sports Complex) were constructed around the basin. Due to continued development in the area, the basin continued to take on more runoff and deteriorated aesthetically.[144]

Planning Objectives: The original planning objectives for the project included: restoration, water harvesting for the area of vegetation and the Kino Ball Fields, and flood control. The original plans also included a golf course which was subsequently removed from the plan.

The original planning objectives state: **"**Restore wetland and riparian vegetative communities representative of historical/optimal conditions in the region; restore habitats for target/beneficial fish and wildlife species; maximize the acreage of functional wetland habitat within limits of the golf course design; achieve an optimal mix of habitats that supports the greatest diversity of target/

[144] U.S. Army Corps of Engineers, Los Angeles District, South Pacific Division. 1998. Tucson (Ajo) Detention Basin, Pima County, Arizona, Final Ecosystem Restoration Report. Los Angeles: U.S. Army Corps of Engineers.

beneficial species while promoting the principal fish and wildlife objective proposed by a restoration alternative (balancing of objectives); minimize disturbance-type impacts to restored wetlands from the adjacent golf course and from pedestrian traffic; restore wetlands to be ecologically resilient and self-sustaining; minimize potential from sediment and organic matter accumulation in restored wetlands (low maintenance design); protect restored wetlands from feral predation; design for and maintain adequate vector control in restored wetlands; enhance water quality of the reclaimed water source (i.e., water treatment function of restored wetlands); maintain the existing flood protection capacity of the Tucson (Ajo) Detention Basin; accommodate incidental recreational values (e.g., interpretive centers, wildlife viewing, education, and research)."[145]

Recommended or Implemented Plan: The area is designed with nine separate zones based on quantity and frequency of inundation with each zone given ample space so that wildlife appropriate to each can easily establish. The watercourse and pond edge zones, however, were lined or minimized in an effort to control mosquito populations. Ed Pastor Kino project included seven elements: riparian area stream courses and ponds, including four stream courses (labeled A-D), a deep pond and a series of in-line ponds; a reclaimed water system that conveys water to the project via the City of Tucson's reclaimed water system; on-site irrigation system; a re-circulation system; conveyance facilities; site security, made necessary by the use of reclaimed water and the steepness of the ponds banks; and additional amenities such as trails.[146]

Monitoring/Management: Pima County is responsible for the operation and maintenance of the site. The site is managed to achieve a series of objectives including: maintain the flood control capacity of the basin; maintain an ecosystem habitat; maximize the use of harvested storm water and minimize the use of reclaimed water; minimize the mosquito population; and maintain water quality.[147] Once restoration was complete, extensive testing of the basin, species counts, water quality monitoring, and vegetation analyses were conducted. The goal of this monitoring is to determine the viability of the design and to attempt a cost-benefit analysis.[148] Audubon Society is monitoring bird life. Arizona Game and Fish is monitoring the establishment of a Burrowing Owl population.

Current Phase: Operation and maintenance, construction was complete in 2002.

Phases: In early 1997, the Corps initiated a Preliminary Restoration Plan (PRP) to determine the feasibility of modifying the basin features for restoration of riparian habitat. An Ecosystem Restoration Report (ERR) followed and was approved in April 1998. Plans and Specifications were initiated in June 1998. Construction was awarded in July 2000. Modifications were completed in 2002 and the original facility was expanded to 141 acres: 50 acres of riparian area within the basin, including freshwater marsh and riparian habitat; twelve acres of wildlife and open water areas; and 38-acres of mesquite bosque and ephemeral grassland. Though a golf course was originally proposed, it was not implemented in the final plan.

Funding and Cost: Funding and authorization for this project came from the USACE Section 1135 of WRDA of 1986 - Project Modification for Improvement of the Environment Total cost

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[145] Ibid. p. 3-14
[146] Supra note 143.
[147] Supra note 144
[148] Bennett, Paul. (2000) "A New Friendlier Corps." Landscape Architecture Magazine. 01/00 Washington, D.C.

of this project was approximately $12 million.[149] Total construction award cost approximately $8,215,444. Water cost is estimated to be $265,000 a year.[150]

Land Ownership: The Basin is owned by Pima County and there is a small parcel adjacent owned by Pima County Regional Flood Control District.

Water: Project uses storm water runoff and reclaimed water. Reclaimed water will be provided by the City of Tucson and is intended to be under contract before the project can move forward. Total water demand is estimated to be 574 acre-feet per year.[151] The project provides the ability to harvest and store storm water as well as reclaimed water. The water harvested and stored in the basin is then used for irrigation and habitat creation within the redesigned basin as well as for irrigation at adjacent parks and sport facilities.[152]

Public Outreach: A school program was developed at a local elementary school, where students created a 9'x 9' model to present to the local community. Audubon has provided outreach, as has Pima County Natural Resources, Parks, and Recreation.

Public access to the site is limited; however, teachers are allowed to take classes into the riparian areas.[153] The site is also being used by Tucson Audubon for Saturday morning bird walks, and a jogging trail is open to the public that goes around the basin.

Challenges/Lessons Learned: One challenge of this project was working through the regulatory issues surrounding the commingling of reclaimed water with storm water. At the present time (2005) changes in regulatory approaches to this issue continue. In addition the use of a "Waters of the U.S." posed challenging regulatory hurdles. Several permits were required for activity within the basin, including:

- Arizona Pollutant Discharge Elimination System (AZPDES) permit (Including a Management Plan as well as current testing requirements).
- An Arizona Aquifer Protection Permit (APP) (Including a Emergency Response Plan that necessitated training of personnel within several city and county agencies)
- A 401/404 permit for upkeep and reconstruction of the basin after flood events
- An Arizona Reclaimed Water Reuse permit for areas needing irrigation outside the basin
- A Pima County Industrial Wastewater Permit for any wet well sediment disposed of within the wastewater conveyance system
- Arizona Water Rights appropriation (for storm water harvesting and use)

[149] Bennett, Paul. 2003. "The Ed Pastor Kino Environmental Restoration Project: How the Use of Reclaimed Water and Harvested Storm water Have Created an Environmental Restoration Benefit." Paper presented at the 2003 Water Use Symposium.

[150] This estimate assumes a cost of $462 per acre-foot. The water will be supplied by the Tucson Water Before the construction phase begins a signed interagency agreement between Pima County and City of Tucson will be required to assure the cost of the water and water availability for the life of the project.
U.S. Army Corps of Engineers, Los Angeles District, South Pacific Division. (1998) Tucson (Ajo) Detention Basin, Pima County, Arizona, Final Ecosystem Restoration Report. Los Angeles: U.S. Army Corps of Engineers. p. 5-22

[151] Ibid.

[152] Bennett, Paul. (2003) "The Ed Pastor Kino Environmental Restoration Project: How the Use of Reclaimed Water and Harvested Storm water have Created an Environmental Restoration Benefit." Paper presented at the 2003 Water Use Symposium.

[153] Bennett, Paul. (2000) "A New Friendlier Corps." Landscape Architecture Magazine. 01/00 Washington, D.C.

- Fifra and TSCA regulations on the application of pesticides within "a Waters of the US"
- Meeting the retention of FEMA 100-year flood events

Prior to the project, there were a number of problems with mosquitoes. Many design features such as lined channels and water recirculation strategies to vary elevations seem to be working to minimize the problem. Mosquito monitoring and management is still needed, but one of the lessons learned is that design can reduce the problem.

Vandalism of irrigation devices and of the burrowing owl nests has also been a problem in this urban environment.

Drivers: The main impetus for the project was to create riparian areas and address existing mosquito issues while maintaining flood storage. Water harvesting for the adjacent park use was a benefit. The site is now being used to establish burrowing owls displaced by development in and around Phoenix.[154]

[154] Julia Fonseca (Pima County Flood Control District) (2005) November. Review comments on draft report of this study.

View of the deep pond
Ed Pastor Kino Environmental Restoration Project

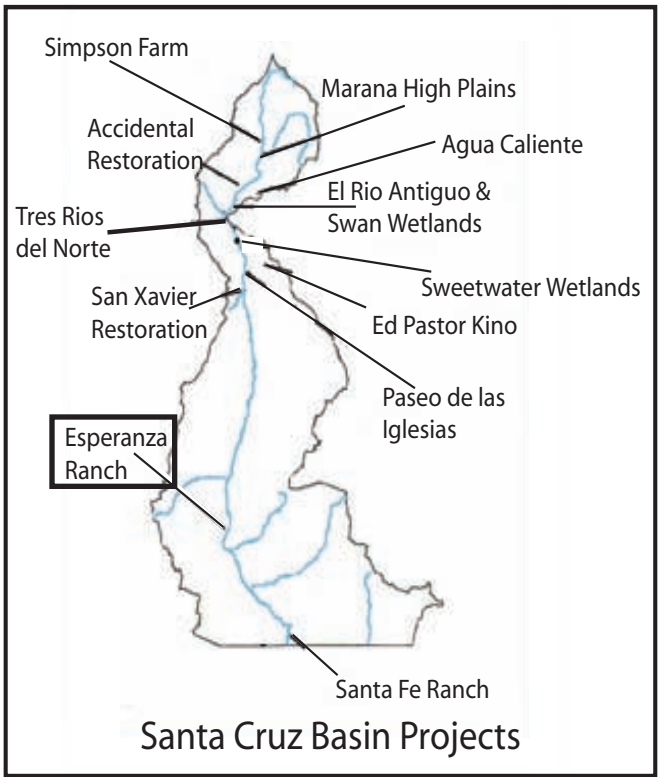
Example of an inline pond
Ed Pastor Kino Environmental Restoration Project

Map of Kino Wetlands and vicinity
Ed Pastor Kino Environmental Restoration Project

Full view of Ed Pastor Kino Wetlands
Ed Pastor Kino Environmental Restoration Project

Photos by Jennifer Jones

Excerpted from the Regulated Riparian Habitat Offsite Mitigation Guidelines for Unincorporated Pima County



Esperanza Ranch Riparian Restoration Project

Primary Information Source: 2004 Arizona Water Protection Fund grant application.

Location and Size: Santa Cruz County off of the I-19 at Agua Linda Road. The restoration project is on a 300-acre conservation easement. The project includes both sides of the Santa Cruz River for one mile and the land on the west side of the channel for another mile, one-half of a mile of the Chivas Wash and a 10-acre pond area.

Primary Sponsor(s): Tucson Audubon Society.

History: The Esperanza ranch has been the site of human endeavors since at least 1956 and has undergone degradation due to grazing, which caused erosion and allowed invasive plants to thrive. The flow of the Santa Cruz River is intermittent through the reach that will be restored. Most of the year the flow comes from effluent released from Nogales International Wastewater Treatment Plant about 20 miles upstream. A pond in the restoration area was created by sand and gravel removal during construction of Interstate 19 and has cottonwood and willow already growing on its banks.

Planning Objectives: "The goals of restoration are to increase the diversity, density and sustainability of riparian habitat for the benefit of birds and other wildlife; engage the local and regional community in site activities and develop a long-range strategy for stewardship of the site." The objectives for the site include conducting site planning; constructing a fence around the site to exclude cattle; increasing native plants through planting and seeding, stabilizing erosion-prone areas; monitoring site conditions to document changes; engaging the community in activities to raise awareness about riparian habitat; and establishing both a plan for long-term stewardship and an endowment to carryout the plan.[155]

Current Phase: The project began in December 2004. The planning stage is almost complete and restoration will begin in the spring of 2006 once the ungulate proof fencing is complete.[156] The project scheduled to be complete in 2008.

Phases: The schedule for design and implementation of the project includes: preparing and submitting plans including a fencing plan (January 2005); plans detailing restoration and revegetation, monitoring, and outreach (January 2006); and a site assessment report (January 2006). Reports on implemented work addressing these same topics will be prepared annually, and

[155] Tucson Audubon Society. (2004) *Application to Arizona Water Protection Fund for Riparian Restoration on Esperanza Ranch.* Tucson: Tucson Audubon Society. p. 6

[156] Phillips, Ann Audrey. (2005) Tucson Audubon Society Esperanza Ranch Riparian Restoration Project: Fencing Workplan. Tucson: Tucson Audubon Society. p. 1

a site stewardship plan will be prepared in 2007.

Recommended or Implemented Plan: The first stage of work on this project is the installation of fencing around the 27,226 foot perimeter of the lands designated under the conservation easement. Once the fence is in place new vegetation will be planted by seeding and planting around the river channel, in the ponds, along Chivas Wash, and in the broad floodplain west of the river. Planting techniques will include pole planting of cottonwoods and willow, seedling planting of riparian and uplands species, and seeding of the broad landscape. All planting will be placed in water harvesting basins and swales to concentrate rainwater around the plants until they can access nearby elevated soil moisture. Erosion around the pond perimeter and east end of Chivas Wash will be addressed through a combination of water harvesting and planting up gradient of erosion, and soil stabilization at the erosion points. Non-native species will be removed and suppressed by cutting and applying herbicides. An endowment will be establishing with contributions from the property owner and Tucson Audubon Society to fund long-term management of the site.[157]

Monitoring/Management: Monitoring will consist of observing habitat conditions, seedling survivorship, avian use, wildlife use, and photo monitoring. Photo monitoring will be used to document conditions before, during, and after restoration efforts. According to the fencing plan, the fencing will be monitored monthly throughout the project period, within 24 hours of significant river flows that could take out river crossing fencing, and within 24 hours of seeing vehicles, cows, or people within the conservation easement who are not supposed to be present.[158] The agreement with the AWPF indicates that the project sponsors must maintain the fence for 15 years after installation and operate and maintain the revegetation site for a minimum of 20 years. [159] A conservation easement has been established on the property to protect the riparian area from development and encroachment in perpetuity.

Funding and Cost: Funding for this project includes $279,411 from AWPF, $135,000 from Devon Energy Corporation (to establish an endowment for long-term stewardship), in-kind contributions of $6,500 from Stewart Loew and the Sky Island Alliance, and matching and in-kind contributions of $151,270 from the Tucson Audubon Society.

Land Ownership: At the time of the grant application, Devon Energy Corporation of Oklahoma City, OK owned the Esperanza Ranch. The 800-acre Esperanza Ranch property, including the 300-acre conservation easement portion, is now owned by Mr. James Olson of Green Valley, Arizona.

Water: At the restoration site, the Santa Cruz River flow is intermittent, consisting of effluent/storm water flow and base flow when the shallow water table is elevated. [160] No water will be pumped from groundwater wells nor diverted from surface water supplies at the Esperanza Ranch site to use in restoration activities due to an agreement entered into by previous owners that restricts pumpage here (the FICO Agreement). This provides an opportunity to conduct restoration activities using harvested rainwater as the sole water source for seedlings planted outside the river corridor.

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[157] Tucson Audubon Society. (2004) Application to Arizona Water Protection Fund for Riparian Restoration on Esperanza Ranch. Tucson: Tucson Audubon Society. p. 6

[158] Phillips, Ann Audrey. (2005) Tucson Audubon Society Esperanza Ranch Riparian Restoration Project: Fencing Workplan. Tucson: Tucson Audubon Society. p. 6

[159] Arizona Water Protection Fund. (2004) Arizona Water Protection Fund Operation and Maintenance Agreement, Agreement No. 05-132 WPF-OM. Phoenix: Arizona Department of Water Resources. p. 9

[160] Tucson Audubon Society. (2004) Application to Arizona Water Protection Fund for Riparian Restoration on Esperanza Ranch. Tucson: Tucson Audubon Society. p. 6

The project does, however, take advantage of the effluent flows coming from the Nogales International Wastewater Treatment Plant. Riparian species will be planted along the river bed that will be sustained by this manmade flow. There is no contract or agreement in place which secures these flows and guarantees that they will continue to be delivered. The project is designed to be resilient and dynamic so that if the effluent flows are removed from the ecosystem, the vegetation will shift to more meso-riparian species but will survive with altered characteristics.[161]

Pubic Outreach: The project will include extensive public outreach that will be outlined in their public outreach plan. Public involvement will include volunteer workdays, tours, and birding field trips at the site as well as public lectures and community participation off-site.[162]

Lessons Learned/Challenges: None noted. Project is in early stages.

Drivers: Increase and restore habitat, then protect the area in perpetuity.

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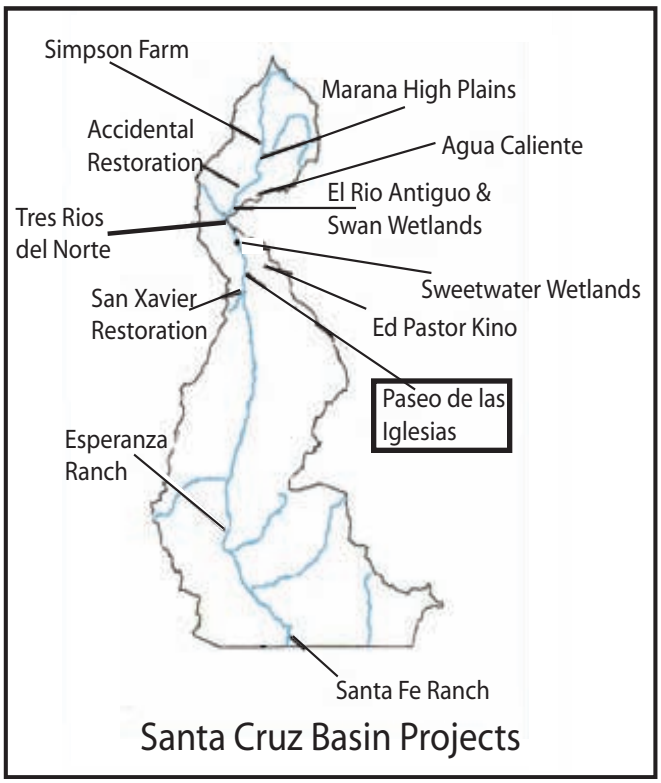
[161] Phillips, Ann (Tucson Audubon Society). (2005) November 15. Stakeholder meeting to discuss draft report of this study.

[162] Tucson Audubon Society. (2004) Application to Arizona Water Protection Fund for Riparian Restoration on Esperanza Ranch. Tucson: Tucson Audubon Society. p 13



Paseo de las Iglesias

Primary Documentation: Santa Cruz River, Paseo de las Iglesias, Pima County, Arizona, Feasibility Report Summary USACE, September 2005.

Location and Size: Santa Cruz River and West Branch of Santa Cruz River, Pima County, Tucson; Los Reales Road to West Congress Street. Project encompasses 7.5 miles and 1,098 acres.[176]

Primary Sponsor(s): Pima County Flood Control District (PCFCD) and U.S. Army Corps of Engineers (USACE).

History: Prior to human intervention and degradation, the Santa Cruz River flowed year round past San Xavier del Bac to downtown Tucson, 10 miles north. At this time the Santa Cruz River was a shallow stream with a wide flood plain, containing cottonwoods, willows, and mesquite bosques. A wetland at the former confluence of the West Branch and the main branch of the Santa Cruz River was turned into a lake during the Spanish/Mexican period and in 1874 became Warner's Lake (approximately 50 acres) which was used for a mill. Later the area was converted into a resort named Silverlake. In the 1900's, the Tohono O'odham Nation at San Xavier and Tucson farmers diverted surface water for irrigating crops. In 1915 the West Branch of Santa Cruz River was diverted to the East Branch to prevent flooding of crops, leaving the current remnants of riparian habitat along the West Branch. In 1935 the WPA straightened the East Branch channel, known today as the main channel of the Santa Cruz River, from San Xavier downstream to Congress Street. Between 1950 and 1960, one million tons of garbage was dumped in and around the Santa Cruz River, artificially narrowing the channel. Construction of I-10 and I-19 helped to further channelize the River, as did the addition of soil cement in portions of the river bed to reduce bank erosion and flood damages. Currently, the Santa Cruz is an ephemeral river, little riparian habitat exists, banks are deeply incised, and groundwater levels are at 150 feet below the surface. The decline in depth to groundwater around the River is in part due to the fact that one-half of all of the groundwater pumped in Tucson comes from wells near the Santa Cruz River.[177]

Planning Objectives: "Increase the acreage of functional riparian and floodplain habitat within the study area; increase wildlife habitat diversity by providing a mix of riparian habitats within the river corridor, riparian fringe, and historic floodplain; provide passive recreation opportunities; provide incidental benefits of flood damage reduction, reduced bank erosion and sedimentation,

[176] Becker, Jennifer (Pima County Regional Flood Control District). (2006) January. Review comments on draft report of this study.

[177] U.S. Army Corps of Engineers, Los Angeles District, South Pacific Division. (2003) Santa Cruz River, Paseo de las Iglesias Pima County, Arizona Draft Feasibility Study Report Alternative Formulation Briefing. Los Angeles: U.S. Army Corps of Engineers.

and improved surface water quality consistent with ecosystem restoration goals; and integrate desires of local stakeholders consistent with federal policy and local planning efforts." [178]

Current Phase: The U.S. Army Corps of Engineers has finalized the feasibility study, Pre-Construction Engineering and Design is set to commence in 2006, and construction is scheduled to begin in 2008.

Phases: Draft Feasibility Report-December 2003; Draft Feasibility Report-July 2004; Final Feasibility Report-July 2005; and Final EIS July 2005.

Recommended or Implemented Plan: The recommended plan for Paseo de las Iglesias is Alterative 3E which is "characterized by irrigated plantings of mesquite and riparian shrub on terraces above the low flow channel and in the historic floodplain with small areas of emergent marsh and cottonwood-willow habitat located at rainwater harvesting features scattered throughout the project. The construction and planting of subsurface water harvesting basins would occur at the confluences of eight tributaries and upstream of six existing grade control structures. A variety of methods would be used to provide permanent irrigation systems for all planted areas including the basins."[179]

Monitoring/Maintenance: Monitoring and maintenance is the responsibility of the local sponsors. The Paseo de las Iglesias project is vulnerable to damage by high flood flows, therefore, periodic maintenance will be necessary for successful restoration. Operation and maintenance will include periodic channel clearance, control of invasive plant species, pumps and irrigation maintenance, and periodic replanting of habitat areas damaged by flood.[180]

Funding and Cost: The feasibility study was funded by the USACE and Pima County through the USACE's General Investigation, Ecosystem Restoration funds. "The total first cost of the recommended plan is $92,058,546 and the total operation and maintenance costs excluding water are $807,046. The Federal share of the recommended plan is $59,666,768 and the non-Federal share is $32,391,778."[181] The cost of providing water for the project is an associated non-Federal cost, and 100 percent of these costs will be paid by the non-Federal sponsor (Pima County). These costs are currently estimated at $1,099,175 annually based on the use of reclaimed water from Tucson Water.[182] Other sources of water are currently (2005) under consideration.

Land Ownership: City of Tucson, Pima County, State of Arizona and private land.

Water: The USACE feasibility study process requires that one source be identified for analyses purposes. Rainwater harvesting and reclaimed water were the two sources of water looked at for the feasibility study; however, the local sponsor (PCRFCD) can use any water source(s) deemed most practical if the project is approved. At this time no water source has been determined for the project. The annual water budget for the tentatively recommended plan is estimated at 1,925 acre-feet per year.[183]

Several procurable sources of water are available to the potential project as well as funding to

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[178] Ibid. p. V-I

[179] U.S. Army Corps of Engineers, Los Angeles District, South Pacific Division. (2004) Santa Cruz River, Paseo de las Iglesias Pima County, Arizona Draft Feasibility Report. Los Angeles: U.S. Army Corps of Engineers. p. iii

[180] Ibid. VI-6

[181] Ibid. p. iv

[182] Ibid. p. VI-4

[183] Ibid.

supply the needed water. Leasing surface water from the Santa Cruz River and/or its tributaries has even been discussed. [184]

Pubic Outreach: Public outreach for this project included a Notice of Intent April 2001; Public Scoping Meetings, March 30 and 31, 2001 with tour of site on April 1, 2001; and an open house by PCRFCD, January 22, 2004. A public meeting was held on October 26, 2004 to present the feasibility study results and recommended plan overview.

"Public comments specific to the Old West Branch suggested: developing plans which serve multiple objectives; incorporating more permaculture techniques in water harvesting, planning, design, and implementation; and incorporating civic amenities such as a self-guided historic walk with written information, shade and benches; trails, picnic areas and ramadas with BBQs.

None of the participants expressed support for flood damage reduction efforts in the study area. Because of the public interest evidenced during the initial meeting, further meetings were scheduled to establish a process for development of public involvement in planning for restoration of the Santa Cruz River in the study area. The principal participants in this public workshop planning process were representatives from federal, state, and local agencies, and citizens from the local area.

Two smaller workshops were held on March 21, 2002 and again on April 9, 2003. In each case, representatives of local agencies, citizens from the local area and other stakeholders were convened to solicit input regarding restoration measures and desired outputs. In addition, a public open house to discuss preliminary findings was conducted by Pima County on January 22, 2004."[185]

Lessons Learned/ Challenges: Project is in initial stages, no lessons learned noted.

Drivers: Reversing the perception of the Santa Cruz River as a dumping ground, restoring both the cultural and ecological heritage of the area.

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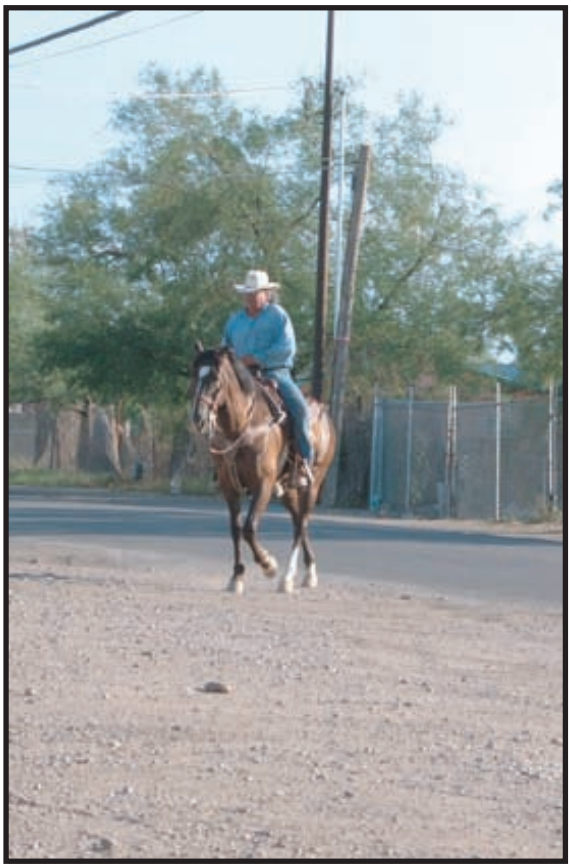
[184] Becker, Jennifer (Pima County Regional Flood Control District). (2006) January. Review comments on draft report of this study.

[185] U.S. Army Corps of Engineers, Los Angeles District, South Pacific Division. (2004) Santa Cruz River, Paseo de las Iglesias Pima County, Arizona Draft Feasibility Report. Los Angeles: U.S. Army Corps of Engineers. p. II-4



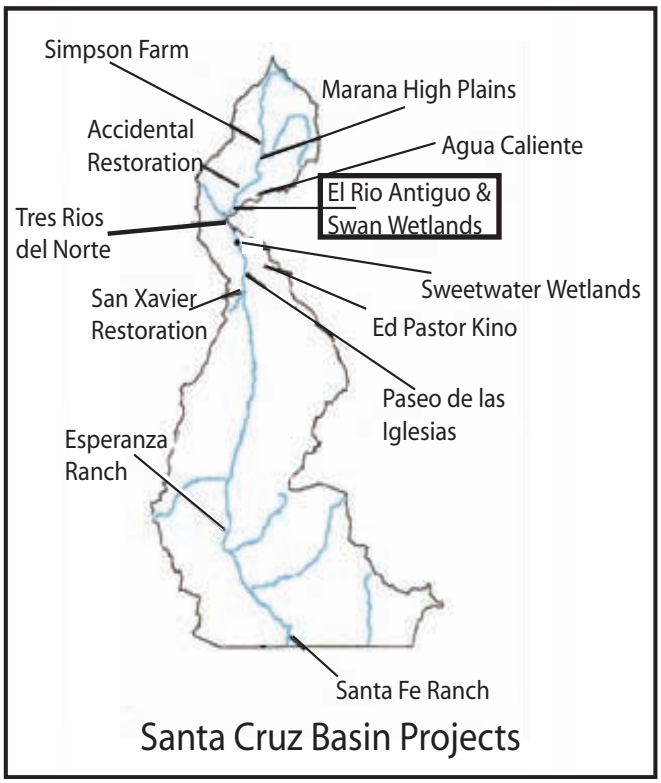
Horseback rider
Paseo de las Iglesias

West branch of Santa Cruz River south of Silverlake Rd.
Paseo de las Iglesias

View of Santa Cruz River from Sentinel Peak
Paseo de las Iglesias

Mesquite bosque and abandoned farmland adjacent to west branch of the Santa Cruz River
Paseo de las Iglesias

Photos by Jennifer Jones
Water Resources Research Center



Rillito River Riparian Area (Swan Wetlands)

Primary Documentation: 2003 U.S. Army Corps of Engineers Rillito River draft feasibility study, restoration report and environmental assessment.

Location and Size: Rillito River, Pima County, Tucson; South Bank of Rillito River, Craycroft Road (confluence of Tanque Verde Creek with Pantano Wash) to Columbus Boulevard. Project is 60.7 acres.

Primary Sponsor(s): Pima County Regional Flood Control District (PCRFCD) and United States Army Corps of Engineers (USACE)

Other Sponsors:

History: In the past, the Rillito River flowed perennially, meandering and supporting dense vegetation of cottonwood, willows, mesquite bosques, numerous beaver dams, and wetlands. Flows supported agriculture along the river. With growing agriculture, in the 1930's, Finger Rock Wash was cut off from the Rillito River and riparian vegetation was removed. Urbanization also increased and contributed to a loss in surface water flow and a decrease in the water table. Today much of the riparian habitat is degraded due to reduced water supply.[186]

Planning Objectives: "Restore riparian vegetative communities within the river corridor to a more natural state, increase the acreage of functional seasonal wetland habitat within the study area, minimize the potential for sediment and organic matter accumulation in restored areas, increase habitat diversity..., increase recreation and environmental education opportunities within the study area." [187]

Current Phase: A contract between the USACE and Pima County was signed February 15, 2005; construction is scheduled to begin in the spring of 2006.[188]

Phases: The preliminary Restoration Plan was approved in June 1999; Environmental Restoration Report and Environmental Assessment (ERR/EA) were completed in November 2003.

Recommended or Implemented Plan: Alternative - 1, Riparian/Xeroriparian Terrace "The alternative emphasizes the creation of riparian woodland habitat along created linear wet areas. Xeroriparian habitat would be used in the remaining areas to buffer the riparian habitat from adjacent land uses. The site is divided into distinct areas based on the restoration effort that will

[186] U.S. Army Corps of Engineers, Los Angeles District, South Pacific Division. (2004) Rillito River, Pima County, Arizona: El Rio Antiguo Draft Feasibility Study. Los Angeles: U.S. Army Corps of Engineers.
[187] Ibid. p. 2-2
[188] Wigg, Andy (Pima County Regional Flood Control District). (2006) January. Review comments on draft report of this study.

occur."[189] "The major factor in selection of this alternative was the desire of the local sponsor to not have surface water conditions that may be a liability concern. A contributing factor in the selection of this alternative is its design compatibility with the existing multi-use trail." [190]

Monitoring/Management: TBD

Funding and Cost: The project was funded and authorized through Section 1135 of WRDA - Modification of existing USACE projects for Ecosystem Restoration. The Rillito River Bank Protection Project was completed in 1996 by USACE and PCRFCD. [191] Total first costs are $2.7 million.[192] Under the cost sharing agreement, 75% of funding will come from the Army Corps and 25% from Pima County. Pima County expects to pay for their portion of the costs through Flood Control District Tax Levy receipts.[193] Under the recommended plan, the project requires 349 acre-feet of water per year, at approximately $230 per acre-foot the total cost of water will be approximately $81,000 per year.[194]

Land Ownership: Pima County

Water: Reclaimed water from the City of Tucson's Roger Road Wastewater Treatment Plant will be used for temporary irrigation. Water will also come from harvesting storm water runoff from Alamo Wash and other local tributaries.[195] Total annual water use is estimated at 349 acre-feet.

Pubic Outreach: A public workshop was held on Jan 6, 2000; The Draft of ERR/EA was released for public comment between March 21, 2003 - April 21, 2003; PCRFCD held two Open Houses April 17, 2003 and May 2004.

Lessons Learned/Challenges: None at this time.

Drivers: Habitat restoration, there are no public use elements in this plan.

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[189] See Rillito River Pima County Ecosystem Restoration Report and Environmental Assessment. p. 3-6 for more information.

[190] U.S. Army Corps of Engineers, Los Angeles District, South Pacific Division. 2003. Rillito River Pima County Ecosystem Restoration Report and Environmental Assessment. Los Angeles: U.S. Army Corps of Engineers. p. 3-24

[191] Ibid.

[192] Ibid. table p. 3-29

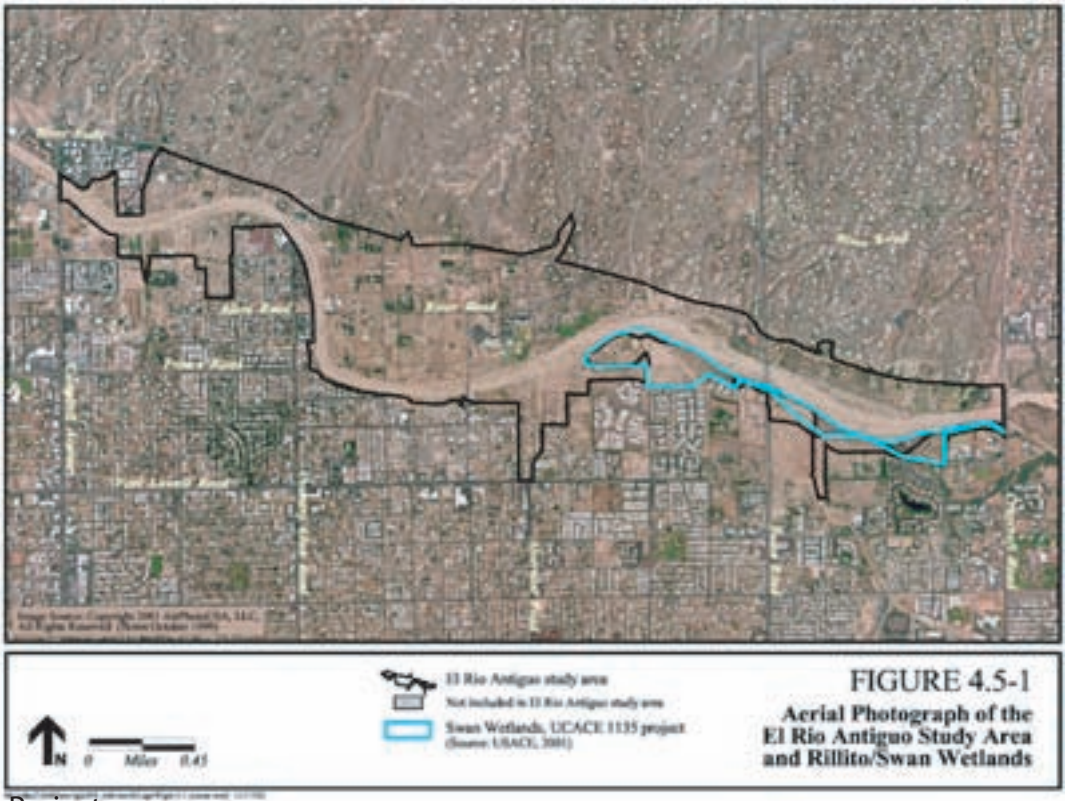
[193] Pima County Regional Flood Control District. Swan Wetland Ecosystem Restoration Fact Sheet. Tucson: Pima County Regional Flood Control District.

[194] The $230 per acre-foot charge is based on the cost to obtain the water from the Tucson Water Department. Ibid. p. 3-14.

[195] Wigg, Andy (Pima County Regional Flood Control District). (2006) January. Review comments on draft report of this study.

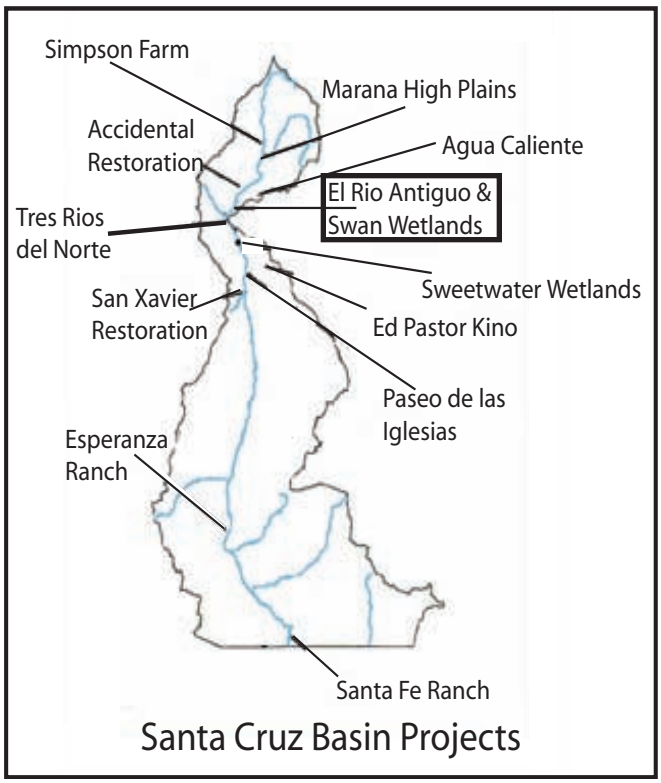
Cottonwood
Swan Wetlands site

Degraded habitat
Swan Wetlands site



Project area
Swan Wetlands

Photos by Jennifer Jones
Water Resources Research Center



El Rio Antiguo

Primary Documentation: 2004 U.S. Army Corps of Engineers El Rio Antiguo draft feasibility study, restoration report and environmental assessment

Location and Size: Rillito River, Pima County, Craycroft Road downstream to Campbell Avenue. The study area for the project includes a 4.8 mile reach of the Rillito River and 1,066 acres, the project area will actually cover 284 acres of the study area.

Primary Sponsor(s): Pima County Regional Flood Control District (PCRFCD) and United States Army Corps of Engineers (USACE).

History: In the past, the Rillito River flowed perennially, meandering and supporting dense vegetation of cottonwood, willows, mesquite bosques, numerous beaver dams, and wetlands. Flows supported agriculture along the river. With growing agriculture, in the 1930's, Finger Rock Wash was cut off from the Rillito River, and riparian vegetation was removed. Urbanization, along with agriculture, increased and contributed to a loss in surface water flow and a decrease in the water table. Today much of the riparian habitat is degraded due to the reduction of water.[196]

Planning Objectives: "Restore riparian vegetative communities within the river corridor to a more natural state; increase the acreage of functional seasonal wetland habitat within the study area; increase habitat diversity by providing a mix of habitats within the river corridor including the riparian fringe and buffer; provide incidental flood control through ecosystem restoration to the extent that it does not adversely impact the restoration objective; increase recreation and environmental education opportunities within the study area." [197]

Current Phase: Feasibility Complete. In October 2004 under WRDA of 2004, USACE will ask Congress for funding for Pre-Engineering Design Phase.

Phases: Reconnaissance Report completed September 2001; Draft Feasibility Report Study published October 2003 and May 2004, Draft EIS Nov 2003.

Recommended or Implemented Plan: Alternative 2H– 1-Terrace without buffer. A set of terraces would be constructed in the area known as the "Bend." Cottonwood/willow, mesquite, shrub and grasses would be planted in the channel, tributary mouths, and in rainwater harvesting basins along the tributaries. Soil cement will be used to stabilize the stream bank with a culvert and pipeline from upstream to allow water to flow behind the soil cement during severe storm water events (larger then 2-yr). The plan also includes a high and low-flow channel created to support a mesquite

[196] U.S. Army Corps of Engineers, Los Angeles District, South Pacific Division. (2004) Rillito River, Pima County, Arizona: El Rio Antiguo Draft Feasibility Study. Los Angeles: U.S. Army Corps of Engineers.
[197] Ibid. p. V-1

community and connect the Finger Rock Wash to the Rillito River. Rainwater harvesting basins at each upstream tributary mouth will collect and detain storm water. An effluent distribution system would also be installed to support the establishment of planted vegetation during dry periods.[198]

Monitoring/Maintenance: Project is still in the planning phase. No monitoring or maintenance plan exists at the present time.

Funding and Cost: The project is funded and authorized through USACE's General Investigation, Ecosystem Restoration. Total First Costs are $66,657,000. Current annual water cost to non-Federal sponsor is approximately $852,000.[199] It is estimated that annual operation and maintenance costs will be $1.26 million. This project is funded through a cost share agreement between the USACE and PCFCD, with the USACE covering 65% of the cost.

Water: The recommended plan requires a total irrigation need of 1,490 acre-feet of water per year.[200] Irrigation for the establishment and maintenance of new vegetation is provided by effluent, rain water harvesting, and surface water diversions from tributaries of the Rio Antiguo.[201]

Public Outreach: During the planning process, public opinion was solicited from a variety of sources. The El Rio Antiguo Work Group, facilitated by Novak Inc. and initiated on May 8, 2002, included seven months of field trips and meetings. The major concerns of the group included: "access to the Rillito River and existing trails; use of native vegetation for restoration; wise use of water; providing wildlife habitat; visual impact of project; using interpretive signage; and working with surrounding neighbors."[202] The final Corps public meeting for the feasibility stage was held on January 28, 2004.

Lessons Learned/Challenges: Project is in early stages, none at this time.

Drivers: Habitat restoration, returning an area to its pre- World War II beauty.

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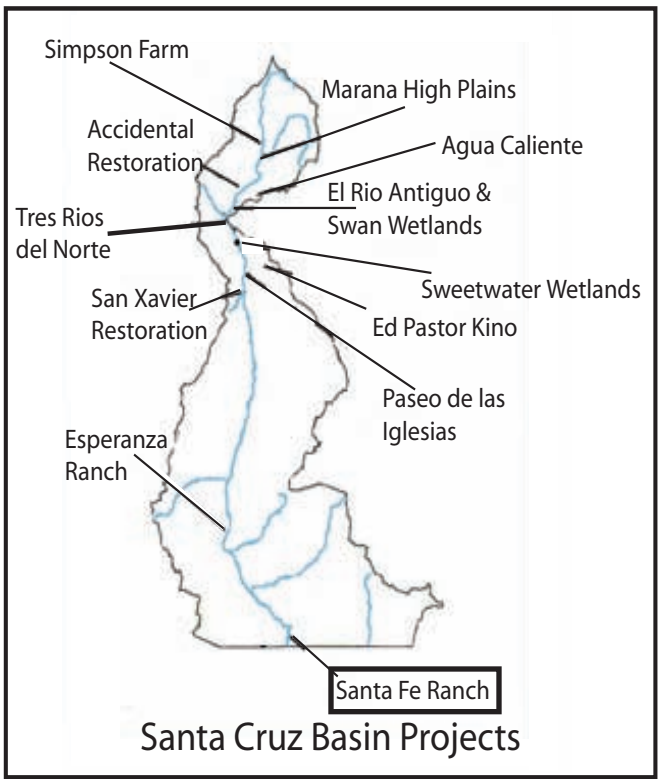
[198] Ibid.
[199] Ibid. p. VI-13
[200] Ibid. Appendix C
[201] Ibid.
[202] Ibid. p. VIII-2

South bank of Rillito River west of Swan Road
El RIo Antiguo

Pedestrian Bridge at Rillito River
El Rio Antiguo

Rillito River east from Swan Road
El Rio Antiguo

Photos by Jennifer Jones
Water Resources Research Center



Santa Fe Ranch Riparian Restoration

Primary Documentation: 2000 Coronado Resource Conservation and Development Area Inc. grant application to Arizona Water Protection Fund.

Location and Size: The project is located five miles north of Nogales in Santa Cruz County and encompasses 1,200 feet of river, through a 10-acre project area.

Primary Sponsor(s): Coronado Resource Conservation and Development Area, Inc. **Other Sponsors:** Arizona Water Protection Fund (AWPF), Arizona Department of Environmental Quality (ADEQ), and Natural Resources Conservation Service (NRCS).

History: In 1967 a flood destroyed mature cottonwoods and other riparian vegetation in the Santa Fe Ranch section of the Santa Cruz River. The storm left timber and large rock piled in the river channel, causing storm water to flood out onto adjacent pasture, eroding tons of topsoil and removing vegetation from those areas that served as buffers and habitat. The project area continued along a downward trend in condition until the initiation of this restoration project.[203]

Planning Objectives: The goal of the Santa Fe Ranch Riparian Restoration project is to reestablish a corridor of historic vegetation on a segment of the Santa Cruz River that will create diverse habitat and reduce stream bank erosion. The three objectives are: erosion control, revegetation of the area, and increased public awareness of riparian systems and values.[204]

Current Phase: Monitoring and outreach activities continue on the site. The final project report for the AWPF was completed in September of 2005.

Phases: Three phase project: Phase one – grant from ADEQ to install Kellner Jacks[205] (Jetty Jacks) to stop further erosion and trap sediment (2000), Phase two – revegetate the area through use of pole plantings (March 2004), Phase three -monitoring, outreach and education to provide information to local schools and land users about the value of riparian areas and options in restoration and techniques for monitoring of such projects (Sept 02 – Sept. 2005).[206]

Recommended or Implemented Plan: The Santa Fe Ranch restoration used a series of plans

[203] Coronado Resource Conservation and Development Area, Inc. (2000) Application to Arizona Water Protection Fund for Riparian Restoration at the Santa Fe Ranch. Benson: Coronado Resource Conservation and Development Area, Inc.

[204] Ibid.

[205] A Kellner Jack or Jetty Jack is a steel structure consisting of 3- 16' long 4"x4"x1/2" steel angles bolted together at their midpoints oriented at right angles to each other. The purpose of a Kellner Jack is to trap sediment and debris during flood events so as to build up its own levee to confine the river channel.

[206] Supra note 203 p. 1

for different aspects of the project. The fencing plan, implemented in October of 2001 included installing fencing between irrigated pasture and the revegetated bank stabilization area to exclude livestock access.[207] The project also implemented an irrigation plan to provide supplemental irrigation to approximately one acre of the site to establish riparian vegetation. The system was used during establishment of trees, shrubs forbs and grasses in a 60 feet wide 700 feet long area. The irrigation schedule during peak use (May and June) is to operate the system for 24 hours every 2.5 days.[208] The revegetation plan designated three planting zones: the floodplain, the scarp (which is the transition zone between upland area and floodplain), and the upland area.[209]

Monitoring/Management: Monitoring activities are focused on determining survivability of pole planting used for revegetation on severely eroded area and to determine the overall benefits of restoring riparian corridors. In order to determine this, the sponsors established a database of baseline conditions using survey and photographic methods. This database included information on plant counts, corresponding well data, and gauging station data from the Arizona Department of Water Resources and United States Geological Survey.[210] After revegetation, the project site was inspected at least on a weekly basis by Santa Fe Ranch personnel. Weekly inspections included: inspecting fencing for breaks or gaps, inspecting the irrigation system for breaks or malfunctions, and observations of plant materials for overall vigor and health. Monitoring also included replacement of dead trees or shrubs and control of invasive species until the revegetated site was decided to be in fully functional condition.[211] According to the May 2005 report to AWPF, the survival rate of willow is 57% and mesquite 63% (35 plantings for each species were conducted originally).[212] Under the agreement with the AWPF, the operation and maintenance period for grant-assisted fencing construction is 15 years following completion of the structure; for all other grant-assisted structures, the operation and maintenance period is 20 years.[213]

Funding and Cost: The project received $49,008 from AWPF, $13,996 from NRCS, and provided $5,063 in matching funds. The project also received funding from an ADEQ 319(h) grant to install the Kellner Jacks and erosion control structures.

Land Ownership: Private –Sedgewick family.

Water: Competing land interests such as a County road on the west side and irrigated pastures on the east side of the river forced NRCS to propose a stream corridor that is less than ideal. The ideal corridor would contain the stream, its banks, the floodplain, and the valley slopes. The proposed corridor will create a pattern of habitat that crosses the stream area and flood plain, connecting

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[207] Coronado Resource Conservation and Development Area, Inc. (2001) Fencing Plan for Water Protection Fund Contract 00-103 WPF. Wilcox: Coronado Resource Conservation and Development Area, Inc. p. 1

[208] Coronado Resource Conservation and Development Area, Inc. (2003) Riparian Restoration on the Santa Cruz River, Santa Fe Ranch: Revised Irrigation Plan. Wilcox: Coronado Resource Conservation and Development Area, Inc.

[209] Ibid. p. 3

[210] Supra note 203.

[211] Coronado Resource Conservation and Development Area, Inc. (2003) Riparian Restoration on Santa Cruz River Santa Fe Ranch: Revegetation Plan. p. 6

[212] Coronado Resource Conservation and Development Area, Inc. (2005) Riparian Restoration on the Santa Cruz River Santa Fe Ranch: Project Report #8. Wilcox: Coronado Resource Conservation and Development Area, Inc. (monitoring summary)

[213] Arizona Water Protection Fund. (2001) Grant Award Agreement Grant no. 00-103. Phoenix: Arizona Department of Water Resources. p. 10

the riparian areas to the upland areas. The proposed corridor will also function to trap sediment and provide hydraulic storage during floods and will trap organic matter necessary for the health function of the stream system.[214] Irrigation of riparian plantings comes from a well that is currently being used to irrigate pasture adjacent to the site. Water table levels have not been conducive to pole planting success at this site.[215] According to the irrigation plan, the estimated peak irrigation need for 70 trees, 130 shrubs, 1,800 grasses and forbs is 19,950 gallons per day.

Pubic Outreach: The project included an Outreach Plan that outlined steps that the restoration team would take to reach individuals in the community. Examples of items in the plan are: a teachers guide to riparian education in desert ecosystems to be used in grades 3 – 8, technical team work with the Nogales High School science class to use the plant nursery at the high school to propagate plants for the project, fact sheets on riparian systems, a power point presentation, and an informational tour for the public and partner agencies of the project site. [216]

Challenges/Lessons Learned: In a later survey of plantings, other vegetation had grown up around plantings, making it difficult to find/identify them. It was suggested that in the future, all plantings be clearly flagged so that their survival rate could be more easily determined. The number of cottonwood plantings were reduced during the project because of survival concerns caused by the drought and a lowering of the water table. At the beginning of the project, the water table was 10-15 feet below the surface and during the project dropped to 24 feet.

Drivers: Previous flood events had decimated the system, the primary goal in restoration was to stabilize bank erosion and reestablish a riparian corridor in order to improve water quality.

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[214] Supra note 203

[215] Supra note 212

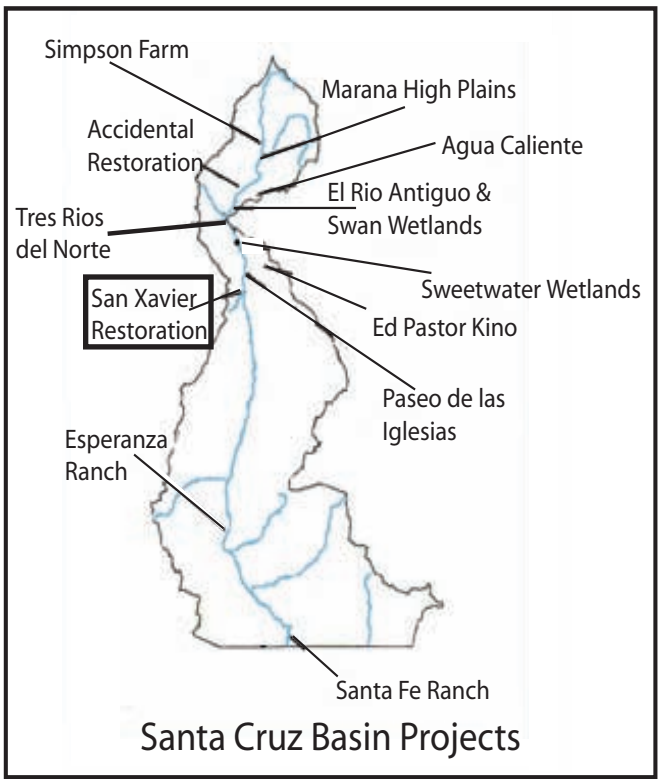
[216] Coronado Resource Conservation and Development Area, Inc. 2003. Revised Outreach Plan for Arizona Water Protection Fund Project Contract 00-103 WPF. Wilcox: Coronado Resource Conservation and Development Area, Inc. p. 3

Revegetation site
Sante Fe Ranch

Ungulate proof fence
Sante Fe Ranch

Kellner jack site
Sante Fe Ranch

All pictures courtesy
of AWPF



San Xavier Indian Reservation Riparian Restoration

Primary Documentation: 1996 San Xavier Indian Reservation grant application to Arizona Water Protection Fund.

Location and Size: Site one is located on the west side of the Santa Cruz River approximately 0.57 miles southeast of the intersection of San Xavier Road and the I-19 bridge in Pima County. Site two is located 1.5 miles upstream from site one. Site one of the project is 12.5 acres and site two is five acres.

Primary Sponsor(s): San Xavier District community.

Other Sponsors: Arizona Water Protection Fund (AWPF), Natural Resource Conservation Service (NRCS), Bureau of Reclamation (BOR), Sonoran Joint Venture, and U.S. Fish and Wildlife Service (USFWS).

History: At the turn of the century, the Santa Cruz River flowed perennially through the restoration area, making it unique amongst the restoration projects studied on the Santa Cruz. At this time, the water table was only 10-15 feet below the surface, and two springs flowed year round creating marshy areas. The vicinity supported a 3,200 acre mesquite bosque, cottonwood-willow groves, and other riparian vegetation. Groundwater pumping began in earnest in the 1940s and over time has lowered the water table over 100 feet, killing mesquites and riparian vegetation. In an effort to address growth and environmental concerns in their region, the San Xavier Reservation community adopted a Vision document in 1990 and Land Use Plan in 1992 that developed a long-term plan for riparian restoration on the reservation.[217] In the two restoration areas, the predominant prior land use was farming by the San Xavier Cooperative Farm.

Planning Objectives: The overall objectives for riparian restoration on the San Xavier Reservation are: develop an ecosystem approach to resource management for the Reservation and surrounding region; conduct a feasibility study on riparian restoration possibilities on the Reservation; enhance and restore riparian vegetation along two arroyos on the Reservation; and establish a grazing management plan to enhance and restore riparian vegetation.[218]

Restoration of the first site began with the process of selecting eligible sites. Objectives for the site selection process included: evaluate and compare the current ecological conditions of the five proposed sites; discuss the ecologic changes that had occurred at the sites in recent years and the reasons for these changes; propose a preliminary plan to restore or at lease improve ecologic

[217] San Xavier Indian Reservation Community. (1996) Application to AZWPF for Riparian Restoration on the San Xavier Indian Reservation Community. Tucson: San Xavier Reservation Community.
[218] Ibid.

conditions for each of the five sites; develop a budget for each of the proposed restoration plans; and provide a ranking of the five sites proposed for restoration activities. [219]

Objectives for the restoration itself at the first site were: develop a resource management guide that identifies specific appropriate riparian restoration strategies and implement the selected strategies. The objectives at site two were: re-establish a mesquite bosque plant community; establish a biologically significant area where tribal members can actively participate in the restoration and management of a desert riparian system; and improve understanding of what restoration strategies can be most effective in bringing back bottomland habitat throughout the Santa Cruz River reach within the San Xavier District.[220]

Current Phase: Restoration activities have been completed and monitoring and maintenance of site one is ongoing. Restoration at the second site is underway.

Phases: Restoration of site one, the Wa:k Hikdañ site, was conduced in four phases: 1) technical and community assessment and site selection between five potential bottomland restoration sites (spring 1999 – winter 2000);[221] 2) pre-implementation phase (winter 2000 – summer 2002); 3) project implementation phase (summer 2002 – spring 2003); and the final phase is monitoring and maintenance (ongoing).[222] Site two will follow the same four phases with the exception of phase one which was completed at the time of Wa:k Hikdañ's restoration.[223]

Recommended or Implemented Plan: Five sites were reviewed and ranked according to nine ecological and three non-ecological parameters on a scale of 1 to 3 (three highest) with the parameter of meets restoration objective receiving twice as much weight as any other parameter. Examples of other parameters include: depth of saturated soils, livestock impacts, undesirable vegetation, restoration potential, distance to Central Arizona Project (CAP) line, community access, and budget.[224] Based on this evaluation, the Wa:k Hikdañ site was chosen with a score of 28 out of 39. Once the site was chosen, a thorough ecological assessment was conducted that included an assessment of channel morphology, hydrology, vegetation, and land use. Once the assessment and permits were in place, the sponsors installed 2,900 feet of cattle exclusion fence, as well as a rock revetment approximately 938 feet long along the eastern edge of the project site for bank stabilization.[225] The final step in the pre-implementation phase was construction of a pipeline link from the main CAP pipeline to the project. The original plan was for a six inch diameter pipe, however; in the spring of 2002, the San Xavier Cooperative Farm approached the AWPF about using the project pipe to convey water to their fields as well. They offered funding and technical assistance from BOR in return for increasing the size of the pipeline to make this possible. [226]

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[219] Briggs, Mark Rome Hammer, Greta Anderson and Ronald Felix. 2003. Restoring the Wa:k Hikdañ: A Riparian Restoration Effort along the Santa Cruz River, San Xavier District of the Tohono O'odham Nation. Tucson: San Xavier District. p. 11

[220] San Xavier District. (2004) Application to Arizona Water Protection Fund for Riparian Restoration on the San Xavier District: Project Two. Tucson: San Xavier District p. 6

[221] The grant from the Water Protection Fund was awarded in 1996 however problems with grant management and administration delayed, and almost ended the project.

[222] Supra note 219

[223] San Xavier District. (2005). San Xavier Restoration Site Two Site Preparation Plan. p. 1

[224] Supra note 219

[225] A revetment is a masonry facing used to support an embankment.

[226] San-Xavier is a fence out district, therefore it is the responsibility of the landowners, not the cattle owners, to construct fences to keep cattle out. Additional funding for this fence was obtained from NRCS through the Wildlife Habitat Incentive Program in 2001

During the implementation phase for site one, undesirable plants were removed, focusing predominantly on the non-native tamarisk and tumbleweed. Once many of the invasive species were removed, the restoration team delineated the areas to be revegetated according to riparian, mesquite bosque, and wetland zones. Irrigation systems were then installed, and construction of the wetland and revegetation of the project area began.

The plan for the second site involves three steps: site preparation, irrigation design and installation, and planting the vegetation. The site preparation activities included removing or treating with herbicide non-native, invasive vegetation, as well as cutting a small trench along the center portion of the floodplain for irrigation water and plant sites for riparian species. Irrigation will consist of a main delivery pipeline bringing water from the CAP pipeline to a drip irrigation system at the site similar to the Wa:k Hikdañ site. Revegetation is divided into two zones for design purposes: terrace surfaces and floodplain surfaces. Terrace surfaces will be planted with mesic species such as mesquite, netleaf hackberry, and desert willow, which are plants that can survive in drier environments where depth to saturated soils can be considerable. Floodplain surfaces will be planted with riparian plants that are capable of withstanding frequent high flow events.[227]

Monitoring/Management: According to the AWPF agreement for both sites "grantee shall develop monitoring and project site maintenance plans. Grantee shall monitor the operation of the irrigation system for as long as it is in use. The Grantee shall monitor plant performance for at least five years; the intensity of monitoring efforts will decrease over time until the fifth year after revegetation. The grantee shall fund monitoring and maintenance work conducted after the termination of this agreement."[228]

Funding and Cost: Site one was funded by AWPF, NRCS, BOR, and the San Xavier District. The total cost of the site selection phase was $184, 260. Restoration of site one cost $413,432. Site two funding included $32,688 from AWPF and $37,555 matching funds which came from the San Xavier District Community, the U.S. Fish and Wildlife Service, and Sonoran Joint Venture.

Land Ownership: The restoration sites are both located on reservation allotted land with a lease administered by the Bureau of Indian Affairs. Before restoration could begin, permission had to be obtained from all of the allottees.[229] No compensation was initially provided to landowners. All but two allottees agreed without payment, and these two landowners were provided a one time payment of $500, an amount derived from an appraisal of an adjacent allotment.

Water: Supplemental water for the project is provided by a diversion of CAP water. The CAP diversion is part of the Southern Arizona Water Right Settlement Act of 1983. The water flows through a created stream and wetland area, nourishing the riparian species and seeping into the aquifer. The primary use of supplemental water is to recharge a perched aquifer under the site. Exploratory drilling during the feasibility phase showed that the perched aquifer was about 47 feet below the surface and extended to the area under both project sites. It is believed that recharge from the stream and wetland areas will create a mound within several years of implementation. It is feasible that this mound will eventually reach sufficient size to support the riparian plant community with scaled-back irrigation.[230] Under the agreement with the AWPF, supplemental irrigation and

[227] Supra note 223

[228] Arizona Water Protection Fund (2003) Amended Grant Award Contract No. 96-0026 amendment no. 7. Phoenix: Arizona Department of Water Resources p. 12

[229] Supra note 219. p. 14

[230] Arizona Water Protection Fund. Amended Grant Award Contract No. 96-0026 amendment no. 7. p 12

maintenance of the irrigation system is the responsibility of the San Xavier Reservation community.[231] Despite the long-term water requirement for the wetlands, the majority of the project was designed to survive without irrigation (after initial establishment). "A significant portion of the site is occupied by deciduous riparian and mesquite bosques plant communities, which will hopefully be able to survive with out long-term inputs of artificial water."[232]

This project was the first to use CAP water in the Tucson basin for riparian restoration and laid the groundwork for the use of as much as 50,000 acre-feet of CAP water for restoration purposes on the Reservation in the years following project.

Pubic Outreach: Quarterly project updates were published in the Wa:k Community newsletter as well as an annual project newsletter for the San Xavier District community members. "In the case of the San Xavier revegetation effort, the restoration project is considered critical to not only meeting documented goals, but also of tantamount importance to many elders and other community members who would like to see a semblance of how the Santa Cruz River used to be before it was affected by human impacts." [233] "The [Citizen's Steering] Committee was particularly effective in obtaining information from community elders on past site conditions, the plant and water conditions that they saw along the Santa Cruz River in Wa:k Hikdañ, their youth, and their ideas as to how the Wa:k Hikdañ should look when completed."[234]

Challenges/Lessons Learned:[235] The restoration team believed that the formation of a citizen steering committee to guide the project's implementation was critical to their success. Initially, they encountered problems with attendance and achieving quorum for monthly meetings. This problem was remedied in part by providing stipends and dinner to attendees.

Another challenge they faced was obtaining the necessary signatures and permission from land allottees, many of whom no longer live near the Wa:k Hikdañ restoration site. As a result, the restoration team recommends that as part of developing restoration efforts on allottee land, a considerable amount of time should be allocated to the pre-implementation phase to allow for the allottee approval process.

The restoration team found that the additional water provided for restoration attracted both desirable and undesirable animals. They noted that the significant time and money invested in the construction of the fence proved critical in realizing restoration objectives, and recommend that it be considered for similar efforts. One of the major construction efforts as part of this restoration was the pipeline. The restoration team ran into problems when the final pipeline design did not include several design features that were included in the Standards and Specs, but not drawn on the pipeline plans, and the contractor did not include them in his bid. They recommend that future projects are careful to include everything from the official plan in the bid plans.

With regards to planting, the majority of the site was planted during the hot months of June through September, which caused the black plant containers to heat up to significant temperatures in the mid-day sun, potentially cooking the roots of the plants and killing the plant before it was put in the ground. They found that plant containers of one-gallon and five-gallon sizes were not as

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[231] Arizona Water Protection Fund. 2005. Arizona Water Protection Fund Operation and Maintenance Agreement No. 05-130 WPF-OM. Phoenix: Arizona Department of Water Resources. p. 9

[232] Briggs, Mark (Briggs Restoration). 2006, February. Review comments of draft report of this study.

[233] Supra note 219

[234] Ibid.

[235] Challenges and lessons learned are from the Wa:k Hikdañ restoration site.

vulnerable to this threat as were seedlings grown in long and narrow tubex tubes that encourage the development of long tap roots, and skinny seedlings. Trees grown with the tubes in the nursery had a high rate of survival when planted in the ground; however, they will not survive if they are subject to extreme heat or sun prior to planting. As important and troublesome as keeping the plantings alive was removing undesirable plants. During the course of the project, the restoration team found that removing non-natives from the site is critical to overall project success, yet it is one of the most tedious and difficult activities to perform. Several strategies were useful in improving the effectiveness of weeding as well as maintaining the energy of maintenance staff. Examples of these strategies are: developing a schedule where groundskeepers focus on only one particular part of the restoration site during any given day, which helped to concentrate the work and maintain the focus of the groundskeepers; focus weeding only in planted areas with the goal of reducing competition, giving planted vegetation more of a chance to survive the critical first year following planting; and bringing in temporary laborers to assist groundskeepers in weeding parts of the site where weeds are particularly problematic.

Another challenge faced was the large turnover of maintenance staff. To combat this problem, the restoration team has implemented several strategies designed to maintain the interest and energy of the groundskeeper team including field trips, training activities, and participation of other staff and technical consultants in various aspects of the work. Conducting 'weeding days' where consultants and staff help groundskeepers to remove undesirable vegetation has been particularly helpful in maintaining a team spirit and interest of the groundskeepers.

Finally, the project ran into problems when in June 2003, the controllers on the irrigation system all failed within a matter of days of each other. The irrigation system was down for several days before the problem was discovered, and close to 10% of the trees in the affected areas died. As a result, the irrigation maintenance schedule was altered to include performance checks of all irrigation programs and weekly tests of the controllers. The restoration team notes that providing additional training in irrigation maintenance after revegetation was finished may have prevented the irrigation system's failure from significantly affecting plantings.[236]

The restoration team also noted the importance of post-implementation maintenance, monitoring, and evaluation activities. They assert that the project would not have succeeded without diligent weeding, replacement of dead plants, and irrigation system maintenance. Mark Briggs of Briggs Restoration recommends that 20% of the entire budget of project be devoted to these post-implementation activities.[237]

Drivers: San Xavier Community created a visioning document where one of the primary objectives was riparian restoration. "One of the other principal reasons for implementing this project [aside from restoration of habitat] was the San Xavier community's desire to create an area for residents to visit for low intensity recreational uses, such as walking, contemplation, and observing wildlife."[238]

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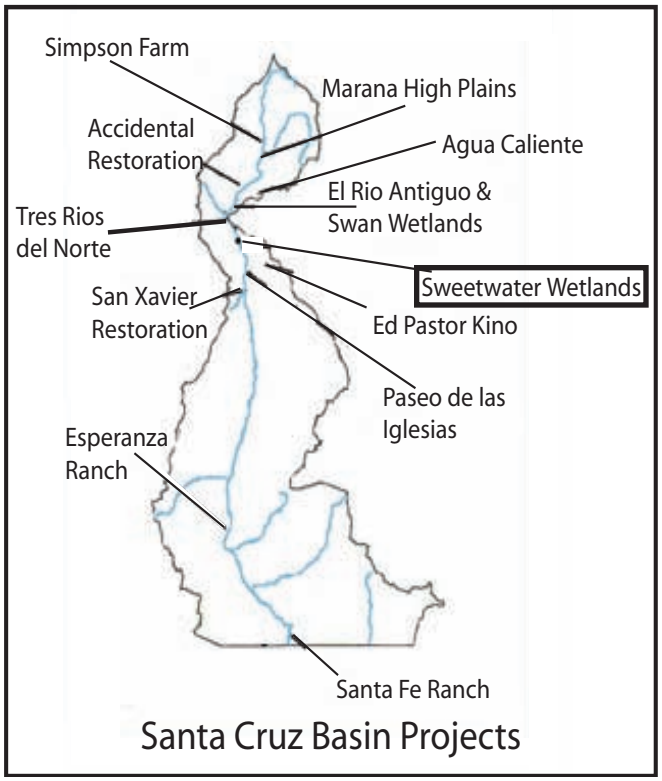
[236] Supra note 219

[237] Briggs, Mark (Briggs Restoration). (2006) February. Review comments of draft report of this study.

[238] Supra note 219



Sweetwater Wetlands

Primary Documentation: 2005 Sweetwater Recharge Facilities Fact Sheet and personal interviews with Tucson Water.

Location and Size: The Sweetwater Wetlands are located on Sweetwater Drive in Tucson, Arizona, just east of the Santa Cruz River. The site, including recharge facilities, is 109 acres with 17.3 acres of constructed wetlands.

Primary Sponsor(s): City of Tucson

History: In November 1993, the Arizona Department of Environmental Quality (ADEQ) issued the City of Tucson a letter of warning citing 24 violations of state drinking water laws and rules. ADEQ then filed suit in May 1994 and Tucson, which did not admit to any wrongdoing, settled in July 1994. As part of the settlement, Tucson agreed to pay between $300,000 and $400,000 to create a wetlands utilizing backwash water used to clean filters at the Tucson Reclaimed Water Treatment Plant. Construction began on the Sweetwater Wetlands in June 1996 and the facility was opened to the public two years later in March 1998. [259]

Planning Objectives: The consent agreement signed with ADEQ required three principal actions: 1) address the backwash issue, 2) create wildlife habitat, and 3) provide public education. The wetlands were therefore designed to address these three issues. Trails, informational signs, and public viewpoints were placed around the eastern wetland pond for public education and passive recreation. The western wetland pond was created with limited signage and one public viewpoint, reserving the rest of the area for wildlife.

Current Phase: Monitoring and maintenance

Phases: Recharge at the site that includes the Sweetwater Wetlands, known as the Sweetwater Recharge Facility, was first conducted as a demonstration/pilot project from 1984 through 1989. The success of the demonstration project led Tucson Water to develop and construct four large, excavated recharge basins beginning in the summer of 1989. In 1996, construction began on the wetlands as well as on four additional recharge basins. The wetlands were completed and opened to the public in March 1998.[260]

Recommended or Implemented Plan: The 17.3 acres of wetlands were built to operate in parallel or in series. With regard to the parallel configuration, the wetland facility could be operated utilizing two flow pathways, one on each side of the wetlands. Each pathway has one settling basin and one wetland pond. The final step is the discharge of the wetland water into the recharge basins. The

[259] Riparian Areas Regulatory Controls in Eastern Pima County. (2003) Water Quality Forum January 9, 2003
[260] Kmiec, John P. and Tim M. Thomure. (2005) "Sweetwater Recharge Facilities: Serving Tucson for 20 Years." Water Reuse. Forthcoming publication Sept. 2005.

facility can also be operated in series where only one settling pond is used, after which the water is conveyed to the eastern wetland pond and then to the western pond. The water is then recharged. In either configuration, the backwash water is filtered by cattail and bulrush colonies throughout the wetland. By design, the settling basins and wetland ponds are situated over a natural clay layer that minimizes infiltration during wetland treatment. However, recharge basins are placed on more permeable soils where infiltration rates are higher.[261] The various wetland components rely on gravity flow to convey water from one point to another along the various flow paths.

Monitoring/Management: The principal focus of monitoring and management of Sweetwater Wetlands revolves around containment and control of the mosquito population. Mosquito management is conducted through the application of larvacide to the vegetated areas on a weekly basis for about 36 weeks per year using a remote control helicopter. The larvacide used is rotated periodically to prevent the mosquitoes from developing a resistance. Adulticide is used only when the number of mosquitoes rises above a certain threshold.[262] Vegetation management at the wetlands consists of controlling bulrush and cattail overgrowth. After a few seasons, both species will die out, causing a dense thatch to form in the wetland ponds which affects the wetland's ability to filter water. To remove the thatches of bulrush and cattail, Tucson Water has instituted a controlled burn program with a strategy of burning a third of the wetlands every third year. This strategy retains a balance between providing habitat for migratory birds and the maintenance of the system.[263] Water quality is measured at eight sampling points throughout the wetlands as well as at the source of water for the wetlands.[264]

Funding and Cost: Approximately $1.6 million. Project was paid for by bonds approved by the voters in the City of Tucson. Annual maintenance cost for the wetlands is $72,000.[265]

Water: The wetlands process approximately 1.6 million gallons per day of secondary effluent and filtered backwash water. The adjoining recharge facility recharged about 57,000 acre-feet between October 1986 and May 2005. Of that, 8-10 percent is water from the wetlands. The remaining water used for recharge is secondary treated effluent.

Pubic Outreach: The community was involved in the planning and designing of this project through the Citizens' Wetlands/Recharge Advisory Committee, with members appointed by the Mayor and Council of Tucson. The committee was assisted by various federal, state, and local agencies. Ten committee meetings and three open houses were held from December 1994 through early September 1995. At these meetings the public was invited to provide their input into the design of the wetlands. As a consequence of public input, all native vegetation was used at the wetlands as well as a more natural looking design for the ponds themselves. In addition to the Advisory Committee, a Wetlands/Recharge Educational Outreach Program was established that produced an official wetlands logo designed by local students.[266] In August 1999 a documented case of mosquito-borne, Western Equine Encephalitis at the wetlands prompted some to call for the closing of the facility. In response to the public's concerns, Tucson Water modified its mosquito control procedures to 1) commence weekly adulticide fogging and 2) remove much of the thatched,

[261] Riparian Areas Regulatory Controls in Eastern Pima County (2003). Water Quality Forum January 9, 2003 pg
[262] Prior, Bruce. (2005) Personal communication with author (Mott Lacroix). July 25, 2005.
[263] Ibid.
[264] Tucson Water. (2005) Sweetwater Recharge Facilities Fact Sheet. Tucson: Tucson Water. p. 2
[265] Ibid.
[266] Gelt, Joe. (1997) "Constructed Wetlands: Using Human Ingenuity, Natural Processes to Treat Water, Build Habitat." Arroyo. March, Tucson: Water Resources Research Center.

dead vegetation that blocked granular larvicide from contacting the water.

Challenges/Lessons Learned: One of the challenges at the Sweetwater Wetlands was the removal of the overgrown cattail and bulrush. The maintenance team first tried to remove the vegetation using mechanical means. This process was problematic, however, because in order to get the equipment into the areas that needed to be thinned, the wetland area had to be completely dried out. Once the machines were in the area and had removed the vegetation, it was then necessary to remove and dispose of the material. Tucson Water found that it was much more efficient to burn about one-third of the wetlands each year to control overgrowth. Burning the vegetation eliminates the need for drying the ponds as well as hauling away debris. These burns do not require a permit from the Arizona Department of Environmental Quality and are used as wildland fire training for the Tucson Fire Department.

Another challenge in managing the wetlands is mosquito control. Three different technologies have been employed to apply granular larvicide: using a land-based, truck-mounted hydro-seeder, a tracked, aquatic water craft with a seed spreader, and a remote controlled helicopter. Tucson Water staff found that the truck-mounted hydro seeder was unable to broadcast the larvacide beyond 100 feet from the edge, and the wetlands were up to 400 feet across in some areas. The tracked aquatic water craft could traverse the cattail and bulrush but could only disperse the granular larvacide in a 30-foot swath. The best, and at this point only, solution is a remote controlled helicopter that is able to cover the entire wetland area in less than two hours.

Finally, Tucson Water noted that designing the ponds so that some of the pools can be drained while leaving others full has proved to be a valuable element of the design. For example, during an outbreak of avian botulism, operations crews contained the epidemic by draining the ponds in the areas most affected by the disease. At the same time, other ponds remained full in adjacent areas providing undisrupted habitat.

Drivers: Multiple use wetland-treatment facility, research, public education, and passive recreation. Initial funding and minimum project requirements for a wetlands project were established through a settlement between the City of Tucson and the Arizona Department of Environmental Quality over alleged drinking water quality violations.[267]

[267] Burchell, Joe. (1994) July 8. Water Suit to Cost City up to $450,000, Arizona Daily Star.

Project Site- Before
Sweetwater Wetlands

Project Site- After
Sweetwater Wetlands

Waterfowl at the wetlands
Sweetwater Wetlands

Photos courtesy of Tucson Water

Excerpted from the Regulated Riparian Habitat Offsite Mitigation Guidelines for Unincorporated Pima County

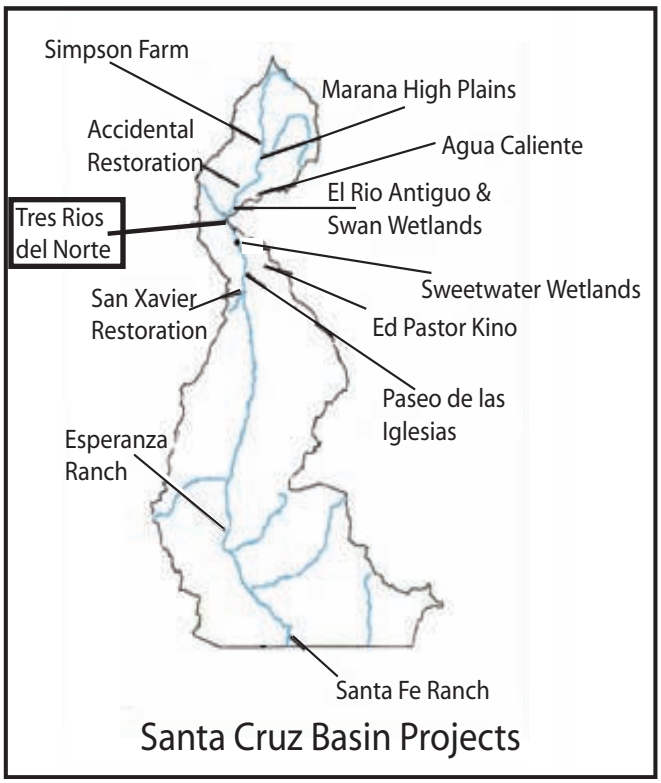
Birdwatcher at wetland
Sweetwater Wetlands

Educational signage
Sweetwater Wetlands

Operations- removing vegatation
from infiltration basin
Sweetwater Wetlands

Operations- loading remote controlled helicoper
for pesticide application
Sweetwater Wetlands

Photos by Andrew Schwarz
and Kelly Mott Lacroix



Tres Rios del Norte

Primary Documentation: 2004 U.S. Army Corps of Engineers, Tres Rios del Norte – Ecosystem Restoration Feasibility Study F4A Milestone - Alternative Formulation

Location and Size: Santa Cruz River, Pima County, Prince Road to Sanders Road, West Moore Road, and West Avra Valley Road. The project area encompasses 19 miles of the Santa Cruz River.

Primary Sponsor(s): Pima County Regional Flood Control District (PCFCD), Town of Marana, City of Tucson and United States Army Corps of Engineers (USACE).

History: Prior to degradation, the Santa Cruz River flowed year round past San Xavier del Bac to downtown Tucson, ten miles north. At that time, the Santa Cruz River was a shallow stream with a wide flood plain containing cottonwoods, willows, and mesquite bosques. Today, a riparian habitat nourished by natural perennial river flows no longer occurs along the river within the project area. Due to past agriculture and current municipal use, groundwater levels today are approximately 100 to 250 feet below the surface contributing to reduced river flows. In addition, sand and gravel mining, which began in the 1970s and '80s near Ina and Cortaro roads and continues today, has further altered the characteristics of the river course. Today, the only water in the river comes from effluent discharge from the Roger and Ina Road Wastewater Treatment Plants and storm water runoff. The effluent flow is variable in its delivery and extent, fluctuating seasonally and throughout the day. Future releases of effluent are not reliable and can not be planned on. In the future, it is expected that growth and development pressures will increase the economic value of effluent to a point where most if not all of the water will be used for purposes other than direct discharge into the river.

Planning Objectives: "Restoring wetland and riparian vegetative communities within the river corridor to a more natural state; increasing the acreage of functional seasonal wetland habitat within the river corridor; minimizing disturbance-type impacts to restored wetlands; minimizing the potential for sediment and organic matter accumulation in restored wetlands; increasing habitat diversity by providing a mix of habitats both in the river corridor and along the riparian fringe

and buffer; recharging and recovering municipal water supplies that also will facilitate vegetation restoration, and reducing potential flood damages in specified areas"[268]

Current Phase: The project's F4 milestone has been completed. The next public meeting is expected to occur February 2006. It is anticipated that public release of the feasibility report will occur in late 2006.

Phases: Reconnaissance Report initiated February 2000 and completed December 2000 (Sec 6 of Flood Control Act of 1938); Feasibility F4A Milestone (AFB) January 2004.

Recommended or Implemented Plan: The Recommended Plan will likely be a combination of enhancements that provide for ecosystem restoration, water supply (recharge and recovery), and recreation. Restoration goals are to improve mesquite, cottonwood-willow, and emergent wetland habitats to a condition supportive of wildlife, and for the benefit of residents and visitors to the area.[269]

Monitoring/Maintenance: Operations and maintenance will consist of regular monitoring of restoration performance, invasive species control, maintenance of water delivery system, replacement of non-surviving vegetation, water and electricity. The annual monitoring is estimated at $60 per acre with control of invasive species costing an additional of $60 per acre.[270]

Land ownership: City of Tucson, State of Arizona, Pima County, Town of Marana, and private.

Funding and Cost: Funding and authorization for this project is from the USACE General Investigation, Ecosystem Restoration. "The tentative plan is currently estimated at a construction cost of approximately $292 million. The Federal share of construction is currently estimated at approximately $170 million, and the non-Federal share at $117 million."[271] The annual cost of water is estimated to be $13,209,560.[272]

Water: Currently, effluent discharge flows perennially from the Roger and Ina Road Wastewater Treatment Plants. The tentative plan includes piped delivery of tertiary reclaimed water and in channel effluent flows. These flows of approximately 44,000 acre-feet in water annually would be used to sustain vegetated areas.[273] "Site work would include micro-grading for individual tree basins, flood irrigation, bubblers, drip irrigation, and implementation of micro- and macro-scale storm water-harvesting features." The revegetated area will include over 3,000 acres of watered and storm water-nourished habitat.[274]

Public Outreach: Public outreach activities have included one public meeting in 2001 and two public meetings in 2003. The next public meeting will take place in February 2006. Public release of the feasibility report will occur later in 2006.

Challenges/Lessons Learned: Project is in initial stages, no lessons learned reported.

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[268] U.S. Army Corps of Engineers, Los Angeles District, South Pacific Division. (2003) Preliminary Draft Environmental Impact Statement, Tres Rios del Norte Feasibility Study. Los Angeles: U.S. Army Corps of Engineers.

[269] U.S. Army Corps of Engineers, Los Angeles District, South Pacific Division. (2004) Tres Rios del Norte – Pima County, Arizona Ecosystem Restoration Feasibility Study F4A Milestone - Alternative Formulation. Briefing Report Los Angeles: U.S. Army Corps of Engineers. p. iii

[270] Ibid. p. 6-14

[271] Ibid. p. iv

[272] According to the F4A Feasibility report water will cost $105 per acre-foot at the assumed source (This number has since been changed to $260 per acre foot.). Ibid. p. 6-14.

[273] Smith, Linda (City of Tucson). (2006) January. Review comments of draft report of this study.

[274] Supra note 269

APPENDIX D
GUIDELINES FOR THE PREPARATION OF A NATURAL RESOURCE ASSESSMENT REPORT

*part of Appendix C, SWCA Report

Criteria:

- Adjacency to existing Preserves;
- Adjacency to major watercourses;
- Connectivity between riparian areas;
- Adjacency to reaches of watercourses defined by the 2002 SDCP Report "Riparian Priorities" (available for viewing and download at http://www.pima.gov/CMO/SDCP/reports.html);
- Adjacency to existing District-/County-owned property; however, this criterion is subject to verification of future uses of that land prior to being considered;
- Within Habitat Protection Priority Areas or Private and state priority areas, pursuant to the Conservation Bond Program 2004;
- Use of Transfer of Development Rights (TDR) Program and Sending Areas. Development rights are severed from these lands, which allows for higher density development in receiving areas (growth areas). TDR Sending Areas must have comparable RRH values; and
- Per the Multi-Species Conservation Plan (MSCP), donated property shall be evaluated for the properties' natural resource values, CLS status, contribution to County MSCP goals, and long-term costs of management and monitoring. The County may, at its discretion, request a monetary donation or endowment from the beneficiary to cover management costs.

In addition, the CLS and SDCP may be used as a guide to locating lands suitable to satisfy the land acquisition option. Key points to remember when selecting land for acquisition include the following:

- A biological evaluation of the land, performed by a professional biologist, shall be required as part of the land acquisition proposal;
- Preference will be given to land within the same watershed as the RHH that is being disturbed. If land cannot be identified within the same watershed, lands outside the watershed will be an option;
- Land must have equivalent or better riparian habitat values (biological and physical) than those that are being disturbed;
- Choose land within the same geographic locale as that being disturbed;
- Include mechanisms to protect resources and conservation values in perpetuity; and
- all land acquisition proposals are subject to District and the Board full review and approval.

APPENDIX D

NATURAL RESOURCE ASSESSMENT REPORT (NRAR) REQUIREMENTS

APPENDIX D. Natural Resource Assessment Report (NRAR) Requirements

A Natural Resource Assessment Report (NRAR) will be required once property(s) selected for mitigation under the Land Transfer or Riparian Habitat Preservation Plan (RHPP) option have been reviewed and approved by the District. The NRAR will provide an evaluation of the ecological resources on the property(s) proposed for mitigation and shall include the following information:

Report Exhibit(s)

1. Mitigation property(s) exhibit(s). Exhibit(s) shall include:
    - Recent aerial photograph. Aerial photographs are available through the Pima County MapGuide website: http://www.gis.pima.gov
    - Existing topography, if available.
    - Scale, north arrow, township/range/section, and parcel tax ID number(s)
    - Prepare exhibit(s) to a standard engineering scale e.g., 1”=20’, 1”=50’, 1”=100’, etc.
    - Location of riparian habitat as shown on the 2005 Riparian Classification Maps
    - Location of riparian habitat not mapped under the 2005 Riparian Classification Maps, if present
    - Location of special elements or features, such as springs, caves, cottonwood-willow forest, etc.

Report Text

Report text shall include a discussion of the following items:

2. Discuss in detail the location of the proposed property in relation to or designated as:

    - Maeveen Marie Behan Conservation Lands System (CLS) Category.

    - Critical Landscape Linkages. The general location of Critical Landscape Linkages can be viewed on the Riparian Acquisition Map under the heading “Critical Landscape Connections”. Descriptions of these six general areas can be found in Exhibit A.

    - A Habitat Protection or Community Open Space priority acquisition property as displayed on Riparian Acquisition Map. Identify which designation applies to the site and comment on the status of

communications, if any, between the owner and Pima County regarding the County's potential acquisition of the property.

3. Lands that may qualify for acquisition under the offsite mitigation program shall be selected based on the following criteria. (This is not necessarily a prioritized list. The qualifying lands will be evaluated based on all criteria, with no weighted consideration). Please evaluate each item listed below in the Report.

   Landscape Level:

   - Landscape position (CLS categories)
   - Covered species habitat (Priority Conservation Areas)

   Watershed/Project Site Level:

   - Adjacency to existing Preserves;
   - Adjacency to major watercourses;
   - Connectivity between riparian areas;
   - 2005 Riparian Classification Maps – Riparian vegetation plant community (Hydroriparian or Mesoriparian (Class H) vs. Xeroriparian) and density (Total Vegetation Volume (TVV) designated by Classes A, B, C, or D);
   - Water Availability (shallow groundwater/intermittent and perennial streams/springs) can be viewed in Mapguide and supporting report, *GIS Coverages of Perennial Streams, Intermittent Streams, and Areas of Shallow Groundwater*, found at: (http://www.pima.gov/CMO/SDCP/reports/d7/002GIS.PDF);
   - Hydrology/Hydraulics – ability to support riparian vegetation (FEMA floodplains, locally mapped floodplains, areas of ponding, etc.);
   - Adjacency to reaches of watercourses defined by the 2002 SDCP Report "Riparian Priorities" (available for viewing and download at http://www.pima.gov/CMO/SDCP/reports.html);
   - Adjacency to existing District-/County-owned property; however, this criterion is subject to verification of future uses of the land prior to being considered. Certain Pima County-owned lands are set aside for future development;
   - Within Habitat Protection Priority Areas or Private and State Priority areas, pursuant to the Conservation Bond Program (2004 and 2010);
   - Connectivity with parks, refuges, existing Pima County restoration projects, and undeveloped land;

- Adjacency to platted Natural Open Space (NOS). NOS can be identified through subdivision plats or development plans, which can be viewed at: http://www.pimaxpress.com/SubDivision/Default.htm;
- Special Elements (bosques, cottonwood/willow, springs, seasonal cienegas, etc.);
- Historical perennial flows, if data is available. Information for historical perennial flows can be found at the following online resources:

  SDCP Publication *Historical Occurrence of Native Fish in Pima County* (http://www.pima.gov/CMO/SDCP/reports/d7/011HIS.PDF)

  USGS water data website for Arizona, which can be viewed at: http://waterdata.usgs.gov/az/nwis/rt
- Constructed vs. natural riverine systems (Mapguide "bank protection" layer); and
- Adjacency to or use of Transfer of Development Rights (TDR) Program Sending Areas. Development rights are severed from these lands, which allows for higher density development in receiving areas (growth areas). TDR Sending Areas must have comparable RRH values.

4. If utilizing the RHPP option, the report must also address the overall connectivity and function of preserved habitat on the proposed mitigation parcel and how the RHPP will enhance overall function of riparian habitat.
5. If areas outside the 2005 Riparian Classification Maps are delineated as riparian habitat under the mitigation proposal, an evaluation of onsite riparian resources in accordance with Technical Procedure 116 will be required.
6. For properties to be conveyed in fee simple to the District, provide a Phase I Environmental Site Assessment (ESA) or Level I Environmental Site Assessment in accordance with standards established by the American Society of Testing and Materials (ASTM). Purpose of this information is to document onsite conditions, particularly possible environmental contaminants, hazards, or stewardship issues.

   A Phase I report should contain the following information: physical description of the property, environmental setting, and general condition of the property. The report should document all environmental hazards, either historically or currently recognized, or indications that a hazard may exist, observed infrastructure, vegetation condition, or other potential concerns, both onsite and offsite, if the recognized offsite environmental condition potentially affects the parcel. A Phase I report also includes all historical and recorded information available on the parcel.

EXHIBIT A

Maeveen Marie Behan Conservation Lands System (CLS) Critical Landscape Linkages

By definition, Critical Landscape Linkages are areas where habitat loss and fragmentation by roads and other infrastructure pose major challenges to wildlife movement.

Critical Landscape Linkage No. 1. Across the Interstate 10/Santa Cruz River corridors in the northwest.

Critical Landscape Linkage No. 2. Through Oro Valley, between the Catalina and Tortolita Mountains.

Critical Landscape Linkage No. 3. Across the Interstate 10 corridor along Cienega Creek in the east.

Critical Landscape Linkage No. 4. Across the Interstate 19 and Santa Cruz River corridors in southern Pima County.

Critical Landscape Linkage No. 5. Across the Garcia Strip extension of the Tohono O'odham Reservation.

Critical Landscape Linkage No. 6. The CAP Canal in Avra Valley.

APPENDIX E

CRITERIA FOR DEVELOPMENT OF RESTRICTIVE COVENANTS OR EASEMENTS

APPENDIX E. CRITERIA FOR DEVELOPMENT OF RESTRICTIVE COVENANTS OR EASEMENTS

Easements generally identify:

- ☐ parties entering into the agreement
- ☐ the location of land upon which the easement is being placed
- ☐ purpose of easement
- ☐ rights of the grantee
- ☐ permitted or prohibited activities (see list of potential permitted and prohibited activities below)
- ☐ identification of resources that will be protected
- ☐ agreement that the conservation value of the property will be protected in perpetuity
- ☐ Maintenance and monitoring of resources
- ☐ third party beneficiary (applicable to conservation easements)
- ☐ Rights of enforcement
- ☐ default and remedies
- ☐ costs and taxes
- ☐ liability and indemnification
- ☐ other general provisions such as severability, successors, amendments, cancellation, no subordination, transfer of property or easement, or other provisions deemed necessary by the District

Covenants generally identify:

- ☐ parties entering into the agreement
- ☐ purpose of covenant
- ☐ the location of land upon which the covenant is being placed
- ☐ permitted or prohibited activities (see list of potential permitted and prohibited activities below)
- ☐ identification of resources that will be protected
- ☐ agreement that the conservation value of the property will be protected in perpetuity

- ☐ Maintenance and monitoring of resources
- ☐ Rights of enforcement
- ☐ default and remedies
- ☐ liability and indemnification
- ☐ other general provisions, such as governing law, recordation, severability, notice, or other provisions deemed necessary by the District

The terms of each covenant or easement shall be negotiated with the District and drafted on a case-by-case basis and will be subject to Pima County Attorney's Office review and approval. When right(s) are being granted to Pima County or the District, the Board of Supervisors sitting as the Flood Control District Board, must officially accept right(s) prior to having the covenant or easement recorded with the Pima County Recorder's Office. The District will be responsible for ensuring the covenant or easement is recorded with the Pima County Recorder's Office.

APPENDIX F

IN-LIEU FEE CALCULATION SPREADSHEET AND TUTORIAL

Appendix F. Determination of ILF Spreadsheet Costs

Commercial and Subdivision Development:

Plant Material (trees and shrubs): Costs include plant material obtained from local vendors and labor for installation. Costs were determined for 1-gallon, 5-gallon, and 15-gallon sized plants. Overall, ILF costs were calculated by averaging 12 commercial/residential ILF submittals obtained over a seven year period (2005-2011). Riparian habitat classification was not considered when averaging plant material costs.

Assumption(s): Cost includes both plant material and labor for installation.

Hydroseed: Cost assigned for hydroseeding (seed, mulch, tackifier, labor) is based on average costs received from actual ILF fee estimates. The costs were calculated by averaging 12 commercial/residential ILF submittals obtained over a seven year period (2005-2011). Riparian habitat classification was not considered when averaging hydroseed costs.

Assumption(s): Seed will be applied via hydroseed method.

Irrigation: Cost assigned for irrigation (materials and installation) is based on average costs received from actual ILF fee estimates. The costs were calculated by averaging 12 commercial/subdivision ILF submittals, obtained over a seven year period (2005-2011). To account for cost difference between the classes of habitat, the average value (averaged across habitat classifications) was used as the base irrigation cost for IRA/H ($2,661/acre). Once assigned, the base irrigation cost was reduced based on the number of plants installed. Tiered irrigation costs are provided in the following table:

Habitat Class	Trees	Shrubs	total # plants	% of base cost	Irrigation ($/ac)
IRA/H, H	135	150	285	100%	$2,661
IRA/XA	113	135	248	87%	$2,316
IRA/XB	90	120	210	74%	$1,961
IRA/XC	68	105	173	61%	$1,615
IRA/XD	45	75	120	42%	$1,120
XA	75	90	165	58%	$1,541
XB	60	80	140	49%	$1,307
XC	45	70	115	40%	$1,074
XD	30	50	80	28%	$747

After cost data was tabulated, the cost values were compared to total cost for plant material only (trees and shrubs) and a percentage was determined. Irrigation costs were determined to be approximately 30% of the total plant material costs. For example, if plant material cost for a project is $3,600.00, irrigation cost would be calculated as follows: $3,600 x 0.30 = **$1,080**.

Assumption(s): Although there will be a base cost for installing an irrigation system, regardless of the number of plants installed, it is known that cost for irrigation will decrease as the quantity of plants installed decrease. This premise was used when developing irrigation cost data.

Maintenance: Cost was calculated for five years of maintenance based on average costs received from actual ILF fee estimates. The costs were calculated by averaging 12 commercial/subdivision ILF submittals over a range of riparian habitat classifications. Out of 12 ILF submittals reviewed, only one provided maintenance costs for Class H habitat mitigation, and the value appeared excessively high compared to other cost data received (cost for maintenance of Class H was calculated to be $14,760 per acre, compared with an average cost of $3,730 per acre for xeroriparian habitat). Therefore, single-lot ILF fee submittals, which provided more comprehensive cost comparison data between Xeroriparian vs. Class H habitat, were reviewed. From the data, it was determined that maintenance costs for Class H habitat are typically 35% higher than maintenance costs

for xeroriparian habitat. A base cost for Class H ($5,035/acre) was calculated by adding 35% to the average base cost for xeroriparian habitat ($3,730/acre). Once assigned, the base maintenance cost was reduced based on the number of plants installed. Tiered maintenance costs are provided in the following table:

Habitat Class	Trees	Shrubs	total # plants	% of base cost	5-yr maintenance ($/ac)
IRA/H, H	135	150	285		$5,035
IRA/XA	113	135	248	100%	$3,730
IRA/XB	90	120	210	85%	$3,158
IRA/XC	68	105	173	70%	$2,602
IRA/XD	45	75	120	48%	$1,805
XA	75	90	165	67%	$2,482
XB	60	80	140	56%	$2,106
XC	45	70	115	46%	$1,730
XD	30	50	80	32%	$1,203

After cost data was tabulated, the cost values were compared to total cost for plant material only (trees and shrubs) and a percentage was determined. On average, maintenance costs were determined to be approximately 45% of total plant material costs, regardless of habitat type. For example, if plant material costs for a project equal $3,600.00, maintenance cost would be calculated as follows: $3,600 x 0.45 = $1,620.

Assumption(s): Although there will be a base cost for maintenance, regardless of the number of plants installed, it is known that maintenance costs will decrease as the quantity of plants installed decrease. This premise was used when developing maintenance cost data. The District used single-lot data to determine percentage of difference between xeroriparian and Class H maintenance costs, which should realistically reflect cost difference due to higher water use plant species and increased quantity of plants.

Monitoring: Monitoring costs were obtained from local consulting firms and are based on riparian habitat mitigation plans (RHMP) from approved development projects. Two projects were reviewed and monitoring costs calculated based on requirements outlined in the "*Riparian Habitat Mitigation Plan Annual Monitoring Report Checklist for Subdivision Plats and Development Plans*". Based on this analysis, an average cost of $1,500 per acre per year was calculated. For xeroriparian habitat, this would be equivalent to $4,500 over a three year period. For Class H and Important Riparian Areas, the value would increase to $11,250 over a five year period.

Single-lot Development

Plant Material (trees and shrubs): Plant material costs were obtained from local vendors and are based on average costs received from actual ILF fee estimates. The costs were calculated by averaging 5 single-lot ILF submittals obtained over a six year period (2006-2011). Costs were determined for 1-gallon, 5-gallon, and 15-gallon sized plants.

Assumption(s): Property owner will install plants, therefore labor costs are not included, only plant material costs.

Seeding: Seed cost is based on an average cost of seed per acre, obtained from local vendors.

Assumption(s): The property owner will purchase seed directly from the vendor and apply seed to the mitigation area by hand (broadcast seeding).

Irrigation: A cost was assigned for irrigation (materials and installation) based on average costs received from actual ILF fee estimates. The costs were calculated by averaging 5 single-lot ILF submittals obtained over a

six year period (2006-2011). Riparian habitat classification was not considered when averaging irrigation costs.

Assumption(s): Property owner will install a drip irrigation system.

Maintenance: Average maintenance cost is based on annual water requirements for plants, plant replacement at 5% over five years, and invasive species control (see calculations below). Maintenance costs are derived from actual estimates obtained from ILF proposals submitted over the past six years (2006-2011). Cost estimates are based on actual plant water use, using City of Tucson water rates (http://cms3.tucsonaz.gov/water/new-rates), plant replacement at 5% of the total number of plants installed, and invasive species control. Cost of maintenance for Xeroriparian vs. Class H habitat was determined separately and is shown in the ILF calculation spreadsheet.

Single-lot development – break-down of maintenance costs per acre:
Water for plants over 5 years (Class H) = $462/ac
Water for plants over 5 years (Xeroriparian - average taken for all classes of habitat (XA-XC)) = $183/ac
Replacement Plants (replace at 5%) for Class H = $461/ac
Replacement Plants (replace at 5%) for Xeroriparian (average taken for all classes of habitat (XA-XC)) = $303/ac
Invasive species control – purchase of 1 - 32 oz bottle of Roundup per year (makes 10 gallons of herbicide) = $125/ac

Maintenance cost for Class H = 462+461+125 = $1,048 (round to $1,050)
Maintenance cost for Xeroriparian = 183+303+125 = $611 (round to $610)

Assumption(s): Invasive species control is cost to purchase herbicide only, and it is assumed labor is performed by the property owner.

Monitoring: A monitoring cost was not assigned for single-lot ILF estimates since the property owner will be monitoring the site.

Assumption(s): Costs for monitoring will be minimal (e.g., cost for paper to draft report and postage to mail report).

Alternative to Using the ILF Spreadsheet Provided by the District

As an alternative to using standard cost estimates provided by the District, the applicant has the option to submit a reasonable cost estimate for the ILF, prepared by a qualified professional. The applicant may provide a cost estimate for the entire fee or determine costs for a portion of the fee, using District costs for the remaining portion(s) of the fee. Requirements for this option are outlined in Section 2 of the Guidelines.

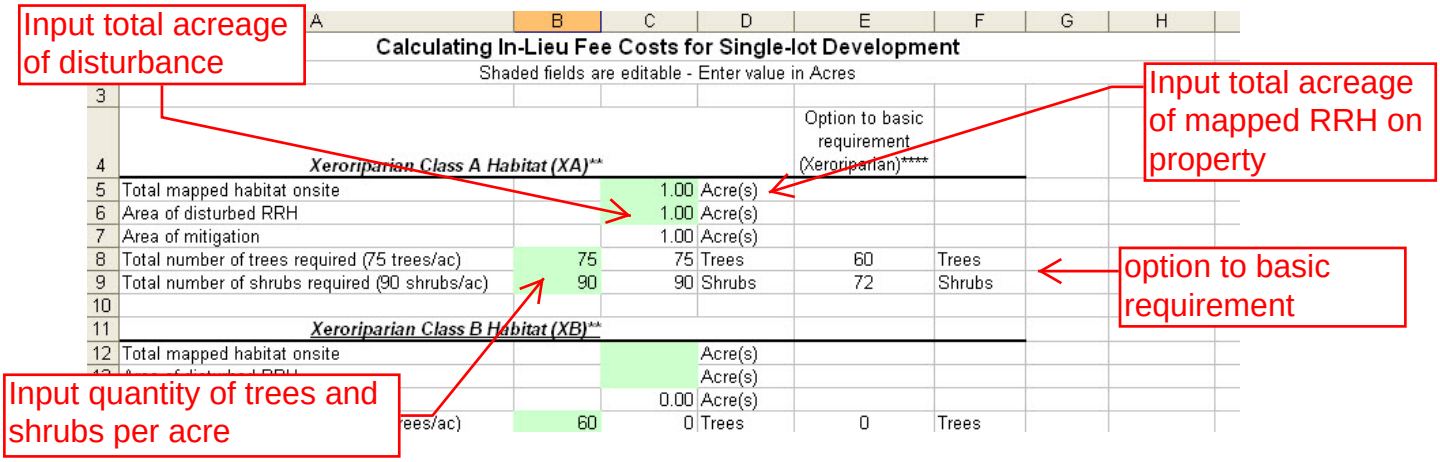
APPENDIX F. IN-LIEU FEE SPREADSHEET TUTORIAL

The following examples explain how to use the In-Lieu Fee (ILF) calculation spreadsheet. The color green indicates cells where data input is required while cells without color are locked from user input and will perform automatic calculations. Please follow examples below for a brief tutorial on how to use the spreadsheet.

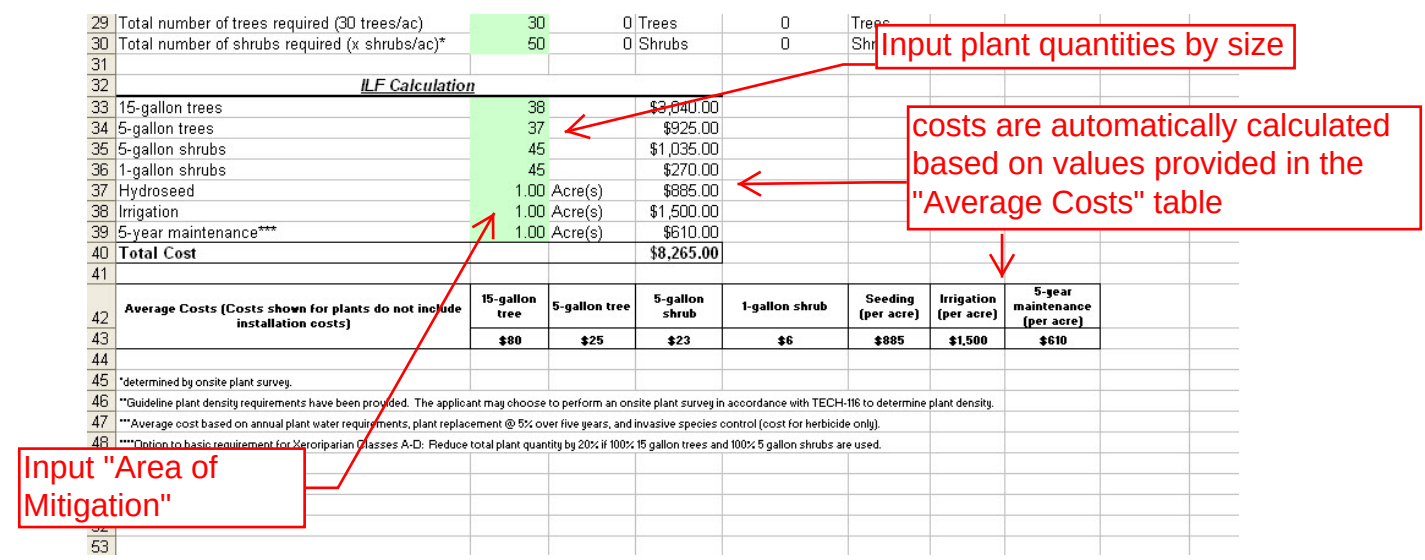
SINGLE-LOT DEVELOPMENT

Example 1. The first example shows the user how to input data into the ILF calculation spreadsheet for disturbance of Xeroriparian Class A habitat on a subdivided lot.

Step 1: Verify the class of Regulated Riparian Habitat (RRH) to be disturbed and then select the correct cells for data input.



Step 2: After inputting total acreage of RRH on the property (cell C5) and total disturbance of RRH (cell C6), scroll to the bottom of the spreadsheet and enter additional data to complete the calculation.



Step 3: The user will input plant quantity data calculated in cells C8 and C9 into cells B33 through B36. Divide plant quantities evenly between 15 gallon and 5 gallon size for trees and 5 gallon and 1 gallon size for shrubs unless “Option to Basic Requirements” was chosen. If this option is chosen, select data from cells E8 and E9 and input into cells B33 and B35 only (all 15 gallon size trees and 5 gallon size shrubs). Insert “Area

of mitigation" value from cell C7 into cells B37 through B39. The spreadsheet will automatically calculate the ILF from the "Average Costs" table (cells B43 through H43).

Example 2. The second example shows the user how to input data into the ILF calculation spreadsheet for disturbance of Class H habitat on a subdivided lot.

Step 1: Verify the class of RRH to be disturbed and then select the correct cells for data input.

Input quantity of trees and shrubs per acre

Input total acreage of mapped RRH on property

option to basic requirement

Input total acreage of disturbance

	A	B	C	D	E	F	G	H
	Calculating In-Lieu Fee Costs for Single-lot Development							
	Shaded fields are editable - Enter value in Acres							
4								
5	***Class H or IRA w/ Underlying Class H Habitat (H or IRA/H)****				Option to basic requirement (Xeroriparian)****	Option to basic requirement (Class H)****		
6	Total mapped habitat onsite		1	Acre(s)				
7	Area of disturbed RRH		1	Acre(s)				
8	% of mapped habitat disturbed		100%	Acre(s)				
9	Area of mitigation		1.50	Acre(s)				
10	Total number of trees required (90 trees/ac)	90	135	Trees	na	162	Trees	
11	Total number of shrubs required (100 shrubs/ac)	100	150	Shrubs	na	180	Shrubs	
12								
13	***IRA w/ Underlying Xeroriparian Class A Habitat (IRA/XA)****							
14	Total mapped habitat onsite			Acre(s)				
15	Area of disturbed RRH			Acre(s)				
16	% of mapped habitat disturbed		#DIV/0!	Acre(s)				
17	Area of mitigation		0.00	Acre(s)				

Step 2: After inputting total acreage of RRH on the property (cell C6) and total disturbance of RRH (cell C7), scroll to the bottom of the spreadsheet and enter additional data to complete the calculation. Please note that for Class H habitat, the area of disturbance is mitigated at a ratio of 1:1.5.

Input "Area of Mitigation"

Input plant quantities by size

costs are automatically calculated based on values provided in the "Average Costs" table

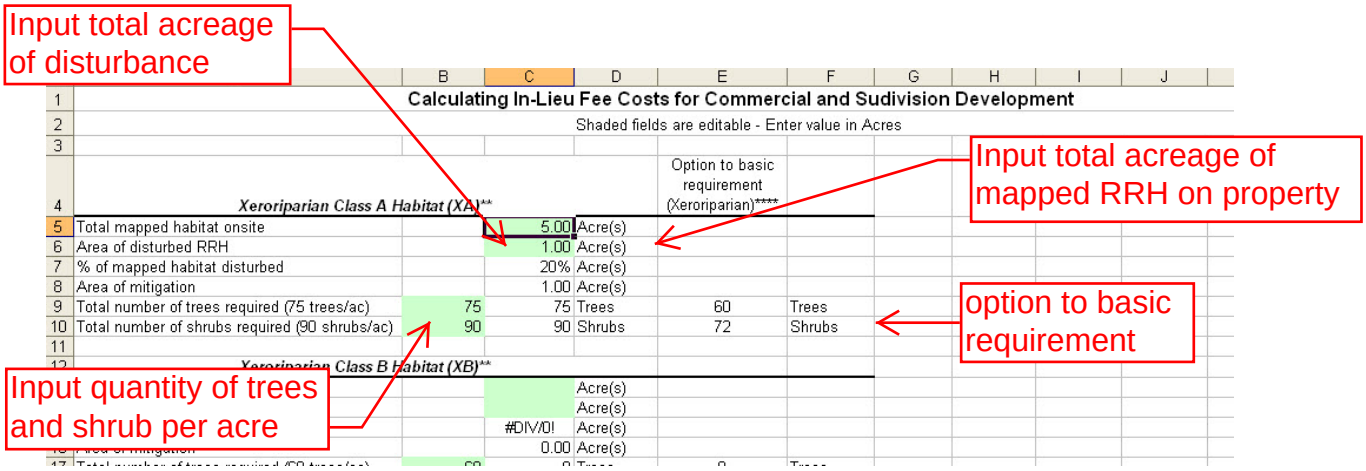
	equired (x shrubs/ac)*	50	75	Shrubs	63	na	Shrubs	
	ILF Calculation							
47	15-gallon trees	135		$10,800.00				
48	5-gallon trees	0		$0.00				
49	5-gallon shrubs	75		$1,725.00				
50	1-gallon shrubs	75		$450.00				
51	Hydroseed	1.50	Acres(s)	$1,327.50				
52	Irrigation	1.50	Acres(s)	$2,250.00				
53	5-year maintenance for Xeroriparian***	0.00	Acres(s)	$0.00				
54	5-year maintenance for H***	1.50	Acres(s)	$1,575.00				
55	**Total Cost**			**$16,552.50**				
56								
57	**Average Costs (Costs shown for plants do not include installation costs)**	**15-gallon tree**	**5-gallon tree**	**5-gallon shrub**	**1-gallon shrub**	**Seeding (per acre)**	**Irrigation (per acre)**	**Class H 5-year maintenance (per acre)**	**Xeroriparian 5-year maintenance (per acre)**
58		**$80**	**$25**	**$23**	**$6**	**$885**	**$1,500**	**$1,050**	**$610**
59									
60	*Density determined by onsite plant survey.								
61	**Guideline plant density requirements have been provided. The applicant may choose to perform an onsite plant survey in accordance with TECH-116 to determine plant density.								
62	***Average cost based on annual plant water requirements, plant replacement @ 5% over five years, and invasive species control (cost for herbicide only).								
63	****Option to basic requirement for Xeroriparian Classes A-D: Reduce total plant quantity by 20% if 100% 15 gallon trees and 100% 5 gallon shrubs are used.								
64	****Option to basic requirement for Class H: Increase total plant quantity by 20% if 50% 15 gallon/50% 5 gallon trees are used and 100% 1 gallon shrubs are used.								
65									
66									

Step 3: The user will input plant quantity data calculated in cells C10 and C11 into cells B47, B49, and B50. If "Option to Basic Requirements" is chosen allowing for 50% 15 gallon/50% 5 gallon size trees and 100% 1 gallon size shrubs, select values from cells F10 and F11 and input into cells B47 through B50. Insert "Area of mitigation" value from cell C9 into cells B51, B52 and B54. The spreadsheet will automatically calculate the ILF from the "Average Costs" table (cells B58 through H58).

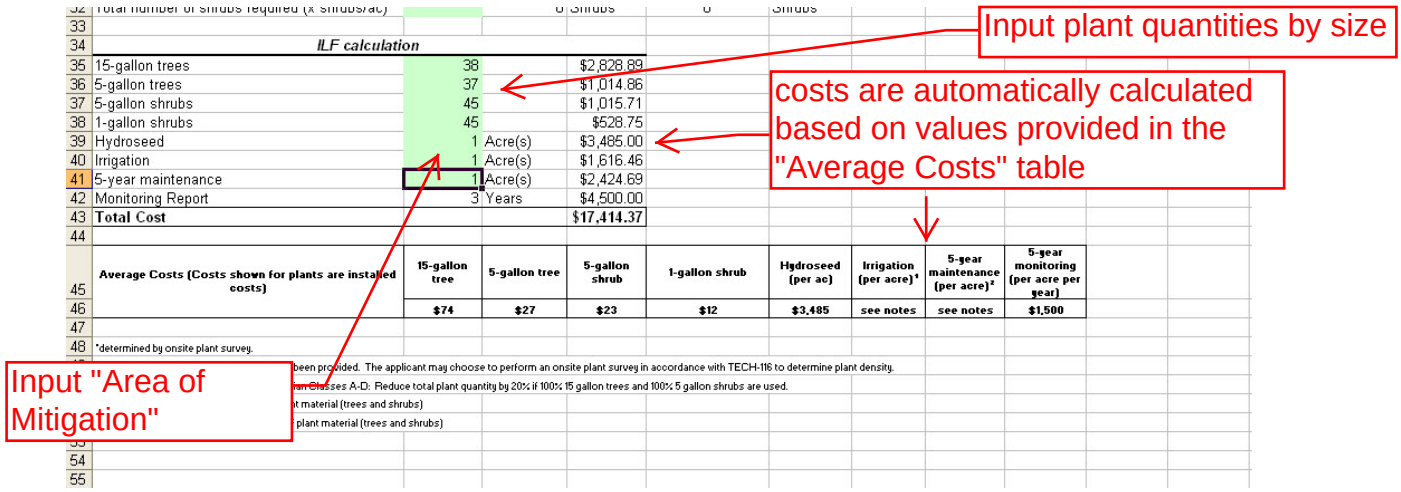
COMMERCIAL AND SUBDIVISION DEVELOPMENT

Example 3. The third example shows the user how to input data into the ILF calculation spreadsheet for disturbance of Xeroriparian Class A habitat due to projects undergoing the development review process.

Step 1: Verify the class of RRH to be disturbed and then select the correct cells for data input.



Step 2: After inputting total acreage of RRH on the property (cell C5) and total disturbance of RRH (cell C6), scroll to the bottom of the spreadsheet and enter additional data to complete the calculation.



Step 3: The user will input plant quantity data calculated in cells C9 and C10 into cells B35 through B38. Divide plant quantities evenly between 15 gallon and 5 gallon size for trees and 5 gallon and 1 gallon size for shrubs unless "Option to Basic Requirements" was chosen. If this option is chosen, select data from cells E9 and E10 and input into cells B35 and B37 only (all 15 gallon size trees and 5 gallon size shrubs). Insert "Area of mitigation" value from cell C8 into cells B39 through B41. The spreadsheet will automatically calculate the ILF from the "Average Costs" table (cells B46 through I46).

Example 4. The third example shows the user how to input data into the ILF calculation spreadsheet for disturbance of Class H habitat due to projects undergoing the development review process.

Step 1: Verify the class of RRH to be disturbed and then select the correct cells for data input.

Input quantity of trees and shrubs per acre

Input total acreage of mapped RRH on property

option to basic requirement

Input total acreage of disturbance

Calculating In-Lieu Fee Costs for Commercial and Subdivision Development

Shaded fields are editable - Enter value in Acres

	B	C	D	E	F	G
4	*Class H or IRA w/ Underlying Class H Habitat (H or IRA/H)***			Option to basic requirement (Xeroriparian)****	Option to basic requirement (Class H)****	
5	Total mapped habitat onsite		5.00	Acre(s)		
6	Area of disturbed RRH		1.00	Acre(s)		
7	% of mapped habitat disturbed		20%	Acre(s)		
8	Area of mitigation		1.50	Acre(s)		
9	Total number of trees required (90 trees/ac)	90	135	Trees	na	162	Trees
10	Total number of shrubs required (100 shrubs/ac	100	150	Shrubs	na	180	Shrubs
11						
12	*IRA w/ Underlying Xeroriparian Class A Habitat (IRA/XA)***					
13	Total mapped habitat onsite			Acre(s)		
14	Area of disturbed RRH			Acre(s)		
15	% of mapped habitat disturbed		#DIV/0!	Acre(s)		
16	Area of mitigation		0.00	Acre(s)		

Step 2: After inputting total acreage of RRH on the property (cell C5) and total disturbance of RRH (cell C6), scroll to the bottom of the spreadsheet and enter additional data to complete the calculation. Please note that for Class H habitat, the area of disturbance is mitigated at a ratio of 1:1.5.

Input "Area of Mitigation"

Input plant quantities by size

costs are automatically calculated based on values provided in the "Average Costs" table

	uired (x shrubs/ac)*		0	Shrubs	0	na	Shrubs		
	ILF Calculation								
46	15-gallon trees	135		$10,050.98					
47	5-gallon trees	0		$0.00					
48	5-gallon shrubs	75		$1,692.86					
49	1-gallon shrubs	75		$881.25					
50	Hydroseed	1.50	Acre(s)	$5,227.50					
51	Irrigation	1.50	Acre(s)	$3,787.23					
52	5-year maintenance	1.50	Acre(s)	$5,680.85					
53	Monitoring Report	5	Years	$11,250.00					
54	**Total Cost**			**$38,569.69**					
55									
56	**Average Costs (Costs shown for plants are installed costs)**	**15-gallon tree**	**5-gallon tree**	**5-gallon shrub**	**1-gallon shrub**	**Hydroseed (per acre)**	**Irrigation (per acre)[1]**	**5-year maintenance (per acre)[2]**	**5-year monitoring (per acre per year)**
57		**$74**	**$27**	**$23**	**$12**	**$3,485**	**see notes**	**see notes**	**$1,500**
58									
59	*Density determined by onsite plant survey.								
60	**Guideline plant density requirements have been provided. The applicant may choose to perform an onsite plant survey in accordance with TECH-116 to determine plant density.								
61	***Option to basic requirement for Xeroriparian Classes A-D: Reduce total plant quantity by 20% if 100% 15 gallon trees and 100% 5 gallon shrubs are used.								
62	****Option to basic requirement for Class H: Increase total plant quantity by 20% if 50% 15 gallon/50% 5 gallon trees are used and 100% 1 gallon shrubs are used.								
63	[1]Irrigation calculated as 30% the cost of plant material (trees and shrubs)								
64	[2]Maintenance calculated as 45% the cost of plant material (trees and shrubs)								
65									
66									

Step 3: The user will input plant quantity data calculated in cells C9 and C10 into cells B46, B48, and B49. If "Option to Basic Requirements" is chosen allowing for 50% 15 gallon/50% 5 gallon size trees and 100% 1 gallon size shrubs, select values from cells F9 and F10 and input into cells B46, B47, and B49. Insert "Area of mitigation" value from cell C8 into cells B50 through B52. The spreadsheet will automatically calculate the ILF from the "Average Costs" table (cells B57 through I57).

APPENDIX G

IN-LIEU FEE SUBMITTAL CHECKLIST

Pima County Regional Flood Control District

Water Resources Division

In-Lieu Fee Submittal Checklist

Applicability: Pursuant to Chapter 16.30.050.A of the Pima County Floodplain and Erosion Hazard Management Ordinance No. 2010-FC5 (Ordinance), if an applicant demonstrates to the satisfaction of the District that alteration of regulated riparian habitat (RRH) cannot reasonably be avoided, a riparian habitat mitigation plan (RHMP) shall be submitted to the District for approval when more than 1/3 acre (14,520 square feet) of RRH is disturbed.

Additionally, if the 1/3 acre (14,520 square feet) disturbance lies within either an Important Riparian Area (IRA) or Hydroriparian/Mesoriparian (Class H) habitat, and exceeds 5% of the total RRH on the property, the RHMP will require Pima County Board of Supervisors (BOS) approval.

If the RHMP has been avoided and/or minimized to the maximum extent practicable, but a RHMP is still required, onsite mitigation shall be performed to compensate for disturbance. If it is shown, to the satisfaction of the District, that onsite mitigation is not feasible, due to lack of a suitable mitigation area, irrigation water source, etc., an offsite mitigation option is allowed per Chapter 16.30.050.D of the Ordinance, in the form of an in-lieu fee (ILF), which will require BOS approval.

Plan Review Timeframes: On average, an in-lieu fee proposal review can be completed within 10 business days, although this timeframe may vary due to workload constraints. Review of the in-lieu fee proposal can be completed concurrently with review of the subdivision plat, development plan, or Floodplain Use Permit (FPUP), provided the proposal is submitted with the plat, plan, or FPUP application. Since BOS approval is required, please account for the additional time required for final approval, which averages 3-4 weeks. The schedule for BOS regular session meetings as well as the Clerk of the Board (COB) deadline for agenda submittals may be viewed at: http://www.pima.gov/cob/schedule.htm. The proposal must be submitted to the District for review, approval, and administrative processing no later than 10 business days prior to the COB deadline.

Submittal Requirements: The in-lieu fee proposal shall follow the requirements outlined in the *Regulated Riparian Habitat Offsite Mitigation Guidelines for Unincorporated Pima County* (Offsite Mitigation Guidelines), which can be viewed at: http://rfcd.pima.gov/wrd/riparian/offsitemwg/reports.htm

The following information shall be included in the offsite mitigation proposal:

- ☐ The plan must be drawn at a measurable, standard engineering scale of 1” = 100’ or larger.
- ☐ Scale and north arrow.
- ☐ Label the plan “Riparian Habitat Mitigation In-Lieu Fee Proposal”.
- ☐ Indicate the FPUP number, project number, project name, owner/developer name, parcel ID number, and parcel address, as applicable.
- ☐ Provide justification for disturbance to RRH. If the property contains developable areas outside of the RRH, but improvements are encroaching into RRH, evidence that no reasonably practicable alternative exists to the proposed impacts and evidence that the impact has been minimized to the maximum extent practicable will be requested at the time of in-lieu fee proposal submittal. The applicant shall provide justification regarding why habitat could not be avoided. Examples of why habitat could not be avoided include site constraints, such as steep slopes which are regulated under the Zoning Code, allowance for legal use of the property requiring encroachment into habitat areas or public health and safety considerations such as traffic control (driveway access relative to major roadways) and

fire safety zones. Additionally, the applicant shall provide justification for inability to provide onsite mitigation. The justification shall be provided as a written statement, either on the exhibit or as a separate sheet of paper (8 1/2" x 11").

- ☐ Provide photographs of RRH to be disturbed. Photographs shall adequately show plant species composition and structure of RRH to be removed.

- ☐ Please provide an exhibit that includes a recent aerial photograph (Aerial photographs may be available at our office located at 97 E. Congress Street, 3rd floor or through the Pima County MapGuide website: http://gis.pima.gov/maps/; aerial photographs are also available from the private sector), limits of RRH as shown on the 2005 Riparian Classification Maps, site specific RRH limits delineated in accordance with Appendix F and G of the *Regulated Riparian Habitat Mitigation Standards and Implementation Guidelines* (as applicable), and limits of disturbance. Limits of disturbance shall include grading limits for all existing and proposed improvements including utility lines, driveways, and septic systems. If your local fire district requires the creation of defensible space around the structure, extend the grading limits to show the additional area of disturbance. As part of the submittal, provide documentation of the defensible space requirement from the local fire district. With documentation, this area can be subtracted from the total disturbance calculation.

- ☐ Use the following line type and legend descriptions on the exhibit to describe RRH:

Line Type Description	Legend Description
IRA	Important Riparian Areas (with underlying class...)*
H	Class H habitat*
XA -D	Xeroriparian Class (A, B, C, or D) habitat*

*add (rectified or field verified) as applicable

- ☐ Provide the following calculations on the exhibit:

  1. Total area of RRH on the project site, by class of habitat
  2. Area of disturbed RRH, by class of habitat
  3. Area of mitigation, by class of habitat (mitigation ratio is 1:1 for Xeroriparian Class A-D and 1.5:1 for Class H and IRA), and
  4. Acreage of habitat to be mitigated for as an in-lieu fee (only include this calculation if the proposal is part of an onsite RHMP).

  Disturbance and mitigation calculations shall be in acres, to the nearest hundredth (ex., 0.33 acres).

- ☐ Provide an ILF cost estimate to compensate for disturbed RRH. Methods for calculating the ILF can be found in the Offsite Mitigation Guidelines: http://rfcd.pima.gov/wrd/riparian/offsitemwg/reports.htm. When submitting the ILF proposal in combination with an onsite RHMP (i.e., partial onsite mitigation and partial ILF), provide a separate section on the RHMP or a separate sheet (8 ½" x 11") that documents the amount of disturbance and plant quantities to be compensated for by the ILF. Additional information, as noted above, will be addressed in the onsite RHMP.

APPENDIX H

LAND ACQUISTION CHECKLIST

APPENDIX H. LAND ACQUISITION CHECKLIST

RIPARIAN ACQUISITION MAP

The Riparian Acquisition Map (RAM), referred to in Mapguide as the "*Watercourse and Riparian Habitat Mitigation Map*" can be viewed online at: http://gis.pima.gov/maps/rfcd/mitigation/

The RAM is intended for use in determining suitability of parcels being considered under a Land Transfer or Riparian Habitat Preservation Plan (RHPP) offsite mitigation proposal. The map will allow applicants to view the location of potential mitigation parcels in relation to the selection criteria listed below.

The RAM is a GIS map based on reports and data developed in support of the Sonoran Desert Conservation Plan (SDCP). These reports spatially define biologically sensitive lands at a landscape level. The map layers include the location of these lands in relation to existing County-owned property, state parks, and federal lands (refuges, national forest, and BLM lands, etc.), special environmental features and natural resources, and corridors associated with watercourses, riparian vegetation, and wildlife movement throughout the County.

LAND ACQUISITION CHECKLIST

Lands that may qualify for acquisition under the offsite mitigation program shall be selected based on the following criteria:

The following checklist items can be determined from the Riparian Acquisition Map:

Landscape Level:

- ☐ Landscape position (Maeveen Marie Behan Conservation Lands System (CLS) categories)
- ☐ Covered species habitat (Priority Conservation Areas)

Watershed/Project Site Level:

- ☐ Adjacency to existing Preserves;
- ☐ Adjacency to major watercourses;
- ☐ Connectivity between riparian areas;
- ☐ 2005 Riparian Classification Maps – Riparian vegetation plant community (Hydroriparian or Mesoriparian (Class H) vs. Xeroriparian) and density (Total Vegetation Volume (TVV) designated by Classes A, B, C, or D);
- ☐ Water Availability (shallow groundwater/intermittent and perennial streams/springs) can be viewed in Mapguide and supporting report, *GIS Coverages of Perennial Streams, Intermittent Streams, and Areas of Shallow Groundwater*, found at: (http://www.pima.gov/CMO/SDCP/reports/d7/002GIS.PDF), or if data and/or

evidence of shallow groundwater, intermittent and perennial streams, or springs is available, please provide.

- ☐ Hydrology/Hydraulics – ability to support riparian vegetation (FEMA floodplains, locally mapped floodplains, areas of ponding, etc.);
- ☐ Adjacency to existing District-/County-owned property; however, this criterion is subject to verification of future uses of the land prior to being considered. Certain Pima County owned lands are set-aside for future development;
- ☐ Within Habitat Protection Priority Areas or Private and state priority areas, pursuant to the Conservation Bond Program (2004 and 2010);
- ☐ Connectivity with parks, refuges, existing Pima County restoration projects, and undeveloped land;
- ☐ Special Elements (bosques, cottonwood/willow, springs, seasonal cienegas, etc.);
- ☐ Constructed vs. natural riverine systems ("bank protection" layer); and
- ☐ Adjacency to or use of Transfer of Development Rights (TDR) Program and Sending Areas. Development rights are severed from these lands, which allows for higher density development in receiving areas (growth areas). TDR Sending Areas must have comparable RRH values or provide corridor connectivity.

The following information can be obtained from resources noted:

- ☐ Adjacency to reaches of watercourses defined by the 2002 SDCP Report "Riparian Priorities" (available for viewing and download at http://www.pima.gov/CMO/SDCP/reports.html);
- ☐ Adjacency to platted Natural Open Space (NOS). NOS can be identified through subdivision plats or development plans, which can be viewed at: http://www.pimaxpress.com/SubDivision/Default.htm;
- ☐ Historical perennial flows, if available. Information for historical perennial flows can be found at the following online resources:

  SDCP Publication *Historical Occurrence of Native Fish in Pima County* (http://www.pima.gov/CMO/SDCP/reports/d7/011HIS.PDF)

  USGS water data website for Arizona, which can be viewed at: http://waterdata.usgs.gov/az/nwis/rt

APPENDIX I

GLOSSARY

Appendix I. Glossary

Compensatory Mitigation: See Mitigation

Conservation Easement: A conservation easement is a voluntary legally binding and enforceable agreement between a landowner and a government agency or a qualified land protection organization for the purposes of conservation. A conservation easement restricts mutually agreed upon activities on a property while the landowner retains private ownership. The easement carries with the land in perpetuity. The agency holding the easement is responsible for enforcing the terms of the easement.

Deed Restrictions: Legally binding and enforceable terms or restrictions placed on a piece of property that is recorded with the County Recorder and carries with the land in perpetuity.

Development Review Process: Process by which development plans and subdivision plats are reviewed and approved by Pima County.

Ecosystem or Habitat Functions: Ecosystem functions are the physical, chemical, and biological processes or attributes that contribute to the self-maintenance or sustainability of an ecosystem or natural habitat

Flat Fee: A fixed monetary fee to compensate for disturbance of Regulated Riparian Habitat, paid in-lieu of onsite mitigation. The Flat Fee is based on the cost to mitigate onsite.

Fee Simple: A real estate term meaning the owners have absolute title to the land, free of any claims. The property owner is entitled to full enjoyment of the property, limited only by the basic government powers, deed or subdivision restrictions or covenants. The duration of this ownership is not limited and can be passed along in a will to the owner's heirs.

Land Transfer: An offsite mitigation option designed to provide compensatory mitigation through the transfer of land to the District in-lieu of onsite mitigation. The transferred land would then be preserved to maintain habitat and ecosystem functions. Such lands must contain equivalent or greater ecosystem value than the habitat being impacted by the proposed project.

In-Lieu Fee: A monetary fee paid in-lieu of onsite mitigation to compensate for disturbance of regulated riparian habitat.

In-Lieu Fee Program Bank Account: A bank account established by Pima County Regional Flood Control District in which in-lieu fees are deposited and withdrawn for the purpose of purchasing or restoring lands containing riparian habitat.

Mitigation (aka compensatory mitigation): Implementation of measures designed to reduce or offset negative effects of a proposed action on natural resources, such as restoration, enhancement, creation, and/or preservation of riparian habitats, carried out to replace or compensate for the loss of habitat value.

> *Onsite, in-kind mitigation* means compensatory mitigation on the project site or on property adjacent to or contiguous with the site which replaces natural habitat area or functions lost as a result of a project with the same or like habitat type and functions.
>
> *Offsite mitigation* means compensatory mitigation at a location other than the project site.

Mitigation Monitoring: The method by which the District ensures continued compliance with permit conditions and identifies problems that may affect success of the mitigation plan. The monitoring program must assess the success of replaced ecosystem functions and values during the regulatory 5 year maintenance period.

Qualified Professional: An individual with one or more of the following qualifications: (1) an arborist with International Society of Arboriculture certification; (2) a landscape architect with Arizona state technical registration as a landscape architect; and/or (3) a biologist, horticulturist, or botanist with a minimum B.A. or B.S. in a plant oriented natural resource field

Stewardship: Habitat stewardship is a land management ethic or practice that includes a range of activities to ensure sustainability of the biological diversity, natural resources, and natural functions on a particular property.