RECLAMATION
Managing Water in the West

Environmental Assessment

Transfer of 1,481 Acre-Feet Annually of CAP Water Entitlement from the Flowing Wells Irrigation District to the Town of Marana Utilities Department
Pima County, Arizona

U. S. Department of the Interior
Bureau of Reclamation
Phoenix Area Office
Glendale, Arizona

August 2009

ENVIRONMENTAL ASSESSMENT

TRANSFER OF 1,481 ACRE-FEET ANNUALLY OF CAP WATER ENTITLEMENT FROM THE FLOWING WELLS IRRIGATION DISTRICT TO THE TOWN OF MARANA UTILITIES DEPARTMENT

Prepared For:

U.S. Bureau of Reclamation

On Behalf of:

Town of Marana Utilities Department

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Interior and Reclamation Mission Statements

The mission of the Department of the Interior is to protect and provide access to our Nation's natural and cultural heritage and honor our trust responsibilities to Indian tribes and our commitments to island communities.

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

August 2009

ABBREVIATIONS AND ACRONYMS

ADWR	Arizona Department of Water Resources
AF	acre-feet
AFA	acre-feet/annually
AGFD	Arizona Game and Fish Department
AMA	Active Management Area
AWS	Assured Water Supply
BE	Biological Evaluation
CAGRD	Central Arizona Groundwater Replenishment District
CAP	Central Arizona Project
CAWCD	Central Arizona Water Conservation District
CAWS	Certificate of Assured Water Supply
CFR	Code of Federal Regulations
cfs	cubic feet per second
CMID	Cortaro Marana Irrigation District
CRBPA	Colorado River Basin Project Act
CWA	Clean Water Act
DAWS	Designation of Assured Water Supply
EA	Environmental Assessment
ESA	Endangered Species Act of 1973, as amended
FR	Federal Register
FWCA	Fish and Wildlife Coordination Act
FWID	Flowing Wells Irrigation District
GIS	Geographic Information System
HCP	Habitat Conservation Plan
HDMS	Heritage Database Management System
ITA	Indian Trust Asset
Listed species	species listed as federally threatened or endangered under the ESA
LSCRP	Lower Santa Cruz Recharge Project
M&I	municipal and industrial
mafa	million acre-feet annually
NIA	non-Indian Agriculture
O&M	Operation & Maintenance
NHPA	National Historic Preservation Act
NEPA	National Environmental Policy Act
P.L.	Public Law
Reclamation	Bureau of Reclamation
SHPO	State Historic Preservation Office
TAMA	Tucson Active Management Area
TMUD	Town of Marana Utilities Department
USFWS	U.S. Fish and Wildlife Service

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CHAPTER 1 – PURPOSE AND NEED

A. INTRODUCTION

This Environmental Assessment (EA) describes the environmental effects of the proposed transfer of 1,481 acre-feet annually (afa) of a Central Arizona Project (CAP) water entitlement from the Flowing Wells Irrigation District (FWID) to the Town of Marana Utilities Department (TMUD; Figure 1). Transfer of this CAP entitlement requires approval by the Bureau of Reclamation (Reclamation) and constitutes a federal action. This EA has been prepared in accordance with the requirements of the National Environmental Policy Act (NEPA), as amended, the Council on Environmental Quality's regulations for implementing NEPA (40 CFR 1500-1508), and the Department of the Interior regulations implementing NEPA (43 CFR Part 46). This EA identifies impacts anticipated to result from Reclamation's signing of the agreement to transfer a portion of FWID's CAP entitlement to the TMUD.

This EA is presented in six chapters plus appendices:

- Chapter 1 – Purpose and Need
- Chapter 2 – Proposed Action and Alternatives
- Chapter 3 – Affected Environment and Environmental Consequences
- Chapter 4 – Consultation and Coordination
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B. Background/ Overview of Federal and State Water Regulations and Policies Directing CAP Entitlement Transfers

The rights to use water resources from the Colorado River are shared by seven Colorado River basin states, tribes, and Mexico. Water rights are determined by federal legislation, court decisions, international treaty, and administrative decisions, which in combination create the "Law of the River." The Colorado River basin is divided into the Upper Basin, which has an entitlement of 7.5 million acre-feet/annually (mafa), and the Lower Basin, which is entitled to 7.5 mafa. Lee's Ferry, located about 18 miles downstream of Glen Canyon Dam in northern Arizona, divides the Upper and Lower Basins. By treaty, Mexico is entitled to 1.5 mafa. The Lower Basin entitlement by state is summarized in Table 1.

Table 1. Distribution of Water in the Lower Basin of the Colorado River

State	Water Allotment
Arizona	2.8 mafa
California	4.4 mafa
Nevada	300,000 afa

The US Congress passed the Colorado River Basin Project Act (CRBPA) on September 30, 1968 (P.L. 90-537). The CRBPA authorized the Secretary of the Interior (Secretary), acting through Reclamation, to build, operate, and maintain the CAP to deliver Colorado River water to central and southern Arizona. Construction of the CAP began in 1973 and was completed 20 years later at a cost of more than $4 billion. The CAP conveys Colorado River water in Arizona through a 336-mile long system of pumping plants, aqueducts, dams, and reservoirs. Starting at Lake Havasu, the main aqueduct extends east to Phoenix then south to Tucson, where it terminates. The CAP has the physical capacity to deliver 2.2 mafa of Arizona's allotted 2.8 mafa, assuming the system is operating 24 hours per day, 7 days per week. However, the average delivery volume is lower, approximately 1.5 mafa, due to time offline for operational needs, such as pump and canal system maintenance and repair.

CRBPA also provided the Secretary with the authority to execute contracts for CAP water. Consistent with federal reclamation laws, uses of CAP water are distributed to three main sectors: municipal and industrial (M&I), non-Indian agricultural (NIA), and Indian. Although the original intent of the CAP system was to distribute water for agriculture, CAP management and purpose have shifted in response to population growth in central and southern Arizona and increased awareness of Indian water rights and needs. CAP management is now focused more on water uses for M&I and tribal entities than for NIA.

In 1971, the Arizona State Legislature authorized the formation of the CAWCD to repay the federal government for the construction cost of the CAP, to contract for delivery of Colorado River water, and to operate and maintain the CAP aqueduct. The CAP system is operated and maintained by the CAWCD under a 1987 Operation and Maintenance (O&M) transfer contract with Reclamation. Today, CAWCD is a municipal corporation governed by a 15-member board of directors with representation from Maricopa, Pinal, and Pima counties. A 1988 repayment contract between the Secretary and CAWCD established the process by which CAWCD and the system's users would repay the federal government for costs associated with construction of the CAP.

In 1980, the Arizona legislature passed the Groundwater Management Act. It established Active Management Areas (AMAs) within which goals for managing groundwater withdrawals were identified. Within the Tucson AMA (TAMA), the goal is to obtain safe-yield, or a balance between groundwater withdrawals out of, and natural and artificial recharge into, the basin. To achieve this, the assured water supply (AWS) rules require that a new residential development within the TAMA must demonstrate there are sufficient water supplies available to meet proposed uses for 100 years and those uses are consistent with achieving the goal of safe yield. Within an AMA, a new residential development can receive a certificate of AWS (CAWS) from ADWR or it can receive service from a water company that has received a Designation of AWS (DAWS) from ADWR, as has the TMUD. Under the AWS rules adopted by ADWR in 1995, the use of renewable water supplies, such as effluent and CAP water, is required for new development within the service area. Renewable water supplies must be provided directly by the water provider or by enrolling in the Central Arizona Groundwater Replenishment District (CAGRD).

CAGRD was created by the Arizona State Legislature in 1993, and is operated by the CAWCD. Member lands (developments that have joined CAGRD to qualify for a CAWS) and member service areas (water

providers that have joined CAGRD to obtain a DAWS) pay CAGRD to replenish groundwater they have pumped that is in excess of their ADWR groundwater allowance. The member lands or member service areas must report annually to CAGRD any groundwater pumped in excess of the maximum allowed by AWS rules. The total volume of excess groundwater reported for all CAGRD members within that AMA becomes the replenishment obligation for the CAGRD and must be recharged in that AMA within three years. ADWR has authority and establishes regulatory requirements for groundwater use within the TAMA. CAGRD must report the replenishment obligation to ADWR and all replenishment completed in the previous year.

The CAGRD utilizes several strategies to assist water service providers with their replenishment obligations, including: (1) storing water at replenishment projects the CAGRD constructs and operates on behalf of its members, (2) recharging water as a cooperator at a state demonstration project or other recharge facility, or (3) purchasing recharge credits that have been previously accrued by CAWCD or another entity.

C. Purpose and Need for Action

The TMUD has been issued a DAWS in the amount of 7,580 afa by ADWR (ADWR 2007a). TMUD is able to meet the water demands for current and anticipated population growth for the next 10 years within the service area based upon an existing agreement for excess CAP water with the CAWCD (CAWCD 1995). TMUD is proposing to acquire 1,481 afa of CAP entitlement from FWID.[1] This would be a permanent and less costly renewable potable water source than using CAGRD to fulfill TMUD's replenishment obligations, and would reduce TMUD's dependence on groundwater within its service area. FWID does not need its entire CAP water entitlement to meet projected demand and would like to reduce its entitlement by 1,500 afa; CAP water service subcontractors currently must pay an annual acre-foot charge for their CAP entitlement, even if it is not used.

The original CAP entitlement transfer request submitted by FWID and TMUD, which was reviewed by ADWR totaled 1,500 afa. Based on the CAP entitlement transfer policy established by ADWR, 19 afa of the original 1,500 afa may be acquired by the city of Tucson, a competing applicant. With the adjustment for Tucson's acquisition, TMUD's transfer request would be reduced from 1,500 afa to 1,481 afa (ADWR 2007b).

The need for the project is to (1) secure a long-term, economically feasible right to a renewable water supply for TMUD, and (2) enable TMUD to reduce its reliance on the CAGRD and purchased excess CAP water to meet its replenishment obligation.

[1] FWID's initially requested transferring 1,500 afa to TMUD. The ADWR Colorado River Management Section performed a review of this transfer in its "Evaluation of the Proposed Partial Transfer of Flowing Wells Irrigation District's CAP Municipal and Industrial Subcontract Allocation" dated January 12, 2007 (a copy of this evaluation is included in Appendix A). Through this evaluation process, ADWR determined the proposed CAP subcontract entitlement transfer from FWID to the TMUD is consistent with the water management objectives, review criteria, and decision guidelines established by ADWR. ADWR determined TMUD should receive 1,481 afa, and 19 afa should be transferred to the city of Tucson (Tucson). Tucson has not requested an amendment to its CAP water service subcontract to obtain the 19 afa; if Reclamation receives that request, NEPA compliance will be completed. Reclamation believes 19 afa to Tucson would be transfer of a minor amount of water to an existing subcontractor.

D. PROJECT LOCATION

The project is located in Pima County, Arizona, and includes the FWID and TMUD service areas (see Figures 2 and 4, respectively). Both service areas are located within the TAMA. The existing LSCRP and associated infrastructure would be used for recharge of the reallocated CAP water. The LSCRP is located in the town of Marana, adjacent to the Santa Cruz River (Figure 5).

D.1. Flowing Wells Irrigation District

The FWID was formed in the late 1800s and currently supplies potable water for urban use within its service area through an established well-and-water distribution system. The FWID has been providing drinking water to its customer base since 1922 and currently has over 3,500 service connections that serve the domestic and fire protection needs for 16,000 people and businesses. The FWID water service area is essentially fully developed and covers approximately 3.4 square miles (2,175 acres) within the incorporated limits in the western portion of the city of Tucson, as well as unincorporated areas in Pima County, Arizona (Figures 2 and 3). FWID currently provides approximately 2,800 afa of potable water to its customers via an existing underground pressurized water delivery system consisting of eight wells and storage tanks.

D.2. Town of Marana Utilities Department

The TMUD is a municipal water utility established in 1997 through the acquisition of several water systems within the town of Marana including the Honea Water Company, Cortaro Water Users Association, portions of the I.M. Water Company, and portions of Marana-Picture Rocks Water Service. For the purpose of this assessment, TMUD's service area encompasses an area of approximately 61,195 acres, and is defined as the incorporated limits of the Town and areas being served by TMUD that are outside the town limits, but excludes areas that are currently served by City of Tucson and Oro Valley Water Utility (Figure 4). Approximately 9,765 acres of developed areas are currently served by TMUD. The developed areas represent approximately 16 percent of the analysis area. Approximately 51,430 acres of undeveloped lands within the analysis area include open space and agricultural areas.

The TMUD provides potable water service to approximately 4,900 residential and commercial connections (TMUD 2008). TMUD actively serves a population of approximately 10,000 people, within its nine water service areas. Existing water service areas are North Marana, Picture Rocks/Continental Reserve/Springs, Cortaro/Oshrin, Airline/Lambert, La Puerta, Palo Verde, Hartman Vistas, Airport, and Falstaff Flats. The TMUD currently is capable of delivering groundwater from 26 production wells. In addition, there are 19 reservoirs and associated booster stations that are used to deliver drinking water to customers.

E. SUMMARY OF PUBLIC INVOLVEMENT

Reclamation issued a scoping memorandum on its website (http://www.usbr.gov/lc/phoenix/) on February 13, 2009. The memorandum summarized the proposed transfer of 1,481 afa of CAP entitlement

from FWID to TMUD, and requested any comments on the proposed transfer be submitted by March 9, 2009. No comments on the proposal were received.

ADWR conducted an extensive public involvement process as part of its evaluation of the proposed CAP water entitlement transfer. This included sending out a notice in fall 2004 to each TAMA and CAP M&I water service subcontractor to solicit input on the proposed transfer. ADWR also published a public notice in the *Business Gazette* on November 4 and 11, 2004, announcing its public comment period on the proposed transfer. ADWR's public comment period ended on December 13, 2004. ADWR received two comment letters during this comment period. Metropolitan Domestic Water Improvement District sent a letter supporting the proposed transfer and Tucson Water requested that it be considered as a competing applicant during ADWR's evaluation process.

CHAPTER 2 – PROPOSED ACTION AND NO ACTION ALTERNATIVE

A. THE PROPOSED ACTION

A.1. Flowing Wells Irrigation District

FWID's original CAP water entitlement of 4,335 afa would be reduced by 1,481 afa and its CAP water service subcontract would be amended to reduce its entitlement to 2,854 afa; FWID would continue to pay the CAP capital charges for the remaining entitlement.

The FWID was allocated 4,354 afa of CAP water on June 19, 1985 (CAP 2008a); however, it has not developed the necessary infrastructure to take, treat, and serve CAP water to its customers. FWID plans to retain 2,854 afa of its CAP water to meet its projected demand and eventually use it to replace the groundwater supply currently used to meet its potable water demand. The FWID recently obtained a DAWS from ADWR that will provide FWID the ability to recharge CAP water and accumulate storage credits. The FWID will continue to pay capital costs to maintain the balance of its CAP water entitlement not used for storage credits.

FWID is a member of a collaborative organization called the Northwest Municipal Water Providers that is studying, in cooperation with Reclamation, the feasibility of constructing a regional CAP water storage reservoir, water treatment plant, and conveyance system to deliver treated CAP to the organization members' water service areas. Should this regional system be constructed and operated in the future, FWID would be able to have its CAP water entitlement treated and delivered via this regional system to the FWID water service area. Regardless of FWID's final plans for taking and using its remaining CAP water entitlement, however, FWID has determined 1,500 afa is excess to its needs and would like to transfer it to another entity to reduce the annual costs of its CAP entitlement.

A.2. Town of Marana Utilities Department

TMUD's CAP water service subcontract would be amended to increase its annual entitlement from 47 to 1,528 afa. As with its existing 47 afa entitlement, TMUD intends to convey the transferred CAP water to the LSCRP using existing infrastructure, where it would be recharged. The TMUD would obtain recharge credits which it would use to offset ground-water pumping. No modification to the existing facilities would be required to handle the additional 1,481 afa.

The TMUD acquired 47 afa of CAP entitlement from CMID through execution of a CAP water service subcontract on October 12, 1999 (CAP 2008b). Currently this entitlement, as well as excess CAP water purchased from CAWCD, is being recharged by the TMUD into the LSCRP. In the near term, TMUD proposes to recharge and recover the transferred 1,481 afa of CAP entitlement in the same manner as its current 46 afa of CAP entitlement. In the long term, TMUD could, as a member of the Northwest

Municipal Water Providers, have this transferred CAP entitlement treated and delivered via the proposed Regional System once it is constructed.

In the future, TMUD's water portfolio will include CAP water (storage and/or direct use), effluent, and allowed groundwater pumping to provide water to its entire service area. The TMUD will continue to obtain and develop renewable water supplies and coordinate with the CAGRD to meet replenishment obligations as needed.

The LSCRP is located in the northeast corner of Township 12 South, Range 11 East and consists of three recharge basins ranging in size from 7.4 to 11.0 acres with a total surface water area of 30 acres. The water is delivered to the LSCRP using three natural gas-powered side pumps installed in the CAP canal. Each pump is capable of operating at 25 cubic feet per second (cfs) or 11,000 gallons per minute (gpm) (CAP 2008b). The water is pumped into an existing open irrigation canal system and conveyed approximately 1 mile to the LSCRP where it is diverted into the recharge basins.

The LSCRP has a current permitted capacity from ADWR for 50,000 afa and a total storage capacity of 600,000 acre-feet (af). With a delivery capacity of 65 cfs, the total amount of water stored at the LSCRP at the end of 2007 reporting year was 236,674 af (CAP, 2008b). The annual storage volume for the LSCRP during the past few years has been approximately 42,000 af. If the total storage capacity of 600,000 af is approached, a request to modify the Underground Storage Facility permit would likely be made to ADWR to increase this volume (ADWR 2008).

The town of Marana has a Water Storage (WS) permit issued by ADWR for the constructed LSCRP in the amount of 30,000 afa (Permit Number 73-561366.0500). This WS permit provides adequate ability for the TMUD to increase its annual recharge storage volume from 47 afa to 1,528 afa of CAP water (CAGRD 2008). The ADWR has also issued TMUD a Recovery Well Permit to allow the recovery of recharged water from eight designated existing wells.

B. NO-ACTION ALTERNATIVE

B.1. Flowing Wells Irrigation District

FWID currently does not have the infrastructure needed to take, treat, and serve CAP water to its customers. Under the no-action alternative, FWID would continue to pay the CAP capital charges to maintain its entitlement unless/until that charge is eliminated. When and as required by ADWR, FWID would recharge a portion of its CAP entitlement consistent with requirements of its DAWS. It would use 2,854 afa of its CAP entitlement to replace the groundwater it currently pumps to meet its water service area's potable water demand. To the degree those plans for taking and using its CAP entitlement require federal review and approval, or involve a federal action or monies, separate compliance with NEPA would be required. Until this occurs, the unused portion of FWID's entitlement would continue to be treated as excess CAP water that would become available to other users through acquisition from the

CAWCD. FWID would likely continue to seek transfer of 1,481 afa of its CAP water entitlement to another entity.

B.2. Town of Marana Utilities Department

Under the no-action alternative, the TMUD would continue to be responsible for delivery of potable water to its service area in accordance with the requirements of its DAWS and other applicable state and federal regulations. TMUD would continue to purchase excess CAP water for recharge at the LSCRP, and would accumulate recharge credits for use in the future to offset groundwater replenishment obligations as a member of CAGRD. In the event that water is not transferred to the TMUD from FWID and/or excess CAP water is not available for purchase, the TMUD would continue to use groundwater to meet its needs and would pay CAGRD for fulfilling TMUD's replenishment obligation. New development would be served by the TMUD under its current DAWS. A modification to the TMUD's DAWS would be submitted to ADWR prior to exceeding its current limit.

C. Alternatives Considered But Eliminated From Further Study

Transfer of 1,500 afa of CAP Water Entitlement from FWID to the TMUD. The ADWR reduced the TMUD's original transfer request by 19 afa and determined that the proposed transfer of 1,481 afa was consistent with the intent of the original CAP distributions.

Transfer of FWID CAP Water Entitlement at Some Volume and Rate Less Than the 1,481 afa Authorized by ADWR. This alternative would be inconsistent with ADWR's findings (Appendix A). Based upon the results of ADWR's review, this alternative was not considered further.

Other Sources of Renewable Water Supplies to Meet the Town of Marana's Needs. The town of Marana has a population of 26,725 in an area of 118 sq. miles (Marana 2008a). From 2000 to 2006, Marana was the eighth fastest growing city in the state of Arizona with a 124.5 percent increase in population (Marana 2008b). In response to recent and anticipated growth, the TMUD has continued to pursue and secure renewable water supplies. Obtaining a CAP entitlement transfer from FWID is one of several strategies under evaluation by the TMUD to ensure a reliable, long-term, renewable water supply. Opportunities for the TMUD to obtain renewable water supplies to reduce groundwater pumping and meet future replenishment obligations are summarized in Table 2. Many of these options do not require federal action and most are outside of Reclamation's scope of authority. None of these options is an exclusive alternative to the proposed re-entitlement of CAP water from the FWID to the TMUD. Some are only an alternative means of reallocated water distribution and use of reallocated water. While these alternatives remain potential actions that could be pursued in the future, they are not considered to be viable to meet TMUD's immediate and near-term objective of increasing its use of renewable water supplies. Therefore, they were eliminated from further consideration.

Table 2. Renewable Water Supply Opportunities and Alternatives

Renewable Water Supply Source	Water Supply Strategy/Description
Effluent	The TMUD is pursuing ownership and operation of wastewater treatment facilities within its projected service area in order to own and reuse the effluent generated by its citizens. Treated effluent would be used to offset groundwater pumping by its direct use as a reclaimed water supply and through recharge. Effluent recharge credits can be accumulated through an underground storage facility (USF) permit issued by ADWR. This future recovery would offset groundwater use.
CAP Recharge	The TMUD can continue to purchase excess CAP water supplies and recharge the water and its CAP entitlement and accumulate long-term storage credits. CAP recharge credits would be accumulated through a USF permit and recovered in the future to offset groundwater reporting.
CAP – Direct Use	The TMUD, as a participant in the Northwest Area Water Providers group will explore alternatives to offset groundwater pumping through direct potable use of CAP water.
In-lieu Recharge	The TMUD has the opportunity to use its CAP entitlement and/or effluent rights for direct delivery to agricultural users in lieu of pumping groundwater to irrigate crops. The TMUD can accumulate in-lieu storage credits through the delivery of its CAP entitlement to an agricultural user. In-lieu storage credits may be recovered by wells and reported as CAP water under an ADWR groundwater savings facility permit.
Recharge Credit Purchase	The TMUD can purchase CAP or effluent recharge credits on the open market from sellers who have accumulated long-term storage credits by a USF permit. Effluent credits could also be obtained from Reclamation as part of the exchange water available from the Southern Arizona Water Rights Settlement Act.
Surface Water	The TMUD is investigating the possibility of obtaining surface water rights currently held by the Cortaro-Marana Irrigation District.

CHAPTER 3 – AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

This section describes the affected environment and likely environmental consequences of the proposed transfer of 1,481 afa of FWID's CAP water entitlement to the TMUD. A no-action scenario is evaluated for both service areas for comparison with the proposed action. Because no new infrastructure is required to deliver and store the additional CAP water entitlement, no ground-disturbing activities would take place and there would be no direct impacts to resources. A number of resource areas are not expected to be affected to any measureable degree, either directly or indirectly and, therefore are not included in this analysis. These include air resources, recreation resources, and geology and soils. Also, there are no Indian Trust Assets affected by the proposed water transfer.

A. WATER RESOURCES

A.1 Affected Environment

A.1.1 Flowing Wells Irrigation District

The FWID is located within portions of the Avra Valley sub-basin and Upper Santa Cruz River sub-basin in the TAMA. These basins are located within the Basin and Range Physiographic providence of southern Arizona. The Basin and Range providence of southern Arizona is characterized by long, broad, alluvial valleys comprised of eroded remnants of the surrounding mountain ranges, including Recent Alluvium (Quaternary), Fort Lowell Formation (Quaternary), and Tinaja beds (Tertiary) (CAP 2008a).

Surface water features are limited within the service area. All drainages are ephemeral and convey stormwater flow through the area. The confluence of the Navajo and Cemetery Washes at the southeast corner of the service area becomes the Flowing Wells Wash, which conveys flows west across the southern portion of the FWID service area and discharges to the Santa Cruz River west of I-10. The Rillito River creates the northern boundary of the service area.

As mentioned in Chapter 1, D.1, FWID's service area is essentially fully built out. It current serves a population of about 16,000 people and businesses using approximately 2,800 afa of pumped groundwater from the Tucson Basin aquifer. FWID's potable water meets all federal and state requirements (FWID 2009). The FWID is not directly using its 4,354 afa of CAP water at this time because the infrastructure to convey the water is not in place and there are currently no plans to develop such infrastructure. Tucson Water also currently provides about 17 afa of potable water and 115 afa of reclaimed water to users within FWID's service area.

A.1.2 Town of Marana Utilities Department

The town of Marana is located within portions of the Avra Valley and Upper Santa Cruz River sub-basin in the TAMA. The main water drainage within the TAMA is the Santa Cruz River which runs south to

north in the Upper Santa Cruz sub-basin then northwest into the Avra Valley sub-basin. Major tributaries to the Santa Cruz River upstream of the town of Marana include the Cañada del Oro Wash, Rillito River, and their tributaries, the Pantano Wash and Tanque Verde Wash. These drainages are ephemeral and flow only in response to rainfall events. However, there is an approximately 9-mile reach of the Santa Cruz River which is perennial due to the volume of treated effluent discharged into the channel at Roger and Ina Roads (ADWR 1999). Stormwater runoff from the adjacent Tucson and Tortolita Mountain ranges, coupled with stormwater infiltration along the Lower Santa Cruz River and its tributaries, contribute to the portion of the aquifer which supplies TMUD.

Historical records indicate impacts from agricultural irrigation, municipal use, and industrial water supplies have considerably altered groundwater levels in TAMA since the 1940s. Fissuring and land subsidence have been attributed to aquifer dewatering in northern Avra Valley. Compaction tests demonstrate a change in surface elevation from 0.02-foot to 0.18-foot at seven locations in the Upper Santa Cruz sub-basin and from 0.01-foot to 0.11-foot at seven locations in the Avra Valley (ADWR 1999). There has been some recovery of groundwater levels along the Santa Cruz River and northern Avra Valley due to decreased agricultural and mine pumping and increased flood flows (ADWR 1999). The use of CAP water for agriculture in lieu of groundwater has also contributed to rising groundwater levels. The stability of the water supply relies on the management of renewable water supplies as demand continues to increase.

The town of Marana currently relies primarily on groundwater for its potable water source. The existing well fields used by TMUD and its wholesale water provider lie primarily within the Upper Santa Cruz Valley sub-basin of the TAMA. As mentioned in Chapter 1, D.2, the TMUD service area is currently served by nine public water systems that make up the TMUD, delivering potable water to the developed portions of Marana. TMUD serves a population of approximately 10,000 people through a total of about 4,900 municipal and commercial meter connections. Most of these systems operate independently from one another, but over time it is expected that interconnections will be made to enhance system reliability. The quality of water delivered by TMUD is good, and consistently meets or exceeds the Safe Drinking Water Standards established by the federal Environmental Protection Agency and Arizona Department of Environmental Quality (Marana 2009a).

A summary of connections within the service areas of the TMUD as of February 2008 is shown in Table 3.

Table 3. Summary of Meter Connections in the TMUD Active Service Area

Service Area	Meter Connections
North Marana	2,034
Picture Rocks/Continental Reserve/Springs	1,800
Cortaro/Oshrin	406
Airline/Lambert	139
La Puerta	78
Palo Verde	50
Hartman Vistas	370
Airport	23
Falstaff Flats	3
TOTAL	**4,903**

TMUD has a DAWS from ADWR and is a member of CAGRD.[2] ADWR's Decision and Order, dated May 14, 2007 (Appendix A), states that 7,580 afa are physically, legally and continuously available to the TMUD to support its AWS designation. The TMUD must meet the depth to groundwater criteria established in the AWS Rules and has the legal right to withdraw groundwater from the identified point(s) of withdrawal.

In 2007,[3] the summary of annual water use reported by the TMUD to ADWR included withdrawn groundwater of 886 af plus 1,002 af of water received from other rights, for a total of approximately 1,888 af (ADWR 2008). The Cortaro Marana Irrigation District (CMID) provided the majority of this water to TMUD and was its principal wholesale water provider. CMID delivered 229 af of surface water and 747 af of groundwater to TMUD in 2007. TMUD supplemented this with approximately 886 af of groundwater pumped from its well system and 26 af of groundwater received from Tucson Water (ADWR 2008).

As a municipal provider and participant in CAGRD, the TMUD is obligated to have the amount of excess groundwater withdrawn replenished by CAGRD based on its DAWS. It may obtain long-term storage credits through the recharge of renewable water supplies. The TMUD currently has in excess of 10,000 af of storage credits as a result of recharging its current CAP entitlement and excess CAP purchases. The TMUD intends to use the transfer of 1,481 afa of FWID's CAP entitlement to increase the recharge component of its water portfolio and reduce its dependency on groundwater supplies, as well as the need to have CAGRD fulfill its replenishment obligations.

TMUD is able to meet the water demands for current and anticipated population growth for the next 10 years within the service area based upon its existing agreement with the CAWCD for excess CAP water (CAWCD 1995).

[2] Membership in CAGRD does not waive the requirement under AWS Rules to demonstrate the physical and legal availability of groundwater.

[3] Water providers are required to report their annual water use to ADWR each year. The most current ADWR annual water withdrawal and use report is from 2007.

In accordance with the TMUD's Member Service Area Agreement with CAWCD, 9/30th (499 af) of the groundwater delivered by TMUD within the service area is considered excess groundwater use in 2007[4] (CAWCD 1995). This excess groundwater use was offset by accumulated recharge credits and the recharge of excess CAP water in the LSCRP using existing turnout and conveyance infrastructure.[5]

A.2 Environmental Consequences

A.2.1 Proposed Action

Flowing Wells Irrigation District

The proposed action would result in the transfer of 1,481 afa of FWID's CAP water entitlement to the TMUD. FWID would retain a CAP entitlement of 2,873 afa, of which 19 afa has been designated as being transferred to Tucson Water. When and as required by ADWR, DAWS FWID would recharge its CAP entitlement as needed to fulfill its replenishment obligations. Negative impacts are not anticipated if FWID releases 1,481 afa of its existing CAP entitlement of 4,354 afa to the TMUD. Water use in FWID has been essentially at a steady state for many years and future development is limited.

Town of Marana Utilities Department

Under the proposed transfer, water would be conveyed through existing infrastructure currently used to deliver CAP water from the CAP canal to the LSCRP. All delivery systems exist and have the capacity to accept the additional flows. The flows would be conveyed to the LSCRP (Figure 5) which consists of three basins ranging from 7.4 to 11.0 acres, for a total of 30 acres. No new storage facilities would need to be constructed for recharge purposes. No impacts associated with the CAP water delivery, recharge, and storage are anticipated. There would be no identifiable impacts to the CAP, FWID, or TMUD operations as a result of this transfer and no significant impacts resulting from this transfer are anticipated. CAP water has been recharged at the LSCRP since 2000. It is likely that a portion of the groundwater produced by some of TMUD's wells is recharged CAP water; there have been no reported adverse impacts to water quality. The recharge of an additional 1,481 afa of CAP water is not anticipated to result in substantial changes to the current local groundwater quality. Use of the existing recharge facilities and recovery wells to store and recover the CAP entitlement would enable Marana to reduce its existing, annual groundwater use (ADWR 2007a).

By acquiring 1,481 afa of CAP entitlement from FWID, the TMUD would contribute to meeting groundwater reduction obligations under the AWS program. The increased CAP water entitlement for the TMUD would reduce its reliance on groundwater resources and be consistent with TAMA water management goals.

[4] This percentage of the groundwater pumped that is considered excess groundwater is calculated on a sliding scale, beginning as 1/30th of the groundwater pumped in 1999 to 16/30th of the groundwater pumped in 2014.

[5] As a member of CAGRD, TMUD could have purchased replenishment credits directly from CAGRD to comply with its DAWS requirements.

A.2.2 No-Action

Flowing Wells Irrigation District

Under the no-action alternative, FWID would continue to hold its CAP entitlement of 4,354 afa and would likely seek to transfer 1,500 afa of it to other entities. There would be no changes to current water resource conditions within FWID's service area. FWID would continue to utilize groundwater to serve the area. Because the area is built out, increased demands for water are not anticipated. Upgraded developments would replace existing structures over time and would incorporate features designed to minimize water use. Therefore, the demand for groundwater is anticipated to remain unchanged or decrease in the future.

Town of Marana Utilities Department

Under the no-action alternative, TMUD would continue to rely on recharge of excess CAP water and CAGRD to meet its replenishment obligations in the reasonably foreseeable future. The TMUD can meet all current ADWR requirements for replenishment via its existing agreements with the CAGRD. TMUD would continue to pursue a number of long term options to meet its replenishment obligations, such as acquiring additional renewable water resources for direct use, recharging available effluent or CAP water supplies, or continuing to rely on the CAGRD to meet its future replenishment obligation at full build-out.

B. LAND USE

B.1. Affected Environment

B.1.1 Flowing Wells Irrigation District

The FWID was formed in the late 1800s. The area served by FWID was formerly agricultural land located south of the Rillito River and east of I-10. FWID currently supplies water through its well systems for urban use to areas on the northwest side of the city of Tucson as well as unincorporated areas in Pima County. Much of the area has converted to residential and retail development (Figure 3). The district is considered built out and any new development would likely replace an existing use within the service area. As of 1999, FWID delivered approximately 2 percent of the total water delivered by large municipal water providers located in the TAMA (ADWR 1999). More than half of the potable water deliveries are to residential customers in manufactured or mobile homes. The remaining residential use is made up of site-built, single-family residences and multi-family units. Non-residential users include schools, shopping areas, offices, restaurants, and light manufacturing.

B.1.2 Town of Marana Utilities Department

For purposes of this EA, the project area for TMUD is defined as the lands within Marana's town limits, as well as some isolated areas outside the town limits which currently are served by TMUD. The project

area does not include areas within the town limits (boundary) that are currently served by Tucson Water and Oro Valley Utility (Figure 4). The project area covers about 61,195 acres, of which approximately 16 percent are developed and receive water from TMUD. The major land uses of developed areas within the town of Marana that currently are served potable water consist of residential, commercial/industrial, and public/institutional/recreation. Over 75 percent of the TMUD project area consists of agricultural, vacant, and/or undeveloped land (Marana 2007a).

Marana's General Plan 2007 provides overall direction for the future growth and development of the community. It is a dynamic document; while the plan forecasts for a 20-year period, it is reviewed annually and amended every 3 to 5 years as deemed appropriate (the prior General Plan was adopted in 2002 and ratified by the public in March 2003) (Marana 2007c). Marana's Strategic Plan, adopted by the Mayor and Town Council in February 2009, addresses goals and objectives for the future appearance and theme of the community, and prioritizes major projects for the town. Similar to the General Plan, it is reviewed on an annual basis and adjusted as deemed appropriate (Marana 2009b).

B. 2 Environmental Consequences

B.2.1 Proposed Action

Flowing Wells Irrigation District

The FWID water service area is essentially fully built out. Any change in land use would not be a result of water issues. The transfer of 1,481 afa of the CAP water entitlement would not affect the current land use pattern within the FWID service area.

Town of Marana Utilities Department

Marana has obtained a DAWS from ADWR and has the ability to provide water to future users within the expanded service area. The TMUD would continue to serve its customers within the area. Transfer of the CAP entitlement would have no effect on land growth patterns within TMUD's service area; growth would continue to be guided by the General and Strategic Plans. The transferred CAP entitlement would be recharged and recovered using existing facilities.

Cumulative Impacts

Because of the prohibitive costs of building the necessary infrastructure to treat and directly deliver CAP water exclusively for any individual CAP water service subcontractor, a number of water providers with CAP entitlements in the northwest metropolitan Tucson area have entered into a partnership to investigate the feasibility of delivering treated CAP water to the area. As part of the Northwest Municipal Providers collaboration, planning is underway, in cooperation with Reclamation, to determine the feasibility and cost of constructing a terminal storage reservoir within the town of Marana, near I-10 and Tangerine Road. In addition to the reservoir, plans include a water treatment system for the conveyance and delivery of treated CAP water to the TMUD, the town of Oro Valley, Metropolitan Domestic Water Improvement District, and FWID. This project is intended to proceed regardless of whether or not the proposed transfer

occurs. Thus, CAP water could eventually be held in a surface storage reservoir, treated and then directly delivered via a system of pipelines and pumps that would connect to the participating water providers' existing delivery system infrastructure. Reclamation is planning to prepare an environmental impact statement on this proposed project in 2010.

B.2.2 No Action

Flowing Wells Irrigation District

If the FWID's CAP water entitlement is not transferred to the TMUD, there would be no effect on land use within the FWID service area.

Town of Marana Utilities Department

Based on its DAWS from ADWR, TMUD has the capacity to provide water to anticipated users within the expanded service area. The TMUD would continue to serve the area and is not dependent upon the transfer of CAP water from FWID. Without the transfer of the CAP entitlement, current and anticipated land use would not be affected within the TMUD service area or within the town of Marana. Growth and development within the town of Marana would continue to be guided by the General and Strategic Plans.

C. BIOLOGICAL RESOURCES

C.1 Affected Environment

C.1.1 Vegetation and Wildlife Habitat

Flowing Wells Irrigation District

The FWID service area is surrounded by development and has a significantly diminished availability of resources and habitat for wildlife. Several parks provide open space for recreational purposes; however there are no sizable tracts of open, native vegetation within the FWID service area. The Navajo and Cemetery washes meet at the southeast corner of the FWID service area to become the Flowing Wells Wash, which crosses the southern portion of the FWID service area (Figure 2). Pima County Mapguide and the city of Tucson identify no significant vegetation associated with this wash, although portions of the channel contain small areas of native vegetation. The Rillito River is located outside the northern boundary of the FWID service area. This portion of the Rillito River is designated as an Important Riparian Area on the Pima County Mapguide. The Rillito River bank, protected along much of its length, is a wide channel which provides an important corridor through Tucson for birds and wildlife.

Town of Marana Utilities Department

Elevations within the TMUD service area range from 3,300 feet (in the Tortolita Mountains) to 1,730 feet (at the northwest corner of the town of Marana's boundary). Except for the Tucson Mountains and the Tortolita Mountains, topography within the TMUD Service Area is generally flat and gently slopes toward the Santa Cruz River. Vegetation in the undisturbed portions of the TMUD service area is typical

of both the lower Colorado River valley and Arizona upland subdivisions of the Sonoran desertscrub biotic community described in *Biotic Communities of the Southwestern United States and Northwestern Mexico* (Brown 1994).

Four general habitat types are present within the TMUD service area including upland, xeroriparian, riparian, and wetland vegetation communities. The habitat types correspond to vegetation communities delineated in Marana's Geographic Information System (GIS; Town of Marana 2007b) (Table 4). Wetland habitat, which is found in small patches along the effluent-dominated lower Santa Cruz River, was not mapped; however, developed areas were included. The approximate percentages of habitat types found within the TMUD service area are as follows:

Table 4. GIS Mapped Acreages within the TMUD Service Area

	Percent
Upland Habitat	54
Xeroriparian	9
Riparian	<1
Developed, agriculture (active) or golf course	33
Not mapped	3

Source: Marana 2007b

The main habitat types are described in the Biological Evaluation (Appendix B).

Drainages that cross the TMUD service area include Cañada Agua 1, Cañada Agua 2, Santa Cruz River, Cottonwood Wash, Picture Rocks Wash, and Yuma Mine Wash. Numerous unnamed tributaries to the Santa Cruz River traverse the area as well. These drainages often support xeroriparian habitat which typically develops denser vegetation and larger individual trees than the surrounding upland desert. This, in turn, provides better habitat for wildlife. These washes also serve as movement corridors for wildlife species. The entire length of the Santa Cruz River and numerous tributaries within the TMUD service area have been designated by Pima County as Important Riparian Areas. Riparian habitat along the Santa Cruz River is primarily supported by effluent releases from wastewater treatment plants. Vegetation consists of Gooding willow (*Salix gooddingii*), coyote willow (*S. exigua*) and scattered patches of cattail (*Typha latifolia*).

The increased plant density and/or structural diversity along the xeroriparian drainages provides increased forage and cover resources for wildlife including reptiles, birds, small mammals, and large mammals such as the coyote, and javelina. Most of these species utilize both upland and wash habitat for movement and are not strictly dependent on washes as movement corridors. However, due to low cover in the adjacent upland habitat, larger wildlife species tend to move along washes. The Santa Cruz River is an important corridor for neotropical migrant birds.

C.1.2 Special-Status Species

Special-status species include federally listed species, species tracked by the Arizona Game and Fish Department (AGFD) in its Heritage Data Management System (HDMS)[6] (AGFD 2008), and species covered by the town of Marana's draft Habitat Conservation Plan (HCP).[7] A detailed Biological Evaluation (BE) (Appendix B) documents existing and adjacent land uses, provides a description of the biotic communities within the service areas, and documents the range and habitat requirements of special-status species within Pima County. The following information is summarized from the BE.

WestLand evaluated the potential for the occurrence of and adverse impact to U.S. Fish & Wildlife Service (USFWS) endangered, threatened, proposed, candidate, or conservation agreement species occurring within the water service areas. This screening analysis was based on a literature review, knowledge of the range and habitat requirements for each species, and fieldwork conducted by WestLand biologists in the town of Marana and the greater Tucson area. The Arizona Game & Fish Department's HDMS was accessed and species with known records of occurrence within 2 miles of the project area are discussed.

ESA Listed Species

Both the FWID and TMUD service areas are located within Pima County. The USFWS (USFWS 2009) currently identifies 21 special-status species that are known or have the potential to occur in Pima County. This list includes six plants, one invertebrate, three fish, one amphibian, two reptiles, four birds, and four mammal species. Based on the nature of the proposed action and the size of the project area, species-specific surveys were not conducted. However, determinations of species' potential to occur within the service areas were based on habitat types, species ranges, and WestLand's familiarity with the region. The following species are not considered further because (1) the range of the species is outside of the project area, or (2) there is no suitable habitat in the project area for the species: Acuña cactus (*Echinomastus erectocentrus* var. a*cunensis)*, Goodding's onion (*Allium gooddingii***),** Huachuca water umbel (*Lilaeopsis schaffneriana* ssp. *Recurva*), Kearney's blue star (*Amsonia kearneyana*), Nichol Turk's head cactus (*Echinocactus horizonthalonius* var. *nicholii*), Pima pineapple cactus (*Coryphantha scheeri* var. *robustispina*), San Xavier talussnail (*Sonorella eremita*), desert pupfish (*Cyprinodon macularius*), Gila

[6] The AGFD maintains the HDMS, which is used to track species of concern in Arizona. The HDMS includes information on wildlife species' locations, so that presence (but not absence) in proximity to a selected site can be confirmed. The HDMS was accessed February 6, 2008 for occurrence records of special-status species within 2 miles of the FWID and 3 miles of the town of Marana general project vicinity.

[7] The town of Marana has prepared a draft HCP that outlines conservation strategies for 13 species and measures that will be implemented to avoid, minimize, and mitigate potential impact to those species. Once the HCP is finalized, USFWS will issue a Section 10 Permit (under the ESA) to the town under which incidental take of federally listed species will be covered, for activities undertaken by non-federal entities associated with development of the town of Marana's Capital Improvement Projects. The 13 species covered by the HCP are as follows: (1) Cactus ferruginous pygmy-owl (*Glaucidium brasilianum cactorum*); (2) Lesser long-nosed bat (*Leptonycteris curasoae yerbabuenae*); (3) Burrowing owl (*Athene cunicularia*); (4) Pale Townsend's big-eared bat (*Corynorhinus townsendii pallenscens*); (5) Ground snake (valley form) (*Sonora semiannulata*); (6) Tucson shovel-nosed snake (*Chionactis occiptalis klauberi*); (7) Southwestern willow flycatcher (*Empidonax traillii extimus*); (8) Western yellow-billed cuckoo (*Coccyzus americanus occidentalis*); (9) Merriam's mesquite mouse (Peromyscus merriami); (10) Mexican garter snake (*Thamnophis eques megalops*); (11) Desert tortoise–Sonoran population (*Gopherus agassizii*); (12) Lowland leopard frog (*Rana yavapaiensis*); and (13) Talus snail (*Sonorella* spp.). The Endangered Species Act defines "take" as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct; furthermore, "harm" to an endangered species can result from habitat modification or degradation.

chub (*Gila intermedia*), Gila topminnow (*Poeciliopsis occidentalis occidentalis*), Chiricahua leopard frog (*Rana chiricahuensis*), Sonoyta mud turtle (*Kinosternon sonoriense longifemorale*), northern Mexican gartersnake (*Thamnophis eques megalops*), masked bobwhite (*Colinus virginianus ridgewayi*), Mexican spotted owl (*Strix occidentalis lucida*), jaguar (*Leopardus pardalis*), ocelot (*Felis pardalis*), Sonoran pronghorn (*Antilocapra americana sonoriensis*).

The project area contains potential habitat for the Southwestern willow flycatcher (*Empidonax traillii extimus*), western yellow-billed cuckoo (*Coccyzus americanus occidentalis*) and the lesser long-nosed bat (*Leptonycteris yerbabuenae*). The only species on the HDMS list that has ESA designation is the western yellow-billed cuckoo, a Candidate for listing. These species are discussed in more detail below. A summary of species listed on the HDMS can be found in Appendix B.

Flowing Wells Irrigation District

The FWID service area consists of residential and commercial development with some non-commercial agricultural use along the western boundary. There are no tracts of open, native vegetation within the service area. Based on the limited availability of resources and habitat requirements for wildlife, it is unlikely any USFWS special-status species that are not tolerant of urban environments would occur within the FWID service area. According to the HDMS, there is no record of occurrence for any species protected under the ESA in the vicinity of the FWID service area. The HDMS had a record of occurrence within 2 miles of the FWID service area for only one species of concern, the western yellow-billed cuckoo. This bird requires mature riparian habitat which is not present within FWID's service area. The HDMS did not have any records of lesser long-nosed bat occurrence within 2 miles of the FWID service area, but individuals have been verified feeding within one mile of the FWID service area (AGFD unpublished data, 2003).

Town of Marana Utilities Department

Approximately 67 percent of the TMUD service area contains native vegetation. Federally-listed species likely to occur within the TMUD service area include the southwestern willow flycatcher, western yellow-billed cuckoo, and the lesser long-nosed bat. Riparian habitat for the southwestern willow flycatcher and western yellow-billed cuckoo is present along effluent-supported portions of the Santa Cruz River within the town of Marana. The lesser long-nosed bat may forage within the TMUD service area where saguaros and agave are found. The species has been documented foraging within 1 mile of the TMUD service area (AGFD unpublished data, 2003). Potential habitat occurs within the town of Marana for all of the species proposed for protection under the HCP. However, site-specific location information for each species is not available at this time.

C.2 Environmental Consequences

C.2.1 Proposed Action

Flowing Wells Irrigation District

The environmental impact to biological resources from the Proposed Action would be similar to the No Action alternative. There would be no ground-disturbing activity associated with this alternative. The proposed action alternative would not result in adverse impacts to biological resources within the FWID service area. Groundwater would continue to be used at existing volumes under both alternatives and is unlikely to affect local biological resources. There are no perennial streams, wetlands, or riparian areas in the service area that provide wildlife values which could be impacted by the continued use of groundwater. The lesser long-nosed bat is the only special-status species with reasonable potential to occur within the FWID service area. No adverse impacts to special-status species or their habitats are anticipated to occur under the Proposed Action.

Town of Marana Utilities Department

There would be no ground-disturbing activity associated with the Proposed Action. The transfer of a portion of the FWID CAP water entitlement to the TMUD would have no adverse effects on biological resources within or adjacent to the area. Additional groundwater recharge would help to reduce groundwater overdraft and could result in a beneficial effect on riparian vegetation dependent on groundwater supplies in certain areas. There would be no impact to the southwestern willow flycatcher, lesser long-nosed bat, or western yellow-billed cuckoo. There would be no new construction or expansion of existing infrastructure for delivery, storage, or recharge of CAP water. The transfer would not directly cause additional development and subsequent loss of habitat as a result. New development can occur within the TMUD Service Area with or without the transfer of this CAP entitlement and would be subject to compliance with Marana's HCP (once the Section 10 permit is issued by USFWS) and other ordinances protecting biological resources.

C.2.2 No-Action Alternative

Flowing Wells Irrigation District

The service area of FWID is essentially fully built out; therefore, the no-action alternative would have no adverse effects on biological resources within or adjacent to the FWID service area. Groundwater consumption would continue at the current rate under both alternatives and is unlikely to affect local biological resources. There are no perennial streams, wetlands, or riparian areas in the service area that provide wildlife values which could be impacted by the continued use of groundwater. The lesser long-nosed bat is the only special-status species with reasonable potential to occur within the FWID service area. No adverse impacts to special-status species or their habitats are anticipated to occur under the no-action alternative.

Town of Marana Utilities Department

There would be no adverse direct or indirect impacts on biological resources within the TMUD Service Area from the no-action alternative. There would be no impact to the southwestern willow flycatcher, lesser long-nosed bat, or western yellow-billed cuckoo. On-going development within the TMUD Service Area would be subject to compliance with Marana's HCP (once USFWS issues the Section 10 permit) and other local, state, and federal laws and ordinances to protect biological resources, as required.

D. CULTURAL RESOURCES

Information gained from archaeological surveys and excavations in the Marana and Flowing Wells areas indicate the Santa Cruz floodplain and environs were intensively occupied from the Late Archaic period (ca.1200 BC-AD 1) up through the Late Formative period (AD 1150-1450). Recent investigations at Las Capas and other Late Archaic sites have uncovered settlements of pithouses with numerous storage pits, abundant artifacts and subsistence remains, and, most amazingly, extensive irrigation systems. Contemporary sites situated away from the river lack cultivar remains and indicate the more distant locations served as bases for collection of wild plant and animal resources.

Formative period (AD 1-1450) occupations in the northern Tucson Basin appear to be a continuation of the settled agricultural pattern that began during the Archaic. Interaction with populations in the Gila and Salt River valleys saw the development a Tucson Basin variant of the Hohokam culture in the Middle Formative (AD 650-1150). Population growth and increased social complexity throughout this period are indicated by an increase in numbers of sites and the development of settlement communities. These communities often consisted of smaller, sometimes specialized, settlements clustered around one larger central site that was the focus of community-wide activities. The central sites often include ballcourts, large excavated features where community-wide activities occurred, while in the Classic period (AD 1150-1450) this integrative function appears to have been served by platform mounds.

The intensive occupation of the northern Tucson Basin during the prehistoric era appears to have dissipated by 1450 and, by the time the Spanish arrived in the 1690s, there were only a few O'odham villages located along the Santa Cruz River. Spanish and Mexican settlement in the 18th and 19th centuries was mostly limited to Tucson and areas to the south, as was most American settlement following the Gadsden Purchase (1958). With the construction of the railroads in the 1880s, however, an influx of immigrants saw the rapid development of ranching, farming, and mining interests that remain important today.

A more detailed cultural history is available in Appendix C. It provides sufficient detail for the analysis of impacts associated with the proposed action, and includes an archaeological background for the project area. No ground disturbing activities or infrastructure alterations are expected as part of the proposed action, which would entail transferring 1,481 afa of CAP entitlement from the FWID to TMUD. As a result, evaluation of cultural resources was limited to a cultural history review of the area and consideration of the known historic properties in the FWID and TMUD service areas (Appendix C).

D.1 Affected Environment

D.1.1 Flowing Wells Irrigation District

The FWID service area is primarily developed and supports a mix of residential and commercial land use. Archaeological projects in the area have largely been related to construction and infrastructure development. To date, at least 13 sites have been recorded within the service area; most of these are associated with the Formative period. The sites are primarily residential and have yielded a variety of artifacts and features, including houses, agricultural terraces and canals. A more detailed discussion of the area's cultural history is provided in Appendix C.

D.1.2 Town of Marana Utilities Department

Archaeological projects conducted within the TMUD service area are mainly related to large-scale water management, municipal expansion, and the expansion of infrastructure for the growing municipality. As indicated in the cultural history (Appendix C), at least 50 sites have been identified within the current service area. While some of these represent Archaic occupations, the majority of the known prehistoric sites date to the Formative period. Known sites also include historic resources that reflect ranching, agriculture, and transportation and utility corridors.

D.2 Environmental Consequences

D.2.1 Proposed Action

Flowing Wells Irrigation District

There would be no ground disturbing activities within the FWID service area in relation to the proposed action; as a result there would be no effect to cultural resources. The environmental impacts to cultural resources from the proposed action would be the same as for the no-action alternative. Any new development within the service area would need to follow cultural resource guidelines provided by the City of Tucson or Pima County, depending on location in relation to city boundaries. No effect to cultural properties would be anticipated as the result of implementing the proposed action

Town of Marana Utilities Department

The transfer of a portion of FWID's CAP water entitlement to the TMUD would not involve any ground-disturbing activities because it does not require the construction of new infrastructure or expansion of the existing recharge facilities; as a result, there would be no direct impacts and no effect to cultural resources. Current and anticipated growth within the TMUD existing and future service areas can be supported by the current water supply and is not dependent on this water transfer. Therefore, there would be no indirect temporal or spatial impacts due to growth resulting from the proposed action. Any new development within the service area will require compliance with Town of Marana Land Development Code Title 20, which establishes guidelines and specifications for the documentation and protection of archaeological resources. The environmental impacts to cultural resources from the proposed action

would be the same as for the no-action alternative. No direct effect to cultural resources would be anticipated as the result of implementing the proposed action; indirect impacts would be the same as under No Action**.**

D.2.2 No-Action Alternative

Flowing Wells Irrigation District

There would be no change in existing conditions within FWID as a result of the no-action alternative. Environmental factors, including surface erosion and the impact of relatively dense residential and commercial land use, would continue to affect any cultural resources in the area. It is assumed that current land use and management practices would continue, as would existing municipal protections to cultural properties. Any new development would require compliance with cultural resource guidelines developed by the City of Tucson or Pima County, depending on location in relation to city boundaries. No effect to cultural properties would be anticipated as the result of not implementing the proposed action.

Town of Marana Utilities Department

There would be no change in existing conditions within the town of Marana as a result of the no-action alternative. Environmental factors, including surface and channel erosion, would continue to affect any cultural resources within the area. It is assumed that anticipated growth would continue within the region and would be served by existing water sources or through groundwater replenishment by CAGRD. Any new development within the service area would require the completion of a Class III cultural resource survey and compliance with the Town of Marana Land Development Code Title 20 that establishes guidelines and specifications for the documentation and protection of archaeological resources. Mitigation actions would be implemented involving either data recovery or preservation of sites as required by the TMUD or if required by other county, state or federal agency permits.

E. SOCIOECONOMIC CONSIDERATIONS

E.1 Affected Environment

Demographics, Employment and Income Patterns

In order to conclude whether the project area demonstrates the same socioeconomic trends as the larger municipal area, each respective service area was compared to the city of Tucson and Pima County (Table 5). The analysis was conducted by evaluating census tract data obtained from the U.S. Census Bureau. Census tracts are geographically small, statistical subdivisions of counties located within a metropolitan or urbanized area. The Census 2000 documents demographic characteristics including population, racial, economic, employment and occupational statistics.

Table 5. Comparative Population, Economic, and Employment Characteristics for FWID, TMUD, City of Tucson, and Pima County

Socioeconomic Characteristics	FWID	Town of Marana	City of Tucson	Pima County
Population Characteristics				
Population	21,703	13,556	486,699	843,746
Percent White of Population	80.9	81.8	70.2	70.4
Percent Non-white of Population	19.1	18.2	29.8	29.6
Economic Characteristics				
Median Household Income (1999)	$26,418	$52,870	$30,981	$36,758
Unemployment Rate (percent) (2000)	4.0	2.9	3.6	7.2
Occupation (Percent)				
Management, Professional	18.8	43.1	32.0	35.0
Services	24.2	17.3	19.1	17.6
Sales and Office	26.7	23.0	28.2	27.1
Farming, Fishing, Forestry	0.5	0.9	0.2	0.2
Construction and Maintenance	17.3	8.6	10.9	10.7
Production and Transportation	12.4	7.2	9.6	9.4

Source: U.S. Census Bureau, Census 2000: <http://factfinder.census.gov> (28 February 2008).

E.1.1 Flowing Wells Irrigation District

The FWID is located in portions of Census Tracts 45.04, 45.05, 47.07 and 47.08. An average of these census tracts was used to compare the FWID service area to the city of Tucson and Pima County (Table 5). The city of Tucson population sample is roughly 90 times the population of the total for FWID. According to Census 2000, these four tracts contain a smaller percentage of non-white populations than the city of Tucson. The average 1999 median household income within FWID was lower than the city of Tucson and Pima County, as well. Only one of the four tracts reports a higher unemployment rate. The average unemployment rate for FWID tracts are 0.4 percent more than the city of Tucson as a whole but 3.2 percent lower than that for Pima County. The most common occupation type for FWID is sales and office work followed by services. The largest job category for the city of Tucson is management and professional work followed by sales and office. Generally, there is not a large difference between the occupation types, but the largest discrepancies are between management and professional jobs and construction and maintenance jobs. The city of Tucson is categorized as having 13.2 percent more management and professional jobs than FWID, whereas FWID has 6.4 percent more construction and maintenance jobs than the city of Tucson. The city of Tucson and Pima County are similar for all listed occupations.

E.1.2 Town of Marana Utilities Department

The TMUD's active service area generally includes the developed portions within the incorporated limits of the town of Marana. Tucson Water does serve a portion of the town of Marana that was developed adjacent to existing Tucson Water infrastructure, but the TMUD will be responsible for providing service for future development within town limits. The city of Tucson population sample is roughly 36 times the

population of the town of Marana. According to Census 2000, the town of Marana contains a smaller percentage of non-whites than the city of Tucson. The 1999 median household income for the town of Marana was substantially higher than the city of Tucson and Pima County; Census data also indicate Marana had reported a lower unemployment rate. When occupation types were compared, the hierarchy of common job types for the town of Marana paralleled that of the city of Tucson. There were no large discrepancies between the two entities but the town of Marana did report a higher percentage of management and professional jobs than the city of Tucson. Table 5 presents a summary of census data for the town of Marana, the city of Tucson, and Pima County for comparative purposes.

E.2 Environmental Consequences

E.2.1 Proposed Action

Flowing Wells Irrigation District

The proposed action would not result in changes to the current socio-economic conditions within the FWID. It does not promote growth nor offer employment opportunities to local residents.

Under the proposed action, FWID would no longer be responsible for paying the annual capital charge to CAP for the portion of the entitlement transferred to the TMUD. This charge is assessed whether or not the subcontractor requests delivery of its CAP entitlement in a given year. The fee for FWID would be reduced by $26,658 annually based on the 2009 capital cost of $18 per af annually for the 1,481 af being transferred to the TMUD. The CAP M&I capital charges are projected by the CAWCD to decline over the next few years and be eliminated in the year 2012 and beyond.

Lands served by FWID would continue to be served through groundwater pumping. FWID has never utilized the water that is proposed for transfer and there is not adequate infrastructure for the delivery and storage of water within the service area. Under the proposed action there would be no change in the water service provided to customers served by FWID. The city of Tucson would continue to provide a portion of FWID's service area with water. FWID would retain 2,854 afa of its original 4,354 afa CAP entitlement for future use. This could include participation in the Northwest Area Water Providers' collaborative effort for direct delivery

Town of Marana Utilities Department

The acquisition of the CAP entitlement would not have direct effects on the current trends in demographics, income, or employment within the TMUD Service Area. Indirect and cumulative impacts would be the same as under No Action.

Under the proposed action, TMUD would assume responsibility for paying the annual capital fee to CAWCD for the additional M&I CAP entitlement until it is phased out in 2012. The TMUD plans to

recharge the CAP entitlement in the LSCRP to accumulate CAP recharge credits. Recharge credits would be used to meet the TMUD's replenishment obligation under ADWR's AWS requirements.

The fee assessed by CAWCD for the delivery of CAP water for the year 2009 is $150 per af. As illustrated in Table 6, this includes the capital charges, delivery charges (fixed OM&R and pumping energy rate), and pumping energy rate. There is an additional fee of $24 per af in TAMA to cover the underground water storage costs for direct recharge to the LSCRP. Under 2009 pricing, the total annual fees owed by the TMUD for the CAP entitlement from FWID (assuming recharge) would be $222,150 ($150 x 1,481 af) (CAP 2007).

Table 6. CAP/CAWCD Firm Water Delivery and Assessment Rates for TAMA

Municipal and Industrial Rate Component	CAP Rate/AF Schedule (2009)[1]	Tucson AMA Rate Component	CAGRD Assessment Rates/AF (2008-09)[2]
Capital Charges	$18	Water & Replenishment	$143
Fixed OM&R	$63	Administrative	$33
Pumping Energy Rate	$45	Infrastructure and Water Rights	$90
Underground Water Storage O&M Capital	 $15 $9	Replenishment Reserve Charge	$39
Total Delivery Charges	$150		$305

[1] Costs associated with Proposed Action.
[2] Costs to meet requirements without the proposed transfer.

E.2.1 No-Action Alternative

Flowing Wells Irrigation District

The no-action alternative would have no impact to the current socio-economic conditions within the FWID service area. FWID would continue to be responsible for paying the required fee to CAWCD for the full CAP water entitlement, whether or not the water is ordered for use. The 2009 rate schedule for FWID based on capital charges is $18/af. This totals $78,372 for the full entitlement of 4,354 afa.

Town of Marana Utilities Department

Under the no-action alternative, the TMUD would continue to pay the required fees to recharge excess CAP water and accumulate recharge credits to meet the replenishment obligations for exceeding its groundwater allowance. The TMUD would continue to investigate options to meet replenishment obligations in the future in anticipation of the reduced availability of excess CAP water.

TMUD pays the required fees to recharge excess CAP water at $127 per af (2008 rate) and accumulates recharge credits to meet the replenishment obligations for the use of excess groundwater (CAP 2009). The

TMUD is currently investigating options to meet future replenishment obligations in anticipation of the reduced availability of excess CAP water.

As shown on Table 6, current CAGRD assessment rates are $305 per af. This would be an increase of $155 per af over the proposed action. Based upon an average annual household water use of 65,740 gallons per residential meter (A. Cuaron, personal communication 2009), the cost for a typical TMUD household using CAGRD to fulfill replenishment obligations would be about $30.00 per year more than under the Proposed Action, using current rates.

F. SUMMARY OF IMPACTS

The proposed action primarily impacts the financial obligations for the use of the CAP water entitlement and recharge. FWID's financial obligation (under current pricing) would be reduced by $26,658 annually based on the capital cost to maintain the annual entitlement of 1,481 af proposed for transfer. This charge is to be eliminated in 2012. The TMUD would incur the annual costs for the 1,481 af of subcontracted CAP water. Assuming that the CAP water is recharged in the LSCRP, the total annual cost for the TMUD, based on current pricing, would be $222,150. This amount is presently comparable to the cost to purchase and recharge excess CAP water; however, excess CAP water is not expected to be available in future years. Under the no action alternative, TMUD's financial cost to meet its replenishment obligation for the 1,481 af through the CAGRD would be $451,705 annually (at current rates); this would be an increase of about 103 percent over the current CAP long term subcontract rates for M & I priority water. Using current water rates and average residential water use volumes, under no action this would result in a water utility bill increase of less than $3 per month for TMUD residential customers.

The proposed action does not require construction of any new facilities or expansion of existing systems in order to delivery, store, and recharge the water as planned. The transfer would not induce growth and no indirect impacts associated with new developments with the service areas are anticipated.

CHAPTER 4 – CONSULTATION AND COORDINATION

List of Agencies Contacted

Federal

- US Department of the Interior: Bureau of Reclamation
- US Fish and Wildlife Service (website accessed)

State

- Arizona Department of Water Resources
- Arizona Game and Fish Department (on-line database management system)

County and Local

- Pima County
- Town of Marana
- Town of Marana Utilities Department
- City of Tucson Water
- Flowing Wells Irrigation District
- Metropolitan Domestic Water Improvement District

CHAPTER 5 – ENVIRONMENTAL LAWS AND DIRECTIVES CONSIDERED

National Environmental Policy Act of 1969, as amended (NEPA) (P.L. 91-190) – This law required federal agencies to evaluate the potential consequences of major federal actions. An action becomes "federalized" when it is implemented by a federal agency, wholly or partially funded with federal monies, or requires authorization from a federal agency. The intent of NEPA is to promote consideration of environmental impacts in the planning and decision-making processes prior to project implementation. NEPA also encourages full public disclosure of the proposed action, any action alternatives, potential environmental effects, and mitigation.

This EA was prepared in accordance with the requirements of NEPA. Reclamation issued a scoping memorandum on its website (http://www.usbr.gov/lc/phoenix/) on February 13, 2009. The memorandum briefly described the proposed transfer of 1,481 afa of CAP entitlement from FWID to TMUD, and requested any comments on the proposed transfer be submitted by March 9, 2009. No comments on the proposal were received.

Fish and Wildlife Coordination Act (FWCA) (P.L. 85-624) – This act requires coordination with federal and state wildlife agencies (USFWS and AGFD) for the purpose of mitigating project-caused losses to wildlife resources from water development projects. The proposed project would not impact or divert surface waters in the FWID or TMUD service areas.

Endangered Species Act of 1973 (ESA) (P.L. 93-205) – Section 7 of the ESA requires federal agencies to consult with USFWS to ensure that undertaking, funding, permitting or authorizing an action is not likely to jeopardize the continued existence of listed plant or animal species or destroy or adversely modify designated critical habitat. The list of species maintained by USFWS for Pima County was reviewed and two listed species are known or likely to occur within the water service areas. The proposed action does not include any construction of infrastructure and no ground disturbing activities would occur. There are no federally listed or candidate species or critical habitat that would be adversely affected by the proposed action.

Wild and Scenic Rivers Act of 1968 (Act) (P.L. 90-542) – This act designated the initial components of the National Wild and Scenic River System. It established procedures for including other rivers or reaches of rivers that possess outstanding scenic, recreational, geologic, fish-and-wildlife, historic, cultural, or other similar resources, and preserving these rivers in a free-flowing condition. There are no rivers designated or proposed for designation as wild or scenic within or near the FWID or TMUD service areas.

Wilderness Act of 1964 (P.L. 88-577, as amended) – This act established the National Wilderness Preservation System to preserve certain federal lands for the public purposes of recreation, scenic, scientific, educational, conservation, and historical use by current and future generations of Americans. There are no lands designated or proposed for designation as wilderness areas within or near the FWID and TMUD service areas.

Clean Water Act (CWA) (P.L. 92-500, as amended) – The CWA is intended to direct the restoration and maintenance of the chemical, physical, and biological integrity of the nation's waters by controlling the discharge of pollutants. The basic means to achieving the goals of the CWA is through a system of water quality standards, discharge limitations, and permits. Section 404 of the CWA identifies conditions under which a permit is required for actions that result in placement of fill or dredged material into waters of the U.S. In addition, a 401 water quality certification and 402 Arizona Pollutant Discharge Elimination System permit are required for activities that discharge pollutants to waters of the US. There would be no construction of infrastructure or delivery system features as part of the proposed action and it would not require authorization under a 402 or 404 permit.

National Historic Preservation Act (NHPA) (P.L. 89-665) – NHPA establishes as federal policy the protection of historic sites and values in cooperation with states, tribes, and local governments. Because the proposed project does not directly involve land-disturbing activities, it does not have the potential to cause effects to historic properties.

Farmland Protection Policy Act (P.L. 97-98) – This act requires identification of proposed actions that would adversely affect any lands classified as prime and unique farmlands and minimizes the unnecessary and irreversible conversion of farmland to nonagricultural uses. The U.S. Department of Agriculture's Natural Resources and Conservation Service administers this act. The proposed action would not directly impact lands classified as prime and unique farmlands. Agricultural land within both the FWID and TMUD service areas, some of which is classified as prime and unique, would continue to be developed based upon the demand for residential and commercial development and other market conditions. Development patterns are expected to be the same under either the no action or proposed action.

Executive Order 11988 (Floodplain Management) – This Presidential directive encourages federal agencies to avoid, where practicable alternatives exist, the short- and long-term adverse impacts associated with floodplain development. Federal agencies are required to reduce the risk of flood loss and minimize the impacts of floods on human safety, health and welfare. In carrying out their responsibilities, agencies must also restore and preserve the natural and beneficial values served by floodplains. The 100-year floodplain for the Santa Cruz River is within the TMUD service area, though the limits of the floodplain are currently under review by the town of Marana and the Federal Emergency Management Agency. The 1,481 afa of CAP water would be recharged at the LSCRP which is adjacent to the Santa Cruz River, near the Marana Airport, and within the town. This facility has the capacity to accept these flows with no required expansion of the site.

Executive Order 12898 (Environmental Justice) (EO 12898) – This executive order requires federal agencies to identify and address, as appropriate, disproportionately high and adverse human health or environmental effects of federal actions on minority and/or low-income populations. Low-income populations include communities or individuals living in proximity to one another and meeting the U.S. Census Bureau statistical thresholds for poverty. Minority populations are identified where the percentage of minorities in the affected area exceeds 50 percent, or where the minority population percentage of the affected area is meaningfully greater than the minority population's percentage of a much broader area.

Census 2000 data were reviewed for the town of Marana, which includes the TMUD, as well as the census tracts within the FWID and Pima County. No disproportionately high or adverse human health or environmental effects on minority and/or low-income populations would result from the proposed action.

Executive Order 11990 (Wetlands) (EO 11990) – This executive order requires federal agencies, in carrying out their land management responsibilities, to take action that will minimize the destruction, loss, or degradation of wetlands, and take action to preserve and enhance the natural and beneficial values of wetlands. There are no wetlands in the project area that would be affected.

Department of Interior, Secretarial Order, Indian Trust Assets (ITAs) – ITAs are legal interests in assets held in trust by the U.S. government for Indian tribes or individual Indians. These assets can be real property or intangible rights and include water rights, hunting rights, money, lands, minerals, and other natural resources. The trust responsibility requires that all federal agencies take actions reasonably necessary to protect ITAs. No tribal lands are located within the service areas. No ITAs are currently known to be present within the FWID or TMUD service areas.

CHAPTER 6 – LIST OF PREPARERS

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CHAPTER 7 – LITERATURE CITED AND REFERENCES

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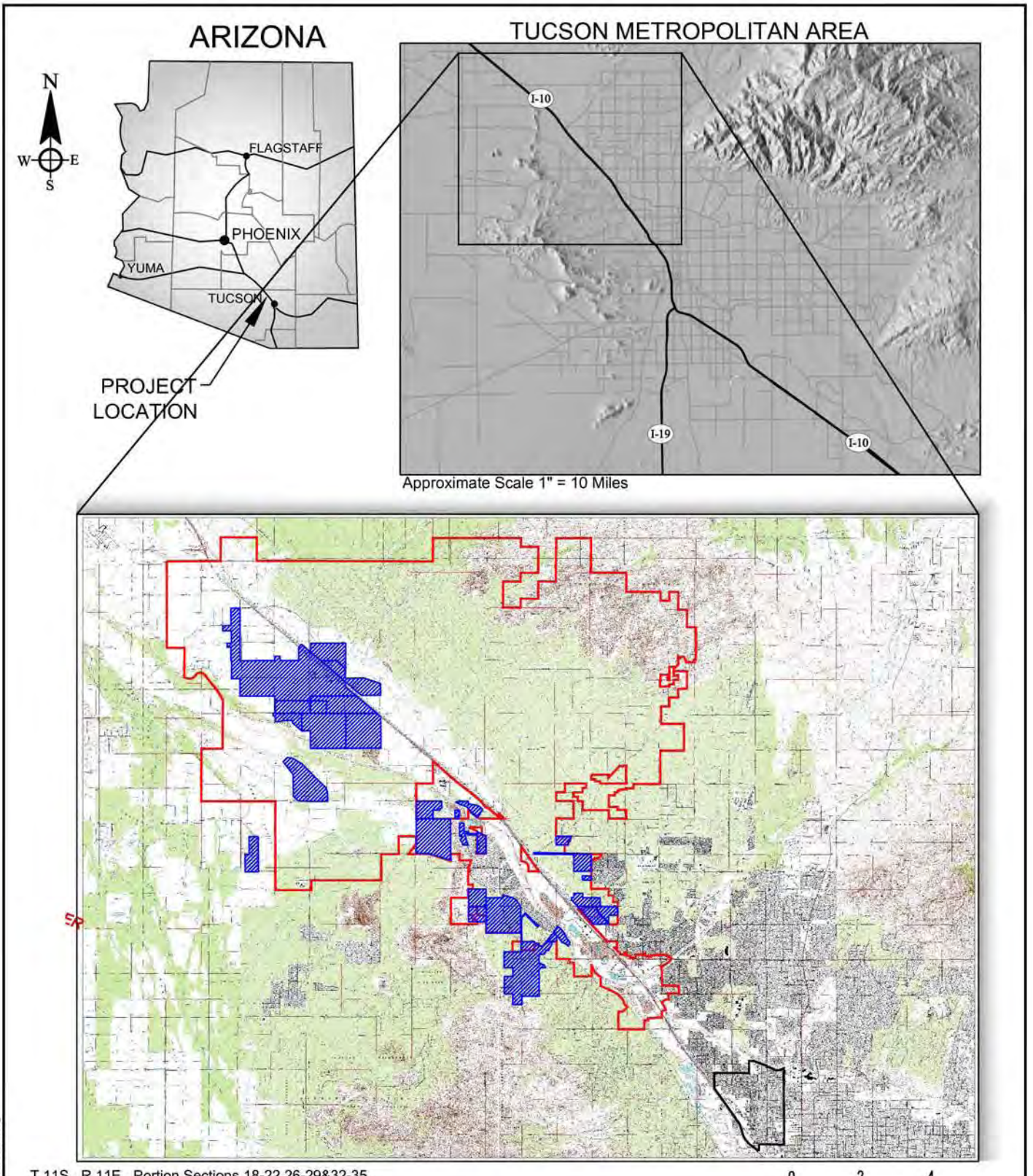
FIGURES



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T.12S., R.11E., Portion Sections 3,4,9,10,17,&20
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T.13S., R.12E., Portion Sections 3,4,9&10
T.13S., R.13E., Portion Sections 15, 21-23, 26-28, 34, & 35.
Pima County, Arizona
Avra, Marana, Jaynes, Ruelas Canyon, Tucson North, & West of Marana
USGS 7.5' Quadrangles

Town of Marana Boundary
FWID Service Area
Areas Currently Served By TMUD

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CAP Entitlement Transfer EA

VICINITY MAP

Figure 1

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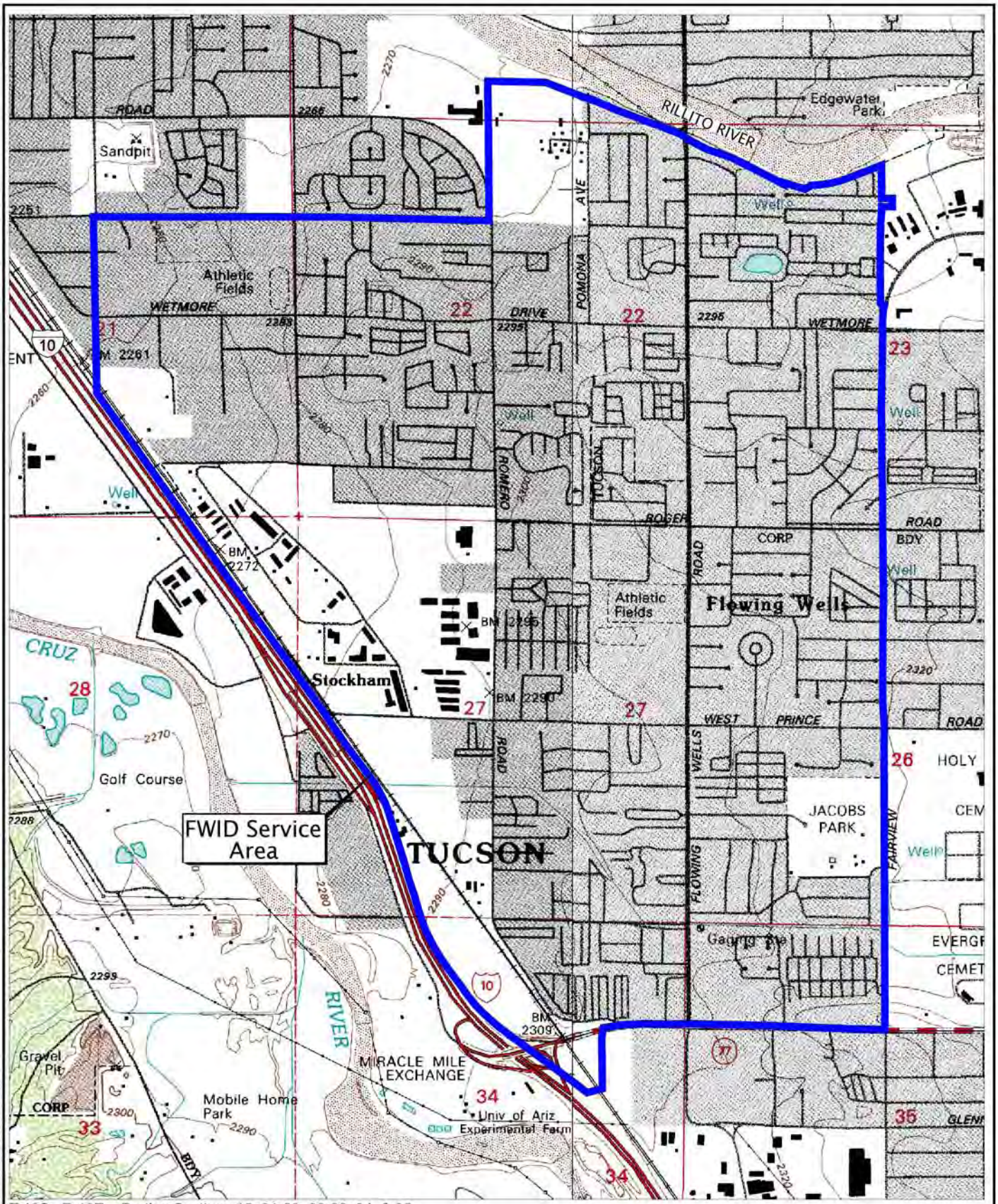

T.13S., R.13E., Portion Sections 15, 21-23, 26-28, 34, & 35.
Pima County, Arizona
Jaynes & Tucson North USGS 7.5' Quadrangles

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FWID SERVICE AREA

CAP Entitlement Transfer EA

FWID SERVICE AREA
Figure 2

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Pima County, Arizona
Photo Source & Date: Aerials Express 2004

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FWID SERVICE AREA

CAP Entitlement Transfer EA

AERIAL OVERVIEW
Figure 3

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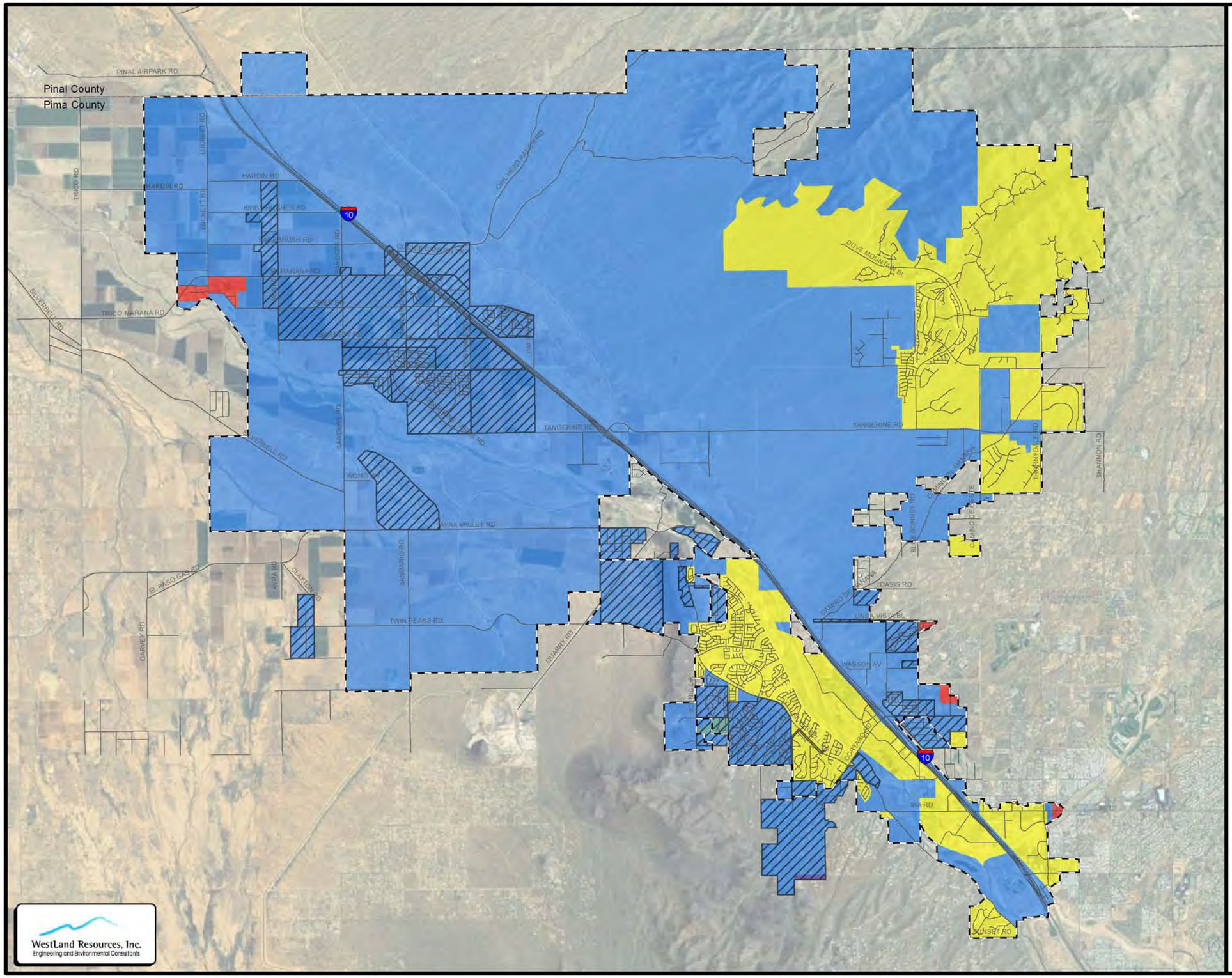

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Legend

- Marana Town Limits (11-12-2007)
- Pima/Pinal County Line
- TMUD Existing Water Service Area
- TMUD EA Analysis Area
- Tucson Water Service within Town Boundary
- Other Water Utilities within Town Boundary

WestLand Resources, Inc.
Engineering and Environmental Consultants

TOWN OF MARANA 1977 ARIZONA

CAP Entitlement Transfer EA

AERIAL OVERVIEW

Figure 4

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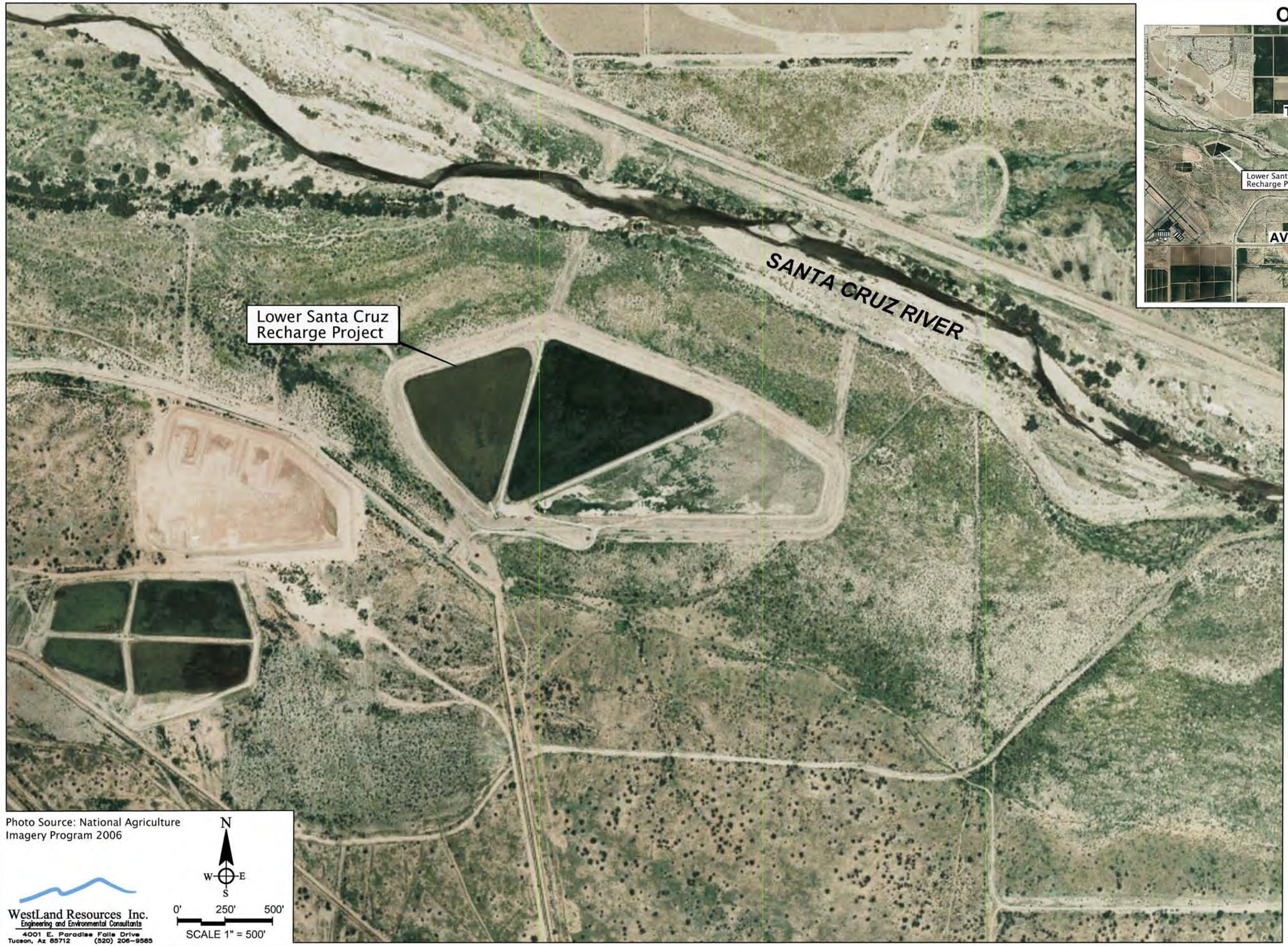

OVERVIEW

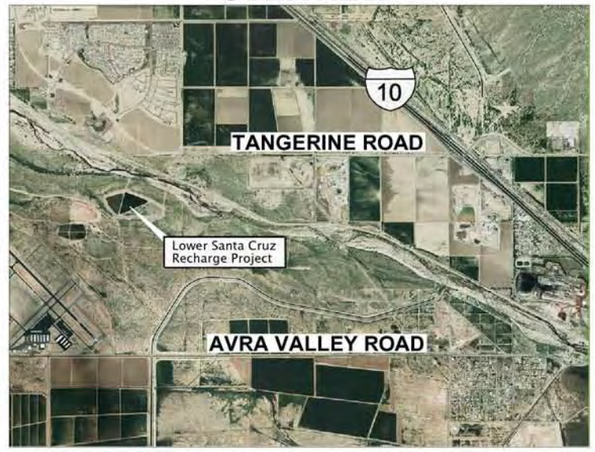

Photo Source: National Agriculture Imagery Program 2006

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SCALE 1" = 500'

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LOWER SANTA CRUZ RECHARGE PROJECT

CAP Entitlement Transfer EA

LOCATION MAP
Figure 5

APPENDIX A

ADWR EVALUATION OF PROPOSED PARTIAL TRANSFER OF FLOWING WELLS IRRIGATION DISTRICT (FWID) CAP MUNICIPAL AND INDUSTRIAL (M&I) SUBCONTRACT ENTITLEMENT JANUARY 12, 2007

Evaluation of the Proposed Partial Transfer of Flowing Wells Irrigation District's (FWID) CAP Municipal and Industrial (M&I) Subcontract Entitlement
01/12/07

I. Introduction

FWID has requested that the Department recommend to Reclamation the transfer of 1,500 acre-feet of its 4,354 acre-feet entitlement of CAP water to the Town of Marana (Marana). During the public notification period for the proposed transfer action, Metropolitan Domestic Water Improvement District submitted a letter indicating its support of the proposed transaction and the City of Tucson (Tucson) requested that it be considered as a competing applicant during the evaluation process.

The following bulleted items briefly summarize the water supply and demand information for each CAP transfer applicant.

FWID

- Holds an entitlement for 4,354 acre-feet of CAP water. Current and build-out M&I water demand is approximately 2,854 acre-feet. Current demand is met entirely with groundwater.
- Proposes to transfer 1,500 acre-feet of its excess CAP entitlement to Marana.
- Tucson Water provides some effluent for non-potable use and serves potable water supplies to a limited number of water users within a portion of FWID's original service area.

Marana

- Has a 47 acre-feet CAP entitlement that it acquired from Cortaro-Marana Irrigation District.
- Current M&I demand is approximately 1,800 acre-feet/year.
- Serves approximately 2,100 residential and commercial customers.
- Annexed large portion of undeveloped state land. With the inclusion of this property, the future service area is approximately 66,000 acres.
- Requests all of the 1,500 acre-feet CAP entitlement to meet its existing and future demand.
- Has recharge storage permits for the Lower Santa Cruz Replenishment Project, Avra Valley Recharge Project and the Cortaro-Marana Irrigation District Groundwater Savings Facility (Cortaro-Marana GSF). Marana has applied for a recovery well permit for several service area wells.
- U.S. Bureau of Reclamation and several north Tucson area water providers (including FWID and Marana) are developing and implementing a plan for future treatment and delivery of CAP water (SARWMS).

Tucson

- Currently holds a 135,966 acre-feet entitlement of CAP water and is in the process of having its subcontract amended to include an additional 8,206 acre-feet that it acquired under the Arizona Water Settlements Act. Its current water demand is approximately 141,000 acre-feet.
- Requests that all or a portion of the entitlement be transferred to it to meet its future water demand.
- Tucson Water's current water resources plan indicates that additional water supplies will be needed prior to 2011.
- Tucson has acquired part of FWID's original service area and provides potable water supplies to these areas. It also provides effluent for landscape irrigation.

The Department has conducted an evaluation of the transfer in accordance with the Department's February 2006 Revised Policy Regarding Transfer of Central Arizona Project Municipal and Industrial Water Subcontract Entitlements (CAP Transfer Policy). Each competing entity was evaluated under the applicable Water Management Objectives, Review Criteria and corresponding Decision Guidelines. This document describes the Department's evaluation of the proposed transfer action and presents the evaluation results.

The following table presents a summarized compilation of each competing applicant's water transfer claims as they relate to the Decision Guideline priorities.

Application of Transfer Policy

Applicant Claims	
Priority	**Claims/Comments**
1	Tucson Mayor and City Council authorized city staff and legal counsel to acquire FWID by eminent domain proceedings and, therefore, Tucson will become successor in interest to FWID's service area. Tucson currently serves a total of 17 acre-feet/year of potable water to a portion of FWID's original service area (Tucson letter of 4/21/05). This area includes: – U of A Agricultural Experimental Station – Approximately 30-40 acres north of Wetmore and east of Fairview Roads – Some Jacob's Park facilities – An industrial park between I-10 and frontage road – 19 lots total. Tucson currently serves 7 lots @ 4,300 gallons/month/lot. At total build-out, additional annual water usage for the 12 lots would be approximately 2 acre-feet. Tucson provides 115 acre-feet/yr. of reclaimed water to irrigate Jacob's Park landscape.
3	Tucson claims continued groundwater pumping by FWID would harm nearby Tucson area wells.
4	Marana has 47 acre-feet of renewable supplies to meet its existing water demand. Marana can directly use the 1,500 acre-feet of CAP water through annual storage and recovery within the area of impact to meet its existing demand.
5	Tucson's 2024 projected demand is approximately 228,786 AF, with an existing renewable water supply of 135,966 acre-feet and a projected renewable supply of 144,172 acre-feet. Marana's 2024 projected demand is approximately 12,137 AF, with an existing renewable water supply of 47 acre-feet.
6	Tucson's projected demand for 2035 is approximately 254,431 acre-feet. Marana's projected demand for 2035 is approximately 15,143 acre-feet.

As competing applicants, Marana and Tucson were evaluated according to the applicable CAP transfer priorities presented in the Decision Guidelines section of the CAP Transfer Policy.

II. Evaluating Competitor's Relative Water Supply, Demand and Use

The competing applicant's were evaluated according to the following applicable CAP Transfer Policy priorities. These include priorities 1, and 3 through 6.

A. Priority 1 Analysis

1. Description of Priority

First priority is "recommended to an entity that is the successor in interest to the transferring entity, or that can provide sufficient evidence that it will become the successor in interest to the transferring entity in the near future, and that it will provide water to the same CAP subcontract service area."

2. Evaluation of Tucson's Water Demand under the First Priority

Tucson cites three claims to FWID CAP water under priority one.

a. *Acquisition through eminent domain* - In December 2004, should negotiations for acquisition be unsuccessful, the Tucson Mayor and City Council conditionally authorized city staff and legal counsel to

acquire FWID through eminent domain proceedings. If an entity is not yet a successor in interest, it must be able to provide the Department with adequate assurance that the proposed acquisition will be successful and that it will occur within a reasonable timeframe.

b. *Potable water supply service* – Tucson provides potable water service to lands within FWID's original service area including the U of A Agricultural Experimental Station, an industrial park, some Jacob's Park facilities and the Wetmore/Fairview Road area. As the water provider responsible for providing potable water supplies to these areas, Tucson is eligible to receive a portion of FWID's entitlement under priority one. Tucson provides approximately 17 acre-feet/year to these water users. Tucson estimates that an additional 2 acre-feet/year will be needed to meet the build-out demand of the industrial park.

c. *Effluent water supply service* – Tucson supplies 115 acre-feet of effluent for the irrigation of some FWID service area landscape. As described by the corresponding review criteria: "This policy favors the transfers of CAP subcontract entitlements that benefit the transferring entity's CAP subcontract service area." The CAP water could not be used by Tucson to benefit this portion of FWID's service area because 1) it would substitute one renewable supply for another, and 2) the reclaimed system is for effluent, not CAP water supplies.

3. Results of Priority 1 Evaluation

a. Tucson's claim as a successor in interest to FWID through potential eminent domain proceedings is not sufficiently certain to support a recommendation under priority one.

b. Tucson's potable water service to the above referenced facilities in the amount of 19 acre-feet at build-out qualifies for a recommendation under priority one. This volume includes the 2 acre-feet of projected demand associated with the industrial park.

c. Tucson's claim under priority one for the delivery of 115 acre-feet of effluent for landscape irrigation within the FWID service area is not consistent with the goals of the CAP Transfer Policy.

With the allocation of 19 acre-feet of the 1,500 acre-feet proposed for transfer to Tucson, a total of 1,481 acre-feet remain to be allocated according to the subsequent priorities.

B. Priority 3 Analysis

1. Description of Priority

Third priority "will be recommended to an entity that demonstrates adverse impacts on its ability to meet its water demands due to groundwater withdrawals by the transferring entity as a result of the transfer of a CAP subcontract entitlement."

2. Evaluation of Impacts to Adjacent Tucson Service Area Wells

Tucson has requested that the Department consider potential impacts to 18 of its service area wells as a result of FWID's continued groundwater pumping. The wells are located within a 2-mile radius of FWID service area boundaries. The Department's evaluation under this priority is limited to determining future impacts to a nearby water provider's wells that may result from continued groundwater pumping that is associated with the volume of CAP water that is transferred away from the intended service area. In this case, FWID will retain adequate CAP entitlement to support its existing and future demand. The fact that FWID is not currently using any of its CAP entitlement, and may not until sometime in the future, is not a criterion for evaluation under this priority.

3. Results of Priority 3 Evaluation

FWID will retain enough of its original CAP entitlement to support its total projected water demand. As a result, future impacts to groundwater supplies cannot be claimed under this priority. Therefore, none of the

CAP entitlement will be recommended for transfer to Tucson under this priority.

C. Priority 4 Analysis

1. Description of Priority

Fourth priority will be "recommended to either: (a) an entity outside the transferring entity's CAP subcontract service area that will directly use the CAP water in the near term to meet its existing groundwater demands, or (b) a replenishment district that will use the CAP water to satisfy a replenishment obligation of the transferring entity or member lands within the transferring entity's service area by replenishing groundwater outside of the area of impact of the transferring entity's groundwater withdrawals."

In accordance with the Department's CAP Transfer Policy, direct use means either: (a) the direct delivery of CAP water, or (b) the storage of water at a groundwater savings facility or underground storage facility and the recovery of the CAP water on an annual basis within the area of impact of the stored water. Storage of CAP water at a groundwater savings facility or an underground storage facility for long-term storage credits will not be considered direct use of CAP water.

2. Applicant Evaluation

Marana has requested that it be considered under this priority. Marana plans to directly use the CAP entitlement by annually storing and recovering it within the area of impact. Marana could recharge the entire volume of CAP water in either the Avra Valley or the Lower Santa Cruz Replenishment Project. It also has the ability to use the Cortaro-Marana Irrigation District Groundwater Savings Facility (Cortaro-Marana GSF) for in-lieu recharge purposes. Marana has acquired a recovery well permit for eight service area wells. On an annual basis, Marana plans to use three of the wells to recover the stored CAP water. The permitted maximum annual recovery volume for the two wells which are located within the area of impact of the two recharge facilities is 3,472 acre-feet. The volume associated with a third well, which is located within the area of impact of the Cortaro-Marana GSF, is unlimited.

3. Results of Priority 4 Evaluation

Marana qualifies under this priority for the transfer of the remaining 1,481 acre-feet. Use of the direct recharge facilities and/or the Cortaro-Marana GSF and the recovery wells to annually store and recover the CAP entitlement will enable Marana to reduce its existing, annual groundwater use.

III. Conclusion

1,500 acre-feet of FWID's CAP allocation can be allocated under priorities one and four to Tucson and Marana, respectively. The results of the evaluation are presented below.

Table 2. Final Transfer Evaluation Results

	Acre-Feet			
Applicant	**Priority 1**	**Priority 3**	**Priority 4**	**Total**
Marana			1,481	1,481
Tucson	19	0		19
Total	19		1,481	1,500

Since all 1,500 acre-feet can be allocated under priorities one and four, no further analysis is necessary.

APPENDIX B

BIOLOGICAL EVALUATION (WESTLAND RESOURCES, INC.)

BIOLOGICAL EVALUATION

TRANSFER OF 1,481 ACRE-FEET OF CAP WATER ENTITLEMENT FROM THE FLOWING WELLS IRRIGATION DISTRICT TO THE TOWN OF MARANA UTILITIES DEPARTMENT

Prepared for:

TOWN OF MARANA
UTILITIES DEPARTMENT

Prepared by:

WestLand Resources, Inc.
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4001 E. Paradise Falls Drive
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August 20, 2009
Project No. 527.13

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EXECUTIVE SUMMARY

The purpose of this Biological Evaluation (BE) is to determine the potential for the occurrence of and adverse impacts to any US Fish & Wildlife Service (USFWS) endangered, threatened, proposed, candidate, or conservation agreement species (collectively referred to as special-status species) as a result of the proposed transfer of 1,481 acre-feet annually (afa) of the Flowing Wells Irrigation District's (FWID) allocation of Central Arizona Project (CAP) water entitlement to the Town of Marana Utilities Department (TMUD) for use by the town of Marana (the Project).

The area served by FWID was formerly agricultural land located south of the Rillito River and east of Interstate 10 (FWID Service Area). Much of the land has been converted to residential and retail uses and the FWID is now considered built out. The Tucson Materials Plant Center, operated by the US Department of Agriculture-Natural Resources Conservation Services, is located within FWID's service area. Any additional development within the 2,175-acre service area would likely replace an existing use within the FWID. The TMUD serves customers located north of the FWID primarily within the corporate limits of the town of Marana (TMUD Service Area). Approximately 9,765 acres of the total service area (61,195 acres) is open space or agricultural land. The Project Area includes both the FWID and the TMUD Service Areas. No new infrastructure is required to deliver and store the transferred water from FWID to the TMUD. No ground-disturbing activities would occur and there would be no direct impacts to biological resources.

A screening analysis was conducted to determine the potential for occurrence within the Project Area of special-status species. Also considered were species included in the town of Marana's draft Habitat Conservation Plan and species for which the Arizona Game & Fish Department has records of occurrence within 2 to 3 miles of the Project Area. The screening analysis resulted in a short list of species with potential to occur within the Project Area that were discussed in greater detail. The results of this BE indicate that because there would be no new construction or expansion of existing infrastructure for delivery or storage of CAP water, there would be no adverse impacts to biological resources, including vegetation, special-status species, other species considered, or habitat for these species. The Project does not occur within any designated or proposed critical habitat and it would not result in impacts to any proposed or designated critical habitat.

1. INTRODUCTION

This Biological Evaluation (BE) has been prepared in support of the Environmental Assessment (EA) for the proposed transfer of Central Arizona Project (CAP) water entitlement from the Flowing Wells Irrigation District (FWID) to the Town of Marana Utilities Department (TMUD) for use by the town of Marana (the Project; Figure 1). This BE evaluates the potential for the occurrence of and adverse impact to any US Fish & Wildlife Service (USFWS) endangered, threatened, proposed, candidate, or conservation agreement species (collectively referred to as special-status species) within the FWID and the TMUD Service Areas (the Project Area) as a result of the transfer of 1,481 acre-feet annually (afa) of the FWID allocation of CAP water to the TMUD. This document also considers the species included in the town of Marana's draft Habitat Conservation Plan (HCP) and species for which the Arizona Game & Fish Department's (AGFD) Heritage Data Management System (HDMS) has records of occurrence within 2 to 3 miles of the Project Area.

The FWID was formed in the late 1800s and encompasses an area of 2,175 acres. Through its well systems, it currently supplies water for urban use on the northwest side of the city of Tucson. The area served by FWID was formerly agricultural land located south of the Rillito River and east of Interstate 10 (I-10; FWID Service Area). FWID serves areas within the city of Tucson as well as unincorporated areas in Pima County. Much of the former agricultural areas have been converted to residential and retail development; although the USDA maintains the Plant Materials Center in the southwest portion of FWID's Service Area (Figure 2).

The TMUD is a municipal water utility located north of the FWID, primarily within the corporate limits of the town of Marana. The town of Marana is mainly bounded by Pinal County to the north (approximately 500 acres are within Pinal County), Trico Road to the west, Ina Road and Twin Peaks Road to the south, and Camino de Oeste and Thornydale Road to the east. TMUD currently serves an approximately 9,765-acre area encompassing developed tracts of land within Marana town limits (TMUD Service Area; Figure 3). The parcels are not all contiguous and encompass only portions of the town of Marana. The entire Project Area is approximately 61,195 acres, which includes the developed areas.

The Project Area includes both the FWID and the TMUD Service Areas.

2. METHODS

Information used to describe the following biological resources was obtained from the Arizona Ecological Field Office of the USFWS for Pima County (USFWS 2009), the AGFD's HDMS, the town of Marana's draft HCP, and a review of scientific publications and available literature. Because of the nature of the project and size of the Project Area, species-specific surveys were not conducted. However, WestLand biologists completed a screening analysis of the species considered to determine which species have the potential to occur within the Project Area. This analysis included a review of published documentation and available literature to determine species-specific information such as preferred habitats and known geographic and seasonal ranges. WestLand biologists have conducted numerous surveys in the area and applied their familiarity with the region to evaluate the vegetation and habitat characteristics of the Project Area for comparison with habitats known to support the special-status and other considered species.

If a species was determined to have no or negligible potential for occurrence within the Project Area, it was considered no further in this document. We determined that there is a negligible potential for occurrence if a species has the ability to roam over or through the Project Area (e.g., birds) but the Project Area has no resources of value to support the species. Species that we determine have more than a negligible potential to occur within the Project Area, or for which we did not have enough information in the screening criteria to make a determination, were subject to more detailed analysis.

3. PROJECT DESCRIPTION

The TMUD is proposing to acquire 1,481 afa of CAP entitlement from FWID. This acquisition would reduce TMUD's need to acquire excess CAP water from other sources for local recharge. The transfer of this CAP allocation would reduce TMUD's potential costs associated with participation in Central Arizona Groundwater Replenishment District and its obligation to Arizona Department of Water Resources' assured water supply replenishment requirements. Water demand for the town of Marana at complete build out is projected to be 45,000 afa. Future water use projections were developed in the Town of Marana Potable Water Master Plan based on residential, commercial, and industrial demand as outlined in the Town of Marana General Plan. If the transfer is approved, the TMUD would convey the allocated CAP water to the Lower Santa Cruz Recharge Project (LSCRP; Figure 4). The LSCRP is an existing groundwater recharge facility with sufficient capacity to recharge the transferred CAP water in compliance with existing state laws and issued permits. No modification or expansion of existing infrastructure is required to deliver and store the additional water allocation. The water transfer would not cause direct impacts to resources. There is anticipated growth within the TMUD's ultimate service area which will result in impacts to biological resources. Any future projects will comply with local, state, and federal policies and laws designed to protect resources and mitigate for impacts or loss to special status species and their habitat.

4. RESULTS

4.1. SITE DESCRIPTION

4.1.1. Existing and Adjacent Land Uses

The FWID is bounded by the Rillito River to the north, I-10 to the west, Miracle Mile to the south and Fairview to the east. The area served by FWID was formerly agricultural land. This land has been largely converted to residential and commercial development with some non-commercial agricultural uses along the western boundary at the USDA's Plant Materials Center.

The town of Marana encompasses approximately 118 square miles in northeastern Pima County and a portion of southern Pinal County. The current TMUD Service Area encompasses developed tracts of land within Marana town limits, however the parcels are not all contiguous and do not encompass the entire town of Marana. The active service area is comprised of approximately 9,765 acres, most of which are developed. The predominant land use is residential, with some commercial and business uses, and includes the Marana Northwest Airport. Dominant features include the Tortolita Mountains, the Santa Cruz River, I-10, the Union Pacific Railroad, and the CAP aqueduct.

4.1.2. Vegetation

The FWID Service Area

The FWID Service Area is surrounded by development and has a significantly diminished availability of resources and habitat for wildlife. Several parks provide open space for recreational purposes; however there are no sizable tracts of open, native vegetation within the FWID Service Area. The Navajo and Cemetery washes meet at the southeast corner of the FWID Service Area to become the Flowing Wells Wash, which crosses the southern portion of the FWID Service Area (Figure 2). Pima County Mapguide and the city of Tucson identify no significant vegetation associated with this wash, although portions of the channel contain small areas of native vegetation. The Rillito River is located outside the northern boundary of the FWID Service Area. This portion of the Rillito is designated as an Important Riparian Area on Pima County Mapguide.

The TMUD Service Area

Elevations within the TMUD Service Area range from 3,300 feet (in the Tortolita Mountains) to 1,730 feet (at the northwest corner of the town of Marana's boundary). Except for the Tucson Mountains and the Tortolita Mountains, topography within the TMUD Service Area is generally planar and gently slopes toward the Santa Cruz River. Vegetation in the undisturbed portions of the TMUD Service Area is typical of the both the lower Colorado River valley and Arizona upland subdivisions of the Sonoran desertscrub biotic community described in *Biotic Communities of the Southwestern United States and Northwestern Mexico* (Brown 1994).

WestLand has observed four general habitat types within and adjacent to the TMUD Service Area, including upland, xeroriparian, riparian, and wetland vegetation communities. Disturbed areas constitute a fifth land area identified. The five cover types correspond to vegetation communities delineated in Marana's Geographic Information System (GIS; Table 1). Marana used a vegetation zone map produced by Pima County and updated it within their town boundaries by delineating developed areas. Marana provided a GIS layer of digitized boundaries of their vegetation zones, which cover more than 97 percent (62,641 acres) of the TMUD Service Area (Table 1). Marana identifies more than 34 percent (21,401 acres) of the digitized area as Developed, Agriculture (Active), or Golf Course, and the remainder as one of six different vegetation types. The main habitat types are described below.

Table 1. Acreage of Habitat Types within the TMUD Service Area (Provided by the Town of Marana, GIS Database, 2007)

Marana GIS Vegetation Type	Acres	Percent of Total TMUD Area
Disturbed Areas		
Agriculture – Active	12,532	19.4
Developed	8,868	13.7
Golf Course	1	0.0
Disturbed Total	***21,401***	***33.2***
Upland Habitats		
Paloverde – Mixed Cacti Upland	31,415	48.7
Paloverde – Mixed Cacti Urban	177	0.3
Paloverde – Mixed Cacti Total	31,592	49.0
Creosote – Bursage Upland	2,171	3.4
Shrub – Scrub Disclimax Upland	1,015	1.6
Mesquite	274	0.4
Annual	13	0.0
Upland Total	***35,064***	***54.3***
Xeroriparian Habitats		
Creosote – Bursage Xeroriparian	843	1.3
Paloverde – Mixed Cacti Xeroriparian	403	0.6
Shrub – Scrub Disclimax Xeroriparian	4,849	7.5
Xeroriparian Total	***6,095***	***9.4***
Hydroriparian Habitats		
Cottonwood – Willow	82	0.1
Hydroriparian Total	***82***	***0.1***
Vegetated Total	**41,241**	**63.9**
Total Mapped Area	**62,642**	97.1*
Total TMUD Area	**64,532**	

*The town of Marana GIS vegetation zone map covers all but 2.9 percent of the TMUD Service Area.

Upland. In the upland habitats of the TMUD Service Area, the dominant tree species are the leguminous velvet mesquite (*Prosopis velutina*), ironwood (*Olneya tesota*), foothill palo verde (*Parkinsonia microphylla*), and blue palo verde (*P. florida*). Shrubs often provide the predominant vegetative cover, ranging from widely spaced to providing several layers of cover. These species include creosotebush (*Larrea tridentata*), whitethorn acacia (*Acacia constricta*), catclaw acacia (*A. greggii*), desert hackberry (*Celtis ehrenbergiana*), wolfberry (*Lycium* sp.), greythorn (*Ziziphus obtusifolia*), desert broom (*Baccharis sarothroides*), and four-wing saltbush (*Atriplex canescens*). Common sub-shrub species include triangle-leaf bursage (*Ambrosia deltoidea*), burroweed (*Ambrosia dumosa*), and desert zinnia (*Zinnia acerosa*). Cacti species include saguaro (*Carnegiea gigantea*) and prickly pear and cholla (*Opuntia* spp.), which are often a significant component of the vegetation community.

Some disturbed areas have little or no remaining native vegetation due to anthropogenic activities. The remainder of the vegetated area, nearly 85 percent (35,051 acres), is one of five upland vegetation types. Paloverde-Mixed Cacti association covers the greatest area, nearly 77 percent (31,592 acres) of the vegetated area, and over 50 percent of the total digitized TMUD Service Area. Other upland vegetation types are Creosote-Bursage (5.3 percent [2,171 acres] of the vegetated area), Shrub-Scrub Disclimax (2.5 percent [1,015 acres] of the vegetated area), Mesquite (0.7 percent [274 acres] of the vegetated area), and Annual (<0.01 percent [13 acres] of the vegetated area).

Xeroriparian. These habitats associated with ephemeral washes contain a denser version of the surrounding upland vegetation. Primary trees include blue and foothill palo verde and catclaw and whitethorn acacia. Some less drought-tolerant species include canyon ragweed (*Ambrosia ambrosioides*), desert willow (*Chilopsis linearis*), and salt cedar (*Tamarix chinensis*), an introduced species common in riparian and xeroriparian areas throughout the southwestern US. Xeroriparian habitats provide correspondingly higher habitat values for some wildlife, particularly birds and small- to medium-sized mammals, because of higher plant density and/or vegetative structural diversity. Vegetation in washes also provides foraging resources and cover for wildlife species that use both uplands and washes, such as coyotes, some reptiles, and numerous birds. Uplands and washes provide movement corridors for these species so they are not strictly dependent on washes for movement. However, due to low cover in desertscrub areas, larger wildlife generally concentrate their movements along washes. This community covers nearly 15 percent (6,095 acres) of the vegetated area.

Mesoriparian and Hydroriparian. Within the TMUD Service Area these habitats, including wetlands, occur in association with portions of the Santa Cruz River that receive effluent from adjacent wastewater treatment plants. The mesoriparian habitats are supported by intermittent or perennial watercourses or areas of shallow groundwater. These habitats provide a more dense and diverse variety of plant species. Plant communities associated with these areas are dominated by species that are found in drier upland habitats but contain some riparian plant species. Hydroriparian habitat on banks adjacent to and on islands within the Santa Cruz River is associated with perennial water flow and is characterized by plant communities dominated by various wetland species. Riparian obligate species that WestLand has identified within the TMUD Service Area in the vicinity of Ina and Cortaro roads include Goodding willow (*Salix gooddingii*), coyote willow (S*alix exigua*), cattail (*Typha latifolia*), and veronica (*Veronica*

anagallis-aquatica). Cottonwood-Willow association, a hydroriparian community, covers less than 0.2 percent (82 acres) of the vegetated area, all along the Santa Cruz River.

Named drainages that cross the TMUD Service Area include Cañada Agua 1, Cañada Agua 2, Santa Cruz River, Cottonwood Wash, Picture Rocks Wash, and Yuma Mine Wash. Numerous unnamed drainages that are tributary to the Santa Cruz River traverse the area as well. As described above, these drainages often support xeroriparian habitats which provide denser vegetation, larger individual trees, and habitat for wildlife. These washes also serve as movement corridors for wildlife species. Important Riparian Area, as designated by Pima County, includes the entire length of the Santa Cruz River and numerous tributaries within the TMUD Service Area.

4.2. SCREENING ANALYSIS

4.2.1. Special-Status Species

USFWS Special-Status Species

Both the FWID and TMUD Service Areas are located within Pima County, except for approximately 500 acres of the TMUD Service Area that extends into Pinal County with some non-contiguous parcels outside the town boundaries. The USFWS (2009) currently identifies 21 special-status species that are known to occur or have the potential to occur in Pima County (Table 2). This list catalogues species as either threatened, endangered, proposed, candidate, or under conservation agreement in Pima County. This list includes six plants, one invertebrate, three fish, one amphibian, one reptile, four birds, and four mammal species. Seventeen of these species were eliminated from further consideration in this BE because the Project Area is either out of the range of the species or does not contain suitable habitat. The Project Area contains habitats similar to habitats known to support the southwestern willow flycatcher (SWFC), yellow-billed cuckoo, and lesser long-nosed bat. These species are considered in greater detail in the sections that follow.

Table 2. Summary of USFWS Special-Status Species in Pima County. Species in bold text are considered in further detail in Section 4.2.

Species	Status	Range and Habitat Requirements	Potential for Occurrence
Plants			
Acuña Cactus *Echinomastus erectocentrus* var. *acunensis*	Candidate	Well-drained knolls and gravel ridges in Sonoran desertscrub. The Acuña cactus is known in Arizona only from the Puerto Blanco, Little Ajo, and Sauceda Mountains, and hills between Florence and Kearny, north and south of the Gila River; and in Sonora, Mexico in the Sonoita Hills, at elevations between 1,300 to 2,000 feet. Data source: AGFD 2004a.	No potential to occur. The Project Area is outside the species' known geographic range.

Table 2. Summary of USFWS Special-Status Species in Pima County. Species in bold text are considered in further detail in Section 4.2.

Species	Status	Range and Habitat Requirements	Potential for Occurrence
Goodding's Onion *Allium gooddingii*	Conservation Agreement	Forested drainage bottoms and moist, north-facing slopes of mixed conifer and spruce fir forests. This species is known only from mountain ranges in central and western Arizona including the White, Santa Catalina, and Chuska Mountains, and in New Mexico, at elevations above 7,500 feet. Data source: AGFD 1999	No potential to occur. The Project Area lacks suitable habitat and is below the lower elevation limit for this species.
Huachuca Water Umbel *Lilaeopsis schaffneriana* ssp. *recurva*	Endangered	Found in cienegas, perennial low-gradient streams, and wetlands. Its known elevation range is 3,500 to 6,500 feet. Data source: AGFD 2003a.	No potential to occur. The Project Area lacks suitable habitat.
Kearney's Blue Star *Amsonia kearneyana*	Endangered	Known only from west-facing drainages in the Baboquivari Mountains at elevations of 3,600 to 3,800 feet. Data source: AGFD 2003b.	No potential to occur. The Project Area is not within the species' known geographic range. To date, this species is known to occur only in the Baboquivari Mountains in Arizona.
Nichol Turk's Head Cactus *Echinocactus horizonthalonius* var. *nicholii*	Endangered	Sonoran desertscrub at the foot of limestone mountains and on inclined terraces and saddles on limestone mountains. The species is known only from Paleozoic limestone outcrops in south-central Arizona, specifically the Horquilla Formation (and older alluvial fans immediately below the Horquilla Formation bedrock) at elevations of 2,400 to 4,100 feet. Found in the Waterman Mountains in north central Pima County, and the Vekol Mountains in southwestern Pinal County. Data source: AGFD 2004b.	No potential to occur. The Project Area occurs outside the species' known geographic range.
Pima Pineapple Cactus *Coryphantha scheeri* var. *robustispina*	Endangered	Sonoran desertscrub or semidesert grassland communities at elevations of 2,300 to 5,000 feet (AGFD 2001a). A Pima pineapple cactus range study under the direction of the Bureau of Reclamation (Ecosphere Environmental Services 1992) refined the extent of the species' range in areas southeast and west of Tucson. Substrates in which this species are known to occur are described as rocky to sandy or silty loams in alluvial valleys or on shallow-sloped hillsides (less than 10 percent grade) (Mills, 1991; Roller, 1996a and b).	No potential to occur. The Project Area occurs outside the species' known geographic range. The species occurs in the south Tucson area but the northern extent of its range in the Tucson area has been fairly well defined.

Table 2. Summary of USFWS Special-Status Species in Pima County. Species in bold text are considered in further detail in Section 4.2.

Species	Status	Range and Habitat Requirements	Potential for Occurrence
Invertebrates			
San Xavier Talussnail *Sonorella eremita*	Conservation Agreement	Deep limestone rockslides with outcrops of limestone and decomposed granite. The San Xavier talussnail occurs only on San Xavier Hill in Pima County, Arizona. Its known elevation range is 3,850 to 3,920 feet. Data source: (AGFD 2003c)	No potential to occur. The Project Area not within range of species (known only to occur on San Xavier Hill).
Fish			
Desert Pupfish *Cyprinodon macularius*	Endangered	Shallow springs, small streams, and marshes. The species tolerates saline and warm water. It is known to occur only at elevations below 5,000 feet. Data source: AGFD 2001b.	No potential to occur. There are no natural populations remaining in Arizona. The only potentially suitable habitat is in the perennial portions of the Santa Cruz River, which are effluent-fed and would have to be stocked for the species to be present.
Gila Chub *Gila intermedia*	Endangered	Pools, springs, cienegas, and streams. Its known elevation range is 2,000 to 3,500 feet. Data source: AGFD 2002a.	Negligible potential to occur. The only potentially suitable habitat is the perennial portions of the Santa Cruz River. While conceivable that individuals from upstream populations could be washed into the Project Area during flood events, it is highly unlikely that their presence within the Project Area would be more than temporary.
Gila Topminnow *Poeciliopsis occidentalis occidentalis*	Endangered	Small streams, springs, cienegas, and shallows. It is known to occur only at elevations below 4,500 feet. Data source: AGFD 2001c.	Negligible potential to occur. The only potentially suitable habitat is in the perennial portions of the Santa Cruz River. While conceivable that individuals from upstream populations could be washed into the Project Area during flood events, it is highly unlikely that their presence within the Project Area would be more than temporary.
Amphibians			
Chiricahua Leopard Frog *Rana chiricahuensis*	Threatened	Streams, rivers, backwaters, ponds, and stock tanks that are free from introduced fish, crayfish, and bullfrogs. The Chiricahua leopard frog requires permanent or nearly permanent water sources. Its range in Arizona is divided into two areas. The first (northern population) extends from montane central	Negligible potential to occur. There are no known records of the species occurring within the Project Area. Although the Project Area is within the species' known geographic range and may contain suitable habitat along the Santa Cruz

Table 2. Summary of USFWS Special-Status Species in Pima County. Species in bold text are considered in further detail in Section 4.2.

Species	Status	Range and Habitat Requirements	Potential for Occurrence
		Arizona east and south along the Mogollon Rim to montane parts of west-southwestern New Mexico. The second is located in the mountains and valleys south of the Gila River in southeastern Arizona and southwestern New Mexico, and extends into Mexico (adjacent Sonora) along the eastern slopes of the Sierra Madre Occidental. Its elevation range is 3,300 to 8,900 feet. Data source: AGFD 2006.	River, its known elevation range is above that of the Santa Cruz River, which is below 2,300 feet at its highest point within the Project Area.
Reptiles			
Sonoyta Mud Turtle *Kinosternon sonoriense longifemorale*	Candidate	Ponds and streams, specifically within Quitobaquito Springs at an elevation of around 1,100 feet. Data source: AGFD 2005a.	No potential to occur. The Project Area is above the lower elevation limit for this species and is far outside of the species' known geographic range (Quitobaquito Springs).
Northern Mexican garter snake *Thamnophis eques megalops*	Candidate	In Arizona, these snakes are most abundant in densely vegetated habitat surrounding cienegas, cienega-streams, and stock tanks and in or near water along streams in valley floors and generally open areas, but not in steep mountain canyon stream habitat. Found in the southeast corner of state from the Santa Cruz Valley east and generally south of the Gila. Recent valid records occur from the San Rafael and Sonoita grasslands area and from Arivaca. Known from the Agua Fria River, Oak Creek, the Verde River, and from several upper Salt/Black River sites, including smaller tributaries. The elevation range is 3,000 to 8,500 feet. Data Source: AGFD 2001r.	Negligible potential to occur. Project Area outside known range for this species.
Birds			
Masked Bobwhite *Colinus virginianus ridgewayi*	Endangered	Desert grasslands with diversity of dense native grasses, forbs, and brush. Their known elevation range is 1,000 to 4,000 feet. The only known population of this species is greater than 40 miles southeast of Tucson. Data source: AGFD 2001d.	No potential to occur. The Project Area is outside the species' known geographic range.
Mexican Spotted Owl *Strix occidentalis lucida*	Threatened	Nests in canyons and dense forests with multi-layered foliage structure at elevations from 4,100 to 9,000 feet. Data source: AGFD 2005b.	No potential to occur. The Project Area lacks suitable habitat and is above the lower elevational limit for the species.
Southwestern Willow	**Endangered**	**Cottonwood/willow and tamarisk vegetation communities along rivers and**	**Potential to occur along effluent-dependent portions of**

Table 2. Summary of USFWS Special-Status Species in Pima County. Species in bold text are considered in further detail in Section 4.2.

Species	Status	Range and Habitat Requirements	Potential for Occurrence
Flycatcher ***Empidonax traillii extimus***		**streams. It is known to occur only at elevations below 8,500 feet. Data source: AGFD 2002b.**	**the Santa Cruz River.**
Yellow-Billed Cuckoo ***Coccyzus americanus***	**Candidate**	**Large blocks of riparian woodlands (cottonwood, willow, or tamarisk galleries). It is known to occur at elevations below 6,500 feet The species is rarely observed in xeric desert or urban settings AGFD, 2002c.**	**Potential to occur along effluent-dependent portions of the Santa Cruz River.**
Mammals			
Jaguar *Leopardus pardalis*	Endangered	Sonoran desertscrub to conifer forests. Rarely this species has been recorded from southern Arizona, New Mexico, and southern Texas. Currently its known range in Arizona is in southeastern Arizona. Confirmed occurrences of this species account for only a fraction of the reports. It is known to occur only at elevations below 8,000 feet. Data source: AGFD 2004c.	Negligible potential to occur. This species is very rare in the United States. Records have been reported in recent years from southeastern Arizona.
Lesser Long-Nosed Bat ***Leptonycteris yerbabuenae***	**Endangered**	**It is found in desertscrub habitat with abundant agave and columnar cactus which serve as forage plants for this species. It typically occurs at elevations below 6,000 feet (AGFD 2003d). In Arizona, New Mexico, and northwestern Mexico, the species is migratory. Pregnant females arrive in Arizona in late April and early May and feed on nectar and pollen of saguaros and other columnar cacti (Wilson 1985).**	**Potential to occur. The Project Area is within the species known geographical range and contains saguaros and agave which provide potential forage. They have also been documented foraging at hummingbird feeders in the Tucson metropolitan region. Potential roost sites are also possible within the mountainous portions of the Project Area.**
Ocelot *Felis pardalis*	Endangered	Humid tropical and subtropical forests, savannahs, and semi-arid thornscrub. Thick cover is recognized as being necessary for ocelots. Very little natural history information is known regarding the ocelot in Arizona. Infrequent and unconfirmed reports of this species for southern Arizona suggest its occurrence anywhere in southern Arizona is very unlikely at this time. It is known to occur only at elevations below 8,000 feet. Data source: AGFD 2004d	Negligible potential to occur. The Project Area lacks suitable habitat and is outside the species' known geographic range.

Table 2. Summary of USFWS Special-Status Species in Pima County. Species in bold text are considered in further detail in Section 4.2.

Species	Status	Range and Habitat Requirements	Potential for Occurrence
Sonoran Pronghorn *Antilocapra americana sonoriensis*	Endangered	Broad, intermountain alluvial valleys with creosote-bursage and palo verde-mixed cacti associations. Found on the Cabeza Prieta National Wildlife Refuge, the Organ Pipe Cactus National Monument, the Luke Air Force Barry M. Goldwater Gunnery Range, and possibly the Tohono O'odham Indian Reservation. Its elevation range is 2,000 to 4,000 feet Data source: AGFD 2002d	Negligible potential to occur. The Project Area is outside the species' known geographic range and natural expansion to the Project Area would be nearly impossible.

Arizona Game and Fish Department- Heritage Database Management System

The AGFD maintains a HDMS database that tracks species of concern in Arizona (AGFD 2008). This tool provides information on wildlife species' locations, so that presence (but not absence) in proximity to a selected site can be confirmed. The HDMS was accessed February 6, 2008, for occurrence records of special-status species within 2 miles of the FWID and 3 miles of the TMUD.

AGFD monitors additional species that are not protected by the ESA and includes them on their HDMS list. Other federal, state, and local agencies (especially land management agencies such as the USDA Forest Service and BLM) also designate selected species for management. These agencies may require an evaluation of potential effects of a proposed activity to these species, should that activity require approval by the agency. However, the US government is only required to consider the effects to species listed under the ESA for federal projects on private lands. For this reason, and because the Project will not result in any ground disturbance within the Project Area, only the ESA species found on this report are considered in further detail. The cactus ferruginous pygmy-owl (CFPO), formerly listed as endangered under the ESA, is also discussed in detail because the species is currently undergoing a 12-month status review with the USFWS. The 12-month review period expires in May 2009, and the species could be proposed for listing.

A summary of species listed in the HDMS report is provided in Table 3 below. The HDMS query reported only one ESA species, the western yellow-billed cuckoo. This species has recorded occurrences within both Service Areas. The Project are does not include any designated or proposed critical habitat.

Table 3. AGFD HDMS Results: Species Occurrences/ Critical Habitat/Tribal Lands Within 2 miles of the FWID and 3 Miles of the Town of Marana. Species in bold text are considered in further detail in Section 4.2.

Name	Common Name	ESA	USFS	BLM	State
Abutilon parishii	Pima Indian Mallow	SC	S	S	SR
Athene cunicularia hypugaea	Western Burrowing Owl	SC		S	
Bat Colony					
Chionactis occipitalis klauberi	Tucson Shovel-Nosed Snake			S	
Coccyzus americanus occidentalis	**Western Yellow-Billed Cuckoo**	**C**	**S**		**WSC**
Dendrocygna bicolor	Fulvous Whistling-Duck	SC			
Dendrocygna autumnalis	Black-Bellied Whistling-Duck				WSC
Euphorbia gracillima	Mexican Broomspurge				WSC
Gastrophryne olivacea	Great Plains Narrow-Mouthed Toad		S		
Glaucidium brasilianum cactorum	**Cactus Ferruginous Pygmy-Owl**	**SC**			**WSC**
Gopherus agassizii (Sonoran Population)	Sonoran Desert Tortoise	SC			WSC
Mammillaria thornberi	Thornber Fishhook Cactus				SR
Myotis velifer	Cave Myotis	SC		S	
Opuntia versicolor	Staghorn Cholla				SR
Sigmodon ochrognathus	Yellow-Nosed Cotton Rat	SC			
Tumamoca macdougalii	Tumamoc Globeberry		S	S	SR

C= Candidate, SC= Special Concern, S= Sensitive, SR=Salvage Restricted, WSC= Wildlife of Special Concern

Town of Marana Habitat Conservation Plan

The town of Marana is in the process of obtaining a Section 10 Incidental Take Permit from the USFWS. Non-federal entities that wish to conduct otherwise lawful activities that might result in "take"[1] of federally listed endangered and threatened species, must first obtain a permit authorizing the take pursuant to section 10(a)(1)(B) of the ESA and prepare a conservation plan which describes how the effects of the take will be addressed. The Habitat Conservation Plan (HCP) outlines conservation strategies for these species and mitigation for any "take" that occurs.

In late 2002, the town of Marana began its HCP process. To date, the HCP includes 13 species as listed below. A draft HCP is currently available for public review and the Final HCP is anticipated for May 2009.[2] As part of the HCP, measures will be implemented to avoid, minimize and mitigate potential impact to the following species (species in bold are considered in detail in Section 4.2):

1) Cactus ferruginous pygmy-owl (*Glaucidium brasilianum cactorum*)
2) Lesser long-nosed bat (*Leptonycteris curasoae yerbabuenae*)
3) Burrowing owl (*Athene cunicularia*)

[1] The Endangered Species Act defines "take" as to harass, harm, pursue, hunt, shoot, wound, hill, trap, capture, or collect, or to attempt to engage in any such conduct; furthermore, "harm" to an endangered species can result from habitat modification or degradation.
[2] http://www.marana.com/index.asp?NID=467.

4) Pale Townsend's big-eared bat (*Corynorhinus townsendii pallenscens*)
5) Ground snake (valley form) (*Sonora semiannulata*)
6) Tucson shovel-nosed snake (*Chionactis occiptalis klauberi*)
7) Southwestern willow flycatcher (*Empidonax traillii extimus*)
8) Western yellow-billed cuckoo (*Coccyzus americanus occidentalis*)
9) Merriam's mesquite mouse (*Peromyscus merriami*)
10) Mexican garter snake (*Thamnophis eques megalops*)
11) Desert tortoise–Sonoran population (*Gopherus agassizii*)
12) Lowland leopard frog (*Rana yavapaiensis*)
13) Talus snail (*Sonorella* spp.)

The US government is only required to consider the effects to species listed under the ESA for federal projects on private lands. For this reason, and because the Project will not result in any ground disturbance within the Project Area, only the ESA species found on this report are considered in further detail in Section 4.2 with the exception of the CFPO. The ESA species are the SWFC, the western yellow-billed cuckoo, and the lesser long-nosed bat. The CFPO, formerly listed as endangered under the ESA, is also discussed in detail because the species is currently undergoing a 12-month status review with the USFWS. The 12-month review period expires in May 2009, and the species could be proposed for listing.

4.3. DETAILED SPECIES ACCOUNTS

4.3.1. Lesser Long-Nosed Bat

Status and Natural History

The lesser long-nosed bat is federally listed as Endangered by the USFWS (53 FR 38456). There is no designated or proposed critical habitat for this species. The AGFD lists it as a Species of Special Concern (AGFD in prep).

The species' habitat in Arizona includes areas below 6,000 feet elevation in Cochise, Pima, Maricopa, Pinal, Graham, and Santa Cruz counties. In Arizona, the species is migratory; it is generally present in Arizona from April through September. Pregnant females arrive in late April and early May, and occupy maternity roosts located in caves and abandoned mines. At night, they disperse to feed upon nectar and pollen of saguaros and other columnar cacti (Wilson 1985). Foraging groups of lesser long-nosed bat are known to fly long distances (50 to 62 miles [80 to 100 km]) each night between their day roosts and night-time foraging areas (USFWS 1997b). In late July and early August, adult males arrive from Mexico to join the females and young that are dispersing from the maternity caves to forage upon the nectar and pollen of agave flowers. After late July, lesser long-nosed bats forage farther east and north, into plant communities occurring at elevations higher than those used earlier in the season (Cockrum and Petryszyn, 1991). By late September, the majority of the bats have left Arizona and returned to their winter range in

Mexico. After the young are able to fly, the bats disperse to post-maternity roosts, often at slightly higher elevations. During this period, prior to their fall migration, the bats forage primarily on agave and saguaro.

Recent information indicates that lesser long-nosed bat forage widely throughout the Tucson area, where they have been observed utilizing backyard hummingbird feeders. The Project Area contains saguaro cacti that could provide suitable forage during the summer period when this species is in the area. No roost sites for the lesser long-nosed bat are known within the TMUD, although the potential exists in such places as the Tortolita and Tucson mountains. The closest known roost site to the Project Area is a post-maternity roost located at Box Canyon Crevice, which is approximately 31 miles (49 km) southeast of the Project Area. The closest known maternity roost is located at Old Mammon Mine, which is approximately 35 miles (56 km) northwest of the Project Area (USFWS, 1995). There is at least one mine in the north end of the Tucson Mountains approximately 1.5 miles south of the town of Marana with potential for roosting, but there are no documented records from this site (RECON Environmental, Inc. 2008).

Potential for Occurrence within the Project Area

WestLand believes it is likely that the lesser long-nosed bat may occasionally forage within the Project Area, due to its ability to forage over long distances and its recently recorded visitation of hummingbird feeders in the Tucson metropolitan area within less than 1 mile of the Project Area (AGFD unpublished data). Also, while there is a possibility that potential suitable roost sites exist in the Tortolita or Tucson Mountains within the Project Area, common sources we checked contain no records of roosts within the Project Area.

Potential for the Project to Impact the Species

There is no potential for the Project to impact the lesser long-nosed bat, due to the lack of any surface disturbance associated with the Project. In addition, under Marana's HCP, impacts to the lesser long-nosed bat are planned to be minimized by enhancing native plant preservation including open apace requirements for foraging and movement corridors, implementation of an invasive species management program**,** and an education program to inform the public on how to avoid impacts to the bat.

4.3.2. Cactus Ferruginous Pygmy-Owl

Status and Natural History

The status of the formerly listed CFPO is currently under review with USFWS and this species could potentially be re-listed in the future.

On March 20, 2007, the USFWS received a petition from the Center for Biodiversity and Defenders of Wildlife (Petitioners) requesting that the CFPO be listed as a threatened or endangered species under the ESA. The Petitioners also requested the designation of Critical Habitat concurrent with the listing. Upon

receipt of a petition to list a species under the ESA, the USFWS conducts an evaluation to determine if the petition presents substantial information indicating that listing under the ESA may be warranted. This evaluation is commonly known as a "90-day finding." If a 90-day finding indicates that listing may be warranted, the USFWS initiates a 12-month status review of the species to determine whether to propose adding a species to the federal lists of endangered or threatened wildlife and plants.

On June 2, 2008, the USFWS published a positive 90-day finding on the petition. Upon review of the petition, the USFWS has determined that "the petition presents substantial scientific or commercial information indicating that the listing of the pygmy-owl may be warranted."[3]

With the publication of the 90-day finding, the USFWS announced the initiation of a 12-month status review of the CFPO. As is customary with these reviews, the USFWS has solicited information from interested parties on the status of the CFPO. The 12-month status review is due for completion on June 2, 2009.

There is currently no designated critical habitat or proposed critical habitat for this species. The AGFD classifies the CFPO as a species of special concern (AGFD in prep).

The CFPO is a small non-migratory, neo-tropical owl found in the Americas from Argentina to southern Arizona and Texas in the US. The northernmost subspecies, the *G. b. cactorum*, though described as common in Arizona early in this century, has declined since 1900 (Millsap and Johnson 1988). The best information available suggests that the Arizona population began to decline in the 1920s and by the 1950s the species was rare (Johnson et al. 1999).

CFPO in Arizona have been known to occur in river bottom woodlands, woody thickets, Sonoran desertscrub, and semidesert grasslands. In the Tucson area, the CFPO has historically been associated with Sonoran riparian deciduous woodlands, xeroriparian washes, and dense Sonoran desertscrub (USFWS 1994b). Increased survey efforts since 1993 have resulted in new sightings. Some members of the Altar Valley population southwest of Tucson occupy habitat different from other known CFPO populations in Arizona. These birds occupy linear riparian and xeroriparian corridors in desert grasslands with pockets of dense mesquite, hackberry, and ash. Saguaros are uncommon in this area. About half of the Altar Valley birds occupy territories in a belt of Sonoran desertscrub habitat found at an elevation of 3,000 to 4,000 feet above mean sea level (pers comm., Michael Ingraldi, AGFD, February 23, 2000). This area has the only significant concentrations of saguaro cacti in the Altar Valley. Other birds in this population occupy transitional habitats between mesquite grassland and Sonoran desertscrub.

[3] A finding that a petition presents substantial information indicates that listing may be warranted does not mean that the USFWS has determined that a species warrants federal protection under the ESA. Rather, this finding is the first step in a process that triggers a thorough review of all available information.

The common element among the different habitats occupied by the owls is dense vegetation and structural diversity with nearby trees and/or saguaros of sufficient size to contain nest cavities (USFWS 1999). CFPO nest sites in Arizona may be loosely associated with water, but the relationship is not definitive. Some nests have been located in areas devoid of water (pers. comm., Michael Ingraldi, AGFD, February 23, 2000). One study found that nest sites in northwest Tucson were located 3 to 35 meters from the nearest water source (Wilcox et al. 1999). Another study conducted in south Texas indicated that when given the opportunity to select, CFPO seem to prefer to nest in close proximity to water (pers. comm., Glenn Proudfoot, June 18, 2002). CFPO may take advantage of water and the associated benefits it provides when available, but the presence of water may not be necessary for successful nesting, nor do we know if it is preferred. This apparent preference for water may be indirectly related to increased vegetation densities and prey availability associated with water sources such as washes, livestock watering facilities, and irrigation.

A significant portion of the known population of CFPO has been located within low-density residential development in northwest Tucson. While the percentage of territories known from low-density residential developments is likely an artifact of sampling, and further surveys in more remote areas are likely to locate new CFPO sites, it has been demonstrated that low-density residential development is used by CFPO.

Potential for Occurrence within the Project Area

CFPO have been confirmed within the Project Area in the past 10 years, but their known numbers declined over subsequent years and AGFD captured the last known CFPO in the northwest Tucson and Marana in 2006. The common element among the different landscapes occupied by breeding CFPO is dense vegetation and structural diversity with nearby trees and/or saguaros of sufficient size to contain nest cavities. Portions of the Project Area supporting these elements, such as the Santa Cruz River corridor and xeroriparian corridors within the Project Area, could potentially provide breeding habitat for CFPO. There is also potential for dispersing CFPO to use the Project Area.

Potential for the Project to Impact the Species

There is no potential for the Project to impact CFPO, due to the lack of any surface disturbance associated with the Project.

4.3.3. Southwestern Willow Flycatcher

The SWFC was listed as endangered without critical habitat (60 Federal Register [FR] 10694) on February 27, 1995. Critical habitat was proposed on July 23, 1993 (58 FR 39495) and was designated on July 22, 1997 (62 FR 39129). The critical habitat decision was reversed in 2001 and redesignated in 2005.

The SWFC nests in dense riparian vegetation associated with streams, rivers, lakes, springs, and other watercourses and wetlands. The elevation range for this species is below 8,500 feet. Throughout its range,

the riparian habitats used by SWFC are rare, widely separated, small, and/or linear locales separated by vast expanses of arid lands. The USFWS' Recovery Plan for the species (2002) provides a description of nesting habitat for the SWFC. Common tree and shrub species that comprise nesting habitat include willow (*Salix* spp.), seepwillow (*Baccharis* sp.), boxelder (*Acer negundo*), cottonwood (*Populus* spp.), arrowweed (*Tessaria sericia*), tamarisk (*Tamarix* sp.), and Russian olive (*Eleagnus angustifolia*). Habitat characteristics such as plant species composition, size, and shape of habitat patch, canopy structure, vegetation height, and vegetation density vary across the subspecies' range. Regardless of the species' composition or height, occupied sites usually consist of dense vegetation in the patch interior, or an aggregate of dense patches interspersed with openings. In most cases, this dense vegetation occurs within the first 3 to 4 meters (10 to 13 feet) above ground. These dense patches are often interspersed with small openings, open water or marsh, or shorter and sparser vegetation. These patches create a mosaic that is not uniformly dense. Critical habitat for this species encompasses approximately 600 miles of riparian habitat along drainages in southern California, Arizona, and New Mexico.

No SWFC are currently known to occur within the TMUD and there is no designated critical habitat for SWFC along the Santa Cruz River. A portion of the Santa Cruz River corridor maintains perennial flow due to effluent wastewater discharge and contains potentially suitable habitat, but the riparian habitat in this area is not typical of breeding habitat for this species. SWFC could migrate through the Santa Cruz River corridor, but constituent elements for breeding habitat are not currently present. However, suitable breeding habitat for the species could develop along the Santa Cruz River.

Potential for the Project to Impact the Species

There is no potential for the Project to impact the SWFC, due to the lack of any surface disturbance associated with the Project. In addition, under Marana's HCP, impacts to SWFC habitat are planned to be minimized by limiting development within the Santa Cruz River floodway, enhancing native plant preservation measures**,** and providing wildlife crossings.

4.3.4. Yellow-billed Cuckoo

The yellow-billed cuckoo was placed on the USFS Sensitive Species List in 1990. The yellow-billed cuckoo was listed as an Arizona "Wildlife Species of Special Concern" in 1996. The USFWS designated the species as a candidate for threatened status in the Western US on July 25, 2001 (66 FR 38611). The species' listing was found to be warranted but precluded due to higher priority listing actions (USFWS).

The yellow-billed cuckoo nests from southern Canada through the northeastern US, south through the US to the Florida Keys, Central America and southern Baja California. The bird winters in South America to central Argentina and Uruguay (AGFD 2002). There have been scattered reports of yellow-billed cuckoo in Pima County along Tanque Verde Creek and Santa Cruz River. The yellow-billed cuckoo occurs within large blocks of riparian woodlands (cottonwood, willow, or tamarisk galleries) below 6,500 feet in elevation (USFWS). In Arizona, streamside cottonwood, willow groves, and larger mesquite bosques for

migrating and breeding is preferred (AGFD 2002). The species is rarely observed in xeric desert or urban settings (AGFD 2002).

The portion of the Santa Cruz River corridor that maintains a perennial flow due to effluent wastewater provides potentially suitable habitat for yellow-billed cuckoo. No breeding pairs have been documented within the town of Marana; however, breeding is suspected at Simpson Farm, approximately 1 mile west of the town of Marana along the Santa Cruz River. Recent bird sightings have been recorded at Sweetwater Wetlands, along the Santa Cruz at Avra Valley Road, Sanders Road, San Xavier Mission, the Tanque Verde Wash in the Rincon Mountains and even within Tucson metropolitan area (RECON Environmental, Inc. 2008).

Potential for the Project to Impact the Species

There is no potential for the Project to impact the western yellow-billed cuckoo due to the lack of any surface disturbance associated with the Project. In addition, under Marana's HCP, impacts to western yellow-billed cuckoo habitat are planned to be minimized by limiting development within the Santa Cruz River floodway, enhancing native plant preservation measures**,** and providing wildlife crossings.

5. CONCLUSIONS

The lesser long-nosed bat is the only species protected under the ESA that currently is likely to occur within the Project Area. In addition, the southwestern willow flycatcher, western yellow-billed cuckoo, and cactus ferruginous pygmy-owl were identified as having the potential to occur in the Project Area. Perennial streams, wetlands, or riparian areas that provide wildlife values are present along a small portion of the Santa Cruz River within the TMUD. This is effluent-dependent and would not be impacted by the continued use of groundwater. No impacts to such species or adverse modification of habitat are expected within the FWID.

Additional groundwater recharge in the town of Marana would help to reduce groundwater overdraft and could result, in certain areas, in a beneficial effect upon riparian vegetation dependent on groundwater supplies. Three federally-listed species and one candidate for listing were identified as having potential to occur in the TMUD Service Area: the southwestern willow flycatcher, lesser long-nosed bat, and yellow-billed cuckoo. No modification or expansion of existing infrastructure is required to deliver and store the additional water allocation for completion of the Project. Recharge of the additional CAP water at the LSCRP would result in no ground disturbance. The transfer would not result in additional development within the TMUD Service Area so there would be no adverse impacts to biological resources including vegetation, special-status species, or habitat for such species.

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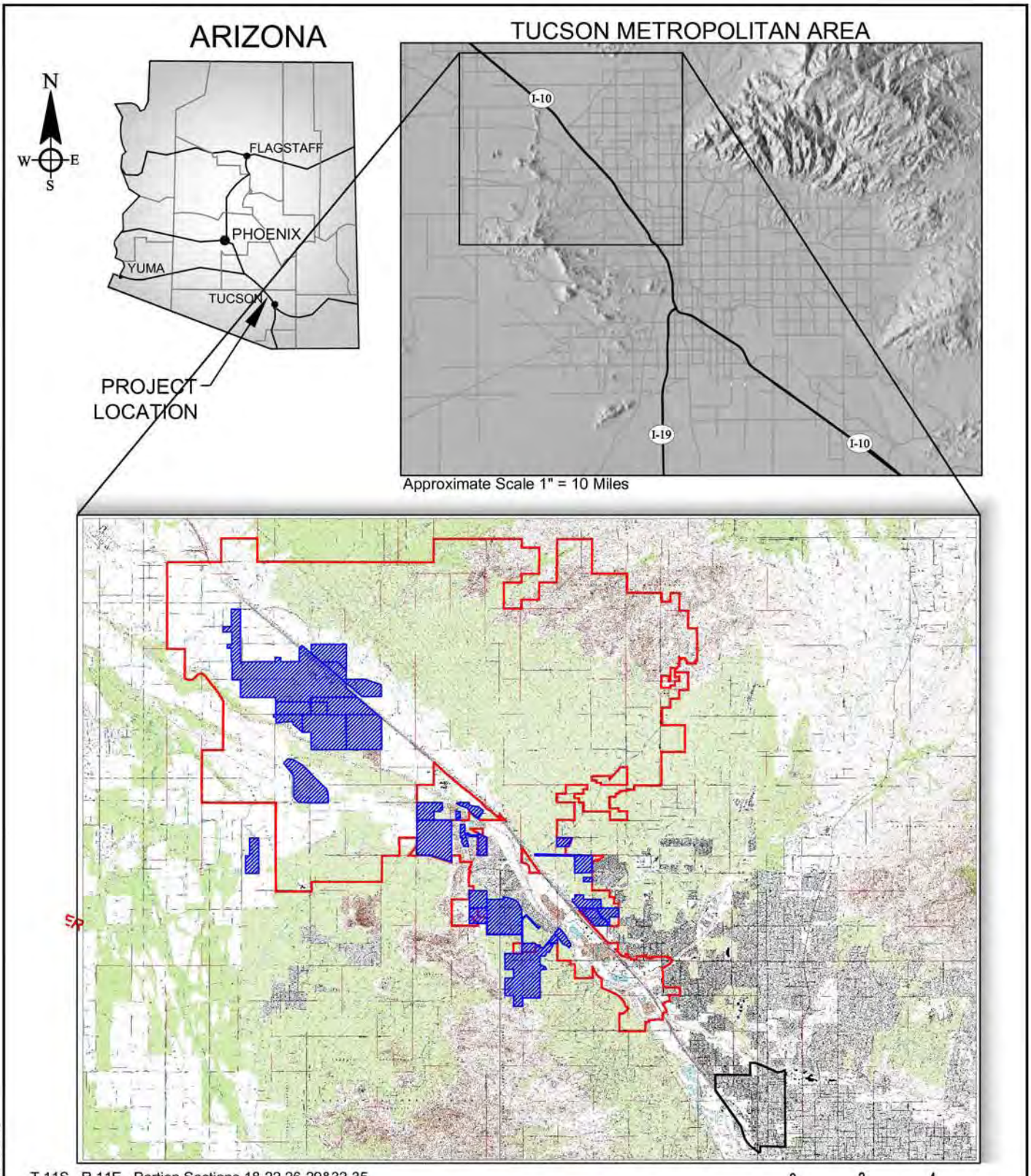
FIGURES



T.11S., R.11E., Portion Sections 18-22,26-29&32-35
T.12S., R.11E., Portion Sections 3,4,9,10,17,&20
T.12S., R.12E., Portion Sections 7,8,14,15,17-19,22,23,25,26-29,33-35
T.13S., R.12E., Portion Sections 3,4,9&10
T.13S., R.13E., Portion Sections 15, 21-23, 26-28, 34, & 35.
Pima County, Arizona
Avra, Marana, Jaynes, Ruelas Canyon, Tucson North, & West of Marana
USGS 7.5' Quadrangles

Town of Marana Boundary
FWID Service Area
Areas Currently Served by TMUD

WestLand Resources Inc.
Engineering and Environmental Consultants
4001 E. Paradise Falls Drive
Tucson, Az 85712 (520) 206-9585

CAP Entitlement Transfer BE

VICINITY MAP

Figure 1

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T.13S., R.13E., Portion Sections 15, 21-23, 26-28, 34, & 35.
Pima County, Arizona
Photo Source & Date: Aerials Express 2004

WestLand Resources Inc.
Engineering and Environmental Consultants
4001 E. Paradise Falls Drive
Tucson, Az 85712 (520) 206-9585

0' 900' 1800'
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FWID SERVICE AREA

CAP Entitlement Transfer BE

AERIAL OVERVIEW
Figure 2

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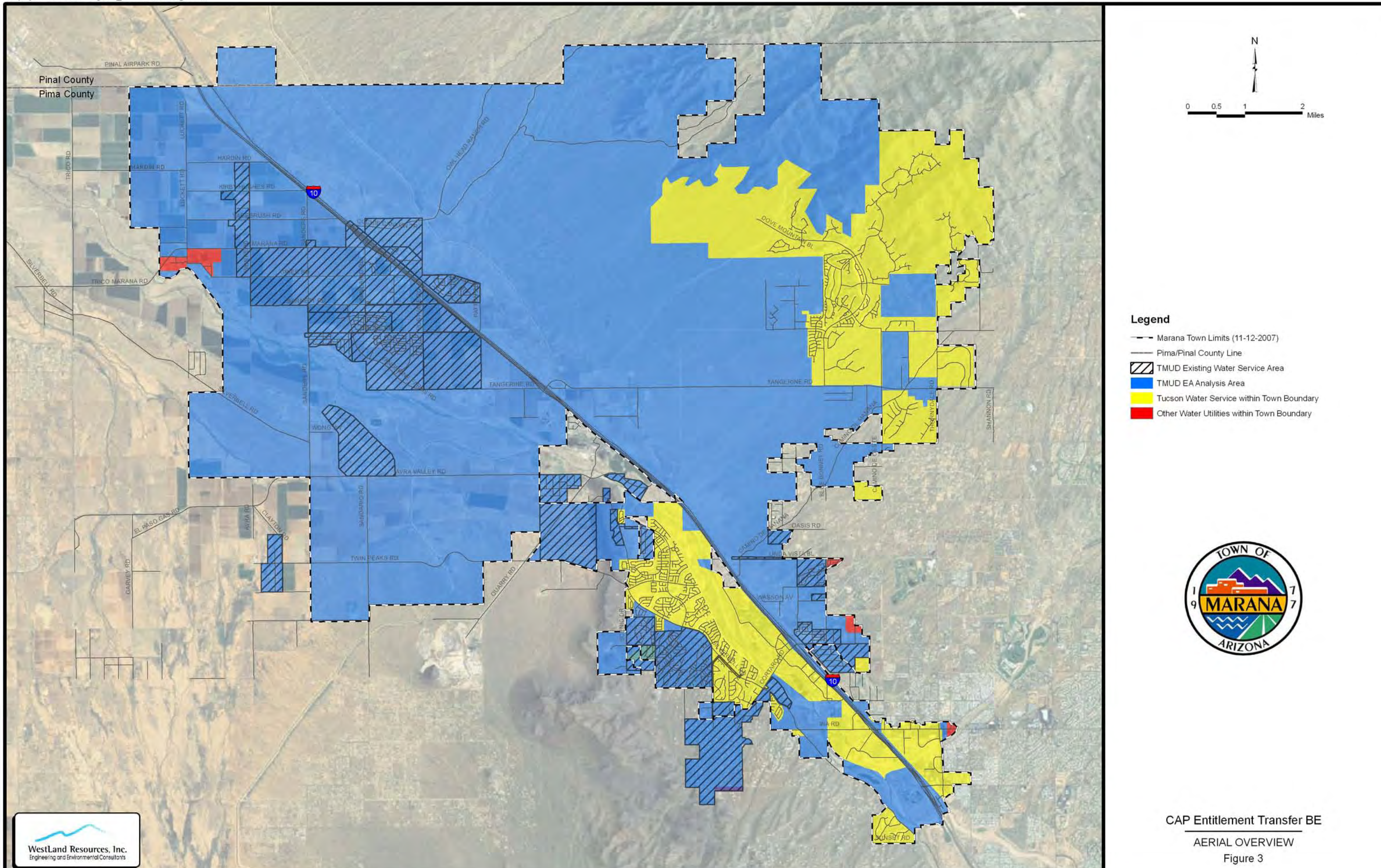

CAP Entitlement Transfer BE

AERIAL OVERVIEW

Figure 3

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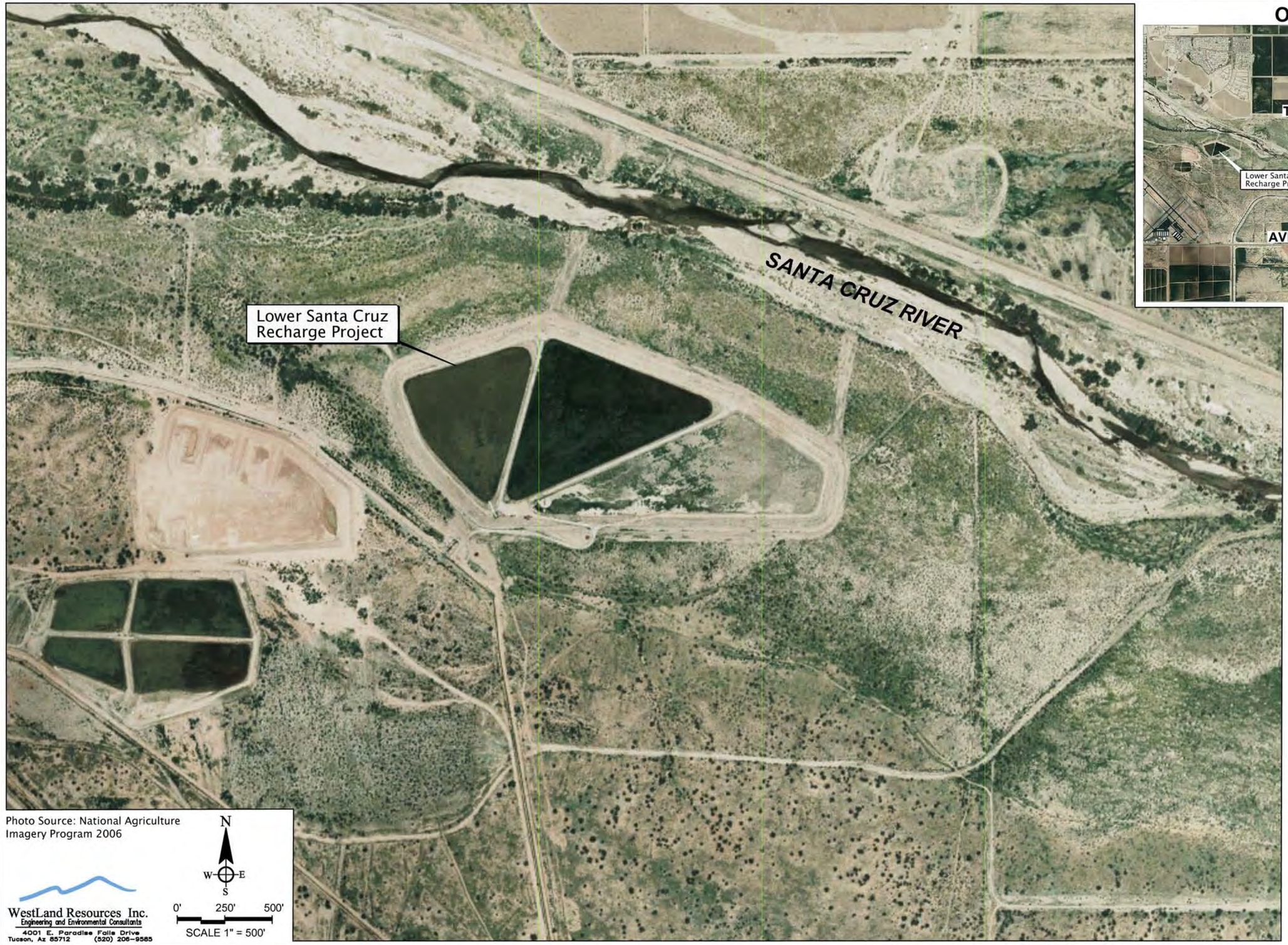

OVERVIEW

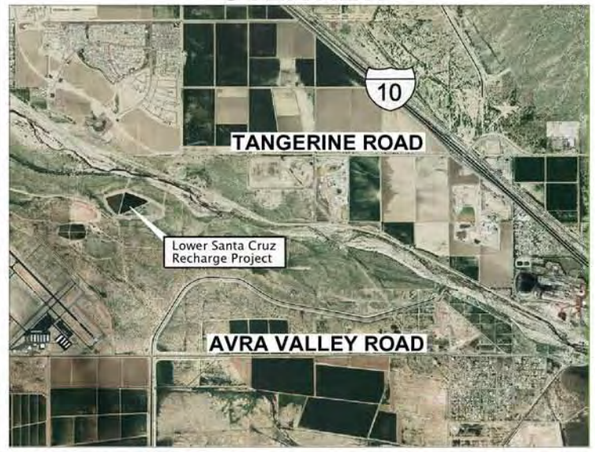

Photo Source: National Agriculture Imagery Program 2006

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WestLand Resources Inc.
Engineering and Environmental Consultants
4001 E. Paradise Falls Drive
Tucson, Az 85712 (520) 206-9585

LOWER SANTA CRUZ RECHARGE PROJECT

CAP Entitlement Transfer BE

LOCATION MAP
Figure 4

APPENDIX A

PIMA COUNTY LIST OF ENDANGERED, THREATENED, PROPOSED, CANDIDATE, OR CONSERVATION AGREEMENT SPECIES

Pima County

COMMON NAME	SCIENTIFIC NAME	STATUS	DESCRIPTION	COUNTY	ELEVATION	HABITAT	COMMENTS
Chiricahua leopard frog	*Lithobates [Rana] chiricahuensis*	Threatened	Cream colored tubercles (spots) on a dark background on the rear of the thigh, dorsolateral folds that are interrupted and deflected medially, and a call given out of water distinguish this spotted frog from other leopard frogs.	Apache, Cochise, Coconino, Gila, Graham, Greenlee, Navajo, Pima, Santa Cruz, Yavapai	3,300-8,900 ft	Streams, rivers, backwaters, ponds, and stock tanks that are mostly free from introduced fish, crayfish, and bullfrogs.	Require permanent or nearly permanent water sources. Populations north of the Gila River may be a closely-related, but distinct, undescribed species. A special rule allows take of frogs due to operation and maintenance of livestock tanks on State and private lands.
Desert pupfish	*Cyprinodon macularius*	Endangered	Small (2 inches) smoothly rounded body shape with narrow vertical bars on the sides. Breeding males blue on head and sides with yellow on tail. Females and juveniles tan to olive colored back and silvery sides.	Cochise, Graham, Maricopa, Pima, Santa Cruz, Yavapai	< 4,000 ft	Shallow springs, small streams, and marshes. Tolerates saline and warm water.	Two subspecies are recognized: Desert Pupfish (C.m. macularis) and Quitobaquito Pupfish (C.m. eremus). Critical habitat includes Quitobaquito Springs, Pima County, portions of San Felipe Creek, Carrizo Wash, and Fish Creek Wash, Imperial County, California.
Gila chub	*Gila intermedia*	Endangered	Deep compressed body, flat head. Dark olive-gray color above, silver sides. Endemic to Gila River Basin.	Cochise, Gila, Graham, Greenlee, Pima, Pinal, Santa Cruz, Yavapai	2,000-5,500 ft	Pools, springs, cienegas, and streams.	Found on multiple private lands, including the Nature Conservancy and the Audubon Society. Also occurs on Federal and state lands and in Sonora, Mexico. Critical habitat occurs in Cochise, Gila, Graham, Greenlee, Pima, Pinal, Santa Cruz, and Yavapai counties.
Gila topminnow	*Poeciliopsis occidentalis occidentalis*	Endangered	Small (2 inches), guppy-like, live bearing, lacks dark spots on its fins. Breeding males are jet black with yellow fins.	Cochise, Gila, Graham, Maricopa, Pima, Santa Cruz, Yavapai	< 4,500 ft	Small streams, springs, and cienegas vegetated shallows.	Species historically also occurred in backwaters of large rivers but is currently isolated to small streams and springs.
Huachuca water umbel	*Lilaeopsis schaffneriana ssp. recurva*	Endangered	Herbaceous, semi-aquatic perennial in the parsley family (Umbelliferae) with slender erect, hollow, leaves that grow from the nodes of creeping rhizomes. Flower: 3 to 10 flowered umbels arise from root nodes.	Cochise, Pima, Santa Cruz	3,500-6,500 ft	Cienegas, perennial low gradient streams, wetlands.	Species also occurs in adjacent Sonora, Mexico, west of the continental divide. Critical habitat in Cochise and Santa Cruz counties (64 FR 37441, July 12, 1999).

COMMON NAME	SCIENTIFIC NAME	STATUS	DESCRIPTION	COUNTY	ELEVATION	HABITAT	COMMENTS
Jaguar	*Panthera onca*	Endangered	Largest species of cat native to Southwest. Muscular, with relatively short, massive limbs and a deep-chested body. Usually cinnamon-buff in color with many black spots. Weights ranges from 90-300 lbs.	Cochise, Santa Cruz, Pima	1,600-9,000 ft	Found in Sonoran desertscrub up through subalpine conifer forest.	Also occurs in New Mexico. A Jaguar conservation team is being formed that is being led by Arizona and New Mexico state entities along with private organizations.
Kearney blue star	*Amsonia kearneyana*	Endangered	A herbaceous perennial about 2 feet tall in the dogbane family (Apocynaceae). Thickened woody root and many pubescent (hairy) stems that rarely branch. Flowers: white terminal inflorescence in April and May.	Pima	3,600-3,800 ft	West-facing drainages in the Baboquivari Mountains.	Plants grow in stable, partially shaded, coarse alluvium along a dry wash in the Baboquivari Mountains. Range is extremely limited. Protected by Arizona Native Plant Law.
Lesser long-nosed bat	*Leptonycteris curasoae yerbabuenae*	Endangered	Elongated muzzle, small leaf nose, and long tongue. Yellowish brown or gray above and cinnamon brown below. Tail minute and appears to be lacking. Easily disturbed.	Cochise, Gila, Graham, Greenlee, Pima, Pinal, Maricopa, Santa Cruz, Yuma	1,600-11,500 ft	Desert scrub habitat with agave and columnar cacti present as food plants.	Day roosts in caves and abandoned tunnels. Forages at night on nectar, pollen and fruit of paniculate agaves and columna cacti. This species is migratory and is present in Arizona usually from April to September and south of the border the remainder of the year.
Masked bobwhite	*Colinus virginianus ridgewayi*	Endangered	Males have a brick-red breast and black head and throat. Females are generally nondescript but resemble other races such as the Texas bobwhite.	Pima	1,000-4,000 ft	Desert grasslands with diversity of dense native grasses, forbs, and brush.	Species is closely associated with Prairie acacia (Acacia angustissima). Formerly occurred in Altar and Santa Cruz valleys, as well as Sonora, Mexico. Presently only known from reintroduced populations on Buenos Aires NWR.
Mexican spotted owl	*Strix occidentalis lucida*	Threatened	Medium sized with dark eyes and no ear tufts. Brownish and heavily spotted with white or beige.	Apache, Cochise, Coconino, Gila, Graham, Greenlee, Maricopa, Mohave, Navajo, Pima, Pinal, Santa Cruz, Yavapai	4,100-9,000 ft	Nests in canyons and dense forests with multi-layered foliage structure.	Generally nest in older forests of mixed conifer or ponderosa pine/gambel oak type in canyons, and use variety of habitats for foraging. Sites with cool microclimates appear to be of importance or are preferred. Critical habitat was finalized on August 31, 2004 (69 FR 53182) in Arizona in Apache, Cochise, Coconino, Gila, Graham, Greenlee, Maricopa, Navajo, Pima, Pinal, Santa Cruz, and Yavapai counties.

COMMON NAME	SCIENTIFIC NAME	STATUS	DESCRIPTION	COUNTY	ELEVATION	HABITAT	COMMENTS
Nichol Turk's head cactus	*Echinocactus horizonthalonius var. nicholii*	Endangered	Blue-green to yellowish-green, columnar, 18 inches tall, 8 inches in diameter. Spine clusters have 5 radial and 3 central spines; one curves downward and is short; 2 spines curve upward and are red or pale gray. Flowers: pink; fruit: woolly white.	Pima, Pinal	2,400-4,100 ft	Sonoran desertscrub.	Found in unshaded microsites in Sonoran desertscrub on dissected alluvial fans at the foot of limestone mountains and on inclined terraces and saddles on limestone mountain sides.
Ocelot	*Leopardus (=Felis) pardalis*	Endangered	Medium-sized spotted cat that is yellowish with black streaks and stripes running from front to back. Tail is spotted and about 1/2 the length of head and body. Face is less heavily streaked than the back and sides.	Cochise, Pima, Santa Cruz	< 8,000 ft	Desert scrub in Arizona. Humid tropical and sub-tropical forests, and savannahs in areas south of the U.S.	May persist in partly-cleared forests, second-growth woodland, and abandoned cultivated areas reverted to brush. Universal component is presence of dense cover. Unconfirmed reports of individuals in the southern part of the State continue tc be received.
Pima pineapple cactus	*Coryphantha scheeri var. robustispina*	Endangered	Hemispherical stems 4-7 inches tall 3-4 inches diameter. Central spine 1 inch long straw colored hooked surrounded by 6-15 radial spines. Flower: yellow, salmon, or rarely white narrow floral tube.	Pima, Santa Cruz	2,300-5,000 ft	Sonoran desertscrub or semi-desert grassland communities.	Occurs in alluvial valleys or on hillsides in rocky to sandy or silty soils. This species can be confused with juvenile barrel cactus (Ferocactus). However, the spines of the later are flattened, in contrast with the round cross-section of the Coryphanta spines. About 80-90% of individuals occur on state or private land.
Sonoran pronghorn	*Antilocapra americana sonoriensis*	Endangered	Upperparts tan; underparts, rump, and two bands across the neck are white. Male has two black cheek pouches. Hoofed with slightly curved black horns having a single prong. Smallest and palest of the pronghorn subspecies.	Maricopa, Pima, Yuma	2,000-4,000 ft	Broad intermountain alluvial valleys with creosote-bursage and palo verde-mixed cacti associations.	Typically, bajadas are used as fawning areas and sandy dune areas provide food seasonally. Cacti (jumping cholla) appears to make up substantial part of diet. This subspecies also occurs in Mexico.

COMMON NAME	SCIENTIFIC NAME	STATUS	DESCRIPTION	COUNTY	ELEVATION	HABITAT	COMMENTS
Southwestern willow flycatcher	*Empidonax traillii extimus*	Endangered	Small passerine (about 6 inches) grayish-green back and wings, whitish throat, light olive-gray breast and pale yellowish belly. Two wingbars visible. Eye-ring faint or absent.	Apache, Cochise, Coconino, Gila, Graham, Greenlee, La Paz, Maricopa, Mohave, Navajo, Pima, Pinal, Santa Cruz, Yavapai, Yuma	< 8,500 ft	Cottonwood/willow and tamarisk vegetation communities along rivers and streams.	Migratory riparian-obligate species that occupies breeding habitat from late April to September. Distribution within its range is restricted to riparian corridors. Difficult to distinguish from other members of the Empidonax complex by sight alone. Training seminar required for those conducting flycatcher surveys. Critical habitat was finalized on October 19, 2005 (50 CFR 60886). In Arizona there are critical habitat segments in Apache, Cochise, Gila, Graham, Greenlee, Maricopa, Mohave, Pima, Pinal, and Yavapai counties.
Acuna cactus	*Echinomastus erectocentrus var. acunensis*	Candidate	Less than 12 inches tall; spine clusters borne on tubercles, each with a groove on the upper surface. 2-3 central spines and 12 radial spines. Radial spines are dirty white with maroon tips. Flowers pink to purple.	Pima, Pinal	1,300-2,000 ft	Well drained knolls and gravel ridges in Sonoran desertscrub.	Immature plants distinctly different from mature plants. Immatures are disc-shaped or spherical and have no central spines until they are about 1.5 inches.
Northern Mexican Gartersnake	*Thamnophis eques megalops*	Candidate	Background color ranges from olive, olive-brown, to olive-gray. Body has three yellow or light colored stripes running down the length of the body, darker towards tail. Species distinguished from other native gartersnakes by the lateral stripes reaching the 3rd and 4th scale rows. Paired black spots extend along dorsolateral fields.	Apache, Coconino, Cochise, Gila, Graham, Navajo, Pima, Pinal, Yavapai	130-8,500 ft	Cienegas, stock tanks, large-river riparian woodlands and forests, streamside gallery forests.	Core population areas in the U.S. include mid/upper Verde River drainage, mid/lower Tonto Creek, and the San Rafael Valley and surrounding area. Status on tribal lands unknown. Distributed south into Mexico along the Sierra Madre Occidental and Mexican Plateau. Strongly associated with the presence of a native prey base including leopard frogs and native fish.
Sonoyta mud turtle	*Kinosternon sonoriense longifemorale*	Candidate	Aquatic; dark, medium-sized; shell up to 7 inches long; head, neck, and limbs mottled; carapace is olive brown to dark brown; plastron hinged; long barbels on chin, webbed feet.	Pima	1,100 ft	Ponds and streams.	Found only in Quitobaquito Springs in Organ Pipe Cactus National Monument, Arizona. Species also occurs in Rio Sonoyta, Sonora, Mexico.

COMMON NAME	SCIENTIFIC NAME	STATUS	DESCRIPTION	COUNTY	ELEVATION	HABITAT	COMMENTS
Yellow-billed cuckoo	*Coccyzus americanus*	Candidate	Medium-sized bird with a slender, long-tailed profile, slightly down-curved bill that is blue-black with yellow on the lower half. Plumage is grayish-brown above and white below, with rufous primary flight feathers.	Apache, Cochise, Coconino, Gila, Graham, Greenlee, La Paz, Maricopa, Mohave, Navajo, Pima, Pinal, Santa Cruz, Yavapai, Yuma	< 6,500 ft	Large blocks of riparian woodlands (cottonwood, willow, or tamarisk galleries).	Neotropical migrant that winters primarily ir South America and breeds primarily in the U.S. (but also in southern Canada and northern Mexico). As a migrant it is rarely detected; can occur outside of riparian areas. Cuckoos are found nesting statewide, mostly below 5,000 feet in central, western, and southeastern Arizona. Concern for cuckoos are primarily focused upon alterations to its nesting and foraging habitat. Nesting cuckoos are associated with relatively dense, wooded, streamside riparian habitat, with varying combinations of Fremont cottonwood, willow, velvet ash, Arizona walnut, mesquite, and tamarisk. Some cuckoos have also been detected nesting in velvet mesquite, netleaf hackberry, Arizona sycamore, Arizona alder, and some exotic neighborhood shade trees.
Gooddings onion	*Allium gooddingii*	Conservation Agreement	Herbaceous perennial plant; broad, flat, rather blunt leaves flowering stalk 14-18 inches tall, flattened, and narrowly winged toward apex; fruit is broader than long; seeds are short and thick.	Apache, Greenlee, Pima	7,500-11,250 ft	Shaded sites on north-trending drainages, on slopes, or in narrow canyons, within mixed conifer and spruce fir forests.	Known from the White, Santa Catalina, anc Chuska Mountains. Also found in New Mexico on the Lincoln and Gila National Forests. A Conservation Agreement between the Service and the Forest Servic signed in February 1998.
San Xavier talussnail	*Sonorella eremita*	Conservation Agreement	Land snail, less than one inch in diameter (about .75 inches) round shell with 4.5 whorls; white to pinkish tint and chestnut-brown shoulder band	Pima	3,850-3,920 ft	Inhabits a deep, northwest-facing limestone rockslide.	Restricted to 50 by 100 foot area of land privately owned in southeastern Arizona. A Conservation Agreement was finalized in 1995 and renewed in May 2008.

COMMON NAME	SCIENTIFIC NAME	STATUS	DESCRIPTION	COUNTY	ELEVATION	HABITAT	COMMENTS
American peregrine falcon	*Falco peregrinus anatum*	Delisted	A crow-sized falcon with slate blue-gray on the back and wings, and white on the underside; a black head with vertical "bandit's mask" pattern over the eyes; long pointed wings; and a long wailing call made during breeding. Very adept flyers and hunters, reaching diving speeds of 200 mph.	Apache, Cochise, Coconino, Gila, Graham, Greenlee, La Paz, Maricopa, Mohave, Navajo, Pima, Pinal, Santa Cruz, Yavapai, Yuma	3,500-9,000 ft	Areas with rocky, steep cliffs, primarily near water, where prey (primarily shorebirds, songbirds, and waterfowl) concentrations are high. Nests are found on ledges of cliffs, and sometimes on man-made structures such as office towers and bridge abutments.	Species recovered with over 1,650 breeding birds in the US and Canada.
Cactus ferruginous pygmy-owl	*Glaucidium brasilianum cactorum*	Delisted; petitioned for relisting	Small reddish-brown owl with a cream-colored belly streaked with reddish-brown. Males average 2.2 oz and females average 2.6 oz. Length is approximately 6.5 in., including a relatively long tail. Lacks ear tufts, and has paired black spots on the back of the head.	Pima, Pinal	< 4,000 ft	Areas of desert woodlands with tall canopy cover. Primarily found in Sonoran desert scrub and occasionally in riparian drainages and woodlands within semi-desert grassland communities. Prefers to nest in cavities in saguaro cacti but has been found in low-density suburban developments that include natural open spaces.	Not recognized as a protected taxonomic entity under the Act, but protected from direct take of individuals and nests/eggs under the Migratory Bird Treaty Act. A 200(petition for relisting under the Act is currently being evaluated. Due to low population numbers, captive breeding research was initiated in 2006 with some success.

APPENDIX C

TECHNICAL MEMORANDUM, CULTURAL HISTORY (WESTLAND RESOURCES, INC.)

REVISED
CULTURAL HISTORY
FOR THE PROPOSED TRANSFER OF 1,481 ACRE-FEET OF CAP WATER ENTITLEMENT FROM THE FLOWING WELLS IRRIGATION DISTRICT TO THE TOWN OF MARANA UTILITIES DEPARTMENT

Prepared for: Town of Marana
Prepared by: WestLand Resources, Inc.
Date: August 20, 2009
Project No.: 527.13

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LIST OF FIGURES

INTRODUCTION AND BACKGROUND

The Town of Marana Utilities Department (TMUD) is currently proposing the transfer of a Central Arizona Project (CAP) water allocation from the Flowing Wells Irrigation District (FWID) to the TMUD for use by the town of Marana (the Project). WestLand Resources, Inc. (WestLand), was retained by the TMUD to provide a culture history for the Project in support of assessing potential impacts to cultural resources. This technical memorandum summarizes the cultural history of the Project region.

1. PROJECT DESCRIPTION

The TMUD is proposing to acquire 1,481 af/yr of CAP allocation from the FWID to reduce its dependency on acquisitions of excess CAP water for local recharge. This acquisition will reduce the TMUD's potential costs associated with participation in the Central Arizona Groundwater Replenishment District and its obligation to the Arizona Department of Water Resources' assured water supply replenishment requirements. Water demand for the town of Marana at complete buildout is projected to be 45,000 af/yr. Future water use projections were developed in the Town of Marana Potable Water Master Plan based on residential, commercial, and industrial demand as outlined in the Town of Marana General Plan. If the transfer is approved, the TMUD would convey the allocated CAP water to the Lower Santa Cruz Recharge Project (LSCRP). The LSCRP is an existing groundwater recharge facility that has sufficient capacity to recharge the transferred CAP water in compliance with existing state laws and the permits issued for the facility without modification or expansion. No modification or expansion of existing infrastructure is required to deliver and store the additional water allocation. No activities will result in direct impacts to cultural resources.

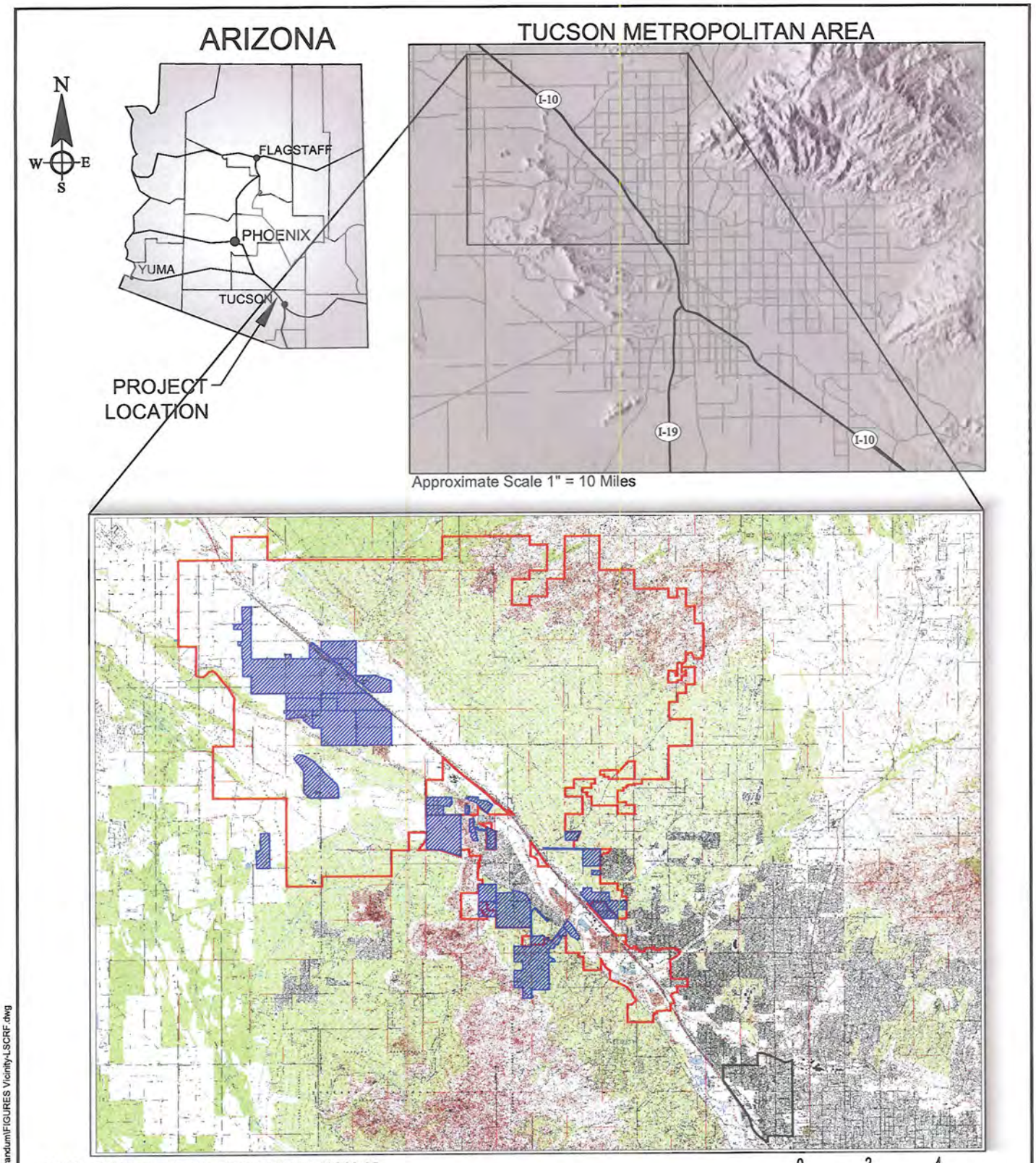
2. PROJECT LOCATION

The Project is located in Pima County, Arizona, and includes the TMUD and FWID service areas ***(Figure 1)***. The existing LSCRP and associated infrastructure will be used for recharge of the reallocated CAP water. This facility is located in Marana adjacent to the Santa Cruz River.

3. METHODS

Prehistoric and historic sites are known throughout the region. Many sites are located within the Santa Cruz River corridor, including prehistoric features and historic ranch structures. A portion of the Santa Cruz River corridor is located in Marana. The FWID service area is primarily developed, although this does not preclude the possibility of cultural resources in the service area. The transfer of a portion of the FWID's CAP water entitlement to the TMUD does not require the construction of new infrastructure or the expansion of existing recharge facilities, so there will be no direct impacts to cultural resources.

Based on the nature of the Project and the size of the Project area, a Class III cultural resources survey will not be conducted because no ground-disturbing activities will result from the proposed Project. Anticipated



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T.12S., R.12E., Portion Sections 7,8,14,15,17-19,22,23,25,26-29&33-35
T.13S., R.12E., Portion Sections 3,4,9&10
T.13S., R.13E., Portion Sections 15,21-23,26-28,34&35.
Pima County, Arizona
Avra, Marana, Jaynes, Ruelas Canyon, Tucson North & West of Marana
USGS 7.5' Quadrangles

Marana Town Boundary
FWID
Areas Currently Served by TMUD

CAP Entitlement Transfer
Cultural History Technical Memorandum

VICINITY MAP

Figure 1

WestLand Resources Inc.
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Tucson, Az 85712 (520) 206-9585

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growth will continue within the region and will be served by existing water sources. Any new development within the service areas will require the completion of a Class III cultural resource survey and compliance with Town of Marana Land Development Code Title 20, which establishes guidelines and specifications for the documentation and protection of archaeological resources. Mitigation actions will be implemented involving either data recovery or preservation of sites as required by the TMUD or other agencies if county, state, or federal permits are required.

4. TRENDS AND CULTURAL DYNAMICS OF SOUTHERN ARIZONA

The FWID and the town of Marana are located in the northern portion of the Tucson Basin in southern Arizona. In order to place the Project area and the Tucson Basin in context within the larger culture area of southern Arizona, a general outline of southern Arizona's rich cultural history is provided below and illustrated graphically in ***Figure 2***. Archaeological resources specific to the Project area are discussed in the sections following this outline.

PALEOINDIAN PERIOD (PRE-8500 B.C.)

The first inhabitants of southern Arizona are referred to by archaeologists as Paleoindians. They were a migratory, nomadic hunting people who roamed across North America at the end of the Pleistocene epoch. Two diagnostic characteristics of Paleoindians are large fluted lanceolate projectile points and the association of these points with the fossil remains of now extinct animals, particularly mammoth (*Mammuthus* spp.) and ancient bison (*Bison antiquus*) (Reid and Whittlesey 1997:30–37). While originally conceptualized as purely "big-game hunters," some Paleoindians are now known to have exploited plant resources in ways akin to later Archaic peoples (Mabry et al. 1997:105–107; Reid and Whittlesey 1997).

The oldest evidence of human occupation in the Southwest is attributed to the Clovis complex. This complex is identified by a distinctive lanceolate spear point with a concave base, longitudinal fluting, and lateral and marginal grinding (Slaughter 1992:72). Several important Clovis sites are located in the upper San Pedro Valley of southeastern Arizona, including Naco, Lehner, Escapule, and Murray Springs (Faught and Freeman 1998:41). Much of the evidence for a Clovis presence in southern Arizona comes from isolated occurrences of Clovis points (either whole or in fragments); for example, isolated Clovis points have been found in the St. Johns and Winslow areas, in Saguaro National Park East and Willow Springs in the Tucson Basin, in the Avra Valley area west of the Tucson Basin, near Kartchner Caverns in the San Pedro Valley, along Big Wash near Oracle Junction, in the area south of Gila Bend, on the northwest bajada of the Pinaleño Mountains, and in the Sanchez area in the Safford Valley (Ayres 1970; Faught and Freeman 1998:44; Huckell 1982; Neily 1985:10; Seymour et al. 1997:1–8).

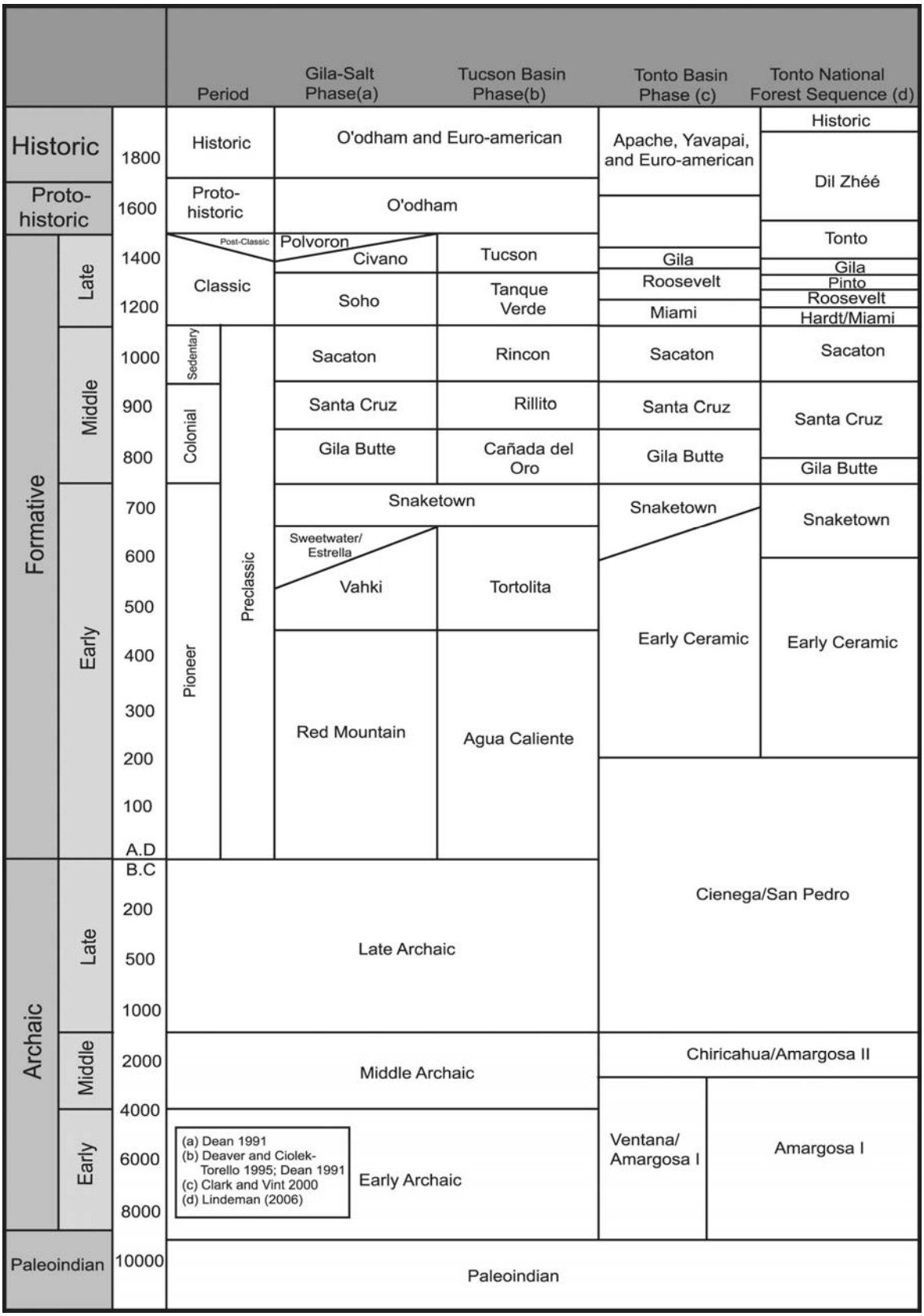

Figure 2. Cultural History of Southern Arizona

The Folsom complex succeeded the Clovis complex. Folsom, like Clovis, is identified by a distinctive style of projectile point. Folsom points are also lanceolate fluted spear points; however, Folsom points are distinguished from Clovis points by the extent of the fluting, which extends the full length of the blade, from the proximal end to the distal end. In addition, the margins of these points were retouched after fluting. In Arizona, Folsom points have been found only in surface contexts on the Colorado Plateau and in the mountainous Mogollon Rim country. No Folsom points have been identified in southern Arizona (Faught and Freeman 1998:45).

Plainview is a third Paleoindian tradition or tool complex that has been identified on the Colorado Plateau and in the southern Basin and Range province (although not, to date, elsewhere in Arizona). The Plainview tradition is attributed to the late Pleistocene or early Holocene period. Plainview points comprise several subtypes, including Meserve, Milnesand, and Belen points. All these points resemble Clovis points in their basic configuration, but they are unfluted (Faught and Freeman 1998:47). A Plainview point was discovered on the bajada of the Winchester Mountains in the Sulphur Springs Valley (Carlson et al. 1989). A few fragmentary projectile points resembling the Plainview type have also been found on the eastern Santa Catalina bajada in the interior of the Tortolita Mountains (Huckell 1984). Later Paleoindian complexes have not been identified anywhere in southern Arizona (Faught and Freeman 1998).

ARCHAIC PERIOD (8500 B.C.–A.D. 1)

The Archaic period was characterized by the collecting of a broad spectrum of wild plant and animal resources for subsistence. The large Pleistocene animals hunted in the Paleoindian period had become extinct by the beginning of the Archaic period, although it has been suggested that the two subsistence strategies overlapped temporally and possibly spatially (Faught and Freeman 1998:50). The hunting of megafauna may have been an opportunistic component of what was otherwise a subsistence strategy resembling that typified by the term *Archaic*. Nevertheless, a rough temporal marker of 8500–8000 B.C. has been chosen as the starting point of the Archaic period, as it was around this time that a ground stone tool industry consisting (initially) of one-handed manos and slab metates became common across the Southwest (Huckell 1996:306, 327). This has been taken to imply that many plant resources (seeds in particular) were not exploited by people using Paleoindian subsistence strategies, and that the beginning of the Archaic marks a broadening of the resource base.

The phrase *Archaic period* refers both to a division of time and the lifeway practiced by the ancient peoples during that time. Geographically, the period of time designated by archaeologists as the Archaic is subdivided into several regions spanning the Southwest as a whole. In the southern Basin and Range region of the Southwest, the broad cultural manifestation termed the *Archaic* is known as the Cochise culture. This culture is distinguishable from four co-traditions: the Colorado Plateau/Great Basin Complex, the Oshara Tradition, the Armagosa, and the Chihuahua Tradition. Temporally, the Cochise culture is subdivided into three broad divisions: Early, Middle, and Late.

The Early Archaic period (ca. 6500–4000 B.C.) of the Cochise culture is known as the Sulphur Springs phase. Sayles and Antevs (1941) originally defined this phase in the Sulphur Springs Valley in southeastern Arizona (Reid and Whittlesey 1997:44). Their archaeological work took place prior to the advent of radiocarbon dating techniques, so there was no independent chronological evidence for dating this early Cochise manifestation. The absence of independent dates contributed to Sayles originally concluding that a Paleoindian tradition (typified by the exploitation of megafauna) co-existed with a hunting-and-gathering tradition that exploited smaller game and various plant resources, as reflected in an artifact assemblage composed of flat milling stones, unifacial scrapers, and other lithic implements. This assessment turned out to be incorrect; however, reexamination of the Sulphur Springs material did establish a reliable beginning date of ca. 6500 B.C. for the Sulphur Springs phase (Huckell 1996:339). Even though they have now been dated with certainty, the sites investigated by Sayles did not include any artifacts that were stylistically distinctive and, therefore, temporally diagnostic. There has been a lack of diagnostic projectile points recovered from Early Archaic sites in southern Arizona that can be directly correlated in time with the Sulphur Springs phase, and sites dating to this era are not always recognizable without direct methods of dating, such as radiocarbon (Huckell 1996:329).

The Middle Archaic period (ca. 4000–1200 B.C.) of the Cochise culture—known as the Chiricahua phase—is typified by the addition of shallow basin metates, mortars and pestles, various bifacial tools, and distinctive side-notched projectile points (Chiricahua points) to the overall tool assemblage (Freeman 1999; Huckell 1996:342; Mabry 1998). Generally, the Middle Archaic period was a time during which regional variations in the material culture across the Southwest became less pronounced. In particular, projectile points take on a similarity of design over large geographic regions (Mabry 1998). Chiricahua points, for example, are similar in style and manufacture technique to Northern Side-notched, Pinto, and San Jose points, all found in other areas of Arizona (Slaughter 1992:70). It is during the Middle Archaic period that evidence of permanent or semi-permanent domestic architecture appears, although bands of people probably remained highly mobile. The first Mesoamerican cultigens (including maize) also arrived in the Southwest during this period, perhaps as early as 2000 B.C. (Huckell 1996:343; Mabry 2005:114, 115).

The Late Archaic period (ca. 1500 B.C.–A.D. 1) appears to have been a time of increasing adaptation to agriculture as the primary subsistence strategy. The prevalence of maize agriculture has led some researchers to refer to this period as the Early Agricultural period (Huckell 1996). It remains unclear whether the adoption of agriculture along with its corresponding changes in social and political relationships and settlement patterns occurred simultaneously across the Southwest. The earliest direct dating of maize from various parts of the Southwest suggests an essentially contemporaneous adoption of this cultigen about 4,000 years ago (Mabry 2005). However, adaptations to this early agricultural product were not the same in all regions, with many people retaining a way of life that could continue to be characterized as Archaic (Diehl 2005; Huckell 1996). Hunting-and-gathering practices remained a vital subsistence strategy throughout the Late Archaic/Early Agricultural period as evidenced by macrobotanical, zooarchaeological, and human osteological data (Diehl 2005:182). Additional evidence suggests that some groups did not cultivate maize at

all. The Coffee Camp site, for instance, at the southern edge of the Santa Cruz Flats provides evidence of a semi-sedentary lifestyle coupled with continued reliance on wild plant and animal resources (Halbirt and Henderson 1993).

In the south, the Cochise culture entered its penultimate cultural stage, the San Pedro phase (1500–800 B.C.), which was named for the type-site first investigated by Sayles on the San Pedro River (Sayles and Antevs 1941). Apart from its distinctive corner- and side-notched projectile points, the San Pedro phase is typified by 1) small oval pithouses, often with large interior bell-shaped storage pits and similar extramural pits (both of which reflect the importance of storage in a subsistence economy that includes the growing of crops); 2) flexed inhumations; 3) refinements in ground stone technology; and 4), in the Santa Cruz River Valley, canal-irrigated farming. Also notable during the Late Archaic period was a ceramic tradition of figurines, beads, and miniature vessels (Heidke 2005; Stinson 2005). Although the miniature vessels are argued to be incipient pottery (Heidke 2005), these objects have decorative qualities reminiscent of baskets and are similar to ceramic effigies found in Early Formative period contexts at other sites (Haury 1976b). Late Archaic incipient pottery may be part of the ceramic effigy tradition.

Until relatively recently, the San Pedro phase was considered the final stage of the Cochise culture. Archaeological work in Tucson and other areas, however, has unearthed evidence that has led to the definition of an additional phase, the Cienega phase, for the final pre-ceramic stage of the Cochise culture in southern Arizona (Gregory 2001:253; Huckell 1996:345). The Cienega phase, in contrast to the earlier San Pedro phase, is characterized by round, rather than oval, pithouses; distinctive projectile points with deep diagonal corner-notching (Cienega points); and a more diverse ground stone artifact assemblage (Huckell 1996:345; Stevens and Sliva 2002:300). Dates proposed for this phase are ca. 800 B.C.–A.D. 150 (Gregory 2001).

FORMATIVE PERIOD (A.D. 1–1450)

The Formative period is differentiated from the Archaic period by the addition of pottery to the material culture repertoire. Pottery is defined here as fired-clay containers and is distinct from the ceramic artifacts recovered from Late Archaic period contexts. The Formative period in southern Arizona is typically considered synchronous with the tenure of the Hohokam culture. However, this may or may not be the case (see Deaver and Ciolek-Torrello 1995; DiPeso 1956). The conventional hypothesis that the Hohokam cultural tradition begins with the appearance of pottery in southern Arizona still needs to be evaluated. For this reason, two different paradigms are used in this report to summarize Formative prehistory. The first is the standard Hohokam cultural chronology that has been used by archaeologists for decades to describe changes within Hohokam culture through time. The second divorces itself from the developmental dynamics of a specific culture region by instead linking its chronological divisions to cultural processes, trends, and events that occur synchronously across a broad area. Each paradigm is summarized and contrasted below.

The standard model segments the Hohokam culture into a sequence of four cultural periods. From oldest to youngest, these are the Pioneer, Colonial, Sedentary, and Classic periods (Gladwin 1965; Haury 1976b,

1978). In their original formulation, these periods represent the thesis that the Hohokam culture derives from Mesoamerican immigrants who "pioneered" a new way of life in the Gila and Salt River valleys of Arizona. After a few centuries of development, the descendents of the original immigrants "colonized" most of the adjoining river valleys of central and southern Arizona using their sophisticated technological, social, political, and religious systems. Once in place, the Hohokam colonists became "sedentary" agriculturalists. In a few centuries, the Hohokam culture reached its zenith, or "classic" cultural development.

The Hohokam cultural sequence was formulated on the notion that the river valleys radiating outward from the Gila and Salt rivers were uninhabited (Doyel 1977; Haury 1976a) or that the bottomlands were unused by the indigenous Archaic peoples. An alternative model for southern Arizona was formulated by DiPeso (1956), who postulated that the river valleys were already inhabited by agricultural peoples whom he referred to as the O'otam. In DiPeso's scenario, the O'otam were subjugated by the Hohokam, but after a few centuries, reasserted and freed themselves from Hohokam oppression.

Two theories on the origins of the Hohokam culture dominate the literature: first, that it derived from immigrants who ascend to dominance because of their impressive technologies and scale of cultural development; second, that it derived *in situ* from the preceding Late Archaic period culture whose Mesoamerican overtones were the result of the transmission of knowledge and ideas across vast regions. Recent archaeological evidence provides resounding proof that the river valleys of central and southern Arizona were inhabited and farmed during the Late Archaic period by relatively substantial populations of indigenous peoples endowed with technologies and a scale of cultural development more impressive than previously acknowledged. This new evidence also reveals that across the greater Southwest, the first pottery-making peoples shared similar subsistence technologies, architectural forms, tool assemblages, mortuary customs, and other cultural traits (Deaver and Ciolek-Torrello 1995; Whittlesey et al. 1994).

The alternative to the Hohokam cultural sequence is a tripartite division of the Formative period into three smaller periods referred to simply as Early, Middle, and Late. This three-part division closely corresponds to DiPeso's (1956) outline of prehistory, which also recognizes the Hohokam culture as a major influence in the prehistory of central and southern Arizona. The Early, Middle, and Late Formative periods are equivalent to DiPeso's Formative O'otam, Hohokam Intrusion, and O'otam Reassertion periods, respectively. Put quite simply, the early-middle-late divisions represent the time before the Hohokam, the time of the Hohokam, and the time after the Hohokam (Deaver and Van West 2001:20–24).

The three Formative periods also correspond generally to the Hohokam cultural sequence (Gladwin et al. 1937; Haury 1978). The Early Formative period encompasses the Pioneer period through the end of the Sweetwater phase. The Middle Formative period begins with the Snaketown phase of the Pioneer period and covers the Colonial and Sedentary periods. The Late Formative period corresponds to the Classic period. The slight mismatch in the two sequences is the result of looking at Hohokam prehistory from the so-called

Hohokam peripheries: the Papaguería, the Tucson Basin, the upper and lower Santa Cruz River valleys, the Gila Bend region, the San Pedro River Valley, the Safford Basin, southeastern Arizona, and the Tonto Basin.

The cultural traditions in these peripheries were affected by far-reaching cultural, environmental, and cosmological phenomena, which provided a similar structure and rhythm to the prehistoric traditions seen in all these regions. The cultural expressions and trajectories of each of these peripheries were singularly unique, however, and it was the response by the indigenous peoples to these far-reaching phenomena in the contexts of the local physiographic, environmental, cultural, and cosmological environments that gave rise to unique local culture histories. An outline of prehistory for southern Arizona from this perspective is presented below.

Early Formative Period (A.D. 1–650)

The Early Formative period represents the time before the appearance of a distinctive Hohokam cultural tradition. In the Tucson Basin, the Early Formative period appears to have developed out of the matrix of the Late Archaic Cochise culture. Archaeological investigations in the Tucson area in particular (for example, at the Houghton Road Site and other sites along the Santa Cruz River) have, over the past several years, yielded a large amount of data supporting this idea (Reid and Whittlesey 1997).

The basic pattern is the appearance of plain brown ware pottery, circular or bean-shaped structures, and a loose circular settlement arrangement with a central specialized or communal structure. Flexed inhumation is still the preferred mortuary practice. This initial Formative development is followed by another that is differentiated by the appearance of red-slipped pottery, a shift in architectural style from circular to rectangular houses, and changes in settlement structure. This second Formative development is then followed by a third, marked by the appearance of line-decorated pottery, additional shifts in architectural style, and further changes in settlement structure.

The Early Formative period encompasses two cultural phases in the Tucson Basin: the Agua Caliente (A.D. 150–550) and the Tortolita (A.D. 550–650). The development of brown plain ware pottery in the form of "seed jars" and bowls occurred during the Agua Caliente phase. The succeeding Tortolita phase represents the local expression of the red ware horizon (Deaver and Ciolek-Torrello 1995). An interesting note about the Tortolita phase in the Tucson Basin is the absence of zoomorphic representations in shell and stone (Vokes 2003). These representations figure prominently in later Hohokam iconography.

Middle Formative Period (A.D. 650–1150)

The Middle Formative period is marked by the appearance of a robust and regionally influential Hohokam cultural pattern. It is evident that this cultural pattern is not indigenous to the Tucson Basin, but has its birthplace to the north on the middle Gila River. The Middle Formative period corresponds, approximately, to what archaeologists have called the late Pioneer, Colonial, and Sedentary periods of the Hohokam sequence.

In the Tucson Basin and the upper Santa Cruz River Valley, the Hohokam sequence is not well defined prior to the Snaketown phase of the Pioneer period, whereas in the Phoenix Basin, archaeologists have defined the Red Mountain, Vahki, Estrella, and Sweetwater phases. The Agua Caliente phase is analogous to the Red Mountain phase in the Phoenix Basin and the Tortolita phase is roughly equivalent to the Vahki phase. The Tortolita phase also encompasses the time previously attributed to the Estrella and Sweetwater phases. The Snaketown phase is the first discernable expression of a Phoenix-Basin-derived Hohokam culture in the Tucson Basin. During the Snaketown phase, structures were mainly of the house-in-pit variety (Haury 1976b) and artifacts included carved stone bowls, stone palettes, figurines, shell jewelry, and pottery vessels (Reid and Whittlesey 1997:90).

During the Colonial period, beginning around A.D. 800, the material culture of the Tucson Basin and Phoenix Basin Hohokam diverged, especially the pottery: the Tucson area Hohokam produced red-on-brown pottery and the Phoenix area Hohokam produced red-on-buff pottery. Populations throughout the Hohokam world apparently increased during the Colonial period, in part because irrigation technology had improved, facilitating the reliable cultivation of maize, beans, squash, and cotton (Reid and Whittlesey 1997). The practice of inhumation was replaced by cremation burial (Wilcox and Sternberg 1983), but both inhumation and cremation were practiced in the middle and upper Santa Cruz River basins. In the Tucson Basin, large primary village sites with ballcourts and associated clusters of smaller sites became the predominant settlement pattern. In the middle and upper Santa Cruz River basins, known sites with Colonial period occupations include Paloparado, Potrero Creek, Nogales Wash, and El Macayo. Of these, Paloparado appears to have been a primary village site similar to those in the Tucson Basin (Deaver and Van West 2001:20, 21).

In the Tucson Basin chronology, the Hohokam Sedentary period (A.D. 950–1150) is divided into Early, Middle, and Late Rincon subphases (Wallace and Craig 1988) based primarily on changes in decoration. This period was distinguished by an overall increase in the number of settlements (many in previously uninhabited locations and environmental niches) and the relocation of some primary villages. These pronounced changes in settlement location may have been related to environmental factors or a response to social upheavals. During the Early Rincon subphase, the previously strong connections between the Tucson and Gila basins began to wane. This is seen in the diminishing quantities of imported Gila Basin pottery and an apparent concomitant increase in the amount of local pottery produced. The local pottery during the Early Rincon subphase is distinguished by a degeneration in the execution of the line work and a bolder, simplified decorative style. The beginning of the Middle Rincon subphase is marked by an apparent rejection of the tenets of Hohokam culture, the mass abandonment of existing settlements, and the founding of new settlements across the basin. More significantly, the ballcourts in the Tucson Basin were abandoned. This suggests a broadscale rejection of a key aspect of Hohokam social organization. Correlating with the broadscale shifts in settlement and population is the appearance of a distinctive pottery style and technological innovations in the indigenous pottery industry that resulted in a variety of bichromatic and polychromatic decorative expressions. These technological innovations were unmatched in the Gila Basin and are found nowhere else in southern and central Arizona. At the end of the Middle Rincon subphase, maybe after four

generations, there was another upheaval in the Tucson Basin; again, existing settlements were abandoned and new settlements founded. The Late Rincon subphase is conventionally considered the last hoorah of the Sedentary period; however, many of the Late Formative period settlements were founded during this subphase. For this reason, the Late Rincon could be considered the initial stage of the Late Formative period.

Late Formative Period (A.D. 1150–1450)

The Late Formative period is marked by significant shifts in population and settlement along with changes in architecture and other aspects of the material culture seemingly related to a chain of events that spawned cultural and social reorganization across the deserts of central and southern Arizona: the migration of peoples from the Colorado Plateau region into these desert regions and the construction and spreading influence of the site of Paquimé in northern Chihuahua. The themes that define these subdivisions are elaborated below.

The mass abandonment of Middle Rincon subphase settlements across the Tucson Basin seems to have occurred sometime between A.D. 1100 and 1150. Associated with this shift in settlement is another shift in decorative styles and technologies. Rincon Polychrome (a distinctive artifact of the Middle Rincon subphase) ceased production, whereas polychrome pottery emphasizing balanced and opposing red and black elements continued to be made in limited numbers. This particular color scheme is similar to the polychrome traditions in northern Chihuahua and to the local polychrome traditions in southeastern and south-central Arizona.

Archaeologists divide the Late Formative period (also known as the Classic period) in the Tucson Basin into two phases: the Tanque Verde phase (A.D. 1150–1300) and the Tucson phase (A.D. 1300–1450). Architecture during this time changed from pithouses to rectangular multi-room surface structures with adobe walls, sometimes reinforced with posts or stones. Houses were often enclosed in rectangular adobe-walled compounds (Fish et al. 1992b; Hayden 1957). At the larger villages, a new form of public architecture appeared: the earthen platform mound. Settlements became fewer but increased in size, possibly the result of population aggregation that may have been a response to increased conflict and the need for mutual defense and safety (Doelle and Wallace 1991). In the Late Rincon subphase, design styles on red-on-brown pottery became simpler and more rectilinear. This simplified style reached its apex during the Tanque Verde phase in the pottery type Tanque Verde Red-on-brown. The Tanque Verde style bears affinity to contemporary styles to the east and northeast. It is an extremely rigid style with limited variation. In the Tucson phase, Salado polychrome pottery became the primary decorated ware (Reid and Whittlesey 1997). In addition, the long-established practice of cremation burial was replaced by inhumation burial.

The Late Formative period ends sometime around A.D. 1450 with the disappearance of the Late Formative period cultures in southern Arizona from the landscape and the abandonment of the major Formative period settlements in the Salt and Gila River valleys, in the Tucson Basin, and in the rest of southern Arizona. Various competing theories have arisen to explain this cultural change. With regard to the Hohokam culture area to the north along the Salt and Gila rivers, soil salinization as a result of intensive irrigation with alkaline

water, water-borne diseases spread through canal systems, overpopulation leading to resource depletion, social and political reconfiguration, raiding and warfare, internal strife, climatic change in the form of floods or droughts, or some combination of these, have all been proposed (e.g., Abbott 2003; Ackerly 1982; Andrews and Bostwick 1997). With regard to the other areas of southern Arizona that were not dependent on a similar level of social organization or extensive networks of irrigation canals, other factors may have been at work. These factors remain as theories and are largely speculative. Little hard evidence is available to reveal what happened at the end of the Formative period. What is clear is that when the Spanish first entered the southwestern United States less than a century later, the large Late Formative period settlements across southern Arizona were long abandoned and the history of these prehistoric cultures had already passed into the folklore of the native peoples that the Spanish encountered.

PROTOHISTORIC PERIOD (A.D. 1450–1691)

Between the Hohokam collapse (ca. A.D. 1450) and the arrival of the Spanish, there appear to have been significant changes in the Native American cultures in the region. Very little is known about this period prior to the arrival of Father Kino in the Santa Cruz River Valley in A.D. 1691. The Spanish identified the people living along the Santa Cruz River as the Pima (O'odham) and those along the San Pedro River as the Sobaipuri (Doelle and Wallace 1990; Masse 1981). Differences between the material culture and lifeways of the Piman peoples and the Hohokam have led some researchers to question whether the Hohokam were the ancestors of the O'odham or if the latter moved into the region after the Hohokam decline (Seymour 2007; Teague 1993). For instance, Sobaipuri sites tend to be subtle when compared to the more extensive Classic period Hohokam sites, containing less substantial architecture and sparser artifact assemblages with little ground stone. A lack of painted pottery, storage features, and extensive irrigation features has also been noted at these sites (Doelle 1984; Masse 1981; c.f. Seymour 2007). This is generally taken as evidence that Sobaipuri groups existed at lower population densities and were more mobile than previous Hohokam populations.

SPANISH AND MEXICAN PERIOD (A.D. 1691–1856)

The Historic period begins in 1691 with the establishment of the mission system in the Santa Cruz River Valley following the arrival of Jesuit missionary Eusebio Kino. Kino made his first forays into the Santa Cruz River Valley in 1691 and 1692, at which time he established the missions at Tumacácori and San Xavier del Bac, respectively (Wilson 1999:12, 13). After a poorly documented visit to the Casa Grande area in 1694, Kino made a second *entrada* into the area in 1697 (Wilson 1999:24) accompanied by Captain Juan Mateo Manje and approximately 20 soldiers and native guides. Missionizing efforts in the Pimería Alta continued into the early eighteenth century, although after Kino's death in 1711, the mission system in Sonora began to deteriorate, partly the result of neglect while Spain was distracted by the War of the Spanish Succession (Walker and Bufkin 1979:14).

In a 1723 report on the state of the mission system in Sonora, Fray Daniel Januske reported that the native population of the Pimería Alta was declining, the result of poor living conditions at the missions and Apache raiding. The Apache had begun raiding Piman settlements just prior to Kino's initial contact (Spicer 1962:234), and the increase in raiding over time resulted in more and more geographical shifts among the Piman-speaking populace. By 1750, most of the people occupying the San Pedro River Valley had been forced to move to the Santa Cruz and Altar valleys. This turned out to be only a temporary solution, as the Apache began raiding these locations as well.

Indian resentment and hostility grew in response to the increasing numbers of Spanish settlers in the Santa Cruz River Valley and their infringement on Indian land, as well as to the paternalism and arrogance of the Spanish missionaries (Officer 1989:35, 36). In 1751, a Pima revolt resulted in the deaths of over 100 settlers, miners, ranchers, and missionaries. The missions at San Xavier and Tumacácori were extensively damaged and the small Spanish settlement at Tubac was destroyed. One year later, in 1752, the Presidio San Ignacio de Tubac was founded to prevent further rebellion and to protect the mission and Spanish settlers. Tubac thus became the first permanent Spanish settlement in Arizona (Officer 1989:36).

Father Bernard Middendorf arrived in the Tucson area in 1757 and established the first Spanish outpost there. However, he and his party were attacked and driven out soon after, and Tucson resumed its status as a *visita* of San Xavier (Officer 1989:38). In 1762, in order to defend themselves from attack and to have access to more Indian souls, the Spanish ordered the forced transfer of Sobaipuri Indians from their villages along the San Pedro River to Pima villages along the Santa Cruz River. Construction of the San Agustín Mission at the base of A Mountain began 10 years later. The mission was built near the location of an Indian village (Dobyns 1976). In 1775, the Presidio of Tucson was established along the Santa Cruz River. Defensive and residential structures were built, and soldiers from the presidio at Tubac were moved north to Tucson to defend against Apache raiding, which had become a problem in the region (Wilcox 1981). Spanish colonists and Native American farmers were attracted to the area by the farmland, the water from the river, and the relative safety provided by the presidio (Officer 1989).

Mexico gained independence from Spain in 1821 and Mexican settlers continued to arrive and farm the Tucson Basin. The San Agustín Mission appears to have been abandoned by 1831 (Elson and Doelle 1987). However, the inhabitants of the region continued to use the Tucson Presidio for protection (Officer 1989).

AMERICAN PERIOD (1856–PRESENT)

The Treaty of Guadalupe-Hidalgo, signed in 1848 following the conclusion of the Mexican-American War, ceded that portion of (what is now) Arizona lying north of the Gila River to the United States. In 1853, the Gadsden Purchase expanded Arizona from the Gila River south to the present day Mexican border. Although the lands included in the Gadsden Purchase had been used for ranching in the past, Arizona's ranges were now open for ranching activities on a large scale. The increase in population in California since 1849 had

created a significant beef market, and Arizona became a thoroughfare for cattle being driven from Texas to California. The U.S. Army arrived in Tucson in 1856 and founded the original Fort Lowell southeast of the old Spanish presidio. As with the presidio, Fort Lowell's main purpose was to protect settlers from the Apache. In 1857, the Butterfield Overland Mail Company was formed to provide stagecoach transportation and mail service from St. Louis, Missouri, through Arkansas, New Mexico, and Arizona, to San Francisco, California. The Southern Pacific Railroad arrived in 1880 (Myrick 1975), bringing with it a flood of Anglo-American settlers. The defeat of the Apache in 1886 with the surrender of Geronimo brought boom times to the region, with mining and cattle ranching being the main industries of growth (Sonnichsen 1987). In recent times, tourism, the health industry, the University of Arizona, and Davis-Monthan Air Force Base have fueled the growth of Tucson and the surrounding areas (Sonnichsen 1987).

5. ARCHAEOLOGICAL BACKGROUND OF THE MARANA AREA

The northern Tucson Basin, encompassing northwest Tucson and the Marana town limits, contains numerous cultural resources, attesting to the lengthy human presence in the region. The Santa Cruz River Valley and surrounding mountain bajadas have been the focus of archaeological investigations for decades, investigations that have revealed and, in some cases, defined the cultural history of greater southern Arizona. In order to better understand the nature of the potential archaeological discoveries in the Project area, important archaeological resources in the Marana area are summarized by time period below.

PALEOINDIAN PERIOD (PRE-8500 B.C.)

Although certain areas of southern Arizona have produced relatively abundant evidence of a Paleoindian occupation (e.g., the San Pedro River Valley), there is very little evidence of a Paleoindian occupation of the Tucson Basin as a whole (Faught and Freeman 1998; Huckell 1984). Paleoindian finds in the region of the northern Tucson Basin are similarly scarce. Three Clovis points are known from the Avra Valley area to the west (Ayres 1970; Huckell 1982); one reworked Clovis point was found near the Willow Springs ranch just north of the Tucson Basin (Huckell 1982); and one Clovis or possibly Folsom point has been reported from the Rattlesnake Pass area at the northern end of the Tucson Mountains (Agenbroad 1967). Subsequent Paleoindian occupation of the region is also poorly represented. A few fragmentary projectile points resembling the Plainview type were found at the Lone Hill site on the eastern Santa Catalina bajada and at Site AZ AA:8:14(ASM) in the interior of the Tortolita Mountains (Huckell 1984). Later Paleoindian complexes have not been identified anywhere in southern Arizona (Faught and Freeman 1998).

Given the evidence of a Clovis presence in other areas of southern Arizona, Huckell (1984) has argued that the absence of Clovis finds in the Tucson Basin may be related to geologic visibility rather than an actual absence of Clovis hunters in the area. In the Tucson Basin, Late Pleistocene-age deposits tend to be deeply buried by alluvium and are rarely exposed in arroyo cuts where they might be identified. However, in the nearby Avra Valley to the west, fossilized mammoth and horse bones have been identified eroding from

arroyo banks at Site AZ AA:16:39(ASM) (Dart 1987:44, 1988). Although Paleoindian-age artifacts were not found at the site and the bones have been interpreted as redeposited and resting atop a Mid- to Late Pleistocene-age soil that likely predates association with human activity (Field 1988; Waters 1987), these deposits nonetheless illustrate the potential for Pleistocene-age arroyo cut exposures in the area. Additionally, late Pleistocene-age landforms are exposed throughout the Tucson Basin, suggesting that surface finds of Clovis points should be more prevalent if the Clovis occupation was substantial. Other biases may be operating to obscure point visibility, such as the intensive later prehistoric occupation of the basin (Huckell 1984).

ARCHAIC PERIOD (8500 B.C.–A.D. 1)

In contrast to the scant evidence of a Paleoindian occupation of the northern Tucson Basin, the Archaic period is better represented. Although evidence of early Archaic occupation is limited, important Middle and Late Archaic period sites are present in the Marana area. Many of these sites are located along the floodplain of the Santa Cruz River and have been discovered, in large part, as a result of recent development and road improvement projects along Interstate 10. Notable among these sites are the Cortaro Fan site (AZ AA:12:486[ASM]), Rillito Loop (AZ AA:12:252[ASM]), the Dairy site (AZ AA:12:285[ASM]), the Valley Farms site (AZ AA:12:736[ASM]), the Cortaro Road site (AZ AA:12:232[ASM]), Willow Ridge (AZ AA:12:968[ASM]), Costello King (AZ AA:12:503[ASM]), Las Capas (AZ AA:12:111[ASM]), and the Rillito Fan site (AZ AA:12:788[ASM]). Most of these sites are dominated by cultural horizons attributed to the Late Archaic period.

Many of the Late Archaic Santa Cruz River floodplain sites in the northern Tucson Basin offer evidence of at least semi-sedentary habitation, agriculture, irrigation (e.g., canals), incipient pottery, long-distance trade (mostly in the form of marine shell from the Sea of Cortez or the Pacific Ocean), expanded storage facilities, and technological innovations related to the procurement and processing of food (Diehl 2005). In general, these sites demonstrate a greater degree of investment in habitation features and storage facilities than earlier Archaic sites, suggesting lengthier habitation and more intensive utilization of the surrounding environment.

Mabry (2007:302, 303) identifies five Late Archaic settlement complexes in the reach of the Santa Cruz River within the Marana town boundaries. These settlement complexes occur along the reach of the river that stretches from its confluence with the Cañada del Oro Wash to Point of the Mountain near Rillito Peak. These complexes are: 1) the Las Capas-Costello King site complex, 2) the Cortaro Road-Valley Farms-Dairy site complex, 3) the Stewart Brickyard site complex, 4) the Rillito Loop-Cortaro Fan site complex, and 5) the Los Morteros, Locus 1 site complex. Four of these settlement complexes are found on the east side of the river. The Los Morteros, Locus 1 complex is the only one on the west side of the river. This complex may also include the Los Morteros site (AZ AA:12:57[ASM]), the Redtail site (AZ AA:12:149[ASM]), and the Lonetree site (AZ AA:12:120[ASM]), all sites containing important Formative period components.

The most extensively investigated Archaic period site in the northern Tucson Basin is the Middle and Late Archaic period site of Las Capas. This site has been intensively investigated by Desert Archaeology (Mabry 2008) and SWCA (Hesse and Foster 2005), and excavations continue presently with Desert Archaeology. Desert Archaeology's initial excavations identified over 100,000 artifacts and roughly 700 features, 468 of which were excavated and dated to the San Pedro phase (1200–800 B.C.). These features included irrigation canals, pithouse depressions, extramural storage pits, hearths, and human and dog inhumations. Bone and flaked stone tools and debris, ground stone tools, faunal and floral remains, pigments, shell and mineral ornamental objects, and crude pinch-ware pottery were recovered during the excavations (Mabry 2008). SWCA's excavations in a different portion of the site identified roughly 1,370 features consisting of extramural storage pits, thermal pits, and pithouse depressions, along with thousands of flaked and ground stone artifacts, a stemmed variety of San Pedro-style projectile point, clay pipes, beads, figurines, containers, and irrigation features (Hesse and Foster 2005). The main focus of SWCA's excavations at the site was the early San Pedro phase horizon, but an earlier component containing thermal and non-thermal pit features, evidence of maize agriculture, and Cortaro projectile points was also found, dating to approximately 3700 B.P. Las Capas is significant for its duration and intensity of occupation, as well as for its evidence of sophisticated canal irrigation that appears to mark the beginning of a developmental sequence that culminates in the more complex Formative period irrigation systems (Mabry 2008). Although not as extensive as Las Capas, the Cortaro Fan site is notable as the type-site for the Middle to Late Archaic period Cortaro projectile point (Roth 1989; Roth and Huckell 1992). These and other Archaic period sites of the Santa Cruz River floodplain have helped to define and, in some cases, rewrite the Late Archaic prehistory of the region.

In addition to the well-documented intensive use of the Santa Cruz River floodplain, Middle and Late Archaic period sites have also been found in the comparatively less studied upper bajadas of the Tortolita and Tucson mountains (Roth 1992, 1998). Roth (1996) has developed a settlement-subsistence model for the Late Archaic period in the Tucson Basin in which the larger alluvial/floodplain sites were the locations of long-term habitation, agriculture, and exploitation of immediately available riverine resources, while the smaller upland sites were limited-activity locations where special-purpose groups exploited wild plant and animal resources on a seasonal basis and obtained raw materials for lithic tool manufacture.

Excavations at the Dairy site complex and the nearby Willow Ridge site (AZ AA:12:968[ASM]) have identified additional evidence of extensive Late Archaic settlements and farming activities along the Santa Cruz River floodplain. The original studies at the Dairy site were conducted by the Arizona State Museum (ASM). Archaeologists documented an extensive profile of alluvial fan deposits in a 500-m-long embankment created during the construction of the Shamrock Farms Dairy (Fish et al. 1992a), including Late Archaic and Early Formative period deposits. The Shamrock Farms Dairy was subsequently demolished. Cultural and Environmental Systems (CES) began archaeological testing in the location of the former dairy in preparation for residential development (Slawson 1994). Statistical Research, Inc. (SRI), took over the testing program and conducted data recovery (Altschul and Huber 1995; Deaver 1996; Deaver and Altschul 1996). SRI documented an extensive distribution of Formative period features and deposits associated with the fan

sediments as well as Archaic period features and deposits associated with the Santa Cruz River floodplain deposits underlying the fan deposits. Additional excavations by Old Pueblo Archaeology (Old Pueblo) and WestLand at the Dairy site have documented structures and other features buried within the Santa Cruz River floodplain deposits at the foot of the Dairy site alluvial fan (Jones 2002a, 2002b, 2004a, 2004b). SWCA conducted excavations at the nearby Valley Farms site, similarly documenting Late Archaic period features and deposits (Wellman 2000, 2008). Archaeological monitoring at the Cortaro Road site documented storage and cooking pits associated with the Late Archaic period (Hesse and Lascaux 2003). Recently completed excavations by WestLand at the Willow Ridge site documented Late Archaic period deposits with cooking pits, storage pits, and a canal.

Archaeological studies of the Late Archaic period sites along the Santa Cruz River floodplain reveal that the reach of the Santa Cruz River within the Marana town limits was intensively occupied and farmed during the Late Archaic period. This stretch of river has yielded a wealth of information that has opened our eyes to the level of sophistication of agricultural technologies, settlement structure, and social organization from as much as 3,400 years ago. The Late Archaic period sites along the floodplain have also contributed greatly to our understanding of the transition from foraging to farming in southern Arizona. In this regard, the nearby Coffee Camp site (AZ AA:6:19[ASM]), although outside the Marana town limits at the southern edge of the Santa Cruz Flats, also bears mentioning. Coffee Camp yielded a primarily Late Archaic period occupation consisting of 354 subsurface features that included pithouses, burials, various types of thermal and storage pits, caches of tools, and a variety of lithic, ceramic, and ground stone artifact types (Halbirt and Henderson 1993). The overall site size and types of features, structures, and material culture present indicated a relatively intensive and long-term occupation of the site, making Coffee Camp similar to other Late Archaic riverine agricultural villages documented further upstream along the Santa Cruz River. However, no cultigens were identified from Coffee Camp in spite of abundant flotation and pollen samples from all types of features. The site's occupants therefore practiced a semi-sedentary lifestyle in conjunction with a continued reliance on wild plant and animal resources. While models of the transition to agriculture have been argued to support population immigration as the source of agriculture in southern Arizona (e.g., Huckell 1990), the lack of cultigens, the evidence of food storage and sedentism, and continuity in the material culture at Coffee Camp seem to provide a developmental link between pre- and post-agricultural Late Archaic period populations and between Late Archaic and Formative period farmers of the region (Halbirt and Henderson 1993).

FORMATIVE PERIOD (A.D. 1–1450)

Increased reliance on agriculture as a subsistence practice during the Archaic period influenced the distribution of settlements. By the Late Archaic period, settlements were aggregated along the farmable reaches of the Santa Cruz River, including within the Marana town limits. The distribution of Formative period settlements was even more influenced by the distribution of farmable land along the Santa Cruz River, the Cañada del Oro Wash, and the alluvial fans associated with the washes at the upper edges of the bajadas near the mountain fronts. Prehistorically, the Santa Cruz River floodplain was the most dynamic and

productive geographic region in the Tucson Basin (Gregory and Nials 2005:27). In this environment, prehistoric communities actively used the floodplain to cultivate crops such as maize, beans, and squash and to exploit a number of natural resources. Although the Santa Cruz River has drastically changed in the last century, it once hosted lush riparian communities teeming with flora and fauna, including forests of cottonwood, willow, and mesquite and wildlife such as freshwater shellfish, small mammals, and several species of migratory birds and bats. In addition to abundant plants and animals, the Santa Cruz River floodplain provided prehistoric populations with other natural resources such as the raw materials for prehistoric lithic and ground stone technologies. Community studies (e.g., Fish et al. 1992b; Madsen et al. 1993) have revealed that settlement clusters concentrated along the Santa Cruz River and surrounding bajadas on the basin edges. The distribution of sites in the Marana area indicates that Formative period peoples predominantly occupied settlements near rivers, streams, and other watercourses, using upland bajada and mountain environments primarily as temporary resource collection and processing locales. For the purposes of this discussion, the Formative period sites along the Santa Cruz River within the Marana town limits are organized into five site groups: 1) the Dairy site group, 2) the Los Morteros group, 3) the Stewart Brickyard group, 4) the Huntington group, and 5) the Marana Mound group. Each group of sites is associated with a particular reach of the Santa Cruz River floodplain.

The Dairy site group consists of sites on and around the Hardy Wash alluvial fan at the eastern margin of the floodplain. These sites are clustered near the intersection of Cortaro Farms Road and Interstate 10. The Dairy site group includes the Dairy site (AZ AA:12:285[ASM]), the Valley Farms site (AZ AA:12:736[ASM]), and the Cortaro Road site (AZ AA:12:232[ASM]). Collectively, these sites represent over 3,400 years of occupation. Individually, Formative period components have been identified at the Dairy site, the Cortaro Road site, and the Valley Farms site.

The Dairy site is perhaps one of the longest occupied locations in Marana. Situated on an alluvial fan at the edge of the Santa Cruz River floodplain, the Dairy site was positioned at a strategic location for floodwater farming, with access to waters from Hardy Wash and to floodwaters from the Santa Cruz River. Combined excavations indicate that this location has been inhabited and farmed for over 3,400 years when taking into consideration the Late Archaic and historic farming components (Wellman 2000, 2008). Archaeologists from ASM first studied archaeological features and deposits exposed in a 500-m-long embankment along the northern edge of the Shamrock Farms Dairy property (it is from this property that the Dairy site derives its name [Fish et al. 1992a]). The embankment was created when the land was leveled to construct the Shamrock Farms Dairy. Local lore tells of burials and exotic funerary objects exposed during the construction excavations, but essentially no permanent record exists of what was lost. What remained for archaeologists to study was a cross-section of the archaeological deposits in the long cut into the alluvial fan deposits where Hardy Wash disgorges onto the Santa Cruz River floodplain. Examination of the profile revealed evidence of pre-ceramic, plain brown ware, and red ware occupational horizons (Fish et al. 1992a). Subsequently, these horizons were redefined as the Cienega, Agua Caliente, and Tortolita phases of the Tucson Basin cultural sequence.

In 1994, CES conducted limited excavations at the Dairy site (Slawson 1994). Subsequently, SRI took over the testing (Altschul and Huber 1995; Deaver 1996; Deaver and Altschul 1996), conducting excavations in eight 50-m-square study units across the site. This archaeological testing identified Early Formative period deposits in all the study units, the most notable discoveries being an Early Formative period canal in Blocks 2 and 5 and a Late Formative period settlement in Block 3. SRI's data recovery efforts focused on the Late Formative period settlement called the Shamrock Ruin. More recently, Tierra Right-of-Way Services (Tierra) has conducted archaeological excavations on two portions of the site, one near Block 2 of the SRI excavations and the other near the eastern boundary east of Hartman Lane. In addition, SWCA has conducted archaeological excavations at the Valley Farms site, AZ AA:12:736(ASM), located on the Santa Cruz River floodplain at the foot of the Dairy site fan (Wellman 2000, 2008).

Excavations have documented extensive archaeological deposits across most of the 120-plus-acres that have been explored. Archaeological remains include structures, pits, burials, a canal system dating to the Early Formative period, and an adobe-walled compound dating to the Late Formative period. The canal system was first identified in the SRI excavations. Expansion of these excavations by Tierra revealed an elaborate complex of floodwater farming canals and fields situated at the foot of the alluvial fan on the edge of the floodplain. Tierra also identified another canal segment with associated structures and cooking pits near the eastern edge of the site, east of Hartman Lane.

SRI's excavations in Block 3 identified the remains of a Late Formative period compound (Deaver 1996) nicknamed the Shamrock Ruin. The structure consisted of several contiguous-walled rooms in association with walled courtyards and plazas. The rooms were both above-ground adobe-walled structures and subterranean pit structures, all joined to the perimeter compound wall. Painted pottery recovered from the excavations was dominated by Gila Polychrome (Deaver 1996). Fragments of a Ramos Polychrome vessel were also found. The Ramos Polychrome attests to the age of the Shamrock Ruin as well as to the breadth of the regional interactions. Archaeomagnetic dating samples from the hearths in the occupation rooms suggest a date of A.D. 1350–1375 for the occupation.

One notable fact that has emerged from the intermittent excavations at the Dairy site is the long gap in the occupational sequence between the Early and Late Formative periods. Pottery sherds have been identified that indicate some presence during the Middle Formative period, but it appears that the Dairy site was essentially abandoned at about the time that a strong Hohokam presence was appearing in the Tucson area (Deaver 1996). The heart of the settlement during the Middle Formative period probably shifted to another location nearby, perhaps on another portion of the alluvial fan, but this location has not yet been identified.

On the west side of the Santa Cruz River is a complex of associated sites. Notable among the sites in this complex are Los Morteros (AZ AA:12:57[ASM]), Coachline (AZ AA:12:321[ASM]), Redtail Village (AZ AA:12:149[ASM]), and Lonetree (AZ AA:12:120[ASM]). The Lonetree site is the type-site for the Tortolita phase (A.D. 400–650) in the Tucson Basin cultural sequence (Bernard-Shaw 1990). The Tortolita phase is the local equivalent of the Hohokam Vahki phase in the Phoenix area. (Lonetree also had Middle and Late

Rincon phase components, but these later components are of less interest at the moment than the Tortolita phase component.) The discovery of the Tortolita phase houses and associated material culture was critical to our archaeological understanding of the Early Formative period and of the development of the Hohokam culture in the Tucson Basin, confirming as it did the presence of agricultural populations living in the Tucson Basin at a time equivalent to the emergence of the Hohokam culture to the north along the Gila River. The Tortolita phase pithouses at Lonetree were small and subrectangular, and were spaced 10 to 20 m apart. The houses had thick plastered walls with plain dirt floors. Entryway orientation varied. The Lonetree discovery also indicated that the local pottery tradition of sand-tempered plain brown wares and red wares was distinct from that of the Gila River, which consisted of heavily micaceous Vahki Plain (i.e., Gila Plain) and Vahki Red pottery. This suggested that the two areas were independent of one another (see Deaver and Ciolek-Torrello 1995), a premise critical to theories of the emergence and development of the Tucson Basin Hohokam culture.

Immediately west of the Lonetree site is the Coachline site. Coachline was recently the center of archaeological excitement with the discovery of Middle Formative period burials rich in Hohokam craft objects. Excavations by Tierra at the site revealed that the residential part of the settlement had been established by the Agua Caliente phase, but that the main part of the occupation dated to the Tortolita phase. Although the residential area was abandoned, the burial area remained in use into the early part of the Middle Formative period. This is consistent with Old Pueblo's previous findings at the site where three houses dating to the Tortolita phase were excavated (Hartmann 1997).

The Middle Formative period occupations of Lonetree and Coachline may have aggregated at the Redtail Village site (Bernard-Shaw 1989b), which is situated between these two sites. Redtail Village is perhaps one of the original Tucson Basin Hohokam settlements, and is one of the only known sites to contain a plaza with a plastered surface surrounded by residential structures. Desert Archaeology investigated the site in 1987, excavating or testing 148 features, including 45 pithouses, 9 occupational surfaces, 15 cremations or burials, 42 extramural features, and a cemetery feature, all associated with the central plaza (Bernard-Shaw 1989b). Pottery recovered from the site included Estrella Red-on-gray, Snaketown Red-on-buff, Cañada del Oro Red-on-brown, Rillito Red-on-brown, plain ware, and early red ware (Bernard-Shaw 1989b:221). Most of the structures dated to the Cañada del Oro phase and appeared to be arranged in two linear house clusters rather than in courtyard groups (Bernard-Shaw 1989b:222). The burial area at the Coachline site continued to be used during the time of the Redtail Village occupation. Bernard-Shaw (1989b:223) summarized the findings at Redtail as follows:

> Cultural processes at the Redtail site changed over time in a manner related to the Hohokam regional system. The earliest occupation of the site was that of a small agriculturally oriented farmstead; other such communities appear in the region at the same time. By the early Colonial period, the evidence indicates that Redtail's site structure was strongly influenced by the construction of a central plaza/cemetery feature. Subsequent to the Cañada del Oro phase the occupation at the site became more dispersed, and Redtail, in effect, was partially

abandoned in the early Rillito phase. Habitation at the site may have become more seasonal in the late Colonial period.

To the north of Redtail Village at the northern point of the Tucson Mountains is the Los Morteros site, the main Hohokam settlement on the west side of the Santa Cruz River north of the Cañada del Oro Wash. Los Morteros is a large village with a ballcourt. The ballcourt indicates that the site was most likely the center of Hohokam ritual activity in the area. Several large archaeological projects have been conducted at Los Morteros, yielding important information about Tucson Basin prehistory. These include a four-year testing program conducted by ASM (Lange and Deaver 1989), research on the Trincheras component at Linda Vista Hill (Downum 1986), investigations at Locus 1 of Los Morteros (Bernard-Shaw 1989a), and Desert Archaeology's work within the Los Morteros section of the site (Wallace 1995a, 1995b). Excavations identified 770 prehistoric cultural features dating to the Rillito, Rincon, and Tanque Verde phases. Archaeologists from Desert Archaeology excavated all or part of 241 features, including portions of a compound, 89 houses, and 9 possible houses. Extramural features included bell-shaped pits, borrow pits, puddling pits, roasting pits, hornos, trash mounds, and human burials (Wallace 1995a). The site also contained a ballcourt, numerous bedrock mortars, and hillside terraces or *trincheras* (Bernard-Shaw 1989a).

The majority of the Rincon phase occupation at Los Morteros shifted to the south of the ballcourt village segment. This shift in settlement location between the Rillito and Rincon phases is a pattern seen across the Tucson Basin and is associated with the abandonment of the ballcourts (Doelle and Wallace 1991). Settlement focus shifted again between the Middle and Late Formative periods, at which time the Middle Rincon village segments were abandoned and the center of residence shifted to the north. According to Wallace (1995a), the Rincon phase residential pattern was replaced by the construction of a compound enclosure and individual adobe-walled structures.

Just to the north of Los Morteros, on the same side of the river, is the Huntington Ruin (AZ AA:12:73[ASM]). Huntington Ruin, like Los Morteros, is a large settlement with occupational components spanning the Formative period. No intensive or sustained archaeological excavations have been carried out at Huntington Ruin, and what is known about the site has been derived from surface observations. It has both Middle and Late Formative period components. Reportedly, there was also a ballcourt at the Huntington Ruin (Huntington 1912:138 in Wallace 1995a:21). The Late Formative period component of the site is the better known of the two components. This part of the settlement sprawls across the alluvial fan deposits at the base of Rillito Peak northward to the Santa Cruz River. The site has been repeatedly investigated throughout the past century (see history of investigation in Wallace 1995a:19–21; also, Desruisseaux 1998; Jones 2005; Levstik 2005; Slaughter and Bierer 1994; Thurtle et al. 1998).

To the east of Los Morteros, on the other side of the Santa Cruz River, is the Stewart Brickyard site (AZ AA:12:51[ASM]). Pottery found on the surface of this site suggests that a substantial Middle Formative period component is present representing the initiation and ascension of the Hohokam culture in the Tucson Basin. Excavations at portions of the site, however, have unearthed substantial Late Archaic period horizons,

including canals, a field characterized by small planting pits alongside the canals, and other features (Doelle 2004).

To the north of the Stewart Brickyard site is the Cortaro Fan site (AZ AA:12:252[ASM]). (The Archaic period components at the Cortaro Fan site were discussed above.) Archaeological excavations were recently conducted by Tierra at portions of this site and, according to Dr. Eric Klucas, the results of the initial testing indicated the possibility of houses, burials, and other features relating to the initial part of the Middle Formative period. The results of the excavations, however, documented a substantial Early Formative period occupation with structures, burials, and features from the Agua Caliente and Tortolita phases.

On the east side of the Santa Cruz River and north of Rillito Peak is the Marana Mound complex. Investigations at the Marana Platform Mound (AZ AA:12:251[ASM]) and surrounding community settlements have revealed a developmental history beginning with pre-ceramic agriculturalists and culminating in an extensive early Classic period occupation based around a platform mound at the community's center (Fish et al. 1992b).

Back on the west side of the river and south of the Los Morteros complex is the Yuma Wash site (AZ AA:12:311[ASM]), a Late Formative period compound similar in age to the Shamrock Ruin. Both the Yuma Wash site and the Shamrock Ruin were occupied after the Marana Platform Mound was abandoned. These two sites represent the final stages of the prehistoric occupation in the Tucson Basin. The Yuma Wash site has been studied intermittently over the past two decades (Jones 1999a, 1999b; Jones et al. 2001; Kaldahl 2005; Rose 2005; Tucker 1996), most recently by Desert Archaeology. The report on recent excavations at the site is not yet available. Both Yuma Wash and the Shamrock Ruin are characterized by contiguous, adobe-walled rooms in enclosed compounds.

Investigations over the past century at sites within the Marana town limits have been of particular importance to the development of archaeological knowledge and interpretations of Formative period prehistory in the northern Tucson Basin. The archaeological sites mentioned in this discussion and others yet to be studied have the potential to contribute ongoing archaeological knowledge about this portion of prehistory. The investigations reveal that the Santa Cruz River was the focal point of Formative period settlements and lifeways. The Early Formative period settlements emerge in locations suitable for floodwater and akchin farming, and reflect a lifestyle similar to that seen to the north in the Gila River as well as other places across the greater southwestern United States (Deaver and Ciolek-Torrello 1995). It seems reasonable to infer that the Early Formative period populations along the Santa Cruz River were the descendents of the Late Archaic period peoples that preceded them. The Middle Formative period emerges rapidly with the appearance of the Hohokam material culture, ceremonialism, iconography, settlement structures, and lifeways. The Middle Formative period settlements in Marana are intimately interlocked with the Hohokam heartland on the Gila River, and the archaeological evidence suggests that Early Formative period settlements were abandoned and new settlements established with the appearance of this Hohokam culture. In the middle of the Middle Formative period, between the Colonial and Sedentary periods, another population shift occurs. Settlements

founded at the advent of the Hohokam culture are abandoned and replaced by new settlements, some located near the older settlements and others at great distances from the older settlements. The transition between the Middle and Late Formative periods is again marked by significant shifts in the material culture and population. The late Middle Formative period settlements are abandoned and the population is reorganized into new settlements. The Late Formative period then witnesses the rise and fall of the platform mound communities and the succession of large compound settlements such as the Shamrock Ruin and the Yuma Wash site. Eventually, the Late Formative period ends with the disappearance of the prehistoric cultures. What happened at the end of the Late Formative period and between the Late Formative period and the Historic period is still largely unknown.

PROTOHISTORIC PERIOD (A.D. 1450–1691)

Although historic Spanish accounts document the presence of Sobaipuri villages along the middle Santa Cruz River Valley at the time of conquest (Bolten 1948; Spicer 1997), there is little detailed evidence of a Protohistoric period occupation of the Tucson Basin as a whole. The northern Tucson Basin is no exception; however, several notable Protohistoric sites do reflect use of the region during this time. In the Marana vicinity, these include the Piman villages of San Clemente at the northern end of the Tucson Mountains, El Valle de Correa in the vicinity of present day Rillito, and San Augustin de Oyaut near the confluence of the Santa Cruz and Rillito rivers (Doelle 1984; Stein 1993). Unfortunately, the archaeological record does little to elaborate on these sparsely documented Protohistoric settlements. As noted by Doelle (1984:201), this is probably due to several factors. First, Protohistoric sites tend to be subtle, with sparse artifact assemblages that frequently lack diagnostics and structures that are ephemeral compared to those of the Formative period. Second, and perhaps more importantly, historically documented riverine village sites were located in areas that have been drastically altered by agricultural development and urban expansion, likely resulting in their destruction.

A Protohistoric presence in the region is confirmed by the archaeological record. For instance, near the confluence of the Cañada del Oro Wash and the Santa Cruz River is the Bechtel Burial site (AZ AA:12:98[ASM]), which was discovered in 1975 during the construction of the Ina Road sewage treatment plant. This burial was a flexed inhumation male, aged 35 to 45, found in association with 4 Sobaipuri projectile points, 17 triangular bifacial preforms, 1 leaf-shaped bifacial knife, 5 unifacially retouched flakes, 10 unmodified flakes, 1 exhausted obsidian core, a ground hematite nodule, and several whitetail deer antler fragments (Brew and Huckell 1987). As noted by Brew and Huckell (1987:171, 172), Spanish period explorers and priests documented Piman Indian burial customs in which the dead were accompanied by items important to them in life. The Bechtel Burial assemblage appears to be a tool kit for making arrows, which would have been important to Sobaipuri groups because of their continual warfare with the Apache. Short-term, seasonal Sobaipuri camps have also been documented in stabilized sand dunes in the Avra Valley to the west, and a Sobaipuri projectile point was reported from the Hodges Ruin (AZ AA:12:18[ASM]) (Doelle 1984:199). A private collection of Sobaipuri projectile points and glass beads, possibly representing a shrine,

has been reported from Wasson Peak, the highest peak in the Tucson Mountains (Doelle 1984:199). The Tator Hills Archaeological Project (Halbirt and Henderson 1993) also identified two sites (AZ AA:6:18[ASM] and AZ AA:6:19[ASM]) with surface Protohistoric components at the southern edge of the Santa Cruz Flats.

HISTORIC PERIOD (A.D. 1691–1950)

Piman populations present along the Santa Cruz River Valley at the time of Spanish conquest are believed to have declined throughout the eighteenth century. Population decline and the associated abandonment of settlements are attributed to increased mortality from the spread of European-introduced disease as well as increased warfare with the Apache (Stein 1993:89). The Anza expedition of 1775–1776 documented this depopulation in the northern Tucson Basin, although there is some debate as to whether these settlements were truly abandoned or just seasonally unoccupied. The Anza expedition passed through a mountain range called La Frente Negra ("Dark Face," now the Tucson Mountains) via a pass called Puerto del Azotado ("lashed" or "whipped"), which, from the description, appears to correspond to what is now Contzen or Rattlesnake Pass (Stein 1993:89 citing Font 1913). The name *Paseo de Azotado* also appears on a twentieth century map of the Tucson Mountains Association and is shown just south of Rillito Peak. However, no Spanish period artifacts have been found in the region that would archaeologically verify the location of the pass (Stein 1993:90). The Spanish, using Indian labor, were also the first to develop the mineral resources of the region (Stein 1993:90).

In 1846, the Mormon Battalion traveled from Tucson through the Santa Cruz River corridor past Picacho Peak to the Gila River. The wagon road opened by the battalion became known as the Southern Emigrants' Route or the Extremely Southern Route (Conkling and Conkling 1947:84). Travelers along this route documented scarce, unpredictable water and extreme heat. Watering holes were exceedingly important locations on the landscape, and semi-predictable water sources like Charco de las Yumas near the town of Rillito were frequently mentioned in journals of the period (Officer 1989:213; Stein 1993:91–93).

In 1858, following the Treaty of Guadalupe-Hidalgo and the Gadsden Purchase, the Butterfield Overland Mail Company was founded. Its route followed the Southern Emigrants' Route and passed near what is now Silverbell Road (Stein 1993:95). A station was constructed near the Charco de las Yumas watering holes at the Point of the Mountain (Rillito Peak). The exact location of the station, which may have been the first Euroamerican structure in the area, is up for debate, but it is believed to have been roughly one-quarter mile northeast of the current Rillito railroad station (Stein 1993:96). Although some Euroamericans had been living at the Butterfield stations several decades earlier, Euroamerican and Mexican-American settlement of the northern Tucson Basin largely followed military containment of the Apaches in 1886 (Thrapp 1967).

The Southern Pacific Railroad brought with it a flood of Anglo-American settlers, and mining and cattle ranching became the main industries of growth (Sonnichsen 1987). The Cortaro Station was established in 1890, and successful homesteading claims are documented in the northern Tucson Basin around this time (Stein 1993:103–105). By 1905, a post office had been established in Rillito to serve the area's growing

population. The early 1900s also saw the development of groundwater wells, pumping stations, and canals near the confluence of the Cañada del Oro Wash and the Santa Cruz River just south of Cortaro Farms Road. Significant agricultural development occurred as the need for cotton increased during the First World War. War materials such as tire cord and airplane fabric were made of cotton, and a record 230,000 ac of cotton were under cultivation at the peak of production during the war (Stein 1993:111).

Much of this expansion was due to businessman and land speculator Edwin R. Post of Battle Creek, Michigan, one of the heirs to the Post cereal fortune (Barnes 1988; Logan 2006). Post developed pumping stations and canal systems, and enticed experienced farmers from throughout the country to try their luck at farming cotton in the Santa Cruz River Valley (Stein 1993:111). The Post Project, as it was known, sought to develop 10 wells and over 20 mi of new cement-lined canals throughout the valley, from the confluence of the Santa Cruz River and Rillito Creek to present day Marana (whose post office was originally known as Postvale) (Batterton 1924; Stein 1993:111). Potential farmers, including Mexican, Yaqui, African-American, and Euroamerican migrants, were not hard to attract, and over 14,000 ac of land were sold (Grier 1925). However, the end of World War I and the subsequent drop in cotton prices negatively impacted many Post Project farmers, causing numerous newly immigrated Arizonans to go bankrupt (Stein 1993:111). Both the Santa Cruz Valley Farms and Valley Farms Company went bankrupt in 1920 (Terzis et al. 1997:84), and the Post Project holdings were transferred to the Pacific Finance Company (Stein 1993:112).

By the mid-1920s, the Pacific Finance Company had sold its holdings to the Pima Farms Company, with over 10,000 ac under cultivation (Grier 1925). The Catalina Water Company now managed the irrigation system, which had become fully operational in 1922 (Terzis et al. 1997:84). Many farmers diversified their farming activities to include dairy farming and vegetable farming (Stein 1993:112; Thiel 2000). In 1927, both companies, like their predecessors, went bankrupt. In 1929, the Pima Farms Company became known as the Cortaro Farms Company of California and the Catalina Water Company became the Cortaro Water Company. New wells were sunk near Marana and over 10,000 ac of crops, predominantly cotton, were put under cultivation (Stein 1993:113). With the drop in cotton prices during the Great Depression years, acreage in the middle Santa Cruz River Valley devoted to farming once again diminished. By 1932, only 3,000 ac were being farmed. The Cortaro Water Company went bankrupt and in 1934, the Marana Irrigation Company was established to manage irrigation in the area. The irrigation system was improved between 1939 and 1943, and irrigated land area returned to over 14,000 ac. The Cortaro Farms Company was managing 85 mi of canals and 42 wells in 1946; that same year, the assets of the Cortaro Farms Company were absorbed by the Cortaro Water Users Association (Terzis et al. 1997:84). The irrigation district still delivers water to agricultural fields and is now known as the Cortaro-Marana Irrigation District.

The agricultural economy of the region has continued to support the local area up to modern times. Excessive groundwater pumping for agriculture in the northern Tucson Basin, however, has resulted in the ecological degradation of the once flowing Santa Cruz River and land subsidence issues (Webb et al. 2007). Development continues, but residential and commercial development is now replacing and quickly obscuring the old agricultural canals, fields, and structures. Although numerous archaeological sites relating to the

historic development of the Marana area have been documented (e.g., sites related to the railroad, ranching, farming, and homesteading), Stein (1993:120, 121) notes that many pre-World War I sites have been completely destroyed.

6. PREVIOUS ARCHAEOLOGICAL STUDIES IN THE FWID AND TMUD SERVICE AREAS

An examination of ASM's AZSITE online database indicates that numerous archaeological resources ranging in age from the Archaic period to the Historic period are present within the FWID and TMUD service areas. The vast majority of these areas encompass portions of the Santa Cruz River floodplain, so it is not surprising that the archaeological resources in these areas consist of large Late Archaic and Formative period agricultural villages similar to those documented along the Santa Cruz River in other portions of the Tucson Basin. A brief summary of the projects that have been conducted and the sites that are present in each service area is provided below.

The FWID, as a whole, is developed, and the archaeological projects that have been conducted within its service area are primarily related to the construction and renovation of roads and transmission lines, and municipal development. At least 13 sites have been recorded within the FWID, most of which are associated with the Formative period. Hodges Ruin (AZ AA:12:18[ASM]), a large Formative period agricultural village site occupied continuously from the Tortolita phase through the Tanque Verde phase (Kelly 1978; Layhe 1986), extends into the northwestern corner of the service area. The Square Hearth site (AZ AA:12:745[ASM]) is another Formative period village site that extends into the FWID from the southwest. This site dates predominantly to the Agua Caliente phase, but a late Colonial or early Sedentary period component is also represented (Mabry et al. 1997). Additional Middle and Late Formative period habitation sites that are present include AZ AA:12:15, AZ AA:12:16, AZ AA:12:31, AZ AA:12:33, AZ AA:12:34, AZ AA:12:35, AZ AA:12:37, AZ AA:12:468, AZ BB:9:27, and AZ BB:9:78 (all ASM). These sites have yielded a variety of feature and artifact types, including agricultural terraces and canals, ceramics, stone hoes, various ground stone items, polishing stones, bone awls, shell, censers, and palettes. Standing adobe architecture has also been identified, as have human cremations and inhumations. Additionally, the Oracle to Tucson transmission line (AZ BB:5:123[ASM]), originally built during the 1940s, runs north-south through the FWID. Many of these sites now lie beneath developed areas of Sections 21, 22, and 27.

Archaeological projects conducted within the TMUD service area are mainly related to large-scale water management and facility development; construction and renovation of roads, transmission lines, sewer lines, and natural gas pipelines; and other municipal expansion and development. The largest of these projects by far is the Northern Tucson Basin Survey (Fish et al. 1992b; Madsen et al. 1993), an 1,800-km^2 study area encompassing most of the northern Tucson and Picacho basins and a portion of the Avra Valley. Previously conducted archaeological projects have resulted in the identification of at least 50 sites in the TMUD service area, the majority of which date to the Formative period. Some of the important Archaic and Formative period

agricultural village sites along the Santa Cruz River floodplain discussed in the *Archaeological Background of Marana* section are located partially within the TMUD service area. These include the Dairy site (AZ AA:12:285[ASM]), Coachline (AZ AA:12:321[ASM]), Los Morteros (AZ AA:12:57[ASM]), the Huntington Ruin (AZ AA:12:73[ASM]), the Valley Farms site (AZ AA:12:736[ASM]), Yuma Wash (AZ AA:12:311[ASM]), and Saguaro Springs (AZ AA:12:77[ASM]). Away from the Santa Cruz River floodplain, on the bajada of the Tucson Mountains, lies the Picture Rocks site (AZ AA:12:62 [ASM]), where over 200 petroglyphs have been recorded. Bedrock mortars were also identified at the site.

Historic period resources are also present within the TMUD, reflecting Euroamerican and Mexican-American agriculturally based development and historic Native American use of the area. Historic sites in the TMUD include Avra Valley Road (AZ AA:11:131[ASM]); the remains of the Bojorquez-Aguirre Ranch (AZ AA:12:122[ASM]); artifact scatters containing Papago Red pottery (e.g., AZ AA:12:320[ASM]); the Marana Siding site (AZ AA:12:742[ASM]), related to the development of the Southern Pacific Railroad; the Cañada (AZ AA:12:780[ASM]) and Cortaro Farms (AZ AA:12:870[ASM]) canals; the remains of the Postvale/Marana townsite (AZ AA:12:876[ASM]); and El Paso Natural Gas Pipeline No. 1007 (AZ AA:12:875[ASM]), one of the first long-distance, high-pressure natural gas pipelines in the United States and the first natural gas pipeline to supply the Phoenix and Tucson areas.

7. CONCLUSION AND MANAGEMENT SUMMARY

As demonstrated above, important cultural resources are present within the FWID and TMUD service areas, as well as the greater Marana area as a whole. The transfer of a portion of the FWID's CAP water entitlement to the TMUD does not require ground-disturbing construction of new infrastructure or expansion of the existing recharge facilities, so existing cultural resources will not be directly impacted. As previously noted, any new development will require the completion of a Class III cultural resources inventory and compliance with Town of Marana Land Development Code Title 20, which establishes guidelines and specifications for the documentation and protection of archaeological resources. Mitigation actions will be implemented involving either data recovery or preservation of sites as required by the TMUD or other agencies if county, state, or federal permits are required.

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