CHAPTER IV
EXISTING CONDITIONS

In conducting this feasibility study, a wide range of technical issues were analyzed with the goal of developing an accurate description of historic, existing, and future without-project conditions in the Rio Salado Oeste study area. The future without-project condition is defined as that condition expected to exist in the absence of any action taken (by the Federal Government) to solve the stated problems and is also described as the No Action Alternative. The future without-project condition forecast provides a description of anticipated actions external to the project and the anticipated consequences of these actions.

Available information was initially collected about existing studies and projects that could assist in the preparation of the inventory of historic and existing conditions and the forecasting of future without-project conditions for the study area. Without a good understanding of the existing condition, one cannot understand what constitutes an improvement from a degraded condition. The information presented under without-project conditions is considered in order to formulate alternative measures that address the watershed problems and opportunities discussed in Chapter V, Plan Formulation. Major technical areas of focus for the study include hydrologic and hydraulic studies, environmental studies related to biological resources, cultural resource and recreation studies, and economic analysis.

4.1 HISTORIC CONDITIONS

Historically, gallery forests of cottonwoods and willows covered hundreds of miles along the lower reaches of rivers like the Salt River in the desert southwest. Optimal conditions for these forests were found along the Lower Salt River prior to 1900. Cottonwood and willow forests are found in depositional environments where fine-grained alluvial soils are located on floodplains. These forests commonly occur with other riparian assemblages because fluvial processes (floodplain aggradation and channel meandering) create environmental gradients and mosaics (e.g., water table depth, inundation frequency), which favor diverse riparian species assemblages.

The Lower Salt River was originally a perennial stream fed by snowmelt from the mountains to the east and the highlands to the northeast. Its clear, streaming waters contrasted greatly with the muddy, sluggish Gila River to the south and west. Flows in the river had a distinct seasonal pattern, with highest flows occurring in December and January and lowest flows in October. The river had many channel meanders, sand bars, and backwater areas that were conducive to riparian growth.

Prior to dam construction in the early 1900s, the Salt River riparian vegetation was dominated by cottonwood, willow, and the various species of mesquite. This suite of vegetation is considered to be representative of the natural "climax community" of species that would be found in an undisturbed riparian corridor along the Salt River. Mesquites occurred along the outer bank of the river, at the extreme edge of the natural riparian vegetation. The willow and cottonwoods were located inward of the mesquites, adjacent to the low-flow channel and closer to where there was a more continuous flow of water. Some channel areas were barren, while others had vegetation in strips along the low-flow channels and abandoned high-flow channels.

The bottomlands of the Salt River supported a variety of vegetation, including trees, shrubs, marsh plants, and some grasses. Large cottonwood, willow, walnut, and alder trees grew along the margins of the river exhibiting the highest percent of annual recruitment in the secondary channel, and mesquite, creosote bush, Palo verde, and bursage covered the low terraces. Dense mesquite and other shrubs made crossing the bottomland impossible in places, while in other locations the vegetation was more scattered. There were several species of fish in the waters, similar to those found in the Gila River.

Large, dense mesquite forests or bosques are found adjacent to natural and created water retention basins, lake edges, and river floodplains in southern Arizona. Mesquite bosques were once the most abundant riparian type in the Southwest. Most modern mesquite bosques are large (typically 1 mile long and 600 feet wide), but these are small compared to pre-development bosques, which extended for miles. Mesquite bosques usually are found in the drier habitat areas within the riparian continuum. The locations for this setting are floodplains or low terraces several yards above the streambed, and up to 45 feet above the water table.

Beginning in the early 1900s, the historical conditions of the Salt River were altered by manmade activities, including two significant Federal water projects. First, USBR constructed the SRP system, a series of dams in the Salt and Verde River watersheds. The water supply and hydropower benefits that the dams provided led to the economic development of the Phoenix metropolitan area. Metropolitan Phoenix has grown from a settlement that supplied food and animal feed to the U.S. Army outposts and mines in the area to its current population of 3.2 million people. Though the SRP project has contributed to the economic success of the Phoenix metro area, the extent of the resulting environmental impacts to the Salt River Basin has only recently begun to be studied and understood, leading to the corrective efforts of this and similar restoration studies and projects.

Due to dams and diversions, perennial flows on the Salt River have ceased. This has caused detrimental environmental impacts to natural wildlife habitat and riparian communities along the Salt River. The elimination of natural base flows reduced Salt River flows to summer or fall rainfall-related flood events. The groundwater table beneath the river dropped. The soil moisture in the riverbed was virtually eliminated, significantly reducing or eliminating microbial and biochemical processes and nutrient cycling, which directly contributed to the rapid decline and loss of the native cottonwoods, willows, and riparian ecosystem of the Salt River Basin. Most areas of the Salt River are barren today and have been significantly impacted by sand and gravel extraction operations. The vegetation observed in the Salt River corridor today is mostly limited to salt cedar, an invasive non-native species with little habitat value, and fragments of poor-quality native riparian vegetation.

4.2 EXISTING/CONDITIONS

Existing conditions are defined as those conditions that exist within the study area at the time of the study. The future without-project condition, which is the same as the “no action” alternative, is a projection of how these conditions are expected to change over time and forms the basis against which alternative plans are developed, evaluated, and compared. The term baseline is also used to refer to the existing conditions at the time of a measurement, observation or calculation and will be used occasionally throughout this report.

4.2.1 Geology, Topography, and Geomorphology

Within the study area, the Salt River flows through a major valley with a relatively flat floor of deep alluvium. Soils in the vicinity of the channel are of the hyperthermic torrifluvents association, a group of soils that are well drained to excessively well drained on nearly level or gently sloping surfaces. They are often sandy to gravelly, but may include lenses of finer particles. These soils are often redistributed by water flows associated with nearby active channels.

Metropolitan Phoenix is geomorphically located within the Gila Lowland Section of the Sonoran Desert Subprovince, a part of the Southern Basin and Range Physiographic Province. This province is characterized by broad, gently sloping, connected alluvial valleys (basins) bounded by moderately high, rugged, northwest- to southeast-trending mountains (ranges). From the end of the Pliocene until recent (Holocene) time, the basins, including the Salt River Valley, filled with unconsolidated and occasional semiconsolidated sediment eroded from the ranges. The thickest accumulations of Valley alluvium formed during the early to middle Quaternary period.

The alluvium of the Salt River Valley is in the final stages of development, as evidenced by the numerous low-lying isolated hills (inselbergs) that project above the valley surfaces. These hills represent peaks of former mountain ranges that are now almost completely buried by alluvial material.

The mountain ranges that border the project area consist mostly of Tertiary-age sedimentary and volcanic rocks that lie unconformably upon an ancient Precambrian igneous and metamorphic basement complex. The complex is composed predominantly of igneous granite and diorite, metamorphosed schist, gneiss, and volcanic rock. The Tertiary rocks are made up of volcanic basalt, andesite, rhyolite, sedimentary sandstone, siltstone, and conglomerate.

The Phoenix basin consists of Quaternary sediments that constitute the valley fill. These consist mostly of poorly to well-consolidated (cemented) and unconsolidated gravel, sand, silt, and clay, representing several environments and ages of deposition. The total thickness of the alluvial material ranges from near 0 feet along the mountain fronts to nearly 10,000 feet under the valley interior. The valley fill materials tend to be of a coarser consistency near the mountain fronts and finer in the interior of the valley. Near the Salt River, the valley fills have been eroded as the river formed terraces during its evolution.

The predominant surface materials within the project area consist of Quaternary-age river sediment deposited as alluvium and terraces and, to a lesser extent, sheetwash-deposited alluvium and slope-deposited colluvium. Thick layers of alluvium and terrace have accumulated within the major streams, tributaries, and floodplains of the Salt River. Streambed alluvium and terraces are flanked, covered, and underlain by thinner layers of wind- and sheetwash-deposited alluvium and bedrock colluvium.

Salt River Valley terrace deposits lie exposed above the Salt River channel in locations throughout the project area. The terraces consist of thick, well-cemented to non-cemented sand and gravel and are considered older than the alluvium within the confines of the Salt River. However, contacts between the two types of deposits are gradational at depth, which means they are undifferentiated and both remain of Quaternary age. The terrace and alluvial deposits in turn overlie thick Tertiary sedimentary and volcanic rocks beneath the basin and interface with Tertiary rocks along mountain ranges and inselbergs. The very thick Precambrian basement complex underlies basin terrace and alluvium at maximum depths of greater than 3,300 feet.

Two major soil associations are found within the project study area. Within and immediately adjacent to the river is the Carrizo-Brios Association, with the Gilman-Estrella-Avondale Association to the south. The Carrizo-Brios Association is characterized by deep, excessively drained soils and nearly level to gently sloping, gravelly sandy loams and sandy loams in stream channels on low-stream terraces. The Gilman-Estrella-Avondale Association is characterized by deep, well-drained soils and nearly level loams and clay loams on valley plains and low stream terraces (Maricopa County, 1992).

Flood flows are probably the most important events in the transportation of sediment along the Salt River. Sediment transported in a scour and fill setting by flood flows tends to move in waves or pulses, rather than at a constant rate through time. In essence there are slugs of sediment moving downstream periodically during flow events. Prior to damming of the river, smaller flow events moved sediment (fine sands, silts, and clays) by incising downward into the larger slugs of sediment found in the channel. However, incision and movement of sediment by these smaller events do not compare to the order of material moved during a flood event.

The Salt River through this reach has been relatively stable but still the riverbanks have moved laterally by as much as one-half mile in some locations during the 130-year record. Much of the lands along the south side of the river have been recovered from the active braided channel system during the period of historical photos. The meander belt varies from approximately 2 miles in width at 19th Avenue to approximately 4 miles in width at 91st Avenue. Lateral migration would not be expected to exceed these limits.

The river is constrained upstream from 19th Avenue by levees constructed as part of earlier projects. The soil cement levees end just downstream from the 19th Avenue Bridge and the river is unconstrained by levees until just above the 91st Avenue WWTP. River alignment is fixed to some extent by bridges located at 35th Avenue, 51st Avenue and additional proposed bridges for a future freeway crossing in the middle section of this reach. The 35th Avenue Bridge is very small and provides a significant constriction to flows. The other bridges have much larger openings and provide less flow constriction. The recent historical evidence examined here indicates that the project reach is in quasi-equilibrium, although adjustments to bank and thalweg lines within the historical meander belt are possible.

Results of a sediment transport analysis show that sediment dynamics are more significant in the proximity of mining operations. The study also revealed that downstream of 35th Avenue the reach experienced mainly erosion while upstream of 35th Avenue the main process was deposition.

For additional information concerning geology of the study reach, please refer to Appendix A, Hydrology and Hydraulics, and Appendix E, Geotechnical Evaluation.

4.2.2 Hydrology

*4.2.2.1 **Surface Water Hydrology***

The Salt River drains 14,500 square miles of mountainous desert terrain in central and eastern Arizona and is the largest tributary to the Gila River. The river rises in the White Mountains of eastern Arizona and flows generally westward to its junction with the Verde River, a northern tributary that drains the edge of the Colorado Plateau near Flagstaff, Arizona. From this junction near the City of Mesa, the Salt River flows westward across the broad Salt River Valley to its confluence with the Gila River, about 14 miles west of the Phoenix Sky Harbor Airport. The Phoenix metropolitan area is near the center of the Gila River basin and lies within the lower Salt

River Valley. After the junction with the Salt River, the Gila River continues westward and joins the Colorado River near Yuma, Arizona.

Annual average rainfall in the lower Salt River Valley is approximately 8 inches; rainfall at the highest elevations of the watershed ranges up to 14 inches annually (U.S. Geological Survey [USGS], 1991). Rainfall is less than the evapotranspiration rate in all months of the year. Precipitation is derived primarily from two types of weather systems: summer thunderstorms and regional storms. Summer thunderstorms in July and August develop from the flow of subtropical air masses from the Gulf of Mexico. These two months are responsible for the majority of the total annual rainfall. Regional storms from the Pacific Ocean generate gentle, widespread showers during the fall and winter months. Summers are hot, with daily temperatures exceeding 100°F from mid-June through August. Mean daily temperatures in the summer range from 65°F to 104°F. The relative humidity is low, ranging from approximately 20 percent to 50 percent. Winters are mild, with mean daily temperatures ranging from 35°F to 70°F.

Little data exist to document the pre-development, seasonal flow fluctuations in the Salt River. In the pre-settlement era prior to 1900, the river was one of the few perennially watered riparian areas of the Sonoran desert, with highly productive cottonwood, willow, and mesquite habitats. Analyses of pre-development conditions indicate that Salt River stream flow infiltrated and recharged groundwater upstream of Indian Bend Wash near Scottsdale. Groundwater discharged to the channel to provide perennial base flow in downstream sections of the channel (USGS, 1991). Under natural conditions, flows peaked in late winter (February and March), supplied by storms and snowmelt. Flows were lowest in June, averaging only 6 percent of the mean high flows in February. Data for 1965 through 1993 show flows occurring most frequently during March and April and least frequently during July and August, much like the natural flow pattern. The system of dams upstream of the study area effectively delays the flows by one month. This delay becomes insignificant, however, in light of the length of periods without flow in a river that is perennial under natural conditions.

Dam System

During the 20th century, the Phoenix area changed from a mainly agricultural region to a mainly urban region, resulting in significant changes in the physical characteristics of the rivers in the area. Agricultural and urban activities have given rise to an intricate network of structures associated with river use for irrigation, drainage, erosion protection and flood damage reduction. Numerous upstream dams on the Salt and Gila Rivers have radically altered the natural hydrologic regime of the rivers. See table 3.2-1 for a listing of the dams on the Salt, Verde, and Agua Fria and Gila Rivers.

The Salt River Project (SRP) operates six storage dams on the Salt and Verde Rivers and one diversion dam just east of the City of Mesa. Granite Reef Diversion Dam (Granite Reef) does not have any storage capacity. The purpose of this facility is to divert water released from the reservoirs into the Arizona Canal (for the area north of the Salt River), and the South Canal (for the area south of the Salt River). The canals supply the Phoenix Metropolitan Area with water for agricultural and municipal and industrial (M&I) use. Stored water is allocated based on water rights associated with the land in the SRP service area.

All Salt River dams have hydrogenation capacity. Safety of Dams modifications (completed in 1996) to Theodore Roosevelt Dam include a zone for flood control. The total space for water-supply storage behind these dams is 2,025,798 acre-feet (ac-ft) including the cities' new conservation storage, with an additional 556,196 ac-ft for flood damage reduction at Roosevelt Dam. The Roosevelt Reservoir is the largest reservoir of the SRP reservoir system. It stores runoff from about 5,800 square miles of the Salt River watershed.

Downstream of the Stewart Mountain Dam, the Verde River discharges into the Salt River. The drainage area of the Verde River is about 6,700 square miles. Its flows are partially controlled by Horseshoe Dam (located furthest upstream) and Bartlett Dam (approximately 25 miles upstream of the confluence with Salt River), which provide an additional 287,403 ac-ft of storage. New Waddell Dam is located on Agua Fria River northwest of Phoenix and downstream of the study area.

Table IV-1: Major Dams and Reservoirs in the Gila River Basin

Dam	River	Reservoir	Date of Origin	Storage (acre-feet)
Waddell	Agua Fria	Lake Pleasant	1927, mods 1994	812,100
Bartlett	Verde	Bartlett Lake	1939	178,186
Horseshoe	Verde	Horseshoe Lake	1949, mods 1951, 1995	109,217
Stewart Mountain	Salt	Saguaro Lake	1930	69,765
Mormon Flat	Salt	Canyon Lake	1938	57,852
Horse Mesa	Salt	Apache Lake	1927, mods 1992	248,138
Roosevelt	Salt	Roosevelt Lake	1911, mods 1996	1,653,043
Coolidge	Gila	San Carlos Lake	1928, mods 1994	1,222,000
Painted Rock	Gila	Painted Rock Lake	1959	2,500,000

The dams have significantly altered the natural hydrologic regime of the lower Salt River and have changed both the magnitude and timing of flows. The system of dams has eliminated perennial flow and steady, high winter flows. Since Bartlett Dam began operating on the Verde River in 1938, the lower Salt River has contained water only as a result of controlled or uncontrolled releases from the Granite Reef Diversion Dam. During normal times, SRP releases water from the reservoirs to meet water needs in the Valley. When the reservoirs approach full capacity, a point which SRP is always fully aware, releases above the water order may b initiated. Water released in excess of the water order typically flows over or around Granite Reef Dam and flows into the normally dry Salt River channel. The actual amount is dependent upon numerous variables including: available storage space, forecasts, downstream impacts and constraints, and desired future storage levels. The Granite Reef Diversion Dam is located about three miles downstream of the Salt-Verde confluence, and is the most downstream SRP dam. The purpose of this facility is to divert upstream reservoir releases into the Arizona Canal (for the area north of Salt River), and the South Canal (for the area south of Salt River). The canal system generally follows the topographic contour of the the Phoenix metropolitan area in order to provide gravity flow delivery of water to agricultural, municipal and industrial users. There are no releases during climatically drier years, as occurred between 1942 and 1964. Except for storm water runoff, groundwater emergence and effluent, the Salt River is dry during those times.

Figure IV-1: Flows in the Salt River on January 19, 2005 (as seen looking NE from an area adjacent to the 51st Avenue Bridge.)

Discharge

Before 1938, an average of 413,000 ac-ft of water flowed through the channel (USACE, 1998). The estimated pre-development, average annual watershed yield was about 1,250,000 ac-ft (USGS, 1991). Since 1965, the channel has carried an average of only 293,000 ac-ft of water per year, with less than 10,000 ac-ft in almost three-fifths of the years (USACE, 1998).

Hydrologic modeling used to develop a water-control plan for Modified Theodore Roosevelt Dam indicates that water would have spilled over Granite Reef Diversion Dam in only 34 of 105 years under the current configuration of dam operations (USACE, 2000). The resulting frequency of spills is approximately once every 3 years. When water is spilled over Granite Reef Diversion Dam, the flow is typically sustained for several days or more, and of significant magnitude. Since 1965, there have been about two releases per year, and they have lasted an average of 22.5 days, with a peak mean daily flow of 13,960 cfs.

Beginning on New Years Eve 2004, SRP began releasing water from Bartlett Dam to accommodate storage for rainfall and snowmelt from the Verde River watershed. The highest recent discharge occurred on February 13, 2005, of approximately 35,000 cfs as recorded by the USGS gauge at 51st Avenue (http://waterdata.usgs.gov/az/nwis/rt).

Storm Water

Storm water enters the Salt River at numerous locations in the study area and has the potential to degrade the surface quality of water in the system. The quality of water from storm drains varies depending on the length of time between storm events, the amount of flow, and the source of storm water runoff. Runoff often contains a significant amount of sediment that is washed from undeveloped land and other sources, as well as chemical contaminants or pollutants. The types of chemical pollutants will vary depending on the land uses within the particular drainage area. Potential water quality impacts associated with runoff from industrial sites are projected to be minimal because the compliance requirements of storm water Arizona Pollutant Discharge Elimination System (AZPDES) permits require each industrial site to have Storm water Pollution Prevention Plan (SWPPP). Runoff from turf areas has the potential to contain pesticide and fertilizer residuals. Runoff from paved areas can contain hydrocarbon products, metals, and anything spilled on the pavement.

*4.2.2.2 **Surface Water Quality***

Contaminants in the surface waters and groundwater of Arizona fall into seven categories: volatile organic compounds (VOCs), pesticides, metals, nutrients, ions, microorganisms, and radiological substances. Similar quality issues exist for all water sources in the lower Salt River, namely contamination by VOCs and various metals, ions, nutrients, and herbicides.

Surface water naturally provides the main source of recharge for groundwater. Shallow groundwater in other reaches of the river often emerges in the channel, creating surface flows. Effluent from WWTPs and other industries contributes to both surface and subsurface flows. Thus, contaminants do not remain in one part of the system and may affect all water sources. Refer to Table IV-2 for a list of contaminant categories and specific contaminants expected at the Oeste location.

Salt River flows maintain high amounts of mineral content and total dissolved solids (TDS). When flood flows do occur, they commonly violate quality standards for fecal coliform bacteria. The Salt River water contains a sodium chloride character both above and below the SRP system dams due to salt springs upstream of the lakes. Verde River water has a lower amount of TDS than found in the Salt River water. The Verde water tends to lower the overall TDS content in flows downstream of their confluence. The quality of water would be sufficient to support native fish species; however, elimination of the base flows does not allow it.

Table IV-2: Types of Water Contaminants in the Lower Salt River

Contaminant Category	Principal Contaminants	Typical Sources	Potential Health Impacts
Volatile organic compounds (VOCs)	Organic solvents Trichloroethene (TCE) Tetrachloroethylene (PCE) 1,1,1 Trichloroethane (TCA) Chloroform 1,1 Dichloroethane (DCE) 1,1 Dichloroethane (DCA) Benzene	Landfills Underground storage tanks Airports High technology industry	Carcinogen
Pesticides	Dibromochloropropane (DBCP) Ethylene dibromide (EDB)	Agriculture (soil fumigants) Urban runoff	Toxics Carcinogen
Metals	Arsenic Barium Boron Chromium Copper Iron Lead Manganese Selenium Zinc	Landfills Mines Metal finishing Natural origin	Toxics Carcinogen
Nutrients	Nitrate	Agriculture (fertilizers) Wastewater treatment Septic tanks Industrial manufacturing	Methemoglobinemia (blue-baby disease)
Ions	Total dissolved solids (TDS) Sulfate Chloride Fluoride	Mines Agriculture Natural origin	Taste, hardness Laxative effect Toxics
Micro-Organisms	Fecal coliform	Septic tanks Wastewater treatment Agriculture	Infectious disease
Radiological		Mines Natural origin	Carcinogen

Source: Graf et al., 1994

Additional discussion of surface water quality can be found in Appendix D, Groundwater Quality and Hydrogeology Report, and Appendix F, Modified Phase I Environmental Site Assessment (ESA).

*4.2.2.3 **Groundwater Hydrology***

Prior to development of the Phoenix metropolitan area and construction of upstream reservoirs, the Salt River was a perennial stream. The river was a significant source of groundwater recharge in some areas and a recipient of groundwater discharge in other areas. (See Table IV-3 for estimated predeveloped groundwater hydrology budgets for Salt River Valley. As the area began to be settled, irrigation to support crops was obtained by diverting the stream flow into canals. By the 1900s, much of the Salt River Valley was waterlogged due to recharge from canal seepage and deep percolation combined with a lack of groundwater pumping. Beginning in the 1920s, substantial groundwater pumping began for irrigation and to control shallow groundwater levels. Following World War II, advances in drilling and pump technology allowed extensive pumping from deep aquifers to occur. The result of the groundwater pumping practices was extensive overdraft.

Table IV-3: Estimated Pre-Development Groundwater Budget for Salt River Valley

Source of Inflow	Volume (ac-ft/yr)
Stream channel recharge	100,000
Groundwater inflow	30,000
Mountain front recharge	10,000
Total inflow	140,000
Groundwater discharge to stream channel	60,000
Evapotranspiration	76,000
Total outflow	140,000

The groundwater supply beneath the study area is regulated by the Arizona Department of Water Resources (ADWR). To aid in monitoring, ADWR differentiates between groundwater basins. The subsurface geologic conditions in the study reach are within the Phoenix Active Management Area (AMA) of ADWR.

URS Corporation (URS), a private Architectural/Engineering firm conducted a groundwater quality and hydrogeology study for the Rio Salado Oeste Project (April 2002). The current groundwater condition in the study area was presented in the URS study report. According to the report, groundwater generally occurs under unconfined conditions within the Upper Alluvial Unit (UAU). Groundwater flow in the eastern third of the study area (east of 39th Avenue) is generally from the south to north-northwest toward the Roosevelt Irrigation District well field located along or north of Lower Buckeye Road between 19th and 35th Avenues. The groundwater gradient is steepest to the north with values as high as 0.008 ft/ft in the vicinity of 35th Avenue and Lower Buckeye Road. The groundwater-flow direction in the western two thirds of the study area (West of 39th Avenue) ranges from northwest to west. The groundwater gradient flattens to the west with values as low as 0.002 ft/ft. Static water level is relatively shallow, ranging from 20 to 50 feet below ground surface within the Salt River channel to 60 to 80 feet below ground surface north and south of the river.

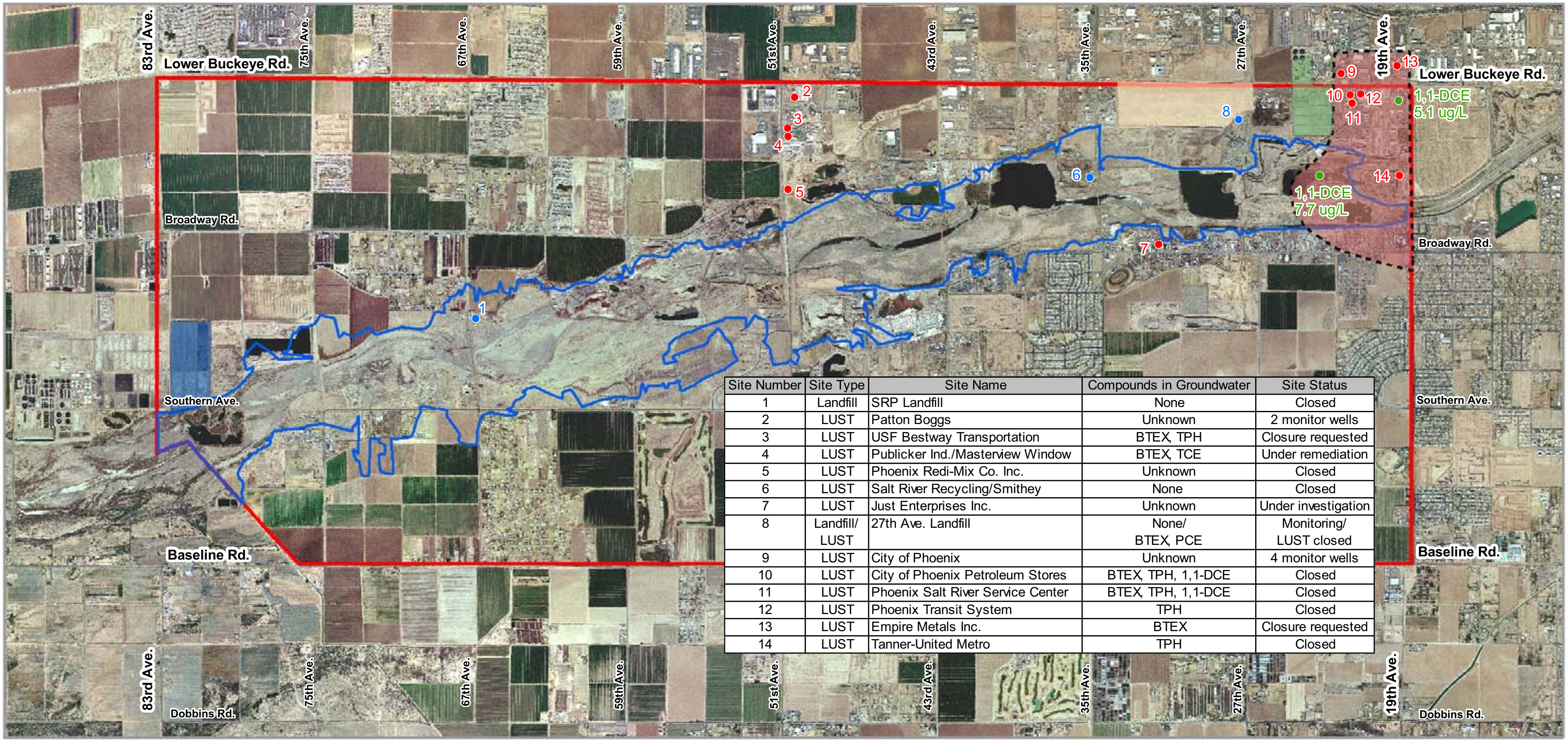
Fluctuations in static water level can be as much as 20 to 30 feet on an annual basis due to agriculture pumping demands, and have declined as much as 25 feet in the last five years (Dames & Moore, 1991; Parsons Engineering Science, 2001). Hydrographs of selected wells show this decline is most pronounced in the eastern portion of the site near the Roosevelt Irrigation District well field. The selected wells provided static water levels from both ends of the study area that have the most complete water level records. Contributing factors that may cause the fluctuations are water discharge from the 35th Avenue water treatment plant outfall during winter months that produces groundwater mounding, and related radial flow during periods of discharge and basin-wide groundwater pumping and storm water runoff into the Salt River.

A groundwater contour map of the study area was prepared using ADWR well data from 1997 because it represented the most complete data set available. ADWR collected many water levels from both production and monitoring wells in the month of October, at the end of the pumping season. Water levels represent static values prior to significant precipitation. Some data outside of the study area were incorporated while contouring to fill data gaps. The hydrographs were prepared and reviewed to validate whether the contour map is representative of current conditions. In general the selected wells show a consistent water level decline without radical changes in gradient direction. Therefore, while the groundwater elevation has declined approximately 10 to 20 feet since 1997, the current contours are likely to be similar to the 1997 contours (URS, 2002). For additional information concerning the groundwater hydrology please refer to Appendix C, Groundwater Modeling.

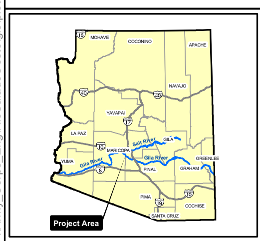
4.2.2.4 ***Groundwater Quality***

When groundwater pumping was initiated in the Phoenix metropolitan area in the 1920s, the groundwater quality, although high in minerals, was considered to be of very good quality. Today, there are a number of groundwater problems in the Salt River Valley. The problems associated with inorganic chemical constituents include high levels of chloride, TDS, nitrates, and salinity. The problems associated with trace organic constituents include the pesticide dibromochloropropane and volatile halocarbons. Most of the regional problems are currently limited to groundwater in the UAU. Areas of groundwater quality concern are summarized in the April 2000 URS report and depicted on Figure IV-2. Those sites include landfills and Leaking Underground Storage Tank (LUST) sites. There are also two superfund sites in the study area.

Groundwater in the eastern half of the study area has lower TDS than other portions but has been impacted by petroleum releases of several Underground Storage Tanks (USTs) and may have elevated concentrations of 1,1-DCE. In the southwestern part of the study area data indicate elevated concentrations of TDS and nitrates.



Site Number	Site Type	Site Name	Compounds in Groundwater	Site Status
1	Landfill	SRP Landfill	None	Closed
2	LUST	Patton Boggs	Unknown	2 monitor wells
3	LUST	USF Bestway Transportation	BTEX, TPH	Closure requested
4	LUST	Publicker Ind./Masterview Window	BTEX, TCE	Under remediation
5	LUST	Phoenix Redi-Mix Co. Inc.	Unknown	Closed
6	LUST	Salt River Recycling/Smithey	None	Closed
7	LUST	Just Enterprises Inc.	Unknown	Under investigation
8	Landfill/ LUST	27th Ave. Landfill	None/ BTEX, PCE	Monitoring/ LUST closed
9	LUST	City of Phoenix	Unknown	4 monitor wells
10	LUST	City of Phoenix Petroleum Stores	BTEX, TPH, 1,1-DCE	Closed
11	LUST	Phoenix Salt River Service Center	BTEX, TPH, 1,1-DCE	Closed
12	LUST	Phoenix Transit System	TPH	Closed
13	LUST	Empire Metals Inc.	BTEX	Closure requested
14	LUST	Tanner-United Metro	TPH	Closed



Legend

- Project Study Area
- Project Implementation Area
- 27th Ave. Landfill
- Possible extent of 1,1-DCE plume
- 23rd Ave. Wastewater Treatment Plant
- 91st Ave. Wastewater Treatment Plant
- Wells with elevated concentrations of 1,1-DCE
- Sites with known or probable groundwater contamination
- Groundwater investigation sites with no known impacts

AREAS OF GROUNDWATER QUALITY CONCERN

Figure IV-2

N W E S

0 5,000 10,000 Feet

March 2005

Source:
Groundwater Quality and Hydrogeology Report, (URS 2002a)

Rio Salado Oeste

US Army Corps of Engineers®

The Groundwater Quality and Hydrogeology Report and Modified Phase I Environmental Site Assessment (ESA) are included in Appendix D and Appendix F, respectively, and include much more detailed discussion of water quality.

4.2.3 Hydraulic Conditions

An existing Flood Insurance Study HEC-RAS model from the confluence with the Gila River (River Mile [RM] 199.82) to about 12th Street (RM 214.14) was provided by FCDMC. This model will be referred to as the FEMA model. The FCDMC also provided aerial photographs from 1993 and 1999, an ArcInfo coverage with contours with a 4-foot interval developed for the Salt/Gila River Master Plan (1992), an ArcInfo coverage with the cut lines of 100 of the FEMA model cross sections, and an ArcInfo Triangular Irregular Network (TIN) of the study area including raw data in point files and breakline format also created for the Salt/Gila River Master Plan (1992). The line coverage included cross sections from RM 202.09 to RM 211.12. Cross section 202.09 is located approximately 1,100 feet downstream of 91st Avenue, while cross section 211.12 is about 2,150 feet downstream of 19th Avenue.

The hydraulic model was used to generate water surface profiles and inundation boundaries for a series of frequency flood events ranging from 5- to 500-year return periods. Small flows are generally contained in the main channel, and only the large flows (100-year and 500-year) occupy significant portions of the floodplains outside the river banks.

4.2.4 Water Supply

Since the source of water that provided for the habitat that historically existed on the Salt River has been altered by upstream dams and adjacent development, alternative water sources would be necessary to implement restoration alternatives. Possible sources for that water supply include flood flows, stormwater runoff, effluent, and groundwater. Decisions pertaining to water supply extend beyond source, quality, quantity, and cost but also include existing legal agreements and water rights that apply to both surface and groundwater.

4.2.4.1 *Effluent*

The City of Phoenix Water Services Department has identified the potential availability of an average 8 mgd of reclaimed water from the 23rd Avenue WWTP. It was recommended that the capacity to handle as much as 20 mgd to accommodate large diurnal variations in flow should be incorporated into the water supply system. Project planning should also account for "no-flow" periods of up to 12 hours. Note: 1 mgd = 1.55 cfs or 3.07 ac-ft/day.

4.2.4.2 *Storm Water*

Although highly dependent on rainfall and not necessarily a consistent source, storm water runoff must be considered in project planning. Table IV-4 provides initial information pertaining to storm water outfalls, their locations, and sizing. While the outfalls listed in Table IV-4 are present in the study area not all of them currently reach the river channel. The Interior Drainage Report in Appendix B includes a detailed description of potential storm water runoff to the study area.

Table IV-4: Storm water Outfalls within the Study Reach

Outfall #	Site Location	Pipe Size	Comments
SR01	51st Avenue and Salt River - North Side	96 inch	
SR02	43rd Avenue and Salt River - North Side	90 inch	
SR03	35th Avenue and Salt River- North Side	75 inch	
SR04	27th Avenue and Salt River- North Side	72 inch	23rd Ave. WWTP discharges
SR05	25th Avenue and Salt River- North Side	102 inch	
SR06	22nd Avenue and Salt River- North Side	78 inch	
SR30	27th Avenue and Salt River- South Side	108 inch	FCDMC first flush sample sta.
SR47	51st Avenue and Salt River- North Side	48 inch	
SR48	45th Avenue and Salt River- South Side	48 inch	
SR49	67th Avenue and Salt River- North Side	96 inch	FCDMC first flush sample sta.
SR58	35th Avenue and Salt River- N/E Side	60 inch	
SR59	2333 W. Durango (23rd Ave. WWTP east side of 35th Avenue and Salt River) - North Side	48 inch	Part of SR05 conveyance system

Storm water may prove sufficient to support ephemeral wetlands or even riparian habitat in portions of the study area. Table IV-5 on the next page provides a summary of outfalls that provide storm water flows to the river channel and that will be considered to potentially provide source water for restoration features. The modification of storm water outfalls to capture runoff to support habitat will be discussed further later in this report.

Table IV-5: Storm water Outfalls and Estimated Average Runoff in Acre-Feet (AF)

No.	Site Location	Jan (AF)	Feb (AF)	Mar (AF)	Apr (AF)	May (AF)	Jun (AF)	Jul (AF)	Aug (AF)	Sep (AF)	Oct (AF)	Nov (AF)	Dec (AF)	Annual (AF)
SR01[1,2]	51st Avenue and Salt River - North Side	23.9	24.7	31.6	8.0	4.4	4.7	29.6	34.3	30.7	23.3	23.6	35.7	274
SR02[1,2]	43rd Avenue and Salt River - North Side	23.9	24.7	31.6	8.0	4.4	4.7	29.6	34.3	30.7	23.3	23.6	35.7	274
SR03[1,2]	35th Avenue and Salt River-North Side	19.5	20.2	25.7	6.5	3.6	3.8	24.2	28.0	25.1	19.0	19.3	29.1	224
SR04[1,2]	27th Avenue and Salt River-North Side	29.6	30.7	39.2	9.9	5.4	5.8	36.8	42.6	38.1	29.0	29.3	44.3	341
SR05[1,2]	25th Avenue and Salt River-North Side	10.9	11.3	14.4	3.6	2.0	2.1	13.5	15.6	14.0	10.6	10.8	16.3	125
SR06[1,2]	22nd Avenue and Salt River-North Side	48.8	50.5	64.5	16.3	9.0	9.5	60.6	70.1	62.8	47.7	48.2	72.9	561
SR07[1,2]	19th Avenue and Salt River-North Side	6.9	7.1	9.1	2.3	1.3	1.3	8.5	9.9	8.8	6.7	6.8	10.3	79
SR30[1,2]	27th Avenue and Salt River-South Side	17.1	17.7	22.6	5.7	3.1	3.3	21.2	24.5	22.0	16.7	16.9	25.5	196
SR31[1,2]	19th Ave, South Bank	20.1	20.8	26.6	6.7	3.7	3.9	25.0	28.9	25.9	19.6	19.9	30.0	231
SR48[1,2]	45th Avenue and Salt River-South Side	142.7	147.6	188.6	47.6	26.2	27.9	177.1	205.0	183.7	139.4	141.0	213.2	1640[3]
SR49[1,2]	67th Avenue and Salt River-North Side	48.5	50.2	64.1	16.2	8.9	9.5	60.2	69.7	62.5	47.4	48.0	72.5	558

1. Monthly storm water runoff distributions were assumed to follow the monthly pattern of rainfall.
2. Annual runoff volumes were computed from the drainage area versus average annual runoff relationships developed for the Rio Salado Study.
3. 1640-acre feet based upon drainage area; however, it is anticipated that runoff from this will decrease with modification in design/construction.

4.2.4.3 *Flood Flows*

The Salt River is dry most of the time due to the upstream dams that were constructed for water supply to agriculture and the Phoenix valley. Although the river is subject to flooding, flood water can only be considered a possible supplemental water supply for a restoration project. Discharge-frequency values are provided in Table IV-6 and more detailed information on flood flows can be found in Appendix A, Hydrology and Hydraulics. The 100-year floodplain is shown on Figure IV-3.

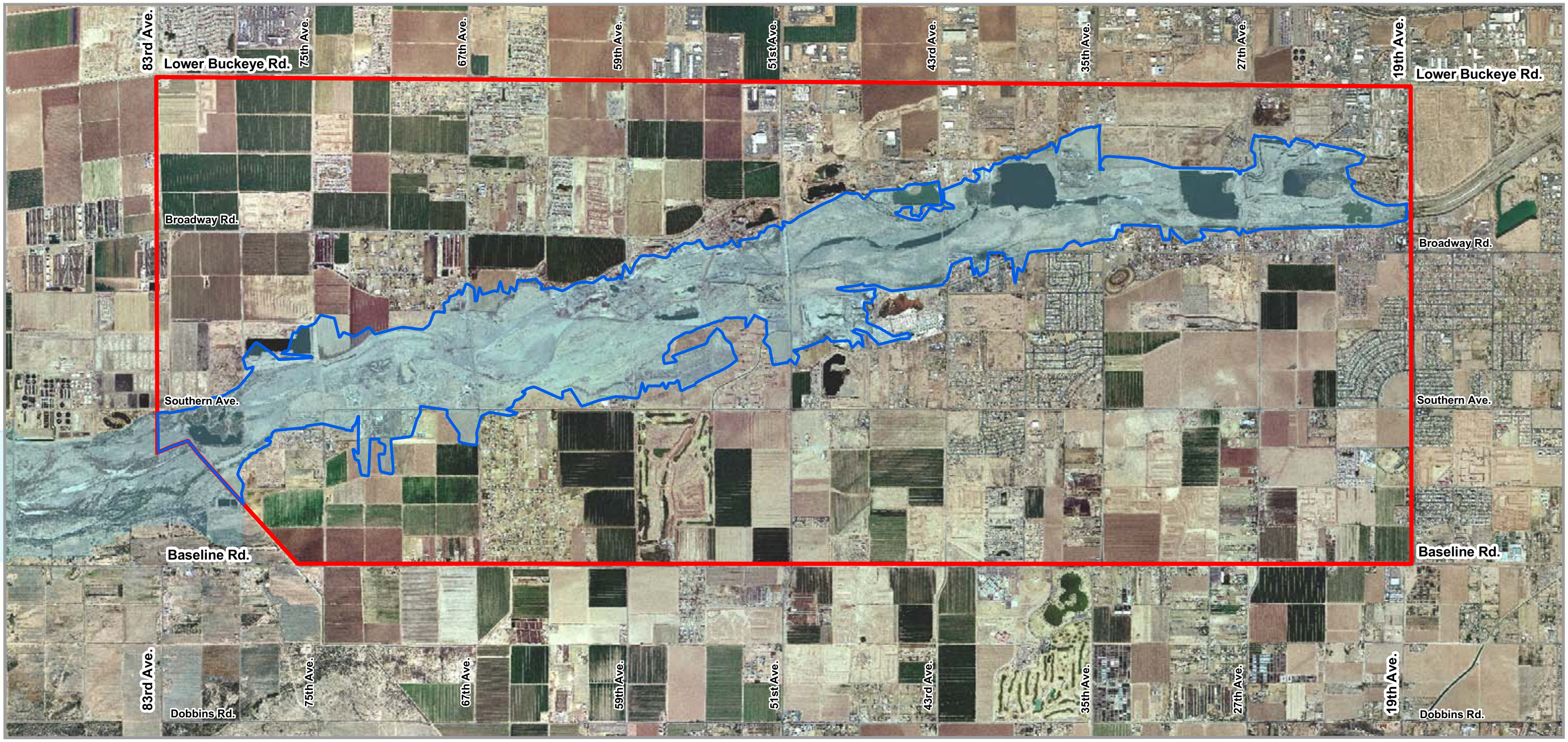
While not necessarily a preferred source for delivery of water and implementation of restoration measures, flood flows need to be considered in plan formulation. In a natural system, they provide the necessary dynamics to maintain the ecosystem and are an important factor in seed dispersal. Measures considered in the formulation of plans should account for the possible damages off loading as well as the potential advantages of flooding—flooding may provide benefits towards project sustainability.

Table IV-6: Discharge-Frequency Values Used in the Existing Conditions Model

Location	Return Period					
	5-yr	10-yr	20-yr	50-yr	100-yr	500-yr
Peak Discharges (ft^3/s) in the Salt River at:						
Central Avenue	20,200	53,000	87,000	135,000	166,000	240,000
67th Avenue	20,000	51,000	84,000	132,000	164,000	237,000

4.2.4.4 *Groundwater*

The Salt River was once a perennial stream, and groundwater levels were shallow and provided for a significant amount of riparian and wetland habitat. Today, static water level ranges from 20 to 50 feet below ground surface within the Salt River channel to 60 to 80 feet below ground surface north and south of the river. Data indicate that over the past 25 years groundwater elevations in the study area have decreased approximately 15 to 20 feet.



Legend

- Project Study Area
- Project Implementation Area
- 100-Year Floodplain

March 2006

100-YEAR FLOODPLAIN

Rio Salado Oeste

N W E S

0 5,000 10,000
Feet

Figure IV-3

US Army Corps of Engineers

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Groundwater quality in the eastern half of the study area has been impacted by hydrocarbon releases and elevated concentrations of 1,1-DCE. Elevated concentrations of TDS and nitrates are of concern on the southwestern side of the project area.

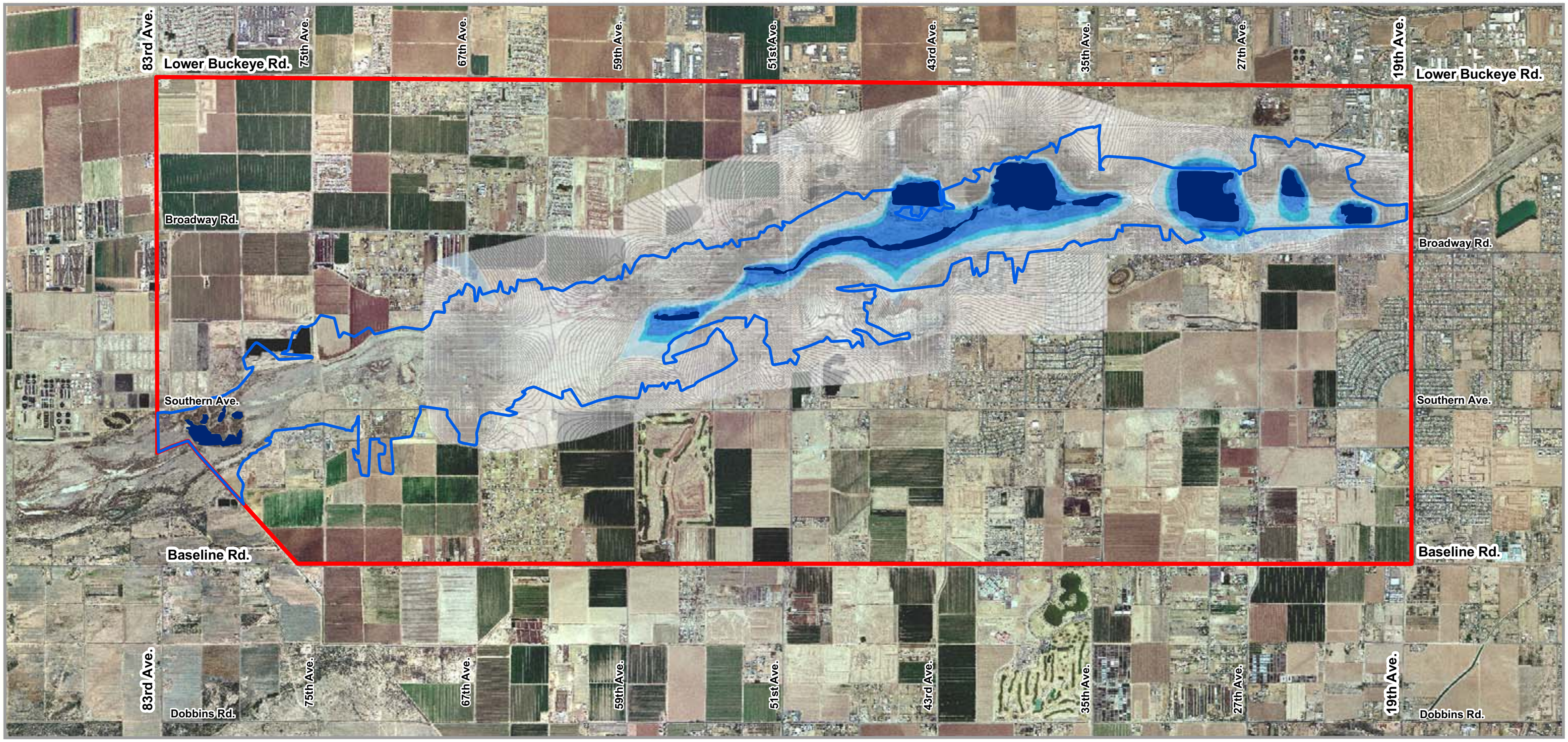
The subsurface geologic conditions in the study reach are within the Phoenix AMA and are regulated by the ADWR. The City has the rights to pumping of groundwater for their service area but would prefer to pursue other sources prior to considering groundwater as a project source. Figure IV-4 depicts an approximation of existing depth to groundwater within the study area, based upon extrapolation of 2002 ADWR well data and observed water levels in excavated gravel pits.

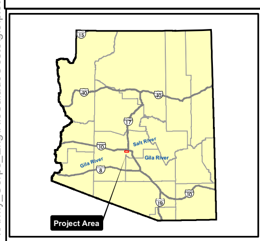
4.2.5 Land Use

The study area is located in a rapidly developing and changing area of metro Phoenix. Land uses range from industrial and commercial to residential and agriculture. Estrella Village and Laveen Village are the two primary planning areas that lie adjacent to the Salt River between 19th Avenue and 83rd Avenue. Estrella Village is characterized by an ample supply of undeveloped land, large parcels, natural and scenic amenities, and excellent transportation access. Approximately 62 percent of the Village is undeveloped, either vacant or with agricultural uses. However, there are at least 21 residential developments in various phases of approval and development.

The Laveen Village contains largely undeveloped and agricultural properties. Primary agricultural crops grown in the area include cotton, citrus, and corn. Farmers, equestrians, and those looking for solitude and mountain access have valued the area. However, development pressures have increased in this area due to its proximity (about 7 miles) to downtown.

Based upon the City of Phoenix General Plan (Revised February 2001), most of the land area on the north side of the river between 19th and 59th Avenues is zoned industrial, with some high-density residential between 43rd and 60th Avenues. From 60th to 83rd Avenues, the primary land use is low-density residential. To the south, some land between 19th and 35th Avenues is zoned as commercial otherwise, the prevailing land use is low- to medium-density residential.





DEPTH TO GROUNDWATER

Figure IV-4

Legend

- Project Study Area
- Project Implementation Area

March 2005

Depth to Groundwater

- Surface Water
- 0 - 3 Feet
- 4 - 5 Feet
- 6 - 10 Feet
- 11 - 112 Feet

0 5,000 10,000
Feet

N S E W

Rio Salado Oeste

US Army Corps of Engineers

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4.2.5.1 Future Land Use

As of July 2003 there were approximately 35,000 approved lots in the Laveen and Estrella Villages. At this rate of growth it is assumed that by 2009 the majority of the lands adjacent to the river will be developed and converted from agriculture to urban.

4.2.5.2 Aggregate Mining

As seen in Figure IV-5 below, since the construction of upstream dams began controlling the flows in the Salt River, sand and gravel mining operations moved into the riverbed and surrounding floodplain to mine the natural resource. The materials extracted from the river have been used extensively throughout the development of the Phoenix Metropolitan area and have contributed to geomorphic changes to the floodplain and adjacent over bank. Removal of sediments also removes materials that would normally be redeposited during flood events.

Figure IV-5: Aggregate mining within the project area.

There are an estimated 671 acres of sand and gravel mining operations within the 100-year floodplain of the project area. Between 19th and 35th Avenues, the river is lined with operations and is nearly 100 percent modified. South of the river between 43rd Avenue and 51st Avenue there are mining operations that cross the river just downstream of 51st and extend on the north side to near 63rd Avenue. Two new operations are in the permitting process between 51st and 67th Avenues. It is assumed that the existing mining operations will continue operating until resources and demand dictate that they are no longer feasible in their existing locations. As can be seen to the west of 51st Avenue, new operations will begin in previously un-mined portions of the river, close to new development.

4.2.6 Vegetative Habitat

Historically, the study area supported significant biological resources including extensive riparian and wetland habitats within the floodplain. Urban development, diversion of water to support agriculture, and domestic livestock grazing have eliminated or altered most of the natural vegetation communities that occupied the project study area leaving only scattered remnants of the original vegetation communities. Modifications of the river system, such as damming and flow diversion, currently allow no natural flow through the project study area, except during flood events. The Salt River below Granite Reef Diversion Dam is essentially devoid of vegetation. Vegetation communities in the project study area have been highly modified from their original state and currently contain a mosaic of degraded natural communities and manmade artificial communities. Included in this reach of the Salt River are a large number of open water areas, mostly the results of gravel mining. Adjacent to several of these there is dense vegetation including some cottonwood and willows as well as the occasional cattail or bulrush.

4.2.6.1 Cover Types

A classification system of cover types was developed for this study and is mainly based upon vegetation cover. Cover types were mapped for the length of the study reach and 1 mile on either side of the thalweg, or center of the river channel. Scattered remnants of natural vegetation remain; those cover types include cotton-willow forest, mesquite, scrub-shrub lands, and emergent wetlands. Of those cover types, scrub-shrub lands are the most dominant in the study area, covering approximately 1,200 acres.   The scarcest is cottonwood/willow forest, extant within merely 10.5 acres (not including an additional 120 acres in which salt cedar dominates Figure IV-6 below).

Figure IV-6: Landscape dominated by Salt Cedar (83rd Avenue)

Cottonwood/Willow Forest

Cottonwood/willow forest is representative of high-quality riparian habitat in Arizona. Riparian habitats are defined as habitats or ecosystems that are associated with adjacent bodies of water (rivers, lakes, or streams) or are dependent on the existence of perennial or ephemeral surface or subsurface water drainage. They are further characterized by having diverse assemblages of plant and animal species in comparison with adjacent upland areas.

Because of the modification of the Salt River system, groundwater elevations have been lowered and have contributed to the decline in cottonwood and willow species. These same conditions have also favored the establishment and dominance of salt cedar. Structural types of most stands of cottonwood/willow within the study area show evidence of disturbed and early successional conditions consistent with past histories of water diversion, infrequent severe floods, and land clearing. These plant species are also found in habitats that are narrow, linear strands of vegetation oriented in the main direction of water flow that may occur in riverine flood channels and along the banks of streams.

In terms of height, basal area, and density, Fremont's cottonwood and Gooding's willow are dominant canopy species in the cottonwood/willow associations in the study area, along with salt cedar. The cottonwood/willow riparian habitat is patchy in the study area and much of the original stands of this habitat have been replaced by the invasive and non-native salt cedar.

Scrub-Shrub Lands

Scrub-shrub lands are common and are present within the active channel of the river occupying 12 percent of the project study area (Figure IV-7). They are dominated by various combinations of burrobush, rabbitbush, quailbush, saltbush, and occasionally by creosotebush. Many of these areas have been highly disturbed from off-highway vehicle (OHV) traffic and gravel mining activities and contain little or no vegetation cover. If the total vegetation cover was less than 10 percent, the area was mapped as unvegetated river bottom; if water was present, it was mapped as low-flow channel. Throughout drainages in the Sonoran Desert there are dense areas of scrublands which are too dense to be considered desert scrub. They usually contain the same species found in the drier desert scrub but area usually more dense and also contain distinctive riparian species including Seepwillow, desert broom, or Desert willow. While river bottom, scrub shrub and riparian scrub are often referred to interchangeably by different disciplines this report will attempt to specify the difference.

Figure IV-7: Scrub-Shrub Lands Dominated by Saltbush and Rabbitbush.

Wetlands (Low-Flow Channels)

Low-flow channels in the Salt River have been almost entirely eliminated, occurring in less than 1 percent of the project study area and mostly associated with effluent or storm water discharges (Figure IV-8). These features are characterized by either seasonal or perennial open water, and are generally unvegetated when present. Vegetation, when present, consists of scattered patches of Bermuda grass, salt heliotrope, and sedges.

Figure IV-8: Low-Flow Channel with Wetland Vegetation (immediately upstream of 51st Avenue Bridge)

Mesquite Woodlands

Mesquite woodlands historically occurred over large areas within the river floodplain and on higher terraces of the river. These communities have been nearly eliminated from the river ecosystem by changes to natural processes. Currently, only small fragmented stands of scattered mesquite woodlands remain along the Salt River. Mesquite is common throughout the region, but has been reduced to remnant patches adjacent to the project study area on the Gila River Indian Community. Although scattered mesquite occurs throughout the study reach there are no large stands that could be considered mesquite woodlands.

4.2.6.2 ***Habitat Evaluation***

Hydrogeomorphic Modeling Process

The Hydrogeomorphic Modeling (HGM) approach was chosen for habitat evaluation on the Rio Salado Oeste because of its ability to provide an analysis of the processes and conditions necessary for restoration and maintenance of riparian and wetland habitat. The HGM—developed by scientists and the Engineering Research and Development Center (ERDC)—allows existing community characteristics, composition, and function to be compared to fully functional systems. Under this assessment procedure, the focus is narrowed to (1) the functions a particular type of wetland will perform and (2) the characteristics of the ecosystem and landscape controls of those functions. The ability of a riverine system to have and sustain a majority of the identified functional components of a wetland ecosystem directly correlates to the quality, quantity, and type of riparian habitat that can establish and survive.

In arid regions, biological resources are typically concentrated along riparian systems. This feasibility study relies on the results of a Hydrogeomorphic Approach to Wetlands Assessment Methodology to yield quantitative descriptions of biological resources along and adjacent to the Salt River in the study area. HGM was chosen for its broad analysis of processes and conditions necessary for support of riparian habitat. Riparian components including size, substrate characteristics, and species composition will be considered in quantification of the biological resource function and value.

An HGM approach treats the biota of an area as the outcome of an ecological process. It also merges these biological events with hydrologic and geologic process at work in a region. Wetlands under this method are measured in terms of functional capacity. This concept is based on the inherent capacity of a wetland to perform a function under its physical, chemical, and biological components, and the level of functioning is determined by interactions between the wetland and surrounding environment. The inherent capacity of a wetland is dynamic and its functional capacity is based on an assessment model defining the relationship between the ecosystem and landscape scale variables and functional capacity. The assessment method develops a Functional Capacity Index (FCI).

The FCI is a quantitative estimate of functional capacity for a wetland. The ideal goal of an FCI is to quantify and produce an index that reflects fully functional capacity at the site. The results of an FCI analysis can be quantified based on a standard 0.0-1.0 scale, where 0.0 represents the lowest functional capacity for the wetland and 1.0 represents the highest. The Functional Capacity Unit (FCU) is a measure of the ability of a wetland to perform a certain function and is calculated by multiplying an FCI by the corresponding wetland area that is producing that FCI. When evaluating and comparing alternative ecosystem restoration plans or scales of plans, the with-project FCU is compared to the future without-project FCU. The net change in FCU represents increases in the biological function of the ecosystem directly attributable to the implementation of alternative plans.

Using this methodology, the Salt River was classified as Riverine Over bank. The Salt River is also characterized regionally as arid and Southwestern. As such, the functions developed in an existing Riverine Over bank Subclass model were modified for Arizona low gradient rivers to be applied in the standard HGM approach for this study. The model for Arizona was further calibrated in a workshop with the Environmental Laboratory of ERDC, the Los Angeles District Corps, local sponsor representatives from the City of Phoenix, City of Tucson, Town of Marana, Pima County Flood Control District, Salt River Pima-Maricopa Community, AGFD, U.S. Fish and Wildlife Service (USFWS), and representatives from the scientific community. Field sampling results based on the calibration of the model during the workshop are used in the analysis of alternatives.

As a first approximation, the HGM approach uses seven wetland classes (groups) as shown below. Detailed descriptions of these groups can be found in Appendix I, Functional Assessment Methodology.

- Depression
- Tidal Fringe
- Lacustrine Fringe
- Slope
- Mineral Soil Flats

- Organic Soil Flats
- Riverine

The level of variability in the continental-scale wetland hydrogeomorphic classes presented above is too large to develop assessment models that can be rapidly applied while still being sensitive enough to detect changes in function at a level of resolution appropriate to the USACE planning process in Arizona. As such, the three classification criteria (geomorphic setting, water source, and hydrodynamics) were applied at a smaller, regional geographic range to identify regional wetland subclasses.

The resulting regional riverine wetland subclasses adopted for the Rio Salado Oeste Project were all associated with low-gradient perennial and ephemeral river systems in Arizona. Within these regional subclasses, homogenous zones exhibiting analogous vegetative species, geographic similarities, and physical conditions that make the area unique were defined as a Partial Wetland Assessment Area (PWAA). In all, five PWAAs were defined for the Rio Salado Oeste Project on the basis of species recognition and dependence, soil types, and topography. The dominant vegetative cover types within the PWAAs included Cottonwood/Willow, Wetland Marsh, Mesquite, and Scrub-Shrub. River Bottom was defined as the active channel and included pool/riffle aquatic areas and open areas characterized by sand, cobble, and/or gravel. During the planning and project formulation processes, various combinations of PWAAs were located within the project area and used to develop a range of restoration alternatives.

Wetland Functions Evaluated

A desired result of this study process was to assess the functional values of wetland habitat types (PWAAs) currently existing within the project area. Wetland functions under this method are measured in terms of functional capacity. This concept is based on the inherent capacity of a wetland to perform a function under its physical, chemical, and biological components, and the level of functioning is determined by interactions between the wetland and surrounding environment. The inherent capacity of a wetland is dynamic and its functional capacity is based on an assessment model defining the relationship between the ecosystem- and landscape-scale variables and functional capacity. The assessment method develops an FCI.

Further, estimates of the functional values were needed for PWAAs at selected times in the future considering the without-project scenario, as well as with-project. Wetlands perform a wide variety of functions, although not all wetlands perform the same functions, nor do similar wetlands perform the same functions to the same level of performance. The ability to perform a function is influenced by the characteristics of the wetland and the physical, chemical, and biological processes within the wetland.

Wetland characteristics and processes influencing one function often also influence the performance of other functions within the same wetland system. The ten functions evaluated with HGM FCI models used in this study are found in Table IV-7.

Table IV-7: Wetland Functions Evaluated

Wetland Function (symbol)	Description
Function 1: Maintenance of Characteristic Channel Dynamics (CHANNELDYN) $(V_{Q}+V_{FPA}+V_{SED})/3$	Physical processes and structural attributes that maintain characteristic channel dynamics. These include flow characteristics, bedload, in-channel coarse woody debris inputs, channel dimensions, and other physical features (e.g. bank vegetation, slope).
Function 2: Dynamic Surface Water Storage/Energy Dissipation (WATSTORENR) $(V_{FREQ}*(V_{FPA}+((V_{TOPO}+V_{TVV}+V_{CWD})/3)/2))^{1/2}$	Dynamic water storage and dissipation of energy at bankfull and greater discharges. These are a function of channel width, depth, bedload, bank roughness (coarse woody debris, vegetation, etc.), presence and number of in-channel coarse woody debris jams, and connectivity to off-channel pits, ponds, and secondary channels.
Function 3: Long Term Surface Water Storage (WATSTORLNG) $(((V_{TOPO}*V_{FREQ})^{1/2})*(((1 - V_{PORE})+V_{SUBIN})/2))^{1/2}$	The capability of a wetland to temporarily store/retain surface water for long durations; associated with standing water not moving over the surface. Water sources may be overbank flow, overland flow, and/or channelized flow from uplands, or direct precipitation.
Function 4: Dynamic Subsurface Water Storage (WATSTORSUB) $(V_{DEPSATSED})$	Availability of water storage beneath the wetland surface. Storage capacity becomes available due to periodic drawdown of water table.
Function 5: Nutrient Cycling (NUTRIENT) $((V_{TVV}+(3*V_{AGSA})/4)+((V_{DECAY}*((V_{LITTER}+V_{FWD}+V_{CWD})/3))^{1/2}))/2$	Abiotic and biotic processes that convert elements from one form to another; primarily recycling processes.
Function 6: Detention of Imported Elements and Compounds (ELEMENTS) $(((V_{FREQ}+V_{SURFIN}+V_{SUBIN})/3)+((V_{AGSA}+V_{LITTER}+(1-V_{PORE}))/3)+V_{TVV})/3$	The detention of imported nutrients, contaminants, and other elements or compounds.
Function 7: Detention of Particles (DETPARTICL)	Deposition and detention of inorganic and organic particulates (> 0.45 µm) from the water column, primarily through physical processes.

Wetland Function (symbol)	Description
$((2*V_{FPA})+V_{TOPO}+((V_{CWD}+V_{FWD}+V_{SED}+V_{TVV})/4))/4$	
Function 8: Maintain Characteristic Plant Communities (PLANTS) Cottonwood/willow and Mesquite Communities: $(((((V_{SPECRICH}+V_{WIS}+V_{INVASIVES})/3)*((V_{CANHERB} + V_{CANSHRUB} + V_{CANTREE})/3))^{1/2}) * V_{LANDBUFF})^{1/2}$ Scrub-Shrublands Communities: $(((((V_{SPECRICH}+V_{WIS}+V_{INVASIVES})/3)*((V_{CANHERB} + V_{CANSHRUB})/2))^{1/2}) * V_{LANDBUFF})^{1/2}$ River Bottom Communities: $(((((V_{SPECRICH}+V_{WIS}+V_{INVASIVES})/3)*(V_{CANHERB}))^{1/2}) * V_{LANDBUFF})^{1/2}$	Species composition and physical characteristics of living plant biomass. The emphasis is on the dynamics and structure of the plant community as revealed by the species of trees, shrubs, seedlings, saplings, and herbs, and by the physical characteristics of the vegetation.
Function 9: Maintain Spatial Structure of Habitat (HABSTRUCT) $(((V_{VEGSTRATA}+((V_{CWD}+V_{FWD}+V_{LITTER})/3))/2) * V_{LANDBUFF})^{1/2}$	The capacity of the wetland to support animal populations and guilds by providing heterogeneous habitats.
Function 10: Maintain Interspersion and Connectivity (INTERSPERS) $(((V_{FREQ}+V_{TOPO}+V_{CONTIG}+V_{TRIB})/4) * V_{LANDBUFF})^{1/2}$	The capacity of the wetland to permit aquatic organisms to enter and leave the wetland via permanent ephemeral surface channels, overbank flow, or unconfined hyporheic gravel aquifers. The capacity pf the wetland to permit access for terrestrial or aerial organisms to contiguous areas of food and cover.

Selecting and Modifying the HGM Models

In the HGM methodology, an FCI is a quantitative estimate of functional capacity for a wetland. The ideal goal of an FCI is to quantify and produce an index that reflects functional capacity at the site. The results of an FCI analysis can be quantified based on a standard 0.0-1.0. scale, where 00.00 represents low functional capacity for the wetland and 1.0 represents high functional capacity for the wetland.

FCU is the unit of measure of the ability of a wetland to perform a certain function and is calculated by multiplying an FCI by the area of the wetland. FCI x acreage = FCU. When evaluating restoration alternatives, with-project FCU will be compared to without-project FCU. The change in FCU will be the unit of measurement of the outputs from restoration measures.

Environmental Output

Baseline (existing conditions) results for the Rio Salado Oeste Project area are shown below in Table IV-8. These results show that riparian and wetland habitats within the study area have low functional values and are therefore highly degraded. Figure IV-9 below depicts the FCI graphically.

Table IV-8: Baseline Conditions Analysis Results

Function	Function Name	Baseline FCI	Baseline FCU
01	Maintenance of Characteristic Channel Dynamics	0.23	41.4
02	Dynamic Surface Water Storage/Energy Dis.	0.42	74.9
03	Long Term Surface Water Storage	0.25	45.2
04	Dynamic Subsurface Water Storage	0.44	78.3
05	Nutrient Cycling	0.28	49.6
06	Detention of Imported Elements and Compounds	0.38	66.9
07	Detention of Particulates	0.33	58.9
08	Maintain Characteristic Plant Communities	0.42	74.8
09	Maintain Spatial Structure of Habitat	0.30	53.1
10	Maintain Interspersion and Connectivity	0.23	40.1
	AVERAGE/TOTAL	0.33	583

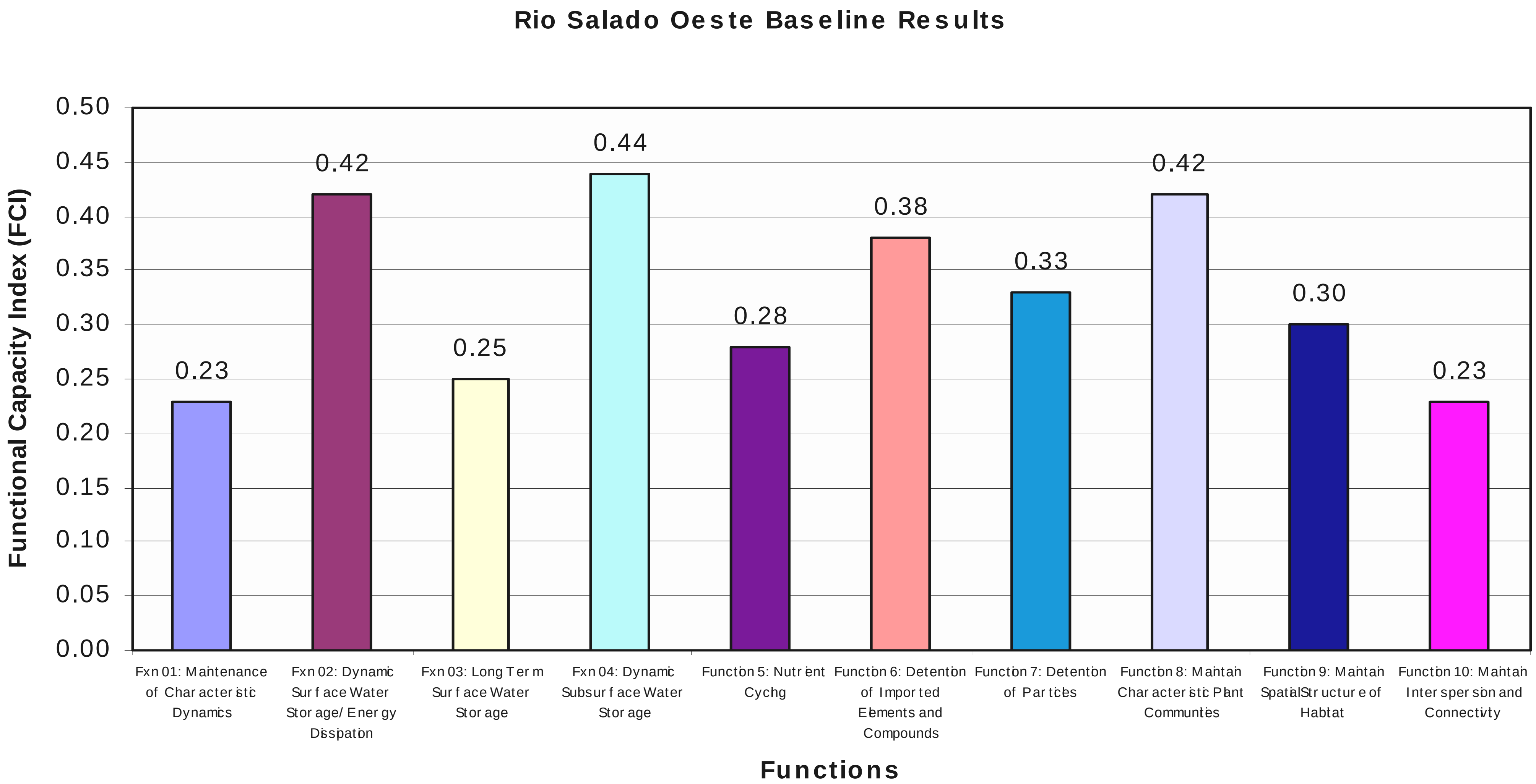


Figure IV-9: FCI for the Rio Salado Oeste Study Area

4.2.7 Hazardous, Toxic, or Radioactive Waste

The presence of Hazardous, Toxic, and Radioactive Wastes (HTRW) within the study area was evaluated for the study. Because of the size of the project study area, approximately 20 square miles total, a typical Phase I ESA was not possible. Consequently, a Modified Phase I ESA was decided to be most appropriate for the size of the project. The basic difference is that a site reconnaissance of every property within the project area would not be conducted, as infeasible. The Modified Phase I ESA was conducted to review past and current land use practices along the site corridor to identify areas of known or suspected contamination that may environmentally impact the subject property. URS completed the assessment under contract to the City of Phoenix. The entire report is found in Appendix F of this report.

The Modified Phase I ESA was accomplished by, and limited to, a visual reconnaissance of the site from existing rights-of-way and public areas, a drive-by survey of the site corridor (or vicinity), a review of publicly available records (including aerial photographs), and a review of pertinent documentation presently and readily available from the client and/or through URS' standard resources. The site corridor is defined as the neighboring properties and facilities along the Salt River within an approximate distance of 1 mile north and south of the river's centerline, the nature of which may adversely affect or have affected environmental conditions at the site due to the presence and/or release of hazardous substances or petroleum products to the environment. The following activities were conducted in accomplishing the Phase I ESA:

- Review of aerial photographs
- Review and interpretation of available archival topographic maps, historical land use maps of the site for information regarding historical site land use that could have involved the manufacture, generation, use, storage and/or disposal of hazardous substances
- Review of the following State and Federal agency lists of known or potential hazardous waste sites, and sites currently under investigation for potential environmental violations as prescribed by the American Society for Testing and Materials. All databases were

searched for areas approximately 1 mile from the Salt River centerline to include the project corridor study area (or buffer area):

Federal National Priorities List (NPL) site list

Federal Comprehensive Environmental Response, Compensation, and Information System (CERCLIS) list

Federal Resource Conservation and Recovery Act (RCRA) CORRACTS TSD facilities list

Federal RCRA non-Corrective Action Report (CORRACTS) Treatment, Storage, and Disposal (TSD) facilities list

Federal RCRA generators list

Federal Emergency Response Notification System (ERNS) list

State lists of hazardous waste sites identified for investigation or remediation:

State-equivalent NPL

State-equivalent CERCLIS

State landfill and/or solid waste disposal site lists

State LUST lists

State-registered UST lists

- Review of previous environmental reports conducted within or relating to the Oeste study area
- Performance of an onsite visual reconnaissance of the subject property and the area within 1-mile of the Salt River centerline in each direction to make visual observations of existing site conditions, activities, and types of land use and businesses within the project corridor area

Sites identified with possible HTRW concerns are for the most part outside the 100-year floodplain and location where project features would be located. Project features are located within the 100-year floodplain and avoid the known HTRW sites. In accordance with Engineer Regulation 1165-2-132, the Corps would not participate in clean up of materials regulated by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) or by the RCRA.

4.2.7.1 "Wildcat" Dumping

"Wildcat" or uncontrolled, random dumping of materials has occurred and continues to occur along the river and study area. This dumping includes soils, concrete, asphalt, household and landscape waste, etc. The reach between 35th and 51st Avenues was at one time littered with such waste materials. However, the City of Phoenix has implemented changes that significantly reduced the amount of dumping in this through barricades and increased policing. It should be assumed that some waste is still present within the study area.

4.2.7.2 Landfills

There are three closed landfills within the study area. These include the 27th Avenue Landfill which was closed in 1995, and the SRP landfill (North of the river at 67th Avenue), closed in 2000. The 19th Avenue landfill, located east of 19th Avenue, has been closed and a remediation plan has been implemented. Groundwater monitoring is conducted at the landfills. Although these landfills are within the study area they are outside the possible location for project features and should not have any impact on the project.

4.2.7.3 Leaking Underground Storage Tanks (LUSTs)

Thirteen LUST sites with monitoring wells on record with ADWR were identified within the study area. Description of the sites can be found within Appendix D, Groundwater Quality and Hydrogeology Report. These sites may have impacts to local soil and water conditions but are not considered likely to affect the project to be implemented within the floodplain.

4.2.8 Cultural Resources

4.2.8.1 ***Prehistory***

Paleoindian and Archaic

Thus far there are no known Paleoindian sites in the Phoenix Basin or surrounding environs. Little is known of the archaic occupation of the area, but newly acquired excavation data is becoming available. The current construction boom in Scottsdale has required new surveys, which in turn has prompted excavation of previously unknown archaic sites. Presently, much of that information is locked up in unpublished, possibly proprietary reports.

Hohokam

The principal prehistoric cultural manifestation in the project area is the Hohokam culture. Hohokam is a Pima word that means "those who have gone" (Gladwin and Gladwin, 1933), or more poetically, "those who have vanished" (Wormington, 1973). The name Hohokam has endured and is still the preferred name in spite of the renaming of some other prehistoric cultures being renamed. The four southern O'odham tribes crafted a policy statement that stated, "We recognized Indian Tribes have mutually agreed to promote and protect the archaeological artifacts and remains of our ancestors, the Hohokam…" (SRPMICC, 1989).

4.2.8.2 History

The potential value of the Salt River was realized when, in 1867, John W. "Jack" Swilling first ventured from Wickenburg to John Y. T. Smith's Hay Station, approximately 4 miles from present-day Phoenix (Granger, 1960). In 1867, as a farmer visiting Smith's Hay Station, he observed the long, low earthen ridges radiating out from the Salt River and concluded that these were the remnants of a long-forgotten irrigation system (SRP, 1979; Myers, 1961). This observation prompted him to envision the irrigation potential of the Salt River.

Other canals followed Swilling's Ditch, developing the agricultural potential of the Salt River Basin. The Maricopa Canal was completed in 1869, the Arizona Canal in 1887, and the Highlands Canal was constructed in 1888. The early canals were beset by their own problems stemming from Salt River floodwaters. Flooding washed out the diversion dams, leaving the headgates high and dry and rendering them useless (Walker and Bufkin, 1986). A number of the historic canals were reconstructed from the old Hohokam canals. The only functional difference between the Hohokam and modern canals is the lack of drop structures and drainage canals in the Hohokam systems, according to Nials and Gregory (1989).

By 1871, Phoenix was an official town. The number of townspeople had risen to 300, a far cry from the old Smith Hay Station: population 1. All the original lots had been sold and the town was formally mapped. Phoenix was one-mile-long and one-half mile wide, and encompassed 96 blocks. Washington Street was the first main street running east-west. The Salt River Valley Post Office was moved to Phoenix, and the first County election was held. In 1872, the 320-acre town site of Phoenix was officially filed in Prescott.

*4.2.8.3 **Previous Work in the Study Area***

The earliest known archaeological work in the vicinity of the Rio Salado Oeste project area included Adolph Bandelier and Frank Cushing's studies in the 1880s of Pueblo Grande, approximately 15 miles to the east (Downum and Bostwick, 1993:17-21), and investigations of the prehistoric Hohokam canals (Hodge, 1893; Patrick, 1903).

The eastern portion of Cashion Ruin was recorded by Frank Midvale in 1923. Turney documented the western portion of Cashion Ruin in 1925 with updates in 1929 and 1935. Cashion Ruin was recorded again and trenched in 1939 by Audie R. Kelley as part of the Salt River Valley Stratigraphic Survey financed by the U.S. Works Progress Administration and headquartered at Pueblo Grande Museum under Director Odd Halseth (Downum and Bostwick 1993:212-220).

Glen Rice (personal communication 1999) said that Midvale's Canal Cashion may not have actually been a canal, and that Midvale's site map was of an area south of the site's actual location. During the Museum of Northern Arizona's (MNA's) excavation of the Cashion Site, Antieau (1981) noted that he was unable to locate the Canal Cashion and three Casa Grande-type ballcourts, probably due to this locational error. Midvale mapped all the ruins in the Palo Verde project area right-of-way in 1967 and in some cases corrected Turney's locations (cf. Legend on Midvale's map of the Cashion ruins in Antieau (1981:42). Antieau's excavations verified that Turney was correct and Midvale was incorrect (Antieau 1978).

Following Turney, Frank Midvale developed an interest in prehistoric irrigation and spent the 1920s, 30s, and 60s investigating every lead he could in an attempt to retrace the flow of irrigation water through the Salt-Gila Basin (Antieau 1981:8). He had also mapped the 5 sites that were excavated by the MNA for the Palo Verde Nuclear Generating Station Wastewater Conveyance System.

The Cashion site, NA 14690, was excavated by the MNA in 1977 and 1978 (Antieau 1981). Midvale originally mapped the Cashion site in 1927 when he called it Los Conejos (Antieau 1981:144). Estimated to cover approximately 640 acres, the Cashion site was listed on the National Register of Historic Places on December 19, 1978 (Reference No. 78000547). It is the largest site excavated near the confluence of the Salt and Gila Rivers, one of the largest and the most complex in the Salt-Gila River Valley (Stein, 1977), and it equals Snaketown in size (Antieau, 1981). Encompassing dates from A.D. 500 - 1150, the Cashion site was occupied from the Pioneer through the Classic Periods (Stein, 1977; Antieau, 1981). By the end of the Classic Period, Cashion was largely abandoned.

4.2.8.4 Records and Literature Search

For the purposes of the record and literature investigation, the following description was used. The study area is approximately 8 miles long extending from 19th Avenue on the east to 83rd Avenue on the west and from Lower Buckeye Road on the north to approximately Baseline Road on the south. The project implementation area extends from 19th Avenue on the east and 83rd Avenue on the west and is the area within the 100-year floodplain of the Salt River. The study area is approximately 4-miles wide and consists of approximately 20,480 acres. The project Area of Potential Effect (APE) is on average approximately 1-mile wide and consists of approximately 3,315 acres, and almost entirely of the outfalls and adjacent or nearest terrace.

A literature search of the proposed project APE was performed through the Arizona State Museum, Arizona State Office of Historic Preservation, the City of Phoenix, and Corps of Engineers files. This search indicated that archeologists had never surveyed the APE.

4.2.8.5 Recommendations

Geoarchaeological investigations were conducted for the Tres Rios project (Onken et al. 2004), which provide a very good reconstruction of the floodplain history just west (downstream) of the Rio Salado Oeste Project, at the junction of the Salt and Agua Fria Rivers with the Gila River. The results of the Tres Rios geomorphological investigation suggest that 94% of that project area has no or low sensitivity for buried prehistoric sites.

Given the Oeste project's location upstream of Tres Rios, it is reasonable to conclude that the alluvial stratigraphy of the lower Salt River might be comparable. The entire length of the Salt River within the Oeste project boundary appears to have been more disturbed than downstream, and has been modified through natural scouring action of periodic flooding, sand and gravel mining, and dumping.

Surveys of selected portions of the river, at all outfalls and adjacent or nearest terrace, were conducted by a Corps of Engineers staff archeologist. No cultural material was observed at any of these areas. The effects of the above mentioned impacts on the river are evident at the outfalls and surrounding areas. Based on the reconnaissance survey, level of disturbance, and data provided by the Tres Rios geological assessment, the Corps believes that the potential for buried archeological resources within the project area is low. A letter was sent to the Arizona State Historic Preservation Officer (SHPO) on July 6, 2005 with our determinations in accordance with 36 CFR 800.4(d). We received a letter of response dated August 10, 2005. This letter concurred with the APE as described in Section 4.4.5 above. The SHPO requested a written report of the survey conducted by Corps personnel. A Memorandum of Record (MFR) was completed describing the survey conducted in March 2004. Copies of all these documents can be found in the EIS.

All supporting documentation required under 36 CFR 800.11(d) has been provided to the SHPO, this includes the draft environmental impact statement (EIS). The archeologist representing the City of Phoenix has received copies of SHPO communications in addition to a copy of the draft EIS.

4.2.8.6 Native American Concerns

Section 106 of the National Historic Preservation Act, as amended 16 U.S.C. 470 et seq. and the American Indian Religious Freedom Act of 1978, Public Law 95-341, 42 U.S.C 1996 require consultation and Coordination with Indian Tribal Governments all require that government agencies consult with Native Americans to determine their interests in federal projects.

Letters including project descriptions and requests for comments were sent to the interested tribes noted below on July 6, 2005. The MFR was transmitted to the tribes on October 6, 2005. Ak-

Chin Indian Community, Gila River Indian Community, Hopi Tribe, Pascua Yaqui Tribe, Salt River Pima-Maricopa Indian Community, Tohono O'odham Nation, and Yavapai-Apache Nation. The draft EIS has been provided to the above groups for comment.

4.2.9 Socioeconomics

Benefits and costs for flood damage reduction analysis was computed at FY05 price levels, but was recomputed at 5 1/8%. Costs for the restoration and recreation alternatives are FY06 price levels, and we are using 5 1/8%. Since no flood damage reduction alternatives are being pursued, additional price level update of the structure inventory was not necessary. The period of analysis is 50 years. The Base Year for economic computations is 2010.

4.2.9.1 Flood Damages

SRP maintains four dams on the Salt River, as well as two on the Verde River, of which only one dam on the Salt River has flood-control capacity. Granite Reef Diversion Dam is located about 5 miles downstream of the confluence of the Salt and Verde Rivers. At this dam site, all water is taken from the Salt River and diverted into the Arizona and South Canals, which deliver drinking and irrigation water to the greater Phoenix area. During significant flood events, the SRP is forced to release water over Granite Reef Dam into the normally dry Salt River.

Historical Flood Damages

The highest release from Granite Reef Dam since the construction of the Salt and Verde River dams occurred in February 1980, when 178,000 cfs was released because of heavy rains and rapid snowmelt in the watersheds. All downstream bridges through Phoenix were forced to close during that flood except the Central Avenue Bridge. Subsequently, most of the remaining bridges crossing the Salt River have been rebuilt to withstand flow rates of 200,000 cfs and greater. (However, the Roosevelt Dam has been modified so it is unlikely that such a large release would occur.)

High releases were also experienced in 1993 (approximately 130,000 cfs). Winter floods during the first three months of 1993 caused extensive damage to property and crops throughout

Maricopa County. Total flood damages throughout the State during this storm were estimated at over $250 million in current dollars.

Information regarding damage estimates specific to the study reach was not available. However, current hydrologic data for the Salt River through the study area shows that peak discharges for the 100-year event are approximately 172,000 cfs. Current hydraulic analysis indicates that there are very few structures in the 100-year floodplain. Therefore, it is likely that damages throughout the study area reach were limited during these storms.

Floodplain Boundaries

An inventory of structures possibly susceptible to damage, and estimates of the value of these structures must first be developed in order to determine potential flooding damages. Floodplain boundaries depicted in Appendix A were used to determine properties susceptible to flooding up to the 500-year floodplain. The Rio Salado Oeste 500-year floodplain encompasses a large area, primarily to the south of the Salt River.

The floodplain has been further segmented into sub-areas, or Reaches, for analysis purposes. Those reaches are shown in Table IV-9 below. Critical factors used to determine reach boundaries include discharge/frequency characteristics, overflow spatial characteristics, and economic activity. Table IV-9 below provides a summary of reach characteristics, including approximate upstream and downstream boundaries.

Table IV-9: Floodplain Reach Definitions

Reach Name	Upstream Limit	Downstream Limit	Notes
1L	75th Ave.	91st Ave.	Only a few structures in this reach
2L	67th Ave.	75th Ave.	Small number of large-lot industrial and agricultural properties/structures along Southern Ave.; some residential development along Baseline Road
2R	67th Ave.	75th Ave.	Small number of structures at northwest corner of Roeser & 67th
3L	51st Ave.	67th Ave.	Under existing conditions, reach includes residential development at downstream end – northwest of Baseline and 67th. Removed under Base Year conditions
4L	43rd Ave.	51st Ave.	Small number of structures along 51st Ave. north of Southern
4R	43rd Ave.	51st Ave.	Includes a few structures just west of 51st Ave. adjacent to floodway
5L	35th Ave.	43rd Ave.	Large residential development in this reach on south side of Salt River; most of development removed from floodplain under Base Year conditions
5R	35th Ave.	43rd Ave.	Mostly industrial structures, concentrated south of Lower Buckeye, between 35th and 39th Aves
6L	27th Ave.	35th Ave.	Limited industrial/commercial development, primarily along Broadway Road
6R	27th Ave.	35th Ave.	Mostly industrial structures, concentrated along east side of 35th Ave., Lower Buckeye to floodway
7R	19th Ave.	27th Ave.	Small number of structures near 27th Ave. on north side of Salt River under existing conditions – removed under Base Year conditions

* Number of structures

The number of structures in the 100- and 500-year floodplains was determined based upon an analysis of aerial photography, parcel maps, real estate assessor's data, and a site survey. Table IV-10 shows that there are approximately 386 structures in the Rio Salado Oeste 500-year floodplain. Of these, 59 percent are residential (single-family residential/multi-family housing [SFR/MH]). Roughly 139 structures are located within the 100-year floodplain boundaries (about 36 percent of the structures in the 500-year floodplain). Reach 5L contains the majority (51 percent) of floodplain structures. This area contains numerous structures, primarily residential (including both single-family residences and mobile homes). Structures in this area are generally of fair to low-cost construction. Most single-family residential structures are of block construction. The other area with the greatest number of structures is within Reach 6L (19 percent), east of 35th Avenue on the south side of the Salt River.

Table IV-10: Number Of Structures

Structure Type	100-Year	500-Year
SFR	15	207
MH	19	22
Industrial	78	114
Office/Commercial	27	43
Public	0	0
Total	**139**	**386**

Without-Project Damages

Expected annual damages by reach and structure type are shown on Table IV-11. Damages to industrial and agricultural structures and contents, primarily located in Reaches 2L and 5R, comprise most of the expected annual damages. This is attributable to the fact that these two reaches contain structures in close proximity to the floodway, and therefore are susceptible to more frequent flood events. It should be noted that these results reflect planned bridge improvements at 35th Avenue. Preliminary analysis indicates that expected annual damages without these improvements would be substantially higher (approximately $670,000 vs. $235,000).

Without-project damages by event for Base Year conditions, as calculated by the HEC-FDA program (see Table IV-11). The non-damaging event is approximately the 10-year event. However, most reaches do not incur damages until less frequent events. Damages calculated for the 20-year event are approximately $1.14 million. A majority of these damages are attributable to one parcel within Reach 5R. There are approximately 11 industrial structures on this parcel (located adjacent to the floodway on the west side of 35th Avenue) owned by a metal scrap recycling business.

Table IV-11: Without-Project Damages by Reach & Event (Base Year – 2010)

(in $1,000s)

Reach	10-year	20-year	50-year	100-year	500-year
1L	$ -	$ -	$ -	$ 1	$ 13
2L	$ -	$ 88	$ 754	$ 1,183	$ 1,561
2R	$ -	$ -	$ -	$ 8	$ 30
3L	$ -	$ -	$ 10	$ 87	$ 254
4L	$ -	$ 4	$ 52	$ 90	$ 125
4R	$ -	$ -	$ -	$ -	$ 10
5L	$ -	$ -	$ 59	$ 1,163	$ 4,039
5R	$ 38	$ 1,050	$ 2,615	$ 3,929	$ 5,633
6L	$ -	$ -	$ 52	$ 378	$ 1,056
6R	$ -	$ -	$ 2	$ 78	$ 659
7L/7R	$ -	$ -	$ -	$ -	$ -
Total	$ 38	$ 1,142	$ 3,544	$ 6,917	$ 13,380

Damages increase significantly for the 50-year event, and approximately double subsequently for the 100-year and 500-year events. A majority of the damages for these flood events are expected to occur in Reaches 5R and 2L (primarily industrial properties) and 5L (which is the reach with the large residential development discussed previously).

4.2.9.2 Demographics

Population

The southern portion of the study area lies in the southwest portion of the City of Phoenix, which has a total population of 1,321,045 (U.S. Census Bureau, 2000). Table IV-12 shows the 2000 population and household characteristics for the county and study area. In 2000, the county population totaled 3,072,149 (U.S. Census Bureau, 2000). The MAG projects that the county's population will grow to approximately 3,709,566 by 2010, and to approximately 4,516,090 by 2020, increases of 637,417 and 1,443,941, respectively (MAG, 2002). The study area makes up only 0.1 percent of the total county population (U.S. Census Bureau, 2000).

Table IV-12: Population and Household Characteristics in the Vicinity of the Study Area

Jurisdiction	Population	Number of Households	Persons per Household	Number of Families	Persons per Family
Maricopa County	3,072,149	3,027,366	2.67	763,110	3.21
Study Area	48,854	11,504	3.93	9,362	4.20
Source: U.S. Census Bureau, 2000					

Population Projections

Table IV-13 displays population estimates and growth projections for Maricopa County and the City of Phoenix, obtained from the MAG and U.S. Census Bureau Web sites. Strong growth for the county and city is expected through year 2050, although the rates of growth will be substantially lower than those experienced in the past decade.

Table IV-13: Projected Population and Annual Growth Rate (AGR) for Maricopa County and the City of Phoenix

Year	Maricopa County	AGR	City of Phoenix	AGR
1995	2,529,000		1,154,000	
2000	3,072,000	4.0	1,321,000	2.7
2010	3,710,000	2.0	1,544,000	1.6
2020	4,516,000	2.0	1,796,000	1.5
2050	7,265,000	1.6	2,568,000	1.2

Source: U.S. Census Bureau and Arizona Department of Economic Security

The Arizona Department of Economic Security projects that population within the Phoenix metropolitan area will total over 7.26 million by the year 2050. Growth rates for the region are anticipated to be more than double the National average throughout the period of analysis.

Ethnicity

The approximate population breakdown of the county by ethnicity is 66.2 percent White, 24.8 percent Hispanic, 3.5 percent African American, 1.4 percent American Indian and Alaskan Native, 2.1 percent Asian, 0.05 percent Native Hawaiian or other Pacific Islander, 0.1 percent other races, and 1.5 percent two or more races (U.S. Census Bureau, 2000). The ethnic composition of the study area differs from that of the county as a whole, most notably in the proportions of White and Hispanic residents (refer to Table IV-14). The proportions of the other races do differ as well, although not as much. The approximate population breakdown in the study area is: 24.3 percent White, 62.0 percent Hispanic, 5.9 percent African American, 6.2 percent American Indian and Alaskan Native, 0.3 percent Asian, 0.06 percent Native Hawaiian or other Pacific Islander, 0.09 percent other races, and 0.85 percent more than two races.

Table IV-14: Ethnic Population Characteristics in the Vicinity of the Study Area

Jurisdiction	White	Black or African American	American Indian or Alaskan Native	Asian	Native Hawaiian or other Pacific Islander	Other	Hispanic or Latino	Two or more Races
Maricopa County	2,034,530	108,521	45,703	64,562	3,725	4,086	763,341	47,681
Percent of County Total	66.2%	3.5%	1.5%	2.1%	0.1%	0.1%	24.8%	1.6%
Rio Salado Oeste Study Area	11,714	2,918	3,019	166	31	47	30,543	416
Percent of Study Area Total	24.0%	6.0%	6.2%	0.3%	0.1%	0.1%	62.5%	0.9%

Source: U.S. Census Bureau, 2000

Income

Table IV-15 shows median household income for residents within Maricopa County and the study area for the year 1999. In 1999, the median household income for the county was $45,358; the median household income for the study area was substantially less, at $27,847 (U.S. Census Bureau, 2000).

Table IV-15: Median Household Income in the Vicinity of the Study Area

Jurisdiction	Median Income Amount
Maricopa County	$45,358
Study Area	$27,847

Source: U.S. Census Bureau, 2000

Additional demographic information can be found in Appendix F, Modified Phase I Environmental Site Assessment, and Appendix G, Economic Evaluation.

4.2.10 Real Estate

The majority of the land within the project area is privately owned. Within the floodplain, or the area where restoration measures will be proposed, this ownership includes sand and gravel companies, the State of Arizona, Maricopa County, and the City of Phoenix (Figure IV-10). The City of Phoenix currently owns approximately 511 acres in the project area and has a Recreation and Public Purposes Lease on an additional 159 acres of Bureau of Land Management property. A general summary of ownership of land within the 100-year floodplain is presented in Table IV-16. See Appendix G, Economic Evaluation, for more details.

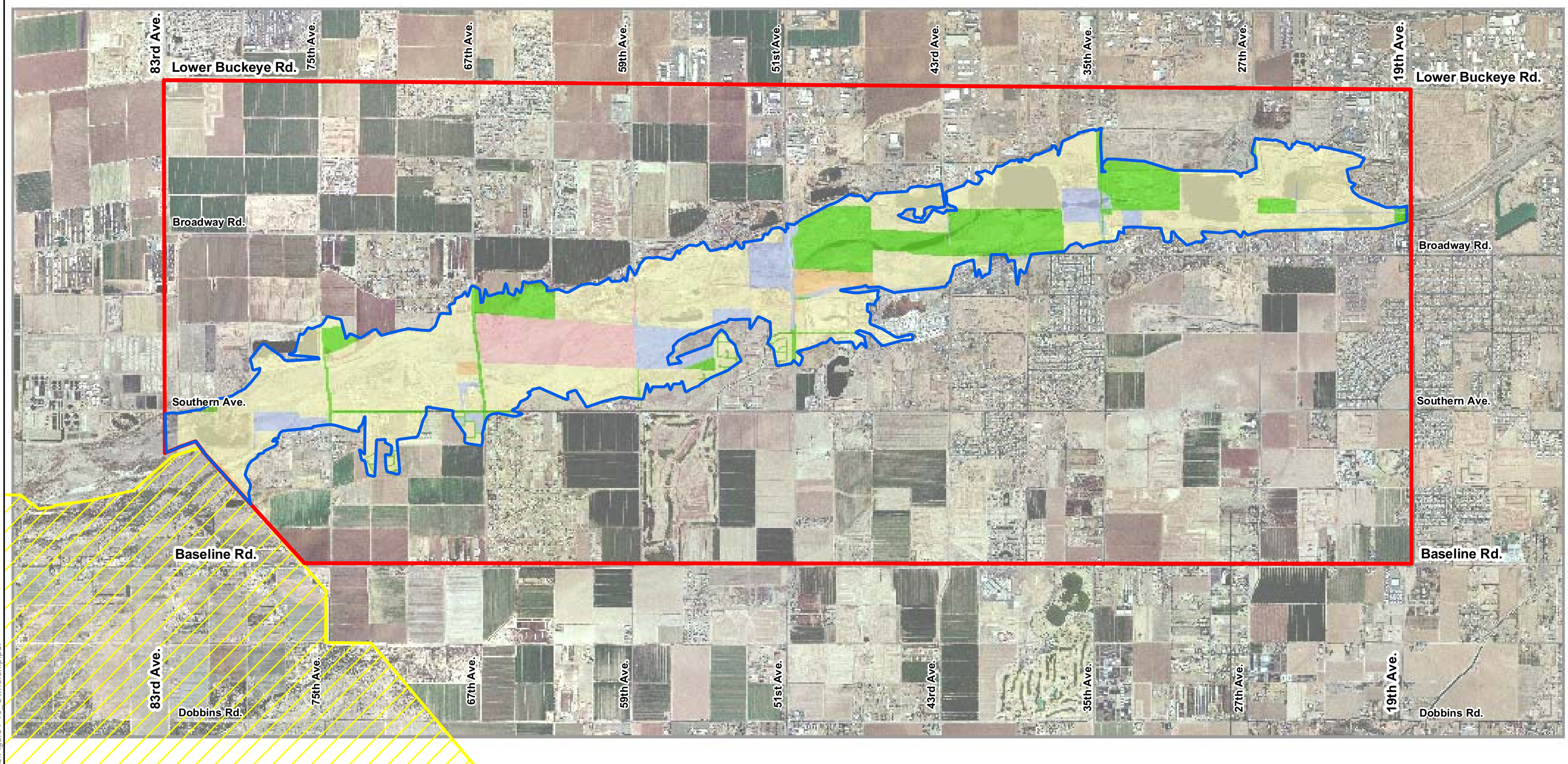
Table IV-16: Property Ownership within the Study Area (100-Year Floodplain)

Owner Type	Acres
City of Phoenix	511
Maricopa County	118
State of Arizona	261
Federal	190
Private	2094
Total	3174

4.2.11 Recreation

4.2.11.1 Nearby Recreation Resources

Arizonans place high importance on the State's outdoor recreation resources. In the 1994 Statewide Comprehensive Outdoor Recreation Plan survey, 94 percent of respondents stated that parks and recreation areas are important to their everyday lifestyles. The greater Phoenix area does not currently have any significant riparian habitat areas with supporting recreation facilities. The major existing parks in the area consist primarily of desert mountain preserves, which do not contain the types of habitat that could be supported in the study area. For purposes of this analysis, the market area will be defined as the greater Phoenix metropolitan area, which would include Maricopa and Pinal Counties, although it is likely that many visitors would be drawn from even greater distances.



Property Ownership and Use Within Project Study Area

Figure IV-10

Legend

- Project Study Area
- Project Implementation Area
- Private
- Federal Government
- State of Arizona
- Maricopa County
- City of Phoenix
- Gila River Indian Community

0 5,000 10,000
Feet

August 2005

Rio Salado Oeste

US Army Corps of Engineers

Estrella Mountain Regional Park, South Mountain Park, and Papago Park are three of the largest recreation areas nearby the study area. Estrella Mountain Regional Park is owned and managed by the Maricopa County Parks and Recreation Department. The rugged and scenic Sierra Estrella Mountains are the most dominant features of Estrella Mountain Regional Park. The terrain of these mountains is characterized by very steep slopes, numerous rock out-crops, shallow soils, and sparse desert vegetation.

South Mountain Park is located about 3 miles south of the Salt River. It extends from about 48th Street on the east to 43rd Avenue on the west—a distance of over 10 miles. The park encompasses about 17,000 acres of desert mountain landscape and is the largest municipal park in the United States. It is bounded on the north by Baseline Road and on the south by Chandler Boulevard, and is over 3 miles wide in some places. It contains an activity complex, hiking and riding trails (extending over 40 miles), an interpretive center, lookouts, ramadas, picnic areas, and restrooms. According to the *Sonoran Preserve Master Plan*, annual park visitation during the 1990s exceeded 3 million.

Papago Park is located just north of the Salt River in eastern Phoenix and western Tempe. It includes about 1,400 acres bounded on the north by Oak Street, on the south by State Highway 202, on the west by 52nd Street, and on the east by 68th Street. The park includes rock formations dating back 15 million years, ramadas, picnic facilities, three fish ponds stocked with rainbow trout and channel catfish, a baseball stadium, a softball complex, volleyball courts, the Phoenix Zoo, botanical gardens, a state historical museum, two golf courses, an archery shooting range, nature trails, and restrooms. Annual visitation exceeds 2 million.

In addition to South Mountain Park, the Phoenix Mountain Preserve is the other major mountain-preserve area in greater Phoenix. Located in the northeastern section of the city, the Phoenix Mountains comprise combination of regional parks and preserves. The regional parks represent the partially developed areas, while the preserves represent the areas which are completely undeveloped except for trails. There are about 1,800 acres of regional parks embedded within the preserves, including the North Mountain, Phoenix Mountain Park (formerly Squaw Peak), and Shaw Butte recreation areas. These parks include extensive trails systems, picnic areas, and restrooms. North Mountain recreation area also features basketball and volleyball facilities and a playground. The combined visitation at North Mountain and Phoenix Mountain Park and Recreation Area has totaled approximately 1.5 million in recent years.

Study Area Recreation Resources

Recreation in the study area is highly dependent upon the availability of surface water and riparian habitat, both of which are dependent upon the supply and availability of groundwater. The portion of the Salt River that passes through the City of Phoenix has, until the recently authorized Rio Salado and Tres Rios Projects and the upstream Tempe Town Lake, consisted of dry river bottom. As a result, virtually no recreation activities took place.

The only improved recreation area adjacent to the Salt River was Rio Salado Park, which is located at 12th Street and Elwood. The park encompasses about 14 acres and contains picnic facilities and racquetball and basketball courts. Most of the users are employees who work at industrial businesses located in the area. According to the City of Phoenix Parks Department, fewer than 200 people visit the park on a weekly basis (or fewer than 10,400 annually). There are currently no plans for expansion of the park, and visitation is not expected to increase in the absence of a Corps project.

The following shows the names and annual visitation for other community parks in the Phoenix area.

Table IV-17: Parks and Annual Visitors for Community Parks

Park	Visitation	Features
Hayden Park	121,000	14 acres, with picnicking, softball, basketball, playground, restrooms
Estaban Park	58,000	62 acres, with picnicking, softball, soccer, volleyball, tennis, playground, restrooms
El Prado	61,000	40 acres, with swimming pool, softball, picnicking, playground, restrooms
Cesar Chavez	310,000	353 acres, with 25-acre lake with fishing/sailing/canoeing, picnicking, restrooms
Encanto	1,200,000	63 acres, with fishing lagoon, 18-hole golf course, clubhouse, swimming pool, racquetball, tennis, basketball, softball, children’s play area
Echo Canyon	350,000	387 acres with hiking trails.

The Rio Salado Project stretches from an upstream limit of 28th Street to a downstream limit of 19th Avenue (which is the upstream limit for this study) and comprises environmental restoration and passive recreation components along the Salt River. Approximately 5 miles (and 580 acres) of the Salt River will be restored to create riparian and wetland habitat. Passive recreation facilities, including over 10 miles of trails and interpretive signage, are also included. Construction commenced on the project in 2000. Recreation project features include parking lots, information kiosks, a visitor center, overlooks, shade structures, bridges, trails, an equestrian staging area, signage, and landscaping. Recreation activities provided by the plan include walking, hiking, biking, horseback riding, rollerblading, picnicking, and bird watching. Scenic overlooks will be included for the enjoyment of the restored desert riparian habitat. Information kiosks and the visitor center will provide education on the resource, including restoration of the habitat, the hydro cycle, a historical perspective of the Salt River, and flora and fauna within the project area. As documented in the Rio Salado Feasibility Study, annual visitation is expected to exceed 500,000.

Immediately upstream of the Rio Salado Project is Tempe Town Lake. The lake was constructed within the existing Salt River flood control channel (about 850 feet in width), extending from the Salt River's confluence with Indian Bend Wash to approximately 2 miles downstream. The river's flood control conveyance capacity is retained through the use of a system of rubber dams that can be deflated during significant floods. The lake contains about 220 surface acres and 20,000 feet of shoreline supporting paddle boating, canoeing, sailing, and fishing. Tempe is hoping to establish the State's largest urban fishing program. Over 1,000 acres of adjacent land has been dedicated for recreational development and open space. Activities will include picnicking, hiking, bicycling, horseback riding, softball/baseball, volleyball, golfing, water slides and play areas. Other possible recreational uses include soccer and major sports events, such as marathons.

While water is a highly attractive feature for recreationists, park trails and facilities have presently been planned away from the Gila River. Once the county completes its Sun Circle Trail System through this reach of the Gila and Salt Rivers, recreation use patterns are expected to expand throughout the study area. The Sun Circle Trail, a component of the National Recreation

Trail system, is a 110-mile loop encompassing the Phoenix metro area. The trail offers a unique opportunity for hiking, horseback riding, and bicycling throughout the urban area. Approximately 70 percent of the Sun Circle trail system is in place. The county has an agreement with the FCDMC to establish the Sun Circle Trail within the flood control district corridor from Skunk Creek to the Gila River–Salt River confluence. The Rio Salado Oeste Project is an excellent opportunity to designate a segment of the Sun Circle Trail. This would benefit Tres Rios, Rio Salado, and Rio Salado Oeste with a major nonmotorized travel way connecting the three river-restoration projects to the other valley areas.

Educational Opportunities

There are no formal environmental-education opportunities associated with the existing Salt River corridor in the study area. As agricultural land near the river is converted to residential, the need for recreation will increase. The 27th Avenue Solid Waste Recycling Facility (just north of the river) has an existing environmental-education master plan. The facility provides tours for children and adults. The 23rd Avenue WWTP also does environmental-education programming and touring for water treatment. These existing facilities provide an opportunity to link environmental education that could be developed for a restored river corridor. Upstream of the study area, the Rio Salado Project will include over 10 miles of trails, an environmental-education facility, and passive recreation opportunities. Passive recreation facilities are also planned downstream for the Tres Rios Project. There are opportunities to link recreation facilities at the study area with those that will be constructed upstream and downstream.

4.2.12 Summary of historic and existing conditions

As can be seen by the existing conditions presented in this section, the problems associated with this reach of the Salt River are significant. Federal dams constructed in the early 1900s on the upper Salt and Verde Rivers have limited flows in the lower Salt River. In pre-settlement times, the Salt River was one of the few perennial streams supporting riparian areas of the Sonoran desert with highly productive cottonwood, willow, and mesquite habitats. These areas were rich in habitat diversity, supporting a wide variety of wildlife species. As the lower Salt River Valley became developed, riparian habitat was degraded significantly. The upstream Federal water projects curtailed year-round water flows and converted the once perennial Salt River into a dry riverbed devoid of habitat. In addition, the area is experiencing rapid growth and most areas adjacent to the river have been or are being developed. Only sporadic vegetation exists in the study area today, and those few native vegetation communities are seriously degraded. However, many opportunities to address problems through environmental restoration measures do exist. Since recreation opportunities in the study are limited and since recreation is compatible and desired in conjunction with ecosystem restoration, they will be evaluated during plan formulation. Although not repeated in this chapter, detailed description of additional resources and areas of environmental compliance are included in the companion Environmental Impact Statement.

4.3 EXPECTED FUTURE WITHOUT-PROJECT CONDITION (2010-2060)

The future without-project condition is defined as that condition expected to exist in the absence of any action taken (by the Federal Government) to solve the stated problems. This condition is vitally important to the evaluation and comparison of alternative plans and the identification of impacts (both beneficial and adverse) attributable to proposed Federal actions. The future without-project condition forecast provides a description of anticipated actions external to the project and the anticipated consequences of these actions.

4.3.1 Hydrology

The hydrologic analysis for Rio Salado Oeste first considered baseline conditions. Baseline flow rates for the Salt River were available from a 1996 Corps analysis of the river, completed as part of a modification project for the Roosevelt Dam. This report contained flow rates for the 5-, 10-, 25-, 50-, 100-, and 500-year events along the river at Central Avenue and 67th Avenue. The flow rates at these two locations were similar to each other for each event, and overall the flow rates varied from 20,000 to 240,000 cfs with the 100-year event equating approximately 166,000 cfs. The values presented from this analysis were for baseline hydrologic conditions.

For future hydrologic conditions, the same flow rates as the baseline conditions were used. However, a continuous hydrograph of the Salt River was used to simulate the erosion and deposition for the study reach. This hydrograph had a period of record from 1889 to 1993, and the worst 50-year period (1889 to 1938) effectively represented the period of record for use in the future-conditions models. The peak flow in this period was about 190,000 cfs, which placed it between the 100- and 500-year events in magnitude. After the sediment simulation, the n-year flood events described above were used to simulate the future without-project condition. For purposes of ecosystem restoration it was assumed that base flow is virtually non existent with the exception of storm water runoff and effluent which is discussed in Section 4.2.4 Water Supply.

4.3.2 Hydraulic Conditions

For the hydraulic analysis of current conditions, the effective HEC-RAS (RAS) model that was created as part of the FEMA Flood Insurance Study of this portion of the Salt River was used. The cross sections from this model that were located between 19th Avenue and 91st Avenue were extracted and supplemented with additional cross sections. Terrain data for all of these cross sections was mostly acquired from a TIN terrain data set created for the Salt/Gila River Master Plan completed in 1992. Additional terrain data were taken from available two-foot contours and 30-meter Digital Elevation Maps. Other changes made to the effective RAS model included slight modifications to the Manning's *n* values, the addition of new bridges at 27th and 51st Avenues, and the adjustment of the ineffective flow areas. The discharges used in this model were taken from the 1996 Corps report mentioned earlier. It is unclear how these flows compared to the flows found in the effective FEMA model.

The results of these updated baseline models were compared to the effective FEMA model. From the downstream end of the models to River Station 204.25, the profiles were essentially identical. At this location, the geometries began to differ between the two models, and this difference caused the updated model to have an elevation 0.45 foot higher than the FEMA model. Between Stations 204.34 and 205.15, the differences between the models increased, with the FEMA model calculating elevations 0.6 to 2.54 feet higher than the updated model. In this area, most of the differences were attributed to variations in the placement of ineffective flow areas. Between Stations 205.25 and 206.51, the two profiles approached each other to within 0.4 foot. However, between Stations 206.6 and 207.07, where there are mining pits within the channel that were handled differently by each model, the updated model produced elevations 0.53 to 2.07 feet higher than the FEMA model. At cross section 207.34, the updated model was 0.78 foot higher, but the difference approached zero at sections 207.48 and 207.49. By Station 207.53, the updated model was 0.49 foot higher. Between Stations 207.62 and 208.75, the models once again produced nearly the same results, but between cross sections 208.85 and 209.24, the update model generated values 0.46 to 2.15 feet higher. Over the remainder of the models, which extended from Station 209.42 to 211.54, the models produced significantly different results based on the differing geometries used to represent the 35th Avenue Bridge.

For analysis of future without-project conditions, the changes to the bed profile were predicted over the next fifty years due to erosion. The geometry from the current conditions RAS model were used to create a sediment-transport model. The sedimentation model used was HEC-6T, and this model produced results within 10 percent or within 1 foot of the depths in the existing conditions RAS model, whichever was smaller, for the 5-, 10-, and 100-year events under fixed bed conditions.

The Corps program SAMAID was used to determine the most appropriate sediment transport relationship, and this investigation determined that Madden's 1985 modification of Laursen's equation and Yang's equation were the best and second best choices, respectively. Based on its use of Yang's equation in previous studies of the Salt River upstream and downstream of this project's extent, Yang's equation was chosen to model the future conditions sediment transport.

The sedimentation model was then run over a 50-year period using the Salt River hydrograph from 1889 to 1938, and bed profiles were output at the end of each ten-year interval. For ease of modeling computations, all of the relevant 105 years of historical discharge information were effectively represented by needing only to simulate the period of record from 1989 to 1939. In addition, the constructed continuous 50-year hydrograph also reflects Salt River flood flows that have been normalized by flow regulation at the upstream Roosevelt Dam. The results of this model were used to create the geometry for the future-conditions RAS model. Overall, areas along the Salt River with ongoing mining operations experienced the greatest changes. In areas where mining was not present, the bed changes reached a maximum of 5.8 feet after 50 years with an overall average change of 1.9 feet.

Five new RAS models representing future conditions in 10, 20, 30, 40, and 50 years were created from the bed profiles predicted by the HEC-6T model. Otherwise, the future RAS models used parameters identical to those found in the existing-conditions RAS model. Overall, the future-conditions RAS models had smoother water surface profiles based on a smoothing of the stream bed over time. The major differences in water surface elevation occurred upstream of the 35th Avenue Bridge, with the future RAS models predicting lower water surface elevations due to erosion at this bridge. There are some other small stretches of the Salt River where moderate decreases in water surface elevations occur over time, but overall the future conditions RAS models mostly predicted decreases in the water surface profile of less than 1 foot within the study reach.

4.3.3 Biological Resources

Modifications of the river system, such as damming and flow diversion, currently allow no natural flow through the project study area except during flood events. The Salt River below Granite Reef Diversion Dam is essentially devoid of vegetation. Vegetation communities in the project study area have been highly modified from their original state and currently contain a mosaic of degraded natural communities and manmade artificial communities. These include a number of open water areas that are essentially old or abandoned borrow pits resulting from sand and gravel mining. Dense vegetation dominated by tamarisk or salt cedar, with some cottonwood and willows as well as the occasional cattail or bulrush, lies adjacent to some of these abandoned pits. Without the project, the biological resources within the study area are expected to continue to degrade. Without modifications to improve the functional components and improve the efficiency and effectiveness of the water resources available the diversity of species that are currently supported are expected to decline, and most of the remnant high value habitat (cottonwood, willow, and mesquite bosque) would be replaced with undesirable invasive plant species would become or devoid of vegetation altogether.

Habitat Evaluation

Table IV-18 below displays cover types and projected acreages in the study area (100-year floodplain only) and how they are projected to change under future without-project conditions.

Figure IV-11 shows that the without-project AACFU output is forecast to remain essentially unchanged (the slight decline from 583 AAFCU to 579 AAFCU is due to rounding error).

Key assumptions in projecting the future conditions include:

- All remaining agricultural land (133 acres) will be developed within five years.
- Remaining cottonwood/willow forest will decrease from 112 acres to 25 acres over 50 years due to reduced water supply, increased urbanization, and expansion of non-native saltcedar.
- Emergent wetlands will decrease slightly from 30 to 25 acres but will remain in areas of surface discharge and stormwater outfalls. O&M activities at these outfall locations will disturb and result in periodic reductions in quantity and quality of the existing emergent wetland areas
- The amount of dry river bottom is expected to increase from 66 acres to 71 acres, as the wetlands are lost.
- The amount of open water will decrease from 240 to 80 acres as other uses for effluent and dewatering are established. Existing areas of open water will likely be converted to bare earth or support undesirable low-value and/or non-native and invasive species, eventually converting to scrub-shrub and desert-wash cover. The amount of scrub shrub will increase from 1,566 to 1,653 acres.
- It is not possible to project acreage changes in sand and gravel operations, but it is assumed that some operations will go out of operation while others start operating. In general, these activities would migrate downstream, to the west end of the study area following the urban development.
- The reduction in water supply and decrease in surface flows will result in the reduction and/or elimination of one of the key mechanisms that drive many biochemical and biogeochemical processes that are associated with movement and cycling of nutrients.

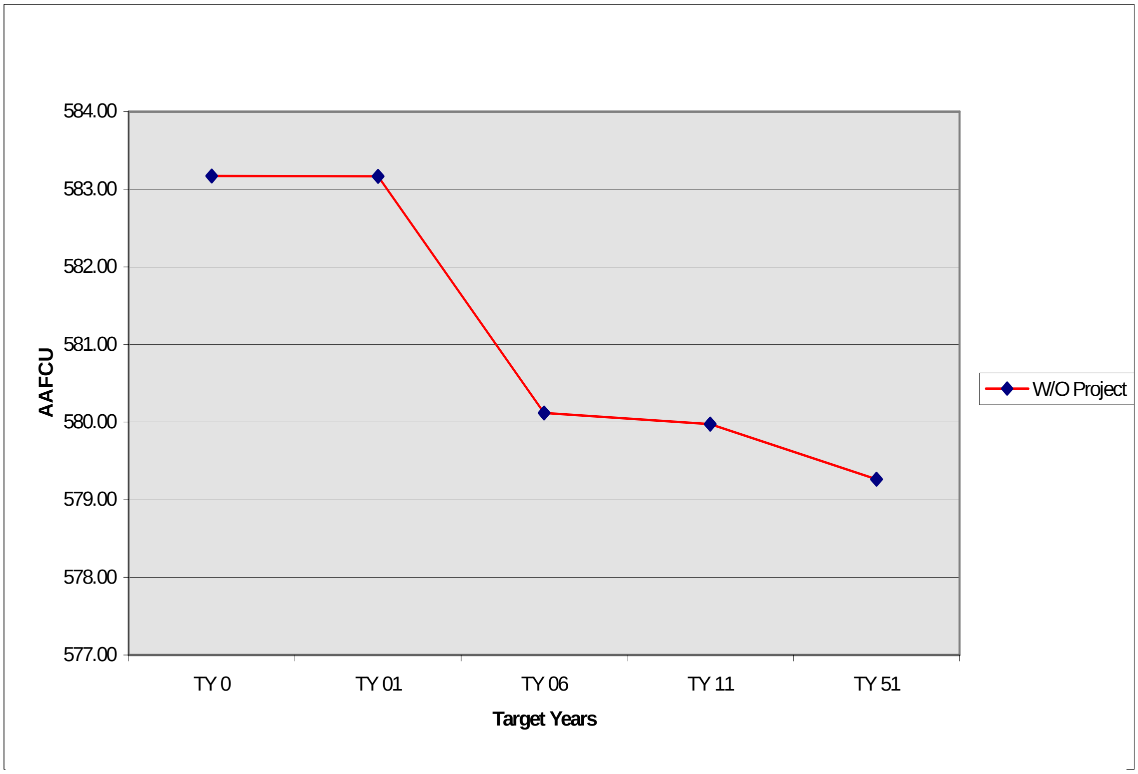


Figure IV-11: Future Without Project

- No establishment of new: cottonwood/willow forest, wet river bottom, emergent wetlands, open water, or mesquite woodlands or bouquets is expected.
- There will be a decrease in the connectivity and spatial structure of the remnant high-value cottonwood/willow strands and a disconnect between the authorized Rio Salado Restoration and Tres Rios Demonstration Projects.
- The biological diversity within the study area is expected to decrease with the reduction in high valley cottonwood/willow forest for cover, breeding, nesting, foraging, and fledging activities. The reduction of open water and emergent wetland areas reduces and/or eliminates a key habitat or life history/cycle component for many native wildlife species and neo-tropical migratory songbirds and over-wintering waterfowl and wading birds.
- The disturbance from unregulated recreation, OHV traffic, and "wildcat" dumping is expected to continue and potentially increase in some areas, further degrading the riparian system and the remaining higher value remnant habitat it currently supports.

Table IV-18: Cover Types and Projected Acres Without Project

COVER	DESCRIPTION	Target Year 0	Target Year 01	Target Year 06	Target Year 26	Target Year 51
AGCROP	Farms and croplands in the uplands - dairy, cotton, and alfalfa	133.00	133.00	0.00	0.00	0.00
CWWFOREST	Existing cottonwood/willow forests in the active channel	112.00	112.00	80.00	50.00	25.00
DITCHES	Existing ditches in the uplands	3.00	3.00	3.00	3.00	3.00
WETRVRBOTTOM	Existing emergent wetlands in the uplands - cattails, cienegas and grasses	30.00	30.00	25.00	25.00	25.00
MESQUITE	Existing mesquite woodlands - on the terraces and in the active channel	0.00	0.00	0.00	0.00	0.00
NEWWETRVRBOTTOM	Newly constructed river channel, includes emergent wetlands within the channel	0.00	0.00	0.00	0.00	0.00
NEWCWWFOR	Newly planted cottonwood/willow forests in the active channel	0.00	0.00	0.00	0.00	0.00
NEWDRYRVRBOTTOM	Newly developed dry river bottom areas in the active channel – largely unvegetated	0.00	0.00	0.00	0.00	0.00
NEWMESQUIT	Newly planted mesquite woodlands - on the terraces and in the active channel	0.00	0.00	0.00	0.00	0.00
NEWOPENWAT	Newly developed open water in the active channel	0.00	0.00	0.00	0.00	0.00
OPENWATER	Existing open water in the active channel - inactive sand and gravel operations	240.00	240.00	168.00	118.00	80.00
DRY RIVER BOTTOM	Existing river bottom in the active channel - largely unvegetated	66.00	66.00	71.00	71.00	71.00
SCRUBSHRUB	Existing scrub-shrub lands in the active channel - rabbitbush, quailbush, ironwood, and saltbush	1566.00	1566.00	1598.00	1628.00	1653.00
SANDGRAVEL	Existing sand and gravel operations/extractions in the active channel	671.00	671.00	671.00	671.00	671.00
DESERT	Desert or bare earth	0.00	0.00	72.00	122.00	160.00
URBAN	Existing residential, industrial and transportation avenues in the uplands	327.00	327.00	460.00	460.00	460.00
	TOTAL ACRES:	3148.00	3148.00	3148.00	3148.00	3148.00

4.3.4 Land Use

Based upon the City of Phoenix General Plan (Revised February 2001), most of the land area on the north side of the Salt River between 19th Avenue and 59th Avenue is zoned as industrial, with some high-density residential between 43rd Avenue and 60th Avenue. From 60th Avenue to 83rd Avenue, the primary land use is low-density residential. South of the Salt River, there is some land between 19th Avenue and 35th Avenue zoned as commercial. Otherwise the prevailing land use designation is low- to medium-density residential. Estrella Village and Laveen Village are the two primary planning areas that lie adjacent to the Salt River between 19th Avenue and 83rd Avenue. Estrella Village is characterized by an ample supply of undeveloped land, large parcels, natural and scenic amenities, and excellent transportation access. As noted on the City of Phoenix Web site, the village also poses unique challenges given the isolation of its existing residential neighborhoods and the extensive industrial activities that have developed over the years. Approximately 62 percent of the Village is undeveloped, either vacant or with agricultural uses. However, there are 21 residential developments in various phases of approval and development (Figure IV-12). Over 8,000 new single-family housing units were

Figure IV-12: New Subdivision along Southern Avenue South of the Project Area

approved in this area in 1999 alone. Primary agricultural crops grown in the area include cotton, citrus, and corn. Farmers, equestrians, and those looking for solitude and mountain access have valued the area.

Land use is quickly changing within the study area as farmland is quickly converted to residential subdivisions, and associated commercial development follows. The study team assumed that within 5 years the lands adjacent to the floodplain would all be developed in some way, maybe sooner. Lands within the floodplain, however, are not expected to be developed unless by future aggregate operations or closure of existing operations.

4.3.5 Recreation

Based upon conversations with representatives from the City of Phoenix Parks and Recreation Department, the AGFD, and other agencies, the proposed habitat and recreation features would attract visitors throughout the Phoenix Valley region. The major existing parks in the area consist primarily of desert mountain preserves, which do not contain the types of habitat that could be supported in the study area. For purposes of this analysis, the market area will be defined as the greater Phoenix metropolitan area, which would include Maricopa and Pinal Counties, although it is likely that many visitors would be drawn from even greater distances. Currently, there are no recreation features that exist in this reach of the Salt River. The activities that do take place in the river corridor in general serve to accelerate the rate of degradation. As the area degrades over time, fewer people will select the study area for recreational activities.

The Tres Rios Project just downstream of the study area will provide recreation opportunities. The Tres Rios Project is located immediately downstream of the study area, beginning at the 91st Avenue WWTP. Components of this plan include new levee alignments for flood control, the establishment of wetland, marsh, and riparian habitat, and passive recreation/environmental education facilities. That project is currently in design and will be constructed within the next several years.

Over the period of analysis it is assumed that the City of Phoenix will develop smaller community parks in the neighborhoods surrounding the study areas.

Maricopa County has approved and begun implementation of the Maricopa Trail. The trail plan is a continuous nonmotorized trail system covering multiple jurisdictions around the county connecting regional parks. The entire loop is 242 miles and will be implemented over the next eight to ten years. The loop intersects the Salt River between 83rd and 91st Avenues and proceeds southward towards South Mountain. The Maricopa County Regional Trail System Plan identifies projects on the Salt River as potential and in the case of Rio Salado existing trail systems that would connect to the regional trail system.

4.3.6 Economics

4.3.6.1 Results – Future Conditions (2059)

Hydrologic and hydraulic analyses were conducted for future without-project conditions to determine the impacts of processes such as sedimentation and channel degradation and the resulting impacts on potential flooding. Updated water surface profiles and stage/discharge uncertainty data were used to re-compute expected annual damages under future conditions. The results are summarized in Table IV-19. A more detailed description of the estimates can be found in Appendix G, Economic Evaluation.

Table IV-19: Without-Project Expected Annual Damages – Future Conditions (2059) ($1,000)

Reach	SFR/MH	Ind/Ag	Office/Com	Public	Total
1L	$ -	$ -	$ -	$ -	$ -
2L	$ 4	$ 16	$ 1	$ -	$ 21
2R	$ -	$ -	$ -	$ -	$ -
3L	$ 2	$ -	$ -	$ -	$ 2
4L	$ 1	$ -	$ -	$ -	$ 1
4R	$ -	$ -	$ -	$ -	$ -
5L	$ 8	$ 4	$ 1	$ -	$ 13
5R	$ -	$ 98	$ 14	$ -	$ 112
6L	$ 1	$ 5	$ 2	$ -	$ 8
6R	$ -	$ 1	$ 1	$ -	$ 2
7L/7R	$ -	$ -	$ -	$ -	$ -
Total	$ 16	$ 124	$ 19	$ -	$ 159

Without-project expected annual damages actually decrease from about $245,000 under Base Year conditions to about $159,000 under future conditions (a drop of about 35 percent). Water surface elevations are generally lower throughout the study area under future conditions due primarily to projected channel degradation and resulting in creases in channel capacity (refer to Appendix A, Hydrology and Hydraulics).

Equivalent annual damages were computed based upon forecast annual damages using a discount rate of 5 3/8 percent (see Table IV-20).

Table IV-20: Without-Project Equivalent Annual Damages (50 Yrs, 5 1/8 Percent) ($1,000s)

Reach	SFR/MH	Ind/Ag	Office/Com	Public	Total
1L	$ -	$ -	$ -	$ -	$ -
2L	$ 7	$ 24	$ 2	$ -	$ 32
2R	$ -	$ -	$ -	$ -	$ -
3L	$ 2	$ -	$ -	$ -	$ 2
4L	$ 2	$ -	$ -	$ -	$ 2
4R	$ -	$ -	$ -	$ -	$ -
5L	$ 24	$ 4	$ 1	$ -	$ 29
5R	$ -	$ 126	$ 16	$ -	$ 142
6L	$ 1	$ 6	$ 3	$ -	$ 10
6R	$ 1	$ 2	$ 2	$ -	$ 5
7L/7R	$ -	$ -	$ -	$ -	$ -
Total	$ 37	$ 161	$ 24	$ -	$ 222

As shown on Table IV-21, equivalent annual damages are concentrated in a few reaches. Reach 5R accounts for about 60 percent of total without-project damages. This reach contains a small concentration of industrial structures along 35th Avenue, primarily south of Lower Buckeye Road. There are several parcels with multiple structures that are within the 50-year floodplain, and just outside the 20-year floodplain. The risk and uncertainty analysis indicates that these structures may be flooded by events more frequent than the 20-year event.

Table IV-21: Without-Project Equivalent Annual Damages (in $1,000s)

Reach	Structure and Content	Cleanup	Temp. Housing	Total
2L	$ 32	$ 10	$ 0.4	$ 42
3L	$ 2	$ 1	$ 0.1	$ 3
4L	$ 2	$ -	$ 0.1	$ 2
5L	$ 29	$ 4	$ 0.9	$ 34
6L	$ 10	$ 3	$ 0.1	$ 13
Total - S. of River	$ 75	$ 18	$ 1.6	$ 95
5R	$ 142	$ 5	$ -	$ 147
6R	$ 5	$ 0.5	$ -	$ 6
Total - N. of River	$ 147	$ 6	$ -	$ 153
Total	$ 222	$ 24	$ 2	$ 247

Note: Damages for Reaches Not Shown are Minimal

On the south side of the Salt River, Reach 2L has the highest amount of expected annual damages. Damages in this reach are attributable to the proximity of several structures to the floodway on the north side of Southern Avenue between 75th and 67th Avenues.

The highest concentration of residential damages is located in Reach 5L. Although there are nearly 200 structures in this reach, damages are limited due to the low per-unit structure values and because most are outside the 100-year floodplain. Most of the structures in this reach are located just southwest of Broadway Road and 35th Avenue.

The only other reach with significant damages is Reach 6L. This reach includes industrial and commercial structures located along Broadway Road between 35th and 27th Avenues.

Impact of Assumed Rio Salado Marsh on Without-Project Damages

Under existing conditions there is potential for flood damages in the study area. However, the planned improvements to the 35th Avenue Bridge and the Rio Salado Marsh that will take place from 37th to 51st Avenues virtually eliminate the potential for damage in the adjacent reaches. Additional floodplain delineations showing Base Year floodplain boundaries with both the bridge improvements and the channel excavation have not been prepared. However, water surface profiles have been developed, and an analysis of these water surface profiles shows that the potential for flooding in the 35th Avenue area is greatly reduced.

A detailed analysis of without-project flood damages reflecting the assumed Rio Salado Marsh between 37th and 51st Avenues has not been completed. However, water surface profiles have been developed for with-project alternatives that reflect the impacts of both the excavation and the features of the alternatives. It has been determined that the impacts of the excavation, particularly in Reach 5 area, are significant. In fact, it appears that the additional channel capacity created by this excavation will greatly reduce the potential for any flooding in this area. As this was the primary damage area under previous assumptions, the removal of the flood threat for this area essentially leaves only minor residual flooding, primarily in Reach 2, under without-project conditions.