US Army Corps of Engineers
Los Angeles District
South Pacific Division

Rio Salado Oeste
F4 Milestone
Salt River-Phoenix, Arizona

APPENDICES

March 04, 2005

US Army Corps of Engineers
Los Angeles District

RIO SALADO OESTE
F4 MILESTONE
Salt River-Phoenix, Arizona

Appendix A
Hydrology and Hydraulics

March 2005

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TABLES OF CONTENTS

INTRODUCTION 1
Purpose 1
Description of Study Area 1
DISCHARGE-FREQUENCY ANALYSIS 2
RUNOFF DISCUSSION 5
STUDY METHODOLOGY 6
Analysis Tool 6
Determination of Manning's Roughness Coefficient 6
Environmental Features 6
Structural Features 8
HYDRAULIC ANALYSIS & RESULTS 8
Without Project Modeling 8
Future Without Project Modeling 9
With Future Mining 9
With Project Modeling 11
Determination of Manning's Roughness Coefficient 11
Discharge frequency values for with project condition 11
Structural Features 12
Low Flow Channel 12
Grade Control Structure 13
Project Features 16
With Project Results 18
Multiple Discharge Analysis 18
100-Year Event Discharge Analysis 19
SEDIMENTATION ANALYSIS 24
Without Project 24
With Project 24
GEOMORPHOLOGY DISCUSSION 25
Erosion 25
RISK AND UNCERTAINTY ANALYSIS 26
OPERATION AND MAINTENANCE 27
Maintenance Considerations 27
Vegetation Damage 27
SUMMARY 28
Hydraulic 28
Risk Assessment 29
REFERENCES 30

LIST OF TABLES

Table 1. Summary of Simulated Salt River Flows. 3
Table 2. Flow Frequency for Salt River..... 4
Table 3. Rainfall Pattern for the Phoenix Area..... 4
Table 4: Selected Cross Section Pertinent Hydraulic Information Data for Baseline Without Project 100-Year Frequency Event Condition..... 5
Table 5: Bridges with the Rio Salado Oeste Study Reach..... 8
Table 6: 100-Year Flood Frequency Event Peak Discharge Analysis for With- and Without Project Conditions..... 19
Table 7: 100-Year Flood Frequency Event Comparative Water Surface Elevation Differentials Between River Mile Station 206.32 to 206.13..... 22
Table 8. Risk Analysis Standard Deviation. 26

LIST OF FIGURES

Figure 1: Study Area..... 2
Figure 2: Location of New Mining Operation 10
Figure 3: 100-year Water Surface Profile With and Without Project Condition for River Stations 209.88 to 209.04. 11
Figure 4: Low Flow Channel 12
Figure 5: A Large Depression Locates at About 1000 ft Downstream of the 35th Ave..... 14
Figure 6: Steep Vertical Drop at 35th Ave. 15
Figure 7: Proposed Location of Grade Control Structure..... 16
Figure 8: Project Features 17
Figure 15: 100-year Event Water Surface Profile..... 18
River Stations..... 22
Figure 16: 100- year Event Water Surface Profile for River Station between 206.13 and 206.3222
Figure 17: Cross section 206.32..... 23
Figure 18: Cross section 206.22..... 23
Figure 19: Cross section 206.13..... 23
Figure 20: Comparison between with and without project condition for low flow channel velocity..... 25
Figure 21: 100-year Water Surface Profile Between Without and Future Without Project Condition..... 28
Figure 22: 100-year Water Surface Profile Between Future With Project Condition and Without Project Condition. 29

INTRODUCTION

Purpose

The purpose of this appendix is to document the hydrologic and hydraulic analyses completed in support of the Rio Salado Oeste Feasibility Study. The goals of the hydraulic analysis were to develop a one-dimensional model of the Salt River study area and model the conditions associated with the Existing Condition, Future Without Project Condition and the conditions associated with selected With Project alternative.

Description of Study Area

The Rio Salado Oeste study area is located within Maricopa County in central Arizona, the area has a general east to west orientation. The study area includes the section of the Salt River that begins at 19th Ave on the east side of the study area and extends downstream to the west for a distance of approximately 9 miles, Figure 1.

The study area is within the jurisdiction of the City of Phoenix, Maricopa County, Arizona.

The channel of the Salt River within the study area contains several active and historic sand and gravel mining pits. There are active and inactive landfills along the north bank and there are storm drains and irrigation drains that discharge to the channel

The Salt River was a perennial stream until the construction of upstream dams, with associated reservoirs, regulated the flow. There are four dams on the Salt River and two dams on the Verde River, a tributary to the Salt River. These structures have changed the hydrologic condition of the Salt River below Granite Reef Dam into an ephemeral river. Granite Reef Dam is a diversion structure, not a water storage or flood control structure. This dam diverts the flow in the Salt River into two major irrigation canals. The flood flows vary in duration, quantity and magnitude depending on the nature of the flood

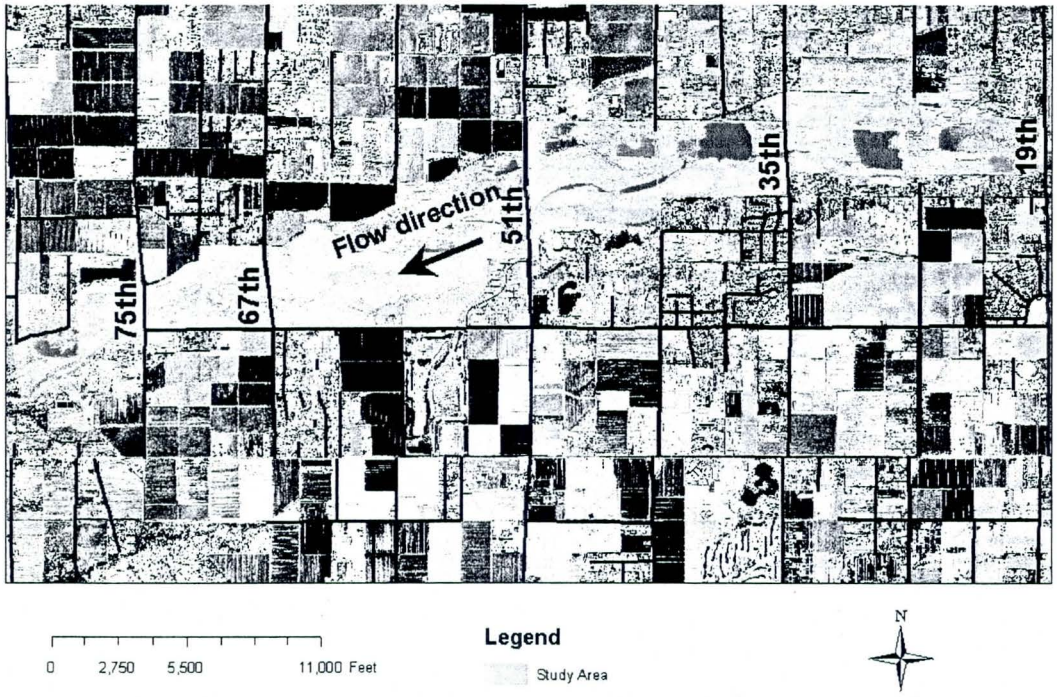

Figure 1: Study Area

DISCHARGE-FREQUENCY ANALYSIS

The Salt River is characterized by infrequent events, spilling over, on average, once every three years. The maximum rate of flow for each event was determined based upon a water control plan developed for the flood control pool at Modified Theodore Roosevelt Dam. The analysis is described in Corps of Engineers report prepared by the Los Angeles District, (USACE, 1996a). The following table shows the maximum discharge simulated for historic flow events from 1914 to present.

Table 1. Summary of Simulated Salt River Flows.

Period of Flow Start Date	Period of Flow End Date	Flow Event Maximum Daily Average Flow (cfs)
2/7/1914	7/2/1914	15,800
1/29/1915	8/18/1915	18,700
1/15/1916	5/15/1916	79,100
9/8/1916	2/4/1917	21,100
4/17/1917	5/15/1917	23,400
3/7/1918	3/26/2018	28,400
11/25/1919	13/14/1919	46,200
1/4/1920	4/25/1920	87,800
12/26/1921	1/9/1922	24,100
2/8/1922	2/18/1922	10,000
3/16/1922	4/10/1922	18,000
9/18/1923	9/22/1923	24,100
12/26/1923	1/8/1924	42,800
3/31/1926	4/16/1926	28,800
2/14/1927	3/19/1927	49,800
9/12/1927	9/20/1927	16,200
4/4/1929	4/19/1929	17,200
2/12/1931	2/20/1931	22,900
2/9/1932	3/29/1932	48,700
2/6/1937	3/25/1937	36,981
2/28/1939	3/17/1939	58,739
2/5/1941	5/25/1941	32,206
12/21/1965	1/12/1966	64,000
2/20/1973	6/5/1973	22,273
2/28/1978	4/11/1978	95,800
12/16/1978	4/19/1979	110,000
1/29/1980	6/3/1980	137,725
2/2/1983	6/17/1983	30,000
9/27/1983	10/24/1983	39,878
12/24/1983	1/24/1984	11,200
12/21/1984	6/1/1985	25,604
12/22/1991	6/21/1992	12,898
8/21/1992	9/8/19992	13,615
12/28/1992	6/4/1993	99,396
1/20/1995	5/2/1995	53,316

A flow frequency distribution information set was developed for the Salt River Rio Salado Oeste study reach based on the dammed Modified Theodore Roosevelt operating condition. The following Table 2 summarizes the discharges that were analyzed for this study's hydraulic models. Note, changes in flow between the two river stations are due to storage effects within the effected floodplain.

Table 2. Flow Frequency for Salt River.

Return Period	Upstream limit at River Station 211.52 (cfs)	River Station 205.52 (cfs)
5 –Year	20200	20000
10 - Year	53000	87000
20 - Year	87000	84000
50 - Year	135000	132000
100 - Year	166000	164000
200 - Year	202000	200000
500 - Year	240000	237000

The average rainfall for the Phoenix area is summarized in the following Table. 3 The information for this rainfall data was extracted from rainfall recorded at the Phoenix Sky Harbor Airport located seven miles east of the downstream section of the study area. However, its important to note that summer thunderstorms can produce local precipitation that exceeds the monthly average which can result in local flooding of streets, drainage channels and washes. The intensity and duration of the precipitation varies depending on the location of the individual storm cells. Therefore, a maximum amount of rainfall at Sky Harbor from a storm may be greater or less than the amount that occurs within the project area.

Table 3. Rainfall Pattern for the Phoenix Area

Month	Rainfall in Inches
January	0.67
February	0.68
March	0.88
April	0.22
May	0.12
June	0.13
July	0.83
August	0.96
September	0.86
October	0.65
November	0.66
December	1.00
Annual Total	7.66

RUNOFF DISCUSSION

The winter months are typically when large regional storms or series of storms occur. These storms may include an accumulation and subsequent melt of the snow pack in the Salt River and Verde River watersheds and result in the releases of water into the Salt River system that can flow over Granite Reef Dam into the study area. While the river stages may be high for an extended period, the quantity and intensity of accompanying storm precipitation is generally reduced in the lower elevations, including the study area.

During the middle to late summer months the monsoon storm pattern is typical. These storms produce intense, short-duration thunderstorms with significant precipitation. During these storms the river stages are low because the storms are localized and because the upstream reservoirs usually have the capacity to store the local runoff from the watershed.

Interior drainage is an assessment of the storm water runoff that accumulated on the up gradient side of levees. But, since the Rio Salado Oeste study reach does not have any significant levees or flood control structures, there are no interior drainage conditions to address. However, there are side drains that outfall into the Salt River within the study area. These drains were evaluated in terms of location and estimated discharge quantity and a more detailed discussion of this topic is presented in the Water Balance Section of these Appendixes.

Table 4 below illustrates an example of typical hydraulic flow conditions at selected locations within the study reach. This pertinent hydraulic information was extracted from the Baseline Without Project 100-Year flood frequency event condition.

Table 4: Selected Cross Section Pertinent Hydraulic Information Data for Baseline Without Project 100-Year Frequency Event Condition

Location Description	River Station In Miles	Min.Channel Elevation (ft)	Water Surface Elevation (ft)	Critical Water Surface (ft)	Slope (ft/ft)	Velocity Channel (ft/s)
19th Ave	211.51	1021.8	1043.8	1037.9	0.002129	15.6
27th Ave	210.44	1017.6	1040.7	1028.8	0.000521	7.4
35th Ave	209.54	1019.6	1036.6	1035.9	0.003416	13.9
43rd Ave	208.48	1007.6	1021.3	1017.8	0.001756	8.4
51st Ave	207.53	999.2	1012.6	1008.1	0.001041	7.5
59th Ave	206.51	990.2	1002.1	999.9	0.002356	10.4
67th Ave	205.52	975.9	994.0	987.0	0.000516	5.7
75th Ave	204.42	971.4	985.5	982.8	0.002884	9.6
83rd Ave	203.48	962.1	975.8	972.0	0.001186	6.5

STUDY METHODOLOGY

Analysis Tool

The HEC River Analysis System (HEC-RAS), Version 3.1.1, was used for the modeling (USACE, 1998a). A series of eight flow profiles were developed for each model based on the 5, 10, 20, 50, 100, 200 and 500 –Year Flood Frequency Events.

Determination of Manning's Roughness Coefficient

The Existing Condition Manning's roughness coefficients ("n" values) were used for the initial channel conditions in the models. The USACE calculated the "n" value of the different environmental features by the procedure where "n" may be computed by:

$$n = (n_0 + n_1 + n_2 + n_3 + n_4)m_5$$

Where n_0 is a basic "n" value for a straight, uniform, smooth channel in the natural riverbed materials. Then n_1 is added to correct for the effect of the surface irregularities, n_2 is added to account for variations in shape and size of the channel cross-section, n_3 is added for channel obstructions and n_4 is a value added for vegetation and flow conditions. The m_5 value is to correct for the meandering of the channel. In this study the Existing Condition Manning's "n" value varied from 0.028 to as much as 0.2 (West, 2002).

Environmental Features

The Rio Salado Oeste study area has locations where there is existing vegetation supported by precipitation, seepage, periodic flood flows, stormwater runoff. The USACE project design developed three alternatives in support of the Feasibility Study F4 Milestone. The goals of these three alternatives were to: 1) increase the native riparian vegetation: 2) increase the vegetation connectivity; and 3) stabilize bank sections where needed. A mixture of four environmental features were incorporated into these With Project alternatives. These four principle environmental features are classified and denoted as Cottonwood/Willow, Mesquite, Wetlands, and River Bottom.

Cottonwood/Willow (CW). The existing CW stands are located near saturated soil conditions near river overbank areas. CW a water table within 25 feet of the land surface or supplemental irrigation will be required to support the vegetation. Initial plantings will require irrigation to achieve a high survival rate. Once established, CW areas will need drip irrigation or water from the Surface Braided Irrigation Network (SBIN) to supply water. Uneven grading of the river bottom and overbank areas to create pockets to retain water will help maintain the CW. In the model, the CW areas were assigned an "n" value of 0.098.

Mesquite (MS). The MS vegetation is commonly located about 5 to 20 feet above the river channel. The water table must be within 30 feet of the surface to support established MS. Irrigation will be needed to help the MS get established but then flood irrigation or water from the SBIN will support the vegetation. In the model, MS was assigned an "n" value of 0.073.

Wetlands (WT). The WT areas can include open water, submerged vegetation and muddy shorelines. These features require a high water table at or near the surface or may need to be lined to retain water from other sources. The WT features will require excavation in the riverbed to construct the basins and this changes the configuration of the channel bed. Some WT features may need both inflow and outflow channels. The WT areas were assigned an "n" value of 0.048.

River Bottom (RB). RB will require some reshaping to fill in large depressions and to create mounds to reduce flood flow impacts to the restoration features. The RB areas may be hydro-seeded with native river bottom shrub and grass species but this vegetation should not impact the hydraulic capacity of the river. The "n" value assigned for RB was 0.035.

Structural Features

There are several structural features within the study area that have been identified as bridges, sand and gravel mining operation sites, and a grade control structure.

The principle bridges in the study area are identified at the River Mile stations shown in Table 5 below. Also, there is a single buried grade control structure in the Salt River immediately located downstream of the 91st Avenue Road Bridge.

Table 5: Bridges with the Rio Salado Oeste Study Reach

Bridges Name	River Station
19th Avenue Bridge	211.52
Conveyor Bridge at 27th Avenue	210.43
35th Avenue Bridge	209.53
51st Avenue Bridge	207.48

Finally, there are a number of active sand and gravel mining operations within the Salt River floodplain of the subject study reach. The locations of these operations are largely between 51st and 35th Avenues and are shown in Figure 2 below.

HYDRAULIC ANALYSIS & RESULTS

A hydraulic analysis of the existing and future without project conditions were developed using the HEC-RAS River Analysis System modeling process. The initial hydraulic analyses were based on a digital terrain model generated from aerial survey's completed in December of 2001. But, since active mining has continued to change the basic terrain along the Salt River floodplain after the December 2001 date, the initial Baseline Without Project model did not reflect this revised condition. However, to account for this ongoing projected mining condition, the Baseline Without Project model was modified by adjusting the current and potential sand and gravel impacted areas by assuming a final mined out "footprint" condition. Once the Baseline model had been revised to reflect the future mined condition, then With Project alternatives were subsequently developed. There were three environmental alternative concepts that were developed by the study team and carried forward in the evaluation process. These three alternatives were assessed in terms of their respective level of habitat value and identified as Alternative "High", Alternative "Medium", and Alternative "Low".

Without Project Modeling

Initially, West consultants completed a hydraulic analysis of the existing without project conditions using HEC-RAS (West, 2002). A 1-dimensional model of the reach was created using HEC-RAS and the HEC-GeoRAS extension in ArcView 3.2a

(Environmental Systems Research Institute, Inc). The cross section geometry for this model was obtained from the TIN using the same cut lines utilized in the FEMA Flood Insurance Study (FIS) model prepared originally by Michael Baker Jr., Inc. However, The WEST hydraulic analysis was based on a digital terrain model generated from updated aerial surveys completed in December of 2001. Finally, the results generated from the West existing model is referred too as the Existing Condition Baseline Model (again prior to WEST 2002 work).

Within the study reach, the Baseline Existing Condition HEC-RAS 100-year water surface elevation results are generally lower than the corresponding elevations in the FEMA Flood Insurance Study (FIS) model prepared by Michael Baker Jr., Inc. The difference in the water surface elevation can be attributed to different geometric cross section information. The FIS model geometry was reported to be based upon aerial surveys flown in 1992 and 1993. In WEST's Baseline Existing Condition model, the cross section floodplain geometry was updated between River Mile Stations 211.51 to 216.53 with one-foot contour interval mapping developed from aerial information flown in1998. In general, the comparative channel inverts for the updated cross sections were on the order of three to four feet lower than those contained in the Baker model.

Future Without Project Modeling

With Future Mining

The City of Phoenix has acquired a large portion of the section of river from 35th to 51st Avenues and will be leasing the area for sand and gravel extraction. The goal of that plan is to allow mineral extraction while leaving the river cross section in a suitable state for restoration. The cross-section in this reach for future conditions is based upon the plans in development by the City. This area is approximately between River Station 207.62 to 209.24 (about 500 feet downstream from the 35th Avenue Bridge) and is shown in Figure 2 below.

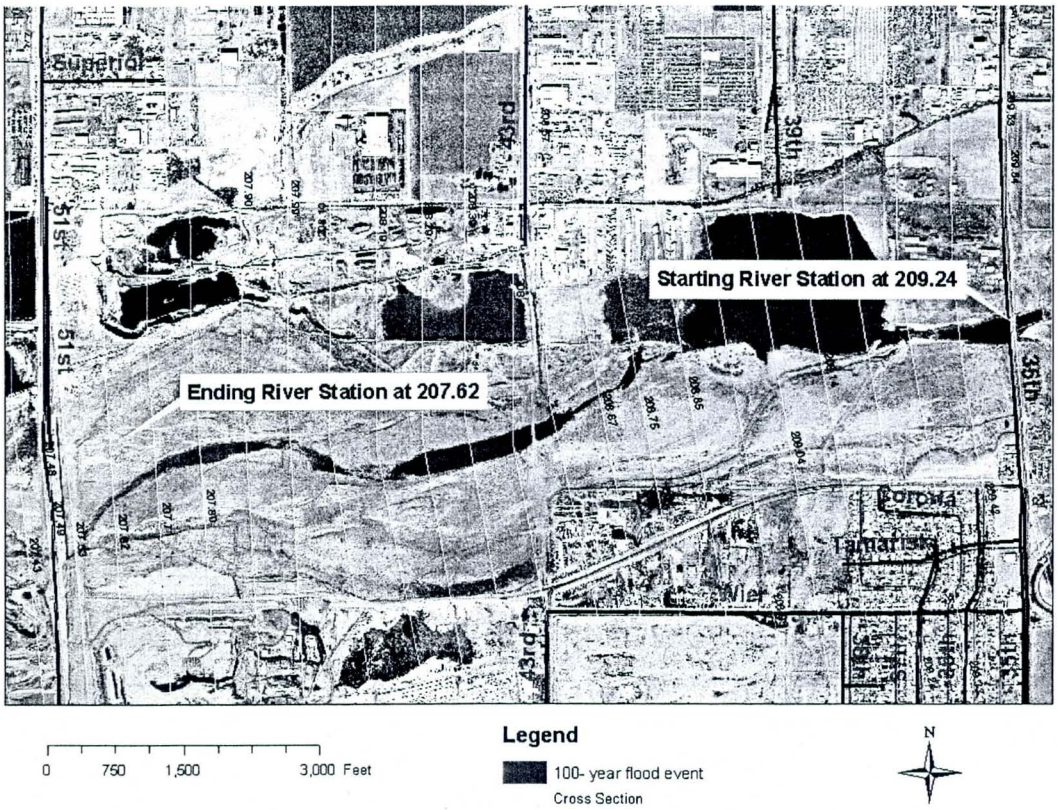

Figure 2: Location of New Mining Operation

The updated revised Existing Condition Baseline model for the Salt River between 51st and 35th Avenues reflects this future mining activity as of target year 2011. These significant channel thalweg depressions can be seen in Figure 3 below.

The associated impact on the channel and overbank in terms of modeled Manning's roughness coefficients ("n" value) were established at 0.025 and 0.043 respectively.

The peak discharges presented in the Discharge Frequency Analysis section of this appendix were used in both the Baseline Conditions and Without Project Condition model simulations.

For the 100-year frequency discharge event, the Future Baseline Without Project Condition water surface elevations were compared to the original Baseline Without Project model results. The comparative resultant water surface profiles are shown in Figure 3 below.

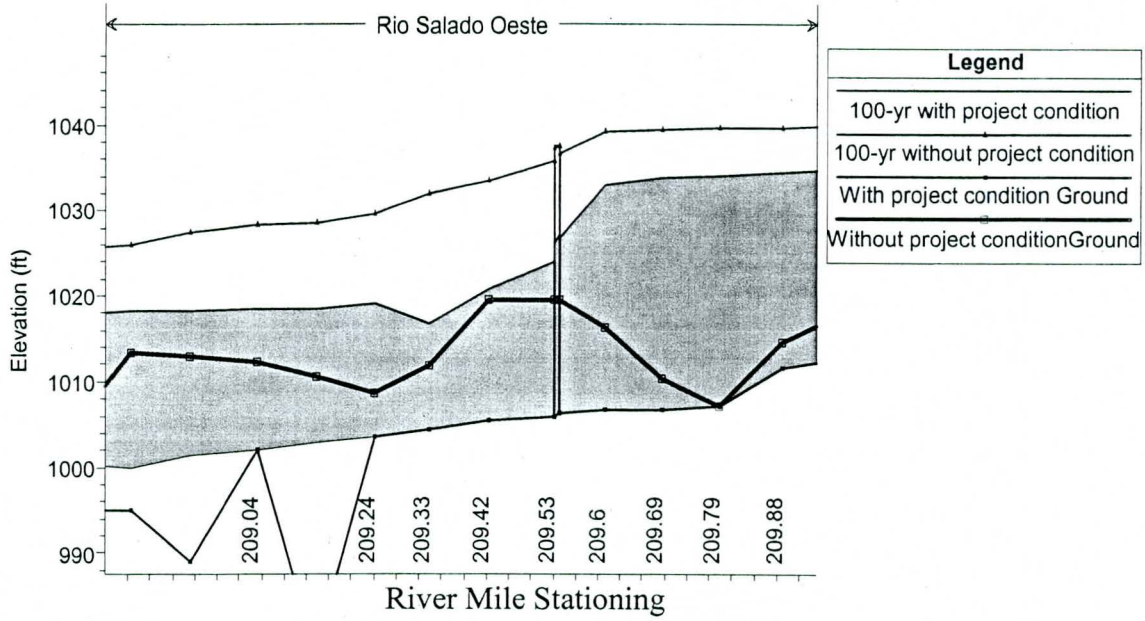

Figure 3: Without Project 100-year Water Surface Profiles for With- and Without Future Mining Operations Between River Mile Stations 209.04 to 209.88.

It was assumed that the channel Manning's roughness coefficient and the ineffective flow areas did not change from the Existing Without Project Baseline Condition or Existing Future Without Project Baseline Condition throughout most of the study area.

With Project Modeling

Determination of Manning's Roughness Coefficient

The maximum Manning's roughness coefficient (*n* value) that can be used in the environmental restoration area without affecting the channel capacity was determined and was correlated to plant density (or % obstruction across the cross-section). This was accomplished by using normal depth calculations for typical cross-sections along the study reach. Then the *n* value was varied horizontally across each cross-section; i.e., the *n* value was set equal to 0.032 for the low flow channel segment while it was varied for the vegetated area.

Discharge frequency values for with project condition

The 100-year discharge of 166,000 cfs was used to design the With Project Salt River floodway through the study reach. Incorporated in this design phase was the need for a low flow channel feature capable of conveying 20,200 cfs. Details on this latter feature will be discussed under the "Low Flow Channel" section of this appendix.

Structural Features

For the With Project Condition analyses, a number of structural features were incorporated into each of the alternative evaluations. These structural features included to some degree a low flow channel, a grade control structure, wetland creation, and some type of surface braided irrigation network. The structural descriptions provided are only preliminary and will be developed more thoroughly, if necessary, during the Preliminary Engineering and Design Phase (PED).

Low Flow Channel

A low flow channel was included in the design along two segments of the Rio Salado Oeste study reach. Specifically, a low flow channel was designed between River Mile Station 203.39 to 207.43 and another segment between River Mile Station 209.53 to 211.52. Essentially, these two low flow segments extend downstream and upstream to the study limits from 51st and 35th Avenues respectively. Both subreaches are shown in Figure 4 below.

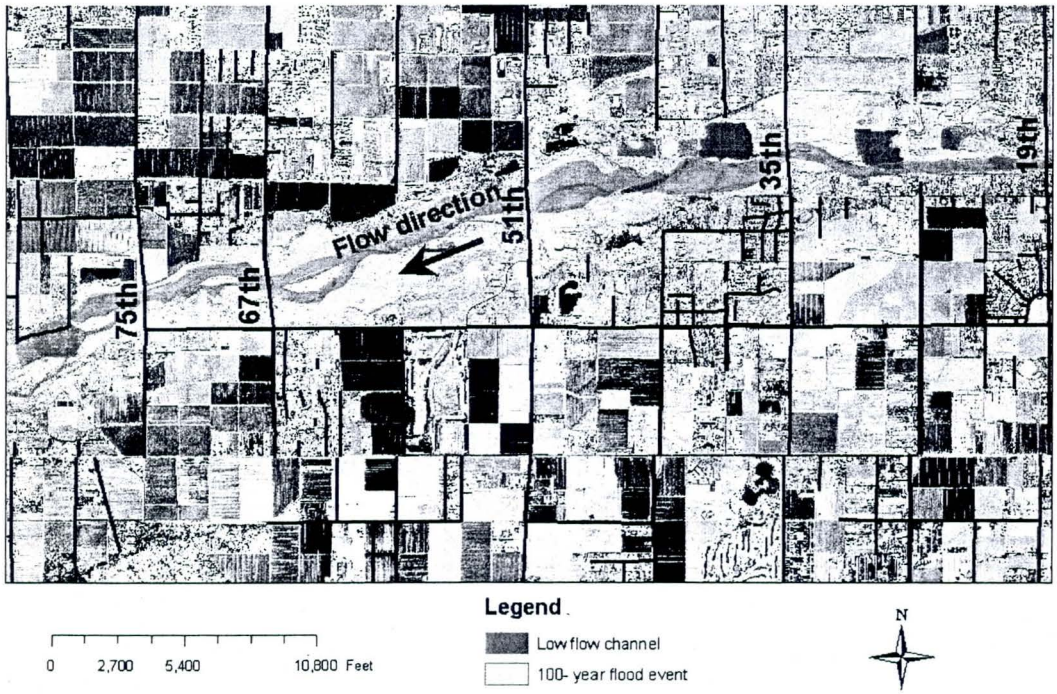

Figure 4: Low Flow Channels

The primary purpose of the low flow channels are to restore the active river channel to a more natural state based on hydraulics and geomorphology. This may include grading and excavation to recreate the natural channel dimensions. Design of the

channel will be for ecosystem and hydraulic connectivity between upstream and downstream reaches, lowering flood profile, and providing stable channel to minimize erosion. That design will include a combination of single and braided channels based upon site conditions to increase overall conveyance within the Salt River floodway to offset the increased roughness caused by new vegetation being proposed in the main channel and to collect excess irrigation water that could be used to irrigate wetland habitat and river bottom areas. The low flow channel was designed to convey 20,200 cfs (approximately a 5-year peak event). This target discharge was incorporated into the design to match the low flow channel conveyance associated with the Rio Salado Phoenix reach immediately upstream of this study. Initial channel dimensions were based on the following general constraints: 1) an average bottom width varying between 300 to 800 feet; 2) an average flow depth of 5 to 10 feet; 3) a design slope of 0.14%; 4) constructed side slope of 1 vertical for 3 horizontal; and 5) a channel n value of 0.032. The low flow channel was configured to follow the existing river thalwag. Finally, the channel design does not incorporate any lining or low flow guide or containment structures and as such, there will be some expected lateral channel migration associated with this project feature.

Grade Control Structure

Current and projected mining along the Salt River within the study area has or will create several large depressions. Evidence of a typical depression is identified in Figure 5 below. As expected, these areas have significant flow conveyance and sediment transport impacts within the floodplain. As a minimum, these large depressions alter the hydraulic conditions that translate into riverbed scouring and/or deposition upstream and downstream of their locations and can also potentially induce bank instability concerns as well.

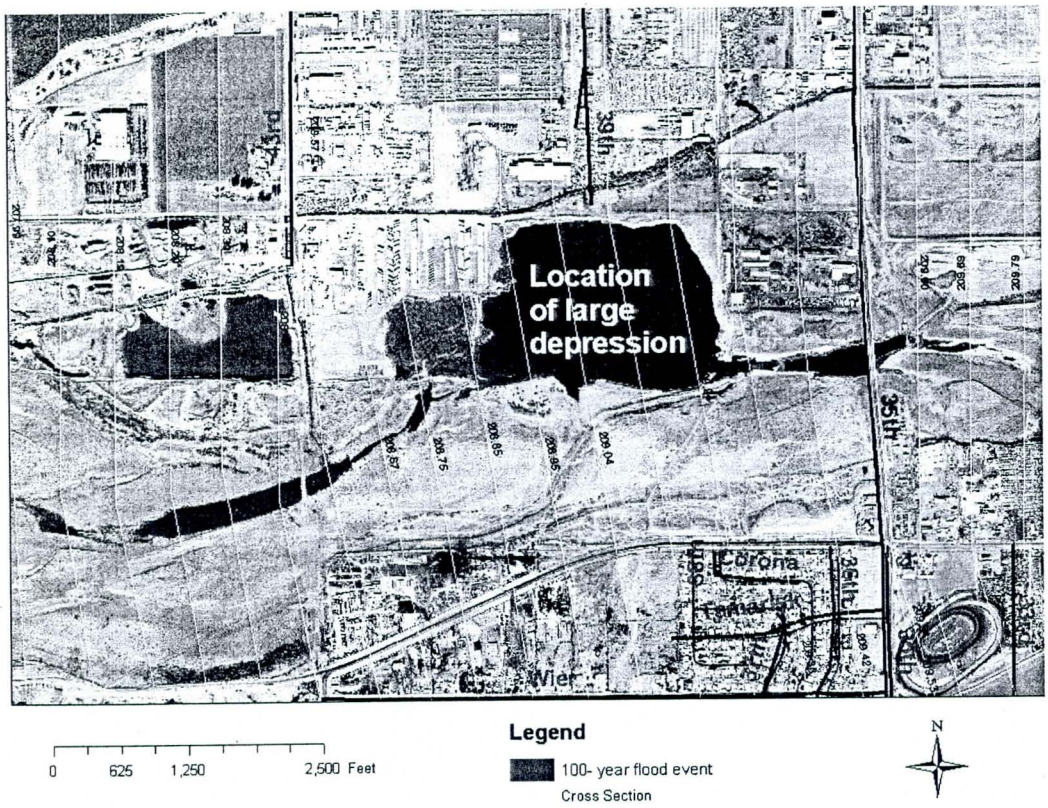

Figure 5: Large Depression Area Immediately Downstream of 35th Avenue

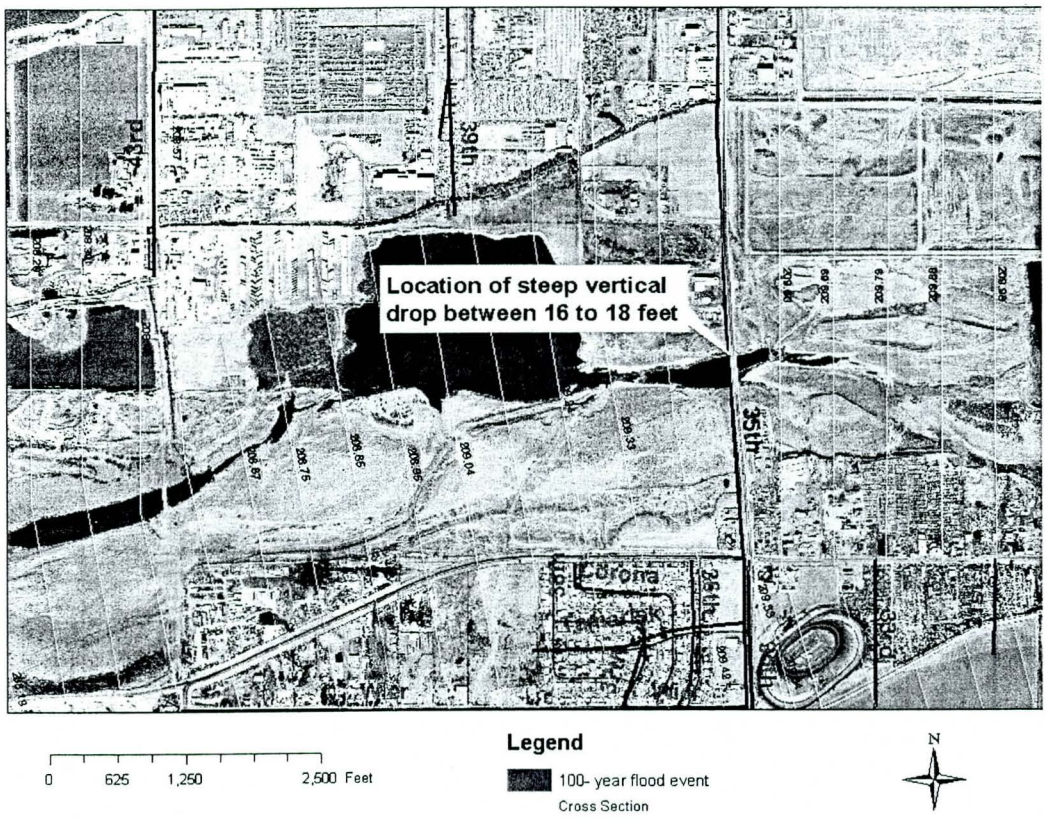

Figure 6: Steep Vertical Drop at 35th Avenue

As a direct result of the large depression downstream of 35th Avenue, there is a 16 to 18 foot thalweg grade break differential. The vicinity of this grade break (future gravel pit mining induced) location is shown in Figure 6 above. In the likelihood that a head will propagate upstream and undermine the 35th Avenue Bridge area, a grade control structure is being recommended to prevent this particular scenario from occurring.

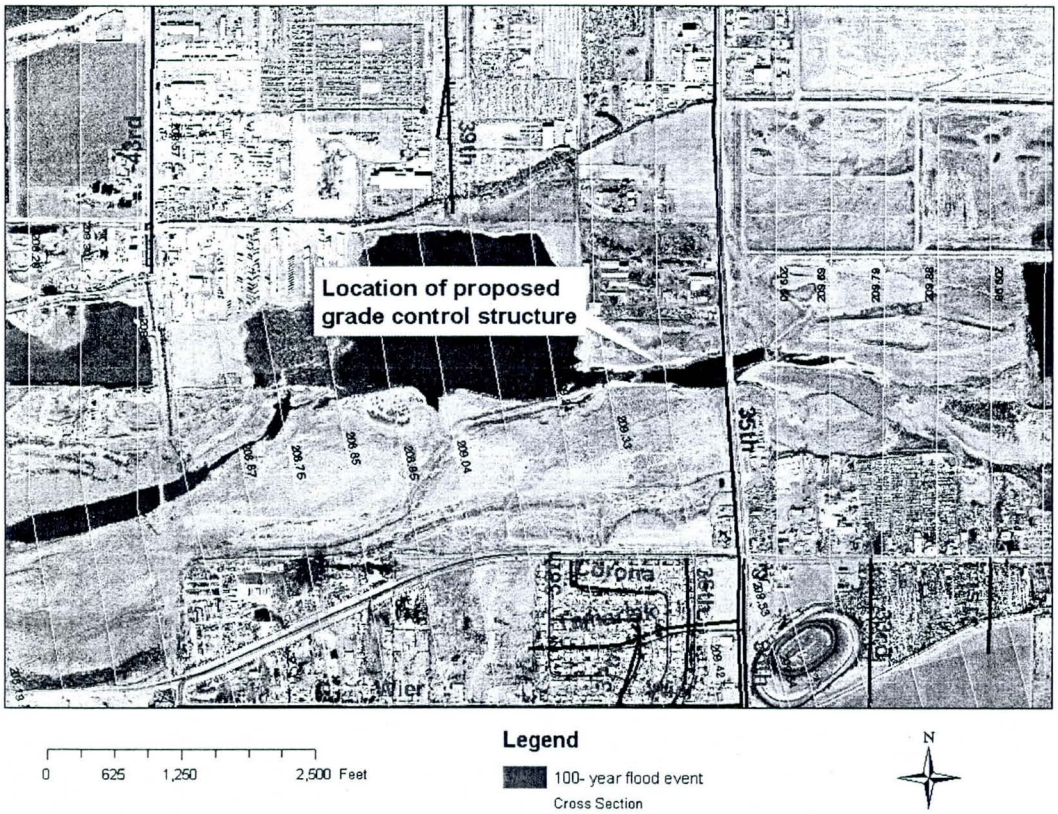

Figure 7: Proposed Location of Grade Control Structure

The proposed grade control structure would be located at approximate River Mile Station 209.42, as shown in Figure 7 above. The proposed grade control structure would extend across the full width of the floodway channel. Preliminary analyses indicate that there would be a requirement for toe protection to extend approximately 27 feet below low flow channel invert.

While the low flow channel is designed to convey 20,200 cfs (approximately a 5-year peak event), the grade control structure would be designed to withstand the 100-year frequency flood peak event. Tentatively, the grade control structure would be constructed out of roller compacted concrete (RCC) and would be similar in design that the two structures that are currently incorporated in the Rio Salado Phoenix project immediately upstream.

Project Features

Initially, the principle environmental project feature alternatives were developed by the study manager in close coordination with the local sponsor. These project features evolved into three distinct alternatives that were closely tied to the density level and site specific location of vegetation patterns throughout the study reach. These three unique vegetation alternatives were identified and classified as "High", "Medium", and "Low". As a further refinement and development of a final

recommended alternative, the study team elected to proceed exclusively with the "High" Alternative option with its associated project features.

As discussed earlier, a HEC-RAS model was developed to assess the "with project" impacts on the Baseline Future Condition Without Project condition. The vegetation layout plan associated with this "High Alternative" is displayed in Figure 8 below. The vegetation types incorporated in this alternative included Cottonwood/Willow (CW), Emergent Wetlands (WT), and Mesquite (MS).

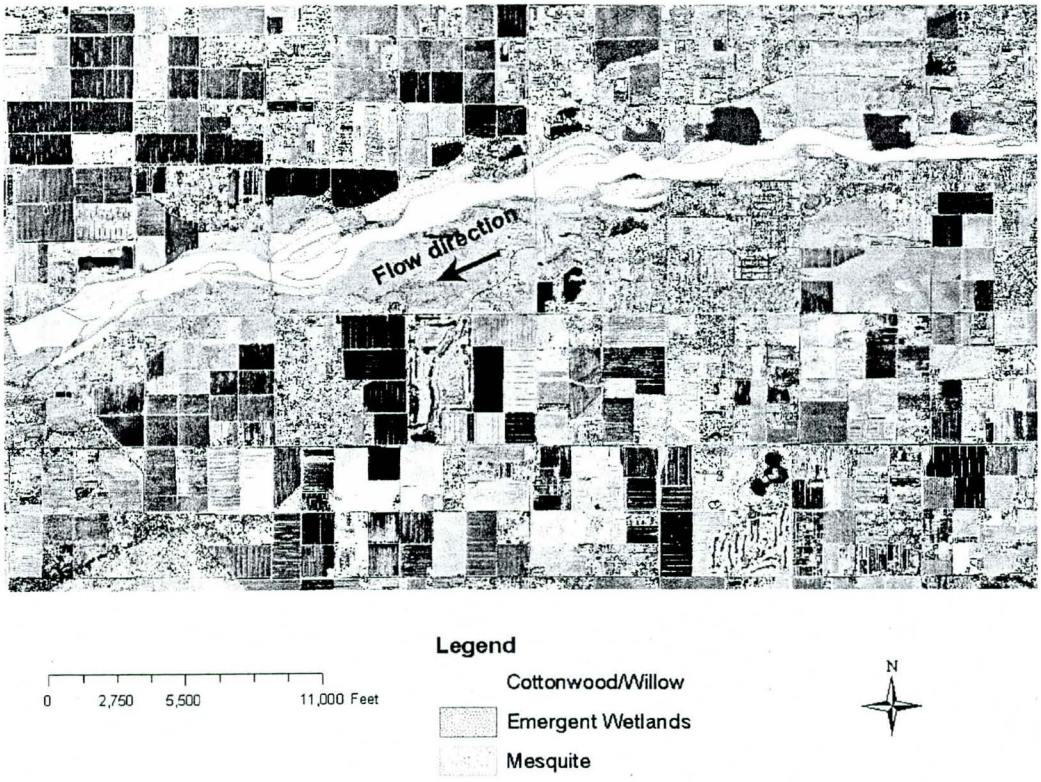

Figure 8: "High Alternative" Environmental Project Features

To properly simulate the with project conditions several changes had to be made to Existing Future Without Project Baseline condition model. Essentially, these changes involved modifications to the original model's ineffective flow areas and adjusting the n values where necessary. With respect to this latter item, n value in the channel and overbank on the floodplain terrace were increased to 0.037 and 0.043 respectively. The increases were required to offset the additional roughness associated with greater surface irregularities, channel cross section variation, and more increased vegetation channel obstruction.

With Project Results

Multiple Discharge Analysis

Since the With Project water surface profiles associated with the 5-, 10-, 20-, 50-, 200-, and 500-year frequency flood events are similar to that of the 100-year frequency flood event with the exception of magnitude, only the 100-year With Project model results were displayed in this document. Figure 9 below captures the With- and Without Future Condition water surface profile for subject study reach.

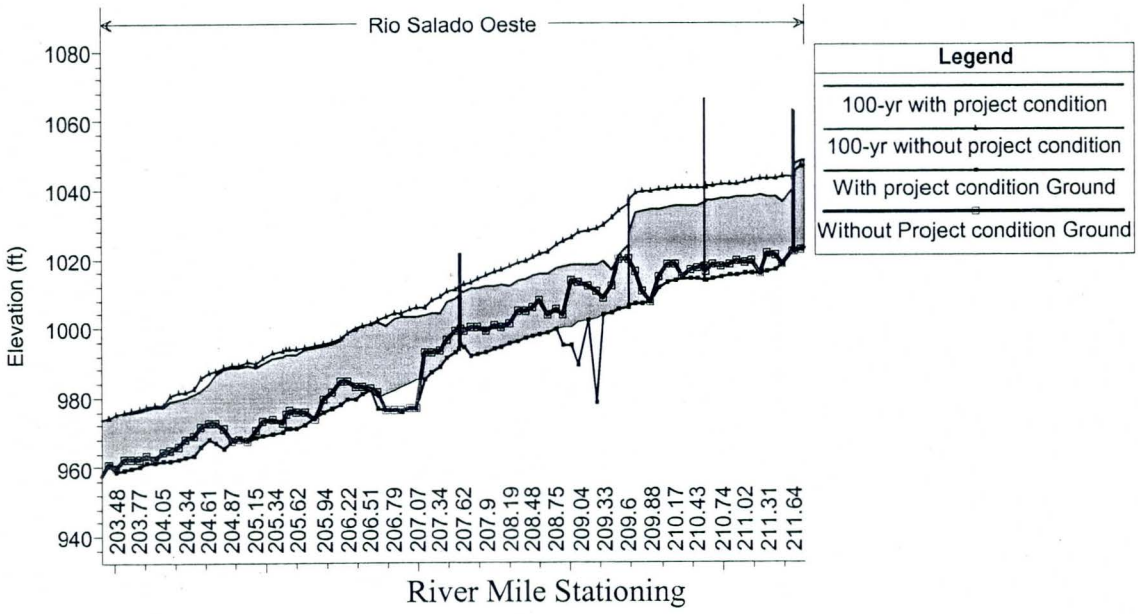

Figure 9: 100-Year Event Water Surface Profile

100-Year Event Discharge Analysis

Corresponding Table 6 below shows pertinent hydraulic 100-year flood frequency event peak discharge information for both With- and Without Project conditions.

Table 6: 100-Year Flood Frequency Event Peak Discharge Analysis for With- and Without Project Conditions

River Station	Q (cfs)	Water Surface Elevation (ft)		Minimum Channel Elevation (ft)		Water Depth (ft)		Average Velocity (ft/s)	
		W/O	W/	W/O	W/	W/O	W/	W/O	W/
211.51	166000	1043.81	1040.23	1021.8	1021.82	22.01	18.41	15.62	22.47
211.41	166000	1043.58	1036.49	1018.3	1018.17	25.28	18.32	13.33	21.89
211.31	166000	1043.16	1038.2	1020.8	1016.88	22.36	21.32	12.14	12.84
211.21	166000	1043.01	1037.93	1021.1	1016.29	21.91	21.64	9.9	10.67
211.12	166000	1043.24	1038.37	1015.67	1015.71	27.57	22.66	7.03	6.28
211.02	166000	1042.41	1038.06	1019.35	1015.59	23.06	22.47	9.11	6.33
210.93	166000	1041.86	1037.97	1018.71	1015.56	23.15	22.41	9.58	5.58
210.83	166000	1041.55	1037.79	1019.14	1015.21	22.41	22.58	9.08	5.54
210.74	166000	1041.48	1037.59	1018.18	1015.01	23.3	22.58	7.75	5.22
210.64	166000	1041.32	1037.35	1017.72	1014.78	23.6	22.57	7.34	5.49
210.55	166000	1041.15	1037.14	1018.02	1013.99	23.13	23.15	6.99	4.9
210.46	166000	1041.05	1036.93	1016.27	1013.47	24.78	23.46	6.49	5.2
210.44	166000	1040.77	1036.6	1017.63	1013.53	23.14	23.07	7.4	7.1
210.43	166000	1040.6	1036.36	1017.52	1013.51	23.08	22.85	7.5	7.11
210.36	166000	1040.44	1035.67	1017.39	1013.92	23.05	21.75	6.74	8.23
210.26	166000	1040.37	1035.59	1016.87	1014.21	23.5	21.38	5.55	6.72
210.17	166000	1040.29	1035.41	1014.74	1013.98	25.55	21.43	4.85	6.21
210.07	166000	1040.28	1035.45	1018.47	1013.5	21.81	21.95	3.73	4.41
209.98	166000	1040.04	1035.11	1018.07	1013	21.97	22.11	4.65	5.54
209.88	166000	1039.78	1034.63	1014.72	1011.65	25.06	22.98	5.23	6.02
209.79	166000	1039.7	1034.34	1020	1007.14	19.7	27.2	4.74	5.28
209.69	166000	1039.49	1034	1019	1006.78	20.49	27.22	5.18	5.66
209.6	166000	1039.18	1033.23	1016.38	1006.68	22.8	26.55	6.42	7.85
209.54	166000	1036.67	1027.51	1019.64	1006.41	17.03	21.1	13.94	19.06
209.53	166000	1035.88	1025.83	1019.65	1005.91	16.23	19.92	15.43	20.41
209.42	166000	1033.54	1023.93	1019.56	1009.83	13.98	14.1	13.47	17.77

209.33	166000	1031.92	1025.78	1019.07	996.09	12.85	29.69	12.55	8.72
209.24	166000	1029.65	1025.72	1017.41	996.09	12.24	29.63	14.08	8.75
209.14	166000	1028.58	1020.91	1014.45	1005.5	14.13	15.41	11.42	18.88
209.04	166000	1028.34	1016.84	1012.24	1004.31	16.1	12.53	8.72	19.42
208.95	166000	1027.44	1019.15	1013.05	1003.61	14.39	15.54	9.57	6.28
208.85	166000	1026.09	1018.42	1013.35	1002.9	12.74	15.52	9.79	8.12
208.75	166000	1025.17	1018.4	1011	1001.96	14.17	16.44	8.92	5.75
208.67	166000	1023.79	1018.2	1010	1001.5	13.79	16.7	10.06	5.2
208.57	166000	1021.83	1018.21	1010	1000	11.83	18.21	11.58	3.97
208.48	166000	1021.28	1017.83	1007.62	1000.1	13.66	17.73	8.44	5.59
208.39	166000	1020.35	1017.4	1005.57	999.4	14.78	18	8.58	6.84
208.29	166000	1019.47	1015.88	1004.7	998.7	14.77	17.18	8.13	10.81
208.19	166000	1018.78	1015.63	1004.66	998.1	14.12	17.53	7.4	9.11
208.1	166000	1017.96	1015.06	1001.33	997.5	16.63	17.56	7.23	8.18
207.99	166000	1016.85	1013.79	999.85	996.79	17	17	7.85	9.66
207.9	166000	1016.26	1013.29	1000.76	996.1	15.5	17.19	6.73	8.55
207.8	166000	1015.28	1012.01	999.08	995.4	16.2	16.61	7.69	9.67
207.71	166000	1014.31	1012.14	1000.34	994.6	13.97	17.54	8.15	5.48
207.62	166000	1012.94	1012.11	1000.23	993.89	12.71	18.22	9.61	4.06
207.53	166000	1012.59	1011.93	999.27	993.1	13.32	18.83	7.48	4.32
207.49	166000	1012.38	1011.58	999.41	992.49	12.97	19.09	7.48	4.85
207.48	166000	1012.05	1009.08	999.23	992	12.82	17.08	7.72	5.4
207.43	166000	1011.14	1008.14	999.03	994.37	12.11	13.77	9.33	8.87
207.34	166000	1010.29	1006.55	996.54	994.96	13.75	11.59	9.8	8.7
207.27	166000	1008.74	1005.33	993.27	994.04	15.47	11.29	11.1	9.04
207.16	166000	1007.7	1004.87	992.67	992.99	15.03	11.88	9.58	10.49
207.07	166000	1006.06	1004.52	992.78	991.22	13.28	13.3	11.78	11.74
206.97	166000	1005.79	1004.24	992.7	988.96	13.09	15.28	8.32	11.6
206.88	166000	1005.42	1004.24	992.6	987.06	12.82	17.18	7.69	9.2
206.79	166000	1004.38	1004.13	993	985.13	11.38	19	9.34	8.25
206.7	166000	1004.1	1003.52	991.2	985	12.9	18.52	7.2	7.01
206.6	166000	1003.43	1001.83	990.5	984	12.93	17.83	7.88	5.33
206.51	166000	1002.1	1002.53	990.2	983	11.9	19.53	10.43	4.94
206.41	166000	1001.2	1002.24	988.8	982	12.4	20.24	9.49	6.72
206.32	166000	1000.48	1002.13	987.4	981	13.08	21.13	8.09	10.19

206.22	166000	999.54	999.3	986	980	13.54	19.3	8.06	4.35
206.13	166000	998.57	998.7	984.62	982.17	13.95	16.53	7.99	5.46
206.03	166000	996.94	996.4	984.67	981	12.27	15.4	9.84	4.41
205.94	166000	995.95	995.19	981.52	979.16	14.43	16.03	8.08	12.42
205.84	166000	995.38	994.95	979.54	979.43	15.84	15.52	6.8	9.62
205.75	166000	994.73	994.24	973.88	977.85	20.85	16.39	7.06	11.86
205.62	166000	994.28	993.77	975.97	977	18.31	16.77	6.18	7.69
205.52	164000	994.03	992.52	975.91	975.96	18.12	16.56	5.68	4.57
205.43	164000	993.74	992.42	976.08	974	17.66	18.42	5.99	6.4
205.4	164000	993.73	992.38	975.49	971.93	18.24	20.45	5.29	4.43
205.34	164000	993.37	991.92	972.7	971	20.67	20.92	6.53	7.6
205.25	164000	992.88	991.53	973.42	971	19.46	20.53	6.93	6.26
205.15	164000	991.15	989.72	973.07	971	18.08	18.72	10.75	5.36
205.06	164000	989.65	988.77	970.41	970	19.24	18.77	10.77	6.94
204.97	164000	990.01	989.18	967.59	969.5	22.42	19.68	5.62	6.87
204.87	164000	989.45	988.93	968.08	969	21.37	19.93	6.94	10.73
204.78	164000	989.39	988.71	967.6	968.5	21.79	20.21	5.08	10.63
204.68	164000	988.71	988.11	971.32	967.59	17.39	20.52	7.22	6.04
204.61	164000	987.92	986.75	972.56	968.03	15.36	18.72	8.55	5.94
204.53	164000	987.03	984.13	972.73	967.6	14.3	16.53	8.73	4.17
204.42	164000	985.49	982.18	971.4	965.54	14.09	16.64	9.64	5.99
204.34	164000	982.74	980.67	969.27	966.95	13.47	13.72	12.19	7.82
204.25	164000	981.35	979.71	967.99	968	13.36	11.71	10.54	10.72
204.15	164000	981.23	979.47	965.87	965.98	15.36	13.49	7.14	11.42
204.05	164000	980.23	978.78	964.99	963.54	15.24	15.24	8.49	11.45
203.96	164000	977.57	977.29	964.14	963	13.43	14.29	11.99	10.24
203.86	164000	977.66	977.1	962.22	962.49	15.44	14.61	6.92	7.39
203.77	164000	977.24	976.75	963.26	961.89	13.98	14.86	6.5	7.69
203.67	164000	976.81	976.46	962.27	961.6	14.54	14.86	6.47	9.81
203.58	164000	976.33	975.95	962.07	961.08	14.26	14.87	6.54	6.76
203.48	164000	975.83	975.68	962.18	961.08	13.65	14.6	6.48	6.15
203.39	164000	975.18	975.14	959.89	960.06	15.29	15.08	6.57	5.85

W/ -With Project condition
W/O -Without Project condition

Minor Water Surface Anomalies

The only significant changes that occurred when introducing the With Project features on the Existing Future Without Project Baseline conditions were observed between River Mile Stations 206.13 to 206.32. The water surface profile through this area is displayed in Figure 10 below while the corresponding water surface elevation differentials are shown in Table 7.

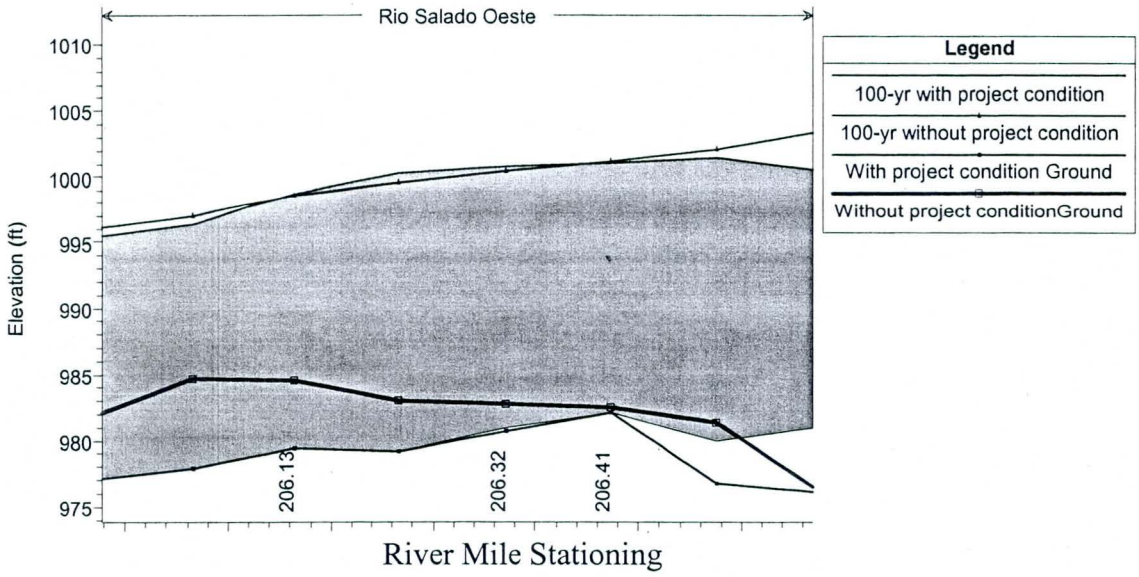

Figure 10: 100-Year Flood Frequency Event Water Surface Profile for River Station between 206.13 and 206.32

Table 7: 100-Year Flood Frequency Event Comparative Water Surface Elevation Differentials Between River Mile Station 206.32 to 206.13

River Station	100- year event discharge (cfs)	Project Condition	Minimum Channel Elevation (ft)	Water Surface Elevation (ft)	Difference in Water Surface between W/ and W/O (ft)
206.32	166000	W/O	987.40	1000.48	
206.32	166000	W/	981.00	1000.82	0.34
206.22	166000	W/O	986.00	999.54	
206.22	166000	W/	979.16	1000.34	0.80
206.13	166000	W/O	984.62	998.57	
206.13	166000	W/	979.43	998.70	0.13

W/ - With Project condition
W/O – Without Project condition

A detailed assessment of the areas in which the With Project water surface elevations are higher than the Without Project Baseline conditions is noted in the accompanying effected River Mile cross sections. Upon a closer examination of Figures 11,12, and 13 below indicate that there would be minimal flood damages since the overbanks are essentially higher in both the With- and Without Project condition.

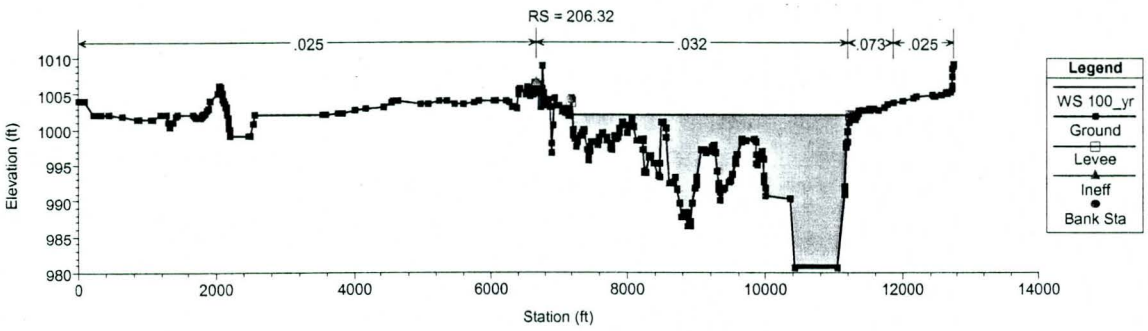

Figure 11: Cross Section at River Mile Station 206.32

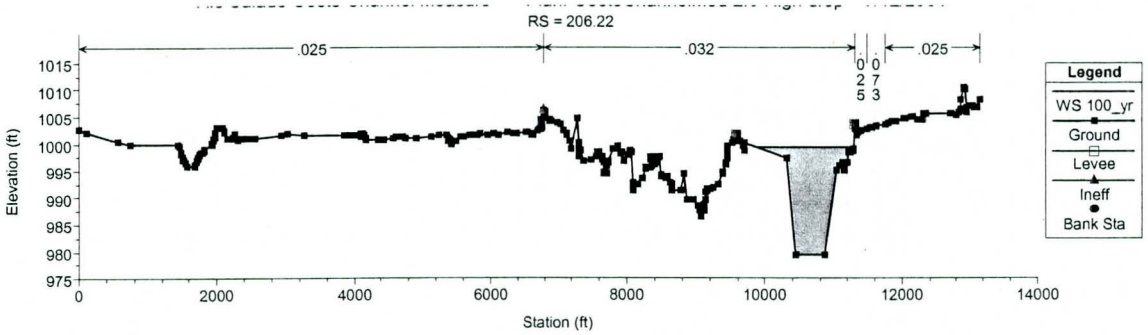

Figure 12: Cross Section at River Mile Station 206.22

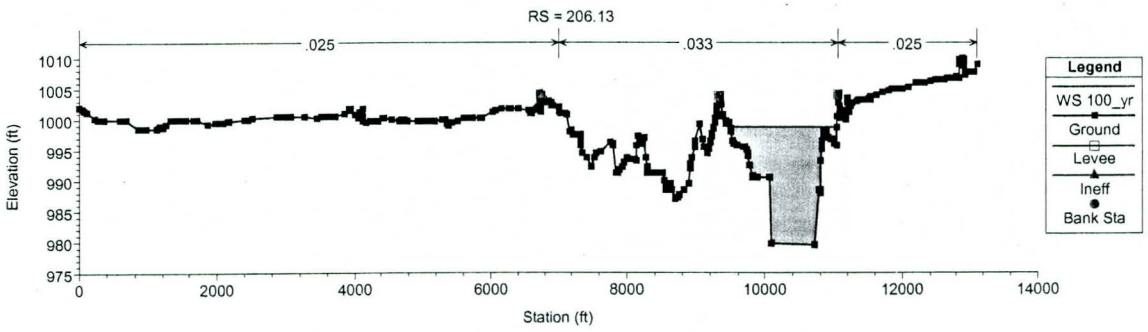

Figure 13: Cross Section at River Mile Station 206.13

However, if flood damages are in fact significantly increased, then further hydraulic modifications will be made during the later feasibility phases to accommodate a more acceptable pre-project condition.

Overall With Project water surface elevations were decreased from River Mile Stations 203.39 to 207.48 and also from River Mile Stations 209.53 to 211.51 as a direct result of the incorporation of a low flow channel feature. Finally, the water

surface elevations were also decreased between River Mile Station 207.62 to 209.42 as a direct consequence of channel mining activity.

SEDIMENTATION ANALYSIS

Without Project

A detailed Without Project sediment analysis was not performed for this study. Instead, it was decided to take advantage (if possible) of existing sediment analyses that had recently been performed by the Corps of Engineers on the Salt River for several ongoing environmental restoration projects adjacent to the Rio Salado Oeste study reach. Specifically, this involved the extrapolation of sediment information from the immediate upstream Rio Salado Salt River, Arizona (Phoenix) Project (for the City of Phoenix) and the immediate downstream Tres Rios, Arizona PED (also for the City of Phoenix) Project (currently in the plans and specs phase of development). In examining the respective without project sediment transport analyses for each of these two bordering projects, they both indicated that their respective reaches were reasonable stability in terms of sediment transport equilibrium (+/- 2 feet in bed movement during the 100-Year Frequency Flood event). Therefore, it was intuitively assumed that the middle Rio Salado Oeste reach would also be reasonably stable as well.

With Project

Due to time constraints a detailed sediment transport analysis was not completed for the with project conditions phase of the study. The Without Project sedimentation analysis and with project hydraulic results were used to assess the With Project sedimentation trends.

Based on existing sediment transport information from the project described above, the study reach appeared to be stable, i.e., non-deposition or aggradation mode. Therefore, no design allowance was made at this time for sediment deposition or aggradation in the channel. Normal depth was used to size the low flow channels. Geometry data was taken from the topography supplied by Michael Baker Jr. Engineers (reference c). The low flow channel alignment was designed to meander across the existing channel bed in order to avoid the proposed channel access points.

The low flow channel velocity was limited to 6 to 8 fps to avoid the potential for bed scour. Figure 14 shows the low flow channel velocities between With and Without Project condition. Note, the hydraulic With Project design targeted a condition such that there would be minimal velocity differentials for the study reach under With and Without Project conditions.

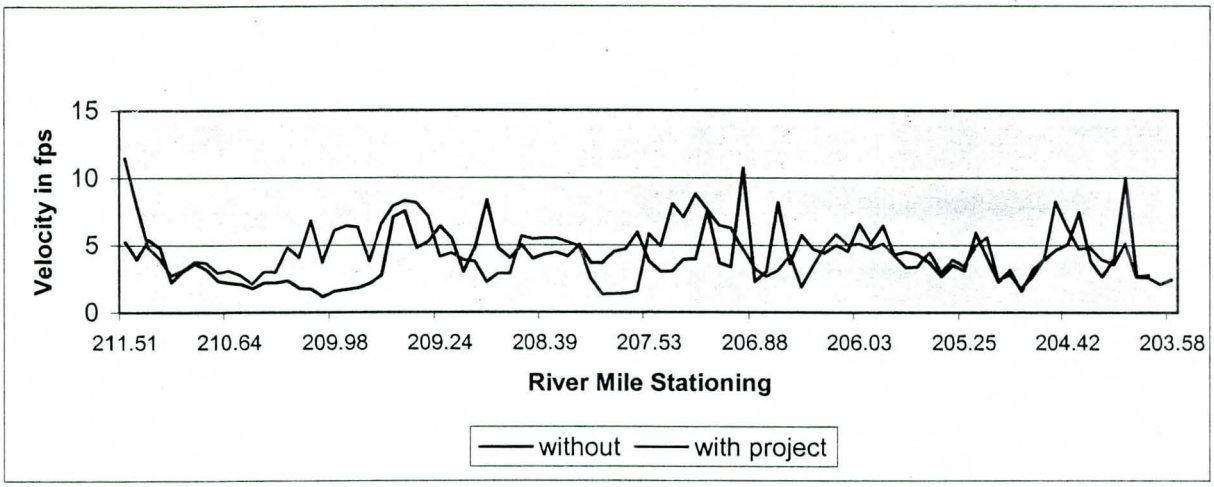

Figure 14: Comparison between With and Without Project condition for Low Flow Channel Velocity

GEOMORPHOLOGY DISCUSSION

Historic records indicate an increase in human influences on the Salt River exemplified by the encroachment of urban, commercial and gravel mining areas. Long-term channel responses are entirely dependent on future development in and around the channel. If there is no additional gravel mining, the channel will reach a state of equilibrium but only after all the gravel pits have reached a sediment transport balance through the natural migration of the river system or restoration activities have been conducted (West, 2002).

A significant concern on the stability of the river is the influence of gravel mining on the erosion and planform evolution of the channel. Gravel pits in the channel act as a reach of zero slope and serve to trap sediment. Downstream of the gravel pits, sediment supply to the channel is reduced due to the trapping of sediments within the pits. In order to meet sediment transport capacity, the downstream channel may erode its bed to reduce its slope and corresponding sediment transport capacity. According to Lane (1957), as the slope is reduced the channel would transition form a braided to intermediate planform condition

Erosion

Another important point is that due to the increase in the Rio Salado Watershed storage capacity upstream of the Granite Reef Dam, because of current climate conditions and increased reservoir storage, flows in the future have a lower probable peak discharge than in the past. Thus, unless climate conditions change, i.e. more precipitation, expected river flows will be less.

Scouring affects the stability of the channel (changes in lateral and vertically channel geometry) and hydraulic conditions (changes in velocity and water surface elevations).

RISK AND UNCERTAINTY ANALYSIS

Procedures outlined in EM 1110-2-1619, "Risk-Based Analysis for Flood Damage Reduction Studies" (USACE, 1996b), were followed to determine the standard deviation for computed water surface profiles at specific index locations. Specifically, Section 5-4, "Uncertainty in Stage for Ungauged Stream Reaches," and Section 5-5, "Uncertainty in Stages for Computed Water Surface Profiles," were followed. Only the 100-Year event standard deviation was calculated using these methods because the computer program HEC-FDA (HEC 1998) adjusts the standard deviation for the other stage discharge values. For discharge values greater than the 100-Year event discharge, the standard deviation is assumed equal to the standard deviation of the 100-year event discharge. For discharge values smaller than the 100-Year event discharge, the standard deviation is the standard deviation of error associated with the 100-Year event discharge multiplied by the ratio of the given discharge to the 100-Year event discharge. A summary of the uncertainty analysis for the different alternatives at the index locations is presented in Table 8. The standard deviation for each alternative is tabulated under the column heading "Stotal."

Table 8. Risk Analysis Standard Deviation.

Reach and Index Cross Section Rio Oeste	Frequency	Q (cfs)	Stotal (ft)
Reach 1	500-yr	240000	0.7
Cross-Section	200-yr	202000	0.7
211.52 to 205.62	100-yr	166000	0.7
	50-yr	135000	0.6
	20-yr	87000	0.4
	10-yr	53000	0.2
	5-yr	20200	0.1
Reach 2	500-yr	237000	0.7
Cross-Section	200-yr	200000	0.7
205.52 to 203.39	100-yr	164000	0.7
	50-yr	132000	0.6
	20-yr	84000	0.4
	10-yr	51000	0.2
	5-yr	20000	0.1

OPERATION AND MAINTENANCE

The Baseline Without Project Condition and With Project hydraulic results and the Without Project sedimentation results were used to assess the operation and maintenance concerns for this project. During this F4 phase of the study, the With Project sediment analysis was not undertaken. Instead, results from the With Project hydraulic analysis and Without Project sediment analysis (West, 2002) were used to estimate the frequency that environmental features are damaged in each alternative. The method of analysis was to compare the Baseline Condition area of inundation for the 5- and 10-Year events to the vegetated area. It was assumed that the Baseline Condition 5 and 10-Year area of inundation represented the area of highest velocities. Because the alternatives did not significantly alter the existing flow path, it was assumed that the Baseline Condition area of inundation would be sufficient to complete the With Project damage assessment. Damage due to duration of inundation was not taken into account in this analysis. Note that the frequency of vegetation replacement was not analyzed in this study.

Maintenance Considerations

As stated above, the With Project low flow channel was designed between River Mile Stations 203.39 to 207.43 and River Mile Stations 209.53 to 211.52. Inherent in the design objective to maintain the average channel velocities to a level as to not significantly exceed a maximum permissible velocity. These target velocities were tied to velocities associated with the 10-Year Frequency Event Peak Discharge. It was assumed that velocities resulting from flows higher than this particular discharge figure would disrupt the general channel equilibrium in terms of generating excessive erosion and deposition quantities. Further, since the low flow channel does not contain any bank stabilization features other than a grade control structure downstream of 35th Avenue, the same channel would most likely experience some minor degree of laterally migration. However, this anticipated movement of the low flow channel alignment would also be expected to stay within the historic channel thalweg footprint. Therefore, it is highly possible that there would be a requirement for some maintenance for flood events greater than the 20-Year Frequency event.

Vegetation Damage

The vegetation damage was evaluated using a similar method as was used for the maintenance considerations. For the 5-Year event it was assumed that 50% of the area inundated was damaged. For the 10-Year event, 70 % of the area inundated was damaged. The area damaged for the 20 to 500-Year events corresponds to a percentage of the vegetated area inundated by the 10-Year event. For the 5-Year

event it was assumed that 50% of the area inundated was damaged. For the 10-Year event, 70 percent of the area inundated was damaged. For the 20-Year event, 80% of the area and 90 % for the 50 to 500-Year events. These assumptions are based on engineering judgment applicable for the F4 phase of this investigation.

SUMMARY

Hydraulic

Existing Baseline, Future Existing Baseline (Without Project), and With Project Future Baseline condition hydraulic and minimal sedimentation studies were conducted for the Rio Salado Oeste study reach. The support analyses principally relied on the use of HEC-RAS models and normal depth calculations.

Initially, the Existing Condition Baseline hydraulic model was first modified to account for continuing and future mining activities within the study reach. This updated model was subsequently identified as the Future Condition Baseline model. Additional model simulations were then executed for With Project conditions, which included such features as environmental habitat areas, lakes, grade control structure, and a low flow channel design. The water surface elevations for the Existing Future Without Project Baseline condition model simulations were less than the Existing Without Project Baseline condition model as a direct consequence of have more recent and updated mapping and incorporating the projected future impact of channel mining activity. The comparative results of the 100-Year water surface elevations are shown in Figure 14 below. The With Project condition was then developed and compared against the Existing Future Without Project Baseline model for the 100-Year Frequency Flood Event and the results are shown in Figure 15.

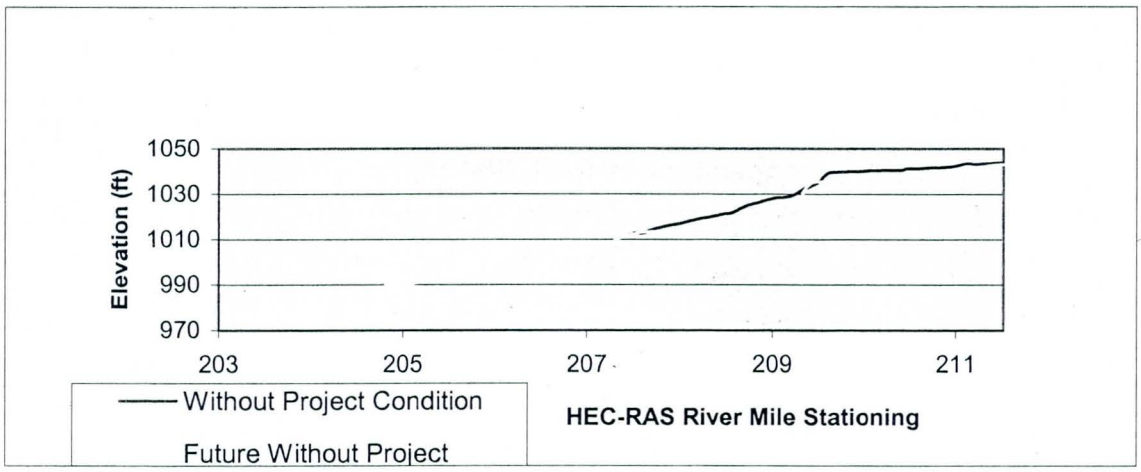

Figure 14: 100-year Water Surface Profile Between Without and Future Without Project Condition.

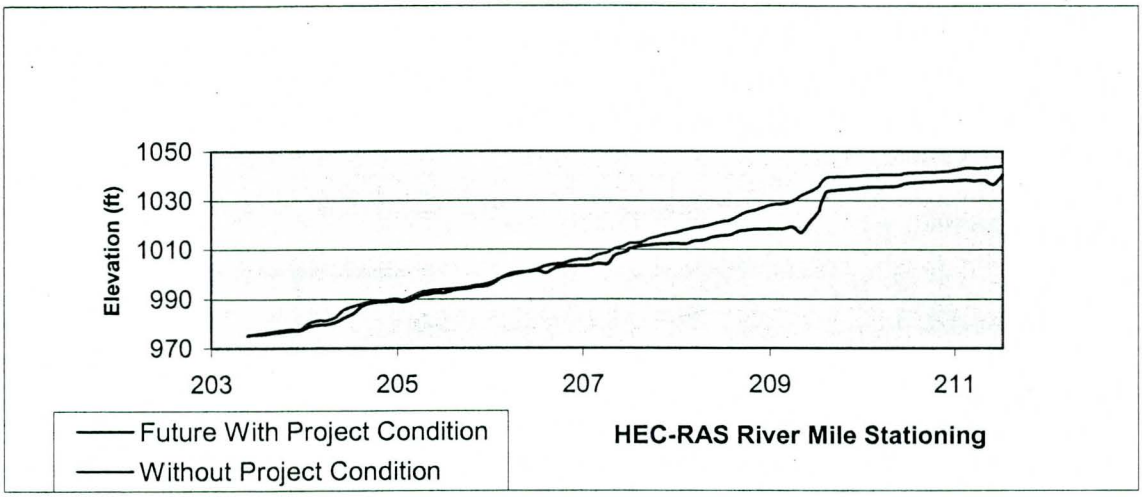

Figure 15: 100-year Water Surface Profile Between Future With Project Condition and Without Project Condition.

As indicated above, the With Project results show minimal water surface elevation variation over the Without Project Baseline condition.

A grade control structure was included in the design to prevent head cutting in the vicinity of 35th Avenue. Finally, minimal sedimentation analyses were conducted in lieu of maintaining non-erosive channel velocities and the preservation of a reasonable equilibrium slope/discharge balance analysis. Also, it was assumed that since the immediate upstream Rio Salado Phoenix Project reach and the immediate downstream Tres Rios PED Study indicated reasonable stability in terms of sediment transport equilibrium (+/- 2 feet in bed movement during the 100-Year Frequency Flood event), it was intuitively assumed that the middle Rio Salado Oeste reach would also be reasonably stable as well. At any rate, a more detailed sedimentation study will be undertaken the PED phase.

Risk Assessment

As discussed in the text above, the features with the highest risk are associated with those features located in the main channel area, or within the 10-Year area of inundation. However not all vegetation found in this area was or should be assumed to damages during flow events. Because of the complexity of risk assessment to vegetation due to hydraulic and sedimentary conditions, it was assumed that a percentage of vegetation within these limits would be at risk to damage, see Operation and Maintenance, Vegetation Damage Section, for more info. Based on those assumption the at risk area amounts were determined. Of that amount, only a portion is located along the riverbed where the highest stresses are found. Wetlands can be engineered to resist high shear stresses such that vegetation will reestablish after larger flow events. Wetland design will be completed in the PED phase

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Rio Salado Oeste Study

Hydraulics Appendix

F4 Milestone

February 2005

This appendix is in two sections

With Project Hydraulic Analysis can be found at the end of the report.

TABLE OF CONTENTS

LIST OF FIGURES iii

LIST OF TABLES iv

1 ..... Introduction 1

1.1. Purpose 1

1.2. Scope 1

1.3. Study Area 1

2 ..... Existing Conditions Hydraulic Analysis 2

2.1. General 2

2.2. Background 2

2.3. Existing Conditions Hydraulic Model 2

2.4. Floodplain Delineation 5

3 ..... Sediment Transport Analysis 15

3.1. General 15

3.2. HEC-RAS Model Conversion 15

3.2.1. Model Geometry 15

3.2.2. Fixed Bed Simulation 15

3.3. Sediment Parameters 16

3.3.1. Bed Sediment Characteristics 16

3.3.2. Inflowing Sediment Rating Curve 16

3.3.3. Movable Bed Limits 17

3.4. Hydrology 17

3.5. Results 18

3.6. Sensitivity Analysis 19

3.6.1. Hydraulic Roughness 19

3.6.2. Inflowing Sediment Load 19

3.6.3. Sediment Transport Equation 20

4 ..... Geomorphic Analysis 29

4.1. Historical Setting 29

4.2. Analysis of Historical Photographs and Maps 29

4.2.1. Bank Lines and Lateral Migration 29
4.2.2. Low Flow Channel 30
4.2.3. Vegetation 30
4.2.4. Mining Activities 30
4.3. Channel Response to Flood Events 30
4.4. Geomorphic Relationships 31
4.4.1. Channel Planform 31
4.4.2. Width / Depth Ratio 31
4.5. Sediment Aggradation/Degradation Potential 32
4.6. Geomorphic Summary 33
4.7. Lateral Bank Migration Rates 33

5 ..... Future Without-Project Hydraulic Analysis 43

6 ..... Summary and Conclusions 57

7 ..... References 58

LIST OF FIGURES

Figure 2-1. Existing conditions water surface elevation profiles. 7
Figure 2-2. Comparison of existing conditions and FEMA models for the 100-year profile..... 11
Figure 3-1. Rating curve at downstream end of sediment transport model. 21
Figure 3-2. Equilibrium sediment load with Yang's equation..... 22
Figure 3-3. Equilibrium sediment load with Laursen-Madden's relation..... 22
Figure 3-4. Sediment inflow gradations with Yang's equation. 23
Figure 3-5. Sediment inflow gradations with Laursen-Madden's relation. 23
Figure 3-6. 50-year hydrograph used to run the sediment transport model..... 24
Figure 3-7. Simulated average bed elevation for selected decades. 25
Figure 4-2. Historical bank lines..... 36
Figure 4-3. Historical thalweg lines..... 37
Figure 4-4. Estimated Lateral Bank Migration Limits..... 38
Figure 4-5. Recent Historical Thalweg Elevations of Salt River – 19th-91st Ave..... 25
Figure 5-1. Future conditions hydraulic analysis: 10-year flood event. 45
Figure 5-2. Future conditions hydraulic analysis: 100-year flood event. 49
Figure 5-3. Future conditions hydraulic analysis: 500-year flood event. 53

LIST OF TABLES

Table 2-1 *n* values used in the existing conditions hydraulic model. 3
Table 2-2. Discharge frequency values used in the existing conditions model. 4
Table 4-1. Width / depth ratios. 32
Table 5-1. Future conditions hydraulic analysis: sensitivity to roughness coefficients. .. 44

1. Introduction

1.1. Purpose

This without-project hydraulic and sedimentation analysis was conducted in support of the Rio Salado Oeste Feasibility – F3 Phase Study.

1.2. Scope

This report documents the hydraulic and sedimentation analysis conducted on a reach of approximately 9.5 miles of the Salt River, within the boundaries of the City of Phoenix, Arizona. The focus of the study was the identification of baseline hydraulic and sediment conditions, which will be used with later alternative condition studies to identify the preferred project alternative(s).

A hydraulic model was created based on "existing conditions", and the inundation boundaries associated with different return periods were delineated. Next, a sediment transport model was developed. Using a 50-year synthetic hydrology, the model was used to simulate long term river processes with results analyzed at 10 year intervals.

1.3. Study Area

The study reach extended from the upstream limit of 19th Avenue down to the lower limit of 91st Avenue. The downstream boundary of the study reach was approximately 2.5 miles upstream of the confluence of the Salt and Gila Rivers. Scattered along the reach were several pits, the result of active and inactive sand and gravel mining operations, both within the channel and in the overbank areas.

2. Existing Conditions Hydraulic Analysis

2.1. General

The objectives of the analysis were to identify an existing conditions hydraulic model, delineate flood inundation boundaries for the 5-, 10-, 20-, 50-, 100-, and 500-year events, and provide the initial geometry for the sediment transport analysis.

2.2. Background

An existing Flood Insurance Study (FIS) HEC-RAS model from the confluence with the Gila River (RM 199.82) to about 12th Street (RM 214.14) was provided by the Flood Control District of Maricopa County (FCD). This model will be referred to as the FEMA model. The FCD also provided aerial photographs from 1993 and 1999, an ArcInfo coverage with contours with a 4-ft 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 TIN (Triangular Irregular Network) 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 1100 ft downstream of 91st Avenue, while cross section 211.12 is about 2150 ft downstream of 19th Avenue.

2.3. Existing Conditions Hydraulic Model

A 1-dimensional model of the reach was created using HEC-RAS and the HEC-GeoRAS extension in ArcView 3.2a (Environmental Systems Research Institute, Inc.). The cross section geometry for this model was obtained from the TIN using the same cut lines utilized in the FEMA model.

First the TIN file, aerial photographs, contours coverage and cross sections coverage (containing the cut lines from the FEMA model) were inspected in ArcView. The cross sections coverage was converted into an ArcView shapefile to facilitate editing the cross sections. Seven new cross section lines were added at the downstream end of the reach (ID numbers 1 through 7). These new cross sections were inserted to prevent the downstream boundary condition from affecting the hydraulics in the project area. In addition, two more cut lines were inserted to model the conveyor bridge in the vicinity of the 27th Avenue alignment. These cross sections were located immediately downstream and upstream of the conveyor bridge, and were identified as River Mile 210.43 and 210.44 respectively.

Using the TIN, the contour coverage and the aerial photographs as reference, new shapefiles were created identifying the location of the bank stations, stream centerline, and flow lines in the channel, left overbank and right overbank.

Using the HEC-GeoRAS extension, a HEC-RAS input data file was generated. The data file contained the geo-referenced stream line and cross section lines, and the cross section station/elevation data. In addition, it included flow lengths in the channel, left overbank and right overbank.

The data file was then imported into HEC-RAS and the cross sections IDs were modified to match those from the FEMA model. Next, cross sections 211.21 through 214.14 from the FEMA model were appended at the upstream end of the reach. Although these cross sections were not geo-referenced they provided the geometry in the vicinity of 19th Avenue (the project's upstream end) and add a 2.5 mile segment at the upstream end of the reach. This segment would not have any effect on the hydraulics of the project area since a subcritical flow regime was expected throughout the reach, but were needed to provide an equilibrium inflowing sediment concentration to the study reach in the sediment transport model.

Next, the cross section geometry was reviewed to ensure proper location of channel bank stations. Roughness coefficients in the FEMA model were evaluated and, based on the field visit and the examination of the aerial photographs, deemed to be acceptable for general use. Some of the n coefficients were adjusted based on inspection of the aerial photographs. The appropriateness of these values for the sediment transport model was further evaluated during a subsequent sensitivity analysis. Typical values used in the model are shown in Table 2.1.

Bridge information and modeling procedures from the FEMA model were reviewed and included with some changes into the current HEC-RAS model. There was a new bridge in place at the 51st Avenue crossing. Plans for this bridge were obtained from the City of Phoenix Engineering Department and used to code the bridge geometry. Plans for the bridges at 19th Avenue and 35th Avenue were also obtained to verify their geometry. Plans for the conveyor bridge near the 27th Avenue alignment were obtained from United Metro Materials.

Contraction/expansion loss coefficients were set to 0.3 and 0.5 respectively in the cross sections near the bridges. The bridges in 35th Avenue, 51st Avenue and 27th Avenue were modeled using the "Multiple Opening Analysis" option in HEC-RAS, with the overbanks modeled as conveyance areas. This selection prevented the use of the weir equation to compute flow on the overbanks for the large flood events simulated.

Table 2-1 Manning's *n* values used in the existing conditions hydraulic model.

LAND USE	*n* VALUE
Sand/gravel mine	0.037
Open shrub	0.04 – 0.043
Agricultural	0.025 – 0.037
Urban/industrial	0.043
Disturbed	0.037 – 0.043
Channel open vegetation	0.037
Channel sand/gravel	0.032 – 0.037

Finally, all the cross sections were inspected to identify the location of ineffective flow boundaries. The area occupied by sand and gravel pits was set ineffective for

conveyance calculations or, where this was not possible, the pits were "filled" using blocked obstructions before computing the steady state profiles. This procedure eliminates the excess conveyance in the pit and therefore results in higher water surface elevation, which is a conservative approach for flooding studies. Consideration of in-channel sand and gravel operations is more important in sediment transport studies. Pits can act as sediment traps and induce headcutting in the upstream direction and/or tailcutting downstream.

The discharges used in the hydraulic analysis were obtained from a report by the U.S. Army Corps of Engineers (USACE, 1996), and are shown in Table 2-1. The discharge at Central Avenue was assigned to cross section 214.14, and the discharge at 67th Avenue was assigned to cross section 205.52.

Table 2-2. 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

The model was run under this configuration and it was observed that several of the cross sections were not able to contain the 500-year flood. In fact, some cross sections could not contain even the 100-year flood. Under these circumstances HEC-RAS extends vertically the end points of the cross section and carries out the flow calculations, but clearly that does not yield the correct water surface elevation.

New elevation data points were needed to extend the terrain model so that the cross sections would be able to contain all floods. The FCD provided additional contour lines (2 ft interval) for the area south of the study reach, between 19th Avenue and 75th Avenue (from Laveen ADMP, 1989). Elevation data for other areas was obtained from the USGS 30m resolution DEM (generated from digitized contours from 1/24,000 USGS topographic maps). The area added through this process is primarily in the far overbank areas of the model where the DEM vertical accuracy is not as critical.

The USGS DEM was converted first from grid format to TIN format to remove points that did not add terrain information. The TIN was then converted into a point shapefile which was then clipped to cover only the area that was not covered by the original TIN or the additional contour map. Finally, a new TIN was generated using the original point and breakline files, the additional contour coverage from the FCD, and the new point shapefile obtained from the 30m DEM.

Using the new TIN as a reference, the cross section cut lines were extended in ArcView and a new HEC-RAS input file was created using HEC-GeoRAS. The input file was imported into HEC-RAS and manipulated in the same manner as before. Cross section plots are shown in Appendix A.

The new model was then executed using the six flood events. The results show that the 100-year flood is now contained in all the cross sections, and the 500-year flood is contained in most of them. The majority of the cross sections that do not contain the largest flow are located near the confluence with the Gila River. It was decided not to extend these cross sections farther to the south because then they would become part of the Gila River floodplain. In any case, the end points of the cross sections that do not contain the 500-year flow are located far from the main channel in ineffective flow areas, and therefore have no effect on the computed water surface elevation.

2.4. Floodplain Delineation

The model was executed for the 5-, 10-, 20-, 50-, 100- and 500-year flood events with the discharges from the Corps report shown in Table 2-1 (for post Roosevelt Dam modifications). Water surface elevation profiles are shown in Figure 2-1. Appendix A shows the 10-, 100- and 500-year water surface elevation in the cross section plots. In addition, Appendix B shows some other variables from the hydraulic model output file.

The model results were exported from HEC-RAS into ArcView to automatically delineate the inundation boundaries using HEC-GeoRAS. The resulting inundation boundaries were then inspected and edited to remove spurious polygons and to ensure that all polygons contained other polygons with smaller return period. Existing conditions floodplain delineations are shown in Appendix C.

The resulting 100-year profile from the Existing Conditions (EC) model was compared to the FEMA model (Figure 2-2). Both profiles are practically identical from the downstream end of the study reach up to river mile 204.25, where the cross sections from the two models show some differences in their geometry. At this location the water surface elevation in the EC model is 0.45 ft higher than in the FEMA model. Upstream of this cross section, between river miles 204.34 and 205.15, the differences between the two models increase, with the FEMA profile 0.6 to 2.54 ft higher than the EC profile. The reason for this divergence is the different location of the ineffective flow limits in the two models. The ineffective flow limits are located closer to the main channel in the FEMA model, constricting the conveyance area resulting in a rise in the water surface elevation. The location of the ineffective flow boundaries differs between the two models because they were developed with different purposes. The FEMA model was developed to define the floodplain only for the 100-year flow. On the other hand, the EC model was created to map flow boundaries for flows with return periods between 5 and 500 years, and then converted into a single sediment transport model driven by measured flows which varied between 20 and 200000 cfs. Therefore, the existing conditions geometry needs to be valid for a wide range of discharges.

From river mile 205.25 to 206.51 the differences between the profiles become small again (0.4 ft or less). The reach between river miles 206.6 and 207.07 has mining pits within the channel. The EC model blocked completely these pits, while the FEMA model raised the bottom of the pits up to a lower elevation than the EC model blockage. As a consequence, the profiles show some differences, with the EC profile being 0.53 to 2.07 ft higher than the FEMA profile.

The cross section in river miles 207.34 shows a difference of 0.78 ft (EC higher than FEMA). The cause is a change in cross section geometry and the election of different locations for the ineffective flow limits. The channel bed is lower for the bridge cross sections (207.48 and 207.49) in the FEMA model, but that did not produce significant difference in the profiles. However, at river mile 207.53 (immediately upstream of the 51st Avenue Bridge) the EC profile is again 0.49 ft higher due once more to the different location of the ineffective flow limits.

The disparity between the profiles is minimal between river miles 207.62 and 208.75. From river mile 208.85 to 209.24 there are again mining pits located within the channel and in the overbank area. The geometry of the blocks used to fill the pits and the location of ineffective flow boundaries are responsible once more for differences in water surface elevation between 0.46 and 2.15 ft. The FEMA model does not block the pits in the channel and blocks the pits in the overbanks to a higher elevation.

The remaining part of the study reach (from river mile 209.42 to 211.54) displays a complete divergence of the two model profiles. The cause for this discrepancy can be found after examination of the cross sections in the vicinity of the 35th Avenue Bridge (209.53 and 209.54). This is a bridge with a very narrow opening. At the same time, the bed slope upstream of the bridge is nearly flat. Therefore, backwater due to the bridge obstruction propagates all the way to the upstream end of the study reach. The bridge cross sections in the FEMA model are much deeper (thalweg elevation $\approx$ 993 ft) than in the EC model (thalweg elevation $\approx$ 1020 ft), increasing the conveyance through the bridge opening and producing a lower water surface upstream of the bridge.

The origin of the 35th Avenue Bridge cross section in the FEMA model is not clear. The cross sections in the EC model were extracted from the TIN using the procedure previously described. In general, all the EC cross sections matched well their FEMA counterparts except those bounding the 35th Avenue Bridge. These cross sections are located in an area of the Salt River with permanent water, where no visual verification was possible. Preliminary runs of the sediment transport model revealed that after 50 years of sediment transport the thalweg under the bridge becomes stable at a depth between 1005 and 1010 ft regardless of the initial conditions,. When the sediment transport model was run with river mile 209.54 from the FEMA model (a deep scour hole under bridge), the cross section experienced deposition, and when it was run using river mile 209.54 from the TIN (representing a shallow depth under bridge), the cross section experienced erosion. It is possible that the TIN elevations represent the water surface under the bridge when the mapping was performed but verification would require an on site survey of the area near the bridge.

The TIN river mile 209.54 geometry was selected because it resulted in a more conservative approach for the existing conditions hydraulic analysis but may be overly conservative for a detailed FEMA study. The FEMA study is likely too optimistic in regards to flow area under the bridge based on the sediment results obtained during this study. The future without-project hydraulic analysis results were similar using both geometries so the more conservative initial conditions were used as the basis for this study.

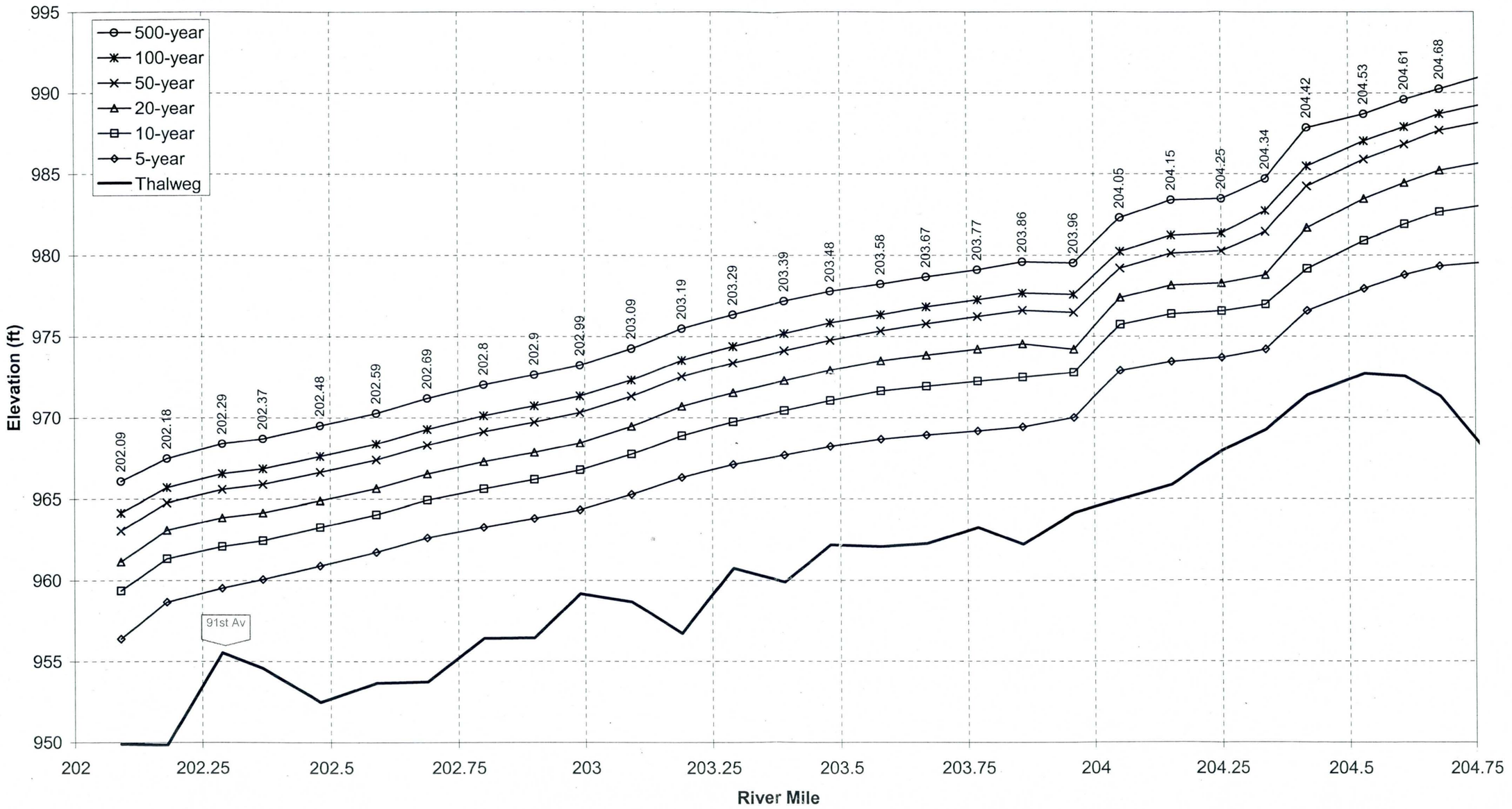


Figure 2-1. Existing conditions water surface elevation profiles.

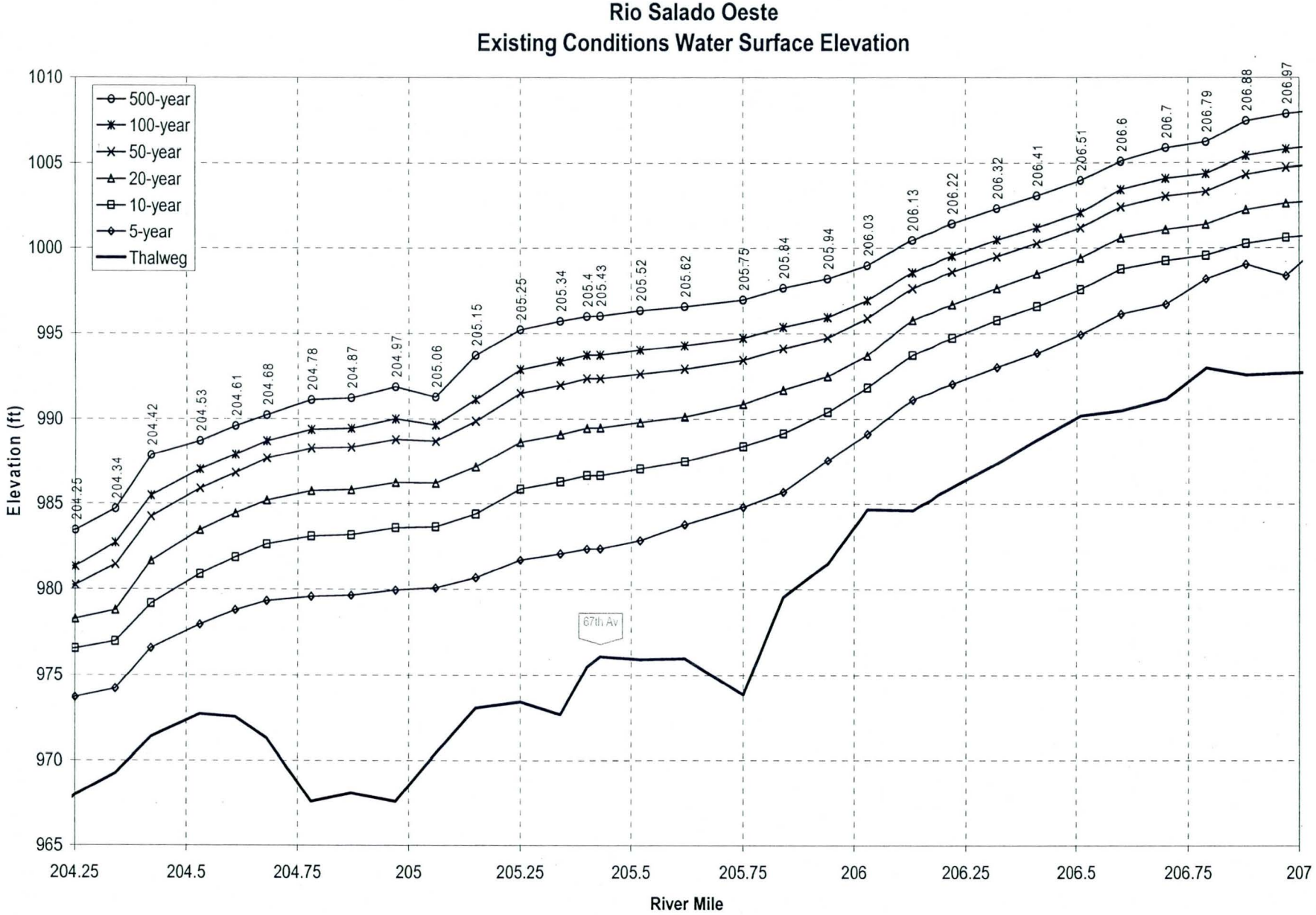


Figure 2-1. *Continued.*

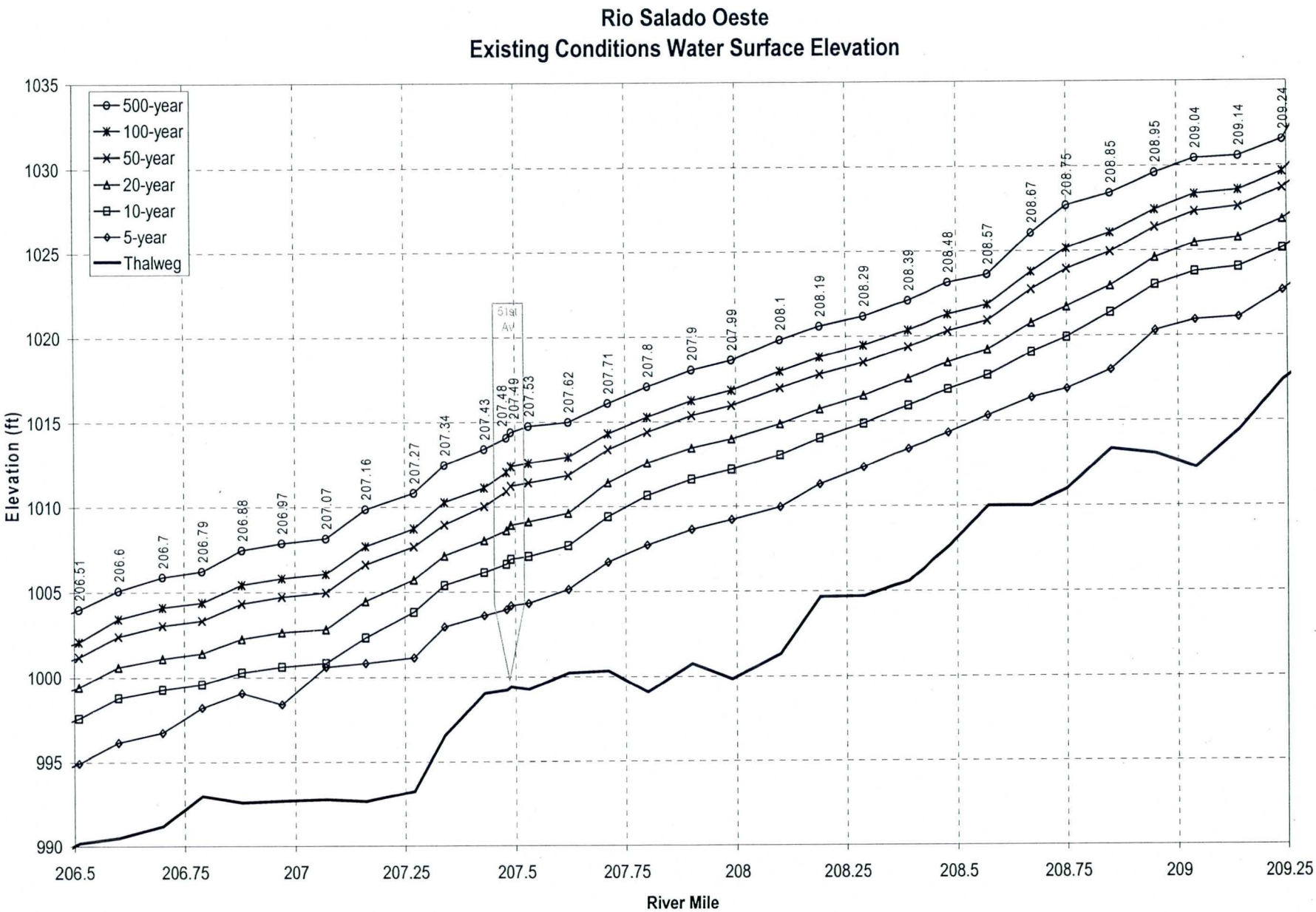


Figure 2-1. *Continued.*

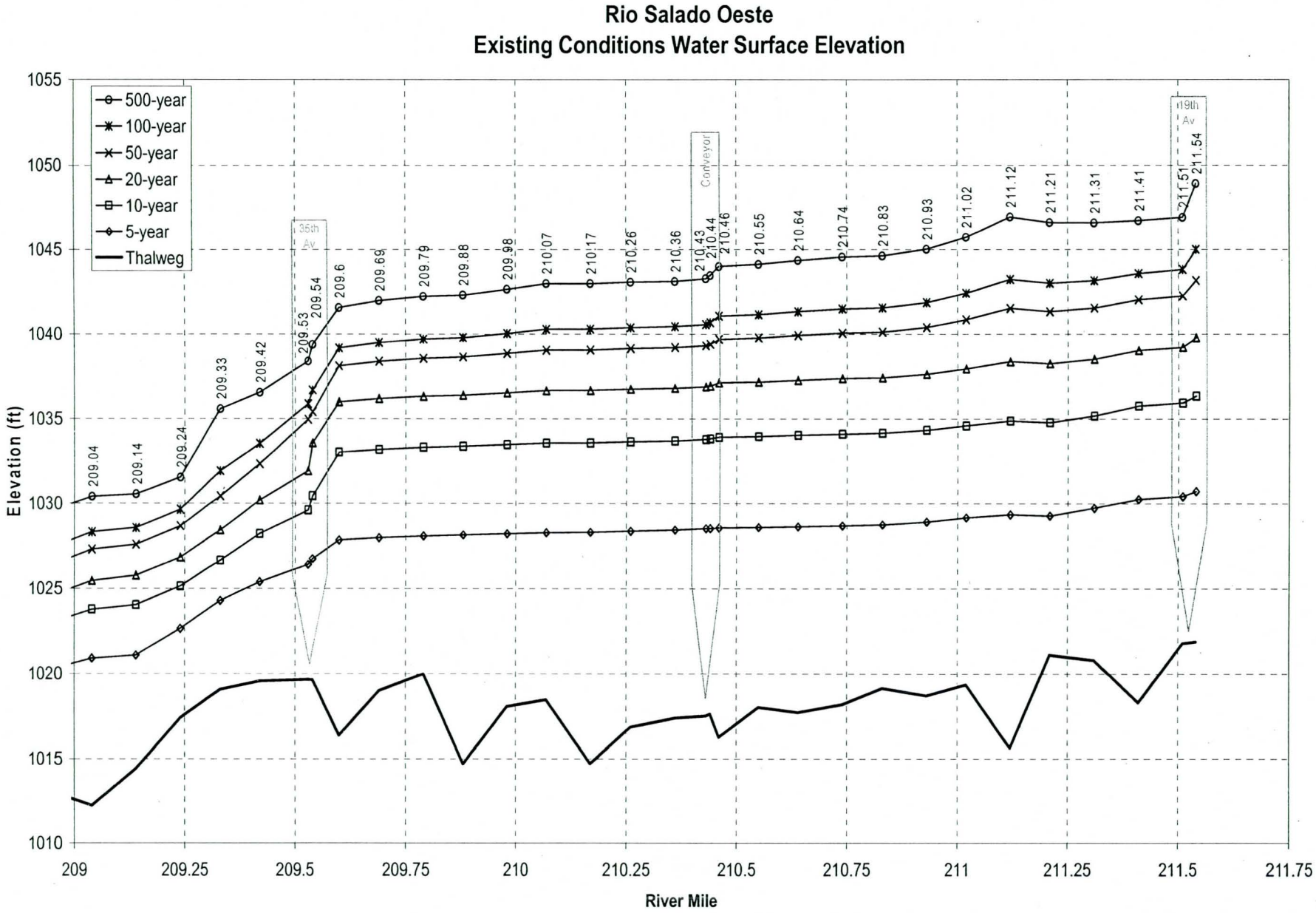


Figure 2-1. *Continued.*

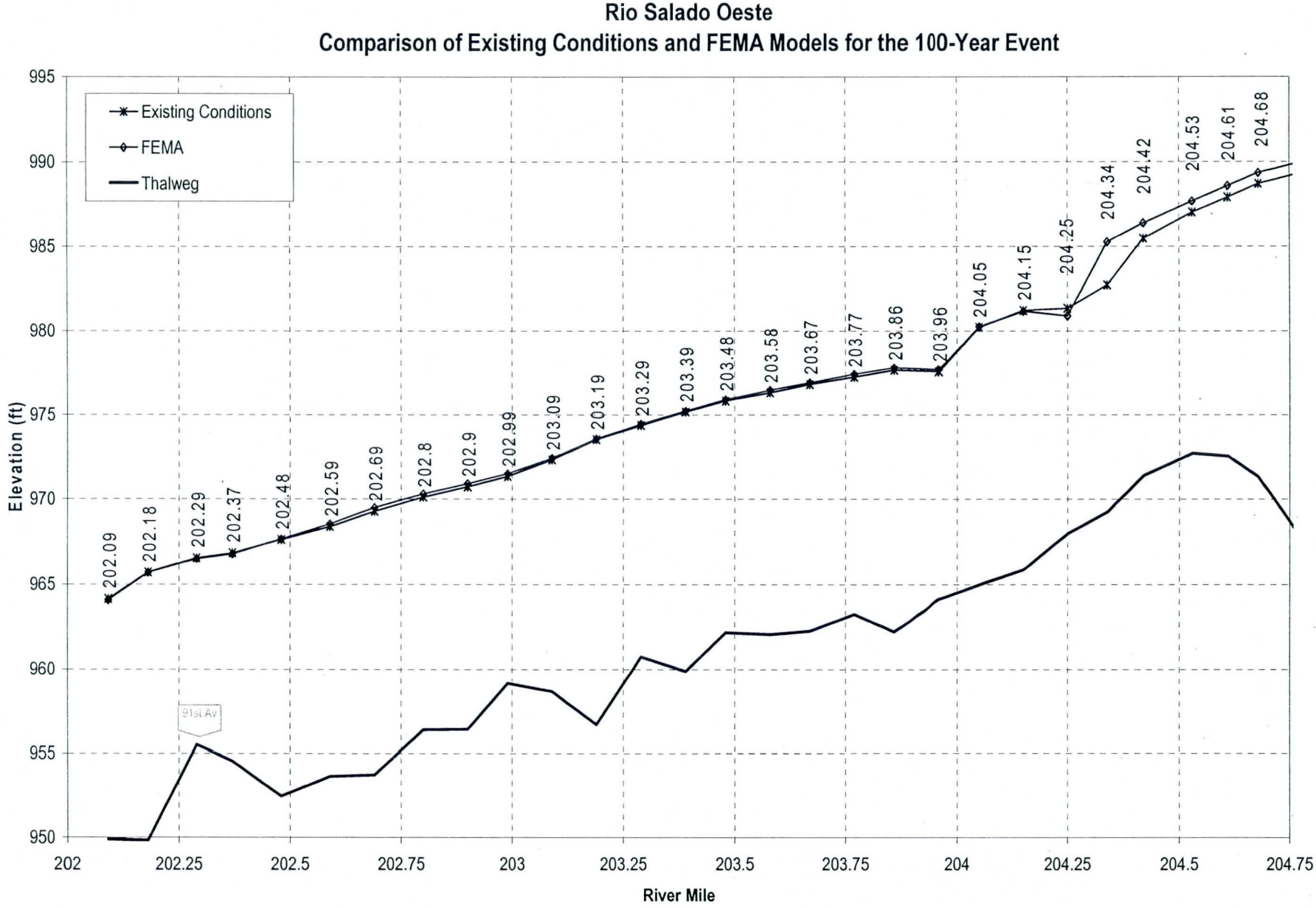


Figure 2-2. Comparison of existing conditions and FEMA models for the 100-year profile.

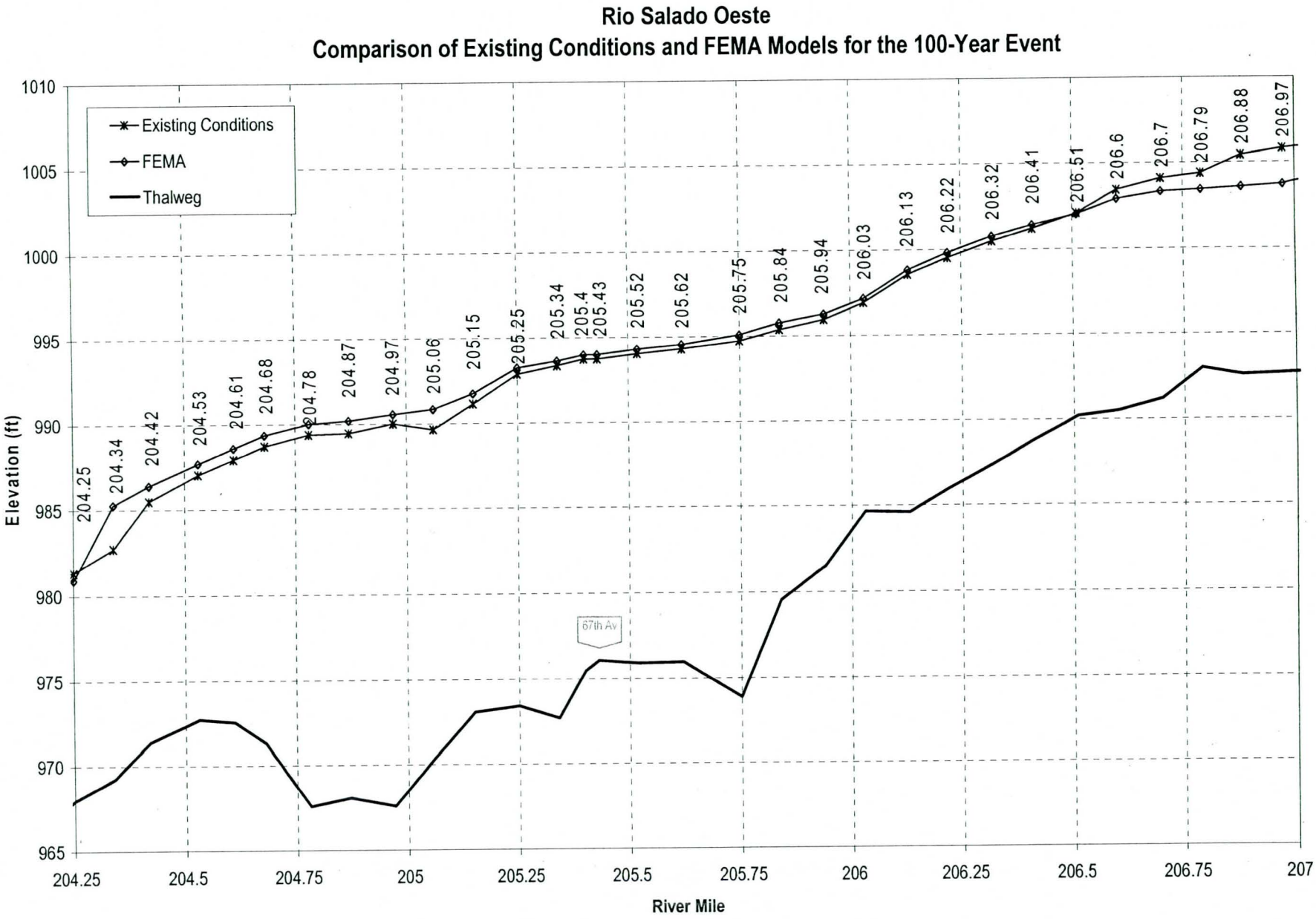


Figure 2-2. ***Continued.***

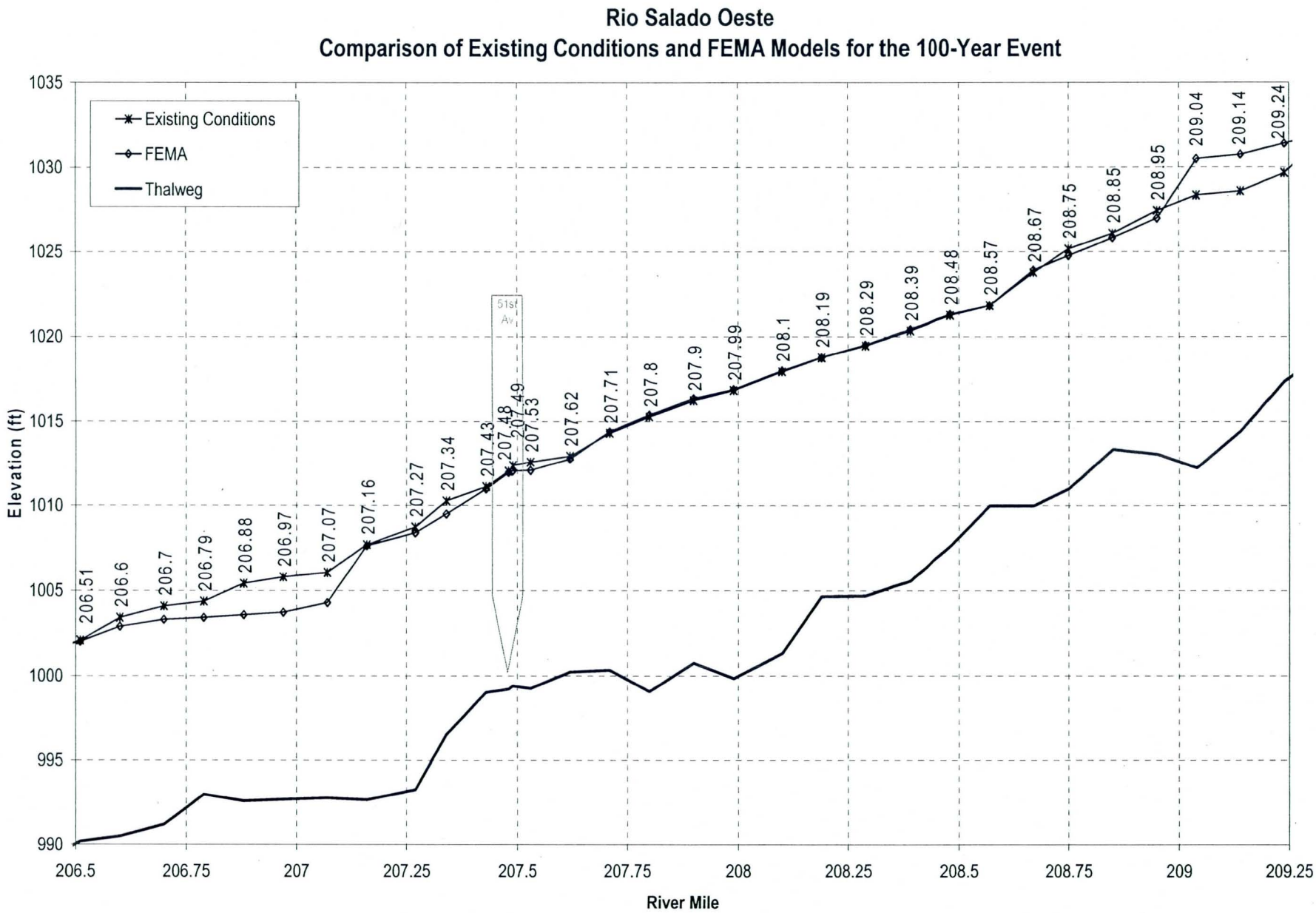


Figure 2-2. *Continued.*

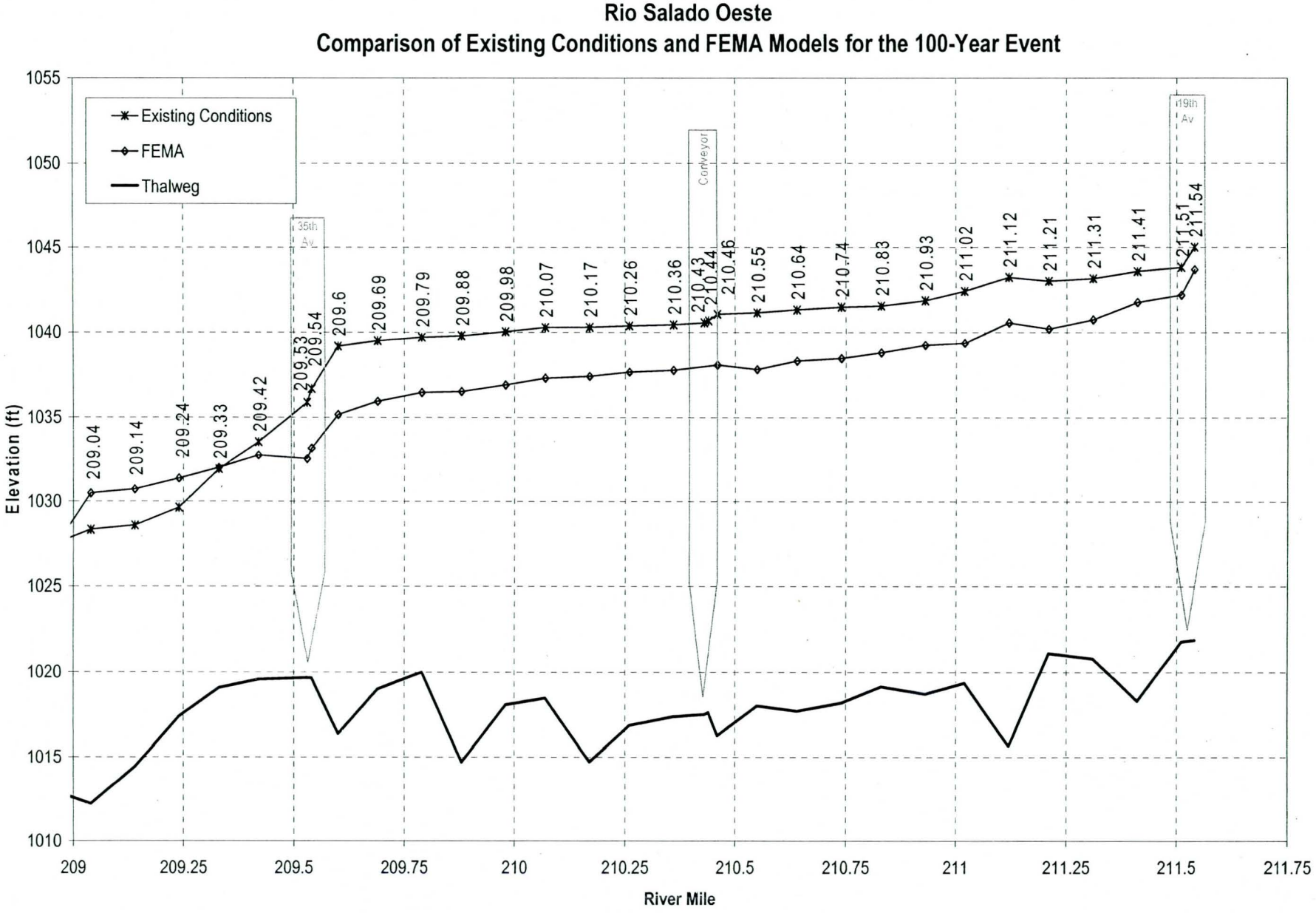


Figure 2-2. ***Continued.***

3. Sediment Transport Analysis

3.1. General

The objective of the sediment transport analysis is to identify baseline sediment conditions, which will be used with later alternative conditions studies to identify the preferred project alternatives. A base conditions sediment transport model was created using the geometry from the existing conditions hydraulic model described in the previous chapter.

The computer program HEC-6T "Sedimentation in Stream Networks", version 5.13.15 of May 24, 2001, was used to conduct the numerical sediment transport modeling in this study. HEC-6T was developed by Mr. William A. Thomas of Mobile Boundary Hydraulics, Clinton, Mississippi.

3.2. HEC-RAS Model Conversion

3.2.1. Model Geometry

The geometry of the hydraulic model was converted into a text file with the format required by the HEC-6T program. Roughness coefficients in several cross sections of the hydraulic model vary horizontally with distance in the cross section. HEC-6T does not allow as much horizontal variation of Manning's n, so an alternative method of expressing the roughness coefficient was required. After running the 5-, 10-, 20-, 50-, 100- and 500-year flood events in HEC-RAS, the profile output tables were used to request conveyance weighted Manning's n values for the channel, left and right overbanks for the different discharges. These data were then entered into the HEC-6T input file using NV records. A default value of 0.04 was used to fill blanks when the conveyance in an overbank area was zero. The result was a configuration of roughness coefficients changing in the vertical by discharge rather than in the horizontal by distance.

Conveyance limits defined in HEC-RAS using ineffective flow boundaries were coded using XL records in HEC-6T. The advantage of using XL records is that they allow deposition to occur in the ineffective flow areas. The effect of bridges crossing the river in the study area was accounted for using a single cross section with the pier geometry superimposed as recommended in the HEC-6T manual. Of the two bounding cross sections used to define each bridge in HEC-RAS, only the upstream one was retained in HEC-6T. The two bounding cross sections are very close to each other and keeping both in HEC-6T could cause numerical instabilities.

3.2.2. Fixed Bed Simulation

An elevation-discharge rating curve was developed at the downstream boundary (cross section 1) for starting water surface elevations. Water surface elevations were computed at this location assuming normal depth and a slope of 0.0019 ft/ft, for discharge values ranging from 7500 cfs to 285000 cfs, at 7500 cfs increments (Figure 3-1).

HEC-6T was then run with a fixed bed using the 5-, 10- and 100-year flood events, and the resulting water surface elevations were compared to the HEC-RAS

existing conditions model. In order to guarantee the quality of the sediment model, the water surface elevations computed by HEC-6T for each of the three events were examined at each cross section to ensure that they did not differ from the HEC-RAS results by either 10% of the maximum depth or 1 foot, whichever was less. The results of this analysis are shown in Appendix D.

3.3. Sediment Parameters

The Corps computer program SAMAID was used to select the most appropriate sediment transport relationship. SAMAID results indicated that Madden's 1985 modification of Laursen's equation and Yang's equation were respectively best and second best sediment transport relations for the characteristics of the study reach. Schoklitsch's equation came out in third place. WEST has used Yang's equation in the past on the Salt River upstream and downstream of the project site. In general, this equation performs well for mid sized rivers transporting large amounts of sand, which is typical of many streams in Arizona. Therefore, the sediment transport equation selected for this study was Yang's unit stream power.

3.3.1. Bed Sediment Characteristics

Nineteen locations were identified for sediment sampling and development of gradation curves. Sampling sites were located approximately 0.5 miles apart, from 19th Avenue to 91st Avenue. Samples were collected from 0 to 2 feet, and laboratory grain-size analyses were performed on the samples. In addition, an in-situ particle count consisting of 100 particles spaced at 1 foot intervals was performed. Bed gradation data were entered into the HEC-6T input file using PF records. Sediment gradations and sample locations are shown in Appendix E.

3.3.2. Inflowing Sediment Rating Curve

Recorded information about sediment loads in the Salt River upstream of the study reach is not available. There are however previous studies reporting sediment transport simulations. One of these studies is the Low Flow Channel Design Analysis for Rio Salado (2000) performed by WEST for the Corps. This study presented a sediment transport model of the Salt River from approximately the I-10 Bridge to the 27th Avenue alignment, based on the Toffaleti, Meyer-Peter and Muller combination transport method. The model used an estimated sediment inflow at the upstream end of the reach based on an equilibrium bed material load analysis performed on a 0.5 mile reach upstream of I-10.

The simulated loads from this previous study were not considered appropriate inflow loads to our model because they were not developed using any of the sediment transport equations identified as suitable for the current study (Yang's equation or Madden's 1985 modification of Laursen's equation). If a sediment inflow based on a different equation was used in the current model, depending on the amount of the sediment loads, there is a possibility that it could lead to either unrealistic erosion or deposition in the upstream end of our study reach.

Since we were confronted with a lack of adequate data on inflowing sediment loads into our study reach, an equilibrium bed material load was assumed. The inflowing load at the upstream end of the model was determined on a reach approximately 3 miles

long at the upstream end of the study reach (from RM 211.21 to RM 214.14) with the gradation information from the two most upstream sediment sample locations. Equilibrium sediment loads for this reach were determined for a range of discharges from 20 to 200000 cfs. To determine the equilibrium load, HEC-6T was run using clear water inflow as the initial condition and the recirculation option on ($RE record). The recirculation option instructs the program to use the sediment discharge at the downstream end of the reach as the sediment inflow at the upstream end for the following time step. When equilibrium is attained, sediment load entering the reach is about equal to the load leaving the reach. For discharges between 20 and 50000 cfs, the simulations were run typically for 10 to 100 days with time steps in the order of 0.01 to 0.1 days. For larger discharges (100000 to 200000 cfs), typical durations were between 5 and 10 days with time steps of 0.001 to 0.01 days.

The inflowing sediment loads defined with Yang and Laursen-Madden relationships are shown in Figures 3-2 and 3-3. The gradation of the inflowing load from the equilibrium analysis is shown in Figures 3-4 and 3-5. This information was entered into the HEC-6T input files using LQ, LT and LF records.

3.3.3. Movable Bed Limits

In general, sediment dynamics tend to be more significant within the active channel, where the bed can either degrade or aggrade in response to erosion or deposition. The overbank areas tend to be more stable and normally are free of erosion, but can experience deposition. HD records were used to specify a bed sediment depth of 20 feet for all cross sections but one. At river mile 211.54 the sediment depth was set to zero to account for the grade control structure located immediately downstream of the 19th Avenue Bridge. Movable bed limits were not identified in the HD records, implying that deposition could occur anywhere in the wetted perimeter. In addition, HE records were used to limit erosion within the channel bank stations.

In order to develop a sound hydraulic model, the mining pits, in particular those located in the channel, were blocked to ensure a solution with a subcritical water profile along the reach. However, when flooded, the mining pits will likely act as sediment traps. For that reason, the sediment deposited on top of the blocked areas within or next to the channel was removed from the system using the dredging options in HEC-6T. HI records were used to identify the areas where sediment should be removed in the case that deposition took place, and the $DREDGE record was used to instantaneously take away the deposited sediment after each time step. In addition, when mining pits were located in the channel, the HE limits were relocated to exclude the pit from the area of potential erosion.

3.4. Hydrology

A continuous 50-year hydrograph consisting of historical flows between 1889 and 1938 was provided by the Corps. This flow series corresponds to the "worst case" continuous 50-year period, in terms of both peak flows and storm volumes, within the 105 years of record, from 1889 to 1993. Discharges less than 20 cfs were removed from the hydrology since no sediment was transported for flows of 20 cfs or less.

Simulations were performed with the 50-year hydrograph, with simulation results requested by decade. Figure 3-6 shows the complete 50-year hydrologic input and identifies the end of each decade. The individual hydrographs used to compile the 50-year long hydrograph are shown in Appendix F.

3.5. Results

The sediment transport analysis results are presented in terms of average bed elevation by decade (Figure 3-7 and Appendix G). The average bed elevation corresponding to a 10,000 cfs discharge of very short duration (0.00001 days) was computed in HEC-6T at 10-year intervals. This discharge was selected to generate average bed elevations because, in general, it provided coverage of the channel bottom (HEC-6T computes average bed elevations only from "wetted" points of the cross sections). The 10,000 cfs discharge is used only to generate output, and the short duration minimizes sediment movement.

The results show two distinct areas with respect to sediment dynamics. Downstream of 35th Avenue the reach mainly experiences degradation, with deposition limited to just a few cross sections. One of the depositional areas is defined by cross sections 203.58 to 203.86, and corresponds to an abandoned mining operation. The end result is a channel with a more homogenous bed slope. There are two areas downstream of 35th Avenue where the model predicts severe erosion:

- The first one is defined by cross sections 206.7 to 206.97. This is an area with active mining pits in the channel and a small berm to prevent low flows into the pit. The small flows (the majority in the hydrologic input) are then confined to a channel just about 200 feet wide resulting in severe degradation. Due to the limitations of the model (1-D steady state) it is not possible to simulate the complex interaction that may occur between the mining pit and the channel. The flows could very well breach the berm and enter the pit, limiting degradation in the channel but creating a headcut that would progress upstream.

- The second area corresponds to cross sections 209.24 to 209.54. This is another mined reach with pits on the right overbank and channel in cross sections 209.24 and 209.33. Cross section 209.54 represents the small bridge opening at 35th Avenue. Erosion in this case is associated with the cross sectional area reduction and velocity increase caused by the bridge.

Upstream of the 35th Avenue Bridge the bed slope is milder. That, along with the backwater effect of the bridge, creates the conditions for sediment deposition in most of the cross sections.

In general, average bed elevation changes are more significant in regions of the reach that are currently affected by mining operations in the channel. Where mining is not an issue, average bed changes reach a maximum of 5.8 ft after 50 years of sediment transport, with an average change of 1.9 ft.

During the simulations most of the bed changes took place in the first decade, with minor adjustments occurring in the remaining time. The first decade contained the flow events with the two largest peaks. In addition, it can be seen that the trend observed

after the first decade is sometimes reversed after subsequent decades. This is a consequence of both changes in the cross section geometry with time, and changes in sediment dynamics associated with flows of very different magnitudes.

Appendix H shows plots comparing the cross sections before and after the sediment transport analysis.

3.6. Sensitivity Analysis

The purpose of the analysis was to explore the sensitivity of the sediment transport model to variations in the parameters, in an attempt to determine the appropriateness of the selected values. Sensitivity runs were performed on the base conditions HEC-6T input file to determine the relative effect of changes to Manning's n, inflowing sediment load, and transport equation to the average bed elevation profiles. Results in tabular and graphic format are provided in Appendix I.

3.6.1. Hydraulic Roughness

The sensitivity of the sediment transport model to the hydraulic roughness coefficients was examined. The base conditions sediment transport model results have been compared to simulation outputs resulting from increasing and reducing all Manning's n coefficients in the input file by 25%.

After 50 years of simulating sediment dynamics, the high roughness profile is generally higher than the base condition profile. This is the result of deposition or reduced scour due to reduced flow velocities caused by the higher roughness coefficients. On the other hand, the low roughness profile is generally lower than the base conditions profile because of higher flow velocities. The average bed profile change was 0.7 ft for high roughness and 1.2 ft for low roughness, implying that small errors in the roughness coefficients selected for the base conditions model probably will not have a significant effect on the results.

The largest differences occur in mined reaches, where a 25% increase in Manning's n can reduce erosion by as much as 3.7 ft, and a 25% decrease in Manning's n can augment erosion by as much as 5.9 ft.

3.6.2. Inflowing Sediment Load

The effect of the inflowing sediment load has been assessed by comparing the base conditions sediment transport model with simulation results after increasing and reducing the sediment discharge to twice and half the equilibrium load determined with Yang's equation.

The most important differences can be observed upstream of the 35th Avenue Bridge. In the reach between cross sections 210.07 and 211.34 the double-inflow profile elevation increases an average of 0.6 ft with respect to the base condition, while for the half inflow profile it decreases an average of 0.5 ft. Downstream of 35th Avenue the differences are reduced as the sediment load reaches equilibrium.

3.6.3. Sediment Transport Equation

Simulation results generated with Yang's unit stream power equation have been compared to the simulation results produced with Madden's 1985 modification of Laursen's sediment transport equation.

The two equations yield bed profiles with the same trends in terms of degradational and agradational areas, with slight differences in the depth of eroded or deposited material. The main differences appear at the upstream end of the study reach. The upstream end of the reach is a transition between a narrow segment with levees in both banks and a wider segment severely disturbed by mining operations. It is not surprising that the model results show some instability in this area, until a new equilibrium is reached a little distance downstream. Laursen's equation, as modified by Madden, seems more susceptible to this effect than Yang's equation.

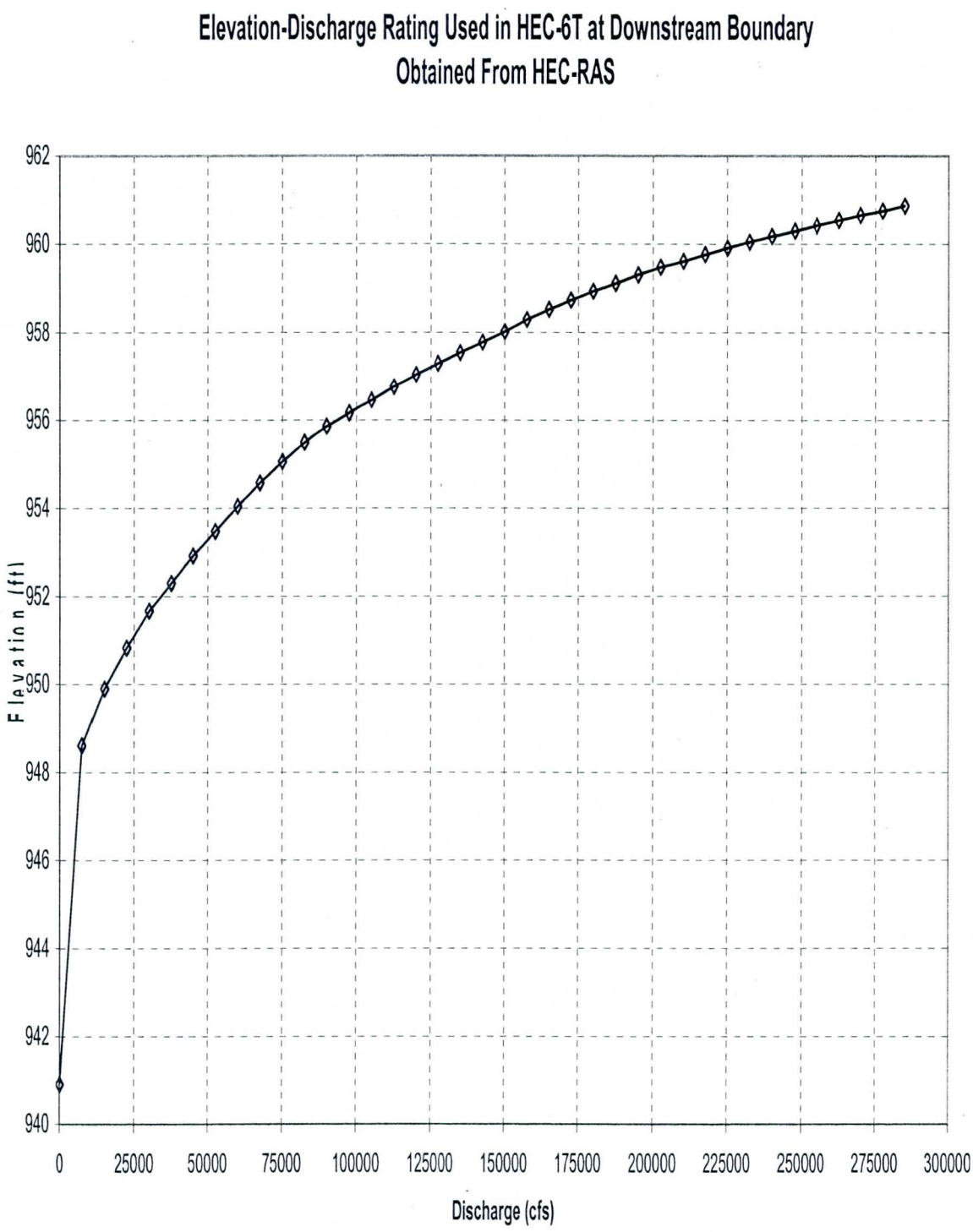


Figure 3-1. Rating curve at downstream end of sediment transport model.

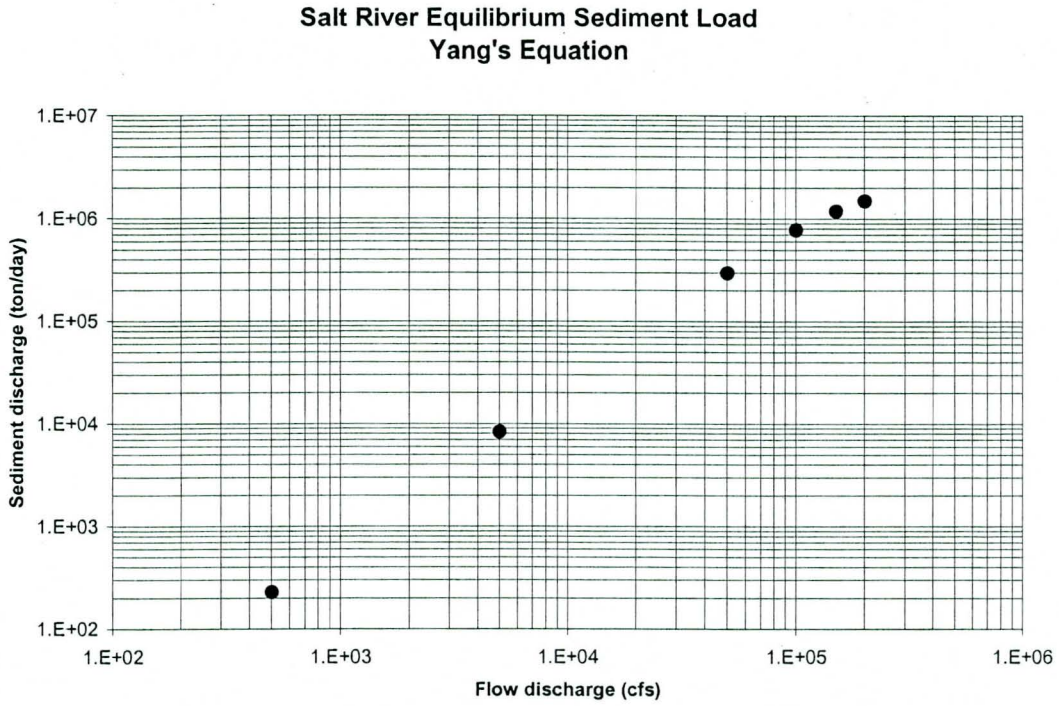


Figure 3-2. Equilibrium sediment load with Yang's equation.

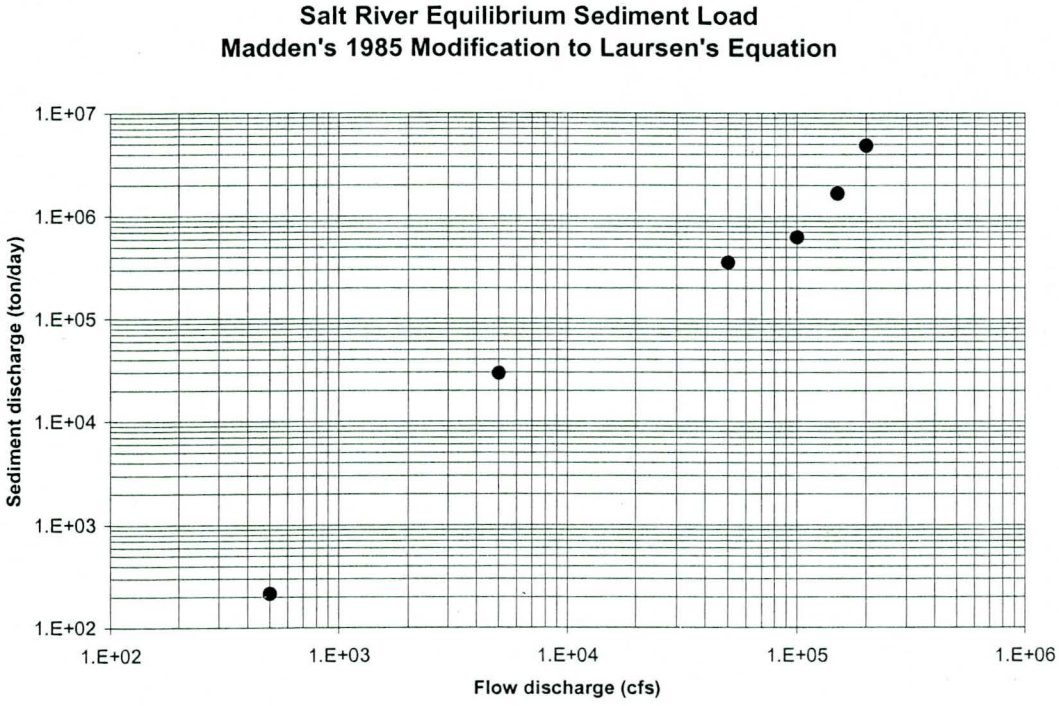


Figure 3-3. Equilibrium sediment load with Laursen-Madden's relation.

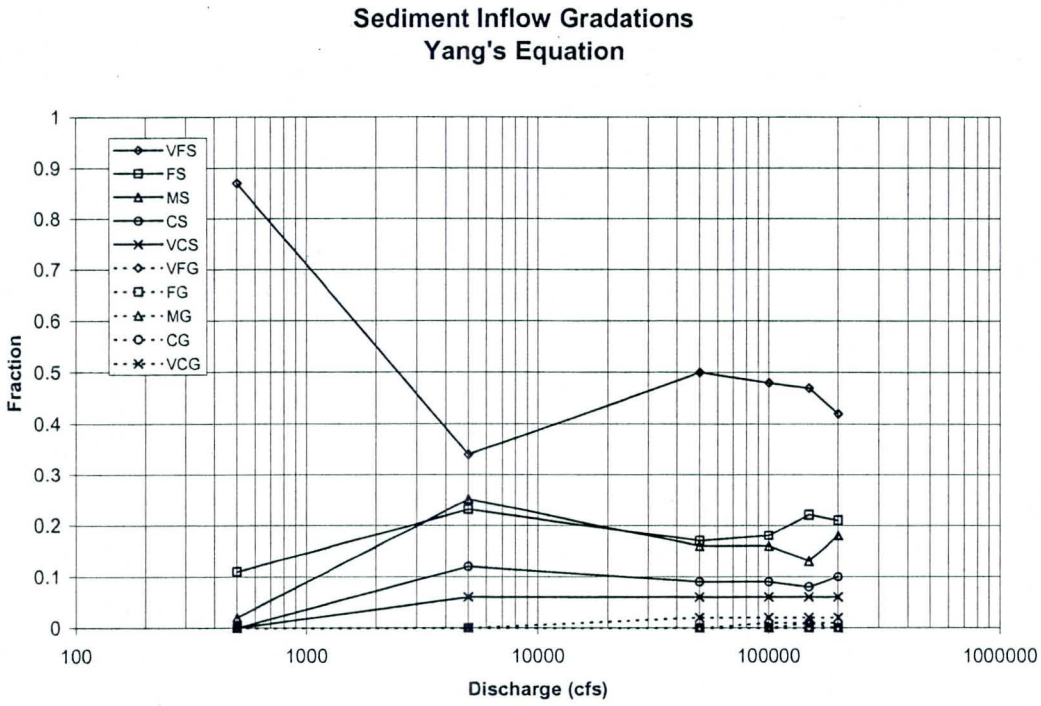


Figure 3-4. Sediment inflow gradations with Yang's equation.

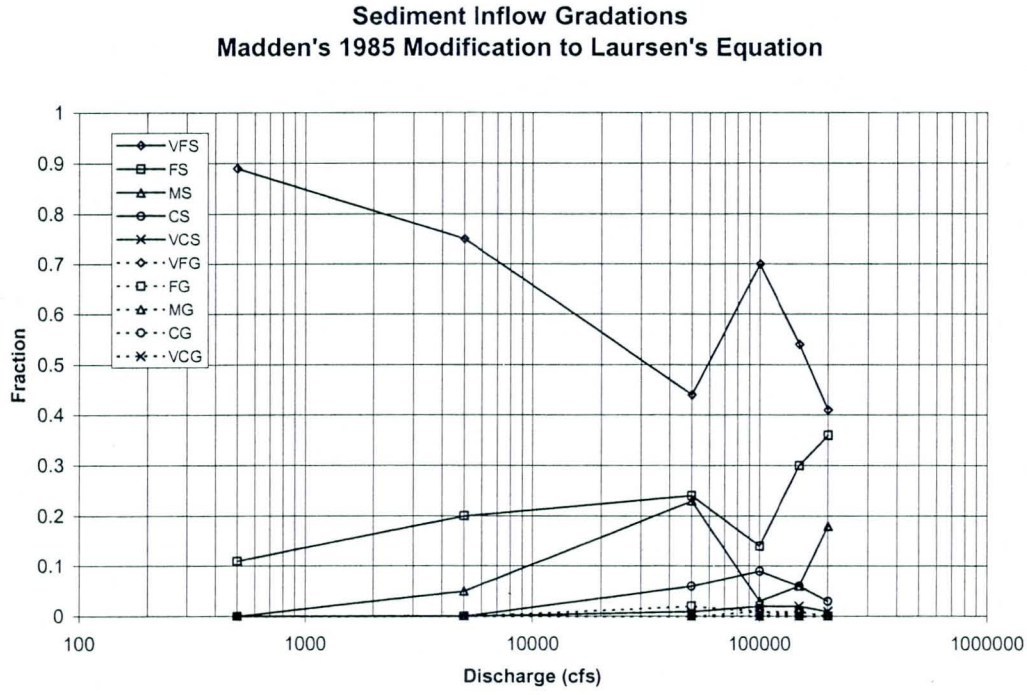


Figure 3-5. Sediment inflow gradations with Laursen-Madden's relation.

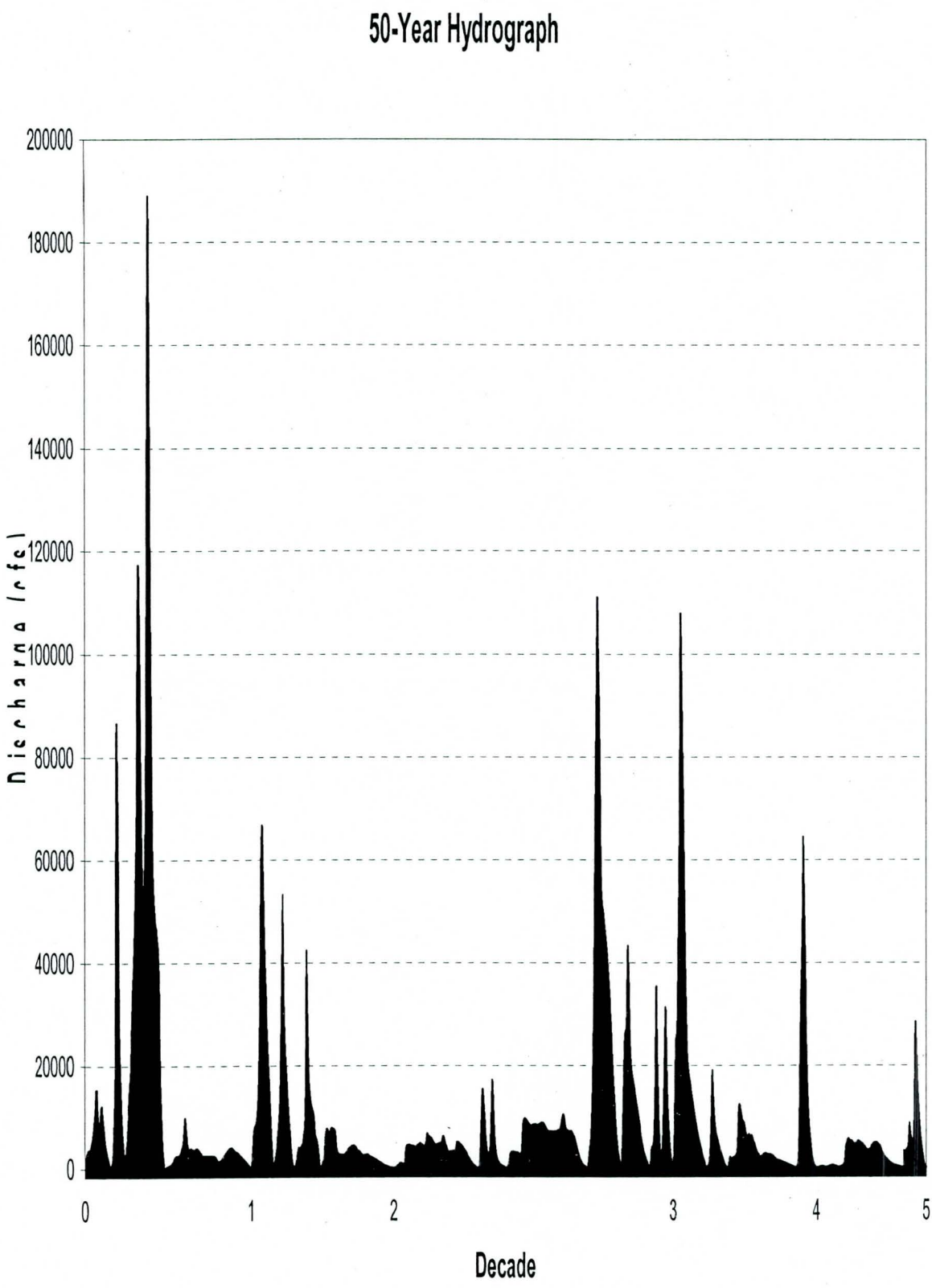


Figure 3-6. 50-year hydrograph used to run the sediment transport model.

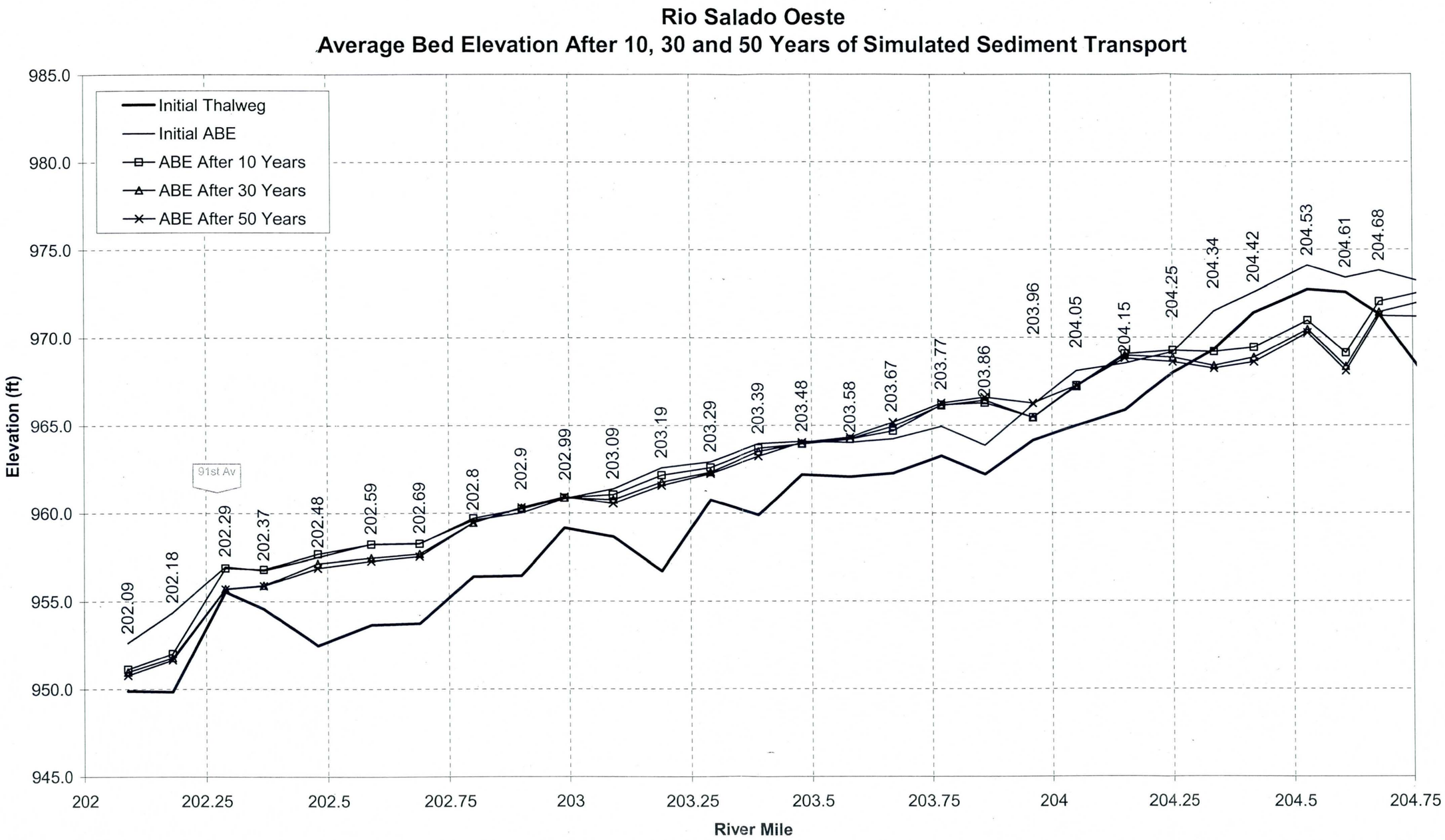


Figure 3-7. Simulated average bed elevation for selected decades.

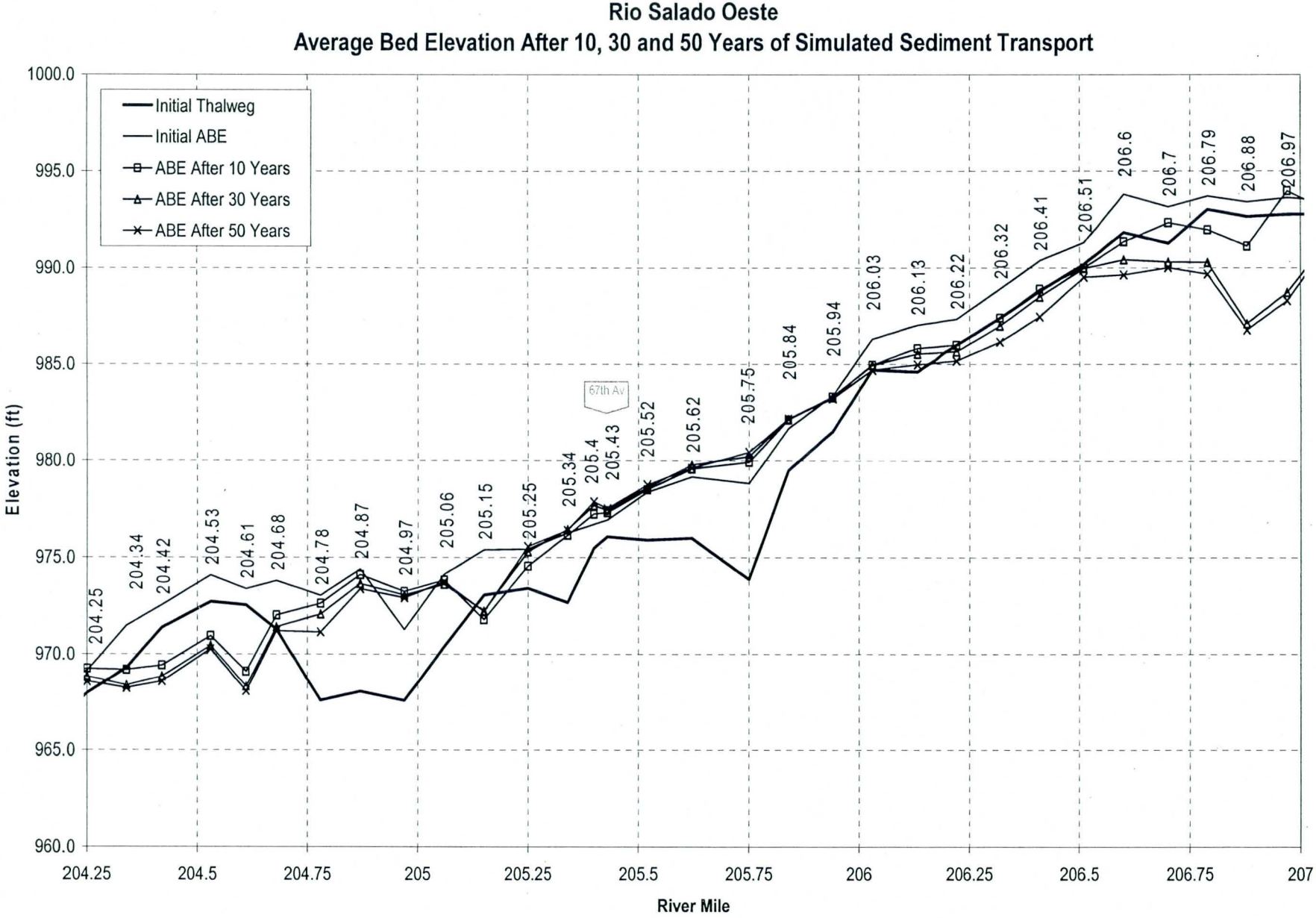


Figure 3-7. *Continued.*

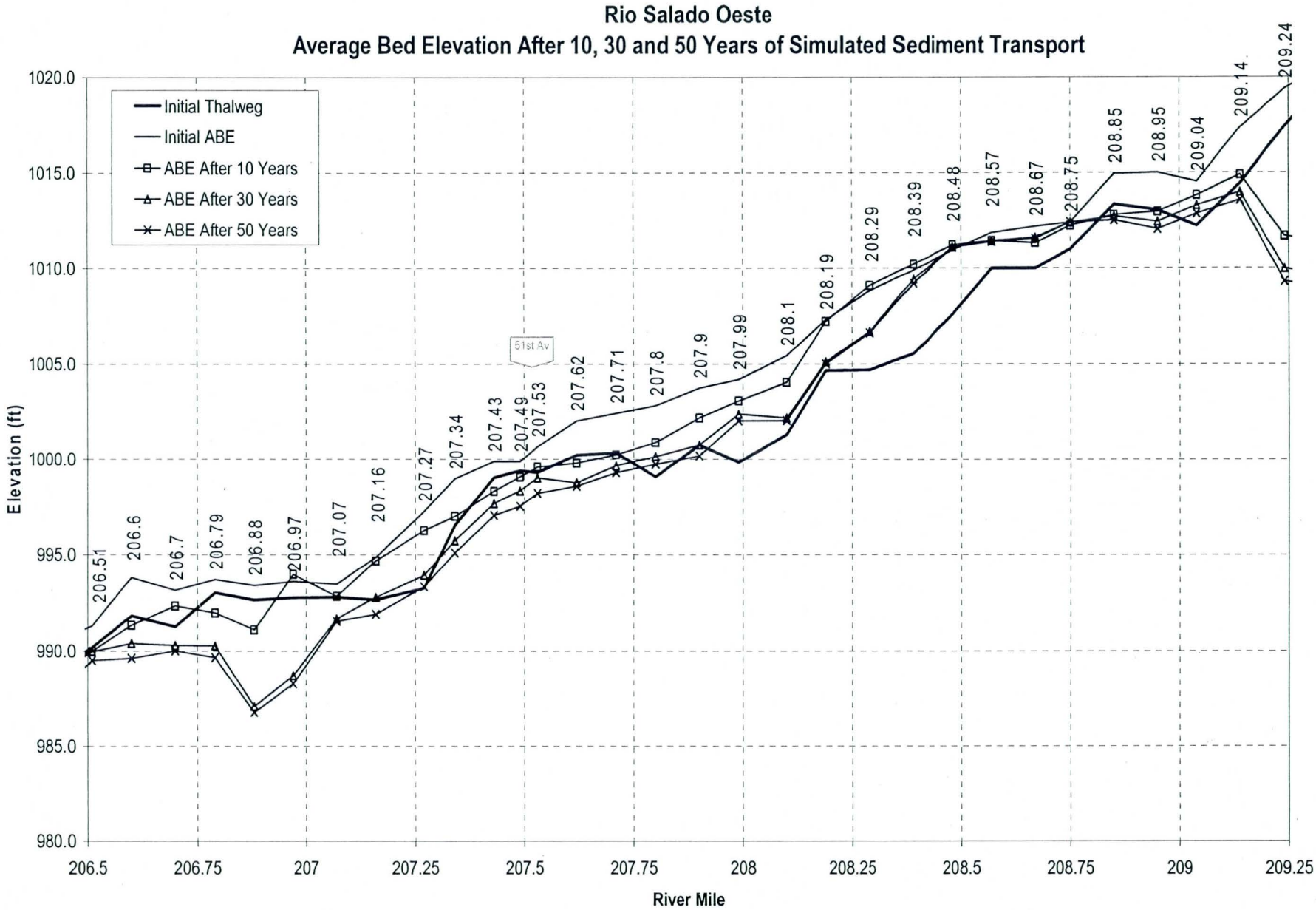


Figure 3-7. *Continued.*

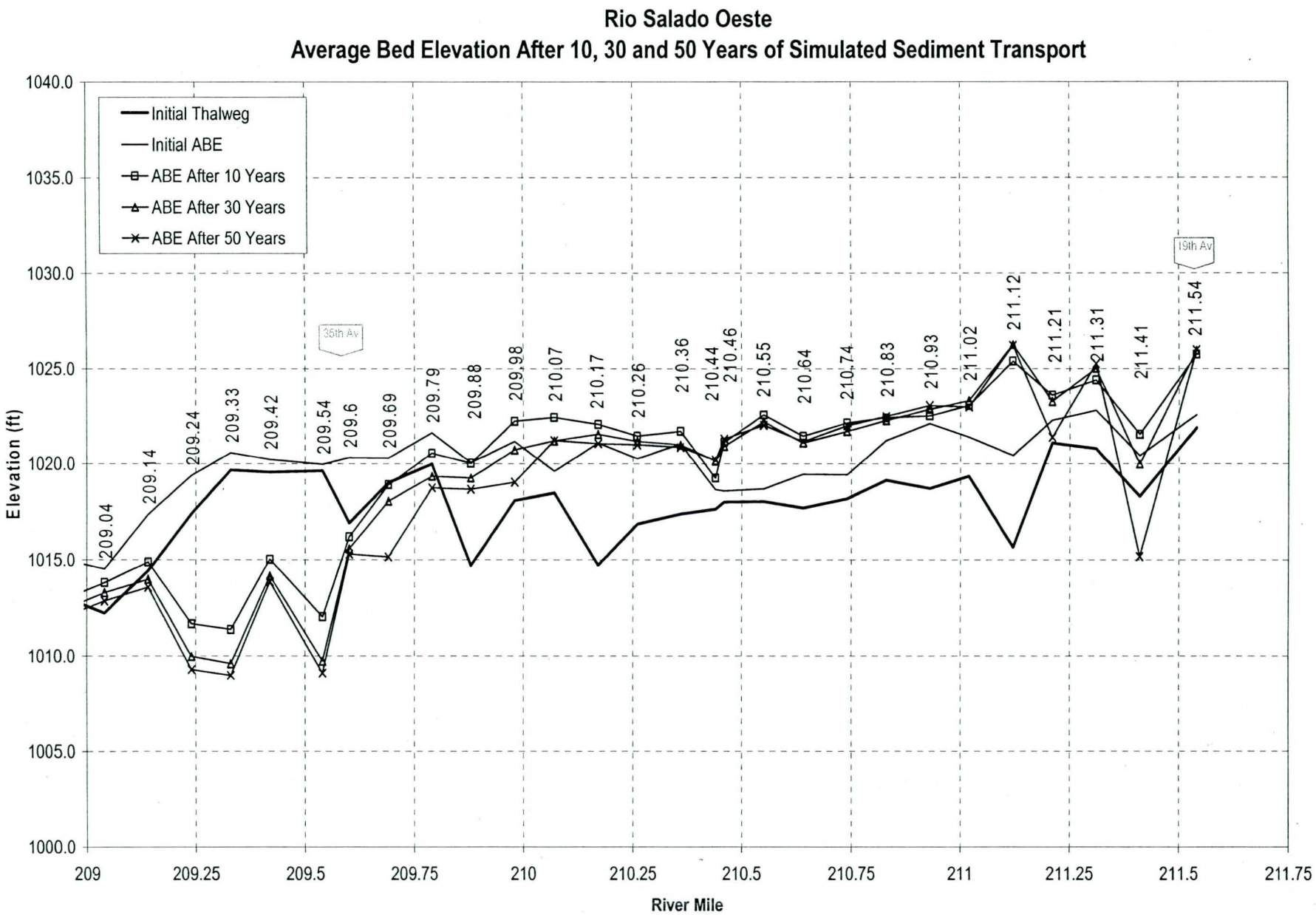


Figure 3-7. *Continued.*

4. Geomorphic Analysis

The primary goal of the geomorphic analysis is to identify historical behavior of the subject river system by the collection and review of historical aerial photographs and the application of geomorphic relationships. The principle objective is to evaluate lateral channel migration, historical bank lines as well as low flow channel locations and sediment aggradation/degradation potential. A qualitative analysis of historical changes to river morphology is followed by a quantitative analysis for basic geomorphic factors of the subject river system.

4.1. Historical Setting

The Salt River was a perennial stream prior to construction of upstream water supply dams in the period 1908-1930. Historical accounts and photographs indicate that the Salt River was a wide, braided channel that supported significant vegetation but was also prone to major flood events. Since completion of the upstream dams on the Salt and Verde Rivers, the study reach has experienced significant periods of virtually no flow.

4.2. Analysis of Historical Photographs and Maps

WEST obtained historical aerial photographs of the project reach for the years 1937, 1958, 1979, and 1999 (approximately every 20 years). In addition, maps from the original land surveys filed in 1870 showing the outline of the river were obtained. The photos and maps were scanned and geo-referenced so as to be compatible with the recent aerial photographs and GIS coordinates. Based on the map and photographic images, a number of analyses were performed and are described in the following sections.

4.2.1. Bank Lines and Lateral Migration

The historical bank lines and channels were reviewed from 1870 to 1999. The historical bank lines, superimposed on the 1999 aerial photography, are shown in Figure 4-1. The Salt River through this reach has been relatively stable but still the river banks 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. Delineating the active channels and banks was made much more complex by the reclamation of fields with active channel scars both upstream and downstream of the new fields as well as expansion of mining pits. Some of the reclaimed areas have subsequently been developed by industrial users.

The lines marked Recent Geologic Banks were determined from reviewing the aerial photos from 1937 to 1999 and viewing the shape of the topographic lines along the river. The boundaries were initially set to include all areas where abandoned meander features were found as well as extending to the areas where the contour lines changed direction from following the regional slopes to being perpendicular to the river channel. This coverage should be fairly close to the maximum historical meander belt for the river in this reach. It varies from approximately two miles in width at 19th Avenue to approximately four miles in width at 91st Avenue.

The river is constrained upstream from 19th Ave by levees constructed as part of earlier projects. The soil cement levees end just downstream from the 19th Ave Bridge and the river is unconstrained by levees until just above the 91st Ave water treatment plant. River alignment is fixed to some extent by bridges located at 35th Ave., 51st Ave. and additional proposed bridges for a future freeway crossing at approximately 61st Ave. The 35th Ave Bridge is very short and provides a significant constriction to flows. The other bridges have much larger openings and provide little, if any, flow constriction.

4.2.2. Low Flow Channel

The historical centerline of the low flow channel, or thalweg, was determined by using the same information previously described. Identification of the main flow channel was sometimes difficult as the system is braided and multiple flow paths can usually be seen at any given time around islands and bars. The thalweg lines from 1870 to 1999 are shown in Figure 4-2. Similar to the bank lines, one can observe that the thalweg consistently shifts its position within the meander belt (compare the thalweg location with the bank lines shown in Figure 4-1). This shifting is typical of braided river systems. The thalweg locations are, however, all within 2000 feet of one another from the downstream boundary of the study at 91st Avenue up to about 35th Avenue. Upstream of this point, the thalweg locations diverge. Available evidence indicates that the river used more northerly channels up until the 1950's, with a shift in the thalweg location to a more southerly location from that time to the present.

4.2.3. Vegetation

Sparse vegetation can still be seen in the 1937 aerial photographs. However, the other sets of aerial photos (1958-1999) show no significant amounts of vegetation in the study reach.

4.2.4. Mining Activities

Mining activities in the Salt River play a significant part in the sediment balance of the river system. In the 1937 photographs, no significant mining activities are seen in or near the river channel. In 1958, two large pits can be seen at the upper end of the study reach (upstream of 35th Avenue). The increase in observable mining activities continues in the 1979 photographs where more pits are observed. These are still located primarily in the upstream part of the study reach. The 1999 photographs show at least 12 pits in and near the river channel more evenly distributed along the reach than in previous years (although still predominantly in the upper portion of the study reach). Since some of these pits are located near the main channel and the river currently flows through some of these pits, they have significant impacts on local flows. These impacts include the redirection of flows through the pits and away from former channel alignments, erosion upstream and downstream from the pits as well as deposition of sediment in the pits.

4.3. Channel Response to Flood Events

To accurately gage the changes wrought by the river to its channel during major flood events, photographs immediately prior to and after the event should be compared. Such a detailed comparison is not part of the present study and photos immediately prior to the floods are not available. However, some information may still be gleaned from the

photos used in this study. For example, in each period in between the dates of the aerial photography (1937-1957, 1958-1979, 1979-1999) a major flood occurred on the Salt River, with the exception of the period 1937-1958. Observing the bank lines and aerial photographs for the period with out large floods reveals that very little change occurred in the channel in the absence of large flood events. During the period between 1973 and 1999 (includes the 1993 Flood) for example the banks in the upstream reach were impacted primarily by gravel mining while areas near 67th Ave and 83rd Avenues widened significantly due to flood events. The widening of selected sections can be seen in comparing the banklines from the various time periods in Figure 4-1.

4.4. Geomorphic Relationships

The current channel geomorphic properties were analyzed in order to quantitatively examine channel stability and potential for lateral migration.

4.4.1. Channel Planform

Leopold, Wolman, and Miller (1964) adopted the sinuosity ratio, defined as the channel (thalweg) length divided by the valley length of the stream, as a criterion which could be used to classify river patterns. Through the observation of several natural river systems, they concluded that systems with a sinuosity greater than or equal to 1.5 would be classified as meandering, while those less than 1.5 would be braided or straight. The average sinuosity for the study reach was approximately 1.4.

Also, Lane (1957) and Leopold & Wolman (1957) developed relationships between channel pattern, channel gradient, and mean discharge based on field data. Figure 4-3 shows these relationships graphically. The significance of this figure is that rivers situated close to the meandering-braided threshold would be expected to experience transitions between one channel form and the other. Utilizing the 5- and 10-year discharges (20,200 and 53,000 cfs, respectively) as indicators of either the mean (Lane) or bankfull (Leopold & Wolman) discharge, error bars are shown for the study reach. The error bar indicates the range of slopes found in geomorphically similar subreaches within the study reach. It can be seen that the study reach plots well into the braided region for both criteria.

4.4.2. Width / Depth Ratio

Width/depth ratios were computed for the study reach using the HEC-RAS model results for both the 5- and 10-year discharges. Results are shown in Table 4-1. It is seen that the channels are very wide and shallow, reflecting the observed braided system (several researchers have defined ratios of 40 or above as "very high", e.g. Rosgen, 1994).

Table 4-1. Width / depth ratios.

	5-Year Flow	10-Year Flow
Maximum	800	561
Minimum	44	31
Average	193	176

4.5. Sediment Aggradation/Degradation Potential

It is common in geomorphic studies to identify "equilibrium" conditions that the channel would experience if inflowing and outflowing amounts of sediment were perfectly in balance. Then areas expected to experience aggradation (deposition) or degradation (erosion) could be identified for areas not conforming to the predicted equilibrium conditions. However, this type of analysis is usually performed either as a precursor to, or in place of, a more detailed sedimentation modeling study. Because such a modeling effort forms part of the current study, and results in predictions of erosional or depositional areas, a separate and more general geomorphic analysis will not be performed here with the exception of a review of recent historical thalweg elevations.

An historic HEC-2 model was obtained from the FCD that contained cross section and thalweg elevations for 1982. This data was compared with the data collected by Baker in 1994 that served as the basis for the current study. These data were also compared with the thalweg from the 50 year simulation as plotted in Figure 4-5. It can be noted that there are some differences between the 1982 (pre-flood) and 1994 (post-flood Baker) data. One of the primary differences is at the 35th Ave bridge where the Baker data shows an extremely deep scour hole under the bridge due to the flood. The 1982 and the future condition thalwegs in this area are nearly in agreement indicating that the channel is relatively stable in this reach for the conditions modeled with large floods scouring deep holes under the bridge to facilitate passage of their high flows.

The channel topography in the TIN supplied for analysis appears to be based on the water level in the river under the bridge rather than the bed elevation as can be seen in Figure 4-6. It was noted, however, that the bed adjusted to the same elevation in the future conditions model regardless of whether the channel elevations from the Baker model (deep scour hole under bridge) or the water surface was used as the initial channel invert.

The 1982 and future thalweg elevations are within approximately 5 ft of each other with most of the larger differences in areas that were mined in prior to the 1982 topography. Differences can be seen at RM 209 and 210.5 for example where mining pits appear to have filled during the 1993 flood.

The correlation between the historical and predicted future conditions again indicates that the river is in a state of dynamic equilibrium and tends to return to its pre-existent state if adequate flow and sediment is available. The impact of gravel mining, at least since 1982, does not appear to have impacted the overall stability of this reach although impacts near the pits are significant.

4.6. Geomorphic Summary

The entire study reach is classified as a braided channel system, conforming to observations in the field and from historical documents and photographs. Braided systems generally have wide main channels in which multiple low flow channels cross, resulting in the braided channel.

Braiding is believed to result primarily from random deposition of materials (sediment) transported during high flows in quantities or sizes too great for continued transport during low flows. Accordingly, as the stream discharge is reduced, larger sediment particles begin to drop to the bed as the stream "sorts" or leaves behind those sizes of the transported sediment (load) which it is unable to transport. The accumulation of these particles on the channel bed initiates the formation of a bar which serves to trap even more sediment particles. Although the depth of flow over the growing bar is gradually decreased, velocity over the bar tends to remain undiminished or even to increase so that some particles moving along the bar are deposited beyond the downstream end where a significant decrease in velocity is associated with the marked increase in depth of flow. Thus, the bar grows by successive addition of sediment particles at its downstream end and some additional growth along its sides. Additional bars will then be propagated through the same process described until the channel obtains its characteristic braided pattern. Growth of the bars will eventually reach a size that will significantly alter the channel conveyance capacity at which time the channel will seek a new equilibrium condition.

The shifting, changing nature of braided channels and the fact that they are often generated by sediment deposition and bed aggradation has led many engineers and river scientists to associate them almost exclusively with disequilibrium in the fluvial system. However, as Leopold et al. (1964) pointed out, braided river systems are a distinct and viable category of dynamically stable planform, along with straight and meandering systems. 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.

4.7. Lateral Bank Migration Rates

It is extremely difficult to predict bank retreat or lateral migration rates in braided river systems. A braided river system regularly attacks its banks and moves them back as the braided meander patterns shift across and along the river. Once a braid of the river directly attacks a bank it normally will retreat rapidly until the meander shifts and the attack terminates. The rate of bank retreat may thus be several hundred feet for a single event but over the historical record be only a few feet per year. Thus a bank that appears stable can retreat very rapidly while under attack and yet appear stable for long periods of time while the river is attacking the bank in other locations. Other banks are relatively resistant and can withstand a direct impact of a braid with little retreat. The limited number of flows in the Salt River only increases the difficulty of estimating long term rates of retreat.

The fact that a bank has been stable for the historic record may only mean that the full force of the river has not, as yet, been redirected toward that bank. If the historic record of bank lines is reviewed in the context of limits presented in Figure 4-2 as the

Recent Geologic Banks, it can be noted that the river has moved widely on the floodplain over its geologic past. Given the proper flows, meander bends, braid patterns, and bank conditions, the river could again move to its geologic limits or even beyond. Given the exiting constraints the movement of the river to its Recent Geologic Banks is unlikely however.

Notwithstanding the difficulty in the estimation of retreat rates, some estimate of probable bank movement can be made based on current constraints, existing patterns within the river and historical bank lines. Based on the historical record as well as geomorphic principles, it is probable that the river will stay within the limits shown in Figure 4-4 as the Probable Lateral Migration Limits. That is not to say that without protection that the river will stay within these limits indefinitely but only that for flows up to and including the 100 year event the river would not be expected to move dramatically beyond the limits shown in a single or short series of events. These lines take into account the historical bank lines as well as the expected bank attacks during high flows.

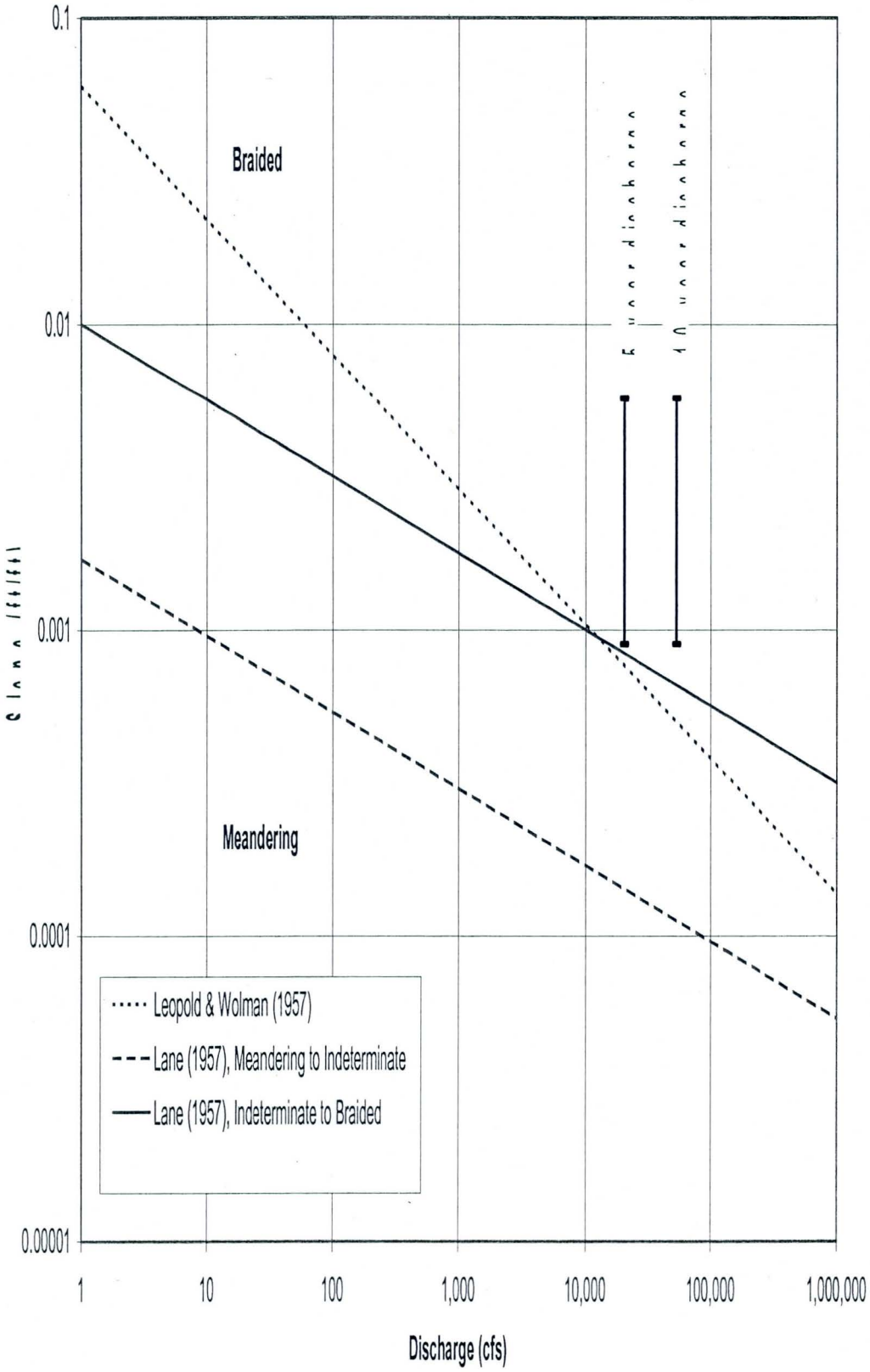


Figure 4-1. Project reach predicted channel form.

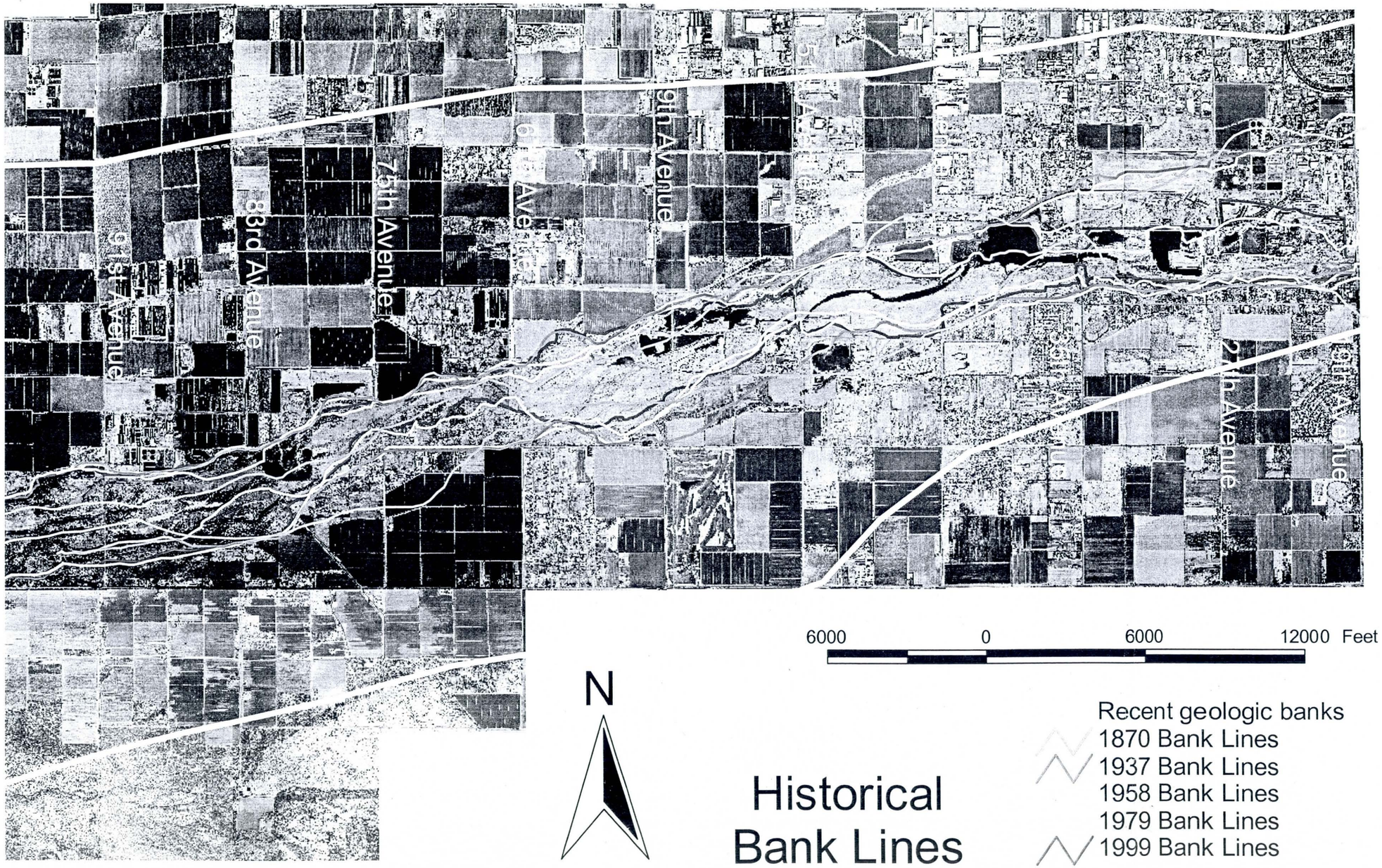


Figure 4-2. Historical bank lines.

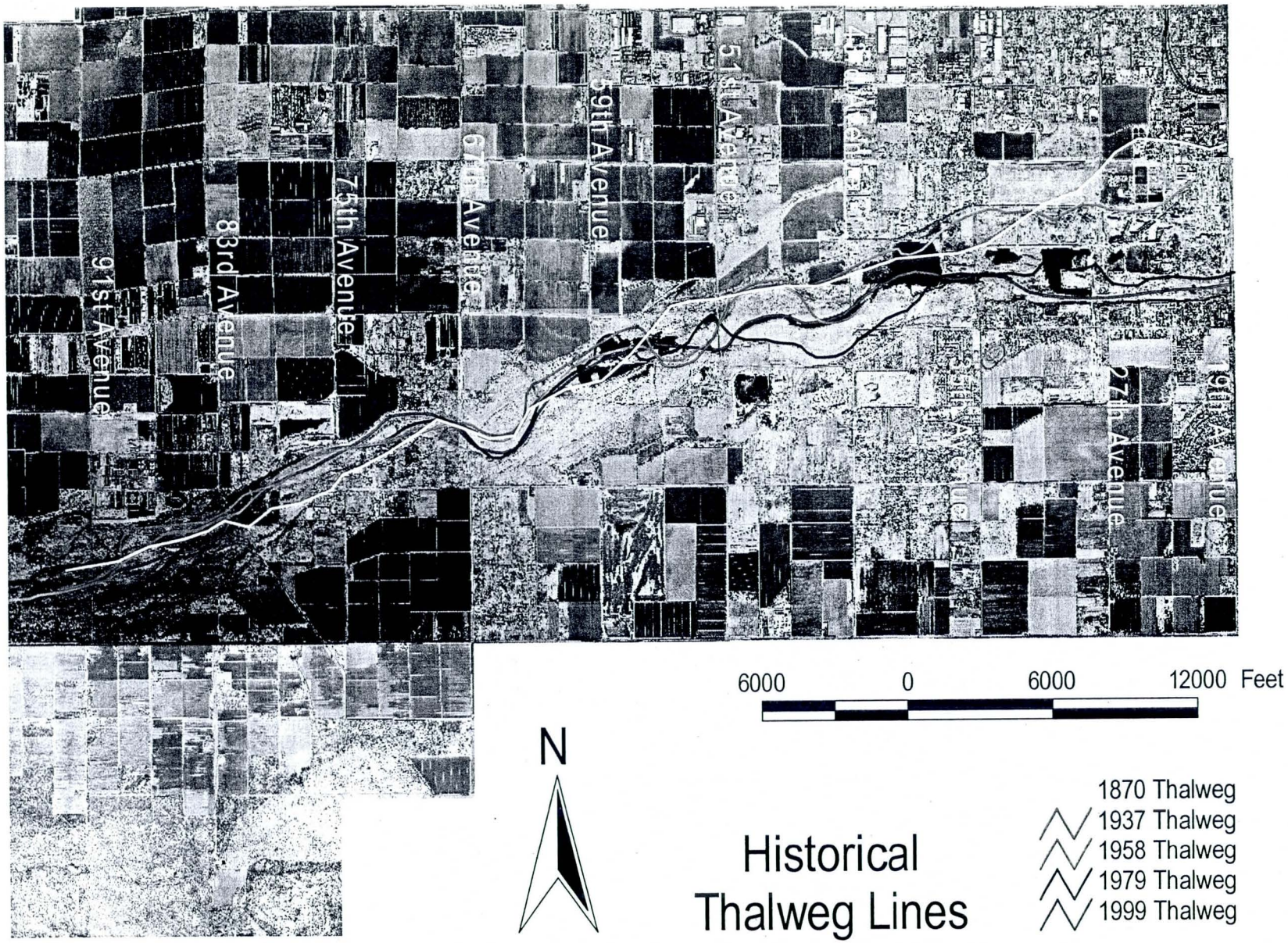


Figure 4-3. **Historical thalweg lines.**

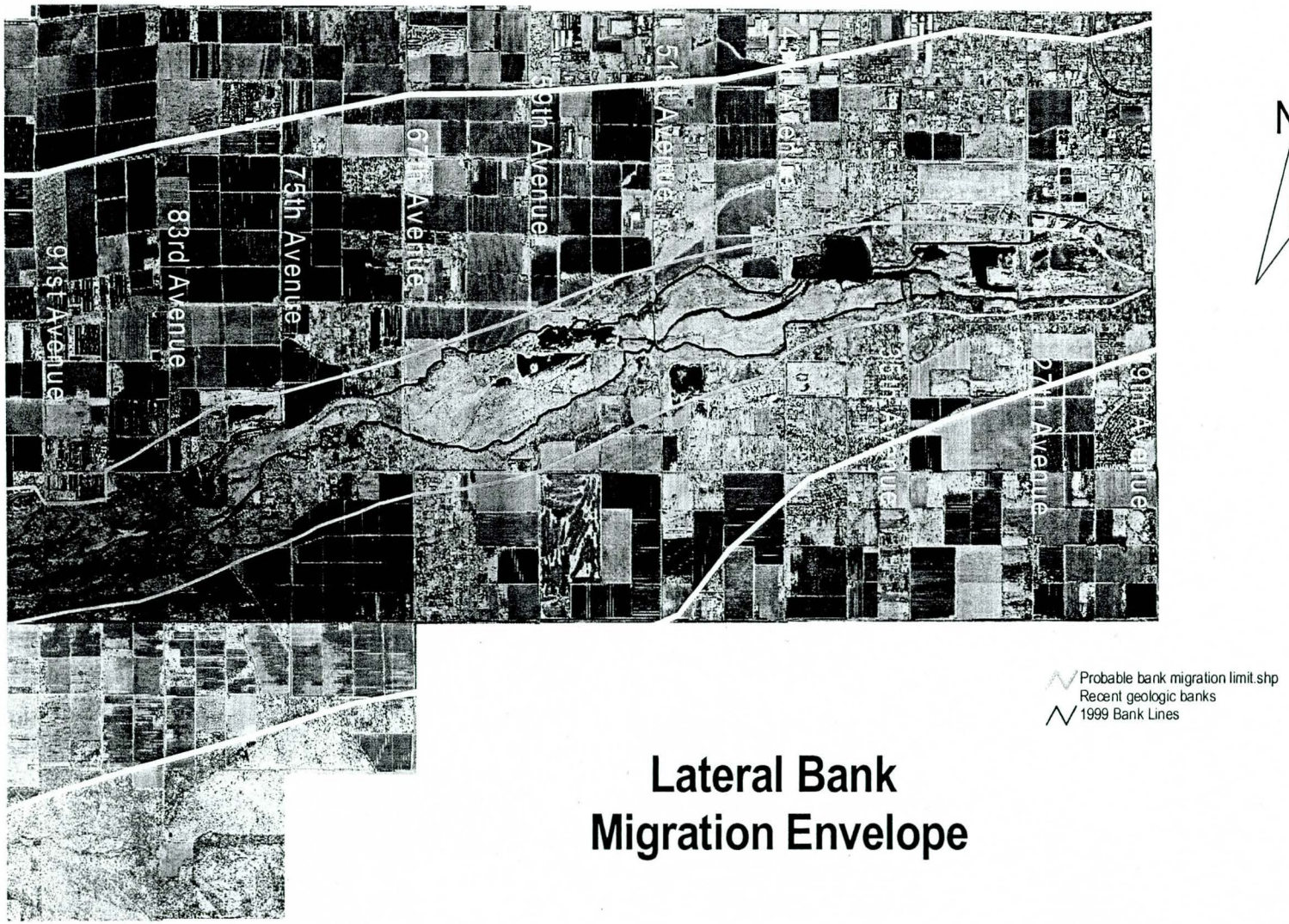


Figure 4-4. Estimated Lateral Bank Migration Limits.

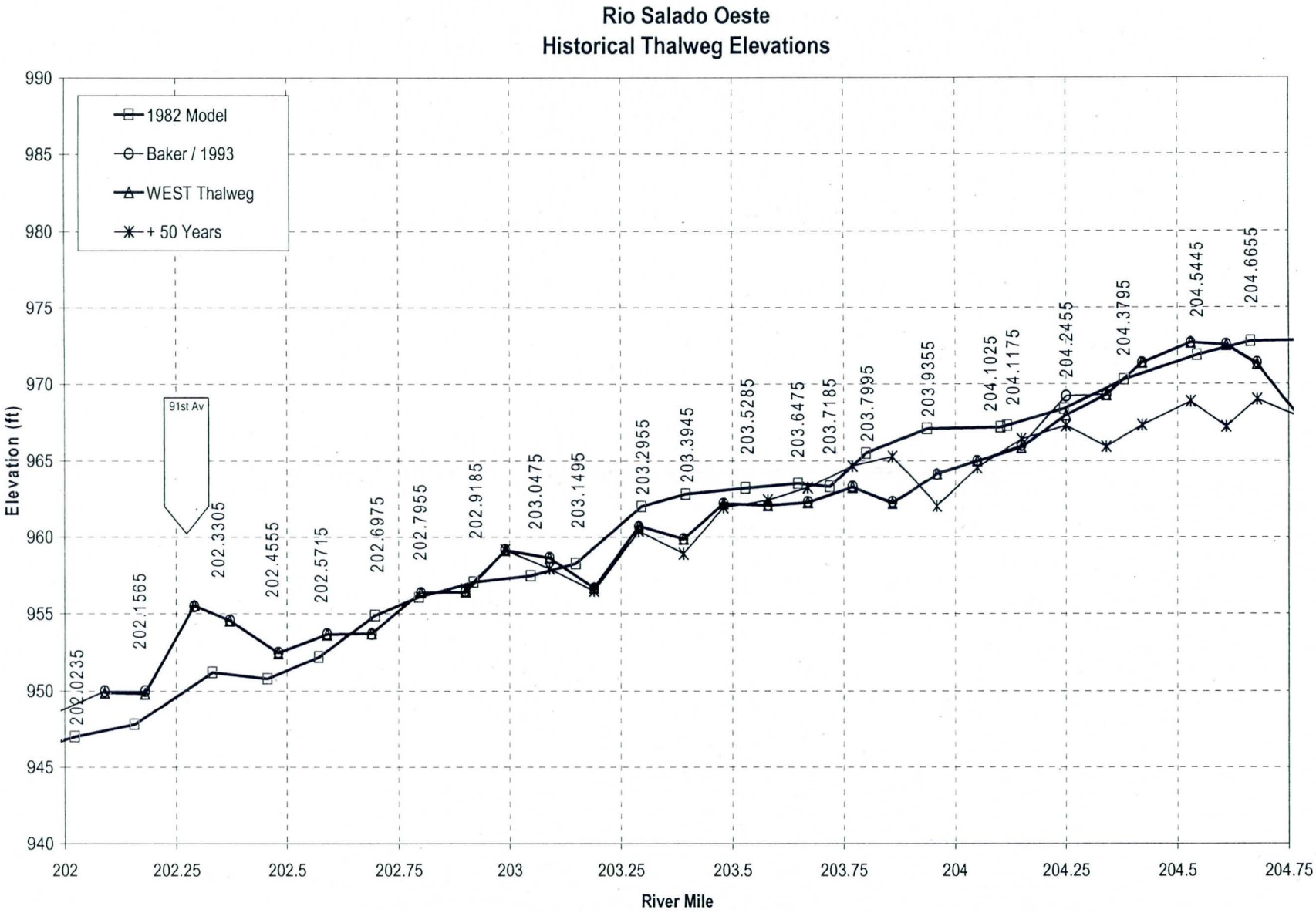


Figure 4-5. Recent Historical Thalweg Elevations of Salt River from 19th Avenue to 91st Avenue.

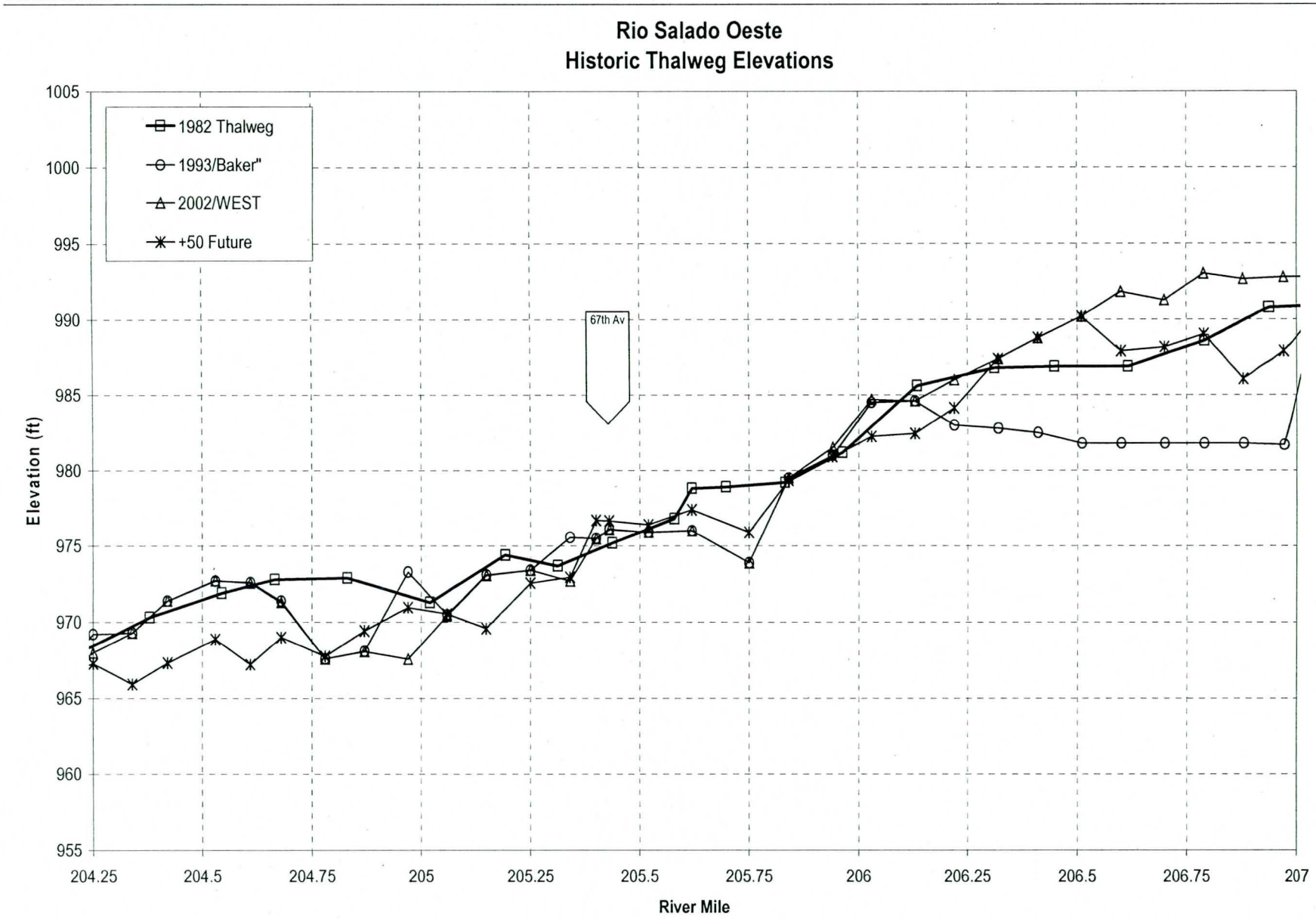


Figure 4-5. *Continued.*

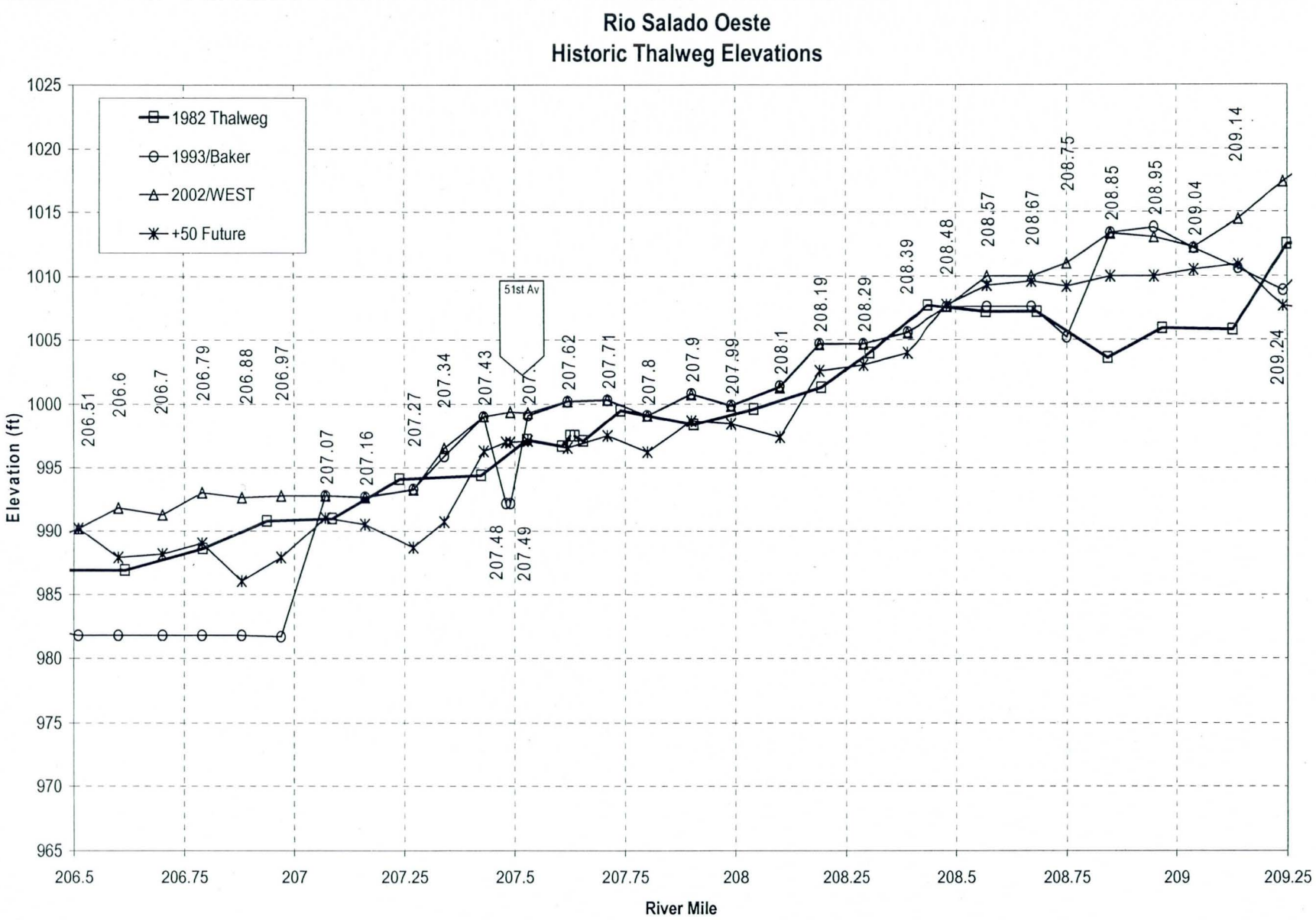


Figure 4-5. *Continued*

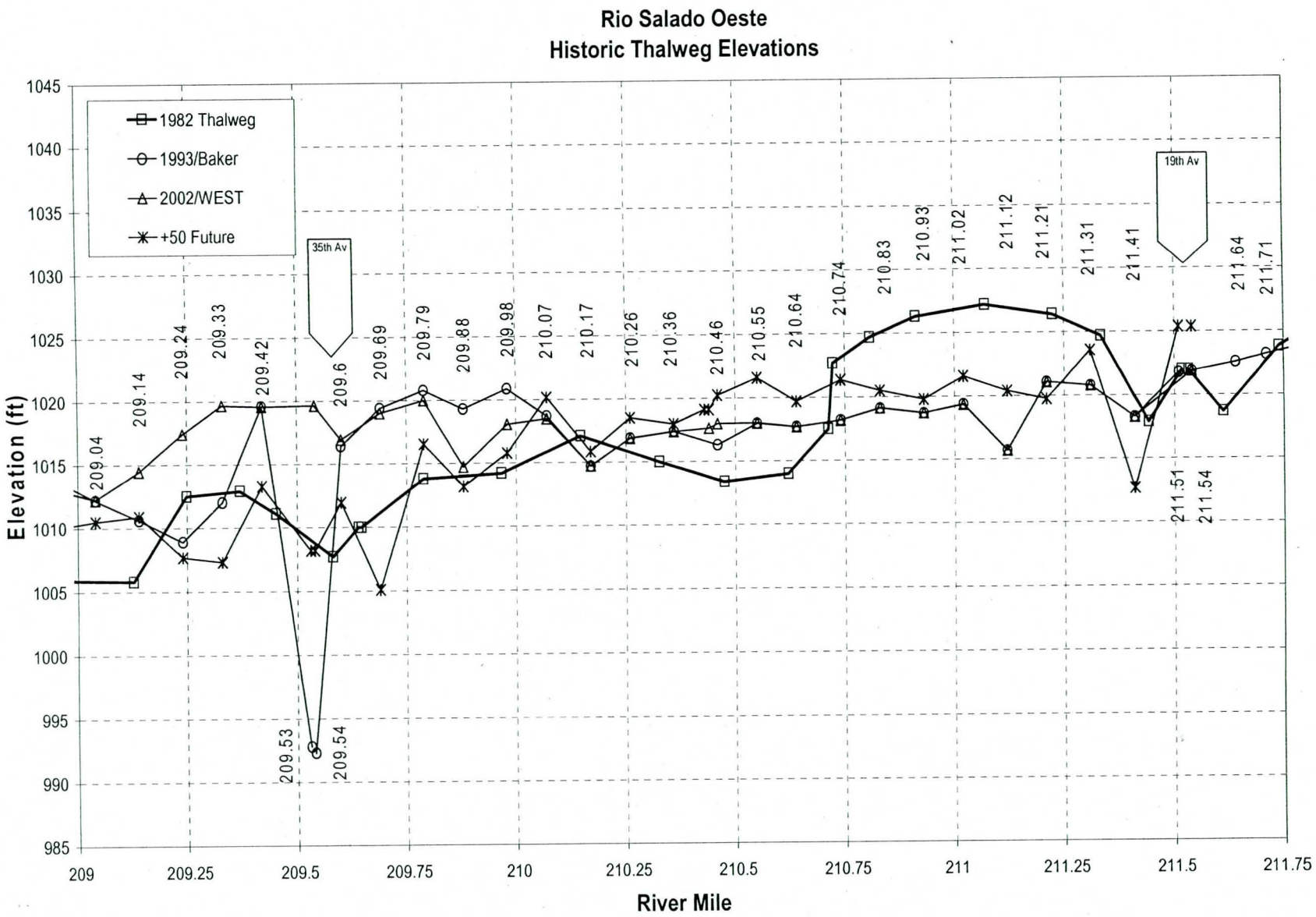


Figure 4-5. *Continued.*

5. Future Without-Project Hydraulic Analysis

HEC-6T generates an output file with the extension T12 where it stores the model geometry at the end of the simulation. The cross section geometry after 10, 20, 30, 40 and 50 years of sediment transport simulation was used to create five new hydraulic models in HEC-RAS. The new cross sections reflect the erosion or deposition that occurred during the sediment transport simulation.

The bridge geometry from the existing conditions model was added to the future conditions model, but first some manipulation of the T12 file was required. HEC-6T uses just one cross section with the superimposed pier geometry to represent each bridge, while HEC-RAS uses two cross sections with bridge geometry specified between the cross sections. Therefore, it was necessary to remove the piers from the bridge cross sections in the T12 file, and a copy of each bridge cross section in the T12 file (with the piers already removed) was placed downstream of each bridge in the HEC-RAS model. The stations of the new downstream cross sections were then adjusted laterally to match the end points and banks of the cross sections downstream of the bridges in the existing conditions model. These new cross sections, placed at the downstream side of the bridges, preserved the distances in the existing conditions model, and the bridge geometry was then imported from the existing conditions HEC-RAS model to complete the future conditions HEC-RAS model.

Hydraulic simulations were performed using the roughness coefficients (Manning's n) in the existing conditions model. Channel and overbank roughness values were then increased 10, 20 and 30% to reflect vegetation growth assuming no clearing is carried out during the 50-year simulation period. Complete simulation results are provided in Appendix J.

Water surface profiles by decade were generated for the 5-, 10-, 20-, 50-, 100- and 500-year discharges in HEC-RAS. Figures 5-1, 5-2 and 5-3 show the water surface profiles for the 10-, 100- and 500-year flood events after 10, 30 and 50 years of sediment transport simulation.

The future conditions water surface profiles are smoother than the existing conditions profiles, as expected for a bed profile with a more homogenous slope. The main differences appear upstream of the 35th Avenue Bridge. The bridge opening in the future conditions model is bigger due to the erosion of the cross section, and therefore the backwater effect diminishes. As a consequence, the inundation boundaries for the future conditions model upstream of 35th Avenue would not extend as far from the channel as for the existing conditions model. If the topography in the TIN shows the water surface under the bridge the initial water surface elevation would be lower and flooding would not be as widespread as indicated in the initial conditions model. A verification of the actual bed elevations should be performed if the bridge is not scheduled for replacement.

The effect of increasing the roughness coefficients to simulate vegetation growth is shown in Table 5-1. The table shows the average increase in water surface elevation caused by an increase of 10, 20 or 30% in Manning's n from the values in the Existing Conditions model.

Table 5-1. Future conditions hydraulic analysis: sensitivity to roughness coefficients.

Flood Event	Average increase in water surface elevation (ft)		
	10% increase in Manning's n	20% increase in Manning's n	30% increase in Manning's n
5-year	0.3	0.5	0.8
10-year	0.4	0.8	1.1
20-year	0.4	0.9	1.3
50-year	0.5	1.0	1.5
100-year	0.5	1.1	1.5
500-year	0.5	1.0	1.5

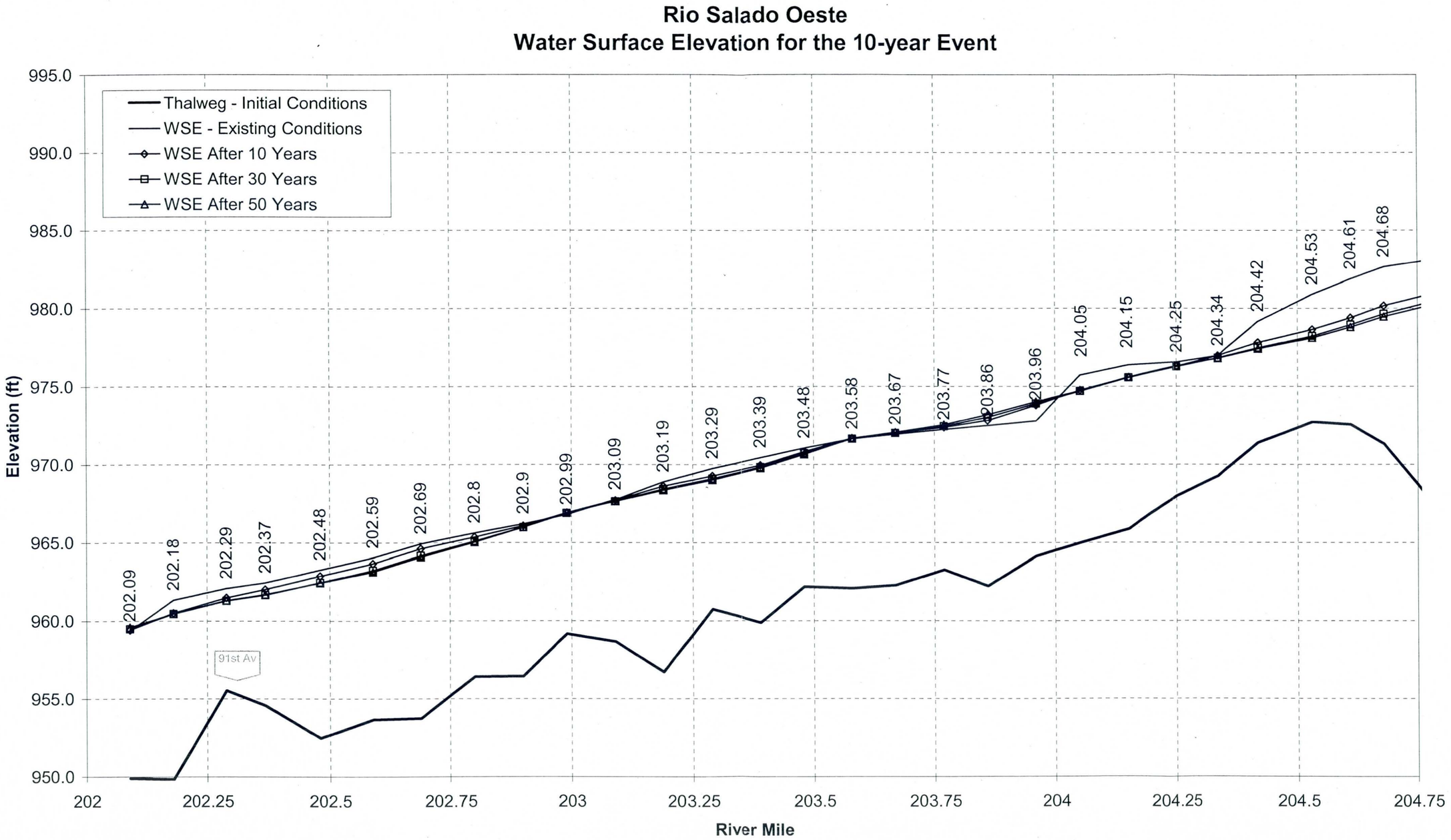
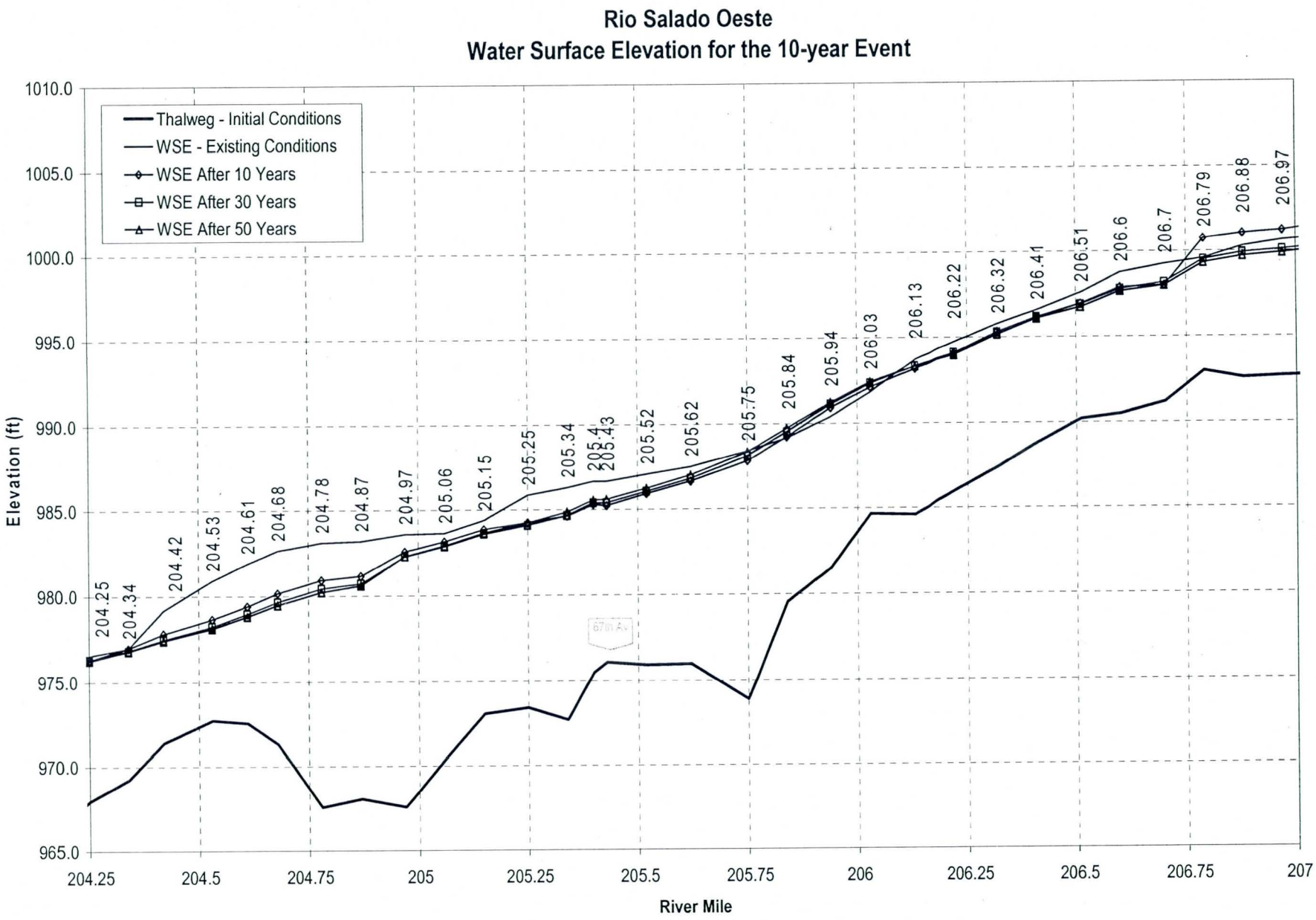


Figure 5-1. Future conditions hydraulic analysis: 10-year flood event.



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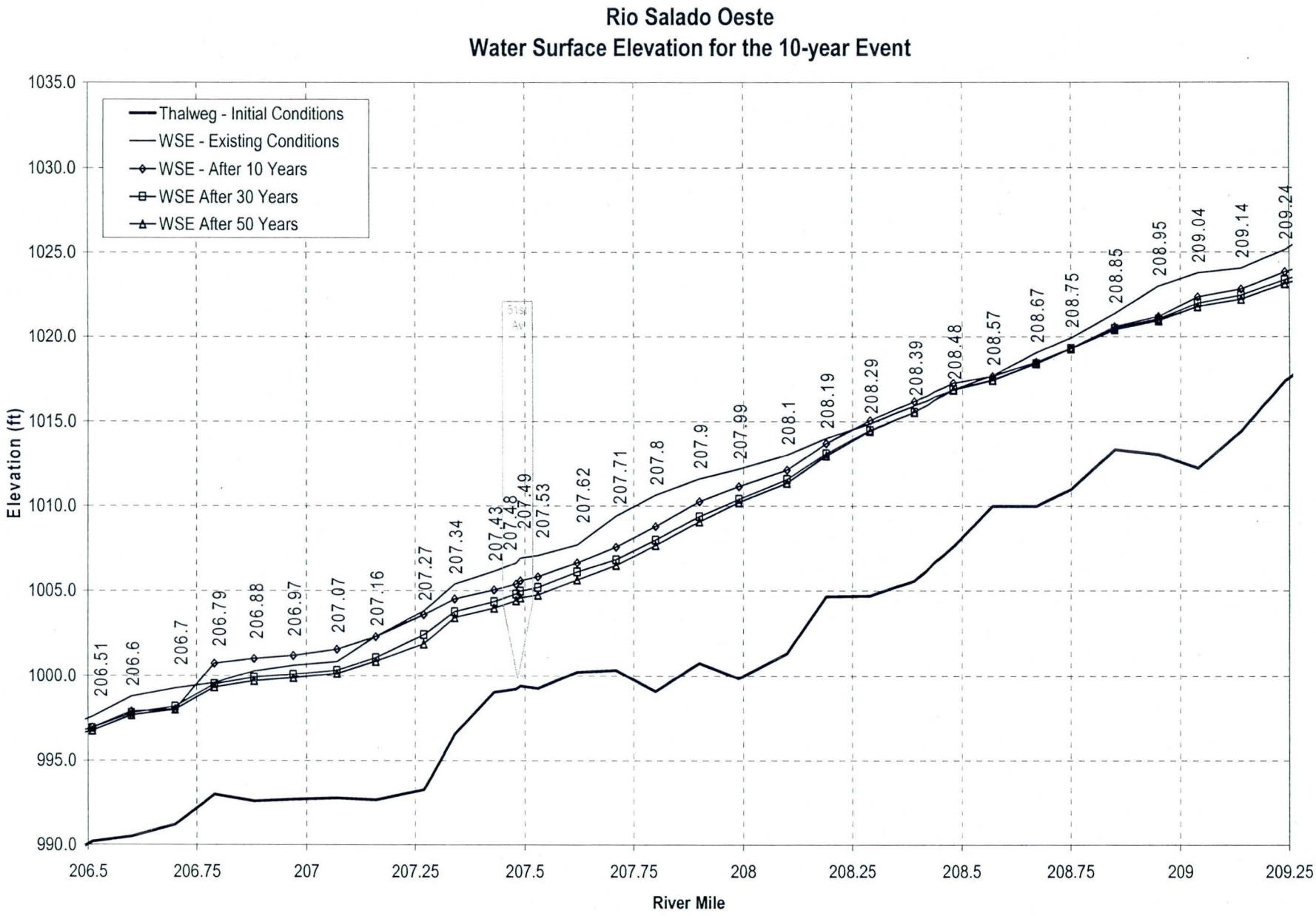

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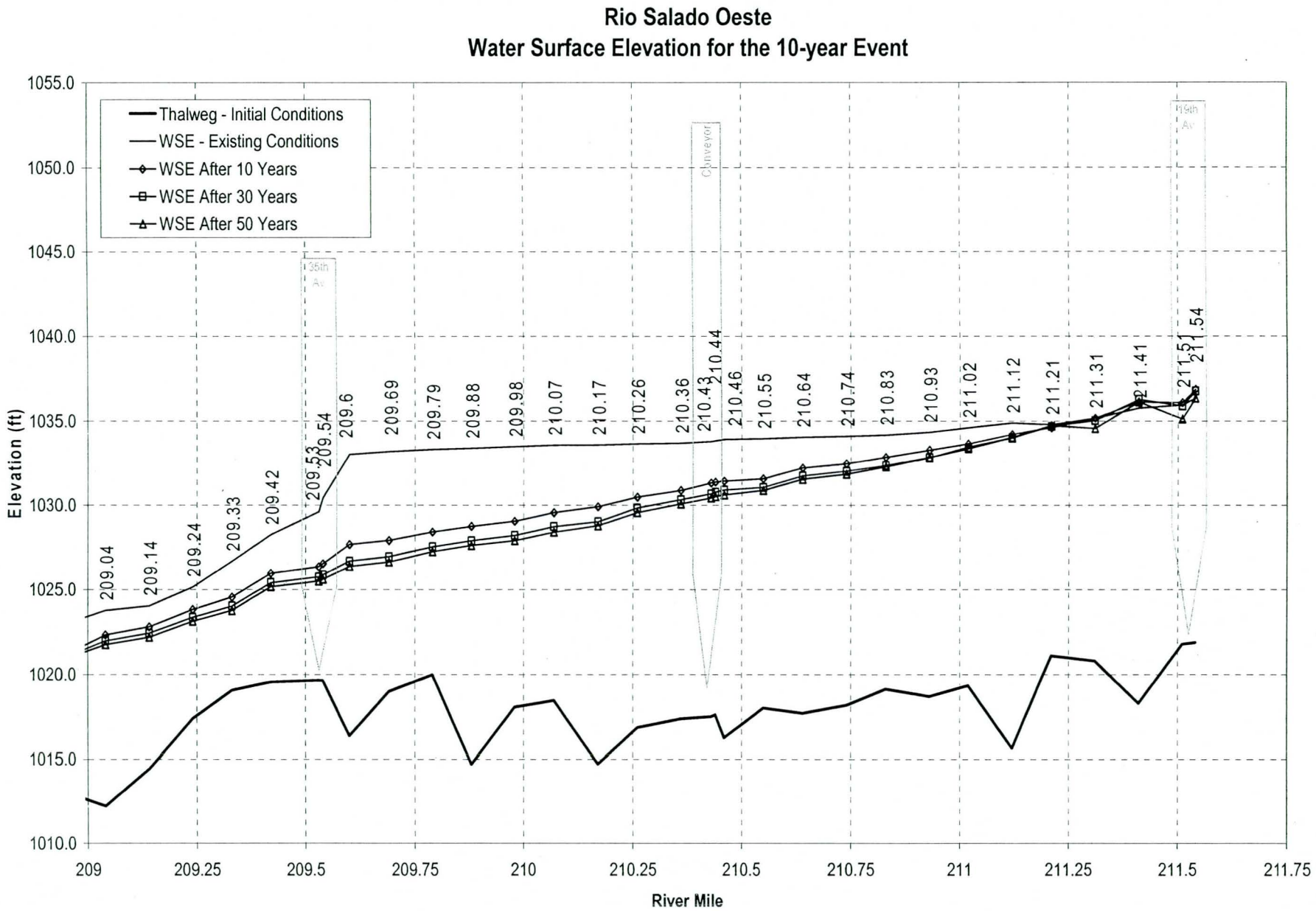

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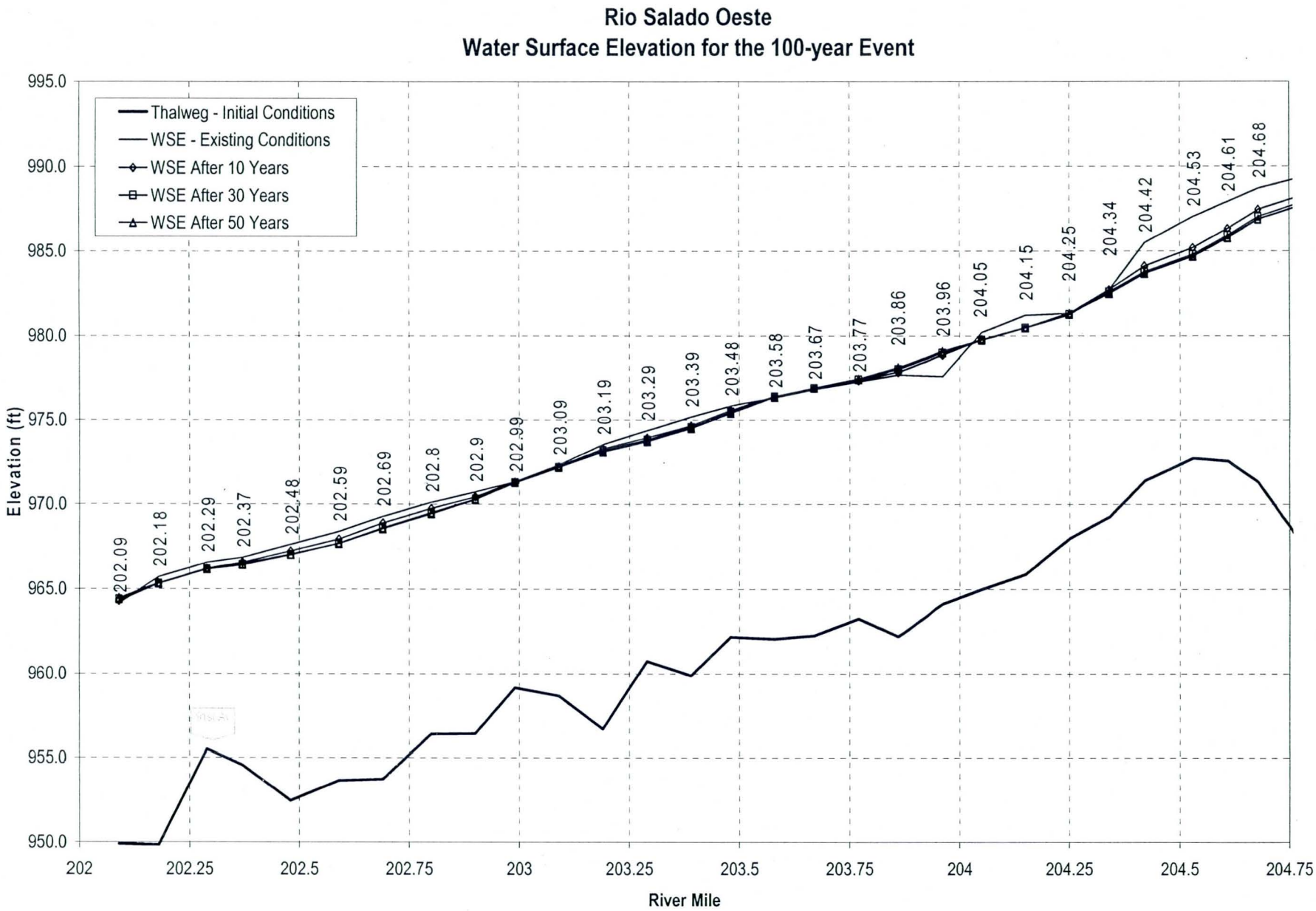

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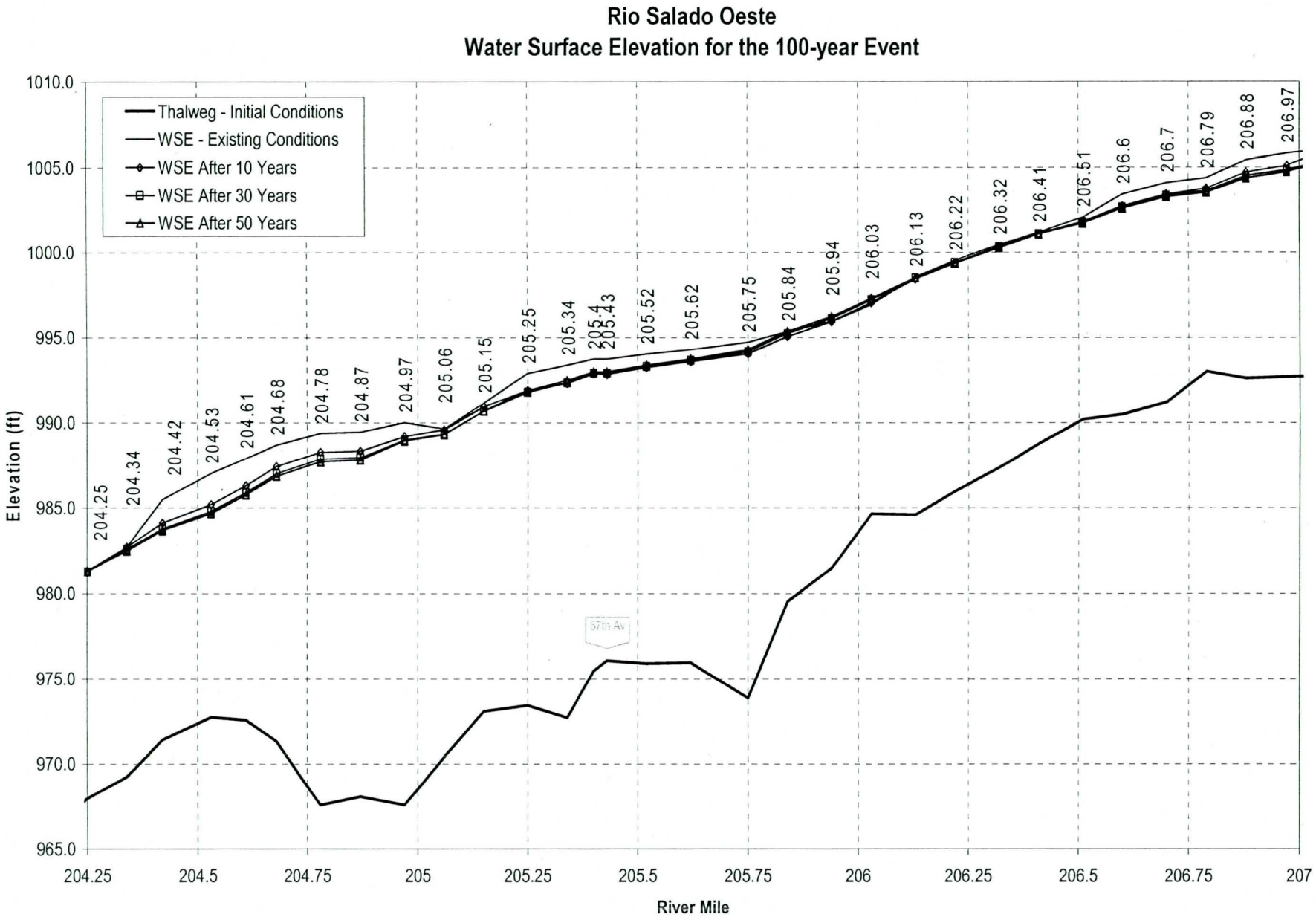

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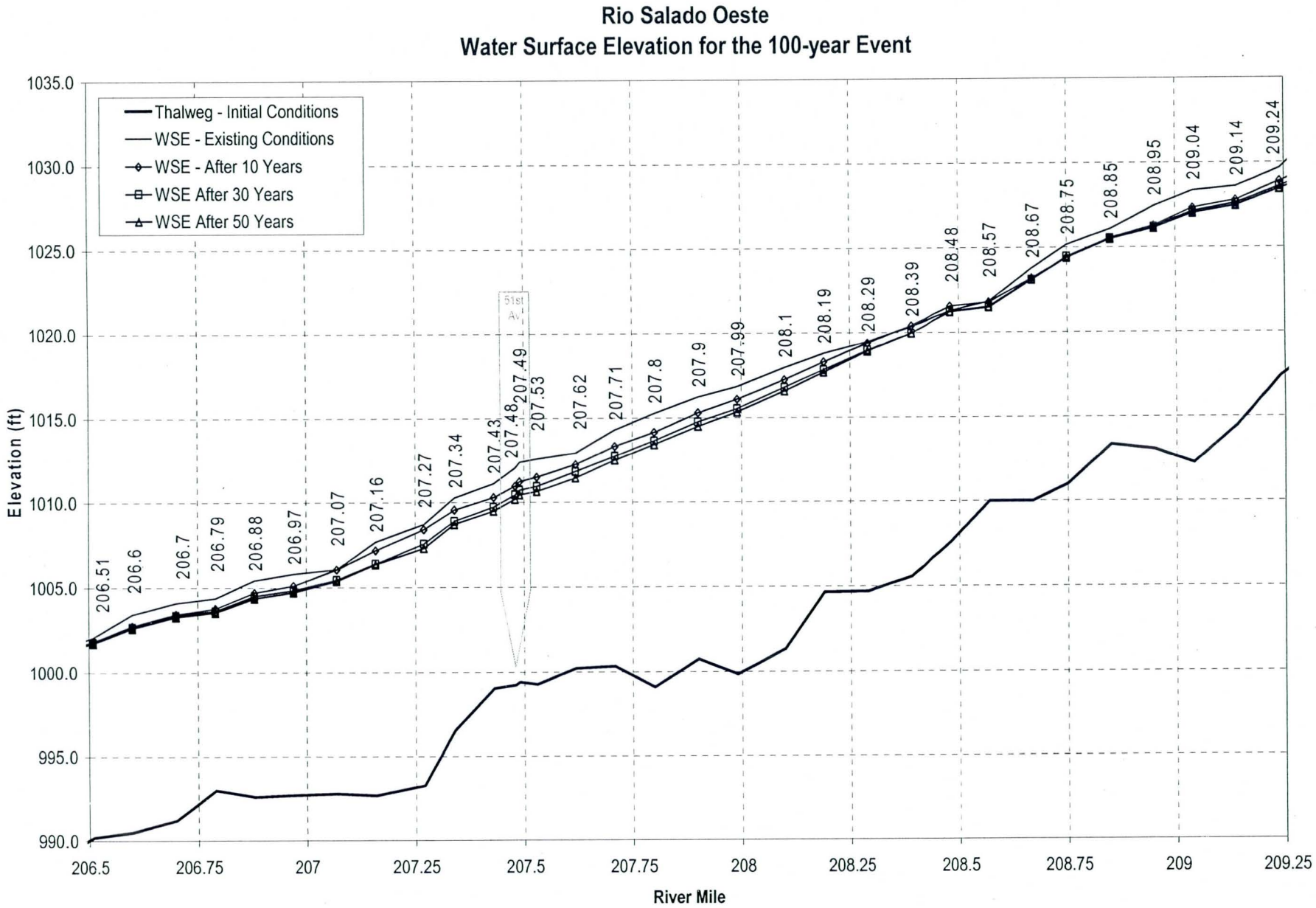

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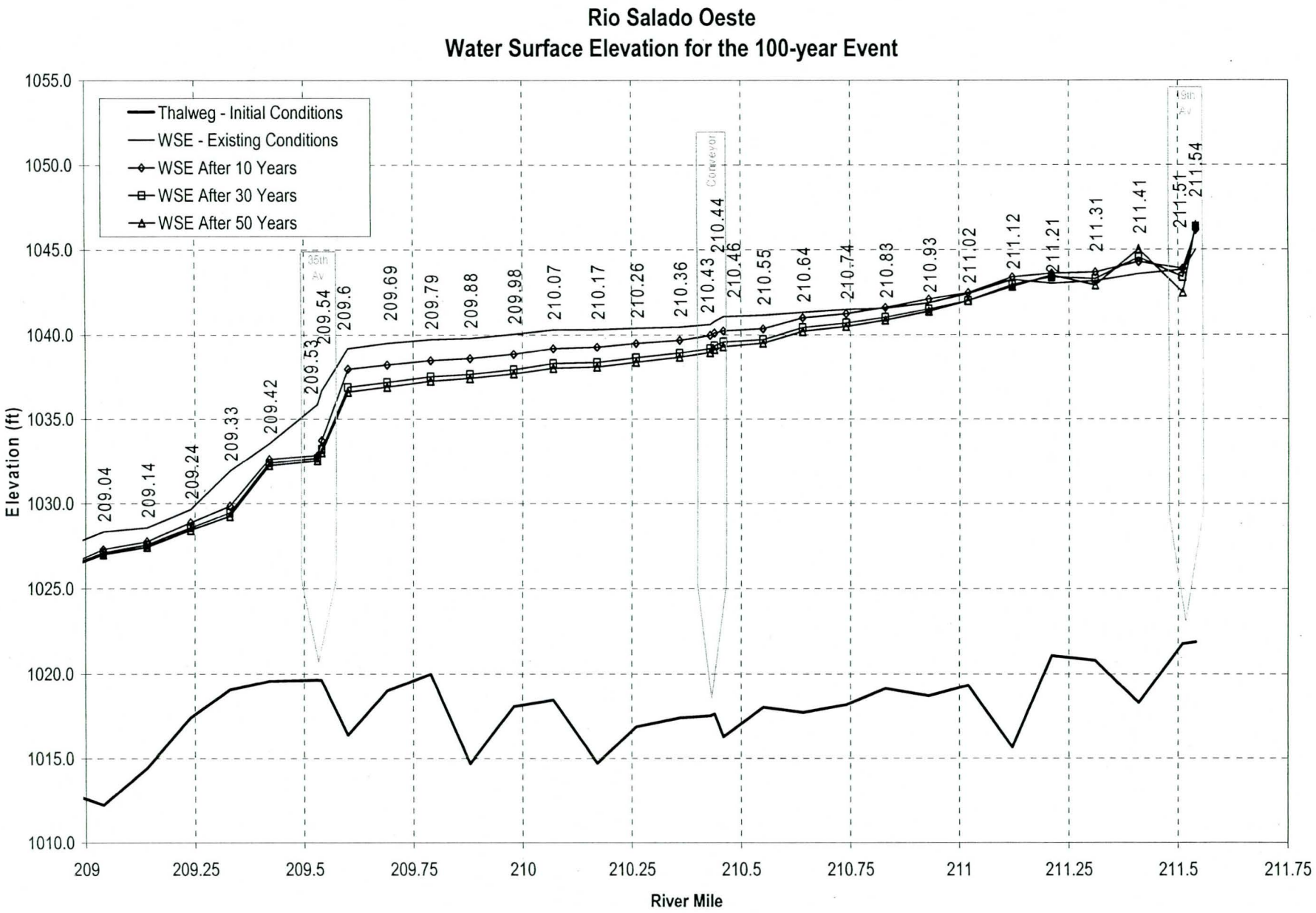

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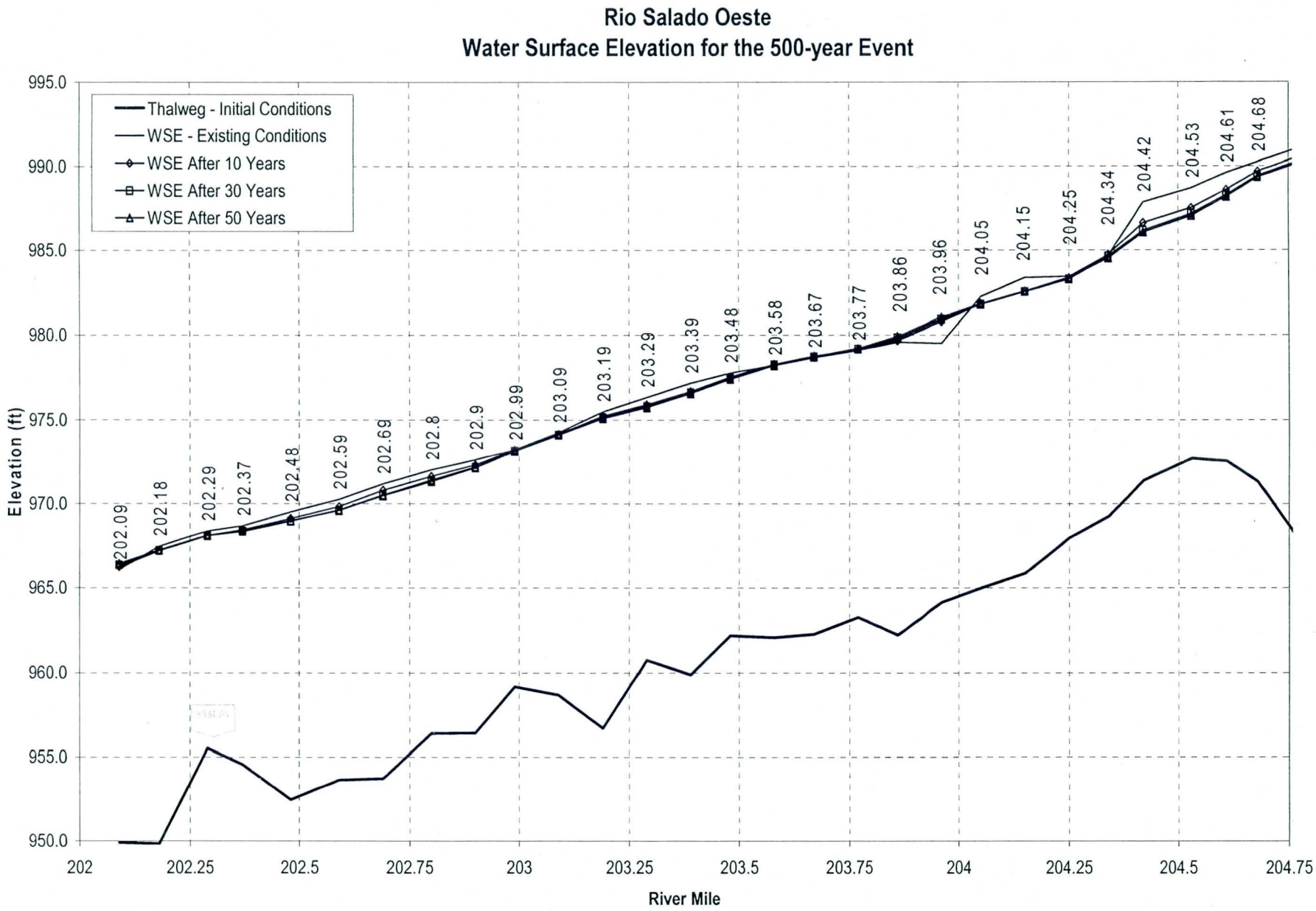
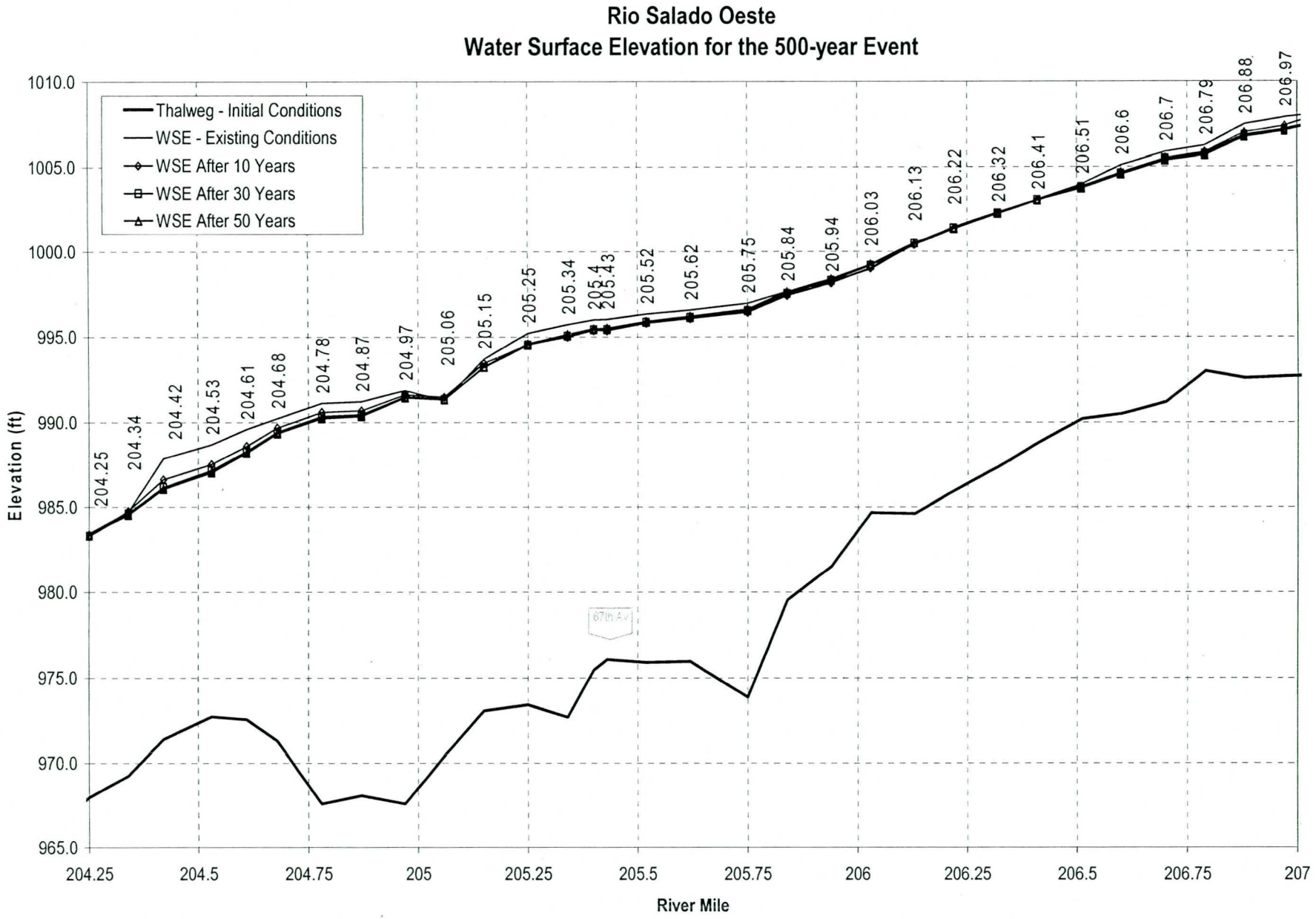


Figure 5-3. Future conditions hydraulic analysis: 500-year flood event.



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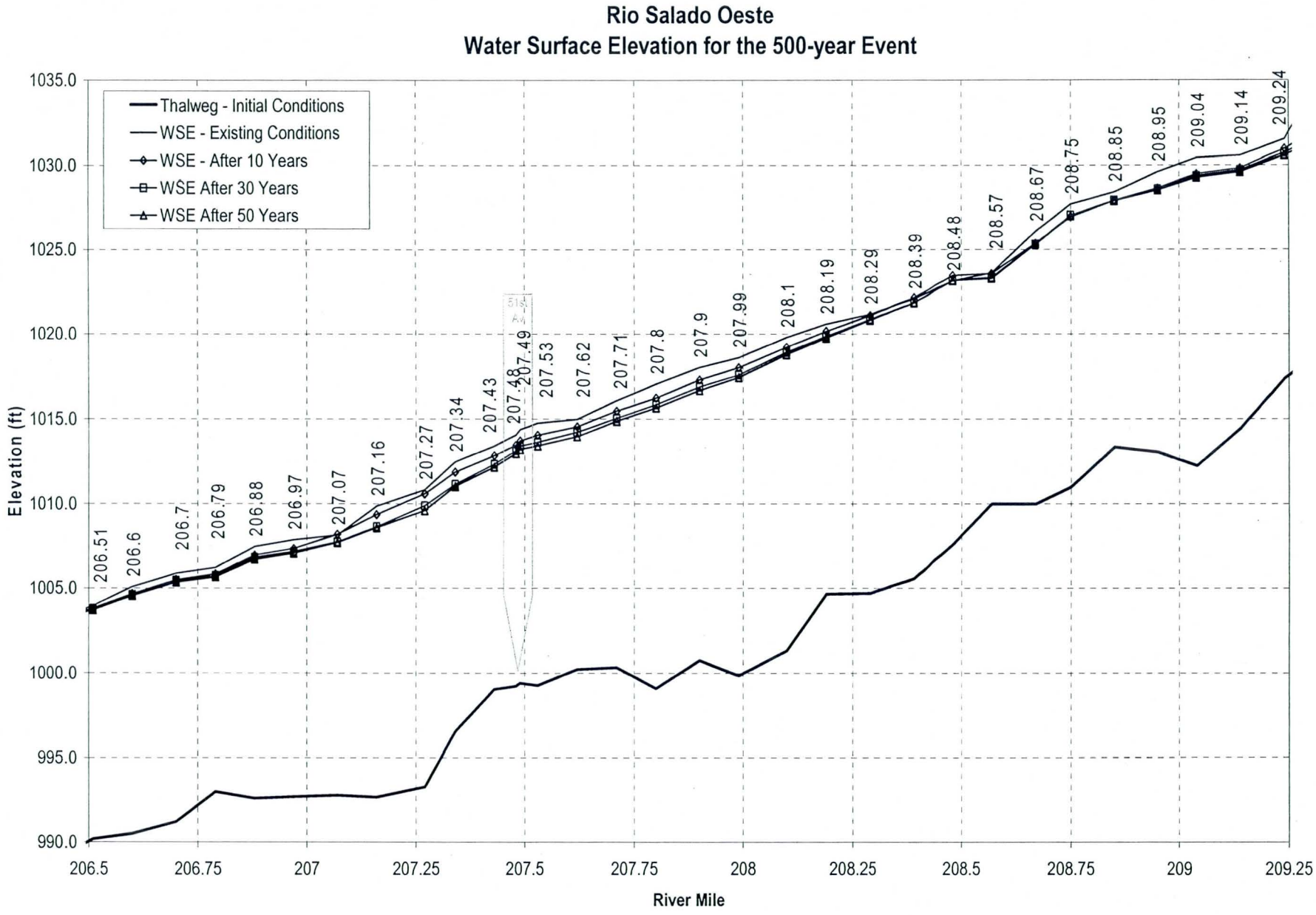

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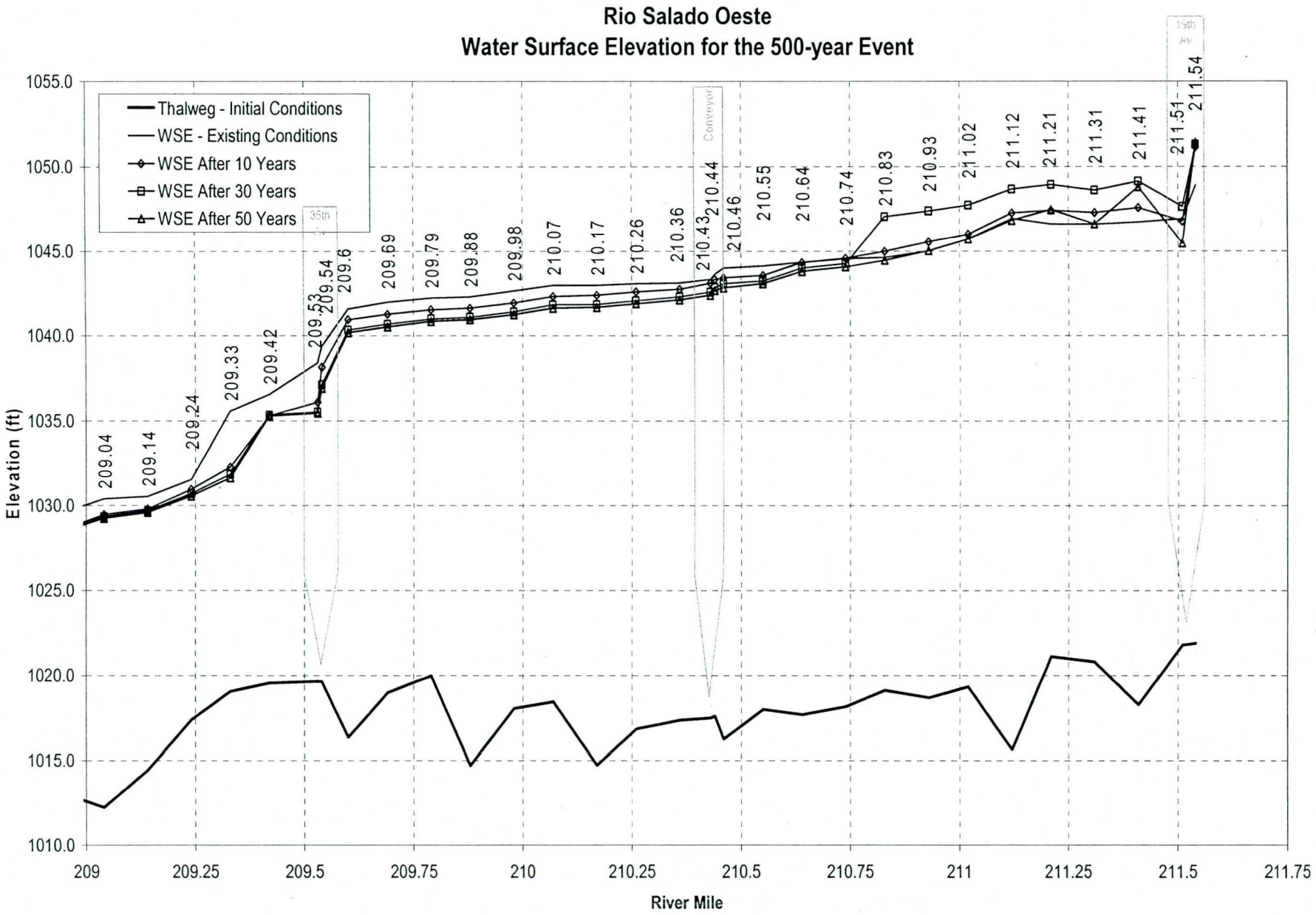

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6. Summary and Conclusions

The results of this hydraulic and sedimentation analysis are intended to support the U.S. Army Corps of Engineers Rio Salado Oeste Feasibility Study.

A hydraulic model was developed in HEC-RAS to represent existing conditions in the Salt River from 19th Avenue to 91st 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. All the bridges in the study reach but one seem appropriate to pass these large flows without important problems. The exception is the 35th Avenue Bridge, which has a very narrow opening and causes significant backwater and inundation on the overbanks.

The hydraulic model was converted to a sediment transport model in HEC-6T, which was used to simulate sediment dynamics in the study reach during a 50-year time frame. The hydrologic input consisted of flows measured in the Salt River from 1889 through 1938, and corresponds to the "worst case" continuous 50-year period, in terms of both peak flows and storm volumes, in 105 years of record. Results of the 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. The bridge cross section suffered severe degradation due to the increase in flow velocity caused by the small size of the bridge opening. In general, most of the changes to the existing conditions geometry took place in the first 10 years of the sediment transport simulation.

The output geometry of the sediment transport model was imported back into HEC-RAS and used to carry out a future conditions without-project hydraulic analysis. The future conditions water surface profiles were then compared to the existing conditions profiles. Results showed the most important differences upstream of the 35th Avenue Bridge. Degradation in the bridge cross section made it possible to increase the conveyance through the bridge opening and reduce the backwater. As a consequence, in the reach upstream of the bridge, the inundation boundaries in the future without-project conditions are expected to stay closer to the channel.

The study includes also a basic geomorphic analysis of the study reach, including historical changes to the river morphology based on the review of historical aerial photographs, and the application of geomorphic relationships. The 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.

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US Army Corps of Engineers
Los Angeles District

RIO SALADO OESTE
F4 MILESTONE
Salt River-Phoenix, Arizona

Appendix B
Water Budget Report
and
Interior Drainage Report

March 2005

U.S. ARMY CORPS OF ENGINEERS, LOS ANGELES DISTRICT
PLANNING DIVISION, WATER RESOURCES BRANCH
P.O. BOX 532711
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Table of Contents

1.0 INTRODUCTION AND SUMMARY 1

1.1 Purpose and Scope 1

1.2 Project Area 1

1.3 Expected Future Without-Project Conditions 2

1.4 Summary of Future With-Project Conditions 3

2.0 WATER USES AND PLANT ROOT ZONE DEPTH 6

2.1 Evapotranspiration Loss 6

2.2 Evaporation Loss 8

2.3 Infiltration Loss 8

2.4 Plant Root Zone Depth 9

3.0 WATER SOURCES 12

3.1 In-situ Groundwater 12
- 3.1.1 Description of Source 12
- 3.1.2 Quantity Analyses 13
- 3.1.3 Quality Analyses 13
- 3.1.4 Water Rights 14
- 3.1.5 Assessment of In-situ Groundwater 14

3.2 Pumped Groundwater 16
- 3.2.1 Description of Source 16
- 3.2.2 Quantity Analyses 16
- 3.2.3 Quality Analyses 16
- 3.2.4 Water Rights 17
- 3.2.5 New Water Well Development 18
- 3.2.6 Assessment of Source 18

3.3 Salt River Flood Flows 19
- 3.3.1 Description of Source 19
- 3.3.2 Quantity Analyses 19
- 3.3.3 Quality Analyses 21
- 3.3.4 Water Rights 21
- 3.3.5 Assessment of Source 21

3.4 Stormwater Discharges 22

3.4.1 Description of Source 22
3.4.2 Quantity Analyses 22
3.4.3 Quality Analyses 23
3.4.4 Assessment of Source 24
3.4.5 Future Drainage Master Plan 24

3.5 Effluent 29
3.5.1 Description of Source 29
3.5.2 Quantity Analyses 29
3.5.3 Quality Analysis 30
3.5.4 Water Rights 30
3.5.5 Assessment of Source 31

3.6 Irrigation Return Flows 31
3.6.1 Description of Source 31
3.6.2 Quantity Analyses 32
3.6.3 Quality Analyses 32
3.6.4 Water Rights 33
3.6.5 Assessment of Source 33

3.7 Irrigation Drains 34
3.7.1 Description of Source 34
3.7.2 Quantity Analyses 34
3.7.3 Quality Analyses 34
3.7.4 Water Rights 34
3.7.5 Assessment of Source 35

3.8 Sand and Gravel Mining Operations Releases 37
3.8.1 Description of Source 37
3.8.2 Quantity Analyses 37
3.8.3 Quality Analyses 37
3.8.4 Water Rights 38
3.8.5 Assessment of Source 38

3.9 Residual Water from Rio Salado project 38
3.9.1 Description of Source 38
3.9.2 Quantity Analyses 38
3.9.3 Quality Analyses 38
3.9.4 Water Rights 38
3.9.5 Assessment of Source 38

4 EVALUATION OF WATER SOURCES 41

5 WATER BUDGET FOR PROJECT ALTERNATIVES 44

6 REFERENCES 47

List of Tables

Table 1-1. Summary of Water Budget Analysis 3
Table 2-1. Evapotranspiration for Salt River Habitat 7
Table 2-2. Vegetation Evapotranspiration Values 7
Table 2-3. Evaporation from Open Water 8
Table 2-4. Infiltration Rates for Tres Rios Demonstration Wetland Cells 9
Table 2-5. Riparian and Constructed Wetland Vegetation Requirements 11
Table 3-1. Summary of Historic Salt River Flood Flows 20
Table 3-2. Discharge frequency values used in the existing conditions model 21
Table 3-3. Storm Drain Average Annual Runoff Volumes 25
Table 3-4. Summary statistics for selected event-mean constituent concentrations measured in stormwater and streamflow, Maricopa County, Arizona. 26
Table 3-5. Rio Salado Oeste Project Storm Water Quality Summary 27
Table 3-6. 23rd Avenue WWTP Discharge (January 1996 – October 2002) 29
Table 3-7. Irrigation Return Flows from the Peterson Farm 33
Table 3-8. SRP 67th Avenue Drain Monthly Volume 36
Table 3-9. Maricopa Drain Monthly Volume 36
Table 3-10. Residual Water Budget from Rio Salado Project for Oeste Project 40
Table 4-1. Water Budget Matrix 42
Table 5-1. Ecosystem Restoration Alternative Plans 45
Table 5-2. Water Budget Analysis for Alternative Plans 46

List of Figures

Figure 1-1. Rio Salado Oeste Project General Study Area Map 4
Figure 1-2. Rio Salado Oeste Study Location Aerial Photo 5
Figure 3-1. Depth to Groundwater 15
Figure 3-2. 23rd Avenue WWTP Discharge Rate 30

1.0 Introduction and Summary

1.1 Purpose and Scope

The Rio Salado Oeste Restoration Project (Oeste Project) addressed the feasibility of environmental restoration, flood damage reduction, and recreation along the Salt River in Phoenix, Arizona. The success of the Oeste Project is largely dependent on the water budget. The water budget must identify each potential source, quantify the amount and seasonality of flow, and evaluate the quality of the water. The water budget required for this project, however, is more than just an inventory of water sources. It must also identify the water demands and quantify the amount and timing. Restoration projects involve wetlands and riparian vegetation, which have seasonal water demands that are greater in the summer than in the winter. In fact, the water demands vary seasonally. It is necessary to evaluate the water budget on a monthly basis because annual information does not contain sufficient detail to allow consideration of these monthly demands.

The report presents the water budget analysis with project condition for the Oeste Project. Specific objectives of this report are:

1. Collect and research on water use/loss data and plant root zone depth in the project area.
2. Collect water sources information in the project area. Evaluate water sources in term of water quantity, water quality, water rights, availability, and other conditions.
3. Analysis of water budget under the proposed project alternatives. This includes mass balance calculations based on inflow (infiltration and effluent), and plant consumptions (evapotranspiration) for each project alternatives.

1.2 Project Area

The Salt River drains 14,500 square miles of mountains desert terrain in central and eastern Arizona (Figure 1-1) 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 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% to 50%. Winters are mild, with mean daily temperatures ranging from 35° F to 70° F.

The project site is located within the Salt River between 19th Avenue on the east and 83rd Avenue on the west in the City of Phoenix (COP), Maricopa County, Arizona. The north and south study boundaries are located between approximately Durango Street and Southern Avenue for the eastern portion, and Broadway Road and Baseline Road for the western portion. Specifically, the northern and southern boundaries were defined by including all areas between 19th and 83rd Avenues that are within one mile of any segment of the Salt River centerline. Figure 1-1 presents the general study area map. Upstream of the study area is the Phoenix Rio Salado Project area, while downstream of the study area is the Tres Rios Project area. Because the geographic location of these three projects are so close, the water budget related data collected from the Tres Rios and Phoenix Rio Salado Project will be used for the current water budget analysis. Figure 1-2 presents the aerial photo between 19th Avenue and 83rd Avenue and the surface water features. As shown in the map, there are several water ponds along with dry riverbed areas in the study reach of the Salt River.

1.3 Expected Future Without-Project Conditions

Under the Future Without-Project Condition, there will be significant negative changes within the study area. Without agreements to the contrary, there will be insufficient water to support existing areas of riparian and associated floodplain fringe habitats. As development continues throughout the study area and larger Salt River watershed and effluent flows are reallocated, loss of riparian and floodplain fringe habitat is likely to accelerate, and many native species may be increasingly confined to highly isolated pockets. Habitat is expected to decline significantly in both extent and value. The lack of native riparian and associated floodplain fringe habitat will mean the extirpation of many species of native wildlife from the study area.

Flood threats to adjacent unprotected properties are expected to rise as the channel itself becomes more likely to migrate or erode because of reduced vegetation.

1.4 Summary of Future With-Project Conditions

Each of the potential water sources has been evaluated based on the quantity and seasonality of flow, water quality, water rights, and institutional considerations. A few dependable and supplemental sources of water are available to supply the Oeste Project. For some of these, there is sufficient information to quantify the potential supply; however, others will require further monitoring to verify the quantity and seasonality of flow. In addition, the Maricopa County, COP, Salt River Project (SRP), or Central Arizona Project (CAP) could make other water sources available upon institutional commitments. These entities will need to decide if, how much, and when they will commit water to the Oeste Project.

Also, preliminary water demand estimates were calculated for each of alternatives based on hydrologic balance equation with the monthly and annual precipitation, evapotranspiration, evaporation, and infiltration data. A summary of water budget for each restoration alternatives is described below (Table 1-1).

Table 1-1. Summary of Water Budget Analysis

Water Supply Sources	Water Sources (acre-feet/yr)	Water Sources (mgd) (COP)	Water Sources (mgd)
Pumped Groundwater	Pending	1.85	Pending
Stormwater Discharge	~4,503	2	~4.02
Effluent	~17,256	15.1	~15.41
Irrigation Return Flows	~9,905	8	~8.84
Irrigation Drains	~5,320		~4.75
Residual Water Flows from Upstream (Rio Salado Project)	~3,966	3.35	~3.54
Water Demands for Alternatives	**Water Demand (acre-feet/yr)**		**Water Demand (mgd)**
Alt. 2	1,583		1.41
Alt. 3	4,524		4.04
Alt. 4	4,701		4.20
Alt. 5	7,752		6.92
Alt. 5A	9,293		8.30
Alt. 5B	9,234		8.24

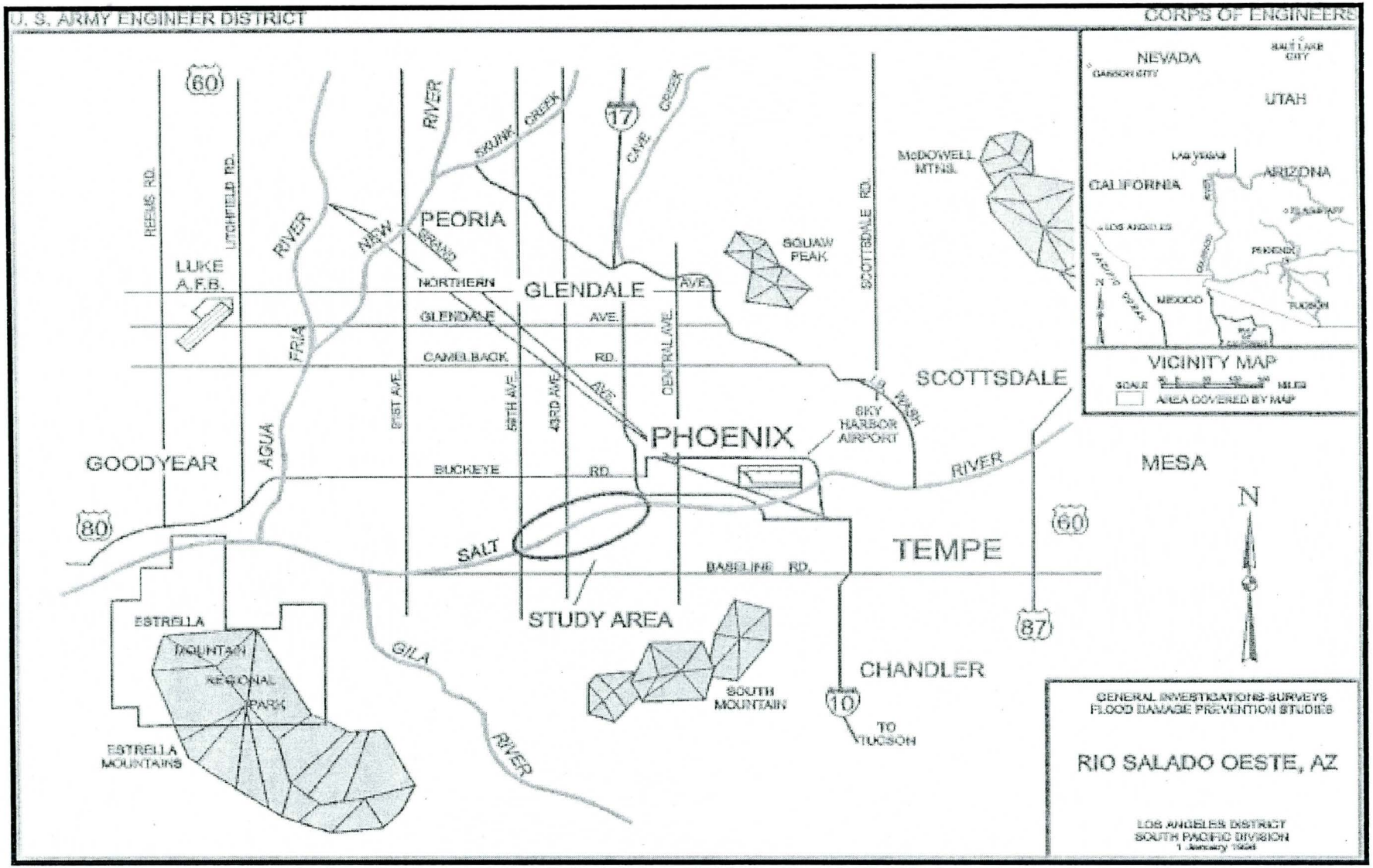


Figure 1-1. Rio Salado Oeste Project General Study Area Map

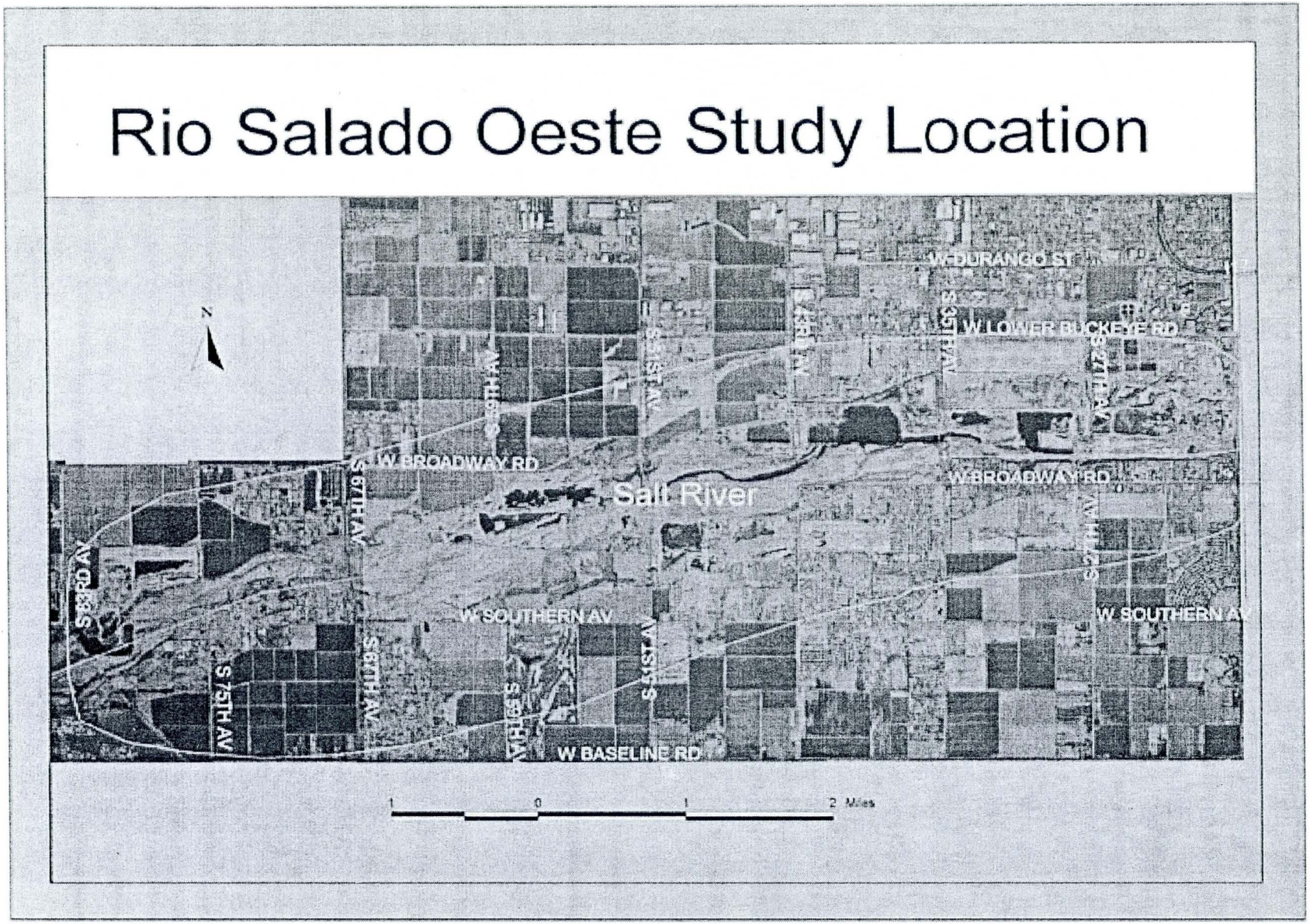


Figure 1-2. Rio Salado Oeste Study Location Aerial Photo

2.0 Water Uses and Plant Root Zone Depth

The hydrologic balance at the Rio Salado Oeste site can be evaluated using the following equation.

$$\mathbf{Q}in + \mathbf{Q}rain = \mathbf{Q}out + \mathbf{Q}evp + \mathbf{Q}eto + \mathbf{Q}inf$$

In the equation, **Q**in and **Q**out are surface water inflow and outflow; **Q**rain is rainfall; **Q**evp is evaporation by the open water; **Q**eto is evapotranspiration by the plant (i.e., the water required by plants for growth, the water that is evaporated by plants, and the evaporation of water from the soil on the immediate area surrounding the plant); and **Q**inf is groundwater infiltration.

As shown in this equation, three primary water demands were identified that are associated with a river restoration project. The monthly and annual water demands were quantified for these water uses as a rate of water used per acre of vegetation or open water. When the project alternatives are finalized, multiplying the per-acre demands by the number of acres for each land use category can project the total demands.

2.1 Evapotranspiration Loss

The water demand of vegetation varies depending on the individual and combination of plant species within a habitat unit. The riparian vegetation in the Salt and Gila River was inventoried as part of the Baseline Ecological Characterization Study (1997). This study, also called the ETI study, inventoried the habitat types and acres of habitat types in the river reach from 67th Avenue on the Salt River downstream to the Buckeye Irrigation Company (BIC) diversion on the Gila River. The ETI study inventoried 4,263 acres within their study area and identified the vegetation communities (Cottonwood-Willow (12.04%), Salt Cedar (32.82%), Marsh (0.38%), Honey Mesquite (3.66%), and Quailbush-Saltbush (5.19%)), desert (3.71%), desert wash (0.14%), open water area (10.39%), and cobble (31.68%, bare riverbed). In the Tres Rios project, the average annual evapotranspiration of river vegetation communities was projected to equal 3.70 acre-feet per acre. This general rate accounted for a mix of vegetation species that is similar to the expected mix for this project (Greeley and Hansen, 2001). The monthly demand is calculated as a percentage of the annual demand and defines the seasonality of the required water supply. Table 2-1 presents the evapotranspiration the Salt River Habitat based on the Tres Rios Project. As shown in Table 2-1, from April through August the plants consume 65% of the annual water usage. The consumptive value shown in Table 2-1 is an average combined value for the Salt River Habitat. The plant evapotranspiration rates associated with the selected vegetation communities are presented on Table 2-2. As shown in Table 2-2, the range of evapotranspiration rate for Marsh is 7.5-16 feet/year and the average evapotranspiration rate for Marsh is 9 feet/year. The average evapotranspiration rates for Cottonwood Willow and Salt Cedar are 6.3 feet/year and 6.1 feet/year respectively.

Table 2-1. Evapotranspiration for Salt River Habitat

Month	Percent of Annual Demand (%)	Evapotranspiration (acre-feet/acre)
January	5	0.185
February	5	0.185
March	5	0.185
April	10	0.370
May	10	0.370
June	15	0.555
July	15	0.555
August	15	0.555
September	5	0.185
October	5	0.185
November	5	0.185
December	5	0.185
Annual	100	3.70

Source: Knight Piesold, Va Shly'ay Akimel Salt River Restoration Project Feasibility Study, Water Budget Report

Table 2-2. Vegetation Evapotranspiration Values

Vegetation Type	Evapotranspiration Range (feet/year)	Evapotranspiration Average (feet/year)
Cottonwood Willow	4.1 – 8.5	8*
Salt Cedar	3 – 9.2	6.1
Honey Mesquite	3	3
Marsh	7.5 – 16	9*
Quailbush-Saltbush	3.2	3.2
Desert	2	2
Desert Wash (Xericriparian)	2	2

Source: Greeley and Hansen, 1998, Tres Rios, Arizona Feasibility Study Salt/Gila Groundwater Analysis
* -COE adjusted for this project.

2.2 Evaporation Loss

The Oeste Project may include open water bodies, constructed wetlands, and marsh areas. In the central Arizona area, the annual evaporation from an open water body averages 72.4 inches or 6.03 feet per year, roughly 6 acre-feet per acre (Table 2-3). However, evaporation is seasonal with the greatest evaporation in the summer months (Cooley, 1970). Constructed wetlands and marshes are open water bodies in which the surface area is shared by water and vegetation. The consumptive use of these areas closely approximates the open water body evaporation rate; thus, the evaporation rate can be used to calculate the water demand for the open water body, constructed wetland, or marsh.

Table 2-3. Evaporation from Open Water

Month	Evaporation (acre-feet/acre)
January	0.183
February	0.258
March	0.417
April	0.550
May	0.750
June	0.825
July	0.825
August	0.750
September	0.575
October	0.442
November	0.275
December	0.183
Annual	6.03

Source: Knight Piesold, Va Shly'ay Akimel Salt River Restoration Project Feasibility Study, Water Budget Report

2.3 Infiltration Loss

The Tres Rios Project included wetland design. Two demonstration wetlands were constructed during the Tres Rios Project, the Cobble Site and Hayfield Site. The long-term average infiltration rates of the Tres Rios Cobble and Hayfield Site wetland cells are shown in Table 2-4. As shown in the table, cell 1 of the Cobble Site is an unlined cell; all other are lined cells use soil liner. The Cobble Site cells are 2.2 acres each and the Hayfield Site cells are 3 acres each. Compared to evaporation, infiltration is a major water loss in the system. The infiltration rates presented in Table 2-4 are long-term average values. Infiltration losses

are solved for from the water balance. At the Hayfield Site Basins, infiltration losses have been extremely stable since startup. This site is characterized by fine sediments deposited during flood events of the Salt River. Long-Term average infiltration loss from Basin H1 = 0.06 ft/d, while Basin H2 = 0.09 ft/d. These rates are very similar to that experienced by the lined Cobble Basin C2 = 0.06 ft/d. The other Cobble Basin (C1), located within the Salt River Floodway and constructed on well-draining sand, gravel, and cobble has behaved differently. In the long-term, C1 has lost an average of 0.74 ft/d to subsurface flow. This was substantiated in April 1997 when subsurface sampling devices were installed by U.S. Geological Survey (USGS) and Tres Rios staff. At that time, the subsurface was saturated to approximately 3 feet below the sediment surface, and then unsaturated to the local groundwater table (approx. 13 feet below ground surface.). Figure 2-1 presents an infiltration rate history from October 1995 to April 1997 for the Tres Rios Cobble Site.

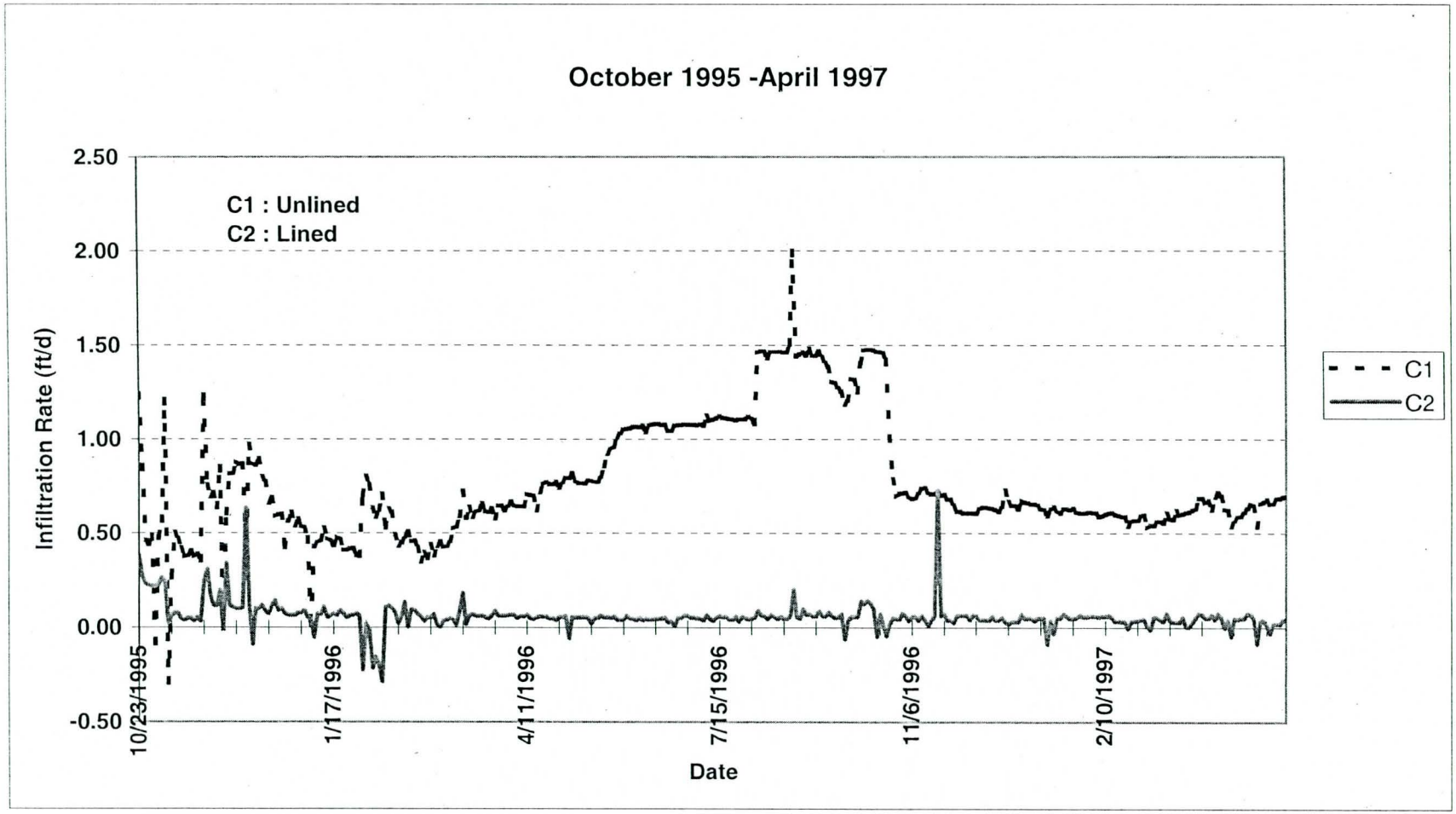
Table 2-4. Infiltration Rates for Tres Rios Demonstration Wetland Cells

	Cobble Site		Hayfield Site	
Cell	C1	C2	H1	H2
Lining	unlined	lined	lined	lined
Size(acre)	2.2	2.2	3.0	3.0
Long Term Average Infiltration Rate (ft/d)	0.74	0.06	0.06	0.09

Source: Tres Rios Demonstration Constructed Wetland Project, 1997

2.4 Plant Root Zone Depth

The root zone depth of vegetation is also an important criterion when assessing the adequacy of water supplies to meet demands. If the roots of plants have access to groundwater, it reduces the irrigation demand. Plants have different water requirements depending on the phase of development; seeding, sapling, and maturity. Table 2-5 (Wass, 2002) presents the root zone depth information for several species common within the Salt River environment. The table also presents the desirable ranges of inundation depth for aquatic plants. These data can be used to assess in-situ groundwater and to calculate irrigation demands during alternative development.



Source: WASS Gerke + Associates, Inc

Figure 2-1. Tres Rios Cobble Site Infiltration Rate History

Table 2-5. Riparian and Constructed Wetland Vegetation Requirements

Vegetation Type		Seedling Establishment	Sapling Growth	Mature Survival
Trees (Groundwater Depth[1] Requirements)				
Cottonwood	Populus freemontii	Moist soils in March/April	0.66 to 6.6 feet	16.5 feet
Willow	Salix gooddingii	Moist soils in April/May	0.66 to 6.6 feet	10 feet
Mesquite	Prospis sp.	< 4 inches	3.3 to 33 feet	< 33 feet
Salt Cedar	Tamarix sp.	Moist soils in May to September	0.66 to 8.2 feet	33 feet
Common Aquatic Plants (Inundation Depth[1] Requirements)				
Shallow Emergent Marsh	Scirpus validus, Scirpus americanus, Scirpus acutus, Sagittaria greggii, Sagittaria latifloa, Alisma triviale, Typha latifola	Saturated soils to 2 inches	Saturated soils	Saturated soils to < 2.6 feet
Deep Emergent Marsh	Typha domingensis, Scirpus californicus, Phragmites australis	Saturated soils to 2 inches	Saturated soils	Saturated soils to < 4.9 feet
Floating Aquatic	Hydrocotyle sp., Ludwegia palustrus, Polygonum hydropeperoides, Potomogeton sp. Rorippa, Nasturtium-aquaticum	Moist soils to 4 inches	Moist soils to 8 inches	Moist soils to 8 inches
Transitional Marsh Plants	Eleocharisparishii, Eleocharis macrostachya, Equisetum laevigatum or similar sp., Cyperus niger, Cyperus laevigatus, Cypeus erythohizos or similar sp., Juncus balticus, Juncus bufonius, Juncius tenurs var. Dudleyi, Juncius inetrior, Juncus torreyi, or similar sp., Heteranthera limosa, Anemopsis californicus	Moist soils to 4 inches	Moist soils to 4 inches	Moist soils to 4 inches

Depth[1]: Depth from ground surface to water table.
Source: WASS Gerke + Associates, Inc.

3.0 Water Sources

The success of a habitat restoration project such as the Oeste Project is largely dependent upon the amount and quality of water that is available to sustain the riparian habitat. A sufficient and reliable supply of suitable water must be developed to support the aquatic, wetland, and upland plant species. Several potential water sources were identified for the Oeste Project area; two relate to groundwater resources and six involve surface water. Groundwater can either be utilized by plant roots in place (in-situ), or it can be pumped to the surface and distributed to the restoration project. These represent the two potential groundwater sources identified. The potential surface water sources identified include Salt River flood flows, stormwater discharges, effluent, irrigation return flows, irrigation drains, and discharges from sand and gravel mining operations. These sources were each evaluated based on the quantity, reliability, and quality of flow available for habitat restoration. In general, the sources were classified into the following four categories.

Dependable source. A source is dependable if it is available on a continuous basis to meet the water demands of the habitat area and has acceptable water quality. Dependable sources constitute the baseline water supply.

Supplemental source. A source may be considered supplemental if it is available to augment the dependable baseline source. This could include infrequent and unreliable flows that can be put to beneficial use when they are available but cannot be relied upon as a dependable base flow. The supplemental flow must also have good water quality.

Problem Source. Problem sources must be accounted for but may not be suitable as a water supply for the Oeste Project. These flows may inhibit the restoration project by potentially damaging restored vegetation or hindering the water quality within the Salt River.

Unacceptable Source. A source is considered unacceptable if it has poor water quality or is not desirable for riparian habitat restoration.

3.1 In-situ Groundwater

3.1.1 Description of Source

In-situ groundwater is defined as groundwater that can be utilized, in place, by riparian vegetation. For this to occur, the groundwater table must be within the root zone depth of the desired plant species. The depth to groundwater (Figure 3-1) as well as the water table fluctuations are important factors for establishing and maintaining riparian habitat.

Historically, the Salt River was a perennial stream and supported riparian and wetland vegetation. However, water storage and diversion projects have depleted the Salt River flows downstream of Granite Reef and, in turn, have decreased the amount of water that gets recharged into the alluvial aquifer. Today static water level is relatively shallow, ranging from 20 to 50 feet below ground surface (bgs) within the Salt River channel to 60 to 80 feet bgs 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. In a few areas the water table is still sufficiently close to the surface so that riparian vegetation can access this water through its root systems. These habitat areas in the Salt River suggest that in-situ groundwater may be a potential source of water for the habitat restoration project.

3.1.2 Quantity Analyses

Depth to groundwater has fluctuated greatly since development of the Salt River Valley began in the late 1890s. Initially, diversion of water from the river for irrigation led to a rise in the water table. Canal seepage locally raised the water table as much as 20 feet above the natural water table.

The City of Phoenix operates the 23rd Avenue Waste Water Treatment Plant (WWTP). Reclaimed water produced by this plant is reused by the Roosevelt Irrigation District (RID), and Peterson Farms for irrigation water. When RID is taking the reclaimed water, there is no flow discharged to the Salt River. RID diversions are seasonal, following the demand for irrigation. During winter, the reclaimed water from the WWTP is discharged into the Salt River. Though Peterson's use is only about 1mgd, approximately 10 mgd must now be diverted via a canal to meet Peterson's demand. The excess water now infiltrates along the canal or is discharged back to the Salt Rivet between 43rd and 51st Avenue. The discharge percolates into the riverbed, but as the discharge season progresses, the flow extends downstream. When hydrologic conditions permit, the flow from the 23rd Avenue WWTP can continue downstream beyond the study area.

These areas receive some groundwater recharge from WWTPs, irrigation seepage, storm drains, irrigation drains, and underflow from the Gila River. The result is that the general groundwater depth beneath the Salt River ranges from 20 to 50 feet below the river channel for the majority of the study area

3.1.3 Quality Analyses

Long-term irrigation practices and landfills within the Salt River Valley have historically influenced water quality in the upper alluvial aquifer. High salinity, chloride, and nitrate concentrations were occasionally found in the shallow groundwater near irrigated or formerly irrigated areas. Also, some landfills have historically caused elevated levels of volatile halocarbons. Since groundwater quality monitoring began in the 1980s, the water quality has significantly improved. Monitoring results from the first quarter of 2002 indicate that there were no exceedences of the maximum contaminant levels for volatile halocarbons in any of the sampled wells (Kenneth D. Schmidt and Associates, 2002). In addition, the concentrations of many volatile halocarbons were the lowest since monitoring commenced.

It should also be noted that there are no superfund sites within the restoration project area. In-situ groundwater is generally suitable for agricultural uses and should be adequate for the habitat restoration project.

3.1.4 Water Rights

Consumptive use of groundwater by vegetation (in-situ groundwater) is not included in state groundwater right categories. There are no water rights to define or restrict the direct use of groundwater by vegetation for habitat restoration projects in central Arizona. In-situ groundwater, when available, can be used as a part of the Oeste Project water supply.

3.1.5 Assessment of In-situ Groundwater

In-situ groundwater can provide a reliable source of water for the open water area formed by effluent and irrigation return water. In this area, seepage from the open water area forms a local perched water table near the surface. Currently, wetland plant species are growing along this reach of the river and extend along the water body. This source of water could be used to restore native riparian vegetation in this area. This local supply is considered a dependable water source for vicinity of open water areas.

The intent of this project is to restore habitat areas for cottonwood, willow, and mesquite trees; these species require that the depth to groundwater be less than approximately 30 feet for survival. Therefore in-situ groundwater is considered to be an unacceptable source of water for areas of the Oeste Project where the depth to groundwater is more than 30 feet.

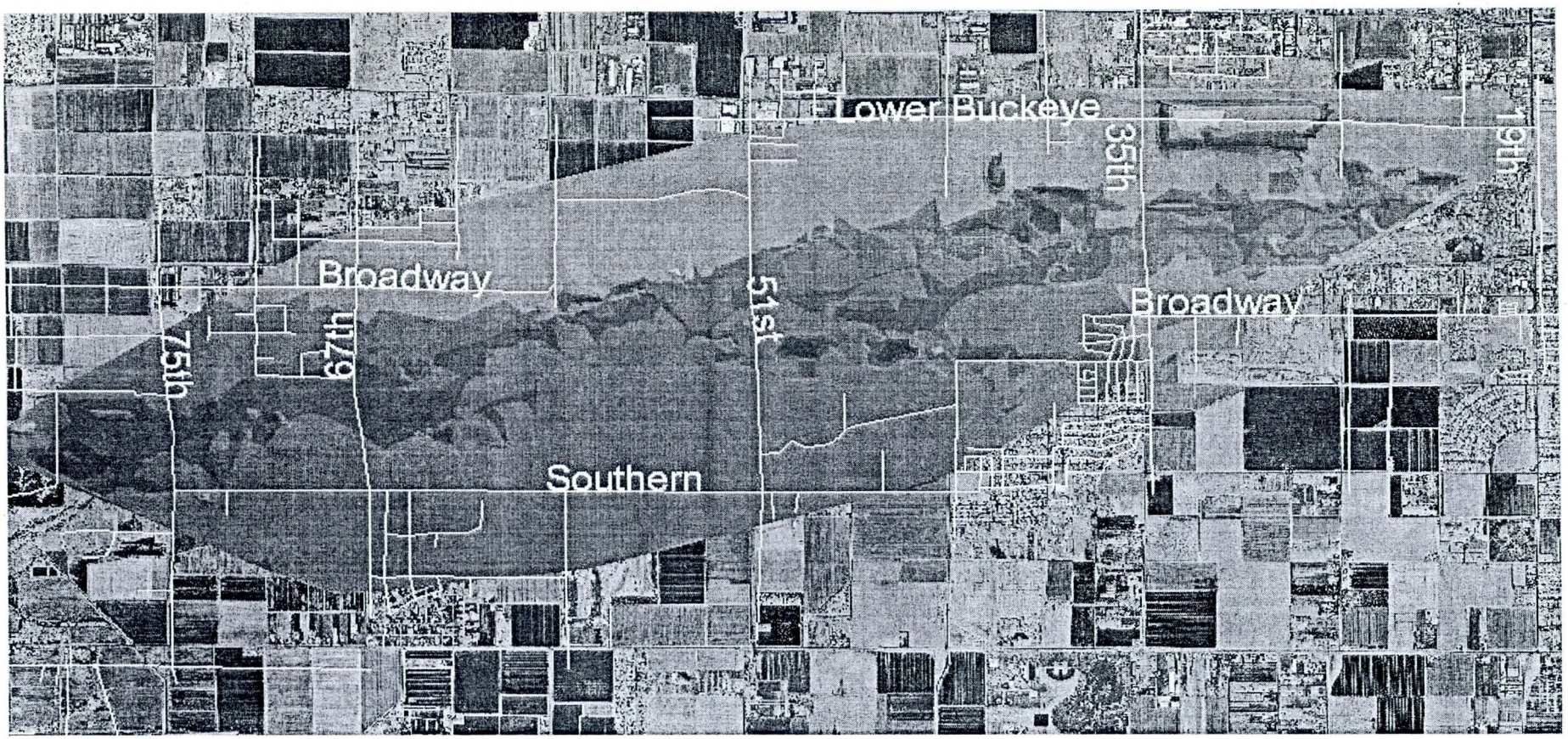


Figure 3-1. Depth to Groundwater

3.2 Pumped Groundwater

3.2.1 Description of Source

Pumped groundwater is groundwater that lies below the root zone of the desired vegetation and must be pumped to the surface to be utilized. After the water is pumped to the surface, a distribution system must be developed to deliver this water to certain areas of the habitat restoration project. There are several legal and institutional implications that pumped groundwater could have on the project.

3.2.2 Quantity Analyses

Groundwater in sufficient quantity to supply water wells is present throughout the majority of the Oeste Project area. This is demonstrated by the location and number of existing wells. Some of these wells are shown on Figure 4 of the Groundwater Quality and Hydrogeology Report (URS, 2002).

Pumped groundwater has been a reliable source of water for many years throughout the Salt River Valley including the Oeste Project area. These wells range in capacity from relatively small wells that produce 10 to 20 gallons per minute (gpm) to large irrigation wells producing more than 6,000 gpm.

Pumped groundwater can be provided using existing wells or new wells. The advantage of using an existing well is that the costs associated with constructing the well have been committed. The constraint is that the location of some wells requires construction of a distribution pipeline and may require a booster pump. The advantage of drilling a new well is that it could be located at a point within the project to minimize distribution pipeline costs. The constraints are the costs associated with constructing a new well and meeting the state regulations.

Pumped groundwater is available on a continuous basis and in sufficient quantity could provide a dependable supply of suitable water for the restoration project. The primary problem associated with using pumped groundwater is the impact that this pumping may have on other nearby groundwater wells.

3.2.3 Quality Analyses

General groundwater quality data were obtained from databases including the Arizona Department of Water Resources (ADWR) Groundwater Site Inventory (GWSI) database, Arizona Department of Environmental Quality (ADEQ) water quality database, and USGS National Water Information System (NWIS) water quality database. Other data were obtained from SRP, RID, the Phase 2 Report, and COP. The locations of wells with groundwater quality data that was useful for this report. For this evaluation, the most recent data available used ranged from 2001 to as far back as 1983.

The above sources provided limited data for nitrates, volatile organic compounds (VOCs), metals, and pesticides. The majorities of these data were below detection levels or detected at concentrations below groundwater quality standards.

The ADWR Well Registry database and Imaged Records database were queried to determine the location, owner, and purpose of monitor wells within the study area. This information was used to identify sites having possible groundwater quality concerns. Further information about sites of particular concern (e.g. landfills, Leaking Underground Storage Tank (LUST) sites, etc.) was obtained from the well owners and ADEQ.

Groundwater conductivity within the study area ranges from about 1,000 to 3,500 micromhos per centimeter (μmhos/cm), which corresponds with an estimated range in TDS of 600 to 2,500 parts per million (ppm). Based on data from wells screened in the Upper Alluvial Unit (UAU) and part of the Middle Fine-Grained Unit (MFU), there is a general trend of increasing conductivity from roughly 1,200 μmhos/cm in the northeast to over 3,000 μmhos/cm in the southwest part of the study area.

Nitrate concentrations are generally less than 10 milligrams per liter (mg/L), with the exception of wells located in the southwestern part of the study area where concentrations are as high as 13.8 mg/L. There is no apparent difference in the concentration of nitrate in the shallow wells versus the deeper wells. Quarterly data from the 23rd Avenue WWTP and the 27th Avenue Landfill monitor wells show that the nitrate concentrations can vary by as much as 4 ppm from quarter to quarter. The changes in nitrate concentration do not appear to be seasonal.

As stated above for in-situ groundwater, groundwater from all alluvial units is generally suitable for agricultural purposes and is expected to be adequate for this habitat restoration project.

3.2.4 Water Rights

The use of groundwater needs to be permitted by the state. Irrigation Grandfather Rights establish the right to pump and use groundwater for the growing of food and forage crops. These rights were established in 1980 on lands that were irrigated before that time and are tied to the specific parcels of land. The water pumped pursuant to the Irrigation Grandfather Right must be used on the land that was originally decreed for that right. The water cannot be used for irrigation on other lands. The lands within the Salt River channel do not fall into the Irrigation Grandfather Right category. Therefore, groundwater pumped pursuant to an Irrigation Grandfather Right is not applicable to the Oeste Project.

COP can pump groundwater pursuant to a Service Area Right. This type of groundwater right is issued to public supply water providers. It allows the water provider to pump the quantity of water needed to meet a given demand, subject to water conservation requirements. The Arizona Groundwater Code dictates that, except in times of surface water drought, all groundwater pumped by an entity, such as COP, with an Assured Water Supply designation must be replenished through the use of long-term storage credits. Irrigation

Grandfather Right extinguishment credits, membership in the Central Arizona Groundwater Replenishment District, annual storage and recovery, or depletion of its groundwater allowance. Groundwater pumped under this right for habitat restoration would count toward COP's annual pumping total and would entail a depletion of their store of credits, making less water available to meet the needs of other current and future water users. Long-term storage credits and Irrigation Grandfather Right extinguishment credits are potential sources of water for the project but require an agreement between the parties to finance their creation.

3.2.5 New Water Well Development

If new wells are to be drilled, permits must be obtained from the ADWR. An impact study is required for all wells with a pump capacity of 500 gpm or greater. The study must demonstrate that the new well will not produce an additional 25 feet of drawdown in existing wells after five years of pumping. If the additional drawdown is less than 10 feet, the permit can be issued. If the drawdown is greater than 10 feet but less than 25 feet, the owner of the new well must obtain a release letter from the owner of each impacted well stating that an agreement has been reached to mitigate the drawdown. This can be a time consuming and expensive process.

Drilling new wells to pump groundwater is feasible and should be considered if there are no existing wells available to supply the project.

3.2.6 Assessment of Source

The water supply and distribution system is critical to the success and sustainability of the Oeste Environmental Restoration Project. A sufficient quantity and adequate quality of water must be available to maintain the viability of the various habitat types that are being considered for Oeste. The primary water supply for the Oeste project is effluent obtained directly from the 23rd Avenue Water Reclamation Plant. Supplemental water could come from a variety of underground sources including: 1) effluent credits "recovered" (pumped) from within the area of hydrologic impact of the RID Groundwater Savings Facility; 2) incidental recharge credits associated with increased recharge from project implementation; 3) groundwater (based on the City's Assured Water Supply allowance); and 4) recovered credits for Central Arizona Project water (stored by the City). Therefore, it did consider groundwater as a makeup source for the seasonal changes of reclaimed water from the 23rd Ave. Water Reclaimed Plant.

The use of pumped water (rather than direct effluent) has several limitations. One of these relates to the City's ability to comply with state mandated water conservation requirements. When the physical availability of pumped groundwater is considered, it is a dependable or supplemental water supply. There are no projections that the aquifer will be depleted, and water rights do not prevent its use for the Oeste Project. However, institutional commitments by COP, or SRP must be made to allow groundwater pumping. These considerations must be resolved before finalizing the design of the pump and delivery system.

3.3 Salt River Flood Flows

3.3.1 Description of Source

The Oeste Project is below the confluence of the Salt River and the Verde River. In the past, both rivers were perennial with consistent flow rates. The construction of dams with water storage reservoirs upstream allowed for the development of water resources to supply water for irrigation and urban use in the Phoenix Valley. Most of the time, all of the flow in the Salt River is diverted at Granite Reef, low-head dam, into the Arizona Canal and Southern Canal. The riverbed downstream is typically dry.

The river, however, is still subject to uncontrolled floods because the reservoirs on the Verde River have no dedicated flood capacity, and only one of the four reservoirs on the Salt River has flood capacity. Due to the design of the dams, only limited flows can be released in anticipation of floods. When the water level exceeds the diversion capacity at Granite Reef, the excess will overflow the spillway to the downstream reaches of the Salt River to flood.

3.3.2 Quantity Analyses

The Salt River is dry the majority of the time due to the upstream dams that were constructed for water supply and hydropower to agriculture and the Phoenix valley. For example, the Salt River flooded in 1941 and then was dry until it flooded again in 1966. The next flood occurred in 1973. The periods from 1978 to 1984 and from 1991 to 1995 were wet periods. Since 1995, there have been no flood releases. Table 3-1 summarizes historic releases at Granite Reef (Tres Rios River Management Plan Water Supply Technical Committee, 1997). This information demonstrates that, in the past, flood flows were more frequent and with less magnitude. Changes in the watershed and construction of additional dams have changed the pattern of flooding. Most of the largest recorded floods have occurred since 1978. Table 3-1 also demonstrates that there is no pattern to the frequency, duration, or magnitude of the flood flows.

Discharge-frequency values are provided in Table 3-2 and more detailed information on flood flows can be found in Appendix A-Hydrology and Hydraulics of Rio Salado Oeste Interim Feasibility Report 2002. While not necessarily a likely preferred source for delivery of water and implementation of restoration measures flood flows need to be considered in plan formulation. On 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 possible damages resulting from flooding as well as taking advantage of the benefits they may provide to sustaining the project.

Table 3-1. Summary of Historic Salt River Flood Flows

(floods with daily flows greater than 10,000 cfs)

Period of Flow Start Date	Period of Flow End Date	Flow Event Maximum Daily Average Flow (cfs)
2/7/1914	7/2/1914	15,800
1/29/1915	8/18/1915	18,700
1/15/1916	5/15/1916	79,100
9/8/1916	2/4/1917	21,100
4/17/1917	5/15/1917	23,400
3/7/1918	3/26/2018	28,400
11/25/1919	13/14/1919	46,200
1/4/1920	4/25/1920	87,800
12/26/1921	1/9/1922	24,100
2/8/1922	2/18/1922	10,000
3/16/1922	4/10/1922	18,000
9/18/1923	9/22/1923	24,100
12/26/1923	1/8/1924	42,800
3/31/1926	4/16/1926	28,800
2/14/1927	3/19/1927	49,800
9/12/1927	9/20/1927	16,200
4/4/1929	4/19/1929	17,200
2/12/1931	2/20/1931	22,900
2/9/1932	3/29/1932	48,700
2/6/1937	3/25/1937	36,981
2/28/1939	3/17/1939	58,739
2/5/1941	5/25/1941	32,206
12/21/1965	1/12/1966	64,000
2/20/1973	6/5/1973	22,273
2/28/1978	4/11/1978	95,800
12/16/1978	4/19/1979	110,000
1/29/1980	6/3/1980	137,725
2/2/1983	6/17/1983	30,000
9/27/1983	10/24/1983	39,878
12/24/1983	1/24/1984	11,200
12/21/1984	6/1/1985	25,604
12/22/1991	6/21/1992	12,898
8/21/1992	9/8/19992	13,615
12/28/1992	6/4/1993	99,396
1/20/1995	5/2/1995	53,316

Source: Greeley and Hansen, Tres Rios, Arizona Feasibility Study, April 1998

Table 3-2. 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

3.3.3 Quality Analyses

The Tres Rios River Management Plan Water Quality Technical Committee (1998) reviewed the water quality records for the Salt River. That study found that there were no chemical water quality issues associated with Salt River water. However, during flood periods, sediments represented a water quality problem; the sediment load exceeded the standard established for the designated uses of the river. The problem was not because the sediments represented contamination. The flood flows can contain pollutants of concern derived from tributary stream inflow, erosion of sediments, and landfills. Large quantities of water in flood flows can dilute the concentration and transport the contaminants through the Oeste study area to downstream areas. There is very little information, however, on the chemical constituents in flood flows. There are no known water quality issues that would prevent flood flows from being used as a water source for the Oeste Project.

3.3.4 Water Rights

Salt River floodwater is subject to surface water rights for diversion. A right filed with the state or established by adjudication is required. However, during a flood, all diversion rights are typically fulfilled. Generally, all water demands are diverted into the two canals at Granite Reef; a flood typically represents surplus water.

3.3.5 Assessment of Source

Flood flows do not occur on a regular basis or in predictable quantities; therefore, they do not represent a dependable water source. While the water may be available, it may be difficult to incorporate flood flows into the Oeste Project water supply. Flood flows do represent a supplemental source because they recharge the groundwater and replicate historic conditions in the river. Aquifer recharge is an indirect use of flood flows. During or shortly after a flood, it is possible that the water table will rise to the point where the vegetation roots can access it. However, when the flood subsides, the water table will return to depths greater than the root zone.

Flood flows have additional benefits to the natural habitat of the river. Small flows will saturate the soils and spread seeds to encourage the seedling germination and development of cottonwood and willow trees. Moderate flood flows will remove some vegetation and

maintain open areas in the river channel. The removal of vegetation is a natural occurrence in river systems. These flows can also redistribute sediments in the channel and help to replace nutrients in the riverbed soils.

Large floods, on the other hand, represent a problem source. The magnitude of these flows can damage restored habitat areas, degrade the reconstructed channels, and deposit excessive amounts of debris throughout the project. The peak flow during the 1980 flood was 200,000 cfs, which did extensive damage to the Salt River Valley (Va Shly'ay Akimel Salt River Restoration Project, Water Budget Report, Knight Piesold, 2002). Flows of this magnitude are neither predictable nor preventable.

3.4 Stormwater Discharges

3.4.1 Description of Source

Stormwater discharges represent runoff to the Salt River from urban and rural areas due to rainfall events. In general, stormwater can enter the Salt River through defined outfall points from stormwater drainage systems or as overland flow from areas immediately adjacent to the river.

In general, roadside ditches and irrigation canals intercept the majority of storm runoff. These features retain most of this runoff, thus eliminating discharges into the Salt River. There are a few areas down gradient of roadside ditches and irrigation canals where runoff will reach the Salt River. However, these areas are relatively small, and little runoff is projected to occur during most storm events.

Several smaller storm drains exist along the bank of the Salt River. Unfortunately, there are limited flow records for these drains. There are also several areas adjacent to the river where overland flow discharges directly to the river. These areas are generally undeveloped with the exception of the occasional sand and gravel mining operation.

3.4.2 Quantity Analyses

Stormwater flows occur in direct response to precipitation. Most stormwater runoff in the study area is not measured or gaged. The runoff is sheet flow across the land, roadside curb and gutter systems, or ditches that drain to the river channels.

U.S. Army Corps of Engineers (USACE) conducted a site investigation to verify the location of storm drains into the Salt River. It was also observed that wetland plant species were growing in the riverbed near outfalls of the north side of 51st Avenue (SR01) and 67th Avenue (SR49). There are limited flow records for those drains, and the exact drainage area that contributes runoff to the drain is not known. However, the presence of wetland plant species indicates that this runoff is sufficient to maintain this vegetation.

To quantify the average monthly and annual volumes of runoff from ungaged storm drains, the approach used in the Rio Salado project (USACE, 1998) was used to estimate the average annual volume of runoff. To estimate the average monthly volume of runoff, the annual amount was distributed according to the monthly rainfall distribution in the Phoenix area (Schmidli, 1996). This approach is described in detail in the Draft Report for the Interior Drainage Analyses (USACE, 2003). Table 3-3 provides the monthly and annual runoff amounts estimated for these drains.

3.4.3 Quality Analyses

It is important to note that stormwater quality is a function of land use, not the size of the watershed (Greeley and Hansen, 2001). In other words, how a specific section of land is used will impact stormwater quality more so than tract size. Table 3-4 provides the summary statistics for selected event-mean constituent concentrations measured in stormwater and stream by the land use. Stormwater 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 stormwater National Pollutant Discharge Elimination System (NPDES) permits require each industrial site to have a stormwater 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. The quality of the "first flush" water is generally poor.

In some locations where the farm fields are near river channels, stormwater can flow directly into the river channels. The agricultural stormwater runoff from fields can contain large amounts of sediment because plowing and cultivation break up the soil surface and make the soil susceptible to erosion. The field stormwater runoff can contain pollutants of concern associated with agriculture, such as nitrates (from fertilizers), pesticides, and herbicides. Past irrigation practices often resulted in the application of excess irrigation water, which was drained from fields into drainage canals and released into the rivers. Discharges of excess irrigation water, or tailwater, are not regulated and their quality is not monitored. Water conservation rules restricting irrigation water use have resulted in a substantial reduction in farm field drainage, but have not eliminated it.

Concentrated animal-feeding operations (CAFOs) can produce very poor quality discharges if the site drainage is not controlled. Animal wastes can drain from the site into storm drains or irrigation systems, including both water supply laterals and drainage canals. The principal pollutant of concern from such operations is nitrate. Bacterial pathogens and other microbiological pollutants, biochemical oxygen demand (BOD), total suspended solids, and nutrient loads can also be generated at a CAFO site. CAFO sites are not located within the Salt River channel, however, uncontrolled runoff from CAFO operations can enter the Salt River through canals and storm drainage systems.

As the runoff continues, the water quality improves. The numeric surface water quality standards established by ADEQ for each designated use were compared against the available surface water quality sample data obtained from the various databases. Where an established surface water quality numeric criterion was exceeded, this information was used to compile Table 3-5, Storm Water Quality Summary. In general, based on analysis of available data versus the numeric water quality standards, stormwater is a vehicle by which surface water quality appears to degrade within the Salt River.

3.4.4 Assessment of Source

Rainfall events are infrequent in the Phoenix area, so stormwater runoff would generally not be considered as a dependable water source for a habitat restoration project. However, the 67th Avenue Drain (SR49) has produced sufficient flow to support a small area of wetland plant species; unfortunately, there are no records to further evaluate this flow. The average monthly and annual volumes of water released from some of the interior drains are of sufficient magnitude to be considered as a potential water source. These drains, however, do not flow consistently, and releases into these drains may not be reliable.

The remaining storm drains represent two categories of water supply – problem and supplemental. The first flush runoff generally has poor water quality and may not be suitable to nourish restored vegetation. Additionally, the peak flow rates emanating from these drains during major storm events may damage the habitat areas. These flows are both problem sources. After the first flush, the water quality generally improves. This runoff could be a supplemental source.

3.4.5 Future Drainage Master Plan

The purpose of the Durango Area Drainage Master Plan and Laveen Area Drainage Master Plan (ADMP) are to identify flood control problems and plan for the construction of facilities that will eliminate or minimize flooding problems. There are two major objectives of these studies. The first is to develop a plan to control stormwater runoff to prevent flood damage within the watershed. The second is to mitigate future potential runoff and subsequent ponding and to provide protection to properties from future 100-year flooding damages. Because the existing stormdrain system is not enough to carry the 100-year, 24-hour storm event. The detention basins, channels, and pipes are sized based on the revised 100-year discharges. Detention basins are sized to maximize flow attenuation with the land area available using both off-line and flow-through concepts. The off-line concept uses a perimeter channel to allow low flow to bypass the detention basin. The flow-through concept allows the entire flow to be intercepted by the detention basin. The Drainage Master plans are not going to reduce the volumes of stormwater discharge in terms of low flow discharge but it is going to reduce the peak flow and provide the longer low flow to the Oeste project area after the flooding season instead.

Table 3-3. Storm Drain Average Annual Runoff Volumes

OUTFALL No.	SITE LOCATION	PIPE SIZE (inch)	Drainage Area (acre)	Drainage Area (mi^2)	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	96	2290	3.6	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	90	2290	3.6	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	75	1856	2.9	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	72	2862	4.5	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	102	1017	1.6	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	78	4790	7.5	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	54	632.77	1.0	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	108	1620	2.5	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	60	1918	3.0	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
SR47[1,2]	51st Avenue and Salt River- North Side 50 feet north of SR01	48	unknown	unknown	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SR48[1,2]	45th Avenue and Salt River- South Side	48	unknown	unknown	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SR48a[1,2]	43rd Avenue and Salt River- South Side	N/A	14502	22.66	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
SR49[1,2]	67th Avenue and Salt River- North Side	96	4762	7.4	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
SR58[1,2]	35th Avenue and Salt River- N/E Side	60	unknown	unknown	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SR59[1,2]	2333 W. Durango (23rd Ave. WWTP east side of 35th Ave. and Salt River) - North Side	48	unknown	unknown	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Total																4503

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 vs. average annual runoff relationships developed for the Rio Salado Study.

Table 3-4. Summary statistics for selected event-mean constituent concentrations measured in stormwater and streamflow, Maricopa County, Arizona.

Constituent	Units	# of Samples	# < Detection Limit	Maximum	Minimum	Mean	Std. Dev.	Detection Limit USGS	Detection Limit Phoenix
RESIDENTIAL									
COD	mg/L	13	1	200	< 10	100	50	10	1
Suspended Solids	mg/L	14	1	910	< 1	180	230	1	10
Total Cadmium	µg/L	14	5	3	< 0.2	0.8	0.7	1	0.2
Total Copper	µg/L	11	0	45	5	23	5	1	1
Total Lead	µg/L	14	0	99	5	32	28	1	1
COMMERCIAL									
COD	mg/L	8	0	330	60	150	90	10	1
Suspended Solids	mg/L	8	0	337	20	120	120	1	10
Total Cadmium	µg/L	9	6	0.9	0.6	0.7	0.2	1	0.2
Total Copper	µg/L	9	0	64	8	20	17	1	1
Total Lead	µg/L	9	0	27	3	12	7.7	1	1
HEAVY INDUSTRY									
COD	mg/L	9	0	4300	110	720	90	10	1
Suspended Solids	mg/L	9	0	1480	84	790	530	1	10
Total Cadmium	µg/L	10	1	6	0.9	2.5	1.7	1	0.2
Total Copper	µg/L	8	0	320	50	140	90	1	1
Total Lead	µg/L	10	0	620	31	250	180	1	1
LIGHT INDUSTRY									
COD	mg/L	6	0	300	53	120	1360	10	1
Suspended Solids	mg/L	7	0	680	10	250	260	1	10
Total Cadmium	µg/L	7	4	2	< 1	0.8	0.8	1	0.2
Total Copper	µg/L	5	0	72	10	43	24	1	1
Total Lead	µg/L	7	0	130	11	38	43	1	1
SOUTH MOUNTAIN AND SALT RIVER									
COD	mg/L	8	0	21000	12	2650	7420	10	1
Suspended Solids	mg/L	8	0	3390	3	620	1140	1	10
Total Cadmium	µg/L	8	7	2	< 1	--------	--------	1	0.2
Total Copper	µg/L	8	0	300	2	70	120	1	1
Total Lead	µg/L	8	2	150	< 1	28	50	1	1

(Data for South Mountain and Salt River were combined to represent nonurban sources and include event-mean and instantaneous concentrations. Data from drainage basins with mixed land use were not grouped into any land-use category. <, less than. Dashes indicate that statistics could not be computed.)
Source: USGS

Table 3-5. Rio Salado Oeste Project Storm Water Quality Summary

Site Name	Sample Date	Constituent	Result	Units	Regulatory Limit	Limiting Criteria
19th Ave. Bridge	3/28/1991	TURBIDITY	275	NTU	50	R18-11-109
19th Ave. Bridge	3/28/1991	LEAD, TOTAL	28	UG/L	9.3	A&Wedw*
19th Ave. Bridge	3/28/1991	FECAL STREPTOCOCCI	6400	CFU/100	800	R18-11-109
19th Ave. Bridge	3/28/1991	BERYLLIUM, TOTAL	0.6	UG/L	0.21	FC
19th Ave. Bridge	3/28/1991	COPPER, TOTAL	38	UG/L	24	A&Wedw*
Salt River at 27th Ave.	12/10/1991	FECAL STREPTOCOCCI	22000	CFU/100	800	R18-11-109
Salt River at 27th Ave.	12/10/1991	FECAL COLIFORM	3100	CFU/100	800	R18-11-109
Salt River at 27th Ave.	12/10/1991	FECAL STREPTOCOCCI	22000	CFU/100	4000	PBC
Salt River at 27th Ave.	12/10/1991	FECAL COLIFORM	3100	CFU/100	800	R18-11-109
Salt River at 27th Ave.	12/10/1991	FECAL STREPTOCOCCI	26000	CFU/100	4000	PBC
Salt River at 27th Ave.	12/10/1991	FECAL COLIFORM	11000	CFU/100	4000	PBC
Salt River at 27th Ave.	12/10/1991	DDE	0.14	UG/L	0.0006	FC
Salt River at 27th Ave.	12/10/1991	DDE	0.14	UG/L	0.0006	FC
Salt River at 27th Ave.	12/10/1991	FECAL STREPTOCOCCI	25500	CFU/100	800	R18-11-109
Salt River at 27th Ave.	3/2/1992	FECAL STREPTOCOCCI	6500	CFU/100	800	R18-11-109
Salt River at 27th Ave.	3/2/1992	DDT	0.1	UG/L	0.0005	FC
Salt River at 27th Ave.	3/2/1992	DDE	0.67	UG/L	0.0006	FC
Salt River at 27th Ave.	3/2/1992	DDT	0.1	UG/L	0.0006	FC
Salt River at 27th Ave.	3/2/1992	FECAL COLIFORM	5500	CFU/100	800	R18-11-109
Salt River at 27th Ave.	3/2/1992	PCB SERIES	0.3	UG/L	0.00009	FC
Salt River at 27th Ave.	3/2/1992	PH (STANDARD UNITS)	9.05		9	R18-11-109
Salt River at 27th Ave.	3/2/1992	FECAL COLIFORM	5500	CFU/100	800	R18-11-109
Salt River at 27th Ave.	3/2/1992	DDE	0.67	UG/L	0.0006	FC
Salt River at 27th Ave.	3/2/1992	FECAL STREPTOCOCCI	6500	CFU/100	800	R18-11-109
Salt River at 27th Ave.	3/8/1992	FECAL STREPTOCOCCI	6600	CFU/100	800	R18-11-109
Salt River at 27th Ave.	3/8/1992	FECAL COLIFORM	5800	CFU/100	800	R18-11-109
Salt River at 27th Ave.	3/8/1992	DDE	1.1	UG/L	0.0006	FC
Salt River at 27th Ave.	3/8/1992	PCB SERIES	0.3	UG/L	0.00009	FC
Salt River at 27th Ave.	3/8/1992	DDE	1.1	UG/L	0.0006	FC
Salt River at 27th Ave.	3/8/1992	FECAL STREPTOCOCCI	6600	CFU/100	800	R18-11-109
Salt River at 27th Ave.	3/8/1992	FECAL COLIFORM	5800	CFU/100	800	R18-11-109
Salt River at 27th Ave.	3/27/1992	FECAL COLIFORM	9500	CFU/100	4000	PBC
Salt River at 27th Ave.	3/27/1992	FECAL STREPTOCOCCI	8500	CFU/100	800	R18-11-109
Salt River at 27th Ave.	7/11/1992	FECAL COLIFORM	4500	CFU/100	800	R18-11-109
Salt River at 27th Ave.	7/11/1992	FECAL STREPTOCOCCI	9800	CFU/100	800	R18-11-109
Salt River at 27th Ave.	7/11/1992	FECAL STREPTOCOCCI	9800	CFU/100	800	R18-11-109
Salt River at 27th Ave.	7/11/1992	FECAL COLIFORM	4500	CFU/100	800	R18-11-109
Salt River at 27th Ave.	7/11/1992	DDE	0.35	UG/L	0.0006	FC
Salt River at 27th Ave.	7/11/1992	DDE	0.35	UG/L	0.0006	FC
Salt River at 27th Ave.	8/22/1992	FECAL STREPTOCOCCI	4170	CFU/100	800	R18-11-109
Salt River at 27th Ave.	8/22/1992	FECAL COLIFORM	5800	CFU/100	800	R18-11-109
Salt River at 27th Ave.	8/22/1992	FECAL STREPTOCOCCI	4200	CFU/100	800	R18-11-109
Salt River at 27th Ave.	8/22/1992	FECAL COLIFORM	5800	CFU/100	800	R18-11-109

Site Name	Sample Date	Constituent	Result	Units	Regulatory Limit	Limiting Criteria
Salt River at 27th Ave.	12/8/1992	FECAL STREPTOCOCCI	15000	CFU/100	4000	PBC
Salt River at 27th Ave.	12/8/1992	DDT	0.1	UG/L	0.0005	FC
Salt River at 27th Ave.	12/8/1992	FECAL COLIFORM	4500	CFU/100	800	R18-11-109
Salt River at 27th Ave.	12/8/1992	DDE	0.4	UG/L	0.0006	FC
Salt River at 27th Ave.	12/8/1992	DDT	0.1	UG/L	0.0006	FC
Salt River at 27th Ave.	12/8/1992	FECAL STREPTOCOCCI	14700	CFU/100	800	R18-11-109
Salt River at 27th Ave.	12/8/1992	DDE	0.4	UG/L	0.0006	FC
Salt River at 27th Ave.	12/8/1992	FECAL COLIFORM	4500	CFU/100	800	R18-11-109
Salt River at 27th Ave.	1/4/1995	CYANIDE, TOTAL	0.01	MG/L	9.7	A&Wedw
Salt River at 27th Ave.	1/4/1995	CYANIDE, TOTAL	0.01	MG/L	9.7	A&Wedw
Salt River at 27th Ave.	11/1/1995	CYANIDE, TOTAL	0.01	MG/L	9.7	A&Wedw
Salt River at 27th Ave.	11/1/1995	PH (STANDARD UNITS)	9.3		9	R18-11-109
Salt River at 27th Ave.	11/1/1995	CYANIDE, TOTAL	0.01	MG/L	9.7	A&Wedw
Salt River at 27th Ave.	11/1/1995	CYANIDE, TOTAL	0.019	MG/L	9.7	A&Wedw
35th Ave. Bridge	3/29/1991	FECAL STREPTOCOCCI	670	CFU/100	800	R18-11-109
35th Ave. Bridge	3/29/1991	LEAD, TOTAL	18	UG/L	6.3	A&Wedw*
35th Ave. Bridge	3/29/1991	TURBIDITY	108	NTU	50	R18-11-109
35th Ave. Bridge	8/22/1992	FECAL COLIFORM	16000	CFU/100	800	R18-11-109
35th Ave. Bridge	12/5/1994	FECAL STREPTOCOCCI	950	CFU/100	800	R18-11-109
35th Ave. Bridge	12/5/1994	FECAL COLIFORM	1100	CFU/100	800	R18-11-109
35th Ave. Bridge	8/19/1995	FECAL STREPTOCOCCI	1300	CFU/100	800	R18-11-109
35th Ave. Bridge	9/7/1995	FECAL STREPTOCOCCI	1000	CFU/100	800	R18-11-109
35th Ave. Bridge	9/28/1995	FECAL COLIFORM	900	CFU/100	800	R18-11-109
35th Ave. Bridge	3/13/1996	FECAL STREPTOCOCCI	1600	CFU/100	800	R18-11-109
35th Ave. Bridge	7/25/1996	FECAL COLIFORM	9000	CFU/100	800	R18-11-109
35th Ave. Bridge	7/25/1996	FECAL STREPTOCOCCI	16000	CFU/100	800	R18-11-109
35th Ave. Bridge	2/22/1997	CYANIDE, TOTAL	0.03	MG/L	9.7	A&Wedw
35th Ave. Bridge	2/22/1997	FECAL COLIFORM	1600	CFU/100	800	R18-11-109
35th Ave. Bridge	12/22/1997	FECAL STREPTOCOCCI	9000	CFU/100	800	R18-11-109
35th Ave. Bridge	2/4/1998	MERCURY, TOTAL	0.6	UG/L	0.6	FC
35th Ave. Bridge	2/4/1998	FECAL STREPTOCOCCI	90000	CFU/100	800	R18-11-109
51st Ave. Bridge-REW	3/29/1991	FECAL STREPTOCOCCI	1500	CFU/100	800	R18-11-109
51st Ave. Bridge-REW	3/29/1991	TURBIDITY	103	NTU	50	R18-11-109
Salt River at 51st Ave.	4/22/1975	FECAL COLIFORM	360000	CFU/100	800	R18-11-109
Salt River at 51st Ave.	4/28/1975	FECAL COLIFORM	23000	CFU/100	800	R18-11-109
Salt River at 51st Ave.	5/1/1975	FECAL COLIFORM	26000	CFU/100	800	R18-11-109
51st Ave. Bridge	6/1/1982	1,1-DICHLOROETHYLENE	0.0277	MG/L	950	A&Wedw
51st Ave. Bridge	6/1/1982	1,1-DICHLOROETHYLENE	0.0445	MG/L	950	A&Wedw
51st Ave. Bridge	6/1/1982	CARBON TETRACHLORIDE	0.0698	MG/L	5.5	FC
51st Ave. Bridge	6/1/1982	CARBON TETRACHLORIDE	0.1039	MG/L	5.5	FC
51st Ave. Bridge	6/1/1982	TETRACHLOROETHYLENE	0.0622	MG/L	11	FC
51st Ave. Bridge	6/1/1982	TETRACHLOROETHYLENE	0.0274	MG/L	11	FC
51st Ave. Bridge	6/13/1983	LEAD, TOTAL	9.1	UG/L	6	A&Wedw*

A&Wedw*: Calculated value from available hardness data

DDE: p,p'-Dichlorodiphenyldichloroethylene

DDT: p,p'-Dichlorodiphenyltrichloroethane

FC= Fish Consumption

A&Wedw= Aquatic and wildlife (effluent dependent water)

PBC= Partial Body Contact

R18-11-109= Refer to section in Article 1, which is the Numeric Water Quality Standards.

Source: URS, Groundwater Quality and Hydrogeology Report Rio Salado Oeste Project Phoenix, Arizona, 2002

3.5 Effluent

3.5.1 Description of Source

Treated effluent represents a drought tolerant water supply. During water shortage periods, most water conservation measures control the external use of water such as lawn watering, car washing, and landscape irrigation. These uses do not contribute to wastewater flow, so the amount of wastewater will only be reduced slightly during most drought periods.

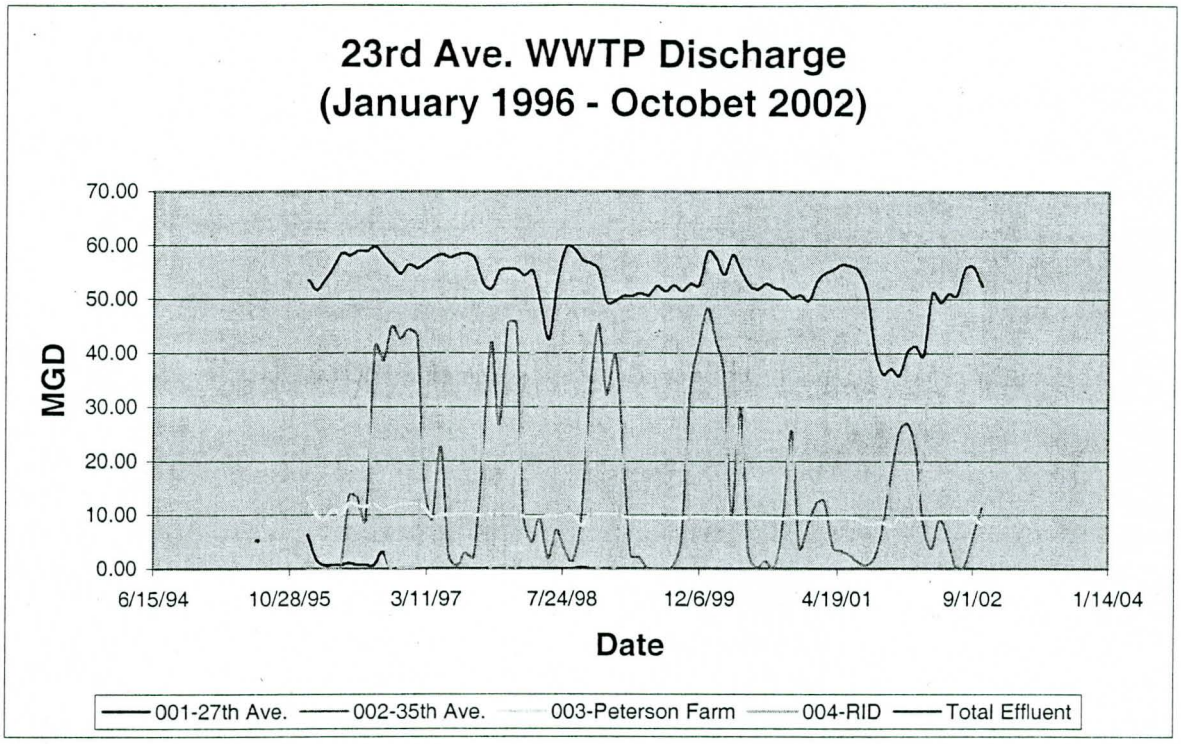
3.5.2 Quantity Analyses

The City of Phoenix operates the 23rd Avenue WWTP. Effluent produced by this plant is reused by the Roosevelt Irrigation District (RID) for irrigation water. When RID is taking the effluent, there is no flow discharged to the Salt River. RID diversions are seasonal, following the demand for irrigation water. During winter, the effluent from the WWTP is discharged into the Salt River. The discharge percolates into the riverbed, but as the discharge season progresses, the flow extends downstream. When hydrologic conditions permit, the flow from the 23rd Avenue WWTP can continue downstream beyond the study area. This occurs during periods when large storm flows or flood flows have saturated the riverbed. Table 3-6 presents the average discharges by month from the 23rd Avenue WWTP. Figure 3-2 also demonstrates the trend of daily discharges (from January 1996 to October 2002) from the 23rd Avenue WWTP.

Table 3-6. 23rd Avenue WWTP Discharge (January 1996 – October 2002)

Source: City of Phoenix

	001 South Gate of discharge structure at 27th Avenue (27th Ave.) Average Flows		002 Pipeline discharge to Salt River at 35th Avenue (35th Ave.) Average Flows		003 West gate of discharge structure at 27th Avenue (Peterson Farm-Irrigation) Average Flows		004 Junction structure on RID pipeline to RID Canal (RID) Average Flows		Total Plant Effluent Average Flows	
	MGD	AC-FT	MGD	AC-FT	MGD	AC-FT	MGD	AC-FT	MGD	AC-FT
January	0.90	85.94	29.39	2,796.23	10.48	997.23	11.20	1,065.91	51.96	4,942.91
February	0.26	22.57	29.23	2,511.40	10.08	866.29	12.54	1,077.51	52.11	4,477.76
March	0.10	9.07	15.19	1,445.07	9.76	928.90	26.97	2,565.79	52.02	4,948.83
April	0.10	9.25	4.89	450.21	9.72	894.93	40.17	3,698.03	54.87	5,052.07
May	0.10	9.51	10.98	1,044.40	9.65	917.97	33.32	3,169.47	54.03	5,140.13
June	0.15	14.06	4.19	385.85	9.97	917.77	38.38	3,533.85	52.69	4,851.03
July	0.10	9.51	3.26	309.69	9.86	938.38	41.16	3,915.91	54.38	5,173.49
August	0.10	9.51	2.57	244.60	9.72	924.91	43.10	4,100.60	55.46	5,276.42
September	0.10	9.21	7.62	701.87	9.82	903.90	36.36	3,347.79	53.90	4,962.23
October	0.50	47.34	14.21	1,351.75	9.23	878.52	27.50	2,616.47	51.44	4,893.79
November	0.00	0.00	32.39	2,981.60	9.74	896.33	8.67	798.05	50.88	4,684.26
December	0.00	0.00	30.96	2,945.02	10.08	958.91	9.68	920.88	50.76	4,828.74
Annual	0.20	225.15	15.41	17,256.45	9.84	11,025.84	27.42	30,715.91	52.87	59,227.22



Source: City of Phoenix

Figure 3-2. 23rd Avenue WWTP Discharge Rate

3.5.3 Quality Analysis

All WWTPs that discharge to surface waters are required to have NPDES permits that include requirements to monitor the quality of the effluent prior to discharge. There are several WWTPs with discharge permits for the Salt River. Discharges from the Mesa and Tempe Water Reclamation Plants upstream would infiltrate into the Salt River bed before reaching the Oeste study area.

23rd Avenue WWTP

The WWTP is currently active, and effluent water is discharged at the outfall point on the north side of the Salt River near 35th Avenue. There are currently eight monitoring wells surrounding the sludge drying beds and a monitoring well near the outfall point. Groundwater from these wells is sampled and analyzed periodically. The well near the 35th Avenue outfall point is monitored as part of the Aquifer Protection Permit (APP) for the site.

The quality of the effluent from the WWTP meets aquifer recharge standards, surface water quality standards, and NPDES requirements. Having met all three of these authoritative standards, the quality of effluent is suitable for the restoration project.

3.5.4 Water Rights

The producer of effluent retains ownership until it is discharged and no longer under the control of the producer. If effluent is discharged to a river channel, a downstream water user can file for an appropriation to divert the water just like any other surface water source. The water user may be granted the surface water right to divert the effluent; however, this right

does not guarantee that the effluent producer will continue to discharge to the river channel. The producer still has control as to where the effluent is discharged.

Normally, when effluent is discharged to the river, the producer loses control and hence the right to the effluent. However, if the receiving water channel is designated to be a part of the conveyance system, the producer can maintain the right to the flow. This could occur if COP discharged effluent to a receiving channel in the Salt River with the intent to transport the flow to the restoration project.

When COP discharges the effluent to the recharge ponds, they retain control of the effluent and maintain the right to this water. Once the effluent is recharged, COP's right to this effluent is protected pursuant to groundwater recharge legislation statutes.

3.5.5 Assessment of Source

Effluent from the WWTP could be a dependable or supplemental supply for portions of the Oeste Project. The water source is drought tolerant and can meet water quality standards for restoration. However, COP, who controls the right to the effluent flow, must make an institutional decision to commit water to the project. Currently, COP owes a substantial water debt to the Roosevelt Water Conservation District (RWCD). Once the reclaimed water line to the RWCD canal line is in place, COP intends to use the majority of the effluent from the WWTP to fulfill this debt. COP receives long-term storage credits from this delivery as well as from water recharged through the percolation ponds. Therefore, use of reclaimed water for habitat restoration would mean a depletion of the long-term storage credits that COP uses to comply with Assured Water Supply requirements and to meet current and future demands.

Effluent could be used directly downstream of 35th Avenue where gravity flow and the reclaimed water distribution system, the 27th Avenue discharge structure and the 43rd Avenue discharge structure of Peterson Farm, can be used to deliver the effluent. However, indirect use of effluent could be achieved throughout the study area by using recovery wells to pump groundwater accounted for as recharge credits.

3.6 Irrigation Return Flows

3.6.1 Description of Source

The Oeste Project lies adjacent to irrigated agricultural lands so that the potential exists to use irrigation return flows as a water source for the ecosystem and habitat restoration. Irrigation return flows constitute the water delivered to the agricultural areas that is not consumed by crops, evaporated, or infiltrated into the soils. These flows can occur under two scenarios.

The first scenario, termed tailwater, occurs when surplus irrigation water is applied to the fields but is not used by the crops. Irrigation in the project area is typically accomplished through a flood irrigation technique where sufficient water is applied at the top of the field to force water through the furrows to the other end. In some areas, sumps have been constructed to collect the excess water and pump it back to the top of the field or divert it to

another water user. In other areas, the excess water drains from the fields and is either intercepted by irrigation canals, stormwater ditches, other diversion structures, or discharged directly into the Salt River.

The second scenario occurs when surplus irrigation water is delivered to the canals but is not applied to the fields. This excess water then either remains in the canal where it evaporates or infiltrates, is diverted to other users, or is discharged into the Salt River. This scenario can occur if a rainfall event occurs after irrigation water is delivered to a lateral canal; the soils in the irrigated areas may be saturated by rainfall so that the canal water is no longer needed. In other cases, the irrigation canals may intercept stormwater runoff; if this stormwater runoff is significant, water may need to be released from the canal to prevent overflowing the canal banks.

3.6.2 Quantity Analyses

Under the current configuration (Table 3-7), the 23rd Avenue WWTP discharges approximately 11,026 acre-feet of irrigation water to the Peterson Farm annually. Though Peterson's use is only about 1 mgd, approximately 10 mgd must now be diverted via a canal to meet Peter's demand. The excess water now infiltrates along the canal or is discharged back to the Salt River between 43rd and 51st Avenue. Thus, if a pressurized pipeline can be constructed to deliver Peterson 1 mgd, the remaining water, adjusted for losses, can be made available to the Rio Salado Oeste Project.

The amount of additional irrigation return flows, irrigation tailwater, generating from irrigation water users is not currently monitored and is difficult to quantify. The irrigation return flows intercepted from irrigation tailwater are not a potential source of water for restoration project.

3.6.3 Quality Analyses

The quality of the irrigation return flows can meet the needs of the Oeste Project in most cases. The water is Salt River water and, as demonstrated in previous sections of this report, the quality is acceptable. In some locations, irrigation drainage water can be saline, but that problem usually occurs far downstream in the western portions of the SRP service area.

Localized water quality problems could occur if surface runoff drainage enters the irrigation drain canals and transports contaminants from surrounding areas into the drain canals. There are no specific concentrated animal feeding operations in the area that could contribute contaminated runoff into the drainage canal system.

Table 3-7. Irrigation Return Flows from the Peterson Farm

	Discharge from 23rd WWTP to Peterson Farm Average Flows		Peterson's Use (Approximation) Average Flows		Excess Water Average Flows	
	MGD	AC-FT	MGD	AC-FT	MGD	AC-FT
January	10.48	997.23	1.00	95.14	9.48	902.10
February	10.08	866.29	1.00	85.93	9.08	780.36
March	9.76	928.90	1.00	95.14	8.76	833.77
April	9.72	894.93	1.00	92.07	8.72	802.87
May	9.65	917.97	1.00	95.14	8.65	822.83
June	9.97	917.77	1.00	92.07	8.97	825.70
July	9.86	938.38	1.00	95.14	8.86	843.24
August	9.72	924.91	1.00	95.14	8.72	829.78
September	9.82	903.90	1.00	92.07	8.82	811.84
October	9.23	878.52	1.00	95.14	8.23	783.39
November	9.74	896.33	1.00	92.07	8.74	804.27
December	10.08	958.91	1.00	95.14	9.08	863.78
Annual	9.84	11,025.84	1.00	1,120.15	8.84	9,905.70

Source: City of Phoenix

3.6.4 Water Rights

Irrigation return flows discharged to the river become available for use by other water users. If this water is diverted and directed into the Oeste Project, it could be utilized to support the wetland and riparian habitat.

3.6.5 Assessment of Source

Irrigation return flows may provide a supplemental source of water for the habitat restoration. In addition, several factors prohibit irrigation return flows from being a reliable source. Typically, only the amount of water necessary for irrigation is delivered to the fields, which minimizes the tailwater amount. Additionally, storm events that produce significant runoff are rare so that surplus canal water is not available on a regular basis. The irrigation flows that do occur, however, only take place during the irrigation season. When the flows are available, they could be incorporated to supplement the water supply for the Oeste Project.

3.7 Irrigation Drains

3.7.1 Description of Source

Irrigation drains are typically constructed along the irrigation canals and laterals in the area to provide a means to discharge excess water to reduce the possibility of a water-overtopping incident. During storm events, some canals and laterals intercept stormwater runoff; if this stormwater runoff is significant, water may need to be released from the canal to prevent overflowing the canal banks. Additionally, the major canals occasionally collect irrigation tail water. In the event more water is being conveyed than can be handled safely, the drains allow the excess water to be carried to the Salt River. Two significant canal drains were identified within the study area, namely the SRP 67th Avenue Drain, and Maricopa Drain. Each of these canal drains is operated by SRP.

There are also several lateral canals that could ultimately drain into the Salt River. These canals, however, are generally relatively small and rarely have a surplus of water. There are no flow records available for these canals. Given the size and infrequent water surplus of these canals, they are not considered to be a potential water source for the habitat restoration project.

3.7.2 Quantity Analyses

Flow records for the SRP 67th Drain were evaluated for the period from January 1993 through December 2002. These records indicate that, for the SRP 67th Drain, the average monthly volume of flow for this period ranged from 26.1 acre-feet in November to 173.4 acre-feet in September with an average annual total of 1,043.7 acre-feet. Table 3-8 summarizes the average monthly and annual volumes of flow for these drains for the period of record evaluated.

Flow records for the Maricopa Drain were evaluated for the period from January 1994 through December 2002. These records indicated that, for the Maricopa Drain, the average monthly volume of flow for this period ranged from 213.2 acre-feet in November to 574.5 acre-feet in April with an average annual total of 4,276.2 acre-feet. Table 3-9 summarizes the average monthly and annual volumes of flow for these drains for the period of record evaluated.

3.7.3 Quality Analyses

The water discharged from irrigation drains is generally high quality and suitable for the habitat restoration project.

3.7.4 Water Rights

Irrigation return flows discharged to the river become available for use by other water users. If this water is diverted and directed into the Oeste Project, it could be utilized to support the wetland and riparian habitat.

3.7.5 Assessment of Source

Irrigation drains could provide a supplemental source of water for the restoration project. The amount of water released through these drains has historically been relatively consistent from month to month. Although these amounts are sufficient to support some riparian vegetation, the timing of these flows is irregular. These releases are not reliable as the drains have historically been dry for long periods; for example, there were no releases to the SRP 67th Avenue Drain throughout the period from November 1996 through February 1997. The Maricopa Drain flows were historically more frequent and reliable. Future releases to this drain are expected to be less frequent than the historic trend. Most of these releases are controlled by SRP and are not expected to be reliable. Irrigation drains are typically utilized when a surplus of water exists in the major canals. When these releases do occur, however, they could be used to supplement the habitat restoration water supply.

Table 3-8. SRP 67th Avenue Drain Monthly Volume

(Units are in acre-feet)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOT
1993	0.2	27.8	445.1	504.9	66.0	105.2	140.9	151.7	4.4	17.2	0.0	45.2	1,508.6
1994	174.0	28.1	57.2	42.6	34.7	30.0	16.6	56.3	17.1	23.6	2.5	14.2	496.9
1995	1.6	56.5	137.5	100.6	56.8	109.4	23.1	24.8	21.5	6.6	7.8	7.1	553.3
1996	7.7	89.4	5.6	31.3	36.2	20.8	24.3	42.7	0.2	16.5	0.0	0.0	274.8
1997	0.0	0.0	41.1	31.8	9.5	0.0	0.0	24.4	24.6	25.3	0.0	306.9	463.6
1998	63.5	64.0	399.4	77.1	247.6	85.5	27.1	51.3	1,344.5	1,015.0	45.1	51.3	3,471.2
1999	10.7	12.3	136.7	92.0	56.4	201.7	82.2	156.1	64.0	76.9	6.0	0.5	895.4
2000	31.7	15.8	30.5	63.1	196.4	219.1	34.2	81.8	27.7	92.0	79.4	11.7	883.5
2001	40.5	2.9	189.6	85.8	120.3	91.5	110.7	87.4	137.0	67.9	1.8	15.6	951.0
2002	37.0	5.5	24.2	47.1	80.9	90.7	90.8	168.4	93.0	119.0	118.3	64.2	939.0
Average	36.7	30.2	146.7	107.6	90.5	95.4	55.0	84.5	173.4	146.0	26.1	51.7	1,043.7

Source: SRP

Table 3-9. Maricopa Drain Monthly Volume

(Units are in acre-feet)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOT
1994	271.5	237.5	296.5	349.7	172.9	431.8	362.2	310.9	1.1	36.2	24.4	366.0	2,860.6
1995	133.7	347.9	338.7	696.7	159.7	357.7	282.7	420.4	78.1	124.2	142.8	173.0	3,255.5
1996	177.9	271.0	482.7	311.1	73.5	287.4	587.8	587.8	191.6	109.0	171.1	271.5	3,522.4
1997	61.0	75.4	315.0	262.7	148.5	189.0	151.6	148.2	170.3	282.0	266.7	366.0	2,436.3
1998	288.7	344.3	481.0	812.2	1,012.8	700.2	1,063.6	682.5	394.8	239.5	241.6	250.5	6,511.7
1999	261.3	376.4	619.8	787.0	692.5	692.4	181.2	439.0	482.1	380.3	210.5	376.4	5,498.9
2000	284.8	341.4	373.8	736.7	711.2	727.3	684.0	574.3	472.2	411.8	296.3	266.3	5,880.1
2001	276.5	236.4	333.9	670.5	597.8	481.7	704.2	205.7	205.7	231.6	363.1	175.6	4,482.8
2002	258.2	273.7	502.6	544.2	518.2	577.0	311.1	33.2	268.6	355.7	202.8	192.4	4,037.5
Average	223.7	278.2	416.0	574.5	454.1	493.8	480.9	378.0	251.6	241.1	213.2	270.8	4,276.2

Source: SRP

3.8 Sand and Gravel Mining Operations Releases

3.8.1 Description of Source

Since the construction of upstream dams began controlling the flows in the Salt River, sand and gravel mining operations moved into the river bed and surrounding flood plain to mine this 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 overbank.

Approximately 1,200 acres within the project area are sand and gravel mining operations. The river between 19th and 35th Avenues is lined with operations and nearly 100% modified. Again South of the river between 43rd Avenue and 51st Avenue are mining operations, which cross the river just downstream of 51st and extend on the North side to near 63rd Avenue. To our knowledge, none of these operations discharge water to the Salt River.

3.8.2 Quantity Analyses

Sand and gravel mining operations use pumped groundwater to sort and wash the aggregate materials. Water is used for processing aggregates and stored in holding ponds when not in use. To our knowledge, no water is being discharged into the Salt River; however, inspection of aerial photography indicated that ponded water exists in the Salt River channel. The origin of this water is unknown.

3.8.3 Quality Analyses

The quality of water discharged from sand and gravel-mining operations is dependant partially on the original water supply. The most significant water quality impairment due to these mining operations is sediment.

These mining operations are usually in the river channels or adjacent to the channels on the riverbanks. Before being pumped for use in these operations, the groundwater flows through materials similar to the mining aggregate. It is therefore expected that the mining will not result in any significant change in the chemical constituent concentrations in the water. Mining can greatly increase the sediment load in the water, however, and mining operations located within waters of the United States are required to have Section 404 permits and Section 401 water quality certification to minimize impacts on water quality. The major water quality impact results when there is an accident that releases water from a mining site or when the site is inundated during flood events in the river and stockpile material is transported downstream. During a flood, any sediment generated by sand and gravel mines is overwhelmed by the sediment transported by the flood flow. Currently, there are active sand and gravel mining operations in the Salt River.

3.8.4 Water Rights

Discharges from sand and gravel-mining operations released to the river become available for use by other water users. If this water is diverted and directed into the Oeste Project, it could be utilized to support the wetland and riparian habitat.

3.8.5 Assessment of Source

Discharges from sand and gravel-mining operations are not considered to be a potential water source for the restoration project. To our knowledge, there are no operations that currently discharge excess water into the Salt River.

3.9 Residual Water from Rio Salado project

3.9.1 Description of Source

The source was to maximize groundwater pumping from the Rio Salado project wells and deliver by either pipe or open channels to Oeste. Rio Saldo drilled five wells into the shallow aquifer and is currently evaluating wellhead treatment for at least two wells to remove volatile organic compounds (VOC).

3.9.2 Quantity Analyses

The Rio Salado wells can yield, if pumped 24 hours a day, 7 days a week, approximately 12.5 mgd. This could provide the Oeste Project with approximately 5.7 mgd to 8mgd if piped or 4.5 mgd to 6.5 mgd if conveyed in open channels (COP). The residual water from Rio Salado project is calculated with given information and assumptions as shown on Table 3-10. The result is shown that the residual water available approximately 3.5 mgd from Rio Salado project.

3.9.3 Quality Analyses

The upper aquifer lies close to the surface and is about 300-400 feet thick. This ground water is under utilized and according to the City's Water Services Department, is not suitable for urban water supplies. It contains varying concentrations of pollutants resulting from agricultural, urban, and adjacent landfill impacts making it available for environmental restoration purposes.

3.9.4 Water Rights

Residual water from the Rio Salado project wells discharge to the river become available for use by other water users. If this water is diverted and directed in the Oeste Project, it could be utilized to support the wetland and riparian habitat.

3.9.5 Assessment of Source

There are concerns however with using the Rio Salado residual water. The main River channel or a low flow channel (LFC) could be used for conveyance reducing construction cost, but a substantial pump would be required in the River to move the water into Oeste's distribution system. Plus, if the water were to be conveyed through open channels, it is

estimated that evaporation and percolation losses would be 20%-30% of the piped amount. These losses could be reduced if the water was piped, but could double the conveyance cost of getting water from Rio Salado to Oeste compared to using an open channel delivery system. Trenching though the overbanks in the Rio Salado involves a high degree of waste removal, over excavation for structural stability, and more expensive construction methods to reduce impacts to existing landfills such as, double containment pipes to capture water that could result from a line break.

Table 3-10. Residual Water Budget from Rio Salado Project for Oeste Project

Month	Days	Precipitation		Stormwater[2]	Groundwater	Water Demand (Average)[1]			Water Demand (Peak)[1]			Residual Water w/ Peak Demand[3]		
		inches	acre-feet per acre	acre-feet	acre-feet	acre-feet	cfs	mgd	acre-feet	cfs	mgd	acre-feet	cfs	mgd
January	31	0.67	0.056	445.12	553.58	269.23	4.38	2.83	432.81	7.04	4.55	343.33	5.58	3.61
February	28	0.68	0.057	451.77	500.01	243.18	4.38	2.83	390.93	7.04	4.55	334.97	6.03	3.90
March	31	0.88	0.073	584.64	553.58	269.23	4.38	2.83	432.81	7.04	4.55	413.09	6.72	4.34
April	30	0.22	0.018	146.16	535.73	260.55	4.38	2.83	418.85	7.04	4.55	189.96	3.19	2.06
May	31	0.12	0.010	79.72	553.58	269.23	4.38	2.83	432.81	7.04	4.55	160.63	2.61	1.69
June	30	0.13	0.011	86.37	535.73	260.55	4.38	2.83	418.85	7.04	4.55	160.06	2.69	1.74
July	31	0.83	0.069	551.42	553.58	269.23	4.38	2.83	432.81	7.04	4.55	396.48	6.45	4.17
August	31	0.96	0.080	637.79	553.58	269.23	4.38	2.83	432.81	7.04	4.55	439.67	7.15	4.62
September	30	0.86	0.072	571.35	535.73	260.55	4.38	2.83	418.85	7.04	4.55	402.55	6.77	4.37
October	31	0.65	0.054	431.83	553.58	269.23	4.38	2.83	432.81	7.04	4.55	336.69	5.48	3.54
November	30	0.66	0.055	438.48	535.73	260.55	4.38	2.83	418.85	7.04	4.55	336.12	5.65	3.65
December	31	1.00	0.083	664.36	553.58	269.23	4.38	2.83	432.81	7.04	4.55	452.95	7.37	4.76
Annual	365	7.66	0.638	5089.00	6518.00	3170.00	4.38	2.83	5096.00	7.04	4.55	3966.50	5.48	3.54
Peak	31		0.083	664.36	553.58	269.23	4.38	2.83	432.81	7.04	4.55	452.95	7.37	4.76

1-Draft Final Conceptual Design Documentation Report, Rio Salado Phoenix, Environmental Restoration Project, Phoenix, Arizona, July 2002, Tables 2-4 and 2-5.

2-Rio Salado Salt River, Arizona, Feasibility Report, Technical Appendice, Appenxix A Hydrology, April 1998, Tables 3-7A and 3-7B.

3-Residual Water w/ Peak Water Demand = 0.5 X Stormwater + Groundwater - Water Demand (Peak).

4 Evaluation of Water Sources

Each of the potential water sources has been evaluated based on the quantity and seasonality of flow, water quality, water rights, and institutional considerations. A few dependable and supplemental sources of water are available to supply the Oeste Project. For some of these, there is sufficient information to quantify the potential supply; however, others will require further monitoring to verify the quantity and seasonality of flow. In addition, the Maricopa County, COP, SRP, or CAP could make other water sources available upon institutional commitments. These entities will need to decide if, how much, and when they will commit water to the Oeste Project. Table 4-1 presents a summary of the analyses.

The water supply and distribution system is critical to the success and sustainability of the Oeste Environmental Restoration Project. A sufficient quantity and adequate quality of water must be available to maintain the viability of the various habitat types that are being considered for Oeste. The primary water supply for the Oeste project is effluent obtained directly from the 23rd Avenue Water Reclamation Plant. Supplemental water could come from a variety of underground sources including: 1) effluent credits "recovered" (pumped) from within the area of hydrologic impact of the RID Groundwater Savings Facility; 2) incidental recharge credits associated with increased recharge from project implementation; 3) groundwater (based on the City's Assured Water Supply allowance); 4) recovered credits for Central Arizona Project water (stored by the City); 5) stormwater discharge; and 6) residual water from Rio Salado Project.

Treated effluent from the City's 23rd Avenue Water Reclamation Plant and one ground water well have been identified as the primary water sources for Oeste. The use of pumped water (rather than direct effluent) has several limitations. One of these relates to the City's ability to comply with state mandated water conservation requirements as discussed above. Secondary influxes of dry weather flows and storm water flows from the network of storm drains that empty into the River, residual Rio Salado flows, and discharges east of 35th Avenue on the north bank from the 23rd Avenue Water Reclamation Plant and at 43rd Avenue on the north bank are also included.

TABLE 4-1

WATER BUDGET MATRIX

Water Source	Description/Location	Quantity Available	Availability	Supply Designation	Discussion/Issues
In-Situ Groundwater					
Regional water table	Throughout the study area	None	Not available	Unacceptable	Regional groundwater is too deep for use by the desired vegetation. Depth exceeds 30 feet, which is the limit for mesquite.
Local or perched water table	River channel between 19th avenue and 83rd avenue	Not measured	Continuous	Dependable	Local supply available at the river channel for majority of the study area.
Pumped Groundwater					
Irrigation Grandfather Rights	Tied to specific parcels of land for growing crops.	Not Available	None	Unacceptable	IGR water must be used on a historically specified parcel of land.
Type I Non-Irrigation Rights	Tied to specific parcels of land for changes in land use.	Not Available	None	Unacceptable	Type I water cannot be used off of the specific land parcel.
Type II Non-Irrigation Rights	Pumping for uses not associated with historic farmland.	Pending	Continuous	Dependable or Supplemental	Requires purchase and transfer of Type II right.
Groundwater Permits	Pumping for new uses.	Not Available	None	Unacceptable	Project can not meet permit requirements and conditions.
Service Area Right	Pumping for public water providers.	Pending	Continuous	Dependable or Supplemental	Pumped water will impact COP's overall water resources unless credits to offset the pumping are purchased or developed.
Salt River Flood Flows					
Direct Use	Flow in the Salt River due to spills over Granite Reef Dam; all reaches	Quantity varies with each flood event	Approximately once every 3 years	Problem	Due to the unpredictable nature of the flood flows, they are not a dependable supply, and may cause damage to restored areas.
Indirect Use	Groundwater recharge due to flood flows in the Salt River; all reaches	Quantity varies with each flood event	During floods and for a short time after	Supplemental	Recharge of groundwater allows for indirect use; and, surface soil saturation will augment seed germination.
Stormwater Discharges					
SR01: 51st Avenue and Salt River	Storm runoff from COP, outfalls along the north bank side	~ 274 ac-ft per yr	During or immediately after rainfall events	Unacceptable to Supplemental	First flush is unacceptable due to potential water quality problems, but the remainder of the flow can be a supplemental water source.
SR02: 43rd Avenue and Salt River	Storm runoff from COP, outfalls along the north bank side	~ 274 ac-ft per yr	During or immediately after rainfall events	Unacceptable to Supplemental	First flush is unacceptable due to potential water quality problems, but the remainder of the flow can be a supplemental water source.
SR03: 35th Avenue and Salt River	Storm runoff from COP, outfalls along the north bank side	~ 224 ac-ft per yr	During or immediately after rainfall events	Unacceptable to Supplemental	First flush is unacceptable due to potential water quality problems, but the remainder of the flow can be a supplemental water source.
SR04: 27th Avenue and Salt River	Storm runoff from COP, outfalls along the north bank side	~ 341 ac-ft per yr	During or immediately after rainfall events	Unacceptable to Supplemental	First flush is unacceptable due to potential water quality problems, but the remainder of the flow can be a supplemental water source.
SR05: 25th Avenue and Salt River	Storm runoff from COP, outfalls along the north bank side	~ 125 ac-ft per yr	During or immediately after rainfall events	Unacceptable to Supplemental	First flush is unacceptable due to potential water quality problems, but the remainder of the flow can be a supplemental water source.
SR06: 22nd Avenue and Salt River	Storm runoff from COP, outfalls along the north bank side	~ 561 ac-ft per yr	During or immediately after rainfall events	Unacceptable to Supplemental	First flush is unacceptable due to potential water quality problems, but the remainder of the flow can be a supplemental water source.
SR07: 19th Avenue and Salt River	Storm runoff from COP, outfalls along the north bank side	~ 79 ac-ft per yr	During or immediately after rainfall events	Unacceptable to Supplemental	First flush is unacceptable due to potential water quality problems, but the remainder of the flow can be a supplemental water source.
SR30: 27th Avenue and Salt River	Storm runoff from COP, outfalls along the south bank side	~ 196 ac-ft per yr	During or immediately after rainfall events	Unacceptable to Supplemental	First flush is unacceptable due to potential water quality problems, but the remainder of the flow can be a supplemental water source.
SR31: 19th Avenue and Salt River	Storm runoff from COP, outfalls along the south bank side	~ 231 ac-ft per yr	During or immediately after rainfall events	Unacceptable to Supplemental	First flush is unacceptable due to potential water quality problems, but the remainder of the flow can be a supplemental water source.
SR47: 51st Avenue and Salt River - 50 feet north of SR01	Storm runoff from COP, outfalls along the north bank side	Minimal	During or immediately after rainfall events	Problem	Runoff is of insufficient quantity with no dedicated collection system; drainage area is not available.

TABLE 4-1 (CONTINUED)

WATER BUDGET MATRIX

Water Source	Description/Location	Quantity Available	Availability	Supply Designation	Discussion/Issues
Stormwater Discharges (continued)					
SR48: 45th Avenue and Salt River	Storm runoff from COP, outfalls along the south bank side	Minimal	During or immediately after rainfall events	Problem	Runoff is of insufficient quantity with no dedicated collection system; drainage area is not available.
SR48a: 43rd Avenue and Salt River	Storm runoff from COP, outfalls along the south bank side	~ 1,640 ac-ft per yr	During or immediately after rainfall events	Unacceptable to Supplemental	First flush is unacceptable due to potential water quality problems, but the remainder of the flow can be a supplemental water source.
SR49: 67th Avenue and Salt River	Storm runoff from COP, outfalls along the north bank side	~ 558 ac-ft per yr	During or immediately after rainfall events	Unacceptable to Supplemental	First flush is unacceptable due to potential water quality problems, but the remainder of the flow can be a supplemental water source.
SR58: 35th Avenue and Salt River	Storm runoff from COP, outfalls along the north bank side	Minimal	During or immediately after rainfall events	Problem	Runoff is of insufficient quantity with no dedicated collection system; drainage area is not available.
SR59: 2333 W. Drango (23rd Ave. WWTP east side of 35th Ave. and Salt River)	Storm runoff from COP, outfall along the north bank side	Minimal	During or immediately after rainfall events	Problem	Runoff is of insufficient quantity with no dedicated collection system; drainage area is not available.
Effluent					
Direct Use	Effluent from the 23rd Avenue WWTP discharged directly into the 35th Avenue.	averages 15.41MGD (~17,256 ac-ft per yr)	Continuous	Dependable or Supplemental	The quantity and availability of effluent water is subject to an institutional commitment by COP; COP has existing commitments for this effluent.
Indirect Use	Effluent from the 23rd Avenue WWTP recharged into the groundwater	Pending	Continuous	Dependable or Supplemental	COP has incorporated the recharge credits for this effluent into its long-term water plan; it would require a reallocation to the project. Indirect use requires wells to recover the recharged water.
Irrigation Return Flows					
Irrigation Tailwater	Excess water applied to crops within the agricultural area of the Community	Minimal	Irrigation season	Supplemental	Supply only available during irrigation season; unreliable because irrigation practices are designed to reduce the tailwater quantity.
Surplus Irrigation Water	Excess water in Peterson Farm	averages 8.84MGD(~9,905 ac-ft per yr)	Continuous	Supplemental	Supply available during all season based on discharge record; unreliable because irrigation practices are designed to reduce the tailwater quantity.
Irrigation Drains					
SRP 67th Avenue Drain	Allows excess flow in SRP's Lateral 2-19.0 to drain to the Salt River: the north bank of the Salt River on the east side of 67th avenue	averages 1,044 ac-ft per yr	In-frequent	Supplemental	Flow is due to controlled releases by SRP; releases occur irregularly and are not reliable.
SRP Maricopa Drain	Allows excess flows from the ditch known as the Maricopa Drain to flow to the Salt River: the south bank of the Salt River near 77th Avenue	averages 4,276 ac-ft per yr	In-frequent	Supplemental	Flow is due to controlled releases by SRP; releases occur irregularly and are not reliable.
Sand & Gravel Mining Releases					
	Within the Salt River; all reaches	None	Not available	Unacceptable	No known discharges from these operations.
Residual Water Flows from Upstream (Rio Salado Project)					
Ridual Water Flows	Excess water in Rio Salado Project. Resiual Water w/ Peak Water Demand=0.5XStormwater+Groundwater-Water Demand(Peak)	averages ~3,966 ac-ft per yr	Continuous	Supplemental	Supply available during all season based on the water budget of Rio Salado project; unreliable because Rio Salado practices are not fixed.

5 Water Budget for Project Alternatives

Prior to developing restoration alternatives constraints were identified that would affect the plan formulation process. Those constraints were:

- Availability of Water
- Maintenance of Floodway Capacity
- Proximity of Recreation to Restoration
- Endangered Species
- Local Acceptability
- Displacement of People
- Rapid Growth
- Real Estate
- County and City Lands

Water to support restoration was identified as one of the most limiting constraints because of its scarcity and cost. The next greatest limiting factor was land that could be dedicated to restoration. In fact, the last four of the constraints identified deal with land use or land cost issues. Although water and land to support restoration were identified as principal limiting constraints, this analysis determined to evaluate what could be accomplished if significant areas of land and substantial volumes of water were available. This approach allows decision makers to weigh the relative cost of the biologic outputs resulting from commitment of substantial volumes of water when evaluating plans for implementation. Alternatives were developed to focus on varying levels of water supply and varying amounts of available land in order to ensure consideration of the effects of these two resources on plan costs and outputs.

These alternatives include the modification of existing storm-water outfall areas to improve retention and water spreading as well as increasing the existing habitat currently supported by these outfalls and modification and/or restructuring of the primary conveyance channel to a more natural state by grading and terracing the river corridor from 19th avenue to 83rd avenue. Those alternatives also include the features described above and add a supplemental water supply in the form of effluent. At locations identified as suitable throughout the project area cottonwood/willow and mesquite cover types will be restored. These alternatives would also address the management, control and removal of invasive species within the study area. Some of alternatives add restoration of emergent wetlands at the existing gravel pits at 29th and 37th Avenues. The results screened are presented in **Table 5-1**.

Table 5-1. Ecosystem Restoration Alternative Plans

Alternative	Acres	Water Demand (A/F)	Water Demand (mgd)
1. No Action			
2. Storm water and Channel: This alternative includes the modification of existing storm-water outfall areas to improve retention and water spreading as well as increasing the existing habitat currently supported by these outfalls. It also includes modification and/or restructuring of the primary conveyance channel to a more natural state by grading and terracing the river corridor from 19th avenue to 83rd avenue. No additional water source is included in this alternative.	C/W: 66 M: 43 W: 28 + 17 Low flow channel	**1,583**	**1.41**
3. Storm water, Channel, Water Supply, Cottonwood, Mesquite, Invasive: This alternative includes the features described in alternative 2 and adds a supplemental water supply in the form of effluent. At locations identified as suitable throughout the project area cottonwood/willow and mesquite cover types will be restored. This alternative would also address the management, control and removal of invasive species within the study area.	C/W: 348 M: 409 W: 28 + 34 Low flow channel	**4,524**	**4.04**
4. Storm water, Channel, Water Supply, Cottonwood, Mesquite, Invasive, Emergent: This alternative adds restoration of emergent wetlands at the existing lake in the channel immediately downstream of 19th Avenue.	C/W: 348 M: 409 W: 33 + 34 Low flow channel	**4,701**	**4.20**
5. Storm water, Channel, Water Supply, Cottonwood, Mesquite, Invasive, Emergent, Lake: Added to this alternative is lake restoration at the existing gravel pits at 29th and 37th Avenues.	C/W: 375 M: 417 W: 76 + 34 Low flow channel O/W: 40	**7,752**	**6.92**
5A. Wetland restoration in lieu of permanent open water and lakes: In lieu of lake restoration this includes regarding of the existing gravel pits to restore them to the floodplain and restoration of emergent wetland and riparian areas.	C/W: 375 M: 417 W: 156 + 34 Low flow channel	**9,293**	**8.30**
5B. This alternative is a hybrid of 5 and 5A: including restoration of one gravel pit to a wetland/riparian complex and the other to include the lake.	C/W: 375 M: 417 W: 136 + 34 Low flow channel O/W: 20	**9,234**	**8.24**

Table 5-2. Water Budget Analysis for Alternative Plans

Functional Assessment Tool Name	PRECIP	OPEN WATER			COVER TYPES						SUB-TOTAL			TOTAL	
	Ann. Avg. Precip.[1] (in/yr)	AREA (acres)	Evapo-ration Loss (ft/yr)	Infiltration Loss (ft/yr)[2]	Mesq. (acres)	Mesq. Water Demand (ft/yr)	CWW (acres)	CWW Water Demand (ft/yr)	Emergent Marsh & Low Flow Channel (acres)	Emergent Marsh Water Demand[3] (ft/yr)	Area (acres)	Water Demand (acre-feet/yr)	Water Demand (mgd)	Water Demand (acre-feet/yr)	Water Demand (mgd)
Alt. 2	7.66		6.03	27.2	43	3.00	66	8.00	28	36.20	137	1583.15	1.41	1583.15	1.41
Alt. 3	7.66		6.03	27.2	366	3.00	282	8.00		36.20	648	2940.36	2.62	4523.51	4.04
Alt. 3-SW	7.66		6.03	27.2	43	3.00	66	8.00	28	36.20	137	1583.15	1.41		
Alt. 4	7.66		6.03	27.2	366	3.00	282	8.00	5	36.20	653	3118.17	2.78	4701.32	4.20
Alt. 4-SW	7.66		6.03	27.2	43	3.00	66	8.00	28	36.20	137	1583.15	1.41		
Alt. 5	7.66	40.00	6.03	27.2	374	3.00	309	8.00	48	36.20	771	6168.65	5.51	7751.79	6.92
Alt. 5-SW	7.66		6.03	27.2	43	3.00	66	8.00	28	36.20	137	1583.15	1.41		
Alt. 5A	7.66		6.03	27.2	374	3.00	309	8.00	128	36.20	811	7709.91	6.88	9293.06	8.30
Alt. 5A-SW	7.66		6.03	27.2	43	3.00	66	8.00	28	36.20	137	1583.15	1.41		
Alt. 5B	7.66	20.00	6.03	27.2	374	3.00	309	8.00	108	36.20	811	7650.51	6.83	9233.66	8.24
Alt. 5B-SW	7.66		6.03	27.2	43	3.00	66	8.00	28	36.20	137	1583.15	1.41		

[1]-Source: National Climatic Center, 1995. Phoenix Annual Summary of the Local Climatological Data

[2]-Assume "27.2" with the clay liner for the wetland and lake (Rio Salado, Salt River, Arizona, Hydrology Appendix).

[3]-Assume "36.2" with the clay liner for the wetland and lake (Infiltration Rate (27.2) + Water Demand for Emergent Marsh (9) = 36.2).

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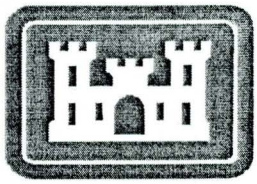


US Army Corps
of Engineers
Los Angeles District

Rio Salado Oeste Environmental Restoration Study
Phoenix, Arizona

Draft
Interior Drainage Report
(Future Condition)

June 2004

LOS ANGELES DISTRICT, CORPS OF ENGINEERS
HYDROLOGY AND HYDRAULICS SECTION

Table of Contents

1.0 INTRODUCTION AND SUMMARY 1

2.0 IRRIGATION DRAINS 5

2.1 SRP 67TH AVENUE DRAIN 5
2.2 SRP MARICOPA DRAIN 9

3.0 STORM DRAINS 12

3.1 SR01: 51ST AVENUE AND SALT RIVER – NORTH SIDE 17
3.2 SR02: 43RD AVENUE AND SALT RIVER – NORTH SIDE 18
3.3 SR03: 35TH AVENUE AND SALT RIVER – NORTH SIDE 18
3.4 SR04: 27TH AVENUE AND SALT RIVER – NORTH SIDE 18
3.5 SR05: 25TH AVENUE AND SALT RIVER – NORTH SIDE 19
3.6 SR06: 22ND AVENUE AND SALT RIVER – NORTH SIDE 19
3.7 SR07: 19TH AVENUE AND SALT RIVER – NORTH SIDE 20
3.8 SR30: 27TH AVENUE AND SALT RIVER – SOUTH SIDE 20
3.9 SR31: 19TH AVENUE AND SALT RIVER – SOUTH SIDE 21
3.10 SR48A: 43RD AVENUE AND SALT RIVER – SOUTH SIDE 21
3.11 SR49: 67TH AVENUE AND SALT RIVER – NORTH SIDE 22
3.12 SUPPLEMENTARY 22
3.13 NATURAL SURFACE DRAINAGE 23

4.0 WATER QUALITY ANALYSES 26

5.0 EVALUATION OF INTERIOR DRAINAGE SYSTEM 26

5.1 DAMAGE TO RESTORED HABITAT 27
5.2 WATER SOURCE 27

REFERENCES 0

List of Tables

TABLE 1-1. Interior Drains Average Monthly Volume 4
TABLE 2-1a. SRP – 67th Avenue Drain Average Daily Volume 7
TABLE 2-1b. SRP – 67th Avenue Drain Maximum Daily Volume 7
TABLE 2-2. SRP – 67th Avenue Drain Monthly Volume 8
TABLE 2-3a. Maricopa Drain Average Daily Volume 10
TABLE 2-3b. Maricopa Drain Maximum Daily Volume 10
TABLE 2-4. Maricopa Drain Monthly Volume 11
TABLE 3-1. Rainfall Pattern for the Phoenix Area 17
TABLE 3-2. Storm Drain N-Year Peak Flow 24
TABLE 3-3. Storm Drain Average Annual Runoff Volumes 25

List of Figures

FIGURE 1-1. Locations of Irrigation Drains and Storm Drains 3
FIGURE 3-1. Peak Flow Relationships for Various Return Periods 14
FIGURE 3-2. Typical Full-Flow Storm Drain Pipe Capacity 15
FIGURE 3-3. Average Annual Storm Drain Runoff for the Phoenix Metro Area 16

Appendices

APPENDIX A. SRP 67th Avenue Drain Daily Flow Records
APPENDIX B. SRP Maricopa Drain Daily Flow Records

1.0 Introduction and Summary

Interior drains, or side drains, that outfall into Salt River between 19th Avenue on the east and 83rd Avenue on the west may have implications on the Rio Salado Oeste Project (Oeste Project).

Two types of interior drains were identified that outfall into the Salt River within the project study limits – irrigation drains and storm drains. Figure 1-1 presents locations of irrigation drains and storm drains. Irrigation drains are designed to release water from the irrigation facilities and discharge it into the Salt River. These drains are an operational mechanism to restrict flow in the irrigation system. Storm drains are designed to collect runoff generated by rainfall events. These are typically installed in urbanizing areas to protect developments from a design storm of a certain return period.

These have been evaluated to assess the potential damage that frequent inundation or high discharge velocities may cause to the restored habitat and the possibility of utilizing this water to support or nourish the reestablishment of riparian vegetation.

The peak flow rates and discharge velocities from the interior drains are sufficient to create localized damage at the outlet of each drain. However, this damage is not expected to extend beyond the immediate vicinity of the pipe outlet. There is little evidence to suggest that flows from these drains have historically done more than wet the riverbed in the immediate vicinity of the drain outlet. To that regard, there is little advantage to providing extensive protection from the interior drainage discharge.

The interior drains were also evaluated to assess the potential for using these flows as a water source to support and nourish the restored vegetation. For this evaluation, these drains were each evaluated based on the quantity, reliability, and quality of flow that is or may be available for habitat restoration.

Salt River Project (SRP) has maintained the discharge gaging stations of two irrigation drain outfalls within this study area. The irrigation drains, which flow in response to controlled releases, have received occasional flows throughout the record period from 1993 through 2002. The average annual volumes of water released to the Salt River during this period were 1,044 acre-feet (the record period from 1993 through 2002), and 4,276 acre-feet (the record period from 1994 through 2002) for the SRP 67th Avenue Drain, and Maricopa Drain, respectively. Although these amounts are sufficient to support some riparian vegetation, the timing of these flows is irregular. These releases are not reliable as the drains have historically been dry for long periods.

To evaluate the possibility of using storm water as a water sources, the approach used in the Rio Salado study (U.S. Army Corps of Engineers (USACE), 1998) was used to estimate the average annual volume of runoff because there are no gaging stations for the storm drains in this study area. The storm drains flow in response to rainfall events, so the

discharge from these drains is typically infrequent and highly variable. The storm drains provide an average annual volume of water to the Salt River ranging from 79 to 561 acre-feet.

Table 1-1 presents the average monthly and annual volumes of water released through the interior drains. The table shows the interior drains can supply 8,183 acre-feet of water annually to the project area. Although this is a reasonable amount of water supply to the project, it was calculated through regressive analysis and long-term arithmetic average values. As mentioned earlier, the water supply from interior drains is ephemeral. It is not a reliable source of water supply for the habitat restoration project. However, it can be treated as a secondary water supply through a storm and irrigation water collection system.

Localized water quality problems could occur if surface runoff drainage enters the irrigation drains and transports contaminants from surrounding areas into the irrigation drain canals. The water discharged from irrigation drains is generally high quality and suitable for the habitat restoration project.

Stormwater runoff often contains a significant amount of sediment that is washed from undeveloped and developed 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 stormwater National Pollutant Discharge Elimination System (NPDES) permits require each industrial site to have a stormwater pollution prevention plan (SWPPP). The quality of the "first flush" water is generally poor. As the runoff continues, the water quality improves.

FIGURE 1-1. Locations of Irrigation Drains and Storm Drains

TABLE 1-1. Interior Drains Average Monthly Volume

OUTFALL 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)
	SRP Irrigation Drains													
67th Ave. Drain[1]	67th Ave. and Salt River- North Side	36.7	30.2	146.7	107.6	90.5	95.4	55.0	84.5	173.4	146.0	26.1	51.7	1,044
Maricopa Drain[2]	Near 77th Ave.and Salt River - South Side	223.7	278.2	416.0	574.5	454.1	493.8	480.9	378.0	251.6	241.1	213.2	270.8	4,276
	Storm Drains													
SR01[3,4]	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[3,4]	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[3,4]	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[3,4]	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[3,4]	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[3,4]	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[3,4]	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[3,4]	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[3,4]	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
SR48a[3,4]	43rd 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
SR49[3,4]	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
	Total													9,823

1. 10-yr statistical average (1993-2002).
2. 9-yr statistical average (1004-2001).
3. Monthly storm water runoff distributions were assumed to follow the monthly pattern of rainfall.
4. Annual runoff volumes were computed from the drainage area vs. average annual runoff relationships developed for the Rio Salado Study.

2.0 Irrigation Drains

Irrigation drains are often constructed along the irrigation canals and laterals in the area to provide a means to discharge excess water from the canal to reduce the possibility of a water-overtopping incident. The drains may be used for a variety of reasons. During storm events, some canals and laterals intercept storm water runoff; if this storm water runoff is significant, water may need to be released from the canal to prevent overflowing the canal banks. Additionally, the major canals occasionally collect irrigation tail water. In the event more water is being conveyed than can be handled safely, the drains allow the excess water to be carried to the Salt River. They also provide a mechanism to empty or lower the water level in the canal to allow for periodic inspection and maintenance or for repairs whenever necessary.

SRP has maintained the discharge data of two outfalls within this study area. The records indicate how many acre-feet per month were discharged at each location. The records do not, however, provide an indication of the instantaneous peak flow rate. SRP 67th Avenue Drain collects and discharges excess water including ordered but unused irrigation water, agricultural return flows, and some street runoff from as far north as Thunderbird Road. The Maricopa Drain collects and discharges excess water including ordered but unused irrigation water, agricultural return flows, and some street runoff from an area as far south as Olney Avenue and as far east as perhaps 16th Street. The average daily flow rates are indicative of the peak flow rates that occur in these canals.

2.1 SRP 67th Avenue Drain

This drain located on the north bank of the Salt River on the east side of 67th Avenue allows excess flows in SRP's Lateral 2-19.0 to drain to the River. Its origin is SRP's Grand Canal near 67th Avenue, just north of Indian School Road. However, it collects and discharges excess water including ordered but unused irrigation water, agricultural return flows, and some street runoff from as far north as Thunderbird Road. The design for the outlet works is detailed on SRP drawing number B-112-405.1. At the point of discharge to the Salt River, it is an open concrete ditch 9.0 feet wide and 3.5 feet deep designed to convey 37.5 cfs.

Flow records for the SRP 67th Avenue Drain were evaluated for the record period from January 1993 through December 2002. These records indicate that the average daily flow rates, on a monthly basis, for this period ranged from 0.87 acre-feet in November to 5.77 acre-feet in September with an average of 2.86 acre-feet. The maximum daily flow rate that occurred during this period was 311.51 acre-feet during October 1998. Table 2-1a and Table 2-1b summarize the average daily and maximum daily flow rates for each month of the period of record evaluated. Although these amounts are sufficient to support some riparian vegetation, these releases are irregular and not reliable since the drains have historically been dry for approximately four months as showed in **Appendix A**. The

average monthly volume of flow for this period ranged from 26.1 acre-feet in November to 173.4 acre-feet in September with an average annual total of 1,043.7 acre-feet. Table 2-2 summarizes the average monthly and annual volumes of flow for the period of record evaluated.

TABLE 2-1a. SRP – 67th Avenue Drain Average Daily Volume

(units are in acre-feet)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVE
1993	0.01	0.99	14.36	16.83	2.13	3.51	4.54	4.89	0.15	0.56	0.00	1.46	4.13
1994	5.61	1.00	1.84	1.42	1.12	1.00	0.54	1.82	0.57	0.76	0.08	0.46	1.36
1995	0.05	2.02	4.44	3.35	1.83	3.65	0.74	0.80	0.72	0.21	0.26	0.23	1.52
1996	0.25	3.08	0.18	1.04	1.17	0.69	0.78	1.38	0.01	0.53	0.00	0.00	0.74
1997	0.00	0.00	1.33	1.06	0.31	0.00	0.00	0.79	0.82	0.82	0.00	9.90	1.27
1998	2.05	2.28	12.88	2.57	7.99	2.85	0.88	1.65	44.82	32.74	1.50	1.66	9.51
1999	0.35	0.44	4.41	3.07	1.82	6.72	2.65	5.04	2.07	2.48	0.20	0.01	2.45
2000	1.02	0.54	0.98	2.10	6.34	7.30	1.10	2.64	0.92	2.97	2.65	0.38	2.42
2001	1.31	0.10	6.12	2.86	3.88	3.05	3.57	2.82	4.57	2.19	0.06	0.50	2.61
2002	1.19	0.20	0.78	1.57	2.61	3.02	2.93	5.43	3.10	3.84	3.94	2.07	2.57
Average	1.18	1.07	4.73	3.59	2.92	3.18	1.77	2.73	5.77	4.71	0.87	1.67	2.86

Source: SRP

TABLE 2-1b. SRP – 67th Avenue Drain Maximum Daily Volume

(units are in acre-feet)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MAX
1993	0.20	6.33	46.73	48.85	9.14	7.91	14.08	25.75	1.15	5.24	0.00	8.65	48.85
1994	9.14	9.56	12.16	11.17	6.51	5.95	3.69	9.58	3.53	3.23	1.11	3.37	12.16
1995	0.65	16.62	13.92	10.95	6.59	27.79	5.81	5.45	2.78	3.13	3.21	3.53	27.79
1996	2.98	10.95	2.46	4.78	4.22	3.67	6.47	7.12	0.12	5.18	0.00	0.00	10.95
1997	0.00	0.00	5.47	8.57	2.34	0.00	0.00	4.40	8.07	6.94	0.00	30.70	30.70
1998	9.64	11.94	31.34	11.17	32.55	19.00	11.88	17.45	305.94	311.51	19.80	18.70	311.51
1999	3.81	4.09	22.49	14.94	8.35	23.35	11.46	18.45	18.51	10.37	3.47	0.26	23.35
2000	9.32	9.88	10.18	11.03	14.66	14.96	6.98	9.32	5.87	12.89	9.34	2.78	14.96
2001	10.23	2.08	123.45	8.39	11.58	11.11	9.28	10.79	10.87	7.72	0.65	4.72	123.45
2002	2.34	0.69	5.79	7.14	13.59	12.38	16.62	9.26	10.45	18.82	18.88	2.24	18.88
Maximum	10.23	16.62	123.45	48.85	32.55	27.79	16.62	25.75	305.94	311.51	19.80	30.70	311.51

Source: SRP

TABLE 2-2. SRP – 67th Avenue Drain Monthly Volume

(units are in acre-feet)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOT
1993	0.2	27.8	445.1	504.9	66.0	105.2	140.9	151.7	4.4	17.2	0.0	45.2	1,508.6
1994	174.0	28.1	57.2	42.6	34.7	30.0	16.6	56.3	17.1	23.6	2.5	14.2	496.9
1995	1.6	56.5	137.5	100.6	56.8	109.4	23.1	24.8	21.5	6.6	7.8	7.1	553.3
1996	7.7	89.4	5.6	31.3	36.2	20.8	24.3	42.7	0.2	16.5	0.0	0.0	274.8
1997	0.0	0.0	41.1	31.8	9.5	0.0	0.0	24.4	24.6	25.3	0.0	306.9	463.6
1998	63.5	64.0	399.4	77.1	247.6	85.5	27.1	51.3	1,344.5	1,015.0	45.1	51.3	3,471.2
1999	10.7	12.3	136.7	92.0	56.4	201.7	82.2	156.1	64.0	76.9	6.0	0.5	895.4
2000	31.7	15.8	30.5	63.1	196.4	219.1	34.2	81.8	27.7	92.0	79.4	11.7	883.5
2001	40.5	2.9	189.6	85.8	120.3	91.5	110.7	87.4	137.0	67.9	1.8	15.6	951.0
2002	37.0	5.5	24.2	47.1	80.9	90.7	90.8	168.4	93.0	119.0	118.3	64.2	939.0
Average	36.7	30.2	146.7	107.6	90.5	95.4	55.0	84.5	173.4	146.0	26.1	51.7	1,043.7

Source: SRP

2.2 SRP Maricopa Drain

This drain, located on the south bank of the Salt River near 77th Avenue allows excess flows from the ditch known as the Maricopa Drain to flow to the River. Its origin is near 23rd Avenue and Roeser Road. However, it collects and discharges excess water including ordered but unused irrigation water, agricultural return flows, and some street runoff from an area as far south as Olney Avenue and as far east as perhaps 16th Street. It also includes excess flows from the Peninsula and Horowitz (P&H) Irrigation service area roughly north of Baseline Road and west of 43rd Avenue. It was historically known as many names including the "Drainage Ditch of the Maricopa County Drainage District No. 5", circa 1930. In addition to carrying excess flows to the Salt River, SRP also uses the facility to transport up to 10 cfs of contracted irrigation water to the Gila River Indian Community, which is diverted from the ditch near 75th Avenue and Baseline. The Flood Control District of Maricopa County plans to convert the western half of the Maricopa Drain to the Laveen Area Conveyance Channel (LACC) sometime in the near future. The capacity of the existing Maricopa Drain northeast of 75th Avenue is approximately 75 cfs and when it's converted to the LACC the updated capacity will be about 2880 cfs. The LACC will carry the normal flows of the existing Maricopa Drain within the LACC's low flow channel.

Flow records for the Maricopa Drain were evaluated for the period from January 1994 through December 2002. These records indicate that the average daily flow rates, on a monthly basis, for this period ranged from 7.11 acre-feet in November to 19.15 acre-feet in April with an average of 11.62 acre-feet. The maximum daily flow rate that occurred during this period was 78.80 acre-feet during May 1995. Table 2-3a and Table 2-3b summarize the average daily and maximum daily flow rates for each month of the period of record evaluated. Although these amounts are sufficient to support some riparian vegetation, these releases are irregular and not reliable since the drains have historically been dry for approximately a month as showed in **Appendix B**.

The average monthly volume of flow for this period ranged from 213.2 acre-feet in November to 574.5 acre-feet in April with an average annual total of 4,276.2 acre-feet. Table 2-4 summarizes the average monthly and annual volumes of flow for the period of record evaluated.

TABLE 2-3a. Maricopa Drain Average Daily Volume

(units are in acre-feet)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVE
1994	8.76	8.48	9.56	11.66	5.58	14.39	11.68	10.03	0.04	1.17	0.81	3.08	7.10
1995	4.31	12.42	10.93	23.22	5.15	11.92	9.12	13.56	2.60	4.01	4.76	5.58	8.92
1996	5.74	9.35	15.57	10.37	2.37	9.58	18.96	18.96	6.39	3.52	5.70	8.76	9.62
1997	1.97	2.69	10.16	8.76	4.79	6.30	4.89	4.78	5.68	9.10	8.89	11.80	6.67
1998	9.31	12.30	15.52	27.07	32.67	23.34	34.31	22.02	13.16	7.73	8.05	8.08	17.84
1999	8.43	13.44	19.99	26.23	22.34	23.08	5.84	14.16	15.55	12.27	7.02	12.14	15.02
2000	9.19	11.77	12.06	24.56	22.94	24.24	22.06	18.53	15.74	13.28	9.88	8.59	16.08
2001	8.92	8.44	10.77	22.35	19.28	16.06	22.72	6.64	6.86	7.47	12.10	5.67	12.28
2002	8.33	9.77	16.21	18.14	16.72	19.23	10.04	1.07	8.95	11.47	6.76	6.21	11.06
Average	7.22	9.85	13.42	19.15	14.65	16.46	15.51	12.19	8.33	7.78	7.11	7.77	11.62

Source: SRP

TABLE 2-3b. Maricopa Drain Maximum Daily Volume

(units are in acre-feet)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MAX
1994	15.81	19.22	33.68	22.08	18.82	24.54	31.34	18.55	1.09	5.59	6.51	9.94	33.68
1995	12.97	19.36	28.90	32.01	78.80	25.73	26.44	78.76	15.59	11.90	31.54	11.94	78.80
1996	22.71	18.29	26.50	24.42	12.89	23.29	31.87	31.87	16.32	17.79	12.00	15.99	31.87
1997	13.23	13.07	23.72	26.26	27.17	20.73	16.64	27.21	12.48	14.06	12.85	22.67	27.21
1998	17.47	26.48	41.89	36.18	57.28	49.75	60.79	38.08	25.83	20.75	17.14	15.03	60.79
1999	14.00	20.89	35.90	52.78	28.44	34.49	27.77	18.98	18.51	27.09	13.73	24.22	52.78
2000	16.68	20.37	33.72	32.41	30.76	34.26	30.59	28.88	24.12	32.05	20.11	24.62	34.26
2001	20.39	17.12	20.01	39.81	29.00	57.36	39.04	19.08	19.08	22.47	21.22	19.80	57.36
2002	12.95	16.72	26.96	27.93	27.07	37.27	20.03	2.18	16.26	37.29	13.69	20.43	37.29
Maximum	22.71	26.48	41.89	52.78	78.80	57.36	60.79	78.76	25.83	37.29	31.54	24.62	78.80

Source: SRP

TABLE 2-4. Maricopa Drain Monthly Volume

(units are in acre-feet)

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOT
1994	271.5	237.5	296.5	349.7	172.9	431.8	362.2	310.9	1.1	36.2	24.4	366.0	2,860.6
1995	133.7	347.9	338.7	696.7	159.7	357.7	282.7	420.4	78.1	124.2	142.8	173.0	3,255.5
1996	177.9	271.0	482.7	311.1	73.5	287.4	587.8	587.8	191.6	109.0	171.1	271.5	3,522.4
1997	61.0	75.4	315.0	262.7	148.5	189.0	151.6	148.2	170.3	282.0	266.7	366.0	2,436.3
1998	288.7	344.3	481.0	812.2	1,012.8	700.2	1,063.6	682.5	394.8	239.5	241.6	250.5	6,511.7
1999	261.3	376.4	619.8	787.0	692.5	692.4	181.2	439.0	482.1	380.3	210.5	376.4	5,498.9
2000	284.8	341.4	373.8	736.7	711.2	727.3	684.0	574.3	472.2	411.8	296.3	266.3	5,880.1
2001	276.5	236.4	333.9	670.5	597.8	481.7	704.2	205.7	205.7	231.6	363.1	175.6	4,482.8
2002	258.2	273.7	502.6	544.2	518.2	577.0	311.1	33.2	268.6	355.7	202.8	192.4	4,037.5
Average	223.7	278.2	416.0	574.5	454.1	493.8	480.9	378.0	251.6	241.1	213.2	270.8	4,276.2

Source: SRP

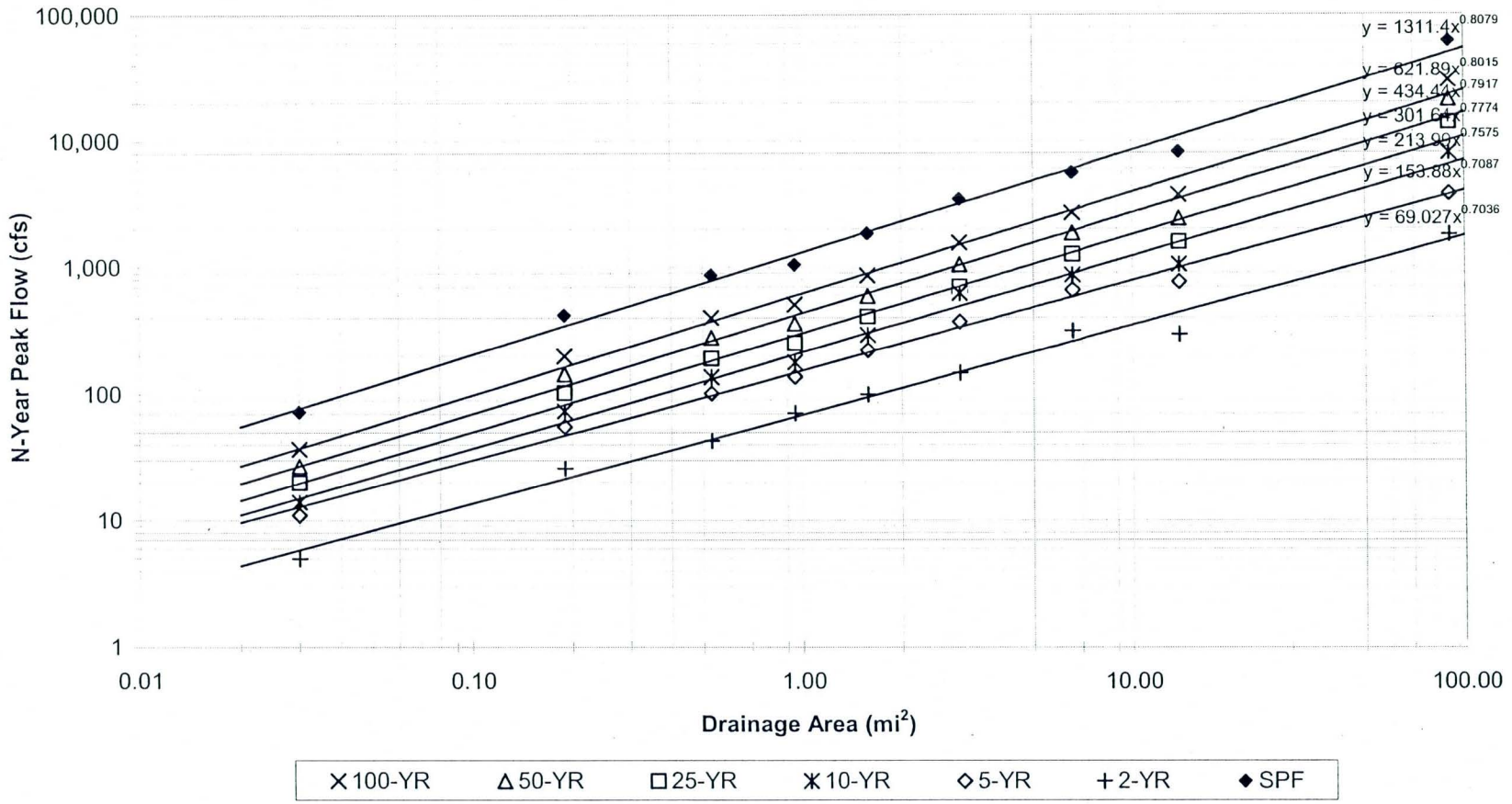
3.0 Storm Drains

Storm drains were evaluated with regard to the potential damage that peak flow rates might have on the restored habitat areas as well as to the possibility of using storm water runoff as a water source. Storm drains are often constructed in urban areas to collect and convey storm water runoff safely through developed or urbanized areas. With increased urbanization, the overall imperviousness of the land generally increases, thus increasing both the peak flow rate and volume of storm water runoff. This storm water runoff can be conveyed through a network of open channels or storm drains to a designated outfall point.

To quantify the potential damage that storm drains may cause to the habitat restoration project, the peak flow rates that occur during or immediately after storm events were examined. Unfortunately, very little information is available from which reasonable peak flow rates can be quantified. Estimates of peak flows were made, however, using the approach developed for the Rio Salado project (USACE, 1998). The Rio Salado project is a similar habitat restoration project within the Salt River. The drainage areas within the Rio Salado study area are similar to those within the Oeste project area. In the Rio Salado project, a series of storm drains were evaluated in which sufficient data were available to model storm runoff using computer modeling techniques. In the Va Shly'ay Akimel Project, a set of N-year peak discharge/drainage area curves was generated by the linear regression analysis to estimate peak flows with only 8-sample drain data without Indian Band Wash (IBW) values. That is a main reason that peak flow rates of Va Shly'ay Akimel project are smaller than peak flow rates of Rio Salado Project. Originally Rio Salado project also included IBW values to aid in providing a consistent set of relationships and to enhance the range established. To keep the consistency for all outfalls to the Salt River, the 8-sample drain sample data and IBW values were then used to generate a series of linear regression curves representing the relationship between peak flow rate and drainage area for this Oeste project. Curves were developed for the 2-year, 5-year, 10-year, 25-year, 50-year, and 100-year storm events. These curves are shown on Figure 3-1.

In many cases, the storm water runoff is conveyed to retention or detention basins. Retention basins are designed to completely capture the storm water runoff, thus eliminating flow to the outfall point. Detention basins are designed to temporarily capture storm water runoff in order to reduce the peak flow rate to a value that meets local drainage criteria. The detained storm water is then released gradually to the outfall point. The capacity of the outlet pipe is often used to control the rate at which water is released from the detention facilities. For these areas, the peak flow rate that can be discharged into the Salt River is governed by the capacity of the outlet pipe. The full-flow capacities for several pipe sizes were determined for a range of longitudinal slopes. These relationships are presented on Figure 3-2. For this analysis, some of longitudinal pipe slopes were surveyed or found in As-Built drawing by the City of Phoenix (COP) but if the existing slope is unable to figure, a longitudinal slope of 0.0015 was assumed as average value of known value.

To evaluate the possibility of using storm water as a water source, the approach used in the Rio Salado study (USACE, 1998) was used to estimate the average annual volume of runoff. Curves similar to those developed that relate peak flow to drainage area were developed to represent the relationship between the average annual volume of runoff and drainage area. These curves are shown in Figure 3-3. To estimate the average monthly volume of runoff, the annual amount was distributed according to the monthly rainfall distribution in the Phoenix area (Schmidli, 1996). The monthly pattern of rainfall is shown in Table 3-1.



SPF: Standard Project Flood
Data Source: USACE Rio Salado Project

FIGURE 3-1. Peak Flow Relationships for Various Return Periods

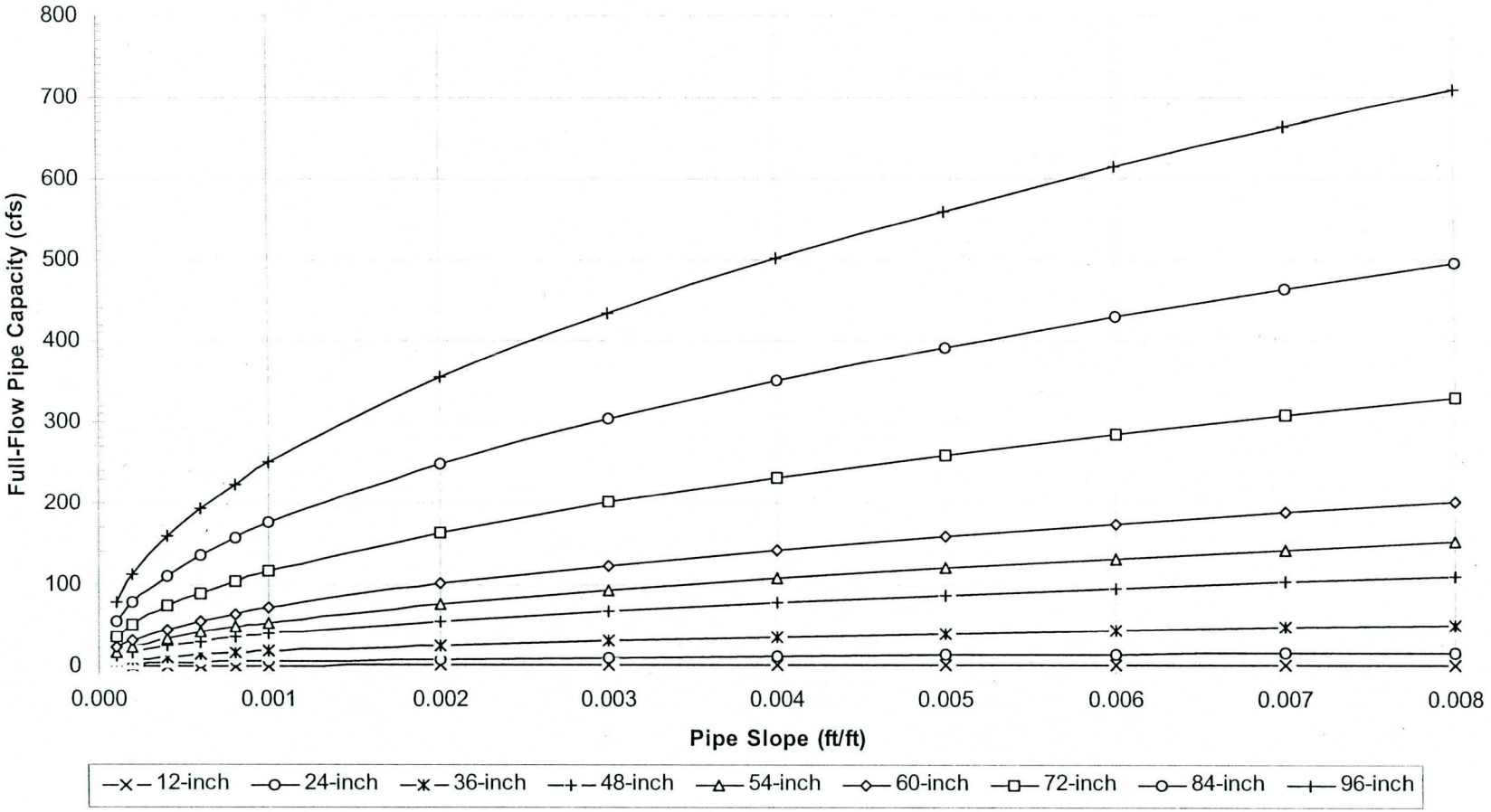
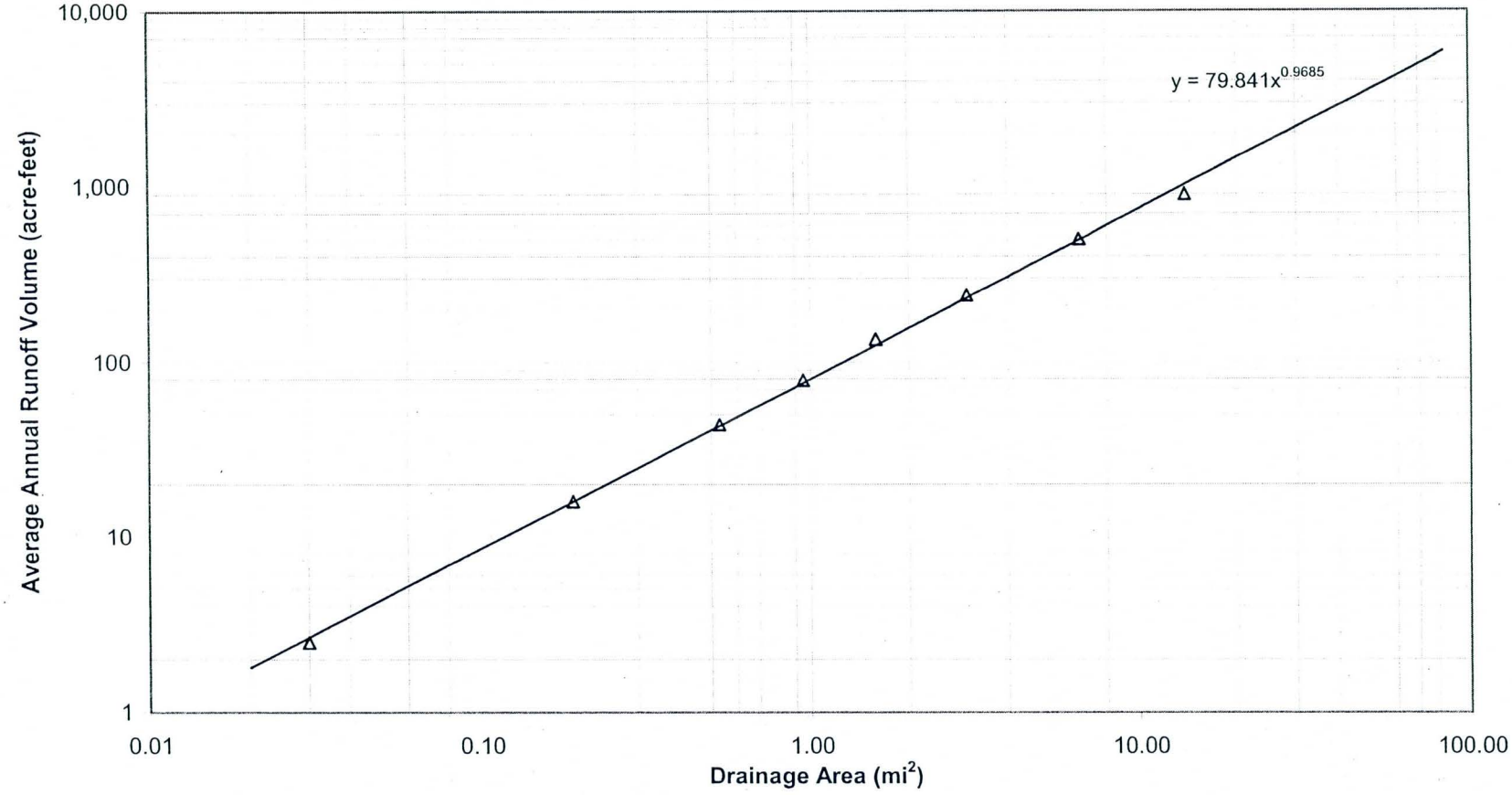


FIGURE 3-2. Typical Full-Flow Storm Drain Pipe Capacity



Source: USACE Rio Salado Project

FIGURE 3-3. Average Annual Storm Drain Runoff for the Phoenix Metro Area

TABLE 3-1. Rainfall Pattern for the Phoenix Area

Month	Rainfall Amount (inches)	Percent of Annual Amount
January	0.67	8.7
February	0.68	9.0
March	0.88	11.5
April	0.22	2.9
May	0.12	1.6
June	0.13	1.7
July	0.83	10.8
August	0.96	12.5
September	0.86	11.2
October	0.65	8.5
November	0.66	8.6
December	1.00	13.0
Annual Total	7.66	100.0

Source: Schmidli, 1996

3.1 SR01: 51st Avenue and Salt River – North Side

The SR01 Storm Drain is located at 51st Avenue of north side bank. A 96-inch storm drain conveys runoff into the Salt River. This drain collects runoff from a drainage area of approximately 3.6 mi^2. There are no flow records available for this drain.

Figure 3-1 was used to estimate the peak flow rates for a series of storm events. These results are provided in Table 3-2. A peak flow rate of approximately 1,728 cfs was estimated for the 100-year storm event. However, Figure 3-2 indicates that the maximum capacity of a 96-inch pipe is approximately 177 cfs. Thus, the peak flow that can realistically discharge from this drain is governed by the pipe size. A peak flow rate of 177 cfs would produce a maximum velocity of approximately 3.5 ft/sec at the outfall to the Salt River.

Figure 3-3 was used to estimate the average annual volume of storm runoff. The average annual volume of runoff and the monthly distribution of annual runoff are provided in Table 3-3. Using this approach, the average annual volume of storm runoff was estimated to be approximately 274 acre-feet.

3.2 SR02: 43rd Avenue and Salt River – North Side

The SR02 Storm Drain is located at 43rd Avenue of north side bank. A 90-inch storm drain conveys runoff into the Salt River. This drain collects runoff from a drainage area of approximately 3.6 mi^2. There are no flow records available for this drain.

Figure 3-1 was used to estimate the peak flow rates for a series of storm events. These results are provided in Table 3-2. A peak flow rate of approximately 1,728 cfs was estimated for the 100-year storm event. However, Figure 3-2 indicates that the maximum capacity of a 90-inch pipe is approximately 221 cfs. Thus, the peak flow that can realistically discharge from this drain is governed by the pipe size. A peak flow rate of 221 cfs would produce a maximum velocity of approximately 5.0 ft/sec at the outfall to the Salt River.

Figure 3-3 was used to estimate the average annual volume of storm runoff. The average annual volume of runoff and the monthly distribution of annual runoff are provided in Table 3-3. Using this approach, the average annual volume of storm runoff was estimated to be approximately 274 acre-feet.

3.3 SR03: 35th Avenue and Salt River – North Side

The SR03 Storm Drain is located at 35th Avenue of north side bank. A 75-inch storm drain conveys runoff into the Salt River. This drain collects runoff from a drainage area of approximately 2.9 mi^2. There are no flow records available for this drain.

Figure 3-1 was used to estimate the peak flow rates for a series of storm events. These results are provided in Table 3-2. A peak flow rate of approximately 1,460 cfs was estimated for the 100-year storm event. However, Figure 3-2 indicates that the maximum capacity of a 75-inch pipe is approximately 123 cfs. Thus, the peak flow that can realistically discharge from this drain is governed by the pipe size. A peak flow rate of 123 cfs would produce a maximum velocity of approximately 4.0 ft/sec at the outfall to the Salt River.

Figure 3-3 was used to estimate the average annual volume of storm runoff. The average annual volume of runoff and the monthly distribution of annual runoff are provided in Table 3-3. Using this approach, the average annual volume of storm runoff was estimated to be approximately 224 acre-feet.

3.4 SR04: 27th Avenue and Salt River – North Side

The SR04 Storm Drain is located at 27th Avenue of north side bank. A 72-inch storm drain conveys runoff into the Salt River. This drain collects runoff from a drainage area of approximately 4.5 mi^2. There are no flow records available for this drain.

Figure 3-1 was used to estimate the peak flow rates for a series of storm events. These results are provided in Table 3-2. A peak flow rate of approximately 2,066 cfs was estimated for the 100-year storm event. However, Figure 3-2 indicates that the maximum capacity of a 72-inch pipe is approximately 235 cfs. Thus, the peak flow that can realistically discharge from this drain is governed by the pipe size. A peak flow rate of 235 cfs would produce a maximum velocity of approximately 8.3 ft/sec at the outfall to the Salt River.

Figure 3-3 was used to estimate the average annual volume of storm runoff. The average annual volume of runoff and the monthly distribution of annual runoff are provided in Table 3-3. Using this approach, the average annual volume of storm runoff was estimated to be approximately 341 acre-feet.

3.5 SR05: 25th Avenue and Salt River – North Side

The SR05 Storm Drain is located at 25th Avenue of north side bank. A 102-inch storm drain conveys runoff into the Salt River. This drain collects runoff from a drainage area of approximately 1.6 mi^2. There are no flow records available for this drain.

Figure 3-1 was used to estimate the peak flow rates for a series of storm events. These results are provided in Table 3-2. A peak flow rate of approximately 901 cfs was estimated for the 100-year storm event. However, Figure 3-2 indicates that the maximum capacity of a 102-inch pipe is approximately 342 cfs. Thus, the peak flow that can realistically discharge from this drain is governed by the pipe size. A peak flow rate of 342 cfs would produce a maximum velocity of approximately 6.0 ft/sec at the outfall to the Salt River.

Figure 3-3 was used to estimate the average annual volume of storm runoff. The average annual volume of runoff and the monthly distribution of annual runoff are provided in Table 3-3. Using this approach, the average annual volume of storm runoff was estimated to be approximately 125 acre-feet.

3.6 SR06: 22nd Avenue and Salt River – North Side

The SR06 Storm Drain is located at 22nd Avenue of north side bank. A 78-inch storm drain conveys runoff into the Salt River. This drain collects runoff from a drainage area of approximately 7.5 mi^2. There are no flow records available for this drain.

Figure 3-1 was used to estimate the peak flow rates for a series of storm events. These results are provided in Table 3-2. A peak flow rate of approximately 3,121 cfs was estimated for the 100-year storm event. However, Figure 3-2 indicates that the maximum capacity of a 78-inch pipe is approximately 112 cfs. Thus, the peak flow that can

realistically discharge from this drain is governed by the pipe size. A peak flow rate of 112 cfs would produce a maximum velocity of approximately 3.4 ft/sec at the outfall to the Salt River.

Figure 3-3 was used to estimate the average annual volume of storm runoff. The average annual volume of runoff and the monthly distribution of annual runoff are provided in Table 3-3. Using this approach, the average annual volume of storm runoff was estimated to be approximately 561 acre-feet.

3.7 SR07: 19th Avenue and Salt River – North Side

The SR07 Storm Drain is located at 19th Avenue of north side bank. A 54-inch storm drain conveys runoff into the Salt River. This drain collects runoff from a drainage area of approximately 1.0 mi^2. There are no flow records available for this drain.

Figure 3-1 was used to estimate the peak flow rates for a series of storm events. These results are provided in Table 3-2. A peak flow rate of approximately 622 cfs was estimated for the 100-year storm event. However, Figure 3-2 indicates that the maximum capacity of a 54-inch pipe is approximately 66 cfs. Thus, the peak flow that can realistically discharge from this drain is governed by the pipe size. A peak flow rate of 66 cfs would produce a maximum velocity of approximately 4.1 ft/sec at the outfall to the Salt River.

Figure 3-3 was used to estimate the average annual volume of storm runoff. The average annual volume of runoff and the monthly distribution of annual runoff are provided in Table 3-3. Using this approach, the average annual volume of storm runoff was estimated to be approximately 79 acre-feet.

3.8 SR30: 27th Avenue and Salt River – South Side

The SR30 Storm Drain is located at 27th Avenue of south side bank. A 108-inch storm drain conveys runoff into the Salt River. This drain collects runoff from a drainage area of approximately 2.5 mi^2. There are no flow records available for this drain.

Figure 3-1 was used to estimate the peak flow rates for a series of storm events. These results are provided in Table 3-2. A peak flow rate of approximately 1,309 cfs was estimated for the 100-year storm event. However, Figure 3-2 indicates that the maximum capacity of a 108-inch pipe is approximately 447 cfs. Thus, the peak flow that can realistically discharge from this drain is governed by the pipe size. A peak flow rate of 447 cfs would produce a maximum velocity of approximately 7.0 ft/sec at the outfall to the Salt River.

Figure 3-3 was used to estimate the average annual volume of storm runoff. The average annual volume of runoff and the monthly distribution of annual runoff are provided in Table 3-3. Using this approach, the average annual volume of storm runoff was estimated to be approximately 196 acre-feet.

3.9 SR31: 19th Avenue and Salt River – South Side

The SR31 Storm Drain is located at 19th Avenue of south side bank. A 60-inch storm drain conveys runoff into the Salt River. This drain collects runoff from a drainage area of approximately 3.0 mi^2. There are no flow records available for this drain.

Figure 3-1 was used to estimate the peak flow rates for a series of storm events. These results are provided in Table 3-2. A peak flow rate of approximately 1,499 cfs was estimated for the 100-year storm event. However, Figure 3-2 indicates that the maximum capacity of a 60-inch pipe is approximately 88 cfs. Thus, the peak flow that can realistically discharge from this drain is governed by the pipe size. A peak flow rate of 88 cfs would produce a maximum velocity of approximately 4.5 ft/sec at the outfall to the Salt River.

Figure 3-3 was used to estimate the average annual volume of storm runoff. The average annual volume of runoff and the monthly distribution of annual runoff are provided in Table 3-3. Using this approach, the average annual volume of storm runoff was estimated to be approximately 231 acre-feet.

3.10 SR48a: 43rd Avenue and Salt River – South Side

The SR48a Storm Drain is located at 43rd Avenue of south side bank. A 96-inch storm drain conveys runoff into the Salt River. This drain collects runoff from a drainage area of approximately 22.66 mi^2. There are no flow records available for this drain.

Figure 3-1 was used to estimate the peak flow rates for a series of storm events. These results are provided in Table 3-2. A peak flow rate of approximately 3,107 cfs was estimated for the 100-year storm event. However, Figure 3-2 indicates that the maximum capacity of a 96-inch pipe is approximately 336 cfs. Thus, the peak flow that can realistically discharge from this drain is governed by the pipe size. A peak flow rate of 336 cfs would produce a maximum velocity of approximately 6.7 ft/sec at the outfall to the Salt River.

Figure 3-3 was used to estimate the average annual volume of storm runoff. The average annual volume of runoff and the monthly distribution of annual runoff are provided in

Table 3-3. Using this approach, the average annual volume of storm runoff was estimated to be approximately 1640 acre-feet.

3.11 SR49: 67th Avenue and Salt River – North Side

The SR49 Storm Drain is located at 67th Avenue of north side bank. A 96-inch storm drain conveys runoff into the Salt River. This drain collects runoff from a drainage area of approximately 7.4 mi^2. There are no flow records available for this drain.

Figure 3-1 was used to estimate the peak flow rates for a series of storm events. These results are provided in Table 3-2. A peak flow rate of approximately 3,107 cfs was estimated for the 100-year storm event. However, Figure 3-2 indicates that the maximum capacity of a 96-inch pipe is approximately 336 cfs. Thus, the peak flow that can realistically discharge from this drain is governed by the pipe size. A peak flow rate of 336 cfs would produce a maximum velocity of approximately 6.7 ft/sec at the outfall to the Salt River.

Figure 3-3 was used to estimate the average annual volume of storm runoff. The average annual volume of runoff and the monthly distribution of annual runoff are provided in Table 3-3. Using this approach, the average annual volume of storm runoff was estimated to be approximately 558 acre-feet.

3.12 Supplementary

The SR47 Storm Drain is located at 51st Avenue of north side 50 feet north of SR01outfall. A 48-inch storm drain conveys runoff into the Salt River. This drain collects runoff from a probably small drainage area. The drainage area is not well defined; however, it is not expected to generate significant amounts of storm runoff. These are not expected to have implications on the habitat restoration project.

The SR48 Storm Drain is located at 45th Avenue of south side bank. A 48-inch storm drain conveys runoff into the Salt River. This drain collects runoff from a probably small drainage area. The drainage area is not well defined; however, it is not expected to generate significant amounts of storm runoff. These are not expected to have implications on the habitat restoration project.

The SR58 Storm Drain is located at 35th Avenue of northeast side bank. A 60-inch storm drain conveys runoff into the Salt River. This drain discharges runoff from a 23rd Avenue Waste Water Treatment Plant (WWTP). The flow records of this outfall are available in the Water Budget Draft Report.

The SR59 Storm Drain is located at 2333 W. Durango (23rd Ave. WWTP east side of 35th Avenue and Salt River) of north side bank. A 48-inch storm drain conveys runoff into the Salt River. This drain is a part of SR05 conveyance system. The drainage area is not well defined; however, it is not expected to generate significant amounts of storm runoff. These are not expected to have implications on the habitat restoration project.

3.13 Natural Surface Drainage

Natural surface drainage ways, west of 67th Avenue from north bank side and west of 27th Avenue from south bank side, ultimately discharge into the Salt River. The SRP canal intercepts a part of runoff from the areas south of the canal. Because runoff from these areas in not confined to a well-defined drainage ways, storm events will not generate significant flow rates at any location. These areas are not expected to have implications on the habitat restoration project.

TABLE 3-2. Storm Drain N-Year Peak Flow

OUTFALL No.	SITE LOCATION	PIPE SIZE (inch)	Drainage Area[1] (AF)	Pipe Slope (ft/ft)	Drainage Area (mi^2)	N-Year Peak Flow[2] (AF)						CAPACITY[3] (CFS)
						2-Year	5-Year	10-Year	25-Year	50-Year	100-Year	
SR01	51st Avenue and Salt River - North Side	96	2290	0.0005	3.58	169	380	562	813	1192	1728	177
SR02	43rd Avenue and Salt River - North Side	90	2290	0.0011	3.58	169	380	562	813	1192	1728	221
SR03	35th Avenue and Salt River- North Side	75	1856	0.0009	2.90	146	327	479	690	1009	1460	123
SR04	27th Avenue and Salt River- North Side	72	2862	0.00409	4.47	198	445	665	966	1422	2066	235
SR05	25th Avenue and Salt River- North Side	102	1017	0.00135	1.59	96	214	304	432	627	901	342
SR06	22nd Avenue and Salt River- North Side	78	4790	0.0006	7.48	284	641	983	1442	2138	3121	112
SR07	19th Avenue and Salt River- North Side	54		0.0015[4]	1.00	69	154	214	302	434	622	66
SR30	27th Avenue and Salt River- South Side	108	1620	0.0017	2.53	133	297	432	621	906	1309	447
SR31	19th Ave, South Bank	60	1918	0.0015[4]	3.00	149	335	491	708	1036	1499	88
SR47	51st Avenue and Salt River- North Side 50 feet north of SR01	48	unknown	0.0015[4]	unknown	N/A	N/A	N/A	N/A	N/A	N/A	48
SR48	45th Avenue and Salt River- South Side	48	unknown	0.0015[4]	unknown	N/A	N/A	N/A	N/A	N/A	N/A	48
SR49	67th Avenue and Salt River- North Side	96	4762	0.0018	7.44	283	638	979	1436	2128	3107	336
SR58	35th Avenue and Salt River- N/E Side	60	unknown	0.0015[4]	unknown	N/A	N/A	N/A	N/A	N/A	N/A	88
SR59	2333 W. Durango (23rd Ave. WWTP east side of 35th Ave. and Salt River) - North Side	48	unknown	0.0015[4]	unknown	N/A	N/A	N/A	N/A	N/A	N/A	48

1. Drainage areas were provided by COP.

2. N-Year peak flow rates were computed from the drainage area vs. peak flow relationships developed for the Rio Salado Study.

3. A Manning's N-values of 0.015 pipe was assumed for the storm drain capacity estimates.

4. A longitudinal slope of 0.0015 was assumed as average value of known value for the storm drain capacity estimates if the existing slope is unknown.

TABLE 3-3. Storm Drain Average Annual Runoff Volumes

OUTFALL No.	SITE LOCATION	PIPE SIZE (inch)	Drainage Area (acre)	Drainage Area (mi^2)	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	96	2290	3.6	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	90	2290	3.6	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	75	1856	2.9	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	72	2862	4.5	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	102	1017	1.6	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	78	4790	7.5	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	54	632.77	1.0	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	108	1620	2.5	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	60	1918	3.0	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
SR47[1,2]	51st Avenue and Salt River- North Side 50 feet north of SR01	48	unknown	unknown	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SR48[1,2]	45th Avenue and Salt River- South Side	48	unknown	unknown	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SR48a[1,2]	43rd Avenue and Salt River- South Side	N/A	14502	22.66	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
SR49[1,2]	67th Avenue and Salt River- North Side	96	4762	7.4	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
SR58[1,2]	35th Avenue and Salt River- N/E Side	60	unknown	unknown	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
SR59[1,2]	2333 W. Durango (23rd Ave. WWTP east side of 35th Ave. and Salt River) - North Side	48	unknown	unknown	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Total																4503

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 vs. average annual runoff relationships developed for the Rio Salado Study.

4.0 Water Quality Analyses

The water quality of the irrigation drains can meet the needs of the Oeste Project in most cases. Localized water quality problems could occur if surface runoff enters the irrigation drains and transports contaminants from surrounding areas into the drain canals. There are no concentrated animal feeding operations in the area that could contribute contaminated runoff into the irrigation drains system.

It is important to note that storm water quality is a function of land use, not the size of the watershed (Greeley and Hansen, 2001). Stormwater 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 stormwater NPDES permits require each industrial site to have a stormwater 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. The quality of the "first flush" water is generally poor. As the runoff continues, the water quality improves. In general, based on analysis of available data versus the numeric water quality standards, stormwater is a vehicle by which surface water quality appears to degrade within the Salt River.

5.0 Evaluation of Interior Drainage System

Two types of interior drains were evaluated that outfall into the Salt River within the Oeste project study limits – irrigation drains and storm drains. The interior drains were evaluated to assess the potential damage that their flows may have on the habitat restoration project. The interior drains were also evaluated to assess the potential for using these flows as a water source to support and nourish the restored vegetation. For this evaluation, these drains were each evaluated based on the quantity, reliability, and quality of flow that is or may be available for habitat restoration. The water source analyses are described in further detail in the Water Budget
Report.

5.1 Damage to Restored Habitat

The irrigation drains flow in response to controlled releases by SRP. These releases are relatively consistent throughout the day and do not have instantaneous peak flow rates considerably greater than the average daily rate. Flow records for these drains indicate that the maximum daily flow rates recorded for these canals were 311.51 acre-feet, and 78.80 acre-feet for the SRP 67th Avenue Drain, and Maricopa Drain, respectively.

The storm drains flow in response to rainfall events. The two major storm drains identified are the SR06 and SR49. For this study, the peak flow rate associated with the 100-year storm was assumed to represent the upper bound possible condition. The peak 100-year flow rates for these drains were estimated to be approximately 3,121 cfs and 3,107 cfs. However, the maximum capacity of the SR06 is considerably less. The peak flow rates that could realistically discharge from these drains are 112 cfs and 336 cfs, which would generate discharge velocities of 3.4 ft/sec and 6.7 ft/sec, respectively.

The remaining storm drains within the project area could discharge peak flow rates as high as 447 cfs with velocities as high as of 7.0 ft/sec into the Salt River. The peak flow rates generated by the drainage areas for these drains may be considerably greater; however, detention facilities or the maximum capacity of the outlet pipes govern the maximum rate at which storm water will be discharged into the restored habitat. A summary of peak flow rates for a series of storm events and the maximum capacities of each outlet is provided in Table 3-2.

The peak flow rates and discharge velocities from the interior drains are sufficient to create localized damage at the outlet of each drain. However, this damage is not expected to extend beyond the immediate vicinity of the pipe outlet. There is little evidence to suggest that flows from these drains have historically done more than wet the riverbed in the immediate vicinity of the drain outlet. Additionally, the maximum flow rates that could potentially discharge from these drains are significantly smaller in magnitude than Salt River flood flows. The Salt River is expected to spill over Granite Reef approximately once every three years, and the 5-year peak discharge from these spills is expected to exceed 20,000 cfs (USACE, 1998). To that regard, there is little advantage to providing protection from the interior drainage discharge.

5.2 Water Source

The irrigation drains, which flow in response to controlled releases, have received occasional flows throughout the record period from 1993 through 2002. The average annual volumes of water released to the Salt River during this period were 1,044 acre-feet (the record period from 1993 through 2002), and 4,276 acre-feet (the record period from 1994 through 2002) for the SRP 67th Avenue Drain, and Maricopa Drain, respectively. Although these amounts are sufficient to support some riparian vegetation, the timing of these flows is irregular. These releases are not reliable as the drains have historically been

dry for long periods; for example, there were no releases to the SRP 67th Avenue Drain throughout the period from November 1996 through February 1997. The Maricopa Drain flows were historically more frequent and reliable. Future releases to this drain are expected to be less frequent than the historic trend. Table 2-2, and Table 2-4 summarize the average monthly and annual volumes of water released through the irrigation drains for the period of record evaluation. The water discharged from irrigation drains is generally high quality and suitable for the habitat restoration project.

The storm drains flow in response to rainfall events, so the discharge from these drains is typically infrequent and highly variable. The storm drains provide an average annual volume of water to the Salt River ranging from 79 to 1640 acre-feet. Table 3-3 summarizes the average monthly and annual volumes of water released through the storm drains. Stormwater 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. The quality or the "first flush" water is generally poor. As the runoff continues, the water quality improves.

The average monthly and annual volumes of water released from some of the interior drains are of sufficient magnitude to be considered as a potential water source. The two irrigation drains have historically supplied a significant amount of water to the Salt River. These drains, however, do not flow consistently, and releases into these drains may not be reliable. The SR06, SR48a, and SR49 Drain have supplied a relatively enough flow to the river based on estimated flow rates. However, long-term records are not available to ascertain this supply. The SR01, SR02, SR03, SR04, SR05, SR06, SR07, SR30, SR31, and SR49 should all be included in the water budget analyses.

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APPENDIX A

SRP 67th Avenue Drain Daily Flow Records

SRP - 67TH AVE. DRAIN
DAILY FLOW RECORDS - 1993
(units are in acre-feet)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	0	0	0.08	40.78	2.64	3.71	0.56	0.77	1.15	0	0	0
2	0	0	0.73	33.96	1.35	2.84	2.72	1.63	0.32	0	0	0
3	0	0	0	30.7	4.24	2.72	6.64	2.04	0.32	0	0	0
4	0.2	0	0	33.08	5.97	2.46	8.65	6.19	0.32	0	0	0
5	0	0	0	37.83	4.34	2.34	3.09	1.19	0.32	0	0	0
6	0	0	0	48.85	5.75	2.52	1.88	0.93	0.32	0	0	2.06
7	0	0	1.13	47.98	6.61	3.37	3.51	1.63	0.32	1.53	0	2.56
8	0	0	5.08	39.75	9.14	3.73	4.05	4.5	0.32	5.18	0	0.02
9	0	0	9.32	21.24	6.33	1.88	3.51	3.63	0.2	5.24	0	0
10	0	0	8.73	8.03	0	0.24	2.96	7.68	0	4.22	0	0.02
11	0	0	5.99	15.51	0	0.44	1.75	6.31	0	0	0	0.52
12	0	0	1.11	10.97	0	1.07	3.21	7.8	0	0	0	3.57
13	0	0	0	8.75	0	3.91	5.69	0.61	0	0	0	0
14	0	0	0.42	10.79	1.31	6.37	5.65	0.58	0	0	0	0
15	0	0	9.4	15.65	2.4	7.91	14.08	0.32	0	0	0	0
16	0	0	15.09	12.38	2.96	4.34	9.08	0.32	0	0	0	0
17	0	0	17.42	10.55	2.34	3.45	9.01	0.32	0	0	0	1.33
18	0	0	10.51	8.75	2.34	2.32	4.88	0.32	0	0	0	0.26
19	0	0	10.31	10.55	2.36	2.48	1.9	0.32	0	0	0	0.06
20	0	0	14.96	6.29	2.4	4.92	1.79	0.32	0	0	0	2.62
21	0	0	17.32	0.52	0.18	6.59	4.07	1.79	0	0	0	4.46
22	0	0	15.57	4.88	0	7.54	3.73	4.34	0	0	0	0
23	0	2.22	8.37	13.73	0	7.56	5.18	5.57	0	0	0	0
24	0	4.4	16.03	9.22	0	7.1	5.83	5.08	0	0	0	0
25	0	4.62	40.84	5.45	0	6.33	10.99	19.46	0.83	0	0	0
26	0	6.33	46.1	7.46	0.26	5.02	7.99	25.75	0	0	0	4.88
27	0	4.01	31.28	4.92	1.33	1.37	1.25	13.31	0	0.02	0	5.3
28	0	6.19	27.85	0.71	0.63	0.24	0.32	4.32	0	0.42	0	8.65
29	0		46.73	0.87	0.3	0.24	1.05	12.42	0	0.28	0	5.26
30	0		41.55	4.7	0.3	0.22	2.42	9.62	0	0.3	0	0.89
31	0		43.22		0.52		3.41	2.66		0.04		2.76
Total	0.20	27.77	445.14	504.85	66.00	105.23	140.85	151.73	4.42	17.23	0.00	45.22
Count	1	6	26	30	23	30	31	31	10	9	0	17
Average	0.01	0.99	14.36	16.83	2.13	3.51	4.54	4.89	0.15	0.56	0.00	1.46
Maximum	0.20	6.33	46.73	48.85	9.14	7.91	14.08	25.75	1.15	5.24	0.00	8.65

Minimum	0.00	0.00	0.00	0.52	0.00	0.22	0.32	0.32	0.00	0.00	0.00	0.00

Source: SRP Daily Flow Records

SRP - 67TH AVE. DRAIN
DAILY FLOW RECORDS - 1994
(units are in acre-feet)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	4.28	0	3.05	2.62	0	0	3.69	0	1.11	0	0	0.48
2	4.58	1.37	4.56	3.11	0	0.06	1.47	0	0	0	0	0.79
3	4.26	3	1.8	3.05	0.5	0	0.75	0	0	0	0	1.11
4	7.91	0	0	0	1.27	3.09	0.06	0	0	0	0	1.23
5	7.99	0	0.16	0	1.43	3	0	3.47	0	0	0	0.12
6	5.06	0	0	0	6.51	0.97	0	9.4	0	0	0.65	0
7	5.1	2.44	5.55	0.16	2.76	0	1.31	5.3	1.79	0.02	0	0
8	5.65	9.56	8.45	5.1	0.3	0	1.79	0	0	0	0	0
9	7.56	2.7	0	11.17	0	0	2.46	0	0	0	0	0.08
10	7.81	8.99	0	3.73	1.55	0	2.22	0	0	0	0	0.26
11	7.28	0.02	0	6.57	2.96	0.63	0.02	0	2.74	0.28	0	0
12	6.17	0	0.02	2.46	1.82	1.13	0	0	2.98	2.64	0	0
13	6.94	0	1.37	2.18	0	1.61	0	0.1	0.5	2.14	0	0
14	7.83	0	0.2	0.4	0.52	0.38	0	0	0	2.2	0	0
15	8.93	0	0	0	0.34	0.4	0	0	0	0.02	0	0
16	7.78	0	0.26	0	0.16	0.14	0	0	0	0	0	0
17	7.32	0	3.09	0	4.74	2.06	0.91	0	0	0	0	0
18	7.44	0	0	0	3.01	5.95	1.96	0	0	0.71	0	0.58
19	4.56	0	0	0	0.89	3.57	0	0	0	2.42	0	0
20	1.09	0	0	0.32	1.79	0.1	0	0	0	3.07	0	0.75
21	5.49	0	0	0.04	0	0	0	0.87	0	3.23	0	1.11
22	9.14	0	0	1.67	0	0	0	9.18	0	1.73	0	0
23	6.39	0	1.41	0	0	0	0	3.91	0.06	0.26	0	3.37
24	4.44	0	8.61	0	0.44	0	0	5.26	3.53	0	0	1.49
25	4.21	0	12.16	0	1.92	0	0	7.85	2.9	0	0	1.33
26	5.87	0	6.37	0	0	0	0	9.58	1.49	0	0	1.47
27	8.35	0.02	0	0	0.02	0	0	0	0	2.76	1.11	0
28	4.56	0	0	0	0	0	0	0	0	2.12	0.04	0
29	0		0	0	0	1.35	0	0	0	0	0.12	0
30	0		0	0	1.8	5.51	0	0	0	0	0.58	0
31	0		0.1		0		0	1.41		0		0
Total	173.99	28.10	57.16	42.58	34.73	29.95	16.64	56.33	17.10	23.60	2.50	14.17
Count	28	8	16	14	20	16	11	11	9	14	5	14

Average	5.61	1.00	1.84	1.42	1.12	1.00	0.54	1.82	0.57	0.76	0.08	0.46
Maximum	9.14	9.56	12.16	11.17	6.51	5.95	3.69	9.58	3.53	3.23	1.11	3.37
Minimum	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Source: SRP Daily Flow Records

SRP - 67TH AVE. DRAIN
DAILY FLOW RECORDS - 1995
(units are in acre-feet)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	0	0	0	0	1.59	0.04	0	1.11	0	0	0	3.53
2	0	3.27	3.11	1.47	4.05	0.14	0	0.38	0	0	0.2	1.51
3	0	8.57	0.12	4.4	0.04	4.62	0	0.02	0	0	0	0.2
4	0	0.52	0.58	7.56	0	9.18	0	0.52	0	0	0	0
5	0.65	0	3.73	6.57	0.02	10.71	0	1.96	0	0	0	0
6	0	0	7.66	6.49	1.07	4.72	0	5.45	0.93	0	0	0
7	0	0.02	11.33	9.46	4.62	0.77	0	3.39	2.78	0	0	0
8	0	4.84	4.64	10.95	4.44	0.85	0	1.47	1.79	0	0	0
9	0.04	1.31	9.58	5.41	4.07	4.64	0	0	0	0	0	0
10	0.08	3.01	13.45	0	1.13	2.28	0	0.04	0	0	0	0
11	0.16	4.11	9.48	0.28	0	5	0	0	0.71	0	0	0
12	0.58	0.18	1.88	6.61	1.88	27.79	0.02	0.16	0	0	0	0
13	0.12	0	0.06	5.97	6.59	11.9	2.32	0	0.18	0	0	0
14	0	0	1.65	8.57	5.91	2.12	0.65	0	0.16	0	0	0
15	0	11.66	0	2.3	2.34	1.01	2.46	0	0.65	0	0	0
16	0	16.62	0	0.73	0.04	0.2	0	0	1.07	0	0	0
17	0	0	0	3.49	2.02	1.79	0	0	0	0	0	0
18	0	0	0.02	5.36	1.41	4.82	0	0	0	0	0	0
19	0	0	0.42	2.76	0	2.76	0	0.77	0.02	0	0	0
20	0	0	0	0.54	0.22	3.77	0	3.23	0.08	2.14	0	0
21	0	0	0.26	0	0.38	7.52	0	0.69	2.6	3.13	0	0
22	0	0	6.78	0	0.02	2.78	0	0.63	2.5	1.29	0	0
23	0	0.48	12.67	0	0.02	0	0	0	2.42	0	0	0.34
24	0	1.07	5.79	0	0.22	0	0	0	2.2	0	0	0.46
25	0	0.54	13.92	0	0	0	0	0	1.53	0	0	0
26	0	0	7.5	0	0	0	5.81	0	0	0	0	0
27	0	0.28	8.09	0.26	1.63	0	2.62	0.87	0	0	0.02	0.95
28	0	0	3.87	1.84	5.57	0	1.92	1.67	1.67	0	1.92	0.08
29	0		5.43	6.61	5.95	0	2.3	1.63	0.18	0	2.46	0
30	0		5.16	2.98	1.59	0	1.73	0.83	0	0	3.21	0
31	0		0.32		0		3.25	0		0		0

Total	1.63	56.48	137.50	100.61	56.82	109.41	23.08	24.82	21.47	6.56	7.81	7.07
Count	6	15	26	22	25	22	10	18	17	3	5	7
Average	0.05	2.02	4.44	3.35	1.83	3.65	0.74	0.80	0.72	0.21	0.26	0.23
Maximum	0.65	16.62	13.92	10.95	6.59	27.79	5.81	5.45	2.78	3.13	3.21	3.53
Minimum	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Source: SRP Daily Flow Records

SRP - 67TH AVE. DRAIN
DAILY FLOW RECORDS - 1996
(units are in acre-feet)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	0	4.34	0.77	0	2.52	0.42	0	0	0.12	0	0	0
2	0	7.46	0	0.36	2.76	0.83	0	0	0	0	0	0
3	0	0	0	0	2.8	0.26	0	0.91	0	0	0	0
4	0	0	0	0.18	1.96	0.26	0	2.62	0	0	0	0
5	0	0	0	1.8	4.22	0.26	0	1.03	0	0	0	0
6	0	0	0	2.1	4.22	0.28	0	0.61	0	0	0	0
7	0	0	0.58	0.75	2.82	0.36	0.36	0	0	0	0	0
8	0	0	0.22	0	0.32	1.15	2.86	0	0	0	0	0
9	0	0	0	0	0	2.16	2.8	0	0	0	0	0
10	0	0	0	0.54	0	0.46	0.79	0	0	0.38	0	0
11	0	0	0	0	0.42	0.26	0.28	0	0.12	0.44	0	0
12	0	0	0	0	1.61	0.4	0	0	0	0.46	0	0
13	0.67	0	0.5	0.28	3.49	3.11	0	0	0	3.29	0	0
14	2.98	0	2.46	1.31	0.5	3.67	0	0	0	3	0	0
15	1.86	0	1.05	3.61	0.5	0.26	0	0.65	0	5.18	0	0
16	0	0	0	4.19	0.24	0.26	0.08	1.05	0	0.54	0	0
17	0	0	0	0	0	0.3	0	0.75	0	0.4	0	0
18	0.81	0	0	0	0	0.26	0	1.65	0	1.57	0	0
19	0.4	0	0	0.22	0	0.44	0	2.58	0	1.11	0	0
20	0.1	0	0	0.16	0	1.33	0.04	1.82	0	0	0	0
21	0	2.82	0	0.32	0	0.08	0.97	1.11	0	0	0	0
22	0	7.32	0	0.1	0	0.1	2.78	3.19	0	0	0	0
23	0	9.34	0	0.89	0.18	0	0.83	7.12	0	0	0	0
24	0	10.75	0	2.46	0.46	0	1.57	6.45	0	0	0	0
25	0	10.37	0	0.93	0.85	0	4.48	3.77	0	0	0	0
26	0	10.31	0	0	1.27	0	6.47	1.41	0	0.12	0	0
27	0	10.25	0	0.22	1.35	0	0	1.39	0	0.04	0	0
28	0.12	10.95	0	1.55	1.35	0.38	0	2.4	0	0	0	0
29	0	5.53	0	4.78	1.21	1.57	0	2.18	0	0	0	0
30	0.04		0	4.58	0.77	1.92	0	0.02	0	0	0	0

31	0.73		0		0.34		0	0		0		0
Total	7.71	89.44	5.58	31.33	36.16	20.78	24.31	42.71	0.24	16.53	0.00	0.00
Count	9	11	6	21	23	25	13	20	2	12	0	0
Average	0.25	3.08	0.18	1.04	1.17	0.69	0.78	1.38	0.01	0.53	0.00	0.00
Maximum	2.98	10.95	2.46	4.78	4.22	3.67	6.47	7.12	0.12	5.18	0.00	0.00
Minimum	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Source: SRP Daily Flow Records

SRP - 67TH AVE. DRAIN
DAILY FLOW RECORDS - 1997
(units are in acre-feet)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	0	0	0	0	0	0	0	0	0.73	1.79	0	1.29
2	0	0	0	0	0	0	0	0	0.3	4.09	0	14.72
3	0	0	0	0	0	0	0	0	0	2.62	0	2
4	0	0	0.87	0	0	0	0	0	0	4.98	0	3.63
5	0	0	0.97	0	0	0	0	0	0	0.18	0	13.45
6	0	0	1.37	0	0	0	0	0	0	0	0	14.44
7	0	0	2.02	0	0	0	0	0	0	0	0	14.44
8	0	0	0.44	0	0	0	0	0	0	0	0	14.44
9	0	0	0	0	0	0	0	0	0	0	0	3.03
10	0	0	0	0	0	0	0	0	0.2	0	0	0
11	0	0	0	0.12	0	0	0	0	4.24	0	0	12.46
12	0	0	0	1.67	0	0	0	0	8.07	0	0	19.46
13	0	0	0	2.08	0	0	0	0	0.06	0	0	18.51
14	0	0	1.84	0	0	0	0	0	0	0	0	13.31
15	0	0	4.74	1.57	0	0	0	0	0	0	0	12.12
16	0	0	5.47	1.37	0	0	0	0	0	0	0	11.8
17	0	0	5.38	1.33	0	0	0	0.3	0	0	0	16.44
18	0	0	2.56	1.19	0	0	0	1.49	0	0	0	17.55
19	0	0	0.04	0.06	0	0	0	2.78	0	0	0	19.56
20	0	0	4.09	1.57	0	0	0	4.38	0.67	0	0	30.7
21	0	0	5.18	8.57	0	0	0	4.4	3.47	0	0	7.66
22	0	0	3.19	2.26	0.1	0	0	4.11	4.01	1.45	0	5.16
23	0	0	2.64	2.42	1.96	0	0	3.95	2.22	3.05	0	2.44
24	0	0	0.14	0.95	1.03	0	0	1.41	0.52	6.94	0	0
25	0	0	0	1.75	2.28	0	0	0.52	0	0.24	0	0
26	0	0	0	2.64	2.34	0	0	0	0	0	0	0
27	0	0	0	2.12	1.63	0	0	0	0	0	0	1.53
28	0	0	0.16	0.12	0	0	0	0	0	0	0	0.63

29	0		0	0	0.16	0	0	0	0	0	0	3.61
30	0		0	0	0	0	0	0.52	0.08	0	0	14.08
31	0		0		0		0	0.58		0		18.41
Total	0.00	0.00	41.10	31.79	9.50	0.00	0.00	24.44	24.57	25.34	0.00	306.87
Count	0	0	17	17	7	0	0	11	12	9	0	27
Average	0.00	0.00	1.33	1.06	0.31	0.00	0.00	0.79	0.82	0.82	0.00	9.90
Maximum	0.00	0.00	5.47	8.57	2.34	0.00	0.00	4.40	8.07	6.94	0.00	30.70
Minimum	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Source: SRP Daily Flow Records

SRP - 67TH AVE. DRAIN
DAILY FLOW RECORDS - 1998
(units are in acre-feet)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	3.45	0	0.34	2.34	1.98	0	0.08	0	21.86	0	2.88	0
2	0.1	0	0	1.23	10.85	0	0.08	0.12	0.08	0	0	0.04
3	0.85	0	4.13	1.17	11.23	0	0.1	0.1	0.14	0	0	0
4	0.02	4.4	3	1.03	10.73	0	0.22	0	0.95	0	0	0
5	1.96	1.92	3.23	0.91	5.91	19	0.08	0.12	0.08	31.12	0	0.44
6	2	0	3.45	1.03	8.53	17.81	0.08	0.18	0.14	51.49	0	3.17
7	6.03	0	13.67	11.17	1.45	0.52	0.14	0.1	0.08	3.47	0	0
8	5.38	1.27	7.26	4.7	1.55	0.71	0.12	0	0.08	0	0.56	0.04
9	1.13	7.93	19.08	6.8	15.87	1.86	0.12	0	0.08	0	19.8	10.37
10	2.14	5.28	22.93	4.58	27.41	6.19	0.08	0	0.08	0	1.19	18.7
11	0.24	3.85	21.58	2.8	10.35	4.78	0.08	1.19	0.08	0	4.76	0
12	0	0	23.8	8.85	20.49	4.98	0.08	4.07	0.08	0	2.32	0
13	0	0	28.98	0.22	32.55	5.55	0.08	5.32	0.08	0	0	0
14	0	0	24.46	0	12.3	1.96	1.23	2.74	0.08	0	0	0
15	0	6.68	23.86	0	8.05	2.72	1.05	0	87.33	0	0	0
16	0.6	0	21.34	0.52	7.54	0.1	1.23	0	32.19	0	0.06	0
17	0.04	11.94	29.77	5.93	0.67	0.12	2.04	2.72	72.16	0	0	0
18	0	10.29	27.89	5.77	0.12	0.12	11.88	0	18.37	0	0	0
19	0	0.79	1.69	1.9	0	0.12	2.1	0	0.08	0	0	0.06
20	0	1.21	0.42	0.73	0	0.34	0.3	0	87.29	0	0	0.87
21	0.26	0.4	3.93	0	0.54	0	0.34	0	189.74	0	0.08	2.62
22	0.22	0	6.68	0.5	2.84	0	0.89	0	269.44	294.15	3	2.4
23	0.48	0	7.46	1.23	0.16	4.94	0.08	0	305.94	311.51	7.24	8.27
24	2.6	4.05	5.16	5.28	5.61	6.49	0.08	0.16	257.56	284.93	1.29	2.6
25	9.64	1.37	2.02	2	10.27	7.12	0.3	0.65	0.08	26.38	1.88	0
26	5.04	0.16	12.44	4.24	10.29	0	0.75	3.53	0.08	5.91	0.02	0

27	6.84	0.97	1.21	0.1	7.74	0	0.91	1.98	0.08	0.12	0	0
28	5.41	1.45	9.86	0.85	10.06	0.04	1.21	3.09	0.08	0	0	0
29	4.5		24.4	0	9.96	0	0.08	6.8	0.08	0.73	0	0.2
30	2.74		31.34	1.17	1.63	0	0.08	17.45	0.08	4.17	0	1.21
31	1.82		13.98		0.87		1.25	0.97		1.03		0.32
Total	63.49	63.96	399.36	77.05	247.55	85.47	27.14	51.29	1,344.47	1,015.01	45.08	51.31
Count	24	17	30	26	29	20	31	18	30	12	13	15
Average	2.05	2.28	12.88	2.57	7.99	2.85	0.88	1.65	44.82	32.74	1.50	1.66
Maximum	9.64	11.94	31.34	11.17	32.55	19.00	11.88	17.45	305.94	311.51	19.80	18.70
Minimum	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.00	0.08	0.00	0.00	0.00

Source: SRP Daily Flow Records

SRP - 67TH AVE. DRAIN
DAILY FLOW RECORDS - 1999
(units are in acre-feet)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	1.55	0	0	0.08	0	0	0.54	2.48	3.37	5.81	0	0.04
2	0	0	0.38	14.94	0	0	0.04	1.69	3.99	7.62	0	0
3	0	0	0.5	0	0	0	0.61	0	2.3	6.21	0	0
4	0	0	2.22	0	0.06	5.69	0.73	4.05	0	5.89	0	0
5	0	0	5.83	0.44	0	11.11	2.56	2.48	0	6.49	0	0
6	0	0	15.21	0	0	8.23	0.32	8.85	0	3.53	0	0
7	0	0	3.23	0	0	0.91	10.65	10.31	0	4.24	0	0
8	0	0	0	0	0.56	0	11.46	9.42	0	0	0	0
9	0	0	0	0.06	1.29	0	6.53	3.13	1.9	0	0	0
10	0	0	0	0.08	0	0	7.8	0.91	2.82	0	0	0
11	0	0	0.02	0	4.74	2.48	1.47	0	3.01	0	0	0
12	0	0	3.27	0	1.8	5.67	0.95	0.06	0.95	0	0.08	0
13	0	0	3.37	2.5	0.08	23.35	0.3	5.12	1.79	0.44	0	0
14	0	0	22.49	5.89	0	17.12	5.95	2.68	3.79	2.9	0	0
15	0	0	11.52	5.18	2.28	0	5.1	2.26	2.62	0	0.34	0
16	0	0.63	9.82	8.43	1.03	0	0.99	1.67	2.42	0	0.73	0
17	0	0	10.25	10.47	2.08	13.9	0	2.74	3.35	3.01	1.05	0
18	0	0	10.87	10.71	4.54	15.95	0	3.07	1.09	6.92	3.47	0
19	0	0	6.76	9.3	1.59	21.46	0	5.53	2.56	5.69	0	0.16
20	0.79	0.02	0.12	3.75	1.71	21.03	0	18.21	2.04	7.74	0	0
21	3.81	0	0	3.05	8.35	4.7	0	3.19	0	10.37	0	0
22	3.77	1.07	0	0.56	3.57	7.76	0.18	1.49	0	0	0	0
23	0.61	1.61	2.58	0.61	0.22	9.38	1.23	3.95	0	0	0	0
24	0.18	1.98	3.03	4.26	6.31	7.42	4.01	2.18	0	0	0	0

25	0	2.86	0	7.6	4.62	10.91	2.06	5.22	0	0	0	0
26	0	4.09	2.16	0.36	4.6	3.29	2.62	18.45	0	0	0	0
27	0	0.04	7.16	0	0	11.33	5.59	11.7	0	0	0	0
28	0	0	5.65	0	0	0	9.96	10.31	0	0	0	0
29	0		4.92	0.42	6.39	0	0.18	4.38	3.73	0	0	0
30	0		3.65	3.31	0	0	0	6.33	3.79	0	0.34	0
31	0		1.67		0.54		0.32	4.28	18.51	0		0.26
Total	10.71	12.30	136.68	92.00	56.36	201.69	82.15	156.14	64.03	76.86	6.01	0.46
Count	6	8	24	21	20	19	25	29	18	14	6	3
Average	0.35	0.44	4.41	3.07	1.82	6.72	2.65	5.04	2.07	2.48	0.20	0.01
Maximum	3.81	4.09	22.49	14.94	8.35	23.35	11.46	18.45	18.51	10.37	3.47	0.26
Minimum	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Source: SRP Daily Flow Records

SRP - 67TH AVE. DRAIN
DAILY FLOW RECORDS - 2000
(units are in acre-feet)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	0	2.72	0	0.02	4.24	6.07	0.93	0.67	2.92	0.69	4.82	2.78
2	0	0	0	0.48	4.4	9.52	2.06	0	0	1.33	4.94	2.5
3	0	0	0	0	5.1	7.66	0.3	0	0	4.05	5.04	0.16
4	0	0	1.61	0	5.3	9.88	0	0	0.04	1.65	5.99	0.2
5	0	0	4.82	0	2.94	4.8	1.19	0.14	0	0	9.34	0.04
6	0	0	10.18	0	5.02	7.7	0.58	1.37	0	0	4.52	0.87
7	0	0	4.46	0	5.02	12.24	0.67	2.16	0	0	1.79	0
8	0	3.11	0.83	0	4.42	12.48	0.99	9.32	0.26	0	4.07	0.2
9	0	9.88	1.05	0	5.97	9.6	2.04	4.96	0.04	0	3.71	0
10	0	0	1.51	0.4	5.97	6.47	0	2.26	0	12.89	3.61	0
11	9.32	0	2.28	2.14	10.95	5.97	2.16	4.68	0.08	4.28	1.69	0
12	5.71	0	1.29	2.92	10.43	6.09	6.98	8.31	0.14	0	2.4	0
13	5.08	0	1.27	3.53	7.34	14.08	1.71	5.47	0	0.12	7.48	0
14	3.73	0	0	4.48	5.18	8.77	2.6	7.85	0.22	0	0	0
15	0	0	0	7.38	1.73	0.18	2.2	3.81	0	0	0	0
16	0	0	0	3.05	1.45	6.92	0	1.57	1.25	0	0	0
17	0	0	0	1.41	2.7	8.73	0	0.32	5.87	0.06	0	0
18	0	0	0	0	5.3	10.45	0	0	1.15	0	0.06	0
19	0	0	0	0	14.66	14.96	0	0	0.58	0	0.4	1.31
20	0	0	0	0	9.38	6.88	0	0.46	0.81	0	0.32	0.24
21	0	0.04	0	0.4	1.61	3.15	0	1.09	0.08	1.07	2.78	0.04
22	0	0	0.12	0.67	3.89	3.13	0	0	4.56	8.31	5.4	0

23	0	0	0	0	11.01	4.26	0.61	0	2.26	4.76	0	0
24	0	0	0	1.25	5.4	2.84	0.1	1.39	3.65	8.99	2.1	0
25	0	0	0	2.56	6.61	2.62	0	0	2.46	6.39	1.71	0
26	0	0	0	0.61	11.72	11.09	0	1.69	0.97	5.95	1.57	0
27	4.32	0	0	6.96	13.63	9.92	0	6.84	0	7.44	0.63	0.04
28	0	0	0	7.68	12.42	7.66	0	5.12	0	5.53	0	0.5
29	3.55	0	0	11.03	5.24	0.95	0.06	4.28	0	5.85	0	1.65
30	0		0.06	6.11	3.63	4.07	5.71	4.52	0.34	7.34	5.06	0.2
31	0		1.05		3.77		3.31	3.51		5.32		0.99
Total	31.71	15.75	30.53	63.08	196.43	219.14	34.20	81.79	27.68	92.02	79.43	11.72
Count	6	4	13	19	31	30	18	23	19	19	23	15
Average	1.02	0.54	0.98	2.10	6.34	7.30	1.10	2.64	0.92	2.97	2.65	0.38
Maximum	9.32	9.88	10.18	11.03	14.66	14.96	6.98	9.32	5.87	12.89	9.34	2.78
Minimum	0.00	0.00	0.00	0.00	1.45	0.18	0.00	0.00	0.00	0.00	0.00	0.00

Source: SRP Daily Flow Records

SRP - 67TH AVE. DRAIN
DAILY FLOW RECORDS - 2001
(units are in acre-feet)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	0	0	50.46	7.99	1.49	1.77	4.28	10.79	6.53	0.58	0.36	0
2	0	0	123.45	4.68	5.22	2.22	3.67	4.98	9.52	2.32	0.26	0
3	0	0	0	0.95	4.07	2.46	1.13	0.67	8.45	2.14	0	1.8
4	0.6	0	0	1.07	7.95	2.68	2.92	0.1	2.94	0.77	0	3.27
5	0	0	0.04	3.13	7.81	2.36	2	2.7	2.34	0.12	0	4.72
6	4.09	2.08	0.26	8.21	4.8	1.57	0.52	0.81	3.21	4.84	0	4.72
7	5.45	0	1.49	8.39	1.75	2.28	0.3	0.58	3.73	4.76	0	0.04
8	3.23	0.06	0.71	6.78	3.15	5.28	6.49	2.58	5.02	1.86	0	0
9	1.25	0	0.71	0.34	7.04	0.26	4.72	2.82	10.87	0.12	0	0
10	0.04	0	0.6	4.05	6.72	0.28	3.69	3.07	6.29	7.72	0	0
11	0.1	0	0.16	1.69	5.77	0.2	3.77	6.92	4.86	6.15	0	0.24
12	2.34	0	0.52	2.96	9.36	0.12	7.68	0.5	4.01	1.35	0.32	0.1
13	0.04	0	0	3.71	8.21	2.24	2.9	0.42	0.6	0.26	0.65	0
14	0	0	0	2.6	2.12	1.53	1.57	0	2	0.71	0	0
15	0	0	0	0	1.9	1.94	1.43	1.49	1.84	1.07	0	0
16	0	0.77	0	0.22	3.07	2.1	3.99	0	4.74	3.99	0	0
17	0	0	0.06	0.4	1.07	2	9.28	0.58	6.9	4.4	0	0
18	0	0	0	0.46	0.38	3.37	4.15	1.82	3.69	1.88	0	0
19	0	0	0	1.61	0	1.63	3.35	0.75	0.81	4.01	0	0
20	0.61	0	0	2.72	0.4	4.24	3.53	2.24	3.59	3.31	0.1	0

21	0.1	0	0	8.15	0.06	1.03	2.08	3.49	2.96	1.47	0	0
22	0.04	0	0	4.92	0.3	1.13	2.28	2.92	6.96	0.14	0	0
23	0	0	0	0.65	1.59	0.81	2.14	5.16	3.49	0	0	0
24	0.44	0	0.5	0.36	1.41	8.99	3	4.96	1.86	0.46	0	0
25	5.16	0	2.44	0.83	0.95	11.11	6.31	9.8	3.53	0.61	0	0
26	6.19	0	0.63	0.46	1.03	10.31	4.68	4.42	7.3	0.6	0	0.02
27	10.23	0	1.37	0.58	2.4	8.53	6.9	3.55	1.63	0.79	0	0.32
28	0.48	0	1.11	2.3	4.21	5.67	0.44	3.07	1.9	0.65	0	0.38
29	0.1		0.36	3.41	10.95	1.86	2.12	2.34	7.22	3.67	0	0
30	0		0.22	2.14	11.58	1.55	3.75	1.75	8.17	4.66	0.1	0
31	0		4.48		3.55		5.65	2.12		2.52		0
Total	40.49	2.91	189.57	85.76	120.31	91.52	110.72	87.40	136.96	67.93	1.79	15.61
Count	18	3	19	29	30	30	31	29	30	30	6	10
Average	1.31	0.10	6.12	2.86	3.88	3.05	3.57	2.82	4.57	2.19	0.06	0.50
Maximum	10.23	2.08	123.45	8.39	11.58	11.11	9.28	10.79	10.87	7.72	0.65	4.72
Minimum	0.00	0.00	0.00	0.00	0.00	0.12	0.30	0.00	0.60	0.00	0.00	0.00

Source: SRP Daily Flow Records

SRP - 67TH AVE. DRAIN
DAILY FLOW RECORDS - 2002
(units are in acre-feet)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	0	0.6	0.52	0	13.59	0	7.48	3.45	2.28	6.64	18.33	2.22
2	0	0.52	0.32	0	5.49	0	8.73	3.55	2.26	8.61	18.88	2.18
3	0.26	0.36	5.79	0	7.62	1.11	16.62	3.45	2.28	2.24	11.33	2.20
4	0.67	0.22	4.24	1.71	4.92	5.81	10.85	3.45	0	0	2.04	2.20
5	0.79	0	4.74	4.96	0.1	4.5	6.07	3.13	9.8	0	2.22	2.20
6	0.77	0	0.97	5.63	0	7.66	5	4.56	10.45	0	2.22	2.20
7	0.5	0.12	0	2.66	0.14	6.27	4.46	5.67	5.93	0	2.22	2.20
8	0.46	0.42	0.18	0.14	0.75	1.55	3.57	7.48	3.15	2.24	2.22	2.20
9	0.77	0.67	0.02	0.24	4.44	12.38	2.96	7.89	2.56	2.24	2.22	1.90
10	0.99	0.69	0	0.52	6.8	2.88	4.13	6.21	2.4	2.24	2.22	1.71
11	0.99	0.61	0.24	0.73	5.08	0.04	4.56	6.57	2.28	2.24	2.2	2.20
12	0.85	0.32	0	0.02	6.19	0	6.05	9.12	2.28	2.24	2.94	2.18
13	0.87	0	0.08	0	0.83	0.02	3.53	4.96	2.2	2.24	5.04	2.18
14	0.99	0	2.9	2.74	0	1.29	3.55	5.26	2.22	2.24	5.87	2.16
15	0.85	0	0	4.09	0.16	3.69	0	7.93	2.32	2.22	5.67	1.47
16	1.07	0	0	5.43	1.11	1.63	0	6.55	2.28	2.24	2.24	1.88
17	0.89	0	0	0.1	1.11	0	0	6.9	0	3.37	2.24	2.20
18	1.21	0	0	0	1.45	0	0	8.45	2.3	2.22	2.24	2.20

19	1.77	0	0.16	0	0	0.46	0	8.73	2.42	2.3	2.24	2.18
20	1.47	0	0.67	0	0	6.51	0	2.32	2.64	3.55	2.24	2.20
21	1.57	0	0.36	0	0	5.91	0	2.24	2.58	2.2	1.77	1.59
22	1.65	0.1	0	0	0	3.19	0	2.3	2.62	2.22	2	1.75
23	2.34	0.61	0	0.3	0	0	0	2.24	2.84	2.22	2.24	2.18
24	2	0.3	0	0	3.07	7.02	0	3.47	2.92	2.22	2.24	2.18
25	2.2	0	0.4	0	7.08	5.14	0	9.26	3.05	2.22	2.2	2.18
26	2.14	0	0.52	0.46	5.67	0.89	0	6.92	2.88	2.3	2.2	2.18
27	2.22	0	0.46	2.9	4.6	0.04	0	2.7	3.69	2.3	2.2	2.16
28	2	0	0.85	0.6	0.34	0.06	0	9.22	2.36	2.22	2.22	1.47
29	1.69		0.73	7.14	0	4.74	0	7.16	4.22	14.66	2.22	2.00
30	1.73		0	6.72	0	7.87	0.61	4.68	3.79	18.82	2.22	2.18
31	1.27		0		0.32		2.6	2.58		18.55		2.24
Total	36.98	5.54	24.15	47.09	80.86	90.66	90.77	168.40	93.00	119.00	118.33	64.21
Count	29	13	19	19	22	24	16	31	28	27	30	31
Average	1.19	0.20	0.78	1.57	2.61	3.02	2.93	5.43	3.10	3.84	3.94	2.07
Maximum	2.34	0.69	5.79	7.14	13.59	12.38	16.62	9.26	10.45	18.82	18.88	2.24
Minimum	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.24	0.00	0.00	1.77	1.47

Source: SRP Daily Flow Records

APPENDIX B

SRP Maricopa Drain Daily Flow Records

MARICOPA DRAIN
DAILY FLOW RECORDS - 1994
(units are in acre-feet)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	7.85	8.27	0.3	22.08	0	7.3	7.28	10.91	0	0.18	6.51	0
2	8.45	6.9	4.66	18.09	0	7.3	7.28	10.91	0	0.32	4.8	0
3	6.8	6.88	12.71	15.35	0	12.65	7.28	9.82	1.09	0.52	1.82	0.81
4	7.26	6.09	2.02	16.58	0	9.5	7.28	9.82	0	0.42	0.08	5.81
5	11.74	9.98	12.58	16.03	0	7.8	7.28	7.64	0	0.36	1.33	1.61
6	12.54	8.53	15.21	12.99	3.03	11.56	7.83	17.45	0	0.28	5.12	7.04
7	11.84	15.67	33.68	10.89	13.31	11.19	10.65	16.36	0	0.04	0.61	1.19
8	9.34	19.22	21.72	16.48	14.76	10.53	11.41	13.09	0	0	0	1.03
9	8.25	9.78	14.62	20.25	7.58	9.14	12.56	6.55	0	0	0	1.51
10	6.09	12.65	8.99	13.27	2.36	6.62	17.12	10.91	0	0.63	0	0.38
11	6.78	6.88	9.06	16.03	0.04	6.7	17.53	12	0	1.31	0	0
12	9.74	7.02	8.51	16.38	0.79	6.7	19.14	12	0	0.18	0	0
13	8.35	12.93	10.23	7.36	2.44	6.03	15.09	9.82	0	0	0.48	0.02
14	11.5	10.31	3.87	1.21	1.69	7	24.06	10.91	0	0	0.04	1.55
15	9.4	8.55	2.68	4.84	4.11	10.97	20.43	15.27	0	0	0	0.26
16	8.31	2.98	2.24	11.41	12.42	10.93	21.6	18.55	0	0	0	0.3
17	9.9	8.99	4.05	10.67	14.72	13.07	30.19	9.82	0	0	0	1.07
18	9.76	5.93	8.65	18.66	18.82	15.77	31.34	10.91	0	0	0	0.91
19	11.56	8.15	11.72	17.85	12.38	13.86	19.26	14.18	0	0	0	0.54
20	6.8	2.9	6.35	19.34	14.3	14.22	12.34	9.82	0	0	0	3.09
21	9.01	3.99	7.2	18.57	15.41	14.12	13.71	9.82	0	0	0	6.92
22	6.59	7.85	6.03	8.63	15.57	22.51	7.7	15.27	0	4.3	0	5.49
23	5.69	4.86	7.95	2.48	14.92	24.54	3.91	9.82	0	4.68	0	9.94
24	8.85	7.44	0.04	14.08	3.09	24.54	4.13	7.64	0	0.79	0	6.66
25	9.8	11.03	8.55	4.8	1.11	24.54	3.81	7.64	0	3.21	0	5.47
26	15.81	9.62	13.69	4.36	0	24.54	3.67	6.55	0	0.26	0.02	9.58
27	8.95	12.95	7.99	10.97	0	24.54	3.67	6.55	0	3.09	0.81	4.17
28	4.36	1.17	8.39	0.02	0	24.54	3.67	8.73	0	5.59	2.04	3.19
29	5.14		10.08	0	0	24.54	3.67	2.18	0	2.22	0.77	7.68

30	6.94		11.56	0	0	24.54	3.67	0	0	2.96	0	6.59
31	8.05		21.16		0		3.67	0		4.86		2.6
Total	271.45	237.52	296.49	349.67	172.85	431.79	362.23	310.94	1.09	36.20	24.43	95.41
Count	31	28	31	28	20	30	31	29	1	20	13	27
Average	8.76	8.48	9.56	11.66	5.58	14.39	11.68	10.03	0.04	1.17	0.81	3.08
Maximum	15.81	19.22	33.68	22.08	18.82	24.54	31.34	18.55	1.09	5.59	6.51	9.94
Minimum	4.36	1.17	0.04	0.00	0.00	6.03	3.67	0.00	0.00	0.00	0.00	0.00

Source: SRP Daily Flow Records

MARICOPA DRAIN
DAILY FLOW RECORDS - 1995
(units are in acre-feet)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	0.54	14.58	9.12	19.54	17.95	20.97	26.44	13.9	0	0	5.32	4.22
2	0	17.53	6.21	21.34	14.06	25.73	17.95	12.77	10.31	0	31.54	7.06
3	0	14.16	11.05	21.24	78.8	23.58	17.79	8.21	15.59	0	3.07	6.84
4	3.31	12.08	5.3	19.3	0	20.87	12.26	3.33	10.29	0	5.83	4.74
5	12.6	15.13	12.2	23.52	0	22	13.79	5.67	9.34	0	6.17	3.33
6	3.35	10.53	20.63	23.25	0	12.4	10.51	2.36	8.51	0	6.13	2.64
7	5.02	9.9	4.94	25.19	0	13.69	11.9	6.09	9.48	0	1.45	4.9
8	1.17	9.94	13.41	24.5	3.43	10.43	8.31	3.93	3.59	0	0.16	10.45
9	4.22	10.83	17.36	21.94	0.16	13.51	17.93	2.4	0	0	0	2.26
10	4.9	9.28	12.2	12.2	6.27	13.75	12.04	7.46	5.53	0	0	2.56
11	3.17	9.42	5.32	16.4	4.64	12.77	4.21	11.84	0	0.54	0	0
12	2.8	10.31	13.92	22.83	5.59	16.13	1.05	78.76	0	4.17	0	6.07
13	2.82	15.27	12.34	23.8	8.71	14.62	5.85	76.84	0	6.9	0	9.01
14	2.32	17.02	10.85	19.8	0	11.27	9.24	0	0	3.87	0	6.31
15	4.15	13.63	5.91	18.8	0	9.06	13.63	8.47	0	2.54	1.39	4.15
16	8.93	12.83	7.97	23.46	0	13.9	10.35	10.59	0	8.37	5.99	4.38
17	4.52	11.23	10.75	27.79	0	2.66	4.92	18.43	0	10.1	8.41	3.07
18	0.34	13.47	14.62	25.35	0	0	1.43	18.94	0	10.35	6.43	0.83
19	0.18	18.15	9.46	27.55	0	0	0	15.95	0	9.32	3.99	0
20	3.09	13.15	6.66	19.3	0	3.17	0	7.42	0	11.9	5.12	5.02

21	2	10.16	0	23.82	0	1.75	5.34	2.52	0	10.91	5.36	7.99
22	2.34	7.02	0	30.72	0	5.41	7.6	0	0	8.11	6.11	11.94
23	3.85	10.49	1.33	23.11	0	3.11	8.79	0	0	3.77	8.77	6.17
24	2.84	7.99	11.39	20.75	0	0	3.77	12.4	0	4.24	2.54	6.8
25	2.88	6.59	7.46	18.98	0	9.6	0.34	15.75	0	7.95	6.19	11.25
26	2.86	15.45	5.67	31.02	0	14.36	0	19.46	0	5.95	7.52	5.99
27	6.33	12.38	13.49	32.01	0	8.79	7.22	18.43	0	8.57	7.06	8.81
28	8.27	19.36	12.73	25.11	0	14.36	11.33	15.87	5.47	2.52	3.51	9.62
29	9.28		28.9	23.05	0	15.57	13.01	14.08	0	2.54	1.75	8.47
30	12.6		22.73	30.98	3.49	24.24	11.23	8.55	0	0.26	2.96	8.07
31	12.97		24.79		16.6		14.5	0		1.31		0
Total	133.65	347.88	338.71	696.65	159.70	357.70	282.73	420.42	78.11	124.19	142.77	172.95
Count	29	28	29	30	11	27	28	27	9	21	24	28
Average	4.31	12.42	10.93	23.22	5.15	11.92	9.12	13.56	2.60	4.01	4.76	5.58
Maximum	12.97	19.36	28.90	32.01	78.80	25.73	26.44	78.76	15.59	11.90	31.54	11.94
Minimum	0.00	6.59	0.00	12.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Source: SRP Daily Flow Records

MARICOPA DRAIN
DAILY FLOW RECORDS - 1996
(units are in acre-feet)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	6.15	8.79	8.49	0.42	11.37	0.06	14.92	14.92	10.75	0	8.59	5.28
2	6.07	9.84	10.41	0	5.16	0.1	15.09	15.09	10.29	0	9.46	9.16
3	5.61	7.83	14.76	0	0.06	4.24	11.41	11.41	9.28	0	9.36	15.99
4	5.55	13.59	8.59	0	0.34	0	17.99	17.99	12.12	0	5.81	11.82
5	5.1	10.27	9.92	9.26	10.81	0	21.78	21.78	10.69	0	7.48	4.22
6	5.02	9.16	13.19	0.06	0.52	0.42	28.58	28.58	7.93	0	5.02	5.43
7	4.13	9.01	24.18	18.27	0	3.01	29.04	29.04	13.15	0	2.2	7.16
8	4.36	9.64	13.09	20.17	0	4.84	15.35	15.35	10.65	0	9.94	10.45
9	4.42	7.4	13.19	23.37	0	9.16	23.19	23.19	5.22	0	7.87	8.81
10	4.21	11.29	21.4	8.85	2.22	13.82	25.09	25.09	0.06	0	5.34	11.62
11	3.67	13.19	19.46	9.02	9.02	15.15	23.29	23.29	8.61	0	2.72	12.91

12	3.55	6.29	17.51	16.86	12.89	17.77	25.69	25.69	12.14	2.84	1.27	13.98
13	3.23	4.92	16.01	20.17	0.06	10.85	31.87	31.87	2.58	10.25	3.97	13.9
14	3.15	8.85	23.27	24.42	0.06	6.37	24.3	24.3	6.25	13.88	3.97	7.54
15	2.82	15.27	14.44	14.38	0.06	6.82	14.78	14.78	12.87	10.69	4.48	13.23
16	2.6	14.34	12.4	10.49	0.06	0	18.59	18.59	12.14	2.56	8.03	7.32
17	3.25	4.64	5.83	12.58	0.85	0	24.54	24.54	16.32	0.06	5.47	8.53
18	4.03	5.87	7.46	14.52	0.06	0	17.79	17.79	13.55	0.06	1.45	8.93
19	5.14	11.21	7.08	6.39	0.06	0.75	13.21	13.21	12.6	0.06	1.53	11.29
20	7.8	8.99	6.88	11.15	0.06	14.22	16.9	16.9	4.36	0.06	4.98	7.66
21	4.66	4.21	13.51	10.18	1.11	17.99	20.49	20.49	0	4.42	9.68	8.09
22	7.04	0.06	18.09	2.92	5.18	16.88	20.41	20.41	0	7.74	2.58	8.81
23	4.74	11.78	20.23	7.06	6.66	18.57	13.94	13.94	0	0.06	6.37	8.31
24	4.6	10.45	22.81	3.95	4.01	15.81	8.57	8.57	0	0.06	2.92	5.61
25	10.73	12.04	26.5	18.51	2.46	12.87	16.98	16.98	0	0.06	0.71	12.65
26	22.71	18.29	24.4	21.78	0.06	17.81	25.79	25.79	0	0.06	6.17	9.8
27	10.2	10.35	22.2	7.89	0.06	22.75	23.33	23.33	0	17.79	7.78	12
28	4.92	8.61	24.4	3.47	0.06	17.12	23.5	23.5	0	9.94	8.19	5.53
29	6.41	4.86	22.61	7.3	0.06	23.29	16.03	16.03	0	10.23	12	4.01
30	5.71		15.85	7.7	0.06	16.74	5.28	5.28	0	10.14	5.71	1.43
31	6.31		4.58		0.08		0.06	0.06		8.03		0.06
Total	177.89	271.04	482.74	311.14	73.46	287.41	587.78	587.78	191.56	108.99	171.05	271.53
Count	31	29	31	27	28	25	31	31	20	20	30	31
Average	5.74	9.35	15.57	10.37	2.37	9.58	18.96	18.96	6.39	3.52	5.70	8.76
Maximum	22.71	18.29	26.50	24.42	12.89	23.29	31.87	31.87	16.32	17.79	12.00	15.99
Minimum	2.60	0.06	4.58	0.00	0.00	0.00	0.06	0.06	0.00	0.00	0.71	0.06

Source: SRP Daily Flow Records

MARICOPA DRAIN
DAILY FLOW RECORDS - 1997
(units are in acre-feet)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	0	0.06	12.06	10.53	8.19	0	3.23	6.43	0.06	10.63	6.23	7.08
2	4.24	3.25	12.26	15.02	18.15	0	10.97	2.62	7.08	8.09	8.33	6.25
3	2.8	1.92	8.83	21.54	4.66	0	8.09	6.23	3.71	5.91	5.43	8.87
4	0	0.06	14.56	20.53	0	1.82	11.82	10.35	0	13.55	12.69	12.69
5	0	0.06	13.69	6.09	0	1.09	11.62	1.8	0	11.92	12.85	14.5
6	0	0.06	12.83	0.06	0	0	14.24	0	0	12.62	11.74	15.43
7	0	0.08	14.48	0.06	0.22	3.59	16.64	0	0	11.84	8.87	13.9
8	0	0.36	14.98	0.06	0.06	14.48	6.59	0	0	9.9	8.43	11.98
9	0	9.6	11.44	0.06	1.71	20.73	0.28	3.65	0	7.95	5.75	10.97
10	0	0.48	5.12	0.95	15.55	18.51	0	0	0.2	10.31	4.82	15.13
11	0	3.89	3.65	1.27	9.52	15.97	0	0	12.18	7.85	12.79	12.2
12	0	13.03	3.31	2.66	3.03	13.84	0	0	11.88	8.99	10.43	10.43
13	0	0.67	0.06	11.41	0	2.68	1.9	0	12.48	6.96	9.92	8.93
14	0	0	12.58	10.08	6.88	3.21	6.92	0	11.56	9.32	8.09	10.02
15	0	0	4.26	2.58	17.87	14.34	7.78	0	11.31	6.78	11.56	4.52
16	0	6.15	23.72	6.86	27.17	9.22	3.45	2.94	10.55	7.18	9.06	8.09
17	0	0.87	9.6	10.81	17.71	14.7	0	7.32	5.65	9.14	7.89	11.05
18	0	0.52	11.7	2.5	3.87	7.83	6.27	27.21	0	9.48	10.43	9.86
19	0	0.06	8.89	0.18	4.8	0.06	0.06	12.75	0	7.6	9.88	10.29
20	0	0.06	9.32	6.31	9.14	0.06	0.06	4.8	0	6.15	5.34	12.73
21	0.44	0.06	11.21	7.76	0	0.06	5.32	6.37	1.33	9.64	4.26	12.02
22	13.23	0.06	1.59	11.42	0	10.12	5.4	12.42	8.55	7.34	8.39	12.32
23	9.38	8.29	20.11	0.06	0	11.41	5.41	10.79	10.95	12.85	10.75	10.73
24	5.61	9.8	13.47	19.38	0	15.79	2.02	12.04	8.15	14.06	11.62	7.74
25	5.1	0.12	13.03	26.26	0	5.38	0.1	8.53	8.55	12.1	7.8	10.41
26	9.52	0.06	10.51	19.3	0	0	7.12	2.86	8.89	9.9	11.66	7.58
27	3.17	2.8	5.51	25.86	0	0	11.23	0.06	10.2	6.98	7.85	17.57
28	0	13.07	0.1	19.68	0	0	3.99	4.07	10.47	8.41	5.79	22.67
29	0		3.05	3.33	0	1.98	0	3.73	6.88	6.92	5.24	19.32
30	0		18.45	0.06	0	2.08	0	0	9.62	5.97	12.81	16.15
31	7.52		10.63		0		1.11	1.23		5.67		14.52
Total	61.01	75.44	315.00	262.67	148.53	188.95	151.62	148.20	170.25	282.01	266.70	365.95
Count	10	26	31	30	16	23	25	21	21	31	30	31

Average	1.97	2.69	10.16	8.76	4.79	6.30	4.89	4.78	5.68	9.10	8.89	11.80
Maximum	13.23	13.07	23.72	26.26	27.17	20.73	16.64	27.21	12.48	14.06	12.85	22.67
Minimum	0.00	0.00	0.06	0.06	0.00	0.00	0.00	0.00	0.00	5.67	4.26	4.52

Source: SRP Daily Flow Records

MARICOPA DRAIN
DAILY FLOW RECORDS - 1998
(units are in acre-feet)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	8.03	3.21	3.45	15.57	21.34	49.75	15.47	23.78	13.92	3.59	4.22	7.3
2	6.76	6.47	3.97	25.75	20.69	29.63	24.36	21.32	23.31	9.64	7.6	7.46
3	7.83	9.54	6.66	25.86	26.38	7.78	45.22	20.89	25.03	1.98	9.16	5.57
4	12.69	16.09	8.45	30.53	24.79	31.44	60.79	21.32	25.83	11.94	10.37	0.81
5	13.88	13.37	8.87	25.81	28.36	23.19	55.78	19.1	19.12	14.8	10	9.04
6	8.09	7.02	10.35	22.85	43.34	5.83	52.68	17.45	23.82	7.24	7.68	10.71
7	10.81	11.74	9.74	34.04	28.7	20.57	52.09	15.39	20.73	7.48	10.31	6.74
8	11.52	8.51	15.83	35.6	51.57	34.2	48.66	18.05	15.53	0	16.26	3.77
9	8.55	22.04	14.18	27.35	57.28	11.66	31.44	19.2	16.98	3.97	17.14	6.37
10	14.8	3.75	9.06	31.82	47.05	26.64	29.38	27.93	18.37	16.5	6.66	5.63
11	17.47	3.67	5.59	36.18	57.12	35.13	31.93	23.86	18.29	18.82	6.01	7.83
12	11.46	11.13	7.4	31.99	42.15	33.12	27.25	21.28	13.05	10.47	5.79	8.67
13	9.1	5.73	7.83	33.5	40.58	15.25	37.73	22.39	17.49	12.75	3.95	14.38
14	4.92	13.45	7.7	30.19	49.25	9.92	38.38	19.6	11.33	16.32	5.3	11.15
15	4.44	24.85	16.28	23.19	42.43	10.51	41.95	25.37	14.06	0	6.57	5.51
16	5.73	3.79	16.23	32.31	35.78	14.08	36.12	29.65	3.59	0	10.81	0.24
17	10.55	11.98	7.58	22.16	21.7	24.91	39.29	31.36	0	0	7.3	11.13
18	6.29	26.48	6.59	17.73	23.17	22.41	39.99	38.08	2.3	0	5.93	15.03
19	11.01	8.07	10.06	22.04	23.52	28.78	36.34	28.6	4.17	0.99	8.03	12.24
20	13.47	14.74	17.51	26.38	10.2	47.39	24.85	29.49	13.9	0	9.4	9.58
21	4.34	12.2	21.44	24.83	14.4	35.19	21.2	19.46	13.01	2.92	6.13	11.17
22	8.21	20.95	22.99	25.15	7.58	24.93	26.42	23.54	13.71	5.59	4.98	9.16

23	13.17	25.85	21.22	26.58	20.05	22.75	26.24	26.44	11.74	2.14	2.46	10.93
24	6.72	24.58	20.87	25.15	17.36	23.25	20.99	25.25	12.58	18.13	0.06	13.09
25	8.91	9.26	25.75	17.91	24.81	25.05	23.27	24.1	8.21	20.75	1.45	12.28
26	8.85	7.74	28.32	22.51	32.53	7.22	32.29	21.08	2.42	19.82	11.84	3.33
27	7.08	10.25	23.05	28.21	36.2	9.3	35.48	22.27	9.24	13.31	10.22	3.65
28	7.7	7.81	22.61	28.9	32.35	22.97	24.71	20.49	3.01	5.89	15.43	6.88
29	9.98		37.77	32.45	40.6	25.81	30.45	9.1	9.5	2.76	11.78	7.34
30	7.83		41.89	29.69	39.73	21.54	29.67	7.08	10.59	5.95	8.77	7.85
31	8.53		21.76		51.77		23.15	9.62		5.75		5.65
Total	288.72	344.27	481.00	812.23	1,012.78	700.20	1,063.57	682.54	394.83	239.50	241.61	250.49
Count	31	28	31	30	31	30	31	31	29	25	30	31
Average	9.31	12.30	15.52	27.07	32.67	23.34	34.31	22.02	13.16	7.73	8.05	8.08
Maximum	17.47	26.48	41.89	36.18	57.28	49.75	60.79	38.08	25.83	20.75	17.14	15.03
Minimum	4.34	3.21	3.45	15.57	7.58	5.83	15.47	7.08	0.00	0.00	0.06	0.24

Source: SRP Daily Flow Records

MARICOPA DRAIN
DAILY FLOW RECORDS - 1999
(units are in acre-feet)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	8.33	4.74	10.39	31.78	18.35	17.95	17.91	13.84	18.51	11.72	13.73	7.68
2	5.61	12.75	12.95	52.78	23.58	16.15	22.75	14.04	18.51	11.72	9.48	10.31
3	5.51	12.69	14.76	28.7	19.99	16.03	27.77	14.84	18.51	10.91	6.62	12.28
4	4.34	11.86	12.79	24.4	18.07	18.64	26.88	16.13	18.51	9.04	5.91	17
5	4.84	19.7	19.18	18.07	19.24	21.38	21.01	13.37	18.51	10.04	5.57	16.62
6	4.56	19.2	35.9	18.94	21.98	28.21	18.86	12.95	18.51	8.89	5.38	8.57
7	8.41	14.02	28.58	20.63	22.43	29.28	16.74	12.42	18.51	12.26	6.43	4.28
8	10.47	13.23	27.15	23.6	23.84	25.03	23.17	11.39	18.51	15.53	5.24	9.64
9	14	12.18	25.73	25.57	20.69	30.55	6.07	10.37	18.51	14.56	7.3	11.15
10	6.47	7.54	21.96	32.43	17.55	16.01	0	11.05	18.51	13.23	8.55	10.1

11	7.08	13.35	19.04	32.63	15.05	15.27	0	12.42	16.13	11.68	8.93	10.37
12	8.15	18.35	11.56	31.78	21.3	14.38	0	13.61	16.13	10.93	9.01	10.1
13	8.77	13.75	14.3	38.02	20.53	25.67	0	13.84	16.13	10.08	6.92	9.56
14	11.9	10.97	17.77	35.9	25.17	23.23	0	13.84	16.13	6.9	5.55	8.55
15	5.77	11.07	19.14	29.85	23.07	25.59	0	15.55	16.13	9.62	5.71	7.81
16	5.89	7.95	19.16	28.46	24.16	27.79	0	16.13	16.13	12.08	4.52	10.93
17	12.95	6.59	20.63	30.37	25.39	28.9	0	16.13	16.13	14.06	6.88	9.08
18	8.39	8.93	15.49	28.62	22.95	22.04	0	16.13	16.13	13.13	6.19	11.07
19	9.26	10.2	11.7	24.3	28.44	25.49	0	16.13	16.13	9.22	7.95	13.33
20	11.66	15.17	11.7	30.09	27.51	28.34	0	14.84	16.13	8.69	9.26	15.35
21	7.85	19.08	13.53	18.35	25.47	26.36	0	11.03	11.72	12.71	6.98	17.38
22	10.73	13.75	15.27	22.06	24.71	23.92	0	11.03	11.72	13.47	5.51	13.53
23	10.22	14.52	19.32	28.3	26.78	24.42	0	11.03	11.72	14.72	4.21	12.12
24	9.58	18.9	20.39	26.24	20.73	34.49	0	11.03	11.72	9.72	4.01	10.89
25	8.21	20.89	24.91	15.03	18.92	28.17	0	12.44	11.72	13.55	8.85	3.07
26	10.39	18.66	31.06	15.13	18.53	21.74	0	13.13	11.72	14.4	10.43	10.65
27	10.69	17.34	25.53	14.46	20.53	24.5	0	17.24	11.72	17.77	7.93	18.9
28	6.53	9.06	25.53	16.4	24.62	17.18	0	18.98	11.72	12.46	8.35	13.88
29	7.5		27.09	23.01	24.67	16.54	0	17.69	11.72	10.77	4.03	19.72
30	9.82		23.43	21.14	25.03	19.1	0	17.89	11.72	27.09	5.08	24.22
31	7.46		23.84		23.19		0	18.51	18.51	9.32		18.23
Total	261.34	376.44	619.78	787.04	692.47	692.35	181.16	439.02	482.11	380.27	210.51	376.37
Count	31	28	31	30	31	30	9	31	31	31	30	31
Average	8.43	13.44	19.99	26.23	22.34	23.08	5.84	14.16	15.55	12.27	7.02	12.14
Maximum	14.00	20.89	35.90	52.78	28.44	34.49	27.77	18.98	18.51	27.09	13.73	24.22
Minimum	4.34	4.74	10.39	14.46	15.05	14.38	0.00	10.37	11.72	6.90	4.01	3.07

Source: SRP Daily Flow Records

MARICOPA DRAIN
DAILY FLOW RECORDS - 2000
(units are in acre-feet)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	7.58	15.67	7.56	21.68	29.93	15.51	19.42	23.09	14.74	13.19	0.42	9.54
2	2.38	14.28	4.03	20.77	30.76	17.36	20.23	20.75	13.23	16.4	11.44	11.15
3	5.87	14.02	6.74	19.32	27.39	14.96	21.56	18.76	14.56	20.91	12.52	12.04
4	7.2	13.53	6.62	26.1	25.85	19.6	16.17	23.15	15.27	17.47	1.65	11.39
5	11.76	12.73	8.49	26.44	20.11	19.12	12.26	18.19	13.03	15.73	0.79	4.46
6	6.51	13.61	33.72	15.95	21.03	19.28	20.07	22.2	10.83	15.93	3.37	3.61
7	6.98	11.76	12.79	13.75	23.21	27.73	21.3	19.82	14.5	23.9	6.61	2.22
8	10.95	16.9	5.1	20.73	21.38	34.26	26.78	21.82	17.75	19.97	6.78	4.62
9	7.18	20.37	7.68	23.9	21.72	29.53	25.79	16.86	12.28	24.12	8.93	7.38
10	7.1	14.12	7.72	23.92	18.9	28.92	30.59	18.8	14.04	14.58	11.11	9.2
11	4.28	14.44	4.3	22.43	25.55	28.54	21.76	16.26	15.47	5.63	10.04	10.75
12	5.2	16.88	5.14	23.56	21.03	26.82	19.48	18.07	10.25	11.68	11.86	4.46
13	6.62	12.87	5.26	25.53	20.61	25.81	25.21	23.64	12.26	9.32	15.03	4.24
14	9.3	12.06	6.27	19.99	21.48	25.09	19.62	21.82	8.01	8.07	12.93	5.61
15	11.56	10.89	8.77	27.39	23.29	17.95	14.8	17.73	21.72	8.63	14.82	4.19
16	8.45	12.85	10.87	27.23	20.19	16.05	19.95	28.88	21.62	10.93	17	6.05
17	6.72	11.66	17.65	26.62	24.2	20.19	22.43	28.8	21.18	10.22	16.6	4.92
18	10.97	13.75	15.69	32.41	21.94	27.41	21.52	20.93	18.41	14.52	14.66	5.02
19	10	9.52	13.94	30.33	23.21	23.86	22.41	19.82	17.93	13.49	9.48	8.05
20	3.23	6.27	16.11	29.91	27.87	27.05	27.55	14.94	15.09	19.89	16.58	6.43
21	3	4.11	16.48	32.35	28.94	31.84	29.36	18.07	14.62	32.05	20.11	2.8
22	12.18	3.11	13.15	27	23.98	27.69	28.68	13.15	16.23	10.81	14.54	4.74
23	9.64	5.77	13.98	24.18	29.81	22.81	26.92	13.49	13.07	11.54	9.08	5.36
24	8.83	7.48	19.8	25.59	21.42	18.8	17.47	14.66	24.12	11.29	10.18	7.97
25	12.3	7.24	10.69	25.86	22.93	27.73	21.2	14.72	16.76	10.73	7.46	8.59
26	15.47	14.68	12.69	28.8	19.7	28.46	19.89	17.38	17.22	21.18	7.93	3.53
27	15.51	15.15	16.21	22.41	21.36	29.57	22.35	15.15	19.89	9.12	3.69	12.5
28	16.68	9.02	18.09	21.12	20.99	24.48	27.55	14.98	19.28	2	5.79	21.28
29	13.9	6.68	13.84	23.72	15.33	24.02	21.68	16.62	14.9	3.95	9.38	24.62
30	14.54		14.96	27.71	20.07	26.86	18.86	12.81	13.96	3.79	5.53	22.87
31	12.93		19.42		17.06		21.12	8.93		0.79		16.68
Total	284.82	341.42	373.76	736.70	711.24	727.30	683.98	574.29	472.22	411.83	296.31	266.27

Count	31	29	31	30	31	30	31	31	30	31	30	31
Average	9.19	11.77	12.06	24.56	22.94	24.24	22.06	18.53	15.74	13.28	9.88	8.59
Maximum	16.68	20.37	33.72	32.41	30.76	34.26	30.59	28.88	24.12	32.05	20.11	24.62
Minimum	2.38	3.11	4.03	13.75	15.33	14.96	12.26	8.93	8.01	0.79	0.42	2.22

Source: SRP Daily Flow Records

MARICOPA DRAIN
DAILY FLOW RECORDS - 2001
(units are in acre-feet)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	19.7	3.83	5.38	21.66	12.83	24.18	17.04	19.08	19.08	13.05	17.87	6.37
2	12.62	3.93	5.97	26.4	14.64	27.37	22.65	16.64	16.64	2.96	21.22	5.34
3	12.4	4.38	5.45	24.56	17.24	32.03	30.09	17.08	17.08	0	18.96	6.01
4	13.82	8.33	8.61	34.93	20.89	21.54	32.17	9.94	9.94	0	14.3	1.61
5	9.74	10.45	12.06	39.81	23.01	27.19	37.15	0.08	0.08	0	15.05	2.88
6	7.26	7.76	9.26	30.92	23.7	20.63	39.04	15.65	15.65	3.69	8.79	5.02
7	8.69	10.51	16.09	27.71	20.29	2.9	20.71	10.2	10.2	12.83	11.72	1.19
8	8.73	12.2	7.7	21.08	23.29	4.46	16.96	0.3	0.3	6.37	10.71	0.12
9	9.94	11.58	8.31	16.86	15.09	10.16	27.35	13.88	13.88	0	9.5	2.68
10	14.3	4.7	4.94	19.97	21.24	12.75	25.88	8.51	8.51	0.95	11.09	4.28
11	11.33	4.42	6.37	14.34	24.56	9.24	25.81	8.67	8.67	7.78	9.64	2.1
12	7.99	3.27	2.58	17.02	17.71	5.4	25.96	17.08	17.08	2.56	11.62	1.98
13	3.39	11.68	4.54	12.69	15.33	4.01	27.21	6.64	6.64	13.67	5.67	0.44
14	9.36	10.06	5.12	14.24	18.23	0.69	19.36	5.26	5.26	9.86	8.23	1.94
15	8.75	10.73	5.4	18.45	15.23	11.13	16.7	12.67	12.67	2.14	11.07	0
16	4.86	7.95	6.47	19	9.72	6.66	23.01	8.79	8.79	0.6	12.99	0
17	9.64	10.2	10.2	25.59	16.52	6.78	14.3	4.46	4.46	0	15.73	0
18	2.46	11.84	5.85	21.5	18.63	3.41	18.61	2.54	2.54	0	20.35	0
19	10.02	12.2	11.31	23.84	15.67	3.55	16.62	0	0	6.82	10.77	4.24
20	12.71	13.27	15.63	24.1	17.93	8.77	22.51	0	0	4.34	15.05	5.1
21	9.04	17.12	13.01	21.08	19.42	20.55	21.32	0	0	6.53	15.95	4.9
22	6.72	11.41	12.48	21.86	17.38	23.44	24.52	6.31	6.31	13.59	11.13	4.6
23	9.66	7.28	14.5	31.44	13.98	17.77	18.94	9.3	9.3	16.54	11.72	11.35
24	7.4	5.18	15.53	27.81	25.81	19.42	20.05	8.71	8.71	20.47	7.42	8.21
25	6.45	6.39	18.64	20.59	17.85	24.91	20.03	0	0	22.47	7.72	7.64

26	6.98	4.82	14.88	21.72	22.12	24.38	17.43	0	0	9.06	7.28	8.77
27	20.39	5.65	15.77	15.19	29	16.68	12.34	0	0	6.41	10.06	12.18
28	3.51	5.28	19.26	20.97	27.69	17.71	13.81	0	0	9.1	11.78	14.14
29	2.2		17.93	21.8	25.65	16.62	30.86	2.3	2.3	12.42	10.79	13.47
30	2.74		14.6	13.41	17.77	57.36	24.5	1.65	1.65	15.77	8.91	19.8
31	3.73		20.01		19.34		21.26	0		11.58		19.28
Total	276.53	236.42	333.85	670.54	597.76	481.69	704.19	205.74	205.74	231.56	363.09	175.64
Count	31	28	31	30	31	30	31	23	23	25	30	27
Average	8.92	8.44	10.77	22.35	19.28	16.06	22.72	6.64	6.86	7.47	12.10	5.67
Maximum	20.39	17.12	20.01	39.81	29.00	57.36	39.04	19.08	19.08	22.47	21.22	19.80
Minimum	2.20	3.27	2.58	12.69	9.72	0.69	12.34	0.00	0.00	0.00	5.67	0.00

Source: SRP Daily Flow Records

MARICOPA DRAIN
DAILY FLOW RECORDS - 2002
(units are in acre-feet)

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	7.46	4.9	12.69	14.36	14.96	14.98	15.09	0.4	3.97	8.13	7.74	1.39
2	2.54	6.7	16.36	11.21	16.24	16.24	12.08	0.6	7.34	12.1	2.98	14.88
3	5.73	9.7	18.8	14.12	12.91	16.7	17.18	1.19	11.9	12.3	3.77	20.43
4	7.8	9.32	17.12	19.04	12.87	14.8	17.22	0.99	8.13	10.12	5.36	16.66
5	7.08	9.68	14.34	23.05	13.17	11.68	17.42	1.19	16.26	6.55	5.95	10.91
6	7.78	10.63	14.7	23.15	12.95	16.46	15.11	1.39	10.12	7.54	10.91	10.91
7	6.11	7.26	9.9	25.94	12.4	15.71	14.66	1.59	10.51	4.36	8.33	12.1
8	2.9	10.67	7.89	27	14.4	15.33	9.9	1.79	15.07	5.16	6.55	8.93
9	8.07	7.72	6.53	27.93	12.77	12.93	10.63	2.18	9.92	9.12	3.17	3.17
10	11.35	9.16	13.31	24.75	11.13	13.01	13.57	1.79	5.75	2.18	1.79	0.2
11	12.81	13.25	18.57	17.36	14	16.38	16.96	1.98	2.58	14.28	0.99	0
12	11.15	13.84	13.88	9.84	21.24	12.75	14.1	1.79	1.79	8.73	6.15	0.2
13	7.64	12.67	16.84	15.69	12.73	18.41	17.42	1.59	4.36	9.92	2.38	2.18
14	8.83	13.07	15.43	22.83	11.64	19.38	20.03	1.19	1.59	10.91	6.15	1.19
15	12.95	11.17	17.55	22.79	15.41	16.92	9.74	0.6	8.13	14.68	3.17	4.96
16	11.6	15.05	12.08	15.03	16.4	18.96	4.07	0.79	10.91	10.71	0.6	5.75
17	8.75	6.05	16.86	18.59	20.79	17.75	2	0.4	7.34	5.16	2.98	0.6
18	3.67	3.91	15.17	18.84	22.39	18.01	7.99	1.19	9.92	2.58	2.38	3.77
19	5.41	8.03	14.08	15.79	20.87	20.25	9.78	1.39	10.71	2.78	3.37	3.37
20	5.3	10.02	14.66	12.97	19.72	24.85	9.4	1.19	10.12	9.52	4.17	7.54
21	5.91	10.81	16.42	20.95	27.07	17.49	8.19	1.39	10.12	17.26	7.14	10.12
22	9.01	9.84	13.81	23.29	25.13	15.13	8.75	0.99	11.7	18.25	8.73	12.89
23	11.11	6.66	22.67	19.04	24.44	31.42	6.88	0.99	3.57	16.66	11.9	7.14
24	11.5	5.22	26.96	8.87	16.07	37.27	5.04	0.6	8.53	17.45	13.69	6.74
25	11.62	13.84	18.8	14.66	17.42	28.88	4.76	0.6	14.88	24.99	13.69	2.98
26	11.8	16.72	17.53	21.48	16.8	16.44	0	0.99	10.12	37.29	6.94	3.57
27	12.65	11.07	23.11	13.86	17.75	20.65	0	0.6	7.54	12.1	13.49	3.97
28	8.13	6.7	20.89	10.83	16.66	28.38	0	0.6	14.68	12.3	13.49	3.97
29	5.28		18.7	12.71	18.61	25.53	0	0.4	8.13	11.11	12.89	4.76
30	7.4		16.86	18.23	14.5	24.26	7.74	0.4	12.89	11.11	11.9	2.38
31	8.87		20.05		14.76		15.43	0.4		10.31		4.76
Total	258.21	273.66	502.56	544.20	518.20	576.95	311.14	33.18	268.58	355.66	202.75	192.42
Count	31	28	31	30	31	30	27	31	30	31	30	30
Average	8.33	9.77	16.21	18.14	16.72	19.23	10.04	1.07	8.95	11.47	6.76	6.21
Maximum	12.95	16.72	26.96	27.93	27.07	37.27	20.03	2.18	16.26	37.29	13.69	20.43
Minimum	2.54	3.91	6.53	8.87	11.13	11.68	0.00	0.40	1.59	2.18	0.60	0.00

Source: SRP Daily Flow Records

US Army Corps of Engineers
Los Angeles District

RIO SALADO OESTE
F4 MILESTONE
Salt River-Phoenix, Arizona

Appendix C
Groundwater Modeling

March 2005

U.S. ARMY CORPS OF ENGINEERS, LOS ANGELES DISTRICT
PLANNING DIVISION, WATER RESOURCES BRANCH
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TABLE OF CONTENTS

Topic **Page**

I. INTRODUCTION 1
1.1 STUDY AREA AND GROUNDWATER MODELING AREA 1
1.2 PURPOSE OF THE STUDY 1

II. HYDROGEOLOGIC SETTING 1

III. HYDROLOGIC SYSTEM 2
3.1 PREDEVELOPMENT HYDROLOGIC SYSTEM 2
3.2 GROUNDWATER FLOW 2
3.3 STREAM RECHARGE 2
3.4 MOUNTAIN FRONT RECHARGE 2
3.5 EVAPOTRANSPIRATION 2
3.6 MODERN HYDROLOGIC SYSTEM 3
3.7 REGIONAL GROUNDWATER-LEVEL CONDITIONS 3
3.8 REGIONAL GROUNDWATER LEVEL CHANGES 3

IV. CURRENT GROUNDWATER CONDITION IN THE STUDY AREA 4

V. DEVELOPMENT OF A GROUNDWATER FLOW MODEL 4
5.1 MODEL GRID 5
5.2 MODEL LAYER AND AQUIFER CONDITION 5
5.3 BOUNDARY CONDITIONS 5
5.4 VERTICAL LEAKANCE 5
5.5 INITIAL WATER LEVEL 6
5.6 AQUIFER PARAMETERS 6
5.7 INITIAL MODEL SIMULATION 6

VI. SUMMARY 7

I. INTRODUCTION

1.1 STUDY AREA AND GROUNDWATER MODELING AREA

The U.S. Army Corps of Engineers (USACE) and the City of Phoenix (COP) have initiated a feasibility study for the Rio Salado Oeste Project to evaluate the design and completion of riparian habitat restoration along the Salt River in Phoenix area. The study area is located along the Salt River, in Phoenix, Arizona, between 19th Avenue and 83rd Avenue. The study area is located in between the authorized Rio Salado Project area and the authorized Tres Rios Project area. The Oeste study area is approximately eight river miles in length. In comparison, the authorized Phoenix reach of the Rio Salado project is five miles long and the Tres Rios study area is about seven miles long. Figure 1 shows the modeling area of the groundwater flow model study. The modeling area is bounded by 40th Street on the East, one mile from 115th Avenue on the West, one mile from Highway I-10 on the North, and Estrella Street on the South. As shown in the figure, the study area is in the central portion of the modeling area and is bounded by 19th Avenue, 83rd Avenue, Buckeye Road, and Baseline Road. The selection of a larger area for groundwater modeling is to avoid the effect from the boundary conditions to the study area.

1.2 PURPOSE OF THE GROUNDWATER MODELING TASK

The groundwater modeling task for this study includes a review of previous studies for the Salt River watershed, development of a site-specific groundwater flow model, and evaluation of project alternatives using the groundwater flow model. The regional groundwater flow model for the Salt River Valley developed by Arizona Department of Water Resources (ADWR) is reviewed and is adapted for the model development. Groundwater model is constructed and will be calibrated for baseline conditions. The developed model will be used to evaluate the impact to the local groundwater due to the selected alternatives.

II. HYDROGEOLOGICAL SETTING

The Rio Salado study area is located in the Phoenix Active Management Area (AMA) and is comprised of portions of two distinct but interconnected alluvial groundwater basins. These basins, West Salt River Valley (WSRV) and East Salt River Valley (ESRV), are shown on Figure 2.

The subsurface geologic conditions in the Salt River Valley (SRV) are described by the USBR (1976), the USGS (Laney and Hahn, 1986; Brown and Pool, 1989), and by ADWR (Corkhill, 1993). All three investigations divide the basin-fill sediments into three hydrogeologic units. However, the units have sometimes been defined differently. This report uses the most recent division of hydrogeologic units, as described by ADWR.

There are three hydrogeologic units: the lower alluvial unit (LAU), the Middle Alluvial Unit (MAU), and the Upper Alluvial Unit (UAU). There is also a Red Unit which forms the base of the aquifer beneath parts of the area. The LAU overlies the Red Unit and consists mainly of

conglomerate and gravel. The LAU is tapped by many city wells and it is estimated that approximately 25 percent of the pumpage in the SRV originates from this unit (ADWR, 1993). The LAU may be less than 100 feet thick near the basin margins and several thousands of feet thick in the central areas of the basins. The MAU overlies the LAU and consists mainly of clay, silt, mudstone and some sand and gravel. The unit ranges in thickness from 100 feet to over 1600 feet in the deeper parts of the basin. The MAU is now the primary source of groundwater in the valley. ADWR estimated that about one half of the total pumpage in the valley is from the MAU. The UAU overlies the MAU and consist primarily of gravel, sand and silt. The amount of coarse-grained deposits in this unit is highest near the Salt and Gila Rivers. The thickness of the UAU is relatively uniform and ranges from 200 to 300 feet thick in ESRV and between 300 and 400 feet thick in the WSRV. In the past, the UAU was the primary source of groundwater in the valley, but because of lower water levels (decreased groundwater elevations) and large areas of poor quality water, only about one fourth of groundwater pumped in the valley is from the UAU. Important sources of recharges to groundwater in the valley include infiltration of Salt River flows, mountain recharge along the McDowell and Superstition Mountains, percolation of excess irrigation water, and canal seepage. Figure 3 shows the Salt River Valley generalized geologic cross-section. The location of the cross-section is shown in Figure 2.

The UAU is divided into four subunits within the study area (URS, 2002). These subunits are designated from youngest to oldest as S, A, B, and C. These subunits appear to be essentially horizontal within the study area and no significant geologic structures have been identified.

- **Subunit S** is exposed at the surface near the river and consists of silty sand with clay and gravel. This unit is typically unsaturated in the vicinity of the Salt River.

- **Subunit A** is further subdivided into Subunits A_1 and A_2, and is generally comprised of sandy gravel and cobbles. Subunit A_1 extends to a depth of 90 to 110 feet below ground surface (bgs) and consists of unconsolidated, poorly sorted, coarse sand and gravel. The primary difference between A_1 and A_2 is that Subunit A_2 contains 30 to 40 percent fine to coarse sand versus 5 to 20 percent in Subunit A_1. In addition, Subunit A_2 is typically better sorted than A_1. The contact between these subunits is gradational and is identified by a transition from coarse to medium-sized gravel, increased roundness, and greater amounts of fine sand and silt (Dames & Moore, 1991). In the vicinity of the 19th Avenue Landfill Subunit A_1 was observed to be about 100 feet thick, and Subunit A_2 was observed to be about 90 feet thick.

- **Subunit B** underlies Subunit A_2 and is dominated by coarse to fine sand, silt, clay, and minor gravels. Subunit B is distinguished by its reddish-brown color and finer-grained nature. In the vicinity of the 19th Avenue Landfill Subunit B was observed to be about 40 feet thick.

- **Subunit C** underlies Subunit B and primarily consists of fine to medium sand, angular to subrounded fine gravel, minor silt, and clay. The transition from Subunit B to Subunit C is identified by an increase in grain size and a color change to brown. In the vicinity of the 19th Avenue Landfill Subunit C was observed to be about 150 feet thick.

III. HYDROLOGIC SYSTEM

3.1 PREDEVELOPMENT HYDROLOGIC SYSTEM

The predevelopment hydrologic system of the Salt River Valley is described by the ADWR. Prior to the arrival of non-Indian settlers in the 1860's and 1870's, the hydrologic system in the SRV was in a state of equilibirum. Flows into and out of the SRV were in approximate balance and water levels generally remained constant. The main components of the predevelopment groundwater budget were underflow, stream channel infiltration, mountain front recharge, and evapotranspiration. An approximate predevelopment groundwater budget is presented in Table 1 and the components are described below.

3.2 GROUNDWATER FLOW

In general, groundwater moved east to west through the SRV. Most of the Salt River Valley groundwater moved in a direction towards the lower topographic areas. Substantial groundwater flow underflow moved northwestward along the Gila River and passed through the gap between the South Mountain and the Sierra Estrella.

3.3 STREAM RECHARGE

Prior to development of the valley and construction of upstream reservoirs, the Salt and Gila Rivers were perennial throughout the SRV. The rivers were significant sources of groundwater recharge in some areas and recipients of groundwater discharge in other areas. The reaches of the river can be classified as losing or gaining. The rivers 'lose' water where the groundwater table elevation is lower than the water level in the river channel. Similiarly, the river 'gains' when groundwater is discharged into the river, where the water table is higher than the water level in the channel. ADWR estimated the total recharge from the Agua Fria River, Cave Creek, New River, Skunk Creek, and Queen Creek to be about 20,000 acre-feet per year.

3.4 MOUNTAIN FRONT DISCHARGE

Mountain-front recharge is water that infiltrates into the alluvial material along the interface between mountains and the alluvial groundwater basin. The amount of mountain-front recharge depends on average precipitation. The ADWR estimated that mountain-front recharge in the SRV is only significant along the McDowell and Superstition Mountains.

3.5 EVAPOTRANSPIRATION

Under predevelopment conditions, ADWR identified evapotranspiration as the major source of discharge from the groundwater system in the SRV. Evapotranspiration is the process of evaporation from water surfaces and moist soil and transpiration from vegetation. During the predevelopment period, there were approximately 48,000 acres of phreatophytes along the Salt and Gila Rivers. ADWR used an evapotranspiration rate of 1.6 acre-feet per acre per year to estimate a loss of 76,000 acre-feet per year.

3.6 MODERN HYDROLOGIC SYSTEM

Irrigation was originally developed by diversion of streamflow into canals. By the turn of the century, much of the valley was waterlogged, due to recharge from canal seepage and deep percolation, combined with a lack of groundwater pumping. Beginning in the 1920's and 1930's, substantial groundwater pumpage began for irrigation and to control shallow groundwater levels. Following World War II, extensive pumpage began, primarily for irrigation. This resulted in extensive groundwater overdraft. With the advent of the State Groundwater Management Act, the extent of overdraft has been curtailed through management procedures such as decreased irrigation pumpage, water conservation pratices, and irrigational recharge projects. By the late 1980's, water levels within the Salt River Project had essentially stabilized. Continuing overdraft was present, however, in some off-project areas.

3.7 REGIONAL STATIC GROUNDWATER-LEVEL CONDITIONS

ADWR published "Maps Showing Groundwater Conditions in the Phoenix Active Management Area" in July 1995. The detailed groundwater survey of fall and winter 1991-92 was the first one in which water levels in wells were measured in all seven sub-basins of the Phoenix Active Management Area at about the same time. The vast majority of the more than 2,000 measurements were made during November 1991. Field work continued intermittently in the area through January 1992 in order to obtain additional data to provide acceptable coverage.

On the regional scale groundwater is generally moving laterally toward extensive and deep depressions in some of the main aquifer systems. In the East Salt River sub-basin, major groundwater depressions are centered in the Scottsdale-Paradise Valley area, in east Mesa, and north of the Santan Mountains. A depression in the vicinity of the community of Maricopa in the Pinal Active Management Area is apparently diverting groundwater from the southern part of the East Salt River sub-basin near the Gila River.

Significant water-level or head differences exist in proximate wells within some of the main aquifer systems. During the 1991-92 measurement period, differences exceed 25 ft in several places, and exceeded 400 ft in a small area north of the Santan Mountains in the East Salt River sub-basin. The major areas of these differences are located in the East Salt River sub-basin, and extend from north Scottsdale to south Chandler to the southeast part of the sub-basin. They are separated by the Salt River. Presumably, the higher water levels are mostly the result of fine-grained deposits in the upper basin fill which inhibit downward movement of water. Much of these areas corresponds to areas described as having perched groundwater in the upper unit by Laney and Hahn (1986), and to a regional perched zone described by Schmidt based on work done by the U.S. Bureau of Reclamation and the U.S. Geological Survey in 1972 (1981).

3.8 REGIONAL GROUNDWATER-LEVEL CHANGES

For the time periods extending from the detailed water-level surveys of fall and winter 1981-82 and 1982-83 to that of fall and winter 1991-92, data indicate there were general rises in water

levels in the study area. During the respective periods, pumpage was reduced compared to the recent past, and abundant surface water was available in many areas, with much of this surface water becoming incidental recharge. Measurements in 1991-92 were made in approximately 1,150 wells that had also been measured in the earlier survey. Of these, only about 100 wells exhibited declines in water levels during the respective periods.

In the main aquifer system, water level rises of 50 feet or more occurred in many wells in all of the major groundwater depressions mentioned in the previous section except in the south portion of the Hassayampa sub-basin, where maximum rises of about 20 feet occurred over the respective time period. The rises in all of these groundwater depressions were probably due primarily to the combined effect of reduced pumping and migration of groundwater from adjacent areas.

In general, water levels declined during the period in much of the areas near the Salt, Gila, and Agua Fria Rivers in the West Salt River sub-basin. The declines were generally less than 25 feet. An explanation for at least part of these declines could be that when the survey was conducted in 1982-83, water levels near these rivers were still elevated due to the especially large flood flows that began in late 1978 and continued off and on through 1981. Part of the rises in areas adjacent to areas of decline might be explained by lateral groundwater movement away from the rivers, where the groundwater had been introduced as recharge during the flood flows. Similarly, this type of process may explain part of the declines and rises in the vicinity of the Town of Queen Creek, near the course of Queen Creek itself, in the East Salt River sub-basin.

III. CURRENT GROUNDWATER CONDITION IN THE STUDY AREA

URS (April 2002) conducted a groundwater quality and hydrogeology study for the Rio Salado Oeste Project. The current groundwater condition in the study area was presented in the URS study report. According to the URS report, groundwater generally occurs under unconfined conditions within the 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 RID well field located along or north of Lower Buckeye Road between 19th and 35th Avenue. 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 RID wellfield. 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 (Figure 4). 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).

IV. DEVELOPMENT OF A GROUNDWATER FLOW MODEL

The Arizona Department of Water Resources (ADWR) has developed a regional groundwater flow model of the Salt River Valley. The goal of the SRV groundwater modeling effort is to provide an analytical tool capable of quantifying the effects of various groundwater management and conservation scenarios on the groundwater supplies within the study area. The SRV groundwater model uses 3D-MODFLOW and has been calibrated under steady state and transient conditions. Based on the SRV groundwater model, a site-specific model along the Rio Salado Oeste study area was developed to assist in the wetland restoration, groundwater infiltration, and drawdown analysis. General model characteristics are presented in this section below.

5.1 MODEL GRID

The site specific model grid is 100 rows by 190 columns, with 3 layers and is aligned with the local baseline and meridian. The north and south boundaries of the model are one mile north of Mc Dowell Road and Estrella Road respectively, while the east and west boundaries are 40th Street and one mile west of 115th Avenue. Model cells are one-tenth mile in length and width. Each model layer corresponds to a single hydrogeologic unit. The active model domain encompasses 190 square miles. Figure 5 presents the model grid.

5.2 MODEL LAYER AND AQUIFER CONDITIONS

Three model layers were used to represent the hydrogeologic system. The uppermost layer, Layer 1, corresponds to the Upper Alluvial Unit (UAU). The UAU is modeled as an unconfined aquifer. The middle layer, Layer 2, corresponds to the Middle Alluvial Unit (MAU). The MAU is modeled as a confined/unconfined aquifer, confined when the overlying UAU is saturated and unconfined when the UAU is dewatered. The bottom layer, Layer 3, corresponds to the Lower Alluvial Unit (LAU). The LAU is also modeled as a confined/unconfined aquifer, confined

when the overlying MAU is saturated and unconfined when the MAU is dewatered. The thickness of each model layer is defined by the elevation of each hydrogeologic unit contact.

5.3 BOUNDARY CONDITIONS

The selection of proper model boundary cell types is essential to the accuracy of the model. Boundary cells define the hydrologic conditions along the model borders. General-Head boundaries were applied in this model. The function of the General-Head Boundary Package is mathematically similar to that of the River, Drain, or ET Packages of the MODFLOW model. In the General-Head boundaries, flow into or out of a cell i,j,k, from an external source is provided in proportion to the difference between the head in the cell, $h_{i,j,k}$, and the head assigned to the external source, $H_{i,j,k}$.

5.4 VERTICAL LEAKANCE

The vertical leakance between Layers 1 and 2, and between Layers 2 and 3 was modeled using the VCONT option. MODFLOW requires VCONT to be calculated independently, and input as an array in the Block Centered File (BCF) package. VCONT was calculated by the following equation:

$$VCONT_{1-2} = 1 / (V_1/2K_{v1} + V_2/2K_{v2})$$

Where:

$VCONT_{1-2}$: Vertical leakance between Layers 1 and 2
V_1 : Saturated thickness of Layer 1 (feet)
V_2 : Saturated thickness of Layer 2 (feet)
K_{v1} : Vertical hydraulic conductivity of Layer 1 (feet/day)
K_{v2} : Vertical hydraulic conductivity of Layer 2 (feet/day)
Units : 1/day

The final calibrated ratios of horizontal hydraulic conductivity for Layers 1, 2, and 3 are given below.

Layer 1 Horizontal:Vertical K ratio = 20:1
Layer 2 Horizontal:Vertical K ratio = 100:1
Layer 3 Horizontal:Vertical K ratio = 50:1

5.5 INITIAL WATER LEVEL

The water-level data for the steady-state model simulation was adapted mainly from the depth to water map constructed by Lee (1905), and predevelopment water level maps constructed by Anderson (1968), and by Thomsen and Baldys (1985). The selected water level contours were then digitized and introduced into the model. After introduced into the model, the water levels were further adjusted to the current water levels based on a few measured water levels.

5.6 AQUIFER PARAMETERS

Initial hydraulic conductivity (K) estimates were developed using aquifer test data from groundwater contamination site studies, specific capacity data from GWSI and other sources, and recovery test data from the Salt River Project (SRP). Hydraulic conductivity values of all model layers were adjusted during the calibration of the steady-state model.

5.7 INITIAL MODEL SIMULATION

Model simulation runs were conducted for initial simulations with the COE's Groundwater Modeling System (GMS). Model runs were converged successfully. Figure 6 shows a test run result. Simulated groundwater contours for the modeling area are shown in the figure. The red line enclosed the modeling area is the general-head boundary. The model grids outside the boundary are inactive grids. Further model runs will be conducted to simulate the known static groundwater condition to complete the model calibration.

IV. SUMMARY

The Phoenix Rio Salado Project Report prepared by COE (April, 1998), ADWR Modeling Report No. 6 and No. 8 (A Regional Groundwater Flow Model of the Salt River Valley Phase I and Phase II), and Groundwater Quality and Hydrogeology Report by URS (April, 2002) were reviewed and applied for this study. A site-specific groundwater flow model was developed based on the regional groundwater flow model developed by ADWR. The project site groundwater condition and hydrogeologic data presented by URS were used for the model development. Initial model simulation runs were conducted for the without project condition.

TABLE 1, ESTIMATED PREDEVELOPMENT GROUNDWATER BUDGET FOR SRV

Source of Inflow to SRV	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

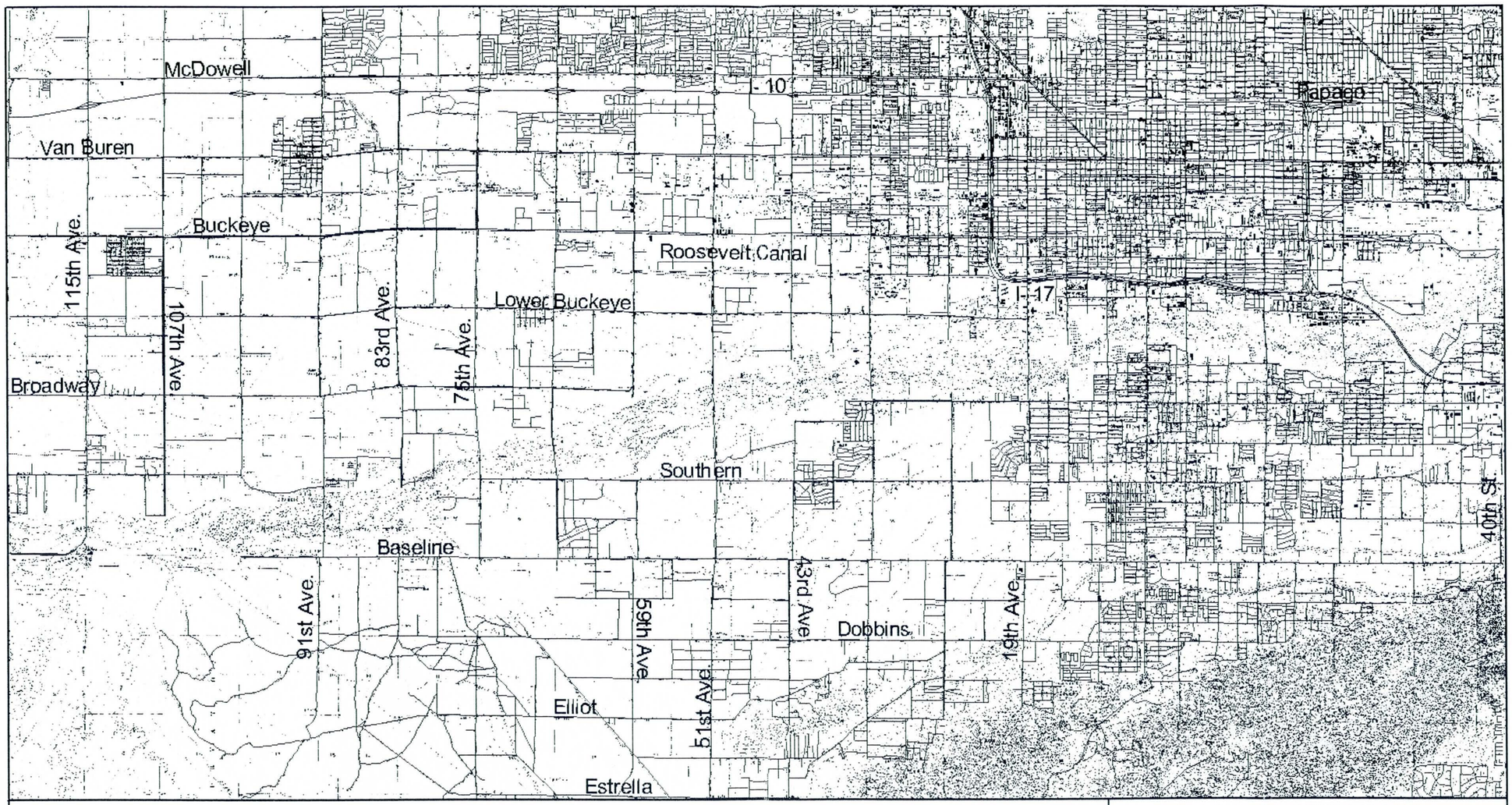
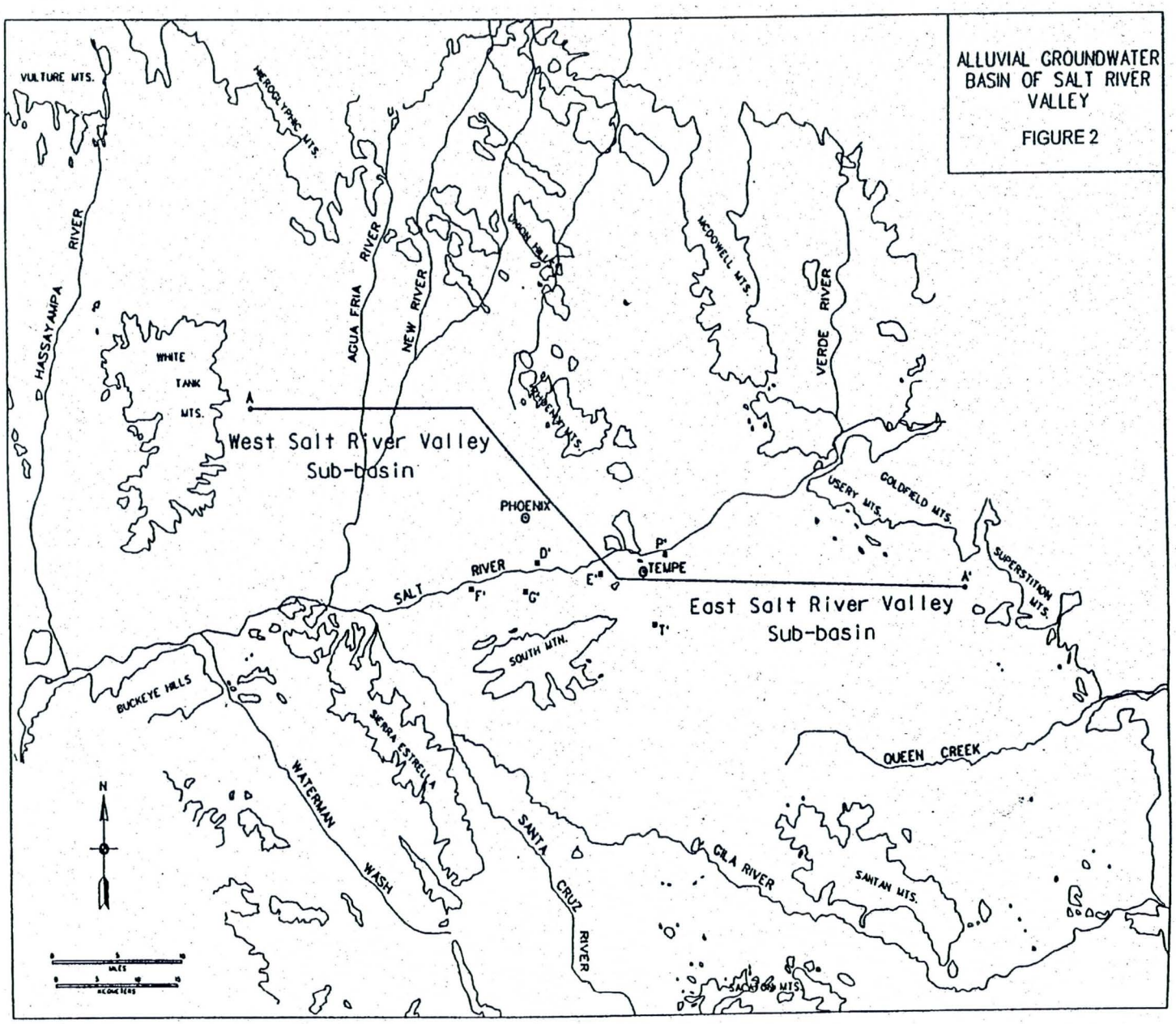


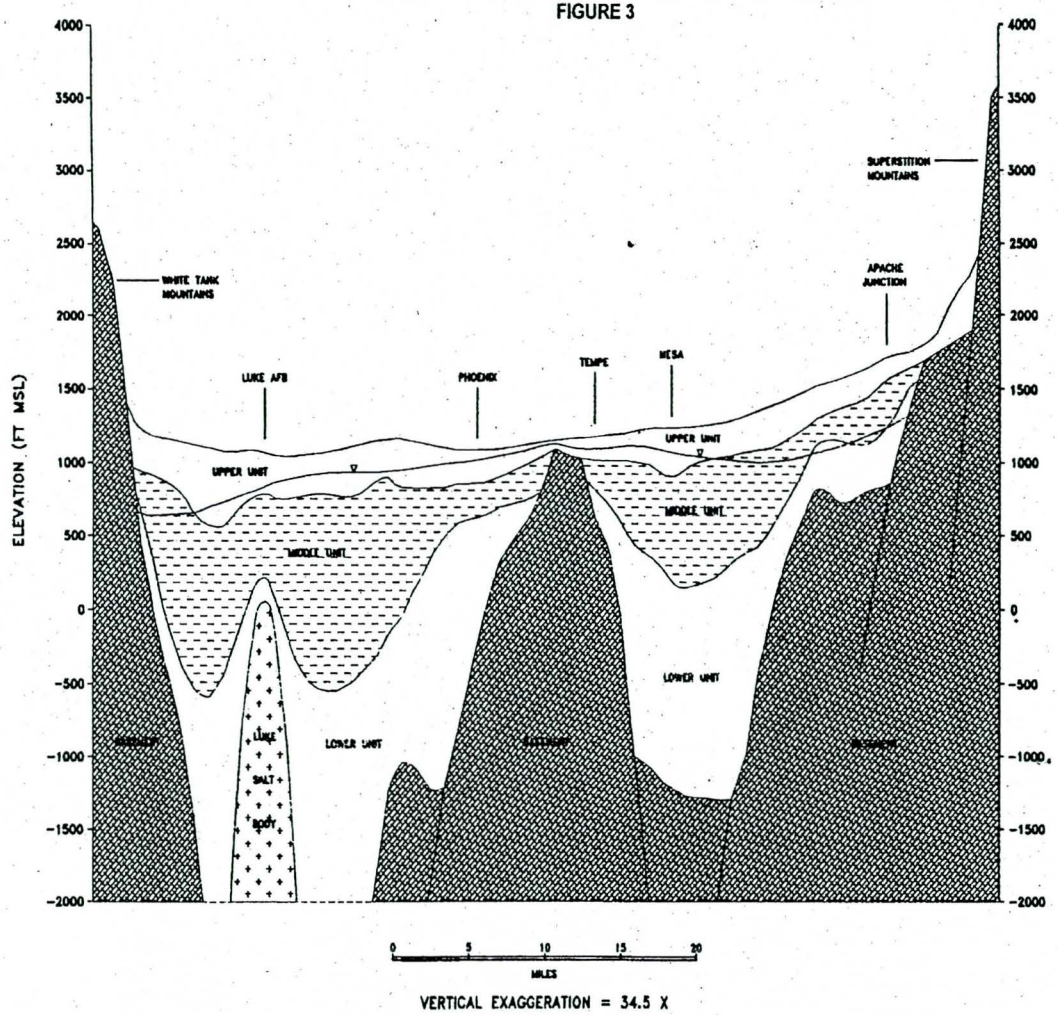
FIGURE 1 GROUNDWATER FLOW MODEL - MODELING AREA

RIO SALADO OESTE STUDY
SALT RIVER
PHOENIX, ARIZONA

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT


ALLUVIAL GROUNDWATER BASIN OF SALT RIVER VALLEY
FIGURE 2
VULTURE MTS.
HASSAYAMPA RIVER
HIEROGLYPHIC MTS.
AGUA FRIA RIVER
NEW RIVER
WHITE TANK MTS.
West Salt River Valley Sub-basin
PHOENIX
TEMPE
SALT RIVER
McDOWELL MTS.
VERDE RIVER
USERY MTS.
GOLDFIELD MTS.
SUPERSTITION MTS.
East Salt River Valley Sub-basin
SOUTH MTN.
BUCKEYE HILLS
SIERRA ESTRELLA
WATERMAN WASH
SANTA CRUZ RIVER
QUEEN CREEK
GILA RIVER
SANTAN MTS.
SACATON MTS.
A
A'
D'
E'
F'
G'
P'
T'
N

SALT RIVER VALLEY GENERALIZED GEOLOGIC CROSS SECTION
FIGURE 3



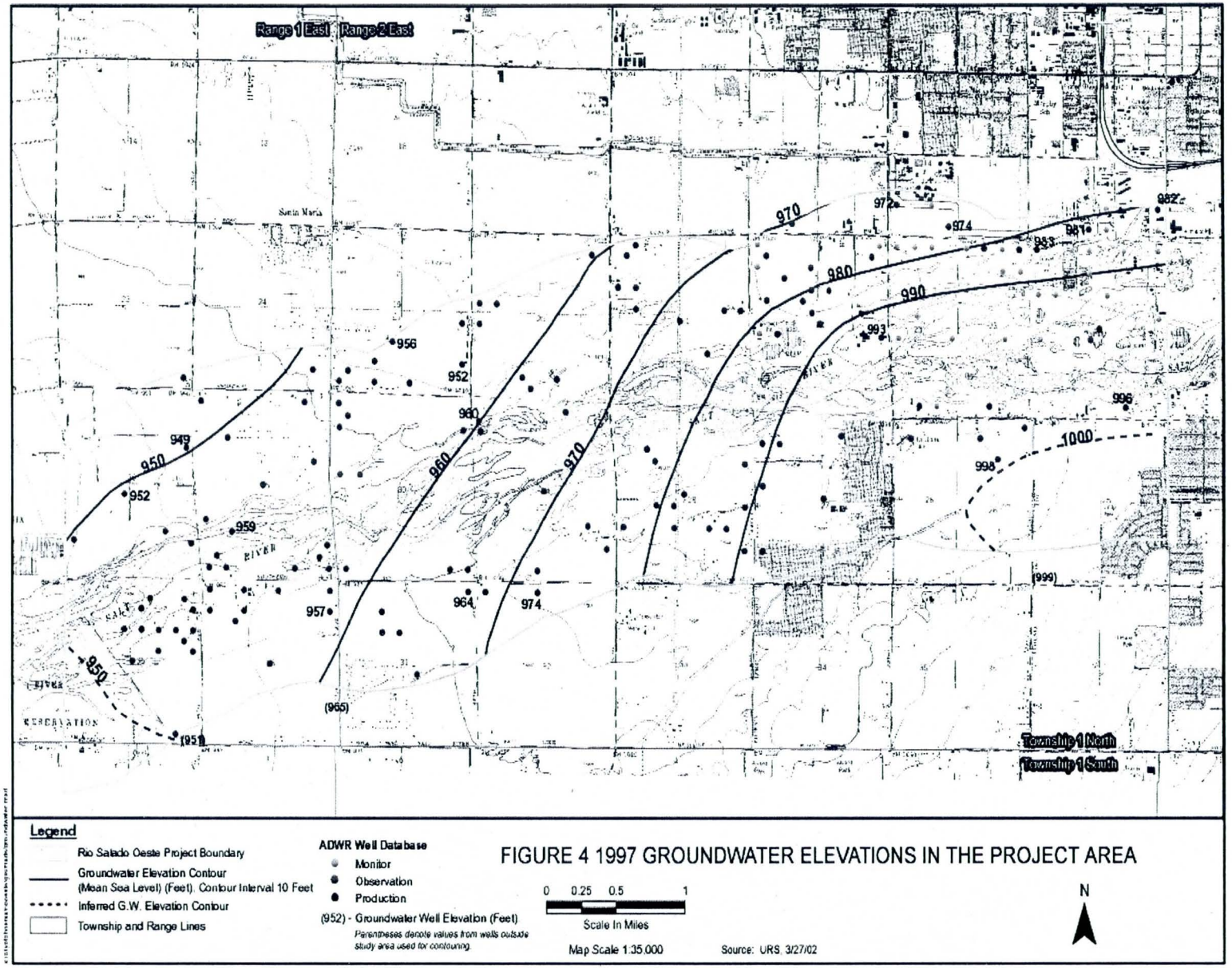


FIGURE 4 1997 GROUNDWATER ELEVATIONS IN THE PROJECT AREA

US Army Corps of Engineers
Los Angeles District

RIO SALADO OESTE
F4 MILESTONE
Salt River-Phoenix, Arizona

Appendix D
Groundwater Quality
and
Hydrogeology Report

March 2005

U.S. ARMY CORPS OF ENGINEERS, LOS ANGELES DISTRICT
PLANNING DIVISION, WATER RESOURCES BRANCH
P.O. BOX 532711
LOS ANGELES, CALIFORNIA 90053-2325

GROUNDWATER QUALITY AND HYDROGEOLOGY REPORT RIO SALADO OESTE PROJECT PHOENIX, ARIZONA

Prepared for
THE CITY OF PHOENIX

URS Job No. E1-00001727.15
April 1, 2002

April 1, 2002

Mr. Blane Work
City of Phoenix
200 West Washington Street
Phoenix, Arizona 85003-1611

Re: Draft Report
Groundwater Quality and Hydrogeology Report
Rio Salado Oeste Project
Phoenix, Arizona
URS Job No. E1-00001727.15

Dear Mr. Work:

Enclosed with this letter is the draft report for the groundwater quality and hydrogeology report for the Rio Salado Oeste project. This report was prepared for the City of Phoenix in accordance with the scope of work presented in our proposal dated February 14, 2002.

We appreciate the opportunity to provide these services. Please call either of us at (602) 371-1100 if you have any questions regarding the content of this report.

Sincerely,

URS

Gary M. Gin
Project Geoscientist

David P. Palmer, R.G.
Project Geologist

GMG/DPP/tc

TABLE OF CONTENTS

		Page
1.0	INTRODUCTION	1-1
2.0	SCOPE OF WORK	2-1
3.0	DATA COLLECTION AND COMPILATION METHODS	3-1
3.1	DATA SOURCES	3-1
3.2	WELL DATA PROCESSING AND REPORTING	3-2
4.0	STUDY RESULTS	4-1
4.1	SITE DESCRIPTION	4-1
4.2	LAND USE	4-1
4.3	SURFACE WATER	4-2
4.3.1	Information Sources	4-2
4.3.1.1	Field Data	4-2
4.3.1.2	Databases	4-4
4.3.2	Water Quality Standards	4-5
4.3.2.1	Designated Uses	4-6
4.3.2.2	Numeric Surface Water Quality Standards	4-6
4.3.2.3	Narrative Surface Water Quality Standards	4-6
4.3.3	Water Quality Summary	4-6
4.3.3.1	Surface Water Sources	4-7
4.3.3.2	Storm Water Data	4-8
4.3.3.3	Numeric Surface Water Quality Criteria Summary	4-9
4.3.3.4	Narrative Surface Water Quality Criteria Summary	4-10
4.3.4	Data Gaps	4-10
4.4	HYDROGEOLOGY	4-11
4.4.1	Geologic Setting	4-11
4.4.2	Hydrogeology and Aquifer Properties	4-12
4.4.3	Depth to Water and Groundwater Gradient	4-14
4.5	GROUNDWATER QUALITY	4-15
4.6	AREAS WITH GROUNDWATER QUALITY CONCERNS	4-16
4.6.1	WQARF/NPL Sites	4-16
4.6.2	Landfills	4-17
4.6.3	Waste Water Treatment Plants	4-18
4.6.4	Leaking Underground Storage Tank Sites	4-18

5.0 CONCLUSIONS 5-1

6.0 REFERENCES 6-1

LIST OF TABLES

4.4.2 Aquifer Properties of the Upper Alluvial Unit

LIST OF FIGURES

1 Existing Land Use
2 Surface Water Features and Sampling Locations
3 Selected Hydrographs in the Rio Salado Oeste Study Area
4 1997 Static Groundwater Elevations
5 Conductivity and Nitrate Concentrations
6 Sites with Groundwater Concerns

LIST OF APPENDICES

A Well Inventory Reports

1.0 INTRODUCTION

The U.S. Army Corp of Engineers (USACE) and the City of Phoenix (COP) have initiated a feasibility study for the Rio Salado Oeste Project (Oeste Project) to evaluate the design and completion of a riparian habitat restoration project. The Oeste Project lies within the Salt River between 19th Avenue on the east and 83rd Avenue on the west. The north and south boundaries are designated to be Durango Street and Southern Avenue, respectively, for the eastern portion; and Broadway Road and Baseline Road, respectively, for the western portion. As part of the feasibility study, the USACE and COP are assessing the various water sources and potential locations and design for the production and monitor wells for the project.

The purpose of this report is to evaluate the existing groundwater and surface water quality, describe the hydrogeology of the project area, and provide information about existing monitor and production wells in tabular format. The hydrogeologic and groundwater data will be used to facilitate the design specifications and future siting of monitor and production wells in the project area.

2.0 SCOPE OF WORK

The scope of work for this project was developed by the COP and during meetings with the USACE. To meet the objectives of this project URS's scope of work included the following tasks:

1. **Provide a Base Map of the Project Area.** URS was tasked to update and delineate the project boundary, major roads, major geographic features, streams, storm water drainages, and existing land use. Major roads and geographic features were derived from URS archives of existing data. Existing land use data were inventoried at 1:35,000 scale. The land use inventory effort resulted in polygon coverage with the following categories: residential, commercial/industrial, landfill, sand/gravel operation, agricultural, recreational, and river bottom/native.

2. **Review "Phase 2 Middle Gila Watershed Study Final Report".** Using the "Phase 2 Middle Gila Watershed Study Final Report" (Phase 2 Report) prepared by Greeley and Hanson (2001), URS provided a general description of the surface water quality in the project area. URS conducted a cursory field reconnaissance along the Salt River to identify discharges of effluent, irrigation return flows, and storm water drainage. The locations of these features were provided on the project base map. Assessing the surface water quality along the Salt River was conducted by researching databases from the COP, U.S. Geological Survey (USGS), U.S. Environmental Protection Agency (EPA) Storage and Retrieval system *STORET,* and Salt River Project (SRP).

3. **Review and Identify Existing Public Records.** This task was to provide a general description of the groundwater chemistry and assess whether water quality should be considered in siting production wells along the Salt River. To accomplish this task, we researched records and files at the Arizona Department of Environmental Quality (ADEQ) and the Arizona Department of Water Resources (ADWR) on existing wells and groundwater investigations. Using the modified base map prepared in Task 1, URS delineated areas of groundwater environmental contamination and identified the potential extent of groundwater contamination where it can be inferred from the available data. URS also delineated areas of high Total Dissolved Solids (TDS), based on conductivity measurements, and nitrate contamination in groundwater, on the project base map.

4. **Describe the Hydrogeology of the Oeste Project.** URS provided a general description of the regional hydrogeology of the project area. We researched available well records,

groundwater modeling reports at ADWR, and the Roosevelt Irrigation District (RID). With the available data, URS calculated and estimated aquifer hydraulic properties such as groundwater gradient, hydraulic conductivity, transmissivity, and storativity. The aquifer property data will be used to provide recommendations for the design specifications and siting for future production wells and monitor wells.

5. **Preparation of the Well Inventory Report.** This task was subdivided into several subtasks and included the following: extraction of ADWR well records, research and compilation of records, database design and form generation, database population, and generation of tabular well inventory reports. The well inventory report tables will be used to facilitate future siting of production and monitor wells for the Oeste Project.

Once this groundwater and hydrogeologic report is completed and finalized, URS will provide a letter report that will provide recommendations on the siting criteria and design specifications for the monitor and production wells that will be required for the habitat restoration project.

3.0 DATA COLLECTION AND COMPILATION METHODS

3.1 DATA SOURCES

URS queried the following databases for groundwater quality, surface water quality, and aquifer properties:

- 1999 and 2002 ADWR well registry database
- ADEQ Water Quality database as of March 2002
- 2002 ADWR Groundwater Site Inventory (GWSI) database
- ADWR Imaged Records database as of March 2002
- EPA *STORET* as of March 2002
- USGS National Water Information System (NWIS) database as of March 2002.

URS collected the following reports to summarize the land use issues, hydrogeology, groundwater quality, and surface water quality of the project area:

- Phase 2 Middle Gila Watershed Study Final Report (Greeley and Hanson, 2001a)
- Salt/Gila Groundwater Analysis Project Summary Report (Greeley and Hansen, 2001b)
- Tres Rios Hydrologic Model Development and Applications Report (Water & Environmental Systems Technology, 2000)
- Del Rio Landfill Report (Dames & Moore, 1991)
- Groundwater Quality Survey, Rio Salado Habitat Restoration Project (Dames & Moore, 1997)
- Draft Well Installation and Data Analysis of Rio Salado Production Well (RSPW-2) (URS, 2002).

URS collected data pertaining to well production capacity, groundwater quality, and surface water features from the various sources:

- SRP
- RID
- Peninsula-Horowitz Irrigation District (P&H)
- COP 23rd Avenue Waste Water Treatment Plant (23rd Avenue WWTP) and 27th Avenue Landfill
- ADEQ Leaking Underground Storage Tank (LUST) files
- Personnel communications with various landowners.

3.2 WELL DATA PROCESSING AND REPORTING

Initially, URS created a suitable reporting format for the well inventory reports, and submitted it to the COP and USACE for approval. Once the format was approved, URS contacted and obtained public files from sources such as the ADWR, ADEQ, COP, SRP, RID, and several private entities, which own wells in the project area. URS then utilized Microsoft Access 2000 to design a relational database with four tables (Sites, Well_Construction, Water_Levels, and Surface_Water_Quality). The compiled electronic as well as hard copy data were then entered into the database. With the database design and population accomplished, URS employed the four (4) tabular reports: Table 1 – Well Locations, Table 2 – Well Construction, Table 3 – Water Levels, and Table 4 – Surface Water Quality. These reports are provided in Appendix A.

4.0 STUDY RESULTS

4.1 SITE DESCRIPTION

The project site is located within the Salt River between 19th Avenue on the east and 83rd Avenue on the west in Phoenix, Maricopa County, Arizona. The north and south study boundaries are located between approximately Durango Street and Southern Avenue for the eastern portion, and Broadway Road and Baseline Road for the western portion. Specifically, the northern and southern boundaries were defined by including all areas between 19th and 83rd Avenues that are within one mile of any segment of the Salt River centerline (Figure 1).

4.2 LAND USE

Land use within the study area was classified into the following seven categories: Residential, Commercial/Industrial, Landfill, Sand/Gravel Operation, Agricultural, Recreational (i.e. public parks), and River Bottom/Native (Figure 1). The project study area was divided into four separate portions of land based on the dominant types of uses; 19th - 35th Avenues, 35th - 51st Avenues, 51st - 67th Avenues, and 67th - 83rd Avenues (Figure 1).

- **19th - 35th Avenues** Sand and gravel operations line the Salt River with no remaining native river bottom. Commercial/industrial properties dominate both north and south of the river with about equal portions of agricultural and sand and gravel operations making up most of the balance

- **35th - 51st Avenues** Major sand and gravel operations exist in and along the Salt River. Almost half the river has remained undisturbed and is designated as native. Large areas of commercial/industrial properties exist primarily north of the river, gravel operations are present along the river, and residential properties are present south of the river

- **51st - 67th Avenues** Sand and gravel operations are present in and along a large portion of the Salt River. Almost half the river has remained undisturbed and is designated as native. Although there are small pockets of residential land north and south of the river, the majority of land is utilized for agricultural purposes

- **67th - 83rd Avenues** Sand and gravel operations are present in and along some areas of the Salt River with a small portion remaining undisturbed. Few commercial/industrial properties are present. While there is a small pocket of residential land north of the river, the majority of land is utilized for agricultural purposes.

4.3 SURFACE WATER

The purpose of this task was to evaluate the data compiled during the Phase 2 Report by Greeley and Hansen (2001) and review that database to identify only those data that are applicable to the Oeste Project area. These data, as well as newly compiled data, were then used to describe the surface water quality within the Oeste Project area and delineate surface water chemical constituents that exceed the Arizona Administrative Code, Title 18, Chapter 11, § 109 A Appendix A, Numeric Water Quality Criteria, September 30, 1996 (A.A.C. R18-11-109.A Appendix A).

4.3.1 Information Sources

Compiling information to provide a general overview of the surface water quality within the Oeste Project area involved three distinct steps. The first step was to conduct cursory field reconnaissance to correlate field data and surface water sources identified within the Phase 2 Report with current project area site conditions, attributes, and narrative water quality standards. Field reconnaissance was conducted on five separate days from March 1 through March 8, 2002. This reconnaissance primarily focused on identifying surface water features, discharge points, and making observations relative to applicable surface water quality narrative standards. In addition, the field work identified commercial and industrial activities that may have the ability to impact surface water quality in the study area.

The second step involved the review of available databases from recognized sources to compile the most recent numeric surface water quality data. Data for the study area were extracted from the Phase 2 Report as well as from those sources known to collect surface water quality data. These additional sources of data include the COP, SRP, ADEQ, ADWR, EPA, and the USGS. All of these sources were able to provide surface water quality data, but not all data were applicable to the Oeste Project area.

The last step in data compilation was to describe the surface water quality within the study area by comparing available surface water quality sample data and field observations with numeric and narrative surface water quality standards, respectively.

4.3.1.1 Field Data

Field reconnaissance was conducted over a period of five days by a two-person field crew. Based on this work, it was concluded that the information presented within the Phase 2 Report was accurate and complete with regard to outfall locations, storm water sampling locations and

commercial and industrial activities. Observations relative to narrative surface water quality standards were also completed.

URS field personnel confirmed that there are a limited number of point-source outfalls impacting the Oeste Project area. These outfalls include the National Pollutant Discharge Elimination System (NPDES) permitted outfalls associated with the 23rd Avenue WWTP operated by the COP. In addition, several point-source, stormwater outfalls were identified and confirmed to be the same as those identified within the Phase 2 Report. A map of surface water features is presented in Figure 2.

It is suspected that there are additional connections to the point-source, stormwater outfalls. These connections are associated with the various canal systems. Irrigation district maps acquired from SRP show irrigation district connections to storm drains at 19th, 27th, 35th, 43rd, and 51st Avenues along the north and south sides of the Salt River. It would require a comprehensive field effort to obtain the necessary authorizations to enter private property and survey the entire project area to identify and assess the extent of these connections. Therefore, although these irrigation-impacted outfalls have been identified, the extent of those connections to the outfalls have not been identified within the scope of this project.

Second, it was confirmed that there is a variety of commercial and industrial activities having the ability to impact the project area via non-point source storm water run-off. Along the south side of the Salt River from 19th Avenue to 43rd Avenue, the land use was predominantly auto-wrecking yards and construction lay-down areas, which can be expected to contribute to the contamination of storm water run-off. The north side of the river was impacted by a larger percentage of commercial and industrial activity between 19th and 43rd Avenues, including the COP transfer station and landfill at 27th Avenue. These sources can be expected to introduce metals, grease, oils and organic contaminants via storm water run-off. Residential impact was minimal. Although a significant amount of agricultural activity was present, most of this activity was not adjacent to the river, but was located along the study area borders. At approximately 51st Avenue, the primary commercial and industrial impact activity transitioned to agricultural use. Sand and gravel mining activities have a significant presence within the Salt River channel. Dewatering from the mining activities has resulted in established riparian segments, although these water features do not meet the ADEQ definition of "surface water" in accordance with A.A.C. R18-11-109.A. Thus, given the variety of commercial and industrial impact activities described above, it is apparent that non-point source storm water run-off has the potential to impact storm water and, thus, surface water quality in the study area. The only exception to this was the COP 27th Avenue Landfill, which has on-site stormwater retention ponds.

Lastly, it was determined that data gaps exist with regard to the quality and impact of irrigation return flows. SRP, RID, and P&H were contacted for available surface water quality information, but they either did not have surface water quality data or they did not have information from within the study area boundaries. SRP did indicate that the return flow networks are complex and the discharge of water empties to multiple sites (personal communication with Gregg Elliott of SRP, March 13, 2002). SRP also indicated that during the early 1980s many former agricultural sites were developed for commercial/industrial use and, in some cases, the canal systems were not removed or disconnected. As a result, storm water from these developed areas would enter the canal system and eventually discharge into the Salt River during a storm event (personal communication with Gregg Elliott of SRP, March 13, 2002). Analysis of canal maps provided by SRP indicates that storm drain connections are present throughout the canal system along the perimeter of the entire project area.

4.3.1.2 Databases

Three databases contained water quality data applicable to the Salt River project area. These databases were part of the original Phase 2 Report and were obtained from:

- EPA STORET,
- SRP, and
- COP.

Several other sources of data were queried for surface water quality data. These sources of data included USGS, ADWR, ADEQ, RID, SRP and P&H. However, surface water quality data from these sources were either: (1) not available, (2) not within the site area boundaries, (3) never delivered from the source, or (4) reported in a format that could not be directly compared to the ADEQ surface water quality standards[1].

EPA STORET

The EPA STORET database is a repository for water quality, biological, and physical data and is used by a variety of local, state and federal agencies. The EPA maintains two data management systems containing water quality information: the Legacy Data Center (LDC) and STORET. The LDC contains historical water quality data from the early part of the 20th Century to the end of

[1] The USGS database reported values to be "less than" a certain quantity. These data could not be directly compared to the ADEQ value to determine if the USGS value exceeded the ADEQ criteria value.

1998. STORET contains data collected beginning in 1999 to the present. Both databases were queried for data applicable to the study area. STORET did contain surface water quality data, but it did not contain any Arizona data from 1997 forward.

SRP

SRP provided flow volume data for the Maricopa Drain, an irrigation drain that discharges to the Salt River in the vicinity of 77th Avenue (Figure 2). Although SRP had previously supplied some surface water quality data for the Phase 2 Report, it was not able to provide any additional surface water quality data for inclusion in this report.

COP

COP provided storm water sampling data and river sampling information as part of the Phase 2 Report. River sampling information pertained to the discharge of the 23rd Avenue WWTP to the Salt River. The data collected by the COP were in response to NPDES permit requirements for both point-source outfalls associated with the 23rd Avenue WWTP and for non-point source impacts (storm water).

4.3.2 Water Quality Standards

Surface water quality standards are comprised of designated uses, associated numeric water quality criteria, and narrative standards. The numeric water quality criteria are established to protect the designated use(s) of the specific reach of a river system, while the narrative standards are to protect all surface waters. Both the designated use and the numeric criteria are prescribed by the ADEQ in accordance with A.A.C. R18-11-109.A Appendix A, and the narrative standards are prescribed in A.A.C. R18-11-108.A and B.

It should be noted that ADEQ is in the process of updating various water quality standards and this update may impact surface water quality standards (personal communication with Samuel Rector of ADEQ, March 2002). Presently, ADEQ has adopted new standards and, although these standards have not been reviewed and approved by the EPA (and thus are not yet applicable as NPDES permit standards), they are considered to be the applicable water quality standards within Arizona. However, a current listing of the revised standards was not yet available from ADEQ. Therefore, those ADEQ numeric standards that have been in effect since 1996 were used in the surface water quality analysis presented herein.

4.3.2.1 Designated Uses

ADEQ separates rivers into specific reaches for the purpose of assigning designated uses. The study area discussed in this report includes Reaches 4 and 5 along the Salt River. Reach 4 extends from the Interstate-10 Bridge at the Salt River to the 23rd Avenue WWTP. Reach 5 extends from the 23rd Avenue WWTP past the 83rd Avenue study area boundary (at the confluence of the Salt and Gila Rivers).

The current associated designated uses for the Salt River (Reaches 4 and 5) are as follows:

- Reach 4 – designated for aquatic life and wildlife – warm water (A&W w), partial body contact – recreation (PBC), and fish consumption (FC)
- Reach 5 – designated for aquatic life and wildlife – effluent dependent water (A&W edw), partial body contact – recreation (PBC), fish consumption (FC), agricultural irrigation (AgI), and agricultural livestock watering (AgL).

4.3.2.2 Numeric Surface Water Quality Standards

For each of the above-designated uses, there are numeric surface water quality criteria established for each established criteria element (A.A.C. R18-11-109.A Appendix A and B). As the numeric standards are used to protect a designated use, a value that exceeds the numeric standard indicates that a particular criteria element is a pollutant that may cause water quality degradation within that Reach. Within this report, data were compared against numeric standards to identify these potential surface water quality pollutants and the source of the pollution.

4.3.2.3 Narrative Surface Water Quality Standards

Narrative water quality standards are established to protect all surface waters. Current standards require that surface water be free from pollutants in accordance with A.A.C. R18-11-108.A and B. In summary, surface water shall be free from pollutants that cause odor, off-taste, undesirable growth, changes in color or contribute to violation of an aquifer water quality standard. Surface water shall also be free from oil, grease, and other pollutants that float as debris, foam or scum.

4.3.3 Water Quality Summary

With respect to the databases discussed in Section 4.3.1.2, the data for the Salt River between 19th Avenue and 83rd Avenue were generally collected prior to 1997. There is a limited amount

of data available for 1999, and no data for this river segment beyond 1999. Also, there is a minor amount of surface water flow in the Salt River between 19th Avenue and 83rd Avenue. As a result, limited water quality sampling information is available for this area. The following sampling location information has been included in this report and was also provided within the Phase 2 Report. The data availability moving downstream through the study area includes the following:

- 23rd Avenue WWTP Outfall (7/92-6/93),
- 35th Avenue Bridge (7/92-6/93),
- 51st Avenue Bridge (7/92- 6/93),
- 59th Avenue and Salt River (4/94-4/95),
- 67th Avenue Bridge (7/92-6/93), and
- SRP Maricopa Drain (1996-1999).

4.3.3.1 Surface Water Sources

The sources of surface water in the study area include: point-source outfalls from the COP 23rd Avenue WWTP, SRP Maricopa Drain, storm water point-source discharges, and irrigation flows. Surface water quality data were available for:

- COP 23rd Avenue WWTP,
- SRP Maricopa Drain, and
- COP storm water outfalls at designated locations.

In 1995, the COP began discharging treated wastewater to the Salt River channel at the 35th Avenue outfall. The COP discharges approximately 45 million gallons per day (MGD) to the river during a 4-month period, generally ranging from mid/late October to mid/late February or March. During the remaining 8 months of the year, treated wastewater is distributed via canals and pipelines to the RID for agricultural use. In addition, approximately 10 MGD of treated effluent is distributed from the 23rd Avenue WWTP continuously throughout the year for other agricultural irrigation allotments (Parsons Engineering Science, 2001).

The SRP Maricopa Drain is an irrigation district discharge point that discharges intermittently dependent upon agricultural needs, system maintenance needs and storm water impacts. It is a drainage ditch that collects unused water from about 27th Avenue west to 75th Avenue.

The COP storm water outfalls provide an intermittent source of surface water to the project area. The average annual rainfall in Phoenix metropolitan area is 7.95 inches per year (Western Regional Climate Center, 2002).

4.3.3.2 Storm Water Data

It is important to note that storm water quality is a function of land use, not the size of the watershed (Greeley and Hansen, 2001). In other words, how a specific section of land is used will impact stormwater quality more so than tract size. Thus, to better manage stormwater data, the Phase 2 Report produced by Greeley and Hansen divided the storm water database into three data sets that are designated as follows:

- In-stream storm water samples from a variety of storm water drainage basins in urbanized areas, including natural runoff and background streamflow.
- Storm water samples at the point of discharge to Waters of the United States (U.S.) that represent storm water from a defined drainage basin and land use mixture.
- Storm water samples from within a municipal storm drain system that represent storm water from a defined drainage basin and land use mixture that are not representative of storm water discharges to Waters of the U.S.

Storm water data were divided into the above files so that data from within the storm drain system are not misunderstood and extrapolated to represent the storm water characteristics at the point of discharge to Waters of the U.S. or in-stream water quality. Greeley and Hansen (2001) strongly caution against the direct comparison of storm water data with water quality standards, particularly those related to acute and chronic toxicity. Storm water data were available from the following in-stream locations within the project area:

- Downstream side of 19th Avenue bridge — In-stream
- Arizona Central District Canal (ACDC) at 43rd Avenue — In-stream
- Downstream side of 51st Avenue bridge over the ACDC — In-stream
- Downstream side of 51st Avenue bridge over Salt River — In-stream

Storm water data were also available for the following point-of-discharge locations:

- Salt River at 27th Avenue – south bank of river — Point-of-Discharge
- Salt River at 35th Avenue – north bank of river — Point-of-Discharge
- 67th Avenue at Salt River — Point-of-Discharge

4.3.3.3 Numeric Surface Water Quality Criteria Summary

The numeric surface water quality standards established by ADEQ for each designated use were compared against the available surface water quality sample data obtained from the various databases. Where an established surface water quality numeric criterion was exceeded, this information was used to compile Table 4, Surface Water Quality Summary (Appendix A). Because the amount of data provided for the study area is rather limited as a whole, and especially limited between 51st Avenue and 83rd Avenue, data from two locations downstream outside of the study area were also included in the analysis. This was done to provide a set of comparison values that may be indicative of the surface water quality of the western portion of the study area and downstream of the study area.

As an overall observation, the A&W edw designated use was frequently problematic for certain metal analytes because the standard requires hardness data for evaluation. Where hardness data were available, all applicable data were evaluated and concentrations greater than the current standard were included in the table. Data from sampling events lacking hardness results were not evaluated as the numeric value for the standard could not be calculated. Additionally, all data that were qualified by the analytical laboratory (e.g. estimates, calibration failure, contamination, etc.) were excluded.

A total of 21 parameters were found to have exceeded numeric surface water quality criteria (Appendix A, Table 4). The parameters included pesticides, metals, chlorinated hydrocarbons, the water quality parameters pH and turbidity, and bacteriological parameters. Approximately 45 percent of the exceedances were elevated bacteria counts, 15 percent of the results were from pesticides, 13 percent of the results were from metals, and 9 percent of the results were chlorinated hydrocarbons. The remainder represents parameters such as pH, dissolved oxygen, and cyanide.

In general, based on analysis of available data versus the numeric water quality standards, stormwater is a vehicle by which surface water quality appears to degrade within the Salt River.

4.3.3.4 Narrative Surface Water Quality Criteria Summary

Based on field observations and the comparison of site data with the narrative water quality standards, stormwater can degrade surface water quality within the Salt River. Point-source stormwater outfalls were observed to be non-compliant with narrative standards as these points tended to accumulate debris, foam, scum and odor.

4.3.4 Data Gaps

In the process of compiling this surface water quality summary, the following data gaps were identified:

- There was a limited amount of surface water quality data for the Salt River study area from 19th to 83rd Avenues (data location gap).
- Based on inquiries, it is believed that additional surface water quality data exists, but it was not delivered timely to URS for inclusion in this summary (data source gaps).
- Older storm water data (from 1992 and 1993) were predominant in the analysis (data date gap). As land use patterns have changed, it is logical to assume that storm water quality has been impacted by these land-use changes and that the older data may no longer be truly reflective of actual site conditions.
- Sample data were not available for the comprehensive list of surface water quality criteria compiled by ADEQ (study parameter data gaps).
- Non-point source storm water run-off is likely a key contributor to the degradation of water quality in the project area, but comprehensive data sets are not available to confirm this supposition.
- Major data gaps include ungaged agricultural drains, impact of concentrated animal feeding operations (CAFO) on water quality, and storm water pollutant loads and RID canals and discharges.
- Gila River Indian Community discharges into the Salt River, just at edge of study area near 83rd Avenue, but no data on these discharges were made available to URS for inclusion in this report.

4.4 HYDROGEOLOGY

The purpose of this task was to evaluate the aquifer characteristics and groundwater use within the study area. Understanding the hydrogeology will help with design and site selection for future monitor and production wells required for habitat restoration project.

4.4.1 Geologic Setting

The Oeste Project is located in the Basin and Range Physiographic Province of Arizona, which is characterized by predominantly north to northwest-trending mountain ranges that are separated by gently sloping alluvial basins. Basin-fill deposits in this region range in thickness from less than 100 feet near the basin margins to over 10,000 feet in the central areas of some basins. Basin-fill deposits consist of intercalated sequences of alluvial sediments and evaporites, and are underlain by basement rocks that consist of Precambrian igneous and metamorphic rocks and Tertiary sedimentary and volcanic rocks (Corkhill, et al., 1993). In the Oeste Project area, unconsolidated basin-fill sediments are approximately 1,000 feet thick at the eastern portion of the study area and thicken to the west to over 3,000 feet.

The clastic sediments are interpreted as alluvial fan, lacustrine, and fluvial deposits formed during development of the Salt River Valley basin and sub-basins. The unconsolidated alluvial and lacustrine deposits have been subdivided into three stratigraphic units from oldest to youngest: the Lower Conglomerate Unit (LCU), the Middle Fine-Grained Unit (MFU), and the Upper Alluvial Unit (UAU). As previously stated, this project focuses on the water quality and water supply potential of the UAU, which is the proposed source of water for the Oeste Project.

The UAU is divided into four subunits within the study area. These subunits are designated from youngest to oldest as S, A, B, and C. These subunits appear to be essentially horizontal within the study area and no significant geologic structures have been identified.

- **Subunit S** is exposed at the surface near the river and consists of silty sand with clay and gravel. This unit is typically unsaturated in the vicinity of the Salt River

- **Subunit A** is further subdivided into Subunits A_1 and A_2, and is generally comprised of sandy gravel and cobbles. Subunit A_1 extends to a depth of 90 to 110 feet below ground surface (bgs) and consists of unconsolidated, poorly sorted, coarse sand and gravel. The primary difference between A_1 and A_2 is that Subunit A_2 contains 30 to 40 percent fine to coarse sand versus 5 to 20 percent in Subunit A_1. In addition, Subunit A_2 is typically better sorted than A_1. The contact between these subunits is gradational and is identified

by a transition from coarse to medium-sized gravel, increased roundness, and greater amounts of fine sand and silt (Dames & Moore, 1991). In the vicinity of the 19th Avenue Landfill Subunit A_1 was observed to be about 100 feet thick and Subunit A_2 was observed to be about 90 feet thick

- **Subunit B** underlies Subunit A_2 and is dominated by coarse to fine sand, silt, clay, and minor gravels. Subunit B is distinguished by its reddish-brown color and finer-grained nature. In the vicinity of the 19th Avenue Landfill Subunit B was observed to be about 40 feet thick

- **Subunit C** underlies Subunit B and primarily consists of fine to medium sand, angular to subrounded fine gravel, minor silt, and clay. The transition from Subunit B to Subunit C is identified by an increase in grain size and a color change to brown. In the vicinity of the 19th Avenue Landfill Subunit C was observed to be about 150 feet thick.

4.4.2 Hydrogeology and Aquifer Properties

Hydrogeologic data and aquifer properties for the UAU were collected from available reports and public database information as described in Section 3.1. URS contacted various owners with a history of groundwater production capacity greater than 500 gallons per minute (gpm), a casing diameter greater than 10 inches, and screen intervals placed in either subunits A, B, or C of the UAU. While many other production and monitor wells were located during the investigation, aquifer properties were based preferentially on data from wells capable of producing significant discharge (≥ 500 gpm) in order to stress the aquifer of the UAU. For wells with limited aquifer property data, but with pumping, drawdown, and well construction information available, a mathematical approximation was used to estimate aquifer characteristics (Razack & Huntley, 1991). ADWR personnel were contacted to obtain the most recent data regarding water levels, aquifer modeling, and recent publications in the study area. ADWR also queried their databases for recent aquifer testing and research done to support submitted Certificates of Assured Water Supply or Water Adequacy Statements, however none were encountered in the study area. The compiled aquifer parameters of the UAU are presented in Table 4.4.2.

TABLE 4.4.2
AQUIFER PROPERTIES OF THE UPPER ALLUVIAL UNIT
RIO SALADO OESTE PROJECT

Sources	Hydrogeologic Units	Transmissivity (ft^2/day)	Storativity (Dimensionless)	Hydraulic Conductivity (K) (ft/day)
161 ARG Site Characterization Report, LUST File Pump Test, (Dames & Moore, 1997)	UAU Unit A	18,048 - 19,519	0.4 – 0.44	27.7 – 338.6
19th Avenue Landfill Modeling, (Dames & Moore, 1997)	UAU Unit A	15,709 - 36,096	NA	NA
19th Avenue Landfill Aquifer Testing, (Dames & Moore, 1997)	UAU Unit A	25,209 (a)	0.11 (a)	30.7
Aquifer Test in Salt River Sediments, Avis Facility at Airport, (Dames & Moore, 1997)	UAU Unit A	25,936	NA	160.4
Salt River Valley Modeling Report No. 8, (Corkhill, et al., 1993)	UAU undifferentiated	NA	0.08 – 0.22	20 – 250
Renovation of Wastewater at the 23rd Avenue Rapid Infiltration Project (Bouwer and Rice, 1984)	UAU Unit A	25,401 (a)	NA	72.6
Well Installation and Data Analysis Report, Rio Salado Production Well No. 2 (RSPW-2), (URS, 2002)	UAU Unit A	21,390	NA	203
Well #55-613468, (personal communication Mr. A. King, 2002)	UAU Unit A	59,927	NA	500
Well #55-605117 (United Metro Materials), (personal communication Mr. A. Shelton, 2002)	UAU Units A, B, and C	27,629	NA	153
Well #55-528969 (Hansen Aggregate), (personal communication Mr. A. Jason, 2002)	UAU Unit C	23,815	NA	297
Well # 55-607697 (SRP 7E-1N), (SRP well database, 3/2002)	UAU Units A, B, and C	32,727	NA	76
Well # 55-607698 (SRP 4.8E-0N), (SRP well database, 3/2002)	UAU Units A, B, and C	23,258	NA	83
Well # 55-608378 (SRP 11.8E-2N), (SRP well database, 3/2002)	UAU Units A, B, and C	26,011	NA	68
Well # 55-578740 (SRP 6E-0.9N), (SRP well database, 3/2002)	UAU Units A, B, and C	19,487	NA	63
Tres Rios Hydrologic Model Development and Applications Report (Water & Environmental Systems Technology Inc., 2000)	UAU Units A, B, and C	NA	0.10-0.15	600-800
Dewatering Investigation Southern Ave. Sewer Line/ Sewage Lift Station #43 (Southwest Groundwater Consultants, Inc., 2000)	UAU Unit A	26,738	0.1	668

ARG= Air Refueling Group
LUST= Leaking Underground Storage Tank
UAU= Upper Alluvial Unit
(a)= averaged calculation
SRP= Salt River Project

Overall, the estimates of transmissivity for the UAU range from 15,000 to 60,000 ft^2/day (112,200 to 448,800 gallons per day per foot [gpd/ft]). However, the average estimate of transmissivity is approximately 27,000 ft^2/day (201,960 gpd/ft). Estimates of storativity ranged

from 0.08 up to 0.44. Hydraulic conductivity values in the study area vary from 20 ft/day to 800 ft/day (150 gpd/ft to 5,984 gpd/ft); the representative estimate of the hydraulic conductivity is 200 ft/day (1,496 gpd/ft).

The range of hydraulic conductivity values result from a combination of three factors: complexity of the fluvial system, well screen constructed across differing hydrogeologic units, and unconfined groundwater conditions in Unit A. Within each of the defined hydrogeologic units some variability in hydraulic conductivity is expected. Lateral changes in grain size or the presence of partial cementation can greatly impact the hydraulic conductivity. Because hydraulic conductivity is the resultant taken from the transmissivity value divided by the thickness of the aquifer, it is sensitive to the thickness of the aquifer. Because many wells in the study area were screened across the subunits A, B, C, of the UAU and sometimes into the MFU, aquifer thickness was estimated to be the length of the screened interval. The consequence of this assumption is that the hydraulic conductivity becomes an average over the entire screened interval for the higher conductivity A and C units as well as the lower conductivity B and MFU units. In general, the presence of low conductivity units within the screened interval decreases the estimated value of hydraulic conductivity. Lastly, inaccurately low hydraulic conductivity values may have resulted from declining water levels or local pumping that dewatered a portion of the screened interval and saturated aquifer, shortening the effective saturated thickness. Where data were available, the hydraulic conductivity estimates were corrected for dewatered screen and aquifer.

4.4.3 Depth to Water and Groundwater Gradient

Groundwater generally occurs under unconfined conditions within the 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 RID well field located along or north of Lower Buckeye Road between 19th and 35th Avenues. During winter months when the well field is inactive, the gradient shifts to the west-northwest. 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 (bgs) within the Salt River channel to 60 to 80 feet bgs north and south of the river (URS, 2002).

Fluctuations in static water level can be as much as 20 to 30 feet on an annual basis due to agricultural 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

(Figure 3) show this decline is most pronounced in the eastern portion of the site near the RID wellfield. 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 (Figure 4). 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. Values that materially impacted contours (southern Study Area boundary) are represented as elevations without a well symbol. 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 shown in Figure 4.

4.5 GROUNDWATER QUALITY

General groundwater quality data were obtained from databases including the ADWR GWSI database, ADEQ water quality database, and USGS NWIS water quality database. Other data were obtained from SRP, RID, the Phase 2 Report, and COP. The locations of wells with groundwater quality data that were useful for this report are shown on Figure 4. For this evaluation, the most recent data available used ranged from 2001 to as far back as 1983.

The above sources provided limited data for nitrates, volatile organic compounds (VOCs), metals, and pesticides. The majority of these data were below detection levels or detected at concentrations below groundwater quality standards.

The ADWR Well Registry database and Imaged Records database were queried to determine the location (Figure 4), owner, and purpose of monitor wells within the study area. This information was used to identify sites having possible groundwater quality concerns. Further information about sites of particular concern (e.g. landfills, LUST sites, etc.) was obtained from the well owners and ADEQ.

Groundwater conductivity within the study area ranges from about 1,000 to 3,500 micromhos per centimeter (μmhos/cm), which corresponds with an estimated range in TDS of 600 to 2,500 parts per million (ppm). Based on data from wells screened in the UAU and part of the MFU, there is a general trend of increasing conductivity from roughly 1,200 μmhos/cm in the northeast to over 3,000 μmhos/cm in the southwest part of the study area (Figure 5).

In the vicinity of the 23rd Avenue WWTP and the associated effluent outfalls, there are a number of monitor wells screened only in the uppermost part of Subunit A of the UAU. Groundwater from these wells has a relatively low conductivity—approximately 1,000 ±500 μmhos/cm—compared to groundwater from the deeper wells. The lower conductivity may be due to recharge of effluent water from the WWTP, or the upper UAU may have lower conductivity throughout the study area. Additional data from the upper UAU in other parts of the study area would be required to determine which is the case. There was not sufficient data available to distinguish between Subunit A and Subunit C of the UAU.

Nitrate concentrations are generally less than 10 milligrams per liter (mg/L), with the exception of wells located in the southwestern part of the study area where concentrations are as high as 13.8 mg/L (Figure 5). There is no apparent difference in the concentration of nitrate in the shallow wells versus the deeper wells. Quarterly data from the 23rd Avenue WWTP and the 27th Avenue Landfill monitor wells show that the nitrate concentrations can vary by as much as 4 ppm from quarter to quarter. The changes in nitrate concentration do not appear to be seasonal.

4.6 AREAS WITH GROUNDWATER QUALITY CONCERNS

The locations of sites where the groundwater quality may have been impacted are shown on Figure 6. These sites include landfills, wastewater treatment plants, and LUST sites. In addition, the study area is located in proximity of two Water Quality Assurance Revolving Fund (WQARF) or National Priority List (NPL) sites also known as Superfund sites. Groundwater investigations at the sites within the study area were all limited to Subunit A of the UAU. Monitor wells at these sites ranged in depth from 60 to 110 feet. The following sections give brief descriptions of each site.

4.6.1 WQARF/NPL Sites

19th Avenue Landfill

The 19th Avenue Landfill is located adjacent to the east side of the study area on 19th Avenue between Lower Buckeye Road on the north and the Salt River on the south. The landfill was used for disposal of municipal and local industrial waste. Historically very low concentrations of

VOCs, heavy metals, and beta radiation have been detected in groundwater at the site. Remediation activities at this site have been completed and the site is currently in the operations and maintenance phase (ADEQ, 2001).

In 2001, 1,1-Dichloroethylene (1,1-DCE) was the only compound detected above drinking water standards. Moderate concentrations of 1,1-DCE were detected in two wells located in the study area and associated with the 19th Avenue Landfill NPL Site. One of these wells had a concentration exceeding the ADEQ Aquifer Water Quality Standard (AWQS) of 7 micrograms per liter (µg/L). Based on these data and data from wells east of the study area, the likely extent of groundwater with high concentrations of 1,1-DCE was estimated as shown on Figure 6.

West Van Buren WQARF Site

The WVB site is located between Buckeye Road on the south and Van Buren Street on the north and between 7th Avenue on the east and 83rd Avenue on the west. Part of the Oeste Project study area falls within the one-mile buffer zone of the WVB site. This site has elevated concentrations of tetrachloroethene (PCE) and trichloroethene (TCE) (ADEQ, 2001).

The portion of the study area north of the Salt River and east of 51st Avenue is most likely to be impacted by poor groundwater quality from these sites. However, the study area is located up-gradient, so encroachment of poor quality groundwater from these sites is not anticipated.

4.6.2 Landfills

27th Avenue Landfill

The 27th Avenue Landfill was closed in 1995. It is currently used as a waste transfer station. Monitor wells are located along the edges of the landfill to monitor groundwater quality in the vicinity of the landfill. Quarterly sampling data from these wells indicate that there has been no impact to groundwater quality from the landfill and that groundwater quality in the area is good.

SRP Landfill

This site is located on the east side of 67th Avenue, just north of the Salt River (Point 1 on Figure 5). There are five observation wells registered with ADWR (Registration Nos.: 55-517070 through 55-517074) that are located at this site. These wells were drilled in 1987, and the purpose of these wells listed on the Notices of Intent to Drill a Well (NOIs) is to monitor potential groundwater contamination, "Monitoring program to identify the extent and nature of

any groundwater contamination at SRP landfills." No groundwater quality data were available from SRP for these wells. Site closure was obtained from ADEQ in 2000.

4.6.3 Waste Water Treatment Plants

23rd Avenue WWTP

The WWTP is currently active, and effluent water is discharged at the outfall point on the north side of the Salt River near 35th Avenue. There are currently eight monitoring wells surrounding the sludge drying beds and a monitoring well near the outfall point. Groundwater from these wells is sampled and analyzed periodically. The well near the 35th Avenue outfall point is monitored as part of the Aquifer Protection Permit (APP) for the site.

91st Avenue WWTP

The WWTP is currently active and effluent water is discharged to the Salt River and used as a water source for the Tres Rios Project, a riparian habitat restoration project that is located west of 83rd Avenue. Part of the WWTP's field of sludge drying beds is located within the project boundary. Since the WWTP's effluent outfalls are west of the study area and groundwater flow is to the west in the vicinity of the WWTP, the WWTP will likely have little influence on groundwater quality within the study area.

4.6.4 Leaking Underground Storage Tank Sites

Only LUST sites where monitor wells were installed and registered with ADWR are discussed here. Many of these sites have obtained site closure from ADEQ. In general, LUST site closure requires the following criteria:

- Extent of contamination at the release location was adequately investigated both laterally and vertically;
- Depth to groundwater determined;
- Soil contamination in exceedance of ADEQ's cleanup standard(s) was remediated to concentrations below the standards;
- Soil that remains in place is below ADEQ's cleanup standard(s) per R18-7-205; and
- Groundwater concentrations of contaminants have remained at or below the AWQS for a sufficient period of time.

Contaminants that were commonly detected in the groundwater at sites within the study area include benzene, toluene, ethylbenzene, and xylenes (BTEX) as well as total petroleum hydrocarbons (TPH). The AWQS for the BTEX compounds are as follows: benzene, 5 µg/L; toluene, 1,000 µg/L; ethylbenzene, 700 µg/L; and total xylenes, 10,000 µg/L. An AWQS for TPH has not been established.

Based on the above criteria it is possible for detectable concentrations of contaminants to remain in the soil and groundwater after the site has been closed. It is assumed that concentrations of petroleum hydrocarbons will degrade over time due to natural processes.

19th Avenue Landfill (ADEQ Facility ID: 0-003859)

There are two LUST sites (Leak IDs: 2235.01 and 2728.01) associated with the landfill. The actual locations and the impacts to groundwater at these sites are unknown; the ADEQ files for these sites were not available for review at the time this report was written. Both of these sites were closed in 1993.

27th Avenue Landfill (ADEQ Facility ID: 0-003858)

There is one LUST site (Leak ID: 1787.01) associated with the 27th Avenue Landfill (Point 6 on Figure 5). One monitor well was installed to determine if there was any impact to groundwater. There were minor BTEX detections that did not exceed the ADEQ AWQS. The well was abandoned when the site was closed in 1998.

PCE was also detected at a concentration of 0.4 µg/L. It was reported that the analytical results of the groundwater samples from the monitor well were typical of the ambient groundwater quality of the WVB study area.

USF Bestway Transportation (ADEQ Facility ID: 0-005062)

This site, located at 3045 South 43rd Avenue. (Point 3 on Figure 5), had three diesel and one gasoline USTs. ADEQ was notified about leakage from these tanks in 1988 (Leak ID: 0456.01). Nine monitor wells were installed to characterize the nature and extent of the impact to groundwater. Initially 12 inches of free product was measured in one monitor well, and detectable concentrations of BTEX and TPH were present in four of these wells. Concentrations exceeded the ADEQ AWQS for benzene in three wells with a maximum concentration of 420 µg/L. Remedial activities have been performed at the site and concentrations have been lowered to levels required by ADEQ. Site closure has been requested.

Publicker Ind/Masterveiw Window (ADEQ Facility ID: 0-004800)

This site is located at 3065 South 43rd Avenue (Point 4 on Figure 5). In 1991 an incident report was filed with ADEQ documenting a release of petroleum hydrocarbons discovered during removal of the UST (Leak ID: 1864.01). Six monitor wells were installed to evaluate the degree and extent of the impact to groundwater. In one of the monitor wells, 4.4 inches of free product was measured. Detectable concentrations of BTEX were present in five of the six monitor wells. Only benzene was detected at concentrations exceeding the ADEQ AWQS of 5 µg/L with concentrations as high as 520 µg/L. Concentrations of isopropylbenzene, 1,3,5-trimethylbenzene, 1,2,4-trimethylbenzene, n-butylbenzene, and naphthalene were detected in five of the monitor wells. These compounds are typical components of unleaded gasoline and are associated with the hydrocarbon release at the site. The site is currently being remediated.

Other compound detections that are not related to the petroleum release at this site include TCE, chloroform, and dichloromethane (methylene chloride). TCE was detected at concentrations as high as 5.7 µg/L. The source and extent of the TCE contamination is unknown; however, it is believed that the source is off-site (Geraghty and Miller, 1997).

Phoenix Transit System (ADEQ Facility ID: 0-003877)

This site is located at 2225 West Lower Buckeye Road (Point 12 on Figure 5). A petroleum release from leaking USTs was reported to ADEQ in 1995 (Leak ID: 3869.01). Six monitor wells were installed to evaluate the impact to groundwater. Approximately 143 gallons of free product had been removed from one of these wells as of July 2, 1996. Free product was not discovered in any of the other wells. No VOCs were detected in the groundwater in any of the wells. Remedial action was taken and the site was closed in 2000.

City of Phoenix Petroleum Stores (ADEQ Facility ID: 0-003854)

This facility located at 2239 West Lower Buckeye Road (Point 10 on Figure 5) is used for fuel and lubricant storage and distribution. Between September 1987 and March 1989 the facility had four incidents of documented product release or inventory loss (Leak ID: 0350.01). Four monitor wells were installed to evaluate the impact to groundwater. Detectable concentrations of TPH, BTEX, and 1,1-DCE were present in all four of the monitor wells. Benzene was detected in one well at concentrations exceeding ADEQ AWQS levels with concentrations up to 39 µg/L. Remedial action was taken to lower the concentration and the site was closed in 1998.

Phoenix Salt River Service Center (ADEQ Facility ID: 0-003864)

This facility located at 3045 South 22nd Avenue is used as a fueling and maintenance facility (Point 11 on Figure 5). At least eleven USTs were removed from the site. Four monitor wells were installed to evaluate the impact to groundwater due to product released from leaking tanks (Leak IDs: 1102.01 through 1102.06). Detectable concentrations of TPH and BTEX were present in all four wells and 1,1-DCE in one well. Benzene was detected in one well at concentrations exceeding the ADEQ AWQS as high as 53µg/L. Remedial action was taken and the site was closed in 1999.

Phoenix Redi-Mix Co Inc (ADEQ Facility ID: 0-004998)

This site is located at 3635 South 43rd Avenue (Point 5 on Figure 5). No groundwater information was found in the available ADEQ files. However, there are two monitor wells at this location registered with ADWR that were reportedly drilled to investigate a UST petroleum release.

Tanner-United Metro (ADEQ Facility ID: 0-004836)

This facility is located at 3640 South 19th Avenue (Point 15 on Figure 5). A diesel fuel release from a UST system was reported in 1988 (Leak ID: 0476.01). The USTs were removed and eight monitor wells were installed to evaluate the impact to groundwater due to the release. As much as 1.6 feet of free product was measured in two of the wells and TPH concentrations up to 11 mg/L were detected in the groundwater from other monitor wells. Remedial action was taken and the site was closed in 1999. Following closure, six of the monitor wells were abandoned. The ADWR records for other monitor wells installed at the site in 1997 indicate that these wells were drilled to monitor potential contamination from a petroleum hydrocarbon constituent released from a former lube pit and oil/water separator. The status of this investigation is not known at this time.

Salt River Recycling/Smithey (ADEQ Facility ID: 0-003031)

This site is located at 3640 South 35th Avenue (Point 14 on Figure 5). One monitor well was installed to determine if there was any impact to groundwater due to leaking USTs (Leak IDs: 4480.01, 4480.02, 4480.03). No detectable concentrations of BTEX or TPH were present. The site was closed in 2000.

Empire Metals Inc. (ADEQ Facility ID: 0-001930)

This site is located at 2010 West Lower Buckeye Road (Point 13 on Figure 5). Two USTs were removed in 1994. Release of hydrocarbons at this site was reported to ADEQ (Leak IDs: 3466.01 and 3466.02). Three monitor wells were installed to evaluate the impact to groundwater. Detectable BTEX concentrations were discovered in all three wells. However, the concentrations were all below the ADEQ AWQS. A request for closure of the site was submitted in 1996. Closure has not yet been granted.

Just Enterprises Inc.

This site is located at 3250 West Broadway Road (Point 7 on Figure 5). One monitor well registered with ADWR (Registration No. 55-586366) was drilled at this site as part of a UST investigation in 2001. No records for this site were found at ADEQ.

Patton Boggs L.L.P.

This site is located on the southeast corner of 43rd Avenue and Lower Buckeye Road (Point 8 on Figure 5). According to ADWR registration records, two monitor wells were installed at this site (Registration Nos. 55-564801 and 55-564802). No other information for this site was found.

5.0 CONCLUSIONS

The primary findings and conclusions of this project are summarized as follows:

- As the Salt River is ephemeral and the average annual rainfall in the area is less than 8 inches per year, it is not possible to collect surface water samples on a regular or routine basis to develop a comprehensive data set for analysis against all the identified surface water quality standards.

- There are numerous sources that impact the surface water quality in and around the Salt River. This impact comes primarily in the form of stormwater run-off, but also includes ungaged agricultural drains. Based on land use, analysis of available numeric data, and field observations compared against narrative surface water quality standards, it is clear the stormwater has the ability to negatively impact stormwater quality by introducing pollutants to the Salt River.

- Groundwater elevations in the study area have declined approximately 15 to 20 feet in the last 25 years; groundwater gradient remains to the west-northwest. The gradient in the eastern end of the site is influenced by heavy groundwater production, which alters the local gradient except during the winter months.

- Overall, the general stratigraphy of the alluvial units is consistent throughout the study area.

- The estimated value of transmissivity for the UAU (Units A_1, A_2, B and C) is 27,000 ft^2/day, and the hydraulic conductivity is estimated to be 200 ft/day.

- Groundwater in the eastern half of the study area has lower TDS relative to other portions of the study area. However, groundwater has been impacted by several petroleum hydrocarbon releases from USTs and may have elevated concentrations of 1,1-DCE.

- Available groundwater quality data indicate that groundwater in the southwestern part of the study area has elevated concentrations of TDS and nitrates.

6.0 REFERENCES

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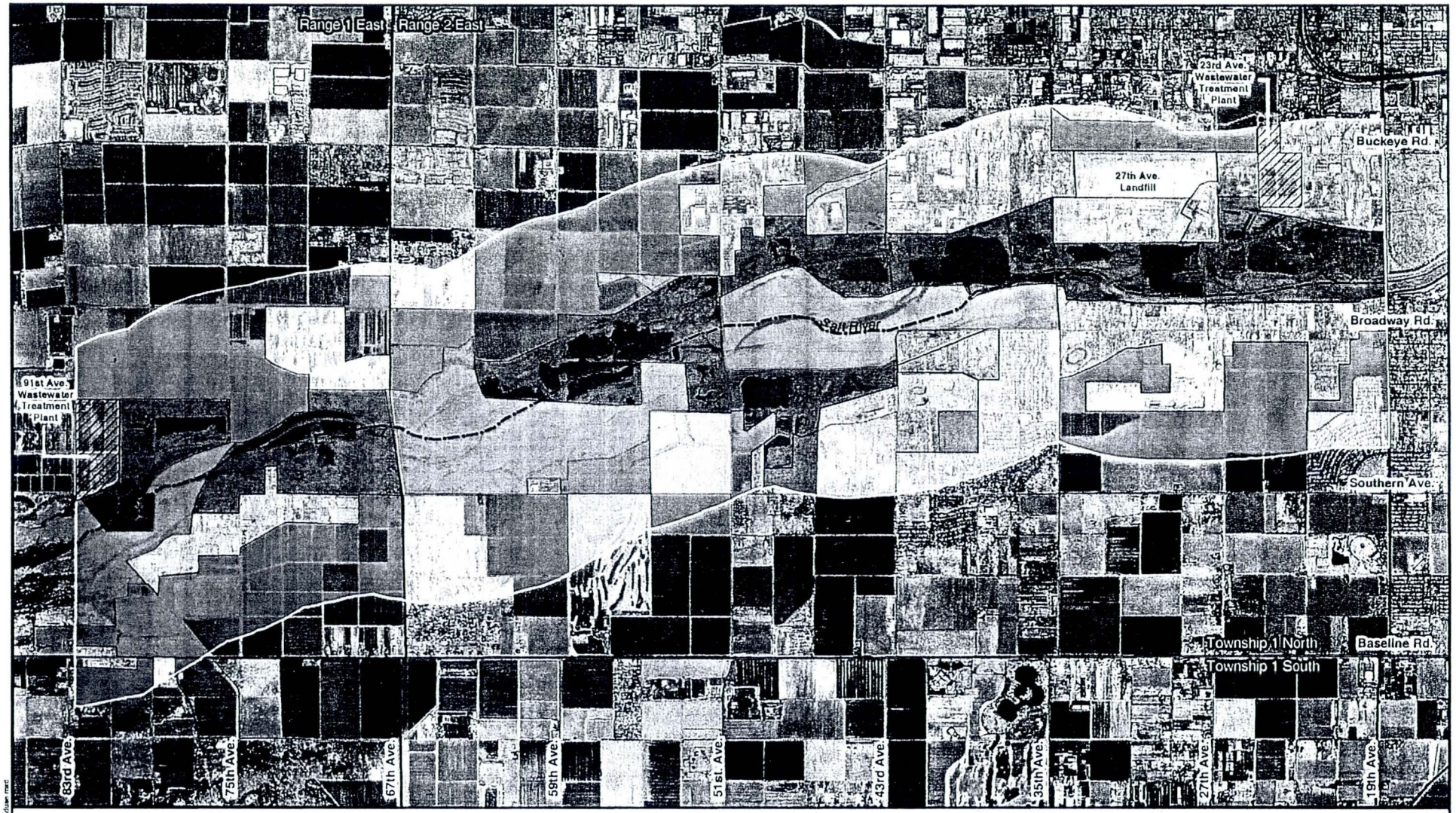
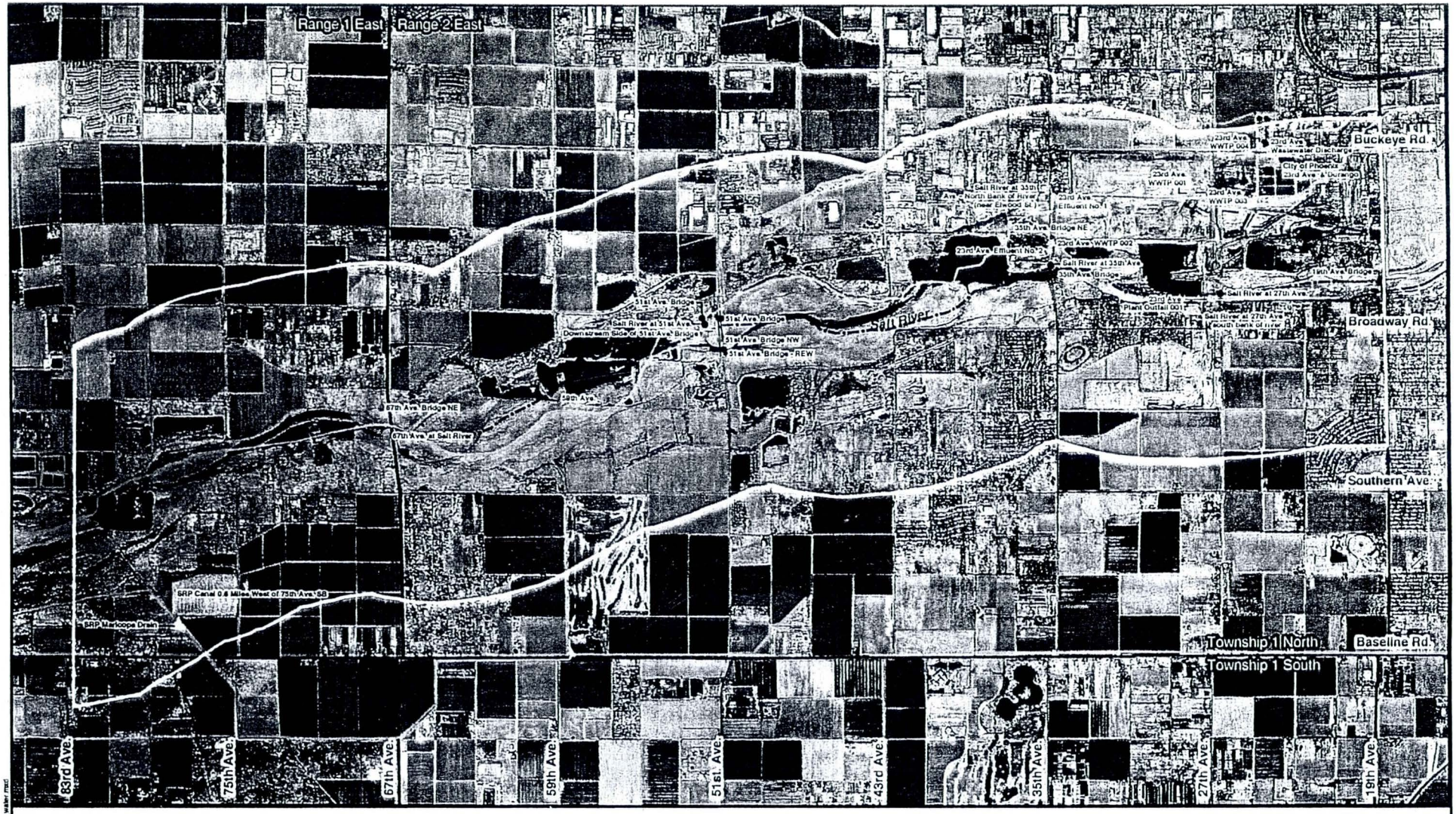
FIGURES



Existing Land Use

Groundwater Quality and Hydrogeology Report
Rio Salado Oeste Project

Figure 1



Legend

- SRP Drain
- Storet Location
- City of Phoenix Stormwater
- City of Phoenix Wastewater Treatment Plant

Small Streams

0 0.25 0.5 1

Scale In Miles

Map Scale 1:35,000

Image Source:
Kenney Aerial Mapping, 2000

N

Surface Water Features and Sampling Locations

Groundwater Quality and Hydrogeology Report
Rio Salado Oeste Project

Figure 2

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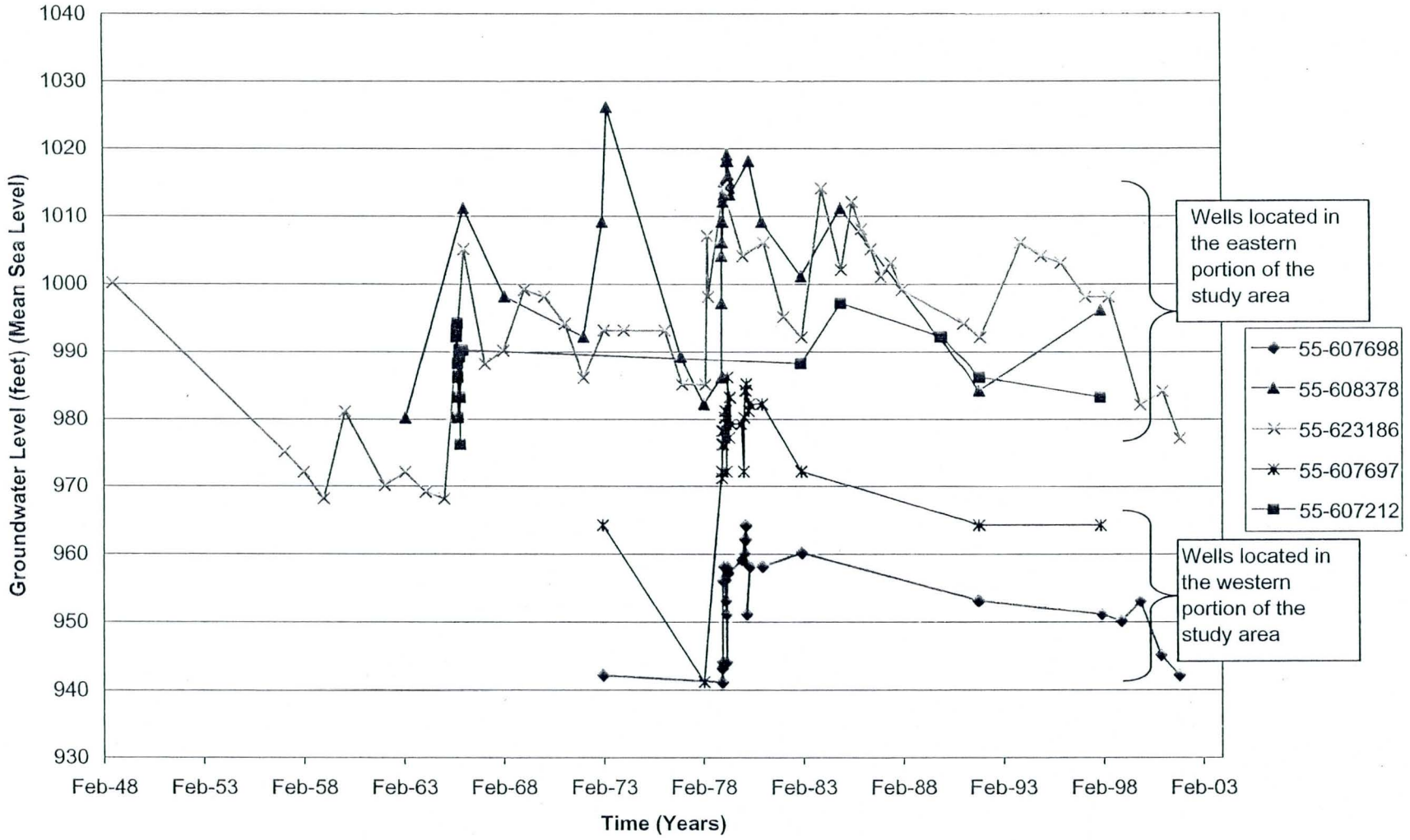
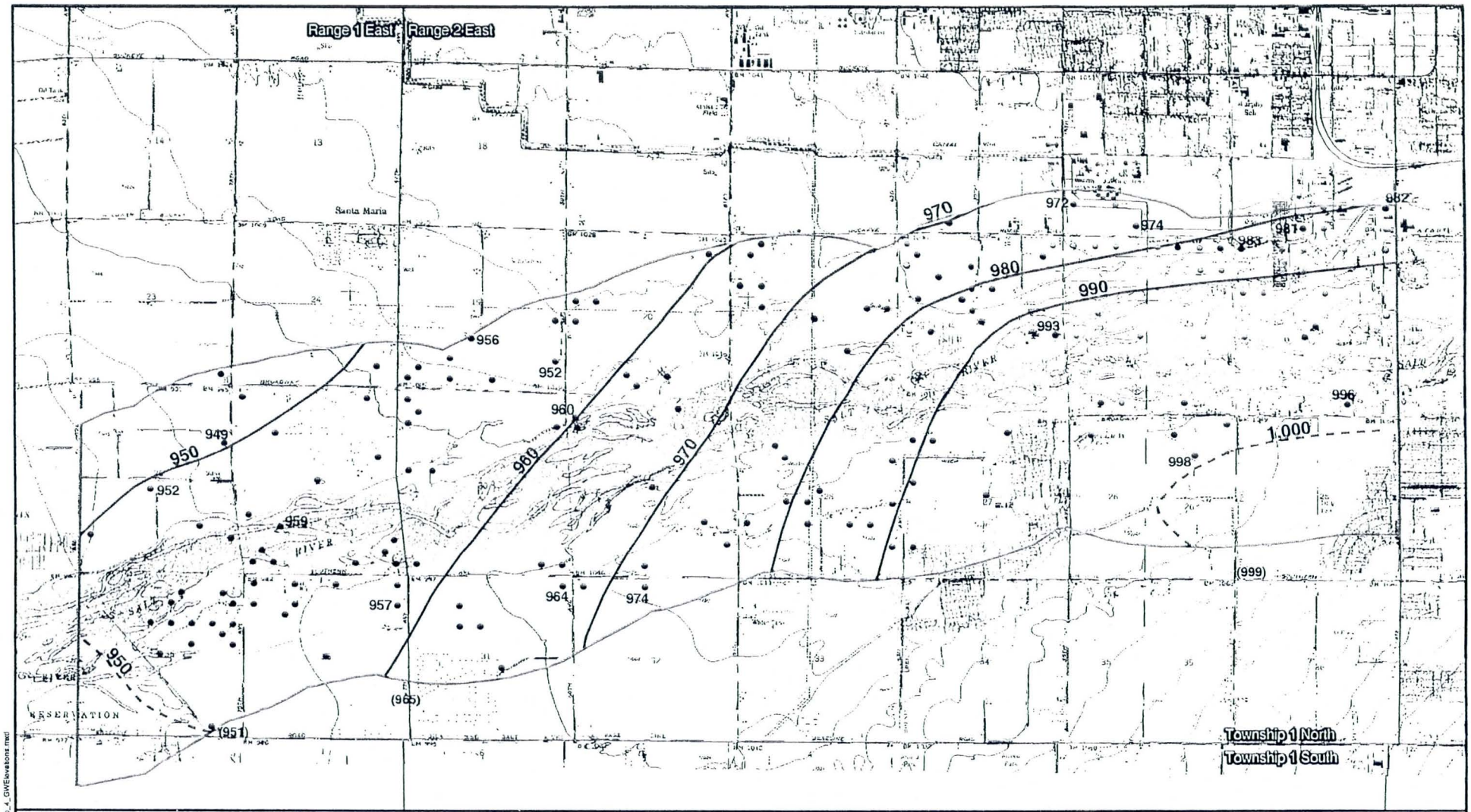
Figure 3
Selected Hydrographs in the Rio Salado Oeste Study Area





Legend

- Rio Salado Oeste Project Boundary
- Groundwater Elevation Contour (Mean Sea Level) (Feet). Contour Interval 10 Feet
- Inferred G.W. Elevation Contour
- Township and Range Lines

ADWR Well Database

- Monitor
- Observation
- Production

(952) - Groundwater Well Elevation (Feet).

Parentheses denote values from wells outside study area used for contouring.

0 0.25 0.5 1

Scale In Miles

Map Scale 1:35,000

Source:
1997 Elevations from ADWR Database 2/27/02,
USGS Topographic Quads: Phoenix and Fowler

1997 Static Groundwater Elevations

Groundwater Quality and Hydrogeology Report
Rio Salado Oeste Project

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Figure 4

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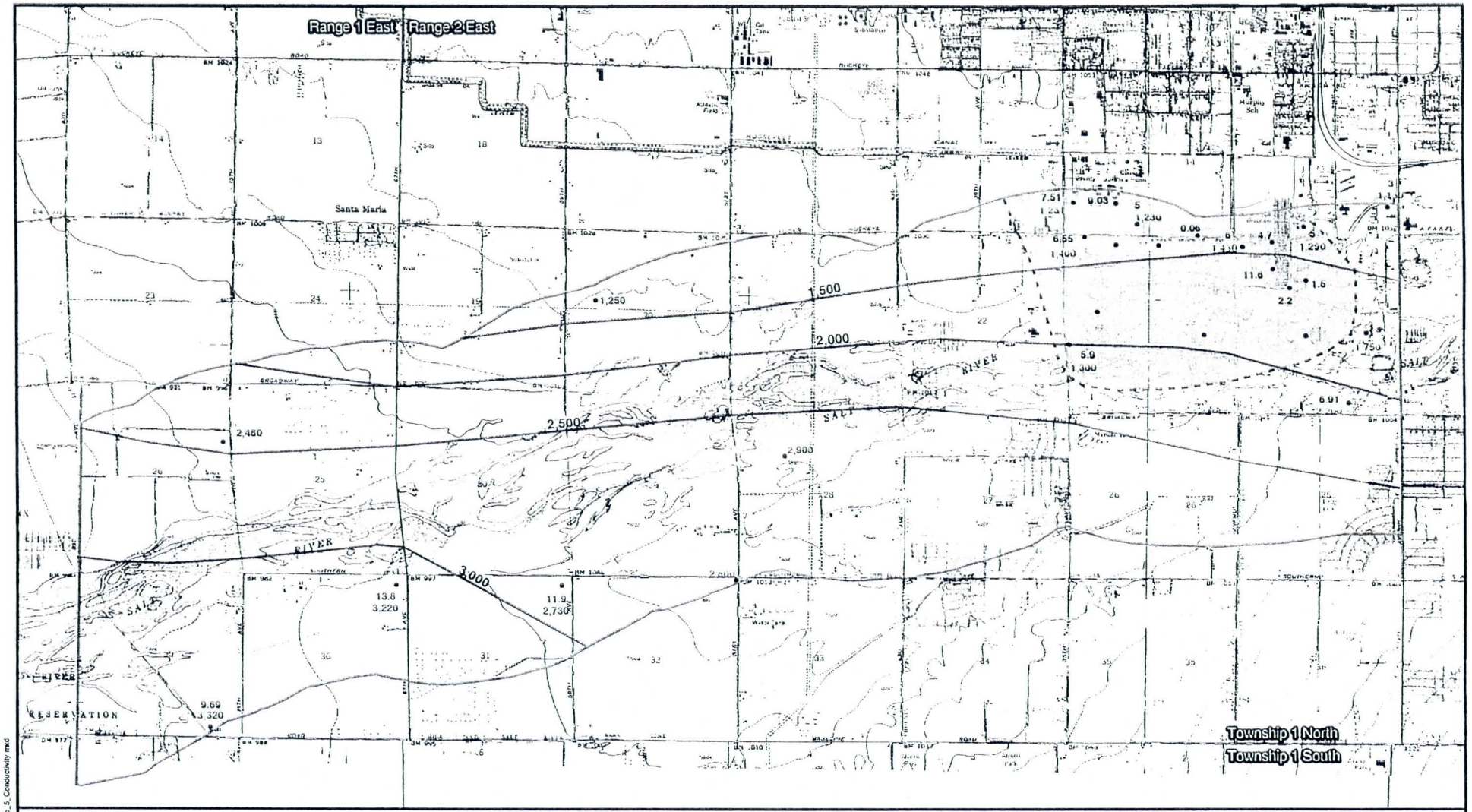

Legend

- Rio Salado Oeste Project Boundary
- Area with lower conductivity in shallow aquifer. (Wells screened in Subunit A of UAU. Values 1,000 +/- 500 umhos/cm)
- Conductivity (Wells screened in UAU and MFU) micromhos per centimeter - (umhos/cm)
- Township and Range Lines
- Wells with available groundwater quality data.
- 6.4 Nitrate concentrations in milligrams per liter (mg/L)
- 2,730 Conductivity (Wells Screened in UAU and MFU) umhos/cm

0 0.25 0.5 1

Scale In Miles

Map Scale 1:35,000

Source:
USGS Topographic Quads: Phoenix and Fowler

Conductivity and Nitrate Concentrations

Groundwater Quality and Hydrogeology Report
Rio Salado Oeste Project

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Figure 5

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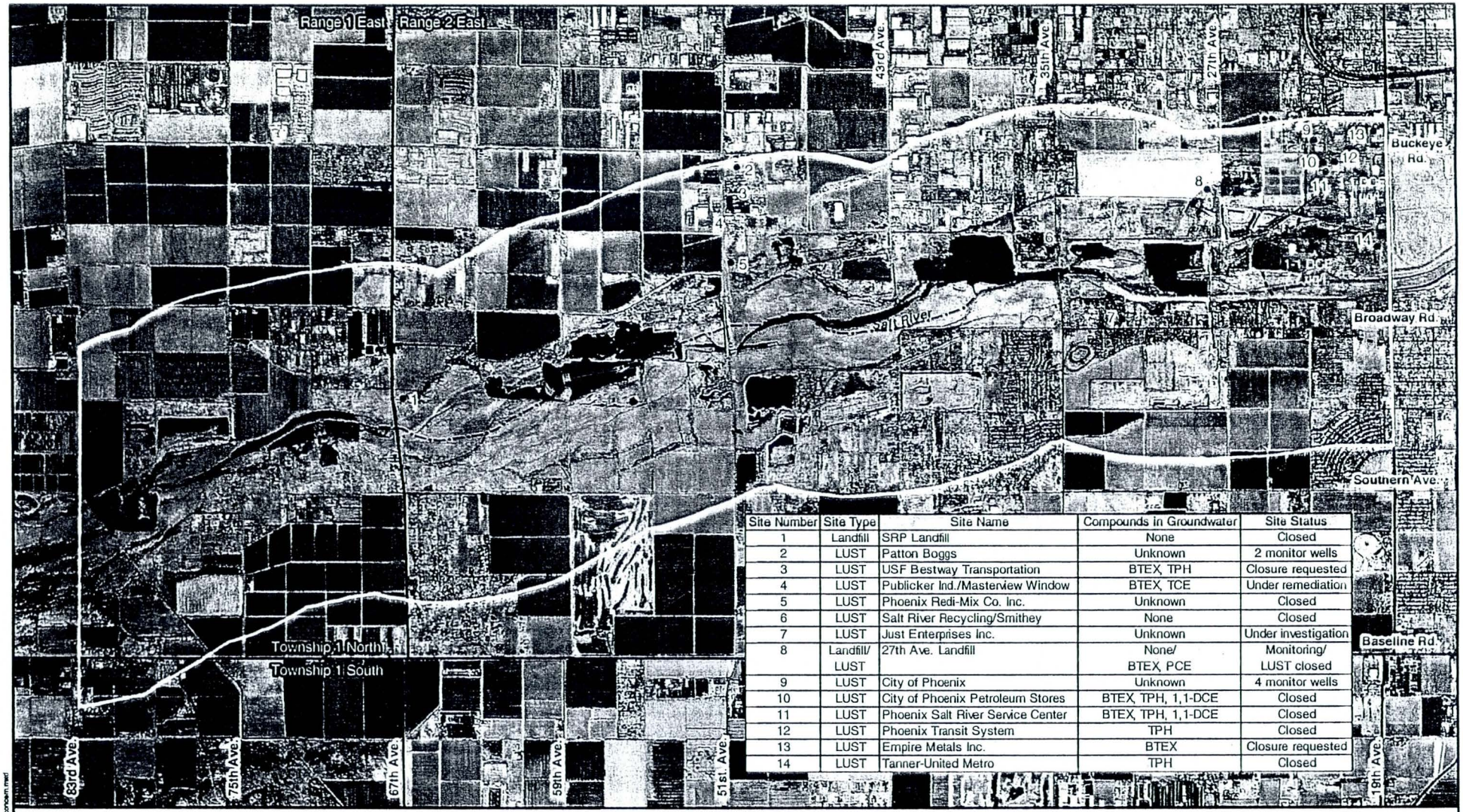

Site Number	Site Type	Site Name	Compounds in Groundwater	Site Status
1	Landfill	SRP Landfill	None	Closed
2	LUST	Patton Boggs	Unknown	2 monitor wells
3	LUST	USF Bestway Transportation	BTEX, TPH	Closure requested
4	LUST	Publicker Ind./Masterview Window	BTEX, TCE	Under remediation
5	LUST	Phoenix Redi-Mix 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

- 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

0 0.25 0.5 1

Scale In Miles

Map Scale 1:35,000

Image Source: Kenney Aerial Mapping, 2000

N

Sites With Groundwater Concerns

Groundwater Quality and Hydrogeology Report
Rio Salado Oeste Project

Figure 6

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APPENDIX A

WELL INVENTORY REPORTS

AVAILABLE UPON REQUEST

US Army Corps of Engineers
Los Angeles District

RIO SALADO OESTE
F4 MILESTONE
Salt River-Phoenix, Arizona

Appendix E
Geotechnical Evaluation

March 2005

U.S. ARMY CORPS OF ENGINEERS, LOS ANGELES DISTRICT
PLANNING DIVISION, WATER RESOURCES BRANCH
P.O. BOX 532711
LOS ANGELES, CALIFORNIA 90053-2325

Table of Contents ***Page***

1.0 Study Purpose 3

2.0 Description of Study Area 3

3.0 Physiography 4

4.0 Geology 5
4.1 Faulting 5
4.2 Geology of the Study Area 6

5.0 Surface and Groundwater 8
5.1 Groundwater 8
5.2 Depth to Groundwater 9

6.0 Soils 10

7.0 Hazards 10
7.1 Seismicity 10
7.2 Subsidence 10

8.0 Sources of Construction Material 11

9.0 Design Considerations 11

10.0 Construction Considerations 11

List of Figures

Figure 1. Location of the Study Area 3
Figure 2. Site Topographic Map 4
Figure 3. Geologic Map 6
Figure 4. Depth to Bedrock 7

1.0 ***Study Purpose.*** The U.S. Army Corps of Engineers Los Angeles District (USACE LAD) and the City of Phoenix (COP) initiated this study to evaluate the design and construction of a riparian habitat restoration project. The Rio Salado Oeste (Salt River East) site comprises approximately 8 river miles and the Rio Salado Phoenix environmental restoration project area abuts the study area on the east. The project lies primarily within the City of Phoenix, however, portions of Maricopa County, state and federal land is also included. The proposed project construction activities will occur mostly within the river floodplain, however, the study area encompasses overbank areas north and south of the riverbed.

USACE has produced a prior planning document; the Feasibility Study Project Management Plan dated May 2001. This Geotechnical Appendix for the Feasibility F-4 Phase (without project conditions) contains input to the study by the USACE LAD Geotechnical Branch and consists of pertinent literature and website information.

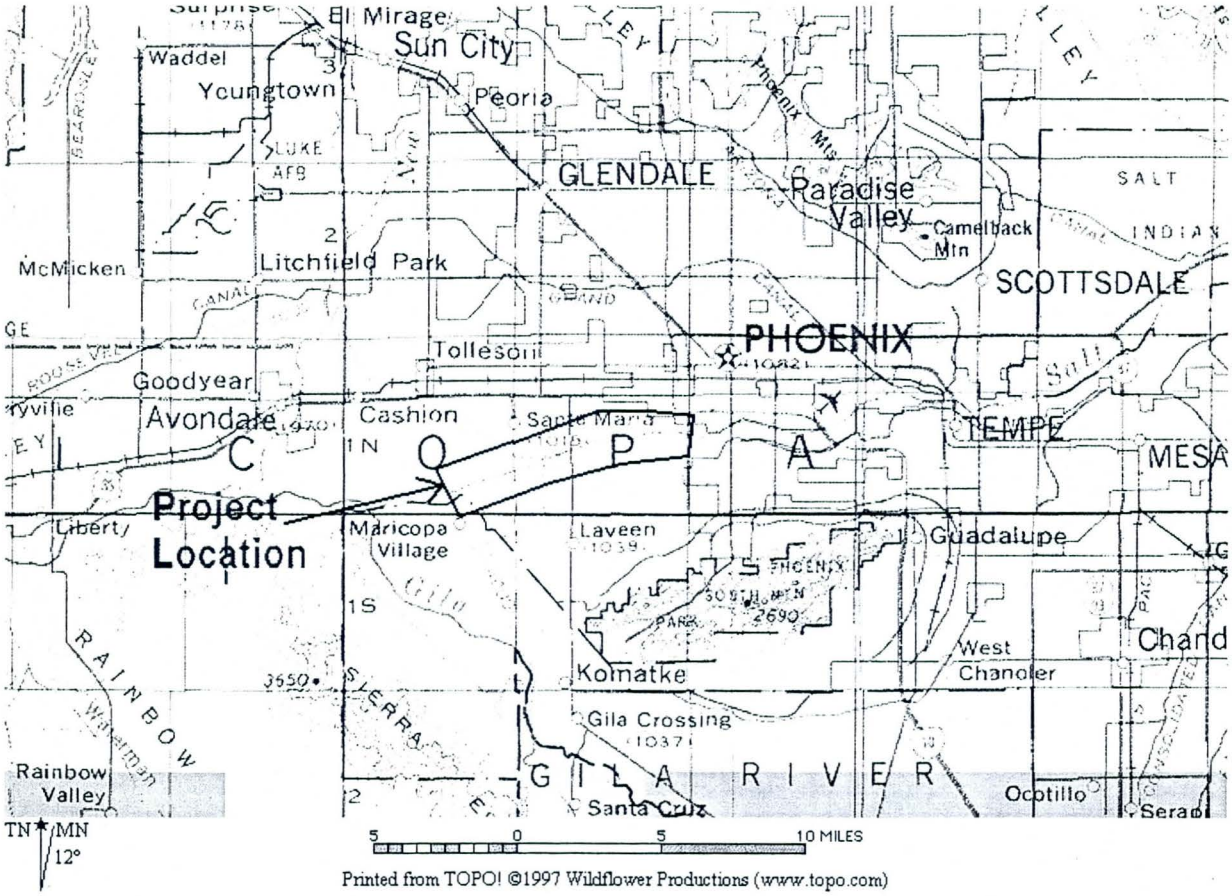

Figure 1. Location of the Rio Salado Oeste study area.

2.0 ***Description of Study Area.***

The Rio Salado Oeste study area is located southwest of Phoenix within Maricopa County, Arizona (see Figures 1 and 2). The area is approximately 8 miles long and 2 miles wide, centered on the Salt River, and comprises approximately 10,000 acres. The upstream boundary of the Rio Salado Oeste Study area is 19th Avenue. From here the study area extends southwest to 83rd Avenue. The study area includes river channel and overbank areas. Topographic relief is very

low to flat, ranging from about 1050 feet at the upstream (east) end of the area, gently sloping down to about 980 feet at the downstream (west) end (see figure 2).

The Rio Salado study area is covered by the following topographic map sheets: Phoenix, Arizona 1:250,000 sheet; Phoenix, Ariz. 1:62,500 sheets; and Phoenix and Fowler, Ariz. 1:24,000 sheets.

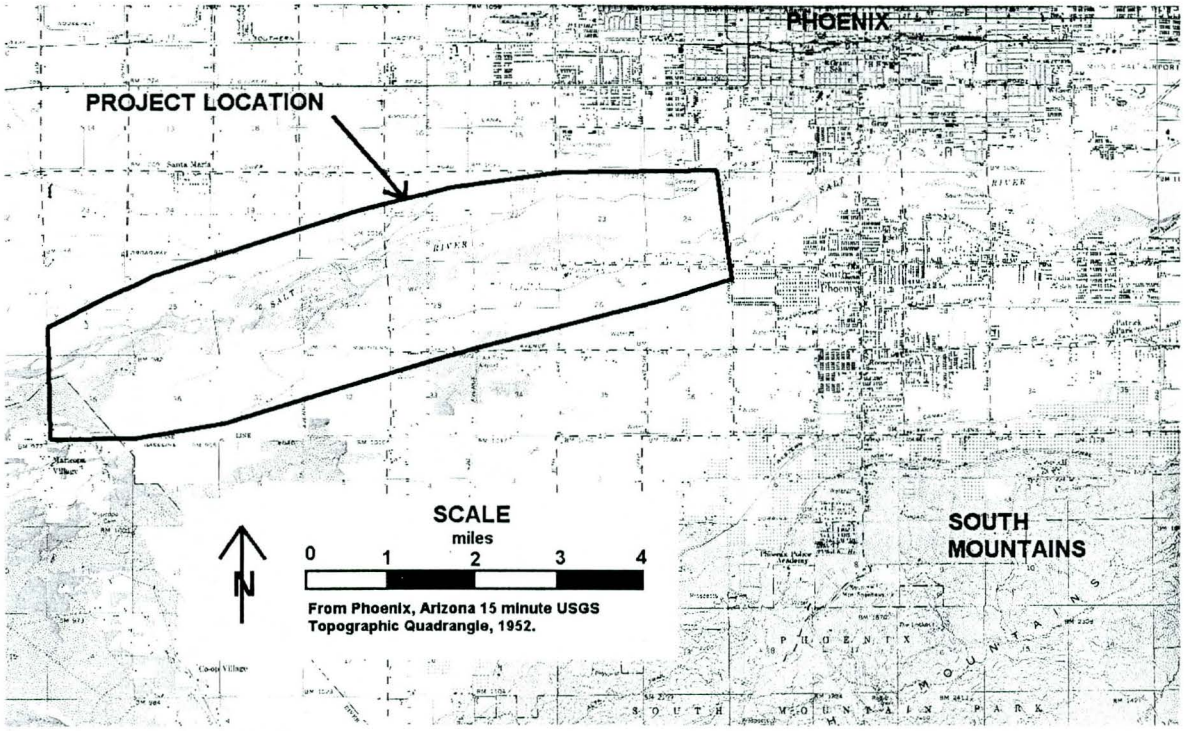

Figure 2. Site Topographic Map.

3.0 ***Physiography.*** The Rio Salado Oeste study area lies in the Salt River valley near the center of the Phoenix basin of south-central Arizona, and is geomorphically within the Gila Lowland Section of the Sonoran Desert subprovince, a small portion of the Southern Basin and Range physiographic province. This province is characterized by broad, gently sloping, interconnected alluvial basins bounded by generally northwest-southeast trending mountain ranges.

The Phoenix Basin comprises a series of topographical and structural basins bounded on the north and east by the Bradshaw-Mazatzal-Superstition Mountains, on the west by the Hassayampa River, on the southwest by the Buckeye Hills, and on the south by the Sierra Estrella and South Mountains (Salt River Mountains on some maps) (Péwé, 1978). The Phoenix Basin contains several small ranges, including the Phoenix, South, and White Tank Mountains. Several major rivers pass through the area, including the Rio Salado, Gila, Verde, and Agua Fria Rivers. The Salt River enters the basin on the east side, flowing southwestward to its junction with the south-flowing Verde River near the west edge of the Mazatzal Mountains. From this junction near Mesa, the Salt River flows westward across the broad Salt River Valley to its confluence with the Gila River. The Gila River continues westward along the northern edge of the Buckeye Hills to its confluence with the Hassayampa River where it turns south toward Gila Bend and exits the basin on its way to the Colorado River. The Agua Fria River enters the basin from the north near the

Hieroglyphic Mountains, and flows south to its confluence with the Gila River near the center of the basin, 15 miles west of Phoenix and 7 miles west of the study area.

Elevations range from over 7,000 feet for the highest peaks of the Mazatzal Mountains, 4,500 feet in the Sierra Estrella, and 2,540 feet in the South Mountains, to a low of about 800 feet on the Gila Riverbed where it exits the basin on the southwest. Interbasin ranges range in height from 3,780 feet in the White Tank Mountains to 2,440 feet in the Phoenix Mountains and to 1,750 feet in the Buckeye Hills.

4.0 ***Geology.*** The study area lies near the center of the Phoenix Basin of south-central Arizona, within the Southern Basin and Range Province. Broad, gently sloping, interconnected alluvial basins bounded by generally northwest-southeast trending mountain ranges characterize this province. Geologic structure in the area is dominated by block faulting, which produces topography of sharp contrasts, in which isolated, almost parallel mountain ranges rise in stark contrast above low-lying desert plains. In many cases, the basin areas are filled with thousands of feet of sediment and debris eroded from the adjacent mountains. However, some of the basin areas are pediments- erosional surfaces cut into the edges of nearby uplands.

Valley fill has been accumulating since the onset of basin and range tectonism, and reaches up to 9,8 00 feet thick in the interior of the Phoenix Valley. Numerous low-lying isolated bedrock hills (inselbergs) project above the valley surfaces. These hills represent peaks of former mountain ranges that are now almost completely buried by alluvial material. Valley fill consists mostly of poorly to well consolidated (cemented) and unconsolidated gravel, sand, silt, and clay, representing several environments and ages of deposition. The valley fills tend to be coarser near the mountain fronts, and finer in the interior of the valley. Calcium carbonate cementation is common, and considerable caliche is present near the mountain fronts. In the interior of the valley, most of the valley floor is covered by coarse to fine-grained alluvium. This material has been continuously deposited by the shifting channels of streams eroding the mountains.

4.1 ***Faulting***. Geologic structure in the study area is dominated by block faulting attributable to late Tertiary Basin and Range tectonic events. This extensional event began between 13-10 Ma in the southern Basin and Range province, and resulted in formation of most of the present structural basins in southern and central Arizona (Peartree and Scarborough, 1984). Major extension ceased in the area during the late Miocene or Pliocene.

Quaternary-age faulting in Arizona is mostly confined by a northwest-trending belt which bisects the state, separating domains of little or no neotectonic faulting in the northeast (Colorado Plateau Province) and southwest (Southern Basin and Range Province) (Menges, 1984). Historically, the Phoenix area exhibits a very low level of seismicity, and evidence of late Quaternary faulting is sparse (Peartree and Scarborough, 1984). Quaternary faults in southern and central Arizona consistently show evidence of very long recurrence intervals, on the order of 100,000+ years, and displacement rates of <0.03mm/yr (Peartree and Scarborough, 1984). The nearest mapped Quaternary faults are found to the northeast of the study area along the western flanks of the Mazatzal Mountains (Peartree and Scarborough, 1984). These faults are composed of short northeast and north-south segments, the nearest of which is the Carefree Fault 20 miles due north of Mesa and 28 miles northeast of the study area.

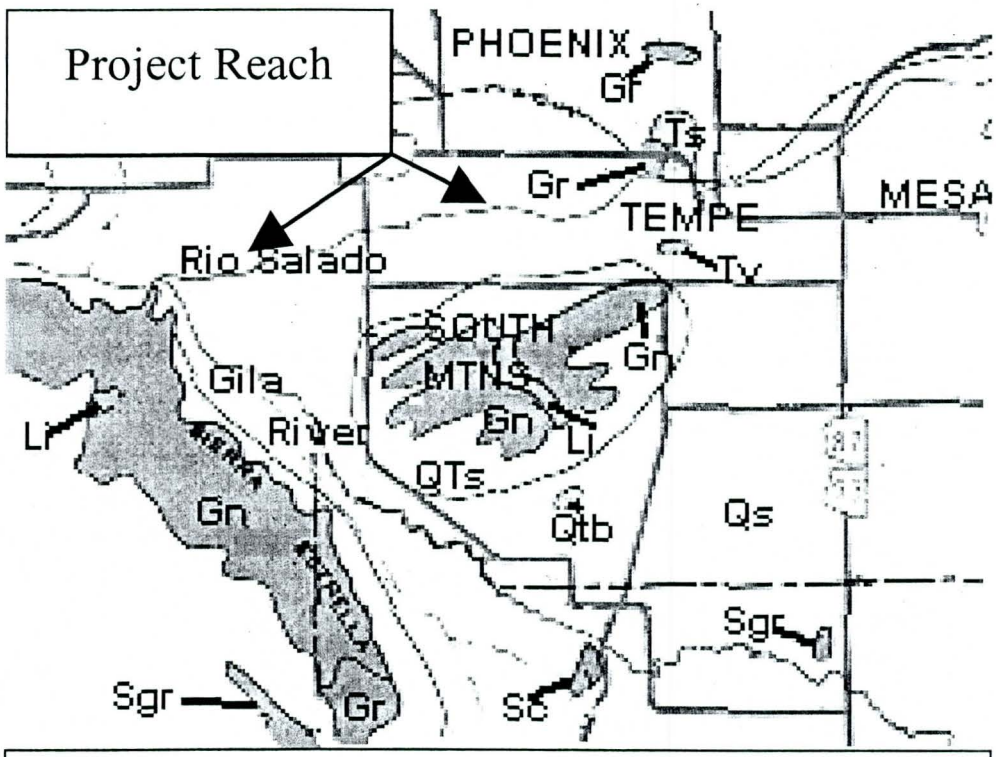

Figure 3. Geologic Map from Arizona Highway Geologic Map, Published by Arizona Geologic Society, 1967.

EXPLANATION		
Map Symbol	**Geologic Time**	**Rock Type**
Qs	Quaternary	Unconsolidated flood plain alluvium.
QTb	Quaternary	Basaltic rocks, cinder cones, dikes and necks. Includes rhyolite and andesite flows and tuffs.
QTs	Quaternary	Weakly to moderately consolidated alluvium, including Gila Group (Gila Conglomerate)in parts of central and southern Arizona. Includes terrace deposits, alluvial fans, and deposits overlying pediments of late Quaternary age. Unconformities are present in the alluvial sequence.
Ts	Middle Tertiary	Sedimentary rocks including the Hement Fanglomerate, Pantano Formation, Whitetail Conglomerate, and Locomotive Fanglomerate in southern Arizona.
Tv	Tertiary	Andesite, rhyolite, latite, dacite flows, welded tuff, and tuff.
Li	Late Cretaceous Early Tertiary	Intrusive igneous rocks consisting mainly of granite and monzonite, usually porphyritic. Laramide Orogeny.
Gr	Precambrian	Granite.
Sgr	Precambrian	Schist and granite undivided.
Sc	Precambrian	Schist, including Yavapai, Pinal and Vishunu.
Gn	Precambrian	Gneiss.

4.2 ***Geology of the Study Area.*** The geology of the Rio Salado Oeste study area is dominated by valley fills and alluvium associated with the Salt River channel. No bedrock outcrops in the project area, however, the South (Salt River) Mountains lie a few miles south of the project and are composed of Precambrian gneiss and late Cretaceous to early Tertiary granite and monzonite (see Figure 3).

The surface materials within the Rio Salado Oeste study area are Quaternary age river sediment deposited as alluvium and to a lesser extent sheet wash deposited alluvium and slope deposited colluvium. This alluvium thins in the direction of local mountains.

Sand and gravel, moderately well sorted and stratified, compose the bulk of the deposits left by the Salt River. These deposits consist of well-rounded clasts and are locally interbedded with irregular silt, sand, and clay lenses. The fine sediments are derived from overbank flows. No prominent terraces of the Salt River are present within the limits of the Rios Salado Oeste project.

Colluvium is formed of loose to well-cemented silt, sand, clay and gravel. The colluvium and alluvial deposits rest upon bedrock consisting of Tertiary sedimentary and volcanic rocks, as well as the Precambrian basement complex. The depth to bedrock in the project varies from 1200 feet on the east end of the project site to 2200 feet on the west side of the project as shown on the depth to bedrock map in Figure 4 (Corkhill 1993).

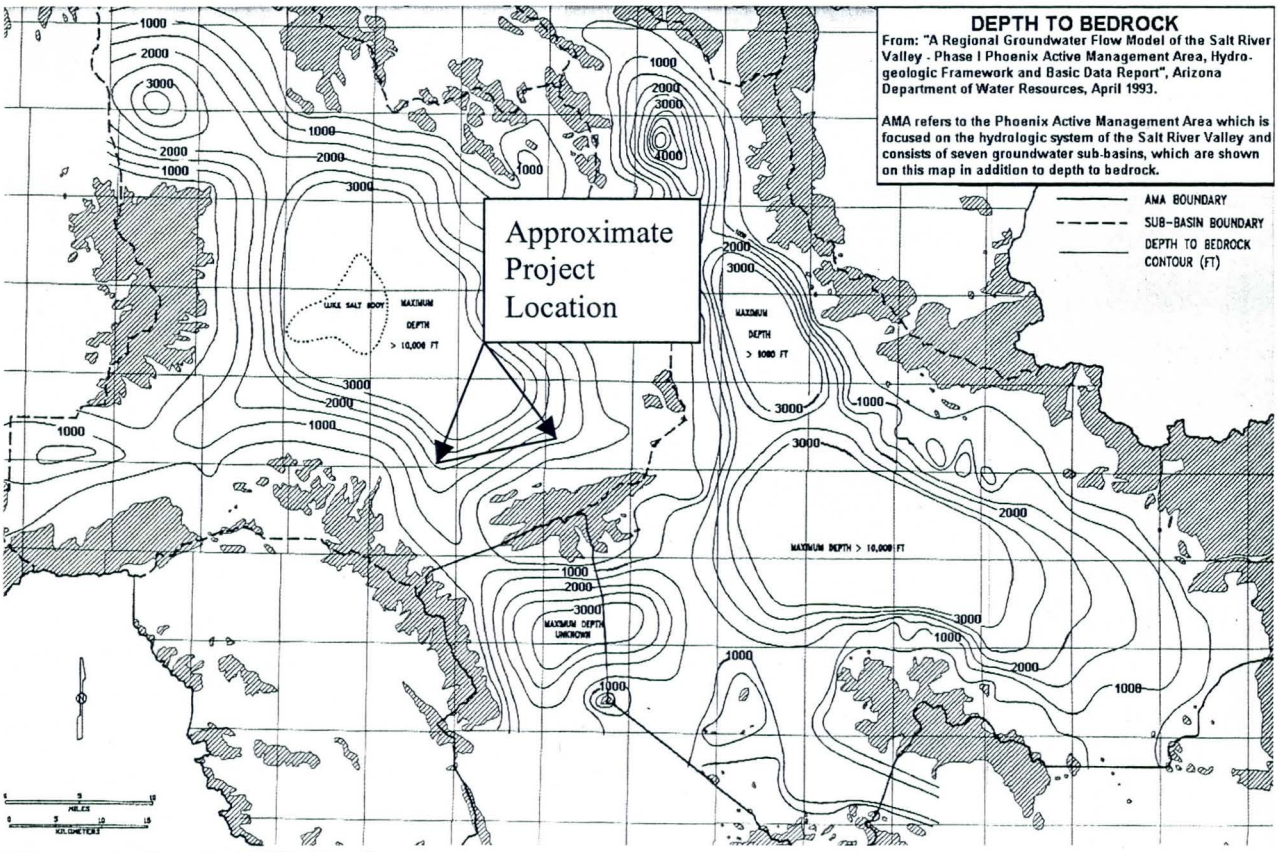

Figure 4. Depth to Bedrock.

5.0 ***Surface and Groundwater.*** The Salt River in this reach is ephemeral, flowing only in response to local flooding and releases from upstream reservoirs. Downstream from the study

area 3 ½ miles, below the confluence between the Gila River and Salt River, the Gila river flows perennially due in part to effluent from wastewater treatment plants.

5.1 ***Groundwater.*** In the Salt River valley groundwater occurs within three major and one minor hydrogeological units that are bounded below by impermeable Tertiary and Precambrian basement rocks (USEPA 1991), and to the south by the Sierra Estrella Mountains which provide a physical boundary to the alluvial aquifer and to groundwater movement. The U.S. Bureau of Reclamation, the U.S. Geological Survey, and the Arizona Department of Water Resources have independently identified the following units, although the descriptions and nomenclature used by these agencies differ slightly:

- Upper Alluvial Unit (UAU),
- Middle Alluvial Unit (MAU),
- Lower Alluvial Unit (LAU), and
- The Red Unit.

The amount of storage and flow within the units varies considerably with area and depth (USEPA 1993). The four hydrogeologic units are derived from Phoenix Basin alluvial materials. The units are described as the following (their age increasing with descending order) (ADWR 1993):

The UAU comprises all alluvial materials at the ground surface, and extends to depths over 500 feet. It varies from 100 feet to 400 feet in thickness under the Salt River, and is thinnest near mountain fronts and bedrock outcrops. The UAU varies in thickness from 250 feet to 300 feet at the project site. This unit was formed during the final stages of alluvial development of the Phoenix Basin, approximately late Pleistocene to recent (Holocene) time. It consists of unconsolidated sand, gravel, cobble and boulders with local thin interlayered beds of clay and silt. The unit is a semi-perched to unconfined aquifer that is both saturated and unsaturated.

The Salt River flows over the UAU and was once the most important source of groundwater recharge for this unit. Water within the UAU is legally referred to as subflow to differentiate it from groundwater in the MAU and LAU. Historically, surface flows from streams and washes provided most water to recharge the UAU. Presently, the minor recharge sources-such as seepage from canals and irrigated land, underflow along major streams, and rainfall-have become more important. Approximately 25% of groundwater withdrawal in the Phoenix basin is from this unit. A very large portion of the groundwater is used for agriculture, while little or none is used for drinking water purposes (Wilson 1991).

The MAU underlies the UAU. At the project site the MAU's contact with the LAU varies from 550 feet to 1280 feet below ground surface. The thickness of the unit at this location varies from 300 feet to 1100 feet. The MAU was formed during the middle stages of alluvial development of the Phoenix Basin, approximately late Tertiary to late Pleistocene time. Unit lithology consists of weakly cemented interlayered beds of clay, silt, sand and gravel. This unit is a semi-confined saturated aquifer comprised of more than several discontinuous semi-confining layers that consist predominantly of silt and clay (USEPA 1993). Approximately 50% of the groundwater production in the Phoenix basin is withdrawn from this unit, most of it used for agriculture. A smaller portion of the groundwater is used for drinking water purposes (Wilson 1991).

The LAU underlies the MAU and the depth to the contact between the LAU and bedrock in the project reach varies from 1750 feet to 2380 feet. The thickness of the unit in this area is from 900 feet to 1100 feet. This unit was formed during the early stages of alluvial development of the Phoenix basin, approximately late to middle Tertiary time. Unit lithology consists of weakly to strongly cemented gravel, boulders, sand, sandy clay, silty sand and interlayered beds of clay. This unit is a semi-confined saturated aquifer comprised of more than several discontinuous semi-confining layers that consist predominantly of clay and mudstone. Approximately 25% of groundwater production in the basin is withdrawn from this unit, the largest portion being used for agriculture. A smaller portion of the groundwater is used for drinking water purposes (Wilson 1991).

The LAU contains a direct or fault contact with the Red Unit at an unknown depth. The Red Unit is included in the LAU and was formed during the earliest stages of alluvial development of the Phoenix basin, approximately late Miocene (Tertiary) time. The Red Unit lithology consists of debris flow materials comprised of reddish well-cemented breccia, conglomerate, sandstone and siltstone rock. The Red Unit is a saturated aquifer and it is not know whether it is confined or unconfined. Aquifer characteristics for the Red Unit are unknown, except that it's groundwater likely originates from within faults and fracture zones within bedrock (ADWR 1993).

Groundwater movement and connection within all three of the upper alluvial units is mostly lateral and somewhat vertical. Vertical groundwater flow occurs through a combination of leakage through all three unit geologic contacts and through water wells that extend vertically across more than one unit.

Within the Phoenix basin, before development, groundwater flowed toward the Salt River and along the river westward, generally following the topography of the land surface. Near Tempe and Buckeye, bedrock constrictions force water to the surface.

The current groundwater conditions are complex and dominated by drawdown from pumping centers and recharge from agricultural irrigation, canals and flood events (ADWR 1993). Long term regional pumping has led to a groundwater divide in the east Phoenix and Tempe area of the basin. Groundwater in the west Salt River valley flows towards two large groundwater depressions. One is north of Glendale (20 miles north of the project) and one is west of Luke Air Force Base (16 miles northwest of the project site). The 1993 ADWR report had a detailed groundwater map from 1983 data that showed groundwater in the project reach flowed toward the northwest. The Groundwater Quality and Hydrogeology Report for the Rio Salado Oeste Project (URS April 2002), which compiles 1997 groundwater data, shows a generally northward trend of groundwater flow in the eastern portion of the study reach from the upstream end of the project until 30th Avenue. Downstream from 30th Avenue groundwater flow ranges from the west to northwest.

5.2 ***Depth to Groundwater.*** According to the April 2002 URS report, the average depth to shallow groundwater in the project area ranges from 20 to 50 feet below ground surface in the channel and from 60 to 80 feet below ground surface north and south of the riverbed.

6.0 ***Soils.*** Soils in the study area have been mapped in great detail by the Natural Resources Conservation Service (NRCS) (formerly called the U.S. Soil Conservation Service) on aerial photographs at a scale of 1:20,000 (U.S. Soil Conservation Service, 1974 and 1977). These maps provide a view of soil conditions in and near the river channels in the early 1970's. Since

that time, conditions in the channels have changed in many areas, but the floodplain and terrace soils have remained generally unchanged. The soils in the vicinity of the river channels in the study area are of the hypothermic torrifluvents association, a group of soils that are well-drained to excessively well-drained on nearly level or gently sloping surfaces. The area soils are often sandy to gravelly, may include lenses of finer particles, and are often redistributed by water flows associated with nearby active channels.

7.0 ***Hazards.*** Geologic hazards that were considered in this report are seismicity and subsidence. Hazardous and/or Toxic Wastes (HTW) are considered in the Modified Phase I Environmental Site Assessment Rio Salado Oeste Project.

7.1 ***Seismicity.*** Faults in central Arizona are generally short, discontinuous normal faults, some of which displace Quaternary formations. Most of these faults are within the Jerome-Wasatch Structural Zone, a 50-mile-wide band that extends from Utah to Mexico. In Arizona, the zone includes the Main Street Fault in the northwest corner of the state and the Verde Fault about 50 miles north of Tempe. Both of these faults are considered to be potentially active.

Near the study area to the east, a zone (¼ mile wide) of exposed, Tertiary age inactive normal faults, exists immediately north of Tempe Butte gap. The zone trends northwest to southeast, and extends northwestward for a distance of 2.7 miles. An east to west trending (1.1 miles long) Tertiary age fault lies concealed below the alluvium, in the middle of the Salt River, at Tempe Butte Gap, 9 miles east of the upstream end of the study area.

The proposed project is in an area of low seismicity as referenced in Zone 1 of the Seismic Zone Map of the Contiguous States (U.S. Army Corps of Engineers, 1983). About 30 earthquakes with maximum epicentral intensities between II and VI on the Modified Mercalli Intensity Scale (MM) have occurred within a 100-mile radius of the project area from 1870 through 1980 (I-III represent slight shaking, IV-VI represent non-damaging, widely perceptible shaking). The largest of these known earthquakes occurred southeast of Ajo in 1961, northeast of Globe in 1969, and northwest of Prescott in 1976. The 1961 event, 82 miles from the project area, had a Richter magnitude of 4.7. The 1969 event, 95 miles from the project area, had a Richter magnitude between 4.4 and 5.1. The 1976 event, 90 miles from the site, had a Richter magnitude of 5.1.

The largest known earthquake to occur in Arizona was of Richter magnitude 5.7 recorded in 1959 near Fredonia, 240 miles from the project area. The seismic historical record for the last 124 years indicates that only one major damaging earthquake (1887 Sonora, Mexico) has occurred and was located outside the 100-mile radius. This earthquake measured a Richter magnitude of 7.2, and was located more than 255 miles from Tempe, AZ, causing rockfalls (MM VI) in the project area. The most recent (1974) regional events, the "New River earthquakes", located 37 miles northeast of the project area, had recorded Richter magnitudes of 2.5 and 3.0.

Because of the relatively low and infrequent seismic activity in and near the study area, it is not expected that strong earthquake motions will have any effect this project.

7.2 ***Subsidence.*** Ground failure in the form of (pumping) subsidence and earth-fissures has occurred in areas of the Phoenix basin. Typically groundwater has declined 100 feet in land subsidence areas. The closest ground failure occurrences to the Rio Salado Oeste area is near Luke Air Force Base, 12 miles north-northwest from the project area, where 1 to 3 feet of subsidence has been measured.

Available information suggests that subsidence in the project area has not occurred in the past and there is very little potential for subsidence to occur in the future. Therefore, subsidence is not projected to influence design or operation of the Rio Salado Oeste project.

8. ***Sources of Construction Materials.*** Two stone borrow sites have been identified as sources of construction material and may be available for potential use to a contractor. Two quarries have produced stone for previous Corps flood control projects at the Arizona Diversion Canal and Indian Bend Wash areas. Stone from both quarries exhibit a good service record and passed all rock quality compliance tests. The quarries are:

Sun State Rock and Materials Corp.
-located 115th Ave. and E. Beardsley Rd, Phx, AZ
-passed rock 1990 quality tests
-passed 1994 visual inspection
-rock type: granite
1-877-566-3304

Salt River Sand & Rock Company
-located at Dobson & McKellips Rds, Phx, AZ
-passed 1994 rock quality tests
-passed 1994 visual inspection
-rock type: green schist
480-990-1987

9. ***Design Considerations.*** The roller compacted concrete mix and details of the liners will be determined during the Planning, Engineering, and Design (PED) Phase.

10. ***Construction Considerations.*** Conventional construction equipment can be used to construct the project features. The diversion and control of water requirements are minimal due to the ephemeral nature of the Salt River. Dewatering will be required to construct the grade control structure upstream of 35th Avenue.

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US Army Corps of Engineers
Los Angeles District

RIO SALADO OESTE
F4 MILESTONE
Salt River-Phoenix, Arizona

Appendix F
Modified Phase I Environmental Site Assessment

March 2005

U.S. ARMY CORPS OF ENGINEERS, LOS ANGELES DISTRICT
PLANNING DIVISION, WATER RESOURCES BRANCH
P.O. BOX 532711
LOS ANGELES, CALIFORNIA 90053-2325

URS

REPORT
MODIFIED PHASE I ENVIRONMENTAL SITE ASSESSMENT
RIO SALADO OESTE PROJECT
IN PHOENIX, ARIZONA
FOR
THE CITY OF PHOENIX

URS No. E1-00001727.15
August 5, 2002

URS

August 5, 2002

Mr. Donn Stoltzfus
City of Phoenix
Office of Environmental Programs
200 West Washington Street, 14th Floor
Phoenix, Arizona 85003-1611

Re: Report
Modified Phase I Environmental Site Assessment
Rio Salado Oeste Project
In Phoenix, Arizona
for the City of Phoenix
URS Job No. E1-00001727.15

Dear Mr. Stoltzfus:

In accordance with our proposal to the City of Phoenix, dated February 4, 2002, URS has completed the Modified Phase I Environmental Site Assessment for the Rio Salado Oeste Project located along the Salt River from 19th to 83rd Avenues in Phoenix, Arizona. The attached report summarizes the findings of this assessment.

We are pleased to be of service to the City of Phoenix. Should you have any questions or if we may be of some additional service, please contact URS at (602) 371-1100.

Sincerely,

URS

MBurrus

Marianne Burrus
Project Environmental Scientist

Robert J. Petrisko

Robert J. Petrisko
Environmental Assessment Manager
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MB/RJP/tc

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TABLE OF CONTENTS

		Page
1.0	INTRODUCTION	1
	1.1 PURPOSE AND SCOPE OF WORK	1
	1.2 LIMITING CONDITIONS	3
	1.3 LIMITATIONS OF THE PHASE I ESA	4
2.0	SITE DESCRIPTION	4
	2.1 PHYSICAL LOCATION AND DESCRIPTION OF PROPERTY	5
	2.2 ENVIRONMENTAL SETTING	5
	2.2.1 Topography	5
	2.2.2 Geology	5
	2.2.3 Hydrology	6
	2.2.4 Soils	6
3.0	SITE RECONNAISSANCE	6
	3.1 GENERAL CONDITIONS	7
4.0	HISTORICAL AERIAL PHOTOGRAPH REVIEW	8
	4.1 FINDINGS	21
5.0	REGULATORY AGENCY REVIEW	23
6.0	PREVIOUS REPORT REVIEW	37
7.0	CONCLUSIONS AND RECOMMENDATIONS	38
	7.1 CURRENT AND HISTORICAL AERIAL PHOTOGRAPHS	38
	7.2 REGULATORY AGENCY REVIEW	39
8.0	REFERENCES	40

LIST OF FIGURES

1 Land Use Map
2 EDR Map of Regulatory Sites

LIST OF APPENDICES

A EDR Database Report
B Summary of Sites by Regulatory Database
C Report - Environmental Contaminants in Fish and Wildlife of the Lower Gila River, Arizona

1.0 INTRODUCTION

The U.S. Army Corps of Engineers (USACE) and the City of Phoenix (the City) have initiated a feasibility study of the Rio Salado Oeste Project area for the purpose of evaluating the design and completion of a riparian habitat restoration project. The project site actually lies within the Salt River between 19th Avenue on the east and 83rd Avenue on the west in Phoenix, Maricopa County, Arizona. However, the north and south study boundaries for this report will be approximately Durango Street and Southern Avenue for the eastern portion, and Broadway Road and Baseline Road for the western portion, respectively. URS was retained by the City of Phoenix to conduct a Modified Phase I Environmental Site Assessment (ESA) for the Rio Salado Oeste Project (the "site" or "subject property"). This Modified Phase I ESA was conducted in accordance with URS' proposal to the City of Phoenix, dated February 4, 2002.

1.1 PURPOSE AND SCOPE OF WORK

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 by the City to be most appropriate for the size of the project. The basic difference being that a site reconnaissance of every property within the project area would not be conducted, or feasible. 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. Due to the size of the project study area and the proposed scope of work, this report will vary slightly from the methods and procedures described in the American Society for Testing and Materials (ASTM) *Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process* published September 2000 (Standard Designation E 1527-00).

ASTM Standard E 1527-00 defines a "recognized environmental condition" as the presence or likely presence of hazardous substances or petroleum products on a property under conditions that indicate an existing release, a past release, or a material threat of a release into structures, ground, groundwater, or surface water on the subject property. The term includes hazardous substances or petroleum products even under conditions in compliance with laws. The term is not intended to include de minimis conditions that generally do not present a material risk of harm to public health or the environment and that generally would not be the subject of an enforcement action if brought to the attention of appropriate governmental agencies.

This Modified Phase I ESA will focus on a broader aspect than identifying a specific "recognized environmental condition". The tasks completed for this project will identify

properties or areas of potential contamination and discuss steps for identifying recognized environmental conditions associated with each property (i.e. ASTM Phase I ESA, further document review, Phase II Investigation). The conclusions presented in this report are qualified by URS' judgement as low, medium, or high, for the potential of significant environmental contamination to exist in an area (or specific property) and is based on URS' experience in Arizona.

The Modified Phase I ESA was accomplished by, and limited to, a visual reconnaissance of the site from existing right-of-ways 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 report consists of two volumes labeled *Volume I – Report* and *Volume II – Aerial Photographs*. Volume I consists of the main report which includes the narrative description of aerial photographs, review of regulatory databases, findings, conclusions, and recommendations. Volume II consists of copies of all aerial photographs reviewed for the project. 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. URS' scope of services for the environmental assessment included the following elements:

- Review aerial photographs and update the portion of the Oeste study area from 17th to 51st Avenue that was originally conducted by URS (formerly Dames & Moore) in August 1998.

- Review aerial photographs for the portion of the Oeste project not previously discussed; 19th to 27th Avenues and 51st to 83rd Avenues. Available aerial photographs will be examined and discussed in narrative form to identify current and previous land use as well as potential sites of environmental contamination.

- 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 ASTM. All databases were extended out approximately 1 mile from the Salt River centerline to include the project corridor study area (or "buffer" area):

Federal NPL site list
Federal CERCLIS list
Federal RCRA CORRACTS TSD facilities list
Federal RCRA non-CORRACTS TSD facilities list
Federal RCRA generators list
Federal 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 leaking UST lists
State registered UST lists

- Review previous environmental reports conducted within or relating to the Oeste study area, including the "Middle Gila River Watershed Management Study Phase 2 GIS Database Update and Functionality Enhancement", prepared by Greeley and Hanson, and the "Environmental Contaminants in Fish and Wildlife of the Lower Gila River, Arizona" report, prepared by the U.S. Fish and Wildlife Service.

- Performance of an onsite visual reconnaissance of the subject property and the area within a 1-mile radius of the Salt River centerline to make visual observations of existing site conditions, activities, and types of land use and businesses within the project corridor area. URS also used this reconnaissance to field verify some of the more predominant identified sites.

- Preparation of a final report describing the research performed and presenting URS' findings and professional opinion regarding properties of potential contamination and a discussion of further steps for identifying recognized environmental conditions associated with areas and/or facilities.

1.2 LIMITING CONDITIONS

It was not the intent of URS to conduct a field reconnaissance of the entire subject property corridor and 1-mile buffer area as part of our scope of work. Our visual site reconnaissance was conducted to help interpret aerial photographs and to verify some of the more environmentally predominant sites in the area. Because URS was not granted Rights-of-Entry for any of the properties, our visual reconnaissance was conducted from right-of-ways and public areas.

1.3 LIMITATIONS OF THE PHASE I ESA

The Modified Phase I Environmental Site Assessment was prepared in accordance with the Scope of Work described in URS' proposal to the City of Phoenix, dated February 4, 2002. The work conducted by URS is limited to the services agreed to in the proposal and no other services beyond those explicitly stated should be inferred or are implied.

The findings and conclusions presented in this report are professional opinions based solely upon URS' visual observations of the site, and upon URS' interpretations of the readily available historical information, and other readily available information, as referenced in the report. These conclusions are intended exclusively for the purpose stated herein, at the site indicated, and for the project indicated.

The information provided by URS is for the exclusive use of City of Phoenix and U.S. Army Corps of Engineers. The scope of services performed during this investigation may not be appropriate for other users, and any use or re-use of this document, or the findings, conclusions, or recommendations presented herein is at the sole risk of said user.

This study was not intended to be a definitive investigation of possible contamination within the subject property corridor and buffer area. The purpose and scope of this investigation was to determine if there is reason to suspect the possibility of contamination from properties or facilities within the site vicinity. No specific site reconnaissance, exploratory borings, soil or groundwater sampling, or laboratory analyses were performed within the subject property corridor or buffer area and, therefore, the conclusions set forth herein are made without the benefit of such investigation.

This report is intended to be used in its entirety. No excerpts may be taken to be representative of the findings of this assessment.

Opinions and recommendations presented in this report apply to site conditions and features as they existed during the course of this project, and those reasonably foreseeable. They cannot necessarily apply to conditions, features, or information of which URS is unaware and has not had the opportunity to evaluate.

2.0 SITE DESCRIPTION

Information concerning the subject property presented in the following subsections is based on a review of readily available published information and a field visit of the general subject property corridor area conducted on March 5, 2002.

2.1 PHYSICAL LOCATION AND DESCRIPTION OF PROPERTY

The Rio Salado Oeste site actually lies within the Salt River between 19th Avenue on the east and 83rd Avenue on the west in Phoenix, Maricopa County, Arizona. For purposes of this study, the north and south boundaries (or "buffer" area) will be approximately Durango Street and Southern Avenue for the eastern portion, and Broadway Road and Baseline Road for the western portion, respectively. The entire subject property is located within the following township, range, and sections of the Gila and Salt River Base Meridian;

Township 1 North, Range 2 East, Sections 13-15 and 19-32.
Township 1 North, Range 1 East, Sections 23-26, 35, and 36.
Township 1 South, Range 1 East, Section 2.

2.2 ENVIRONMENTAL SETTING

Environmental characteristics including topography, geology, and hydrogeology were evaluated based on site observations, published literature, and maps.

2.2.1 Topography

According to the United States Geological Survey (USGS) Phoenix and Fowler, Arizona 7.5-minute topographic quadrangle maps (1952, photorevised 1982), the elevation of the subject property is approximately 1,100 feet above mean sea level in the east and approximately 980 feet in the west. The general direction of surface water flow along the subject property is to the west.

2.2.2 Geology

The site is located in the Salt River Valley. The Salt River Valley is a broad alluvial basin within the Basin and Range physiographic province. The basin is almost completely surrounded by mountains composed primarily of granitic, metamorphic, and volcanic rocks and minor amounts of consolidated sedimentary rocks. The valley floor is underlain by unconsolidated to semiconsolidated basin-fill sediments. In the eastern part of the Salt River Valley area, sedimentary deposits form the main water-bearing units and consist mainly of unconsolidated and weakly consolidated clay, silt, sand, and gravel. The main water-bearing unit ranges in thickness from a few tens of feet near the mountains to more than 1,200 feet in the central part of the area (Cooley, 1973).

2.2.3 Hydrology

According to B.A. Hammett and R.L. Herther's *Maps Showing Groundwater Conditions in the Phoenix Active Management Area, Maricopa, Pinal and Yavapai Counties, Arizona - 1992,* and based on information obtained for this report, the general depth to groundwater in the area of the subject property is approximately 60-70 feet below ground surface. Although certain areas of the eastern portion of the subject property do experience heavy pumping activity 8 months out of the year, the overall general direction of groundwater flow in the vicinity of the subject property appears to be to the west.

Because the subject property is located in and along the Salt River, it is expected that it would be located within the boundaries of a 100-year floodplain. Consequently, the subject property is depicted within a 100-year floodplain according to the following Flood Insurance Rate Map Nos.; 04013C2115-E, 04013C2120-E, and 04013C2140-E, all dated July 19, 2001, published by the Federal Emergency Management Agency (FEMA).

2.2.4 Soils

URS reviewed readily available reference material providing soil types for Maricopa County. According to the U.S. Department of Agriculture Soil Conservation Service, naturally occurring on-site surface soil consists primarily of Carrizo and Brios soil in the Carrizo Series (USDA, 1977). These soils are in or adjacent to channels of the Salt River. It is bisected by small stream channels and old meander cutoffs. Once every 5 to 20 years the lower lying areas are flooded. Flooding changes the soil material and occasionally the course of the main channel. Generally this mapping unit is typically a combination of Carrizo, Brios, and Vint soils. The Carrizo soil is usually in the lowest position nearest the stream channel, the Vint soil along the outer rim, the Brios soil in the intermediate position.

The engineering classifications of the soils are also found in the USDA 1977 publication. The Brios soil is classified as a sand and very gravelly sand (SP). The Carrizo soil is classified as a very gravelly coarse sand (SW-SM) to a very coarse sandy gravel (GW-GM). The Vint soil is classified as a loamy fine sand (SM).

3.0 SITE RECONNAISSANCE

URS conducted a preliminary site reconnaissance at the commencement of this project to become familiarized with the type of properties associated with the project study area. URS traversed the major (and some of the minor) streets and roads along the north and south sides of the Salt River from 19th Avenue to 83rd Avenue. The intent of this reconnaissance was not to

observe specific properties or features, but rather to gain insight into the general existing conditions and types of properties within the project study area.

3.1 GENERAL CONDITIONS

URS viewed the project study area to observe and understand basic land use within the following seven categories; Residential, Commercial/Industrial, Landfill, Sand/Gravel Operation, Agricultural, Recreational (i.e. public parks), and River Bottom/Native (see Figure 1). To remain consistent with our historical aerial photograph review of land use, the project study area was divided into four separate portions of land; 19th - 35th Avenue, 35th - 51st Avenue, 51st - 67th Avenue, and 67th - 83rd Avenue. The following is a brief summary of general land use activities based on existing data and a preliminary reconnaissance of the project area (as shown on Figure 1 at the end of this report).

19th Avenue - 35th Avenue

Sand and gravel operations line the Salt River with no remaining native river bottom. Commercial/industrial properties flourish in this area both north and south of the river. The 27th Avenue Landfill lies north of the river bottom in an area almost surrounded by commercial/industrial properties. Only a small portion of land is occupied by residential and/or agricultural land. The following percentages are estimated for land use categories within this portion of the project study area; Residential - 3%, Commercial/Industrial – 43%, Landfill - 6, Sand/Gravel Operation - 22%, Agricultural - 26%, Recreational - 0.5%, and River Bottom/Native - 0%.

35th Avenue - 51st Avenue

Major sand and gravel operations exist in and along the Salt River with almost half the river remaining native. Large areas of commercial/industrial properties exist primarily on the north side of the river, leaving more residential properties to the south of the river. Agricultural properties are fairly sparse. The following percentages are estimated for land use categories within this portion of the project study area; Residential - 16%, Commercial/Industrial - 31%, Landfill - 0%, Sand/Gravel Operation - 26%, Agricultural - 8%, Recreational - 0%, and River Bottom/Native - 19%.

51st Avenue - 67th Avenue

Sand and gravel operations remain in and along a large portion of the Salt River with almost half the river remaining native. Almost no commercial/industrial properties exist. Although there are small pockets of residential land north and south of the river, the majority of land is still used for

agricultural purposes. The following percentages are estimated for land use categories within this portion of the project study area; Residential - 17%, Commercial/Industrial - 2%, Landfill - 0%, Sand/Gravel Operation - 17%, Agricultural - 38%, Recreational - 4%, and River Bottom/Native - 22%.

67th Avenue - 83rd Avenue

Sand and gravel operations continue to exist in and along some areas of the Salt River with a small portion remaining native. Few commercial/industrial properties exist. However, some do lie along the southern bank of the river. Although there is a small pocket of residential land north of the river, the majority of land is still used for agricultural purposes. The following percentages are estimated for land use categories within this portion of the project study area; Residential – 7 percent, Commercial/Industrial – 12 percent, Landfill – 0 percent, Sand/Gravel Operation – 23 percent, Agricultural – 49 percent, Recreational – 0 percent, and River Bottom/Native – 9 percent.

4.0 HISTORICAL AERIAL PHOTOGRAPH REVIEW

URS conducted a review of available aerial photographs to discuss and describe changes in land use within the project study area. Because of the quality and extensive coverage available at Landiscor Aerial Photography, URS concentrated our review efforts there. The review of aerial photographs included the entire project study area from 19th Avenue (on the east) to 83rd Avenue (on the west) with north and south boundaries of approximately Durango Street and Southern Avenue (for the eastern portion) and Broadway Road and Baseline Road (for the western portion), respectively. Available aerial photographs examined and discussed herein consisted of 1962 to 2002 and are contained in Volume II of this report. URS has included approximately every other year starting with 1962 and continuing until 2002. Additionally, for ease of viewing the included photographs, URS has included an overlay approximately every ten years. Because of scaling difficulties encountered by the laboratory, the overlays may have to be realigned for proper boundary placement in order to view each subsequent photograph.

The aerial photograph review consisted of viewing a photograph and then comparing it to the next available photograph in chronological sequence. Notations were made regarding changes in land use similar to the seven categories previously discussed. Specific industrial activity or land use was noted when it could be confidently identified (i.e. salvage yard, landfill, etc.) although many of the commercial/industrial activities were left unidentified (i.e. industrial complex). Because of the expanse of area covered by this project, it was not feasible to identify and record every single development or change in property that occurred. Consequently, general statements

may be made for some properties or areas that may not specifically coincide with the exact year of a photograph.

URS compiled the information according to the year of the photograph and its location within the project study area. Because of the overall size of the study area, URS divided the area into four separate portions of land consisting of approximately two miles long each; 19th - 35th Avenue, 35th - 51st Avenue, 51st - 67th Avenue, and 67th - 83rd Avenue. Within each two-mile portion of land, the area was then subdivided into quarter sections as described in the City of Phoenix Quarter Section Index Map. Basically, any given Section (1-mile square) within a Township and Range location can be divided into four quarter-sections with each of these quarter-sections already assigned a specific number (i.e. the four numbers assigned to Section 26 of Township 1 North, Range 2 East are 3-9, 3-10, 4-9, and 4-10). For discussion purposes in the narrative descriptions below, the word "quarter-section" will be denoted as QS.

19th Avenue to 35th Avenue (inclusive of Township 1 North, Range 2 East, Sections 13, 14, 23-26)

3-21 (North half of QS only); The land has been utilized primarily for agricultural purposes from 1962-2002.

3-22 (North half of QS only); The land has been utilized primarily for agricultural purposes from 1962-2002.

3-23 (North half of QS only); The land has been utilized primarily for agricultural purposes from 1962-2002.

3-24 (North half of QS only); The land has been utilized primarily for residential purposes from 1962-2002.

4-21; A racetrack (currently Manzanita Speedway) has been visible in the northwest corner of the QS from 1962-2002. Additionally, a small commercial facility has also been visible on the corner of Broadway Road and 35th Avenue from 1962-2002. Auto salvage yards begin appearing in the northeast quarter of the QS in the early-1970s and greatly expand throughout the 1970s, 1980s, and 1990s while remaining visible in 2002. The southern half of the QS is utilized for agricultural purposes from 1962-2002 with sand/gravel removal/operations occurring in the southeast corner from 1998-2002.

4-22; The land is utilized primarily for agricultural purposes with auto salvage yards along the northern edge (Broadway Road) of the QS from 1962 to the early-1980s. By the mid-1980s, some of the agricultural land has gone fallow with sand and gravel removal occurring in the

southern half of the QS. By the early-1990s, the QS has become entirely occupied by sand/gravel removal, auto salvage yards (along the northern edge), and areas of fallow agricultural land.

4-23; From 1962 to 1974, the QS is utilized for agricultural purposes. In 1976, the QS remains agricultural with two small commercial-type facilities now visible along Broadway Road. Through the remainder of the 1970s and 1980s, the northern portion of the QS expands with more commercial-type facilities and salvage yards while the remainder of the QS continues as agricultural up to 2002. However, an oval-shaped depression is visible in the southeast corner of the QS from 1982 to 2002 and appears to possibly be used as a dump with only a single structure visible.

4-24; The QS is primarily utilized for agricultural and residential purposes from 1962 to 1976. In 1978, several auto salvage yards begin to appear in the northwest quarter of the QS and expand further south up until 2002. Some remaining agricultural land is still visible but has slowly turned fallow through the years.

5-21; In 1962, the QS contained light industrial storage in the western quarter section and small sand/gravel pits in the southern half of the QS. In 1964, an industrial building along 35th Avenue was noted. An auto salvage yard was identified on 35th Avenue in 1966 until it was destroyed by flooding sometime in 1968. In the early-1970s, an auto salvage yard was identified on the north side of Broadway Road with interspersed small sand/gravel pits. By 1975, the salvage yard had expanded covering the older gravel pits. Throughout the 1980s and 1990s, the salvage yards continued operation in the south half of the QS as small sand/gravel pits were noted in the northern half.

5-22; North half of QS; Sand/gravel removal/operations seem quite prevalent throughout most of the river bottom from 1962 to 1996. By 1998, a large portion of these operations were flooded by water with continued sand/gravel removal occurring immediately surrounding the flooded areas through 2002.

South half of QS; Commercial-type facilities (auto salvage yards) line the southern edge of the QS along Broadway Road from 1962 to 2002.

5-23; North portion of QS; Although some minor sand/gravel removal occurred in the river bottom in the northern portion of the QS in the 1970s (with subsequent flooding in the early-1980s), a large expanse of sand/gravel removal occurred in the QS and in the entire area in the late-1980s, before being once again flooded through the 1990s. By 2000, the northern portion of the QS was utilized primarily as roads leading to nearby sand/gravel pits.

South portion of QS; Commercial/light industrial facilities line Broadway Road from 1962 to the mid-1970s. By 1978, it became apparent that most of the properties were now auto salvage yards that have remained along the bottom one-third of the QS to 2002.

5-24; Extensive sand/gravel removal/operations occurring in the northern half of the QS from 1962 to 2002. Based on the equipment/machinery observed in the photographs, there is likely a cement batch plant on-site also.

Commercial/light industrial/storage yard-type facilities along Broadway Road are visible in 1962 and appear to increase and expand with auto salvage yards in the early-1970s. By the mid-1980s, the salvage yards dramatically increase with junk that remains visible to 2002. One of the facilities located in the southeast corner of the QS constructs a larger building by 1994 which remains visible to 2002.

6-21; North half of QS; Land is utilized primarily for agricultural purposes from 1962 to 1974. By 1976, sand/gravel removal of the north half of the QS was visible for the initial stages of the 27th Avenue Landfill. By 1982, landfill activity began while an auto salvage yard was noted in the northwest corner of the QS with additional industrial properties visible along the western edge. By the early-1990s, the landfill appeared to be capped while industrial facilities and the auto salvage yard remained active along the western edge of the QS through 2002.

South half of QS; The south half of the QS consists of a large (effluent) recharge basin from the 27th Avenue Wastewater Treatment Plant (located to the northeast). The basin appears wet and dry throughout the years from 1962 to the mid-1980s. It then appears to remain (dry) dormant through 2002.

6-22; North half of QS; Land is used in part for agricultural purposes with a portion appearing as native river bottom from 1962 to 1974. By 1976, sand/gravel removal of the north half of the QS was visible for the initial stages of the 27th Avenue Landfill. By 1982, landfill activity was visible and by the early-1990s, the landfill appeared to be capped.

South half of QS; The south half of the QS consists of a large (effluent) recharge basin from the 27th Avenue Wastewater Treatment Plant (located to the northeast). The basin appears wet and dry throughout the years from 1962 to the mid-1980s. It then appears to remain (dry) dormant through 2002. However, a large industrial facility was visible in the southeast corner of the QS from 1993 to 2002.

6-23; North half of QS; Wastewater treatment ponds associated with the (adjacent) 27th Avenue Wastewater Treatment plant are visible in the north-central and northeast corner of the QS from

1962 to 2002. The northwest corner of the QS consists of sand/gravel removal activities in the 1960s before turning into a disorganized-type property with numerous buildings and heavily stained soil visible from 1970 to 2002.

South half of QS; The south half of the QS consists basically of native river bottom with two man-made drainage channels visible in the 1960s and 1970s; one leading from the wastewater treatment pond area and one leading from an adjacent (QS 6-24) storage lot and facility first visible in the 1960s. A road is later visible in the mid-1970s transecting one of the drainage channels. Large sand/gravel pits are prevalent in the 1980s and 1990s as one of the drainage channels still appears visible in 2002.

6-24; The starting point of a man-made drainage channel is located in the western portion of this QS and remains visible from 1962 to 2002. In 1962, the following additional observations were made; several yards (auto salvage, construction, industrial) are located along the eastern portion of the QS (west side of 19th Avenue), sand/gravel removal is occurring along the western half of the QS, and a storage area for trailers is noted in the center of the QS.

By 1966, the sand/gravel operations were replaced by a new facility in the northwest quarter of the QS, while the northeast quarter has expanded with a larger storage yard and more structures. However, sand/gravel operations now expand into the southeast corner of the QS.

By 1972, the entire east portion of the QS is filled with various facilities and yards, including one near the center that stretches ¼-mile from north to south. By 1978, the ¼-mile long facility yard now stretches west.

In 1982, a new (large) building is visible in the north-central portion and the entire QS is filled with numerous commercial/industrial facilities, yards, and buildings. Sand/gravel removal continues to occur along the southern edge of the QS while the remainder of the QS continues with ongoing industrial activities through 2002.

7-21 (South half of QS only); The land has been utilized primarily for agricultural purposes from 1962-2000. By 2002, three large facilities were visible in the southeast quarter of the QS with continued construction/development occurring in the south-central portion and agricultural land remaining in the southwest portion of the QS.

7-22; (South half of QS only); Land primarily utilized for agricultural purposes from 1962 to 1996, then becoming fallow between 1998 to 2000 and finally appearing graded in the 2002 photograph.

7-23; (South half of QS only); The west half of the QS is utilized for agricultural purposes from 1962 to 2002. The east half of this QS contains a large wastewater treatment plant with numerous ponds, buildings, and structures (including aboveground storage tanks) visible from 1962 to 2002. Although the lay-out and design of the ponds have changed throughout the years, the wastewater treatment plant has occupied the east half of this QS from 1962 to 2002.

7-24; (South half of QS only); Although some farm-type homes/properties existed in the northeast corner of the south half, the area appeared somewhat industrial in nature beginning in the 1960s, containing several large buildings and a portion of the wastewater treatment plant facilities along the western edge of the QS. By the late-1970s, the western portion contained more paved-type of facilities, whereas the eastern portion contained open-ground properties with dark soil staining, which remained visible into the late-1990s. By 2000, several facilities occupied the QS with large areas now covered by paved parking lots and unpaved storage yards.

35th Avenue to 51st Avenue (inclusive of Township 1 North, Range 2 East, Sections 15, 21, 22, 27, and 28)

3-17; Land is primarily utilized for agricultural purposes from 1962 to 1980. In 1982, commercial activity appears to begin along the western half of the QS. By 1994, a large portion of the agricultural land becomes fallow and by the late-1990s, is used for sand/gravel removal.

3-18; The land is a mixture of agricultural land and residential properties from 1962 to the late-1970s. Some of the properties then become commercial. By the late-1980s a mixture of agricultural land, residential and commercial properties are prevalent, especially in the northeast corner and along the southern edge of the QS. The northern tip of the QS contains a portion of an industrial facility (elongated buildings) from 1982 to 2002.

3-19; (North half of QS); The land is utilized primarily for agricultural purposes in to the late-1960s until residential homes begin development in the early-1970s. By the mid-1980s, some commercial development is visible and by the mid-1990s, the entire northwest quarter of the QS appears to be commercial. Conversely, the northeast quarter of the QS turns fallow and remains this way into 2002.

(South half of QS); From 1962-1964, this portion of the QS is fallow agricultural. By 1966, homes begin development at which by 1972, the area is completely developed with single-family homes which remain visible to 2002.

3-20; The land is primarily utilized for agricultural purposes with a residential subdivision in the northeast quarter and one (large) building in the northwest corner of the QS in the early-1960s.

By the late-1960s, the QS is filled with more homes as the agricultural land slowly changes to residential use. The large building in the northwest corner expands to a large (commercial) complex of several buildings by 1972. With the southeast corner still primarily vacant, the entire QS has remained relatively unchanged since the early-1970s.

4-17; (North half of QS); Native river bottom with intermittent sand/gravel removal from 1962-2002.

(South half of QS); Agricultural land with associated farm houses visible from 1962-1986. By 1988, sand/gravel operations are visible and slowly taking over the land to 2002.

4-18; (North half of QS); River bottom and riverbank from 1962 to 2002.

(South half of QS); Land utilized primarily for agricultural purposes with possible cattle lot located in the southeast corner of the QS from 1962 to 1980. A large scale sand/gravel operation (currently Vulcan) was visible from the early-1980s to 2002 along with an industrial (concrete mold) facility in the southeast corner of the QS.

4-19 (North half of QS); Land utilized primarily for agricultural purposes from 1962 to 1976. By the late-1970s, auto salvage yards were quite predominant and increasing with debris to 2002.

(South half of QS); Land utilized primarily for agricultural purposes with a farm house from 1962 to 1988. From 1990 to 2002, the land was then utilized for sand/gravel removal by the 27th Avenue Landfill; likely for capping of individual cells.

4-20; The eastern ¾ of the QS has been a residential subdivision from 1962 to 2002. The western ¼ of the QS has been a combination of native, agricultural, and residential, with a portion used just as an access road (1993-2002) to a nearby sand/gravel pit from 1962 to 2002.

5-17; (North half of QS); Land utilized primarily for agricultural purposes from 1962 to 1982 before being graded (but not fallow) from 1985 to 1998. In 2000 and 2002, sand/gravel removal is occurring within this portion of the QS.

(South half of QS); Native river bottom from 1962 to 2002.

5-18; (Northern portion of QS); The northern portion of the QS has been agricultural from 1962 to 1998 before being used for sand/gravel removal in 2000 and 2002.

(Middle portion of QS); Although minor sand/gravel removal may have occurred in the early-1960s, more predominant sand/gravel operations began in the late-1960s and continued to 2002 with major operations and buildings first visible in 2000.

(Southern portion of QS); Land is primarily native river bottom from 1962 to 2002 with a small portion in the north used for sand/gravel removal.

5-19; (North half of QS); Land is primarily utilized for agricultural purposes from 1962 to 1970. In 1972, the beginning of a large sand/gravel removal/operation is visible in the northwest corner of the QS which then expands to include the entire northern half of the QS by 1983.

(South half of QS); The southern half of the QS remains native river bottom (with some small sand/gravel removal in the southwest corner in the 1960s) until the late-1980s. At that time, the sand/gravel removal encompasses more of the southern half of the QS. By 1998, the sand/gravel appeared to diminish in activity and by 2000, equipment associated with the sand/gravel operation had been removed from the site. In 2002, the sand/gravel site (in the northwest corner) was paved and now consists of a storage yard for semi-trucks/trailers. Water still occupies the former sand/gravel pit in the east portion of the quarter while the southern portion remains native river bottom.

5-20; Although the QS is primarily native river bottom in the early-1960s, sand/gravel removal is evident in various places such as the northeast, southeast, and southwest corners of the QS. It appears that someone may have tried to farm a portion of land in the southwest corner of the QS in 1962 and 1964. In 1966, the northeast corner of the QS contained a property resembling a salvage yard that expanded in the 1970s with piles of mounded debris and winding roads visible. By the late-1980s, the piles of debris diminished (until 1996) as the buildings multiplied. By 1998, the debris piles once again increased as the site looks quite disorganized and "dirty" in 2002.

6-17; In the early to mid-1960s, the QS appears as agricultural and residential in use. In 1968, an industrial yard is noted in the southwest corner of the QS with miscellaneous parts and scrap. This yard immensely expands by 1974 to encompass the entire southwest corner of the QS and appears to now consist of a cluster of four to five businesses. In 1976, a roof truss manufacturer (previously identified as such) replaces one of the junkyards, and by 1983, expands to the south. In 1985, a large industrial building (and smaller one) is noted in the northwest corner of the QS. Also in 1985, the residence located in the northeast corner of the QS appears to become industrial in nature as some of the agricultural land turns fallow and the buildings and debris increase dramatically. In 1986, a smaller commercial building is visible in the extreme northwest corner of the QS and remains visible through 2002. By 1998, the large industrial property in the northwest corner of the QS increases with additional buildings, pavement, and the storage of over 100 tractor trailers.

6-18; The land is utilized primarily for agricultural purposes with a natural wash running through it and a residence located in the southeast corner of the QS from 1962 to 1998. A large industrial building is visible in the southwest quarter of the QS in 2000 and 2002 with the storage of large metal pieces or equipment to the south of the building.

6-19; The land is utilized primarily for agricultural purposes from 1962 to 1972. From 1974 to 1978, the QS remains agricultural with a stock yard visible in the southwest quarter. By the early-1980s, several facilities were constructed along the west half of the QS, along with an additional facility (sand/gravel operation) visible in the southeast corner. In 1988, a junk yard appeared along the southwest corner of the QS. Another facility became visible in 1998 in the center of the QS, which included a large parking lot. By 2000, the sand/gravel pit in the southeast corner has been shaped with uniform even slopes and by 2002, it appears as if it is being used as a landfill.

6-20; From 1962 to the early–1970s, most of the land was used for agricultural purposes (orchards or possibly a nursery). By 1972, a wastewater treatment facility was observed in the southeast corner of the QS. In 1974, a small sand/gravel operation was visible in the eastern middle section of the QS and an industrial facility (previously identified as a pipe yard) is first visible in the northwest corner. In 1978, auto salvage yards were visible in the northeast quarter and the western central quarter of the QS. By 1980, the orchard is completely replaced by industrial activities. In 1982, a large industrial yard is visible in the northern-central quarter section which later expands throughout the 1980s and early-1990s.

7-19 (South half of QS only); Land is utilized primarily for agricultural purposes from 1962 to 1976. However, a small building (first visible in the southeast quarter of the QS) begins to expand in the late-1970s with a junkyard. The buildings and junkyard remain visible through 2002. Back in 1978, a large portion of land is graded and two large buildings are constructed in the southwest corner by 1980. These two buildings remain visible in 2002.

7-20 (South half of QS only); Land is utilized primarily for agricultural purposes from 1962 to 1970. By 1972, two industrial complexes (with several buildings each) are visible. In 1974, a salvage yard is visible in the north, and by 1978, a second salvage yard is visible just south of the first one. The industrial complexes and salvage yards remain visible in 2002.

51st Avenue to 67th Avenue (inclusive of Township 1 North, Range 2 East, Sections 19, 20, 29, 30, and 31)

1-13 (North half of QS only); Land is utilized primarily for agricultural purposes from 1962 to 1974. From 1976 to 2002, the QS is residential.

1-14 (North half of QS only); Land is utilized primarily for agricultural purposes from 1962 to 1974 with one farm in the northwest corner of the QS. Residential homes begin development in the west portion of the QS in 1985 while the east portion remains agricultural to 2002.

2-13; Land is utilized primarily for agricultural purposes from 1962 to 1980. The development of residential homes begins in 1982 and continues to expand across the QS to 2002 with the agricultural land becoming almost non-existent.

2-14; Land is utilized primarily for agricultural purposes from 1962 to 2002.

2-15; Land is utilized primarily for agricultural purposes (with a farm house visible in the northwest corner of the QS) from 1962 to 1992. From 1994 to 2002, the QS contains a golf course.

2-16; Land is utilized primarily for agricultural purposes (with four farm house visible in the southeast corner of the QS) from 1962 to 1974. From 1976 to 2002, the farm houses have been removed and the QS consists entirely of agricultural land.

3-13; The QS primarily consists of native river bottom from 1962 to 2002 with small sand/gravel removal occurring in the northwest corner (throughout the years) and a large sand/gravel operation in the southwest corner (especially in the 1960s and 1970s and finally fading in the 1990s).

3-14; The QS consists of native river bottom from 1962 to 1985. From 1986 to 2002, the QS consists of native river bottom with a commercial business visible in the southeast corner of the QS.

3-15; The QS consists of agricultural land and native river bottom from 1962 to 2002.

3-16; The QS is utilized primarily for agricultural purposes (with numerous farm houses and related structures, especially in the 1960s and 1970s) from 1962 to 2002.

4-13; The QS consists of agricultural land (with a farm house along the west edge) and native river bottom from 1962 to 2002. However, a small oval-shaped track is visible from near the farm house from 1968 to 1974.

4-14; The north half of the QS is utilized for agricultural purposes from 1962 to 2002. The south half of the QS is river bottom with sand/gravel removal occurring from 1962 to 2002.

4-15; The northwest corner of the QS is utilized for agricultural purposes from 1962 to 1985 before sand/gravel operations take over. The remainder of the QS has sand/gravel operations

periodically occurring from 1962 to 2002 with major activity occurring in the late-1980s and 1990s.

4-16; The QS appears primarily as native river bottom with periodic sand/gravel removal in the southeast corner in the 1960s to early-1970s. Major sand/gravel operations in the southeast corner (and in the north) occur from 1980 to 1994. By 1996, the entire QS is utilized for sand/gravel removal/operations.

5-13; The QS is utilized for agricultural and residential purposes from 1962 to 2002.

5-14; The QS is primarily utilized for agricultural purposes with several large buildings along the eastern edge. The buildings appear to be farm related and may have been used as a cattle lot in the 1960s. From the early-1970s to 2000, the QS remains agricultural with several farm-type structures along the eastern edge. By 2002, the eastern portion of the QS is developed with a residential subdivision while the eastern portion of the QS has graded for upcoming residential development.

5-15; The QS is primarily utilized for agricultural purposes except for a residence/farm area along the northwestern edge. In the 1960s, the northwestern edge appears to be utilized as a cattle lot (likely associated with the one adjacent to the west in QS 5-14).

5-16; The northern half of the QS is utilized for agricultural purposes from 1962 to 2002. The southern half of the QS is native river bottom from 1962 to 1985 and then utilized for major sand/gravel operations from 1986 to 2002.

6-15; The QS is primarily utilized for agricultural purposes from 1962 to 2002 with one or two farm houses visible throughout the years.

6-16; The QS is primarily utilized for agricultural purposes from 1962 to 1994. From 1996 to 2002, the west half of the QS remains agricultural while the east half contains a large industrial facility in the southwest quarter and two industrial facilities (visible in 2002 only) in the northeast quarter of the QS.

67th Avenue to 83rd Avenue (inclusive of Township 1 North, Range 1 East, Sections 24, 25, 26, 35, 36 and Township 1 South, Range 1 East, Section 2)

01-9 (North half of QS only); The QS is utilized for agricultural and residential purposes from 1962 to 1968. From 1970 to 2002, the QS contains some commercial buildings along with the original agricultural land and residential homes..

01-10 (North half of QS only); The QS is utilized for agricultural and residential purposes (including a cattle feed lot) from 1962 to 2002.

1-9; The northwest quarter of the QS is native land and river bottom from 1962 to 2002. The northeast quarter of the QS is river bottom with a small piece of agricultural land from 1962 to 1976. From 1978 to 2002, the northeast quarter of the QS is primarily agricultural land with some native river bottom. However, a wastewater pond is visible in the northeast quarter from 1988 to 1994 with two ponds then visible from 1996 to 2002. the south half of the QS has been agricultural with some farmhouses and small commercial properties from 1962 to 2002.

1-10; The QS has been utilized primarily for agricultural purposes from 1962 to 2002.

1-11; The QS has been utilized primarily for agricultural purposes from 1962 to 2002.

1-12; The QS has been utilized primarily for agricultural purposes from 1962 to 1972. From 1974 to 2002, the QS has been half agricultural and half residential.

2-9; The north half of the QS is native river bottom from 1962 to 1984. From 1986 to 2002, a large sand/gravel operation (primarily removal) is visible from 1986 to 2002 in the north half. The south half of the QS is primarily native river bottom with a small agricultural farm in the southeast corner visible from 1962 to 2002. The southwest corner contains a small sand/gravel operation from 1962 to the early-1980s.

2-10; The northeast quarter of the QS is native river bottom from 1962 to 1970. By the early-1970s, industrial properties began to develop, and by 1980, the area began an increase in industrial activity to 2002. The northwest quarter of the QS has remained native river bottom from 1962 to 2002. The southeast quarter of the QS has been agricultural with farmhouses from 1962 to 2002. The southwest quarter of the QS has been native river bottom from 1962 to the late-1970s before becoming a horse farm which has remained visible to 2002.

2-11; The north half of the QS has been primarily agricultural from 1962 to 1968 with one building visible in 1966 and 1968. By the early 1970s, the northwest quarter of the QS was divided into several parcels with commercial/light industrial facilities slowly being constructed . In 1978, a salvage yard appeared in the lower portion of the northwest quarter and expanded slowly northward until 1986. In 1988, the northwest corner was again graded and now utilized to store sand and gravel. The south half of the QS has been utilized for agricultural purposes from 1962 to 2002.

2-12; The QS has been utilized for agricultural purposes from 1962 to 2002, except for the northwest corner, which has been industrial from 1970 to 2002.

3-9; The west half of the QS has been utilized for agricultural purposes from 1962 to the early-1980s. From 1985 to 2002, the west half has contained several large drying beds associated with the 91st Avenue Wastewater Treatment Plant. The east half of the QS has been primarily utilized for agricultural purposes (and some native river bottom) from 1962 to 1985. From 1986 to 2002, the east half is slowly engulfed by a large sand/gravel operation.

3-10; The north half of the QS is utilized for agricultural purposes from 1962 to 1994. From 1996 to 2002, the agricultural land is replaced by a large sand/gravel operation occurring in the area. The south half of the QS is native river bottom from 1962 to 2002 except for the southeast corner. The southeast corner contained a small facility visible at the corner of Southern and 75th Avenues in the middle of the river. The facility grows larger expanding to the west and then to the north with north-south elongated buildings (as many as 12) through 1976. The elongated buildings (or structures) appear to diminish through 1988 until only a single building remains through 1996. From 1998 to 2002, this portion of the QS remains vacant.

3-11; The north half of the QS is agricultural and native river bottom from 1962 to 2002. The south half of the QS is native river bottom from 1962 to 1968. A sand/gravel operation is then visible from 1970 to 2002.

3-12; Sand/gravel removal occurs in the QS from 1962 to 1974 with commercial/light industrial activity along the eastern edge of the QS. Larger scale sand/gravel operation/removal occurs in the 1980s and 1990s with continued commercial/light industrial properties along the eastern edge of the QS to 2002.

4-9; The QS is primarily utilized for agricultural purposes with two farm areas visible from 1962 to 2002.

4-10; The QS is primarily utilized for agricultural purposes from 1962 to 2002.

4-11; The QS is used primarily for agricultural purposes with two farms visible from 1962 to 1966. It then remains agricultural with a dairy farm in the northwest corner of the QS through 1974. From 1976 to 2002, the QS primarily remains agricultural, but is subdivided between several residential homes. The dairy farm in the northwest corner is visible through 2002.

4-12; The QS is entirely agricultural with a dairy farm visible in the northeast corner from 1962 to 1974. Beginning in 1976, the dairy farm expands and the remainder of the QS is subdivided between several residential homes visible to 2002.

5-10 (South half of QS only); This half of the QS is agricultural with one house visible from 1962 to 2000. However, from 1968 to 1986, a large tailwater sump is visible along the northern

edge of the QS. In 2002, the development of a subdivision is visible throughout the entire south half of the QS.

5-11 (South half of QS only); This half of the QS has been utilized for agricultural purposes from 1962 to 2002 with only a small area of ground disturbance located in the northeast corner from 1962 to 1982.

5-12 (South half of QS only); This half of the QS has been utilized primarily for agricultural purposes from 1962 to 1980 except for a residential home located in the northeast corner. From 1982 to 2002, the QS is agricultural except for a commercial development located in the northeast corner.

4.1 FINDINGS

Based on the above aerial photographs reviewed, URS has provided a summary of the findings to help delineate and identify areas (Quarter Sections) for further investigation. The following tables have been designed to generally describe the current overall use of each QS, the potential contaminant that may be associated with that land use, and a priority ranking for further investigation. The land use category identified for each QS is similar to that previously described; Residential, Commercial/Industrial, Landfill, Sand/Gravel Operation, Agricultural, Recreational (i.e. public parks), and River Bottom/Native.

For this summary, URS attempted to assign land use categories based on what the QS primarily consisted of in 2002. In some cases, a QS may have been assigned multiple categories if they appeared to consist of a large percentage of a certain use (i.e. a QS consisting of half agricultural land and half industrial land will be assigned both categories). Potential contaminants associated with a certain land use are general in nature but are listed based on URS' past experience conducting site assessments on various properties. This is not to say that other contaminants may or may not be associated with a certain land use, but rather that these contaminants may be the most commonly found. The priority ranking of Low, Medium, and High (and derivations of these) are based on the type of current land use and the potential contaminant that is usually found during associated activities. Although there may be many other contaminants found, the following guidelines were typically used; insecticides/pesticides for Agricultural, petroleum products for Sand/Gravel Operations, and petroleum products and solvents for Commercial/Industrial. If auto salvage yards or junkyards were specifically observed in a Commercial/Industrial setting, the contaminant of metals was also listed.

19th Avenue to 35th Avenue			
Quarter Section	**Current Overall Land Use**	**Potential Containment**	**Priority Ranking (for Further Investigation)**
3-21 (North ½ only) 3-22 (North ½ only) 3-23 (North ½ only) 7-22 (South ½ only)	Agricultural	Insecticides/Pesticides	Low- Medium
3-24 (North ½ only)	Residential	---	Low
4-24 7-21 (South ½ only) 7-23 (South ½ only) 7-24 (South ½ only)	Commercial/Industrial	Petroleum products, solvents, metals	High
4-21	Agricultural commercial/ industrial sand/gravel	Insecticides/pesticides, petroleum products, solvents, metals	High
4-23	Agricultural commercial industrial	Insecticides/pesticides petroleum products solvents, metals	High
4-22, 5-21, 5-22, 5-23, 5-24, 6-23, 6-24	Commercial/industrial and sand/gravel operations	Petroleum products, solvents, metals	High
6-21, 6-22	Commercial/industrial and landfill	Petroleum products, solvents, metals	High

35th Avenue to 51st Avenue			
Quarter Section	**Current Overall Land Use**	**Potential Containment**	**Priority Ranking (for Further Investigation)**
3-2, 4-20	Residential	---	Low
3-17, 4-17, 5-18, 5-19	Sand/gravel operations	Petroleum products	Medium-High
4-19, 6-17, 6-20 7-19 (South ½ only) 7-20 (South ½ only)	Commercial/industrial	Petroleum products, solvents, metals	High
3-18	Agricultural, residential commercial/industrial	Insecticides/pesticides petroleum products, solvents, metals	High
3-19	Residential and commercial/industrial	Petroleum products solvents	High
4-18, 5-20	Sand/gravel operations commercial/industrial	Petroleum products, solvents, metals	High
5-17	Native/river bottom sand/gravel operations	Petroleum products	Medium-High
6-18	Agricultural and commercial/industrial	Insecticides/pesticides petroleum products solvents	High
6-19	Commercial/industrial and landfill	Petroleum products, solvents	High

51st Avenue to 67th Avenue			
Quarter Section	**Current Overall Land Use**	**Potential Containment**	**Priority Ranking (for Further Investigation)**
1-14, 2-14, 2-16, 4-13, 5-13, 5-15, 6-15	Agricultural	Insecticides/pesticides	Low-Medium
1-13, 2-13, 3-16, 5-14	Residential	---	Low
2-15	Recreational	---	Low
3-13, 3-14	Native/river bottom	---	Low
4-15, 4-16	Sand/gravel operations	Petroleum products	Medium-High
3-15	Agricultural and native/ river bottom	Insecticides/pesticides	Low-Medium
4-14, 5-16	Agricultural and sand/gravel operations	Insecticides/pesticides and petroleum products	Medium-High
6-16	Agricultural and commercial/industrial	Insecticides/pesticides, petroleum products, solvents	High

67th Avenue to 83rd Avenue			
Quarter Section	**Current Overall Land Use**	**Potential Containment**	**Priority Ranking (for Further Investigation)**
01-9, 01-10, 1-9, 1-10, 1-11, 1-12, 2-10, 2-12, 4-9, 4-10, 4-11, 4-12, 5-11 (South ½ only) 5-12	Agricultural	Insecticides/pesticides	Low-Medium
2-9	Native/river bottom	---	Low
3-11	Sand/gravel operations	Petroleum products	Medium-High
5-10 (south ½ only)	Residential	---	Low
2-11	Agricultural and commercial/industrial	Insecticides/pesticides, petroleum products, solvents	High
3-9, 3-12	Sand/gravel operations and commercial/industrial	Petroleum products, solvents	High
3-10	Native/river bottom and sand/gravel operations	Petroleum products	Medium-High

5.0 REGULATORY AGENCY REVIEW

A review of applicable regulatory agency documents and lists of known or potential hazardous waste sites or landfills, and properties or facilities currently under investigation for potential environmental violations was conducted by Environmental Data Resources, Inc. (EDR). A list and brief description of the EPA and state agency databases reviewed is tabled below. A copy of the EDR report is presented in Appendix A.

Type of Database	Description of Database	Date of Database Revision
Federal Databases		
NPL	The National Priorities List (NPL) identifies uncontrolled or abandoned hazardous waste sites. To appear on the NPL, sites must have met or surpassed a predetermined hazard ranking system score, been chosen as a state's top priority site, pose a significant health or environmental threat, or be a site where the EPA has determined that remedial action is more cost-effective than removal action.	10/22/01
CERCLIS	The Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) database identifies hazardous waste sites that require investigation and possible remedial action to mitigate potential negative impacts on human health or the environment.	11/21/01
RCRA TSDs	The EPA's Resource Conservation and Recovery Information System (RCRIS) identifies and tracks hazardous waste from the point of generation to the point of disposal. The RCRIS Treatment, Storage, Disposal (TSD) Facilities List is a compilation by EPA of reporting facilities that generate, transport, store, treat, or dispose of hazardous waste as defined by the Resource Conservation and Recovery Act (RCRA) but are not undergoing any "corrective action".	6/21/00
CORRACTS	RCRA TSD facilities ordered to implement corrective actions. A "corrective action order" is issued pursuant to RCRA Section 3008 (h) when there has been a release of hazardous waste or constituents into the environment from a RCRA TSD facility. Corrective actions may be required beyond the facility's boundary and can be required regardless of when the release occurred, even if it predates RCRA.	11/14/01
RCRA Generators	RCRA-regulated hazardous waste generator notifiers list; both Large and Small Quantity Generators are included in this list. (LQG – Large Quantity Generator, SQG – Small Quantity Generator)	6/21/00
ERNS	EPA's Emergency Response Notification System (ERNS) list contains reported spill records of oil and hazardous substances.	8/08/00
ROD	The EPA's Record of Decision (ROD) documents mandate a permanent remedy at a NPL site containing technical and health information to aid in the cleanup.	9/30/00
Arizona State Databases		
SPL/WQARF	A Water Quality Assurance Revolving Fund (WQARF) area (referred to as a State Priority List (SPL) site by EDR) which is also referred to as a state Superfund area, is a region designated by ADEQ for further investigation regarding environmental concerns. This designation is typically based on known areas of groundwater contamination, or past or present land uses which have been known to use and discharge chemicals that can contaminate groundwater.	6/12/01

Type of Database	Description of Database	Date of Database Revision
SHWS/ACIDS	The Arizona CERCLIS Information Data System (ACIDS) List has been used by the ADEQ Superfund Programs Section (SPS) for the past decade in tracking WQARF sites and portions of sites, potential WQARF sites, referrals, and other cases of interest to the SPS. As of March 13, 2000, there were approximately 1,500 entries on the ACIDS list. While some of the cases on this list are relevant to Arizona's Superfund Program, others are not and their inclusion may be misleading. For this reason, the SPS has elected to archive the ACIDS list, and no longer distribute it. In its stead, the ACIDS List has been replaced by the Arizona Superfund Programs List (SPL). This list is more representative of the sites and potential sites within the jurisdiction of the ADEQ SPS. According to ADEQ, the listing of properties on the ACIDS list is not an indication of liability or potential liability. Many of these properties on this list have no present involvement in WQARF or federal Superfund.	1/3/00
SWLF	State inventory of solid waste disposal and landfill sites.	11/01/00
LUST	List of information pertaining to all reported leaking underground storage tanks.	11/08/01
UST	State underground storage tank sites listing. The state of Arizona requires that owners of most underground storage tanks (USTs) register their USTs with ADEQ.	11/07/01
AZ-Spills	Releases and incidents recorded by ADEQ Emergency Response Unit.	6/30/00
Drywells	State drywell registration list. Dry wells are typically constructed on commercially-developed properties to collect rainwater surface runoff, and therefore, have the potential to introduce contaminants into the subsurface.	12/01/01

EDR compiled a list of properties or facilities located within the project study area (approximately one mile north and south of the Salt River) that appeared on one or more of the above-mentioned databases. URS reviewed the information presented by EDR and additional information presented on-line by EPA and ADEQ to identify sites that may have the potential to adversely affect environmental conditions at the subject property. A summary of the listed sites, addresses, database on which the site is listed, and the site's potential to adversely affect environment conditions at the subject property is tabled below. The tables are complied in one-mile increments north of the river and south of the river and listed separately. The identification numbers listed in the tables are those assigned for reference purposes only by EDR. Additional tables compiled by regulatory databases are included in Appendix B.

The priority ranking is based on current and prior activities as provided by the above-reference material. It should be noted that all facilities with registered USTs or listed LUSTs were ranked with a Low to Medium priority due to the potential for past and/or future contamination involving the USTs and their current status (i.e. closed/open LUST case, active/removed UST, etc.). A brief summary of all sites with a Medium or High Priority Ranking follows each of the associated tables.

7th Avenue to 19th Avenue - North of the Salt River

Although this area is outside the site boundaries as described in Section 2.1, these sites lie within one mile and are hydrologically upgradient of the subject property and therefore, may have a potential environmental affect on the subject property.

ID	Site Name	Site Address	Database	Status	Priority
Z	19th Avenue Landfill	19th Ave and Lower Buckeye Road	CERCLIS	Remedy assessment phase	High
			NPL	Status: Final	
			ROD	See additional information below	
			LUST	2 closed 1993	
			UST	0 active / 3 removed	
			SWLF	Closed	
2	Blue Circle West Leasing	2625 S. 19th Ave.	RCRIS-SQG	No violations found	Low
2	Kenworth of AZ Sunward Materials	2625 S. 19th Ave.	RCRIS-SQG	No violations found	Low
			CERC-NFRAP	1988 PA – NFRAP	
			SHWS	WVB	
2	Williams Detroit Diesel	2602 S. 19th Ave.	RCRIS-SQG	No violations found	Low
2	Neils Detroit Diesel Inc.	2602 S. 19th Ave.	UST	0 active / 3 removed	Low- Med.
2	Frontier Freightways	2465 S. 19th Ave.	RCRIS-SQG	No violations found	Low
2	Cypress Environmental	2465 S. 19th Ave.	RCRIS-SQG	No violations found	Low
2	Superior Companies	2402 S. 19th Ave.	LUST	1 Closed – 1995	Low- Med.
			UST	0 active / 1 removed	
2	Arizona Beef	2401 S. 19th Ave.	LUST	1 Closed – 1990	Low- Med.
			UST	0 active / 2 removed	
2	Marlam Industries, Inc.	2465 S. 19th Ave.	RCRIS-LQG	2 Low priority violations	Low- Med.
2	Arizona Truck & Trailer	2235 S. 19th Ave.	Dry Wells	1 Dry well	Low
2	Bradley Investment Co.	2235 S. 19th Ave.	UST	0 active / 2 removed	Low- Med.
4	Greenfield Environmental (AKA Innovative Waste Utilization)	2575 S. 16tth Ave.	RCRIS-LQG	49 Violations	Medium
			RCRIS-TSD	Med. CORRACTS priority	
			CORRACTS		
4	MP Environmental	2530 S. 16th Ave.	AZ Spills	1994 incident	Low- Med.
			ERNS		

ID	Site Name	Site Address	Database	Status	Priority
10	Phoenix Tallow	2602 S. 15th Ave.	LUST	3 closed – 1999	Low- Med.
			UST	0 active / 6 removed	
13	Phoenix Metal Recycling	3210 S. 19th Ave.	RCRIS-SQG	No violations found	Low
13	Asphalt Products Transport Co.	3050 S. 19th Ave.	UST	0 active / 2 removed	Low- Med.
			AZ Spills	1993 incident	
13	Lincoln Auto	3020 S. 19th Ave.	UST	0 active / 2 removed	Low
13	Waste Management of Phoenix (AKA Universal Waste Control)	3000 S. 19th Ave.	LUST	1 closed 1996 / 1 unknown	Low-Med.
			UST	2 active/3 removed	
			Dry Wells	1 Dry well	
			RCRIS-SQG	No violations found	
19	United Metro Material Plant 11	3640 S. 19th Ave.	RCRIS-SQG	1 low priority violation	Low- Med.
			AZ Spills	1995 Diesel release	
19	Tanner-United Metro	3640 S. 19th Ave.	LUST	1 closed 1999	Low- Med.
			UST	4 active / 7 removed	

Notes:
ID – Map ID (see Figure 2)
NFRAP – No further remedial action planned
PA/SI – Preliminary Assessment/Site Investigation
WVB –Sites with this notation have been investigated as part of the West Van Buren (WVB) WQARF program

19th Avenue Landfill

The 19th Avenue Landfill facility is located near the southeast corner of 19th Avenue and Lower Buckeye Road in Phoenix and covers approximately 213 acres within the floodplain of the Salt River. Although the site was originally used as a sand and gravel operation, it has been a landfill since the late-1950s.

During the remedial investigation, the groundwater was found to contain low concentrations of volatile organic compounds, various heavy metals, and beta radiation. Currently, only one compound (1,1-dichloroethene) is above drinking water standards. Because groundwater in the area is used for industrial purposes only and there are no direct pathways to the City of Phoenix drinking water supply, the landfill is not considered to be a threat to public health.

A consent decree (entered in June 1992) called for capping of the landfill cells, removal and treatment of methane gas, monitoring of groundwater, and a contingency plan to treat groundwater if standards are exceeded. ADEQ is the lead regulatory agency on this EPA project through WQARF. ADEQ approved the Remedial Design Plans and Project Specifications in

May 1995 and completed the required five-year monitoring of the site. According to ADEQ, the remedy is protective of human health and the environment.

Greenfield Environmental (AKA Innovative Waste Utilization)

The Greenfield Environmental facility is located near the northeast corner of 19th Avenue and Lower Buckeye Road in Phoenix. According to information obtained from the EPA, the facility handles, stores, transports, and manages many chemicals including volatile organic compounds and various heavy metals. The types of waste management conducted at the facility include incineration, energy recovery, solidification and stabilization, and wastewater treatment.

According to EDR, Greenfield Environmental has received 49 RCRA violations between 1985 and 1996. Of the 49 violations, 41 were reported as low priority and 8 high priority. All the violations appear to have been brought back into compliance by 1998. Although the Greenfield facility releases volatile organic compounds into the air, according to the EPA the facility is currently in compliance.

7th Avenue to 19th Avenue - South of the Salt River

Although this area is outside the site boundaries as described in Section XX, these sites are within one mile and hydrologically upgradient of the subject property therefore, may have a potential environmental affect on the subject property.

ID	Site Name	Site Address	Database	Status	Priority
20	Ace Asphalt of Arizona	895 W. Elwood	LUST	3 closed 1998	Low- Med.
			UST	2 active / 3 removed	
			RCRIS-SQG	No violations found	
			AZ Spills	1988 Unknown release	
23	Laidlaw Environmental Services	888 W. Illini Street	RCRIS-SQG	3 low priority violations	Low
23	Disposal Control Services, Inc.	888 W. Illini Street	SHWS	PA/SI	Low
25	Circle K #670	4422 S. 19th Ave.	LUST	1 closed 1996	Low- Med.
			UST	0 active / 3 removed	
25	Cooley Wholesale Lumber Co.	1930 W. Broadway	LUST	1 closed date unknown	Low- Med.
			UST	0 active / 2 removed	
25	Arizona Teamsters App.	1820 W. Broadway	LUST	1 closed 2000	Low- Med.
			UST	0 active / 2 removed	
25	CSW Contractors Inc.	1824 W. Broadway	UST	0 active / 2 removed	Low
25	Industrial Recycling Solutions	2610 W. Holly	RCRIS-SQG	No violations found	Low

ID	Site Name	Site Address	Database	Status	Priority
25	Solvent Recyclean Inc.	1850 W. Broadway	RCRIS-SQG	1 low priority violation	Low
25	Circle K #1968	4305 S. 19th Ave.	UST	3 active / 0 removed	Low- Med.
25	Arizona Barrel and Can Co.	4225 S. 19th Ave.	CERC-NFRAP	Site inspection completed 1992	Low
25	Western Block Company	4021 S. 19th Ave.	LUST	1 closed 1998	Low- Med.
			UST	0 active / 4 removed	
25	19th Ave. Airstrip	NEC 19th/Broadway	SHWS	PA/SI	Low
27	Road Jammers Machinery	4300 S. 17th Ave.	LUST	1 closed 1994	Low- Med.
			UST	0 active / 3 removed	
30	Briscoe Inc.	15th Ave./Broadway	AZ Spills	1985 petroleum release	Low-Med.
30	Broadway Cardlock #23	1307 W. Broadway	LUST	1 closed 1999	Low- Med.
			UST	0 active / 3 removed	
30	Progressive Roofing	1501 W. Broadway	UST	0 active / 1 removed	Low- Med.
30	Sandvick Equipment & Supply Co.	1502 W. Broadway	UST	0 active / 1 removed	Low- Med.
30	Turners Machine Shop	1521 W. Broadway	RCRIS-SQG	No violations found	Low
30	Brown Tank & Steel	4300 S. 15th Ave.	UST	0 active / 2 removed	Low- Med.
44	CJ Joregenstein Elementary	1701 W. Roeser	AZ Spills	1998 incident	Low

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NFRAP – No further remedial action planned
PA/SI – Preliminary Assessment/Site Investigation
WVB –Sites with this notation have been investigated as part of the West Van Buren (WVB) WQARF program

19th Avenue to 27th Avenue - North of the Salt River

City of Phoenix Quarter Section Index Map Numbers: 5-23, 5-24, 6-23, 6-24, 7-23, and 7-24.

ID	Site Name	Site Address	Database	Status	Priority
NL	23rd Avenue Landfill	23rd Ave./ Low Buck Rd	SWLF	Closed	Low-Med.
3	Old 23rd Ave. Sludge Disp. Ponds	23rd & Low Buck Rd	SHWS	WVB	Low
5	27th Avenue Landfill	27th Ave. & Lower Buckeye Road	LUST	1 closed 1998	Low-Med.
			UST	0 active / 1 removed	
			AZ Spills	1992 incident	
			Dry Wells	1 Dry well	
			SWLF	Transfer station	
			SHWS	WVB	
5	Phoenix Union High School	2800 S. 27th Ave.	AZ Spills	1991 incident	Low

ID	Site Name	Site Address	Database	Status	Priority
6	Phoenix Transit System	2225 W. Low Buck Rd	RCRIS-SQG	No violations found	Medium
			RCRIS-LQG	1 low priority violation	
			LUST	1 closed 2000	
			UST	19 active / 0 closed	
6	COP Petroleum Storage Facility	2239 W. Low Buck Rd	Dry Wells	1 dry well	Medium
			RCRIS-SQG	No violations found	
			LUST	1 closed 1998	
			UST	0 active / 7 removed	
6	Kerley Chemical Corp.	2248 W. Low Buck Rd	AZ Spills	1986 incident	Low- Med.
			UST	0 active / 1 removed	
			RCRIS-SQG	No violations found	
			SHWS	WVB	
6	Phoenix Salt River Service Center	3045 S. 22nd Ave.	LUST	6 closed 1997 – 1999	Medium
			UST	8 active / 16 removed	
9	Empire Metals Inc.	2010 W. Low Buck Rd	LUST	2 closed 1994	Low- Med.
			UST	0 active / 3 removed	
			RCRIS-SQG	1 low priority violation	
14	Operating Engineers Road	3225 S. 22nd Ave.	UST	0 active / 3 removed	Low- Med.

Notes:
ID – Map ID (see Figure 2)
NFRAP – No further remedial action planned
NL – Not listed
PA/SI – Preliminary Assessment/Site Investigation
WVB –Sites with this notation have been investigated as part of the West Van Buren (WVB) WQARF program

Phoenix Transit System/Phoenix Salt River Service Center/COP Petroleum Storage Facility

The Phoenix Transit System, Salt River Service Center, and COP Petroleum Storage Facility are all fueling and/or maintenance yards for the City of Phoenix vehicles. They are all located at approximately 22nd Avenue and Lower Buckeye Road in Phoenix. Although the facilities do not appear to have any substantial violations, they are considered medium priority rankings due to the high number of active and removed USTs at each site.

19th Avenue to 27th Avenue - South of the Salt River

City of Phoenix Quarter Section Index Map Numbers: 3-23, 3-24, 4-23, and 4-24.

ID	Site Name	Site Address	Database	Status	Priority
32	Yank Your Part	2104 W. Broadway	RCRIS-SQG	No violations found	Low
32	AETS	2301 W. Broadway	SWF/LF	Active (accepts PCS)	Low- Med.
33	AG Products	2630 W. Broadway	RCRIS-SQG	No violations found	Low
33	Chemical Waste Management	2301 W. Broadway	AZ Spills	8 incidents from 1984-89	Med./High
33	Onyx Environmental Services	2301 W. Broadway	RCRIS-SQG	22 low priority violations	
			RCRIS-LQG		
			CORRACTS	Low CORRACTS priority	
			CERC-NFRAP	Site inspection completed 1990	
			SHWS	PA/SI	
33	M&M Auto Storage Pool Inc	2299 W. Broadway	UST	0 active / 1 removed	Low
33	Fuelco #112	2401 W. Broadway	UST	0 active / 5 removed	Low- Med.
33	Smith Pre-Cast	2410 W. Broadway	UST	2 active / 0 removed	Low
33	AG Products	2525 W. Broadway	Dry Wells	2 Dry wells	Low
33	Alan Harris Trucking	2505 W. Broadway	UST	0 active / 1 removed	Low- Med.
33	Regent Auto & Truck Parts	2528 W. Broadway	SHWS	PA/SI	Low- Med.
33	A&S Auto Wrecking	2528 W. Broadway	SHWS	PA/SI	Low- Med.
34	Motorola (Bic)	2200 W. Broadway	AZ Spills	1984 incident	Low

Notes:
ID – Map ID (see Figure 2)
NFRAP – No further remedial action planned
PA/SI – Preliminary Assessment/Site Investigation
PCS – Petroleum contaminated soil
WVB –Sites with this notation have been investigated as part of the West Van Buren (WVB) WQARF program

Chemical Waste Management (AKA Onyx Environmental Services)

Chemical Waste Management is a hazardous waste handler and transporter located on 23rd Avenue and Broadway in Phoenix. The facility had 22 low priority RCRA violations between 1985 through 1996 and 8 spill incidents during approximately the same time frame. According to EDR, two low priority corrective actions were completed by the facility in 1990 and 1992 (one each year). EPA conducted a preliminary assessment and site inspection at the facility in 1990. No further remedial action is currently planned by the EPA.

27th Avenue to 35th Avenue - North of the Salt River

City of Phoenix Quarter Section Index Map Numbers: 5-21, 5-22, 6-21, 6-22, 7-21, and 7-22.

ID	Site Name	Site Address	Database	Status	Priority
15	Maricopa By-Products Inc.	3602 W. Elwood St.	UST	0 active / 6 removed	Low-Med.
			SHWS	WVB	
15	Copperstate Express Lines	3044 S. 35th Ave.	RCRIS-SQG	No violations found	Low
15	Quality Block Company Inc.	3035 S. 35th Ave.	LUST	3 closed 1997	Low-Med.
			UST	0 active / 3 removed	
			SHWS	WVB	
15	Arizona Precast	3045 S. 35th Ave.	SHWS	WVB	Low
22	Metal Management of Arizona	3640 S. 35th Ave.	AZ Spills	1999 Auto shreds fire	Low-Med.
22	Salt River Recycling / Smithey	3640 S. 35th Ave.	LUST	1 closed 1999 / 2 2000	Low-Med.
			UST	0 active / 3 removed	
22	Smithey Recycling Company	3649 S. 35th Ave.	SHWS	WVB	Low

Notes:
ID – Map ID (see Figure 2)
NFRAP – No further remedial action planned
PA/SI – Preliminary Assessment/Site Investigation
WVB –Sites with this notation have been investigated as part of the West Van Buren (WVB) WQARF program

27th Avenue to 35th Avenue - South of the Salt River

City of Phoenix Quarter Section Index Map Numbers: 3-21, 3-22, 4-21, and 4-22.

ID	Site Name	Site Address	Database	Status	Priority
31	Vista Construction	2836 W. Broadway	UST	2 active / 0 removed	Low-Med.
31	Royden Construction Co	2844 W. Broadway	UST	0 active / 4 removed	Low-Med.
31	Enviro-Solv	2844 W. Broadway	AZ Spills	2000 incident	Low-Med.
			RCRIS-SQG	No violations found	
31	Construction Yard	2850 W. Broadway	UST	0 active / 2 removed	Low-Med.
31	Unknown	2744 W. Broadway	AZ Spills	1995 incident	Low
35	All-A-Matic Transmissions	3011 W. Broadway	AZ Spills	1993 incident	Low
35	Swift Transport	3106 W. Broadway	RCRIS-SQG	No violations found	Low
36	Bob Auto and Pickup Wrecking	3408 W. Broadway	RCRIS-SQG	No violations found	Low
36	Western States Petroleum	3331 W. Broadway	AZ Spills	1985 gasoline release	Low
36	Urban Forest Products Co.	3330 W. Broadway	AZ Spills	1995 incident	Low
36	Fuelco #113	3331 W. Broadway	LUST	1 closed 1993	Low-Med.
			UST	0 active / 3 removed	
36	Liquid Air Co.	3332 W. Broadway	AZ Spills	1985 incident	Low
36	Rotman Properties	3250 W. Broadway	LUST	1 unknown closed date	Low-Med.
			UST	0 active / 2 removed	

ID	Site Name	Site Address	Database	Status	Priority
36	Ricketts Trucking Inc	3434 W. Broadway	LUST	1 Closed date unknown	Low-Med.
			UST	0 active / 4 removed	
36	Phillips 66 Company	3449 W. Broadway	UST	0 active / 4 removed	Low-Med.
36	Manzanita Speedway	35th Ave / Broadway	SHWS	WVB	Low

Notes:
ID – Map ID (see Figure 2)
NFRAP – No further remedial action planned
PA/SI – Preliminary Assessment/Site Investigation
WVB –Sites with this notation have been investigated as part of the West Van Buren (WVB) WQARF program

35th Avenue to 43rd Avenue - North of the Salt River

City of Phoenix Quarter Section Index Map Numbers: 5-19, 5-20, 6-19, 6-20, 7-19, and 7-20.

ID	Site Name	Site Address	Database	Status	Priority
1	Circle K #8870	3501 W. Low Buck Rd	UST	3 active / 0 removed	Low-Med.
1	Rio Salado Auto Body	2801 S. 35th Ave.	RCRIS-SQG	No violations found	Low
			SHWS	WVB	
1	EMCO Recycling	3700 W. Lower Buckeye Road	LUST	1 closed 1999	Low-Med.
			UST	0 active / 4 removed	
			AZ Spills	2 1996 incidents	
1	Unknown	3650 W. Low Buck Rd	SHWS	WVB	Low
1	ChemCon Inc.	3702 W. Low Buck Rd	RCRIS-SQG	1 low priority violation	Low-Med.
			CORRACTS	Low CORRACTS priority	
1	Copperstate Metals Inc.	3720 W. Low Buck Rd	RCRIS-SQG	1 low priority violation	Low-Med.
			AZ Spills	2 incidents (1986/1988)	
			CERC-NFRAP	Discovery Assessment	
			SHWS	WVB	
1	Desert Transformer Inc.	3751 W. Low Buck Rd	LUST	1 closed 1999	Low-Med.
			UST	0 active / 3 removed	
1	RJ Ruff & Co.	3883 W. Low Buck Rd	LUST	1 closed 1998	Low-Med.
			UST	0 active / 3 removed	
1	Reuter Equipment Co.	3816 W. Low Buck Rd	UST	0 active / 3 removed	Low-Med.
1	Unknown	39 Ave. / Low Buck Rd	AZ Spills	1 incident (2000)	Low-Med.
1	CAVCO Industries Inc.	2602 S. 35th Ave.	UST	0 active / 2 removed	Low-Med.
			Dry wells	7 Dry Wells	
1	CAVCO Industries Inc.	2502 W. Durango	UST	0 active / 2 removed	Low-Med.
1	Castle MFG, Inc.	3702 W. Low Buck Rd	SHWS	WVB	Low

ID	Site Name	Site Address	Database	Status	Priority
1	Dagleys	2455 S. 35th Ave.	SHWS	WVB	Low
1	Angel Auto	2450 S. 35th Ave.	SHWS	WVB	Low
7	Mardian Construction Company	4044 W. Low Buck Rd	LUST	2 closed 1996	Low-Med.
			UST	0 active / 4 removed	
7	Zieman MFG	4025 W. Low Buck Rd	RCRIS-SQG	No violations found	Low-Med.
			UST	0 active / 1 removed	
8	Phoenix Redi Mix Company Inc.	3635 S. 43rd Ave.	RCRIS-SQG	No violations found	Low-Med.
			LUST	5 closed 1998-1999	
			UST	0 active / 9 removed	
8	Glenn Wienberger Landfill	3425 S. 43rd Ave.	RCRIS-SQG	No violations found	Low
			UST	1 active / 0 removed	
			SWLF	Closed	
8	A&K Partnership	3211 S. 43rd Ave.	UST	0 active / 2 removed	Low-Med.
8	Publicker Ind / Masterview Window	3065 S. 43rd Ave.	LUST	1 closed date unknown	Low-Med.
			UST	0 active / 1 removed	
8	USF Bestway Transportation	3045 S. 43rd Ave.	LUST	1 closed 1988	Low-Med.
			UST	1 active / 4 removed	
			RCRIS-SQG	No violations found	
8	Stanton Industries of Arizona	4215 W. LBR	UST	0 active / 1 removed	Low-Med.
11	C and M Enterprises	3240 S. 37th Ave.	RCRIS-SQG	No violations found	Low
17	Sunrise / Scorpio Steel Inc.	3420 S. 39th Ave.	LUST	3 closed 1997	Low-Med.
			UST	0 active / 2 removed	
17	All Valley Wrecker	3401 S. 39th Ave.	UST	0 active / 2 removed	Low-Med.
21	Reynolds Aluminum Plant Ponds	43rd Ave. / Salt River	AZ Spills	1 incident 1998	Low
			SHWS	WVB	

Notes:
ID – Map ID (see Figure 2)
NFRAP – No further remedial action planned
PA/SI – Preliminary Assessment/Site Investigation
WVB –Sites with this notation have been investigated as part of the West Van Buren (WVB) WQARF program

35th Avenue to 43rd Avenue - South of the Salt River

City of Phoenix Quarter Section Index Map Numbers: 3-19, 3-20, 4-19, and 4-20.

ID	Site Name	Site Address	Database	Status	Priority
38	CalMat Yard	4830 S. 43rd Ave.	LUST	1 closed 1990	Low-Med.
			UST	0 active / 1 removed	

ID	Site Name	Site Address	Database	Status	Priority
42	Tatel Inc.	5250 S. 43rd Ave.	UST	2 active / 0 removed	Low-Med.
42	Coreslab Structures Inc.	5026 S. 43rd Ave.	LUST	1 closed 2000	Low-Med.
			UST	0 active / 3 removed	

Notes:
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43rd Avenue to 51st Avenue – North of the Salt River

City of Phoenix Quarter Section Index Map Numbers: 5-17, 5-18, 6-17, and 6-18.

ID	Site Name	Site Address	Database	Status	Priority
16	Royden Construction Company	3423 S. 31st Ave.	UST	0 active / 2 removed	Low-Med.
16	RPS Inc.	3410 S. 51st Ave.	RCRIS-SQG	No violations found	Low
16	FedEx Ground	3410 S. 51st Ave.	AZ Spills	1996 Diesel release	Low-Med.
			UST	1 active / 0 removed	
16	Arizona Truss Fabricators	3207 S. 51st Ave.	LUST	1 closed 1990	Low-Med.

Notes:
ID – Map ID (see Figure 2)
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PA/SI – Preliminary Assessment/Site Investigation
WVB –Sites with this notation have been investigated as part of the West Van Buren (WVB) WQARF program

43rd Avenue to 51st Avenue - South of the Salt River

City of Phoenix Quarter Section Index Map Numbers: 3-17, 3-18, 4-17, and 4-18.

ID	Site Name	Site Address	Database	Status	Priority
43	Arizona Oil Recyclers Assoc.	5040 S. 51st Ave.	RCRIS-SQG	No violations found	Low
			AZ-Spills	1992 oil release	
48	A-1 Tire Company	4825 W. Southern	AZ-Spills	1990 fire	Low

Notes:
ID – Map ID (see Figure 2)
NFRAP – No further remedial action planned
PA/SI – Preliminary Assessment/Site Investigation
WVB –Sites with this notation have been investigated as part of the West Van Buren (WVB) WQARF program

51st Avenue to 59Th Avenue - North of the Salt River

City of Phoenix Quarter Section Index Map Numbers: 4-15, 4-16, 5-15, 5-16, 6-15 and 6-16.

- No Sites

51st Avenue to 59Th Avenue - South of the Salt River

City of Phoenix Quarter Section Index Map Numbers: 2-15, 2-16, 3-15, and 3-16.

- No Sites

59Th Avenue to 67th Avenue - North of the Salt River

City of Phoenix Quarter Section Index Map Numbers: 4-13, 4-14, 5-13, and 5-14.

- No Sites

59Th Avenue to 67th Avenue - South of the Salt River

City of Phoenix Quarter Section Index Map Numbers: 1-13, 1-14, 2-13, and 2-14.

ID	Site Name	Site Address	Database	Status	Priority
49	USA Tire Recycling	5922 W. Southern	AZ Spills	1992 fire	Low
51	Arnold Machinery Company of AZ	6024 W. Southern	RCRIS-SQG	No violations found	Low-Med.
			UST	1 active / 0 removed	
52	Mobile Soil Processing Unit	5922 W. Southern	RCRIS-SQG	No violations found	Low

Notes:
ID – Map ID (see Figure 2)
NFRAP – No further remedial action planned
PA/SI – Preliminary Assessment/Site Investigation
WVB –Sites with this notation have been investigated as part of the West Van Buren (WVB) WQARF program

67th Avenue to 75th Avenue - North of the Salt River

City of Phoenix Quarter Section Index Map Numbers: 3-11, 3-12, 4-11, and 4-12.

ID	Site Name	Site Address	Database	Status	Priority
28	Farm	7502 W. Broadway	UST	0 active / 2 removed	Low-Med.
28	Marbella	75th Ave / Broadway	Dry wells	9 Dry wells	Low

Notes:
ID – Map ID (see Figure 2)
NFRAP – No further remedial action planned
PA/SI – Preliminary Assessment/Site Investigation
WVB –Sites with this notation have been investigated as part of the West Van Buren (WVB) WQARF program

67th Avenue to 75th Avenue - South of the Salt River

City of Phoenix Quarter Section Index Map Numbers: 1-11, 1-12, 2-11, and 2-12.

ID	Site Name	Site Address	Database	Status	Priority
47	Iron Horse Equipment Corp	7316 W. Southern	RCRIS-SQG	No violations found	Low
53	Western Meat Company	7201 W. Southern	LUST	1 closed 1997	Low-Med.
			UST	0 active / 2 removed	

Notes:
ID – Map ID (see Figure 2)
NFRAP – No further remedial action planned
PA/SI – Preliminary Assessment/Site Investigation
WVB –Sites with this notation have been investigated as part of the West Van Buren (WVB) WQARF program

75th Avenue to 83rd Avenue - North of the Salt River

City of Phoenix Quarter Section Index Map Numbers: 3-09, 3-10, 4-09, and 4-10.

- No Sites

75th Avenue to 83rd Avenue - South of the Salt River

City of Phoenix Quarter Section Index Map Numbers: 1-09, 1-10, 2-09, and 2-10.

- No Sites

6.0 PREVIOUS REPORT REVIEW

URS reviewed two previous assessments provided by the City of Phoenix: Middle Gila River Watershed Management Study Phase 2 (Greeley, 2001) and Environmental Contaminants in Fish and Wildlife of the Lower Gila River, Arizona (U.S. F&W, 1997). Although the study areas of neither report were inclusive of the entire subject property, the general subject matter as it pertains to conditions along rivers such as the Gila or Salt was reviewed.

The 1997 Fish and Wildlife report summarizes the investigation of work conducted along the lower Gila River and the associated agricultural canals (see Appendix C). From 1994 through 1995, six study sites were investigated along the lower Gila River watershed between 59th Avenue and Painted Rock Dam. According to that report, organochlorine pesticides (including DDT, DDE, dieldrin, and chlordane), polychlorinated biphenyls (PCBs), and metals (including primarily aluminum, copper, mercury, nickel, selenium, vanadium, and zinc) were detected in the fish and wildlife along the watershed study area. The high levels of pesticides were found to be directly related to those agriculturally applied within the area. Based on the overall agricultural use along the lower Gila River watershed, similar pesticide contamination may exist

in areas of heavy agricultural use along the Salt River. The source for metals contamination was not discussed in the report.

The Phase 2 report summarizes the comprehensive study of the Gila River watershed. The purpose of the report was to consolidate data obtained during the Phase 1 and 2 studies and to enhance the current database of this information. Included in this report is information concerning groundwater and surface water quality, stormwater issues, land use, etc. as they pertain to water resource. Although the information contained in this report was not directly used in this ESA, the data was included in URS' Groundwater Quality and Hydrogeology Report.

7.0 CONCLUSIONS AND RECOMMENDATIONS

URS conducted this Modified Phase I Environmental Site Assessment of the Rio Salado Oeste Project area for the purpose of identifying potential sites of contamination as part of the due diligence process of evaluating the design and completion of a riparian habitat restoration project. The project site lies within the Salt River between 19th Avenue and 83rd Avenue in Phoenix, Maricopa County, Arizona. This study was also conducted to help delineate and identify areas for further investigation. The findings of this study have been accomplished primarily by two tasks and are presented with separate findings above. URS' recommendations are presented below for each of the two primary tasks;

7.1 CURRENT AND HISTORICAL AERIAL PHOTOGRAPHS

The findings of our current and historical aerial photograph review have identified several areas by Quarter Section (QS) for further investigation. Each area has been identified with a Priority Ranking of Low, Medium, or High (or derivation therein). URS recommends that areas with a Medium-High or High priority ranking be further investigated by first conducting a "windshield survey", since Rights-of-Entry to many of these sites will not be able to be obtained. The windshield survey report would be conducted to observe and document the environmental conditions of a facility (or area) as much as possible to determine the potential for past or future contamination of the project area. Based on the information obtained during the windshield survey, the City of Phoenix may wish to conduct an ASTM Phase I Environmental Site Assessment on the identified site (or area).

Because a large portion of the project study area has been utilized for agricultural purposes for many years, insecticide/pesticide residuals may be present in soils. It is beyond the scope of this project to assess the specific impact of current or former insecticide/pesticide use in the project study area. Former studies (as presented in Section 6.0) show that pesticide use can have a dramatic negative impact to fish and wildlife in the surrounding area. Consequently, further

investigation should be conducted to specifically address the potential for insecticides/pesticides to impact the Rio Salado Oeste project area from past (or current) agricultural use.

7.2 REGULATORY AGENCY REVIEW

The findings of the Regulatory Review have identified specific facilities for further investigation and again assigned a Priority Ranking of Low, Medium, or High (or derivation therein). URS recommends that the facilities (or sites) listed as Medium or High be further investigated by reviewing specific regulatory files associated with each to determine the potential for past or future contamination of the project area. Based on the information obtained during the regulatory records review, the City of Phoenix may wish to conduct an ASTM Phase I Environmental Site Assessment on the identified site (or facility).

8.0 REFERENCES

American Society for Testing and Materials (ASTM), Standard E 1527-00, "Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process," published September 2000.

Arizona Department of Environmental Quality (ADEQ), The Superfund Programs Section Information Packet, June 1999.

Environmental Data Resources, Inc. (EDR), Corridor Study Report, Inquiry Number: 738880.1r, February 27, 2002.

FEMA, Flood Insurance Rate Map (FIRM), Maricopa County, Arizona and Incorporated Areas, Panel 2115 of 4350, Map Number 04013C2115-E, July 19, 2001.

FEMA, Flood Insurance Rate Map (FIRM), Maricopa County, Arizona and Incorporated Areas, Panel 2120 of 4350, Map Number 04013C2120-E, July 19, 2001.

FEMA, Flood Insurance Rate Map (FIRM), Maricopa County, Arizona and Incorporated Areas, Panel 2140 of 4350, Map Number 04013C2140-E, July 19, 2001.

Greeley and Hansen, Middle Gila River Watershed Management Study Phase 2, February, 2001.

Hammett, B.A. and R.L. Herther, Maps Showing Groundwater Conditions in the Phoenix Active Management Area, Maricopa, Pinal and Yavapai Counties, Arizona, Arizona Department of Water Resources in cooperation with the U.S. Geological Survey, 1992.

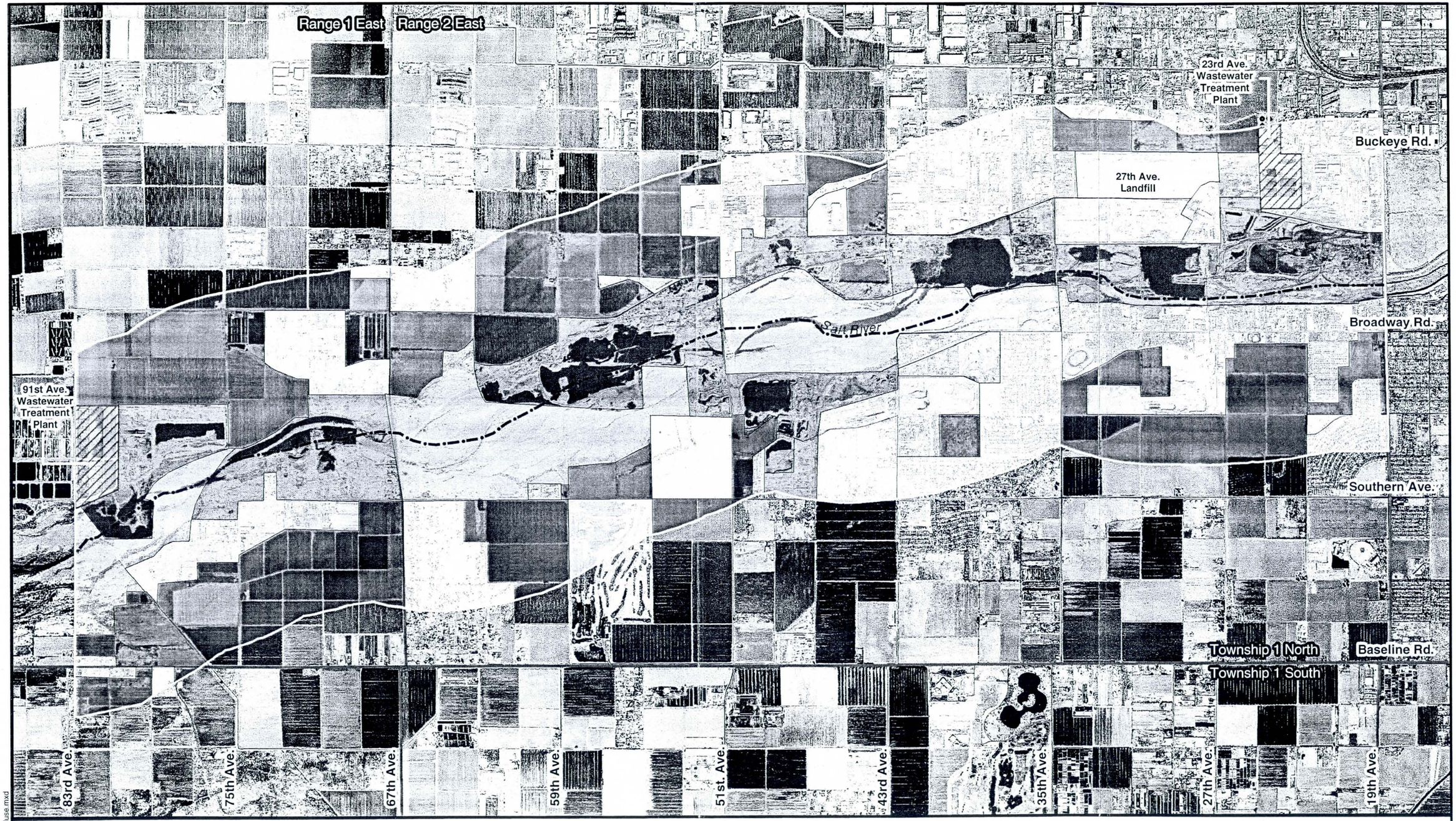
U.S. Department of Agriculture, Soil Conservation Service, Soil Survey of Maricopa County, Arizona, Central Part, September 1977.

U.S. Fish and Wildlife Service, Environmental Contaminants in Fish and Wildlife of the Lower Gila River, Arizona, December 1997.

U.S. Geological Survey, 7½-Minute Topographic Quadrangle Map, "Fowler, Arizona" 1952, Photorevised, 1982.

U.S. Geological Survey, 7½-Minute Topographic Quadrangle Map, "Phoenix, Arizona" 1952, Photorevised, 1982.

FIGURES



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Legend

- Residential
- Commercial/Industrial
- Landfill
- Sand/Gravel Operation
- Agricultural
- Recreational
- River Bottom/Native

0 0.25 0.5 1

Scale In Miles

Map Scale 1:35,000

Image Source:
Kenney Aerial Mapping, 2000

N

Existing Land Use

Groundwater Quality and Hydrogeology Report
Rio Salado Oeste Project

Figure 1

Rio Salado Oeste

- Listed Sites
- Earthquake Epicenters (Richter 5 or greater)
- Search Boundary
- Roads
- Major Roads
- Waterways
- Railroads
- Contour Lines
- Pipelines
- Powerlines
- Fault Lines
- Water
- Superfund Sites
- 100-Yr Flood Zones

Figure 2

Phoenix, AZ

0 1/2 1

Scale in Miles

Environmental Data Resources, Inc.

APPENDIX A

EDR DATABASE REPORT

The EDR Corridor Study Report

Study Area
Rio Salado Oeste
Phoenix, AZ 85339

February 27, 2002

Inquiry number 738880.1r

Environmental Data Resources, Inc.

The Source For Environmental Risk Management Data

3530 Post Road
Southport, Connecticut 06490

Nationwide Customer Service

Telephone: 1-800-352-0050
Fax: 1-800-231-6802
Internet: www.edrnet.com

EXECUTIVE SUMMARY

A search of available environmental records was conducted by Environmental Data Resources, Inc. (EDR).

TARGET PROPERTY INFORMATION

ADDRESS

RIO SALADO OESTE
PHOENIX, AZ 85339

DATABASES WITH NO MAPPED SITES

No mapped sites were found in EDR's search of available ("reasonably ascertainable ") government records within the requested search area for the following databases:

FEDERAL ASTM STANDARD

Proposed NPL..... Proposed National Priority List Sites

STATE ASTM STANDARD

SPL..... Superfund Program List
AZ WQARF..... Water Quality Assurance Revolving Fund Sites

FEDERAL ASTM SUPPLEMENTAL

CONSENT..... Superfund (CERCLA) Consent Decrees
Delisted NPL..... National Priority List Deletions
MLTS..... Material Licensing Tracking System
NPL Liens..... Federal Superfund Liens
RAATS..... RCRA Administrative Action Tracking System

STATE OR LOCAL ASTM SUPPLEMENTAL

AZ DOD..... Department of Defense Sites

EDR PROPRIETARY HISTORICAL DATABASES

Coal Gas..... Former Manufactured Gas (Coal Gas) Sites

SURROUNDING SITES: SEARCH RESULTS

Surrounding sites were identified.

Page numbers and map identification numbers refer to the EDR Radius Map report where detailed data on individual sites can be reviewed.

Sites listed in ***bold italics*** are in multiple databases.

Unmappable (orphan) sites are not considered in the foregoing analysis.

EXECUTIVE SUMMARY

FEDERAL ASTM STANDARD

NPL: Also known as Superfund, the National Priority List database is a subset of CERCLIS and identifies over 1,200 sites for priority cleanup under the Superfund program. The source of this database is the U.S. EPA.

A review of the NPL list, as provided by EDR, and dated 01/29/2002 has revealed that there is 1 NPL site within the searched area.

Site	Address	Map ID	Page
NINETEENTH AVENUE LANDFILL	*19TH AVE*	*0*	*3*

CERCLIS: The Comprehensive Environmental Response, Compensation and Liability Information System contains data on potentially hazardous waste sites that have been reported to the USEPA by states, municipalities, private companies and private persons, pursuant to Section 103 of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA).
CERCLIS contains sites which are either proposed to or on the National Priorities List (NPL) and sites which are in the screening and assessment phase for possible inclusion on the NPL.

A review of the CERCLIS list, as provided by EDR, and dated 11/21/2001 has revealed that there is 1 CERCLIS site within the searched area.

Site	Address	Map ID	Page
NINETEENTH AVENUE LANDFILL	*19TH AVE*	*0*	*3*

CERCLIS-NFRAP: As of February 1995. CERCLIS sites designated "No Further Remedial Action Planned" (NFRAP) have been removed from CERCLIS. NFRAP sites may be sites where, following an initial investigation, no contamination was found, contamination was removed quickly without the need for the site to be placed on the NPL, or the contamination was not serious enough to require Federal Superfund Action or NPL consideration. EPA has removed approximately 25,000 NFRAP sites to lift the unintended barriers to the redevelopment of these properties and has archived them as historical records so EPA does not needlessly repeat the investigations in the future. This policy change is part of the EPA's Brownfields Redevelopment Program to help cities, states, private investors and affected citizens to promote economic redevelopment of unproductive urban sites.

A review of the CERC-NFRAP list, as provided by EDR, and dated 11/21/2001 has revealed that there are 4 CERC-NFRAP sites within the searched area.

Site	Address	Map ID	Page
COPPERSTATE METALS INC	*3720 W LOWER BUCKEYE RD*	*1*	*11*
KENWORTH OF AZ SUNWARD MATERIA	*2625 S 19TH AVE*	*2*	*17*
ARIZONA BARREL AND CAN COMPANY	4225 S. 19TH AVENUE	25	98
ONYX ENVIRONMENTAL SERVICES LL	*2301 W BROADWAY RD*	*33*	*109*

EXECUTIVE SUMMARY

CORRACTS: CORRACTS is a list of handlers with RCRA Corrective Action Activity. This report shows which nationally-defined corrective action core events have occurred for every handler that has had corrective action activity.

A review of the CORRACTS list, as provided by EDR, and dated 11/14/2001 has revealed that there are 3 CORRACTS sites within the searched area.

Site	Address	Map ID	Page
CHEMCON INC	*3702 W LOWER BUCKEYE*	*1*	*11*
GREENFIELD ENVIRONMENTAL OF AZ	*2575 S 16TH AVE*	*4*	*22*
ONYX ENVIRONMENTAL SERVICES LL	*2301 W BROADWAY RD*	*33*	*109*

RCRIS: The Resource Conservation and Recovery Act database includes selected information on sites that generate, store, treat, or dispose of hazardous waste as defined by the Act. The source of this database is the U.S. EPA.

A review of the RCRIS-TSD list, as provided by EDR, and dated 06/21/2000 has revealed that there are 2 RCRIS-TSD sites within the searched area.

Site	Address	Map ID	Page
GREENFIELD ENVIRONMENTAL OF AZ	*2575 S 16TH AVE*	*4*	*22*
ONYX ENVIRONMENTAL SERVICES LL	*2301 W BROADWAY RD*	*33*	*109*

RCRIS: The Resource Conservation and Recovery Act database includes selected information on sites that generate, store, treat, or dispose of hazardous waste as defined by the Act. The source of this database is the U.S. EPA.

A review of the RCRIS-LQG list, as provided by EDR, and dated 06/21/2000 has revealed that there are 4 RCRIS-LQG sites within the searched area.

Site	Address	Map ID	Page
MARLAM INDUSTRIES INC	*2465 S 19TH AVE STE D*	*2*	*20*
GREENFIELD ENVIRONMENTAL OF AZ	*2575 S 16TH AVE*	*4*	*22*
PHOENIX TRANSIT SYSTEM	*2225 W LOWER BUCKEYE*	*6*	*38*
ONYX ENVIRONMENTAL SERVICES LL	*2301 W BROADWAY RD*	*33*	*109*

RCRIS: The Resource Conservation and Recovery Act database includes selected information on sites that generate, store, treat, or dispose of hazardous waste as defined by the Act. The source of this database is the U.S. EPA.

A review of the RCRIS-SQG list, as provided by EDR, and dated 06/21/2000 has revealed that there are 41 RCRIS-SQG sites within the searched area.

Site	Address	Map ID	Page
RIO SALADO AUTOBODY INC	*2801 S 35TH AVE*	*1*	*7*
CHEMCON INC	*3702 W LOWER BUCKEYE*	*1*	*11*
COPPERSTATE METALS INC	*3720 W LOWER BUCKEYE RD*	*1*	*11*
BLUE CIRCLE WEST LEASING	*2625 S 19TH AVE*	*2*	*16*
KENWORTH OF AZ SUNWARD MATERIA	*2625 S 19TH AVE*	*2*	*17*

Site	Address	Map ID	Page
WILLIAMS DETROIT DIESEL ALLISO	*2602 S 19TH AVE*	*2*	*18*
FRONTIER FREIGHTWAYS	*2465 S 19TH AVE*	*2*	*19*
CYPRESS ENVIRONMENTAL	*2465 S 19TH AVE STE A2*	*2*	*19*
PHOENIX TRANSIT SYSTEM	*2225 W LOWER BUCKEYE*	*6*	*35*
PHOENIX CITY OF FINANCE FUEL	*2239 W LOWER BUCKEYE*	*6*	*39*
TESSENDERLO KERLEY INC	*2248 W LOWER BUCKEYE RD*	*6*	*41*
ZIEMAN MFG	*4025 LOWER BUCKEYE*	*7*	*47*
PHOENIX REDI MIX CO INC	*3635 S 43RD AVE*	*8*	*47*
TNT BESTWAY TRANSPORATION	3045 S 43RD AVE	8	53
TNT BESTWAY TRANSPORATION	*3045 S 43RD AVE*	*8*	*53*
EMPIRE WASTE AND RECYCLING	*2010 W LOWER BUCKEYE*	*9*	*55*
C AND M ENTERPRISES	*3240 S 37TH AVE*	*11*	*58*
PHOENIX METAL RECYCLING	*3210 S 19TH AVE*	*13*	*58*
WASTE MANAGEMENT OF PHX SOUTH	3000 S 19TH AVE	13	62
UNIVERSAL WASTE CONTROL	*3000 S 19TH AVE*	*13*	*62*
COPPERSTATE EXPRESS LINES	*3044 S 35TH AVE*	*15*	*65*
RPS INC	*3410 S 51ST AVE*	*16*	*76*
GLENN WEINBERGER LANDFILL	3410 S 39TH AVE	17	82
UNITED METRO MATERIAL PLANT 11	*3640 S 19TH AVE*	*19*	*83*
ACE ASPHALT	*895 W ELWOOD*	*20*	*88*
LAIDLAW ENVMTAL SVCS SOUTHWEST	*888 W ILLINI ST*	*23*	*92*
INDUSTRIAL RECYCLING SOLUTIONS	*2610 W HOLLY ST C*	*25*	*97*
SOLVENT RECYCLEAN INC	*1850 W BROADWAY STE 106*	*25*	*97*
TURNERS MACHINE SHOP	*1521 W BROADWAY*	*30*	*103*
ENVIROSOLVE LLC	*2844 W BROADWAY RD*	*31*	*105*
YANK YOUR PART	*2104 W BROADWAY*	*32*	*106*
A G PRODUCTS	*2630 W BROADWAY RD*	*33*	*107*
SWIFT TRANSPORT	*3106 W BROADWAY*	*35*	*121*
BOB AUTO AND PICKUP WRECKING	*3408 W BROADWAY*	*36*	*121*
ARIZONA OIL RECYCLERS ASSOC	*5040 S 51ST AVE*	*43*	*129*
CHANDLER CONVERTER REBUILDERS	*284 E CHILTON DR STE 9*	*47*	*130*
IRON HORSE EQUIPMENT CORP	*7316 W SOUTHERN*	*47*	*131*
W W T P 91ST AVE	*91ST AVE SOUTHERN*	*50*	*132*
ARNOLD MACHINERY CO OF ARIZONA	*6024 W SOUTHERN AVE*	*51*	*132*
MOBILE SOIL PROCESSING UNIT	*5922 W SOUTHERN RT 1 BO*	*52*	*133*
IR INDUSTRIES	*83RD AVENUE*	*54*	*134*

ERNS: The Emergency Response Notification System records and stores information on reported releases of oil and hazardous substances. The source of this database is the U.S. EPA.

A review of the ERNS list, as provided by EDR, and dated 08/08/2000 has revealed that there are 12 ERNS sites within the searched area.

Site	Address	Map ID	Page
3700 W. LOWER BUCKEYE RD	3700 W. LOWER BUCKEYE R	1	9
2530 SOUTH 16 AVENUE	2530 SOUTH 16 AVENUE	4	33
27 AVE & LOWER BUCKEYE	27 AVE & LOWER BUCKEYE	5	33
3045 S. 22ND AVE	3045 S. 22ND AVE	6	46
2301 WEST BROADWAY ROAD	2301 WEST BROADWAY ROAD	33	107
2301 W BROADWAY RD	2301 W BROADWAY RD	33	107
2301 W. BROADWAY	2301 W. BROADWAY	33	118
6842 W.ROMLEY	6842 W.ROMLEY	37	126
4842 S. 36TH AVE	4842 S. 36TH AVE	40	127
5040 S 51ST AVE	5040 S 51ST AVE	43	128

EXECUTIVE SUMMARY

Site	Address	Map ID	Page
5436 S. 43RD AVE.	5436 S. 43RD AVE.	45	130
5922 W SOUTHERN	5922 W SOUTHERN	49	131

STATE ASTM STANDARD

SHWS: The State Hazardous Waste Sites records are the states' equivalent to CERCLIS. These sites may or may not already be listed on the federal CERCLIS list. Priority sites planned for cleanup using state funds (state equivalent of Superfund) are identified along with sites where cleanup will be paid for by potentially responsible parties. The data come from the Department of Environmental Quality's ZipAcids database.

A review of the SHWS list, as provided by EDR, has revealed that there are 24 SHWS sites within the searched area.

Site	Address	Map ID	Page
RIO SALADO AUTOBODY INC	***2801 S 35TH AVE***	***1***	***7***
UNKNOWN 2	3650 W. LOWER BUCKEYE R	1	8
CASTLE MFG, INC	3702 W. LOWER BUCKEYE R	1	10
COPPERSTATE METALS INC	***3720 W LOWER BUCKEYE RD***	***1***	***11***
DAGLEYS	2455 S. 35TH AVE.	1	16
ANGEL AUTO	2450 S. 35TH AVE.	1	16
KENWORTH MOTOR TRUCK DISTRIBUT	2625 S 19TH AVE	2	17
OLD 23RD AVE SLUDGE DISPOSAL P	23RD AVE / LOWER BUCK	3	21
CITY OF PHOENIX PETROLEUM STOR	***2239 W LOWER BUCKEYE RD***	***6***	***39***
KERLEY ENTERPRISES	2248 W. LOWER BUCKEYE R	6	41
C AND M ENTERPRISES	***3240 S 37TH AVE***	***11***	***58***
PIONEER TRUCK SERVICE	3202 S. 35TH AVE.	15	63
MARICOPA BY-PRODUCTS INC	***3602 W ELWOOD ST***	***15***	***63***
ARIZONA PRECAST	3045 S. 35TH AVE	15	64
QUALITY BLOCK CO., INC.	3035 S. 35TH AVE.	15	65
27TH AVE. LANDFILL	***27TH AVE. AND LOWER BUC***	***18***	***83***
REYNOLDS ALUMINUM PLANT PONDS	***43RD AVE / SALT RIVER***	***21***	***88***
SMITHEY RECYCLING CO	3649 S. 35TH AVE.	22	89
DISPOSAL CONTROL SERVICES	888 WEST ILLINI ST.	23	94
19TH AVE AIRSTRIP	NE CORNER 19TH AVE /	25	98
ONYX ENVIRONMENTAL SERVICES LL	***2301 W BROADWAY RD***	***33***	***109***
REGENT AUTO & TRUCK PARTS	2528 WEST BROADWAY ROAD	33	120
A & S AUTO WRECKING	2528 W. BROADWAY ROAD	33	120
MANZANITA SPEEDWAY	35TH AVE. / WEST BROADW	36	126

SWF/LF: The Solid Waste Facilities/Landfill Sites records typically contain an inventory of solid waste disposal facilities or landfills in a particular state. The data come from the Department of Environmental Quality's Municipal Solid Waste Landfills.../Closed Solid Waste Landfills...database.

A review of the SWF/LF list, as provided by EDR, has revealed that there are 2 SWF/LF sites within the searched area.

Site	Address	Map ID	Page
27TH AVE. LANDFILL	***27TH AVE. AND LOWER BUC***	***18***	***83***

Site	Address	Map ID	Page
AETS	SOUTHWEST PORTION OF TH	32	107

LUST: The Leaking Underground Storage Tank Incident Reports contain an inventory of reported leaking underground storage tank incidents. The data come from the Department of Environmental Quality's LUST File Listing by Zip Code.

A review of the LUST list, as provided by EDR, and dated 11/08/2001 has revealed that there are 35 LUST sites within the searched area.

Site	Address	Map ID	Page
EMCO RECYCLING	*3700 W LOWER BUCKEYE RD*	*1*	*9*
DESERT TRANSFER INC	*3751 W LOWER BUCKEYE RD*	*1*	*13*
R J RUFF & CO	*3883 W LOWER BUCKEYE RD*	*1*	*13*
SUPERIOR COMPANIES	*2402 S 19TH AVE*	*2*	*19*
ARIZONA BEEF	*2401 S 19TH AVE*	*2*	*20*
PHOENIX 27TH AVE LANDFILL	*27TH AVE & LOWER BUCKEY*	*5*	*33*
PHOENIX TRANSIT SYSTEM	*2225 W LOWER BUCKEYE*	*6*	*35*
CITY OF PHOENIX PETROLEUM STOR	*2239 W LOWER BUCKEYE RD*	*6*	*39*
PHOENIX SALT RIVER SERVICE CTR	*3045 S 22ND AVE*	*6*	*42*
MARDIAN CONSTRUCTION COMPANY	*4044 W LOWER BUCKEYE RD*	*7*	*46*
PHOENIX REDI-MIX CO INC	*3635 S 43RD AVE*	*8*	*48*
PUBLICKER IND/MASTERVIEW WINDO	*3065 S 43RD AVE*	*8*	*51*
USF BESTWAY TRANSPORTATION	*3045 S 43RD AVE*	*8*	*52*
EMPIRE METALS INC	*2010 W LOWER BUCKEYE RD*	*9*	*55*
PHOENIX TALLOW	*2602 S 15TH AVE*	*10*	*56*
WASTE MANAGEMENT OF PHOENIX	*3000 S 19TH AVE*	*13*	*60*
QUALITY BLOCK CO INC	*3035 S 35TH AVE*	*15*	*65*
ARIZONA TRUSS FABRICATORS INC	*3207 S 51ST AVE*	*16*	*81*
SUNRISE STEEL/SCORPIO STEEL IN	*3420 S 39TH AVE*	*17*	*82*
TANNER-UNITED METRO	*3640 S 19TH AVE*	*19*	*84*
ACE ASPHALT OF ARIZONA INC	*895 W ELWOOD*	*20*	*86*
SALT RIVER RECYCLING/SMITHEY	*3640 S 35TH AVE*	*22*	*90*
CIRCLE K # 670	*4422 S 19TH AVE*	*25*	*94*
COOLEY WHOLESALE LUMBER CO	*1930 W BROADWAY*	*25*	*95*
ARIZONA TEAMSTERS APPRENTICESH	*1820 W BROADWAY*	*25*	*96*
19TH AVE LANDFILL	*19TH AVE & SALT RIVER*	*25*	*99*
WESTERN BLOCK COMPANY	*4021 S 19TH AVE*	*25*	*99*
ROAD JAMMERS MACHINERY	*4300 S 17TH AVE*	*27*	*100*
BROADWAY CARDLOCK #23	*1307 W BROADWAY RD*	*30*	*102*
FUELCO #113	*3331 W BROADWAY*	*36*	*123*
ROTMAN PROPERTIES	*3250 W BROADWAY RD*	*36*	*124*
RICKETTS TRUCKING INC	*3434 W BROADWAY*	*36*	*124*
CALMAT YARD	*4830 S 43RD AVE*	*38*	*126*
CORESLAB STRUCTURES INC	*5026 S 43RD AVE*	*42*	*127*
WESTERN MEAT COMPANY	*7201 W SOUTHERN AVE*	*53*	*133*

EXECUTIVE SUMMARY

UST: The Underground Storage Tank database contains registered USTs. USTs are regulated under Subtitle I of the Resource Conservation and Recovery Act (RCRA). The data come from the Department of Environmental Quality's Arizona UST-DMS Facility and Tank Data Listing by City database.

A review of the UST list, as provided by EDR, and dated 11/07/2001 has revealed that there are 70 UST sites within the searched area.

Site	Address	Map ID	Page
CIRCLE K # 8870	3501 W LOWER BUCKEYE RD	1	7
EMCO RECYCLING	***3700 W LOWER BUCKEYE RD***	***1***	***9***
DESERT TRANSFER INC	***3751 W LOWER BUCKEYE RD***	***1***	***13***
R J RUFF & CO	***3883 W LOWER BUCKEYE RD***	***1***	***13***
REUTER EQUIPMENT COMPANY	3816 W LOWER BUCKEYE RD	1	14
CAVCO INDUSTRIES INC	2602 S 35TH AVE	1	15
CAVCO INDUSTRIES INC	2502 & 2550 W DURANGO	1	16
NEILS DETROIT DIESEL INC	2602 S 19TH AVE	2	18
SUPERIOR COMPANIES	***2402 S 19TH AVE***	***2***	***19***
ARIZONA BEEF	***2401 S 19TH AVE***	***2***	***20***
BRADLEY INVESTMENT CO	2235 S 19TH AVE	2	21
PHOENIX 27TH AVE LANDFILL	***27TH AVE & LOWER BUCKEY***	***5***	***33***
27TH AVE LANDFILL	2800 S 27TH AVE	5	34
PHOENIX TRANSIT SYSTEM	***2225 W LOWER BUCKEYE***	***6***	***35***
CITY OF PHOENIX PETROLEUM STOR	***2239 W LOWER BUCKEYE RD***	***6***	***39***
KERLEY AGRICULTURAL PRODUCTS	2248 W LOWER BUCKEYE RD	6	41
PHOENIX SALT RIVER SERVICE CTR	***3045 S 22ND AVE***	***6***	***42***
MARDIAN CONSTRUCTION COMPANY	***4044 W LOWER BUCKEYE RD***	***7***	***46***
ZIEMAN MFG	***4025 LOWER BUCKEYE***	***7***	***47***
PHOENIX REDI-MIX CO INC	***3635 S 43RD AVE***	***8***	***48***
GLENN WIENBEGER	3425 S 43RD AVE	8	50
A & K PARTNERSHIP	3211 S 43RD AVE	8	51
PUBLICKER IND/MASTERVIEW WINDO	***3065 S 43RD AVE***	***8***	***51***
USF BESTWAY TRANSPORTATION	***3045 S 43RD AVE***	***8***	***52***
STANTON INDUSTRIES OF ARIZONA	4215 W LOWER BUCKEYE RD	8	54
EMPIRE METALS INC	***2010 W LOWER BUCKEYE RD***	***9***	***55***
PHOENIX TALLOW	***2602 S 15TH AVE***	***10***	***56***
ASPHALT PRODUCTS TRANSPORT CO	3050 S 19TH AVE	13	59
LINCOLN AUTO	3020 S 19TH AVE	13	60
WASTE MANAGEMENT OF PHOENIX	***3000 S 19TH AVE***	***13***	***60***
OPERATING ENGINEER'S YARD	3225 S 22ND AVE	14	62
MARICOPA BY-PRODUCTS INC	***3602 W ELWOOD ST***	***15***	***63***
QUALITY BLOCK CO INC	***3035 S 35TH AVE***	***15***	***65***
ROYDEN CONSTRUCTION CO	3423 S 51ST AVE	16	67
FEDEX GROUND	***3410 S 51ST AVE***	***16***	***76***
ARIZONA TRUSS FABRICATORS INC	***3207 S 51ST AVE***	***16***	***81***
SUNRISE STEEL/SCORPIO STEEL IN	***3420 S 39TH AVE***	***17***	***82***
ALL VALLEY WRECKER	3401 S 39TH AVE	17	83
TANNER-UNITED METRO	***3640 S 19TH AVE***	***19***	***84***
ACE ASPHALT OF ARIZONA INC	***895 W ELWOOD***	***20***	***86***
SALT RIVER RECYCLING/SMITHEY	***3640 S 35TH AVE***	***22***	***90***
CIRCLE K # 670	***4422 S 19TH AVE***	***25***	***94***
COOLEY WHOLESALE LUMBER CO	***1930 W BROADWAY***	***25***	***95***
ARIZONA TEAMSTERS APPRENTICESH	***1820 W BROADWAY***	***25***	***96***
C S W CONTRACTORS INC	1824 W BROADWAY	25	96
CIRCLE K # 1968	4305 S 19TH AVE	25	98
19TH AVE LANDFILL	***19TH AVE & SALT RIVER***	***25***	***99***
WESTERN BLOCK COMPANY	***4021 S 19TH AVE***	***25***	***99***
ROAD JAMMERS MACHINERY	***4300 S 17TH AVE***	***27***	***100***
FARM	7502 W BROADWAY RD	28	101

Site	Address	Map ID	Page
BROADWAY CARDLOCK #23	*1307 W BROADWAY RD*	*30*	*102*
PROGESSIVE ROOFING	1501 W BROADWAY	30	103
SANDVICK EQUIPMENT & SUPPLY CO	1502 W BROADWAY RD	30	103
BROWN TANK & STEEL	4300 S 15TH AVE	30	103
VISTA CONSTRUCTION	2836 W BROADWAY	31	104
ROYDEN CONSTRUCTION CO	2844 W BROADWAY	31	104
CONSTRUCTION YARD	2850 W BROADWAY RD	31	106
M & M AUTO STORAGE POOL INC	2299 W BROADWAY	33	118
FUELCO #112	2401 W BROADWAY	33	118
SMITH PRE-CAST	2410 W BROADWAY	33	119
ALAN HARRIS TRUCKING	2505 W BROADWAY RD	33	120
FUELCO #113	*3331 W BROADWAY*	*36*	*123*
ROTMAN PROPERTIES	*3250 W BROADWAY RD*	*36*	*124*
RICKETTS TRUCKING INC	*3434 W BROADWAY*	*36*	*124*
PHILLIPS 66 COMPANY #016633	3449 W BROADWAY	36	125
CALMAT YARD	*4830 S 43RD AVE*	*38*	*126*
TATEL INC	5250 S 43RD AVE	42	127
CORESLAB STRUCTURES INC	*5026 S 43RD AVE*	*42*	*127*
ARNOLD MACHINERY COMPANY #4627	6024 W SOUTHERN	51	133
WESTERN MEAT COMPANY	*7201 W SOUTHERN AVE*	*53*	*133*

FEDERAL ASTM SUPPLEMENTAL

RODS: Record of Decision. ROD documents mandate a permanent remedy at an NPL (Superfund) site containing technical and health information to aid the cleanup.

A review of the ROD list, as provided by EDR, has revealed that there is 1 ROD site within the searched area.

Site	Address	Map ID	Page
NINETEENTH AVENUE LANDFILL	*19TH AVE*	*0*	*3*

FINDS: The Facility Index System contains both facility information and "pointers" to other sources of information that contain more detail. These include: RCRIS; Permit Compliance System (PCS); Aerometric Information Retrieval System (AIRS); FATES (FIFRA [Federal Insecticide Fungicide Rodenticide Act] and TSCA Enforcement System, FTTS [FIFRA/TSCA Tracking System]; CERCLIS; DOCKET (Enforcement Docket used to manage and track information on civil judicial enforcement cases for all environmental statutes); Federal Underground Injection Control (FURS); Federal Reporting Data System (FRDS); Surface Impoundments (SIA); TSCA Chemicals in Commerce Information System (CICS); PADS; RCRA-J (medical waste transporters/disposers); TRIS; and TSCA. The source of this database is the U.S. EPA/NTIS.

A review of the FINDS list, as provided by EDR, and dated 10/29/2001 has revealed that there are 58 FINDS sites within the searched area.

Site	Address	Map ID	Page
RIO SALADO AUTOBODY INC	*2801 S 35TH AVE*	*1*	*7*
CHEMCON INC	*3702 W LOWER BUCKEYE*	*1*	*11*
COPPERSTATE METALS INC	*3720 W LOWER BUCKEYE RD*	*1*	*11*

EXECUTIVE SUMMARY

Site	Address	Map ID	Page
CAVCO INDUSTRIES LLC	2602 S 35TH AVE	1	15
BLUE CIRCLE WEST LEASING	*2625 S 19TH AVE*	*2*	*16*
KENWORTH OF AZ SUNWARD MATERIA	*2625 S 19TH AVE*	*2*	*17*
WILLIAMS DETROIT DIESEL ALLISO	*2602 S 19TH AVE*	*2*	*18*
FRONTIER FREIGHTWAYS	*2465 S 19TH AVE*	*2*	*19*
CYPRESS ENVIRONMENTAL	*2465 S 19TH AVE STE A2*	*2*	*19*
MARLAM INDUSTRIES INC	*2465 S 19TH AVE STE D*	*2*	*20*
GREENFIELD ENVIRONMENTAL OF AZ	*2575 S 16TH AVE*	*4*	*22*
PHOENIX TRANSIT SYSTEM	*2225 W LOWER BUCKEYE*	*6*	*38*
PHOENIX CITY OF FINANCE FUEL	*2239 W LOWER BUCKEYE*	*6*	*39*
TESSENDERLO KERLEY INC	*2248 W LOWER BUCKEYE RD*	*6*	*41*
POLICE SURPLUS YARD	3032 S 22ND AVE	6	46
ZIEMAN MFG	*4025 LOWER BUCKEYE*	*7*	*47*
PHOENIX REDI MIX CO INC	*3635 S 43RD AVE*	*8*	*47*
TNT BESTWAY TRANSPORATION	*3045 S 43RD AVE*	*8*	*53*
STANTON INDUSTRIES	*4215 W LOWER BUCKEYE RD*	*8*	*54*
EMPIRE WASTE AND RECYCLING	*2010 W LOWER BUCKEYE*	*9*	*55*
C AND M ENTERPRISES	*3240 S 37TH AVE*	*11*	*58*
PHOENIX CITY OF 27TH AVE LANDF	3060 S 27TH AVE	12	58
PHOENIX METAL RECYCLING	3210 S 19TH AVE	13	58
PHOENIX METAL RECYCLING	*3210 S 19TH AVE*	*13*	*58*
T P A C DIV	3052 S 19TH AVE	13	59
CHEVRON USA INCORPORATED PHOEN	3050 S. 19TH AVE.	13	59
UNIVERSAL WASTE CONTROL	*3000 S 19TH AVE*	*13*	*62*
COPPERSTATE EXPRESS LINES	*3044 S 35TH AVE*	*15*	*65*
RPS INC	*3410 S 51ST AVE*	*16*	*76*
RPS INC	3410 S 51ST AVE	16	81
UNITED METRO MATERIAL PLANT 11	*3640 S 19TH AVE*	*19*	*83*
ACE ASPHALT	*895 W ELWOOD*	*20*	*88*
METAL MANAGEMENT ARIZONA INC	3640 S 35TH AVE	22	91
BRYANT INDUSTRIES INC	788 W ILLINI STREET	23	91
LAIDLAW ENVMTAL SVCS SOUTHWEST	*888 W ILLINI ST*	*23*	*92*
COHONE TECHNOLOGIES INC	1824 W BROADWAY	25	96
INDUSTRIAL RECYCLING SOLUTIONS	*2610 W HOLLY ST C*	*25*	*97*
SOLVENT RECYCLEAN INC	*1850 W BROADWAY STE 106*	*25*	*97*
WESTERN BLOCK	4019 S 19TH AVE	25	100
TURNERS MACHINE SHOP	*1521 W BROADWAY*	*30*	*103*
ENVIROSOLVE LLC	2844 W BROADWAY RD	31	105
ENVIROSOLVE LLC	*2844 W BROADWAY RD*	*31*	*105*
YANK YOUR PART	*2104 W BROADWAY*	*32*	*106*
A G PRODUCTS	*2630 W BROADWAY RD*	*33*	*107*
ONYX ENVIRONMENTAL SERVICES LL	*2301 W BROADWAY RD*	*33*	*109*
SWIFT TRANSPORT	*3106 W BROADWAY*	*35*	*121*
BOB AUTO AND PICKUP WRECKING	*3408 W BROADWAY*	*36*	*121*
WESTERN STATES PETROLEUM	3331 W. BROADWAY RD.	36	122
SELF SERVICE SALVAGE	3250 W BROADWAY	36	123
CALMAT COMPANIES THE	4830 S 43RD AVE	38	126
ARIZONA OIL RECYCLERS ASSOC	*5040 S 51ST AVE*	*43*	*129*
CHANDLER CONVERTER REBUILDERS	*284 E CHILTON DR STE 9*	*47*	*130*
IRON HORSE EQUIPMENT CORP	*7316 W SOUTHERN*	*47*	*131*
CEMEX USA - LAVEEN PLANT	6002 S 75TH AVE	47	131
W W T P 91ST AVE	*91ST AVE SOUTHERN*	*50*	*132*
ARNOLD MACHINERY CO OF ARIZONA	*6024 W SOUTHERN AVE*	*51*	*132*
MOBILE SOIL PROCESSING UNIT	*5922 W SOUTHERN RT 1 BO*	*52*	*133*
IR INDUSTRIES	*83RD AVENUE*	*54*	*134*

EXECUTIVE SUMMARY

HMIRS: The Hazardous Materials Incident Report System contains hazardous material spill incidents reported to the Department of Transportation. The source of this database is the U.S. EPA.

A review of the HMIRS list, as provided by EDR, and dated 09/30/2001 has revealed that there are 166 HMIRS sites within the searched area.

Site	Address	Map ID	Page
Not reported	3045 SOUTH 43RD AVENUE	8	52
Not reported	3045 SOUTH 43RD AVENUE	8	53
Not reported	2925 S 43RD AVE	8	54
Not reported	3510 S 51ST AVE	16	66
Not reported	3510 S 51ST AVE	16	66
Not reported	3510 S 51ST AVE	16	66
Not reported	3510 S. 51ST AVE	16	66
Not reported	3410 S 51ST AVENUE	16	67
Not reported	3410 S 51ST AVENUE	16	67
Not reported	3410 S 51ST AVE	16	67
Not reported	3410 S 51ST AVE	16	67
Not reported	3410 S 51ST AVE	16	67
Not reported	3410 S 51ST AVENUE	16	67
Not reported	3410 S 51ST AVE	16	67
Not reported	3410 S 51ST AVE	16	67
Not reported	3410 S 51ST AVE	16	68
Not reported	3410 S. 51ST AVE	16	68
Not reported	3410 S 51 AVE	16	68
Not reported	3410 S 51 AVE	16	68
Not reported	3410 S 51ST AVE	16	68
Not reported	3410 S 51 ST AVE	16	68
Not reported	3410 S 51 AVE	16	68
Not reported	3410 S 51 AVE	16	68
Not reported	3410 S 51ST AVE	16	68
Not reported	3410 S 51 AVE	16	68
Not reported	3410 S 51 AVE	16	68
Not reported	3410 S 51 AVE	16	68
Not reported	3410 S 51 ST AVE	16	69
Not reported	3410 S 51ST AVE	16	69
Not reported	3410 S 51 ST AVE	16	69
Not reported	3410 S 51ST AVE	16	69
Not reported	3410 S 51ST AVE	16	69
Not reported	3410 S 51ST AVE	16	69
Not reported	3410 S 51ST AVE	16	69
Not reported	3410 S 51ST AVE	16	69
Not reported	3410 S 51ST AVE	16	69
Not reported	3410 S 51ST AVE	16	69
Not reported	3410 S 51ST AVE	16	69
Not reported	3410 S 51 ST AVE	16	69
Not reported	3410 S 51ST AVE	16	69
Not reported	3410 S 51 ST AVE	16	70
Not reported	3410 S 51ST AVE	16	70
Not reported	3410 S 51ST AVE	16	70
Not reported	3410 S 51 ST AVE	16	70
Not reported	3410 S 51 ST AVE	16	70
Not reported	3410 S 51ST AVE	16	70
Not reported	3410 S 51ST AVE	16	70
Not reported	3410 S 51ST AVE	16	70
Not reported	3410 S 51ST AVE	16	70
Not reported	3410 S 51ST AVENUE	16	70
Not reported	3410 S. 51ST AVE	16	70
Not reported	3410 S. 51ST AVE	16	70

Site	Address	Map ID	Page
Not reported	3410 S. 51ST AVE	16	71
Not reported	3410 S 51ST AVE	16	71
Not reported	3410 S 51ST AVE	16	71
Not reported	3410 S 51ST AVE	16	71
Not reported	3410 S 51ST AVE	16	71
Not reported	3410 S 51 ST AVE	16	71
Not reported	3410 SOUTH 51ST AVENUE	16	71
Not reported	3410 SOUTH 51ST AVENUE	16	71
Not reported	3410 S 51 AVENUE	16	71
Not reported	3410 S 51 AVENUE	16	71
Not reported	3410 S 51 AVENUE	16	71
Not reported	3410 S 51ST AVE	16	71
Not reported	3410 SOUTH 51 AVE	16	72
Not reported	3410 S 51ST AVENUE	16	72
Not reported	3410 SOUTH 51ST AVENUE	16	72
Not reported	3410 S 51ST AVE	16	72
Not reported	3410 S 51 AVE	16	72
Not reported	3410 S 51ST AVE	16	72
Not reported	3410 S 51 AVE	16	72
Not reported	3410 S 51 AVE	16	72
Not reported	3410 S 51 AVE	16	72
Not reported	3410 S 51ST AVE	16	72
Not reported	3410 S 51ST AVE	16	72
Not reported	3410 S 51ST AVE	16	72
Not reported	3410 S 51ST AVE	16	73
Not reported	3410 S 51ST AVE	16	73
Not reported	3410 S 51ST AVE	16	73
Not reported	3410 S 51ST AVE	16	73
Not reported	3410 S 51ST AVE	16	73
Not reported	3410 S 51ST AVE	16	73
Not reported	3410 S 51ST AVE	16	73
Not reported	3410 S 51 AVE	16	73
Not reported	3410 S 51ST AVE	16	73
Not reported	3410 S 51 AVE	16	73
Not reported	3410 S 51ST AVENUE	16	73
Not reported	3410 S 51ST AVE	16	74
Not reported	3410 S 51ST AVENUE	16	74
Not reported	3410 S 51ST AVENUE	16	74
Not reported	3410 S 51 AVE	16	74
Not reported	3410 S 51ST AVENUE	16	74
Not reported	3410 S 51ST AVE	16	74
Not reported	3410 S 51ST AVE	16	74
Not reported	3410 S. 51ST AVE	16	74
Not reported	3410 S 51ST AVE	16	74
Not reported	3410 S 51ST AVE	16	74
Not reported	3410 S 51ST AVE	16	74
Not reported	3410 S 51ST AVENUE	16	74
Not reported	3410 S 51ST AVENUE	16	75
Not reported	3410 S 51ST AVE	16	75
Not reported	3410 S 51ST AVENUE	16	75
Not reported	3410 S 51ST AVE	16	75
Not reported	3410 S 51ST AVENUE	16	75
Not reported	3410 S 51ST AVE	16	75
Not reported	3410 S 51ST AVE	16	75
Not reported	3410 S 51ST AVENUE	16	75

Site	Address	Map ID	Page
Not reported	3410 S 51ST AVE	16	75
Not reported	3410 S 51 AVE	16	75
Not reported	3410 S 51ST AVENUE	16	75
Not reported	3410 S 51ST AVE	16	75
Not reported	3410 S 51 AVE	16	76
Not reported	3410 S 51ST AVE	16	76
Not reported	3410 S 51ST AVE	16	76
Not reported	3410 S 51ST AVENUE	16	76
Not reported	3410 S 51ST AVE	16	76
Not reported	3410 S 51ST AVENUE	16	76
Not reported	3410 S 51ST AVE	16	76
Not reported	3410 S 51ST AVE	16	77
Not reported	3410 S 51ST AVE	16	77
Not reported	3410 S 51ST AVE	16	77
Not reported	3410 S 51ST AVE	16	77
Not reported	3410 S 51S AVE	16	77
Not reported	3410 S 51ST AVE	16	77
Not reported	3410 S 51ST AVE	16	77
Not reported	3410 S 51 AVE	16	77
Not reported	3410 S 51 AVE	16	78
Not reported	3410 S 51 AVE	16	78
Not reported	3410 S 51ST AVE	16	78
Not reported	3410 S 51ST AVE	16	78
Not reported	3410 S 51ST AVE	16	78
Not reported	3410 S 51ST AVE	16	78
Not reported	3410 S 51ST AVE	16	78
Not reported	3410 S 51 AVE	16	78
Not reported	3410 S 51 AVE	16	78
Not reported	3410 S 51ST AVE	16	78
Not reported	3410 S 51ST AVE	16	78
Not reported	3410 S. 51 AVE	16	78
Not reported	3410 S 51ST AVE	16	79
Not reported	3410 S 51ST AVE	16	79
Not reported	3410 S 51 AVE	16	79
Not reported	3410 S 51 AVE	16	79
Not reported	3410 S 51 AVE	16	79
Not reported	3410 S 51 AVE	16	79
Not reported	3410 S 51 AVE	16	79
Not reported	3410 S 51ST AVENUE	16	79
Not reported	3410 S 51ST AVENUE	16	79
Not reported	3410 S 51ST AVENUE	16	79
Not reported	3410 S 51ST AVENUE	16	79
Not reported	3410 S 51ST AVENUE	16	79
Not reported	3410 S 51ST AVE	16	80
Not reported	3410 S 51ST AVE	16	80
Not reported	3410 S 51ST AVE	16	80
Not reported	3410 S 51ST AVE	16	80
Not reported	3410 S 51 AVE	16	80
Not reported	3410 SOUTH 51ST AVENUE	16	80
Not reported	3410 SOUTH 51ST AVENUE	16	80
Not reported	3410 SOUTH 51ST AVENUE	16	80
Not reported	3410 S 51 AVE	16	80
Not reported	3410 SOUTH 51ST AVE	16	80
Not reported	3410 S 51ST AVE	16	80
Not reported	3410 S 51ST AVENUE	16	80
Not reported	3410 SOUTH 51ST AVENUE	16	81

Site	Address	Map ID	Page
Not reported	3410 SOUTH 51ST AVENUE	16	81
Not reported	3410 SOUTH 51ST AVENUE	16	81
Not reported	4310 S 51ST AVE	26	100

Mines: Mines Master Index File. The source of this database is the Dept. of Labor, Mine Safety and Health Administration.

A review of the MINES list, as provided by EDR, and dated 12/14/2001 has revealed that there are 5 MINES sites within the searched area.

Site	Address	Map ID	Page
PHOENIX REDI-MIX		8	50
SUNWARD MATERIALS		8	50
L G EVERIST INCORPORATED		24	94
UNITED METRO MATERIALS IN		24	94
EDWARD S KELTON CONTRACTI		46	130

PADS: The PCB Activity Database identifies generators, transporters, commercial storers and/or brokers and disposers of PCBs who are required to notify the United States Environmental Protection Agency of such activities. The source of this database is the U.S. EPA.

A review of the PADS list, as provided by EDR, and dated 09/30/2001 has revealed that there are 2 PADS sites within the searched area.

Site	Address	Map ID	Page
LAIDLAW ENVMTAL SVCS SOUTHWEST	*888 W ILLINI ST*	*23*	*92*
ONYX ENVIRONMENTAL SERVICES LL	*2301 W BROADWAY RD*	*33*	*109*

TRIS: The Toxic Chemical Release Inventory System identifies facilities that release toxic chemicals to the air, water, and land in reportable quantities under SARA Title III, Section 313. The source of this database is the U.S. EPA.

A review of the TRIS list, as provided by EDR, and dated 12/31/1999 has revealed that there are 4 TRIS sites within the searched area.

Site	Address	Map ID	Page
INNOVATIVE WASTE UTILIZATION L	2575 S. 16TH AVE.	4	22
TESSENDERLO KERLEY INC.	2248 W. LOWER BUCKEYE R	6	41
CHEVRON USA INC. - PHOENIX ASP	3050 S. 19TH AVE.	13	60
WESTERN STATES PETROLEUM	3331 W. BROADWAY	36	123

TSCA: The Toxic Substances Control Act identifies manufacturers and importers of chemical substances included on the TSCA Chemical Substance Inventory list. It includes data on the production volume of these substances by plant site. The United States Environmental Protection Agency has no current plan to update and/or re-issue this database.

A review of the TSCA list, as provided by EDR, and dated 12/31/1998 has revealed that there are 2 TSCA sites within the searched area.

Site	Address	Map ID	Page
PHOENIX TALLOW CO.	***ATTN: E.S. MURAKAMI***	***10***	***58***
CHEVRON USA INC. PHOENIX ASPHA	3050 S. 19TH AVE.	13	60

FTTS: FTTS tracks administrative cases and pesticide enforcement actions and compliance activities related to FIFRA, TSCA and EPCRA (Emergency Planning and Community Right-to-Know Act) over the previous five years. To maintain currency, EDR contacts the Agency on a quarterly basis.

A review of the FTTS list, as provided by EDR, and dated 01/11/2002 has revealed that there are 4 FTTS sites within the searched area.

Site	Address	Map ID	Page
STANTON INDUSTRIES	***4215 W LOWER BUCKEYE RD***	***8***	***54***
CHEMICAL WASTE MANAGEMENT	2301 W BROADWAY RD	33	117
ONYX ENVIRONMENTAL SERVICES	2301 WEST BROADWAY	33	117
ONYX ENVIRONMENTAL SERVICES	2301 W BROADWAY	33	118

STATE OR LOCAL ASTM SUPPLEMENTAL

AST: The Aboveground Storage Tank database contains registered ASTs. The data come from the Department of Environmental Quality's Arizona UST-DMS Facility and Tank Data Listing by City database.

A review of the AST list, as provided by EDR, and dated 12/31/2000 has revealed that there are 2 AST sites within the searched area.

Site	Address	Map ID	Page
CORE SLAB STRUCTURES	5026 SOUTH 43RD AVENUE	42	128
POHLCAT MOUNTAIN VIEW GOLF COU	5841 WEST SOUTHERN AVE.	49	132

SPILLS: The ADEQ Emergency Response unit documents chemical spills and incidents that are referred to the Unit. The logbook information for 1984-1986 consists of handwritten entries of the date, incident number and name of facility if known. Current logbooks are computerized and can be sorted by date, incident number, name, city (zip codes are not included), county, chemical and quantity. The sources is the Department of Environmental Quality's Hazardous Material Logbook.

A review of the AZ Spills list, as provided by EDR, has revealed that there are 32 AZ Spills sites within the searched area.

Site	Address	Map ID	Page
HOLT RESIDENCE	3600 W. LOWER BUCKEYE	1	8

Site	Address	Map ID	Page
EMCO RECYCLING	3700 W. LOWER BUCKEYE R	1	10
EMCO RECYCLING	3700 W. LOWER BUCKEYE R	1	10
COPPERSTATE METALS INC	***3720 W LOWER BUCKEYE RD***	***1***	***11***
UNKNOWN/COP	39 AVE. / LOWER BUCKE	1	14
MP ENVIRONMENTAL	2530 SO. 16 AVENUE	4	33
27TH AVENUE LANDFILL	***27 AVE. / LOWER BUCKE***	***5***	***34***
PHOENIX CITY LANDFILL	27 AVE / LOWER BUCKEY	5	34
PHOENIX UNION HIGH SCHOOL	2800 S. 27 AVE.	5	34
KERLEY CHEMICAL CORP.	***2248 W. LOWER BUCKEYE***	***6***	***40***
CHEVRON, PHX ASHALT PLANT	3050 SO. 19TH AVE	13	60
27 AVE. LANDFILL	3035 SO. 35TH AVE	15	65
FEDEX GROUND	***3410 S 51ST AVE***	***16***	***76***
UNITED METRO	3640 SO. 19TH AVENUE	19	84
ACE ASPHALT	***895 W ELWOOD***	***20***	***88***
REYNOLDS ALUMINUM PLANT PONDS	***43RD AVE / SALT RIVER***	***21***	***88***
METAL MANAGEMENT OF AZ	3640 S. 35 AVE.	22	89
BRISCOE INC.	15 AVE / BROADWAY	30	102
ENVIRO-SOLV	2844 W. BROADWAY RD.	31	105
UNKNOWN	2744 W. BROADWAY (S.R.	31	106
CHEMICAL WASTE MANAGEMENT	2301 W. BROADWAY	33	107
MOTOROLA (BIC)	2200 W. BROADWAY	34	120
ALL-A-MATIC TRANSMISSIONS	3011 W. BROADWAY	35	121
WESTERN STATES PETROLEUM	3331 W. BROADWAY	36	122
URBAN FOREST PRODUCTS CO.	3330 W. BROADWAY RD.	36	122
LIQUID AIR CORP.	3332 W. BROADWAY	36	123
WILSON, R.L.	3748 W. ROMLEY	41	127
AZ OIL RECYCLERS	5040 SO. 51 AVE.	43	129
CJ JOREGENSTEN ELEMENTARY SCHO	1701 W. ROESER, RM 31	44	129
BEST DISPOSAL	5436 SO. 43 AVENUE	45	130
A-1 TIRE CO.	4825 W. SOUTHERN	48	131
USA TIRE RECYCLING	5922 W. SOUTHERN	49	132

WWFAC: Statewide list of waste water treatment facilities.

A review of the WWFAC list, as provided by EDR, and dated 12/12/2000 has revealed that there are 20 WWFAC sites within the searched area.

Site	Address	Map ID	Page
PHOENIX, CITY OF - 27TH AVENUE	27TH AVE. / LOWER BUC	5	33
KERLEY CHEMICAL CORP.	***2248 W. LOWER BUCKEYE***	***6***	***40***
RAINBOW VALLEY TOPSOIL AND LAN	3425 S. 43RD AVE.	8	50
GLENN WEINBERGER LANDFILL	***3425 S. 43RD AVENUE***	***8***	***51***
PHOENIX TALLOW CO.	***ATTN: E.S. MURAKAMI***	***10***	***58***
MARICOPA LAND AND CATTLE CO.,	3602 WEST ELWOOD STREET	15	63
MARICOPA BY-PRODUCTS INC	***3602 W ELWOOD ST***	***15***	***63***
WEINBERGER TOPSOIL LANDFILL	3410 S 39TH AVE	17	82
UNITED METRO MATERIALS, INC.	***3640 S. 19TH AVE***	***19***	***86***
ACE ASPHALT OF ARIZONA INC	***895 W ELWOOD***	***20***	***86***
ACE ASPHALT	***895 W ELWOOD***	***20***	***88***
SALT RIVER RECYCLING/SMITHEY	***3640 S 35TH AVE***	***22***	***90***
VISS I DAIRY	7443 WEST BROADWAY ROAD	28	101
VISS II DAIRY	6809 WEST BROADWAY ROAD	29	102
CASITAS BONITAS- AMER PUBLIC S	2410 W.BROADWAY RD	33	119

Site	Address	Map ID	Page
SIERRA ENTRADA WWTP	2410 W. BROADWAY	33	119
DIVERSIFIED CONTRACTORS, INC.	4054 WIER AVE	39	126
CORESLAB STRUCTURES, INC	***5026 S. 43RD AVE***	***42***	***128***
CORESLAB STRUCTURES, ARIZ INC	5026 SOUTH 43RD AVENUE	42	128
WESTERN MEAT COMPANY	***7201 W SOUTHERN AVE***	***53***	***133***

Aquifers: The aquifer protection permitted facilities database comes from the Dept. of Env. Quality

A review of the Aquifer list, as provided by EDR, has revealed that there are 3 Aquifer sites within the searched area.

Site	Address	Map ID	Page
GLENN WEINBERGER LANDFILL	***3425 S. 43RD AVENUE***	***8***	***51***
UNITED METRO MATERIALS, INC.	***3640 S. 19TH AVE***	***19***	***86***
CORESLAB STRUCTURES, INC	***5026 S. 43RD AVE***	***42***	***128***

Drywells: Drywell is a bored, drilled, or driven shaft or hole whose depth is greater than its width and is designed and constructed specifically for the disposal of storm water. The source is Arizona's Department of Environmental Quality.

A review of the Dry Wells list, as provided by EDR, has revealed that there are 8 Dry Wells sites within the searched area.

Site	Address	Map ID	Page
CAVCO IND.	2602 SOUTH 35TH AVENUE	1	15
CAVCO IND	2602 SOUTH 35TH AVE	1	15
ARIZONA TRUCK & TRAILER SERVIC	2235 S. 19TH AVE	2	21
27TH AVENUE LANDFILL	***27 AVE. / LOWER BUCKE***	***5***	***34***
C.O.P. PETROLEUM STORAGE FACIL	2239 WEST LOWER BUCKEYE	6	38
WASTE MANAGEMENT OF AZ - 19TH	3000 SOUTH 19TH AVE	13	61
MARBELLA	75TH AVE / N. BROADWA	28	102
AG PRODUCTS	2525 WEST BROADWAY ROAD	33	120

AZ AIRS: Arizona major (has the potential to emit over 100 tons of criteris pollutant) and minor (below 100 tons) sources.

A review of the AZ AIRS list, as provided by EDR, has revealed that there is 1 AZ AIRS site within the searched area.

Site	Address	Map ID	Page

EXECUTIVE SUMMARY

Please refer to the end of the findings report for unmapped orphan sites due to poor or inadequate address information.

MAP FINDINGS SUMMARY

Database	Total Plotted
FEDERAL ASTM STANDARD	
NPL	1
Proposed NPL	0
CERCLIS	1
CERC-NFRAP	4
CORRACTS	3
RCRIS-TSD	2
RCRIS Lg. Quan. Gen.	4
RCRIS Sm. Quan. Gen.	41
ERNS	12
STATE ASTM STANDARD	
SPL	0
State Haz. Waste	24
State Landfill	2
LUST	35
UST	70
AZ WQARF	0
FEDERAL ASTM SUPPLEMENTAL	
CONSENT	0
ROD	1
Delisted NPL	0
FINDS	58
HMIRS	166
MLTS	0
MINES	5
NPL Liens	0
PADS	2
RAATS	0
TRIS	4
TSCA	2
FTTS	4
STATE OR LOCAL ASTM SUPPLEMENTAL	
AST	2
AZ Spills	32
AZ DOD	0
WWFAC	20
Aquifer	3
Dry Wells	8
AZ AIRS	0
EDR PROPRIETARY HISTORICAL DATABASES	
Coal Gas	0

MAP FINDINGS SUMMARY

Database	Total Plotted

* Sites may be listed in more than one database

Coal Gas Site Search: No site was found in a search of Real Property Scan's ENVIROHAZ database.

NPL **NINETEENTH AVENUE LANDFILL** **CERCLIS 1000223728**
Region **19TH AVE** **NPL AZD980496780**
PHOENIX, AZ 85041 **ROD**

CERCLIS Classification Data:

Site Incident Category:	Not reported	Federal Facility:	Not a Federal Facility
Non NPL Status:	Not reported		
Ownership Status:	Mixed Ownership	NPL Status:	Currently on the Final NPL
Site Description:	INACTIVE PUBLIC LANDFILL RECEIVED WASTES SUCH AS HEAVY MET- ALS, SOLVENTS, AND PESTICIDES FROM 1954 TO 1979. METHANE GASHAS ALSO BEEN GENERATED IN EXCESS AMOUNTS. GROUND AND SUR- FACE WATERS HAVE BEEN CONTAMINATED.		

CERCLIS Assessment History:

Assessment:	DISCOVERY	Completed:	04/01/1979
Assessment:	PRELIMINARY ASSESSMENT	Completed:	10/01/1979
Assessment:	HRS PACKAGE	Completed:	12/01/1982
Assessment:	SITE INSPECTION	Completed:	12/01/1982
Assessment:	PROPOSAL TO NPL	Completed:	12/30/1982
Assessment:	FINAL LISTING ON NPL	Completed:	09/08/1983
Assessment:	FORWARD PLANNING	Completed:	07/25/1986
Assessment:	PRP RI/FS	Completed:	09/29/1989
Assessment:	RECORD OF DECISION	Completed:	09/29/1989
Assessment:	REMOVAL ASSESSMENT	Completed:	06/13/1990
Assessment:	RD/RA NEGOTIATIONS	Completed:	09/28/1990
Assessment:	ADMIN/VOLUNTARY COST RECOVERY	Completed:	01/13/1992
Assessment:	REMOVAL ASSESSMENT	Completed:	12/15/1992
Assessment:	PRP RD	Completed:	05/11/1995
Assessment:	PREPARATION OF COST DOCM PKGE	Completed:	03/12/1998
Assessment:	PRP RA	Completed:	09/30/1998
Assessment:	FIVE YEAR REMEDY ASSESSMENT	Completed:	09/29/2000

CERCLIS Site Status:
Not reported

CERCLIS Alias Name(s):
SALT RIVER LDFLS
NINETEENTH AVENUE LANDFILL

NPL:

EPA ID:	AZD980496780
Region:	09
Federal:	General
Final Date:	09/08/1983

NPL Contaminant:

NPL Status:	Final
Substance Id:	C307
Case Num:	74-82-8
Substance :	METHANE
Pathway :	AIR
GW Scoring :	Not reported
SW Scoring :	Not reported
Air Scoring:	Observed Release
Soil Scoring:	Not reported
DC Scoring:	Not reported
FE Scoring:	Not reported

NPL Status:	Final
Substance Id:	C151

NINETEENTH AVENUE LANDFILL (Continued) 1000223728

Case Num: 7439-89-6
Substance : IRON AND COMPOUNDS, NOS (FE)
Pathway : GW
GW Scoring : Observed Release
SW Scoring : Not reported
Air Scoring: Not reported
Soil Scoring: Not reported
DC Scoring: Not reported
FE Scoring: Not reported

NPL Status: Final
Substance Id: C200
Case Num: 7439-95-4
Substance : MAGNESIUM AND COMPOUNDS, NOS (MG)
Pathway : GW
GW Scoring : Observed Release
SW Scoring : Not reported
Air Scoring: Not reported
Soil Scoring: Not reported
DC Scoring: Not reported
FE Scoring: Not reported

NPL Status: Final
Substance Id: C201
Case Num: 7439-96-5
Substance : MANGANESE AND COMPOUNDS, NOS (MN)
Pathway : GW
GW Scoring : Observed Release & Toxicity
SW Scoring : Not reported
Air Scoring: Not reported
Soil Scoring: Not reported
DC Scoring: Not reported
FE Scoring: Not reported

NPL Status: Final
Substance Id: C472
Case Num: 7664-41-7
Substance : AMMONIUM, NOS
Pathway : GW
GW Scoring : Observed Release
SW Scoring : Not reported
Air Scoring: Not reported
Soil Scoring: Not reported
DC Scoring: Not reported
FE Scoring: Not reported

NPL Status: Final
Substance Id: D005
Case Num: 7440-39-3
Substance : BARIUM
Pathway : GW
GW Scoring : Observed Release
SW Scoring : Not reported
Air Scoring: Not reported
Soil Scoring: Not reported
DC Scoring: Not reported
FE Scoring: Not reported

NPL Status: Final
Substance Id: A006

NINETEENTH AVENUE LANDFILL (Continued) 1000223728

Case Num: 7440-39-3
Substance : BARIUM AND COMPOUNDS, NOS (BA)
Pathway : SW
GW Scoring : Not reported
SW Scoring : Observed Release
Air Scoring: Not reported
Soil Scoring: Not reported
DC Scoring: Not reported
FE Scoring: Not reported

NPL Status: Final
Substance Id: A020
Case Num: 7440-47-3
Substance : CHROMIUM AND COMPOUNDS, NOS (CR)
Pathway : SW
GW Scoring : Not reported
SW Scoring : Observed Release & Toxicity
Air Scoring: Not reported
Soil Scoring: Not reported
DC Scoring: Not reported
FE Scoring: Not reported

NPL Status: Final
Substance Id: A038
Case Num: 7440-02-0
Substance : NICKEL AND COMPOUNDS, NOS (NI)
Pathway : SW
GW Scoring : Not reported
SW Scoring : Observed Release
Air Scoring: Not reported
Soil Scoring: Not reported
DC Scoring: Not reported
FE Scoring: Not reported

NPL Status: Final
Substance Id: C178
Case Num: 7440-50-8
Substance : COPPER AND COMPOUNDS, NOS (CU)
Pathway : SW
GW Scoring : Not reported
SW Scoring : Observed Release
Air Scoring: Not reported
Soil Scoring: Not reported
DC Scoring: Not reported
FE Scoring: Not reported

NPL Status: Final
Substance Id: C247
Case Num: 7440-66-6
Substance : ZINC AND COMPOUNDS, NOS (ZN)
Pathway : SW
GW Scoring : Not reported
SW Scoring : Observed Release
Air Scoring: Not reported
Soil Scoring: Not reported
DC Scoring: Not reported
FE Scoring: Not reported

NPL Status: Final
Substance Id: D008

NINETEENTH AVENUE LANDFILL (Continued) **1000223728**

Case Num: 7439-92-1
Substance : LEAD (PB)
Pathway : SW
GW Scoring : Not reported
SW Scoring : Observed Release
Air Scoring: Not reported
Soil Scoring: Not reported
DC Scoring: Not reported
FE Scoring: Not reported

NPL Site:
CERCLIS Id: AZD980496780
Site City: Phoenix
Site State: AZ
NPL Status: Final
Status Date: 09/08/83
Federal Site: Not reported
HRS Score: 54.27
GW Score: 93.88
SW Score: 0.00
Air Score: 0.00
Soil Score: 0.00
DC Score: 0.00
FE Score: 0.00

NPL Char:
NPL Status: Final
Category Description: DEPTH TO AQUIFER
Category Value: 85

NPL Status: Final
Category Description: DISTANCE TO THE NEAREST POPULATION
Category Value: 500

NPL Status: Final
Category Description: OBSERVED RELEASE-Ground Water
Category Value: Not reported

NPL Status: Final
Category Description: OBSERVED RELEASE-Surface Water
Category Value: Not reported

NPL Status: Final
Category Description: OTHER GROUND WATER USE-Industrial Process Cooling
Category Value: Not reported

NPL Status: Final
Category Description: OTHER GROUND WATER USE-Irrigation
Category Value: Not reported

NPL Status: Final
Category Description: PHYSICAL STATE-Liquid
Category Value: Not reported

NPL Status: Final
Category Description: PHYSICAL STATE-Sludge
Category Value: Not reported

NPL Status: Final
Category Description: PHYSICAL STATE-Solid
Category Value: Not reported

NINETEENTH AVENUE LANDFILL (Continued) 1000223728

NPL Status: Final
Category Description: SITE ACTIVITY WASTE SOURCE-Industry Combination Landfill
Category Value: Not reported

NPL Status: Final
Category Description: SITE ACTIVITY WASTE SOURCE-Industry Commercial Landfill
Category Value: Not reported

NPL Status: Final
Category Description: SITE ACTIVITY WASTE SOURCE-Industry Municipal Landfill
Category Value: Not reported

NPL Status: Final
Category Description: SURFACE WATER ADJACENT TO SITE-Intermittent Stream
Category Value: Not reported

ROD:
Full-text of USEPA Record of Decision(s) is available from EDR.

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1 **CIRCLE K # 8870** UST U003050428
3501 W LOWER BUCKEYE RD N/A
PHOENIX, AZ 85009

UST:

Facility ID:	0-005940	Tank ID:	1
Owner:	CIRCLE K CORPORATION	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	True		
Date Removed:	/ /		
Date Closed:	/ /		
In Use:	True		

Facility ID:	0-005940	Tank ID:	2
Owner:	CIRCLE K CORPORATION	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	True		
Date Removed:	/ /		
Date Closed:	/ /		
In Use:	True		

Facility ID:	0-005940	Tank ID:	3
Owner:	CIRCLE K CORPORATION	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	True		
Date Removed:	/ /		
Date Closed:	/ /		
In Use:	True		

---

1 **RIO SALADO AUTOBODY INC** RCRIS-SQG 1000589572
2801 S 35TH AVE SHWS AZD983473273
PHOENIX, AZ 85009 FINDS

RIO SALADO AUTOBODY INC (Continued) 1000589572

RCRIS:
Owner: BUFFORD WARREN
(602) 937-5179

Contact: BUFFORD WARREN
(602) 937-5179

Record Date: 07/25/1995
Classification: Small Quantity Generator
Used Oil Recyc: No

Violation Status: No violations found

FINDS:
Other Pertinent Environmental Activity Identified at Site:
Facility Registry System (FRS)
Resource Conservation and Recovery Act Information system (RCRAINFO)

SHWS:
EPA ID: Not reported
Program: WQARF
Facility Id: 587
Site Code: Not reported
Discovery Date: Not reported
Source: Not reported
Operable Unit: 0
QWARF Area: WVB
Lat/Long: Not reported
Lat/Long Method: 80
Comments: Not reported

---

1 **HOLT RESIDENCE** AZ Spills S104559640
3600 W. LOWER BUCKEYE N/A
PHOENIX, AZ

Az Spills:
Facility ID: 86-099
Response Date: 07/31/86
Type: Fire
Referred to: Not reported
Chemicals: Hydrochloric Acid
Property Mngmt: Private
Fund Amount: Pvt/Unk
Quantity: Not reported
Incident Date: 07/31/86
Report / Assist: Not reported
No of Samples: Dr

---

1 **UNKNOWN 2** SHWS S101570165
3650 W. LOWER BUCKEYE RD. N/A
PHOENIX, AZ 85009

SHWS:
EPA ID: Not reported
Program: WQARF
Facility Id: 617
Site Code: Not reported
Discovery Date: Not reported
Source: Not reported
Operable Unit: 0
QWARF Area: WVB
Lat/Long: Not reported

Map ID / Direction / Distance / Distance (ft.)	Site	Database(s)	EDR ID Number / EPA ID Number
	UNKNOWN 2 (Continued)		**S101570165**
	Lat/Long Method: 80 Comments: Not reported		
1	**3700 W. LOWER BUCKEYE RD** **3700 W. LOWER BUCKEYE RD** **PHOENIX, AZ 85009**	**ERNS**	**94386916** **N/A**
1	**EMCO RECYCLING** **3700 W. LOWER BUCKEYE** **PHOENIX, AZ 85036**	**HAZNET**	**S104564755** **N/A**

HAZNET:

Gepaid:	AZC950811109
Tepaid:	CAL000024110
Gen County:	99
Tsd County:	Los Angeles
Tons:	.8250
Category:	Other inorganic solid waste
Disposal Method:	Recycler
Contact:	EMCO RECYCLING
Telephone:	(000) 000-0000
Mailing Address:	P O BOX 21366 PHOENIX, AZ 85036
County	99

Map ID / Direction / Distance / Distance (ft.)	Site	Database(s)	EDR ID Number / EPA ID Number
1	**EMCO RECYCLING** **3700 W LOWER BUCKEYE RD** **PHOENIX, AZ 85009**	**LUST** **UST**	**U003050463** **N/A**

LUST:

Facility ID:	0-006122
Lust Number:	5123.01
Leak Priority:	CLOSED SOIL LVL MEETS TIER1
Notification:	06/23/1999
Date Closed:	10/27/1999

UST:

Facility ID:	0-006122	Tank ID:	1
Owner:	EMCO RECYCLING/METAL MGMT	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	06/09/99		
Date Closed:	/ /		
In Use:	False		
Facility ID:	0-006122	Tank ID:	2
Owner:	EMCO RECYCLING/METAL MGMT	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	06/09/99		
Date Closed:	/ /		
In Use:	False		
Facility ID:	0-006122	Tank ID:	3
Owner:	EMCO RECYCLING/METAL MGMT	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	06/09/99		

EMCO RECYCLING (Continued) U003050463

Date Closed: / /
In Use: False

Facility ID: 0-006122 Tank ID: 4
Owner: EMCO RECYCLING/METAL MGMT Owner ID: Not reported
Owner Contact: Not reported
In Use: False
Date Removed: 06/09/99
Date Closed: / /
In Use: False

---

1 **EMCO RECYCLING** AZ Spills S104559604
3700 W. LOWER BUCKEYE RD. N/A
PHOENIX, AZ

Az Spills:
Facility ID: 96-032-D Incident Date: 08/03/96
Response Date: 08/03/96 Report / Assist: Not reported
Type: Threat No of Samples: Me
Referred to: Not reported
Chemicals: Radioactive Material
Property Mngmt: Private
Fund Amount: Pvt/Unk
Quantity: Not reported

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1 **EMCO RECYCLING** AZ Spills S104559605
3700 W. LOWER BUCKEYE ROAD N/A
PHOENIX, AZ

Az Spills:
Facility ID: 94-021-A Incident Date: 05/15/94
Response Date: 08/03/96 Report / Assist: Not reported
Type: Fire No of Samples: Not reported
Referred to: Not reported
Chemicals: Shredder Fluff
Property Mngmt: 05/15/94
Fund Amount: Not reported
Quantity: Not reported

---

1 **CASTLE MFG, INC** SHWS S103391940
3702 W. LOWER BUCKEYE RD. N/A
PHOENIX, AZ 85009

SHWS:
EPA ID: Not reported
Program: WQARF
Facility Id: 505
Site Code: Not reported
Discovery Date: Not reported
Source: Not reported
Operable Unit: 0
QWARF Area: WVB
Lat/Long: Not reported
Lat/Long Method: 80
Comments: Not reported

Map ID / Direction / Distance / Distance (ft.)	Site	Database(s)	EDR ID Number / EPA ID Number
1	**CHEMCON INC** **3702 W LOWER BUCKEYE** **PHOENIX, AZ 85009**	**RCRIS-SQG** **FINDS** **CORRACTS**	**1000297061** **AZD980737415**

CORRACTS Data:

EPA Id:	AZD980737415
Region:	9
State:	Not reported
Area Name:	ENTIRE FACILITY
Original Scheduled Date:	12/27/1988
New Scheduled Date:	Not reported
Actual Date:	/ /
Corrective Action:	CA075LO - CA Prioritization, Facility or area was assigned a low corrective action priority

RCRIS:

Owner:	CHEMCON INC (602) 257-0422
Contact:	ENVIRONMENTAL MANAGER (602) 257-0422
Record Date:	10/29/1992
Classification:	Not reported
Used Oil Recyc:	No

Violation Status: Violations exist

Regulation Violated:	Not reported
Area of Violation:	TSD-Other Requirements
Date Violation Determined:	07/16/1991
Priority of Violation:	Low
Schedule Date to Achieve Compliance:	08/25/1991
Actual Date Achieved Compliance:	10/13/1992
Enforcement Action:	Written Informal
Enforcement Action Date:	07/25/1991
Proposed Monetary Penalty:	Not reported
Final Monetary Penalty:	Not reported

There are 1 violation record(s) reported at this site:

Evaluation	Area of Violation	Date of Compliance
Compliance Evaluation Inspection (CEI)	TSD-Other Requirements	10/13/1992

FINDS:

Other Pertinent Environmental Activity Identified at Site:
- Facility Registry System (FRS)
- Resource Conservation and Recovery Act Information system (RCRAINFO)

1	**COPPERSTATE METALS INC** **3720 W LOWER BUCKEYE RD** **PHOENIX, AZ 85009**	**RCRIS-SQG** **SHWS** **FINDS** **AZ Spills** **CERC-NFRAP**	**1000472587** **AZD982432668**

CERCLIS-NFRAP Classification Data:

Site Incident Category:	Not reported	Federal Facility:	Not a Federal Facility
Non NPL Code:	NFRAP		
Ownership Status:	Private	NPL Status:	Not on the NPL

CERCLIS-NFRAP Assessment History:

Assessment:	DISCOVERY	Completed:	08/02/1991

COPPERSTATE METALS INC (Continued) **1000472587**

Assessment: PRELIMINARY ASSESSMENT Completed: 05/26/1992

RCRIS:
Owner: COPPERSTATE METALS INC
(415) 555-1212

Contact: ENVIRONMENTAL MANAGER
(602) 272-6434

Record Date: 10/16/1990
Classification: Conditionally Exempt Small Quantity Generator
Used Oil Recyc: No

Violation Status: Violations exist

Regulation Violated:	Not reported
Area of Violation:	Generator-All Requirements
Date Violation Determined:	07/23/1993
Priority of Violation:	Low
Schedule Date to Achieve Compliance:	10/23/1993
Actual Date Achieved Compliance:	05/26/1994
Enforcement Action:	Written Informal
Enforcement Action Date:	09/09/1993
Proposed Monetary Penalty:	Not reported
Final Monetary Penalty:	Not reported

There are 1 violation record(s) reported at this site:

Evaluation	Area of Violation	Date of Compliance
Compliance Evaluation Inspection (CEI)	Generator-All Requirements	05/26/1994

FINDS:
Other Pertinent Environmental Activity Identified at Site:
Enforcement Docket System (DOCKET)
Resource Conservation and Recovery Act Information system (RCRAINFO)

SHWS:

EPA ID:	AZD982432668
Program:	PA/SI
Facility Id:	513
Site Code:	70041
Discovery Date:	70041
Source:	Not reported
Operable Unit:	0
QWARF Area:	WVB
Lat/Long:	Not reported
Lat/Long Method:	80
Comments:	Not reported

Az Spills:

Facility ID:	86-149	Incident Date:	10/02/86
Response Date:	10/02/86	Report / Assist:	Not reported
Type:	Threat	No of Samples:	Un
Referred to:	AGO/Field		
Chemicals:	PCB		
Property Mngmt:	Private		
Fund Amount:	Pvt/Unk		
Quantity:	Not reported		
Facility ID:	88-391	Incident Date:	12/29/88

COPPERSTATE METALS INC (Continued) 1000472587

Response Date:	12/29/88	Report / Assist:	Not reported
Type:	Releae	No of Samples:	Tr
Referred to:	Not reported		
Chemicals:	Oil (Transformer)		
Property Mngmt:	Private		
Fund Amount:	Not reported		
Quantity:	Not reported		

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1 **DESERT TRANSFER INC** LUST U001625837
3751 W LOWER BUCKEYE RD UST N/A
PHOENIX, AZ 85009

LUST:

Facility ID:	0-002207
Lust Number:	2596.01
Leak Priority:	CLOSED SOIL LVL MEETS TIER1
Notification:	11/17/1992
Date Closed:	11/19/1999

UST:

Facility ID:	0-002207	Tank ID:	1
Owner:	DESERT TRANSFER INC	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	10/28/92		
Date Closed:	/ /		
In Use:	False		

Facility ID:	0-002207	Tank ID:	2
Owner:	DESERT TRANSFER INC	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	10/28/92		
Date Closed:	/ /		
In Use:	False		

Facility ID:	0-002207	Tank ID:	3
Owner:	DESERT TRANSFER INC	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	10/28/92		
Date Closed:	/ /		
In Use:	False		

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1 **R J RUFF & CO** LUST U003050031
3883 W LOWER BUCKEYE RD UST N/A
PHOENIX, AZ 85009

LUST:

Facility ID:	0-004212
Lust Number:	3594.01
Leak Priority:	CLOSED SOIL LVL MEETS TIER1
Notification:	07/08/1994
Date Closed:	07/14/1998

UST:

Facility ID:	0-004212	Tank ID:	1
Owner:	R J RUFF & CO	Owner ID:	Not reported
Owner Contact:	Not reported		

R J RUFF & CO (Continued) U003050031

In Use:	False		
Date Removed:	07/06/94		
Date Closed:	/ /		
In Use:	False		
Facility ID:	0-004212	Tank ID:	2
Owner:	R J RUFF & CO	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	07/06/94		
Date Closed:	/ /		
In Use:	False		
Facility ID:	0-004212	Tank ID:	3
Owner:	R J RUFF & CO	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	07/06/94		
Date Closed:	/ /		
In Use:	False		

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1 **REUTER EQUIPMENT COMPANY** UST U003051829
3816 W LOWER BUCKEYE RD N/A
PHOENIX, AZ 85009

UST:

Facility ID:	0-004134	Tank ID:	1
Owner:	REUTER EQUIPMENT COMPANY	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	09/01/90		
Date Closed:	/ /		
In Use:	False		
Facility ID:	0-004134	Tank ID:	2
Owner:	REUTER EQUIPMENT COMPANY	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	09/01/90		
Date Closed:	/ /		
In Use:	False		
Facility ID:	0-004134	Tank ID:	3
Owner:	REUTER EQUIPMENT COMPANY	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	09/01/90		
Date Closed:	/ /		
In Use:	False		

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1 **UNKNOWN/COP** AZ Spills S104851719
39 AVE. / LOWER BUCKEYE N/A
PHOENIX, AZ

Az Spills:

Facility ID:	00-153-D	Incident Date:	04/18/00
Response Date:	Not reported	Report / Assist:	04/18/00
Type:	Release	No of Samples:	Co

Map ID / Direction / Distance / Distance (ft.)	Site	Database(s)	EDR ID Number / EPA ID Number

UNKNOWN/COP (Continued) S104851719

Referred to: Not reported
Chemicals: Oil(Hydraulic) Transform.
Property Mngmt: City
Fund Amount: COP/Unk
Quantity: 110 gals.

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1 **CAVCO INDUSTRIES INC** UST U003049498
2602 S 35TH AVE N/A
PHOENIX, AZ 85009

UST:

Facility ID:	0-000981	Tank ID:	1
Owner:	CAVCO INDUSTRIES INC	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	07/07/88		
Date Closed:	/ /		
In Use:	False		

Facility ID:	0-000981	Tank ID:	2
Owner:	CAVCO INDUSTRIES INC	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	03/12/98		
Date Closed:	/ /		
In Use:	False		

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1 **CAVCO INDUSTRIES LLC** FINDS 1004086391
2602 S 35TH AVE 000007913192
PHOENIX, AZ 85009

FINDS:
Other Pertinent Environmental Activity Identified at Site:
AIRS Facility System (AIRS/AFS)
Facility Registry System (FRS)
Toxic Chemical Release Inventory System (TRIS)

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1 **CAVCO IND.** Dry Wells S103491360
2602 SOUTH 35TH AVENUE N/A
PHOENIX, AZ 85009

DRY WELLS:
Number of Wells: 7
Beginning Registration Number: 10476

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1 **CAVCO IND** Dry Wells 1001534277
2602 SOUTH 35TH AVE N/A
PHOENIX, AZ 85009

DRY WELLS:
Number of Wells: 2
Beginning Registration Number: 13295

Map ID / Direction / Distance / Distance (ft.)	Site	Database(s)	EDR ID Number / EPA ID Number
1	**DAGLEYS** **2455 S. 35TH AVE.** **PHOENIX, AZ 85009**	**SHWS**	**S101570102** **N/A**

SHWS:

EPA ID:	Not reported
Program:	WQARF
Facility Id:	515
Site Code:	Not reported
Discovery Date:	Not reported
Source:	Not reported
Operable Unit:	0
QWARF Area:	WVB
Lat/Long:	Not reported
Lat/Long Method:	80
Comments:	Not reported

1	**ANGEL AUTO** **2450 S. 35TH AVE.** **PHOENIX, AZ 85009**	**SHWS**	**S101570080** **N/A**

SHWS:

EPA ID:	Not reported
Program:	WQARF
Facility Id:	470
Site Code:	Not reported
Discovery Date:	Not reported
Source:	Not reported
Operable Unit:	0
QWARF Area:	WVB
Lat/Long:	Not reported
Lat/Long Method:	80
Comments:	Not reported

1	**CAVCO INDUSTRIES INC** **2502 & 2550 W DURANGO** **PHOENIX, AZ 85009**	**UST**	**U001625916** **N/A**

UST:

Facility ID:	0-002358	Tank ID:	1
Owner:	CAVCO INDUSTRIES INC	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	01/01/88		
Date Closed:	/ /		
In Use:	False		
Facility ID:	0-002358	Tank ID:	2
Owner:	CAVCO INDUSTRIES INC	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	03/05/97		
Date Closed:	/ /		
In Use:	False		

2	**BLUE CIRCLE WEST LEASING** **2625 S 19TH AVE** **PHOENIX, AZ 85009**	**RCRIS-SQG** **FINDS**	**1000195834** **AZD982512055**

BLUE CIRCLE WEST LEASING (Continued) 1000195834

RCRIS:
Owner: BLUE CIRCLE WEST INC
(415) 555-1212

Contact: ENVIRONMENTAL MANAGER
(602) 253-2505

Record Date: 05/23/1988
Classification: Conditionally Exempt Small Quantity Generator
Used Oil Recyc: No

Violation Status: No violations found

FINDS:
Other Pertinent Environmental Activity Identified at Site:
Resource Conservation and Recovery Act Information system (RCRAINFO)

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2 **KENWORTH OF AZ SUNWARD MATERIALS** RCRIS-SQG 1000438630
2625 S 19TH AVE FINDS AZD980496756
PHOENIX, AZ 85034 CERC-NFRAP

CERCLIS-NFRAP Classification Data:
Site Incident Category: Not reported
Non NPL Code: NFRAP
Ownership Status: Unknown
Federal Facility: Not a Federal Facility
NPL Status: Not on the NPL

CERCLIS-NFRAP Assessment History:
Assessment: DISCOVERY Completed: 12/01/1979
Assessment: PRELIMINARY ASSESSMENT Completed: 04/01/1983
Assessment: PRELIMINARY ASSESSMENT Completed: 10/01/1988

RCRIS:
Owner: R L FRENCH
(415) 555-1212

Contact: UNKNOWN UNKNOWN
(602) 258-7791

Record Date: 10/10/1986
Classification: Small Quantity Generator
Used Oil Recyc: No

Violation Status: No violations found

FINDS:
Other Pertinent Environmental Activity Identified at Site:
Facility Registry System (FRS)
Resource Conservation and Recovery Act Information system (RCRAINFO)

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2 **KENWORTH MOTOR TRUCK DISTRIBUTOR** SHWS 1000438631
2625 S 19TH AVE N/A
PHOENIX, AZ 85009

SHWS:
EPA ID: AZD980496756
Program: PA/SI
Facility Id: 176
Site Code: Not reported
Discovery Date: Not reported
Source: Not reported
Operable Unit: 0

KENWORTH MOTOR TRUCK DISTRIBUTOR (Continued) 1000438631

QWARF Area: WVB
Lat/Long: Not reported
Lat/Long Method: 80
Comments: Not reported

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2 **WILLIAMS DETROIT DIESEL ALLISON** RCRIS-SQG 1000291841
2602 S 19TH AVE FINDS AZD981661663
PHOENIX, AZ 85009

RCRIS:
Owner: NEILS DETROIT DIESEL
(415) 555-1212

Contact: DAVE LONG
(602) 257-0561

Record Date: 04/15/1992
Classification: Small Quantity Generator
Used Oil Recyc: No

Violation Status: No violations found

FINDS:
Other Pertinent Environmental Activity Identified at Site:
Facility Registry System (FRS)
Resource Conservation and Recovery Act Information system (RCRAINFO)

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2 **NEILS DETROIT DIESEL INC** UST U001628058
2602 S 19TH AVE N/A
PHOENIX, AZ 85009

UST:

Facility ID:	0-006541	Tank ID:	1
Owner:	NEILS DETROIT DIESEL INC	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	12/22/88		
Date Closed:	/ /		
In Use:	False		

Facility ID:	0-006541	Tank ID:	2
Owner:	NEILS DETROIT DIESEL INC	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	12/22/88		
Date Closed:	/ /		
In Use:	False		

Facility ID:	0-006541	Tank ID:	3
Owner:	NEILS DETROIT DIESEL INC	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	12/22/88		
Date Closed:	/ /		
In Use:	False		

2 **FRONTIER FREIGHTWAYS** RCRIS-SQG 1000322325
2465 S 19TH AVE FINDS AZD981395346
PHOENIX, AZ 85007

RCRIS:
Owner: WAYNE BARNES
(415) 555-1212

Contact: ENVIRONMENTAL MANAGER
(602) 256-2975

Record Date: 04/23/1986
Classification: Small Quantity Generator, Hazardous Waste Transporter
Used Oil Recyc: No

Violation Status: No violations found

FINDS:
Other Pertinent Environmental Activity Identified at Site:
Facility Registry System (FRS)
Resource Conservation and Recovery Act Information system (RCRAINFO)

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2 **CYPRESS ENVIRONMENTAL** RCRIS-SQG 1000856732
2465 S 19TH AVE STE A2 FINDS AZD983483074
PHOENIX, AZ 85009

RCRIS:
Owner: HARRISON PROPERTIES JD HARRISON
(602) 840-4295

Contact: DAVID CAUCHI
(602) 257-9480

Record Date: 10/15/1993
Classification: Conditionally Exempt Small Quantity Generator
Used Oil Recyc: No

Violation Status: No violations found

FINDS:
Other Pertinent Environmental Activity Identified at Site:
Resource Conservation and Recovery Act Information system (RCRAINFO)

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2 **SUPERIOR COMPANIES** LUST U003050621
2402 S 19TH AVE UST N/A
PHOENIX, AZ 85009

LUST:
Facility ID: 0-006656
Lust Number: 4038.01
Leak Priority: CLOSED SOIL LVL MEETS TIER1
Notification: 04/14/1995
Date Closed: 06/21/1995

UST:
Facility ID: 0-006656 Tank ID: 1
Owner: SUPERIOR COMPANIES Owner ID: Not reported
Owner Contact: Not reported
In Use: False
Date Removed: / /
Date Closed: / /
In Use: False

2 **ARIZONA BEEF** LUST U003050298
2401 S 19TH AVE UST N/A
PHOENIX, AZ 85009

LUST:
Facility ID: 0-005324
Lust Number: 0582.01
Leak Priority: CLOSED SOIL LVL MEETS TIER1
Notification: 11/10/1988
Date Closed: 11/15/1990

UST:
Facility ID: 0-005324 Tank ID: 1
Owner: HURLEY PROP/R HURLEY/HELEN SMITH Owner ID: Not reported
Owner Contact: Not reported
In Use: False
Date Removed: 11/11/93
Date Closed: / /
In Use: False

Facility ID: 0-005324 Tank ID: 2
Owner: HURLEY PROP/R HURLEY/HELEN SMITH Owner ID: Not reported
Owner Contact: Not reported
In Use: False
Date Removed: 11/10/88
Date Closed: / /
In Use: False

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2 **MARLAM INDUSTRIES INC** FINDS 1000276453
2465 S 19TH AVE STE D RCRIS-LQG AZD981438534
PHOENIX, AZ 85007

RCRIS:
Owner: ARMEL LON S
(415) 555-1212
Contact: ENVIRONMENTAL MANAGER
(602) 253-0003
Record Date: 09/09/1986
Classification: Large Quantity Generator
Used Oil Recyc: No

Violation Status: Violations exist

Regulation Violated: Not reported
Area of Violation: Generator-All Requirements
Date Violation Determined: 07/09/1986
Priority of Violation: Low
Schedule Date to Achieve Compliance: 10/03/1986
Actual Date Achieved Compliance: 12/24/1986

Enforcement Action: Written Informal
Enforcement Action Date: 08/19/1986
Proposed Monetary Penalty: Not reported
Final Monetary Penalty: Not reported

Regulation Violated: Not reported
Area of Violation: Generator-All Requirements
Date Violation Determined: 07/09/1986
Priority of Violation: Low
Schedule Date to Achieve Compliance: 10/03/1986
Actual Date Achieved Compliance: 12/24/1986

Enforcement Action: Written Informal

MARLAM INDUSTRIES INC (Continued) 1000276453

Enforcement Action Date: 08/19/1986
Proposed Monetary Penalty: Not reported
Final Monetary Penalty: Not reported

There are 2 violation record(s) reported at this site:

Evaluation	Area of Violation	Date of Compliance
Compliance Evaluation Inspection (CEI)	Generator-All Requirements	12/24/1986
	Generator-All Requirements	12/24/1986

FINDS:
Other Pertinent Environmental Activity Identified at Site:
Resource Conservation and Recovery Act Information system (RCRAINFO)

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2 **ARIZONA TRUCK & TRAILER SERVICE** Dry Wells S104530883
2235 S. 19TH AVE N/A
PHOENIX, AZ 85009

DRY WELLS:
Number of Wells: 1
Beginning Registration Number: 19162

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2 **BRADLEY INVESTMENT CO** UST U001000615
2235 S 19TH AVE N/A
PHOENIX, AZ 85007

UST:

Facility ID:	0-000753	Tank ID:	1
Owner:	JOHN S BRADLEY	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	06/24/88		
Date Closed:	/ /		
In Use:	False		

Facility ID:	0-000753	Tank ID:	2
Owner:	JOHN S BRADLEY	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	06/24/88		
Date Closed:	/ /		
In Use:	False		

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3 **OLD 23RD AVE SLUDGE DISPOSAL PONDS** SHWS 1000100794
23RD AVE / LOWER BUCKEYE RD N/A
PHOENIX, AZ 85009

SHWS:

EPA ID:	AZD981679640
Program:	PA/SI
Facility Id:	230
Site Code:	Not reported
Discovery Date:	Not reported
Source:	Not reported
Operable Unit:	0
QWARF Area:	WVB
Lat/Long:	Not reported

OLD 23RD AVE SLUDGE DISPOSAL PONDS (Continued) 1000100794

Lat/Long Method: 80
Comments: Not reported

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4 **INNOVATIVE WASTE UTILIZATION L.L.C.** TRIS 1003885319
2575 S. 16TH AVE. 85007NNVTV25
PHOENIX, AZ 85007

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4 **GREENFIELD ENVIRONMENTAL OF AZ** FINDS 1000170294
2575 S 16TH AVE RCRIS-LQG AZD980892731
PHOENIX, AZ 85007 RCRIS-TSD
CORRACTS

CORRACTS Data:

EPA Id:	AZD980892731
Region:	9
State:	Not reported
Area Name:	ENTIRE FACILITY
Original Scheduled Date:	Not reported
New Scheduled Date:	Not reported
Actual Date:	08/31/1991
Corrective Action:	CA075ME - CA Prioritization, Facility or area was assigned a medium corrective action priority
EPA Id:	AZD980892731
Region:	9
State:	Not reported
Area Name:	ENTIRE FACILITY
Original Scheduled Date:	Not reported
New Scheduled Date:	Not reported
Actual Date:	03/02/1992
Corrective Action:	CA075ME - CA Prioritization, Facility or area was assigned a medium corrective action priority

RCRIS Corrective Action Summary:
Effective Date: 08/31/1993
Legal Authority: Other, specified by Legal Authority Citation

RCRIS:
Owner: INNOVATIVE WASTE UTILIZATION
(619) 431-5500

Contact: DAVID ALLOY
(909) 984-9984

Record Date: 12/07/1998
Classification: Large Quantity Generator, Hazardous Waste Transporter

BIENNIAL REPORTS:
Last Biennial Reporting Year: 1999

Waste	Quantity (Lbs)	Waste	Quantity (Lbs)
D001	98034.00	D002	32205.00
D003	979.00	D004	6508.00
D005	31089.00	D006	53390.00
D007	109347.00	D008	82799.00
D009	707.00	D010	12645.00
D011	31222.00	D018	8993.00
D019	80.00	D021	4345.00
D022	3981.00	D026	85.00
D028	187.00	D035	42187.00
D038	85.00	D039	3518.00

GREENFIELD ENVIRONMENTAL OF AZ (Continued) **1000170294**

D040	957.00	F001	470.00
F002	37647.00	F003	34888.00
F004	4480.00	F005	38193.00
F006	30936.00	F007	948.00
F009	319.00	F019	6000.00
F034	456.00	K044	360.00
P003	0.00	P024	45.00
P105	45.00	U044	89.00
U146	45.00	U201	45.00

Used Oil Recyc: No

Violation Status: Violations exist, high priority violator

Regulation Violated:	Not reported
Area of Violation:	Generator-All Requirements
Date Violation Determined:	02/22/1991
Priority of Violation:	High
Schedule Date to Achieve Compliance:	Not reported
Actual Date Achieved Compliance:	08/27/1998

Regulation Violated:	Not reported
Area of Violation:	Generator-Land Ban Requirements
Date Violation Determined:	02/22/1991
Priority of Violation:	Low
Schedule Date to Achieve Compliance:	Not reported
Actual Date Achieved Compliance:	08/27/1998

Regulation Violated:	Not reported
Area of Violation:	Transporter-All Requirements
Date Violation Determined:	02/22/1991
Priority of Violation:	High
Schedule Date to Achieve Compliance:	Not reported
Actual Date Achieved Compliance:	03/04/1994

Regulation Violated:	Not reported
Area of Violation:	Formal Enforcement Agreement
Date Violation Determined:	02/22/1991
Priority of Violation:	Low
Schedule Date to Achieve Compliance:	Not reported
Actual Date Achieved Compliance:	08/27/1998

Regulation Violated:	Not reported
Area of Violation:	TSD-Financial Responsibility Requirements
Date Violation Determined:	02/22/1991
Priority of Violation:	Low
Schedule Date to Achieve Compliance:	Not reported
Actual Date Achieved Compliance:	08/27/1998

Regulation Violated:	Not reported
Area of Violation:	TSD-Closure/Post Closure Requirements
Date Violation Determined:	02/22/1991
Priority of Violation:	Low
Schedule Date to Achieve Compliance:	Not reported
Actual Date Achieved Compliance:	08/27/1998

Regulation Violated:	Not reported
Area of Violation:	TSD-Financial Responsibility Requirements
Date Violation Determined:	02/22/1991
Priority of Violation:	Low
Schedule Date to Achieve Compliance:	Not reported
Actual Date Achieved Compliance:	03/04/1994

GREENFIELD ENVIRONMENTAL OF AZ (Continued) **1000170294**

Regulation Violated:	Not reported
Area of Violation:	TSD-Closure/Post Closure Requirements
Date Violation Determined:	02/22/1991
Priority of Violation:	Low
Schedule Date to Achieve Compliance:	Not reported
Actual Date Achieved Compliance:	03/04/1994
Regulation Violated:	Not reported
Area of Violation:	Generator-All Requirements
Date Violation Determined:	07/27/1984
Priority of Violation:	Low
Schedule Date to Achieve Compliance:	06/20/1985
Actual Date Achieved Compliance:	Not reported
Regulation Violated:	Not reported
Area of Violation:	TSD-Other Requirements
Date Violation Determined:	03/14/1996
Priority of Violation:	Low
Schedule Date to Achieve Compliance:	06/14/1996
Actual Date Achieved Compliance:	09/27/1996
Enforcement Action:	Written Informal
Enforcement Action Date:	04/25/1996
Proposed Monetary Penalty:	Not reported
Final Monetary Penalty:	Not reported
Regulation Violated:	Not reported
Area of Violation:	TSD-Other Requirements
Date Violation Determined:	11/30/1993
Priority of Violation:	Low
Schedule Date to Achieve Compliance:	02/28/1994
Actual Date Achieved Compliance:	05/19/1994
Enforcement Action:	Written Informal
Enforcement Action Date:	02/28/1994
Proposed Monetary Penalty:	Not reported
Final Monetary Penalty:	Not reported
Regulation Violated:	Not reported
Area of Violation:	TSD-Land Ban Requirements
Date Violation Determined:	09/10/1992
Priority of Violation:	High
Schedule Date to Achieve Compliance:	12/10/1992
Actual Date Achieved Compliance:	10/27/1994
Regulation Violated:	Not reported
Area of Violation:	TSD-Other Requirements
Date Violation Determined:	09/10/1992
Priority of Violation:	High
Schedule Date to Achieve Compliance:	12/10/1992
Actual Date Achieved Compliance:	10/27/1994
Regulation Violated:	Not reported
Area of Violation:	TSD-Other Requirements
Date Violation Determined:	06/19/1991
Priority of Violation:	High
Schedule Date to Achieve Compliance:	Not reported
Actual Date Achieved Compliance:	03/04/1994
Enforcement Action:	Written Informal
Enforcement Action Date:	08/08/1991
Proposed Monetary Penalty:	Not reported

GREENFIELD ENVIRONMENTAL OF AZ (Continued) **1000170294**

Final Monetary Penalty:	Not reported
Regulation Violated:	Not reported
Area of Violation:	TSD-Land Ban Requirements
Date Violation Determined:	06/19/1991
Priority of Violation:	Low
Schedule Date to Achieve Compliance:	Not reported
Actual Date Achieved Compliance:	03/04/1994
Enforcement Action:	Written Informal
Enforcement Action Date:	08/08/1991
Proposed Monetary Penalty:	Not reported
Final Monetary Penalty:	Not reported
Regulation Violated:	Not reported
Area of Violation:	TSD-Closure/Post Closure Requirements
Date Violation Determined:	06/19/1991
Priority of Violation:	Low
Schedule Date to Achieve Compliance:	Not reported
Actual Date Achieved Compliance:	03/04/1994
Enforcement Action:	Written Informal
Enforcement Action Date:	08/08/1991
Proposed Monetary Penalty:	Not reported
Final Monetary Penalty:	Not reported
Regulation Violated:	Not reported
Area of Violation:	Generator-All Requirements
Date Violation Determined:	06/17/1991
Priority of Violation:	High
Schedule Date to Achieve Compliance:	Not reported
Actual Date Achieved Compliance:	03/04/1994
Regulation Violated:	Not reported
Area of Violation:	Generator-All Requirements
Date Violation Determined:	02/22/1991
Priority of Violation:	High
Schedule Date to Achieve Compliance:	Not reported
Actual Date Achieved Compliance:	03/04/1994
Regulation Violated:	Not reported
Area of Violation:	Generator-Land Ban Requirements
Date Violation Determined:	02/22/1991
Priority of Violation:	Low
Schedule Date to Achieve Compliance:	Not reported
Actual Date Achieved Compliance:	03/04/1994
Regulation Violated:	Not reported
Area of Violation:	Transporter-All Requirements
Date Violation Determined:	02/22/1991
Priority of Violation:	High
Schedule Date to Achieve Compliance:	Not reported
Actual Date Achieved Compliance:	03/04/1994
Regulation Violated:	Not reported
Area of Violation:	Formal Enforcement Agreement
Date Violation Determined:	02/22/1991
Priority of Violation:	Low
Schedule Date to Achieve Compliance:	Not reported
Actual Date Achieved Compliance:	03/04/1994
Regulation Violated:	Not reported

GREENFIELD ENVIRONMENTAL OF AZ (Continued) 1000170294

Area of Violation:	Transporter-All Requirements
Date Violation Determined:	10/05/1990
Priority of Violation:	Low
Schedule Date to Achieve Compliance:	06/13/1991
Actual Date Achieved Compliance:	03/04/1994
Enforcement Action:	Written Informal
Enforcement Action Date:	05/03/1991
Proposed Monetary Penalty:	Not reported
Final Monetary Penalty:	Not reported
Regulation Violated:	Not reported
Area of Violation:	Generator-All Requirements
Date Violation Determined:	10/05/1990
Priority of Violation:	Low
Schedule Date to Achieve Compliance:	06/13/1991
Actual Date Achieved Compliance:	03/04/1994
Enforcement Action:	Written Informal
Enforcement Action Date:	05/03/1991
Proposed Monetary Penalty:	Not reported
Final Monetary Penalty:	Not reported
Regulation Violated:	Not reported
Area of Violation:	Transporter-All Requirements
Date Violation Determined:	04/07/1989
Priority of Violation:	Low
Schedule Date to Achieve Compliance:	07/01/1990
Actual Date Achieved Compliance:	03/04/1994
Enforcement Action:	Judicial Orders
Enforcement Action Date:	10/02/1989
Proposed Monetary Penalty:	Not reported
Final Monetary Penalty:	Not reported
Regulation Violated:	Not reported
Area of Violation:	Generator-All Requirements
Date Violation Determined:	04/07/1989
Priority of Violation:	Low
Schedule Date to Achieve Compliance:	07/01/1990
Actual Date Achieved Compliance:	03/04/1994
Enforcement Action:	Judicial Orders
Enforcement Action Date:	10/02/1989
Proposed Monetary Penalty:	Not reported
Final Monetary Penalty:	Not reported
Regulation Violated:	Not reported
Area of Violation:	Transporter-All Requirements
Date Violation Determined:	06/03/1988
Priority of Violation:	Low
Schedule Date to Achieve Compliance:	09/01/1990
Actual Date Achieved Compliance:	03/04/1994
Enforcement Action:	Judicial Orders
Enforcement Action Date:	10/02/1989
Proposed Monetary Penalty:	Not reported
Final Monetary Penalty:	Not reported
Regulation Violated:	Not reported
Area of Violation:	Generator-All Requirements
Date Violation Determined:	06/03/1988

GREENFIELD ENVIRONMENTAL OF AZ (Continued) 1000170294

Priority of Violation:	Low
Schedule Date to Achieve Compliance:	09/01/1990
Actual Date Achieved Compliance:	03/04/1994
Enforcement Action:	Judicial Orders
Enforcement Action Date:	10/02/1989
Proposed Monetary Penalty:	Not reported
Final Monetary Penalty:	Not reported
Regulation Violated:	Not reported
Area of Violation:	Generator-All Requirements
Date Violation Determined:	03/10/1987
Priority of Violation:	Low
Schedule Date to Achieve Compliance:	08/26/1987
Actual Date Achieved Compliance:	05/05/1988
Enforcement Action:	Written Informal
Enforcement Action Date:	07/17/1987
Proposed Monetary Penalty:	Not reported
Final Monetary Penalty:	Not reported
Regulation Violated:	Not reported
Area of Violation:	Generator-All Requirements
Date Violation Determined:	03/10/1987
Priority of Violation:	Low
Schedule Date to Achieve Compliance:	08/26/1987
Actual Date Achieved Compliance:	05/05/1988
Enforcement Action:	Written Informal
Enforcement Action Date:	07/17/1987
Proposed Monetary Penalty:	Not reported
Final Monetary Penalty:	Not reported
Regulation Violated:	Not reported
Area of Violation:	TSD-Financial Responsibility Requirements
Date Violation Determined:	03/10/1987
Priority of Violation:	Low
Schedule Date to Achieve Compliance:	08/26/1987
Actual Date Achieved Compliance:	05/05/1988
Enforcement Action:	Written Informal
Enforcement Action Date:	07/17/1987
Proposed Monetary Penalty:	Not reported
Final Monetary Penalty:	Not reported
Regulation Violated:	Not reported
Area of Violation:	Transporter-All Requirements
Date Violation Determined:	03/10/1987
Priority of Violation:	Low
Schedule Date to Achieve Compliance:	08/26/1987
Actual Date Achieved Compliance:	05/05/1988
Enforcement Action:	Written Informal
Enforcement Action Date:	07/17/1987
Proposed Monetary Penalty:	Not reported
Final Monetary Penalty:	Not reported
Regulation Violated:	Not reported
Area of Violation:	Transporter-All Requirements
Date Violation Determined:	03/10/1987
Priority of Violation:	Low
Schedule Date to Achieve Compliance:	08/26/1987

GREENFIELD ENVIRONMENTAL OF AZ (Continued) **1000170294**

Actual Date Achieved Compliance: 05/05/1988

Enforcement Action: Written Informal
Enforcement Action Date: 07/17/1987
Proposed Monetary Penalty: Not reported
Final Monetary Penalty: Not reported

Regulation Violated: Not reported
Area of Violation: TSD-Closure/Post Closure Requirements
Date Violation Determined: 06/02/1986
Priority of Violation: Low
Schedule Date to Achieve Compliance: 10/05/1986
Actual Date Achieved Compliance: 12/01/1986

Enforcement Action: Written Informal
Enforcement Action Date: 09/05/1985
Proposed Monetary Penalty: Not reported
Final Monetary Penalty: Not reported

Regulation Violated: Not reported
Area of Violation: Transporter-All Requirements
Date Violation Determined: 06/02/1986
Priority of Violation: Low
Schedule Date to Achieve Compliance: 10/05/1986
Actual Date Achieved Compliance: 12/01/1986

Enforcement Action: Written Informal
Enforcement Action Date: 09/05/1985
Proposed Monetary Penalty: Not reported
Final Monetary Penalty: Not reported

Regulation Violated: Not reported
Area of Violation: Transporter-All Requirements
Date Violation Determined: 06/02/1986
Priority of Violation: Low
Schedule Date to Achieve Compliance: 10/05/1986
Actual Date Achieved Compliance: 12/01/1986

Enforcement Action: Written Informal
Enforcement Action Date: 09/05/1985
Proposed Monetary Penalty: Not reported
Final Monetary Penalty: Not reported

Regulation Violated: Not reported
Area of Violation: Generator-All Requirements
Date Violation Determined: 05/22/1986
Priority of Violation: Low
Schedule Date to Achieve Compliance: 10/05/1986
Actual Date Achieved Compliance: 12/01/1986

Enforcement Action: Written Informal
Enforcement Action Date: 09/05/1986
Proposed Monetary Penalty: Not reported
Final Monetary Penalty: Not reported

Regulation Violated: Not reported
Area of Violation: Generator-All Requirements
Date Violation Determined: 05/22/1986
Priority of Violation: Low
Schedule Date to Achieve Compliance: 10/05/1986
Actual Date Achieved Compliance: 12/01/1986

Enforcement Action: Written Informal

GREENFIELD ENVIRONMENTAL OF AZ (Continued) **1000170294**

Enforcement Action Date:	09/05/1986
Proposed Monetary Penalty:	Not reported
Final Monetary Penalty:	Not reported
Regulation Violated:	Not reported
Area of Violation:	TSD-Closure/Post Closure Requirements
Date Violation Determined:	05/22/1986
Priority of Violation:	Low
Schedule Date to Achieve Compliance:	10/05/1986
Actual Date Achieved Compliance:	12/01/1986
Enforcement Action:	Written Informal
Enforcement Action Date:	09/05/1986
Proposed Monetary Penalty:	Not reported
Final Monetary Penalty:	Not reported
Regulation Violated:	Not reported
Area of Violation:	Transporter-All Requirements
Date Violation Determined:	05/22/1986
Priority of Violation:	Low
Schedule Date to Achieve Compliance:	10/05/1986
Actual Date Achieved Compliance:	12/01/1986
Enforcement Action:	Written Informal
Enforcement Action Date:	09/05/1986
Proposed Monetary Penalty:	Not reported
Final Monetary Penalty:	Not reported
Regulation Violated:	Not reported
Area of Violation:	Transporter-All Requirements
Date Violation Determined:	05/22/1986
Priority of Violation:	Low
Schedule Date to Achieve Compliance:	10/05/1986
Actual Date Achieved Compliance:	12/01/1986
Enforcement Action:	Written Informal
Enforcement Action Date:	09/05/1986
Proposed Monetary Penalty:	Not reported
Final Monetary Penalty:	Not reported
Regulation Violated:	Not reported
Area of Violation:	Generator-All Requirements
Date Violation Determined:	02/17/1986
Priority of Violation:	Low
Schedule Date to Achieve Compliance:	08/26/1985
Actual Date Achieved Compliance:	07/17/1987
Enforcement Action:	Final Formal 3008(a) Compliance Order
Enforcement Action Date:	07/12/1985
Proposed Monetary Penalty:	Not reported
Final Monetary Penalty:	Not reported
Regulation Violated:	Not reported
Area of Violation:	TSD-Closure/Post Closure Requirements
Date Violation Determined:	02/17/1986
Priority of Violation:	Low
Schedule Date to Achieve Compliance:	08/26/1985
Actual Date Achieved Compliance:	07/17/1987
Enforcement Action:	Final Formal 3008(a) Compliance Order
Enforcement Action Date:	07/12/1985
Proposed Monetary Penalty:	Not reported

GREENFIELD ENVIRONMENTAL OF AZ (Continued) **1000170294**

Final Monetary Penalty:	Not reported
Regulation Violated:	Not reported
Area of Violation:	TSD-Financial Responsibility Requirements
Date Violation Determined:	02/17/1986
Priority of Violation:	Low
Schedule Date to Achieve Compliance:	08/26/1985
Actual Date Achieved Compliance:	07/17/1987
Enforcement Action:	Final Formal 3008(a) Compliance Order
Enforcement Action Date:	07/12/1985
Proposed Monetary Penalty:	Not reported
Final Monetary Penalty:	Not reported
Regulation Violated:	Not reported
Area of Violation:	Transporter-All Requirements
Date Violation Determined:	02/17/1986
Priority of Violation:	Low
Schedule Date to Achieve Compliance:	08/26/1985
Actual Date Achieved Compliance:	07/17/1987
Enforcement Action:	Final Formal 3008(a) Compliance Order
Enforcement Action Date:	07/12/1985
Proposed Monetary Penalty:	Not reported
Final Monetary Penalty:	Not reported
Regulation Violated:	Not reported
Area of Violation:	TSD-Financial Responsibility Requirements
Date Violation Determined:	01/10/1986
Priority of Violation:	Low
Schedule Date to Achieve Compliance:	01/28/1986
Actual Date Achieved Compliance:	01/28/1986
Enforcement Action:	Written Informal
Enforcement Action Date:	01/13/1986
Proposed Monetary Penalty:	Not reported
Final Monetary Penalty:	Not reported
Regulation Violated:	Not reported
Area of Violation:	TSD-Financial Responsibility Requirements
Date Violation Determined:	04/25/1985
Priority of Violation:	Low
Schedule Date to Achieve Compliance:	09/12/1985
Actual Date Achieved Compliance:	01/28/1986
Enforcement Action:	Written Informal
Enforcement Action Date:	05/17/1985
Proposed Monetary Penalty:	Not reported
Final Monetary Penalty:	Not reported
Regulation Violated:	Not reported
Area of Violation:	Generator-All Requirements
Date Violation Determined:	07/27/1984
Priority of Violation:	Low
Schedule Date to Achieve Compliance:	08/26/1985
Actual Date Achieved Compliance:	05/22/1986
Enforcement Action:	Final Formal 3008(a) Compliance Order
Enforcement Action Date:	07/12/1985
Proposed Monetary Penalty:	Not reported
Final Monetary Penalty:	Not reported
Regulation Violated:	Not reported

GREENFIELD ENVIRONMENTAL OF AZ (Continued) **1000170294**

Area of Violation:	Generator-All Requirements
Date Violation Determined:	05/15/1984
Priority of Violation:	Low
Schedule Date to Achieve Compliance:	08/26/1985
Actual Date Achieved Compliance:	05/03/1988
Enforcement Action:	Final Formal 3008(a) Compliance Order
Enforcement Action Date:	07/12/1985
Proposed Monetary Penalty:	Not reported
Final Monetary Penalty:	Not reported
Regulation Violated:	Not reported
Area of Violation:	Generator-All Requirements
Date Violation Determined:	11/18/1983
Priority of Violation:	Low
Schedule Date to Achieve Compliance:	02/20/1984
Actual Date Achieved Compliance:	05/15/1984
Enforcement Action:	Written Informal
Enforcement Action Date:	01/10/1984
Proposed Monetary Penalty:	Not reported
Final Monetary Penalty:	Not reported

GREENFIELD ENVIRONMENTAL OF AZ (Continued) **1000170294**

There are 49 violation record(s) reported at this site:

Evaluation	Area of Violation	Date of Compliance
Compliance Evaluation Inspection (CEI)	TSD-Other Requirements	09/27/1996
Compliance Evaluation Inspection (CEI)	TSD-Other Requirements	05/19/1994
Compliance Evaluation Inspection (CEI)	TSD-Land Ban Requirements	10/27/1994
	TSD-Other Requirements	10/27/1994
Compliance Evaluation Inspection (CEI)	TSD-Other Requirements	03/04/1994
	TSD-Land Ban Requirements	03/04/1994
	TSD-Closure/Post Closure Requirements	03/04/1994
Compliance Evaluation Inspection (CEI)	Generator-All Requirements	03/04/1994
Compliance Evaluation Inspection (CEI)	Generator-All Requirements	08/27/1998
	Generator-Land Ban Requirements	08/27/1998
	Transporter-All Requirements	03/04/1994
	Formal Enforcement Agreement	08/27/1998
	TSD-Financial Responsibility Requirements	08/27/1998
	TSD-Closure/Post Closure Requirements	08/27/1998
	TSD-Financial Responsibility Requirements	03/04/1994
	TSD-Closure/Post Closure Requirements	03/04/1994
	Generator-All Requirements	03/04/1994
	Generator-Land Ban Requirements	03/04/1994
	Transporter-All Requirements	03/04/1994
	Formal Enforcement Agreement	03/04/1994
Compliance Evaluation Inspection (CEI)	Transporter-All Requirements	03/04/1994
	Generator-All Requirements	03/04/1994
Compliance Evaluation Inspection (CEI)	Transporter-All Requirements	03/04/1994
	Generator-All Requirements	03/04/1994
Compliance Evaluation Inspection (CEI)	Transporter-All Requirements	03/04/1994
	Generator-All Requirements	03/04/1994
Compliance Evaluation Inspection (CEI)	Generator-All Requirements	05/05/1988
	Generator-All Requirements	05/05/1988
	TSD-Financial Responsibility Requirements	05/05/1988
	Transporter-All Requirements	05/05/1988
	Transporter-All Requirements	05/05/1988
Compliance Evaluation Inspection (CEI)	TSD-Closure/Post Closure Requirements	12/01/1986
	Transporter-All Requirements	12/01/1986
	Transporter-All Requirements	12/01/1986
Compliance Evaluation Inspection (CEI)	Generator-All Requirements	12/01/1986
	Generator-All Requirements	12/01/1986
	TSD-Closure/Post Closure Requirements	12/01/1986
	Transporter-All Requirements	12/01/1986
	Transporter-All Requirements	12/01/1986
Compliance Schedule Evaluation (CSE)	Generator-All Requirements	07/17/1987
	TSD-Closure/Post Closure Requirements	07/17/1987
	TSD-Financial Responsibility Requirements	07/17/1987
	Transporter-All Requirements	07/17/1987
Financial Record Review (FRR)	TSD-Financial Responsibility Requirements	01/28/1986
Financial Record Review (FRR)	TSD-Financial Responsibility Requirements	01/28/1986
Non-Financial Record Review	Generator-All Requirements	
Compliance Schedule Evaluation (CSE)	Generator-All Requirements	05/22/1986
Compliance Schedule Evaluation (CSE)	Generator-All Requirements	05/03/1988
Compliance Evaluation Inspection (CEI)	Generator-All Requirements	05/15/1984

GREENFIELD ENVIRONMENTAL OF AZ (Continued) 1000170294

FINDS:
Other Pertinent Environmental Activity Identified at Site:
AIRS Facility System (AIRS/AFS)
Biennial Reporting System (BRS)
Facility Registry System (FRS)
Resource Conservation and Recovery Act Information system (RCRAINFO)
Toxic Chemical Release Inventory System (TRIS)

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4 **MP ENVIRONMENTAL** AZ Spills S104559736
2530 SO. 16 AVENUE N/A
PHOENIX, AZ

Az Spills:

Facility ID:	94-055-C	Incident Date:	12/28/94
Response Date:	Not reported	Report / Assist:	Not reported
Type:	Release	No of Samples:	Bi
Referred to:	Not reported		
Chemicals:	Vanadium Pentoxide		
Property Mngmt:	Private		
Fund Amount:	Pvt/Unk		
Quantity:	Not reported		

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4 **2530 SOUTH 16 AVENUE** ERNS 94418494
2530 SOUTH 16 AVENUE N/A
PHOENIX, AZ 85007

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5 **27 AVE & LOWER BUCKEYE** ERNS 92288695
27 AVE & LOWER BUCKEYE N/A
PHOENIX, AZ

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5 **PHOENIX 27TH AVE LANDFILL** LUST U003229024
27TH AVE & LOWER BUCKEYE RD UST N/A
PHOENIX, AZ 85009

LUST:

Facility ID:	0-003858
Lust Number:	1787.01
Leak Priority:	CLOSED SOIL/GW LVL MEETS TIER1
Notification:	04/26/1991
Date Closed:	04/07/1998

UST:

Facility ID:	0-003858	Tank ID:	1
Owner:	CITY OF PHOENIX PUBLIC WORKS DPT	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	04/17/91		
Date Closed:	/ /		
In Use:	False		

---

5 **PHOENIX, CITY OF - 27TH AVENUE LANDFILL** WWFAC S102789414
27TH AVE. / LOWER BUCKEYE N/A
PHOENIX, AZ 85009

AZ WWFAC:
Owner Address: 251 West Washington

PHOENIX, CITY OF - 27TH AVENUE LANDFILL (Continued) S102789414

Phoenix, A Z8500

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5 **27TH AVENUE LANDFILL** AZ Spills S102257583
27 AVE. / LOWER BUCKEYE RD. Dry Wells N/A
PHOENIX, AZ 85009

Az Spills:

Facility ID:	96-006-D	Incident Date:	03/17/96
Response Date:	03/17/96	Report / Assist:	Not reported
Type:	Fire	No of Samples:	Du
Referred to:	AQD/SWS		
Chemicals:	Wood Smoke		
Property Mngmt:	City		
Fund Amount:	COP/Unk		
Quantity:	Not reported		

DRY WELLS:

Number of Wells:	1
Beginning Registration Number:	7378

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5 **PHOENIX CITY LANDFILL** AZ Spills S100885756
27 AVE / LOWER BUCKEYE RD. N/A
PHOENIX, AZ

Az Spills:

Facility ID:	92-099-C	Incident Date:	07/13/92
Response Date:	Not reported	Report / Assist:	Not reported
Type:	Dumping	No of Samples:	Ca
Referred to:	Solid Wast		
Chemicals:	Flammable Liq/Used Oil		
Property Mngmt:	City		
Fund Amount:	Unknown		
Quantity:	Not reported		

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5 **27TH AVE LANDFILL** UST U003159642
2800 S 27TH AVE N/A
PHOENIX, AZ 85009

UST:

Facility ID:	0-005848	Tank ID:	1
Owner:	CITY OF PHOENIX EQUIP MGMT DIV	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	04/17/91		
Date Closed:	/ /		
In Use:	False		

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5 **PHOENIX UNION HIGH SCHOOL** AZ Spills S104560076
2800 S. 27 AVE. N/A
PHOENIX, AZ

Az Spills:

Facility ID:	91-101-B	Incident Date:	09/04/91
Response Date:	Not reported	Report / Assist:	Not reported
Type:	Release	No of Samples:	Un
Referred to:	Not reported		
Chemicals:	Pentachlorophenol		
Property Mngmt:	City		

PHOENIX UNION HIGH SCHOOL (Continued) **S104560076**

Fund Amount: Not reported
Quantity: Not reported

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6 **PHOENIX TRANSIT SYSTEM** **RCRIS-SQG 1000208059**
2225 W LOWER BUCKEYE **LUST AZD981676224**
PHOENIX, AZ 85009 **UST**

RCRIS:
Owner: CITY OF PHOENIX
(415) 555-1212
Contact: ENVIRONMENTAL MANAGER
(602) 256-3405
Record Date: 09/16/1997
Classification: Conditionally Exempt Small Quantity Generator
Used Oil Recyc: No

Violation Status: No violations found

LUST:
Facility ID: 0-003877
Lust Number: 3869.01
Leak Priority: CLOSED SOIL/GW LVL MEETS TIER2
Notification: 01/10/1995
Date Closed: 04/18/2000

UST:

Facility ID:	0-003877	Tank ID:	1
Owner:	CITY OF PHOENIX	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	True		
Date Removed:	/ /		
Date Closed:	/ /		
In Use:	True		

Facility ID:	0-003877	Tank ID:	2
Owner:	CITY OF PHOENIX	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	True		
Date Removed:	/ /		
Date Closed:	/ /		
In Use:	True		

Facility ID:	0-003877	Tank ID:	3
Owner:	CITY OF PHOENIX	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	True		
Date Removed:	/ /		
Date Closed:	/ /		
In Use:	True		

Facility ID:	0-003877	Tank ID:	4
Owner:	CITY OF PHOENIX	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	True		
Date Removed:	/ /		
Date Closed:	/ /		
In Use:	True		

PHOENIX TRANSIT SYSTEM (Continued) **1000208059**

Facility ID: 0-003877
Owner: CITY OF PHOENIX
Owner Contact: Not reported
In Use: True
Date Removed: / /
Date Closed: / /
In Use: True
Tank ID: 5
Owner ID: Not reported

Facility ID: 0-003877
Owner: CITY OF PHOENIX
Owner Contact: Not reported
In Use: True
Date Removed: / /
Date Closed: / /
In Use: True
Tank ID: 6
Owner ID: Not reported

Facility ID: 0-003877
Owner: CITY OF PHOENIX
Owner Contact: Not reported
In Use: True
Date Removed: / /
Date Closed: / /
In Use: True
Tank ID: 7
Owner ID: Not reported

Facility ID: 0-003877
Owner: CITY OF PHOENIX
Owner Contact: Not reported
In Use: True
Date Removed: / /
Date Closed: / /
In Use: True
Tank ID: 8
Owner ID: Not reported

Facility ID: 0-003877
Owner: CITY OF PHOENIX
Owner Contact: Not reported
In Use: True
Date Removed: / /
Date Closed: / /
In Use: True
Tank ID: 9
Owner ID: Not reported

Facility ID: 0-003877
Owner: CITY OF PHOENIX
Owner Contact: Not reported
In Use: True
Date Removed: / /
Date Closed: / /
In Use: True
Tank ID: 10
Owner ID: Not reported

Facility ID: 0-003877
Owner: CITY OF PHOENIX
Owner Contact: Not reported
In Use: True
Date Removed: / /
Date Closed: / /
In Use: True
Tank ID: 11
Owner ID: Not reported

PHOENIX TRANSIT SYSTEM (Continued) 1000208059

Facility ID: 0-003877
Owner: CITY OF PHOENIX
Owner Contact: Not reported
In Use: True
Date Removed: / /
Date Closed: / /
In Use: True
Tank ID: 12
Owner ID: Not reported

Facility ID: 0-003877
Owner: CITY OF PHOENIX
Owner Contact: Not reported
In Use: True
Date Removed: / /
Date Closed: / /
In Use: True
Tank ID: 13
Owner ID: Not reported

Facility ID: 0-003877
Owner: CITY OF PHOENIX
Owner Contact: Not reported
In Use: True
Date Removed: / /
Date Closed: / /
In Use: True
Tank ID: 14
Owner ID: Not reported

Facility ID: 0-003877
Owner: CITY OF PHOENIX
Owner Contact: Not reported
In Use: True
Date Removed: / /
Date Closed: / /
In Use: True
Tank ID: 15
Owner ID: Not reported

Facility ID: 0-003877
Owner: CITY OF PHOENIX
Owner Contact: Not reported
In Use: True
Date Removed: / /
Date Closed: / /
In Use: True
Tank ID: 16
Owner ID: Not reported

Facility ID: 0-003877
Owner: CITY OF PHOENIX
Owner Contact: Not reported
In Use: True
Date Removed: / /
Date Closed: / /
In Use: True
Tank ID: 17
Owner ID: Not reported

Facility ID: 0-003877
Owner: CITY OF PHOENIX
Owner Contact: Not reported
In Use: True
Date Removed: / /
Date Closed: / /
In Use: True
Tank ID: 18
Owner ID: Not reported

PHOENIX TRANSIT SYSTEM (Continued) **1000208059**

Facility ID: 0-003877
Owner: CITY OF PHOENIX
Owner Contact: Not reported
In Use: True
Date Removed: / /
Date Closed: / /
In Use: True
Tank ID: 19
Owner ID: Not reported

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6 **PHOENIX TRANSIT SYSTEM** **FINDS** **1000208048**
2225 W LOWER BUCKEYE **RCRIS-LQG** **AZD981666670**
PHOENIX, AZ 85009

RCRIS:
Owner: CITY OF PHOENIX
(602) 261-8284

Contact: ROBERT COX
(602) 534-2629

Record Date: 06/18/1996
Classification: Large Quantity Generator
Used Oil Recyc: No

Violation Status: Violations exist

Regulation Violated: Not reported
Area of Violation: Generator-All Requirements
Date Violation Determined: 03/29/1996
Priority of Violation: Low
Schedule Date to Achieve Compliance: 06/29/1996
Actual Date Achieved Compliance: 11/19/1996

Enforcement Action: Written Informal
Enforcement Action Date: 05/16/1996
Proposed Monetary Penalty: Not reported
Final Monetary Penalty: Not reported

There are 1 violation record(s) reported at this site:

Evaluation	Area of Violation	Date of Compliance
Compliance Evaluation Inspection (CEI)	Generator-All Requirements	11/19/1996

FINDS:
Other Pertinent Environmental Activity Identified at Site:
Biennial Reporting System (BRS)
Facility Registry System (FRS)
Resource Conservation and Recovery Act Information system (RCRAINFO)

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6 **C.O.P. PETROLEUM STORAGE FACILITY** **Dry Wells** **S103491217**
2239 WEST LOWER BUCKEYE **N/A**
PHOENIX, AZ 85009

DRY WELLS:
Number of Wells: 1
Beginning Registration Number: 8204

Map ID / Direction / Distance / Distance (ft.)	Site	Database(s)	EDR ID Number / EPA ID Number

6 **PHOENIX CITY OF FINANCE FUEL** RCRIS-SQG 1000208041
2239 W LOWER BUCKEYE FINDS AZD981648728
PHOENIX, AZ 85009

RCRIS:
Owner: CITY OF PHOENIX
(415) 555-1212
Contact: ENVIRONMENTAL MANAGER
(602) 262-7555
Record Date: 03/02/1987
Classification: Small Quantity Generator
Used Oil Recyc: No

Violation Status: No violations found

FINDS:
Other Pertinent Environmental Activity Identified at Site:
Facility Registry System (FRS)
Resource Conservation and Recovery Act Information system (RCRAINFO)

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6 **CITY OF PHOENIX PETROLEUM STORES** SHWS U003049945
2239 W LOWER BUCKEYE RD LUST N/A
PHOENIX, AZ 85009 UST

SHWS:
EPA ID: Not reported
Program: WQARF
Facility Id: 510
Site Code: 70504
Discovery Date: 70504
Source: Not reported
Operable Unit: 0
QWARF Area: WVB
Lat/Long: Not reported
Lat/Long Method: 80
Comments: Not reported

LUST:
Facility ID: 0-003854
Lust Number: 0350.01
Leak Priority: CLOSED SOIL/GW LVL MEETS TIER1 RECORDED VEMUR
Notification: 09/30/1987
Date Closed: 05/06/1998

UST:
Facility ID: 0-003854 Tank ID: 1
Owner: CITY OF PHOENIX PUBLIC WORKS DPT Owner ID: Not reported
Owner Contact: Not reported
In Use: False
Date Removed: 04/30/92
Date Closed: / /
In Use: False

Facility ID: 0-003854 Tank ID: 2
Owner: CITY OF PHOENIX PUBLIC WORKS DPT Owner ID: Not reported
Owner Contact: Not reported
In Use: False
Date Removed: 04/30/92
Date Closed: / /
In Use: False

CITY OF PHOENIX PETROLEUM STORES (Continued) U003049945

Facility ID:	0-003854	Tank ID:	3
Owner:	CITY OF PHOENIX PUBLIC WORKS DPT	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	04/30/92		
Date Closed:	/ /		
In Use:	False		

Facility ID:	0-003854	Tank ID:	4
Owner:	CITY OF PHOENIX PUBLIC WORKS DPT	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	04/30/92		
Date Closed:	/ /		
In Use:	False		

Facility ID:	0-003854	Tank ID:	5
Owner:	CITY OF PHOENIX PUBLIC WORKS DPT	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	04/30/92		
Date Closed:	/ /		
In Use:	False		

Facility ID:	0-003854	Tank ID:	6
Owner:	CITY OF PHOENIX PUBLIC WORKS DPT	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	04/30/92		
Date Closed:	/ /		
In Use:	False		

Facility ID:	0-003854	Tank ID:	7
Owner:	CITY OF PHOENIX PUBLIC WORKS DPT	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	04/30/92		
Date Closed:	/ /		
In Use:	False		

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6 **KERLEY CHEMICAL CORP.** **AZ Spills** S104560041
2248 W. LOWER BUCKEYE **WWFAC** N/A
PHOENIX, AZ

Az Spills:

Facility ID:	86-004	Incident Date:	01/12/86
Response Date:	01/12/86	Report / Assist:	Not reported
Type:	Release	No of Samples:	Fi
Referred to:	Not reported		
Chemicals:	Anhydrous Ammonia		
Property Mngmt:	Private		
Fund Amount:	Not reported		
Quantity:	Not reported		

AZ WWFAC:

Owner Address:	2248 W. Lower Buckeye Phoenix, A Z8500

Map ID / Direction / Distance / Distance (ft.)	Site	Database(s)	EDR ID Number / EPA ID Number
6	**KERLEY ENTERPRISES** **2248 W. LOWER BUCKEYE RD.** **PHOENIX, AZ 85009**	**SHWS**	**S101570122** **N/A**

SHWS:

EPA ID:	Not reported
Program:	WQARF
Facility Id:	548
Site Code:	501389
Discovery Date:	13/89/50
Source:	Not reported
Operable Unit:	0
QWARF Area:	WVB
Lat/Long:	Not reported
Lat/Long Method:	80
Comments:	Not reported

6	**KERLEY AGRICULTURAL PRODUCTS** **2248 W LOWER BUCKEYE RD** **PHOENIX, AZ 85009**		**UST**	**U001628194** **N/A**

UST:

Facility ID:	0-006812	Tank ID:	1
Owner:	KERLEY ENTERRPISES	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	12/27/90		
Date Closed:	/ /		
In Use:	False		

6	**TESSENDERLO KERLEY INC.** **2248 W. LOWER BUCKEYE RD.** **PHOENIX, AZ 85009**	**TRIS**	**1001200794** **85009KRLYG22**

6	**TESSENDERLO KERLEY INC** **2248 W LOWER BUCKEYE RD** **PHOENIX, AZ 85009**	**RCRIS-SQG** **FINDS**	**1000589042** **AZD983466574**

RCRIS:

Owner:	TESSENDERLO KERLEY INC (602) 528-0600
Contact:	DAWN KOMINSKI (602) 528-0665
Record Date:	05/07/1997
Classification:	Small Quantity Generator

BIENNIAL REPORTS:

Last Biennial Reporting Year: 1999

Waste	Quantity (Lbs)	Waste	Quantity (Lbs)
D001	64100.00	D003	64528.00
D018	64628.00	LABP	27.00

TESSENDERLO KERLEY INC (Continued) 1000589042

Used Oil Recyc: No

Violation Status: No violations found

FINDS:
Other Pertinent Environmental Activity Identified at Site:
Facility Registry System (FRS)
Resource Conservation and Recovery Act Information system (RCRAINFO)
Toxic Chemical Release Inventory System (TRIS)

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6 **PHOENIX SALT RIVER SERVICE CTR** LUST U001626679
3045 S 22ND AVE UST N/A
PHOENIX, AZ 85009

LUST:

Facility ID:	0-003864
Lust Number:	1102.01
Leak Priority:	CLOSED SOIL/GW LVL MEETS TIER1
Notification:	02/01/1990
Date Closed:	04/29/1997

Facility ID:	0-003864
Lust Number:	1102.02
Leak Priority:	CLOSED SOIL LVL MEETS TIER1
Notification:	10/05/1990
Date Closed:	04/29/1997

Facility ID:	0-003864
Lust Number:	1102.03
Leak Priority:	CLOSED SOIL LVL MEETS TIER1
Notification:	02/28/1991
Date Closed:	07/15/1999

Facility ID:	0-003864
Lust Number:	1102.04
Leak Priority:	CLOSED SOIL LVL MEETS TIER1
Notification:	02/28/1991
Date Closed:	07/15/1999

Facility ID:	0-003864
Lust Number:	1102.05
Leak Priority:	CLOSED SOIL LVL MEETS TIER1
Notification:	02/04/1998
Date Closed:	07/15/1999

Facility ID:	0-003864
Lust Number:	1102.06
Leak Priority:	CLOSED SOIL LVL MEETS TIER1
Notification:	05/26/1999
Date Closed:	07/15/1999

UST:

Facility ID:	0-003864	Tank ID:	1
Owner:	CITY OF PHOENIX PUBLIC WORKS DPT	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	07/03/86		
Date Closed:	/ /		
In Use:	False		

PHOENIX SALT RIVER SERVICE CTR (Continued) **U001626679**

Facility ID:	0-003864	Tank ID:	2
Owner:	CITY OF PHOENIX PUBLIC WORKS DPT	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	07/01/86		
Date Closed:	/ /		
In Use:	False		

Facility ID:	0-003864	Tank ID:	3
Owner:	CITY OF PHOENIX PUBLIC WORKS DPT	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	07/11/86		
Date Closed:	/ /		
In Use:	False		

Facility ID:	0-003864	Tank ID:	4
Owner:	CITY OF PHOENIX PUBLIC WORKS DPT	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	07/11/89		
Date Closed:	/ /		
In Use:	False		

Facility ID:	0-003864	Tank ID:	5
Owner:	CITY OF PHOENIX PUBLIC WORKS DPT	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	02/20/88		
Date Closed:	/ /		
In Use:	False		

Facility ID:	0-003864	Tank ID:	6
Owner:	CITY OF PHOENIX PUBLIC WORKS DPT	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	02/20/88		
Date Closed:	/ /		
In Use:	False		

Facility ID:	0-003864	Tank ID:	7
Owner:	CITY OF PHOENIX PUBLIC WORKS DPT	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	02/20/88		
Date Closed:	/ /		
In Use:	False		

Facility ID:	0-003864	Tank ID:	8
Owner:	CITY OF PHOENIX PUBLIC WORKS DPT	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	02/20/88		
Date Closed:	/ /		
In Use:	False		

PHOENIX SALT RIVER SERVICE CTR (Continued) U001626679

Facility ID:	0-003864	Tank ID:	9
Owner:	CITY OF PHOENIX PUBLIC WORKS DPT	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	02/20/88		
Date Closed:	/ /		
In Use:	False		

Facility ID:	0-003864	Tank ID:	10
Owner:	CITY OF PHOENIX PUBLIC WORKS DPT	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	02/20/88		
Date Closed:	/ /		
In Use:	False		

Facility ID:	0-003864	Tank ID:	11
Owner:	CITY OF PHOENIX PUBLIC WORKS DPT	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	09/11/90		
Date Closed:	/ /		
In Use:	False		

Facility ID:	0-003864	Tank ID:	12
Owner:	CITY OF PHOENIX PUBLIC WORKS DPT	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	True		
Date Removed:	/ /		
Date Closed:	/ /		
In Use:	True		

Facility ID:	0-003864	Tank ID:	13
Owner:	CITY OF PHOENIX PUBLIC WORKS DPT	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	True		
Date Removed:	/ /		
Date Closed:	/ /		
In Use:	True		

Facility ID:	0-003864	Tank ID:	14
Owner:	CITY OF PHOENIX PUBLIC WORKS DPT	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	True		
Date Removed:	/ /		
Date Closed:	/ /		
In Use:	True		

Facility ID:	0-003864	Tank ID:	15
Owner:	CITY OF PHOENIX PUBLIC WORKS DPT	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	True		
Date Removed:	/ /		
Date Closed:	/ /		
In Use:	True		

PHOENIX SALT RIVER SERVICE CTR (Continued) U001626679

Facility ID:	0-003864	Tank ID:	16
Owner:	CITY OF PHOENIX PUBLIC WORKS DPT	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	True		
Date Removed:	/ /		
Date Closed:	/ /		
In Use:	True		

Facility ID:	0-003864	Tank ID:	17
Owner:	CITY OF PHOENIX PUBLIC WORKS DPT	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	True		
Date Removed:	/ /		
Date Closed:	/ /		
In Use:	True		

Facility ID:	0-003864	Tank ID:	18
Owner:	CITY OF PHOENIX PUBLIC WORKS DPT	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	True		
Date Removed:	/ /		
Date Closed:	/ /		
In Use:	True		

Facility ID:	0-003864	Tank ID:	19
Owner:	CITY OF PHOENIX PUBLIC WORKS DPT	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	True		
Date Removed:	/ /		
Date Closed:	/ /		
In Use:	True		

Facility ID:	0-003864	Tank ID:	20
Owner:	CITY OF PHOENIX PUBLIC WORKS DPT	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	01/22/98		
Date Closed:	/ /		
In Use:	False		

Facility ID:	0-003864	Tank ID:	21
Owner:	CITY OF PHOENIX PUBLIC WORKS DPT	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	01/22/98		
Date Closed:	/ /		
In Use:	False		

Facility ID:	0-003864	Tank ID:	22
Owner:	CITY OF PHOENIX PUBLIC WORKS DPT	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	01/22/98		
Date Closed:	/ /		
In Use:	False		

PHOENIX SALT RIVER SERVICE CTR (Continued) U001626679

Facility ID:	0-003864	Tank ID:	23
Owner:	CITY OF PHOENIX PUBLIC WORKS DPT	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	01/22/98		
Date Closed:	/ /		
In Use:	False		

Facility ID:	0-003864	Tank ID:	24
Owner:	CITY OF PHOENIX PUBLIC WORKS DPT	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	01/22/98		
Date Closed:	/ /		
In Use:	False		

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6 **3045 S. 22ND AVE** ERNS 93305346
3045 S. 22ND AVE N/A
PHOENIX, AZ 85003

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6 **POLICE SURPLUS YARD** FINDS 1004181184
3032 S 22ND AVE 000009072646
PHOENIX, AZ 85041

FINDS:
Other Pertinent Environmental Activity Identified at Site:
Facility Registry System (FRS)
Resource Conservation and Recovery Act Information system (RCRAINFO)

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7 **MARDIAN CONSTRUCTION COMPANY** LUST U001001034
4044 W LOWER BUCKEYE RD UST N/A
PHOENIX, AZ 85009

LUST:

Facility ID:	0-003040
Lust Number:	0478.01
Leak Priority:	CLOSED SOIL LVL MEETS TIER1
Notification:	06/23/1988
Date Closed:	07/30/1996

Facility ID:	0-003040
Lust Number:	0478.02
Leak Priority:	CLOSED SOIL LVL MEETS TIER1
Notification:	06/23/1988
Date Closed:	07/30/1996

UST:

Facility ID:	0-003040	Tank ID:	1
Owner:	MARDIAN CONSTRUCTION COMPANY	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	06/24/90		
Date Closed:	/ /		
In Use:	False		

Facility ID:	0-003040	Tank ID:	2
Owner:	MARDIAN CONSTRUCTION COMPANY	Owner ID:	Not reported

MARDIAN CONSTRUCTION COMPANY (Continued) U001001034

Owner Contact: Not reported
In Use: False
Date Removed: 06/24/90
Date Closed: / /
In Use: False

Facility ID: 0-003040 Tank ID: 3
Owner: MARDIAN CONSTRUCTION COMPANY Owner ID: Not reported
Owner Contact: Not reported
In Use: False
Date Removed: 06/24/90
Date Closed: / /
In Use: False

Facility ID: 0-003040 Tank ID: 4
Owner: MARDIAN CONSTRUCTION COMPANY Owner ID: Not reported
Owner Contact: Not reported
In Use: False
Date Removed: 09/24/90
Date Closed: / /
In Use: False

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7 **ZIEMAN MFG** RCRIS-SQG 1000295480
4025 LOWER BUCKEYE FINDS AZD981686983
PHOENIX, AZ 85009 UST

RCRIS:
Owner: ZIEMAN MFG
(415) 555-1212
Contact: ENVIRONMENTAL MANAGER
(602) 484-0210
Record Date: 10/27/1986
Classification: Small Quantity Generator
Used Oil Recyc: No

Violation Status: No violations found

FINDS:
Other Pertinent Environmental Activity Identified at Site:
Facility Registry System (FRS)
Resource Conservation and Recovery Act Information system (RCRAINFO)

UST:
Facility ID: 0-007185 Tank ID: 1
Owner: ZIEMAN CORPORATION Owner ID: Not reported
Owner Contact: Not reported
In Use: False
Date Removed: 09/28/94
Date Closed: / /
In Use: False

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8 **PHOENIX REDI MIX CO INC** RCRIS-SQG 1000208008
3635 S 43RD AVE FINDS AZD056898679
PHOENIX, AZ 85009

PHOENIX REDI MIX CO INC (Continued) **1000208008**

RCRIS:
Owner: VALENTE THOMAS
(602) 272-2637

Contact: TOBY BALLENTINE
(602) 272-2637

Record Date: 10/06/1986
Classification: Small Quantity Generator
Used Oil Recyc: No

Violation Status: No violations found

FINDS:
Other Pertinent Environmental Activity Identified at Site:
AIRS Facility System (AIRS/AFS)
Facility Registry System (FRS)
Resource Conservation and Recovery Act Information system (RCRAINFO)

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8 **PHOENIX REDI-MIX CO INC** **LUST U001155405**
3635 S 43RD AVE **UST N/A**
PHOENIX, AZ 85009

LUST:
Facility ID: 0-004998
Lust Number: 0477.01
Leak Priority: CLOSED SOIL LVL MEETS TIER1
Notification: 06/28/1988
Date Closed: 08/30/1999

Facility ID: 0-004998
Lust Number: 0477.02
Leak Priority: CLOSED SOIL LVL MEETS TIER1
Notification: 03/30/1989
Date Closed: 08/30/1999

Facility ID: 0-004998
Lust Number: 0477.03 2009.01
Leak Priority: CLOSED SOIL LVL MEETS TIER1
Notification: 10/15/1991
Date Closed: 12/03/1998

Facility ID: 0-004998
Lust Number: 0477.04
Leak Priority: CLOSED SOIL LVL MEETS TIER1
Notification: 10/28/1998
Date Closed: 08/30/1999

Facility ID: 0-004998
Lust Number: 2009.01 0477.03
Leak Priority: LUST CASE COMBINED - CLOSED OUT
Notification: 10/15/1991
Date Closed: 10/30/1998

UST:
Facility ID: 0-004998 Tank ID: 1
Owner: PHOENIX REDI-MIX CO/BOB STROM Owner ID: Not reported
Owner Contact: Not reported
In Use: False
Date Removed: 08/01/88

PHOENIX REDI-MIX CO INC (Continued) **U001155405**

Date Closed: / /
In Use: False

Facility ID: 0-004998 Tank ID: 2
Owner: PHOENIX REDI-MIX CO/BOB STROM Owner ID: Not reported
Owner Contact: Not reported
In Use: False
Date Removed: 08/01/88
Date Closed: / /
In Use: False

Facility ID: 0-004998 Tank ID: 3
Owner: PHOENIX REDI-MIX CO/BOB STROM Owner ID: Not reported
Owner Contact: Not reported
In Use: False
Date Removed: 08/01/88
Date Closed: / /
In Use: False

Facility ID: 0-004998 Tank ID: 4
Owner: PHOENIX REDI-MIX CO/BOB STROM Owner ID: Not reported
Owner Contact: Not reported
In Use: False
Date Removed: 08/15/91
Date Closed: / /
In Use: False

Facility ID: 0-004998 Tank ID: 5
Owner: PHOENIX REDI-MIX CO/BOB STROM Owner ID: Not reported
Owner Contact: Not reported
In Use: False
Date Removed: 08/15/91
Date Closed: / /
In Use: False

Facility ID: 0-004998 Tank ID: 6
Owner: PHOENIX REDI-MIX CO/BOB STROM Owner ID: Not reported
Owner Contact: Not reported
In Use: False
Date Removed: 10/07/98
Date Closed: / /
In Use: False

Facility ID: 0-004998 Tank ID: 7
Owner: PHOENIX REDI-MIX CO/BOB STROM Owner ID: Not reported
Owner Contact: Not reported
In Use: False
Date Removed: 10/07/98
Date Closed: / /
In Use: False

Facility ID: 0-004998 Tank ID: 8
Owner: PHOENIX REDI-MIX CO/BOB STROM Owner ID: Not reported
Owner Contact: Not reported
In Use: False
Date Removed: 10/07/98
Date Closed: / /

PHOENIX REDI-MIX CO INC (Continued) U001155405

In Use: False

Facility ID: 0-004998 Tank ID: 9
Owner: PHOENIX REDI-MIX CO/BOB STROM Owner ID: Not reported
Owner Contact: Not reported
In Use: False
Date Removed: 10/07/98
Date Closed: / /
In Use: False

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8 **PHOENIX REDI-MIX** MINES M100004128 N/A

MARICOPA (County), AZ

U.S. MINES:
Mine ID: 0201070 SIC Codes: 14410 00000 00000 00000 00000 00000
Entity Name: PHOENIX REDI-MIX Company: PHOENIX REDI-MIX
State FIPS code: 04 County FIPS code: 025
Status Date: 02/06/1997 Status: permanently abandoned
Operation Class: Non-coal mining Number of Shops: 0
Number of Pits: 000 Number of Plants: 0
Latitude: 33 24 58 Longitude: 112 09 06

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8 **SUNWARD MATERIALS** MINES M100004095 N/A

MARICOPA (County), AZ

U.S. MINES:
Mine ID: 0201037 SIC Codes: 14410 00000 00000 00000 00000 00000
Entity Name: WEST PLANT #72 Company: SUNWARD MATERIALS
State FIPS code: 04 County FIPS code: 013
Status Date: 10/01/1987 Status: Full-time permanent
Operation Class: Non-coal mining Number of Shops: 6
Number of Pits: 000 Number of Plants: 0
Latitude: 33 24 58 Longitude: 112 09 06

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8 **GLENN WIENBEGER** UST U003051098 N/A
3425 S 43RD AVE
PHOENIX, AZ 85009

UST:
Facility ID: 0-008757 Tank ID: 1
Owner: GLENN WIENBERGER Owner ID: Not reported
Owner Contact: Not reported
In Use: True
Date Removed: / /
Date Closed: / /
In Use: True

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8 **RAINBOW VALLEY TOPSOIL AND LANDFILL** WWFAC S104826947 N/A
3425 S. 43RD AVE.
PHOENIX, AZ 85009

AZ WWFAC:
Owner Address: 3425 S. 43rd Ave.
Phoenix, A Z8500

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number / EPA ID Number

8 **GLENN WEINBERGER LANDFILL** — Aquifer S103931916
3425 S. 43RD AVENUE — WWFAC N/A
PHOENIX, AZ 85009

AQUIFER:
App #: P103697
Invoice #: 103697
Owner Address: 3401 S. 39th Avenue
Phoenix, AZ 85009
Contact Name: Glenn Weinberger
Attention: Glenn Weinberger

AZ WWFAC:
Owner Address: 3410 S. 39th Avenue
Phoenix, A Z8500

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8 **A & K PARTNERSHIP** — UST U001156003
3211 S 43RD AVE — N/A
PHOENIX, AZ 85041

UST:
Facility ID: 0-007632 — Tank ID: 1
Owner: A & K RAILROAD MATERIALS — Owner ID: Not reported
Owner Contact: Not reported
In Use: False
Date Removed: 12/27/91
Date Closed: / /
In Use: False

Facility ID: 0-007632 — Tank ID: 2
Owner: A & K RAILROAD MATERIALS — Owner ID: Not reported
Owner Contact: Not reported
In Use: False
Date Removed: 12/27/91
Date Closed: / /
In Use: False

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8 **PUBLICKER IND/MASTERVIEW WINDOW** — LUST U001001045
3065 S 43RD AVE — UST N/A
PHOENIX, AZ 85041

LUST:
Facility ID: 0-004800
Lust Number: 1864.01
Leak Priority: FREE PRODUCT ON GW
Notification: 06/20/1991
Date Closed: Not reported

UST:
Facility ID: 0-004800 — Tank ID: 1
Owner: PUBLICKER INDUSTRIES INC. — Owner ID: Not reported
Owner Contact: Not reported
In Use: False
Date Removed: 04/29/91
Date Closed: / /
In Use: False

8 | HMIRS | 90080419
3045 SOUTH 43RD AVENUE | N/A
PHOENIX, AZ

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8 | HAZNET | S102791124
TNT BESTWAY TRANSPORTATION | N/A
3045 S 43RD AVE
PHOENIX, AZ 85009

HAZNET:

Gepaid:	AZD981654544
Tepaid:	CAT000613893
Gen County:	99
Tsd County:	Los Angeles
Tons:	.2160
Category:	Oxygenated solvents (acetone, butanol, ethyl acetate, etc.)
Disposal Method:	Transfer Station
Contact:	Not reported
Telephone:	(000) 000-0000
Mailing Address:	3045 S 43RD AVE PHOENIX, AZ 85009
County	99

Gepaid:	AZD981654544
Tepaid:	CAT000613893
Gen County:	99
Tsd County:	Los Angeles
Tons:	.1365
Category:	Oxygenated solvents (acetone, butanol, ethyl acetate, etc.)
Disposal Method:	Not reported
Contact:	Not reported
Telephone:	(000) 000-0000
Mailing Address:	3045 S 43RD AVE PHOENIX, AZ 85009
County	99

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8 | LUST | U001627312
USF BESTWAY TRANSPORTATION | UST | N/A
3045 S 43RD AVE
PHOENIX, AZ 85009

LUST:

Facility ID:	0-005062
Lust Number:	0456.01
Leak Priority:	GROUNDWATER DEINFED, REMEDIATION PENDING
Notification:	05/17/1988
Date Closed:	Not reported

UST:

Facility ID:	0-005062	Tank ID:	1
Owner:	USF BESTWAY TRANSPORTATION	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	12/21/88		
Date Closed:	/ /		
In Use:	False		

Facility ID:	0-005062	Tank ID:	2
Owner:	USF BESTWAY TRANSPORTATION	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	04/01/90		
Date Closed:	/ /		

USF BESTWAY TRANSPORTATION (Continued) U001627312

In Use: False

Facility ID: 0-005062 Tank ID: 3
Owner: USF BESTWAY TRANSPORTATION Owner ID: Not reported
Owner Contact: Not reported
In Use: False
Date Removed: 04/01/90
Date Closed: / /
In Use: False

Facility ID: 0-005062 Tank ID: 4
Owner: USF BESTWAY TRANSPORTATION Owner ID: Not reported
Owner Contact: Not reported
In Use: False
Date Removed: 04/01/90
Date Closed: / /
In Use: False

Facility ID: 0-005062 Tank ID: 5
Owner: USF BESTWAY TRANSPORTATION Owner ID: Not reported
Owner Contact: Not reported
In Use: True
Date Removed: / /
Date Closed: / /
In Use: True

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8 **TNT BESTWAY TRANSPORATION** RCRIS-SQG 1000104727
3045 S 43RD AVE AZD981654544
PHOENIX, AZ 85009

RCRIS:
Owner: THOMAS NATIONWIDE
(415) 555-1212
Contact: MR LOPAZ
(602) 278-0242
Record Date: 09/15/1986
Classification: Small Quantity Generator
Used Oil Recyc: No

Violation Status: No violations found

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8 HMIRS 90080418
3045 SOUTH 43RD AVENUE N/A
PHOENIX, AZ

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8 **TNT BESTWAY TRANSPORATION** RCRIS-SQG 1000104728
3045 S 43RD AVE FINDS AZD981675622
PHOENIX, AZ 85009

TNT BESTWAY TRANSPORATION (Continued) **1000104728**

RCRIS:
Owner: TNT INC
(602) 555-1212
Contact: LORAINE KELLY
(602) 269-3101
Record Date: 02/18/1994
Classification: Small Quantity Generator
Used Oil Recyc: No

Violation Status: No violations found

FINDS:
Other Pertinent Environmental Activity Identified at Site:
Facility Registry System (FRS)
Resource Conservation and Recovery Act Information system (RCRAINFO)

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8 **HMIRS** **97120299**
2925 S 43RD AVE **N/A**
PHOENIX, AZ

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8 **STANTON INDUSTRIES OF ARIZONA** **UST** **U003050464**
4215 W LOWER BUCKEYE RD **N/A**
PHOENIX, AZ 85009

UST:

Facility ID:	0-006125	Tank ID:	1
Owner:	STANTON INDUSTRIES OF ARIZONA	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	04/18/92		
Date Closed:	/ /		
In Use:	False		

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8 **STANTON INDUSTRIES** **FINDS** **1004438085**
4215 W LOWER BUCKEYE RD **FTTS** **AZ0000914192**
PHOENIX, AZ 85009

FTTS Insp:

Region:	09
Inspected Date:	09/15/94
Insp Number:	09/15/94
Violation occurred:	No
Inspector:	PTSAI
Investigation Type:	EPCRA, Enforcement, Federal Conducted
Facility Function:	Manufacturer
Investig Reason:	Neutral Scheme, Region
Legislation Code:	EPCRA

FINDS:
Other Pertinent Environmental Activity Identified at Site:
National Compliance Database (NCDB)

9 **EMPIRE METALS INC** — LUST U001625690
2010 W LOWER BUCKEYE RD — UST N/A
PHOENIX, AZ 85009

LUST:

Facility ID:	0-001930
Lust Number:	3466.01
Leak Priority:	GW DEFINED & < AWQS; SOIL PORTION NEEDS TPH VEMUR
Notification:	04/08/1994
Date Closed:	Not reported

Facility ID:	0-001930
Lust Number:	3466.02
Leak Priority:	GW DEFINED & < AWQS; SOIL PORTION NEEDS TPH VEMUR
Notification:	04/08/1994
Date Closed:	Not reported

UST:

Facility ID:	0-001930	Tank ID:	1
Owner:	EMPIRE METALS INC	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	04/08/94		
Date Closed:	/ /		
In Use:	False		

Facility ID:	0-001930	Tank ID:	2
Owner:	EMPIRE METALS INC	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	04/08/94		
Date Closed:	/ /		
In Use:	False		

Facility ID:	0-001930	Tank ID:	3
Owner:	EMPIRE METALS INC	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	04/18/98		
Date Closed:	/ /		
In Use:	False		

---

9 **EMPIRE WASTE AND RECYCLING** — RCRIS-SQG 1000261272
2010 W LOWER BUCKEYE — FINDS AZD982523375
PHOENIX, AZ 85009

RCRIS:

Owner:	EMPIRE MTLS INC (415) 555-1212
Contact:	BOB CAREY (602) 257-9400
Record Date:	06/02/1989
Classification:	Hazardous Waste Transporter

EMPIRE WASTE AND RECYCLING (Continued) 1000261272

Used Oil Recyc: No

Violation Status: Violations exist

Regulation Violated:	Not reported
Area of Violation:	Transporter-All Requirements
Date Violation Determined:	03/01/1991
Priority of Violation:	Low
Schedule Date to Achieve Compliance:	06/08/1991
Actual Date Achieved Compliance:	09/24/1993
Enforcement Action:	Written Informal
Enforcement Action Date:	05/08/1991
Proposed Monetary Penalty:	Not reported
Final Monetary Penalty:	Not reported

There are 1 violation record(s) reported at this site:

Evaluation	Area of Violation	Date of Compliance
Compliance Evaluation Inspection (CEI)	Transporter-All Requirements	09/24/1993

FINDS:
Other Pertinent Environmental Activity Identified at Site:
Facility Registry System (FRS)
Resource Conservation and Recovery Act Information system (RCRAINFO)

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10 **PHOENIX TALLOW** LUST U001155252
2602 S 15TH AVE UST N/A
PHOENIX, AZ 85007

LUST:

Facility ID:	0-000624
Lust Number:	0661.01
Leak Priority:	CLOSED SOIL LVL MEETS TIER1
Notification:	03/02/1989
Date Closed:	06/10/1999
Facility ID:	0-000624
Lust Number:	0661.02 2687.01
Leak Priority:	CLOSED SOIL LVL MEETS TIER1
Notification:	03/02/1989
Date Closed:	06/10/1999
Facility ID:	0-000624
Lust Number:	0661.03
Leak Priority:	CLOSED SOIL LVL MEETS TIER1
Notification:	07/15/1993
Date Closed:	06/10/1999
Facility ID:	0-000624
Lust Number:	2687.01 0661.02
Leak Priority:	LUST CASE COMBINED - CLOSED OUT
Notification:	02/22/1993
Date Closed:	06/14/1996
Facility ID:	0-000624
Lust Number:	2917.01 0661.03
Leak Priority:	LUST CASE COMBINED - CLOSED OUT
Notification:	07/15/1993
Date Closed:	06/14/1996

PHOENIX TALLOW (Continued) U001155252

Facility ID: 0-000624
Lust Number: 2917.02 0661.02
Leak Priority: LUST CASE COMBINED - CLOSED OUT
Notification: 01/27/1995
Date Closed: 06/14/1996

UST:

Facility ID:	0-000624	Tank ID:	1
Owner:	BAKER COMMODITIES INC	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	09/29/89		
Date Closed:	/ /		
In Use:	False		

Facility ID:	0-000624	Tank ID:	2
Owner:	BAKER COMMODITIES INC	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	09/29/89		
Date Closed:	/ /		
In Use:	False		

Facility ID:	0-000624	Tank ID:	3
Owner:	BAKER COMMODITIES INC	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	09/29/89		
Date Closed:	/ /		
In Use:	False		

Facility ID:	0-000624	Tank ID:	4
Owner:	BAKER COMMODITIES INC	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	02/04/93		
Date Closed:	/ /		
In Use:	False		

Facility ID:	0-000624	Tank ID:	5
Owner:	BAKER COMMODITIES INC	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	02/04/93		
Date Closed:	/ /		
In Use:	False		

Facility ID:	0-000624	Tank ID:	6
Owner:	BAKER COMMODITIES INC	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	02/04/93		
Date Closed:	/ /		
In Use:	False		

Map ID / Direction / Distance / Distance (ft.)	Site	Database(s)	EDR ID Number / EPA ID Number
10	**PHOENIX TALLOW CO.** **ATTN: E.S. MURAKAMI** **PHOENIX, AZ 85007**	**WWFAC** **TSCA**	**1000208092** **N/A**

AZ WWFAC:
Owner Address: 3602 West Elwood Street
Phoenix, A Z8500

11	**C AND M ENTERPRISES** **3240 S 37TH AVE** **PHOENIX, AZ 85009**	**RCRIS-SQG** **SHWS** **FINDS**	**1000455221** **AZD982493884**

RCRIS:
Owner: CREECH CLYDE
(415) 555-1212

Contact: ENVIRONMENTAL MANAGER
(602) 278-4178

Record Date: 07/18/1990
Classification: Small Quantity Generator
Used Oil Recyc: No

Violation Status: No violations found

FINDS:
Other Pertinent Environmental Activity Identified at Site:
Facility Registry System (FRS)
Resource Conservation and Recovery Act Information system (RCRAINFO)

SHWS:
EPA ID: Not reported
Program: WQARF
Facility Id: 499
Site Code: Not reported
Discovery Date: Not reported
Source: Not reported
Operable Unit: 0
QWARF Area: WVB
Lat/Long: Not reported
Lat/Long Method: 80
Comments: Not reported

12	**PHOENIX CITY OF 27TH AVE LANDFILL SANITA** **3060 S 27TH AVE** **PHOENIX, AZ 85009**	**FINDS**	**1004176242** **000009006994**

FINDS:
Other Pertinent Environmental Activity Identified at Site:
Facility Registry System (FRS)
Resource Conservation and Recovery Act Information system (RCRAINFO)

13	**PHOENIX METAL RECYCLING** **3210 S 19TH AVE** **PHOENIX, AZ 85009**	**FINDS**	**1004067650** **000007531884**

13	**PHOENIX METAL RECYCLING** **3210 S 19TH AVE** **PHOENIX, AZ 85009**	**RCRIS-SQG** **FINDS**	**1001226893** **AZR000003160**

Map ID / Direction / Distance / Distance (ft.)	Site	Database(s)	EDR ID Number / EPA ID Number

PHOENIX METAL RECYCLING (Continued) — 1001226893

RCRIS:
Owner: ALAMEDA STREET METAL CORP
(213) 564-5601
Contact: ASPET CHATER
(602) 253-3275
Record Date: 03/22/1996
Classification: Conditionally Exempt Small Quantity Generator
Used Oil Recyc: No

Violation Status: No violations found

FINDS:
Other Pertinent Environmental Activity Identified at Site:
Facility Registry System (FRS)
Resource Conservation and Recovery Act Information system (RCRAINFO)

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13 **T P A C DIV** — FINDS — 1004176062 / 000009005042
3052 S 19TH AVE
PHOENIX, AZ 85009

FINDS:
Other Pertinent Environmental Activity Identified at Site:
Facility Registry System (FRS)
Resource Conservation and Recovery Act Information system (RCRAINFO)

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13 **ASPHALT PRODUCTS TRANSPORT CO** — UST — U000015922 / N/A
3050 S 19TH AVE
PHOENIX, AZ 85009

UST:

Facility ID:	0-000482	Tank ID:	1
Owner:	ASPHALT PRODUCTS TRANSPORT CO	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	12/16/88		
Date Closed:	/ /		
In Use:	False		

Facility ID:	0-000482	Tank ID:	2
Owner:	ASPHALT PRODUCTS TRANSPORT CO	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	12/16/88		
Date Closed:	/ /		
In Use:	False		

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13 **CHEVRON USA INCORPORATED PHOENIX ASPHALT TERMINAL** — FINDS — 1004439022 / AZT000615179
3050 S. 19TH AVE.
PHOENIX, AZ 85009

CHEVRON USA INCORPORATED PHOENIX ASPHALT TERMINAL (Continued) — 1004439022

FINDS:
Other Pertinent Environmental Activity Identified at Site:
Facility Registry System (FRS)
Resource Conservation and Recovery Act Information system (RCRAINFO)
Toxic Chemical Release Inventory System (TRIS)

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13 **CHEVRON USA INC. - PHOENIX ASPHALT TERMINAL** — TRIS — 1001200796
3050 S. 19TH AVE. — 85009PHNXS30
PHOENIX, AZ 85009

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13 **CHEVRON USA INC. PHOENIX ASPHA** — TSCA — 1000434298
3050 S. 19TH AVE. — N/A
PHOENIX, AZ 85009

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13 **CHEVRON, PHX ASHALT PLANT** — AZ Spills — S104851016
3050 SO. 19TH AVE — N/A
PHOENIX, AZ

Az Spills:

Facility ID:	84-001	Incident Date:	12/08/83
Response Date:	Not reported	Report / Assist:	Not reported
Type:	Release	No of Samples:	Tr
Referred to:	Not reported		
Chemicals:	Asphalt QSH		
Property Mngmt:	Private		
Fund Amount:	Pvt/Unk		
Quantity:	Not reported		

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13 **LINCOLN AUTO** — UST — U000735911
3020 S 19TH AVE — N/A
PHOENIX, AZ 85009

UST:

Facility ID:	0-002668	Tank ID:	1
Owner:	BETTY L CLEMENS	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	10/22/90		
Date Closed:	/ /		
In Use:	False		

Facility ID:	0-002668	Tank ID:	2
Owner:	BETTY L CLEMENS	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	10/22/90		
Date Closed:	/ /		
In Use:	False		

---

13 **WASTE MANAGEMENT OF PHOENIX** — LUST — U001001412
3000 S 19TH AVE — UST — N/A
PHOENIX, AZ 85009

LUST:
Facility ID: 0-004798

WASTE MANAGEMENT OF PHOENIX (Continued) **U001001412**

Lust Number: 2169.01
Leak Priority: CLOSED SOIL/GW LVL MEETS TIER1
Notification: 01/30/1992
Date Closed: 12/05/1996

Facility ID: 0-004798
Lust Number: 2169.02
Leak Priority: UNDEFINED OR UNKNOWN SOIL CONTAMINATION
Notification: 04/29/1998
Date Closed: Not reported

UST:

Facility ID:	0-004798	Tank ID:	1
Owner:	WASTE CONTROL OF ARIZONA	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	12/07/88		
Date Closed:	/ /		
In Use:	False		

Facility ID:	0-004798	Tank ID:	2
Owner:	WASTE CONTROL OF ARIZONA	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	01/10/92		
Date Closed:	/ /		
In Use:	False		

Facility ID:	0-004798	Tank ID:	3
Owner:	WASTE CONTROL OF ARIZONA	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	True		
Date Removed:	/ /		
Date Closed:	/ /		
In Use:	True		

Facility ID:	0-004798	Tank ID:	4
Owner:	WASTE CONTROL OF ARIZONA	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	04/29/98		
Date Closed:	/ /		
In Use:	False		

Facility ID:	0-004798	Tank ID:	5
Owner:	WASTE CONTROL OF ARIZONA	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	True		
Date Removed:	/ /		
Date Closed:	/ /		
In Use:	True		

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13 **WASTE MANAGEMENT OF AZ - 19TH AVE** Dry Wells **S104895400**
3000 SOUTH 19TH AVE **N/A**
PHOENIX, AZ 85041

DRY WELLS:
Number of Wells: 1
Beginning Registration Number: 21138

Map ID / Direction / Distance / Distance (ft.)	Site	Database(s)	EDR ID Number / EPA ID Number
13	**WASTE MANAGEMENT OF PHX SOUTH** **3000 S 19TH AVE** **PHOENIX, AZ 85005**	**RCRIS-SQG**	**1000397411** **AZD981675788**

RCRIS:
Owner: WASTE MANAGEMENT INC
(415) 555-1212

Contact: ENVIRONMENTAL MANAGER
(602) 257-1313

Record Date: 10/08/1986
Classification: Small Quantity Generator
Used Oil Recyc: No

Violation Status: No violations found

13	**UNIVERSAL WASTE CONTROL** **3000 S 19TH AVE** **PHOENIX, AZ 85009**	**RCRIS-SQG** **FINDS**	**1000431584** **AZD078998614**

RCRIS:
Owner: UNIVERSAL PRODUCTS COMPANY INC
(415) 555-1212

Contact: UNKNOWN UNKNOWN
(602) 257-1313

Record Date: 08/18/1980
Classification: Hazardous Waste Transporter
Used Oil Recyc: No

Violation Status: No violations found

FINDS:
Other Pertinent Environmental Activity Identified at Site:
Facility Registry System (FRS)
Resource Conservation and Recovery Act Information system (RCRAINFO)

14	**OPERATING ENGINEER'S YARD** **3225 S 22ND AVE** **PHOENIX, AZ 85009**	**UST**	**U000015331** **N/A**

UST:

Facility ID:	0-003865	Tank ID:	1
Owner:	CITY OF PHOENIX PUBLIC WORKS DPT	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	09/05/90		
Date Closed:	/ /		
In Use:	False		

Facility ID:	0-003865	Tank ID:	2
Owner:	CITY OF PHOENIX PUBLIC WORKS DPT	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	09/05/90		
Date Closed:	/ /		
In Use:	False		

Facility ID:	0-003865	Tank ID:	3
Owner:	CITY OF PHOENIX PUBLIC WORKS DPT	Owner ID:	Not reported

Map ID / Direction / Distance / Distance (ft.)	Site	Database(s)	EDR ID Number / EPA ID Number

OPERATING ENGINEER'S YARD (Continued) — U000015331

Owner Contact: Not reported
In Use: False
Date Removed: 09/05/90
Date Closed: / /
In Use: False

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15 **PIONEER TRUCK SERVICE** — SHWS — S101570141
3202 S. 35TH AVE. — N/A
PHOENIX, AZ 85009

SHWS:
EPA ID: Not reported
Program: WQARF
Facility Id: 576
Site Code: Not reported
Discovery Date: Not reported
Source: Not reported
Operable Unit: 0
QWARF Area: WVB
Lat/Long: Not reported
Lat/Long Method: 80
Comments: Not reported

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15 **MARICOPA LAND AND CATTLE CO., INC.** — WWFAC — S104826890
3602 WEST ELWOOD STREET — N/A
PHOENIX, AZ 85009

AZ WWFAC:
Owner Address: 3602 West Elwood Street
Phoenix, A Z8500

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15 **MARICOPA BY-PRODUCTS INC** — SHWS, UST, WWFAC — U001626265
3602 W ELWOOD ST — N/A
PHOENIX, AZ 85041

SHWS:
EPA ID: Not reported
Program: WQARF
Facility Id: 552
Site Code: 501387
Discovery Date: 13/87/50
Source: Not reported
Operable Unit: 0
QWARF Area: WVB
Lat/Long: Not reported
Lat/Long Method: 80
Comments: Not reported

AZ WWFAC:
Owner Address: 3602 W. Elwood
Phoenix, A Z8504

UST:
Facility ID: 0-003041 — Tank ID: 1
Owner: MARICOPA BY-PRODUCTS INC — Owner ID: Not reported
Owner Contact: Not reported
In Use: False
Date Removed: 01/01/88
Date Closed: / /

MARICOPA BY-PRODUCTS INC (Continued) U001626265

In Use: False

Facility ID: 0-003041 Tank ID: 2
Owner: MARICOPA BY-PRODUCTS INC Owner ID: Not reported
Owner Contact: Not reported
In Use: False
Date Removed: 01/01/88
Date Closed: / /
In Use: False

Facility ID: 0-003041 Tank ID: 3
Owner: MARICOPA BY-PRODUCTS INC Owner ID: Not reported
Owner Contact: Not reported
In Use: False
Date Removed: 01/01/88
Date Closed: / /
In Use: False

Facility ID: 0-003041 Tank ID: 4
Owner: MARICOPA BY-PRODUCTS INC Owner ID: Not reported
Owner Contact: Not reported
In Use: False
Date Removed: 01/01/88
Date Closed: / /
In Use: False

Facility ID: 0-003041 Tank ID: 5
Owner: MARICOPA BY-PRODUCTS INC Owner ID: Not reported
Owner Contact: Not reported
In Use: False
Date Removed: 01/01/88
Date Closed: / /
In Use: False

Facility ID: 0-003041 Tank ID: 6
Owner: MARICOPA BY-PRODUCTS INC Owner ID: Not reported
Owner Contact: Not reported
In Use: False
Date Removed: 01/01/88
Date Closed: / /
In Use: False

---

15 **ARIZONA PRECAST** **SHWS** **S101570087**
3045 S. 35TH AVE **N/A**
PHOENIX, AZ 85009

SHWS:
EPA ID: Not reported
Program: WQARF
Facility Id: 478
Site Code: Not reported
Discovery Date: Not reported
Source: Not reported
Operable Unit: 0
QWARF Area: WVB
Lat/Long: Not reported
Lat/Long Method: 80
Comments: Not reported

15 **COPPERSTATE EXPRESS LINES** — RCRIS-SQG 1000346585, FINDS AZD980881056
3044 S 35TH AVE
PHOENIX, AZ 85041

RCRIS:
Owner: KUNKLE TRANSFER AND STORAGE
(415) 555-1212
Contact: UNKNOWN UNKNOWN
(602) 272-3201
Record Date: 09/08/1997
Classification: Conditionally Exempt Small Quantity Generator, Hazardous Waste Transporter
Used Oil Recyc: No
Violation Status: No violations found

FINDS:
Other Pertinent Environmental Activity Identified at Site:
Facility Registry System (FRS)
Resource Conservation and Recovery Act Information system (RCRAINFO)

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15 **QUALITY BLOCK CO., INC.** — SHWS S103391949, N/A
3035 S. 35TH AVE.
PHOENIX, AZ 85009

SHWS:
EPA ID: Not reported
Program: WQARF
Facility Id: 579
Site Code: Not reported
Discovery Date: Not reported
Source: Not reported
Operable Unit: 0
QWARF Area: WVB
Lat/Long: Not reported
Lat/Long Method: 80
Comments: Not reported

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15 **27 AVE. LANDFILL** — AZ Spills S104560102, N/A
3035 SO. 35TH AVE
PHOENIX, AZ

Az Spills:
Facility ID: 87-071
Response Date: Not reported
Type: Threat
Referred to: HWIU/Solid
Chemicals: Methane Gas
Property Mngmt: Private
Fund Amount: Not reported
Quantity: Not reported
Incident Date: 03/31/87
Report / Assist: Not reported
No of Samples: Un

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15 **QUALITY BLOCK CO INC** — LUST U001626756, UST N/A
3035 S 35TH AVE
PHOENIX, AZ 85041

LUST:
Facility ID: 0-004016
Lust Number: 2614.01
Leak Priority: CLOSED SOIL LVL MEETS TIER1

QUALITY BLOCK CO INC (Continued) U001626756

Notification: 12/24/1992
Date Closed: 02/27/1997

Facility ID: 0-004016
Lust Number: 2614.02
Leak Priority: CLOSED SOIL LVL MEETS TIER1
Notification: 12/24/1992
Date Closed: 02/27/1997

Facility ID: 0-004016
Lust Number: 2614.03
Leak Priority: CLOSED SOIL LVL MEETS TIER1
Notification: 12/24/1992
Date Closed: 02/27/1997

UST:
Facility ID: 0-004016 Tank ID: 1
Owner: QUALITY BLOCK CO INC Owner ID: Not reported
Owner Contact: Not reported
In Use: False
Date Removed: 12/23/92
Date Closed: / /
In Use: False

Facility ID: 0-004016 Tank ID: 2
Owner: QUALITY BLOCK CO INC Owner ID: Not reported
Owner Contact: Not reported
In Use: False
Date Removed: 12/23/92
Date Closed: / /
In Use: False

Facility ID: 0-004016 Tank ID: 3
Owner: QUALITY BLOCK CO INC Owner ID: Not reported
Owner Contact: Not reported
In Use: False
Date Removed: 12/23/92
Date Closed: / /
In Use: False

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16 **3510 S 51ST AVE** HMIRS 97031190
PHOENIX, AZ N/A

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16 **3510 S 51ST AVE** HMIRS 97020290
PHOENIX, AZ N/A

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16 **3510 S 51ST AVE** HMIRS 97031191
PHOENIX, AZ N/A

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16 **3510 S. 51ST AVE** HMIRS 97020313
PHOENIX, AZ N/A

Map ID / Direction / Distance / Distance (ft.)	Site	Database(s)	EDR ID Number / EPA ID Number
16	ROYDEN CONSTRUCTION CO 3423 S 51ST AVE PHOENIX, AZ 85043	UST	U001625787 N/A

UST:

Facility ID:	0-002114	Tank ID:	1
Owner:	ROYDEN CONSTRUCTION CO	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	07/02/91		
Date Closed:	/ /		
In Use:	False		

Facility ID:	0-002114	Tank ID:	2
Owner:	ROYDEN CONSTRUCTION CO	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	07/02/91		
Date Closed:	/ /		
In Use:	False		

16	3410 S 51ST AVENUE PHOENIX, AZ	HMIRS	96090240 N/A

16	3410 S 51ST AVENUE PHOENIX, AZ	HMIRS	96010705 N/A

16	3410 S 51ST AVE PHOENIX, AZ	HMIRS	96090924 N/A

16	3410 S 51ST AVE PHOENIX, AZ	HMIRS	96110234 N/A

16	3410 S 51ST AVE PHOENIX, AZ	HMIRS	96091360 N/A

16	3410 S 51ST AVENUE PHOENIX, AZ	HMIRS	96020571 N/A

16	3410 S 51ST AVE PHOENIX, AZ	HMIRS	97060362 N/A

16	3410 S 51ST AVE PHOENIX, AZ	HMIRS	96061233 N/A

Map ID Direction Distance Distance (ft.)	Site	Database(s)	EDR ID Number EPA ID Number
16	3410 S 51ST AVE PHOENIX, AZ	HMIRS	96080797 N/A
16	3410 S. 51ST AVE PHOENIX, AZ	HMIRS	96120196 N/A
16	3410 S 51 AVE PHOENIX, AZ	HMIRS	2000110544 N/A
16	3410 S 51 AVE PHOENIX, AZ	HMIRS	2000120404 N/A
16	3410 S 51ST AVE PHOENIX, AZ	HMIRS	2000110109 N/A
16	3410 S 51 ST AVE PHOENIX, AZ	HMIRS	2000100955 N/A
16	3410 S 51 AVE PHOENIX, AZ	HMIRS	2000101438 N/A
16	3410 S 51 AVE PHOENIX, AZ	HMIRS	2000121485 N/A
16	3410 S 51ST AVE PHOENIX, AZ	HMIRS	2000331096 N/A
16	3410 S 51 AVE PHOENIX, AZ	HMIRS	2000121112 N/A
16	3410 S 51 AVE PHOENIX, AZ	HMIRS	2000120405 N/A
16	3410 S 51 AVE PHOENIX, AZ	HMIRS	2000120406 N/A

Map ID Direction Distance Distance (ft.)	Site	Database(s)	EDR ID Number EPA ID Number
16	3410 S 51 ST AVE PHOENIX, AZ	HMIRS	2000033876 N/A
16	3410 S 51ST AVE PHOENIX, AZ	HMIRS	2000033862 N/A
16	3410 S 51 ST AVE PHOENIX, AZ	HMIRS	2000033875 N/A
16	3410 S 51ST AVE PHOENIX, AZ	HMIRS	2000033863 N/A
16	3410 S 51ST AVE PHOENIX, AZ	HMIRS	2000033864 N/A
16	3410 S 51ST AVE PHOENIX, AZ	HMIRS	2000080267 N/A
16	3410 S 51ST AVE PHOENIX, AZ	HMIRS	2000051436 N/A
16	3410 S 51ST AVE PHOENIX, AZ	HMIRS	2000034808 N/A
16	3410 S 51ST AVE PHOENIX, AZ	HMIRS	2000033861 N/A
16	3410 S 51ST AVE PHOENIX, AZ	HMIRS	2000034807 N/A
16	3410 S 51 ST AVE PHOENIX, AZ	HMIRS	2000032715 N/A
16	3410 S 51ST AVE PHOENIX, AZ	HMIRS	2000032716 N/A

Map ID Direction Distance Distance (ft.)	Site	Database(s)	EDR ID Number EPA ID Number
16	3410 S 51 ST AVE PHOENIX, AZ	HMIRS	2000032714 N/A
16	3410 S 51ST AVE PHOENIX, AZ	HMIRS	96110481 N/A
16	3410 S 51ST AVE PHOENIX, AZ	HMIRS	95120297 N/A
16	3410 S 51 ST AVE PHOENIX, AZ	HMIRS	2000032722 N/A
16	3410 S 51 ST AVE PHOENIX, AZ	HMIRS	2000032723 N/A
16	3410 S 51ST AVE PHOENIX, AZ	HMIRS	2000032719 N/A
16	3410 S 51ST AVE PHOENIX, AZ	HMIRS	2000032717 N/A
16	3410 S 51ST AVE PHOENIX, AZ	HMIRS	2000032718 N/A
16	3410 S 51ST AVE PHOENIX, AZ	HMIRS	9900010327 N/A
16	3410 S 51ST AVENUE PHOENIX, AZ	HMIRS	9900010814 N/A
16	3410 S. 51ST AVE PHOENIX, AZ	HMIRS	9900009210 N/A
16	3410 S. 51ST AVE PHOENIX, AZ	HMIRS	9900007583 N/A

Map ID Direction Distance Distance (ft.)	Site	Database(s)	EDR ID Number EPA ID Number
16	3410 S. 51ST AVE PHOENIX, AZ	HMIRS	9900009162 N/A
16	3410 S 51ST AVE PHOENIX, AZ	HMIRS	9900016646 N/A
16	3410 S 51ST AVE PHOENIX, AZ	HMIRS	2000033259 N/A
16	3410 S 51ST AVE PHOENIX, AZ	HMIRS	9900016494 N/A
16	3410 S 51ST AVE PHOENIX, AZ	HMIRS	9900014660 N/A
16	3410 S 51 ST AVE PHOENIX, AZ	HMIRS	9900016493 N/A
16	3410 SOUTH 51ST AVENUE PHOENIX, AZ	HMIRS	9703037864 N/A
16	3410 SOUTH 51ST AVENUE PHOENIX, AZ	HMIRS	9703037863 N/A
16	3410 S 51 AVENUE PHOENIX, AZ	HMIRS	9709038151 N/A
16	3410 S 51 AVENUE PHOENIX, AZ	HMIRS	9709038149 N/A
16	3410 S 51 AVENUE PHOENIX, AZ	HMIRS	9709038150 N/A
16	3410 S 51ST AVE PHOENIX, AZ	HMIRS	9900004917 N/A

Map ID Direction Distance Distance (ft.)	Site	Database(s)	EDR ID Number EPA ID Number
16	3410 SOUTH 51 AVE PHOENIX, AZ	HMIRS	9900005150 N/A
16	3410 S 51ST AVENUE PHOENIX, AZ	HMIRS	200051436 N/A
16	3410 SOUTH 51ST AVENUE PHOENIX, AZ	HMIRS	9703037862 N/A
16	3410 S 51ST AVE PHOENIX, AZ	HMIRS	9609037657 N/A
16	3410 S 51 AVE PHOENIX, AZ	HMIRS	2000028868 N/A
16	3410 S 51ST AVE PHOENIX, AZ	HMIRS	2000021910 N/A
16	3410 S 51 AVE PHOENIX, AZ	HMIRS	2000028867 N/A
16	3410 S 51 AVE PHOENIX, AZ	HMIRS	2000028974 N/A
16	3410 S 51 AVE PHOENIX, AZ	HMIRS	2000090409 N/A
16	3410 S 51ST AVE PHOENIX, AZ	HMIRS	2000091096 N/A
16	3410 S 51ST AVE PHOENIX, AZ	HMIRS	2000091104 N/A
16	3410 S 51ST AVE PHOENIX, AZ	HMIRS	2000025475 N/A

Map ID / Direction / Distance / Distance (ft.)	Site	Database(s)	EDR ID Number / EPA ID Number
16	3410 S 51ST AVE PHOENIX, AZ	HMIRS	2000021911 N/A
16	3410 S 51ST AVE PHOENIX, AZ	HMIRS	2000025474 N/A
16	3410 S 51ST AVE PHOENIX, AZ	HMIRS	2000027910 N/A
16	3410 S 51ST AVE PHOENIX, AZ	HMIRS	2000027911 N/A
16	3410 S 51ST AVE PHOENIX, AZ	HMIRS	2000022487 N/A
16	3410 S 51ST AVE PHOENIX, AZ	HMIRS	2000033260 N/A
16	3410 S 51ST AVE PHOENIX, AZ	HMIRS	2000022486 N/A
16	3410 S 51ST AVE PHOENIX, AZ	HMIRS	2000028966 N/A
16	3410 S 51 AVE PHOENIX, AZ	HMIRS	2000028973 N/A
16	3410 S 51ST AVE PHOENIX, AZ	HMIRS	2000028965 N/A
16	3410 S 51 AVE PHOENIX, AZ	HMIRS	2000028959 N/A
16	3410 S 51ST AVENUE PHOENIX, AZ	HMIRS	2000028960 N/A

Map ID / Direction / Distance / Distance (ft.)	Site	Database(s)	EDR ID Number / EPA ID Number
16	3410 S 51ST AVE PHOENIX, AZ	HMIRS	97041049 N/A
16	3410 S 51ST AVENUE PHOENIX, AZ	HMIRS	96081186 N/A
16	3410 S 51ST AVENUE PHOENIX, AZ	HMIRS	96020562 N/A
16	3410 S 51 AVE PHOENIX, AZ	HMIRS	97010781 N/A
16	3410 S 51ST AVENUE PHOENIX, AZ	HMIRS	96090249 N/A
16	3410 S 51ST AVE PHOENIX, AZ	HMIRS	96091286 N/A
16	3410 S 51ST AVE PHOENIX, AZ	HMIRS	96091299 N/A
16	3410 S. 51ST AVE PHOENIX, AZ	HMIRS	96120583 N/A
16	3410 S 51ST AVE PHOENIX, AZ	HMIRS	96100967 N/A
16	3410 S 51ST AVE PHOENIX, AZ	HMIRS	97070542 N/A
16	3410 S 51ST AVE PHOENIX, AZ	HMIRS	96110491 N/A
16	3410 S 51ST AVENUE PHOENIX, AZ	HMIRS	97041051 N/A

Map ID Direction Distance Distance (ft.)	Site	Database(s)	EDR ID Number EPA ID Number
16	3410 S 51ST AVENUE PHOENIX, AZ	HMIRS	96060963 N/A
16	3410 S 51ST AVE PHOENIX, AZ	HMIRS	96090932 N/A
16	3410 S 51ST AVENUE PHOENIX, AZ	HMIRS	96060626 N/A
16	3410 S 51ST AVE PHOENIX, AZ	HMIRS	96050337 N/A
16	3410 S 51ST AVENUE PHOENIX, AZ	HMIRS	96080803 N/A
16	3410 S 51ST AVE PHOENIX, AZ	HMIRS	96020538 N/A
16	3410 S 51ST AVE PHOENIX, AZ	HMIRS	97050305 N/A
16	3410 S 51ST AVENUE PHOENIX, AZ	HMIRS	97110297 N/A
16	3410 S 51ST AVE PHOENIX, AZ	HMIRS	96091287 N/A
16	3410 S 51 AVE PHOENIX, AZ	HMIRS	96110807 N/A
16	3410 S 51ST AVENUE PHOENIX, AZ	HMIRS	96081172 N/A
16	3410 S 51ST AVE PHOENIX, AZ	HMIRS	96070668 N/A

Map ID Direction Distance Distance (ft.)	Site	Database(s)	EDR ID Number EPA ID Number
16	3410 S 51 AVE PHOENIX, AZ	HMIRS	96090920 N/A
16	3410 S 51ST AVE PHOENIX, AZ	HMIRS	96070669 N/A
16	RPS INC 3410 S 51ST AVE PHOENIX, AZ 85043	RCRIS-SQG FINDS	1001480966 AZR000034660

RCRIS:
Owner: RPS INC SAFETY DEPT
(412) 262-7351
Contact: CHRISTOPHER PRESTON
(602) 272-0045
Record Date: 03/30/1999
Classification: Conditionally Exempt Small Quantity Generator, Hazardous Waste Transporter
Used Oil Recyc: No
Violation Status: No violations found

FINDS:
Other Pertinent Environmental Activity Identified at Site:
Facility Registry System (FRS)
Resource Conservation and Recovery Act Information system (RCRAINFO)

16	3410 S 51ST AVE PHOENIX, AZ	HMIRS	96060410 N/A
16	3410 S 51ST AVENUE PHOENIX, AZ	HMIRS	96081188 N/A
16	3410 S 51ST AVE PHOENIX, AZ	HMIRS	97060360 N/A
16	3410 S 51ST AVENUE PHOENIX, AZ	HMIRS	96020873 N/A
16	3410 S 51ST AVE PHOENIX, AZ	HMIRS	96040012 N/A
16	FEDEX GROUND 3410 S 51ST AVE PHOENIX, AZ 85043	AZ Spills UST	U003153865 N/A

FEDEX GROUND (Continued) **U003153865**

Az Spills:

Facility ID:	96-013-D	Incident Date:	04/17/96
Response Date:	Not reported	Report / Assist:	Not reported
Type:	Release	No of Samples:	Ta
Referred to:	Not reported		
Chemicals:	Diesel		
Property Mngmt:	Private		
Fund Amount:	Pvt/Unk		
Quantity:	Not reported		

UST:

Facility ID:	0-008876	Tank ID:	1
Owner:	FEDEX GROUND	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	True		
Date Removed:	/ /		
Date Closed:	/ /		
In Use:	True		

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16 HMIRS 97041048
3410 S 51ST AVE N/A
PHOENIX, AZ

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16 HMIRS 96010917
3410 S 51ST AVE N/A
PHOENIX, AZ

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16 HMIRS 96091277
3410 S 51ST AVE N/A
PHOENIX, AZ

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16 HMIRS 97040948
3410 S 51ST AVE N/A
PHOENIX, AZ

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16 HMIRS 97110308
3410 S 51S AVE N/A
PHOENIX, AZ

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16 HMIRS 97060813
3410 S 51ST AVE N/A
PHOENIX, AZ

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16 HMIRS 97060816
3410 S 51ST AVE N/A
PHOENIX, AZ

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16 HMIRS 2001040205
3410 S 51 AVE N/A
PHOENIX, AZ

Map ID Direction Distance Distance (ft.)	Site	Database(s)	EDR ID Number EPA ID Number
16	3410 S 51 AVE PHOENIX, AZ	HMIRS	2001050643 N/A
16	3410 S 51 AVE PHOENIX, AZ	HMIRS	2001030747 N/A
16	3410 S 51ST AVE PHOENIX, AZ	HMIRS	2001030474 N/A
16	3410 S 51ST AVE PHOENIX, AZ	HMIRS	2001030476 N/A
16	3410 S 51ST AVE PHOENIX, AZ	HMIRS	2001070329 N/A
16	3410 S 51ST AVE PHOENIX, AZ	HMIRS	2001070372 N/A
16	3410 S 51ST AVE PHOENIX, AZ	HMIRS	2001070320 N/A
16	3410 S 51 AVE PHOENIX, AZ	HMIRS	2001051759 N/A
16	3410 S 51 AVE PHOENIX, AZ	HMIRS	2001060326 N/A
16	3410 S 51ST AVE PHOENIX, AZ	HMIRS	2001011194 N/A
16	3410 S 51ST AVE PHOENIX, AZ	HMIRS	2001020042 N/A
16	3410 S. 51 AVE PHOENIX, AZ	HMIRS	2001011134 N/A

Map ID Direction Distance Distance (ft.)	Site	Database(s)	EDR ID Number EPA ID Number
16	3410 S 51ST AVE PHOENIX, AZ	HMIRS	2000035193 N/A
16	3410 S 51ST AVE PHOENIX, AZ	HMIRS	2000035194 N/A
16	3410 S 51 AVE PHOENIX, AZ	HMIRS	2001020449 N/A
16	3410 S 51 AVE PHOENIX, AZ	HMIRS	2001020982 N/A
16	3410 S 51 AVE PHOENIX, AZ	HMIRS	2001020448 N/A
16	3410 S 51 AVE PHOENIX, AZ	HMIRS	2001020244 N/A
16	3410 S 51 AVE PHOENIX, AZ	HMIRS	2001020245 N/A
16	3410 S 51ST AVENUE PHOENIX, AZ	HMIRS	9608037611 N/A
16	3410 S 51ST AVENUE PHOENIX, AZ	HMIRS	9608037612 N/A
16	3410 S 51ST AVENUE PHOENIX, AZ	HMIRS	9605037432 N/A
16	3410 S 51ST AVENUE PHOENIX, AZ	HMIRS	9604037366 N/A
16	3410 S 51ST AVENUE PHOENIX, AZ	HMIRS	9605037431 N/A

Map ID Direction Distance Distance (ft.)	Site	Database(s)	EDR ID Number EPA ID Number
16	3410 S 51ST AVE PHOENIX, AZ	HMIRS	96090940 N/A
16	3410 S 51ST AVE PHOENIX, AZ	HMIRS	96120198 N/A
16	3410 S 51ST AVE PHOENIX, AZ	HMIRS	96121053 N/A
16	3410 S 51ST AVE PHOENIX, AZ	HMIRS	9609037656 N/A
16	3410 S 51 AVE PHOENIX, AZ	HMIRS	97101214 N/A
16	3410 SOUTH 51ST AVENUE PHOENIX, AZ	HMIRS	2001081565 N/A
16	3410 SOUTH 51ST AVENUE PHOENIX, AZ	HMIRS	2001081589 N/A
16	3410 SOUTH 51ST AVENUE PHOENIX, AZ	HMIRS	2001081512 N/A
16	3410 S 51 AVE PHOENIX, AZ	HMIRS	2001070720 N/A
16	3410 SOUTH 51ST AVE PHOENIX, AZ	HMIRS	2001071859 N/A
16	3410 S 51ST AVE PHOENIX, AZ	HMIRS	2001090759 N/A
16	3410 S 51ST AVENUE PHOENIX, AZ	HMIRS	9604037365 N/A

Map ID / Direction / Distance / Distance (ft.)	Site	Database(s)	EDR ID Number / EPA ID Number
16	3410 SOUTH 51ST AVENUE PHOENIX, AZ	HMIRS	2001081611 N/A
16	3410 SOUTH 51ST AVENUE PHOENIX, AZ	HMIRS	2001081590 N/A
16	3410 SOUTH 51ST AVENUE PHOENIX, AZ	HMIRS	2001081592 N/A
16	RPS INC 3410 S 51ST AVE PHOENIX, AZ 85043	FINDS	1004085346 000007900408
16	ARIZONA TRUSS FABRICATORS INC 3207 S 51ST AVE PHOENIX, AZ 85043	LUST UST	U001626566 N/A

LUST:

Facility ID:	0-003631
Lust Number:	0659.01
Leak Priority:	CLOSED SOIL LVL MEETS TIER1
Notification:	02/27/1989
Date Closed:	11/30/1990

UST:

Facility ID:	0-003631	Tank ID:	1
Owner:	ARIZONA TRUSS FABRICATORS INC	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	01/05/89		
Date Closed:	/ /		
In Use:	False		

Facility ID:	0-003631	Tank ID:	2
Owner:	ARIZONA TRUSS FABRICATORS INC	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	01/05/89		
Date Closed:	/ /		
In Use:	False		

Facility ID:	0-003631	Tank ID:	3
Owner:	ARIZONA TRUSS FABRICATORS INC	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	01/05/89		
Date Closed:	/ /		
In Use:	False		

Facility ID:	0-003631	Tank ID:	4
Owner:	ARIZONA TRUSS FABRICATORS INC	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	01/05/89		
Date Closed:	/ /		

ARIZONA TRUSS FABRICATORS INC (Continued) — **U001626566**

In Use: False

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17 **SUNRISE STEEL/SCORPIO STEEL INC** — **LUST U001155417**, **UST N/A**
3420 S 39TH AVE
PHOENIX, AZ 85009

LUST:

Facility ID:	0-004386
Lust Number:	2695.01
Leak Priority:	CLOSED SOIL LVL MEETS TIER1
Notification:	01/13/1993
Date Closed:	10/06/1997

Facility ID:	0-004386
Lust Number:	2695.02
Leak Priority:	CLOSED SOIL LVL MEETS TIER1
Notification:	01/13/1993
Date Closed:	10/06/1997

Facility ID:	0-004386
Lust Number:	2695.03
Leak Priority:	CLOSED SOIL LVL MEETS TIER1
Notification:	01/13/1993
Date Closed:	10/06/1997

UST:

Facility ID:	0-004386	Tank ID:	1
Owner:	SCORPIO STEEL C/O JOSEF SEHNAL	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	11/25/92		
Date Closed:	/ /		
In Use:	False		

Facility ID:	0-004386	Tank ID:	2
Owner:	SCORPIO STEEL C/O JOSEF SEHNAL	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	11/25/92		
Date Closed:	/ /		
In Use:	False		

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17 **WEINBERGER TOPSOIL LANDFILL** — **WWFAC S102790815**
3410 S 39TH AVE — **N/A**
BUCKEYE, AZ

AZ WWFAC:

Owner Address:	6730 W. Gelding Phoenix, A Z8534

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17 **GLENN WEINBERGER LANDFILL** — **RCRIS-SQG 1001201374**
3410 S 39TH AVE — **AZN000007120**
PHOENIX, AZ 85009

Map ID / Direction / Distance / Distance (ft.)	Site	Database(s)	EDR ID Number / EPA ID Number

GLENN WEINBERGER LANDFILL (Continued) — 1001201374

RCRIS:
- Owner: GLENN WEINBERGER (602) 278-9155
- Contact: Not reported
- Record Date: Not reported
- Classification: Not reported
- Used Oil Recyc: No
- Violation Status: No violations found

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17 **ALL VALLEY WRECKER** — UST — U001628745
3401 S 39TH AVE — N/A
PHOENIX, AZ 85009

UST:

Facility ID:	0-008115	Tank ID:	1
Owner:	JOHN HENRY FIKSE	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	02/05/93		
Date Closed:	/ /		
In Use:	False		
Facility ID:	0-008115	Tank ID:	2
Owner:	JOHN HENRY FIKSE	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	02/05/93		
Date Closed:	/ /		
In Use:	False		

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18 **27TH AVE. LANDFILL** — SHWS — S103391938
27TH AVE. AND LOWER BUCKEYE — SWF/LF — N/A
PHOENIX, AZ 85009

SHWS:
- EPA ID: Not reported
- Program: WQARF
- Facility Id: 441
- Site Code: 70345
- Discovery Date: 70345
- Source: Not reported
- Operable Unit: 0
- QWARF Area: WVB
- Lat/Long: Not reported
- Lat/Long Method: 80
- Comments: Not reported

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19 **UNITED METRO MATERIAL PLANT 11** — RCRIS-SQG — 1000313267
3640 S 19TH AVE — FINDS — AZD982000721
PHOENIX, AZ 85009

UNITED METRO MATERIAL PLANT 11 (Continued) **1000313267**

RCRIS:
Owner: UNITED METRO MATERIALS
(602) 220-5000

Contact: THOMAS DUNWELL
(602) 220-5129

Record Date: 11/14/1996
Classification: Small Quantity Generator
Used Oil Recyc: No

Violation Status: Violations exist

Regulation Violated:	Not reported
Area of Violation:	Generator-All Requirements
Date Violation Determined:	09/20/1996
Priority of Violation:	Low
Schedule Date to Achieve Compliance:	12/20/1996
Actual Date Achieved Compliance:	12/13/1996
Enforcement Action:	Written Informal
Enforcement Action Date:	10/10/1996
Proposed Monetary Penalty:	Not reported
Final Monetary Penalty:	Not reported

There are 1 violation record(s) reported at this site:

Evaluation	Area of Violation	Date of Compliance
Compliance Evaluation Inspection (CEI)	Generator-All Requirements	12/13/1996

FINDS:
Other Pertinent Environmental Activity Identified at Site:
AIRS Facility System (AIRS/AFS)
Enforcement Docket System (DOCKET)
Facility Registry System (FRS)
National Compliance Database (NCDB)
Resource Conservation and Recovery Act Information system (RCRAINFO)
Toxic Chemical Release Inventory System (TRIS)

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19 **UNITED METRO** **AZ Spills** **S104560149**
3640 SO. 19TH AVENUE **N/A**
PHOENIX, AZ

Az Spills:

Facility ID:	95-025-G	Incident Date:	04/10/95
Response Date:	04/10/95	Report / Assist:	Not reported
Type:	Release	No of Samples:	Ta
Referred to:	Not reported		
Chemicals:	Diesel		
Property Mngmt:	Private		
Fund Amount:	Pvt/Unk		
Quantity:	Not reported		

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19 **TANNER-UNITED METRO** **LUST** **U001627191**
3640 S 19TH AVE **UST** **N/A**
PHOENIX, AZ 85009

LUST:
Facility ID: 0-004836
Lust Number: 0476.01

TANNER-UNITED METRO (Continued) **U001627191**

Leak Priority: CLOSED SOIL/GW LVL MEETS TIER1
Notification: 06/23/1988
Date Closed: 01/19/1999

UST:

Facility ID:	0-004836	Tank ID:	1
Owner:	UNITED METRO/FRMR TANNER CO	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	08/10/88		
Date Closed:	/ /		
In Use:	False		

Facility ID:	0-004836	Tank ID:	2
Owner:	UNITED METRO/FRMR TANNER CO	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	08/01/90		
Date Closed:	/ /		
In Use:	False		

Facility ID:	0-004836	Tank ID:	3
Owner:	UNITED METRO/FRMR TANNER CO	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	08/01/88		
Date Closed:	/ /		
In Use:	False		

Facility ID:	0-004836	Tank ID:	4
Owner:	UNITED METRO/FRMR TANNER CO	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	08/01/88		
Date Closed:	/ /		
In Use:	False		

Facility ID:	0-004836	Tank ID:	5
Owner:	UNITED METRO/FRMR TANNER CO	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	08/01/88		
Date Closed:	/ /		
In Use:	False		

Facility ID:	0-004836	Tank ID:	6
Owner:	UNITED METRO/FRMR TANNER CO	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	True		
Date Removed:	/ /		
Date Closed:	/ /		
In Use:	True		

Facility ID:	0-004836	Tank ID:	7
Owner:	UNITED METRO/FRMR TANNER CO	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	True		
Date Removed:	/ /		

TANNER-UNITED METRO (Continued) U001627191

Date Closed: / /
In Use: True

Facility ID: 0-004836 Tank ID: 8
Owner: UNITED METRO/FRMR TANNER CO Owner ID: Not reported
Owner Contact: Not reported
In Use: True
Date Removed: / /
Date Closed: / /
In Use: True

Facility ID: 0-004836 Tank ID: 9
Owner: UNITED METRO/FRMR TANNER CO Owner ID: Not reported
Owner Contact: Not reported
In Use: True
Date Removed: / /
Date Closed: / /
In Use: True

Facility ID: 0-004836 Tank ID: 10
Owner: UNITED METRO/FRMR TANNER CO Owner ID: Not reported
Owner Contact: Not reported
In Use: False
Date Removed: / /
Date Closed: / /
In Use: False

Facility ID: 0-004836 Tank ID: 11
Owner: UNITED METRO/FRMR TANNER CO Owner ID: Not reported
Owner Contact: Not reported
In Use: False
Date Removed: 07/11/91
Date Closed: / /
In Use: False

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19 **UNITED METRO MATERIALS, INC.** Aquifer S101641021
3640 S. 19TH AVE WWFAC N/A
PHOENIX, AZ 85072

AQUIFER:
App #: P103223
Invoice #: 103223
Owner Address: 3640 S. 19th AVE
Phoenix, AZ 85072
Contact Name: Thomas Dunwell
Attention: Thomas Dunwell

AZ WWFAC:
Owner Address: 3640 S. 19th AVE
Phoenix, A Z8507

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20 **ACE ASPHALT OF ARIZONA INC** LUST U001627847
895 W ELWOOD UST N/A
PHOENIX, AZ 85041 WWFAC

LUST:
Facility ID: 0-006129
Lust Number: 4735.01
Leak Priority: CLOSED SOIL LVL MEETS TIER1

ACE ASPHALT OF ARIZONA INC (Continued) U001627847

Notification: 07/16/1997
Date Closed: 11/30/1998

Facility ID: 0-006129
Lust Number: 4735.02
Leak Priority: CLOSED SOIL LVL MEETS TIER1
Notification: 07/16/1997
Date Closed: 11/30/1998

Facility ID: 0-006129
Lust Number: 4735.03
Leak Priority: CLOSED SOIL LVL MEETS TIER1
Notification: 07/16/1997
Date Closed: 11/30/1998

AZ WWFAC:
Owner Address: 895 W. Elwood St
Phoenix, A Z8504

UST:

Facility ID:	0-006129	Tank ID:	1
Owner:	ACE ASPHALT OF ARIZONA INC	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	12/13/89		
Date Closed:	/ /		
In Use:	False		

Facility ID:	0-006129	Tank ID:	2
Owner:	ACE ASPHALT OF ARIZONA INC	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	07/08/97		
Date Closed:	/ /		
In Use:	False		

Facility ID:	0-006129	Tank ID:	3
Owner:	ACE ASPHALT OF ARIZONA INC	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	07/08/97		
Date Closed:	/ /		
In Use:	False		

Facility ID:	0-006129	Tank ID:	4
Owner:	ACE ASPHALT OF ARIZONA INC	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	True		
Date Removed:	/ /		
Date Closed:	/ /		
In Use:	True		

Facility ID:	0-006129	Tank ID:	5
Owner:	ACE ASPHALT OF ARIZONA INC	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	True		
Date Removed:	/ /		
Date Closed:	/ /		

ACE ASPHALT OF ARIZONA INC (Continued) U001627847

In Use: True

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20 **ACE ASPHALT** RCRIS-SQG 1000904753
895 W ELWOOD FINDS AZ0000564104
PHOENIX, AZ 85041 AZ Spills
WWFAC

RCRIS:
Owner: ACE ASPHALT OF ARIZONA INC
(602) 243-4100
Contact: DARRICK ERVIN
(602) 243-4100
Record Date: 08/09/1994
Classification: Small Quantity Generator
Used Oil Recyc: No

Violation Status: No violations found

FINDS:
Other Pertinent Environmental Activity Identified at Site:
Facility Registry System (FRS)
Resource Conservation and Recovery Act Information system (RCRAINFO)

Az Spills:
Facility ID: 88-133
Response Date: Not reported
Type: Release
Referred to: SWS/AQC
Chemicals: Unknown
Property Mngmt: Private
Fund Amount: Not reported
Quantity: Not reported
Incident Date: 05/10/88
Report / Assist: Not reported
No of Samples: Ta

AZ WWFAC:
Owner Address: 3412 N. Nebraska Court
Chandler, A Z8522

---

21 **REYNOLDS ALUMINUM PLANT PONDS** SHWS 1000318249
43RD AVE / SALT RIVER AZ Spills N/A
PHOENIX, AZ 85043 CA Cal-Sites

SHWS:
EPA ID: AZD981679822
Program: PA/SI
Facility Id: 112
Site Code: Not reported
Discovery Date: Not reported
Source: Not reported
Operable Unit: 0
QWARF Area: WVB
Lat/Long: Not reported
Lat/Long Method: 80
Comments: Not reported

Az Spills:
Facility ID: 88-296
Response Date: 09/28/88
Type: Fire
Referred to: Not reported
Incident Date: 09/28/88
Report / Assist: Not reported
No of Samples: Wo

REYNOLDS ALUMINUM PLANT PONDS (Continued) 1000318249

Chemicals: Wood Creosote
Property Mngmt: Private
Fund Amount: Not reported
Quantity: Not reported

CAL-SITES:
Facility ID: 36200001
Status: REFOA - DOES NOT REQUIRE DTSC ACTION OR OVERSITE ACTIVITY. REFERED TO OTHER AGENCY LEAD
Status Date: 08/22/1995
Lead: Not reported
Region: 4 - LONG BEACH
Branch: SB - SOUTHERN CA. - B
File Name: Not reported
Status Name: PROPERTY/SITE REFERRED TO ANOTHER AGENCY
Lead Agency: N/A
NPL: Not reported
SIC: 20 MANU - FOOD & KINDRED PRODUCTS
Facility Type: N/A
Type Name: Not reported
Staff Member Responsible for Site: Not reported
Supervisor Responsible for Site: MMONROY
Region Water Control Board: Not reported
Access: Not reported
Cortese: Not reported
Hazardous Ranking Score: Not reported
Date Site Hazard Ranked: Not reported
Groundwater Contamination: Not reported
No. of Contamination Sources: 0
Lat/Long: 0° 0' 0.00" / 0° 0' 0.00"
Lat/long Method: Not reported
State Assembly District Code: Not reported
State Senate District: Not reported

Not reported

The CAL-SITES database may contain additional details for this site.
Please contact your EDR Account Executive for more information.

---

22 **SMITHEY RECYCLING CO** SHWS S101570156
3649 S. 35TH AVE. N/A
PHOENIX, AZ 85009

SHWS:
EPA ID: Not reported
Program: WQARF
Facility Id: 598
Site Code: 70059
Discovery Date: 70059
Source: Not reported
Operable Unit: 0
QWARF Area: WVB
Lat/Long: Not reported
Lat/Long Method: 80
Comments: Not reported

---

22 **METAL MANAGEMENT OF AZ** AZ Spills 1002845128
3640 S. 35 AVE. N/A
PHOENIX, AZ 85041

METAL MANAGEMENT OF AZ (Continued) **1002845128**

Az Spills:

Facility ID:	00-012-B	Incident Date:	08/30/99
Response Date:	08/30/99	Report / Assist:	08/30/99
Type:	Fire	No of Samples:	Pi
Referred to:	SWS		
Chemicals:	AutoShreds		
Property Mngmt:	Private		
Fund Amount:	Pvt/Unk		
Quantity:	Unknown		

---

22 **SALT RIVER RECYCLING/SMITHEY** LUST U001626260
3640 S 35TH AVE UST N/A
PHOENIX, AZ 85009 WWFAC

LUST:

Facility ID:	0-003031
Lust Number:	4480.01
Leak Priority:	CLOSED SOIL LVL MEETS TIER2
Notification:	06/07/1996
Date Closed:	06/09/2000

Facility ID:	0-003031
Lust Number:	4480.02
Leak Priority:	CLOSED SOIL LVL MEETS TIER2
Notification:	06/07/1996
Date Closed:	06/09/2000

Facility ID:	0-003031
Lust Number:	4480.03
Leak Priority:	CLOSED SOIL LVL MEETS TIER1
Notification:	06/23/1999
Date Closed:	10/27/1999

AZ WWFAC:

Owner Address:	3640 S. 35th Ave Phoenix, A Z8504

UST:

Facility ID:	0-003031	Tank ID:	1
Owner:	EMCO RECYCLING/METAL MGMT	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	06/10/99		
Date Closed:	/ /		
In Use:	False		

Facility ID:	0-003031	Tank ID:	2
Owner:	EMCO RECYCLING/METAL MGMT	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	06/10/99		
Date Closed:	/ /		
In Use:	False		

Facility ID:	0-003031	Tank ID:	3
Owner:	EMCO RECYCLING/METAL MGMT	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	06/10/99		

SALT RIVER RECYCLING/SMITHEY (Continued) U001626260

Date Closed: / /
In Use: False

---

22 **METAL MANAGEMENT ARIZONA INC** FINDS 1004438137
3640 S 35TH AVE AZ0001257328
PHOENIX, AZ 85041

FINDS:
Other Pertinent Environmental Activity Identified at Site:
AIRS Facility System (AIRS/AFS)
Facility Registry System (FRS)

---

23 **BRYANT INDUSTRIES INC** FINDS 1004438177
788 W ILLINI STREET AZ0001279249
PHOENIX, AZ 85041

FINDS:
Other Pertinent Environmental Activity Identified at Site:
AIRS Facility System (AIRS/AFS)
Facility Registry System (FRS)
Resource Conservation and Recovery Act Information system (RCRAINFO)

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23 **DISPOSAL CONTROL SERVICE, INC.** Ind. Haz Waste S102746338
888 W ILLINI ST N/A
PHOENIX, AZ 85041

TX IHW:

Registration Number:	41019
Registration Initial Notification Date:	01/09/1987
Registration Last Amendment Date:	Not reported
EPA Identification:	AZO981675432
TNRCC Permit Number:	Not reported
Description of Facility Site Location:	Not reported
Site Primary Standard Industrial Code:	00
	Not reported
Registration is a Generator of Waste:	No
Registration is a Receivers of Waste:	No
Registration is a Transporter of Waste:	Yes
Registration is a Transfer Facility:	No
Mexican Facility:	Does not represent a Maquiladora (Mexican Facility)
Facility Status:	Active
Type of Generator:	Not reported
Company Name:	DISPOSAL CONTROL SERVICE, INC.
Facility County:	Not reported
TNRCC Region:	Not reported
Mailing Address:	888 W ILLINI ST
	PHOENIX, AZ 85041
Mailing County:	USA
Mailing Add 3:	Not reported
Contact:	MIKE GINGERELLA
Contact Telephone Number:	602-268-0999

Additional detail may be available for this site. Please contact your EDR Account Executive for more information

Registration Number:	41019
Registration Initial Notification Date:	01/09/1987
Registration Last Amendment Date:	Not reported

DISPOSAL CONTROL SERVICE, INC. (Continued) **S102746338**

EPA Identification:	AZO981675432
TNRCC Premit Number:	Not reported
Description of Facility Site Location:	Not reported
Site Primary Standard Industrial Code:	00
	Not reported
Registration is a Generator of Waste:	No
Registration is a Receivers of Waste:	No
Registration is a Transporter of Waste:	Yes
Registration is a Transfer Facility:	No
Mexican Facility:	Does not represent a Maquiladora (Mexican Facility)
Facility Status:	Active
Type of Generator:	Not reported
Company Name:	DISPOSAL CONTROL SERVICE, INC.
Facility County:	Not reported
TNRCC Region:	Not reported
Mailing Address:	888 W ILLINI ST
	PHOENIX, AZ 85041
Mailing County:	USA
Mailing Add 3:	Not reported
Contact:	MIKE GINGERELLA
Contact Telephone Number:	602-268-0999

Additional detail may be available for this site. Please contact your EDR Account Executive for more information

Registration Number:	41019
Registration Initial Notification Date:	01/09/1987
Registration Last Amendment Date:	Not reported
EPA Identification:	AZO981675432
TNRCC Premit Number:	Not reported
Description of Facility Site Location:	Not reported
Site Primary Standard Industrial Code:	00
	Not reported
Registration is a Generator of Waste:	No
Registration is a Receivers of Waste:	No
Registration is a Transporter of Waste:	Yes
Registration is a Transfer Facility:	No
Mexican Facility:	Does not represent a Maquiladora (Mexican Facility)
Facility Status:	Active
Type of Generator:	Not reported
Company Name:	DISPOSAL CONTROL SERVICE, INC.
Facility County:	Not reported
TNRCC Region:	Not reported
Mailing Address:	888 W ILLINI ST
	PHOENIX, AZ 85041
Mailing County:	USA
Mailing Add 3:	Not reported
Contact:	MIKE GINGERELLA
Contact Telephone Number:	602-268-0999

Additional detail may be available for this site. Please contact your EDR Account Executive for more information

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23 **LAIDLAW ENVMTAL SVCS SOUTHWEST** **PADS** **1000348975**
888 W ILLINI ST **RCRIS-SQG** **AZD981675432**
PHOENIX, AZ 85041 **FINDS**

LAIDLAW ENVMTAL SVCS SOUTHWEST (Continued) **1000348975**

RCRIS:
Owner: LAIDLAW ENVIRON SVCS OF CALIFORNIA
(510) 372-4800

Contact: BRIAN SMITH
(602) 268-0999

Record Date: 12/08/1994
Classification: Conditionally Exempt Small Quantity Generator, Hazardous Waste Transporter
Used Oil Recyc: No

Violation Status: Violations exist

Regulation Violated:	Not reported
Area of Violation:	Generator-All Requirements
Date Violation Determined:	12/27/1991
Priority of Violation:	Low
Schedule Date to Achieve Compliance:	03/27/1992
Actual Date Achieved Compliance:	07/30/1993
Enforcement Action:	Written Informal
Enforcement Action Date:	12/14/1992
Proposed Monetary Penalty:	Not reported
Final Monetary Penalty:	Not reported
Regulation Violated:	Not reported
Area of Violation:	TSD-Other Requirements
Date Violation Determined:	09/27/1988
Priority of Violation:	Low
Schedule Date to Achieve Compliance:	10/17/1988
Actual Date Achieved Compliance:	10/28/1988
Enforcement Action:	Written Informal
Enforcement Action Date:	09/27/1988
Proposed Monetary Penalty:	Not reported
Final Monetary Penalty:	Not reported
Regulation Violated:	Not reported
Area of Violation:	TSD-Other Requirements
Date Violation Determined:	09/27/1988
Priority of Violation:	Low
Schedule Date to Achieve Compliance:	10/17/1988
Actual Date Achieved Compliance:	10/28/1988
Enforcement Action:	Written Informal
Enforcement Action Date:	09/27/1988
Proposed Monetary Penalty:	Not reported
Final Monetary Penalty:	Not reported

There are 3 violation record(s) reported at this site:

Evaluation	Area of Violation	Date of Compliance
Compliance Evaluation Inspection (CEI)	Generator-All Requirements	07/30/1993
Compliance Evaluation Inspection (CEI)	TSD-Other Requirements	10/28/1988
	TSD-Other Requirements	10/28/1988

LAIDLAW ENVMTAL SVCS SOUTHWEST (Continued) 1000348975

FINDS:
Other Pertinent Environmental Activity Identified at Site:
Facility Registry System (FRS)
PCB Handler Activity Data System (PADS)
Resource Conservation and Recovery Act Information system (RCRAINFO)

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23 **DISPOSAL CONTROL SERVICES** SHWS S101570376
888 WEST ILLINI ST. N/A
PHOENIX, AZ 85041

SHWS:

EPA ID:	AZD981675432
Program:	PA/SI
Facility Id:	989
Site Code:	Not reported
Discovery Date:	Not reported
Source:	Not reported
Operable Unit:	0
QWARF Area:	Not reported
Lat/Long:	Not reported
Lat/Long Method:	80
Comments:	Not reported

---

24 **L G EVERIST INCORPORATED** MINES M100015198
N/A

MARICOPA (County), AZ

U.S. MINES:

Mine ID:	0502135	SIC Codes:	14410 00000 00000 00000 00000 00000
Entity Name:	SILVERTHORNE	Company:	L G EVERIST INCORPORATED
State FIPS code:	08	County FIPS code:	117
Status Date:	09/29/1983	Status:	permanently abandoned
Operation Class:	Non-coal mining	Number of Shops:	0
Number of Pits:	000	Number of Plants:	0
Latitude:	33 24 38	Longitude:	112 07 11

---

24 **UNITED METRO MATERIALS IN** MINES M100004047
N/A

MARICOPA (County), AZ

U.S. MINES:

Mine ID:	0200988	SIC Codes:	14410 00000 00000 00000 00000 00000
Entity Name:	PLANT 11	Company:	UNITED METRO MATERIALS IN
State FIPS code:	04	County FIPS code:	013
Status Date:	07/04/1976	Status:	Full-time permanent
Operation Class:	Non-coal mining	Number of Shops:	1
Number of Pits:	000	Number of Plants:	0
Latitude:	33 24 38	Longitude:	112 07 11

---

25 **CIRCLE K # 670** LUST U003091197
4422 S 19TH AVE UST N/A
PHOENIX, AZ 85041

LUST:

Facility ID:	0-001283
Lust Number:	3357.01
Leak Priority:	CLOSED SOIL LVL MEETS TIER1

CIRCLE K # 670 (Continued) U003091197

Notification: 02/03/1994
Date Closed: 12/10/1996

UST:

Facility ID:	0-001283	Tank ID:	1
Owner:	CIRCLE K [ORPHAN SITES]	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	11/30/93		
Date Closed:	/ /		
In Use:	False		

Facility ID:	0-001283	Tank ID:	2
Owner:	CIRCLE K [ORPHAN SITES]	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	11/30/93		
Date Closed:	/ /		
In Use:	False		

Facility ID:	0-001283	Tank ID:	3
Owner:	CIRCLE K [ORPHAN SITES]	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	11/30/93		
Date Closed:	/ /		
In Use:	False		

---

25 **COOLEY WHOLESALE LUMBER CO** LUST U001156013
1930 W BROADWAY UST N/A
PHOENIX, AZ 85041

LUST:

Facility ID:	0-002113
Lust Number:	2842.01
Leak Priority:	UNDEFINED OR UNKNOWN SOIL CONTAMINATION
Notification:	06/03/1993
Date Closed:	Not reported

UST:

Facility ID:	0-002113	Tank ID:	1
Owner:	COOLEY LUMBER	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	05/11/93		
Date Closed:	/ /		
In Use:	False		

Facility ID:	0-002113	Tank ID:	2
Owner:	COOLEY LUMBER	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	03/11/93		
Date Closed:	/ /		
In Use:	False		

25 **ARIZONA TEAMSTERS APPRENTICESHIP** — LUST U001156006
1820 W BROADWAY — UST N/A
PHOENIX, AZ 85041

LUST:
Facility ID: 0-008097
Lust Number: 2705.01
Leak Priority: CLOSED SOIL LVL MEETS TIER1
Notification: 02/18/1993
Date Closed: 04/28/2000

UST:
Facility ID: 0-008097 Tank ID: 1
Owner: ARIZONA TEAMSTERS APPRENTICESHP Owner ID: Not reported
Owner Contact: Not reported
In Use: False
Date Removed: 12/30/92
Date Closed: / /
In Use: False

Facility ID: 0-008097 Tank ID: 2
Owner: ARIZONA TEAMSTERS APPRENTICESHP Owner ID: Not reported
Owner Contact: Not reported
In Use: False
Date Removed: 12/30/92
Date Closed: / /
In Use: False

---

25 **COHONE TECHNOLOGIES INC** — FINDS 1004175751
1824 W BROADWAY — 000009001718
PHOENIX, AZ 85041

FINDS:
Other Pertinent Environmental Activity Identified at Site:
Facility Registry System (FRS)
Resource Conservation and Recovery Act Information system (RCRAINFO)

---

25 **C S W CONTRACTORS INC** — UST U001627310
1824 W BROADWAY — N/A
PHOENIX, AZ 85041

UST:
Facility ID: 0-005058 Tank ID: 1
Owner: C S W CONTRACTORS INC Owner ID: Not reported
Owner Contact: Not reported
In Use: False
Date Removed: 10/08/91
Date Closed: / /
In Use: False

Facility ID: 0-005058 Tank ID: 2
Owner: C S W CONTRACTORS INC Owner ID: Not reported
Owner Contact: Not reported
In Use: False
Date Removed: 10/08/91
Date Closed: / /
In Use: False

Map ID
Direction
Distance
Distance (ft.) Site

EDR ID Number
Database(s) EPA ID Number

25 **INDUSTRIAL RECYCLING SOLUTIONS** **RCRIS-SQG 1000904764**
2610 W HOLLY ST C **FINDS AZ0000616383**
PHOENIX, AZ 85009

RCRIS:
Owner: ED TANG C O SUN MAID GROCERS
(602) 979-3620

Contact: DALE LETCHER
(602) 268-4022

Record Date: 08/24/1994
Classification: Hazardous Waste Transporter
Used Oil Recyc: No

Violation Status: No violations found

FINDS:
Other Pertinent Environmental Activity Identified at Site:
Facility Registry System (FRS)
Resource Conservation and Recovery Act Information system (RCRAINFO)

---

25 **SOLVENT RECYCLEAN INC** **RCRIS-SQG 1000817978**
1850 W BROADWAY STE 106 **FINDS AZD983480948**
PHOENIX, AZ 85041

RCRIS:
Owner: JACK BERG
(818) 345-6681

Contact: DAVID BENNETT
(602) 268-2600

Record Date: 12/30/1992
Classification: Small Quantity Generator, Hazardous Waste Transporter
Used Oil Recyc: No

Violation Status: Violations exist

Regulation Violated:	Not reported
Area of Violation:	Generator-All Requirements
Date Violation Determined:	12/30/1993
Priority of Violation:	Low
Schedule Date to Achieve Compliance:	03/30/1994
Actual Date Achieved Compliance:	12/20/1994
Enforcement Action:	Written Informal
Enforcement Action Date:	04/30/1994
Proposed Monetary Penalty:	Not reported
Final Monetary Penalty:	Not reported

There are 1 violation record(s) reported at this site:

Evaluation	Area of Violation	Date of Compliance
Compliance Evaluation Inspection (CEI)	Generator-All Requirements	12/20/1994

Map ID / Direction / Distance / Distance (ft.)	Site	Database(s)	EDR ID Number / EPA ID Number
	SOLVENT RECYCLEAN INC (Continued)		**1000817978**

FINDS:
Other Pertinent Environmental Activity Identified at Site:
Facility Registry System (FRS)
Resource Conservation and Recovery Act Information system (RCRAINFO)

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25 **19TH AVE AIRSTRIP** — **SHWS** — **1000237509**
NE CORNER 19TH AVE / BROADWAY — **N/A**
PHOENIX, AZ 85007

SHWS:

EPA ID:	AZD981679764
Program:	PA/SI
Facility Id:	222
Site Code:	Not reported
Discovery Date:	Not reported
Source:	Not reported
Operable Unit:	0
QWARF Area:	Not reported
Lat/Long:	Not reported
Lat/Long Method:	80
Comments:	Not reported

---

25 **CIRCLE K # 1968** — **UST** — **U003049636**
4305 S 19TH AVE — **N/A**
PHOENIX, AZ 85041

UST:

Facility ID:	0-001534	Tank ID:	1
Owner:	TOSCO MARKETING CO	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	True		
Date Removed:	/ /		
Date Closed:	/ /		
In Use:	True		
Facility ID:	0-001534	Tank ID:	2
Owner:	TOSCO MARKETING CO	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	True		
Date Removed:	/ /		
Date Closed:	/ /		
In Use:	True		
Facility ID:	0-001534	Tank ID:	3
Owner:	TOSCO MARKETING CO	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	True		
Date Removed:	/ /		
Date Closed:	/ /		
In Use:	True		

---

25 **ARIZONA BARREL AND CAN COMPANY** — **CERC-NFRAP** — **1003879320**
4225 S. 19TH AVENUE — **AZD982415788**
PHOENIX, AZ 85007

ARIZONA BARREL AND CAN COMPANY (Continued) 1003879320

CERCLIS-NFRAP Classification Data:
Site Incident Category: Not reported
Non NPL Code: NFRAP
Ownership Status: Private
Federal Facility: Not a Federal Facility
NPL Status: Not on the NPL

CERCLIS-NFRAP Assessment History:
Assessment: DISCOVERY — Completed: 11/01/1988
Assessment: PRELIMINARY ASSESSMENT — Completed: 12/29/1988
Assessment: SITE INSPECTION — Completed: 11/24/1992

---

25 **19TH AVE LANDFILL** LUST U001626676
19TH AVE & SALT RIVER UST N/A
PHOENIX, AZ 85041

LUST:
Facility ID: 0-003859
Lust Number: 2235.01
Leak Priority: CASE REFERRAL-NOT IN UST JURISDICTION
Notification: 03/20/1992
Date Closed: 09/02/1993

Facility ID: 0-003859
Lust Number: 2728.01
Leak Priority: CASE REFERRAL-NOT IN UST JURISDICTION
Notification: 03/20/1992
Date Closed: 11/05/1993

UST:
Facility ID: 0-003859 Tank ID: 1
Owner: CITY OF PHOENIX PUBLIC WORKS DPT Owner ID: Not reported
Owner Contact: Not reported
In Use: False
Date Removed: 01/01/78
Date Closed: / /
In Use: False

Facility ID: 0-003859 Tank ID: 2
Owner: CITY OF PHOENIX PUBLIC WORKS DPT Owner ID: Not reported
Owner Contact: Not reported
In Use: False
Date Removed: 01/01/78
Date Closed: / /
In Use: False

Facility ID: 0-003859 Tank ID: 3
Owner: CITY OF PHOENIX PUBLIC WORKS DPT Owner ID: Not reported
Owner Contact: Not reported
In Use: False
Date Removed: 03/12/92
Date Closed: / /
In Use: False

---

25 **WESTERN BLOCK COMPANY** LUST U001627591
4021 S 19TH AVE UST N/A
PHOENIX, AZ 85041

LUST:
Facility ID: 0-005611
Lust Number: 1128.01

WESTERN BLOCK COMPANY (Continued) U001627591

Leak Priority: CLOSED SUSPECTED RELEASE CASE (FALSE ALARM)
Notification: 02/22/1990
Date Closed: 09/08/1998

UST:

Facility ID:	0-005611	Tank ID:	1
Owner:	WESTERN BLOCK COMPANY	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	12/04/91		
Date Closed:	/ /		
In Use:	False		

Facility ID:	0-005611	Tank ID:	2
Owner:	WESTERN BLOCK COMPANY	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	12/04/91		
Date Closed:	/ /		
In Use:	False		

Facility ID:	0-005611	Tank ID:	3
Owner:	WESTERN BLOCK COMPANY	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	12/04/91		
Date Closed:	/ /		
In Use:	False		

Facility ID:	0-005611	Tank ID:	4
Owner:	WESTERN BLOCK COMPANY	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	02/02/90		
Date Closed:	/ /		
In Use:	False		

---

25 **WESTERN BLOCK** FINDS 1004438528
4019 S 19TH AVE AZD074484007
PHOENIX, AZ 85041

FINDS:
Other Pertinent Environmental Activity Identified at Site:
AIRS Facility System (AIRS/AFS)
Facility Registry System (FRS)

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26 HMIRS 2001070370
4310 S 51ST AVE N/A
PHOENIX, AZ

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27 **ROAD JAMMERS MACHINERY** LUST U001156024
4300 S 17TH AVE UST N/A
PHOENIX, AZ 85041

LUST:

Facility ID:	0-004162
Lust Number:	2381.01
Leak Priority:	CLOSED SOIL LVL MEETS TIER1

ROAD JAMMERS MACHINERY (Continued) U001156024

Notification: 07/07/1992
Date Closed: 11/18/1994

UST:

Facility ID:	0-004162	Tank ID:	1
Owner:	ROAD JAMMERS MACHINERY	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	07/07/92		
Date Closed:	/ /		
In Use:	False		

Facility ID:	0-004162	Tank ID:	2
Owner:	ROAD JAMMERS MACHINERY	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	07/07/92		
Date Closed:	/ /		
In Use:	False		

Facility ID:	0-004162	Tank ID:	3
Owner:	ROAD JAMMERS MACHINERY	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	07/07/92		
Date Closed:	/ /		
In Use:	False		

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28 **FARM** UST U003799502
7502 W BROADWAY RD N/A
PHOENIX, AZ 85043

UST:

Facility ID:	0-009629	Tank ID:	1
Owner:	PATTERSON DEVELOPMENT	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	06/12/00		
Date Closed:	/ /		
In Use:	False		

Facility ID:	0-009629	Tank ID:	2
Owner:	PATTERSON DEVELOPMENT	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	06/12/00		
Date Closed:	/ /		
In Use:	False		

---

28 **VISS I DAIRY** WWFAC S104827070
7443 WEST BROADWAY ROAD N/A
PHOENIX, AZ 85043

AZ WWFAC:
Owner Address: 7443 WEST BROADWAY
PHOENIX, A Z8504

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number / EPA ID Number

28 **MARBELLA** | Dry Wells | S104282269
75TH AVE / N. BROADWAY RD | N/A
PHOENIX, AZ 0

DRY WELLS:
Number of Wells: 9
Beginning Registration Number: 19033

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29 **VISS II DAIRY** | WWFAC | S104827071
6809 WEST BROADWAY ROAD | N/A
PHOENIX, AZ 85043

AZ WWFAC:
Owner Address: 6829 WEST BROADWAY
PHOENIX, A Z8504

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30 **BRISCOE INC.** | AZ Spills | S100888366
15 AVE / BROADWAY | N/A
PHOENIX, AZ 85000

Az Spills:

Facility ID:	85-060	Incident Date:	05/01/85
Response Date:	Not reported	Report / Assist:	Not reported
Type:	Release	No of Samples:	Tr
Referred to:	Not reported		
Chemicals:	Gasoline/Diesel/Hydraulic		
Property Mngmt:	Private		
Fund Amount:	Pvt/Unk		
Quantity:	Not reported		

---

30 **BROADWAY CARDLOCK #23** | LUST | U001628289
1307 W BROADWAY RD | UST | N/A
PHOENIX, AZ 85041

LUST:

Facility ID:	0-006997
Lust Number:	5054.01
Leak Priority:	CLOSED SOIL LVL MEETS TIER1
Notification:	03/29/1999
Date Closed:	07/27/1999

UST:

Facility ID:	0-006997	Tank ID:	1
Owner:	BROWN EVANS DISTRIBUTING CO	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	03/11/99		
Date Closed:	/ /		
In Use:	False		
Facility ID:	0-006997	Tank ID:	2
Owner:	BROWN EVANS DISTRIBUTING CO	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	03/11/99		
Date Closed:	/ /		
In Use:	False		
Facility ID:	0-006997	Tank ID:	3
Owner:	BROWN EVANS DISTRIBUTING CO	Owner ID:	Not reported

BROADWAY CARDLOCK #23 (Continued) U001628289

Owner Contact: Not reported
In Use: False
Date Removed: 03/11/99
Date Closed: / /
In Use: False

---

30 **PROGESSIVE ROOFING** UST U001626736
1501 W BROADWAY N/A
PHOENIX, AZ 85041

UST:
Facility ID: 0-003977 Tank ID: 1
Owner: PROGESSIVE ROOFING Owner ID: Not reported
Owner Contact: Not reported
In Use: False
Date Removed: 08/04/92
Date Closed: / /
In Use: False

---

30 **SANDVICK EQUIPMENT & SUPPLY CO** UST U003050456
1502 W BROADWAY RD N/A
PHOENIX, AZ 85041

UST:
Facility ID: 0-006074 Tank ID: 1
Owner: ROBERT M SANDVICK Owner ID: Not reported
Owner Contact: Not reported
In Use: False
Date Removed: 10/21/93
Date Closed: / /
In Use: False

---

30 **TURNERS MACHINE SHOP** RCRIS-SQG 1000685697
1521 W BROADWAY FINDS AZD983477084
PHOENIX, AZ 85041

RCRIS:
Owner: WAYNE TURNER
(602) 276-5711

Contact: WAYNE TURNER
(602) 276-5711

Record Date: 05/19/1992
Classification: Small Quantity Generator
Used Oil Recyc: No

Violation Status: No violations found

FINDS:
Other Pertinent Environmental Activity Identified at Site:
Facility Registry System (FRS)
Resource Conservation and Recovery Act Information system (RCRAINFO)

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30 **BROWN TANK & STEEL** UST U001625102
4300 S 15TH AVE N/A
PHOENIX, AZ 85041

BROWN TANK & STEEL (Continued) — **U001625102**

UST:

Facility ID:	0-000778	Tank ID:	1
Owner:	BROWN TANK & STEEL	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	08/23/88		
Date Closed:	/ /		
In Use:	False		

Facility ID:	0-000778	Tank ID:	2
Owner:	BROWN TANK & STEEL	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	08/23/88		
Date Closed:	/ /		
In Use:	False		

---

31 **VISTA CONSTRUCTION** — UST — **U001627558**
2836 W BROADWAY — **N/A**
PHOENIX, AZ 85041

UST:

Facility ID:	0-005548	Tank ID:	1
Owner:	VISTA CONSTRUCTION	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	True		
Date Removed:	/ /		
Date Closed:	/ /		
In Use:	True		

Facility ID:	0-005548	Tank ID:	2
Owner:	VISTA CONSTRUCTION	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	True		
Date Removed:	/ /		
Date Closed:	/ /		
In Use:	True		

---

31 **ROYDEN CONSTRUCTION CO** — UST — **U001001232**
2844 W BROADWAY — **N/A**
PHOENIX, AZ 85041

UST:

Facility ID:	0-001618	Tank ID:	1
Owner:	ROYDEN CONSTRUCTION CO	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	01/01/90		
Date Closed:	/ /		
In Use:	False		

Facility ID:	0-001618	Tank ID:	2
Owner:	ROYDEN CONSTRUCTION CO	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	01/01/90		
Date Closed:	/ /		
In Use:	False		

ROYDEN CONSTRUCTION CO (Continued) U001001232

Facility ID:	0-001618	Tank ID:	3
Owner:	ROYDEN CONSTRUCTION CO	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	01/01/90		
Date Closed:	/ /		
In Use:	False		

Facility ID:	0-001618	Tank ID:	4
Owner:	ROYDEN CONSTRUCTION CO	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	01/01/90		
Date Closed:	/ /		
In Use:	False		

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31 **ENVIROSOLVE LLC** FINDS 1004178269
2844 W BROADWAY RD 000009034968
PHOENIX, AZ 85041

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31 **ENVIRO-SOLV** AZ Spills S104851738
2844 W. BROADWAY RD. N/A
PHOENIX, AZ

Az Spills:

Facility ID:	00-134-E	Incident Date:	04/30/00
Response Date:	04/30/00	Report / Assist:	04/30/00
Type:	Release	No of Samples:	Dr
Referred to:	Not reported		
Chemicals:	Ammonium Hydroxide, etc.		
Property Mngmt:	Private		
Fund Amount:	Pvt/Unk		
Quantity:	Misc.		

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31 **ENVIROSOLVE LLC** RCRIS-SQG 1001815350
2844 W BROADWAY RD FINDS AZR000035840
PHOENIX, AZ 85041

RCRIS:

Owner: ENVIROSOLVE LLC
(918) 587-9664

Contact: JAMES FEHRLE
(918) 587-9664

Record Date: 09/03/1999
Classification: Hazardous Waste Transporter
Used Oil Recyc: Yes

Violation Status: No violations found

ENVIROSOLVE LLC (Continued) 1001815350

FINDS:
Other Pertinent Environmental Activity Identified at Site:
Facility Registry System (FRS)
Resource Conservation and Recovery Act Information system (RCRAINFO)

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31 **CONSTRUCTION YARD** UST U003050656
2850 W BROADWAY RD N/A
PHOENIX, AZ 85041

UST:

Facility ID:	0-006802	Tank ID:	1
Owner:	UNITED METRO/FRMR TANNER CO	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	04/04/90		
Date Closed:	/ /		
In Use:	False		

Facility ID:	0-006802	Tank ID:	2
Owner:	UNITED METRO/FRMR TANNER CO	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	04/04/90		
Date Closed:	/ /		
In Use:	False		

---

31 **UNKNOWN** AZ Spills S101641003
2744 W. BROADWAY (S.R. BANK) N/A
PHOENIX, AZ

Az Spills:

Facility ID:	95-007-B	Incident Date:	02/16/95
Response Date:	02/16/95	Report / Assist:	Not reported
Type:	Release	No of Samples:	Un
Referred to:	Not reported		
Chemicals:	Unknown Red Substance		
Property Mngmt:	Federal		
Fund Amount:	Not reported		
Quantity:	Not reported		

---

32 **YANK YOUR PART** RCRIS-SQG 1001195199
2104 W BROADWAY FINDS AZR000006197
PHOENIX, AZ 85041

RCRIS:

Owner:	DAVE BUCKMEYER (602) 268-4444
Contact:	JORGE DIAZ (602) 268-4444
Record Date:	04/01/1997
Classification:	Small Quantity Generator

YANK YOUR PART (Continued) 1001195199

Used Oil Recyc: No

Violation Status: No violations found

FINDS:
Other Pertinent Environmental Activity Identified at Site:
Facility Registry System (FRS)
Resource Conservation and Recovery Act Information system (RCRAINFO)

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32 **AETS** SWF/LF S103086593
SOUTHWEST PORTION OF THE CITY OF PHOENIX NR.19TH A N/A
MARICOPA (County), AZ

LF:
Facility Type: Treatment/Storage
Facility Status: Active
Operator: AETS
Operator Telephone: (602) 243-6154
Operator Address: 2301 W. Broadway Rd
Phoenix, Az 85041

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33 **2301 WEST BROADWAY ROAD** ERNS 875907
2301 WEST BROADWAY ROAD N/A
PHOENIX, AZ

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33 **2301 W BROADWAY RD** ERNS 8713636
2301 W BROADWAY RD N/A
PHOENIX, AZ

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33 **A G PRODUCTS** RCRIS-SQG 1000163353
2630 W BROADWAY RD FINDS AZD097121164
PHOENIX, AZ 85041

RCRIS:
Owner: A G PRODUCTS
(602) 268-8707
Contact: FRANK HAMBICKI
(602) 268-8707
Record Date: 08/04/1999
Classification: Small Quantity Generator
Used Oil Recyc: No

Violation Status: No violations found

FINDS:
Other Pertinent Environmental Activity Identified at Site:
Facility Registry System (FRS)
Resource Conservation and Recovery Act Information system (RCRAINFO)

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33 **CHEMICAL WASTE MANAGEMENT** AZ Spills 1003047862
2301 W. BROADWAY N/A
PHOENIX, AZ 85005

Az Spills:
Facility ID: 84-019 Incident Date: 03/15/84

CHEMICAL WASTE MANAGEMENT (Continued) **1003047862**

Response Date: Not reported
Type: Release
Referred to: Not reported
Chemicals: Sulfuric Acid (96%)
Property Mngmt: Private
Fund Amount: Pvt/Unk
Quantity: Not reported
Report / Assist: Not reported
No of Samples: Ta

Facility ID: 84-034
Response Date: 05/18/84
Type: Release
Referred to: Not reported
Chemicals: Chlorine Oxidizer Release
Property Mngmt: Private
Fund Amount: Pvt/Unk
Quantity: Not reported
Incident Date: 05/18/84
Report / Assist: Not reported
No of Samples: Dr

Facility ID: 84-086
Response Date: Not reported
Type: Release
Referred to: Not reported
Chemicals: PCB
Property Mngmt: Private
Fund Amount: Pvt/Unk
Quantity: Not reported
Incident Date: 06/06/84
Report / Assist: Not reported
No of Samples: Bl

Facility ID: 85-102
Response Date: 08/27/85
Type: Release
Referred to: HWCU/CRO
Chemicals: Flammable Liquid NOS
Property Mngmt: Private
Fund Amount: Pvt/Unk
Quantity: Not reported
Incident Date: 08/27/85
Report / Assist: Not reported
No of Samples: Dr

Facility ID: 86-083
Response Date: Not reported
Type: Release
Referred to: HWCU/HWIU
Chemicals: diphenol methane/diisocyn
Property Mngmt: Private
Fund Amount: Pvt/Unk
Quantity: Not reported
Incident Date: 07/07/86
Report / Assist: Not reported
No of Samples: Dr

Facility ID: 86-115
Response Date: Not reported
Type: Release
Referred to: Not reported
Chemicals: Waste Poisonous Liq. NOS
Property Mngmt: Private
Fund Amount: Pvt/Unk
Quantity: Not reported
Incident Date: 08/18/86
Report / Assist: Not reported
No of Samples: Dr

Facility ID: 87-127
Response Date: Not reported
Type: Release
Referred to: Not reported
Incident Date: 06/01/87
Report / Assist: Not reported
No of Samples: Ro

CHEMICAL WASTE MANAGEMENT (Continued) **1003047862**

Chemicals: Chromium Hydroxide
Property Mngmt: Private
Fund Amount: Pvt/Unk
Quantity: Not reported

Facility ID: 89-233
Response Date: Not reported
Type: Release
Referred to: HWP/HWC/HW
Chemicals: Nitric Acid (Fuming)
Property Mngmt: Private
Fund Amount: Pvt/Unk
Quantity: Not reported
Incident Date: 08/08/89
Report / Assist: Not reported
No of Samples: Dr

Facility ID: 93-034-F
Response Date: Not reported
Type: Release
Referred to: Not reported
Chemicals: Hydrogen Peroxide
Property Mngmt: Private
Fund Amount: Pvt/Unk
Quantity: Not reported
Incident Date: 06/28/93
Report / Assist: Not reported
No of Samples: Dr

---

33 **ONYX ENVIRONMENTAL SERVICES LLC** **PADS 1000299389**
2301 W BROADWAY RD **SHWS AZT050010180**
PHOENIX, AZ 85041 **FINDS**
RCRIS-LQG
RCRIS-TSD
CORRACTS
CERC-NFRAP
CA HAZNET

CERCLIS-NFRAP Classification Data:
Site Incident Category: Not reported
Non NPL Code: DR
Ownership Status: Private
Federal Facility: Not a Federal Facility
NPL Status: Not on the NPL

CERCLIS-NFRAP Assessment History:

Assessment:	DISCOVERY	Completed:	09/18/1989
Assessment:	RCRA FACILITY ASSESSMENT	Completed:	03/27/1990
Assessment:	PRELIMINARY ASSESSMENT	Completed:	03/27/1990
Assessment:	SITE INSPECTION	Completed:	03/27/1990

CORRACTS Data:
EPA Id: AZT050010180
Region: 9
State: Not reported
Area Name: ENTIRE FACILITY
Original Scheduled Date: Not reported
New Scheduled Date: Not reported
Actual Date: 03/27/1990
Corrective Action: CA075LO - CA Prioritization, Facility or area was assigned a low corrective action priority
EPA Id: AZT050010180
Region: 9
State: Not reported
Area Name: ENTIRE FACILITY
Original Scheduled Date: Not reported
New Scheduled Date: Not reported
Actual Date: 08/26/1992

ONYX ENVIRONMENTAL SERVICES LLC (Continued) **1000299389**

Corrective Action: CA075LO - CA Prioritization, Facility or area was assigned a low corrective action priority

RCRIS:

Owner: MVW DEVELOPMENT LTD PSHP
(602) 944-5981

Contact: EDWARD CSIRA
(602) 243-6154

Record Date: 12/29/1995
Classification: Large Quantity Generator, Hazardous Waste Transporter

BIENNIAL REPORTS:

Last Biennial Reporting Year: 1999

Waste	Quantity (Lbs)	Waste	Quantity (Lbs)
D001	11912.00	D002	3904.00
D003	1317.00	D004	1314.00
D006	152.00	D007	1942.00
D008	3668.00	D009	150.00
D010	30.00	D011	357.00
D018	196.00	D019	34.00
D026	34.00	D027	34.00
D030	55.00	D035	2952.00
D039	740.00	D040	1818.00
F001	1094.00	F002	2931.00
F003	7501.00	F004	63.00
F005	4869.00	F007	50.00
F019	435.00	K062	200.00
LABP	1816.00	P001	120.00
P030	4.00	P044	2052.00
P050	2052.00	P098	4.00
P105	122.00	U002	12.00
U062	580.00	U079	22.00
U134	420.00	U226	16.00
U239	837.00		

Used Oil Recyc: No

Violation Status: Violations exist

Regulation Violated: Not reported
Area of Violation: Transporter-All Requirements
Date Violation Deterrnined: 09/03/1996
Priority of Violation: Low
Schedule Date to Achieve Compliance: Not reported
Actual Date Achieved Compliance: Not reported

Regulation Violated: Not reported
Area of Violation: TSD-Land Ban Requirements
Date Violation Determined: 08/27/1996
Priority of Violation: Low
Schedule Date to Achieve Compliance: Not reported
Actual Date Achieved Compliance: Not reported

Regulation Violated: Not reported
Area of Violation: TSD-Other Requirements
Date Violation Determined: 02/14/1986
Priority of Violation: Low
Schedule Date to Achieve Compliance: Not reported
Actual Date Achieved Compliance: Not reported

ONYX ENVIRONMENTAL SERVICES LLC (Continued) 1000299389

Enforcement Action: Written Informal
Enforcement Action Date: 03/13/1987
Proposed Monetary Penalty: Not reported
Final Monetary Penalty: Not reported

Regulation Violated: Not reported
Area of Violation: TSD-Other Requirements
Date Violation Determined: 04/01/1985
Priority of Violation: Low
Schedule Date to Achieve Compliance: 05/01/1985
Actual Date Achieved Compliance: 04/16/1985

Regulation Violated: Not reported
Area of Violation: TSD-Other Requirements
Date Violation Determined: 05/18/1994
Priority of Violation: Low
Schedule Date to Achieve Compliance: 08/18/1994
Actual Date Achieved Compliance: 03/01/1995

Enforcement Action: Written Informal
Enforcement Action Date: 06/06/1994
Proposed Monetary Penalty: Not reported
Final Monetary Penalty: Not reported

Regulation Violated: Not reported
Area of Violation: Generator-All Requirements
Date Violation Determined: 12/31/1991
Priority of Violation: Low
Schedule Date to Achieve Compliance: 03/31/1992
Actual Date Achieved Compliance: 08/30/1993

Enforcement Action: Written Informal
Enforcement Action Date: 12/01/1992
Proposed Monetary Penalty: Not reported
Final Monetary Penalty: Not reported

Regulation Violated: Not reported
Area of Violation: TSD-Other Requirements
Date Violation Determined: 09/18/1990
Priority of Violation: Low
Schedule Date to Achieve Compliance: 03/08/1991
Actual Date Achieved Compliance: 02/08/1991

Enforcement Action: Written Informal
Enforcement Action Date: 11/05/1990
Proposed Monetary Penalty: Not reported
Final Monetary Penalty: Not reported

Regulation Violated: Not reported
Area of Violation: TSD-Other Requirements
Date Violation Determined: 03/20/1990
Priority of Violation: Low
Schedule Date to Achieve Compliance: 08/17/1990
Actual Date Achieved Compliance: 09/04/1990

Enforcement Action: Written Informal
Enforcement Action Date: 07/09/1990
Proposed Monetary Penalty: Not reported
Final Monetary Penalty: Not reported

Regulation Violated: Not reported
Area of Violation: TSD-Other Requirements

ONYX ENVIRONMENTAL SERVICES LLC (Continued) | **1000299389**

Date Violation Determined: 09/03/1989
Priority of Violation: Low
Schedule Date to Achieve Compliance: 08/17/1990
Actual Date Achieved Compliance: 09/04/1990

Enforcement Action: Written Informal
Enforcement Action Date: 03/16/1990
Proposed Monetary Penalty: Not reported
Final Monetary Penalty: Not reported

Regulation Violated: Not reported
Area of Violation: TSD-Other Requirements
Date Violation Determined: 04/06/1988
Priority of Violation: Low
Schedule Date to Achieve Compliance: 05/03/1988
Actual Date Achieved Compliance: 05/11/1988

Enforcement Action: Written Informal
Enforcement Action Date: 04/26/1988
Proposed Monetary Penalty: Not reported
Final Monetary Penalty: Not reported

Regulation Violated: Not reported
Area of Violation: TSD-Other Requirements
Date Violation Determined: 03/01/1988
Priority of Violation: Low
Schedule Date to Achieve Compliance: 04/06/1988
Actual Date Achieved Compliance: 12/10/1988

Enforcement Action: Written Informal
Enforcement Action Date: 03/23/1988
Proposed Monetary Penalty: Not reported
Final Monetary Penalty: Not reported

Regulation Violated: Not reported
Area of Violation: TSD-Other Requirements
Date Violation Determined: 01/15/1988
Priority of Violation: Low
Schedule Date to Achieve Compliance: 08/23/1988
Actual Date Achieved Compliance: 11/18/1988

Enforcement Action: Written Informal
Enforcement Action Date: 07/13/1988
Proposed Monetary Penalty: Not reported
Final Monetary Penalty: Not reported

Regulation Violated: Not reported
Area of Violation: TSD-Other Requirements
Date Violation Determined: 06/01/1987
Priority of Violation: Low
Schedule Date to Achieve Compliance: 09/30/1987
Actual Date Achieved Compliance: 10/02/1987

Enforcement Action: Written Informal
Enforcement Action Date: 08/21/1987
Proposed Monetary Penalty: Not reported
Final Monetary Penalty: Not reported

Regulation Violated: Not reported
Area of Violation: TSD-Other Requirements
Date Violation Determined: 06/01/1987
Priority of Violation: Low

ONYX ENVIRONMENTAL SERVICES LLC (Continued) 1000299389

Schedule Date to Achieve Compliance: 09/30/1987
Actual Date Achieved Compliance: 10/02/1987

Enforcement Action: Written Informal
Enforcement Action Date: 08/21/1987
Proposed Monetary Penalty: Not reported
Final Monetary Penalty: Not reported

Regulation Violated: Not reported
Area of Violation: TSD-Other Requirements
Date Violation Determined: 02/10/1987
Priority of Violation: Low
Schedule Date to Achieve Compliance: 02/26/1987
Actual Date Achieved Compliance: 03/24/1987

Enforcement Action: Written Informal
Enforcement Action Date: 02/12/1987
Proposed Monetary Penalty: Not reported
Final Monetary Penalty: Not reported

Regulation Violated: Not reported
Area of Violation: TSD-Other Requirements
Date Violation Determined: 08/06/1986
Priority of Violation: Low
Schedule Date to Achieve Compliance: 12/29/1986
Actual Date Achieved Compliance: 01/20/1987

Enforcement Action: Written Informal
Enforcement Action Date: 11/18/1986
Proposed Monetary Penalty: Not reported
Final Monetary Penalty: Not reported

Regulation Violated: Not reported
Area of Violation: TSD-Other Requirements
Date Violation Determined: 08/06/1986
Priority of Violation: Low
Schedule Date to Achieve Compliance: 12/29/1986
Actual Date Achieved Compliance: 01/20/1987

Enforcement Action: Written Informal
Enforcement Action Date: 11/18/1986
Proposed Monetary Penalty: Not reported
Final Monetary Penalty: Not reported

Regulation Violated: Not reported
Area of Violation: TSD-Other Requirements
Date Violation Determined: 05/12/1986
Priority of Violation: Low
Schedule Date to Achieve Compliance: 05/30/1986
Actual Date Achieved Compliance: 06/10/1986

Enforcement Action: Written Informal
Enforcement Action Date: 05/14/1986
Proposed Monetary Penalty: Not reported
Final Monetary Penalty: Not reported

Regulation Violated: Not reported
Area of Violation: TSD-Financial Responsibility Requirements
Date Violation Determined: 05/12/1986
Priority of Violation: Low
Schedule Date to Achieve Compliance: 05/30/1986
Actual Date Achieved Compliance: 06/10/1986

ONYX ENVIRONMENTAL SERVICES LLC (Continued) **1000299389**

Enforcement Action:	Written Informal
Enforcement Action Date:	05/14/1986
Proposed Monetary Penalty:	Not reported
Final Monetary Penalty:	Not reported
Regulation Violated:	Not reported
Area of Violation:	TSD-Other Requirements
Date Violation Determined:	09/17/1985
Priority of Violation:	Low
Schedule Date to Achieve Compliance:	04/18/1986
Actual Date Achieved Compliance:	06/10/1986
Enforcement Action:	Written Informal
Enforcement Action Date:	03/12/1986
Proposed Monetary Penalty:	Not reported
Final Monetary Penalty:	Not reported
Regulation Violated:	Not reported
Area of Violation:	TSD-Financial Responsibility Requirements
Date Violation Determined:	09/17/1985
Priority of Violation:	Low
Schedule Date to Achieve Compliance:	04/18/1986
Actual Date Achieved Compliance:	06/10/1986
Enforcement Action:	Written Informal
Enforcement Action Date:	03/12/1986
Proposed Monetary Penalty:	Not reported
Final Monetary Penalty:	Not reported
Regulation Violated:	Not reported
Area of Violation:	TSD-Financial Responsibility Requirements
Date Violation Determined:	01/10/1985
Priority of Violation:	Low
Schedule Date to Achieve Compliance:	02/12/1985
Actual Date Achieved Compliance:	02/12/1985
Enforcement Action:	Written Informal
Enforcement Action Date:	01/10/1985
Proposed Monetary Penalty:	Not reported
Final Monetary Penalty:	Not reported

ONYX ENVIRONMENTAL SERVICES LLC (Continued) **1000299389**

There are 22 violation record(s) reported at this site:

Evaluation	Area of Violation	Date of Compliance
Compliance Evaluation Inspection (CEI)	Transporter-All Requirements	
	TSD-Land Ban Requirements	
Compliance Evaluation Inspection (CEI)	TSD-Other Requirements	03/01/1995
Compliance Evaluation Inspection (CEI)	Generator-All Requirements	08/30/1993
Compliance Evaluation Inspection (CEI)	TSD-Other Requirements	02/08/1991
Compliance Evaluation Inspection (CEI)	TSD-Other Requirements	09/04/1990
Compliance Evaluation Inspection (CEI)	TSD-Other Requirements	09/04/1990
Compliance Evaluation Inspection (CEI)	TSD-Other Requirements	05/11/1988
Non-Financial Record Review	TSD-Other Requirements	12/10/1988
Sampling Inspection	TSD-Other Requirements	11/18/1988
Sampling Inspection	TSD-Other Requirements	10/02/1987
	TSD-Other Requirements	10/02/1987
Non-Financial Record Review	TSD-Other Requirements	03/24/1987
Compliance Evaluation Inspection (CEI)	TSD-Other Requirements	01/20/1987
	TSD-Other Requirements	01/20/1987
Compliance Schedule Evaluation (CSE)	TSD-Other Requirements	06/10/1986
	TSD-Financial Responsibility Requirements	06/10/1986
Non-Financial Record Review	TSD-Other Requirements	
Compliance Evaluation Inspection (CEI)	TSD-Other Requirements	06/10/1986
	TSD-Financial Responsibility Requirements	06/10/1986
Non-Financial Record Review	TSD-Other Requirements	04/16/1985
Non-Financial Record Review	TSD-Financial Responsibility Requirements	02/12/1985

NY MANIFEST
Additional detail is available in NY MANIFEST. Please contact your EDR Account Executive for more information.

FINDS:
Other Pertinent Environmental Activity Identified at Site:
Biennial Reporting System (BRS)
Facility Registry System (FRS)
National Compliance Database (NCDB)
PCB Handler Activity Data System (PADS)
Resource Conservation and Recovery Act Information system (RCRAINFO)

SHWS:

EPA ID:	AZT050010180
Program:	PA/SI
Facility Id:	774
Site Code:	70224
Discovery Date:	70224
Source:	Not reported
Operable Unit:	0
QWARF Area:	Not reported
Lat/Long:	Not reported
Lat/Long Method:	80
Comments:	Not reported

ONYX ENVIRONMENTAL SERVICES LLC (Continued) 1000299389

HAZNET:

Gepaid:	AZT050010180
Tepaid:	CAD050806850
Gen County:	99
Tsd County:	Los Angeles
Tons:	.7500
Category:	Off-specification, aged, or surplus inorganics
Disposal Method:	Transfer Station
Contact:	JERRY DEMPSI, PRES/VP
Telephone:	(708) 572-8800
Mailing Address:	2301 W BROADWAY RD
	PHOENIX, AZ 85041 - 2111
County	99

Gepaid:	AZT050010180
Tepaid:	CAD980884183
Gen County:	99
Tsd County:	Sacramento
Tons:	1.0801
Category:	
Disposal Method:	Transfer Station
Contact:	JERRY DEMPSI, PRES/VP
Telephone:	(708) 572-8800
Mailing Address:	2301 W BROADWAY RD
	PHOENIX, AZ 85041 - 2111
County	99

Gepaid:	AZT050010180
Tepaid:	CAT000646117
Gen County:	99
Tsd County:	Kings
Tons:	.4587
Category:	Unspecified sludge waste
Disposal Method:	Not reported
Contact:	JERRY DEMPSI, PRES/VP
Telephone:	(708) 572-8800
Mailing Address:	2301 W BROADWAY RD
	PHOENIX, AZ 85041 - 2111
County	99

Gepaid:	AZT050010180
Tepaid:	CAT000646117
Gen County:	99
Tsd County:	Kings
Tons:	2.1265
Category:	Liquids with nickel > 134 mg/l
Disposal Method:	Treatment, Tank
Contact:	JERRY DEMPSI, PRES/VP
Telephone:	(708) 572-8800
Mailing Address:	2301 W BROADWAY RD
	PHOENIX, AZ 85041 - 2111
County	99

ONYX ENVIRONMENTAL SERVICES LLC (Continued) 1000299389

Gepaid: AZT050010180
Tepaid: CAT000646117
Gen County: 99
Tsd County: Kings
Tons: 50.5680
Category: Other inorganic solid waste
Disposal Method: Disposal, Land Fill
Contact: JERRY DEMPSI, PRES/VP
Telephone: (708) 572-8800
Mailing Address: 2301 W BROADWAY RD
PHOENIX, AZ 85041 - 2111
County 99

The CA HAZNET database contains 549 additional records for this site.
Please contact your EDR Account Executive for more information.

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33 **CHEMICAL WASTE MANAGEMENT** FTTS 1004626540
2301 W BROADWAY RD N/A
PHOENIX, AZ 85041

FTTS Insp:
Region: 09
Inspected Date: 07/09/91
Insp Number: 07/09/91
Violation occurred: Yes
Inspector: JKARKOSKI
Investigation Type: Section 6 PCB Federal Conducted
Facility Function: Storer
Investig Reason: Neutral Scheme, Region
Legislation Code: TSCA

Region: 09
Inspected Date: 01/27/93
Insp Number: 01/27/93
Violation occurred: No
Inspector: RKEMMERRER
Investigation Type: Section 6 PCB Federal Conducted
Facility Function: User
Investig Reason: Neutral Scheme, Region
Legislation Code: TSCA

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33 **ONYX ENVIRONMENTAL SERVICES** FTTS 1004642332
2301 WEST BROADWAY N/A
PHOENIX, AZ 85041

FTTS Insp:
Region: 09
Inspected Date: 09/11/01
Insp Number: 09/11/01
Violation occurred: Yes
Inspector: CROLLINS
Investigation Type: Section 6 PCB Federal Conducted
Facility Function: User
Investig Reason: For Cause, Disposal
Legislation Code: TSCA

Map ID / Direction / Distance / Distance (ft.)	Site	Database(s)	EDR ID Number / EPA ID Number

33 **M & M AUTO STORAGE POOL INC** — UST — U001626250
2299 W BROADWAY — N/A
PHOENIX, AZ 85041

UST:

Facility ID:	0-003013	Tank ID:	1
Owner:	M & M AUTO STORAGE POOL INC	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	12/14/89		
Date Closed:	/ /		
In Use:	False		

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33 **2301 W. BROADWAY** — ERNS — 90171280
2301 W. BROADWAY — N/A
PHOENIX, AZ 85041

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33 **ONYX ENVIRONMENTAL SERVICES** — FTTS — 1004642331
2301 W BROADWAY — N/A
PHOENIX, AZ 85041

FTTS Insp:

Region:	09
Inspected Date:	04/11/01
Insp Number:	04/11/01
Violation occurred:	Not reported
Inspector:	EACOSTA/DE
Investigation Type:	EPCRA, Enforcement, Federal Conducted
Facility Function:	Permitted Disposer - Alternative Methods
Investig Reason:	Neutral Scheme, Region
Legislation Code:	EPCRA

---

33 **FUELCO #112** — UST — U001627597
2401 W BROADWAY — N/A
PHOENIX, AZ 85041

UST:

Facility ID:	0-005624	Tank ID:	1
Owner:	WESTERN STATES PETROLEUM/R. KE	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	12/15/88		
Date Closed:	/ /		
In Use:	False		

Facility ID:	0-005624	Tank ID:	2
Owner:	WESTERN STATES PETROLEUM/R. KE	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	12/15/88		
Date Closed:	/ /		
In Use:	False		

Facility ID:	0-005624	Tank ID:	3
Owner:	WESTERN STATES PETROLEUM/R. KE	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	12/15/88		
Date Closed:	/ /		

FUELCO #112 (Continued) U001627597

In Use: False

Facility ID: 0-005624 Tank ID: 4
Owner: WESTERN STATES PETROLEUM/R. KEC Owner ID: Not reported
Owner Contact: Not reported
In Use: False
Date Removed: 12/15/88
Date Closed: / /
In Use: False

Facility ID: 0-005624 Tank ID: 5
Owner: WESTERN STATES PETROLEUM/R. KEC Owner ID: Not reported
Owner Contact: Not reported
In Use: False
Date Removed: 12/15/88
Date Closed: / /
In Use: False

---

33 **CASITAS BONITAS- AMER PUBLIC SERV** WWFAC S102787842
2410 W.BROADWAY RD N/A
PHOENIX, AZ 85041

AZ WWFAC:
Owner Address: 2410 W. Broadway Rd
Phoenix, A Z8504

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33 **SIERRA ENTRADA WWTP** WWFAC S102789985
2410 W. BROADWAY N/A
PHOENIX, AZ 85041

AZ WWFAC:
Owner Address: 2410 W. Broadway
Phoenix, A Z8504

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33 **SMITH PRE-CAST** UST U003052220
2410 W BROADWAY N/A
PHOENIX, AZ 85041

UST:
Facility ID: 0-008548 Tank ID: 1
Owner: SMITH PRE-CAST Owner ID: Not reported
Owner Contact: Not reported
In Use: True
Date Removed: / /
Date Closed: / /
In Use: True

Facility ID: 0-008548 Tank ID: 2
Owner: SMITH PRE-CAST Owner ID: Not reported
Owner Contact: Not reported
In Use: True
Date Removed: / /
Date Closed: / /
In Use: True

Map ID Direction Distance Distance (ft.)	Site	Database(s)	EDR ID Number EPA ID Number
33	**AG PRODUCTS** **2525 WEST BROADWAY ROAD** **PHOENIX, AZ 85041**	Dry Wells	1001607344 N/A

DRY WELLS:
Number of Wells: 2
Beginning Registration Number: 9912

33	**REGENT AUTO & TRUCK PARTS** **2528 WEST BROADWAY ROAD** **PHOENIX, AZ 85041**	SHWS	S101570378 N/A

SHWS:
EPA ID: AZD983480831
Program: PA/SI
Facility Id: 1209
Site Code: 70456
Discovery Date: 70456
Source: Not reported
Operable Unit: 0
QWARF Area: Not reported
Lat/Long: Not reported
Lat/Long Method: 80
Comments: Not reported

33	**A & S AUTO WRECKING** **2528 W. BROADWAY ROAD** **PHOENIX, AZ 85041**	SHWS	1000709257 N/A

SHWS:
EPA ID: AZD983484866
Program: PA/SI
Facility Id: 1228
Site Code: 70675
Discovery Date: 70675
Source: Not reported
Operable Unit: 0
QWARF Area: Not reported
Lat/Long: Not reported
Lat/Long Method: 80
Comments: Not reported

33	**ALAN HARRIS TRUCKING** **2505 W BROADWAY RD** **PHOENIX, AZ 85041**	UST	U003051054 N/A

UST:
Facility ID: 0-008634
Tank ID: 1
Owner: ALAN HARRIS TRUCKING
Owner ID: Not reported
Owner Contact: Not reported
In Use: False
Date Removed: 06/04/99
Date Closed: / /
In Use: False

34	**MOTOROLA (BIC)** **2200 W. BROADWAY** **PHOENIX, AZ**	AZ Spills	S104559782 N/A

MOTOROLA (BIC) (Continued) S104559782

Az Spills:
Facility ID: 84-004 | Incident Date: 01/10/84
Response Date: Not reported | Report / Assist: Not reported
Type: Release | No of Samples: Re
Referred to: Not reported
Chemicals: Solvent Mix
Property Mngmt: Private
Fund Amount: Pvt/Unk
Quantity: Not reported

---

35 **ALL-A-MATIC TRANSMISSIONS** AZ Spills S104560094
3011 W. BROADWAY N/A
PHOENIX, AZ

Az Spills:
Facility ID: 93-021-G | Incident Date: 10/29/93
Response Date: 11/02/93 | Report / Assist: Not reported
Type: Release | No of Samples: Dr
Referred to: HWIU
Chemicals: Transmission Fluid
Property Mngmt: Private
Fund Amount: Pvt/Unk
Quantity: Not reported

---

35 **SWIFT TRANSPORT** RCRIS-SQG 1000856761
3106 W BROADWAY FINDS AZD983483405
PHOENIX, AZ 85041

RCRIS:
Owner: JERRY MOYES
(602) 269-9700
Contact: GARY WEINBERGER
(602) 269-9700
Record Date: 06/14/1993
Classification: Small Quantity Generator
Used Oil Recyc: No

Violation Status: No violations found

FINDS:
Other Pertinent Environmental Activity Identified at Site:
Resource Conservation and Recovery Act Information system (RCRAINFO)

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36 **BOB AUTO AND PICKUP WRECKING** RCRIS-SQG 1000589618
3408 W BROADWAY FINDS AZD983473745
PHOENIX, AZ 85041

BOB AUTO AND PICKUP WRECKING (Continued) 1000589618

RCRIS:
Owner: BILL REEVES
(602) 246-1151
Contact: STEPHEN CORBEIL
(602) 276-2552
Record Date: 02/23/1998
Classification: Small Quantity Generator
Used Oil Recyc: No

Violation Status: No violations found

FINDS:
Other Pertinent Environmental Activity Identified at Site:
Facility Registry System (FRS)
Resource Conservation and Recovery Act Information system (RCRAINFO)

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36 **WESTERN STATES PETROLEUM** AZ Spills 1001480443
3331 W. BROADWAY N/A
PHOENIX, AZ 85041

Az Spills:
Facility ID: 85-093
Response Date: 07/30/85
Type: Release
Referred to: Not reported
Chemicals: Gasoline (Regular)
Property Mngmt: Private
Fund Amount: Pvt/Unk
Quantity: Not reported
Incident Date: 07/30/85
Report / Assist: Not reported
No of Samples: Ta

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36 **WESTERN STATES PETROLEUM** FINDS 1004438352
3331 W. BROADWAY RD. AZ0002454304
PHOENIX, AZ 85041

FINDS:
Other Pertinent Environmental Activity Identified at Site:
Facility Registry System (FRS)
Toxic Chemical Release Inventory System (TRIS)

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36 **URBAN FOREST PRODUCTS CO.** AZ Spills S104559649
3330 W. BROADWAY RD. N/A
PHOENIX, AZ

Az Spills:
Facility ID: 95-018-F
Response Date: 07/18/95
Type: Release
Referred to: AQD
Chemicals: Wood Chips
Property Mngmt: Private
Fund Amount: Pvt/Unk
Quantity: Not reported
Incident Date: 07/18/95
Report / Assist: Not reported
No of Samples: Wo

Map ID / Direction / Distance / Distance (ft.)	Site	Database(s)	EDR ID Number / EPA ID Number
36	**FUELCO #113** **3331 W BROADWAY** **PHOENIX, AZ 85009**	**LUST** **UST**	**U000735437** **N/A**

LUST:

Facility ID:	0-001652		
Lust Number:	2198.01		
Leak Priority:	CASE REFERRAL-NOT IN UST JURISDICTION		
Notification:	02/25/1992		
Date Closed:	06/16/1993		

UST:

Facility ID:	0-001652	Tank ID:	1
Owner:	WESTERN STATES PETROLEUM/R. KE	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	08/15/88		
Date Closed:	/ /		
In Use:	False		

Facility ID:	0-001652	Tank ID:	2
Owner:	WESTERN STATES PETROLEUM/R. KE	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	08/15/88		
Date Closed:	/ /		
In Use:	False		

Facility ID:	0-001652	Tank ID:	3
Owner:	WESTERN STATES PETROLEUM/R. KE	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	08/15/88		
Date Closed:	/ /		
In Use:	False		

36	**LIQUID AIR CORP.** **3332 W. BROADWAY** **PHOENIX, AZ**	**AZ Spills**	**S104851004** **N/A**

Az Spills:

Facility ID:	85-087	Incident Date:	07/12/85
Response Date:	Not reported	Report / Assist:	Not reported
Type:	Threat	No of Samples:	Ge
Referred to:	HWC/GWP		
Chemicals:	Caustic Slurry		
Property Mngmt:	Private		
Fund Amount:	Not reported		
Quantity:	Not reported		

36	**WESTERN STATES PETROLEUM** **3331 W. BROADWAY** **PHOENIX, AZ 85041**	**TRIS**	**1003888473** **85041WSTRN33**

36	**SELF SERVICE SALVAGE** **3250 W BROADWAY** **PHOENIX, AZ 85041**	**FINDS**	**1004175696** **000009001092**

SELF SERVICE SALVAGE (Continued) 1004175696

FINDS:
Other Pertinent Environmental Activity Identified at Site:
Facility Registry System (FRS)
Resource Conservation and Recovery Act Information system (RCRAINFO)

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36 **ROTMAN PROPERTIES** LUST U003050841
3250 W BROADWAY RD UST N/A
PHOENIX, AZ 85041

LUST:
Facility ID: 0-008079
Lust Number: 2648.01
Leak Priority: KNOWN OR PROBABLE AFFECT ON GW
Notification: 01/22/1993
Date Closed: Not reported

UST:
Facility ID: 0-008079 Tank ID: 1
Owner: ROTMAN PROPERTIES Owner ID: Not reported
Owner Contact: Not reported
In Use: False
Date Removed: 01/22/93
Date Closed: / /
In Use: False

Facility ID: 0-008079 Tank ID: 2
Owner: ROTMAN PROPERTIES Owner ID: Not reported
Owner Contact: Not reported
In Use: False
Date Removed: 01/22/93
Date Closed: / /
In Use: False

---

36 **RICKETTS TRUCKING INC** LUST U003153555
3434 W BROADWAY UST N/A
PHOENIX, AZ 85041

LUST:
Facility ID: 0-000762
Lust Number: 4953.01
Leak Priority: DEFINED SOIL LVL BETWN RESIDENTIAL AND NON STANDARDS VEMUR OPTION
Notification: 10/19/1998
Date Closed: Not reported

UST:
Facility ID: 0-000762 Tank ID: 1
Owner: RICKETTS TRUCKING INC Owner ID: Not reported
Owner Contact: Not reported
In Use: False
Date Removed: 01/01/86
Date Closed: / /
In Use: False

Facility ID: 0-000762 Tank ID: 2
Owner: RICKETTS TRUCKING INC Owner ID: Not reported
Owner Contact: Not reported
In Use: False
Date Removed: 01/01/86
Date Closed: / /

RICKETTS TRUCKING INC (Continued) U003153555

In Use: False

Facility ID: 0-000762 Tank ID: 3
Owner: RICKETTS TRUCKING INC Owner ID: Not reported
Owner Contact: Not reported
In Use: False
Date Removed: 09/10/98
Date Closed: / /
In Use: False

Facility ID: 0-000762 Tank ID: 4
Owner: RICKETTS TRUCKING INC Owner ID: Not reported
Owner Contact: Not reported
In Use: False
Date Removed: 09/10/98
Date Closed: / /
In Use: False

---

36 **PHILLIPS 66 COMPANY #016633** UST U001155187
3449 W BROADWAY N/A
PHOENIX, AZ 85041

UST:
Facility ID: 0-003739 Tank ID: 1
Owner: LA MANCHA DEVELOPMENT CORP Owner ID: Not reported
Owner Contact: Not reported
In Use: False
Date Removed: 04/01/88
Date Closed: / /
In Use: False

Facility ID: 0-003739 Tank ID: 2
Owner: LA MANCHA DEVELOPMENT CORP Owner ID: Not reported
Owner Contact: Not reported
In Use: False
Date Removed: 04/01/88
Date Closed: / /
In Use: False

Facility ID: 0-003739 Tank ID: 3
Owner: LA MANCHA DEVELOPMENT CORP Owner ID: Not reported
Owner Contact: Not reported
In Use: False
Date Removed: 04/01/88
Date Closed: / /
In Use: False

Facility ID: 0-003739 Tank ID: 4
Owner: LA MANCHA DEVELOPMENT CORP Owner ID: Not reported
Owner Contact: Not reported
In Use: False
Date Removed: 04/01/88
Date Closed: / /
In Use: False

Map ID Direction Distance Distance (ft.)	Site	Database(s)	EDR ID Number EPA ID Number
36	MANZANITA SPEEDWAY 35TH AVE. / WEST BROADWAY ROAD PHOENIX, AZ 85041	SHWS	S103391973 N/A

SHWS:

EPA ID:	Not reported
Program:	WQARF
Facility Id:	912
Site Code:	Not reported
Discovery Date:	Not reported
Source:	Not reported
Operable Unit:	0
QWARF Area:	Not reported
Lat/Long:	Not reported
Lat/Long Method:	80
Comments:	Not reported

37	6842 W.ROMLEY 6842 W.ROMLEY PHOENIX, AZ	ERNS	96475004 N/A

38	CALMAT COMPANIES THE 4830 S 43RD AVE PHOENIX, AZ 85041	FINDS	1004176098 000009005444

FINDS:

Other Pertinent Environmental Activity Identified at Site:
Facility Registry System (FRS)
Resource Conservation and Recovery Act Information system (RCRAINFO)

38	CALMAT YARD 4830 S 43RD AVE PHOENIX, AZ 85043	LUST UST	U000738588 N/A

LUST:

Facility ID:	0-007824
Lust Number:	0862.01
Leak Priority:	CASE REFERRAL-NOT IN UST JURISDICTION
Notification:	09/01/1989
Date Closed:	01/12/1990

UST:

Facility ID:	0-007824	Tank ID:	1
Owner:	WESTERN STATES PETROLEUM/R. KEO	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	09/01/89		
Date Closed:	/ /		
In Use:	False		

39	DIVERSIFIED CONTRACTORS, INC. 4054 WIER AVE PHOENIX, AZ 85041	WWFAC	S102788201 N/A

AZ WWFAC:

Owner Address:	1701 W. Linden St - Ste A Phoenix, A Z8500

40 **4842 S. 36TH AVE** — **ERNS** — **93329484**
4842 S. 36TH AVE — **N/A**
PHOENIX, AZ 85009

---

41 **WILSON, R.L.** — **AZ Spills** — **S104559617**
3748 W. ROMLEY — **N/A**
PHOENIX, AZ

Az Spills:

Facility ID:	96-054-B	Incident Date:	07/09/96
Response Date:	07/09/96	Report / Assist:	Not reported
Type:	Threat	No of Samples:	Mi
Referred to:	Not reported		
Chemicals:	Drug Lab Chemicals		
Property Mngmt:	Federal		
Fund Amount:	DEA/Unk		
Quantity:	Not reported		

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42 **TATEL INC** — **UST** — **U001628050**
5250 S 43RD AVE — **N/A**
PHOENIX, AZ 85041

UST:

Facility ID:	0-006526	Tank ID:	1
Owner:	TATEL INC	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	True		
Date Removed:	/ /		
Date Closed:	/ /		
In Use:	True		

Facility ID:	0-006526	Tank ID:	2
Owner:	TATEL INC	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	True		
Date Removed:	/ /		
Date Closed:	/ /		
In Use:	True		

---

42 **CORESLAB STRUCTURES INC** — **LUST** — **U003050144**
5026 S 43RD AVE — **UST** — **N/A**
LAVEEN, AZ 85339

LUST:

Facility ID:	0-004737
Lust Number:	3515.01
Leak Priority:	CLOSED SOIL LVL MEETS TIER1
Notification:	05/11/1994
Date Closed:	01/20/2000

UST:

Facility ID:	0-004737	Tank ID:	1
Owner:	CORESLAB STRUCTURES INC	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	05/06/94		
Date Closed:	/ /		
In Use:	False		

Facility ID:	0-004737	Tank ID:	2

CORESLAB STRUCTURES INC (Continued) U003050144

Owner:	CORESLAB STRUCTURES INC	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	05/06/94		
Date Closed:	/ /		
In Use:	False		
Facility ID:	0-004737	Tank ID:	3
Owner:	CORESLAB STRUCTURES INC	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	False		
Date Removed:	05/10/94		
Date Closed:	/ /		
In Use:	False		

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42 **CORESLAB STRUCTURES, INC** Aquifer S102788050
5026 S. 43RD AVE WWFAC N/A
PHOENIX, AZ 85005

AQUIFER:

App #:	P101428
Invoice #:	101428
Owner Address:	P.O. Box 18150 Phoenix, AZ 85005
Contact Name:	Coreslab Structures
Attention:	Not reported

AZ WWFAC:

Owner Address:	P.O. Box 18150 Phoenix, A Z8500

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42 **CORESLAB STRUCTURES, ARIZ INC** WWFAC S102788048
5026 SOUTH 43RD AVENUE N/A
PHX, AZ 85041

AZ WWFAC:

Owner Address:	P.O. Box 1868 Cedar Park, T X7863

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42 **CORE SLAB STRUCTURES** AST A100170473
5026 SOUTH 43RD AVENUE N/A
LAVEEN, AZ

AST:

Facility Status:	Not reported
Group Code:	AGSTS
Ownership:	Not reported
Owner:	Stanley Ruben
Owner Telephone:	Not reported
Comments:	Not reported

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43 **5040 S 51ST AVE** ERNS 92270867
5040 S 51ST AVE N/A
LAVEEN, AZ 85334

43 **ARIZONA OIL RECYCLERS ASSOC** | RCRIS-SQG | 1000589593
5040 S 51ST AVE | FINDS | AZD983473497
PHOENIX, AZ 85043 | CA HAZNET

RCRIS:
Owner: GEORGE F BOLDUC
(602) 266-5515
Contact: BETTY TOMASELLO
(602) 266-5515
Record Date: 11/20/1991
Classification: Hazardous Waste Transporter
Used Oil Recyc: Yes

Violation Status: No violations found

FINDS:
Other Pertinent Environmental Activity Identified at Site:
Facility Registry System (FRS)
Resource Conservation and Recovery Act Information system (RCRAINFO)

HAZNET:
Gepaid: AZD983473497
Tepaid: CAT080013352
Gen County: 99
Tsd County: Los Angeles
Tons: 52.1250
Category: Waste oil and mixed oil
Disposal Method: Not reported
Contact: Not reported
Telephone: (000) 000-0000
Mailing Address: 5040 S 51ST AVE
PHOENIX, AZ 85043
County 99

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43 **AZ OIL RECYCLERS** | AZ Spills | S100885708
5040 SO. 51 AVE. | N/A
PHOENIX, AZ

Az Spills:
Facility ID: 92-008-D
Response Date: 04/21/92
Type: Release
Referred to: Not reported
Chemicals: Oil
Property Mngmt: Private
Fund Amount: Not reported
Quantity: Not reported
Incident Date: 04/21/92
Report / Assist: Not reported
No of Samples: AS

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44 **CJ JOREGENSTEN ELEMENTARY SCHOOL** | AZ Spills | S104851077
1701 W. ROESER, RM 31 | N/A
PHOENIX, AZ

Az Spills:
Facility ID: 99-065-D
Response Date: 11/25/98
Type: Release
Referred to: Not reported
Chemicals: Mercury
Property Mngmt: City
Fund Amount: Pvt/Unk
Incident Date: 11/25/98
Report / Assist: Not reported
No of Samples: Co

CJ JOREGENSTEN ELEMENTARY SCHOOL (Continued) S104851077

Quantity: Not reported

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45 **BEST DISPOSAL** AZ Spills S104560235
5436 SO. 43 AVENUE N/A
PHOENIX, AZ

Az Spills:

Facility ID:	94-072-B	Incident Date:	12/21/94
Response Date:	12/21/94	Report / Assist:	Not reported
Type:	Release	No of Samples:	Ta
Referred to:	HWI		
Chemicals:	Diesel		
Property Mngmt:	Private		
Fund Amount:	Pvt/Unk		
Quantity:	Not reported		

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45 **5436 S. 43RD AVE.** ERNS 94418485
5436 S. 43RD AVE. N/A
PHOENIX, AZ 85041

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46 **EDWARD S KELTON CONTRACTI** MINES M100004682
N/A

MARICOPA (County), AZ

U.S. MINES:

Mine ID:	0201624	SIC Codes:	14410 00000 00000 00000 00000 00000
Entity Name:	PORTABLE PLANT =2	Company:	EDWARD S KELTON CONTRACTI
State FIPS code:	04	County FIPS code:	013
Status Date:	02/11/1983	Status:	permanently abandoned
Operation Class:	Non-coal mining	Number of Shops:	0
Number of Pits:	000	Number of Plants:	0
Latitude:	33 23 40	Longitude:	112 13 42

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47 **CHANDLER CONVERTER REBUILDERS** RCRIS-SQG 1000310860
284 E CHILTON DR STE 9 FINDS AZD982481780
CHANDLER, AZ 85225

RCRIS:

Owner: RAY VANDOYER
(415) 555-1212

Contact: ENVIRONMENTAL MANAGER
(602) 497-0881

Record Date: 05/18/1998
Classification: Small Quantity Generator
Used Oil Recyc: No

Violation Status: No violations found

CHANDLER CONVERTER REBUILDERS (Continued) — 1000310860

FINDS:
Other Pertinent Environmental Activity Identified at Site:
Facility Registry System (FRS)
Resource Conservation and Recovery Act Information system (RCRAINFO)

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47 **IRON HORSE EQUIPMENT CORP** — RCRIS-SQG, FINDS — 1000305213, AZD982469546
7316 W SOUTHERN
LAVEEN, AZ 85339

RCRIS:
Owner: JIM GOLSON
(415) 555-1212
Contact: ENVIRONMENTAL MANAGER
(602) 237-3330
Record Date: 02/22/1989
Classification: Small Quantity Generator
Used Oil Recyc: No

Violation Status: No violations found

FINDS:
Other Pertinent Environmental Activity Identified at Site:
Facility Registry System (FRS)
Resource Conservation and Recovery Act Information system (RCRAINFO)

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47 **CEMEX USA - LAVEEN PLANT** — FINDS — 1004432585, 000012109860
6002 S 75TH AVE
LAVEEN, AZ 85009

FINDS:
Other Pertinent Environmental Activity Identified at Site:
AIRS Facility System (AIRS/AFS)

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48 **A-1 TIRE CO.** — AZ Spills — S104560407, N/A
4825 W. SOUTHERN
LAVEEN, AZ

Az Spills:
Facility ID: 90-091-D
Response Date: 07/05/90
Type: Fire
Referred to: AGO
Chemicals: Tires
Property Mngmt: Private
Fund Amount: WQARF/25.K
Quantity: Not reported
Incident Date: 07/05/90
Report / Assist: Not reported
No of Samples: Ti

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49 **5922 W SOUTHERN** — ERNS — 92322443, N/A
5922 W SOUTHERN
LAVEEN, AZ 85339

Map ID
Direction
Distance
Distance (ft.) Site | Database(s) | EDR ID Number / EPA ID Number

49 **USA TIRE RECYCLING** — AZ Spills — S104560410
5922 W. SOUTHERN — N/A
LAVEEN, AZ

Az Spills:

Facility ID:	92-087-B	Incident Date:	09/28/92
Response Date:	09/28/92	Report / Assist:	Not reported
Type:	Fire	No of Samples:	Ti
Referred to:	Not reported		
Chemicals:	Tires		
Property Mngmt:	Private		
Fund Amount:	WQARF/50K		
Quantity:	Not reported		

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49 **POHLCAT MOUNTAIN VIEW GOLF COURSE** — AST — A100156360
5841 WEST SOUTHERN AVE. — N/A
PHOENIX, AZ

AST:

Facility Status:	Not reported
Group Code:	AGSTS
Ownership:	Not reported
Owner:	Mark J. Davis, Golf 36 Corp. 4440 South Rural Rd. Suite 201 Tempe, AZ
Owner Telephone:	Not reported
Comments:	Not reported

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50 **W W T P 91ST AVE** — RCRIS-SQG, FINDS — 1000344402, AZT050010123
91ST AVE SOUTHERN
PHOENIX, AZ 85037

RCRIS:

Owner:	JOINT OWNERSHIP MULTICITY (415) 555-1212
Contact:	ENVIRONMENTAL MANAGER (602) 262-1827
Record Date:	08/18/1980
Classification:	Conditionally Exempt Small Quantity Generator
Used Oil Recyc:	No

Violation Status: No violations found

FINDS:
Other Pertinent Environmental Activity Identified at Site:
Enforcement Docket System (DOCKET)
Resource Conservation and Recovery Act Information system (RCRAINFO)

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51 **ARNOLD MACHINERY CO OF ARIZONA** — RCRIS-SQG, FINDS — 1000856724, AZD983482951
6024 W SOUTHERN AVE
LAVEEN, AZ 85339

ARNOLD MACHINERY CO OF ARIZONA (Continued) 1000856724

RCRIS:
Owner: ARNOLD MACHINERY 10
(801) 972-4000

Contact: KEN ANDERSON
(602) 237-3755

Record Date: 05/04/1993
Classification: Small Quantity Generator
Used Oil Recyc: No

Violation Status: No violations found

FINDS:
Other Pertinent Environmental Activity Identified at Site:
Facility Registry System (FRS)
Resource Conservation and Recovery Act Information system (RCRAINFO)

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51 **ARNOLD MACHINERY COMPANY #4627** UST U003229062
6024 W SOUTHERN N/A
LAVEEN, AZ 85339

UST:

Facility ID:	0-006232	Tank ID:	1
Owner:	ARNOLD MACHINERY CO	Owner ID:	Not reported
Owner Contact:	Not reported		
In Use:	True		
Date Removed:	/ /		
Date Closed:	/ /		
In Use:	True		

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52 **MOBILE SOIL PROCESSING UNIT** RCRIS-SQG 1000254228
5922 W SOUTHERN RT 1 BOX 270 FINDS AZD982039745
LAVEEN, AZ 85339

RCRIS:
Owner: BARNHART GAYLE
(415) 555-1212

Contact: ENVIRONMENTAL MANAGER
(602) 237-2014

Record Date: 09/01/1987
Classification: Not reported
Used Oil Recyc: No

Violation Status: No violations found

FINDS:
Other Pertinent Environmental Activity Identified at Site:
Facility Registry System (FRS)
Resource Conservation and Recovery Act Information system (RCRAINFO)

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53 **WESTERN MEAT COMPANY** LUST U001000035
7201 W SOUTHERN AVE UST N/A
LAVEEN, AZ 85339 WWFAC

LUST:
Facility ID: 0-000846

WESTERN MEAT COMPANY (Continued) U001000035

Lust Number: 4431.01 0771.03
Leak Priority: LUST CASE COMBINED - CLOSED OUT
Notification: 04/23/1996
Date Closed: 10/30/1997

AZ WWFAC:
Owner Address: 7201 West Southern Avenue
Laveen, A Z8533

UST:
Facility ID: 0-000846 Tank ID: 1
Owner: WESTERN MEAT COMPANY Owner ID: Not reported
Owner Contact: Not reported
In Use: False
Date Removed: 05/05/90
Date Closed: / /
In Use: False

Facility ID: 0-000846 Tank ID: 2
Owner: WESTERN MEAT COMPANY Owner ID: Not reported
Owner Contact: Not reported
In Use: False
Date Removed: 01/07/92
Date Closed: / /
In Use: False

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54 **IR INDUSTRIES** RCRIS-SQG 1000352281
83RD AVENUE FINDS AZD980881304
TOLLESON, AZ 85353

RCRIS:
Owner: NOT REQUIRED
(415) 555-1212
Contact: ENVIRONMENTAL MANAGER
(602) 257-0422
Record Date: 11/04/1992
Classification: Not reported
Used Oil Recyc: No
Violation Status: No violations found

FINDS:
Other Pertinent Environmental Activity Identified at Site:
Resource Conservation and Recovery Act Information system (RCRAINFO)

City	EDR ID	Site Name	Site Address	Zip	Database(s)	Facility ID
LAVEEN	S104826871	LAS LOMAS DAIRY INC.	ROUTE 1 BOX 82	85353	WWFAC	
LAVEEN	S104826899	MESQUITE DAIRY	ROUTE 1 BOX 79-H	85339	WWFAC	
LAVEEN	1000182491	STACY WHITE FARM	31ST AVE DOBBINS RD	85339	FINDS, RCRIS-LQG	
LAVEEN	1000332151	FLOOD CONTROL DISTRICT	67TH AVE GILA RIVER	85339	RCRIS-SQG, FINDS	
LAVEEN	94393623	AREA OF 67TH AVENUE AND ALTA VISTA	AREA OF 67TH AVENUE AND ALTA VISTA	85339	ERNS	
LAVEEN	U003049882	PAUL E OLIVER	4023 W ELLIOT RD RT BOX 576	85339	UST	0-003550
LAVEEN	S103931971	TAYLOR, WILLIAM, FLYING SERVICE	T1S R2E SEC 20	85043	SHWS	AZD980883490
MARICOPA COUNTY	S103895113	DEER VALLEY	19TH AVE. AND SOUTH OF GREENWAY		SWF/LF	
MARICOPA COUNTY	S103895110	CITY OF PHOENIX 22ND AVE.	22ND AVE. AND LOWER BUCKEYE RD.		SWF/LF	
MARICOPA COUNTY	S103895104	ARIZONA SAND & ROCK	AGUA FRIA RIVER AND GRAND AVE.		SWF/LF	
MARICOPA COUNTY	S103895000	MARTORI FARMS	AGUILA, AZ		SWF/LF	
MARICOPA COUNTY	S103278189	QUEEN CREEK	26402 B.SOUTH HAWES RD.1/2 MILE S.OF CHANDLE HIGHT		SWF/LF, WWFAC	
MARICOPA COUNTY	S103895106	BEARDSLEY	BETWEEN CENTRAL AVE. AND 7TH ST SOUTH BEARDSLEY		SWF/LF	
MARICOPA COUNTY	S103277500	DEL RIO	BETWEEN 7TH AND 16TH ST. NORTH OF ELWC RD.		SWF/LF, WWFAC	
MARICOPA COUNTY	S103894989	ARIZONA MEDICAL WASTE	2 BLOCKS NORTH OF CAMELBACK RD. ON 51S AVE. 2 BLO		SWF/LF	
MARICOPA COUNTY	S103086637	RESOURCE PROCESSING INC.	CENTRAL PORTION OF GILA BEND BASIN		SWF/LF	
MARICOPA COUNTY	S103894997	DEER VALLEY	SW CORNER OF 12TH ST. AND ALAMEDA		SWF/LF	
MARICOPA COUNTY	S103895108	CITY OF MESA	NORTHEAST CORNER OF CENTER ST. AND LE RD.		SWF/LF	
MARICOPA COUNTY	S103895118	LAYLOR MATERIALS	NORTHEAST CORNER OF 16TH ST. BEARDSLE		SWF/LF	
MARICOPA COUNTY	S103895127	UFI	SOUTHEAST CORNER OF 123RD. AVE. AND BE RD.		SWF/LF	
MARICOPA COUNTY	S103895128	VAL VISTA	SOUTHEAST CORNER OF RAY RD. AND VAL VISTA DR		SWF/LF	
MARICOPA COUNTY	S103895130	WILLIAMS AIR FORCE BASE	SOUTHWEST CORNER OF WILLIAMS AIR FORC BASE		SWF/LF	
MARICOPA COUNTY	S103895120	OLD TOWN DUMP	DYSART RD. TO RID CANAL NORTH OF THOM/ MILE		SWF/LF	
MARICOPA COUNTY	S103895115	GENERAL MOTORS PROVING GROUNDS	ELLIOT RD. EAST TO SOSSMAN RD. SOUTH TC WARNER GO		SWF/LF	
MARICOPA COUNTY	S103894995	CITY OF CHANDLER	GILA AND SALT RIVER BASE AND MERIDIAN		SWF/LF	
MARICOPA COUNTY	S103086668	CHANDLER INT. #1 INTERIM	SOUTHEAST INTERSECTION OF FRYE AND DOBSON RD.		SWF/LF	
MARICOPA COUNTY	S103809877	WQ-GILA RIVER DDT	LOWER GILA RIVER--SW AZ		SHWS	
MARICOPA COUNTY	S103895116	GOODYEAR - SUMP #1	1 MILE NORTH OF MC DOWELL RD.		SWF/LF	
MARICOPA COUNTY	S103895119	MORRISTOWN	1 MILE SOUTH OF US 60 OFF MORRISTOWN OVERPASS		SWF/LF	
MARICOPA COUNTY	S103895123	SALT RIVER/PIMA TRIBE/TRI-CITY	1 MILE NORTH OF MC DOWELL ON THE BEELI HIGHWAY A		SWF/LF	

City	EDR ID	Site Name	Site Address	Zip	Database(s)	Facility ID
MARICOPA COUNTY	S103895109	CITY OF PHOENIX 19TH AVE.	1 MILE SOUTH OF I-17ON EAST SIDE OF 19TH AVE.		SWF/LF	
MARICOPA COUNTY	S103278512	TERRA QUEST	1.5 MILE SOUTH OF BASELINE EAST SIDE PRIEST AVE. A		SWF/LF, WWFAC	
MARICOPA COUNTY	S103086670	CHANDLER INT. #3 INTERIM	MILE NORTH OF GERMAN RD. MILE EAST OF GILBERT RD.		SWF/LF	
MARICOPA COUNTY	S103895202	UNION ROCK CENTRAL AVE.	.25 MILES SOUTH OF I-17 ON CENTRAL AVE. WEST .25MI		SWF/LF	
MARICOPA COUNTY	S103895005	REMAT/METCO RECYCLING FACILITY	3 1/2 MILES SOUTH OF I-10 AT 830 N. MILLER RD.CENT		SWF/LF	
MARICOPA COUNTY	S103894988	ALLIED WASTE SOUTHWEST REGIONAL	6 MILES SOUTH OF BUCKEYE		SWF/LF	
MARICOPA COUNTY	S100293348	CAVE CREEK	8.3 MILES EAST OF I-17 ON THE SOUTH		SWF/LF	
MARICOPA COUNTY	S100293351	GILA BEND	3.4 MILES N OF AZ. 85 ON WEST SIDE		SWF/LF	
MARICOPA COUNTY	S100293356	NORTHWEST REGIONAL	3.5 MILES WEST OF U.S. 89 ON DEER V		SWF/LF	
MARICOPA COUNTY	S100293357	QUEEN CREEK	.5 MILES S OF CHANDLER HEIGHTS ROAD		SWF/LF	
MARICOPA COUNTY	S100293360	WEINBERGER	.5 MILES SOUTH OF LOWER BUCKEYE ROA		SWF/LF	
MARICOPA COUNTY	S103894987	APS/PALO VERDE RUBBISH	6 MILES SOUTH OF I-10 ON WINTERSBERG RD.WEST OF PH		SWF/LF	
MARICOPA COUNTY	S103895103	AGUILA	3.1 MILES WEST OF AQUILA ON THE SOUTH SIDE OF US		SWF/LF	
MARICOPA COUNTY	S103278201	RAINBOW VALLEY	5.5 MILES FROM AZ 85 WEST TO AIRPORT RD. SOUTH OF		SWF/LF, WWFAC	
MARICOPA COUNTY	S100293355	NEW RIVER	4.3 MILES W OF I-17 ON THE E SIDE O		SWF/LF	
MARICOPA COUNTY	S103895200	TOWN OF WICKENBURG	4.6 MILES WEST OF INTERSECTION OF US 60 AND AZ 89		SWF/LF	
MARICOPA COUNTY	S103086710	SATORISE (EARTHWORKS)	1.5 MILES EAST OF I-17 ON END OF GREENWAY RD.		SWF/LF	
MARICOPA COUNTY	S103277326	BUCKEYE	AT MILLER RD. AND GILA RIVER		SWF/LF, WWFAC	
MARICOPA COUNTY	S103894996	CITY OF GLENDALE	NORTHSIDE OF GLENDALE AVE.EAST OF THE AGUA FRIA RI		SWF/LF	
MARICOPA COUNTY	S100240624	ALLIED	SOUTH OF INDIAN SCHOOL RD, WEST SID		SWF/LF	
MARICOPA COUNTY	S103894998	K & B TIRE CO.	SOUTH OF MC DOWELL RD. BETWEEN 27TH A 19TH. AVE.		SWF/LF	
MARICOPA COUNTY	S103895002	NORTHWEST REGIONAL	SOUTH OF 195TH AVE AND DEER VALLEY		SWF/LF	
MARICOPA COUNTY	S103894990	BAKER SOUTHWEST	11400 E. PECOS RD.EAST OF ELLSWORTH RD.ON PECOS RD		SWF/LF	
MARICOPA COUNTY	S103895105	AVONDALE	NORTH SIDE OF INTERSECTION OF US 80 AND AGUA FRIA		SWF/LF	
MARICOPA COUNTY	S103895112	CITY OF TEMPE	SOUTH SIDE OF SALT RIVER ON HAYDEN DR.		SWF/LF	
MARICOPA COUNTY	S103086789	CHANDLER INT. #2 INTERIM	SOUTH SIDE OF QUEEN CREEK RD. 1 MILE EA OF VAL VI		SWF/LF	
MARICOPA COUNTY	S103895111	CITY OF PHOENIX 91ST AVE.	WEST SIDE OF 91ST. AVE.		SWF/LF	
MARICOPA COUNTY	S103895114	ESTES	EAST SIDE OF 40TH ST. SOUTH OF THE SALT RIVER		SWF/LF	
MARICOPA COUNTY	S100293344	27TH AVENUE	THE SOUTHWEST CORNER OF 27TH AVE AN		SWF/LF	
MARICOPA COUNTY	S100293350	DEER VALLEY LANDFILL	THE SOUTHWEST CORNER OF 16TH STREET		SWF/LF	
MARICOPA COUNTY	S100293354	LONE CACTUS LANDFILL	ON THE N WEST CORNER OF 7TH ST /		SWF/LF	

City	EDR ID	Site Name	Site Address	Zip	Database(s)	Facility ID
MARICOPA COUNTY	S103895121	PERRYVILLE	YUMA RD. EAST OF LUKE AIR FORCE AUXILAF FIELD #		SWF/LF	
PHOENIX	S103391935	UNKNOWN 4	2XX S. 16TH AVE.	85007	SHWS	
PHOENIX	S103658688	1X INTERSTATE COATING	420 SOUTH 19TH AVE	85009	HAZNET	
PHOENIX	S103391972	19TH AVE. LANDFILL	19TH AVE	85041	SHWS	AZD980496780
PHOENIX	1000993816	PHOENIX SOUTHWEST SERVICE CITY OF	3045 S 22ND AVE SWSC	85041	PADS, RCRIS-SQG, FINDS	
PHOENIX	1000978024	THERMO FLUIDS INC BUCKEYE	1201 S 39TH AVE	85043	RCRIS-SQG, FINDS	
PHOENIX	1000472666	BENNETT OIL COMPANY	54 N 45TH AVE STE I	85043	RCRIS-SQG, FINDS	
PHOENIX	1000284175	WILLIAMS FARMS	51ST AVE ESTRELLA RD	85043	RCRIS-SQG, FINDS	
PHOENIX	S102789171	MOTOROLA - 52ND STREET	52ND STREET		Aquifer, WWFAC	P101592
PHOENIX	1001492787	DIVERSIFIED TRANSPORTATION INC	1649 S 59TH AVE STE E	85043	RCRIS-SQG, FINDS	
PHOENIX	S103391974	ARIZONA DIESEL ENGINES	2XX S. 59TH AVE.	85043	SHWS	
PHOENIX	S102788806	KIERLAND GOLF COURSE	66TH STREET, N. OF GREENW		WWFAC	
PHOENIX	S103809881	WQ-WADDELL DAM PROJECT	T. 6N, R.1E SEC. 21		SHWS	
PHOENIX	S103932000	OLD 91ST AVE SLIDGE DISPOSAL PONDS	91ST AVE / SALT RIVER	85353	SHWS	AZD981679707
PHOENIX	92288690	IN A REMOTE AREA OF NORTH PHOENIX	IN A REMOTE AREA OF NORTH PHOENIX		ERNS	
PHOENIX	S103278113	PHOENIX, CITY OF - CAVE CREEK	ACCESS ROAD TO AZ VETS CE		Aquifer, WWFAC	P103320
PHOENIX	92256445	AREA OF 6TH & OSBORNE	AREA OF 6TH & OSBORNE		ERNS	
PHOENIX	S103809875	WQ-WELL CONST. STUDY	AREA WIDE		SHWS	
PHOENIX	S103809874	WQ-WEST VAN BUREN AREA	AREA WIDE		SHWS	
PHOENIX	S103809876	WQ-WEST CENTRAL PHOENIX	AREA WIDE		SHWS	
PHOENIX	96497684	ON B.L.M LAND NORTH OF BEARDSLEY IN THE AREA OF 112TH STREET	ON B.L.M LAND NORTH OF BEARDSLEY IN THE AREA OF 112TH STREET		ERNS	
PHOENIX	S103978218	MONOHAN CORP	3717 E BROADWAY RD STE 6		HAZNET	
PHOENIX	S103391932	MARICOPA CO. MATERIAL FACILITY WAREHOUSE	319 W. BUCHANAN	85007	SHWS	
PHOENIX	S103391939	ADRIEN'S COMPLETE AUTO BODY REPAIR	24XX W. BUCKEYE RD.	85009	SHWS	
PHOENIX	S103809871	WQ-EAST CENTRAL PHOENIX	CAMELBACK TO THOMAS, 16TH TO 56TH STRE		SHWS	
PHOENIX	1000399295	UNITED TRUCK & EQUIPMENT	SE COR OF JONES / S 19TH AVE	85041	SHWS, WWFAC	AZD081686107
PHOENIX	1001260809	CHEVRON PHOENIX TERMINAL	SW CORNER VAN BUREN / T1ST AVE	85043	SHWS	AZT000615286
PHOENIX	S103391979	CHEVRON USA, INC.	SW CORNER VAN BUREN / T1ST AVE	85043	SHWS	AZT000615286
PHOENIX	96475605	DOING UPGRADES AND FOUND A LEAK IN DISPENSER AREA UNK CAUSE	DOING UPGRADES AND FOUND A LEAK IN DISPENSER AREA UNK CAUSE		ERNS	
PHOENIX	98418204	DUMP AREA	DUMP AREA		ERNS	
PHOENIX	98421397	DYNAIR CARGO AREA	DYNAIR CARGO AREA		ERNS	
PHOENIX	92288716	FACILITY HAZ WASTE STORAGE AREA	FACILITY HAZ WASTE STORAGE AREA		ERNS	
PHOENIX	96476170	FEDERAL EXPRESS AREA PHOENIX SKY HARBOR	FEDERAL EXPRESS AREA PHOENIX SKY HARE		ERNS	
PHOENIX	1000818038	ADOT EAST AREA LAB	2003 E JACKSON	85009	RCRIS-SQG, FINDS	
PHOENIX	1000227522	BASF WYANDOTTE CORP RINCH	1550 W LOWER BUCKEYE RD B	85007	FINDS, RCRIS-LQG	
PHOENIX	S103391953	VALLEY STEEL	3XXX W. LOWER BUCKEYE	85009	SHWS	
PHOENIX	S100412096	EXXON	XX MADISON	85043	SHWS	
PHOENIX	S103809883	RIO SALADO PROJECT - PHOENIX REACH	SALT RIVER I-10 OVERPASS/19TH AVE OVERPASS		SHWS	
PHOENIX	S103278757	WESTCO 43 BUSINESS PARK	SWC OF VAN BUREN / 43RD A		WWFAC	
PHOENIX	S103391984	MADDUX	XXX N. 69TH AVE	85043	SHWS	
TOLLESON	S104826843	HEARTLAND DAIRY I	11901 W. LOWER BUCKEYE RO	85353	WWFAC	
TOLLESON	S104827068	VAN'S DAIRY	11926 WEST SOUTHERN AVENU	85353	WWFAC	

EPA Waste Codes Addendum

Code	Description
D001	IGNITABLE HAZARDOUS WASTES ARE THOSE WASTES WHICH HAVE A FLASHPOINT OF LESS THAN 140 DEGREES FAHRENHEIT AS DETERMINED BY A PENSKY-MARTENS CLOSED CUP FLASH POINT TESTER. ANOTHER METHOD OF DETERMINING THE FLASH POINT OF A WASTE IS TO REVIEW THE MATERIAL SAFETY DATA SHEET, WHICH CAN BE OBTAINED FROM THE MANUFACTURER OR DISTRIBUTOR OF THE MATERIAL. LACQUER THINNER IS AN EXAMPLE OF A COMMONLY USED SOLVENT WHICH WOULD BE CONSIDERED AS IGNITABLE HAZARDOUS WASTE.
D002	A WASTE WHICH HAS A PH OF LESS THAN 2 OR GREATER THAN 12.5 IS CONSIDERED TO BE A CORROSIVE HAZARDOUS WASTE. SODIUM HYDROXIDE, A CAUSTIC SOLUTION WITH A HIGH PH, IS OFTEN USED BY INDUSTRIES TO CLEAN OR DEGREASE PARTS. HYDROCHLORIC ACID, A SOLUTION WITH A LOW PH, IS USED BY MANY INDUSTRIES TO CLEAN METAL PARTS PRIOR TO PAINTING. WHEN THESE CAUSTIC OR ACID SOLUTIONS BECOME CONTAMINATED AND MUST BE DISPOSED, THE WASTE WOULD BE A CORROSIVE HAZARDOUS WASTE.
D003	A MATERIAL IS CONSIDERED TO BE A REACTIVE HAZARDOUS WASTE IF IT IS NORMALLY UNSTABLE, REACTS VIOLENTLY WITH WATER, GENERATES TOXIC GASES WHEN EXPOSED TO WATER OR CORROSIVE MATERIALS, OR IF IT IS CAPABLE OF DETONATION OR EXPLOSION WHEN EXPOSED TO HEAT OR A FLAME. ONE EXAMPLE OF SUCH WASTE WOULD BY WASTE GUNPOWDER.
D004	ARSENIC
D005	BARIUM
D006	CADMIUM
D007	CHROMIUM
D008	LEAD
D009	MERCURY
D010	SELENIUM
D011	SILVER
D018	BENZENE
D019	CARBON TETRACHLORIDE
D021	CHLOROBENZENE
D022	CHLOROFORM
D026	CRESOL
D027	1,4-DICHLOROBENZENE
D028	1,2-DICHLOROETHANE

EPA Waste Codes Addendum

Code	Description
D030	2,4-DINITROTOLUENE
D035	METHYL ETHYL KETONE
D038	PYRIDINE
D039	TETRACHLOROETHYLENE
D040	TRICHLOROETHYLENE
F001	THE FOLLOWING SPENT HALOGENATED SOLVENTS USED IN DEGREASING: TETRACHLOROETHYLENE, TRICHLOROETHYLENE, METHYLENE CHLORIDE, 1,1,1-TRICHLOROETHANE, CARBON TETRACHLORIDE, AND CHLORINATED FLUOROCARBONS; ALL SPENT SOLVENT MIXTURES/BLENDS USED IN DEGREASING CONTAINING, BEFORE USE, A TOTAL OF TEN PERCENT OR MORE (BY VOLUME) OF ONE OR MORE OF THE ABOVE HALOGENATED SOLVENTS OR THOSE SOLVENTS LISTED IN F002, F004, AND F005, AND STILL BOTTOMS FROM THE RECOVERY OF THESE SPENT SOLVENTS AND SPENT SOLVENT MIXTURES.
F002	THE FOLLOWING SPENT HALOGENATED SOLVENTS: TETRACHLOROETHYLENE, METHYLENE CHLORIDE, TRICHLOROETHYLENE, 1,1,1-TRICHLOROETHANE, CHLOROBENZENE, 1,1,2-TRICHLORO-1,2,2-TRIFLUOROETHANE, ORTHO-DICHLOROBENZENE, TRICHLOROFLUOROMETHANE, AND 1,1,2-TRICHLOROETHANE; ALL SPENT SOLVENT MIXTURES/BLENDS CONTAINING, BEFORE USE, A TOTAL OF TEN PERCENT OR MORE (BY VOLUME) OF ONE OR MORE OF THE ABOVE HALOGENATED SOLVENTS OR THOSE LISTED IN F001, F004, OR F005, AND STILL BOTTOMS FROM THE RECOVERY OF THESE SPENT SOLVENTS AND SPENT SOLVENT MIXTURES.
F003	THE FOLLOWING SPENT NON-HALOGENATED SOLVENTS: XYLENE, ACETONE, ETHYL ACETATE, ETHYL BENZENE, ETHYL ETHER, METHYL ISOBUTYL KETONE, N-BUTYL ALCOHOL, CYCLOHEXANONE, AND METHANOL; ALL SPENT SOLVENT MIXTURES/BLENDS CONTAINING, BEFORE USE, ONLY THE ABOVE SPENT NON-HALOGENATED SOLVENTS; AND ALL SPENT SOLVENT MIXTURES/BLENDS CONTAINING, BEFORE USE, ONE OR MORE OF THE ABOVE NON-HALOGENATED SOLVENTS, AND, A TOTAL OF TEN PERCENT OR MORE (BY VOLUME) OF ONE OR MORE OF THOSE SOLVENTS LISTED IN F001, F002, F004, AND F005, AND STILL BOTTOMS FROM THE RECOVERY OF THESE SPENT SOLVENTS AND SPENT SOLVENT MIXTURES.
F004	THE FOLLOWING SPENT NON-HALOGENATED SOLVENTS: CRESOLS AND CRESYLIC ACID, AND NITROBENZENE; ALL SPENT SOLVENT MIXTURES/BLENDS CONTAINING, BEFORE USE, A TOTAL OF TEN PERCENT OR MORE (BY VOLUME) OF ONE OR MORE OF THE ABOVE NON-HALOGENATED SOLVENTS OR THOSE SOLVENTS LISTED IN F001, F002, AND F005; AND STILL BOTTOMS FROM THE RECOVERY OF THESE SPENT SOLVENTS AND SPENT SOLVENT MIXTURES.
F005	THE FOLLOWING SPENT NON-HALOGENATED SOLVENTS: TOLUENE, METHYL ETHYL KETONE, CARBON DISULFIDE, ISOBUTANOL, PYRIDINE, BENZENE, 2-ETHOXYETHANOL, AND 2-NITROPROPANE; ALL SPENT SOLVENT MIXTURES/BLENDS CONTAINING, BEFORE USE, A TOTAL OF TEN PERCENT OR MORE (BY VOLUME) OF ONE OR MORE OF THE ABOVE NON-HALOGENATED SOLVENTS OR THOSE SOLVENTS LISTED IN F001, F002, OR F004; AND STILL BOTTOMS FROM THE RECOVERY OF THESE SPENT SOLVENTS AND SPENT SOLVENT MIXTURES.
F006	WASTEWATER TREATMENT SLUDGES FROM ELECTROPLATING OPERATIONS EXCEPT FROM THE

EPA Waste Codes Addendum

Code	Description
	FOLLOWING PROCESSES: (1) SULFURIC ACID ANODIZING OF ALUMINUM; (2) TIN PLATING ON CARBON STEEL; (3) ZINC PLATING (SEGREGATED BASIS) ON CARBON STEEL; (4) ALUMINUM OR ZINC-ALUMINUM PLATING ON CARBON STEEL; (5) CLEANING/STRIPPING ASSOCIATED WITH TIN, ZINC AND ALUMINUM PLATING ON CARBON STEEL; AND (6) CHEMICAL ETCHING AND MILLING OF ALUMINUM.
F007	SPENT CYANIDE PLATING BATH SOLUTIONS FROM ELECTROPLATING OPERATIONS
F009	SPENT STRIPPING AND CLEANING BATH SOLUTIONS FROM ELECTROPLATING OPERATIONS WHERE CYANIDES ARE USED IN THE PROCESS.
F019	WASTEWATER TREATMENT SLUDGES FROM THE CHEMICAL CONVERSION COATING OF ALUMINUM EXCEPT FROM ZIRCONIUM PHOSPHATING IN ALUMINUM CAN WASHING WHEN SUCH PHOSPHATING IS AN EXCLUSIVE CONVERSION COATING PROCESS.
F034	WASTEWATERS, PROCESS RESIDUALS, PRESERVATIVE DRIPPAGE, AND SPENT FORMULATIONS FROM WOOD PRESERVING PROCESS GENERATED AT PLANTS THAT USE CREOSOTE FORMULATIONS. THIS LISTING DOES NOT INCLUDE K001 BOTTOM SEDIMENT SLUDGE FROM THE TREATMENT OF WASTEWATER FROM WOOD PRESERVING PROCESSES THAT USE CREOSOTE AND/OR PENTACHLOROPHENOL. (NOTE: THE LISTING OF WASTEWATERS THAT HAVE NOT COME INTO CONTACT WITH PROCESS CONTAMINANTS IS STAYED ADMINISTRATIVELY. THE STAY WILL REMAIN IN EFFECT UNTIL FURTHER ADMINISTRATIVE ACTION IS TAKEN.)
K044	WASTEWATER TREATMENT SLUDGES FROM THE MANUFACTURING AND PROCESSING OF EXPLOSIVES
K062	SPENT PICKLE LIQUOR GENERATED BY STEEL FINISHING OPERATIONS OF FACILITIES WITHIN THE IRON AND STEEL INDUSTRY (SIC CODES 331 AND 332).
P001	2H-1-BENZOPYRAN-2-ONE, 4-HYDROXY-3-(3-OXO-1-PHENYLBUTYL)-, & SALTS, WHEN PRESENT AT CONCENTRATIONS GREATER THAN 0.3%
P001	WARFARIN, & SALTS, WHEN PRESENT AT CONCENTRATIONS GREATER THAN 0.3%
P003	ACROLEIN
P003	2-PROPENAL
P024	BENZENAMINE, 4-CHLORO-
P024	P-CHLOROANILINE
P030	CYANIDES (SOLUBLE CYANIDE SALTS), NOT OTHERWISE SPECIFIED
P044	DIMETHOATE
P044	PHOSPHORODITHIOIC ACID, O,O-DIMETHYL S-[2-(METHYLAMINO)-2-OXOETHYL] ESTER
P050	ENDOSULFAN
P050	6,9-METHANO-2,4,3-BENZODIOXATHIEPIN, 6,7,8,9,10,10-HEXACHLORO-1,5,5A,6,9,9A-HEXAHYDRO- , 3-OXIDE

EPA Waste Codes Addendum

Code	Description
P098	POTASSIUM CYANIDE
P098	POTASSIUM CYANIDE K(CN)
P105	SODIUM AZIDE
U002	ACETONE (I)
U002	2-PROPANONE (I)
U044	CHLOROFORM
U044	METHANE, TRICHLORO-
U062	CARBAMOTHIOIC ACID, BIS(1-METHYLETHYL)-, S-(2,3-DICHLORO-2-PROPENYL) ESTER
U062	DIALLATE
U079	1,2-DICHLOROETHYLENE
U079	ETHENE, 1,2-DICHLORO-, (E)-
U134	HYDROFLUORIC ACID (C,T)
U134	HYDROGEN FLUORIDE (C,T)
U146	LEAD, BIS(ACETATO-O)TETRAHYDROXYTRI-
U146	LEAD SUBACETATE
U201	1,3-BENZENEDIOL
U201	RESORCINOL
U226	ETHANE, 1,1,1-TRICHLORO-
U226	METHYL CHLOROFORM
U239	BENZENE, DIMETHYL- (I,T)
U239	XYLENE (I)

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

To maintain currency of the following federal and state databases, EDR contacts the appropriate governmental agency on a monthly or quarterly basis, as required.

Elapsed ASTM days: Provides confirmation that this EDR report meets or exceeds the 90-day updating requirement of the ASTM standard.

FEDERAL ASTM STANDARD RECORDS

NPL: National Priority List
Source: EPA
Telephone: N/A
National Priorities List (Superfund). The NPL is a subset of CERCLIS and identifies over 1,200 sites for priority cleanup under the Superfund Program. NPL sites may encompass relatively large areas. As such, EDR provides polygon coverage for over 1,000 NPL site boundaries produced by EPA's Environmental Photographic Interpretation Center (EPIC) and regional EPA offices.

Date of Government Version: 10/22/01
Date Made Active at EDR: 12/11/01
Database Release Frequency: Semi-Annually

Date of Data Arrival at EDR: 11/05/01
Elapsed ASTM days: 36
Date of Last EDR Contact: 02/04/02

NPL Site Boundaries

Sources:

EPA's Environmental Photographic Interpretation Center (EPIC)
Telephone: 202-564-7333

EPA Region 1
Telephone 617-918-1143

EPA Region 3
Telephone 215-814-5418

EPA Region 4
Telephone 404-562-8033

EPA Region 6
Telephone: 214-655-6659

EPA Region 8
Telephone: 303-312-6774

Proposed NPL: Proposed National Priority List Sites
Source: EPA
Telephone: N/A

Date of Government Version: 10/22/01
Date Made Active at EDR: 12/11/01
Database Release Frequency: Semi-Annually

Date of Data Arrival at EDR: 11/05/01
Elapsed ASTM days: 36
Date of Last EDR Contact: 02/04/02

CERCLIS: Comprehensive Environmental Response, Compensation, and Liability Information System
Source: EPA
Telephone: 703-413-0223
CERCLIS contains data on potentially hazardous waste sites that have been reported to the USEPA by states, municipalities, private companies and private persons, pursuant to Section 103 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). CERCLIS contains sites which are either proposed to or on the National Priorities List (NPL) and sites which are in the screening and assessment phase for possible inclusion on the NPL.

Date of Government Version: 11/21/01
Date Made Active at EDR: 02/04/02
Database Release Frequency: Quarterly

Date of Data Arrival at EDR: 12/26/01
Elapsed ASTM days: 40
Date of Last EDR Contact: 12/26/01

CERCLIS-NFRAP: CERCLIS No Further Remedial Action Planned
Source: EPA
Telephone: 703-413-0223
As of February 1995, CERCLIS sites designated "No Further Remedial Action Planned" (NFRAP) have been removed from CERCLIS. NFRAP sites may be sites where, following an initial investigation, no contamination was found, contamination was removed quickly without the need for the site to be placed on the NPL, or the contamination was not serious enough to require Federal Superfund action or NPL consideration. EPA has removed approximately 25,000 NFRAP sites to lift the unintended barriers to the redevelopment of these properties and has archived them as historical records so EPA does not needlessly repeat the investigations in the future. This policy change is part of the EPA's Brownfields Redevelopment Program to help cities, states, private investors and affected citizens to promote economic redevelopment of unproductive urban sites.

Date of Government Version: 11/21/01
Date Made Active at EDR: 02/04/02
Database Release Frequency: Quarterly
Date of Data Arrival at EDR: 12/26/01
Elapsed ASTM days: 40
Date of Last EDR Contact: 12/16/01

CORRACTS: Corrective Action Report
Source: EPA
Telephone: 800-424-9346
CORRACTS identifies hazardous waste handlers with RCRA corrective action activity.

Date of Government Version: 11/14/01
Date Made Active at EDR: 01/14/02
Database Release Frequency: Semi-Annually
Date of Data Arrival at EDR: 11/14/01
Elapsed ASTM days: 61
Date of Last EDR Contact: 11/14/01

RCRIS: Resource Conservation and Recovery Information System
Source: EPA/NTIS
Telephone: 800-424-9346
Resource Conservation and Recovery Information System. RCRIS includes selective information on sites which generate, transport, store, treat and/or dispose of hazardous waste as defined by the Resource Conservation and Recovery Act (RCRA).

Date of Government Version: 06/21/00
Date Made Active at EDR: 07/31/00
Database Release Frequency: Varies
Date of Data Arrival at EDR: 07/10/00
Elapsed ASTM days: 21
Date of Last EDR Contact: 01/14/02

ERNS: Emergency Response Notification System
Source: EPA/NTIS
Telephone: 202-260-2342
Emergency Response Notification System. ERNS records and stores information on reported releases of oil and hazardous substances.

Date of Government Version: 08/08/00
Date Made Active at EDR: 09/06/00
Database Release Frequency: Varies
Date of Data Arrival at EDR: 08/11/00
Elapsed ASTM days: 26
Date of Last EDR Contact: 02/01/02

FEDERAL ASTM SUPPLEMENTAL RECORDS

BRS: Biennial Reporting System
Source: EPA/NTIS
Telephone: 800-424-9346
The Biennial Reporting System is a national system administered by the EPA that collects data on the generation and management of hazardous waste. BRS captures detailed data from two groups: Large Quantity Generators (LQG) and Treatment, Storage, and Disposal Facilities.

Date of Government Version: 12/31/99
Database Release Frequency: Biennially
Date of Last EDR Contact: 12/17/01
Date of Next Scheduled EDR Contact: 03/18/02

CONSENT: Superfund (CERCLA) Consent Decrees
Source: EPA Regional Offices
Telephone: Varies
Major legal settlements that establish responsibility and standards for cleanup at NPL (Superfund) sites. Released periodically by United States District Courts after settlement by parties to litigation matters.

Date of Government Version: N/A
Database Release Frequency: Varies
Date of Last EDR Contact: N/A
Date of Next Scheduled EDR Contact: N/A

ROD: Records Of Decision
Source: NTIS
Telephone: 703-416-0223
Record of Decision. ROD documents mandate a permanent remedy at an NPL (Superfund) site containing technical and health information to aid in the cleanup.

Date of Government Version: 09/30/00
Database Release Frequency: Annually

Date of Last EDR Contact: 01/07/02
Date of Next Scheduled EDR Contact: 04/08/02

DELISTED NPL: National Priority List Deletions
Source: EPA
Telephone: N/A
The National Oil and Hazardous Substances Pollution Contingency Plan (NCP) establishes the criteria that the EPA uses to delete sites from the NPL. In accordance with 40 CFR 300.425.(e), sites may be deleted from the NPL where no further response is appropriate.

Date of Government Version: 11/13/01
Database Release Frequency: Semi-Annually

Date of Last EDR Contact: 02/04/02
Date of Next Scheduled EDR Contact: 05/06/02

FINDS: Facility Index System/Facility Identification Initiative Program Summary Report
Source: EPA
Telephone: N/A
Facility Index System. FINDS contains both facility information and 'pointers' to other sources that contain more detail. EDR includes the following FINDS databases in this report: PCS (Permit Compliance System), AIRS (Aerometric Information Retrieval System), DOCKET (Enforcement Docket used to manage and track information on civil judicial enforcement cases for all environmental statutes), FURS (Federal Underground Injection Control), C-DOCKET (Criminal Docket System used to track criminal enforcement actions for all environmental statutes), FFIS (Federal Facilities Information System), STATE (State Environmental Laws and Statutes), and PADS (PCB Activity Data System).

Date of Government Version: 10/29/01
Database Release Frequency: Quarterly

Date of Last EDR Contact: 01/07/02
Date of Next Scheduled EDR Contact: 04/08/02

HMIRS: Hazardous Materials Information Reporting System
Source: U.S. Department of Transportation
Telephone: 202-366-4526
Hazardous Materials Incident Report System. HMIRS contains hazardous material spill incidents reported to DOT.

Date of Government Version: 05/31/01
Database Release Frequency: Annually

Date of Last EDR Contact: 01/21/02
Date of Next Scheduled EDR Contact: 04/22/02

MLTS: Material Licensing Tracking System
Source: Nuclear Regulatory Commission
Telephone: 301-415-7169
MLTS is maintained by the Nuclear Regulatory Commission and contains a list of approximately 8,100 sites which possess or use radioactive materials and which are subject to NRC licensing requirements. To maintain currency, EDR contacts the Agency on a quarterly basis.

Date of Government Version: 10/25/01
Database Release Frequency: Quarterly

Date of Last EDR Contact: 01/07/02
Date of Next Scheduled EDR Contact: 04/08/02

MINES: Mines Master Index File
Source: Department of Labor, Mine Safety and Health Administration
Telephone: 303-231-5959

Date of Government Version: 12/14/01
Database Release Frequency: Semi-Annually

Date of Last EDR Contact: 01/02/02
Date of Next Scheduled EDR Contact: 04/01/02

NPL LIENS: Federal Superfund Liens
Source: EPA
Telephone: 205-564-4267
Federal Superfund Liens. Under the authority granted the USEPA by the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) of 1980, the USEPA has the authority to file liens against real property in order to recover remedial action expenditures or when the property owner receives notification of potential liability. USEPA compiles a listing of filed notices of Superfund Liens.

Date of Government Version: 10/15/91
Database Release Frequency: No Update Planned

Date of Last EDR Contact: 11/19/01
Date of Next Scheduled EDR Contact: 02/18/02

PADS: PCB Activity Database System
Source: EPA
Telephone: 202-260-3936
PCB Activity Database. PADS Identifies generators, transporters, commercial storers and/or brokers and disposers of PCB's who are required to notify the EPA of such activities.

Date of Government Version: 09/30/01
Database Release Frequency: Annually

Date of Last EDR Contact: 11/13/01
Date of Next Scheduled EDR Contact: 02/12/02

RAATS: RCRA Administrative Action Tracking System
Source: EPA
Telephone: 202-564-4104
RCRA Administration Action Tracking System. RAATS contains records based on enforcement actions issued under RCRA pertaining to major violators and includes administrative and civil actions brought by the EPA. For administration actions after September 30, 1995, data entry in the RAATS database was discontinued. EPA will retain a copy of the database for historical records. It was necessary to terminate RAATS because a decrease in agency resources made it impossible to continue to update the information contained in the database.

Date of Government Version: 04/17/95
Database Release Frequency: No Update Planned

Date of Last EDR Contact: 12/11/01
Date of Next Scheduled EDR Contact: 03/11/02

TRIS: Toxic Chemical Release Inventory System
Source: EPA
Telephone: 202-260-1531
Toxic Release Inventory System. TRIS identifies facilities which release toxic chemicals to the air, water and land in reportable quantities under SARA Title III Section 313.

Date of Government Version: 12/31/99
Database Release Frequency: Annually

Date of Last EDR Contact: 12/26/01
Date of Next Scheduled EDR Contact: 03/25/02

TSCA: Toxic Substances Control Act
Source: EPA
Telephone: 202-260-5521
Toxic Substances Control Act. TSCA identifies manufacturers and importers of chemical substances included on the TSCA Chemical Substance Inventory list. It includes data on the production volume of these substances by plant site.

Date of Government Version: 12/31/98
Database Release Frequency: Every 4 Years

Date of Last EDR Contact: 01/22/02
Date of Next Scheduled EDR Contact: 04/22/02

FTTS: FIFRA/ TSCA Tracking System - FIFRA (Federal Insecticide, Fungicide, & Rodenticide Act)/TSCA (Toxic Substances Control Act)
Source: EPA/Office of Prevention, Pesticides and Toxic Substances
Telephone: 202-564-2501
FTTS tracks administrative cases and pesticide enforcement actions and compliance activities related to FIFRA, TSCA and EPCRA (Emergency Planning and Community Right-to-Know Act). To maintain currency, EDR contacts the Agency on a quarterly basis.

Date of Government Version: 10/25/01
Database Release Frequency: Quarterly

Date of Last EDR Contact: 12/26/01
Date of Next Scheduled EDR Contact: 03/25/02

FTTS INSP: FIFRA/ TSCA Tracking System - FIFRA (Federal Insecticide, Fungicide, & Rodenticide Act)/TSCA (Toxic Substances Control Act)
Source: EPA
Telephone: 202-564-2501

Date of Government Version: 10/25/01
Database Release Frequency: Quarterly

Date of Last EDR Contact: 12/26/01
Date of Next Scheduled EDR Contact: 03/25/02

STATE OF ARIZONA ASTM STANDARD RECORDS

SPL: Superfund Program List
Source: Dept. of Environmental Quality
Telephone: 602-207-4360
The list is representative of the sites and potential sites within the jurisdiction of the Superfund Program Section. It is comprised of the following elements: 1) Water Quality Assurance Revolving Fund Registry Sites; 2) Potential WQARF Registry sites; 3) NPL sites; and 4) Department of Defense sites requiring SPS oversight.

Date of Government Version: 10/23/00
Date Made Active at EDR: 01/03/01
Database Release Frequency: Semi-Annually
Date of Data Arrival at EDR: 12/04/00
Elapsed ASTM days: 30
Date of Last EDR Contact: 12/04/01

SHWS: ZipAcids List
Source: Department of Environmental Quality
Telephone: 602-207-2202
The ACIDS list consists of more than 750 locations subject to investigation under the State Water Quality Assurance Revolving Fund (WQARF) and Federal CERCLA programs. The list is no longer updated by the state.

Date of Government Version: 01/03/00
Date Made Active at EDR: 05/16/00
Database Release Frequency: No Update Planned
Date of Data Arrival at EDR: 04/11/00
Elapsed ASTM days: 35
Date of Last EDR Contact: 01/21/02

SWF/LF: Directory of Solid Waste Facilities
Source: Department of Environmental Quality
Telephone: 602-207-4132
Solid Waste Facilities/Landfill Sites. SWF/LF type records typically contain an inventory of solid waste disposal facilities or landfills in a particular state. Depending on the state, these may be active or inactive facilities or open dumps that failed to meet RCRA Subtitle D Section 4004 criteria for solid waste landfills or disposal sites.

Date of Government Version: 11/01/00
Date Made Active at EDR: 02/01/01
Database Release Frequency: Annually
Date of Data Arrival at EDR: 01/02/01
Elapsed ASTM days: 30
Date of Last EDR Contact: 01/04/02

LUST: Leaking Underground Storage Tank Listing
Source: Department of Environmental Quality
Telephone: 602-207-4345
Leaking Underground Storage Tank Incident Reports. LUST records contain an inventory of reported leaking underground storage tank incidents. Not all states maintain these records, and the information stored varies by state.

Date of Government Version: 11/08/01
Date Made Active at EDR: 11/27/01
Database Release Frequency: Semi-Annually
Date of Data Arrival at EDR: 11/13/01
Elapsed ASTM days: 14
Date of Last EDR Contact: 11/07/01

UST: Underground Storage Tank Listing
Source: Department of Environmental Quality
Telephone: 602-207-4345
Registered Underground Storage Tanks. UST's are regulated under Subtitle I of the Resource Conservation and Recovery Act (RCRA) and must be registered with the state department responsible for administering the UST program. Available information varies by state program.

Date of Government Version: 11/07/01
Date Made Active at EDR: 12/10/01
Database Release Frequency: Annually
Date of Data Arrival at EDR: 11/08/01
Elapsed ASTM days: 32
Date of Last EDR Contact: 01/14/02

WQARF: Water Quality Assurance Revolving Fund Sites
Source: Department of Environmental Quality
Telephone: 602-207-2202
Sites which may have an actual or potential impact upon the waters of the state, cause by hazardous substances. The WQARF program provides matching funds to political subdivisions and other state agencies for clean-up activities.

Date of Government Version: 06/12/01
Date Made Active at EDR: 09/24/01
Database Release Frequency: Annually
Date of Data Arrival at EDR: 06/26/01
Elapsed ASTM days: 90
Date of Last EDR Contact: 01/02/02

STATE OF ARIZONA ASTM SUPPLEMENTAL RECORDS

AST: List of Aboveground Storage Tanks
Source: Dept. of Building & Fire Safety
Telephone: 602-255-4964
Aboveground storage tanks that the Dept. of Building & Fire Safety have permitted.

Date of Government Version: 12/31/00
Database Release Frequency: Annually
Date of Last EDR Contact: 01/25/02
Date of Next Scheduled EDR Contact: 04/15/02

SPILLS: Hazardous Material Logbook
Source: Department of Environmental Quality
Telephone: 602-207-2202
ADEQ Emergency Response Unit. The ADEQ Emergency Response Unit documents chemical spills and incidents which are referred to the Unit. The logbook information for 1984-1986 consists of handwritten entries of the date, incident number and name of facility if known. Current logbooks are computerized and can be sorted by date, incident number, name, city (zip codes are not included), county, chemical and quantity.

Date of Government Version: 06/30/00
Database Release Frequency: Semi-Annually
Date of Last EDR Contact: 01/02/02
Date of Next Scheduled EDR Contact: 04/01/02

DOD: Department of Defense Sites
Source: Department of Environmental Quality
Telephone: 602-207-2202
These sites are federal facilities that are either being assessed for potential contamination, or have active remediation taking place on them.

Date of Government Version: 06/12/01
Database Release Frequency: Annually
Date of Last EDR Contact: 01/02/02
Date of Next Scheduled EDR Contact: 03/25/02

WWFAC: Waste Water Treatment Facilities
Source: Department of Environmental Quality
Telephone: 602-207-4623
Statewide list of waste water treatment facilities.

Date of Government Version: 12/12/00
Database Release Frequency: Varies
Date of Last EDR Contact: 11/26/01
Date of Next Scheduled EDR Contact: 02/25/02

AQUIFER: Waste Water Treatment Facilities
Source: Department of Environmental Quality
Telephone: 602-207-4623
Waste Water Treatment Facilities with APP (Aquifer Protection Permits.)

Date of Government Version: 11/01/01
Database Release Frequency: Semi-Annually
Date of Last EDR Contact: 01/28/02
Date of Next Scheduled EDR Contact: 04/29/02

DRY WELLS: Drywell Registration
Source: Department of Environmental Quality
Telephone: 602-207-2202
A drywell is a bored, drilled, or driven shaft or hole whose depth is greater than its width and is designed and constructed specifically for the disposal of storm water.

Date of Government Version: 12/01/01
Database Release Frequency: Semi-Annually
Date of Last EDR Contact: 12/26/01
Date of Next Scheduled EDR Contact: 03/25/02

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

AZ AIRS: Arizona Airs Database
Source: Department of Environmental Quality
Telephone: 602-207-2344
Arizona major (has the potential to emit over 100 tons of criteria pollutant) and minor (below 100 tons) sources.

Date of Government Version: 12/17/01
Database Release Frequency: Semi-Annually

Date of Last EDR Contact: 02/05/02
Date of Next Scheduled EDR Contact: 05/06/02

EDR PROPRIETARY HISTORICAL DATABASES

Former Manufactured Gas (Coal Gas) Sites: The existence and location of Coal Gas sites is provided exclusively to EDR by Real Property Scan, Inc. ©Copyright 1993 Real Property Scan, Inc. For a technical description of the types of hazards which may be found at such sites, contact your EDR customer service representative.

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OTHER DATABASE(S)

Depending on the geographic area covered by this report, the data provided in these specialty databases may or may not be complete. For example, the existence of wetlands information data in a specific report does not mean that all wetlands in the area covered by the report are included. Moreover, the absence of any reported wetlands information does not necessarily mean that wetlands do not exist in the area covered by the report.

Oil/Gas Pipelines/Electrical Transmission Lines: This data was obtained by EDR from the USGS in 1994. It is referred to by USGS as GeoData Digital Line Graphs from 1:100,000-Scale Maps. It was extracted from the transportation category including some oil, but primarily gas pipelines and electrical transmission lines.

Sensitive Receptors: There are individuals deemed sensitive receptors due to their fragile immune systems and special sensitivity to environmental discharges. These sensitive receptors typically include the elderly, the sick, and children. While the location of all sensitive receptors cannot be determined, EDR indicates those buildings and facilities - schools, daycares, hospitals, medical centers, and nursing homes - where individuals who are sensitive receptors are likely to be located.

Flood Zone Data: This data, available in select counties across the country, was obtained by EDR in 1999 from the Federal Emergency Management Agency (FEMA). Data depicts 100-year and 500-year flood zones as defined by FEMA.

NWI: National Wetlands Inventory. This data, available in select counties across the country, was obtained by EDR in 1999 from the U.S. Fish and Wildlife Service.

Thank you for your business.
Please contact EDR at 1-800-352-0050
with any questions or comments.

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APPENDIX B

SUMMARY OF SITES BY REGULATORY DATABASE

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SUMMARY OF SITES BY REGULATORY DATABASE

NPL

The National Priorities List (NPL) identifies uncontrolled or abandoned hazardous waste sites. To appear on the NPL, sites must have met or surpassed a predetermined hazard ranking system score, been chosen as a state's top priority site, pose a significant health or environmental threat, or be a site where the EPA has determined that remedial action is more cost-effective than removal action. Revision date: 10/22/01

ID	Site Name	Site Address	Status	Priority
Z	19th Avenue Landfill	19th Ave and Lower Buckeye Road	Status: Final	High
Notes: ID – Map ID (see Figure 2)				

CERCLIS

The Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) database identifies hazardous waste sites that require investigation and possible remedial action to mitigate potential negative impacts on human health or the environment. Revision date: 11/21/01

ID	Site Name	Site Address	Status	Priority
Z	19th Avenue Landfill	19th Ave and Lower Buckeye Road	Remedy assessment phase	High
2	Kenworth of AZ Sunward Materials	2625 S. 19th Ave.	1988 PA – NFRAP	Low
25	Arizona Barrel and Can Co.	4225 S. 19th Ave.	Site inspection completed 1992	Low
33	Onyx Environmental Services	2301 W. Broadway	Site inspection completed 1990	Med-High
1	Copperstate Metals Inc.	3720 W. Low Buck Rd	Discovery Assessment	Low-Med.
Notes: ID – Map ID (see Figure 2) NFRAP – No further remedial action planned PA/SI – Preliminary Assessment/Site Investigation				

RCRA-TSD

The EPA's Resource Conservation and Recovery Information System (RCRIS) identifies and tracks hazardous waste from the point of generation to the point of disposal. The RCRIS Treatment, Storage, Disposal (TSD) Facilities List is a compilation by EPA of reporting facilities that generate, transport, store, treat, or dispose of hazardous waste as defined by the Resource Conservation and Recovery Act (RCRA) but are not undergoing any "corrective action". Revision date: 6/21/00

ID	Site Name	Site Address	Status	Priority
4	Greenfield Environmental (AKA Innovative Waste Utilization)	2575 S. 16th Ave.	Med. CORRACTS priority	Medium
Notes: ID – Map ID (see Figure 2)				

CORRACTS

RCRA TSD facilities ordered to implement corrective actions. A "corrective action order" is issued pursuant to RCRA Section 3008 (h) when there has been a release of hazardous waste or constituents into the environment from a RCRA TSD facility. Corrective actions may be required beyond the facility's boundary and can be required regardless of when the release occurred, even if it predates RCRA. Revision date: 11/14/01

ID	Site Name	Site Address	Status	Priority
4	Greenfield Environmental (AKA Innovative Waste Utilization)	2575 S. 16th Ave.	Med. CORRACTS priority	Medium
33	Onyx Environmental Services	2301 W. Broadway	Low CORRACTS priority	Med.-High
1	ChemCon Inc.	3702 W. Low Buck Rd	Low CORRACTS priority	Low-Med.
Notes: ID – Map ID (see Figure 2)				

RCRA-GENERATORS

RCRA-regulated hazardous waste generator notifiers list; both Large and Small Quantity Generators are included in this list (LQG – Large Quantity Generator, SQG – Small Quantity Generator). Revision date: 6/21/00

ID	Site Name	Site Address	Type	Status	Priority
2	Blue Circle West Leasing	2625 S. 19th Ave.	SQG	No violations found	Low
2	Kenworth of AZ Sunward Materials	2625 S. 19th Ave.	SQG	No violations found	Low
2	Williams Detroit Diesel	2602 S. 19th Ave.	SQG	No violations found	Low
2	Frontier Freightways	2465 S. 19th Ave.	SQG	No violations found	Low
2	Cypress Environmental	2465 S. 19th Ave.	SQG	No violations found	Low
2	Marlam Industries, Inc.	2465 S. 19th Ave.	LQG	2 Low priority violations	Low- Med.
4	Greenfield Environmental (AKA Innovative Waste Utilization)	2575 S. 16th Ave.	LQG	49 Violations	Medium
13	Phoenix Metal Recycling	3210 S. 19th Ave.	SQG	No violations found	Low

ID	Site Name	Site Address	Type	Status	Priority
13	Waste Management of Phoenix (AKA Universal Waste Control)	3000 S. 19th Ave.	SQG	No violations found	Low- Med.
19	United Metro Material Plant 11	3640 S. 19th Ave.	SQG	1 low priority violation	Low- Med.
20	Ace Asphalt of Arizona	895 W. Elwood	SQG	No violations found	Low- Med.
23	Laidlaw Environmental Services	888 W. Illini Street	SQG	3 low priority violations	Low
25	Industrial Recycling Solutions	2610 W. Holly	SQG	No violations found	Low
25	Solvent Recyclean Inc.	1850 W. Broadway	SQG	1 low priority violation	Low
30	Turners Machine Shop	1521 W. Broadway	SQG	No violations found	Low
6	Phoenix Transit System	2225 W. Low Buck Rd	SQG/LQG	1 low priority violation	Medium
6	COP Petroleum Storage Facility	2239 W. Low Buck Rd	SQG	No violations found	Medium
6	Kerley Chemical Corp.	2248 W. Low Buck Rd	SQG	No violations found	Low- Med.
9	Empire Metals Inc.	2010 W. Low Buck Rd	SQG	1 low priority violation	Low-Med.
32	Yank Your Part	2104 W. Broadway	SQG	No violations found	Low
33	AG Products	2630 W. Broadway	SQG	No violations found	Low
33	Onyx Environmental Services	2301 W. Broadway	SQG/LQG	22 low priority violations	Med.-High
15	Copperstate Express Lines	3044 S. 35th Ave.	SQG	No violations found	Low
31	Enviro-Solv	2844 W. Broadway	SQG	No violations found	Low-Med.
35	Swift Transport	3106 W. Broadway	SQG	No violations found	Low
36	Bob Auto and Pickup Wrecking	3408 W. Broadway	SQG	No violations found	Low
1	Rio Salado Auto Body	2801 S. 35th Ave.	SQG	No violations found	Low
1	ChemCon Inc.	3702 W. Low Buck Rd	SQG	1 low priority violation	Low-Med.
1	Copperstate Metals Inc.	3720 W. Low Buck Rd	SQG	1 low priority violation	Low-Med.
7	Zieman MFG	4025 W. Low Buck Rd	SQG	No violations found	Low-Med.
8	Phoenix Redi Mix Company Inc.	3635 S. 43rd Ave.	SQG	No violations found	Low-Med.
8	Glenn Wienberger Landfill	3425 S. 43rd Ave.	SQG	No violations found	Low
8	USF Bestway Transportation	3045 S. 43rd Ave.	SQG	No violations found	Low-Med.
11	C and M Enterprises	3240 S. 37th Ave.	SQG	No violations found	Low
16	RPS Inc.	3410 S. 51st Ave.	SQG	No violations found	Low
43	Arizona Oil Recyclers Assoc.	5040 S. 51st Ave.	SQG	No violations found	Low
51	Arnold Machinery Company of AZ	6024 W. Southern	SQG	No violations found	Low-Med.
52	Mobile Soil Processing Unit	5922 W. Southern	SQG	No violations found	Low
47	Iron Horse Equipment Corp	7316 W. Southern	SQG	No violations found	Low

Notes:
ID – Map ID (see Figure 2)

ERNS

EPA's Emergency Response Notification System (ERNS) list contains reported spill records of oil and hazardous substances. Revision date: 8/08/00

ID	Site Name	Site Address	Status	Priority
4	MP Environmental	2530 S. 16th Ave.	1994 incident	Low- Med.
Notes: ID – Map ID (see Figure 2)				

ROD

The EPA's Record of Decision (ROD) documents mandate a permanent remedy at a NPL site containing technical and health information to aid in the cleanup. Revision date: 9/30/00

ID	Site Name	Site Address	Status	Priority
Z	19th Avenue Landfill	19th Ave and Lower Buckeye Road	1992 Remedial Plan	High
Notes: ID – Map ID (see Figure 2)				

SPL/WQARF

A Water Quality Assurance Revolving Fund (WQARF) area (referred to as a State Priority List (SPL) site by EDR) which is also referred to as a state Superfund area, is a region designated by ADEQ for further investigation regarding environmental concerns. This designation is typically based on known areas of groundwater contamination, or past or present land uses which have been known to use and discharge chemicals that can contaminate groundwater. Revision date: 6/12/01

ID	Site Name	Site Address	Status	Priority
	None sites found			

SHWS/ACIDS

The Arizona CERCLIS Information Data System (ACIDS) List has been used by the ADEQ Superfund Programs Section (SPS) for the past decade in tracking WQARF sites and portions of sites, potential WQARF sites, referrals, and other cases of interest to the SPS. As of March 13, 2000, there were approximately 1,500 entries on the ACIDS list. While some of the cases on this list are relevant to Arizona's Superfund Program, others are not and their inclusion may be misleading. For this reason, the SPS has elected to archive the ACIDS list, and no longer distribute it. In its stead, the ACIDS List has been replaced by the Arizona Superfund Programs

List (SPL). This list is more representative of the sites and potential sites within the jurisdiction of the ADEQ SPS. According to ADEQ, the listing of properties on the ACIDS list is not an indication of liability or potential liability. Many of these properties on this list have no present involvement in WQARF or federal Superfund. Revision date: 1/03/00

ID	Site Name	Site Address	Status	Priority
2	Kenworth of AZ Sunward Materials	2625 S. 19th Ave.	WVB	Low
23	Disposal Control Services, Inc.	888 W. Illini Street	PA/SI	Low-Med.
25	19th Ave. Airstrip	NEC 19th/Broadway	PA/SI	Low-Med.
3	Old 23rd Ave. Sludge Disp. Ponds	23rd & Low Buck Rd	WVB	Low
5	27th Avenue Landfill	27th Ave. & Lower Buckeye Road	WVB	Low-Med.
6	Kerley Chemical Corp.	2248 W. Low Buck Rd	WVB	Low- Med.
33	Onyx Environmental Services	2301 W. Broadway	PA/SI	Med.-High
33	Regent Auto & Truck Parts	2528 W. Broadway	PA/SI	Low- Med.
33	A&S Auto Wrecking	2528 W. Broadway	PA/SI	Low- Med.
15	Maricopa By-Products Inc.	3602 W. Elwood St.	WVB	Low-Med.
15	Quality Block Company Inc.	3035 S. 35th Ave.	WVB	Low-Med.
15	Arizona Precast	3045 S. 35th Ave.	WVB	Low
22	Smithey Recycling Company	3649 S. 35th Ave.	WVB	Low
36	Manzanita Speedway	35th Ave / Broadway	WVB	Low
1	Rio Salado Auto Body	2801 S. 35th Ave.	WVB	Low
1	Unknown	3650 W. Low Buck Rd	WVB	Low
1	Copperstate Metals Inc.	3720 W. Low Buck Rd	WVB	Low-Med.
1	Castle MFG, Inc.	3702 W. Low Buck Rd	WVB	Low
1	Dagleys	2455 S. 35th Ave.	WVB	Low
1	Angel Auto	2450 S. 35th Ave.	WVB	Low
21	Reynolds Aluminum Plant Ponds	43rd Ave. / Salt River	WVB	Low

Notes:
ID – Map ID (see Figure 2)
PA/SI – Preliminary Assessment/Site Investigation
WVB –Sites with this notation have been investigated as part of the West Van Buren (WVB) WQARF program

SWLF

State inventory of solid waste disposal and landfill sites. Revision date: 1/3/00

ID	Site Name	Site Address	Type	Priority
Z	19th Avenue Landfill	19th Ave and Lower Buckeye Road	Closed	High
5	27th Avenue Landfill	27th Ave. & Lower Buckeye Road	Transfer station	Low-Med.
NL	23rd Avenue Landfill	23rd Ave. & Lower Buckeye Road	Closed	Low-Med.
8	Glen Wienburger Rainbow Valley	3425 S. 43rd Ave.	Active (CDLF)	Low
32	AETS	2301 W. Broadway	Active (accepts PCS)	Low- Med.

Notes:
ID – Map ID (see Figure 2)
NL – Not listed
CDLF – Construction debris landfill
PCS – Petroleum contaminated soils

LUST

List of information pertaining to all reported leaking underground storage tanks. Revision date: 11/08/01

ID	Site Name	Site Address	Status	Priority
Z	19th Avenue Landfill	19th Ave and Lower Buckeye Road	2 closed 1993	High
2	Superior Companies	2402 S. 19th Ave.	1 Closed – 1995	Low- Med.
2	Arizona Beef	2401 S. 19th Ave.	1 Closed – 1990	Low- Med.
10	Phoenix Tallow	2602 S. 15th Ave.	3 closed – 1999	Low- Med.
13	Waste Management of Phoenix (AKA Universal Waste Control)	3000 S. 19th Ave.	1 closed 1996 / 1 unknown	Low-Med.
19	Tanner-United Metro	3640 S. 19th Ave.	1 closed 1999	Low- Med.
20	Ace Asphalt of Arizona	895 W. Elwood	3 closed 1998	Low- Med.
25	Circle K #670	4422 S. 19th Ave.	1 closed 1996	Low- Med.
25	Cooley Wholesale Lumber Co.	1930 W. Broadway	1 closed date unknown	Low- Med.
25	Arizona Teamsters App.	1820 W. Broadway	1 closed 2000	Low- Med.
25	Western Block Company	4021 S. 19th Ave.	1 closed 1998	Low- Med.
27	Road Jammers Machinery	4300 S. 17th Ave.	1 closed 1994	Low- Med.
30	Broadway Cardlock #23	1307 W. Broadway	1 closed 1999	Low- Med.
5	27th Avenue Landfill	27th Ave. & Lower Buckeye Road	1 closed 1998	Low-Med.
6	Phoenix Transit System	2225 W. Low Buck Rd	1 closed 2000	Medium
6	COP Petroleum Storage Facility	2239 W. Low Buck Rd	1 closed 1998	Medium

ID	Site Name	Site Address	Status	Priority
6	Phoenix Salt River Service Center	3045 S. 22nd Ave.	6 closed 1997 – 1999	Medium
9	Empire Metals Inc.	2010 W. Low Buck Rd	2 closed 1994	Low- Med.
15	Quality Block Company Inc.	3035 S. 35th Ave.	3 closed 1997	Low-Med.
22	Salt River Recycling / Smithey	3640 S. 35th Ave.	1 closed 1999 / 2 2000	Low-Med.
36	Fuelco #113	3331 W. Broadway	1 closed 1993	Low-Med.
36	Rotman Properties	3250 W. Broadway	1 unknown closed date	Low-Med.
36	Ricketts Trucking Inc	3434 W. Broadway	1 Closed date unknown	Low-Med.
1	EMCO Recycling	3700 W. Lower Buckeye Road	1 closed 1999	Low-Med.
1	Desert Transformer Inc.	3751 W. Low Buck Rd	1 closed 1999	Low-Med.
1	RJ Ruff & Co.	3883 W. Low Buck Rd	1 closed 1998	Low-Med.
7	Mardian Construction Company	4044 W. Low Buck Rd	2 closed 1996	Low-Med.
8	Phoenix Redi Mix Company Inc.	3635 S. 43rd Ave.	5 closed 1998-1999	Low-Med.
8	Publicker Ind / Masterview Window	3065 S. 43rd Ave.	1 closed date unknown	Low-Med.
8	USF Bestway Transportation	3045 S. 43rd Ave.	1 closed 1988	Low-Med.
17	Sunrise / Scorpio Steel Inc.	3420 S. 39th Ave.	3 closed 1997	Low-Med.
38	CalMat Yard	4830 S. 43rd Ave.	1 closed 1990	Low-Med.
42	Coreslab Structures Inc.	5026 S. 43rd Ave.	1 closed 2000	Low-Med.
16	Arizona Truss Fabricators	3207 S. 51st Ave.	1 closed 1990	Low-Med.
53	Western Meat Company	7201 W. Southern	1 closed 1997	Low-Med.

Notes:
ID – Map ID (see Figure 2)

UST

State underground storage tank sites listing. The state of Arizona requires that owners of most underground storage tanks (USTs) register their USTs with ADEQ. Revision date: 11/07/01

ID	Site Name	Site Address	Status	Priority
Z	19th Avenue Landfill	19th Ave and Lower Buckeye Road	0 active / 3 removed	High
2	Neils Detroit Diesel Inc.	2602 S. 19th Ave.	0 active / 3 removed	Low- Med.
2	Superior Companies	2402 S. 19th Ave.	0 active / 1 removed	Low- Med.
2	Arizona Beef	2401 S. 19th Ave.	0 active / 2 removed	Low- Med.
2	Bradley Investment Co.	2235 S. 19th Ave.	0 active / 2 removed	Low- Med.
10	Phoenix Tallow	2602 S. 15th Ave.	0 active / 6 removed	Low- Med.
13	Asphalt Products Transport Co.	3050 S. 19th Ave.	0 active / 2 removed	Low- Med.
13	Lincoln Auto	3020 S. 19th Ave.	0 active / 2 removed	Low

ID	Site Name	Site Address	Status	Priority
13	Waste Management of Phoenix (AKA Universal Waste Control)	3000 S. 19th Ave.	2 active/3 removed	Low-Med.
19	Tanner-United Metro	3640 S. 19th Ave.	4 active / 7 removed	Low- Med.
20	Ace Asphalt of Arizona	895 W. Elwood	2 active / 3 removed	Low- Med.
25	Circle K #670	4422 S. 19th Ave.	0 active / 3 removed	Low- Med.
25	Cooley Wholesale Lumber Co.	1930 W. Broadway	0 active / 2 removed	Low- Med.
25	Arizona Teamsters App.	1820 W. Broadway	0 active / 2 removed	Low- Med.
25	CSW Contractors Inc.	1824 W. Broadway	0 active / 2 removed	Low
25	Circle K #1968	4305 S. 19th Ave.	3 active / 0 removed	Low- Med.
25	Western Block Company	4021 S. 19th Ave.	0 active / 4 removed	Low- Med.
27	Road Jammers Machinery	4300 S. 17th Ave.	0 active / 3 removed	Low- Med.
30	Broadway Cardlock #23	1307 W. Broadway	0 active / 3 removed	Low- Med.
30	Progressive Roofing	1501 W. Broadway	0 active / 1 removed	Low- Med.
30	Sandvick Equipment & Supply Co.	1502 W. Broadway	0 active / 1 removed	Low- Med.
30	Brown Tank & Steel	4300 S. 15th Ave.	0 active / 2 removed	Low- Med.
5	27th Avenue Landfill	27th Ave. & Lower Buckeye Road	0 active / 1 removed	Low-Med.
6	Phoenix Transit System	2225 W. Low Buck Rd	19 active / 0 closed	Medium
6	COP Petroleum Storage Facility	2239 W. Low Buck Rd	0 active / 7 removed	Medium
6	Kerley Chemical Corp.	2248 W. Low Buck Rd	0 active / 1 removed	Low- Med.
6	Phoenix Salt River Service Center	3045 S. 22nd Ave.	8 active / 16 removed	Medium
9	Empire Metals Inc.	2010 W. Low Buck Rd	0 active / 3 removed	Low- Med.
14	Operating Engineers Road	3225 S. 22nd Ave.	0 active / 3 removed	Low- Med.
33	M&M Auto Storage Pool Inc	2299 W. Broadway	0 active / 1 removed	Low
33	Fuelco #112	2401 W. Broadway	0 active / 5 removed	Low- Med.
33	Smith Pre-Cast	2410 W. Broadway	2 active / 0 removed	Low
33	Alan Harris Trucking	2505 W. Broadway	0 active / 1 removed	Low- Med.
15	Maricopa By-Products Inc.	3602 W. Elwood St.	0 active / 6 removed	Low-Med.
15	Quality Block Company Inc.	3035 S. 35th Ave.	0 active / 3 removed	Low-Med.
22	Salt River Recycling / Smithey	3640 S. 35th Ave.	0 active / 3 removed	Low-Med.
31	Vista Construction	2836 W. Broadway	2 active / 0 removed	Low-Med.
31	Royden Construction Co	2844 W. Broadway	0 active / 4 removed	Low-Med.
31	Construction Yard	2850 W. Broadway	0 active / 2 removed	Low-Med.
36	Fuelco #113	3331 W. Broadway	0 active / 3 removed	Low-Med.
36	Rotman Properties	3250 W. Broadway	0 active / 2 removed	Low-Med.

ID	Site Name	Site Address	Status	Priority
36	Ricketts Trucking Inc	3434 W. Broadway	0 active / 4 removed	Low-Med.
36	Phillips 66 Company	3449 W. Broadway	0 active / 4 removed	Low-Med.
1	Circle K #8870	3501 W. Low Buck Rd	3 active / 0 removed	Low-Med.
1	EMCO Recycling	3700 W. Lower Buckeye Road	0 active / 4 removed	Low-Med.
1	Desert Transformer Inc.	3751 W. Low Buck Rd	0 active / 3 removed	Low-Med.
1	RJ Ruff & Co.	3883 W. Low Buck Rd	0 active / 3 removed	Low-Med.
1	Reuter Equipment Co.	3816 W. Low Buck Rd	0 active / 3 removed	Low-Med.
1	CAVCO Industries Inc.	2602 S. 35th Ave.	0 active / 2 removed	Low-Med.
1	CAVCO Industries Inc.	2502 W. Durango	0 active / 2 removed	Low-Med.
7	Mardian Construction Company	4044 W. Low Buck Rd	0 active / 4 removed	Low-Med.
7	Zieman MFG	4025 W. Low Buck Rd	0 active / 1 removed	Low-Med.
8	Phoenix Redi Mix Company Inc.	3635 S. 43rd Ave.	0 active / 9 removed	Low-Med.
8	A&K Partnership	3211 S. 43rd Ave.	0 active / 2 removed	Low-Med.
8	Publicker Ind / Masterview Window	3065 S. 43rd Ave.	0 active / 1 removed	Low-Med.
8	USF Bestway Transportation	3045 S. 43rd Ave.	1 active / 4 removed	Low-Med.
8	Stanton Industries of Arizona	4215 W. LBR	0 active / 1 removed	Low-Med.
8	Glen Weinburger	3425 S. 43rd Ave.	1 active / 0 removed	Low-Med.
17	Sunrise / Scorpio Steel Inc.	3420 S. 39th Ave.	0 active / 2 removed	Low-Med.
17	All Valley Wrecker	3401 S. 39th Ave.	0 active / 2 removed	Low-Med.
38	CalMat Yard	4830 S. 43rd Ave.	0 active / 1 removed	Low-Med.
42	Tatel Inc.	5250 S. 43rd Ave.	2 active / 0 removed	Low-Med.
42	Coreslab Structures Inc.	5026 S. 43rd Ave.	0 active / 3 removed	Low-Med.
16	Royden Construction Company	3423 S. 31st Ave.	0 active / 2 removed	Low-Med.
16	FedEx Ground	3410 S. 51st Ave.	1 active / 0 removed	Low-Med.
51	Arnold Machinery Company of AZ	6024 W. Southern	1 active / 0 removed	Low-Med.
28	Farm	7502 W. Broadway	0 active / 2 removed	Low-Med.
53	Western Meat Company	7201 W. Southern	0 active / 2 removed	Low-Med.

Notes:
ID – Map ID (see Figure 2)

AZ-SPILLS

Releases and incidents recorded by ADEQ Emergency Response Unit. Revision date: 6/30/00

ID	Site Name	Site Address	Status	Priority
4	MP Environmental	2530 S. 16th Ave.	1994 incident	Low- Med.
13	Asphalt Products Transport Co.	3050 S. 19th Ave.	1993 incident	Low- Med.
19	United Metro Material Plant 11	3640 S. 19th Ave.	1995 Diesel release	Low- Med.
20	Ace Asphalt of Arizona	895 W. Elwood	1988 Unknown release	Low- Med.
30	Briscoe Inc.	15th Ave./Broadway	1985 petroleum release	Low-Med.
44	CJ Joregenstein Elementary	1701 W. Roeser	1998 incident	Low
5	27th Avenue Landfill	27th Ave. & Lower Buckeye Road	1992 incident	Low-Med.
5	Phoenix Union High School	2800 S. 27th Ave.	1991 incident	Low
6	Kerley Chemical Corp.	2248 W. Low Buck Rd	1986 incident	Low- Med.
33	Chemical Waste Management	2301 W. Broadway	8 incidents from 1984-89	Med./High
34	Motorola (Bic)	2200 W. Broadway	1984 incident	Low
22	Metal Management of Arizona	3640 S. 35th Ave.	1999 auto shreds fire	Low-Med.
31	Enviro-Solv	2844 W. Broadway	2000 incident	Low-Med.
31	Unknown	2744 W. Broadway	1995 incident	Low
35	All-A-Matic Transmissions	3011 W. Broadway	1993 incident	Low
36	Western States Petroleum	3331 W. Broadway	1985 gasoline release	Low
36	Urban Forest Products Co.	3330 W. Broadway	1995 incident	Low
36	Liquid Air Co.	3332 W. Broadway	1985 incident	Low
1	EMCO Recycling	3700 W. Low Buck Rd	2 – 1996 incidents	Low-Med.
1	Copperstate Metals Inc.	3720 W. Low Buck Rd	2 incidents (1986/1988)	Low-Med.
1	Unknown	39 Ave. / Low Buck Rd	1 incident (2000)	Low-Med.
21	Reynolds Aluminum Plant Ponds	43rd Ave. / Salt River	1 incident 1998	Low
16	FedEx Ground	3410 S. 51st Ave.	1996 diesel release	Low-Med.
43	Arizona Oil Recyclers Assoc.	5040 S. 51st Ave.	1992 oil release	Low
48	A-1 Tire Company	4825 W. Southern	1990 fire	Low
49	USA Tire Recycling	5922 W. Southern	1992 fire	Low

Notes:
ID – Map ID (see Figure 2)

DRY WELLS

State dry well registration list. Dry wells are typically constructed on commercially-developed properties to collect rainwater surface runoff, and therefore, have the potential to introduce contaminants into the subsurface. Revision date: 12/01/01

ID	Site Name	Site Address	Status	Priority
2	Arizona Truck & Trailer	2235 S. 19th Ave.	1 Dry well	Low
13	Waste Management of Phoenix (AKA Universal Waste Control)	3000 S. 19th Ave.	1 Dry well	Low-Med.
5	27th Avenue Landfill	27th Ave. & Lower Buckeye Road	1 Dry well	Low-Med.
6	COP Petroleum Storage Facility	2239 W. Low Buck Rd	1 dry well	Medium
33	AG Products	2525 W. Broadway	2 Dry wells	Low
1	CAVCO Industries Inc.	2602 S. 35th Ave.	7 Dry Wells	Low-Med.
28	Marbella	75th Ave / Broadway	9 Dry wells	Low
Notes: ID – Map ID (see Figure 2)				

APPENDIX C

REPORT - ENVIRONMENTAL CONTAMINANTS IN FISH AND WILDLIFE OF THE LOWER GILA RIVER, ARIZONA

MARSH

U.S. Fish and Wildlife Service
Region 2
Contaminants Program

ENVIRONMENTAL CONTAMINANTS IN FISH AND WILDLIFE OF THE LOWER GILA RIVER, ARIZONA

by

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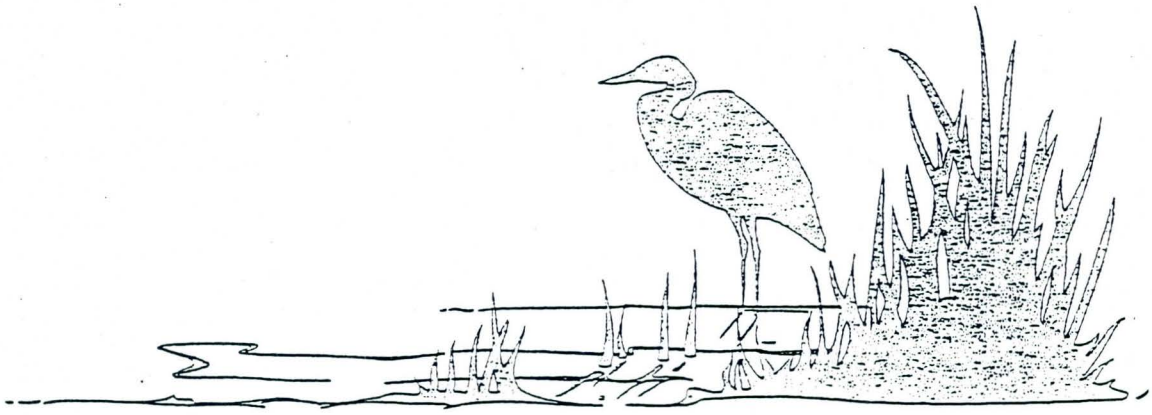

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Arizona Ecological Services Field Office
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December 1997

ABSTRACT

Levels and potential effects of pesticides and metals on fish and wildlife of the lower Gila River and associated agricultural drainage canals in Maricopa County, Arizona, were investigated in 1994-95. Residues of DDT, an insecticide that has been suspended from use in Arizona for 25 years, are still present in fish, turtles, and birds. DDT was detected in 86, 62, and 50% of the fish collected from Buckeye Canal, Gillespie Dam, and Allenville, respectively. DDT was recovered in all turtles from Gillespie Dam, and in all black-crowned night-herons from Painted Rock.

DDE residues in fish from the lower Gila River drainage were the highest in the United States associated with agriculturally applied pesticides. Although DDE residues declined over the past decade; current levels remain extremely high. DDE was present at concentrations known to impact biotic resources. Fish collected from agricultural drainage canals generally contained higher DDE residues than fish from the river. DDE residues were highest in common carp (*Cyprinus carpio*) from Buckeye Canal (11.17 µg/g wet weight), an agricultural drain and tributary to the Gila River. The overall frequency of occurrence of organochlorine compounds is declining, however, as only 6 compounds were detected in samples collected in 1994-95 versus 16 recovered in samples collected from the same sites in 1985. Residues of all other pesticides and PCBs were below levels associated with adverse affects on fish and wildlife.

Concentrations of 11 potentially toxic metals were detected in fish. Carp collected near Allenville had the second highest aluminum concentration ever recorded in Arizona. Copper exceeded the national 85th percentile in 31 of 48 samples. Because of its occurrence at relatively high levels and its propensity to interact with other compounds and elements, copper remains a contaminant of concern. Concentrations of most metals remained unchanged from 1985 to 1994-95.

Spiny softshell turtles (*Trionyx spiniferus*) generally contained higher organochlorine and metal concentrations than fish. DDE and most metals were highest in turtles from the middle river sampling sites. Residues of DDE and chlordane declined by about one-half from 1985 to 1994-95. PCB, dieldrin, and DDT levels remained relatively constant over the past decade while copper, nickel, vanadium, and zinc concentrations declined. Levels of arsenic, mercury, and selenium in turtles collected in 1994-95 were statistically similar to concentrations in turtles collected in 1985.

Whiptail lizards (*Cnemodophorus* spp.) collected from areas adjacent to the lower Gila River contained higher organochlorine residues than lizards collected from other Arizona locations. DDE and selenium exceeded toxic threshold levels that could be hazardous to avian predators that consume a large proportion of lizards in their diet. Mean mercury concentrations increased from 1985 to 1994-95 and were about 3- to 10-times higher in lizards collected in the Gila River basin than in lizards from other Arizona locations.

DDE, mercury, and selenium pose a significant environmental challenge to black-crowned night-herons (*Nycticorax nycticorax*) and possibly to other avian species nesting and wintering on the lower Gila River. All night-heron and two of four red-winged blackbird (*Agelaius phoeniceus*) carcasses contained >3.4 μg/g wet weight DDE; the level associated with impaired reproduction. One-half of the blackbird carcasses contained sufficiently high DDE residues to represent a hazard to predatory birds that regularly feed on blackbirds. Mercury concentrations in five of six night-heron livers approached or exceeded the toxic threshold and the maximum concentration, 28.07 μg/g dry weight, was 4.5-times higher than the toxic threshold. Selenium concentrations in night-heron livers (13 - 18 μg/g dry weight) indicate that adults are not at risk of selenium intoxication, but selenium impacts on reproduction are possible.

Project No. 22410-1130-2F30

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LIST OF TABLES

Table		Page
1.	Organochlorine residues in individual whole body fish collected from the lower Gila River, Arizona, 1994-95	49
2.	Organochlorine compounds in common carp collected from the lower Gila River, Arizona, 1994-95: a comparison among collection sites	51
3.	Organochlorine compounds in fish fillets collected from the lower Gila River, Arizona, 1994-95	52
4.	Metals in individual whole body fish collected from the lower Gila River, Arizona, 1994-95	53
5.	Metals in common carp collected from the lower Gila River, Arizona, 1994-95: a comparison among collection sites	55
6.	Metals in common carp and largemouth bass fillet samples collected from the lower Gila River, Arizona, 1994-95	57
7.	Organochlorine residues in individual softshell turtles collected from the lower Gila River, Arizona, 1994-95	58
8.	Geometric mean concentrations of organochlorine compounds in softshell turtles collected from the lower Gila River, Arizona 1994-95	59
9.	Trace element concentrations in individual whole body softshell turtles collected from the lower Gila River, Arizona, 1994-95	60
10.	Metals in softshell turtles collected from the lower Gila River, Arizona, 1994-95: a comparison among collection sites	61
11.	Organochlorine compounds in whiptail lizards collected from the lower Gila River, Arizona, 1985 and 1994-95	62
12.	Metals in whiptail lizards collected from the lower Gila River, Arizona, 1985 and 1994-95.	63
13.	Organochlorine residues in bird carcasses collected from the lower Gila River, Arizona, 1994-95	64
14.	Metals in whole body red-winged blackbirds collected from the lower Gila River, Arizona, 1985 and 1994-95	65
15.	Metals in black-crowned night-heron and red-winged blackbird whole body and liver samples collected from the lower Gila River, Arizona, 1994-95	66

BIRDS 33
Organochlorines in birds 34
Metals in birds 35
HUMAN HEALTH CONCERNS 37

8. CONCLUSIONS 38

9. RECOMMENDATIONS 39

10. ACKNOWLEDGEMENTS 40

11. LITERATURE CITED 41

12. TABLES 49

13. APPENDIX 67

INTRODUCTION

The development of a cotton monoculture during the 1950s in Arizona's lower Gila River Valley resulted in infestations by insect pests such as the pink bollworm (*Pectinophora gossypiella*) which, by the late-1950s, threatened to severely decimate the Valley's cotton crop (Stanton 1987). In an attempt to control the pink bollworm with insecticides, about 33,000 acres (13,355 ha) in the Valley's Buckeye-Avondale area were treated with 1.7 million pounds (772,727 kg) of technical DDT during 1958-1960 (Parsons 1987). As a result of multiple applications throughout the growing season, up to 23 pounds per acre (25.7 kg/ha) of technical DDT was applied per year. Soil tests conducted in 1985 by University of Arizona personnel revealed 1.5 μg/g DDE (a metabolite of DDT) and 0.4 μg/g DDT, about 20-times background concentrations, at levels 18-inches below the soil surface (N.A. Buck *in* Parsons 1987). The total farmland irrigated by DDT-contaminated drainwater exceeded 100,400 acres (40,632 ha), and an estimated 4,917 tons of DDT and metabolites (DDTr) reached the lower Gila River via agricultural drainwater return flow (Parsons 1987). Johnson and Lew (1970) concluded that, "the Gila River appears to be the most DDT-burdened stream of 20 sampled in the western United States."

Concern that pesticides may have adversely affected fish and wildlife was first expressed during the mid-1960s. Between 1966 and 1982, 460 samples were collected by four agencies for residue analyses (Ellingson 1984). European starlings (*Sturna vulgaris*) collected near the lower Gila River during a 1982 nationwide survey of 129 sites contained the highest (8.4 μg/g wet weight) DDE concentration in the United States (Bunck et al. 1987). A separate study reported that mallards (*Anas platyrhynchos*) taken in the same general area had the second highest DDT residue in the nation (Cain 1981). Subsequent reports by the Arizona Department of Health Services (ADHS) indicated that fish from the lower Gila River at Painted Rock Borrow Pit Lake (Painted Rock) were contaminated not only with pesticides, but by heavy metals such as arsenic, cadmium, lead, mercury, and zinc (ADHS 1991). Earth Technology Corporation (1993) concluded, "Based on TCLP analysis, fish and turtles (from Painted Rock) could be considered a hazardous waste and would require treatment and disposal." Of special concern was the potential adverse effects these pesticides could have on federally listed threatened and endangered species, such as the Yuma clapper rail (*Rallus longirostris yumanensis*), bald eagle (*Haliaeetus leucocephalus*), peregrine falcon (*Falco peregrinus*) and brown pelican (*Pelecanus occidentalis*) that were present in the lower Gila River area.

The U.S. Fish and Wildlife Service (Service) completed a comprehensive investigation of organochlorine pesticide levels and potential effects of those compounds on lower Gila River fish and wildlife during 1985 (Kepner 1986, 1987). That report identified a significant threat to fish, wildlife, and human health. Based on Kepner's data, and those of the Arizona Game and Fish Department (AGFD), and the Arizona Department of Environmental Quality (ADEQ), fish consumption advisories were posted, and are currently still in effect, at several sites within the study area including portions of the Gila, Salt, and Hassayampa Rivers, and at Dysart Drain (ADHS 1991, ADEQ 1996).

The objectives of this study were to, 1) document and assess current levels of selected organochlorine and metal contaminants in fish and wildlife of the lower Gila River, 2) evaluate trends in contaminant concentrations spacially and temporally using current data and those collected from the same area a decade earlier (Kepner 1986, 1987), 3) compare the occurrence of selected contaminants in lower Gila River fish and wildlife with national averages using national monitoring networks (Schmitt and Brumbaugh 1990, Schmitt et al. 1990) and U.S. Environmental Protection Agency (USEPA) special national studies (USEPA 1992), and 4) assess the risk of exposure to known action levels for fish and wildlife.

STUDY AREA

The lower Gila River study area is located southwest of Phoenix, in southwestern Arizona (Figure 1). We attempted to replicate the 1985 Service study by collecting samples from the same general locations as described by Kepner (1987). Six study sites were located in the lower Gila River watershed along an 88 mile (142 km) stretch of river between 59th Avenue and Painted Rock. The most eastern site, 59th Avenue, is located on the lower Salt River 12 miles (20 km) upstream from its confluence with the Gila River. Four additional collection sites were located on the river at approximately equidistant intervals; the Gila River at Estrella Park, Allenville, Gillespie Dam, and Painted Rock. Samples collected at Painted Rock came from the 100-acre (40.5 ha.) borrow pit lake below the dam. A final set of samples was collected from Buckeye Canal, a canal that provides irrigation water to farmers and return run-off to the Gila River. A single incidental sample was taken at Dysart Drain, another agricultural drain that flows into the Gila River under run-off conditions.

METHODS

Sample collections: Fish, turtles, lizards, and birds were collected from the lower Gila River and Buckeye Canal from April to August 1994 and 1995. Channel catfish (*Ictalurus punctatus*), common carp (*Cyprinus carpio*), and largemouth bass (*Micropterus salmoides*) were caught using gill and cast nets. Fish were weighed and measured on site and individual whole body samples were wrapped in aluminum foil and stored on wet ice until they were transferred to a commercial freezer at the end of the day. In addition to whole body samples, fillets from both sides of carp and largemouth bass were taken at selected sites. Spiny softshell turtles (*Trionyx spiniferus*) were collected using a baited wire turtle trap and trot lines. Turtles were placed on wet ice until they became lethargic enough to be handled safely, then weighed and individually wrapped in aluminum foil. Turtles were then replaced on wet ice until transferred to a commercial freezer. Whiptail lizards (*Cnemodophorus* spp.) were sampled from four sites using a .22 caliber rifle or handgun and lead shotshells. Lizards were composited into a single sample at each site. All fish, turtles, and lizards were analyzed for organochlorine compounds and trace elements. Black-crowned night-herons (*Nycticorax nycticorax*) and red-winged blackbirds (*Agelaius phoeniceus*) were collected at selected sites using a shotgun and steel shotshells. Birds were weighed in the field then bills, legs, wingtips, feathers, and gastrointestinal tracts were removed and discarded. Carcass and liver samples were weighed then wrapped in aluminum foil and placed on wet ice until they were transferred to a commercial freezer. Carcasses were analyzed for organochlorines and trace elements while livers were analyzed only for trace elements. Red-winged blackbird carcasses were composited by site and black-crowned night-heron carcasses were analyzed individually.

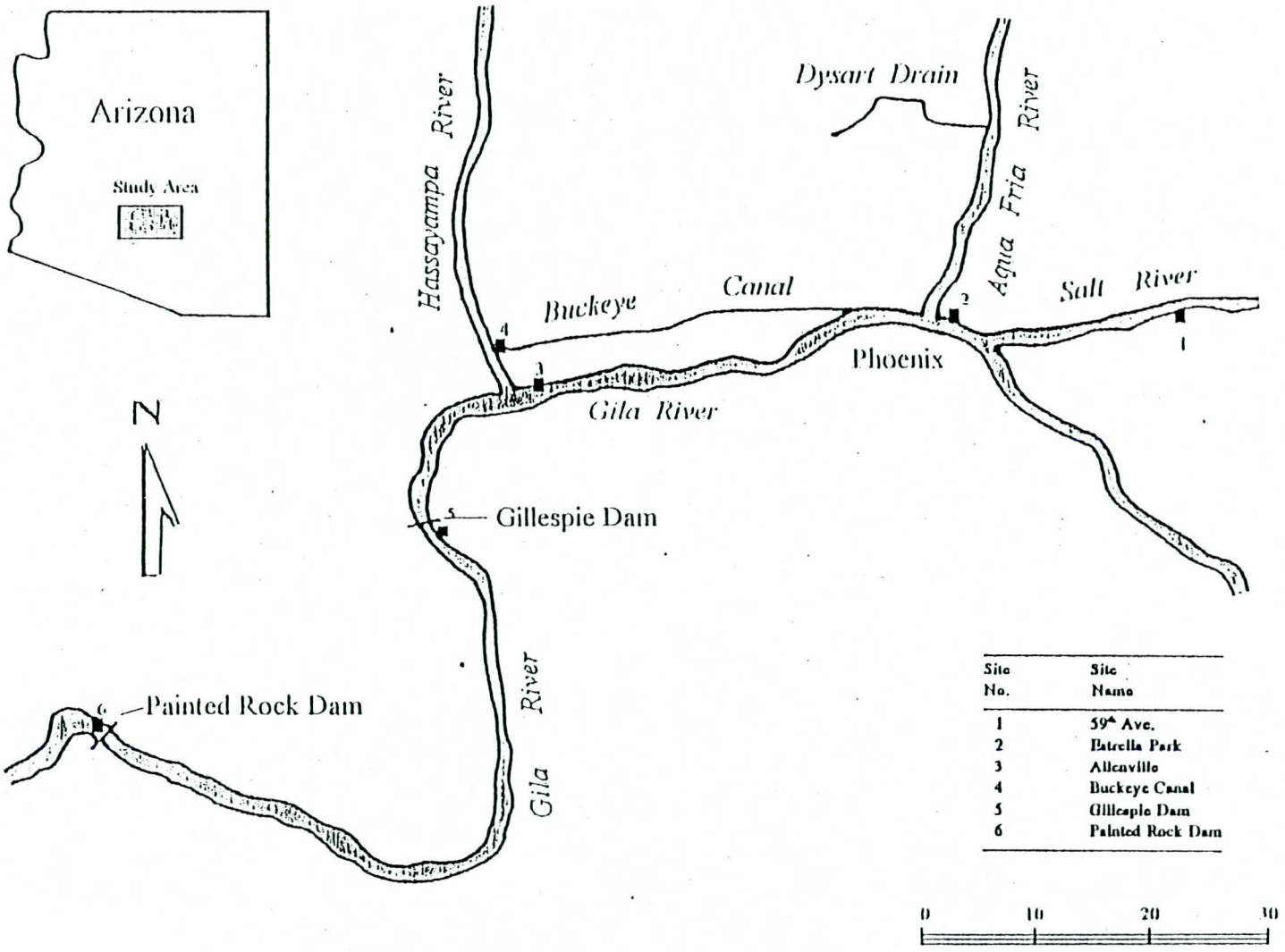


Figure 1. Lower Gila River sample collection sites, 1994-95.

Chemical analyses: All samples except bird livers were analyzed for organochlorine compounds including o,p'- and p,p'-DDE, o,p'- and p,p'-DDD, o,p'- and p,p'-DDT, dieldrin, heptachlor epoxide, hexachlorobenzene (HCB), alpha, beta, delta, and gamma BHC, alpha and gamma chlordane, oxychlordane, *trans*-nonachlor, *cis*-nonachlor, endrin, toxaphene, mirex, and total polychlorinated biphenyls (PCB) at Hazleton Environmental Services, Inc. Madison, Wisconsin. For each analysis, the sample was homogenized and mixed with anhydrous sodium sulfate and soxhlet extracted with hexane for seven hours. The extract was then concentrated by rotary evaporation to dryness for lipid determination. The weighed lipid sample was dissolved in petroleum ether and extracted four times with acetonitrile saturated with petroleum ether. Lipids were removed by Florisil column chromatography (Cromartie et al. 1975). The column was then eluted with diethyl ether/petroleum ether and separated into two fractions. One fraction was concentrated to appropriate volume for quantification of residues by packed or capillary column electron capture gas chromatography. The other fraction was concentrated and transferred to a SilicAR acid chromatographic column for additional cleanup required for separation of PCBs from other organochlorines for quantification of residues by packed or megabore column, electron capture gas chromatography. The lower limit of quantification was 0.01 μg/g (parts per million) for most organochlorine pesticides and 0.05 μg/g for toxaphene and PCBs. Organochlorine compounds are expressed in μg/g wet weight unless otherwise specified. Organochlorine compounds are primarily stored in body lipids; therefore, lipid levels are presented for each sample.

Whole body fish, fish fillets, turtles, lizards, bird carcasses, and bird livers were analyzed for aluminum, arsenic, beryllium, boron, cadmium, chromium, copper, lead, mercury, molybdenum, nickel, selenium, strontium, vanadium, and zinc at Hazleton Laboratories America, Inc. Mercury concentrations were quantified by cold vapor atomic absorption, arsenic and selenium were analyzed by hydride generation atomic absorption spectrophotometry. All other elements were analyzed following preconcentration to lower detection limits by using inductively coupled plasma emission spectroscopy (ICP). Trace element concentrations in fish samples are reported in μg/g wet weight to facilitate comparison of results with those of other studies. Percent moisture is presented to permit wet weight to dry weight conversions. Wet weight values can be converted to dry weight equivalents by dividing the wet weight values by one minus percent moisture as illustrated in the following equation:

$$\text{Dry weight} = \frac{\text{wet weight}}{1 - \text{percent moisture}}$$

Element concentrations in turtles, lizards, and birds are presented in μg/g dry weight. The lower limits of analytical quantification varied by element and by sample mass are listed in the appropriate tables.

RESULTS

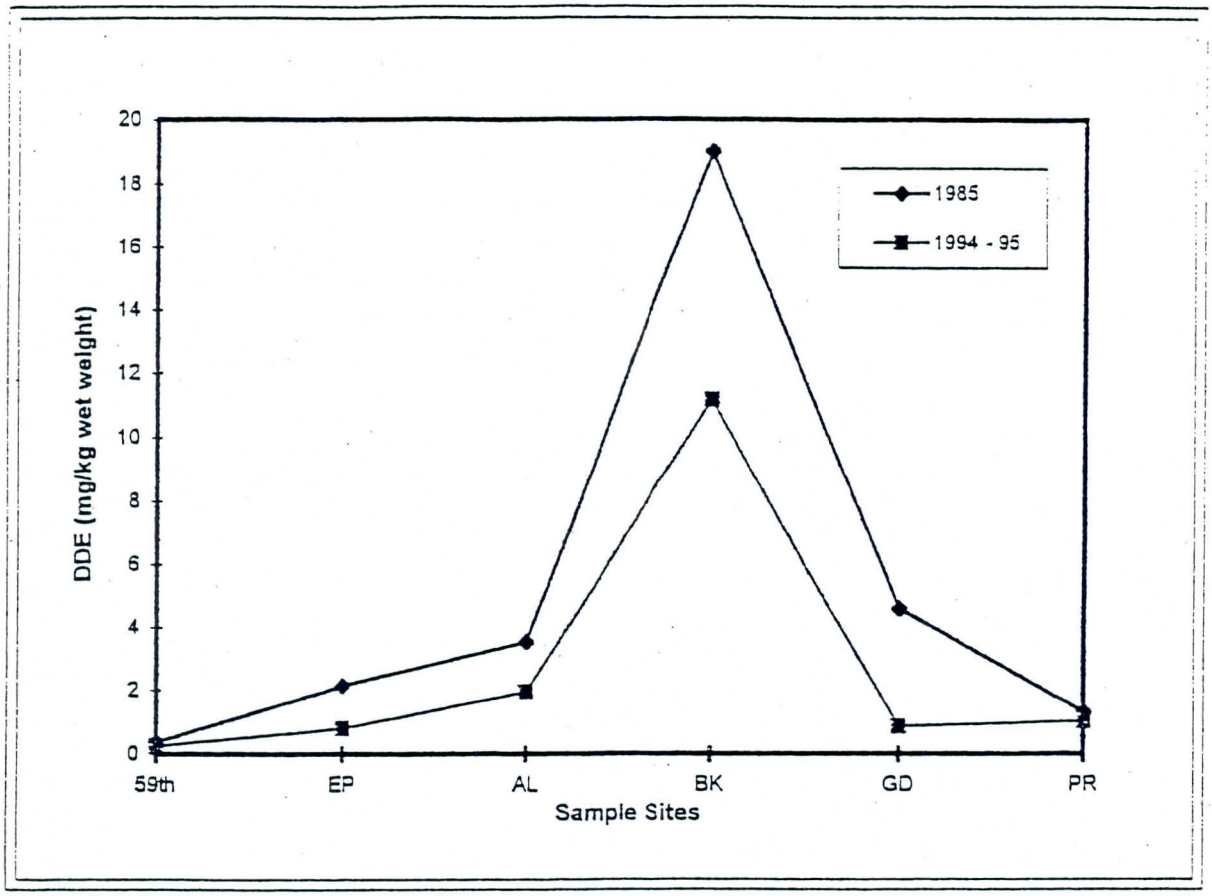
FISH

Organochlorines in whole fish: From three to five common carp were sampled at each site (Table 1). Channel catfish were taken at all sites except Estrella Park and sample size ranged from one to nine individuals per site. Five largemouth bass were collected at both 59th Avenue and Painted Rock.

Whole body fish samples contained residues of six organochlorine compounds (Table 1). DDE was present in all samples and individual residues ranged from 0.16 to 21.0 μg/g wet weight. Geometric mean DDE levels in carp were lowest in 59th Avenue samples (0.27 μg/g) and highest in carp from Buckeye Canal (11.17 μg/g, Table 2). Carp and largemouth bass geometric means were similar (P = 0.1750) for samples collected at 59th Avenue and Painted Rock; carp/catfish means were similar (P = 0.0581) for samples from Gillespie Dam. The geometric mean DDE residue in carp was significantly (P = 0.0007) lower in 1994-95 (1.29 μg/g wet weight) than in 1985 (2.65 μg/g, Figure 2); however, the frequency of occurrence (100%) was similar during both collection periods.

DDT was detected most frequently in fish from Buckeye Canal; six of seven samples (86%) contained DDT. The frequency of recovery of DDT in fish from other sites ranged from zero at 59th Avenue and Estrella Park, to 25% at Painted Rock, 50% at Allenville, and 62% at Gillespie Dam. The maximum DDT residue was 0.15 μg/g wet weight in a carp from Buckeye Canal. Only carp samples from Buckeye Canal, Gillespie Dam, and Painted Rock contained DDT at sufficient frequency (>50%) for statistical comparisons. Geometric mean residues were similar among areas (P = 0.0964), but differed between years (P = 0.0306, 2-way ANOVA, Table 2). None of the bass from 59th Avenue and Painted Rock contained DDT; therefore, residue comparisons between species (carp/bass) were not possible. Geometric mean DDT residues in carp collected from Gillespie Dam (0.014 μg/g wet weight) were similar (P = 0.1250) to those in catfish (0.007 μg/g) from the same area. Residues in carp collected in 1994-95 (Gmean = 0.03 μg/g) were one-tenth those in carp collected in 1985 (Gmean = 0.33 μg/g).

PCBs were detected in all fish samples from 59th Avenue, Estrella Park, and Buckeye Canal and were present in about 50% of the samples from the remaining collection sites (Table 1). Individual residues ranged to 0.70 μg/g wet weight. Geometric mean residues in carp were similar between years but were different among areas (P = 0.0042, 2-way ANOVA, Table 2). PCB concentrations in carp from Gillespie Dam were lower (P = 0.0014) than those in carp collected at three upstream sampling stations including 59th Avenue, Estrella Park, and Buckeye Canal (Table 2). PCB residues in carp from 59th Avenue (Gmean = 0.30 μg/g wet weight) were similar to those in largemouth bass (0.38 μg/g) from the same area. PCBs were not detected in a sufficient number of



59th - 59th Avenue
EP - Estrella Park
AL - Allenville
BK - Buckeye Canal
GD - Gillespie Dam
PR - Painted Rock

Figrure 2. Geometric mean DDE residues in carp, lower Gila River, Arizona, 1985 and 1994-95.

Painted Rock and Gillespie Dam carp samples to permit between species comparison of residue levels. The geometric mean PCB residue in carp collected in 1994-95 (0.15 μg/g wet weight) was similar to that in carp collected in 1985 (0.19 μg/g, P = 0.1868). The frequency of recovery of chlordane in fish samples ranged from 25% at Painted Rock to 86% at Buckeye Canal (Table 1). Overall, 29 of 52 (56%) whole body fish samples contained chlordane. Chlordane was present in fewer than one-half the carp samples at each study area except Buckeye Canal which negated a comparison of residue levels among collection sites and among species. In 1985, chlordane was detected in only 3 of 24 samples (Appendix A1); therefore, a comparison of residue levels between years was not possible. However, the frequency of occurrence of chlordane was greater in 1994-95 (56%) than in 1985 (12.5%).

Dieldrin was recovered in 16 of 52 fish samples with the highest recovery rate, 73% (8/11) in samples from 59th Avenue (Table 1). Like chlordane, dieldrin was recovered infrequently and statistical comparisons among species, among areas, and between years were not possible. The frequency of occurrence of dieldrin in samples collected in 1985 (83%) was greater than in 1994-95 (31%).

Toxaphene was not detected in carp but was present in 3 of 15 catfish and in all largemouth bass (Table 1). Residues ranged to 5.4 μg/g wet weight. Highest residues were recorded in two catfish samples from Buckeye Canal. Interspecific differences in toxaphene residues could not be determined because of the lack of detectable residues in carp. The geometric mean toxaphene residue in largemouth bass from 59th Avenue (0.26 μg/g wet weight) was similar (P = 0.1774) to that in bass from Painted Rock (0.21 μg/g, Table 2). Toxaphene was not detected in carp collected in 1994-95, but was present in 61% of the carp sampled in 1985.

Organochlorines in fish fillets: Fillets were taken from three carp collected at Buckeye Canal and from one carp and three largemouth bass from Painted Rock (Table 3). DDE, dieldrin, and toxaphene were the only organochlorine compounds detected in fillet samples. Individual DDE residues in Buckeye Canal carp fillets ranged from 1.30 to 4.50 μg/g wet weight. The single carp fillet sample from Painted Rock contained 0.33 μg/g DDE. DDE in Painted Rock bass fillets ranged from 0.85 to 2.87 μg/g. One of three carp samples from Buckeye Canal contained 0.01 μg/g wet weight dieldrin. Toxaphene was recovered in all Buckeye Canal carp fillets (0.31 to 0.81 μg/g wet weight) and in two bass fillets from Painted Rock (0.11 and 0.14 μg/g).

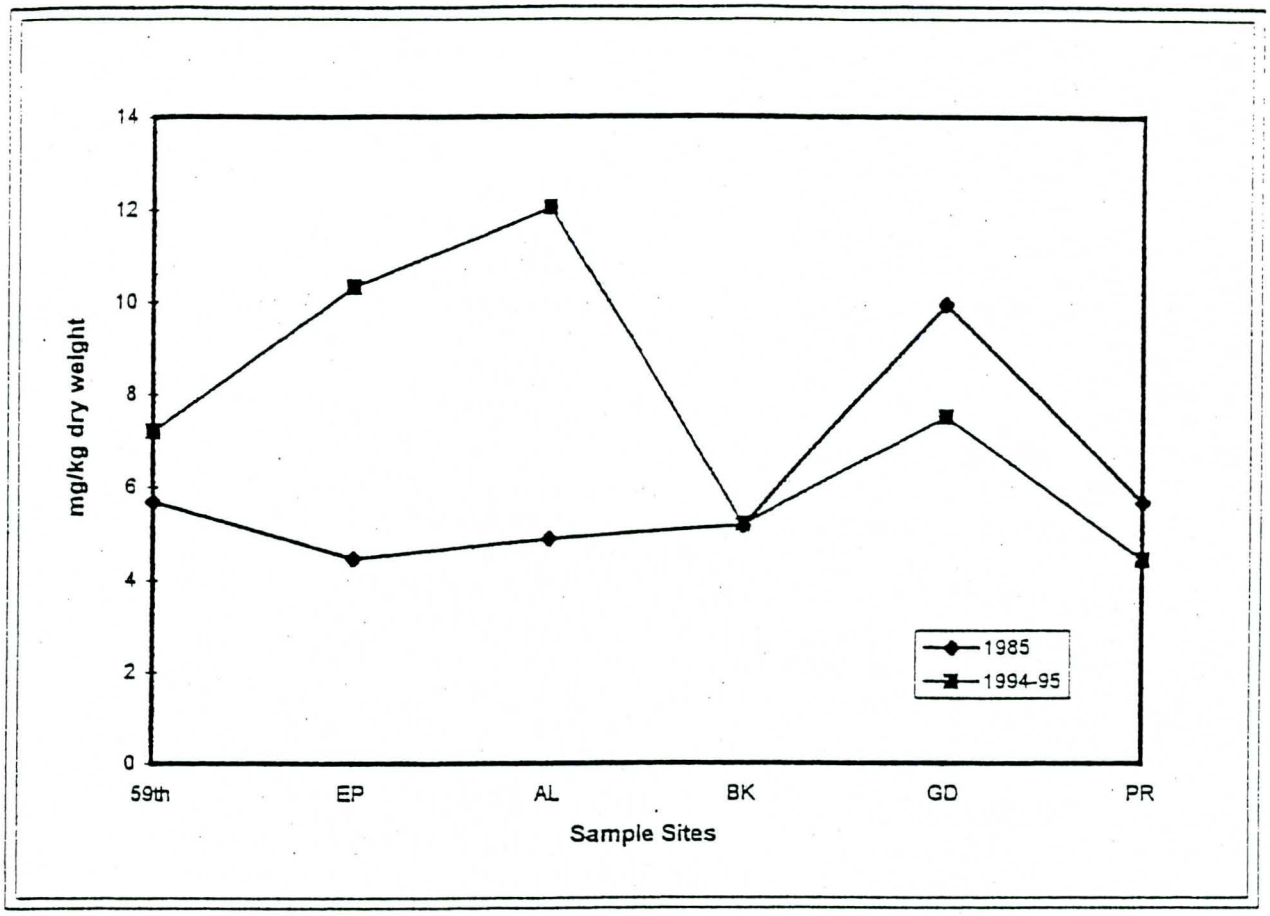
Metals in whole fish: Concentrations of 15 metals potentially toxic to fish are presented in Table 4. Aluminum was detected in 45 of 48 fish samples (94%) and levels ranged from <0.98 to 172 μg/g wet weight. Geometric mean levels, calculated on a dry weight basis, were lower in carp from Painted Rock than in carp from Estrella Park, Allenville, and Gillespie Dam (P = 0.0016, 1-way ANOVA, Table 5). Aluminum concentrations in carp from Painted Rock (Gmean = 17.0 μg/g dry weight) were significantly

(7.51 μg/g dry weight) and catfish (5.42 μg/g) from Gillespie Dam were similar, but concentrations in carp from 59th Avenue (7.21 μg/g) were significantly greater ($P = 0.0017$) than those in largemouth bass (1.65 μg/g) from the same area. At Painted Rock, Gmean concentrations in carp (4.43 μg/g) were similar ($P = 0.3609$) to those in bass (2.80 μg/g). Copper concentrations in carp remained at about the same level ($P = 0.1828$) from 1985 (Gmean = 5.76 μg/g dry weight) to 1994-95 (7.06 μg/g), although they appear more elevated in the upper river reaches compared to the previous study (Figure 4).

Mercury was detected in all samples and concentrations ranged from 0.03 to 0.41 μg/g wet weight (Table 4). Geometric mean mercury levels in carp were significantly different among areas ($P = 0.0242$), but similar between years ($P = 0.9147$, 2-way ANOVA, Table 5). Our relatively small sample size masked the Tukey's test for mean separation among areas. Sequential *t*-tests revealed area differences shown in Table 5. Mercury concentrations in carp from 59th Avenue (Gmean = 0.55 μg/g dry weight) were similar ($P = 0.1256$) to those in bass (0.28 μg/g). Mercury concentrations in carp (0.77 μg/g dry weight) and bass (1.03 μg/g) from Painted Rock were similar ($P = 0.0507$). Mercury concentrations in carp from Gillespie Dam (0.26 μg/g) were similar ($P = 0.5179$) to those in catfish (0.23 μg/g) from the same area. Bass from Painted Rock had significantly ($P = 0.0001$) higher concentrations (1.03 μg/g) than those from 59th Avenue (0.28 μg/g). Mercury levels in carp collected in 1985 and 1994-95 are illustrated in Figure 5. Mercury concentrations in carp collected in 1994-95 (Gmean = 0.47 μg/g dry weight) were almost identical ($P = 0.8751$) to levels in carp (0.48 μg/g) collected in 1985.

Nickel was present in 22 of 48 samples (Table 4) and was recovered most frequently in fish from Estrella Park (100%) and Buckeye Canal (86%) and least frequently in fish from Painted Rock (8%). Geometric mean concentrations in carp were similar among areas ($P = 0.5942$), but were different between years ($P = 0.0001$). Levels present in carp collected in 1985 (3.54 μg/g dry weight) were 3-times higher than those in carp collected in 1994-95 (1.16 μg/g). Nickel was not present at sufficient frequencies to determine differences among species.

Selenium was recovered in 42 of 48 samples (Table 4). Individual concentrations ranged to 1.47 μg/g wet weight. Geometric mean selenium concentrations in carp differed among areas ($P = 0.0043$) but were similar between years ($P = 0.1915$). Although not statistically significant, geometric mean selenium levels were highest in carp from Allenville (3.92 μg/g dry weight) and lowest in carp from 59th Avenue (Table 5). Selenium levels in carp (Gmean = 0.97 μg/g dry weight) and bass (0.96 μg/g) from 59th Avenue were almost identical ($P = 0.9912$). At Painted Rock, selenium concentrations in carp (Gmean = 2.40 μg/g) were also statistically similar ($P = 0.3025$) to levels in bass (1.89 μg/g). Gillespie Dam carp (2.42 μg/g dry weight) contained significantly ($P = 0.0053$) higher levels of selenium than catfish (1.11 μg/g) from the same area. Comparative levels of selenium in carp collected in 1985 and 1994-95 are presented in Figure 6. Selenium concentrations in carp collected in 1994-95 (1.87 μg/g dry weight) were similar ($P = 0.1915$) to those in carp collected in 1985 (1.60 μg/g).



59th - 59th Avenue
EP - Estrella Park
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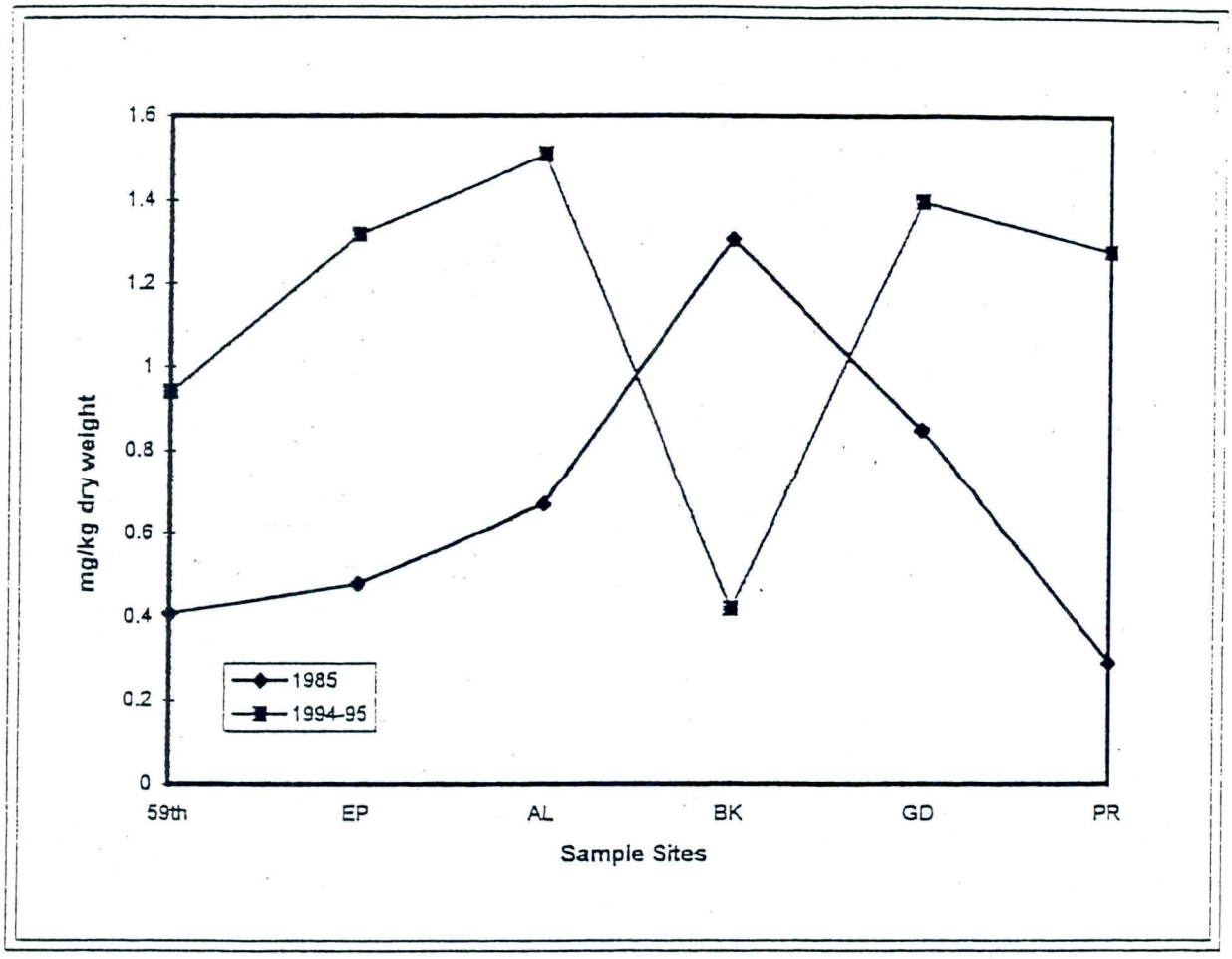
BK - Buckeye Canal
GD - Gillespie Dam
PR - Painted Rock

Figure 4. Geometric mean copper concentrations in carp, lower Gila River, Arizona, 1986 and 1994-95.



59th - 59th Avenue
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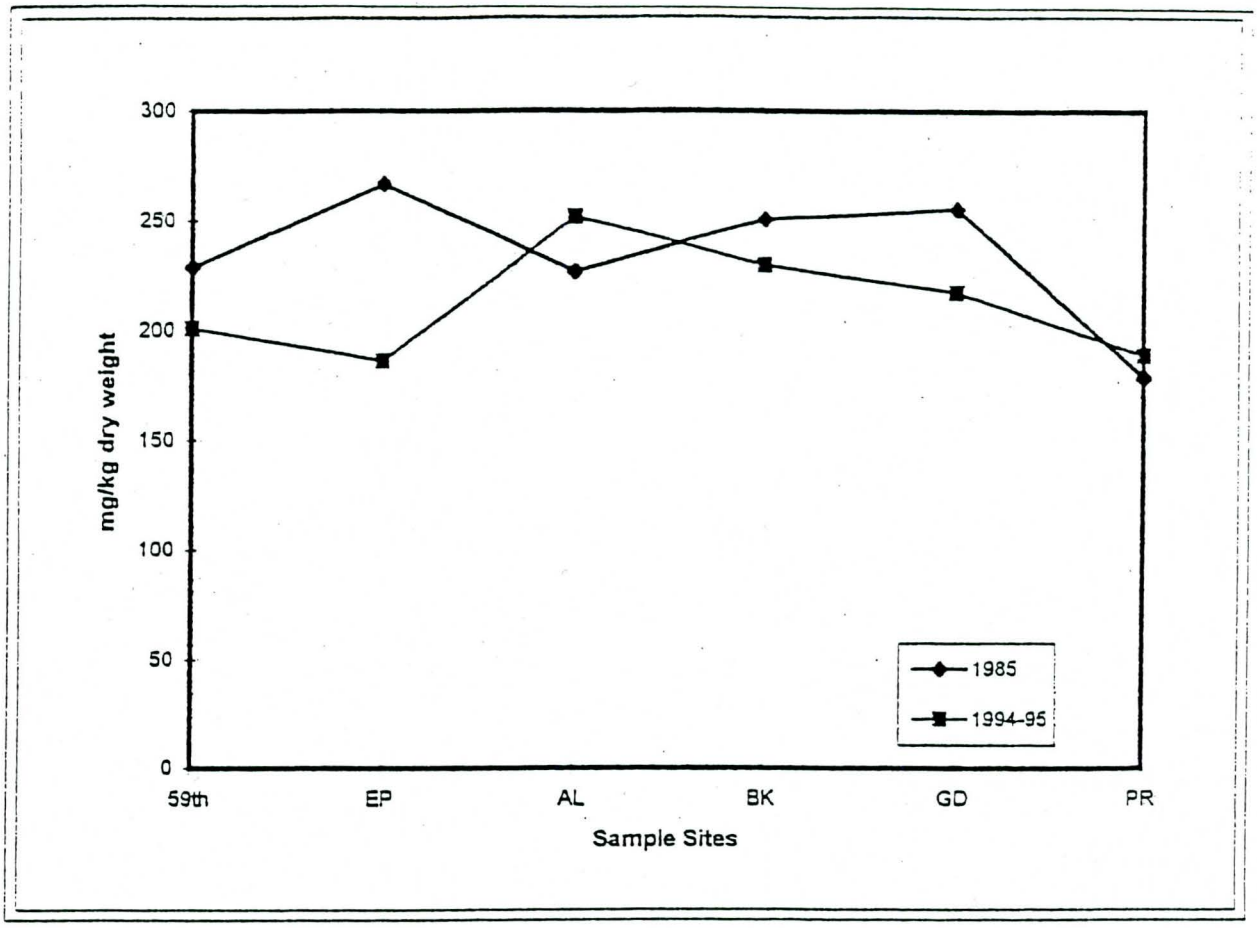
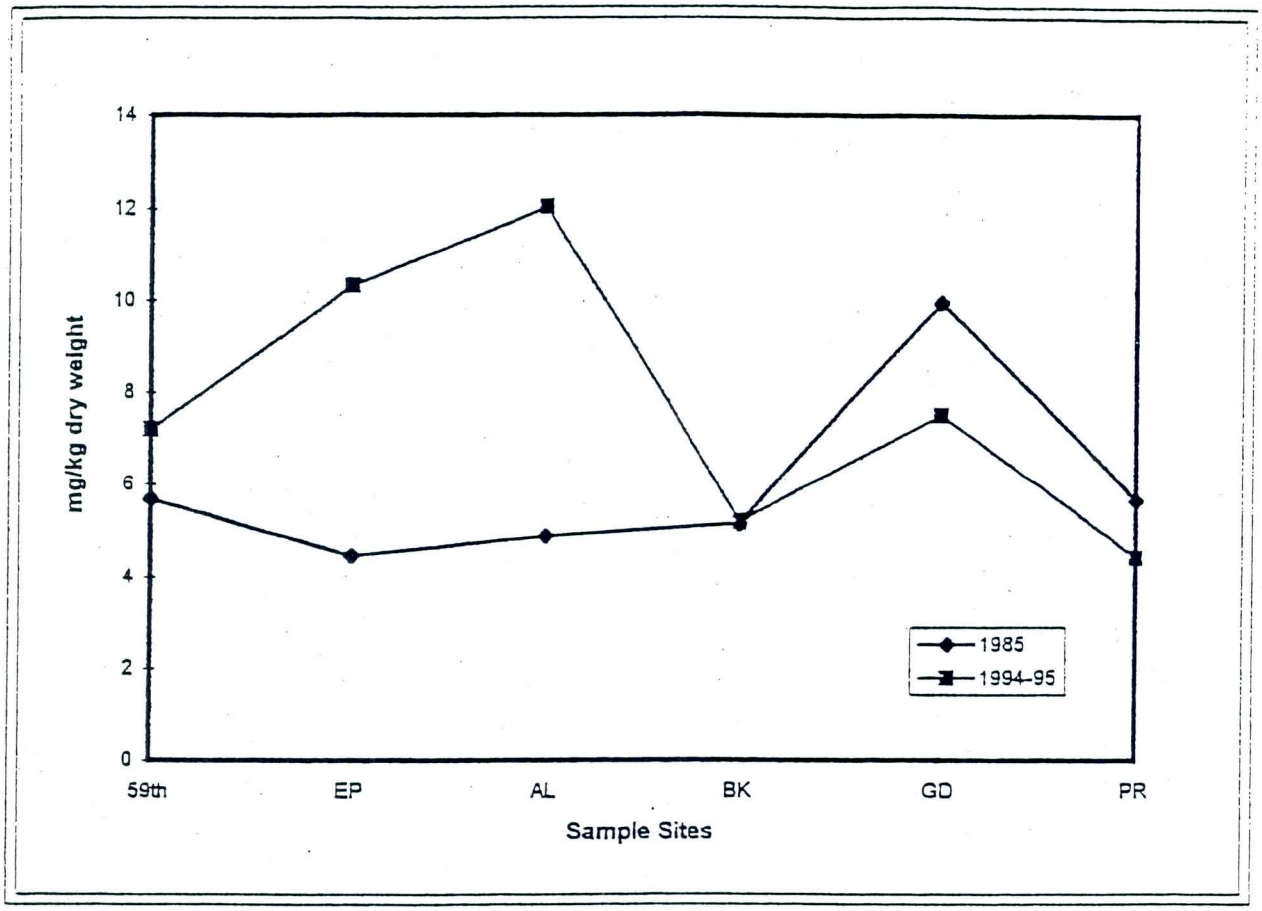
BK - Buckeye Canal
GD - Gillespie Dam
PR - Painted Rock

Figure 7. Geometric mean vanadium concentrations in carp, lower Gila River, Arizona, 1985 and 1994-95.



59th - 59th Avenue
EP - Estrella Park
AL - Allenville
BK - Buckeye Canal
GD - Gillespie Dam
PR - Painted Rock

Figure 8. Geometric mean zinc concentrations in carp, lower Gila River, Arizona, 1985 and 1994-95.



59th - 59th Avenue
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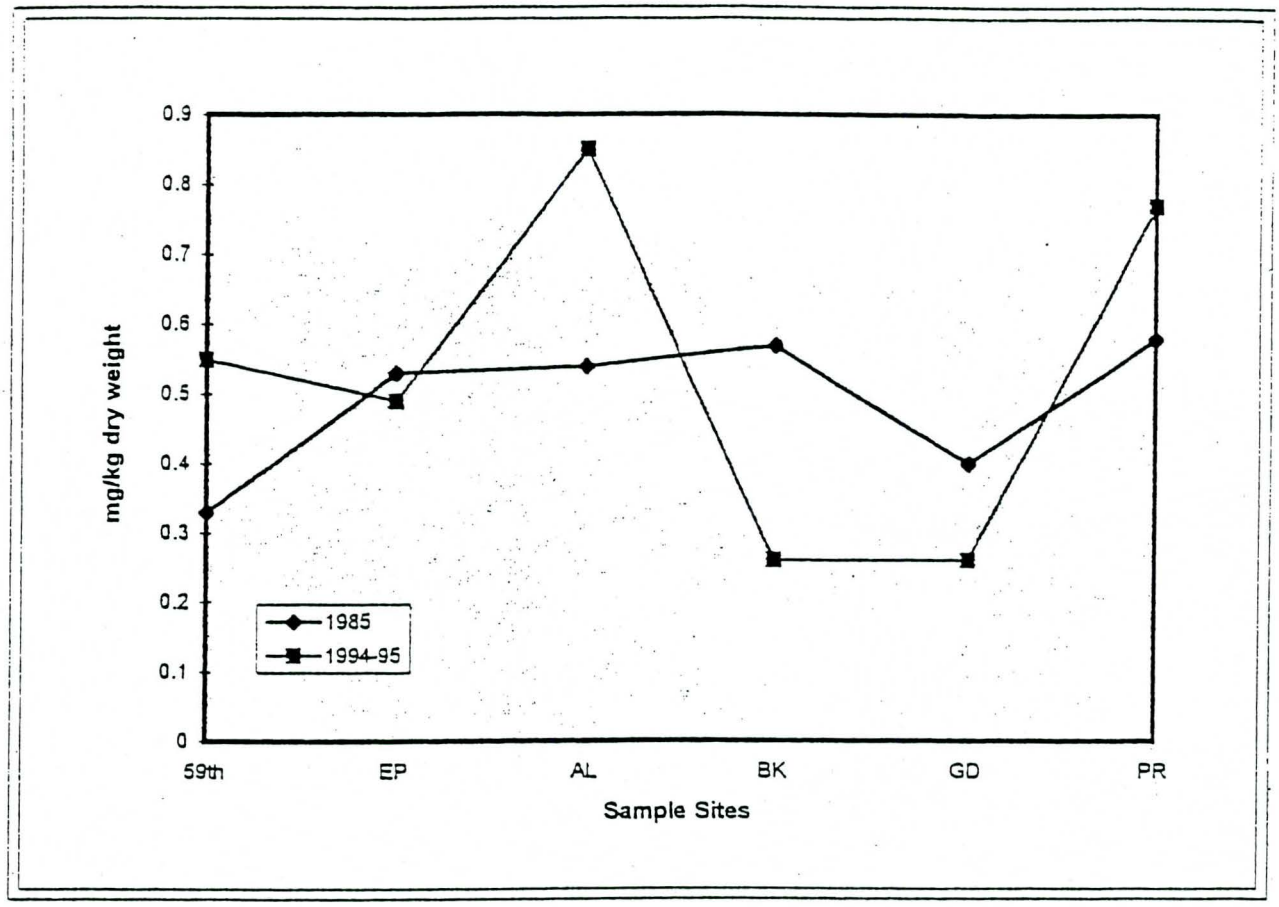
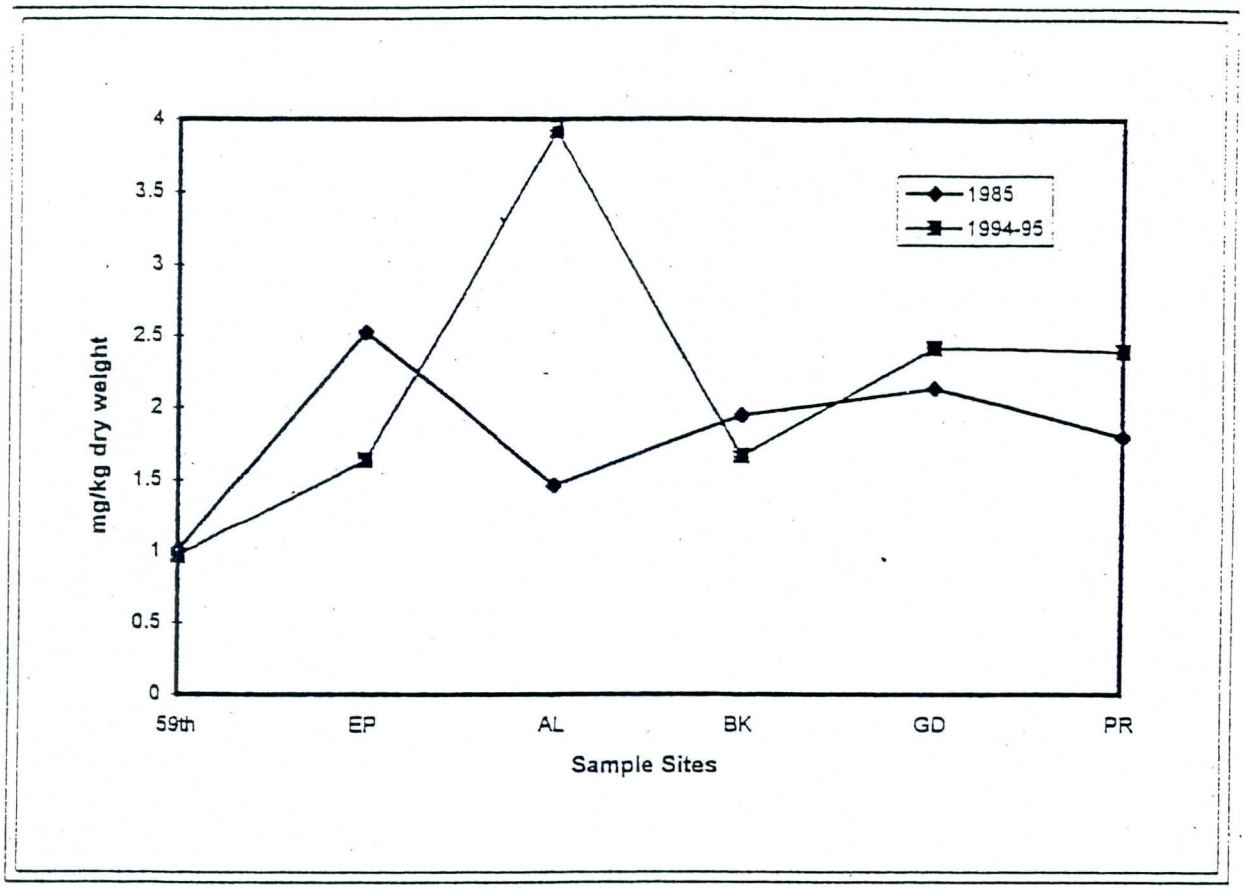
AL - Allenville
BK - Buckeye Canal
GD - Gillespie Dam
PR - Painted Rock

Figure 4. Geometric mean copper concentrations in carp, lower Gila River, Arizona, 1986 and 1994-95.



59th - 59th Avenue
EP - Estrella Park
AL - Allenville
BK - Buckeye Canal
GD - Gillespie Dam
PR - Painted Rock

Figure 5. Geometric mean mercury concentrations in carp, lower Gila River, Arizona, 1985 and 1994-95.



59th - 59th Avenue
EP - Estrella Park
AL - Allenville
BK - Buckeye Canal
GD - Gillespie Dam
PR - Painted Rock

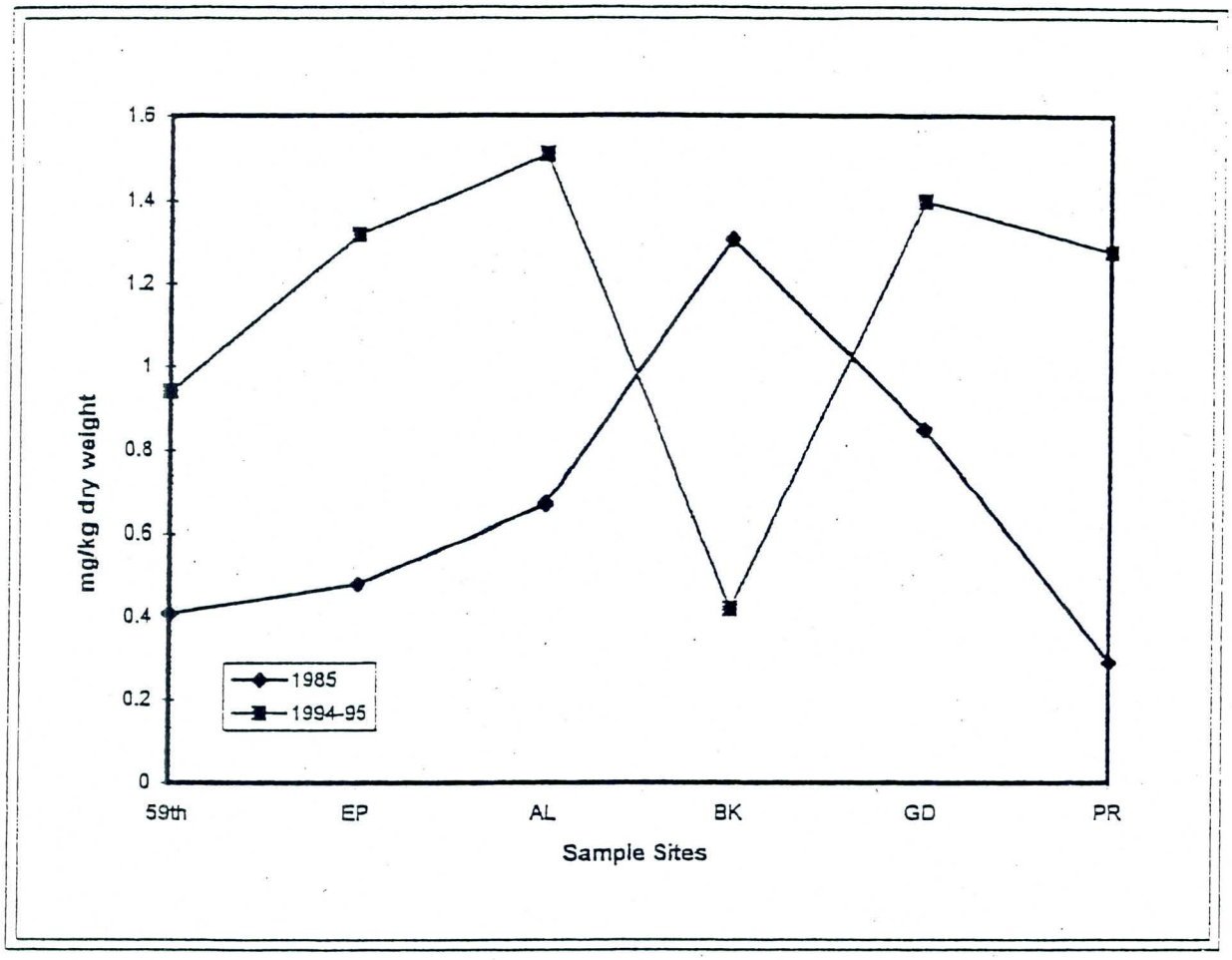
Figure 6. Geometric mean selenium concentrations in carp, lower Gila River, Arizona, 1985 and 1994-95.

Strontium was detected in all samples and levels ranged from 18.0 to 96.5 μg/g wet weight (Table 4). Geometric mean concentrations were statistically lower in carp from 59th Avenue than in samples from all other sites except Estrella Park (Table 5). Concentrations in carp were significantly higher than those in bass at both 59th Avenue and Painted Rock. Strontium concentrations in carp (Gmean = 267 μg/g dry weight) were about 2.5-times higher (P = 0.0037) than those in catfish (Gmean = 105.2) at Gillespie Dam. Samples collected in 1985 were not analyzed for strontium.

Vanadium was detected in all carp and catfish samples but was present in only one of ten largemouth bass (Table 4). Levels ranged from <0.05 to 1.05 μg/g wet weight. A comparison of geometric mean concentrations in carp from all collection sites indicated that among area concentrations were similar (P = 0.4725, Table 5). Vanadium levels in carp from Gillespie Dam (Gmean = 1.40 μg/g dry weight) were almost 5-times higher than concentrations in catfish (0.30 μg/g) from the same area. Because vanadium was present in only one of 10 bass samples; carp/bass comparisons were not possible. Vanadium concentrations in carp collected in 1994-95 (Gmean = 1.02 μg/g dry weight) were significantly higher (P = 0.0135) than levels in carp-(0.62 μg/g) collected in 1985 (Figure 7). At Buckeye Canal however, mean vanadium concentrations were higher in carp collected in 1985 than in samples collected in 1994-95.

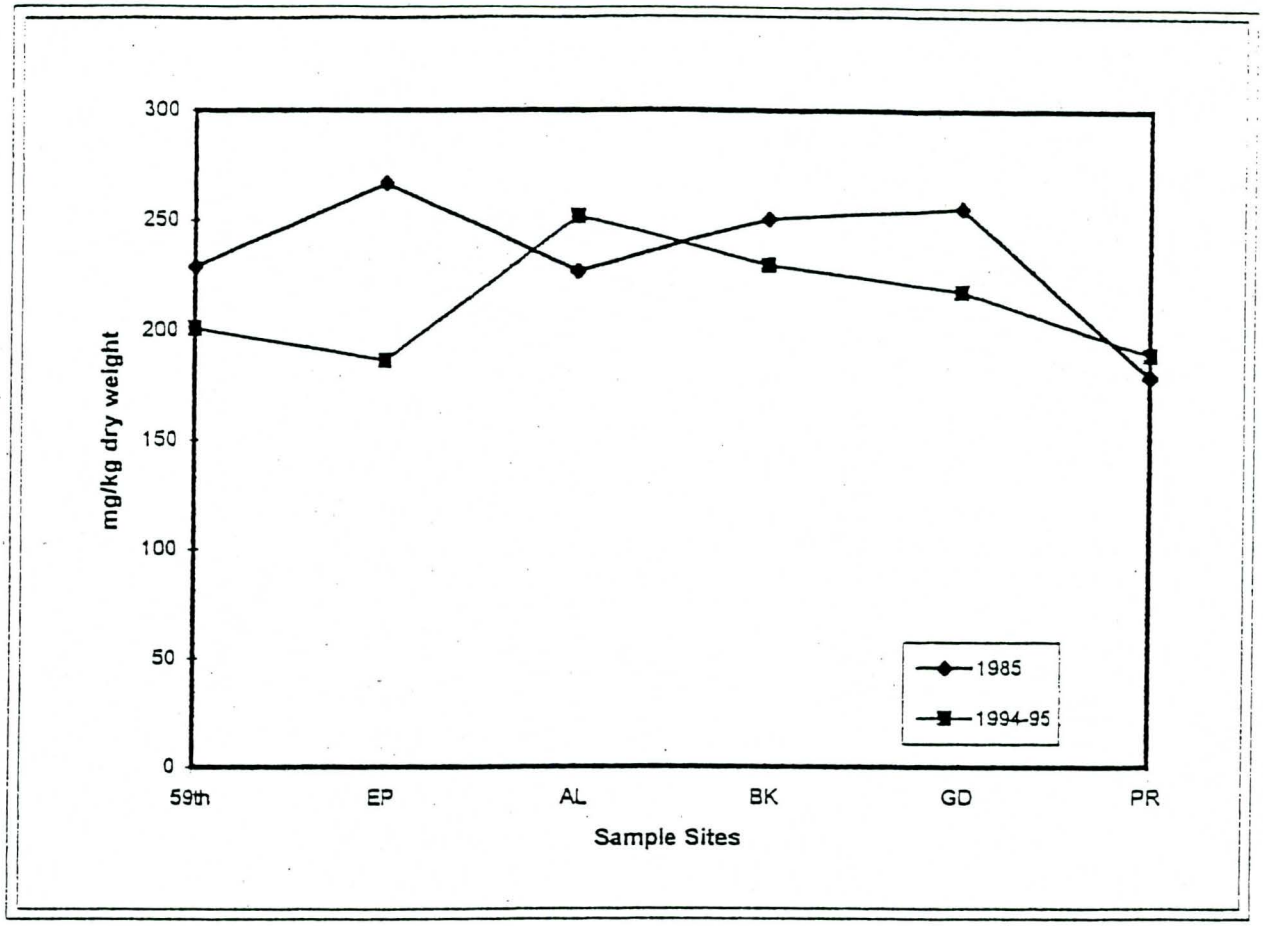
Zinc was present in all fish samples. Concentrations in individual fish ranged from 11.7 to 85.1 μg/g wet weight (Table 4). None of the catfish or largemouth bass contained zinc in excess of the NCBP 85th percentile level. No significant differences were detected in zinc concentrations in carp among areas (P = 0.3139, Table 5). Zinc concentrations in carp from 59th Avenue (200.7 μg/g dry weight) were more than three-times higher (P = 0.0001) than levels in largemouth bass (58.9 μg/g) collected from the same site. At Painted Rock, zinc concentrations were also higher (P = 0.0001) in carp (Gmean = 189 μg/g) than in bass (46.1 μg/g). For samples collected at Gillespie Dam, zinc concentrations were significantly (P = 0.0001) higher in carp (Gmean = 218 μg/g dry weight) than in catfish (57.7μg/g). Concentrations of zinc in carp collected in 1985 and 1994-95 are presented in Figure 8. The geometric mean zinc concentration in carp collected in 1994-95 (2.32 μg/g dry weight) was similar (P = 0.1619) to that collected almost a decade earlier in 1985 (2.37 μg/g).

Metals in fish fillets: Concentrations of 10 elements were detected in fish fillet samples (Table 6). The limited number of samples (three carp from Buckeye Canal and one carp and three largemouth bass and from Painted Rock) precluded meaningful statistical comparisons. Aluminum concentrations were highly variable and ranged from below detection levels in two samples to 122 μg/g wet weight. Arsenic in carp and bass fillets were 2.6- and 2.7-times higher than whole body concentrations. Boron in carp and bass was about 2-times higher in whole body samples than fillets. Chromium, copper, and selenium concentrations were similar (less than 2X difference) in both carp and bass whole body and fillet samples. The highest mercury concentration in fillet samples, 0.05 μg/g wet weight, was detected in a largemouth bass from Painted Rock, (Table 6).



59th - 59th Avenue
EP - Estrella Park
AL - Allenville
BK - Buckeye Canal
GD - Gillespie Dam
PR - Painted Rock

Figure 7. Geometric mean vanadium concentrations in carp, lower Gila River, Arizona, 1985 and 1994-95.



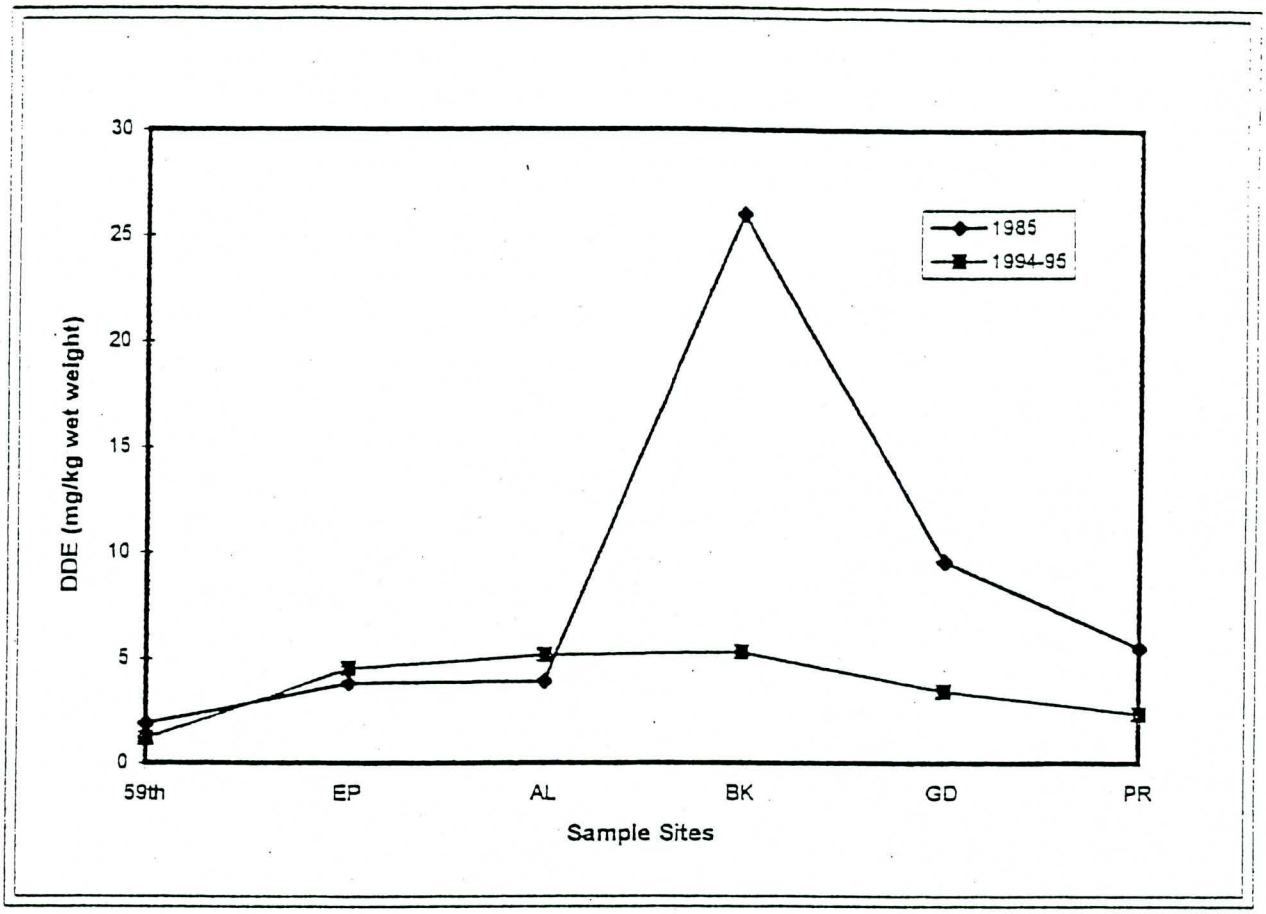
59th - 59th Avenue
EP - Estrella Park
AL - Allenville
BK - Buckeye Canal
GD - Gillespie Dam
PR - Painted Rock

Figure 8. Geometric mean zinc concentrations in carp, lower Gila River, Arizona, 1985 and 1994-95.

Mercury in Buckeye Canal carp fillets (Gmean = 0.67 µg/g dry weight) was about 2.6-times higher than in carp whole body samples (0.26 µg/g) from the same area. Similarly, mercury concentrations in bass fillets from Painted Rock were about 2.2-times higher than in whole body samples. Strontium, which concentrates in bone, differed greatly between whole body and fillet samples; concentrations in carp whole body samples from Buckeye Canal (Gmean = 250 µg/g dry weight) were about 27-times higher than levels in fillets (9.4 µg/g). Differences in strontium concentrations were even greater (59-times) in bass whole body (Gmean = 135 µg/g dry weight) and fillet samples (2.3 µg/g). Zinc in Buckeye Canal whole body carp (Gmean = 237 µg/g dry weight) was 4.4-times higher than in carp fillet samples (53.7 µg/g) from the same area. Largemouth bass from Painted Rock contained a geometric mean whole body concentration of 46.1 µg/g dry weight zinc as compared to 21.1 µg/g in fillet samples.

TURTLES

Organochlorines in turtles: From one to six softshell turtles were collected per site (Table 7). Residues of five organochlorine compounds were recovered in whole body samples. DDE residues were lowest in turtles from 59th Avenue (Gmean = 0.93 µg/g wet weight) and Painted Rock (1.89 µg/g, P = 0.0008, Table 8). The geometric mean DDE residue declined (P = 0.0118) from 1985 (4.28 µg/g wet weight) to 1994-95 (2.57 µg/g, Figure 9). DDE residues in turtles (Gmean = 2.57) were higher (P = 0.0207) than those in carp (Gmean = 1.27). Buckeye Canal was not included in the statistical analysis because only one turtle was collected from that site. PCBs were recovered in all turtle samples from upstream sites; but at the farthest downstream site, Painted Rock, PCBs were detected in only one of six samples. There was no difference in PCB residues among areas (P = 0.1807) or between years (P = 0.0825, Table 8). Chlordane and dieldrin were detected in all but one turtle sample. Geometric mean chlordane residues did not differ significantly among collection sites (P = 0.1894), but mean concentrations in turtles collected in 1985 (0.08 µg/g wet weight) were significantly higher (P = 0.0086) than chlordane residues in turtles collected in 1994-95 (0.04 µg/g). Dieldrin residues were lowest (P = 0.0012) in samples from Painted Rock (Gmean = 0.02 µg/g). Average dieldrin residues in turtles collected in 1994-95 (Gmean = 0.04 µg/g wet weight) were similar to those (0.03 µg/g) in turtles collected from the same areas in 1985 (P = 0.1741). DDT was present in 44% of the samples. Reportable residues were detected most frequently in turtles collected from the middle portions of the study area including Estrella Park downstream to Gillespie Dam. None of the turtles from the most upstream site (59th Avenue) or the farthest downstream site (Painted Rock) contained detectable DDT residues. The maximum DDT residue, 0.06 µg/g wet weight, was recorded in turtles from Allenville (n=2) and Gillespie Dam (n=1). Geometric mean DDT residues were similar among sites (P = 0.2794) and between the 1985 and 1994-95 collection period (P = 0.1355).



Note: Only one small turtle was collected from Buckeye Canal in 1994-95 while nine were collected in 1985. The 1994-95 Buckeye Canal value is not a mean and may not be representative of current DDE levels.

59th - 59th Avenue
EP - Estrella Park
AL - Allenville
BK - Buckeye Canal
GD - Gillespie Dam
PR - Painted Rock

Figure 9. Geometric mean DDE residues in softshell turtles, lower Gila River, Arizona, 1985 and 1994-95.

Metals in turtles: Aluminum was present in all whole body turtle samples and levels ranged from 16.4 to 150.4 μg/g dry weight (Table 9). Geometric mean concentrations (29.9 - 70.7 μg/g dry weight) did not differ among sites ($P = 0.0986$, 1-way ANOVA, Table 10). Aluminum was not quantified in turtles collected in 1985; therefore, trends over time cannot be assessed.

Arsenic was recovered in 21 of 27 (78%) turtle samples. Geometric means (0.25 to 0.43 μg/g dry weight) were statistically similar ($P = 0.6799$) among sites (Table 10). Arsenic concentrations in turtles collected in 1994-95 (Gmean = 0.29 μg/g dry weight) were almost identical to those collected in 1985 (Gmean = 0.30 μg/g).

Boron was detected in all turtles (Table 9). Mean levels were significantly higher ($P = 0.0001$) in samples from middle and downstream sites including Allenville and Gillespie Dam, than in turtles from 59th Avenue and Estrella Park (Table 10). Boron was not quantified in samples collected in 1985; therefore, trends were not assessed.

Cadmium was not detected in turtle samples and lead was present only in samples from 59th Avenue ($n=2$) and Estrella Park ($n=4$). Lead concentrations in individuals from those collection sites may have been biased by lead from .22 caliber bullets used for collection. None of the turtles trapped at Allenville, Buckeye Canal, Gillespie Dam, and Painted Rock contained lead.

Chromium was present in 21 of 27 turtle samples (Table 9). There was no difference in mean concentrations (Gmeans = 1.31 - 1.68 μg/g dry weight) among collection sites (Table 10). Chromium was not quantified in turtles collected in 1985.

Copper was recovered in all turtles and levels ranged from 1.25 to 1128.57 μg/g dry weight (Table 9). Some turtles captured on trot lines at 59th Avenue, Estrella Park, and Allenville were dispatched with a .22 caliber rifle. Because copper coated bullets may have biased chemical results, copper data for turtles from these areas were deleted from statistical analyses. Copper concentrations in turtles collected from Gillespie Dam (Gmean = 2.87 μg/g dry weight) were higher than levels in turtles from Painted Rock (Gmean = 1.69 μg/g, Table 10). Mean levels in turtles collected in 1994-95 at Gillespie Dam (Gmean = 2.87 μg/g dry weight) were significantly ($P = 0.0444$) lower than levels in turtles collected from the same area in 1985 (Gmean = 6.04 μg/g). Similarly, copper levels declined ($P = 0.0009$) from 1985 (Gmean = 4.40 μg/g) to 1994-95 (1.69 μg/g) in Painted Rock turtles.

Mercury was detected in all turtles (Table 9). Individual levels ranged from 0.02 to 1.42 μg/g dry weight. Geometric mean mercury concentrations differed among sites ($P = 0.0001$), but not between years ($P = 0.0693$). The lowest mean mercury concentration was recorded in turtles from 59th Avenue (Table 10). Levels in turtles from all other sites were statistically similar.

The frequency of recovery of nickel in turtles ranged from 20 to 100% (Table 9). Because of the low recovery rate at many sites, we were able to statistically compare

nickel only in samples from Estrella Park and Painted Rock. Nickel concentrations were statistically different between areas and between years (P = 0.0001, 2-way ANOVA, Table 10). Concentrations were almost 10-times higher in turtle samples from Estrella Park (Gmean = 2.21 μg/g dry weight) than those in turtles from Painted Rock (0.23 μg/g). The geometric mean concentration in turtles collected in 1994-95 (0.72 μg/g dry weight) was significantly lower than that in turtles collected from the same areas in 1985 (7.16 μg/g).

Selenium was present in 19 of 27 (70%) of the turtle samples (Table 9). The frequency of recovery of selenium increased from upstream to downstream sites; one of five samples from 59th Avenue, two of five samples from Estrella Park, and four of five samples from Allenville contained detectable concentrations of selenium. All samples from the most downstream collection sites, Gillespie Dam and Painted Rock, contained selenium. Geometric mean concentrations were significantly different among areas (P = 0.0345), but not between years (P = 0.5757, Table 10). Mean concentrations of selenium in turtles from Gillespie Dam were higher than levels in turtles from Painted Rock but similar to levels at Allenville (Table 10). Mean concentrations in turtles collected in 1994-95 (Gmean = 1.53 μg/g dry weight) were similar (P = 0.5757) to those in turtles collected from the same areas in 1985 (Gmean = 1.34 μg/g).

Strontium was recovered in all turtle samples (Table 9). Geometric mean levels were significantly higher (P = 0.0018) in turtles collected from middle river collection sites including Estrella Park, Allenville, and Gillespie Dam than at 59th Avenue or Painted Rock (Table 10). Strontium was not quantified in samples collected in 1985; therefore, between year comparisons were not possible.

Vanadium was present in all but five turtle samples and residues were generally low ($\leq$0.89, Table 9). Geometric mean concentrations were statistically similar (P = 0.2728) among collection sites but were different (P = 0.0024) between years (Table 10). Vanadium concentrations in turtles collected in 1994-95 (Gmean = 0.23 μg/g dry weight) were less than one-half those (0.51 μg/g) in turtles collected in 1985.

Zinc was recovered in all turtles (Table 9). Geometric mean levels were similar among collection sites (Table 10) but differed between years (P = 0.0007, 2-way ANOVA). Zinc concentrations in turtles collected in 1994-95 (Gmean = 70.85 μg/g dry weight) were lower than those in turtles collected in 1985 (Gmean = 87.13 μg/g).

LIZARDS

Organochlorines in lizards: From three to five whiptail lizards were collected at Estrella Park, Allenville, Gillespie Dam, and Painted Rock. Only lizards from Estrella Park and Painted Rock were analyzed for organochlorines. DDE was the only compound detected (Table 11). Residues ranged from 0.12 μg/g wet weight in the composite sample from Estrella Park to 0.49 μg/g in the Painted Rock sample. Because only two samples were analyzed, we did not attempt statistical tests to determine differences between 1994-95 and 1985 means. However, lizards collected in 1985 from Estrella Park and Painted Rock contained an average of 0.59 and 0.06 μg/g wet weight DDE, respectively, in three composite samples (15 specimens) from each area (Kepner 1987).

Metals in lizards: Due to the highly variable concentrations of certain elements, particularly arsenic, the elemental content of "lead" shotshells was questioned. We were concerned that lizard samples were contaminated by elements other than lead in the shot. An analysis of a composite sample of shot from five shotshells indicated that the shot also contained arsenic (4,447 μg/g dry weight), boron (11 μg/g), cadmium (1.8 μg/g), and copper (65 μg/g). The high level of probability that lizards collected with shotshells were contaminated by arsenic, boron, cadmium, copper and lead from the shot, makes interpretation of residue data difficult. Data for these elements are presented in Table 12 for information purposes only. Because each site was represented by only one sample, no among site statistical comparisons were possible. Aluminum, boron, chromium, and strontium were quantified in 1994-95 samples only; therefore, we were unable to establish temporal trends for these elements. Despite the potential for contamination from cadmium in lead shotshells, none of the samples contained detectable levels of cadmium.

Mercury was recovered in only one of three lizard samples from both Allenville and Gillespie Dam in 1985; therefore, we deleted these areas from the 1985 data set for between-year statistical comparisons. The geometric mean mercury concentration in 1994-95 samples (0.60 μg/g dry weight) was about three-times higher ($P = 0.0031$) than the mean for samples collected in 1985 (0.021 μg/g). Nickel concentrations in 1994-95 samples (Gmean = 1.01 μg/g dry weight) were similar ($P = 0.1927$) to samples collected in 1985 (Gmean = 1.59 μg/g). Selenium averaged 3.45 μg/g in 1994-95 samples and concentrations were more than two-times higher ($P = 0.0022$) than those collected a decade earlier (1.32 μg/g). Vanadium was present in all 1994-95 and 1985 samples. Geometric mean concentrations were similar ($P = 0.4908$) between 1994-95 (1.35 μg/g) and 1985 samples (1.63 μg/g). Zinc was recovered in all lizard samples. The geometric mean zinc level in lizards collected in 1994-95 (124.9 μg/g dry weight) was similar ($P = 0.6340$) to that (133.3 μg/g) collected 10 years earlier.

DISCUSSION

During normal flow periods, almost all water in the lower Salt and Gila Rivers in the Phoenix metropolitan area originates as discharge from waste water treatment plants (WWTPs). Perennial flow begins at the discharge point for the 23rd Avenue WWTP and additional effluent is received from the 91st Avenue WWTP. There are a total of 12 point source discharges in the lower Gila River basin within our study area identified by National Pollutant Discharge Elimination System (NPDES) permits (Earth Technology 1993). Agricultural drainwater return flow supplements the system. While agricultural drainwater is exempt from the NPDES permit process, it is not exempt from Arizona water quality standards. The lower Gila River is primarily an effluent dominated waterbody.

The presence of pollutants does not necessarily mean that environmental risk exists. Whenever possible, we attempt to equate levels of pollutants with potential hazards to fish and wildlife resources. Actual impacts of contamination are not well documented.

Chemical residue data indicate that fish and wildlife of the lower Gila River are accumulating a wide spectrum of potential toxicants including pesticides, industrial pollutants (PCBs), and metals. When assessing impacts of contaminants on fish and wildlife populations, we must consider the additive or synergistic toxicity of compounds and elements. For example, individuals or populations with appreciable but sublethal residues of DDT, DDE, chlordane, and possibly other chemical pollutants may be affected after additional exposure to these or similar compounds (Ludke 1976). The question arises as to which chemical or chemicals may adversely impact an individual or the population. The answer is not necessarily the chemical with the greatest residue, nor even one chemical alone; each may contribute relative to its toxicity. The potential for this type of interaction is greatest in areas such as the lower Gila River that are contaminated with a wide variety of agricultural and industrial compounds and metals.

FISH

Organochlorines in whole fish: The use of DDT in Arizona was restricted in 1968 and totally suspended in 1969 (Ware 1974). In fish tissue, DDT rapidly metabolizes to DDE; therefore, the occurrence of DDT in 1994-95 fish samples is of concern because it suggests that fish were recently exposed to that compound. DDT was detected most frequently in fish from Buckeye Canal (86%), Gillespie Dam (62%), and Allenville (50%).

The geometric mean DDE residue in all lower Gila River fish collected during 1994-95 was 4.6-times higher than the 1984 NCBP mean (Schmitt et al. 1990). The highest DDE residue recorded in this study, 21.0 μg/g wet weight, was more than three-times greater than the maximum (6.76 μg/g) recorded during the 1984 nationwide sampling program (Schmitt et al. 1990). USEPA (1992) conducted a similar national sampling of fish from 388 sites during 1986-1989 to determine the prevalence and sources of selected

bioaccumulative pollutants. The USEPA screening program was not a random sampling; it focused on 314 sites thought to be influenced by various point and nonpoint pollutant sources. The investigation also included fish from 74 background locations to provide a chemical baseline from uncontaminated areas. The maximum DDE concentration reported in fish from highly contaminated sites was 14.0 μg/g wet weight. Four of seven samples from Buckeye Canal exceeded the USEPA (1992) reported maximum, although none of the fish from the lower Gila River approached that level. The mean DDE residue from 74 background sites was 0.056 μg/g (USEPA 1992); all fish samples from the lower Gila River exceeded the national background level.

All Service Environmental Contaminant Specialists in the nation were questioned via e-mail to determine if other biologists have recently recorded DDE residues in fish that approached or exceeded levels detected in lower Gila River samples. Only fish from two superfund sites, both associated with the manufacture of DDT, had DDT/DDE residues greater than those in fish from the lower Gila River. Largemouth bass collected from the Tombigbee River downstream of the Ciba-Giegy Superfund Site, near McIntosh, Alabama where DDT was manufactured from 1952-1972 (USFWS 1996), exceeded concentrations recorded in lower Gila River samples. White croaker (*Genyonemus lineatus*) collected near the Palos Verdes outfall drain of the Montrose Chemical Company (Los Angeles, California), a former DDT manufacturing facility, contained an average of 23 μg/g wet weight DDT family compounds (DDTr) in muscle tissue (Los Angeles County Sanitation District 1997). No other records were located of fish populations with DDE residues higher than those in Gila River samples; therefore, we conclude that DDE residues in fish from the lower Gila River are the highest in the United States associated with agriculturally applied DDT.

Fish collected from agricultural drainage canals that are tributaries to the Gila River generally contained higher DDE residues than fish from the river. Mean DDE residues were highest in carp and catfish from Buckeye Canal which confirms findings of Kepner (1987) who also reported highest DDE residues in carp from Buckeye Canal. A composite sample of five carp collected in 1994 from another agricultural drain, Dysart Drain, contained 24 μg/g wet weight DDE, (Rector 1997). This level was almost two-times the maximum in fish collected during the 1986-89 USEPA nationwide sampling program (USEPA 1992). A composite sample of 50 mosquitofish (*Gambusia affinis*) collected from Dysart Drain in April 1994 contained 17.0 μg/g DDE (King unpub. data). Mosquitofish are a relatively short-lived species, ≤2 years under natural conditions, and it is remarkable that they bioaccumulate such high levels of DDE during their short life span.

Toxaphene use as a broad spectrum agricultural insecticide increased significantly following the national suspension of DDT (Kepner 1986). Toxaphene applications averaged 7.6 pounds per acre in Arizona in 1965 (Johnson and Lew 1970). Most domestic use of toxaphene and DDT was on cotton crops. Before the suspension of both products, toxaphene-DDT mixtures were frequently used to control insects pests. Toxaphene contamination in fish and wildlife was a major concern during the 1980s. Kepner (1986) reported residues as high as 8.4 μg/g wet weight in whole body carp and an overall frequency of occurrence of 61%. In 1994-95, toxaphene was not detected in

carp suggesting a significant decline in environmental residues. However, toxaphene was present at low levels in all largemouth bass (≤ 0.34 μg/g wet weight) which may reflect a different bioaccumulation rate among species. Toxaphene was detected in 20 percent of the catfish. Catfish collected from Buckeye Canal contained relatively high toxaphene residues (2.6 and 5.4 μg/g wet weight). The lower level of detection for toxaphene ranged from 0.05 to 0.80 μg/g wet weight; therefore, all detectable residues were in excess of the 0.03 μg/g NCBP 85th percentile (Schmitt et al. 1990).

PCBs were generally highest at upstream collection sites, those closest to the Phoenix urban/industrial area. However, PCBs in all fish were below the NCBP 85th percentile (Schmitt et al. 1990). The frequency of occurrence of chlordane was greatest in fish from Buckeye Canal (80%). Chlordane was present in less than one-half of the samples from other areas. None of the fish contained chlordane in excess of the NCBP 85th percentile level of 0.17 μg/g wet weight (Schmitt et al. 1990), although residues in one catfish from Buckeye Canal (0.14 μg/g) approached that level. Chlordane was present in 56% of the 1994-95 fish samples versus 12.5% in 1985 samples suggesting an increase in frequency of occurrence over the past decade. Conversely, dieldrin showed a downward trend during the same time period. Dieldrin was present in 83% of the 1985 fish samples but was detected in only 31% of the 1994-95 samples. Dieldrin was detected most frequently in fish from 59th Avenue, the collection site closest to Phoenix, indicating that urban use of this compound may have persisted longer than agricultural use. Four of five largemouth bass from 59th Avenue contained dieldrin in excess of the NCBP 85th percentile level (Schmitt et al. 1990). Carp, however, did not bioaccumulate dieldrin. Dieldrin was detected at low levels (≤ 0.27 μg/g wet weight) in only 7 of 27 samples. Current levels of PCBs, chlordane, and dieldrin are low and do not present a hazard to fish in the lower Gila River.

Metals in whole fish: Although aluminum is not an USEPA priority pollutant, the especially high levels recorded in fish from Allenville (Gmean = 434 μg/g dry weight) and Gillespie Dam (Gmean = 369 μg/g) warrant special attention. The geometric mean aluminum concentration in carp from Allenville was 25-times greater than the mean at Painted Rock, the area with the lowest aluminum concentrations. By comparison, aluminum in carp from several other southern Arizona lakes and rivers including Lake Pleasant, Alamo Lake, San Carlos Reservoir, and the Verde River ranged from 2.6 to 60.6 μg/g wet weight (King et al. 1991). Comparing the Allenville carp data with data from these and other Arizona studies (Radtke et al. 1988, King et al. 1993a, Baker and King 1994, Andrews et al. 1997, Tadayon et al. 1997) indicates that carp collected at Allenville had the second highest mean aluminum level ever recorded in Arizona. Only the concentration in carp (n=3) from one highly contaminated agricultural drain near San Luis in the Yuma Valley (mean = 895 μg/g wet weight, Tadayon et al. 1997) was higher than that in carp from Allenville (434 μg/g).

Arsenic acts as a cumulative poison (Jenkins 1981) and is listed by the USEPA as 1 of 129 priority pollutants (Keith and Telliard 1979). Background arsenic concentrations in biota are usually less than 1 μg/g wet weight (Eisler 1988a). Toxic effects of arsenicals on aquatic organisms have been reported at concentrations of 1.3 to 5.0 μg/g wet weight.

Although 19% of the fish samples exceeded the NCBP 85th percentile (Schmitt and Brumbaugh 1990), none contained concentrations that approached the toxic threshold. There appears to be little potential for arsenic related problems in fish at the lower Gila River sites we sampled.

Cadmium was detected in only 1 of 48 fish samples; a lower frequency of occurrence than that reported by most other authors for fish collected from southern Arizona. Seventy-seven percent of the fish samples from three National Wildlife Refuges (NWR) on the Colorado River contained cadmium (King et al. 1993a). Cadmium was detected in 30 to 54% of fish collected from the upper and middle Gila River including Mineral Creek (Baker and King 1994, King and Baker 1995, Andrews and King 1997). Only one of three composite samples of carp, catfish, and bass collected in 1993 from Havasu NWR contained low (0.02 μg/g wet weight) concentrations of cadmium (Andrews et al. 1997); cadmium was detected in 6% of the fish collected in 1995 from the lower Colorado River and irrigation drains in the Yuma Valley (Tadayon et al. 1997). We located only one study which documented a lower frequency of occurrence than what we encountered during our 1994-95 sampling effort; none of the carp collected in 1985 at 11 sites in the Yuma Valley area contained cadmium (Radtke et al. 1988). Cadmium is not a contaminant of concern for fish populations in the lower Gila River.

Chromium was not quantified in the NCBP program (Schmitt and Brumbaugh 1990); therefore, comparisons with national levels are not possible. The organs and tissues of fish and wildlife that contain >4.0 μg/g total chromium dry weight should be viewed as presumptive evidence of chromium contamination (Eisler 1986). None of the fish samples from the lower Gila River contained chromium in excess of 4.0 μg/g.

Copper is an essential dietary element for plants and animals, but elevated levels can be toxic to fish (USEPA 1980). Copper is one of the most common contaminants associated with urban runoff. Specific sources include industrial and sewage treatment plant discharges (USEPA 1980). Copper can combine with other contaminants such as ammonia (common in wastewater effluent), mercury, and zinc to produce additive toxic effects on fish (Skidmore 1964, Hilmy et al. 1987, Eisler 1997). Copper exceeded the NCBP 85th percentile (Schmitt and Brumbaugh 1990) in 31 of 48 fish samples and all samples from Estrella Park and Allenville exceeded the NCBP 85 percentile. Because of its occurrence at relatively high levels at some sites and its propensity to interact with other compounds and elements, copper remains a contaminant of concern in the lower Gila River.

The frequency of occurrence of lead in lower Gila River fish declined over the last decade. Lead was not detected in fish collected during 1994-95 (this study), but was present in 37% of the fish collected in 1985. Ten percent of the composite carp samples collected in 1985 from the lower Colorado and Gila Rivers by Radtke et al. (1988) contained lead, but concentrations were low (≤ 0.33 μg/g wet weight). Lead was not detected in any of the 31 fish collected in 1995 from the Colorado River and irrigation

drains in the Yuma Valley (Tidayon et al. 1997). Lead is not a contaminant of concern for fish in the study area.

Mercury concentrations are of special concern because mercury can bioconcentrate in organisms and biomagnify through the aquatic food chain. Mercury has no known biological function and its presence in cells of living organisms is undesirable and potentially hazardous. Mercury in the environment exists in a wide range of inorganic and organic forms with varying degrees of stability and toxicity (Thompson 1996). It is generally accepted that methylmercury is the most stable form and the form most toxic to wildlife. From 95-99% of the mercury in fish is methylmercury (Wiener and Spray 1996). Even though thirty-one percent (15/48) of the fish samples exceeded the NCBP 85th percentile of 0.17 μg/g wet weight, the highest concentration of methylmercury (mercury) detected in lower Gila River fish, 0.41 μg/g wet weight, was well within the $\leq$1.0 μg/g range generally accepted as the concentration in biota from unpolluted environments (Eisler 1987). There is probably little potential for adverse affects of mercury alone on adult fish survival or reproduction. Mercury, however, when ingested in combination with other compounds and elements such as parathion, cadmium, and copper can have additive or synergistic toxic effects (Hoffman et al. 1990, Calabrese and Baldwin 1993, Eisler 1997).

Food chain accumulation of mercury from fish to fish-eating predators is also of concern. There is a great deal of conflicting literature regarding the threshold dietary food chain level above which mercury may adversely affect higher predators. Eisler (1987) states, "For the protection of sensitive species of mammals and birds that regularly consume fish and other aquatic organisms, total mercury concentrations in these prey items should probably not exceed 0.1 μg/g fresh weight for birds, and 1.1 μg/g for small mammals." Walsh et al. (1977) suggested, "To protect fish and predatory organisms, total mercury burdens in these organisms should not exceed 0.5 μg/g wet weight." Three μg/g mercury dry weight ($\approx$ 0.9 μg/g wet weight) in earthworms should be considered hazardous to sensitive species that eat earthworms (Beyer and Stafford 1993). One-half of our fish samples exceeded the most conservative threshold, 0.1 μg/g, proposed by Eisler (1987), but none exceeded food chain toxicity thresholds suggested by Walsh et al. (1977) and Beyer and Stafford (1993). Bioaccumulation of mercury from fish to fish-eating birds is discussed in greater detail under the section on birds.

Nickel is listed by the USEPA as one of 129 priority pollutants (Keith and Telliard 1979). Freshwater fish from uncontaminated habitats usually contain $<$0.80 to 8.0 μg/g wet weight nickel (Jenkins 1980). Only two samples contained nickel in excess of 0.8 μg/g, a carp (1.76 μg/g) and catfish (1.19 μg/g) from Buckeye Canal. Nickel, by itself, is not a potentially threatening contaminant at current levels. Nickel, however, can combine with zinc to have additive toxic effects on fish (Eisler 1997)

Selenium is an essential trace element in animal diets, but it is toxic at concentrations only slightly above required dietary levels. Only 6 of 48 samples (12.5%) exceeded the NCBP 85th percentile (Schmitt and Brumbaugh 1990) level and selenium was generally

below toxic concentrations likely to affect fish reproduction. The highest wet weight whole body selenium concentration recorded in this study was 1.74 μg/g, well below the 6.9 - 7.2 μg/g wet weight threshold associated with selenium induced reproductive failure of bluegills at selenium contaminated Hyco Reservoir in North Carolina (Gillespie and Baumann 1986). In a comprehensive summary of selenium threshold effect levels, Lemly and Smith (1987) reported that selenium induced reproductive failure in fish was associated with whole body selenium concentrations of 12 μg/g dry weight. The highest concentration of selenium in fish in our study was 6.45 μg/g dry weight; therefore, there is little potential for selenium toxicity to fish populations in the lower Gila River.

Zinc was present in 93% (25/27) of the carp samples at concentrations that exceeded the NCBP 85th percentile level of 34.2 μg/g wet weight (Schmitt and Brumbaugh 1990). Bioaccumulation rates for zinc were species specific; while 93% of the carp exceeded the NCBP 85th percentile, none of the catfish or bass contained elevated levels of zinc. This finding is consistent with conclusions of other authors who reported that common carp apparently accumulate zinc to a greater extent than other species (Lowe et al. 1985, Schmitt and Brumbaugh 1990). Zinc levels in carp from the lower Gila River were within the range of concentrations in carp collected from other areas of Arizona (Radtke et al. 1988, King et al. 1991, Lusk 1993, Andrews et al. 1997, Tadayon et al. 1997). Zinc, however, may interact with other elements and compounds and the patterns of accumulation, metabolism, and toxicity from zinc interactions greatly differ from those produced by zinc alone. Zinc in combination with other elements can have antagonistic, additive, or synergistic effects as reviewed by Eisler (1993, 1997). Zinc is more toxic to embryos and juveniles of aquatic organisms than to adults, and zinc is more toxic in the presence of nickel, cadmium, chromium, copper, and mercury (Eisler 1997). The toxicity of zinc is also modified by ambient environmental factors. Zinc is more toxic under conditions of comparatively low dissolved oxygen (Spear 1981), a condition that occurs frequently at Painted Rock. Also, zinc is more toxic at elevated temperatures (NAS 1979, Spear 1981, Hilmy et al. 1987), a condition common in the desert southwest.

TURTLES

Organochlorines in turtles: DDT was detected in 44% of the softshell turtle samples. With few exceptions, residues of organochlorine compounds were considerably higher in turtles than those in fish collected from the same location. ADEQ (1996) reported similar results for turtles and fish collected at Painted Rock. Turtles generally have a longer lifespan than fish and therefore accumulate contaminants over a longer period of time. Significant among area differences were detected only for DDE and dieldrin. DDE was highest in the middle river sampling sites and mean dieldrin residues were lowest at the farthest downstream site, Painted Rock. DDE and chlordane residues, declined by about one-half from 1985 to 1994-95. Residues of PCB, dieldrin, and DDT remained relatively constant during the decade.

Metals in turtles: A comparison of spacial trends in turtles with those in fish revealed few site specific similarities other than the generalization that higher levels of metals were usually found at the middle river sampling stations. Although not statistically significant, geometric mean levels of boron, vanadium, and zinc were higher in turtles and fish collected at Allenville than at other sampling stations. Temporal trends were established for seven metals. Geometric mean concentrations of copper, nickel, vanadium, and zinc declined from 1985 to 1994-95. Levels of arsenic, mercury, and selenium remained unchanged over the study period.

LIZARDS

Organochlorines in lizards: Lizards may be excellent indicators of terrestrial contamination as much of their diet consists of small invertebrates of local origin. Lizards are intermediate predators often consumed by numerous upper trophic level species. Because only two composite lizard samples were analyzed for organochlorine compounds, interpreting residue data is difficult. DDE residues reported in this study (0.12 and 0.49 μg/g wet weight) are similar to the mean (0.443 μg/g) reported for Texas spotted whiptail lizards (*C. gularis*) collected from agricultural areas in Texas, but lower than residues (mean = 1.00 μg/g, range = not detected to 9.6) in six-lined racerunner (*C. sexlineatus*) carcasses from Florida (Clark et al. 1995). Whiptail lizards collected from Estrella Park and Painted Rock generally contained higher organochlorine residues than lizards collected from other Arizona locations including southeastern Arizona and the upper and middle Gila Rivers (King et al. 1993b, Baker and King 1994, King and Baker 1995).

Metals in lizards: We compared priority pollutant concentrations in lizards collected in 1994-95 with concentrations in lizards collected in other areas of Arizona. Comparisons did not include arsenic, cadmium, copper, and lead because of possible contamination from lead shot. Chromium, selenium, and zinc concentrations in lower Gila River lizards were similar to, or lower than, concentrations in lizards from southeastern Arizona and from the upper and middle Gila Rivers (King et al. 1993b, Baker and King 1994, King and Baker 1995). Nickel in lizards from the lower Gila River was generally higher than in lizards from southeastern Arizona but comparable to levels in lizards from the upper and middle Gila River areas. Mercury concentrations were about 10-times higher in lizards collected from sites along the lower Gila River (mean = 0.60 μg/g dry weight, range = 0.27 - 1.36) than in lizards from southeastern Arizona (mean = 0.065 μg/g, range = 0.04 - 0.11) (King et al. 1993b) and were about 3-times higher than in lizards from the upper Gila (mean = 0.17 μg/g, range 0.10 - 0.26) (Baker and King 1994) and middle Gila River areas (mean = 0.18 μg/g, range = 0.04 - 0.70) (King and Baker 1995). Mean mercury concentrations in lizards increased from 1985 (0.021 μg/g dry weight) to 1994-95 (0.60 μg/g). We are at a loss to explain this 30-fold increase in mercury concentrations in lizards. None of the other segments of the lower Gila River ecosystem experienced such a dramatic 10-year increase in mercury levels. Selenium

concentrations decreased over the same time period. Temporal trends for other metals remained unchanged or could not be assessed.

We found no biological effect threshold data in the literature to aid in interpretation of contaminant hazard to lizard survival and reproduction. Lizards are consumed by a wide variety of bird and mammal predators. Concentrations of DDE exceeded threshold levels above which DDE impacts on sensitive avian species are possible (please see the discussion of DDE concern levels in avian predators in the following section on birds). DDE residues in lizards could pose problems for avian predators that consume a large proportion of lizards in their diet.

Little research has been completed on mercury concentrations in food items of predatory birds likely to consume lizards. In contrast, there is a great deal of information available on levels and effects of mercury in aquatic ecosystems. For the protection of sensitive species of birds that regularly consume fish and other aquatic organisms, total mercury concentrations in prey items should probably not exceed 0.1 μg/g wet weight (approximately 0.33 μg/g dry weight) (Eisler 1987). In an extensive review of the chronic toxicity of mercury in birds, Scheuhammer (1987) reported that the lowest level of mercury in food items to adversely affect birds was 0.3 - 0.4 μg/g wet weight (approximately 1 - 1.3 μg/g dry weight). All lizard samples exceeded Eisler's more conservative estimate and three of four exceeded Scheuhammer's (1987) proposed toxicity threshold.

Limited data are available on the toxicity of selenium to terrestrial birds. Ironically, several field and laboratory studies indicated that even background selenium levels in food items, concentrations as low as 3 to 8 μg/g dry weight, could cause adverse reproductive effects in sensitive aquatic bird species (Heinz et al. 1987, Lemly and Smith 1987, Hoffman et al. 1991, Skorupa and Ohlendorf 1991). Selenium concentrations in lizards (as potential prey) are within the lower end of the toxic range.

BIRDS

Assessing exposure of birds to environmental contaminants is difficult because birds are highly mobile, often migratory, and may accumulate contaminants over broad geographic areas. All red-winged blackbirds sampled were adults, and we cannot be certain that their contaminant burdens reflect local conditions. However, concentrations of contaminants in liver tissues usually reflect recent exposure. We were also unable to determine if the subadult black-crowned night-herons were hatched locally or were birds that wintered in the area. A heronry located on islands in Painted Rock Borrow Pit Lake in the early 1990s did not contain night-herons. Although an intensive effort was made to locate a night-heron colony near Painted Rock, none was found during the years of study through 1997 (Urquidez pers. comm.). Night-herons were common throughout the winter months in the Painted Rock area; at least 50% of the birds were sub-adults. Wild

black-crowned night-herons initiate nesting on islands in urban Phoenix lakes in early April. We assume that if night-herons were nesting in the Painted Rock area, that the nesting period would be chronologically similar to that in nearby Phoenix colonies. If nesting was initiated in early April, it would have been impossible to collect fledged young-of-the-year herons hatched in local colonies in late April. Most probably, we collected sub-adult herons that were at least 10-months-of-age or older hatched from an unknown location.

Organochlorines in birds: Residues of all organochlorine compounds were higher in black-crowned night-herons than red-winged blackbirds which substantiates the finding that food habits and relative position on the food chain determines the risk for dietary contaminant exposure. In general, top level carnivores such as black-crowned night-herons accumulate higher residues of organochlorines than omnivores, e.g. red-winged blackbirds, which accumulate more than herbivores.

Organochlorine residues, particularly DDE, in birds collected from the southwestern United States have historically been higher than those from the rest of the nation (Cain 1981, Fleming and Cain 1985), Fleming et al. 1983, White and Krynitsky 1986, Bunck et al. 1987). European starlings (*Sturna vulgaris*) collected near the lower Gila River during a 1982 nationwide survey of 129 sites contained the highest (8.4 μg/g wet weight) DDE concentrations in the United States (Bunck et al. 1987). Residues in Gila River starlings far exceeded the national geometric mean of 0.15 μg/g. DDE reported here for red-winged blackbird carcasses (1.9 - 7.4 μg/g wet weight) exceeded the upper 95% confidence interval (0.23 μg/g wet weight) reported by Bunck et al. (1987). Average DDE residues in blackbirds collected from the lower Gila River were higher than those in blackbirds (1.68 μg/g wet weight) and grackles (0.46 - 3.06 μg/g) collected in other areas of the desert southwest (Fleming et al. 1983, Fleming and Cain 1985) and northwestern Mexico (Mora and Anderson 1991).

Two of four red-winged blackbird samples contained >3.4 μg/g DDE wet weight; the level associated with poor reproductive performance in other species of birds, particularly the American black duck (*Anas rubripes*) (Longcore and Stendell 1977). Also, one-half of the blackbird carcasses contained more than 3.0 μg/g DDE, a level that represents a hazard to predatory birds that feed on blackbirds (Wiemeyer and Porter 1970, McLane and Hall 1972, Mendenhall et al. 1983). Red-winged blackbirds have been recorded in the diet of the endangered peregrine falcon (Enderson et al. 1982, DeWeese et al. 1986) and the Gila River study area is within the range of the peregrine falcon.

Blackbirds collected in 1994-95 did not contain residues of toxaphene. This finding is in sharp contrast to the occurrence of toxaphene in all 14 samples from five sites in 1985. There has been an obvious downward trend in the presence of toxaphene in avian samples over the past ten years.

A literature search failed to locate other southwestern United States investigations of contaminant levels in black-crowned night-heron carcass and liver tissues with which to compare our data. Night-heron carcasses from Painted Rock contained considerably higher DDE residues (5.2 - 15 μg/g wet weight) than carcasses (2.70 μg/g) of nestling double-crested cormorants (*Phalacrocorax auritis*) collected in 1994 from island colonies at Painted Rock (Rector 1997). Pre-fledging cormorants were sampled; therefore, they had been feeding on DDE-contaminated fish for less than six weeks. DDE concentrations in Painted Rock night-herons also were higher than those in carcasses of cormorants (2.1 - 6.6 μg/g) collected at three sites along the Colorado River (Radtke et al. 1988) and in the Yaqui (0.28 - 2.39 μg/g wet weight) and Culiacan (1.89 - 13.46 μg/g) valleys in western Mexico (Mora and Anderson 1991). A single cormorant collected in the Mexicali Valley near the United States - Mexico boundary; however, contained 11.46 μg/g DDE, a level similar to those recorded in night-herons from Painted Rock. All night-heron carcasses contained residues of DDE exceeding the 3.4 μg/g level associated with poor reproductive performance in black ducks (Longcore and Stendell 1977).

Many fish-eating and raptorial bird species are susceptible to DDE-induced eggshell-thinning and reproductive failure (Hickey and Anderson 1968, Ohlendorf et al. 1979, Blus 1996). In laboratory studies, as little as ≤3.0 μg/g wet weight DDE in the diet has resulted in a significant degree of eggshell thinning in a variety of birds (Wiemeyer and Porter 1970, McLane and Hall 1972, Mendenhall et al. 1983). Under field conditions, however, much lower levels of DDE in the diet have been associated with eggshell thinning and population declines of fish-eating birds including ≤0.15 μg/g wet weight in brown pelicans (*Pelecanus occidentalis*) (Blus 1996, Blus et al. 1977, 1979), ≤0.39 μg/g in bald eagles (Wiemeyer et al. 1978), and 0.2 - 1.9 μg/g in osprey (*Pandion haliaetus*) (Wiemeyer et al. 1975). It was not the purpose of this study to assess the food-chain accumulation of contaminants in fish-eating birds, but certainly DDE residues up to 21 μg/g wet weight in carp from Buckeye Canal and 17.0 μg/g DDE in mosquitofish from Dysart Drain are good indications that harmful food-chain accumulation is possible. DDE residues in fish from all lower Gila River collection sites exceeded the level associated with eggshell thinning in sensitive avian species. Brown pelicans, bald eagles, and osprey are DDE sensitive species and all have been observed feeding in the lower Gila River watershed.

Metals in birds: The elements most likely to be toxic to birds include cadmium, lead, mercury, and selenium (Eisler 1985a, 1987, Eisler 1988b, Scheuhammer 1987, Ohlendorf et al. 1988). Because aluminum was detected at relatively high levels in lower Gila River fish, we will briefly discuss the potential for food chain accumulation of aluminum from fish to fish-eating birds. No data are available on potentially toxic levels of aluminum in the diet of fish-eating birds and information is limited for other trophic level species. Juvenile ringed turtle-doves (*Streptopelia risoria*) fed up to 1,500 μg/g dry weight aluminum for 63 days demonstrated no growth impairments (Scheuhammer 1987). Flycatchers (*Ficedula hypoleuca*) feeding on insects that contained 1,230 μg/g dry weight

aluminum experienced severe eggshell defects, reduced clutch size, and a high incidence of mortality (Nyholm 1982, Nyholm and Myhrberg 1977). The highest aluminum concentration detected in a potential food fish, 614 μg/g dry weight, was below the lowest observed effect concentration reported in ringed turtle-doves and also less than the level determined to be toxic to flycatchers. Additional research is needed to determine the relative sensitivity of fish-eating birds to aluminum.

The concentration of cadmium in liver tissues of birds considered to represent normal background levels is <3 μg/g dry weight (Ohlendorf 1993). Cadmium was recovered in all three blackbird samples, but levels were low, ≤ 1.22 μg/g dry weight. Cadmium was not present in night-heron tissues and is not considered a contaminant of concern for birds nesting and wintering in the lower Gila River ecosystem.

Normal background levels of lead in livers of adult birds living in relatively uncontaminated environments are 0.5 to 5.0 μg/g dry weight (Scheuhammer 1987, Ohlendorf 1993). The liver is the tissue of choice for assessing recent exposure to lead; whereas, bone is preferred for assessing long-term exposure. Lead was not detected in red-winged blackbird and black-crowned night-heron livers indicating minimal recent exposure. There is little evidence to indicate that lead is a contaminant of concern for birds on the lower Gila River.

Background concentrations of mercury in bird livers are <1 - 10 μg/g dry weight, but concentrations greater than 6 μg/g dry weight may be toxic to some species (Ohlendorf 1993). The maximum concentration of mercury in blackbird livers was 2.89 μg/g, well within the background range. Mercury concentrations in five of six night-heron livers approached or exceeded the toxic threshold of 6 μg/g dry weight. The liver of the single adult night-heron (28.07 μg/g dry weight) was 4.5-times higher than the toxic threshold established by Ohlendorf (1993). Mercury may present a serious threat to the health and reproductive success of fish-eating birds nesting along the lower Gila River.

Selenium-induced reproductive failure of aquatic birds has been documented throughout the western United States (Ohlendorf et al. 1988, Ohlendorf 1989, Skorupa et al. 1990). Normal food chain selenium levels in the aquatic environment are ≤ 2.0 μg/g dry weight (Ohlendorf et al. 1990). The generally accepted toxic threshold in fish and other aquatic food items consumed by birds is 3 to 4 μg/g dry weight (Lemly and Smith 1987, Lemly 1993). Ten percent of the lower Gila River fish contained selenium in excess of 3 μg/g dry weight. Bioconcentration of selenium from fish to fish-eating birds is discussed in greater detail in the following section on birds.

Selenium usually averages 3 - 10 μg/g dry weight in livers of birds from selenium normal environments (Eisler 1985b, Ohlendorf 1989, Skorupa et al. 1990, Ohlendorf 1993). Concentrations of selenium greater than 10 μg/g wet weight (approximately 33 μg/g dry weight) in the liver can be considered harmful to the health of young and adult birds; concentrations above 3 μg/g wet weight (approximately 10 μg/g dry weight) in the livers of laying females has been associated with reproductive impairment (Heinz 1996). Selenium in livers of red-winged blackbirds was well within the normal or background

range. Selenium concentrations in the livers of black-crowned night-herons (13 - 18 μg/g dry weight) indicate that adult and fledged young are not at risk of acute selenium toxicity, but selenium impacts on reproduction are possible. These data support findings of Martinez (1994) who reported that 81% of the fish-eating birds nesting in backwater lakes farther downstream in the Gila-Colorado River drainage system had selenium concentrations in liver tissues above the effect threshold for reproductive impairment or embryotoxicity. Additional field study is needed to assess the effects of selenium on fish-eating birds nesting at Painted Rock and elsewhere in the lower Gila River system.

HUMAN HEALTH CONCERNS

Our study was designed to address impacts of contaminants on fish and wildlife rather than on human health; therefore, we analyzed few fish fillet samples. Consumption guidelines developed for the protection of human health focus on edible portions of fish and wildlife. ADHS's (1991) human health risk assessment, based on USEPA guidelines (USEPA 1989) concluded, "elevated and potentially health-threatening levels of organochlorine pesticide and methylmercury were found in the edible portion of various species of (Painted Rock) lake fish." Painted Rock bass fillet samples collected in 1994-95 contained a mean of 0.32 μg/g wet weight DDE, a level similar to the mean (0.27 μg/g) for DDTr reported by ADHS (1991) for bass samples collected from Painted Rock in 1986, 1987, and 1989. Our limited 1994-95 data reveal that DDE in bass fillets from Painted Rock and carp fillets from Buckeye Canal (2.57 μg/g) still exceed the 0.3 μg/g wet weight screening value currently proposed by USEPA (1995) and adopted by ADHS and ADEQ. Screening values were developed to identify concentrations of chemical contaminants in edible portions of commonly consumed fish that indicate a potential for significant health risks to human consumers. Toxaphene residues in all carp fillet samples from Buckeye Canal (0.31 - 0.81 μg/g wet weight) exceeded the USEPA screening value of 0.1 μg/g. Toxaphene in two of four fish samples from Painted Rock (0.11, 0.14 μg/g wet weight) also exceeds the screening value. Mercury concentrations in Painted Rock bass fillets (mean = 0.47 μg/g, 0.44 - 0.50) were 1.5-times higher than the mean (0.31 μg/g) reported by ADHS (1991) for bass collected from the same area in the late-1980s. However, mercury concentrations were below the USEPA screening value of 0.6 μg/g wet weight. Based on current USEPA guidelines, consumption of fish from Painted Rock and Buckeye Canal continues to pose a hazard to human health at, least with respect to DDE and toxaphene.

Definition

Elevated contaminant levels in whole body turtle samples do not necessarily relate to edible (fillet) tissues and concentrations therefore, should be interpreted with caution. DDE in all whole body turtle samples exceeded the USEPA's screening value of 0.3 μg/g wet weight. The maximum mercury residue in whole body turtles was 0.75 μg/g. Since mercury tends to concentrate in muscle tissue, additional work is needed to assess the risk to human health from eating softshell turtles from the lower Gila River.

CONCLUSIONS

- Residues of DDT, an insecticide that has been suspended from use in Arizona for more than 25 years, are still present in fish and wildlife. DDT was detected in 86, 62, and 50% of the fish collected from Buckeye Canal, Gillespie Dam, and Allenville, respectively. DDT was present in all turtles from Gillespie Dam, and in all black-crowned night-herons from Painted Rock.

- DDE residues in fish are the highest in the United States associated with agriculturally applied DDT. Although DDE residues have declined over the past decade; current levels remain extremely high when compared to national averages. DDE is present at concentrations known to impact biotic resources.

- DDE residues were greatest in fish from agricultural drains that are tributaries to the lower Gila River. Agricultural drains, particularly Buckeye Canal and Dysart Drain, may be point sources for DDE input into the river.

- The number of pesticide compounds detected in biota have declined dramatically over the past decade. Only 6 of 22 organochlorines were present in samples collected in 1994-95 versus 16 compounds in samples from 1985.

- The frequency of occurrence of chlordane in carp and turtles increased from 1985 to 1994-95. In 1985, chlordane was present in 11 and 83% of the carp and turtle samples. By 1994-94, the frequency of occurrence increased to 37 and 96%, respectively.

- The presence of toxaphene in fish and wildlife tissues declined dramatically from 1985 to 1994-95. Toxaphene was recovered in 61 and 94% of the carp and turtles collected in 1985, but toxaphene was not detected in 1994-95 carp and turtle samples. Toxaphene, however, was present at low levels in all largemouth bass. Catfish collected from Buckeye Canal contained relatively high (2.6 and 5.4 $\mu g/g$ wet weight) toxaphene residues.

- Eleven potentially toxic metals were detected in biota. Concentrations of most metals remained unchanged from 1985 to 1994-95. Carp collected near Allenville had the second highest mean aluminum concentration ever recorded in Arizona.

- Copper concentrations in 65% of the fish exceeded the national average. Because of its occurrence at relatively high levels at some sites and its propensity to interact with other compounds and elements, copper remains a contaminant of concern.

- Softshell turtles generally were more contaminated with pesticides and metals than fish. DDE and most metals were highest in turtles from the middle river sampling sites.

- Concentrations of mercury and selenium, elements that often present significant environmental hazards to fish and wildlife, were relatively low and do not pose a threat to fish.

- The greatest potential impact of contaminants is to top-level predators such as black-crowned night-herons. DDE, mercury, and selenium present significant hazards to night-herons and possibly to other avian species nesting and wintering in the area. All night-herons contained DDE at levels associated with impaired reproduction. Mercury in five of six night-herons approached or exceeded the toxic threshold. The maximum mercury concentration was 4.5-times higher than the toxic threshold. Adult night-herons are not at risk of selenium toxicity, but selenium impacts on reproduction are possible.

- This study focused on contaminant threats to fish and wildlife, but hazards to human health were also obvious. Potentially health threatening levels of DDE were present in fish fillets from Buckeye Canal and Painted Rock. DDE in fish fillets from Painted Rock and Buckeye Canal still exceed the screening value currently proposed by USEPA and ADEQ for the protection of human health.

- None of the fish fillet samples exceeded the USEPA standard for mercury. However, mercury concentrations in Painted Rock bass fillets were two-times higher than the average reported by ADEQ for bass collected from the same area in the late-1980s.

RECOMMENDATIONS

Point sources of DDT/DDE input into agricultural drains should be identified. Assistance may be available through Arizona's Water Quality Assurance Revolving Fund (WQARF) administered by ADEQ. This state funded program has declared portions of the Gila River within the boundaries of our 1994-95 study, a WQARF Superfund site (WQARF Decision Record Lower/Middle Gila River, 1989). One purpose of WQARF is to finance immediate remedial action necessary to prevent, minimize, and mitigate danger to public health and the environment. The fund specifically allows for study, management, and cleanup of hazardous substances. Funds and personnel may be provided to intensively sample the entire agricultural drainage system to locate, then mitigate, point sources of pollution.

Since many contaminant problems are associated with return of agricultural drainwater to the lower Gila River, an agricultural engineering perspective is needed to better manage irrigation practice, especially drainwater removal. Water conservation efforts should focus on diverting a minimal amount of water from the Gila River for irrigation purposes with emphasis on maximizing water use on crops so that there is little or no runoff. By initially removing only the optimum amount of water from the Gila River, maximum downstream flows would be ensured.

Many synthetic organic compounds have the potential to disrupt the endocrine system of fish and wildlife; these compounds include organochlorine pesticides, polyaromatic hydrocarbons, phthalates and phenols (Colborn and Clement 1992, Colborn et al. 1993). Many of these compounds are associated with wastewater treatment plant effluent. This study documented high levels of organochlorine insecticides in fish and wildlife tissues. Future investigations should quantify the presence of endocrine disrupting compounds and document histopathological parameters in lower Gila River fish and turtles.

Additional research is needed to assess levels and potential effects of contaminants in populations of fish-eating birds nesting and wintering in the lower Gila River ecosystem. DDE, mercury, and selenium were detected at sufficiently high levels in night-heron carcass and liver tissues to suggest that harmful impacts on reproduction are possible.

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Table 1. (Cont). Organochlorine residues in individual whole body fish collected from the lower Gila River, Arizona, 1994-95

Site and sample[2]	Weight (g)	Prcnt lipid	Concentration (µg/g wet weight)[1] p,p' DDE	Totl PCB	Totl chlor[3]	Diel-drin	Toxa-phene	p,p' DDT
NCBP 85th %[4]	NA[5]	NA	0.33	0.80	0.17	0.05	0.03	0.03
Gillespie Dam								
C Carp	269	3.52	1.30	0.07	<0.01	<0.01	<0.25	0.02
C Carp	338	2.92	0.67	<0.05	<0.01	<0.01	<0.25	0.02
C Carp	2395	4.49	1.00	0.10	0.01	0.01	<0.25	<0.01
C Carp	365	5.49	0.73	<0.05	<0.01	<0.01	<0.25	0.02
C catfish	1487	6.98	7.90	0.18	0.01	<0.01	<0.80	0.09
C catfish	1544	10.04	4.60	0.12	0.01	<0.01	<0.80	0.11
C catfish	1621	14.40	4.20	0.10	0.01	<0.01	<0.80	0.08
C catfish	1564	9.31	8.40	0.11	<0.01	<0.01	<0.80	0.07
C catfish	444	11.85	1.30	<0.05	0.02	<0.01	<0.05	<0.01
C catfish	957	7.77	0.96	<0.05	0.03	<0.01	<0.05	0.02
C catfish	364	1.58	0.35	<0.05	<0.01	<0.01	<0.05	<0.01
C catfish	590	16.31	0.84	<0.05	0.04	<0.01	<0.05	<0.01
C catfish	1901	14.09	3.50	0.06	0.04	<0.04	1.80	<0.01
Painted Rock								
C Carp	913	1.88	0.94	<0.05	<0.01	<0.01	<0.05	<0.01
C Carp	1209	2.62	1.60	0.05	<0.01	0.01	<0.25	<0.01
C Carp	1684	4.90	0.72	<0.05	<0.01	0.27	<0.25	0.02
C Carp	956	1.25	0.64	<0.05	<0.01	<0.01	<0.05	<0.01
C Carp	845	6.96	2.00	0.08	<0.01	0.02	<0.05	0.04
C catfish	472	20.12	1.15	<0.05	0.04	<0.01	<0.05	0.02
C catfish	467	18.10	1.15	<0.05	0.04	<0.01	<0.05	<0.01
LM bass	435	9.14	1.90	0.08	<0.01	<0.01	0.26	<0.01
LM bass	697	5.15	1.80	0.09	<0.01	<0.01	0.19	<0.01
LM bass	856	5.87	1.60	0.07	<0.01	<0.01	0.18	<0.01
LM bass	536	7.27	1.20	<0.05	<0.01	0.01	0.24	<0.01
LM bass	666	10.70	2.00	0.08	0.01	0.01	0.19	<0.01

[1] No other organochlorine compounds were detected other than those listed.

[2] C carp = common carp, C catfish = channel catfish, and LM bass = largemouth bass.

[3] Total chlordane = the sum of all chlordane isomers (alpha chlordane, oxychlordane + *cis*-chlordane + *trans*-nonachlor + *cis*-nonachlor).

[4] The 85th percentile for each compound was calculated using data listed in Schmitt et al. (1990).

[5] NA = Data not available.

Table 2. Organochlorine compounds in common carp collected from the lower Gila River, Arizona, 1994-95: a comparison among collection sites

Area	N[3]	Geometric mean concentration[1] (µg/g wet weight) n[2]/range DDE (.33)	PCB (.80)	Chlordane (.11)	Dieldrin (.05)	DDT (.03)
59th Avenue	5	0.27 (5) A[4] 0.16-0.63	0.30 (5) A 0.14-0.65	----[5] (2) ND - 0.03	---- (2) ND - 0.02	---- (0)
Estrella Park	5	0.81 (5) AB 0.30-2.00	0.19 (5) A 0.09-0.29	---- (2) ND - 0.03	---- (0)	---- (0)
Allen-ville	3	1.95 (3) B 1.10-6.10	---- (1) ND - 0.07	---- (1) 0.01	---- (0)	---- (1) 0.02
Buckeye Canal	5	11.17 (5) C 4.50-21.0	0.16 (5) A 0.07-0.29	0.04 (4) ND - 0.09	---- (1) 0.02	0.05 (4) ND - 0.15
Gillespie Dam	4	0.89 (4) AB 0.67-1.30	0.05 (4) B 0.03-0.10	---- (1) 0.01	---- (1) 0.01	0.01 (3) ND - 0.02
Painted Rock	5	1.07 (5) B 0.64-2.00	---- (2) ND - 0.08	---- (0)	0.02 (3) 0.01-0.27	---- (2) ND - 0.04

[1] Toxaphene was detected only in catfish collected from Buckeye Canal and Gillespie Dam (Gmeans = 3.78, 4.71 µg/g) and in largemouth bass from 59th Avenue and Painted Rock (Gmeans = 0.26 and 0.21 µg/g). Toxaphene was not detected in carp.

[2] n = number of fish with detectable residues.

[3] N = number of fish in each sample.

[4] Means sharing the same letter are statistically similar (P > 0.05).

[5] Means were not calculated because fewer than one-half of the samples had detectable residues.

Table 3. Organochlorine residues in fish fillet samples collected from the lower Gila River, Arizona, 1994-95

Site and sample	Wt. (g)	Prcnt lipid	µg/g wet weight[1] p,p' DDE	Diel- drin	Toxa- phene
Buckeye Canal					
Common carp	231	1.28	1.90	0.01	0.81
Common carp	234	1.01	4.50	<0.01	0.74
Common carp	228	0.64	1.30	<0.01	0.31
Painted Rock					
Common carp	141	0.81	0.32	<0.01	<0.05
Largemouth bass	497	2.87	0.38	<0.01	0.11
Largemouth bass	311	2.57	0.39	<0.01	0.14
Largemouth bass	558	0.85	0.19	<0.01	<0.05

[1] No other organochlorine compounds were detected other than those listed.

Table 4. Metals in individual whole body fish collected from the lower Gila River, Arizona, 1994-95

Area and species[2]	Prcnt moist	Element concentration (µg/g wet weight)[1]										
		Al	As	B	Cu	Cr	Hg	Ni	Se	Sr	V	Zn
NCBP 85th %[3]	NA	NA[4]	0.27	NA	1.0	NA	0.17	NA	0.73	NA	NA	34.2
59th Avenue												
C carp	68.8	61.30	<0.05	0.47	5.62	0.92	0.07	0.37	<0.20	44.7	1.05	85.1
C carp	71.1	47.00	0.09	0.40	1.43	0.48	0.06	0.17	<0.20	33.8	0.30	53.6
C carp	76.3	29.20	0.09	<0.39	1.27	0.31	0.16	<0.12	0.40	32.1	0.18	47.6
C carp	77.9	26.70	0.32	1.28	1.39	0.24	0.28	<0.12	0.37	18.0	0.15	45.3
C carp	79.4	12.60	0.18	<0.39	1.33	0.22	0.24	<0.12	0.57	22.2	0.08	32.2
LM bass	72.6	1.68	0.69	0.41	0.93	0.44	0.07	<0.12	<0.20	25.8	<0.05	16.1
LM bass	70.6	1.55	0.39	0.66	0.35	0.49	0.08	<0.12	0.31	30.0	<0.05	17.2
LM bass	73.4	2.05	0.59	0.62	0.39	0.43	0.09	<0.12	0.26	23.5	<0.05	17.3
LM bass	73.4	1.55	0.82	0.90	0.55	0.47	0.07	0.30	<0.20	29.7	<0.05	18.1
LM bass	69.2	1.62	0.85	0.59	0.31	0.46	0.08	<0.12	0.29	26.9	<0.05	14.4
C catfish	76.7	10.40	0.09	0.60	0.36	0.53	0.03	<0.12	<0.20	33.9	0.13	21.6
Estrella Park												
C carp	74.2	3.92	0.10	0.44	1.51	0.37	0.23	0.16	0.33	52.2	0.16	30.4
C carp	74.2	61.80	0.11	0.50	1.80	0.60	0.11	0.23	0.39	59.9	0.45	68.2
C carp	76.2	108.00	0.12	0.54	6.73	0.66	0.09	0.32	0.65	34.6	0.52	41.4
C carp	76.2	52.20	0.16	0.60	3.45	0.42	0.10	0.21	0.29	44.7	0.22	40.8
C carp	76.3	72.80	0.12	0.89	1.68	0.59	0.09	0.22	0.43	56.6	0.43	56.4
Allenville												
C carp	77.2	99.70	0.16	0.50	6.02	0.44	0.13	0.68	1.47	46.1	0.31	75.3
C carp	77.2	111.00	0.17	0.57	2.11	0.45	0.14	0.15	0.84	50.6	0.36	51.7
C carp	76.4	90.70	0.35	0.84	1.69	0.42	0.41	<0.12	0.60	63.1	0.38	50.2
C catfish	72.8	<0.99	0.08	0.77	2.43	0.23	0.11	<0.12	0.66	43.8	0.07	14.5
Buckeye Canal												
C carp	74.6	14.00	0.09	0.61	1.30	0.42	0.04	0.23	0.87	56.3	0.08	64.7
C carp	77.9	19.80	0.07	0.50	1.10	0.46	0.05	0.22	0.25	57.9	0.08	67.4
C carp	75.0	11.10	0.09	0.48	1.15	0.39	0.25	<0.12	0.43	49.0	0.10	77.2
C carp	70.1	18.60	<0.05	0.65	1.37	0.52	0.05	0.15	0.33	79.6	0.23	38.8
C carp	78.3	16.50	0.06	1.11	1.54	0.47	0.04	1.76	0.38	70.0	0.09	52.3
C catfish	78.1	147.00	0.19	2.69	2.86	0.62	0.07	1.19	0.24	26.9	0.43	18.0
C catfish	76.7	107.00	0.14	1.96	0.71	0.57	0.11	0.19	<0.20	32.7	0.33	20.3
Gillespie Dam												
C carp	72.9	96.90	0.09	1.05	1.82	0.75	0.08	0.25	0.83	91.7	0.63	75.4
C carp	75.1	57.40	0.05	1.17	1.29	0.49	0.07	0.20	0.56	96.5	0.18	46.1
C carp	72.0	172.00	0.17	0.91	5.44	0.59	0.08	0.31	0.58	38.8	0.44	72.8
C carp	72.4	101.00	0.16	1.40	1.30	0.58	0.05	0.21	0.66	77.2	0.41	46.3
C catfish	72.6	3.54	0.46	2.84	0.50	0.36	0.06	<0.12	0.23	36.4	0.16	14.3
C catfish	67.6	2.66	0.06	0.81	5.99	0.31	0.09	<0.12	0.41	29.2	0.09	19.6
C catfish	68.8	3.96	0.10	1.09	1.57	0.41	0.08	<0.12	0.39	43.3	0.10	20.9
C catfish	69.4	1.78	0.12	0.90	0.53	0.28	0.06	0.13	0.27	31.9	0.07	15.8
C catfish	65.7	2.06	0.10	0.52	5.49	0.31	0.07	<0.12	0.48	25.5	0.07	20.1

Table 4. (Cont.). Metals in individual whole body fish collected from the lower Gila River, Arizona, 1994-95

Area and species[2]	Pcnt moist	Element concentration (µg/g wet weight)[1]										
		Al	As	B	Cu	Cr	Hg	Ni	Se	Sr	V	Zn
NCBP 85th %[3]	NA	NA[4]	0.27	NA	1.0	NA	0.17	NA	0.73	NA	NA	34.2
Painted Rock												
C carp	77.7	1.02	<0.05	0.77	0.93	0.42	0.18	<0.12	0.55	57.0	0.27	38.4
C carp	76.9	82.90	<0.05	0.44	2.12	0.34	0.15	0.13	0.62	46.6	0.28	61.2
C carp	72.1	2.14	<0.05	0.45	1.12	0.35	0.24	<0.12	0.88	51.7	0.18	51.0
C carp	78.3	5.53	<0.05	0.56	0.73	0.43	0.21	<0.12	0.60	50.2	0.25	53.0
C carp	71.0	1.26	<0.05	0.47	0.96	0.46	0.16	<0.12	0.40	81.2	0.93	34.6
C catfish	63.6	1.01	0.05	0.60	0.28	0.33	0.20	<0.12	0.46	34.2	0.10	15.5
C catfish	63.2	1.58	<0.05	1.39	0.30	0.37	0.18	<0.12	0.27	35.6	0.17	16.9
LM bass	68.1	1.78	0.46	1.53	0.40	0.52	0.29	<0.12	0.33	49.6	0.06	17.0
LM bass	73.0	5.98	0.24	1.28	1.94	0.42	0.32	<0.12	0.51	33.1	<0.05	12.6
LM bass	70.3	1.21	0.17	0.70	2.60	0.50	0.36	<0.12	0.85	40.7	<0.05	14.8
LM bass	69.5	<0.99	0.28	1.08	0.59	0.49	0.28	<0.12	0.65	50.0	<0.05	14.5
LM bass	67.0	<0.98	0.13	0.89	0.38	0.41	0.32	<0.12	0.67	34.5	<0.05	11.7

[1] Not detected in any samples: beryllium lower limit of detection (LLD) ≤0.02, lead LLD ≤0.5, and molybdenum LLD ≤0.4. Cadmium was present in one Gillespie Dam carp at 0.07 µg/g.

[2] Species: C carp = common carp, LM bass = largemouth bass, C catfish = channel catfish.

[3] National Contaminant Biomonitoring Program 85th percentile (Schmitt and Brumbaugh 1990).

[4] NA = NCBP samples were not analyzed for this element.

Table 6. Metals in common carp and largemouth bass fillet samples collected from the lower Gila River, Arizona, 1994-95

Area and species[2]	Percent moist	Element concentration (µg/g wet weight)[1]								
		Al	As	B	Cr	Cu	Hg	Se	Sr	Zn
Buckeye Canal										
C carp	79.2	1.55	0.11	0.70	0.15	1.07	0.13	0.37	1.41	10.60
C carp	78.8	21.60	0.14	0.58	0.19	2.28	0.18	0.44	2.85	7.64
C carp	80.6	1.88	0.15	0.84	0.16	0.80	0.11	0.44	1.68	16.40
Painted Rock										
C carp	79.3	73.20	0.22	<0.39	0.25	0.52	0.42	0.48	1.85	4.68
LM bass	77.9	<0.99	0.29	0.91	0.13	0.82	0.44	0.40	0.45	4.63
LM bass	77.2	122.00	0.47	0.52	0.19	2.27	0.47	0.58	0.78	5.45
LM bass	78.4	<1.00	0.82	0.70	0.15	0.34	0.50	0.52	0.34	4.06

[1] The following elements were not detected in any fillet samples: beryllium lower limit of detection (LLD) 0.02 µg/g wet weight, cadmium LLD 0.02 µg/g, molybdenum LLD = 0.40 µg/g, lead LLD = 0.50 µg/g, and vanadium LLD = 0.05 µg/g. One Painted Rock largemouth bass fillet sample contained 0.26 µg/g nickel.

[2] Species: C carp = common carp, LM bass = largemouth bass.

Table 5. (Cont.). Metals in common carp collected from the lower Gila River, Arizona, 1994-95: a comparison among collection sites

Area	N[2]	Geometric mean (µg/g dry weight) n[1]/range				
		Nickel	Selenium	Strontium	Vanadium	Zinc
59th Avenue	5	----[3] (2) ND - 1.18	0.97 (3) A[4] ND - 2.77	125 (5) A 108-143	0.94 (5) A 0.41 3.37	201 (5) A 156-273
Estrella Park	5	1.64 (5) A 0.64-1.34	1.64 (5) AB 1.24-2.74	198 (5) AB 145-239	1.32 (5) A 0.63-2.18	185 (5) A 118-264
Allen-ville	3	1.26 (2) A ND - 2.99	3.92 (3) B 2.54-6.45	229 (3) B 202-267	1.51 (3) A 1.35-1.61	252 (3) A 212-330
Buckeye Canal	5	1.78 (4) A ND - 8.11	1.67 (5) AB 1.12-3.41	250 (5) B 196-323	0.42 (5) A 0.30-0.77	237 (5) A 129-308
Gillespie Dam	4	1.74 (4) A 0.77-1.10	2.42 (4) AB 0.77-1.10	267 (4) B 139-388	1.40 (4) A 0.71-2.31	218 (4) A 108-278
Painted Rock	5	---- (1) ND - 0.54	2.40 (5) AB 1.38-3.16	228 (5) B 185-280	1.28 (5) A 0.63-3.20	189 (5) A 119-265

[1] n = number of fish with detectable residues.

[2] N = number of fish in each sample.

[3] Means were not calculated because fewer than one-half of the samples had detectable residues.

[4] Means sharing the same letter are statistically similar ($P > 0.05$).

Table 7. Organochlorine residues in individual softshell turtles collected from the lower Gila River, Arizona, 1994-95

Site and sample	Weight (g)	Prcnt lipid	Concentration (µg/g wet weight)[1] p,p' DDE	Totl PCB	Totl chlor[2]	Diel-drin	p,p' DDT
59th Avenue							
Sample 1	1857	12.13	1.40	0.11	0.05	0.07	<0.01
Sample 2	2164	20.99	1.20	0.15	0.06	0.04	<0.01
Sample 3	1562	11.39	0.32	0.10	0.03	<0.01	<0.01
Sample 4	1058	12.71	0.52	0.31	0.01	0.04	<0.01
Sample 5	3550	21.75	2.50	6.70	0.24	0.19	<0.03
Estrella Park							
Sample 1	2159	11.27	5.90	0.40	0.07	0.06	0.02
Sample 2	2745	12.72	4.50	0.85	0.19	0.10	0.02
Sample 3	1671	11.39	8.60	0.41	0.10	0.11	<0.01
Sample 4	1997	17.39	1.40	0.46	0.05	0.05	<0.01
Sample 5	2897	18.88	2.20	0.27	0.09	0.07	0.05
Allenville							
Sample 1	417	6.01	4.90	0.27	0.05	0.03	<0.01
Sample 2	508	10.49	6.40	0.38	0.08	0.05	<0.01
Sample 3	2351	11.92	4.80	0.18	0.05	0.04	0.06
Sample 4	529	6.13	6.70	0.23	0.05	0.06	0.06
Sample 5	364	2.87	3.00	0.14	0.03	0.03	0.03
Buckeye Canal							
Sample 1	463	1.83	5.30	0.57	0.13	0.06	0.04
Gillespie Dam							
Sample 1	332	9.37	2.70	0.10	0.04	0.05	0.06
Sample 2	416	6.79	6.50	0.13	0.05	0.06	0.05
Sample 3	455	4.38	2.50	0.11	0.02	0.03	0.03
Sample 4	513	2.47	2.30	0.07	0.01	0.02	0.02
Sample 5	872	8.51	3.20	0.10	0.01	0.04	0.05
Painted Rock							
Sample 1	1612	15.14	2.80	0.06	0.02	0.02	<0.01
Sample 2	1503	20.69	2.10	<0.05	0.02	0.01	<0.01
Sample 3	2110	16.05	2.30	<0.05	0.02	0.01	<0.01
Sample 4	1851	17.54	1.70	<0.05	0.02	0.01	<0.01
Sample 5	4433	23.81	1.20	<0.05	0.05	0.02	<0.05
Sample 6	3327	19.96	1.70	<0.05	<0.01	0.02	<0.03

[1] No other organochlorine compounds were detected.

[2] Total chlordane = the sum of all chlordane isomers (alpha chlordane, oxychlordane + *cis*-chlordane + *trans*-nonachlor + *cis*-nonachlor).

Table 9. Trace element concentrations (µg/g dry weight) in individual whole body softshell turtles collected from the lower Gila River, Arizona, 1994-95.

Area and sample	Concentration, µg/g dry weight[1]											Prcnt moist
	Al	As	B	Cr	Cu	Hg	Ni	Se	Sr	V	Zn	
59th Avenue												
Sample 1	36.9	<0.13	1.37	2.08	12.53	0.03	2.04	<0.52	161.	0.15	62.0	62.1
Sample 2	39.1	<0.12	1.25	1.58	303.96	0.02	1.98	<0.49	120.	0.35	58.7	59.6
Sample 3	34.5	0.21	4.90	1.65	2.21	0.22	<0.35	0.72	170.	0.32	76.7	66.1
Sample 4	25.6	0.33	2.31	1.43	1.62	0.17	<0.31	<0.51	134.	0.22	62.8	61.0
Sample 5	33.4	<0.16	2.93	1.71	2.39	0.21	<0.39	<0.65	144.	0.20	79.7	69.5
Estrella Park												
Sample 1	41.3	0.45	3.72	1.89	384.62	0.62	2.71	<0.64	242.	<0.16	84.6	68.8
Sample 2	123.0	0.38	3.20	1.82	149.10	0.43	1.70	<0.51	194.	0.51	73.9	60.9
Sample 3	96.4	0.57	3.18	1.52	1128.57	0.45	8.11	<0.70	167.	0.34	100.0	72.0
Sample 4	148.5	<0.14	2.44	1.87	17.45	0.17	1.04	0.81	154.	0.47	61.8	63.1
Sample 5	24.3	0.13	1.87	1.33	167.74	0.37	1.38	0.98	187.	<0.13	54.8	62.8
Allenville												
Sample 1	55.1	0.25	7.82	2.56	64.24	0.20	0.86	<0.63	421.	0.37	101.3	68.4
Sample 2	62.5	0.20	10.14	2.72	4.60	0.33	0.56	0.95	338.	0.19	101.4	64.8
Sample 3	27.5	<0.22	3.78	<0.31	1.76	0.43	<0.37	2.60	161.	0.24	51.4	67.7
Sample 4	59.4	0.67	6.93	<0.39	2.40	0.41	<0.47	2.76	208.	0.38	76.0	74.6
Sample 5	150.4	0.31	6.43	<0.44	4.04	0.63	<0.53	3.97	189.	0.89	79.5	77.6
Buckeye Canal												
Sample 1	50.0	0.37	3.81	1.16	5.09	1.42	<0.56	4.44	163.	0.27	86.4	78.6
Gillespie Dam												
Sample 1	52.7	<0.16	5.62	1.73	6.37	0.37	2.75	2.51	217.	<0.15	74.8	68.3
Sample 2	31.7	0.53	13.51	<0.37	2.33	0.69	<0.45	3.13	214.	0.27	77.7	73.5
Sample 3	19.8	0.49	10.04	<0.37	2.06	0.44	<0.44	2.57	217.	<0.18	80.2	73.2
Sample 4	27.6	0.65	5.60	0.96	2.26	0.63	<0.51	2.11	157.	0.26	58.2	76.8
Sample 5	59.1	1.08	5.02	<0.38	2.83	0.49	<0.46	2.24	191.	0.31	69.1	74.1
Painted Rock												
Sample 1	57.3	0.24	3.63	1.60	1.93	0.73	<0.38	1.57	123.	0.36	67.1	67.2
Sample 2	24.7	0.35	3.32	1.05	1.73	0.29	0.46	0.98	105.	0.26	57.2	62.6
Sample 3	92.5	0.26	4.34	1.71	2.35	0.66	0.32	0.98	150.	0.49	76.3	61.1
Sample 4	18.1	0.25	3.37	1.21	1.69	0.47	0.33	0.58	108.	<0.14	61.4	63.5
Sample 5	18.3	0.18	3.12	1.15	1.42	0.49	<0.26	0.71	136.	0.15	57.6	55.4
Sample 6	16.4	0.24	5.07	1.29	1.25	0.65	<0.28	1.11	177.	0.18	62.8	57.8

[1] Cadmium was not detected in turtle samples. An unknown number of turtles from 59th Avenue and Estrella Park were shot with lead bullets which biased chemical analysis for lead. Lead data for these sites are not presented. None of turtles trapped at the remaining collection sites contained lead.

Table 11. Organochlorine compounds in whiptail lizards collected from the lower Gila River, Arizona, 1985 and 1994-95

Year, site and sample[2]	Weight (g)	Prcnt lipid	µg/g wet weight[1] p,p' DDE	Chlordane[3]	Dieldrin
1994-95					
Estrella Park	50	2.38	0.12	ND[4]	ND
Painted Rock	34	2.11	0.49	ND	ND
1985					
59th Avenue					
Sample A	66	2.18	1.10	ND	0.01
Sample B	52	1.62	0.45	ND	0.01
Sample C	45	1.88	0.59	ND	0.01
Estrella Park					
Sample A	89	2.50	0.94	ND	ND
Sample B	75	3.16	0.44	ND	ND
Sample C	61	2.66	0.40	ND	ND
Allenville					
Sample A	83	7.66	0.32	ND	ND
Sample B	55	5.70	0.37	ND	ND
Sample C	50	5.12	0.14	ND	ND
Buckeye Canal					
Sample A	78	4.32	4.20	0.02	0.02
Sample B	61	3.82	3.10	0.01	0.01
Sample C	46	5.42	3.10	0.02	0.02
Gillespie Dam					
Sample A	79	14.40	0.59	ND	ND
Sample B	59	11.10	0.60	ND	ND
Sample C	45	9.16	1.00	ND	ND
Painted Rock					
Sample A	88	3.30	0.03	ND	ND
Sample B	71	4.60	0.02	ND	ND
Sample C	55	3.90	0.12	ND	ND

[1] No other organochlorine compounds were detected.

[2] Five individual lizards were composited per sample at each site except the 1994-95 Painted Rock sample which contained three lizards.

[3] Total chlordane = the sum of all chlordane isomers (alpha chlordane, oxychlordane + *cis*-chlordane + *trans*-nonachlor + *cis*-nonachlor).

[4] ND = No residue detected.

Table 12. Metals in western whiptail lizards collected from the lower Gila River, Arizona, 1985 and 1994-95

Year, area, and sample	N[2]	Element concentration (µg/g dry weight)[1] Al	As	B	Cd	Cr	Cu	Hg	Ni	Se	Sr	V	Zn	Prcnt moist
1985														
59th Avenue														
Sample A	5	NA[3]	0.25	NA	<0.21	NA	0.53	0.14	2.11	1.86	NA	1.43	146.8	72.0
Sample B	5	NA	0.57	NA	0.28	NA	14.18	0.14	2.38	1.84	NA	1.95	133.0	71.8
Sample C	5	NA	0.36	NA	<0.22	NA	17.86	0.22	1.47	0.22	NA	1.61	129.9	77.6
Estrella Park														
Sample A	5	NA	0.26	NA	0.83	NA	8.68	0.10	3.15	0.96	NA	3.54	150.2	68.9
Sample B	5	NA	0.31	NA	0.61	NA	9.79	0.15	9.48	0.95	NA	3.36	133.9	67.3
Sample C	5	NA	0.31	NA	0.67	NA	14.70	0.15	0.67	1.04	NA	4.60	149.7	67.4
Allenville														
Sample A	5	NA	0.56	NA	0.25	NA	7.19	ND[4]	1.22	1.40	NA	1.59	110.3	68.0
Sample B	5	NA	0.56	NA	0.35	NA	9.06	ND	0.91	2.06	NA	0.94	138.0	71.3
Sample C	5	NA	0.64	NA	0.32	NA	13.43	0.14	1.45	1.70	NA	1.48	183.7	71.7
Buckeye Canal														
Sample A	5	NA	16.67	NA	ND	NA	5.56	0.10	1.31	1.27	NA	1.14	147.8	69.4
Sample B	5	NA	1.42	NA	ND	NA	5.28	0.10	1.52	1.16	NA	1.09	182.5	69.7
Sample C	5	NA	0.67	NA	ND	NA	7.33	0.10	0.97	1.23	NA	0.67	145.3	70.0
Gillespie Dam														
Sample A	5	NA	1.43	NA	ND	NA	3.15	ND	0.69	1.12	NA	0.97	86.2	65.1
Sample B	5	NA	0.58	NA	ND	NA	3.87	0.13	1.29	1.52	NA	1.29	101.9	69.0
Sample C	5	NA	0.90	NA	ND	NA	4.67	ND	1.10	1.50	NA	1.70	91.0	70.0
Painted Rock														
Sample A	5	NA	3.96	NA	ND	NA	4.95	0.46	1.88	2.41	NA	1.68	184.2	69.7
Sample B	5	NA	10.74	NA	ND	NA	6.04	0.37	2.28	1.88	NA	1.81	152.7	70.2
Sample C	5	NA	6.48	NA	ND	NA	6.83	0.55	2.15	2.01	NA	2.25	166.6	70.7
1994-95														
Estrella Park	6	220.5	15.29	3.63	ND	0.37	18.02	0.36	0.43	2.45	47.8	0.64	119.8	72.2
Allenville	5	596.6	0.47	5.02	ND	2.29	21.73	0.27	1.41	3.42	69.2	1.88	129.8	70.5
Gillespie Dam	5	588.6	1.04	4.62	ND	2.37	20.60	0.40	1.48	4.11	49.5	1.73	127.4	70.1
Painted Rock	3	722.6	6.75	6.82	ND	2.44	12.09	1.36	1.15	4.11	46.3	1.58	122.9	70.8

[1] Lizards were collected with lead shotshells. The lead shot contained arsenic, boron, cadmium and copper.

[2] N = Number of individuals in each composite sample.

[3] Samples from 1985 were not analyzed for aluminum, boron, chromium, and strontium.

[4] ND = No residue detected.

Table 13. Organochlorine residues in bird carcasses collected from the lower Gila River, Arizona, 1994-95

Site	Species[2]	Age[3]	N[4]	Weight (g)[5]	Prcnt moist	Prcnt lipid	Concentration (µg/g wet weight)[1] p,p' DDE	Totl PCB	Totl chlor[6]	Diel-drin	p,p' DDT
59th Avenue	RWBB	Ad	5	305	68.4	4.93	1.90	0.16	<0.01	0.02	<0.01
Allenville	RWBB	Ad	5	300	70.7	4.81	2.10	<0.05	<0.01	<0.01	<0.01
Estrella Pk.	RWBB	Ad	5	347	72.4	5.35	4.80	0.09	<0.01	0.01	<0.01
Gillespie Dam	RWBB	Ad	6	375	69.2	4.78	7.40	0.08	<0.01	0.02	<0.03
Painted Rock	BCNH	Ad	1	944	53.8	24.52	15.00	0.67	0.12	0.11	0.09
Painted Rock	BCNH	Imm	1	907	61.4	17.23	5.20	0.25	0.08	0.07	0.03
Painted Rock	BCNH	Imm	1	958	66.8	9.12	12.00	0.55	0.08	0.27	0.11
Painted Rock	BCNH	Imm	1	915	65.7	9.67	9.30	0.41	0.01	0.15	0.06
Painted Rock	BCNH	Imm	1	733	64.4	18.45	11.00	0.52	0.08	0.07	0.05
Painted Rock	BCNH	Imm	1	949	61.3	15.62	9.70	0.23	0.07	0.06	0.06

[1] No other organochlorine compounds were detected.

[2] Species: RWBB = red-winged blackbird, BCNH = black-crowned night-heron. Blackbirds are composite samples. Heron carcasses were analyzed individually.

[3] Age: Ad = adult, Imm = immature.

[4] N= number of individuals per sample. Numbers >1 indicates a composite sample.

[5] Weight is whole body weight.

[6] Total chlordane = the sum of all chlordane isomers (alpha chlordane + oxychlordane + *cis*-chlordane + *trans*-nonachlor + *cis*-nonachlor).

Table 14. Metals in whole body red-winged blackbirds collected from the lower Gila River, Arizona, 1985 and 1994-95[1]

Year, area and sample	N[2]	Element concentration (µg/g dry weight)[1]											Prcnt moist
		Al	As	B	Cr	Cu	Hg	Ni	Se	Sr	V	Zn	
1994-95													
59th Avenue	5	21.7	<0.16	2.76	1.25	8.01	0.20	<0.38	2.12	24.0	<0.16	82.6	68.4
Estrella Park	5	63.0	<0.18	3.39	1.66	11.16	0.17	0.49	1.63	32.0	<0.18	88.8	72.4
Allenville	5	19.3	0.44	2.15	1.17	8.57	0.08	0.45	1.55	31.0	<0.17	86.3	70.7
1985													
59th Avenue													
Sample A	4	NA[3]	0.12	NA	NA	6.49	0.18	6.08	1.38	NA	0.41	46.0	50.7
Sample B	5	NA	0.28	NA	NA	9.43	0.38	10.69	2.23	NA	0.25	87.7	68.2
Estrella Park													
Sample A	5	NA	0.25	NA	NA	9.82	0.35	20.63	1.96	NA	0.35	107.7	71.5
Sample B[4]	5	NA	ND[5]	NA	NA	10.84	1.05	97.76	2.17	NA	0.31	112.9	71.4
Sample C	5	NA	0.49	NA	NA	NA	0.43	NA	2.03	NA	NA	NA	69.5
Allenville													
Sample A	5	NA	0.19	NA	NA	13.43	ND	0.63	1.56	NA	ND	92.5	68.0
Sample B	5	NA	ND	NA	NA	7.87	ND	29.84	1.48	NA	0.16	92.8	69.5
Sample C	5	NA	0.23	NA	NA	9.24	ND	170.30	1.58	NA	ND	92.4	69.7
Gillespie Dam													
Sample A	5	NA	0.20	NA	NA	8.31	ND	23.65	0.20	NA	0.17	84.1	69.9
Sample B	5	NA	0.23	NA	NA	8.52	0.07	45.57	0.23	NA	0.23	78.4	69.5
Sample C	5	NA	ND	NA	NA	9.15	0.07	28.04	ND	NA	0.33	94.8	69.4
Painted Rock													
Sample A	5	NA	0.19	NA	NA	10.67	ND	2.69	1.26	NA	ND	91.3	74.7
Sample B	5	NA	0.21	NA	NA	10.11	0.07	0.72	1.26	NA	0.36	101.4	72.3
Sample C	5	NA	0.69	NA	NA	11.53	ND	0.77	1.27	NA	0.31	92.3	74.0

[1] Whole body samples were plucked and bill, feet, wingtips, and GI tract were discarded. Livers were removed for supplemental chemical analysis (please see Table 15). Lead was detected in two of three blackbird carcass samples at 13.62 µg/g (Estrella Park) and 73.38 µg/g (Allenville).

[2] N = Number of individual birds in each composite sample.

[3] NA = Not analyzed.

[4] Cadmium was detected at 0.28 µg/g dry weight.

[5] ND = Not detected.

Table 15. Metals in black-crowned night-heron and red-winged blackbird whole body and liver samples collected from the lower Gila River, Arizona, 1994-95

			Element concentration (µg/g dry weight)[1]												
Species[2]	Sample	Area	Al	As	B	Cr	Cu	Hg	Ni	Se	Sr	V	Zn	Prcnt moist	Age[3]
BCNH	Carcass	Painted Rock	17.82	0.18	1.68	1.20	3.99	1.05	<0.31	0.76	43.00	0.29	71.2	61.4	Imm.
BCNH	Carcass	Painted Rock	11.08	<0.15	2.40	1.39	5.99	2.97	<0.36	2.02	40.00	<0.15	72.9	66.8	Imm.
BCNH	Carcass	Painted Rock	5.98	0.17	<1.16	1.24	4.29	1.92	<0.35	1.99	31.00	<0.15	60.3	65.7	Imm.
BCNH	Carcass	Painted Rock	6.97	<0.14	<1.11	0.76	7.16	2.87	0.90	0.94	20.00	<0.14	53.1	64.4	Imm.
BCNH	Carcass	Painted Rock	8.63	0.21	1.17	1.00	3.57	1.07	<0.43	1.02	37.00	0.14	58.9	61.3	Ad.
BCNH	Carcass	Painted Rock	16.69	<0.11	2.94	0.91	4.13	2.19	<0.36	0.96	47.00	<0.11	53.0	53.8	Imm.
BCNH	Liver	Painted Rock	<3.60	1.05	<1.44	0.63	46.18	6.04	<0.34	18.00	0.33	0.31	124.0	72.5	Imm.
BCNH	Liver	Painted Rock	<3.37	1.15	<1.49	0.99	18.61	8.68	0.54	14.27	0.25	0.38	61.0	70.5	Imm.
BCNH	Liver	Painted Rock	3.58	0.64	2.52	0.60	11.77	4.92	<0.37	13.43	0.28	0.36	48.6	67.3	Imm.
BCNH	Liver	Painted Rock	<3.37	1.02	3.91	0.67	91.16	12.38	<0.40	16.80	0.60	0.33	98.0	70.6	Imm.
BCNH	Liver	Painted Rock	<3.53	0.57	1.69	0.56	40.00	5.64	<3.35	15.71	0.28	<0.30	57.9	72.0	Imm.
BCNH	Liver	Painted Rock	<2.99	0.87	1.79	0.60	12.50	28.07	<2.99	13.16	0.22	<0.24	94.0	66.8	Ad.
RWBB	Liver[4]	59th Avenue	25.28	0.06	2.36	0.64	27.04	0.56	25.28	7.96	<1.	<0.55	2.4	63.8	Ad.
RWBB	Liver[4]	Estrella Park	34.29	0.17	3.08	0.78	19.57	0.94	<0.34	9.05	0.58	0.23	59.4	65.3	Ad.
RWBB	Liver	Allenville	NA[5]	NA	NA	NA	NA	1.21	NA	9.15	NA	NA	NA	71.9	Ad.
RWBB	Liver[4]	Gillespie Dam	9.14	0.36	2.88	0.68	24.18	2.89	<0.35	13.95	1.31	0.15	69.4	66.3	Ad.

[1] Lead was not detected in any samples.

[2] Species: BCNH = black-crowned night-heron, RWBB = red-winged blackbird.

[3] Age: Ad. = adult, Imm. = immature

[4] Cadmium was detected at 0.45, 0.24, and 1.22 µg/g dry weight in 59th Avenue, Estrella Park and Gillespie Dam samples.

[5] NA = not applicable. Sample not analyzed for this element.

Appendix A-1. Organochlorine compounds in composite whole body fish samples collected from the lower Gila River, Arizona, 1985

Site and sample[1]	N[2]	Weight (g)	Prcnt lipid	Concentration (µg/g wet wt.) p,p' DDE	Total PCB	Total chlor[3]	Diel-drin	Toxa-phene	p,p' DDT
59th Avenue									
C Carp	5	1003	5.34	0.77	0.17	ND[4]	0.01	ND	0.17
C Carp	5	1128	6.09	0.70	0.17	ND	ND	ND	0.18
C Carp	5	1256	7.80	0.50	0.15	ND	0.01	ND	0.26
Estrella Park									
C Carp	5	4155	7.68	7.60	0.30	0.09	0.06	8.40	0.14
C Carp	5	810	6.59	0.63	0.17	0.02	0.03	0.28	0.23
C Carp	5	2168	8.28	2.10	0.52	ND	0.02	ND	0.14
Allenville									
C Carp	5	2387	7.03	3.40	0.20	ND	0.06	2.00	ND
C Carp	5	1541	5.97	3.80	0.28	ND	ND	2.00	ND
C Carp	5	1116	5.53	3.50	0.25	ND	0.02	1.40	ND
C catfish	4	4275	12.70	6.10	0.18	ND	0.02	5.30	ND
C catfish	5	1647	8.49	6.30	0.22	ND	ND	5.00	ND
C catfish	5	935	6.09	4.90	0.19	ND	0.05	5.50	ND
Buckeye Canal									
C Carp	5	2795	3.47	20.00	0.21	ND	0.02	5.90	0.30
C Carp	5	1109	7.62	15.00	0.17	ND	0.05	8.10	0.28
C Carp	5	682	7.41	23.00	0.19	ND	0.04	14.00	0.44
Gillespie Dam									
C Carp	5	2099	5.50	5.00	0.19	ND	0.02	14.00	ND
C Carp	5	1439	4.46	4.90	0.17	ND	0.02	2.10	ND
C Carp	5	1084	5.84	4.00	0.11	ND	0.02	1.90	ND
Painted Rock									
C Carp	5	1303	4.05	1.40	ND	ND	0.01	ND	0.10
C Carp	5	1192	4.36	1.80	0.05	ND	0.02	ND	0.11
C Carp	5	941	3.55	0.93	ND	ND	0.01	ND	ND
C catfish	5	3409	17.30	4.20	0.12	0.06	ND	1.40	ND
C catfish	5	2316	15.40	3.90	0.18	ND	0.01	2.50	ND
C catfish	5	1764	10.80	4.00	0.13	ND	0.02	0.87	ND

[1] C carp = common carp and C catfish = channel catfish.

[2] N = number of individual fish in each composite sample.

[3] Total chlordane = the sum of chlordane isomers (alpha chlordane, oxychlordane + *cis*-chlordane + *trans*-nonachlor + *cis*-nonachlor.

[4] ND = No residue detected.

Appendix A-2. Organochlorine compounds in composite spiny softshell turtle samples collected from the lower Gila River, Arizona, 1985

Site and sample[1]	Weight (g)	Prcnt lipid	Concentration (µg/g wet wt.) p,p' DDE	Total PCB	Total chlor[2]	Diel-drin	Toxa-phene	p,p' DDT
59th Avenue								
Sample A	1137	7.23	2.20	0.77	0.02	ND[3]	0.52	0.19
Sample B	1416	6.09	1.90	0.98	0.22	0.04	ND	0.22
Sample C	2852	6.42	1.70	0.73	0.27	0.05	1.30	0.44
Estrella Park								
Sample A	883	2.61	1.50	0.16	0.02	0.04	1.30	0.09
Sample B	1295	4.71	8.40	0.45	0.18	ND	6.60	ND
Sample C	1404	3.49	1.60	0.38	0.08	0.01	0.91	ND
Allenville								
Sample A	4500	7.79	6.40	0.34	ND	0.04	4.90	ND
Sample B	1294	5.33	3.40	0.29	0.05	0.02	2.10	0.05
Sample C	889	3.65	2.00	0.11	0.03	0.01	1.70	0.02
Buckeye Canal								
Sample A	7321	10.20	28.00	0.61	0.29	0.07	4.80	ND
Sample B	2434	8.26	23.00	0.26	ND	0.07	14.00	ND
Sample C	1971	4.48	27.00	0.28	ND	0.11	15.00	ND
Gillespie Dam								
Sample A	6805	10.10	12.00	0.79	0.18	0.14	5.10	ND
Sample B	4067	8.13	9.80	0.44	0.12	0.05	5.10	ND
Sample C	1229	4.51	6.90	0.61	0.11	0.07	3.40	ND
Painted Rock								
Sample A	8321	19.30	6.00	0.36	0.08	0.01	3.30	ND
Sample B	2736	12.50	5.00	0.67	0.09	0.01	1.70	ND
Sample C	2345	12.80	5.50	0.36	0.09	0.01	2.40	ND

[1] Three individual turtles were composited per sample at each site.

[2] Total chlordane = the sum of all chlordane isomers (alpha chlordane, oxychlordane + *cis*-chlordane + *trans*-nonachlor + *cis*-nonachlor).

[3] ND = no residue detected.

Appendix A-3. Organochlorine compounds in composite red-winged blackbird carcasses collected from the lower Gila River, Arizona, 1985

Site and sample[2]	Weight (g)	Prcnt lipid	Concentration (µg/g wet wt.)[1] Total chlor[3]	Diel-drin	p,p' DDE	Toxa-phene	p,p' DDT
59th Avenue							
Sample A	251	5.32	0.02	0.14	21.00	0.58	ND[4]
Sample B	275	6.06	0.08	0.03	21.00	0.58	ND
Estrella Park							
Sample A	373	3.89	0.02	0.03	41.00	0.19	0.05
Sample B	342	3.82	0.02	0.03	36.00	0.81	0.07
Sample C	311	3.13	0.01	0.08	25.00	0.19	0.05
Allenville							
Sample A	354	4.86	0.05	0.03	28.00	1.10	ND
Sample B	332	4.33	0.02	0.03	15.00	0.45	ND
Sample C	307	3.08	0.05	0.03	27.00	0.10	ND
Gillespie Dam							
Sample A	374	4.66	ND	0.03	6.00	0.22	ND
Sample B	349	4.14	ND	0.08	16.00	0.10	ND
Sample C	321	4.11	ND	0.01	9.30	0.10	ND
Painted Rock							
Sample A	358	4.62	0.01	ND	7.80	0.62	ND
Sample B	361	4.74	0.01	0.01	7.40	0.90	ND
Sample C	334	3.99	0.01	0.02	7.70	0.64	ND

[1] No other organochlorine compounds were detected other than those listed.

[2] Five individual adult male red-winged blackbirds were composited per sample at each site.

[3] Total chlordane = the sum of all chlordane isomers (alpha chlordane, oxychlordane + *cis*-chlordane + *trans*-nonachlor + *cis*-nonachlor).

[4] ND = no residue detected.

Appendix A-4. Metals in fish collected from the lower Gila River, Arizona, 1985

Area and sample[1]	Species[2]	Prcnt moist	Concentration (µg/g wet weight)								
			As	Cd	Cu	Hg	Ni	Pb	Se	V	Zn
NCBP 85th %[3]	Mixed	NA	0.27	0.05	1.00	0.17	NA[4]	NA	0.73	NA	34.2
59th Avenue											
Sample A	C carp	73.6	0.09	<0.06	1.30	0.09	0.93	<0.10	0.32	0.18	63.3
Sample B	C carp	74.1	0.05	<0.06	1.90	0.08	0.68	<0.10	0.28	0.12	62.3
Sample C	C carp	72.6	0.06	<0.06	1.40	0.09	0.66	0.10	0.22	0.06	57.6
Estrella Park											
Sample A	C carp	70.2	<0.05	0.07	1.40	0.15	0.73	<0.10	0.47	0.10	75.9
Sample B	C carp	71.8	<0.05	<0.07	1.30	0.14	0.82	<0.10	0.40	0.22	77.7
Sample C	C carp	76.4	<0.05	<0.06	0.97	0.14	2.70	<0.10	0.38	0.10	63.9
Allenville											
Sample A	C carp	71.5	0.06	0.08	1.20	0.13	0.36	0.20	0.35	0.21	58.4
Sample B	C carp	74.3	0.08	0.07	1.40	0.14	0.67	<0.09	0.39	0.15	64.6
Sample C	C carp	74.7	0.09	0.08	1.30	0.16	0.60	0.10	0.42	0.18	57.4
Sample D	C catf	70.4	0.08	<0.05	0.57	0.08	0.20	<0.09	0.31	0.09	14.0
Sample E	C catf	76.7	<0.05	<0.06	0.35	0.09	0.23	<0.09	0.27	0.12	14.5
Sample F	C catf	76.9	<0.05	<0.05	0.41	0.10	0.31	<0.09	0.26	0.10	17.4
Buckeye Canal											
Sample A	C carp	79.0	0.10	<0.05	0.96	0.20	1.20	0.30	0.45	0.27	65.6
Sample B	C carp	75.3	0.07	<0.06	1.50	0.13	1.20	0.39	0.50	0.43	45.2
Sample C	C carp	76.0	0.10	<0.06	1.20	0.09	0.96	0.70	0.41	0.24	66.5
Gillespie Dam											
Sample A	C carp	76.3	0.10	<0.06	9.52	0.08	1.90	0.20	0.62	0.45	56.7
Sample B	C carp	77.6	0.10	0.07	1.10	0.11	0.70	0.30	0.43	0.10	57.4
Sample C	C carp	78.1	0.10	0.07	1.10	0.08	0.66	0.10	0.43	0.16	60.2
Painted Rock											
Sample A	C carp	72.6	<0.05	<0.05	1.90	0.14	0.55	<0.09	0.51	0.05	48.3
Sample B	C carp	66.9	<0.05	<0.05	1.90	0.15	0.44	<0.09	0.50	<0.04	49.3
Sample C	C carp	78.9	<0.05	<0.05	0.96	0.18	0.26	<0.08	0.44	0.10	46.7
Sample D	C catf	63.2	0.07	<0.07	0.90	0.22	0.30	<0.10	0.33	0.08	14.9
Sample E	C catf	66.7	0.06	<0.07	0.45	0.20	0.21	<0.10	0.32	0.07	15.0
Sample F	C catf	70.6	<0.05	<0.06	0.55	0.23	0.28	<0.10	0.25	0.16	15.7

[1] Sample size = five fish in each composite sample.

[2] Species: C carp = common carp and C catf = channel catfish.

[3] National Contaminant Biomonitoring Program 85th percentile (Schmitt and Brumbaugh 1990).

[4] NA = Not applicable. The NCBP program did not quantitate this element.

Appendix A-5. Metals in turtles collected from the lower Gila River, Arizona, 1985

Area and sample[1]	N[2]	Pcnt moist	Concentration (µg/g dry weight)								
			As	Cd	Cu	Hg	Ni	Pb	Se	V	Zn
59th Avenue											
Sample A	3	68.7	<0.16	<0.22	8.95	0.29	6.07	<0.32	1.53	0.22	74.1
Sample B	3	73.2	<0.19	<0.22	5.60	0.45	5.47	<0.37	1.34	0.26	81.0
Sample C	3	69.7	<0.17	<0.20	4.95	0.33	3.63	0.33	0.96	0.33	75.2
Estrella Park											
Sample A	3	76.0	<0.21	0.29	8.75	0.33	7.92	2.37	2.12	0.37	102.9
Sample B	3	75.1	<0.20	<0.24	6.83	0.36	5.62	<0.40	1.33	<0.20	114.1
Sample C	3	75.1	<0.20	<0.20	9.24	0.28	5.22	<0.40	0.76	0.64	105.2
Allenville											
Sample A	3	68.2	0.19	ND[3]	5.97	0.31	8.49	ND	0.82	0.28	77.7
Sample B	5	71.6	0.21	ND	4.23	0.43	2.25	ND	1.80	0.35	96.8
Sample C	5	74.6	0.31	ND	4.33	0.39	3.54	ND	1.14	0.31	92.9
Buckeye Canal											
Sample A	3	70.6	0.14	ND	3.74	0.44	6.80	ND	1.19	0.68	87.1
Sample B	5	72.3	ND	ND	3.97	0.40	2.56	ND	1.23	0.32	81.9
Sample C	5	75.7	ND	ND	3.95	0.49	4.53	ND	1.11	0.41	88.9
Gillespie Dam											
Sample A	3	67.3	ND	ND	4.90	0.49	1.90	1.53	1.37	0.33	87.7
Sample B	5	72.2	0.22	0.25	7.91	0.40	5.76	21.22	1.47	0.36	89.6
Sample C	5	77.1	0.26	ND	5.68	0.66	4.06	3.89	2.14	0.44	122.7
Painted Rock											
Sample A	3	60.9	0.26	ND	3.32	0.87	8.44	0.15	1.20	0.89	57.8
Sample B	3	69.6	0.79	ND	4.28	1.09	9.87	ND	1.38	4.93	77.3
Sample C	3	69.9	0.56	ND	5.98	0.66	6.98	1.00	1.13	2.39	75.4

[1] Each sample consists of three to five turtles composited into a single sample.

[2] Number of individuals in each composite sample.

[3] ND = Not detected.

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US Army Corps of Engineers
Los Angeles District

RIO SALADO OESTE
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Salt River-Phoenix, Arizona

Appendix G
Economic Evaluation

March 2005

U.S. ARMY CORPS OF ENGINEERS, LOS ANGELES DISTRICT
PLANNING DIVISION, WATER RESOURCES BRANCH
P.O. BOX 532711
LOS ANGELES, CALIFORNIA 90053-2325

PURPOSE

The following presents an economic evaluation of the benefits and costs associated with riparian habitat restoration, flood control and recreation opportunities along the Salt River (19th Avenue to 83rd Avenue) in Phoenix, Arizona.

METHODOLOGY

Methodology employed for this economic analysis is in accordance with current principles and guidelines and standard economic practices, as outlined in the *Planning Guidance Notebook – ER 1105-2-100.* Evaluation of environmental restoration alternatives has been completed in conformance with *IWR Report #95-R-1 -- Evaluation of Environmental Investments: Procedures Manual (May 1995).* Benefits and costs are computed at FY 2004 price levels utilizing the current Federal Discount rate of 5 5/8 percent. The period of analysis is 50 years. The Base Year for economic computations is 2008.

STUDY AREA

Location

The study area is located along the Salt River, in Phoenix, Arizona, between 19th Ave and 83rd Avenue. The study area is located in between the authorized Rio Salado and Tres Rios project areas. The study area includes portions of the City of Phoenix, Maricopa County, state and federal land. **Figure 1** shows the location of the Rio Salado Oeste study area. **Figure 2** provides an aerial view of the study area.

Problems & Opportunities

Environmental Resources

In pre-settlement times (prior to 1900) the Salt River was one of the few perennially-watered riparian areas of the Arizona 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 degraded significantly. The once perennial Salt River has now been transformed into a dry riverbed virtually devoid of habitat. Native plant species and wildlife habitat have been eliminated along the Salt River and adjacent overbank areas due to upstream water resources development, increased depths to groundwater beneath the river channel, changes in the natural flood regime, and land use changes, e.g., landfills and sand and gravel mining.

There is an opportunity to take advantage of existing open water bodies, in the river and adjacent properties, as potential restoration sites. Discharges from the 23rd Avenue Waste Water Treatment Plant, as well as underground water supply currently used for agricultural purposes, could be utilized to supplement surface water sources of water for restoration and other needs. There is also an opportunity to link other upstream and downstream projects to provide a continuous restoration and flood control corridor. These would include the authorized Rio Salado project, located immediately upstream of the project area, and the Tres Rios project, located immediately downstream of the project area.

FIGURE 1
RIO SALADO OESTE STUDY AREA LOCATION

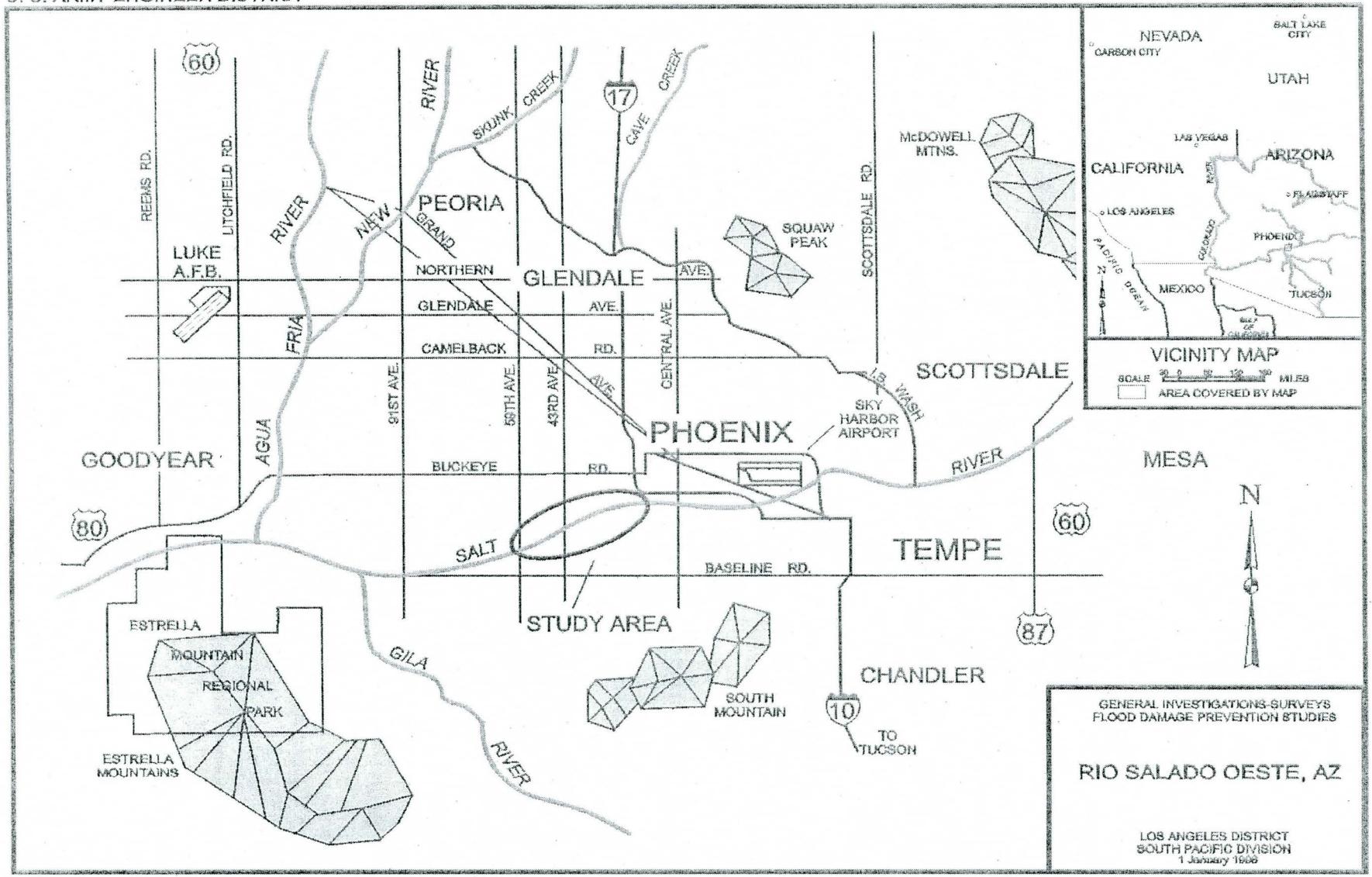
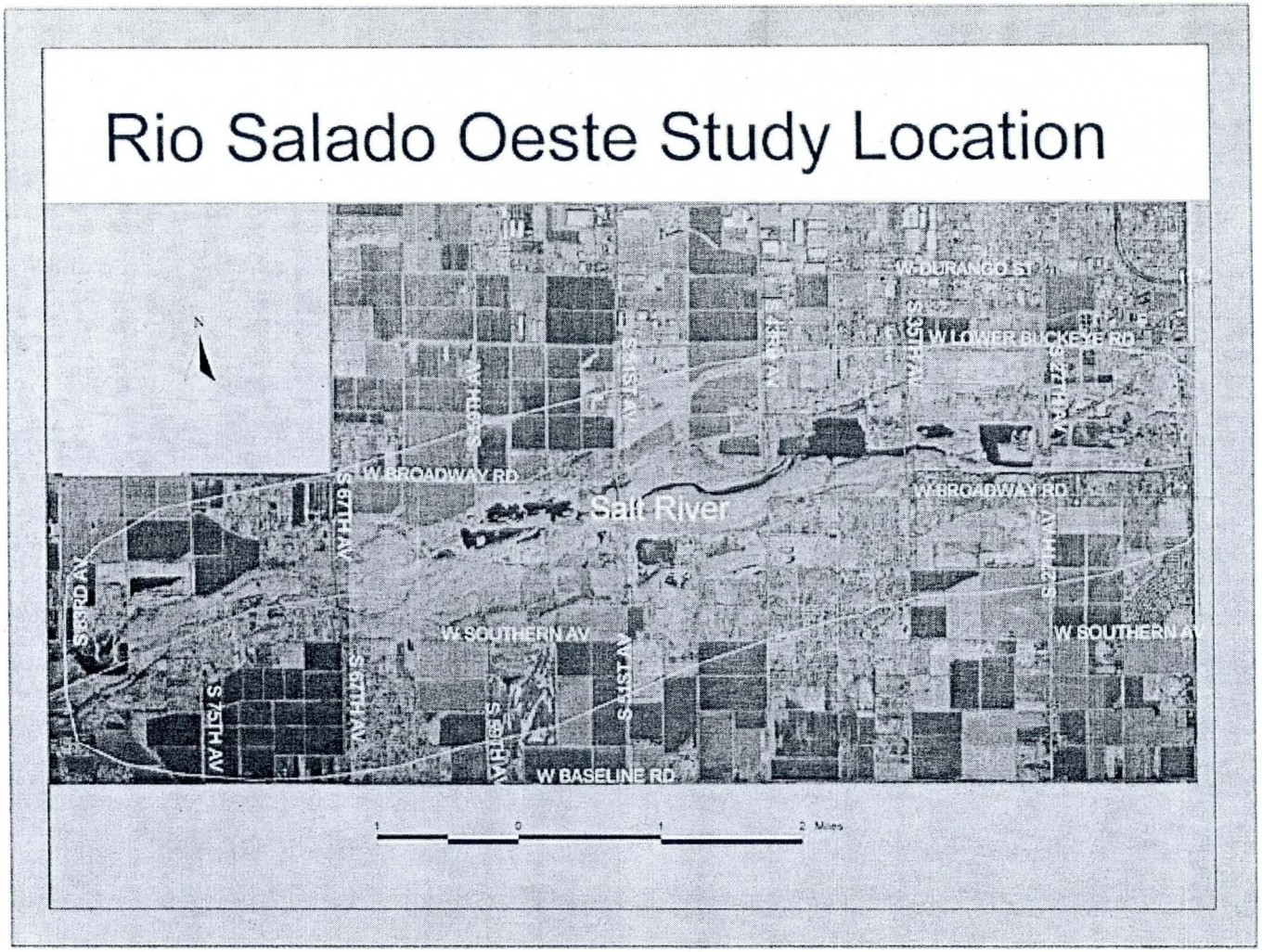


FIGURE 2
RIO SALADO OESTE STUDY AREA – AERIAL VIEW



Flooding

Flood flows along the Salt River through the Study Area that result from frequent flooding events are generally contained within the channel banks. However, during less frequent events, such as the 100-year and 500-year events, hydrologic and hydraulic analyses indicate that under existing conditions, there is a potential for significant flood damages. During these low-probability events, flood flows may overtop the channel banks and break out, primarily to the south of the River, and inundate many residential, industrial and agricultural properties. However, there are plans to make improvements to the 35th Avenue Bridge that crosses the Salt River. The configuration of this bridge contributes to the flooding problem in the Study Area. A hydraulic analysis has been conducted to determine the impact the proposed improvements will have on flooding in the Study Area. This analysis indicates that the flooding problem will be significantly reduced, and most structures that are currently susceptible to flooding during major events will no longer be threatened. Although flood damages with the planned bridge improvements are limited, there may be an opportunity to reduce potential food damages by implementing projects to increase the conveyance capacity of the Salt River through specific areas.

Recreation

The City of Phoenix and Maricopa County have experienced tremendous population growth. While the number of parks has steadily increased in the greater Phoenix area, it has not kept pace with the growth in population. The current supply of recreation in the Study Area is insufficient, based upon local and national standards of required acres of recreation facilities per capita. This deficit is anticipated to increase in the future due to continued population growth in the Study Area.

There are no formal existing recreation or environmental education opportunities associated with the existing Salt River corridor in the Study Area. 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 Waste Water Treatment Plant 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 ten 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.

Population

The study area is located in central Maricopa County and extends through the city of Phoenix. As of July 2003, Maricopa County had a population of 3.39 million (the fourth highest in the nation). From 2000 to 2003, County population grew by over 317,000, representing an average annual growth rate of over 3.3 percent.

The city of Phoenix is by far the largest in the county in terms of population. Phoenix's population grew from about 1.15 million in 1995 to over 1.39 million in 2003, or by about 2.4 percent on an annual basis. About 41 percent of the County population resides within the City of Phoenix, although this ratio is declining, due to higher growth rates outside the city.

Population Projections

The following table displays population estimates and growth projections for Maricopa County and the City of

Phoenix, obtained from the Maricopa County Association of Governments (MAG) and US Census websites. Strong growth for the County and City is expected through year 2050, although the rates of growth will be substantially lower than those experienced the past decade.

Table 1
Projected Population & Annual Growth Rate (AGR)
Maricopa County and the City 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: US Census 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.

The City of Phoenix is divided into 14 Urban Villages, with each addressing problems and needs related to the implementation of the General Plan. The two main villages in the study area are the Estrella Village to the north of the River and the Laveen Village to the south. Estrella Village encompasses about 41 square miles and is bounded by Interstate 10 on the north, 19th Avenue on the east, the Salt River on the south and 107th Avenue on the west. The Laveen planning area encompasses about 28 square miles and extends south of the Salt River and north of South Mountain between 27th Avenue and the Gila River Indian Community. The combined population in these two planning areas as of 2000 was approximately 53,000. The area experienced an annual growth rate of about 4.2 percent over the prior five years. MAG projections indicate that the population for this area is expected to increase to about 86,000 by the year 2010 (or nearly five percent per year). Hence, this area is anticipated to experience high growth, outpacing the city and county as a whole.

The Study Area also includes a portion of the Rio Montaña subarea of the South Mountain Village. Rio Montaña encompasses about 10.4 square miles and extends from 27th Avenue to South Central Avenue, south of the Salt River and north of South Mountain Preserve. The Study Area therefore excludes that portion of Rio Montaña east of 19th Avenue. Rio Montaña had a population of about 26,000 as of 1995, although a significant portion of this total is upstream of the Study Area.

The Estrella Village Plan, approved by the Phoenix City Council in March 1999, projects that this planning area can accommodate a population of nearly 105,000. The current plans for Laveen (*Laveen: A Guide for Development*, prepared by the City of Phoenix South Area Planning Team) indicate that this planning area can accommodate a population of about 95,000. Hence, the planning areas extending along the Salt River through the study area have buildout population estimated at about 200,000 (excluding that portion of Rio Montaña between 27th and 19th Avenues).

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 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 commercial. Otherwise the prevailing land use designation is low to medium density residential.

As noted earlier, 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 website, 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. Over 8,000 new single-family housing units were approved in this area in 1999 alone.

The Laveen Village contains largely undeveloped and agricultural properties. Primary agricultural crops grown in the area include cotton, citrus and corn. The area has been valued by farmers, equestrians and those looking for solitude and mountain access. However, development pressures have increased in this area due to its proximity (about seven miles) to downtown. This pressure is expected to increase along with access to the future South Mountain Loop transportation corridor. There are twelve residential developments in various phases of approval and development in the Laveen Village area, which is anticipated to result in a doubling of population over the next decade.

The Rio Montaña planning area is also primarily comprised of agriculture, vacant land, and low-density residential uses. In fact, these categories, along with open space, represent over 85 percent of the space in this planning area.

Housing Unit Projections

According to the US Census and MAG, the ratio of persons per housing unit in the city and county is about 2.5. Assuming that this ratio holds in the future, Table 2 shows the number of additional housing units that would need to be built to accommodate the anticipated population increases.

Table 2
Projected Housing Unit Growth
Maricopa County and the City of Phoenix

	Maricopa County		City of Phoenix	
Period	Population Inc.	HU Inc.	Population Inc.	HU Inc.
2000-2010	638,000	255,000	223,000	89,000
2010-2020	806,000	322,000	252,000	101,000
2020-2050	2,749,000	1,100,000	772,000	309,000
Total	4,193,000	1,677,000	1,247,000	499,000

Table 2 shows that roughly 1.68 million new housing units would be needed in the county and about 499,000 in the city by the year 2050 to accommodate projected future population increases.

Based upon the Proposed Land Use Map and Plan Element for Phoenix and the interactive maps supplied by the Maricopa County Association of governments obtained through the Internet, the residential land for the County and City will be developed at an average density ranging from two to five dwelling units per acre. The publication, *Valley Vision 2025* (February 2000), also posted on the MAG website, specifies an assumed density in the region of about 3.7 dwelling units per acre. Based upon this ratio, about 453,000 additional acres in the county, and about 135,000 additional residential acres in the city would need to be developed between 2000 and 2050.

MAG data indicate that, as of 1995, there were about 329,000 acres of residential property in the County. However, the General Plan shows that nearly ten times that amount is designated for future residential development. Most of that land is currently designated vacant, although it is assumed that a significant portion of existing agricultural land will be used in the future for residential development.

The current plans for Estrella and Laveen Villages project the number of dwelling units at buildout in these areas will be approximately 38,300 and 35,000, respectively. With a combined buildout population of about 200,000 and a combined number of dwelling units of about 73,000, the corresponding projected ratio of persons/household in the study area is about 2.74, which is slightly higher than the county average

Non-Household Projections

Commercial, industrial, office and public property currently represents about 39 percent of total residential development in area based upon 1995 data from MAG. Assuming that this ratio reflects future non-residential development requirements, the County, non-residential development through 2050 for the County is expected to total about 177,000 acres. The corresponding total for the city is about 53,000 acres.

According to 1995 land use data, there are 3,033,408 acres of vacant land in Maricopa County. Hence, it is not anticipated that the County will be completely built out by the end of the period of analysis. *Valley Vision 2025* states that there is enough vacant and planned land to adequately meet the demand for housing between now and 2025 without putting abnormal pressure on market prices, noting that less than ten percent of the 9,200 square miles in the region have been developed.

Summary

Rapid population growth is anticipated for the City of Phoenix as well as Maricopa County as a whole. Significant development of residential and non-residential land will be required to accommodate the projected growth. In the Study Area, existing land uses are primarily comprised of agriculture, industrial and low-density residential. It is anticipated that additional low-to-medium density residential development will take place due to the close proximity of the area to the City core. Existing vacant lots and agriculture land will likely be converted to residential uses.

Employment & Economy

The Phoenix area population growth illustrated above has been due primarily to net migration into the area. Factors contributing to this inmigration include diverse job availability, climate, quality of life, low cost of living, and a strong, diversified industrial base.

Statistics obtained from the City of Phoenix indicate that greater Phoenix accounts for 64 percent of Arizona=s

workforce, with a labor force exceeding 650,000. Inmigration and high graduation levels from Arizona State University have provided local employers with a quality labor force. Primary industries in the area include aerospace and electronics manufacturing, business services, travel and tourism and information processing. Phoenix is also the state capital and home to the Maricopa County government, as well as many Federal government services. The following table provides breakdown of employment by industry in the greater Phoenix area.

Table 3
Greater Phoenix Employment by Industry

Services	33%
Trade	24%
Government	12%
Manufacturing	10%
Finance, Insur., & Real Estate	8%
Construction	7%
Transport., Comm. & Utilities	5%
Ag. & Mining	1%

Source: Arizona Dept. of Economic Security (December 2000)

From 1998 to 2003, non-farm payroll employment in Maricopa County increased by nearly 158,000. The largest increases have come in the construction, services and trade sectors. By far, the largest employer in the Phoenix area is the State of Arizona, which employs approximately 60,000. The City and County are also major public sector employers. Among private sector employers, information technology businesses have provided a large influx of employment to the area. As shown on Table 4 below, several high-tech firms, including Honeywell, Inc., Raytheon Co. and Intel Corporation, are now among the area=s five largest employers.

Table 4
Greater Phoenix Largest Private Employers

Wal-Mart Stores, Inc.	19,189
Honeywell Inc.	13,303
Banner Health Systems	12,408
Raytheon Co.	10,100
Intel Corp.	9,575
Albertsons, Inc.	9,500
Bashas' Supermarkets	9,282
Wells Fargo & Co.	9,100
Kroger Co.	9,053
Target Corp.	8,778

Source: Arizona Republic:Tthe Republic 100 (2003)

The substantial growth in employment opportunities has helped maintain low unemployment rates in the Phoenix area in recent years. For example, unemployment rates in the Phoenix-Mesa Metropolitan Area (3.2 percent as of December 2004) have remained below the state (4.2 percent) and the national rates (5.1 percent).

To accommodate the population expansion in the area, more than 39,000 new residential building permits were issued in the greater Phoenix area in the first nine months of 2003 alone, exceeding the total for the entire year of 2002 according to the *Phoenix Business Journal* (December 1, 2003). According to information obtained from the City of Phoenix, over 30 percent of the housing stock has been constructed in the past 10 years. Most of the newer homes are constructed in master-planned communities, offering such amenities as lakes, golf courses and bike trails. New homes in the area are reasonably priced compared to other metropolitan areas. Low housing costs are a primary factor making the overall cost of living in Phoenix among the lowest of major U.S. metropolitan areas.

WITHOUT PROJECT CONDITIONS

Without Project Conditions are those conditions projected to prevail over the 50-year period of analysis in the absence of any management measures designed to address the problems and opportunities outlined earlier in this report. They serve as the basis for comparison to determine the benefits of proposed management measures. Hence, without-project conditions must first be calculated in order to ascertain the potential benefits that may result from implementing alternatives.

Environmental Resources

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 ground water table beneath the river dropped. The soil moisture in the riverbed was virtually eliminated, and the native cottonwoods, willows and riparian ecosystem rapidly died out. Most areas of the Salt River are barren today. What little vegetation that does exist is mostly limited to salt cedar, an exotic non-native species with little habitat value.

There are a large number of open water areas along the Salt River, mostly the results of gravel mining. Adjacent to several of these there is dense vegetation including some cottonwood and willows as well as cattails and bulrush.

Hydrogeomorphic Model Description

The value of the limited amount of habitat existing in the Study Area has been assessed using a Hydrogeomorphic Modeling (HGM) process. HGM is an evaluation methodology in which the environmental impacts of projects are measured in ecological, rather than monetary terms. As a result, it is not possible to perform a direct benefit/cost analysis. Rather, the focus of HGM analysis, as well as other non-monetary evaluation techniques, is to determine the most cost-effective way to provide an array of environmental outputs. This is typically completed through an incremental cost analysis in which the marginal cost of providing additional environmental outputs is determined.

The U.S. Army Engineer Waterways Experiment Station has developed HGM for the purpose of assessing wetland functions. Wetland functions are a result of the interaction between the structural components of wetlands, such as soil, plants and animals, and the physical, chemical and biological processes that occur in

wetlands. The assessment phase of the procedure is to measure the ability of a wetland to perform functions, in terms of its functional capacity. The functional capacity of a wetland is determined using a functional capacity index (FCI).

In HGM, an FCI model is a quantitative estimate of the functional capacity for a wetland. The ideal goal of an FCI model is to quantify and produce an index that reflects the functional capacity at the subject site. The results of an FCI analysis can be quantified on the basis of a standard 1-1.0 scale, where 0.00 represents the low functional capacity for the wetland, and 1.0 represents the high function capacity for the wetland. The FCI model can be defined in words or mathematical equations that clearly describe the rules and assumptions necessary to combine functional capacity indices.

Functional Capacity Units (FCU's) are a quantitative environmental value, considered to be the biological currency in the HGM methodology. FCUs are calculated by multiplying the area of available wetland (quantity) by the quality of the wetland based on functionality, which is represented by values derived from the FCIs. FCU = Area times FCI. Changes in FCUs represent potential impacts or improvements of proposed actions.

HGM Results – Without Project Conditions

FCI functions have been developed specifically for the desert southwest ecosystem along the Salt River. These functions have been applied to the existing areas of habitat throughout the Study Area to derive estimates of FCUs, both for existing and future without project conditions.

The first four functions (F1-F4) are water-related variables, such as surface and subsurface water storage and channel dynamics. The next three (F5-F7) are biochemical-related variables, such as the presence of required nutrients. Finally, the last three variables (F8-F10) are habitat-related variables, such as the quantity, type and locations of vegetation. Table 5 below summarizes the results. Note that FCUs for each function have been estimated for Target Years 0, 1, 6, 26, and 51 (Target Year 0 being existing conditions and Target Year 1 being equivalent to the first year of construction). These projected values were then converted into average annual FCUs (AAFCUs) for each function. The total combined AAFCU representative of without project conditions was derived by simply averaging the AAFCU values for each of the ten functions (i.e., no weighting was applied to the different functions, and each was therefore assigned equal importance in terms of measuring the without project condition habitat value).

Table 5
Rio Salado Oeste Study Area
Without Project AAFCUs

	T0	T1	T6	T26	T51	AAFCUs
F1	414	414	414	414	414	414
F2	749	746	744	742	742	743
F3	452	443	436	439	439	439
F4	783	799	814	826	826	821
F5	496	485	472	465	465	468
F6	669	659	647	645	645	647
F7	589	585	580	578	578	579
F8	748	744	740	737	737	738
F9	531	523	514	508	508	511
F10	401	401	437	438	438	435
Avg	583	580	580	579	579	**580**

As shown in Table 5, AAFCUs are projected to remain fairly stable over the planning horizon. The AAFCU value of 580 will be the basis for comparison when assessing the potential benefits of proposed restoration alternatives.

Flood Damages

The Salt River Project maintains four dams on the Salt River, as well as two on the Verde River. Granite Reef Diversion Dam is located about five 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 Salt River Project 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 cubic feet per second 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.

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. Total flood damages throughout Arizona during this storm were estimated at over $250 million in current dollars.

Information regarding damages estimates specific to the study reach were not available. However, current hydrologic data for the Salt River through the Study Area shows that peak discharges for the 50-year, 100-year and 200-year events are approximately 135,000 cfs, 165,000 cfs and 200,000 cfs, respectively. Current hydraulic analysis indicates that there are very few structures in the 50-year floodplain, and most floodplain structures are outside the 100-year floodplain. Therefore, it is likely that damages throughout the Study Area reach were limited during these storms.

Floodplain Boundaries & Reach Definitions

Before determining potential damages within the floodplain, an inventory of structures susceptible to damage and estimates of the value of these structures must first be developed. As noted earlier, proposed bridge improvements at 35th Avenue will reduce study area flooding significantly. **Figure 3** shows the Base Year floodplain boundaries (which reflect the proposed bridge improvements being in place). As shown on Figure 3, the floodplain is primarily confined within the channel, with only minor flooding even for the 500-year flood event. **Figure 4** shows a comparison of the 500-year floodplains for existing and Base Year conditions. As clearly shown on Figure 4, potential flood damages without the planned bridge improvements would be significantly higher.

The floodplain has been further segmented into sub areas, or Reaches, for analysis purposes. Critical factors used to determine reach boundaries include: discharge/frequency characteristics, overflow spatial characteristics, and economic activity. **Figure 5** shows floodplain reach Boundaries. **Table 6** below provides a summary of reach characteristics, including approximate upstream and downstream boundaries. The "R" and "L" designations denote that the reach only includes the areas on the north (Right, looking downstream) or south (Left) side of the river, respectively.

Table 6
Rio Salado Oeste
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 & 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.

Figure 3
Rio Salado Oeste Floodplain Boundaries (Base Year)

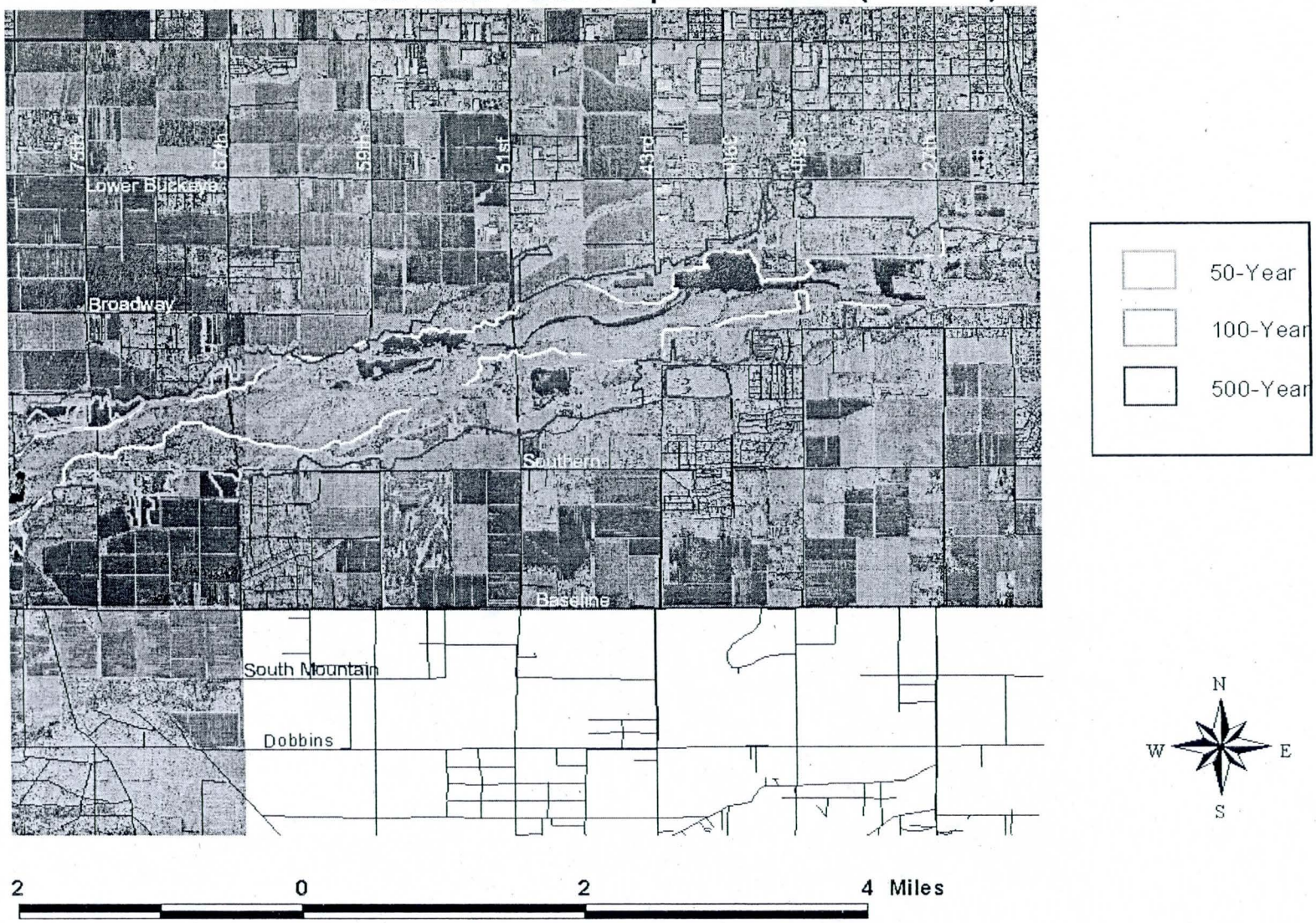


Figure 4
Rio Salado Oeste 500-Year Floodplains - Existing & Base Year

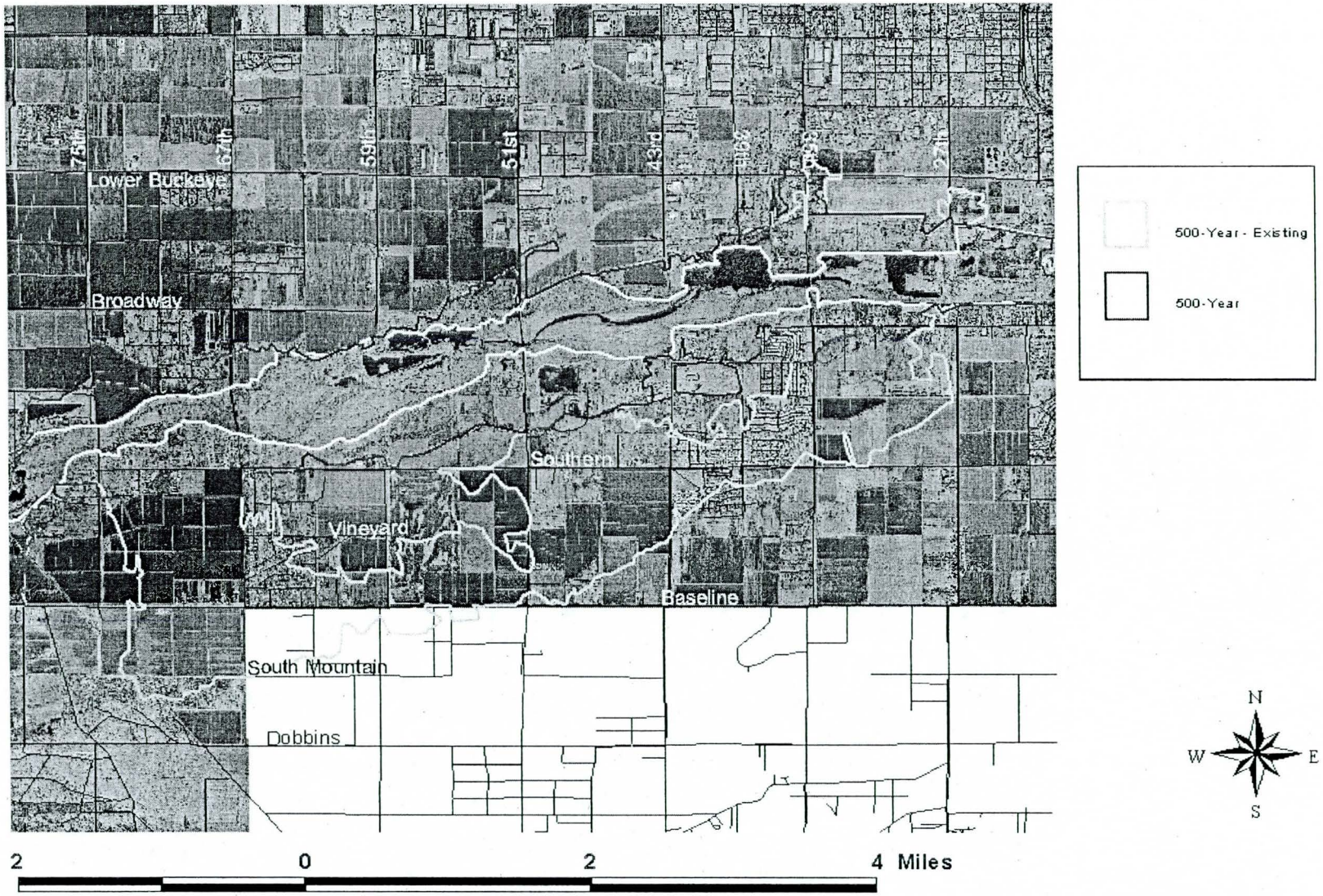
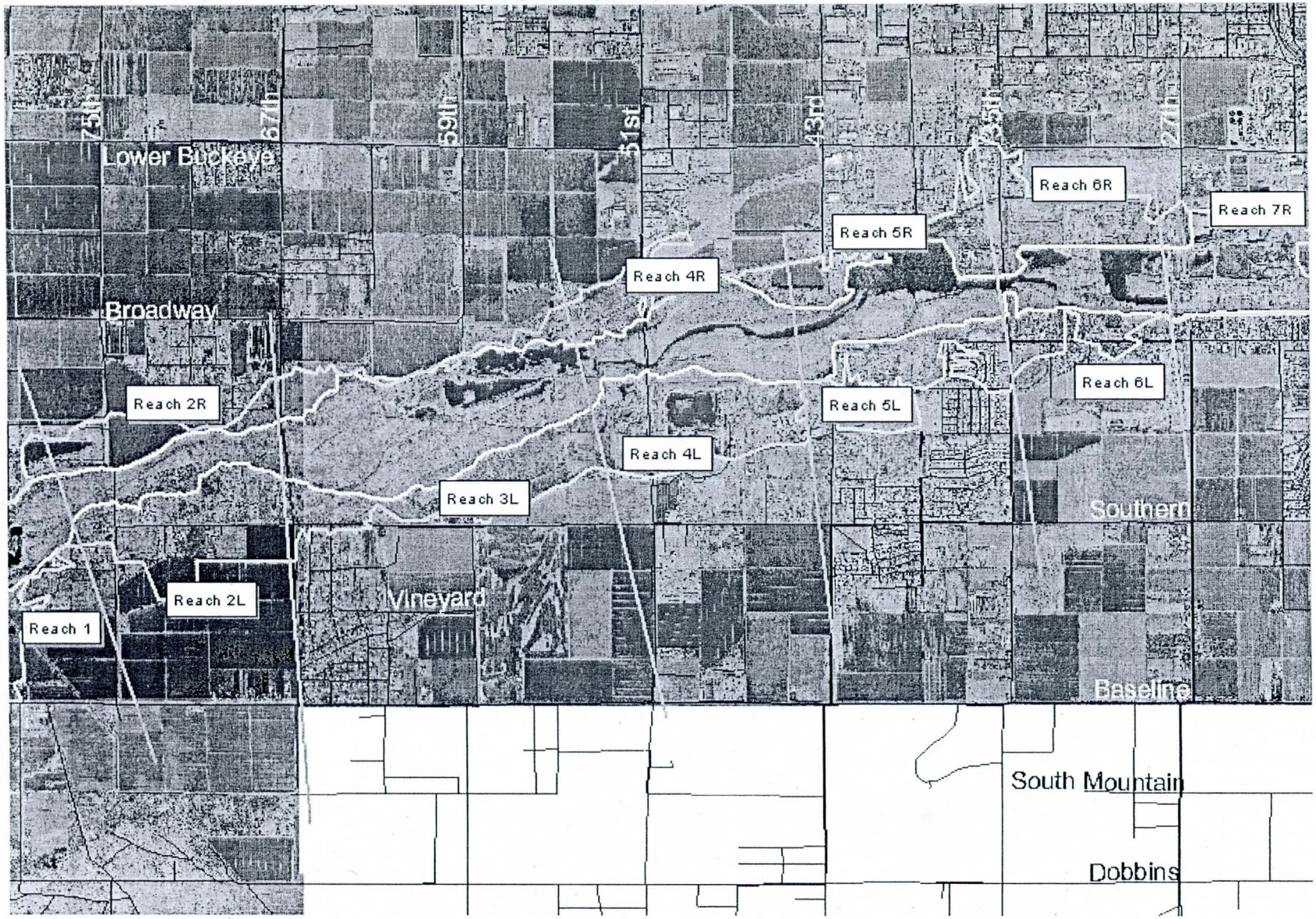


FIGURE 5
Rio Salado Oeste Reach Delineations



As indicated in the notes in Table 6 and as can be seen in Figure 5, Reach 5L contains the majority of floodplain structures. This area contains about 200 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.

Number of Structures

The number of structures in the 100-year and 500-year floodplains was determined based upon an analysis of aerial photography, parcel maps, real estate assessor's data and a site survey. **Tables 7 and 8** which follow show the number of structures by reach, floodplain and structure type.

Table 7
Rio Salado Oeste 100 & 500-Year Floodplains
Number of Structures

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

Table 7 shows that there are approximately 386 structures in the Rio Salado Oeste floodplain. Of this total, most (59 percent) are residential. Roughly 139 structures are located within the 100-year floodplain boundaries (about 36 percent of the structures in the 500-year floodplain).

Table 8
Rio Salado Oeste 500-Year Floodplain
Number of Structures by Reach

Location	Number of Structures
Reaches 2R through 7R (All North of River)	70
Reaches 1L, 2L (S. of River, West of 67th)	36
Reach 3L (S. of River, 67th to 51st)	8
Reach 4L (S. of River, 51st to 43rd)	5
Reach 5L (S. of River, 43rd to 35th)	195
Reach 6L (S. of River, East of 35th)	72
Total	386

As indicated in Table 8, more than half of floodplain structures are located in Reach 5L, and about 19 percent are located in Reach 6L. There are very few structures located within the floodplain on the north side of the Salt River. Most are industrial and storage structures located in Reaches 5R and 6R.

Value of Structures & Contents

Depreciated structure values were calculated as follows:

1) Square footage for each structure was obtained from real estate assessor's data.
2) Structure construction type and condition were noted during a field survey.
3) Appropriate Marshall & Swift Valuation Service multipliers were determined for each structure

based upon its condition, classification and construction type. These multipliers were applied to square footage estimates to derive depreciated structure replacement values.

4) Values were adjusted to reflect local building costs for the Maricopa County area using Marshall & Swift locality multipliers.

Content values were estimated as a percentage of depreciated structure value for each structure. Content ratios by structure type were based upon values derived for several recent Los Angeles District Feasibility Studies. The study areas for all of these projects were located in the Southwestern U.S. Ratios were developed based upon a statistical analysis of content surveys mailed to local residents. The content ratios by structure type used for this study are as follows:

- Residential 50%
- Commercial 140%
- Industrial/Agriculture 171%
- Office 80%
- Public 33%

Tables 9 and 10 provide a summary of floodplain structure and content values, respectively, by structure category and reach.

Table 9
Rio Salado Oeste 500-Year Floodplain
Value of Structures & Contents By Structure Type
(In $Millions)

Structure Type	Struct Val	Cont Val	Total
SFR	9.1	4.5	13.6
MH	1.1	0.5	1.6
Industrial/Agric.	15.0	25.7	40.7
Office/Commercial	5.0	4.6	9.6
Public	0	0	0
Total	30.2	35.3	65.5

Table 10
Rio Salado Oeste 500-Year Floodplain
Value of Structures & Contents By Reach
(In $Millions)

Location	Struct Val	Cont Val	Total
Reaches 2R through 7R (All N. of River)	11.8	16.4	28.2
Reaches 1L, 2L (S. of River, West of 67th)	3.6	4.8	8.4
Reach 3L (S. of River, 67th to 51st)	0.9	0.4	1.3
Reach 4L (S. of River, 51st to 43rd)	0.2	0.1	0.3
Reach 5L (S. of River, 43rd to 35th)	7.9	4.9	12.8
Reach 6L (S. of River, East of 35th)	5.8	8.7	14.5
Total	30.2	35.3	65.5

As displayed on Tables 9 and 10, the total estimated value of property in the floodplain is about $65.5 million. Although nearly 51 percent of floodplain structures are located in Reach 5L, the value of property in this reach is only about 20 percent of the total value for the 500-year floodplain. This is attributable to the fact that

almost all of the structures in Reach 5L are fair/low cost residential structures, whereas other reaches include more higher-value industrial and commercial structures. Table 9 shows that although residential structures (i.e., single family residences and mobile homes) represent about 59 percent of total floodplain structures, they only account for about 23 percent in terms of value.

Without Project Structure & Content Damages

Overview of Methodology

A risk-based analysis (RBA) procedure has been used to evaluate without project flood damages in the study area. Guidance for conducting RBA is included in Corps Engineering Regulation 1105-2-101, *Risk-Based Analysis for Evaluation of Hydrology/Hydraulics, Geotechnical Stability and Economics in Flood Damage Reduction Studies (1 March 1996).*

The guidance specifies that the derivation of expected annual flood damage must take into account the uncertainty in hydrologic, hydraulic and economic factors. Risk and uncertainty are intrinsic in water resource planning and design. They arise from measurement errors and the inherent variability of complex physical, social and economic situations. Best estimates of key variables, factors, parameters and data components are developed, but are often based on short periods of record, small sample sizes, measurements subject to error, and innate residual variability in estimating methods. RBA explicitly analytically incorporates these uncertainties by defining key variables in terms of probability distributions, rather than single-point estimates. The focus of RBA is to concentrate on the uncertainties of variables having the largest impact on study conclusions.

The following are the primary sources of uncertainty for flood damage analysis studies:

1) Discharge/Probability: For a flood or storm event with a given probability of occurrence, there is uncertainty regarding what the resulting discharge will be at a specific location along the stream or river. The reliability of discharge/probability estimates is directly linked to the historical record of stream gauge data available. In cases where records are small or incomplete, the associated uncertainty increases. To address this uncertainty, an analytical or graphical method is typically used to determine statistical distributions of discharge for a range of probabilities at locations throughout the floodplain.

   For this study, discharge/probability uncertainty has been estimated for each reach using the graphical method, based upon an equivalent record length of 105 years.

2) Stage/Discharge: For a given discharge, there is uncertainty regarding what the resulting water surface elevation will be at a given location. Factors contributing to this uncertainty include bed forms, water temperatures, debris or other obstructions, unsteady flow effects, variation in hydraulic roughness with season, sediment transport, channel scour or deposition, changes in channel shape during or as a result of flood events, as well as other factors. To address this uncertainty, standard deviation estimates are developed for stages associated with a range of discharges at locations throughout the floodplain.

   For this study, the standard deviations of error for stages associated with a range of discharges were provided for each reach by Engineering Division. The error values generally increase in value from about 0.1 feet for the 5-year flood event up to about0.7 feet for 100-year to 500-year flood events.

3) Geotechnical Features: When there are improvements such as levees along a river or stream, there is uncertainty regarding how effective they will be in containing a given flood event. Specifically, there is uncertainty regarding what combination of discharge and stage will result in levee failure. To address this uncertainty, probable failure and non-failure points (elevations) for levees are determined at various locations along the levee's length.

There are not any existing levees along the Salt River in the Rio Salado Oeste study area.

4) Structure Elevation: A structure's susceptibility to being inundated is a function of its location within the floodplain and its elevation. There are two sources of potential error in determining elevation. The first is the topographic ground elevation of the structure. This uncertainty is a function of the data source used to derive the elevation estimate. For example, there is greater potential error associated with elevation estimates derived from examining a 5-foot contour topographic map than a 2-foot aerial survey contour map. The other source of uncertainty is associated with estimates of first floor elevations above ground level (or foundation height). This variable is key, as a structure built on fill or with a large crawl space, for example, may sustain only minor or no damages, even though the surrounding ground is underwater. First floor elevation estimate errors also vary with the methods used to derive them, ranging from best-guess estimates from windshield surveys to professional surveys. Statistical uncertainty in elevation is typically determined by referencing the standard deviation estimates contained in Corp Engineering Manual 1110-2-1619 – *Risk Based Analysis for Flood Damage Reduction Studies (1 August 1996).* This publication presents standard deviation estimates for a wide range of measurement methods.

For this study, ground elevations for each structure were derived from a 2-foot interval digital elevation model in GIS format. First floor elevations above ground level were estimated during a field survey. Based upon the Engineering Manual cited above, the error associated with first floor elevation estimates is assumed to be normal, with a mean of 0 and a standard deviation of 0.6 feet.

5) Structure Values: Structure values have been determined based upon Marshall & Swift multiplication factors applied to square footage estimates. Square footage estimates were primarily obtained from real estate assessor's data and are determined to be accurate. The primary source of potential error results from misclassification of a given structure in terms of its construction quality and condition. The errors associated with structure value estimates are assumed to be normal, with a mean of 0 and standard deviations ranging from 10 to 21 percent (depending on structure type), based upon upper and lower ranges of M&S factors.

6) Inundation Depth/Percent Damage: There is considerable uncertainty regarding the percentage of damage to structures and contents given a certain level of flooding. The National Flood Insurance Program of FEMA collects damage data following flood disasters and publishes depth/damage functions. These functions are used to derive estimates of damages to non-residential structures. For residential structures, depth-damage functions and associated standard error estimates have been developed by the Institute for Water Resources based upon a statistical analysis of actual flood damages that have occurred throughout the United States. Damage percentages for both structures and contents are based upon corresponding structure values. These functions were used for this analysis.

The Corps of Engineers Hydrologic Engineering Center has developed software specifically designed for conducting RBA, referred to as the HEC-FDA Program (Version 1.2 used for this analysis). This program applies a Monte Carlo simulation process, whereby the expected value of damages is determined explicitly

through a numerical integration technique accounting for uncertainty in the basic parameters described above. Data requirements for the program include:

- Structure data, including structure I.D., category (sfr, mfr, etc.), stream location, ground and/or first floor elevation, structure value and content value. This data was developed in a Microsoft Excel spreadsheet and imported into the HEC-FDA program.
- Hydrologic and hydraulic data, including water surface profiles, frequency/discharge relationships, and stage/discharge relationships. For this study, water surface profiles were developed using the HEC-RAZ program. These functions were imported into the HEC-FDA program.
- Depth/Damage functions. Functions for residential and non-residential structures were obtained from the Institute for Water Resources and FEMA's National Flood Insurance Program.
- Risk & Uncertainty Parameters, as described in detail previously, were also entered into the program.

Results – Base Year (2008)

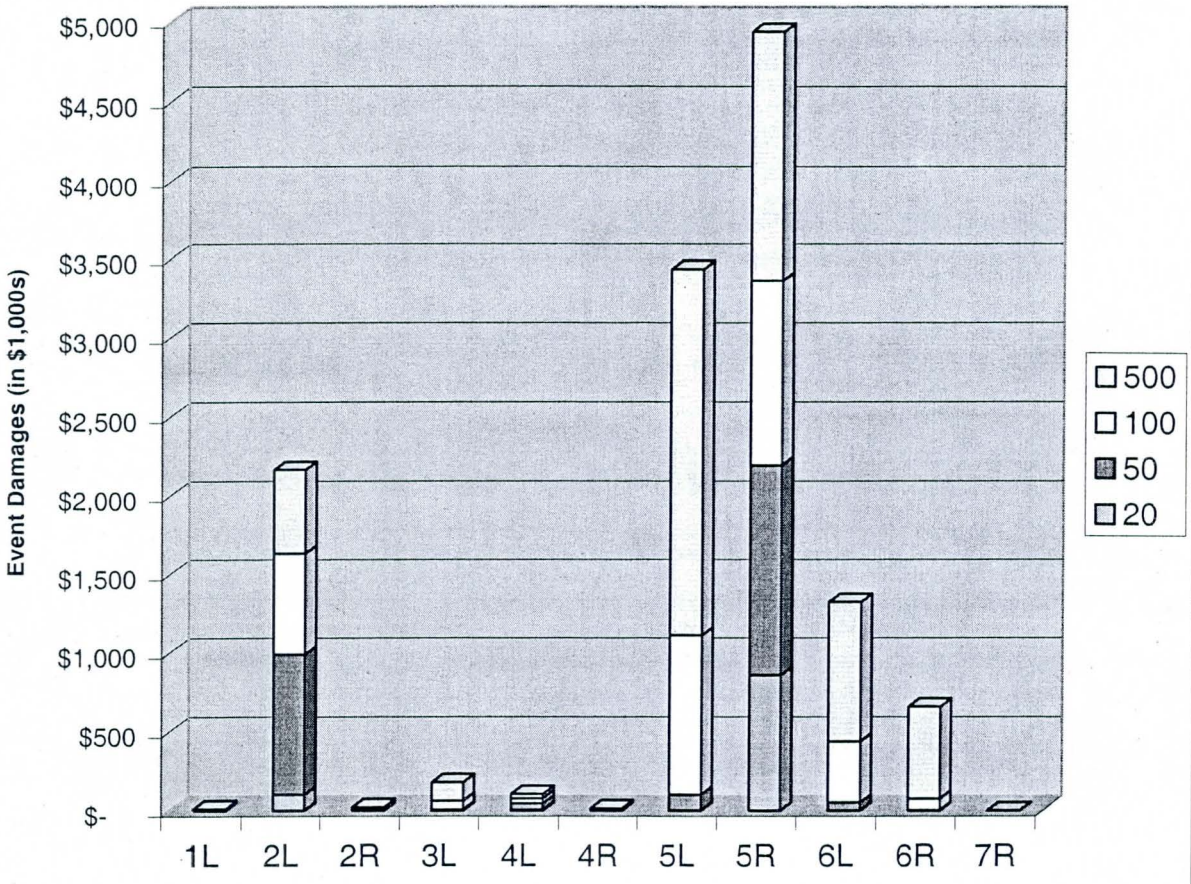
Without project damages by event for Base Year conditions, as calculated by the HEC-FDA program, are shown in **Tables 11** and on **Figure 6.** The non-damaging event is approximately the 10-year event. However, most reaches do not incur damages until less frequent events. Damages calculated for the 20-year event are approximately $992,000. 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.

Damages increase significantly for the 50-year event, and approximately double subsequently for the 100-year and 500-year events. A majority of 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).

Table 11
Rio Salado Oeste
Without Project Damages By Reach & Event (Base Year – 2008)
(in $1,000s)

Reach	10	20	50	100	500
1L	$ -	$ -	$ -	$ 1	$ 12
2L	$ -	$ 100	$ 988	$ 1,631	$ 2,165
2R	$ -	$ -	$ -	$ 5	$ 21
3L	$ -	$ -	$ 6	$ 61	$ 179
4L	$ -	$ 3	$ 45	$ 76	$ 105
4R	$ -	$ -	$ -	$ -	$ 13
5L	$ -	$ -	$ 100	$ 1,108	$ 3,433
5R	$ 33	$ 889	$ 2,226	$ 3,393	$ 4,967
6L	$ -	$ -	$ 51	$ 436	$ 1,322
6R	$ -	$ -	$ 1	$ 75	$ 658
7L/7R	$ -	$ -	$ -	$ -	$ -
Total	$ 33	$ 992	$ 3,417	$ 6,786	$ 12,875

Figure 6
Rio Salado Oeste
Without Project Structure & Content Damages by Frequency & Reach



Expected annual damages by reach and structure type are shown on Table 12. 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 that are within close proximity of 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).

Table 12 Rio Salado Oeste Without Project Expected Annual Damages – Base Year (in $1,000s)					
Reach	SFR/MH	Ind/Ag	Office/Com	Public	Total
1L	$ -	$ -	$ -	$ -	$ -
2L	$ 6	$ 40	$ 2	$ -	$ 48
2R	$ -	$ -	$ -	$ -	$ -
3L	$ 2	$ -	$ -	$ -	$ 2
4L	$ 2	$ -	$ -	$ -	$ 2
4R	$ -	$ -	$ -	$ -	$ -
5L	$ 22	$ 10	$ 1	$ -	$ 33
5R	$ -	$ 118	$ 14	$ -	$ 132
6L	$ 1	$ 9	$ 3	$ -	$ 13
6R	$ 1	$ 3	$ 1	$ -	$ 5
7L/7R	$ -	$ -	$ -	$ -	$ -
Total	$ 34	$ 180	$ 21	$ -	$ 235

Results – Future Conditions (2057)

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 recomputed expected annual damages under future conditions. Table 13 summarizes the results.

Table 13 Rio Salado Oeste Without Project Expected Annual Damages – Future Conditions (2057) (in $1,000s)					
Reach	SFR/MH	Ind/Ag	Office/Com	Public	Total
1L	$ -	$ -	$ -	$ -	$ -
2L	$ 4	$ 26	$ 1	$ -	$ 31
2R	$ -	$ -	$ -	$ -	$ -
3L	$ 2	$ -	$ -	$ -	$ 2
4L	$ 1	$ -	$ -	$ -	$ 1
4R	$ -	$ -	$ -	$ -	$ -
5L	$ 5	$ 9	$ 1	$ -	$ 15
5R	$ -	$ 84	$ 12	$ -	$ 96
6L	$ 1	$ 6	$ 2	$ -	$ 9
6R	$ -	$ 2	$ 1	$ -	$ 3
7L/7R	$ -	$ -	$ -	$ -	$ -
Total	$ 13	$ 127	$ 17	$ -	$ 157

Without project expected annual damages actually decrease from about $235,000 under Base Year conditions to about $157,000 under future conditions (a drop of about 33 percent). Water surface elevations are generally lower throughout the Study Area under future conditions (refer to Hydraulic appendix for details).

Equivalent annual damages were computed based upon forecast annual damages using a discount rate of 5 5/8% (see Table 14).

Table 14 Rio Salado Oeste Without Project Equivalent Annual Damages (50 Yrs, 5 5/8%) (in $1,000s)					
Reach	SFR/MH	Ind/Ag	Office/Com	Public	Total
1L	$ -	$ -	$ -	$ -	$ -
2L	$ 5	$ 36	$ 1	$ -	$ 42
2R	$ -	$ -	$ -	$ -	$ -
3L	$ 2	$ -	$ -	$ -	$ 2
4L	$ 2	$ -	$ -	$ -	$ 2
4R	$ -	$ -	$ -	$ -	$ -
5L	$ 17	$ 9	$ 1	$ -	$ 27
5R	$ -	$ 109	$ 14	$ -	$ 123
6L	$ 1	$ 8	$ 2	$ -	$ 11
6R	$ 1	$ 2	$ 1	$ -	$ 4
7L/7R	$ -	$ -	$ -	$ -	$ -
Total	$ 28	$ 164	$ 19	$ -	$ 211

Without Project Emergency & Cleanup Costs

Cleanup, Debris Removal & Public Infrastructure Repairs

Emergency costs are defined as those expenses resulting from a flood that would not otherwise be incurred. Emergency costs include such items as emergency protective measures, post-flood cleanup and debris removal, utility repairs, and evacuation, reoccupation and temporary housing costs for floodplain residents.

Emergency costs related to public infrastructure repairs, debris removal and post-flood cleanup have been calculated by applying an average per acre cost to the number of developed acres inundated by flood event. Based upon several recent Los Angeles District studies, per acre costs for these items may range from $1,250 to $7,500 per acre. In accordance with this range, $5,000 per acre has been assumed for this analysis.

Per acre costs are applied to floodplain acreage with existing development. Floodway and undeveloped acreage are not included. ArcView GIS software was utilized to determine acreage by flood event that would require cleanup, public repairs and debris removal. Table 15 displays without project cleanup related costs by frequency, while Table 16 displays expected annual costs by reach.

Table 15 Rio Salado Oeste Without Project Cleanup Costs (in $1,000s)		
Event	Acres	Costs
20	11	$ 55
50	70	$ 350
100	105	$ 525
500	387	$ 1,935
Expected Annual Damages		$ 24

Table 16 Rio Salado Oeste Without Project Expected Annual Cleanup Costs By Reach (in $1,000s)	
Reach	Expected Annual Costs
2L	$10
3L	$1
4L	$0
5L	$4
6L	$3
Total South of River	$18
2R	$0.5
5R	$5
6R&7R	$0.5
Total North of River	$6
Total – All Reaches	$24

Temporary Evacuation, Relocation and Housing Assistance Costs

FEMA provides grants to assist individuals and families to find suitable housing when they are displaced in cases of federally declared disasters. The program assures that people have a safe place to live until their homes can be repaired. This assistance is directly attributable to the disaster and being an expenditure that would not be undertaken except for the disaster falls under the emergency cost guidance of ER 1105-2-100. Therefore, the funds expended by FEMA for temporary housing assistance in the event of flooding are NED flood damages.

An Internet database search of FEMA disaster reports for flood and storm damage was performed. Data was collected and analyzed for ten recent flood disasters, including the October/November 2000 flooding in Maricopa and La Paz counties in Arizona. For these ten disasters, 18,799 housing assistance claims were approved for a total payout of $27.93 million. This represents an average amount per claim of approximately $1,500.

To estimate temporary housing costs by flood event for this study, the number of houses and mobile homes inundated by frequency was ascertained through an analysis of HEC-FDA output files, and the per housing unit claim of $1,500 was applied. Table 17 shows the results.

Table 17 Rio Salado Oeste Without Project Temporary Housing Costs (in $1,000s)		
Event	Structures	Costs
20	2	$ 3
50	6	$ 9
100	14	$ 21
200	41	$ 62
500	212	$ 318
Expected Annual Damages		$ 1.6

Note that the number of residential structures shown in Table 17 as sustaining inundation for the 100-year and 500-year events differs from the number of estimated floodplain structures shown in Table 7. This is because the structure counts shown in Table 7 are based strictly on floodplain delineation maps overlaid onto aerial photography of the study area. These floodplain boundaries are based upon median discharge values and do not account for the probabilistic ranges of values for either discharge or stage. The figures in Table 17 are based upon the results of the HEC-FDA model, which incorporate risk and uncertainty in such areas as frequency/discharge, stage/discharge, and structure elevation, i.e., Table 17 represents expected values resulting from the simulation model.

Table 18 shows expected annual without project temporary housing costs by reach.

Table 18
Rio Salado Oeste
Without Project Expected Annual Temporary Housing Costs
By Reach (in $1,000s)

Reach	Expected Annual Costs
2L	$0.4
3L	$0.1
4L	$0.1
5L	$0.9
6L	$0.1
Total South of River	$1.6
Total North of River	$0
Total – All Reaches	**$1.6**

Without Project Flood Damage Analysis Summary

Without project flood damages are summarized on Table 19.

Table 19 Rio Salado Oeste Without Project Equivalent Annual Damages (in $1,000s)								
Reach	**Structure & Content**		**Cleanup**		**Temp. Housing**		**Total**	
2L	$	42	$	10	$	0.4	$	52
3L	$	2	$	1	$	0.1	$	3
4L	$	2	$	-	$	0.1	$	2
5L	$	27	$	4	$	0.9	$	32
6L	$	11	$	3	$	0.1	$	14
Total - S. of River	$	84	$	18	$	1.6	$	104
5R	$	123	$	5	$	-	$	128
6R	$	4	$	0.5	$	-	$	5
Total - N. of River	$	127	$	6	$	-	$	133
Total	$	211	$	24	$	2	$	236

Notes: Damages for Reaches Not Shown are Minimal

As shown on Table 19, equivalent annual damages are concentrated in a few reaches. Reach 5R accounts for about 54 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 of 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.

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 close 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.

Recreation

As demonstrated earlier in this report, the Phoenix area has experienced rapid population growth. As the Phoenix MSA population has now expanded to over three million people, so has the demand for both passive and active recreation opportunities. Envisioned recreational opportunities coinciding with habitat restoration projects for the study area consist primarily of passive recreation, such as bird watching, walking, jogging, hiking, bike riding, horse-back riding, picnicking, and other passive uses of open space.

Existing Recreation Resources in Market Area

Based upon conversations with representatives from the City of Phoenix Parks, Recreation and Library Department, the Arizona Game and Fish Department and other agencies, the proposed habitat and recreation features would attract visitors throughout the Phoenix Valley region. 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.

The following presents the primary recreation areas in the greater Phoenix area. This does not include the area's numerous golf courses and man-made lakes.

National Trails Systems

- North Mountain Trail: Nine miles of trails located in Northwest Phoenix.
- South Mountain Trail: Fourteen miles of desert trails in the center of South Mountain Park, providing for hiking and horseback riding.
- Sun Circle Trail: Includes 110 miles of urban to open desert trails forming a loop around the Phoenix Valley for hiking and bicycling.
- Squaw Peak Trail: 1.2 miles of urban wilderness area.

State Parks

- Painted Rocks State Park: 140 acre historical park located approximately 15 miles west of Gila Bend on the Gila River.
- Lost Dutchman State Park: 300 acres of desert park on the Apache Trail located near the Maricopa/Pinal County border. Includes 35 campsites, picnic facilities, and restrooms.

BLM Lands

- Greenbelt Resource Conservation Area located south of Buckeye -- includes hunting and hiking.

State Game & Fish Department

- Black Canyon Shooting Range: 1,290 acres located 20 miles north of Phoenix.
- Base and Meridian: 173 acres of wildlife habitat located three miles south of Cashion.
- Gila River Wildlife Area: 6,896 acres of wildlife habitat extending from Avondale to the Gillespie Dam.

Major Water Bodies

- Apache Lake Marina: Located approx. 35 miles east of Phoenix in Maricopa and Gila County.

- Bartlett Lake: Maricopa County (approx. 35 miles northeast of Phoenix)..
- Canyon Lake: Maricopa County (approx. 30 miles east of Phoenix).
- Lake Pleasant: Maricopa and Yavapai County (approx. 25 miles north of Phoenix).
- Saguaro Lake: Maricopa County (approx. 25 miles east of Phoenix).

Maricopa County

- Estrella Mountain Regional Park: 19,200 acres located three miles south of Goodyear.
- Thunderbird Park/Adobe Dam
- Cave Buttes Recreation Area

Municipal Parks & Other Recreation Areas

Papago Park
Case Abbot Recreational Area
Phoenix Zoo
Phoenix Mountain Preserve
Tempe Beach Park
El Prado Park
Rio Salado Industrial Park
Encanto Park
Hayden Park
Nuestro Park
Harmon Park
Alkire Park
Canal Park
Eldorado Park
Chapparal Park
Coffelt Park
South Mountain Park
Phoenix Municipal Stadium
A.S.U. Sun Devil Stadium
Moeur Park
Playa Margarita
Lindo Park
Echo Canyon Recreation Area
Estaban Park
Green Valley Park
Nueve Park
Barrios Unidos
University Park
McKellips Lake Park
Indian School Park
Vista del Camino Park
Cesar Chavez Park

Estrella Mountain Regional Park, South Mountain Park and Papago Park are three of the largest recreation areas listed above which are nearby the study area. Estrella Mountain Regional Park is owned and managed by Maricopa County Parks and Recreation Department. The rugged and scenic Sierra Estrella Mountains are the most dominant feature 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.

The County has developed a master plan for the 19,200-acre park, located approximately 20 miles southwest of downtown Phoenix. The master plan envisions the preservation of scenic desert wilderness areas while incorporating sensitive development of recreational facilities and activities. The Plan accommodates the expected annual demand of 1 million visitors while insuring that the existing Sonoran Desert environment remains in its existing condition. In fact, 90 percent of the park will remain essentially untouched. The remaining 10 percent will be sensitively utilized for educational, camping, picnicking, and sporting activities.

South Mountain Park is located about three miles south of the Salt River and 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 U.S. It is bounded on the north by Baseline Road and on the south by Chandler Boulevard, and is over three 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 at this park exceeds 2 million.

In addition to South Mountain Park, Phoenix Mountain Preserve is the other major mountain preserve area in greater Phoenix. Located in the northeastern section of the city, the Phoenix Mountains are a 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, Squaw Peak, and Shaw Butte recreation areas. These parks include an extensive trails system, picnic areas and restrooms. North Mountain recreation area also features basketball and volleyball facilities and a playground. The combined visitation at North Mountain and Squaw Peak Recreation Areas has totaled approximately 1.5 million in recent years.

Existing Recreation Resources in Study Area

Recreation along 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 ground water. The Salt River 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 less 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.

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, mountain biking, horseback riding

The Rio Salado Project stretches from an upstream limit of Interstate 10 to a downstream limit of 19th Avenue (which is the upstream limit for this study) and is comprised of environmental restoration and passive recreation components along the Salt River. Approximately five miles (and 580 acres) of the Salt River will be restored to create riparian and wetland habitat. Passive recreation facilities, including over ten 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, roller blading, 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 anticipated to exceed 500,000.

In addition to the Rio Salado Project, the Tres Rios project just downstream of the Study area will also provide recreation opportunities. The Tres Rios Project is located immediately downstream of the Study Area, beginning at the 91st Avenue Wastewater Treatment Plant. 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.

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 two miles downstream. The river's flood control conveyance capacity is retained through the use of a system of rubber dams which 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.

Recreation Demand

Many factors contribute to make the proposed riparian habitat area extremely attractive in terms of recreation potential. They include:

1) Environment: Demand for recreation opportunities must be considered in the context of the surrounding environment. Although there are many recreation areas in greater Phoenix, the only recreation facilities located within wetland/riparian habitat areas are those which will be provided adjacent to the study area by the Rio Salado and Tres Rios projects. Most of the existing parks are small community parks. The larger regional parks are located in desert mountain terrain (e.g., South Mountain) and not in wetland and riparian habitat areas. This is expected to result in significant recreation demand at the study area if such habitat is established. As discussed previously, riparian habitat would also attract wildlife to the area. According to the 1991 *National Survey of Fishing, Hunting and Wildlife-Associated Recreation (Arizona)*, published by the U.S. Fish and Wildlife Service, over 1.1 million Arizona residents 16 years and older (or 40 percent of the population) participated in non-consumptive activities where the enjoyment of wildlife was the primary purpose of the activity. Such activities include observing and photographing wildlife. Nearly 3.3 million trips were taken by Arizona residents to participate in non-consumptive activities one mile or greater from their residence.

2) Location: In a study conducted for the 1994 Arizona Statewide Comprehensive Outdoor Recreation Plan (SCORP), over 1,200 respondents were asked what the primary barriers were to outdoor recreation participation. After lack of time, the number two and three barriers cited were: 2) recreation areas are too far away; and 3) don't know where to go. The 1991 Fish and Wildlife Survey indicated that Arizona residents travel an average distance of nearly 30 miles to participate in non-consumptive recreation activities. The closest major water bodies to the city of Phoenix are located approximately 25 miles away. These barriers would not be associated with recreation at the study area. According to the publication, *Arizona Trails 2000*, prepared by the Arizona State Parks Board (October 1999), the number one reason given by recreation trail users for preferring a particular area is its proximity to home.

The study area is located in the middle of the Phoenix metropolitan area, which has a population exceeding three million. Portions of the study area are located within minutes of downtown Phoenix, and are thus easily and quickly accessible to the public. In addition, a major freeway (Interstate 10) and several major bridges cross the Salt River. This provides the area with tremendous exposure, and would likely attract many who would otherwise not frequent such a park.

Family and lifestyle changes also contribute to high demand for more local recreation facilities. As described in the *Town Lake Capacity and Needs Study: Rio Salado Project* (BRW Moffatt & Nichol Engineers, 1996), "More single-parent families, more families where both spouses work full-time, moderate growth in income and less time for leisure time activities all contribute to heavy pressure on local park and recreation facilities. People are looking for park and recreation facilities which are close, offer a variety of water-based and land-based activities and are in an attractive setting."

3) Attitudes: Arizonans place high importance on the state's outdoor recreation resources. In the 1994 SCORP survey, 94 percent of respondents stated that parks and recreation areas are important to their everyday lifestyles. There is also strong support for protecting natural and cultural resources and for environmental education. Arizonans care deeply about the state's air, water and riparian areas. Seventy-five percent (75%) favor preserving rivers and stream-side habitats, even if it means limiting some uses of privately owned lands. A separate study conducted by the Arizona Game & Fish Heritage Fund (*Attitudes Toward Urban Wildlife Management, Volume 1, May 1995*) supports these statistics. A statewide survey was conducted of 1,200 residents. In the Heritage Fund survey, 89 percent of respondents stated that the continued presence of wildlife in their town is important to them. The importance placed on protecting water-based habitat and recreation areas can be attributed to the limited amount of surface water available. Arizona has approximately 113,642 square miles of land surface, but only about 360 square miles are water-covered.

4) Activities: Proposed recreational activities for the study area include trails for hiking, biking, jogging, and horseback riding, birdwatching, and picnicking. In addition, interpretive centers and lookout points could be established along the banks of the river at key scenic vantage points. In a ranking of overall demand for outdoor activities in the recent SCORP, visiting outstanding scenic areas was ranked first, picnicking ranked fourth, and walking ranked fifth. Other envisioned recreation features for the study area were ranked as follows: day trail hiking (10); bicycling (14); horseback riding (18); mountain biking in a natural setting (26); nature study/birdwatching (27); and jogging/running (36). Among those activities identified as having the greatest latent or unmet demand, picnicking, visiting outstanding scenic areas,

walking, trail hiking, horseback riding and bicycling all ranked in the top fifteen. In terms of public funding priorities, visiting outstanding scenic areas, picnicking, trail hiking, and walking all ranked in the top ten.

According *Arizona Trails 2000*, over half of Arizona residents consider themselves non-motorized recreation trail users. Surveys indicated that trail users spent an average of 22 days using trails during the prior year. Over 70 percent of respondents indicated that they supported using state funds to develop trails. Survey results are supported by the fact that Arizona State parks have experienced a 16 percent increase in visitation over the past five years.

There is also a shift in the types of recreation demanded by Americans in general. The National Survey on Recreation and the Environment conducts periodic surveys on public recreation use and demand. From 1983 to 1995, the percentage of Americans involved in such activities as fishing and hunting actually declined. On the other hand, the activities that have seen the most dramatic increases in demand have been hiking (+94%), birdwatching (+155%) and backpacking (+73%).

5) Population Growth: As demonstrated earlier in this report, the greater Phoenix area has experienced tremendous growth. For example, Maricopa County's population has grown from 2.12 million to over three million between 1990 and 2000 (or nearly 45 percent), and is expected to reach over 4.5 million by the year 2020. With this projected growth, there will be increasing demand for outdoor recreation opportunities. As quoted in the 1994 SCORP report (p. 68),

"This large and rapidly growing population in our two metropolitan counties has several implications for outdoor recreation. Most obvious, local providers are hard-pressed to keep up with demand for facilities and services. As development continues to expand, providing and protecting open space becomes an important issue. Increasingly, city dwellers mention a major barrier to participation that recreation providers must address: outdoor recreation areas are too far away."

6) Education: The establishment of riparian habitat would attract diverse wildlife to the study area. Elementary and high schools would frequent the area for class field trips, and colleges could utilize the area for environmental-related research.

According to the article, "Assessing Recreation Demand", posted on the U.S. Department of Transportation Statistics' Internet site, the use of population based standards represents one of the most widely used methods for assessing community demand and need for open space and recreation. This is attributed to the fact that they are easily understood and administratively convenient. Such standards are considered most useful as a means for generating alternatives for consideration and as a means for supporting participation data. The City of Phoenix Parks Recreation and Library Department's *Long Range Plan (Draft, September 2001)* (LRP) describes national standards that have been established for various types of recreation. These standards indicate desired and ideal service levels on a per capita basis. The National Recreation and Parks Association (NRPA) established a range of standards, but also recommended that each community develop individual standards to the most appropriate range, quantity and quality of recreation facilities within their fiscal restrictions.

The standard established by the City is 4.5 acres of developed park space per 1,000 residents, although historical NRPA standards are higher. According to the LRP, the 4.5-acre standard (rather than a higher level)

was selected because the area has Desert Parks, Sonoran Desert Preserves and Mountain Preserves, which also provide recreation activities. Even though the preserves do not provide a wide range of recreation opportunities like neighborhood, community and district parks, they do provide additional open space and some amenities (such as multi-use trails) on portions of the land.

There are currently about 132 parks covering about 4,086 acres within the City. As noted earlier, the population in Phoenix is about 1.4 million. Hence, the existing service level is about 2.9 acres per thousand residents. This figure is well below the desired standard of 4.5, and the supply deficit will become worse with the anticipated rapid population growth in the future. For example, by 2020, the population in the City is expected to reach 1.8 million. With no additional parks, the ratio of parks per thousand residents would worsen to 2.3. Based upon an expected population of 2.6 million by 2050, the corresponding ratio would be about 1.6. As noted in the LRP, over 2,800 acres of additional parks would be required over the next decade to both meet the desired standards and keep up with the population influx.

The LRP specifically discusses the Study area by noting that the new growth areas of Estrella and Laveen continue to present a problem as they are developing and growing faster than previously projected. For example, in the Central Phoenix planning area, which includes Estrella Village, the existing service level is only about 2.4 acres per thousand residents.

Trails would likely be an important component of any recommended plan for the Study area. According to the LRP, nearly 100 miles of new trails would be needed in the City by the year 2010 to meet the established standard of one mile per 8,000 residents. The LRP specifically notes the desire to implement new trails to link with those proposed for the Rio Salado project.

As the above analysis indicates, the Phoenix area lacks sufficient recreation resources. As noted in the City of Phoenix *Sonoran Preserve Master Plan*, although the amount of dedicated open space has continually increased within the City and County, the acreage per capita has decreased. Unless a significant number of recreation facilities are built, the projected population growth will make the existing deficit become worse.

Recreation Opportunities

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, comprises 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 Maricopa County Flood District 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 will benefit Tres Rios, Rio Salado, and Rio Salado Oeste with a major non-motorized travelway connecting the three river restoration projects to the other valley areas.

The Rio Salado Oeste project provides a unique opportunity to enhance resource-based recreation and environmental education. The restoration of the dry Salt River channel will bring a riparian open space feature to the rapidly expanding Laveen and Estrella Planning Areas. Rio Salado Oeste will provide a habitat and recreational connection to the desert riparian habitat corridor created by the Rio Salado and Tres Rios Projects. By connecting the seven-mile gap between the two projects, Rio Salado Oeste will enhance the unique recreation and education opportunities for residents and out-of-town visitors. Drawing on a population base of

over two million in the Valley, it is estimated that visitation to the Rio Salado Oeste project will be significant. Primary use times for this unique resource would coincide with the "visitor season" between October and May when temperatures are moderate.

The goal of the environmental education and recreation component is to provide opportunities for visitors of all ages, abilities, and backgrounds to enjoy this unique resource while developing an awareness, knowledge and understanding of desert riparian habitat and its relationship to the surrounding environment. Additionally, it presents an opportunity to acknowledge and understand the influence of Salt Rivers on the environment and cultures throughout the Valley's history. Visitors to potential recreation facilities along the Study Area reach could participate in a variety of pursuits from enjoying scenic views, picnicking with the family, learning about the habitat, or exploring the resource on foot, by bicycle or horseback. Recognizing the diverse local society, the Rio Salado Oeste project would employ design components ranging from areas adapted for special needs to multi-lingual signage.

WITH PROJECT CONDITIONS

Environmental Resources

The following provides an analysis of alternatives developed to provide ecosystem restoration benefits. Note that Alternative 1 represents the No Action Plan, or Without Project Condition, which has already been described earlier in this report.

Description of Alternatives

Below is a summary description of the restoration alternatives. Please refer to the Main Report and Environmental Impact Statement for a more detailed description of these alternatives.

Alternative 2

Storm water and Channel: This alternative includes the modification of existing storm-water outfall areas to improve retention and water spreading as well as increasing the existing habitat currently supported by these outfalls. It also includes modification and/or restructuring of the primary conveyance channel to a more natural state. This could include grading and terracing the river corridor from 19th avenue to 83rd avenue. No additional water source is included in this alternative.

Alternative 3

Storm water, Channel, Water Supply, Cottonwood, Mesquite, Invasive: This alternative includes the features described in alternative 2 and ads a supplemental water supply in the form of effluent. At locations identified as suitable throughout the project area cottonwood/willow and mesquite cover types will be restored. This alternative would also address the management, control and removal of invasive species within the study area. Two types of irrigation (drip and flood) will be evaluated for each.

Alternative 4

Storm water, Channel, Water Supply, Cottonwood, Mesquite, Invasive, Emergent: This alternative adds restoration of emergent wetlands at the existing lake in the channel immediately downstream of 19th Avenue.

Alternative 5

Storm water, Channel, Water Supply, Cottonwood, Mesquite, Invasive, Emergent, Lake: Added to this alternative is lake restoration at the existing gravel pits at 29th and 37th Avenues.

Alternative 5A

Storm water, Channel, Water Supply, Cottonwood, Mesquite, Invasive, Emergent, Lake: Instead of restoration of both gravel pit lakes to permanent water for fishing this alternative includes regrading to incorporate the pits to the floodplain and restoration of wetland and riparian habitat.

Alternative 5B

Storm water, Channel, Water Supply, Cottonwood, Mesquite, Invasive, Emergent, Lake: This alternative is similar to 5 and 5A. However it includes the restoration of one gravel pit to a lake and the other to a wetland/riparian area.

Benefits of Alternatives

Based upon the individual features proposed for each alternative, the number of acres and functional capacity indices were projected in order to derive with-project estimates of average annual functional capacity units (AAFCUs). The same methodology as was employed for assessing without project conditions was also employed to assess the habitat output of each alternative. Benefits are defined as the increase in AAFCUs for each alternative relative to without project conditions. Table 20 shows the results.

TABLE 20
RIO SALADO OESTE STUDY AREA
WITH PROJECT AVERAGE ANNUAL FUNCTIONAL CAPACITY UNITS (FCUs)

	Without Project	Alt 2	Alt 3	Alt 4	Alt 5	Alt 5A	Alt 5B
T0	583	583	583	583	583	583	583
T1	580	619	689	691	766	791	778
T6	580	627	716	717	796	822	809
T26	579	635	751	755	828	857	842
T51	579	633	771	775	851	879	865
Avg (T0-T51)	580	631	742	745	820	847	833
Increase (T0-T51)		**51**	**162**	**165**	**240**	**267**	**253**
Increase	PY1-PY50	**53**	**169**	**172**	**247**	**275**	**261**

As shown on Table 20, the proposed alternatives result in increased AAFCUs (relative to without project conditions) ranging from 51 for Alternative 2 to 267 for Alternative 5A.

The above AAFCU values were calculated for the time period Target Year 0 (T0) through T51, with T0 being "base conditions" (prior to construction), and T1 being the first year of construction. Planning guidance specifies that benefits and costs for all alternatives should be analyzed over the same time period. For this study, a Base Year of 2008 was established based upon estimates of Feasibility Study completion, project authorization, and completion of engineering, design and construction. Construction is estimated to be completed within a three-year period for all alternatives. Therefore, T1 would correspond with three years prior to the Base Year, and T4 would correspond with the Base Year. AAFCUs were recalculated for the 50-year period commencing with the Base Year (PY1 through PY50), which corresponds with T4-T53. Although the results do not change significantly, it was deemed appropriate to make the adjustment for temporal consistency of benefits and costs. These results are shown in the last line of the table.

Cost Estimates

Table 21 which follows displays the derivation of average annual costs by alternative. Total first costs range from $36.7 million for Alternative 2 to $167.7 million for Alternative 5.

TABLE 21
RIO SALADO OESTE STUDY AREA
WITH PROJECT AVERAGE ANNUAL COSTS BY ALTERNATIVE (in $1,000s)

	Alt 2	Alt 3	Alt 4	Alt 5	Alt 5A	Alt 5B
Construction	$ 6,550	$ 33,560	$ 33,684	$ 86,736	$ 61,744	$ 74,240
Contingency (25%)	$ 1,637	$ 8,390	$ 8,421	$ 21,684	$ 15,436	$ 18,560
PED/EDC (11%)	$ 720	$ 3,692	$ 3,705	$ 9,541	$ 6,792	$ 8,166
S&A (6.5%)	$ 426	$ 2,181	$ 2,189	$ 5,638	$ 4,013	$ 4,826
Real Estate	$ 27,000	$ 35,575	$ 35,575	$ 39,200	$ 39,200	$ 39,200
Subtotal	$ 36,334	$ 83,398	$ 83,574	$ 162,800	$ 127,185	$ 144,992
Monitoring & Adapt. Mgmt.	$ 373	$ 1,913	$ 1,920	$ 4,944	$ 3,519	$ 4,232
Total First Cost	**$ 36,707**	**$ 85,311**	**$ 85,494**	**$ 167,743**	**$ 130,704**	**$ 149,224**
IDC	$ 2,044	$ 8,382	$ 8,400	$ 18,830	$ 14,711	$ 16,770
Gross Investment	$ 38,751	$ 93,693	$ 93,894	$ 186,573	$ 145,415	$ 165,994
Annualized Investment Cost	$ 2,331	$ 5,635	$ 5,648	$ 11,222	$ 8,746	$ 9,984
Associated Cost (Water Delivery System)	$ -	$ 37	$ 37	$ 37	$ 37	$ 37
Associated Cost (Water Supply)	$ -	$ 312	$ 331	$ 654	$ 817	$ 811
O&M	$ 98	$ 1,696	$ 1,696	$ 2,215	$ 2,076	$ 2,131
Total Annual Cost	**$ 2,429**	**$ 7,680**	**$ 7,711**	**$ 14,128**	**$ 11,676**	**$ 12,963**

Cost Effectiveness & Incremental Cost Analysis

Average Cost per Average Annual Function Capacity Unit

Table 22 summarizes average annual output and cost by alternative, as well as average annual cost per AAFCU.

TABLE 22
RIO SALADO OESTE STUDY AREA
AVERAGE ANNUAL COSTS PER AVERAGE ANNUAL FCU BY ALTERNATIVE
(in $1,000s)

Alternative	AAFCU	AA COST	AAC/AAFCU
Alt 2	53	$ 2,429	$ 45.87
Alt 3	169	$ 7,680	$ 45.55
Alt 4	172	$ 7,711	$ 44.92
Alt 5	247	$ 14,128	$ 57.14
Alt 5A	275	$ 11,676	$ 42.48
Alt 5B	261	$ 12,963	$ 49.65

Cost Effectiveness Analysis

Alternatives are considered cost effective if there are not any other alternatives which provide greater output for the same cost or provide the same output for a lesser cost. This step eliminates alternatives that are inefficient from further consideration. Table 23 shows the cost effective plans.

TABLE 23
RIO SALADO OESTE STUDY AREA
COST EFFECTIVENESS ANALYSIS
(in $1,000s)

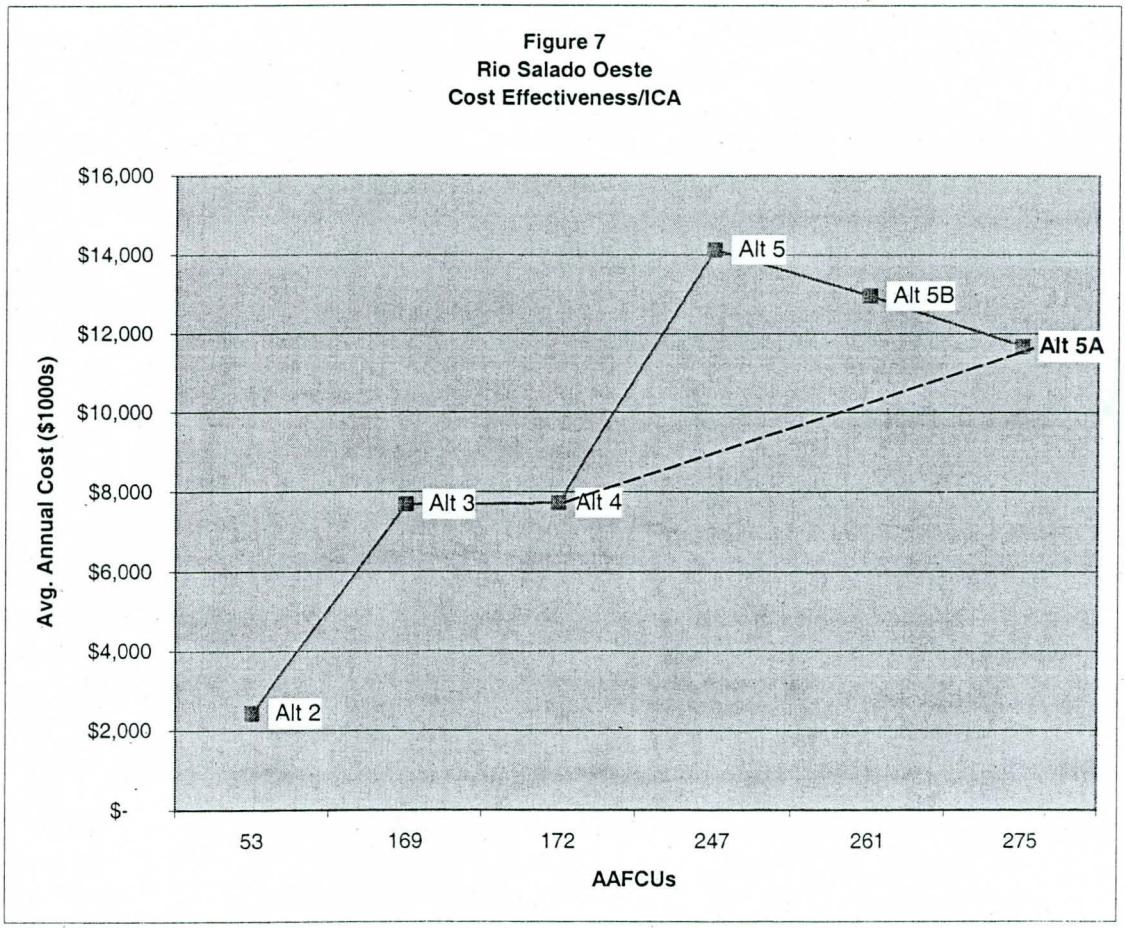
	AAFCU	AA COST	AAC/AAFCU
Alt 2	53	$ 2,429	45.87
Alt 3	169	$ 7,680	45.55
Alt 4	172	$ 7,711	44.92
Alt 5A	**275**	**$ 11,676**	**42.48**

As shown above, there are only four cost effective plans. Alternatives 5 and 5B are not cost effective because they have a higher cost than Alternative 5A, but provide less environmental benefits.

Incremental Cost Analysis

Incremental Cost Analysis goes beyond cost effectiveness analysis to identify "best buy" plans. Best Buy plans are those that have the lowest incremental average annual cost per incremental increase in output. For the alternatives formulated for this study, Alternative 5A has the greatest output and the lowest average annual cost per average annual functional capacity unit. Therefore, it is the only Best Buy plan. Figure 7 shows the results of this analysis.

Figure 7
Rio Salado Oeste
Cost Effectiveness/ICA



Recommended Ecosystem Restoration Plan

Based upon the CE/ICA analysis, Alternative 5A has been identified as the NER Plan. (Subject to further revisions, potential for LPP).

MCACES Cost Estimate

To Be Provided for eventual Recommended Plan.

Flood Damage Analysis

HEC-FDA Analysis – to be conducted for Recommended Plan to assure no induced flood damages.

Flood Damage Reduction Alternatives Analysis

As documented in the Without Project Conditions section of this report, equivalent annual damages along the Study Area are estimated at $236,000. Approximately 90 percent of total damages are concentrated in three reaches – 2L, 5L and 5R. Reach 5R accounts for about 54 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 of 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.

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 close 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.

Analyses were conducted for several different flood damage reduction measures, keeping in mind the amount and location of expected annual damages. The three alternatives included levees, channelization and non-structural measures.

Levees

Given the large concentration of structures and damages in the area, it was evident that the primary area to focus an analysis of the economic viability of constructing levees was through Reaches 5L and 5R. It was determined that the analysis would include levees to protect both banks/reaches to assure that there would not be a potential for induced damages on the opposite side of the river.

Two levels of protection were analyzed – 100-year and 500-year. Benefits were derived by using the levee function of the HEC-FDA program. Levee heights were entered corresponding to the water surface elevations associated with the 100-year and 500-year median discharge values.

The following table presents the benefits and costs for the two levee options.

Table 24 Rio Salado Oeste With Project Analysis - Levee Improvements						
	Without Project		**100-Year**		**500-Year**	
EAD						
Reach 5L	$	32,400	$	29,800	$	10,300
Reach 5R	$	127,800	$	53,900	$	12,800
Total	$	160,200	$	83,700	$	23,100
Annual Benefits						
Reach 5L			$	2,600	$	22,100
Reach 5R			$	73,900	$	115,000
Total			**$**	**76,500**	**$**	**137,100**
First Cost			$	2,148,000	$	2,636,000
IDC			$	60,000	$	73,000
Investment Cost			$	2,208,000	$	2,709,000
Annual Cost			**$**	**133,000**	**$**	**163,000**
Net Benefits				($56,500)		($25,900)
Benefit/Cost Ratio				**0.58**		**0.84**

Note - Does Not Include Any OMRR&R Costs

Table 24 shows that neither level of protection is economically justified. Most of the damages, and therefore benefits are attributable to Reach 5R. Benefits for this reach increase substantially for the 500-year levee option relative to the 100-year levee option. The 100-year levee provides very minimal benefits to Reach 5L, since this is approximately equal to the non-damaging frequency for this reach.

Channelization

Reaches 5L and 5R were also determined to be the only segment of the study area that there was any potential for an economically viable channel alternative. A determination was made that the channel improvements would need to extent upstream of these reached into reaches 6L/6R for hydrologic and hydraulic functionality. As is shown in the following table, neither of the channel options is economically justified.

Table 25 Rio Salado Oeste With Project Analysis - Channel Improvements			
	Without Project	100-Year	500-Year
EAD			
Reach 5L	$ 32,400	$ 6,100	$ 800
Reach 5R	$ 127,800	$ 48,900	$ 20,600
Reach 6L	$ 14,300	$ 2,900	$ 1,900
Reach 6R	$ 4,800	$ 400	$ 200
Total	$ 179,300	$ 58,300	$ 23,500
Annual Benefits			
Reach 5L		$ 26,300	$ 31,600
Reach 5R		$ 78,900	$ 107,200
Reach 6L		$ 11,400	$ 12,400
Reach 6R		$ 4,400	$ 4,600
Total		**$ 121,000**	**$ 155,800**
First Cost		$ 10,019,000	$ 17,819,000
IDC		$ 278,000	$ 494,000
Investment Cost		$ 10,297,000	$ 18,313,000
Annual Cost		**$ 619,000**	**$ 1,101,000**
Net Benefits		$ (498,000)	$ (945,200)
Benefit/Cost Ratio		**0.20**	**0.14**

Note - Does Not Include Any OMRR&R Costs

Non-Structural Measures

In order to determine whether non-structural measures could be economically feasible, a detailed analysis was conducted of expected annual damages by individual parcel. Sixteen parcels were identified that have the highest expected damages. These parcels contain 41 structures and have a combined structure and content value of over $18 million (about 28% of total Study Area floodplain structure and content value). Combined expected annual damages for these parcels are estimated at about $177,000 (or 84% of total structure and content damages for the Study Area). These parcels also account for about 90 percent of total damages for the 100-year event.

Relocation

For parcels containing residential structures, the non-structural benefit/cost analysis focused on relocation. Relocation costs were estimated for 5 of the 16 parcels. Four of the five parcels were located in Reach 2L, with the other located in Reach 4L. Relocation costs per parcel were estimated at 120% of assessed property value. These values were annualized and compared with the expected annual structure and content damages to determine whether relocation may be justified for any of the parcels. The approximate benefit/cost ratios were less than 0.3 for four parcels and only 0.6 for the remaining parcel.

Floodwall

The remaining 11 parcels with the highest damage potential were primarily industrial zoned properties, containing industrial and office structures. Cost estimates were developed for both a two-foot and four-foot floodwall for each parcel. These costs were converted to average annual equivalents to compare with potential expected annual damages reduced (benefits). Reductions in EAD for the two floodwall elevation options were derived by determining the residual flood damage potential, given the water surface elevations at the parcel location. For seven of the 11 parcels, the average annual costs of the floodwalls exceeded total without-project expected annual damages. Hence, the floodwalls would not be justified even if they eliminated all damages. There are two other parcels in which EAD exceed floodwall costs, but the EAD reduced does not.

The only parcels that appear to have a potentially economically justifiable floodproofing option are the two parcels on which a metal recycling business is located. As described in the Without Project Conditions section of this report, damages to this property represent a significant portion of total without project damages. In fact, approximate damages to this property on an average annual basis total about $123,000, or about 58 percent of total floodplain damages. The damage potential for this property is significant because: 1) there are eleven industrial and office structures on this lot, which contain various machinery and equipment associated with metal recycling; 2) the property is within very close proximity to the channel; 3) although the structures on this property are just outside the 20-year floodplain boundary, there is the potential for damages at this frequency when accounting for uncertainties in hydrologic and hydraulic variables. The following figures show aerial views of the property. The property includes parcels 10546004B and 10546004G.

FIGURE 8
Rio Salado Oeste
Reach 5R Floodplain Parcels

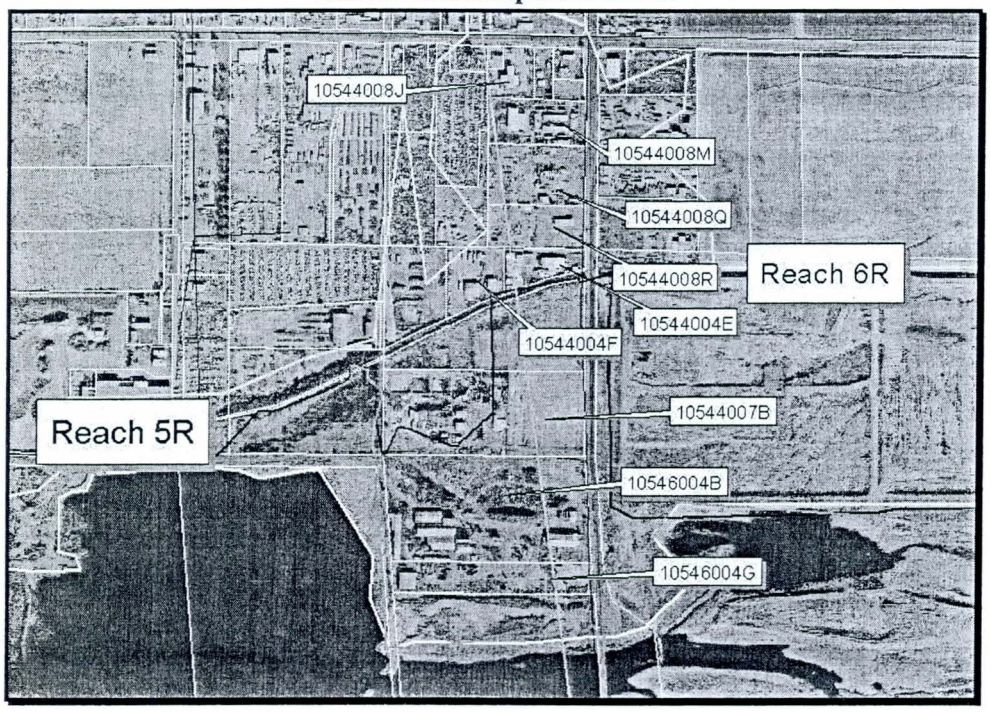
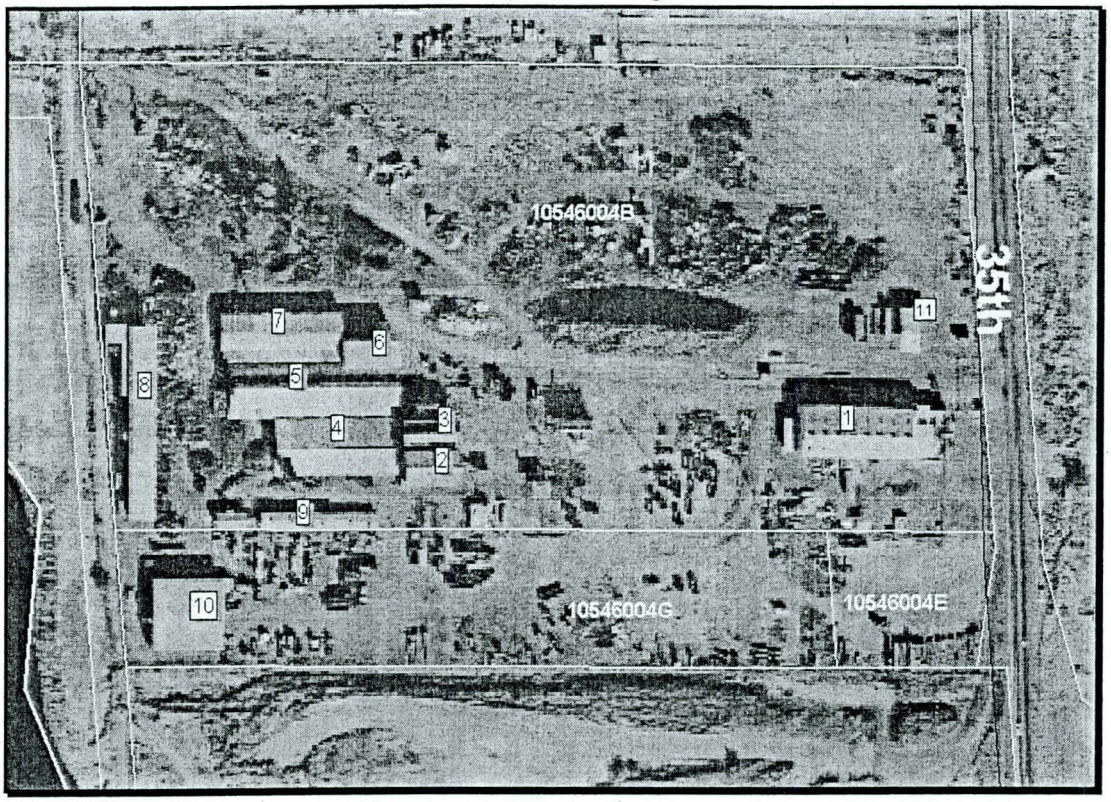


Figure 9
Rio Salado Oeste
Parcels with Highest Damage Potential



The following table shows the benefit/cost analysis for the two floodwall options. This analysis indicates that both options are economically justified.

Table 26
Rio Salado Oeste
With Project Analysis - Floodwall Improvements
Parcels with Highest Damage Potential

	2 Foot Floodwall	4 Foot Floodwall
Without Project	$ 123,800	$ 123,800
With Project	$ 62,300	$ 31,100
Damages Reduced	$ 61,500	$ 92,700
First Cost	$ 331,100	$ 485,900
Annual Cost	$ 20,000	$ 29,000
Net Benefits	$ 41,500	$ 63,700
Benefit/Cost Ratio	**3.1**	**3.2**

Recreation

Overview of Methodology

National Economic Development benefits arising from recreation opportunities created by a project are measured in terms of aggregate willingness to pay. Corps Principles and Guidelines describes three techniques which have been developed to estimate recreation demand and value. They include: 1) the Travel Cost Method; 2) the Contingent Value Method; and 3) the Unit Day Method. The Unit Day method was the method chosen for this analysis.

The Unit Day method does not attempt to account for the impact of price on visitation to a recreation site. Instead, an assigned user day value is applied to the total number of estimated visitors. User day values are simulated market values judgmentally derived from a range of values agreed to by Federal water resource agencies. It is intended to represent the users average willingness to pay for a day of recreation activity at the site. When a properly formulated unit day value is applied to estimated use, an approximation of the area under the site demand curve is obtained, which is used in estimating recreation benefits.

A national schedule is available showing a range of values for both specialized and general recreation opportunities. A point rating system can be used to select a specific value from the published schedule of value ranges. Once alternatives have been formulated and recreation and environmental components identified and described, then unit day values can be selected with the input of Corps and local government agencies. These values are then applied to projected visitation.

There are several techniques available for projecting visitation. These include regional and site-specific use estimating models, the similar project method, and the capacity method. Since it has been established that there is substantial unmet demand for recreation in the market area, the method which will be utilized to estimate visitation is the capacity method. The capacity method involves the estimation of annual recreation use based on instantaneous resource or facility capacities and expected daily, weekly and seasonal use patterns. As specified in *National Economic Development Procedures Manual - Recreation* (IWR Report 86-R-4, p. 13-14), ABecause the capacity method does not involve the estimation of site-specific demand, its use is valid only when it has been otherwise determined that sufficient need exists in the market area of the proposed project to accommodate the project=s calculated capacity...The capacity method has its greatest potential for use in urban settings when it is immediately obvious that sufficient need exists for the opportunities that the proposed project could provide.≅

Unit day values will be calculated by assigning points to each activity (based upon Federal guidelines) and then converting total points to dollar recreation values (per ER 1105-2-100 conversion table). Point values are derived by ranking the potential recreation resource according to five different criteria:

Criteria	Key Variables	Range of Point Values
Recreation Experience	Number & type of activities	0-30
Availability of Opportunity	# of similar opportunities nearby	0-18
Carrying Capacity	Adequacy of facilities for activities	0-14
Accessibility	Ease of access to and within site	0-18
Environmental	Esthetic quality of site	0-20
Total		0-100

Based upon the total number of points assigned, UDV=s (FY 2005) can range from $3.09 to $9.28 per recreation day.

Proposed Recreation Alternatives

The City of Phoenix has developed a preliminary Recreation Plan. A copy of the analysis conducted by the City is included in the Recreation Appendix of the Feasibility Report. Please refer to this document for a detailed description of the proposed recreation plan. The plan=s goal is to provide opportunities for visitors of all ages from varied backgrounds to enjoy the environmental resource created by the restoration project while developing an awareness, knowledge and understanding of desert riparian habitats and its interrelatedness to the environment as a whole.

Major project features include four parking lots, information kiosks, a visitor center, overlooks, shade structures, bridges, trails, a staging area, signage and landscaping. Recreation activities provided by the plan include: walking, hiking, biking, horseback riding, roller blading, picnicking, birding and possibly urban fishing. 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.

Benefit Analysis

Visitation Projections

Visitation at the resource will be limited based upon the available parking in the area. Phoenix=s design includes four parking lots with a total of 310 spaces. Visitation data maintained by the City for other recreation sites indicates an average number of visitors per vehicle of 2.75. In addition, it is estimated that ten percent of visitors arrive to the site by an alternative mode of transportation, e.g., bicycle, foot traffic and public transportation.

Annual visitation has been estimated for both winter (October - May) and summer (June - September) seasons. In addition, visitation has also been broken down by prime time (weekends and holidays) and non-prime time (weekdays). The following summarizes the results:

Table 27 Rio Salado Oeste Recreation Plan Baseline Visitation Estimate			
	Days	Turnover/Day	Visits*
Winter (Oct-May)	243		
Prime Time	78	1.50	99,743
Non-Prime Time	165	0.50	70,331
Winter Total			170,074
Summer (Jun-Sep)	122		
Prime Time	36	1.00	30,690
Non-Prime Time	86	0.25	18,329
Summer Total			49,019
Grand Total (By Vehicle)			219,093
Add - Arrive by Alternative Mode (10%)			21,909
Total Visitation			241,002
Less Transfers (10%)			24,100
Baseline Visitation for Benefit Analysis (Rounded)			217,000
* Note - Based Upon Parking Capacity of 190 Spaces & Avg. of 2.75 Persons/Vehicle			

Transfers are expected to be minimal due to the unique recreation opportunities and setting offered at the restoration site. The City expects the primary transfers to be in the categories of education field trips, bird watchers, passive nature watchers, canal joggers and recreational cyclists. Annual transfers were estimated at ten percent of total visitation. Excluding transfers, annual visitation is estimated at 217,000.

The above visitation projections were also compared to standards established by the National Recreation & Parks Association (NRPA), regarding trail usage and capacity. NRPA standards for trail capacity and use range from 40 to 90 users per day per trail mile (or between 14,600 to 32,850 users per year per trail mile). The proposed recreation plan includes approximately 24 miles of multipurpose trails. With baseline visitation projected at 217,000, this equates with a value of about 9,042 users per year per trail mile, which supports that the proposed facilities should be able to accommodate the projected visitation. Further, the proposed facilities should also be able to support likely increases in visitation over time, as the general population growth in the Study Area will inevitably increase demand and use of the facilities.

Unit Day Point Value Estimates

A panel of Phoenix Parks, Recreation and Library department personnel including Park Managers, Recreation Supervisors, Recreation Coordinators, and Landscape Architects reviewed the recreation plan in light of its location within the planned environmental restoration study area and derived the following point values for the Unit Day Value analysis:

Criteria	Range of Point Values	Assigned Value
Recreation Experience	0-30	29
Availability of Opportunity	0-18	12
Carrying Capacity	0-14	14
Accessibility	0-18	18
Environmental	0-20	17
Total	0-100	90

Recreation experience was rated very high, although most recreation activities could be described as general recreation. This is because of the context within which the recreation takes place. There are very few recreation sites in the market area located in a riparian and wetland environmental setting. This enhances the value of these activities. In addition, non-general recreation and education opportunities are provided, such as interpretive areas and scenic overlooks, birding, etc. The project will be designed to maximize recreational values in the other categories to the extent possible. Please refer to the City=s recreation analysis for additional details.

Table 6-28 of ER 1105-2-100 provides ranges for point value to dollar value conversion. The dollar value corresponding with a point value of 90 is $8.89. This point value was applied to projected annual visitation to derive the annual value of the recreation resource. The resulting annual recreation value totals $1,929,000 (rounded).

Recreation Costs & Benefit/Cost Analysis

Table 28, which follows, details the preliminary cost estimates for the proposed recreation plan.

Table 28
Rio Salado Oeste
Recreation Plan
Expected Annual Costs

First Cost		
51st Ave. Access Point		
Parking Lot (130 Spaces)	$	130,000
Other Features	$	300,000
35th, 67th & 83rd Ave. Access Points		
Parking Lots (3 x 60 spaces each)	$	180,000
Other Features (Combined Total)	$	677,000
Multipurpose Trails (24 Miles)	$	551,000
Trail Viewing Shelters (4)	$	1,000,000
Vegetation	$	303,000
Culverts & Bridgets (9 Each)	$	168,000
Subtotal – Construction	$	3,309,000
Contingency (25%)	$	827,250
PED/EDC (11%)	$	363,990
S&A (7%)	$	231,630
Total First Cost	**$**	**4,732,000**
Interest During Construction	$	266,000
Gross Investment	**$**	**4,998,000**
Annualized Investment Cost	$	300,600
OMRR&R	$	1,623,100
Total Annual Cost	**$**	**1,923,700**

Average annual benefits have been estimated at $1,929,000, and average annual costs are estimated at about $1,924,000. Therefore, preliminary analysis indicates that the proposed recreation plan is economically justified.

Rio Salado Oeste Feasibility Study

Table of Contents

PURPOSE 1
METHODOLOGY 1
STUDY AREA 1
Location 1
Problems & Opportunities 1
Population 4
Population Projections 4
Land Use 6
Housing Unit Projections 6
Non-Household Projections 7
Summary 7
Employment & Economy 7
WITHOUT PROJECT CONDITIONS 9
Environmental Resources 9
Hydrogeomorphic Model Description 9
HGM Results – Without Project Conditions 10
Flood Damages 11
Historical Flood Damages 11
Floodplain Boundaries & Reach Definitions 11
Number of Structures 16
Value of Structures & Contents 16
Without Project Structure & Content Damages 18
Overview of Methodology 18
Results – Base Year (2008) 20
Results – Future Conditions (2057) 22
Without Project Emergency & Cleanup Costs 23
Cleanup, Debris Removal & Public Infrastructure Repairs 23
Temporary Evacuation, Relocation and Housing Assistance Costs 24
Without Project Flood Damage Analysis Summary 25
Recreation 27
Existing Recreation Resources in Market Area 27
Recreation Demand 30
Recreation Opportunities 33
WITH PROJECT CONDITIONS 35
Environmental Resources 35
Description of Alternatives 35
Alternative 2 35
Alternative 3 35
Alternative 4 35
Alternative 5 35
Alternative 5A 35
Alternative 5B 35
Benefits of Alternatives 36
Cost Estimates 36
Cost Effectiveness & Incremental Cost Analysis 37
Average Cost per Average Annual Function Capacity Unit 37
Cost Effectiveness Analysis 37
Incremental Cost Analysis 38

Recommended Ecosystem Restoration Plan 39
MCACES Cost Estimate 39
Flood Damage Analysis 39
Flood Damage Reduction Alternatives Analysis 40
Levees 40
Channelization 41
Non-Structural Measures 42
Relocation 42
Floodwall 43
Recreation 45
Overview of Methodology 45
Proposed Recreation Alternatives 46
Benefit Analysis 46
Visitation Projections 46
Unit Day Point Value Estimates 47
Recreation Costs & Benefit/Cost Analysis 48

US Army Corps of Engineers
Los Angeles District

RIO SALADO OESTE
F4 MILESTONE
Salt River-Phoenix, Arizona

Appendix H
Real Estate

March 2005

U.S. ARMY CORPS OF ENGINEERS, LOS ANGELES DISTRICT
PLANNING DIVISION, WATER RESOURCES BRANCH
P.O. BOX 532711
LOS ANGELES, CALIFORNIA 90053-2325

NARRATIVE SUMMARY

1. Project Location:

Rio Salado Oesta translates into Salt River- West. The Area is locate within Maricopa County, Arizona and consists of an 8-mile reach of the Salt River. This project lies immediately between the Rio Salado and the Tres Rios environmental restoration projects, both currently under construction and sponsored by the City of Phoenix. The Rio Salado Oesta study area extends from 19th avenue, the low end of the Rio Salado project, to 83rd Avenue, the point of commencement for the Tres Rios Project. The entire area where environmental restoration features will be implemented is within the 100 year floodplain. Restoration of this reach of the Salt River will provide connectivity and a corridor of environmental restoration on the Salt River through the city. The project is also aimed at providing some measure of flood damage protection and a holistic approach to the restoration to the hydraulic and riparian processes and functions of the Salt River .

2. Estimated Values:

(This Section to be developed.)

3. Recommendation for Easement .

This report will outline and support the use of an easement for environmental restoration to implement the proposed project . The suggested easement estate will be permanent and assignable so as to "run with the land". The suggested *Channel Improvement Estate* has been modified and adopted specifically for the project features to be developed and is submitted for approval with this feasibility level report according to ER 405-1-12 Chapter 12 , Paragraph 12-8 e

Figure 1: Study and Project Area Boundaries

(Reserved)

Appendix G: Draft Real Estate Plan Jan 2005

Rio Salado Oesta, Arizona
Feasibility Study

Abstract of Project Data:

Project Name: Rio Salado Oesta, Phoenix, Arizona

Location: City of Phoenix , Arizona

Project Purpose: Environmental Restoration

Acreage: Lands Required for Environmental Restoration (Alt. 5A): _____Total Acres;

Project Sponsor: City of Phoenix.

NOTE: This is DRAFT written prior to identification to a selected alternative. As such much of the material presently known on the plan formulation is preliminary in nature and subject to refinement. A more detailed REP will be prepared upon selection of a recommended plan, Phase 4A, which will fill in many of the areas that are reserved or where more detailed information is to be presented.

1. Introduction:

The Rio Salado Oesta , Salt River (West) Study is being performed to investigate water resources related problems and provide potential solutions to these identified problems. The primary problem identified is that of ecosystem restoration, which is the focus of the Feasibility Study and this Real Estate Plan (REP).

The study area and total environs consists of approximately 3,315 acres. Not all of this study area designated as a broad corridor of the study environs will be used in the final selected alternative.

The Salt River River has experienced large-scale channel and environmental degradation over the last century. The construction of upstream dam and reservoirs for irrigation and reclamation coupled with the impacts of urbanization have resulted in the loss of critical riparian habitat and overall ecosystem degradation on the Salt River basin. Prior to development and urbanization in the Phoenix area, the Salt River flowed as a major perennial river, fed by the snowmelt and watersheds of the lands upon the Mogollan Rim and northeastern Arizona. In the early 1900's the construction of irrigation dams on the Salt River diverted water for agricultural and urban uses. Urbanization and development along the Salt River corridor further changed the natural river system. The habitat became severely degraded and disrupted due to these sudden changes. In conjunction, the basin experienced reduced flows , both in terms of surface flows surviving into the Phoenix reach and in the depth and availability of groundwater needed to support a riparian community. Today only isolated fragments of a once healthy

riparian system, once capable of sustaining the renown Hohokam and Pima cultures , remain.

2. Authority:

The statutory authority for this project is contained in the following enacted laws:

Section 6, Public Law 761, Seventy-fifth Congress, dated June 28, 1938, which reads,

> *"The Secretary of War is hereby authorized and directed to cause preliminary examination and surveys at the following locations...Gila River and Tributaries, Arizona."*

Additional authority was provided by House Resolution 2425, dated March 17, 1994 stating:

> *"... The Secretary of War is hereby requested to review reports of the Chief of Engineers on the State of Arizona... in the interest of flood damage reduction, environmental protection and restoration, and related purposes."*

Authority for project implementation will be sought in an upcoming Water Resources Development Act as a separately authorized civil works project.

3. Purpose of this Report:

The purpose of this Real Estate Plan (REP) is to support the Feasibility Study decision document. No prior REP has been developed.

4. Sponsor Capability:

The non-federal sponsor is a duly organized municipal organization in the State of Arizona and is vested with sufficient power to acquire and hold title, and to condemn lands as needed for public purposes. The sponsor has previously participated in other Corp of Engineers' Local Cooperation Projects such as the Rio Salado and Tres Rios projects. Both of these are similar large scale environmental restoration efforts. The City of Phoenix and has demonstrated their capabilities in acquiring real estate and performing the related obligations of a Non-Federal Sponsor.

5. Description of Recommended Plan:

This section is to be developed. As of January 2005 a recommended plan is not selected. However indication in the Draft "F-4" report suggests that alternative 5A or a variation *may emerge* as the selected plan. Details of the project features to be included in the final recommended plan will be furnished in the F-4A (AFB submittal)

6. Land Use and Acreage Allocations:

All of the acreage to be acquired for this project will be allocated to the project purpose of environmental restoration and credited accordingly for cost sharing purposes. There are no separable recreation lands and no separate recreation component. Any

recreational use described in the report falls under the heading of incidental recreation use.

the project footprint will be determined through the application of sound real estate principles including blocking out along regular and definable boundaries; minimizing severance; and maintaining usable and economic remainders ,. The project footprint is the minimal area needed to accommodate the construction, operation, maintenance, repair and replacement of the proposed project and will be the area credited toward the project.

7. Federal Lands, Interests or Reservations:

There are no federally owned lands, interests or reservations within the study or project area.

8. Navigational Servitude:

In the upstream reaches , the Salt River has been adopted and modified by several regional scale reclamation projects that are situated upstream of the proposed project area. These projects were constructed by the Bureau of Reclamation in association with the Salt River project, a municipal- governmental corporation established for irrigation and hydroelectric power generation and distribution in the Salt River Valley. Although the Salt River is not navigable, per se, the project area is located entirely within the floodway and floodplain influence, that is " between the banks" of the Salt River. This river corridor is regulated by the restrictions that are placed on the floodplain by the Federal Emergency Management Agency's programs and the Federal Flood Insurance Program. The river corridor within the 100 year floodplain is also regulated as being within the jurisdiction of the Clean Water Act as a "water of the United States".

Thus there are some areas where the Federal Government has exercised its jurisdiction and laws that have been enacted by Congress under the commerce clause. These laws and controls regulate activities in the floodplain of the Salt River. To the extent that there is some jurisdiction and regulation within the river corridor and 100-year floodplain, this provides support and justification for the use of a permanent easement estate. Some of the lands in this reach are Owned by public resource agencies such as the State of Arizona, and the Arizona Department of Game and Fish. These lands are managed and protected by the state as lands within the riverbed for their natural resource values. Together with the restrictions on the river and floodplain that already exist , it is recommended that a permanent and assignable easement estate possessed by the City of Phoenix will provide the minimally sufficient interest in the land to construct, operate, maintain rehabilitate, repair and replace this environmental restoration project. (See paragraph 14).

9. Description of Lands:

This section will be developed. At present the land within the study area includes private lands, along with some land owned by the Arizona Dept of Game and Fish and City of

Phoenix owned lands. The City of Phoenix is also acquiring some of this private land as opportunities arise in an ongoing effort at regenerating this urban corridor for public use.

The Salt River corridor within this study environs has been identified in the Maricopa County Comprehensive Plan for "Proposed Open Space" on the long term land use map. The comprehensive plan would contemplate that privately held lands within the river corridor be acquired to support a public use and managed for their natural amenities and open space attributes that are important to the quality of life in the County.

Based upon the City of Phoenix General Plan (dated February 2001) most of the land adjacent to the project that is usable and developable and situated on the north side of the river corridor between 19th avenue and 59th Avenue is zoned industrial with some residential use predominately between 43rd avenue and 60th avenue. Westward of 60th avenue to 83rd avenue, the land outside of the 100-year floodplain is zoned residential. The majority of the land on the south side of the Salt River is characterized by residential zoning.

Within the 100-year floodplain, where the environmental restoration features will be located, the land ownership includes private owners, sand and gravel operators, the State of Arizona , Maricopa County and the City of Phoenix. Because the land is within the river corridor there is a high degree of public agency ownership of the river basin and corridor.

10. Project Maps:

Project maps are included in the main body of the feasibility report.

11. Crediting for LERRD's:

Crediting will follow standard procedures as set out in a model Project Cooperation Agreement (PCA). No Credit will be afforded to any lands or interests previously acquired and credited for any applicable Corps of Engineers Project.

Credit will only be applied to the acreage within the "project footprint", namely the lands or corridor required for the Recommended Plan of improvements to be included in the Federal/Local Sponsor environmental restoration plan. Lands outside of the project requirements and lands that may be acquired for the sponsor's own purposes would not be creditable LERRD's. Only lands deemed necessary to be included in the project have been included.

Corps policy prescribes that credit will not be afforded for lands purchased with Federal funds or grants where the granting of such credit is not permissible. This might apply, for example, to lands acquired with funding from Department of the Interior agencies such as Fish and Wildlife Lands purchased with Federal funds.

12. Facility Relocations:

No information has been provided to date by plan formulation regarding the necessity for any facility relocations in the project area. Further engineering and design work will refine requirements for facility relocations during subsequent phases of the study and Pre-Construction Engineering and Design (PED), if approved for implementation.

Note: The following policy statement and disclaimer concerning any potential facility relocations prevails over any other statement, description or presentation in this report:

> *Any conclusion or categorization contained in this report that an item is a utility or facility relocation to be performed by the Non Federal Sponsor as part of its LERRD responsibilities is preliminary only. The Government will make a final determination of the relocations necessary for the construction, operation and maintenance of the project after further analysis. An Attorney's Opinion of Compensability will be generated for each facility/utility relocation and that is required for the project and which will be performed by, and credited to, the Non-Federal Sponsor under the definitions and terms of the PCA.*

Because the project is aimed at maximizing environmehntal restoration outputs in the river channel, it is contemplated that the physical relocation of utilities and pre-exisiting facilities will be avoided in formulation and design wherever possible. This will enable the project to concentrate its funding and resources on environmental outputs rather than utility infrastructure.

13. Mineral Activity:

The impacts of sand and gravel extraction are present within the study area. If at the time of valuation and acquisition of specific parcels, these activates are still present on lands to be acquired for the project, the appropriate valuation and highest and best use determinations will be applied as to any sand and gravel operations. It is contemplated that sand and gravel extraction will be diminishing and allowed to "play out" prior to the time that project implementation actually proceeds. Since this project is in the planning stages (contingent on future WRDA authorization), project implementation, that is construction, may be several years in the future.

As has been the practice on the Tres Rios and Rio Salado projects, the in place value of any merchantable sand and gravel and "common variety materials" will be incorporated into the valuation of river bottom lands where such materials exists and where it has been found by the appraiser as appropriate to include in the lands' valuation. This will fully considered when developing a gross appraisal and "LERRD" estimate.

14. Estates:

The recommended standard estate for environmental restoration projects is fee simple title. However, in this project due to the limitations imposed on the lands that preclude development within the floodplain and floodway and due to the fact that these lands are already subject to the flow and 100-year flood event of the Salt River, it is recommended that a permanent and assignable channel improvement easement for environmental restoration purposes may be used for this project. This is recommended in this

feasibility report pursuant to ER 405-1-12 Chapter 12–8 e and the recommended text of this permanent easement estate is set out here below: This is the ***minimally*** sufficient estate recommended for project implementation and does not preclude the City of Phoenix from acquiring fee where fee simple title can be acquired. The easement estate is contemplated principally for publicly owned lands such as the State of Arizona, Department of Fish and Game, and Maricopa County. Such easements will easements appurtenant and will be acquired so as to "run with the land".

CHANNEL IMPROVEMENTS FOR ENVIRONMENTAL RESTORATION EASEMENT- Rio Salado Project Tract:

A perpetual and assignable right and easement, to construct operate, maintain, repair , rehabilitate and replace works and measures for channel improvement and environmental restoration and incidental recreation, including, but not limited to,

** See Instructional Note **

{channel excavations, cuts and fills, channel construction , rectification and alignment, measures for water retention, detention and conveyance, basins and wetlands, irrigation systems patrol roads, lanes and paths to accommodate public travel, and the planting, management , maintenance and replacement of vegetation, including removal of invasive or undesired vegetation;}

on, over and across the land described in Schedule A, for the purposes of constructing the Rio Salado Oesta Environmental Restoration Project, Maricopa County Arizona, as authorized by the Act of Congress approved _____ , Water Resources Development Act of _____ and the attendant Chiefs of Engineer's Report cited therein, which report is available at the City Of Phoenix, Parks and Libraries Division 200 West Washington, Phoenix Arizona :, and for other purposes as may be required in connection with said project and the authorized plan of improvement; reserving however to the landowners, their heirs and assigns, all such rights and privileges as may be used without interfering with or abridging the rights and easement hereby acquired; subject however, to existing easements for public roads and highways, public utilities, railroads and pipelines.

This Easement shall run with the land and shall be binding upon the Grantor(s) named herein and their respective successors and assigns.

*{ * Instructional Note: within the bracketed material the acquiring agency (Grantee) may add, select or delete those features or measures as applicable to this particular tract acquisition}*

15. Construction Induced Flooding:

Appropriate measures will be taken for the care and diversion of water, if any, during construction. There will be no construction induced flooding on lands not normally subject to the flood flow and influence of the Salt River.

16. Baseline Cost Estimate:

Baseline cost estimate for all lands, easements, and rights-of-way included in the recommended plan { this valuation to be provided}.

17. Relocation Assistance (URA Relocations):

The City of Phoenix will accomplish all property acquisitions in accordance with Public Law 91-646, as amended, and the Uniform Regulations as promulgated by the U.S. Department of Transportation. The property needed for the project footprint is largely unimproved and it does not appear that any displacements of businesses or residences will be required due to the design and configuration of the project.

18. Other Matters, Other Property Interests, Use of Zoning:

No timber activity affects these lands. The sponsor is not using any zoning ordinances in lieu of acquisitions of lands or easements within the project take areas.

19. Hazardous Waste Assessments:

The sponsor fully understands its responsibilities for assessing the properties for any potential or presence of hazardous waste materials as defined and regulated under CERCLA. There is no known "Superfund" sites or sites presently under CERCLA remediation or response orders identified in the project area. There are no known presences of any substances in the project area that are regulated under CERCLA or other environmental statutes or regulations. Assessments and site investigations for the presence of such substances have not been conducted to date. The LERRD estimate is predicated on the assumption that all lands and properties are clean and require no remediation. The model PCA conditions contain specific terms and conditions governing the sponsor's responsibility for environmental cleanup for CERCLA regulated substances. Hazardous Waste Assessments are covered as a project cost under the model PCA.

20. Recreation:

There is no identified separable land (i.e., land acquired exclusively for recreation purposes for this project). All lands are allocated for the project purpose of environmental restoration.

21. Attitude of Landowners:

There is no focused or organized landowner opposition to the project. The sponsor will be conducting landowner and public information meetings to promote understanding of the project and how the landowners will be affected.

22. Report Content:

This report follows the requirements of ER-405-1-12, Chapter 12 and has been prepared using the information on the project formulation that has been provided. Comments received during internal Corps review have been incorporated and addressed as needed.

US Army Corps of Engineers
Los Angeles District

RIO SALADO OESTE
F4 MILESTONE
Salt River-Phoenix, Arizona

Appendix I
Functional Assessment Methodology

March 2005

U.S. ARMY CORPS OF ENGINEERS, LOS ANGELES DISTRICT
PLANNING DIVISION, WATER RESOURCES BRANCH
P.O. BOX 532711
LOS ANGELES, CALIFORNIA 90053-2325

Table of Contents

Summary
Chapter 1: Introduction
Study Purpose
Quantifying Ecological Processes and Biological Resources
Selection of a Functional Assessment Method for the Arizona Ecosystem Restoration Studies
Applying Functional Assessment to the Rio Salado Oeste Study: 10 Steps
Step 1: Rio Salado Oeste's Ecosystem Evaluation Team (E-team)
Step 2: Defining the Rio Salado Oeste Project
Step 3: Mapping Rio Salado Oeste's Partial Wetland Assessment Areas
Step 4: The Arizona Riverine Functional Assessment Tool
Step 5: Field Sampling for the Rio Salado Oeste Study
Step 6: Data Management and Statistical Analysis
Step 7: Calculate Baseline Conditions
Step 8: Rio Salado Oeste's Goals, Objectives, Project Life, and Target Years
Step 9: Rio Salado Oeste's Without-Project Conditions
Step 10: Rio Salado Oeste's With-Project Scenarios

Chapter 2: Baseline Conditions
Baseline Acres
Baseline Variable Values for Each Cover Type
Baseline Functional Assessment Results
Chapter 3: Without-Project Conditions
Acreage Losses in Rio Salado Oeste's Future Without-Project Condition
Functional Losses in Rio Salado Oeste's Future Without-Project Condition
Chapter 4: With-Project Conditions
Final Array of Alternatives Under Consideration
Chapter 5: Conclusions and Recommendations

List of Tables

Table 1-1. E-Team Members Participating in the Rio Salado Oeste Study
Table 1-2. Cover Types Identified for the Arizona Riverine Functional Assessment Tool
Table 1-3. Functions in the Arizona Riverine Functional Assessment Tool
Table 2-?. Rio Salado Oeste's Without-Project FCI and AAFCU Output
Table 2-1. Baseline Acres and Cover Types for Rio Salado Oeste
Table 2-2. Interpretation of FCI Scores Resulting From HGM Assessments
Table 2-3. Description of Existing Conditions in Terms of Ecological Processes, and Ecosystem Restoration Goals

Table 3-1. Without-Project Projections of Acreage Changes Over 50 Years

List of Figures

Figure 1 Rio Salado Oeste Study Area Location
Figure 2 Rio Salado Oeste Study Area Location
Figure 3 Example Variable Subindex (VSI) Curve

Summary

This report contains the analysis, results, and documentation of the Rio Salado Oeste HGM assessment. The U.S. Army Corps of Engineers (USACE), Los Angeles District is actively engaged in a Feasibility Study and Environmental Impact Statement (EIS) to evaluate the environmental benefits of proposed alternatives for the Rio Salado Oeste ecosystem restoration. An intensive Hydrogeomorphic Wetland Assessment (HGM) was undertaken to quantify ecosystem restoration benefits generated by proposed wetland design alternatives for the Rio Salado Oeste, Phoenix, Arizona, Ecosystem Restoration Feasibility Study (Oeste). The Rio Salado Oeste study area lies within and along the Salt River between 19th and 83rd Avenues in Phoenix, Maricopa County, Arizona. The 3,148-acre study area is approximately eight river miles in length. The study area lies upstream of the Tres Rios Feasibility Study area, and downstream of the authorized Rio Salado project area. The non-federal sponsor for the feasibility phase of the study is the City of Phoenix.

The Rio Salado Oeste Feasibility Study is coincident with four other riparian ecosystem restoration project feasibility studies in Arizona. Three of these projects are located in and around the Tucson, Arizona metropolitan area in reaches of the Santa Cruz and the Rillito Rivers. The fourth study is located upstream of the authorized Rio Salado project on the Salt River in the Phoenix, Arizona metropolitan area. Since these feasibility studies are addressing ecosystem restoration needs in similar riparian habitats in a small geographic area, there was an opportunity to develop a single functional assessment methodology for common use, which lead to the development of the Hydrogeomorphic Arizona Riverine Model.

Activities to be completed by the USACE during this feasibility study include investigating and evaluating all reasonable alternatives to improve and restore functional components of this highly disturbed riparian ecosystem and provide improved conditions for the establishment and persistence of native Sonoran Desert riparian vegetation communities and the associated native wildlife. The ecosystem restoration benefits resulting from the proposed alternatives were determined using an assessment methodology known as Hydrogeomorphic Modeling, (HGM). The specific HGM assessment tool was the Arizona Riverine Model developed with the input of regional experts, (Table 1-1). The Rio Salado Oeste study will also investigate and evaluate measures to increase flood protection and, where possible, to provide increased passive recreation and educational opportunities afforded by ecosystem restoration facilities. To determine the ecosystem restoration benefits resulting from various design alternatives, the HGM functional assessment model was modified and calibrated so that community characteristics, composition and functions observed and measured could be compared to what these attributes would be in a fully functional system, (Those measured and observed at the reference sites). The HGM assessment evaluated future changes in quantity (acres) and quality (functional capacity) of the aquatic, wetland and terrestrial ecosystems. Average Annual Functional Capacity Unit (AAFCU's) were calculated for the 50-year life of the project.

The District requested the assistance of the U. S. Army Engineer Research and Development Center, Environmental Laboratory (ERDC) to develop and evaluate a hydrogeomorphic wetland assessment (HGM)-based functional assessment methodology for use in the aforementioned

studies. Early in the evaluation process, an interagency Ecosystem Assessment Team (E-Team) was convened for the purpose of completing the field assessments. The E-team consisted of representatives from Planning Section C, the Los Angeles District technical sections, the U.S. Fish and Wildlife Service (USFWS), the Arizona Department of Fish and Game (ADFG), several environmental consulting firms, academia, and local and county governments. Each project team also included individuals responsible for project design and management. Together these individuals brought together the necessary technical expertise to support planning efforts requiring disciplines related to botany, soils, hydrology, hydraulics, geomorphology, and wildlife ecology.

Between 2002 and 2003, the E-Team completed intensive baseline habitat sampling activities at ten sites within the Gila River watershed. These sites consisted of the five feasibility study areas (including Rio Salado Oeste), and five "reference standard sites" for the calibration of the Functional Capacity Index (FCI) models. Based on the land uses present, the areas assessed were categorized into one of 19 cover types, or partial wetland assessment areas (PWAAs). Twenty-eight separate variables were measured for each PWAA in an attempt to develop a description of the baseline (2002) conditions at these sites. Ten FCI models were developed and used in the assessment to capture the functional capacity of the riparian habitats. These models focused on maintenance of characteristic channel dynamics, dynamic surface water storage and energy dissipation, long term surface water storage, dynamic subsurface water storage, nutrient cycling, removal and/or detention of imported elements, detention of particulates, maintenance of characteristic plant communities, maintain spatial structure of habitat, and the maintenance of corridors for interspersion and connectivity.

The specific, HGM-based functional assessment method resulting from these efforts is now known as the Arizona Riverine Assessment Tool (Functional Assessment Tool). The functional assessment was designed to evaluate the future changes in quantity (acres) and quality (functional capacity) of riverine, wetland and terrestrial riparian strand ecosystems. Outputs have been calculated in terms of annualized changes anticipated over the life of the project (e.g., Average Annual Functional Capacity Units or AAFCUs).

The Rio Salado Oeste E-Team developed twelve alternatives for the Rio Salado Oeste study and further refined these twelve to five alternative designs to intensively evaluate with the Functional Assessment Tool. The effects of proposed alternative designs were captured as change from the baseline condition over a 50-year project life in the assessment. AAFCU's have been calculated for the 50-year life of the project.

The results of the HGM analyses were compared using the Corps standard Cost Effectiveness (CEA) and Incremental Cost Analysis (ICA) techniques, and the biologically productive, cost effective alternative designs were revealed.

Chapter 1: Introduction

Study Purpose

The Rio Salado Oeste, Phoenix, Arizona; Ecosystem Restoration Feasibility Study is being conducted as a joint effort between the U.S. Army Corps of Engineers (USACE), Los Angeles District and the Non Federal Sponsor, the City of Phoenix (COP). The activities to be completed by the Corps during the feasibility study include investigating and evaluating all reasonable alternatives to provide for the restoration of Sonoran-desert riparian vegetation; and the associated riparian strand habitat, by restoring functional components of the riparian system that improve the systems ability to express and support associated high value native riparian plant communities, which support native wildlife and increase biodiversity. Other activities aim to increase flood protection, and where possible, to provide increased passive recreation and educational opportunities afforded by ecosystem restoration facilities.

The purpose of this study is to: (1) Identify and define the extent and magnitude of ecosystem degradation resulting from degradation and/or a loss in several functional components that drive riparian ecosystems; (2) Identify and define potential impacts due to flood events, and other damages related to land and water resource problems; (3) Evaluate problems and identify opportunities, constraints, and potential solutions; (4) Evaluate a comprehensive array of measures, elements, and ultimately comprehensive alternatives, on the basis of established planning criteria; (5) Identify a combined National Ecosystem Restoration (NER)/National Economic Development (NED) flood damage reduction, ecosystem restoration, and recreation plan; (6) Identify a "Locally Preferred Plan" (LPP) for implementation, should that plan differ from the combined NER/NED plan, and; (7) Recommend a plan for implementation, should federal interest and local support for the plan be demonstrated. This effort has involved, and will continue to involve, large-scale public communications and cooperation. Concurrently, the U. S. Fish and Wildlife Service, Phoenix, Arizona Office (USFWS) are preparing a Fish and Wildlife Coordination Act Report (CAR) under the National Transfer Fund agreement.

Quantifying Ecological Processes and Biological Resources

This feasibility study analyzes the alternatives being proposed for the Rio Salado Oeste ecosystem restoration project. The study area includes the system's broad river bottom, immediate banks, small washes, and older and stabilized depositional floodplain terraces, along with biological components that make up ecological communities and riparian ecosystems of the Sonoran Desert. Several tributary washes traverse these older floodplain terraces. Active floodplains are considered to be areas with hydrologic connection to the river.

Biotic resources, whether plant communities or individuals of species, inherently follow riverine patterns. Determining the value of biological resources requires a method to characterize why the biotic patterns appear as they do within the study area, rather than merely describing existing conditions. This feasibility study assesses ecosystem function using the methodology developed in the following report, which is incorporated by reference:

Burks-Copes, K. A. and A. C. Webb. 2003. *Tres Rios del Norte (Pima County, Arizona) Ecosystem Restoration Functional Assessment Using HGM: Analyses, Results and Documentation.* Draft Report. U. S. Army Engineer Research and Development Center, Environmental Laboratory, Vicksburg, MS. 112 pp. + appendices.

This functional assessment yields quantitative descriptions of biological resources along and adjacent to the Salt River, projections of changes in fundamental ecosystem processes without which ecosystem restoration itself cannot happen, and quantitative predictions of the results of implementing the proposed alternatives. The assessment was designed to evaluate the future changes in quantity (acres) and quality (wetland functional capacity) of riverine, wetland and terrestrial riparian strand ecosystems. Outputs have been calculated in terms of annualized changes anticipated over the life of the project (e.g., Average Annual Functional Capacity Units or AAFCUs). Results are compared using standard USACE incremental analysis (Economics Appendix).

Results were compared using standard USACE cost evaluation procedures. Early in the evaluation process, an interagency Ecosystem Assessment Team (E-Team) was convened. Scientists from the U. S. Army Engineer Research and Development Center, Environmental Laboratory (ERDC) facilitated the efforts. Representatives from Planning Section C, the Los Angeles District technical sections, the U.S. Fish and Wildlife Service (USFWS), the Arizona Department of Fish and Game (ADFG), several environmental consulting firms, academia, and local and county governments actively participated in the assessments. The functional assessment for the Rio Salado Oeste feasibility study follows.

The Rio Salado Oeste ER-FS HGM assessments in their entirety, in addition to the results of the cost analyses are presented in the following chapters. The body of this report is divided into five (5) chapters:

Chapter 1: Introduction
Chapter 2: Methods
Chapter 3: Without-Project and With-Project Conditions
Chapter 4: Trade-Offs
Chapter 5: Summary and Conclusions

In addition, other chapters that lend support to this report are Literature Cited and the Glossary.

Chapter 2 presents the HGM tool and describes the methods used to develop the models and conduct the HGM assessment. A description is provided that details the selection, development, verification, and deployment of the functional model(s) used to assess the efficacy of the proposed Rio Salado Oeste ER-FR. The E-Team is introduced in this chapter and the decisions and assumptions made during the HGM development and evaluation processes are fully documented. Technical terminologies utilized in the description and applications of the HGM tool are also included in this chapter.

Chapter 3 provides the results of the analysis of the proposed Rio Salado Oeste ecosystem restoration effort. First, a description of the baseline habitat conditions is provided including the

documentation of sampling techniques, delineation of cover types and Partial Wetland Assessment Areas (PWAA's), data handling techniques, decisions made in the utilization of data in the analysis, and the derivation of baseline functional capacity units per PWAA. Next the assumptions and projected data used in the HGM are presented with the results of the analyses detailed at the end of the chapter. Details of the functional habitat gains are summarized in a series of "Results" tables located within this chapter.

Chapter 4 discusses the trade-offs process and used for the Rio Salado Oeste Environmental Restoration Study. Although the biological study Team did not adopt the ERDC trade offs process, during the HGM process and alternatives formulation process, alternatives were compared based upon the model outcomes with respect to wetland functions achieved, plant communities present, and the overall species mixture of the proposed system. This chapter discusses the rational used in foregoing the formal trade off process in lieu of assumptions made at the variable level of the model development process.

Chapter 5 provides an overall project summary of the results and conclusions of the HGM analysis. Included is a summary of the top three biological (HGM), and top three incrementally cost effective alternatives.

Chapter 2 Methods:

The restoration of an ecosystem must focus on the recovery of specific system attributes that promote human welfare independent of human use. Such "non-use" benefits can arise from the mere existence and/or maintenance of nationally or regionally rare and unique ecosystems. Indeed, the public is likely to view the protection of endangered species and their associated habitats, as an important goal of ecosystem restoration. There is no doubt the determination of restoration success based on ecosystem processes is complex. Yet, federal law requires USACE Districts to evaluate the measures proposed for restoring ecosystem service outputs at levels used to justify the project. To facilitate efficiency, evaluation methodologies need be no more elaborate than required to demonstrate that the anticipated ecological outputs justify project costs effectively. To ensure effectiveness, these methods need to include the ecosystem elements necessary for linking management measures to the resulting level of ecosystem integrity providing the justifying level of output. To guarantee plan completeness, the scope of the method or tool should fit the ecological and social dimensions of environmental problems targeted by ecosystem restoration. To assure plan acceptance, the models and other decision-support methods must comply with institutional constraints and influential public opinion (both technically and politically). The main problem addressed in the search for appropriate decision-support methods is how to evaluate the relative ecosystem restoration worthiness of non-monetary environmental service. Once non-monetary service is characterized in a fundable measure, it can be compared to other proposed projects, and to independent estimates of monetized service benefits and costs in a public forum. With key stakeholders involved, the monetized opportunity costs incurred by restoring the non-monetary service value can be weighed against the opportunity costs among other inputs.

Types of Ecosystem Restoration Evaluation Methodologies

USACE planning studies in general depend upon non-monetary evaluation methodologies to quantify inherent ecological processes - the functions ecosystems carry out in nature. These functions depend upon particular attributes that correspond to physical features of an ecological setting (e.g., the density of tree canopy over a section of stream bank, permeability of soils which form that bank, and complexity of surface relief along that bank). It should be noted, that these attributes can be measured, counted, or described concisely in a standardized way. The attributes of interest in landscape-scale analyses of ecologically important processes nearly always have an inherent sense of quantity that affects the manner in which they influence the ecosystem. For example, dense tree canopy is indicative of forest age, health, vigor, water availability and nutrient cycling at any given location. Several evaluation techniques have been developed to capture or quantify ecosystem health and function. Three approaches are described here: Species-based models, Community-based models, and Function-based models.[1]

Species-Based Habitat Indices

USACE presently uses the habitat unit concept to characterize the non-monetary outputs of ecosystems that must justify project costs. The concept is closely associated with development of the HEP developed under the lead of the USFWS (USFWS 1980a-c). HEP measures the effects of environmental change through a series of species-based Habitat Suitability Indices (HSIs) developed for approximately 160 individual fish and wildlife species. The species-based HSI models rely on field measured habitat parameters, which are integrated into a single, probability-of-use index ranging from zero to one. HEP uses a simple multiplication product of impacted area in acres and HSI to calculate Habitat Units (HUs). Species-based HSIs models deployed in the traditional HEP methodology are numerous, easy to use, are relatively inexpensive, but not immediately available or applicable to the arid southwest region, and do not capture all of the important habitat/ecosystem elements or all of the justifying value needed to restore ecosystems. Species-based HSI models are not scaled based on ecosystem integrity and should only be used to indicate a more naturally integrated ecosystem condition when the HSI value is known for the targeted restored condition. Few existing single-species HSI models satisfy these criteria well, but ecosystems might be characterized by new models for native dominant and keystone species, including dominant plant species and top-carnivore species, used in series with a few HSI models for rare species in the community. Several species-based HSIs might then "bracket" the community-habitat relationships satisfactorily, but the need for many new models offsets this technique's primary advantages.

Community-Based Habitat Indices

Existing community-based HSI models offer more promise than species-based HSI models because they are more efficient in capturing those habitat measures necessary for restoring ecosystem integrity and can be compared across a wide range of ecosystems for prioritization purposes (Stakhiv et al. 2001). Community-based HSI models indicate relative ecosystem value

[1] For more details regarding terms used here, refer to Appendix B.

more inclusively than species-based models because they link habitat more broadly to ecosystem components or functions. While species richness is relatively easy to link to habitat features in community-based HSI models, species richness may not effectively predict the number of endangered species present in an ecosystem. Most species richness measures are limited to a few taxonomic categories, such as birds, fish, or aquatic insects. The taxonomic groups chosen for characterizing integrity may not characterize to a fine enough degree the habitat needs of the endangered species. Complete models would need to account for this potential deficiency by assuring the diversity measure is inclusive of the vulnerable species or by including a separate relationship between vulnerable-species and habitat conditions. Again, each community would require a unique model of habitat-species relationships. Relatively few community prototype models have been developed for the arid southwest, and most of the models would require considerable investment to cover the variety of ecosystems managed by USACE nationwide.

Function-Based Indices

Recently, ERDC developed a HEP-like approach to assessing the functional capacity of a wetland using standard wetland assessment protocols typically deployed in the regulatory arena (Smith et al. 1995). Referred to as the Hydrogeomorphic Approach or HGM, an assessment model is developed and serves as a simple representation of functions performed by a wetland ecosystem (Ainslie et al. 1999). The functional models developed in HGM define the relationships between one or more characteristics/processes of the wetland ecosystem (or surrounding landscape) and the functional capacity of a wetland ecosystem. Functional capacity is simply the ability of a wetland to perform a function as it compares to the level of performance in reference standard wetlands. The HGM approach is based on a series of predictive FCIs – quantifying the capacity of wetlands to perform a function relative to other wetlands from a regional wetland subclass in a reference domain. Some examples of FCI models include floodwater detention, internal nutrient cycling, organic carbon export, removal and sequestration of elements and compounds, maintenance of characteristic plant communities, and wildlife habitat maintenance. FCI models are, by definition, scaled from zero to one. An index of "1" indicates that a wetland performs a function at the highest sustainable functional capacity, the level equivalent to a wetland under reference standard conditions in a reference domain. An index of "0" indicates the wetland does not perform the function at a measurable level and will not recover the capacity to perform the function through natural processes. An HGM subclass model is basically an assimilation of multiple FCI models combined in a specific fashion to mimic a site's functionality. Users review and select several FCI models to evaluate the overall site's functionality.[2]

Past Ecosystem Evaluation Methods Used in the District

In prior studies, the District primarily evaluated wildlife benefits using a technique referred to as modified Habitat Evaluation Procedures (mHEP) (Tetra Tech, Inc. 2002). The basic premise of this modified procedure focused on a field reconnaissance approach where biologists surveyed a study site to familiarize themselves with the current conditions of the study area. The conditions were characterized by experts in the field and assigned a score between zero and one based on

[2] For more background information on the HGM approach refer to Webb, Burks-Copes and Henderson 2003.

their opinion of healthy, pristine, natural conditions. Graphical illustrations of conditions ranging from the zero to one scale were provided to the experts, and they were asked to select the "best-fit" representation for each community per site. The score for each location of each community was assigned, and an average was calculated for at least five locations (where more than five were available). By multiplying the average value by the total measured area of each community type, a single derived number was calculated to obtain units. This approach was often efficient, however, the results were often not repeatable and clearly subjective. In other words, a new team of experts visiting the site could derive a wholly different set of values for the communities, and baseline conditions would appear much worse or much better than this initial study predicts.

Selection of the HGM Method for the Arizona Ecosystem Studies

In 2002, the District began the process of formulating alternative designs for the five Arizona Ecosystem Restoration planning studies (El Rio Antiguo on the Rillito River, Paseo de las Iglesias and Tres Rios del Norte on the Santa Cruz River, Rio Salado Oeste and Va Shly'ay Akimel on the Salt River). With USACE's history of concentrating solely on a flood control mission, the challenge (made by participating resource agencies) was to utilize ecosystem restoration as the overall study design. The District partnered with ERDC and two resource agencies [i.e., USFWS and ADFG] to ensure all stakeholder issues were considered. Given these "outside" interests, setting ecosystem restoration objectives and performance criteria on the holistic recovery of "non-use" benefits, such as wildlife habitat, hydrology and biogeochemical processes, was critical to the overall planning process for the studies. It is important to note the basic ecological premise behind ecosystem restoration is the recovery of limiting components, defined by their primary functional characteristics, be they water, soils and/or habitat structure. The primary goal of the Arizona planning studies was therefore focused on the restoration of such functional components within each study area. It was important then, that the approach selected to quantify benefits for the studies be repeatable, efficient and effective, as results would more than likely be questioned by outside interests - the participating agencies could not afford to spend excessive quantities of time justifying designs.

As indicated above, both HGM and HEP quantify benefits in terms of "quality" based on index models scaled from zero to one. Both approaches use the same math to generate units (i.e., they both multiply index scores by acreage). Both HEP and HGM require the use of "time-scale" projections to capture these units in both the with- and without-project conditions. The primary difference between the two techniques is in the modeling itself. HGM emphasizes the functions associated with the range of physical and chemical attributes comprising habitat of wetland ecosystems. HEP assessments are generally ineffective in capturing wetland functionality as a whole, and more focused on habitat suitability for a specific species. Thus, the HGM approach has one important advantage over the HEP, in that it is more inclusive of dynamic ecosystem functions relevant to ecosystem services.[3] For these reasons, the District selected HGM to quantify the anticipated benefits gained by the proposed ecosystem restoration activities.

[3] For more details regarding the similarities and differences of the HEP and HGM approaches refer to Appendix C.

Selection of a Functional Assessment Method for the Arizona Ecosystem Restoration Studies

In 2002, the District began the process of formulating alternative designs for the five Arizona Ecosystem Restoration planning studies (El Rio Antiguo on the Rillito River, Paseo de las Iglesias and Tres Rios del Norte on the Santa Cruz River, and Rio Salado Oeste and Va Shly'ay Akimel on the Salt River). With the USACE's history of concentrating solely on a flood control mission, the challenge was to utilize ecosystem restoration as the overall study design. The District partnered with ERDC, sponsors, environmental consultants, local universities and scientists, and two resource agencies (USFWS and ADFG) to ensure that all issues were considered.

Setting ecosystem restoration objectives and performance criteria on the holistic recovery of "non-use" benefits, such as wildlife habitat, hydrology and biogeochemical processes, is critical to the overall planning process for the studies. It is important to note the basic ecological premise behind ecosystem restoration is the recovery of limiting components, defined by their primary functional characteristics. The primary goal of these studies is the restoration of ecosystem functional components within each study area.

The Arizona Riverine Assessment Tool was selected as the functional assessment method for use in the Rio Salado Oeste study because it offers a "holistic" approach to ecosystem evaluation, which provides a boarder perspective when planning complex restoration project. Additionally, there is a lack of representative species, for the index references of which the habitat evaluation procedure (HEP) is comprised making it less feasible for this study. Although every evaluation is somewhat subjective, this application of functional assessment for this study is carefully documented, repeatable, and based on consistent scientific input from the study team.

Finally, the results of the functional assessment can be communicated to engineers and scientists in terms that allow for design and restoration measures and further analysis. For this study, the functional assessment can be considered a tool by which collective expert knowledge on ecosystem processes is gathered and expressed in a measurable format. Rather than focus on the overall evaluation of an ecosystem, which may be subjective, the functional assessment method directs the focus of the study team experts on the functions, or "building blocks," of the ecosystem. Functional assessment combines the expert knowledge on these ecosystem building blocks. It provides the basis for the "biological yardstick" to measure ecosystem health and evaluate alternatives.

Applying Functional Assessment to the Rio Salado Oeste Study: 10 Steps

Ten steps were completed in the assessment of Rio Salado Oeste's proposed ecosystem restoration designs using this functional assessment method. Briefly, they included:

1. Building a multi-disciplinary evaluation team (E-Team).

2. Defining the project.
3. Mapping the site's PWAAs.
4. The Arizona Riverine Functional Assessment Tool
5. Conducting field sampling.
6. Performing data management and statistical analyses.
7. Calculating baseline conditions.
8. Setting goals and objectives, and defining project life and Target Years (TYs).
9. Generating without-project conditions and calculating outputs.
10. Generating with-project conditions and calculating outputs.

The following sections provide the details of the application of the Rio Salado Oeste application plan formulation process and the application of the HGM technique to the study's designs.

Step 1: Rio Salado Oeste's Ecosystem Evaluation Team (E-team)

In using functional assessment, an interagency, interdisciplinary team is formed to lead both the model selection/development phase of the project, and to establish the baseline and future conditions of the site(s). Participants often include representatives from USACE, the U. S. Environmental Protection Agency (USEPA), USFWS, the Natural Resources Conservation Service (NRCS), state fish and game offices, and other federal, state, and local governments as well as tribes as is deemed necessary. The technical expertise necessary to support planning efforts should include, but is not restricted to, representatives from botany, soils, hydrology, and wildlife ecology disciplines. The team should also include those individuals responsible for project design and management (i.e., engineers, project managers, NEPA consultants, cost-share sponsors, university professors, etc.).

Scientists from the U. S. Army Engineer Research and Development Center, Environmental Laboratory (ERDC) facilitated the ecosystem evaluation efforts. Representatives from Planning Section C, the Los Angeles District proper, the U.S. Fish and Wildlife Service (USFWS), the Arizona Department of Fish and Game (ADFG), several environmental consulting firms, academia, and local and county actively participated in the modification of the HGM method for Arizona streams and assessment of the study site. The multidisciplinary ecosystem evaluation team (E-Team) was convened early in June of 2002 to conduct without project assessments for the Rio Salado Oeste study and again in 2004 to evaluate with project conditions. Members of the E-Team participating in the Rio Salado Oeste Feasibility Study are listed in Table 1-1.

Table 1 – 1. E-Team Members Participating in the Rio Salado Oeste Study

NAME	ORGANIZATION/COMPANY	DISCIPLINE
Mr. Scott Estergard	USACE, Los Angeles District	Study Mgr/Biologist/Ecologist
Mr. Mike Fink	USACE, Los Angeles District	Biologist
Ms. Antisa Webb	ERDC-EL	Facilitator
Ms. Kelly Burks-Copes	ERDC-EL	Facilitator
Ms. Amy Lee	ERDC-EL	Ecologist
Ms. Karen Dada	City of Phoenix	Study Manager
Walt Kinsler	City of Phoenix	Landscape Architect
Mr. Mike Martinez	U.S. Fish and Wildlife Service	Biologist
Kathy Reichert	City of Phoenix	Parks and Recreation
Ms. Michele Waltz	Jones & Stokes	Project Manager
Mr. Bill Werner	Arizona Game & Fish Department	Ecologist
Karen Williams	City of Phoenix	Project Manager
Mr. Timothy Kennedy	USACE, Los Angeles District	Environmental Coordinator
Ms. Lois Goodman	USACE, Los Angeles District	Biologist

Step 2: Defining the Rio Salado Oeste Project

Geographic Location. The study area is located in the lower Sonoran Desert in the Salt River Watershed. The study area includes portions of the City of Phoenix, Maricopa County, and state and federal land. The study reach extends from the upstream limit of 19th Avenue down to the lower limit of 83rd Avenue – a distance of approximately eight miles. The downstream boundary of the study reach lies approximately 2.5 miles upstream of the confluence of the Salt and Gila Rivers. **Figure 1** shows the location of the Rio Salado Oeste study area. **Figure 2** provides an aerial view of the study area. The study area is located upstream of the Tres Rios Feasibility Study area, and downstream of the authorized Rio Salado project area

FIGURE 1
RIO SALADO OESTE STUDY AREA LOCATION

U. S. ARMY, ENGINEER DISTRICT — CORPS OF ENGINEERS

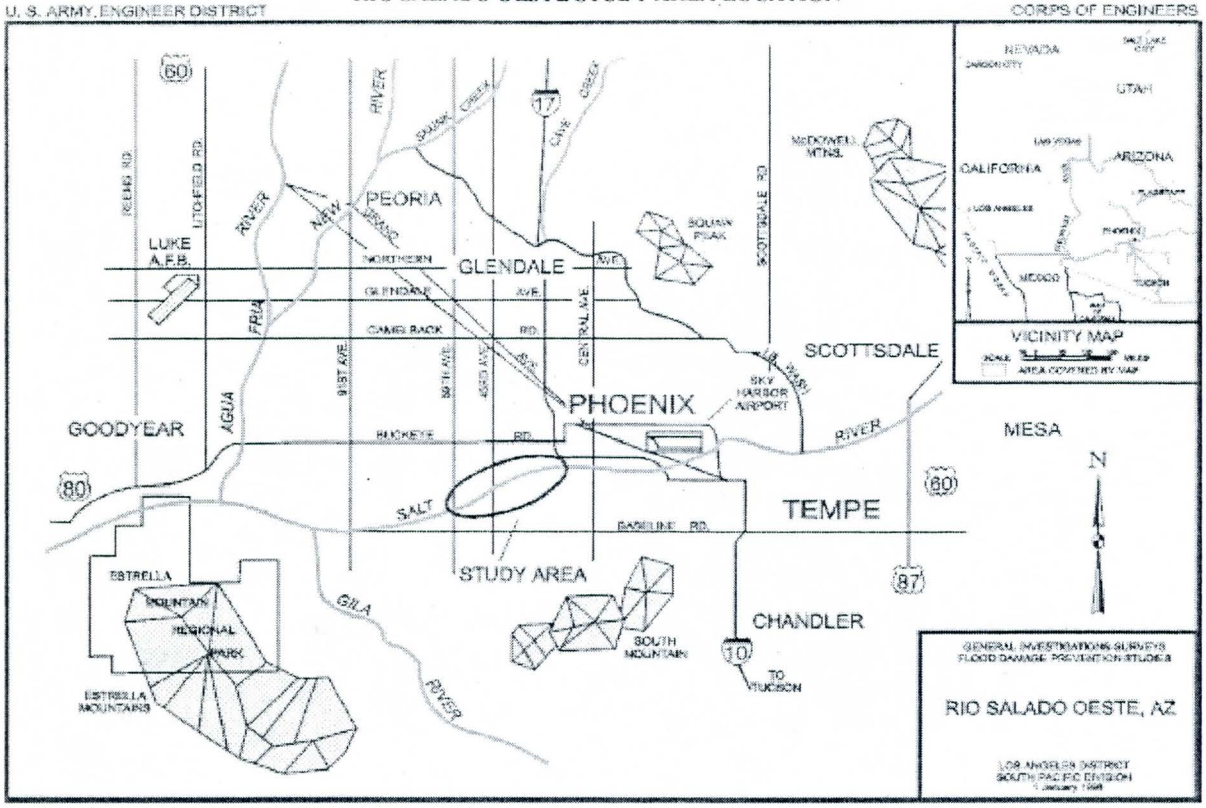
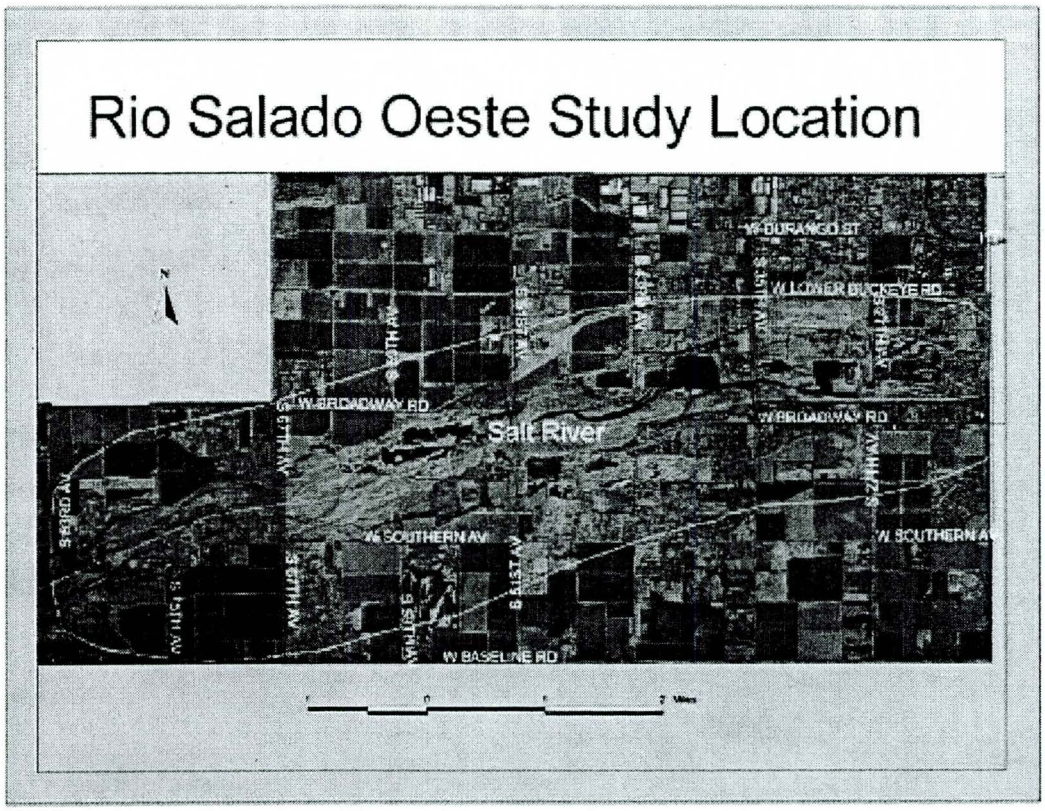


FIGURE 2
RIO SALADO OESTE STUDY AREA – AERIAL VIEW



Hydrology and Geomorphology. 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).

The Rio Salado Oeste study area lies within the lower Salt River valley near the center of the Gila River basin. The Salt River drains 14,500 square miles of mountainous terrain in central and eastern Arizona. By far, the largest tributary of the Salt River is the Verde River, which joins the Salt River approximately 30 miles upstream of 19th Avenue. The Salt River is the largest tributary to the Gila River. Annual average rainfall in the lower Salt River Valley is approximately 8 inches, while rainfall at the highest elevations of the watershed ranges up to 14 inches annually (U.S. Geological Survey, 1991). – full reference citation needed.

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 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.

Prior to the onset of European settlement, the Salt River was one of the few perennially watered riparian areas of the Sonoran Desert, supporting Native Americans, wildlife, and highly productive cottonwood, willow, and mesquite habitats. Flows in the river had a distinct seasonal pattern, with highest flows occurring in December and January and lowest flows in October. The river was a significant source of ground water recharge in some areas and a recipient of ground water discharge in other areas.

Beginning in the early 1900's, the historical conditions of the Salt River were altered by construction of dams on the Salt and Verde Rivers upstream of the study area. Due to dam construction, flow diversions and subsequent ground water withdrawal, perennial flows on the Salt River ceased. This 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 ground water table beneath the river dropped, soil moisture in the riverbed was virtually eliminated, and the native cottonwoods, willows and riparian ecosystem rapidly died out. The river has been further impacted by construction of bridges and levees, and ongoing sand and gravel mining operations. Most areas of the Salt River are barren today. What little vegetation does exist is mostly limited to salt cedar, an exotic non-native species with little habitat value.

Soil moisture within close proximity to the surface (in the bed and banks of the channel) remains high in areas adjacent to wastewater treatment plant effluent discharges. However, this water is not available throughout the study area, nor is it available to support historical extent of riparian vegetation once associated with these reaches. Indeed, changes in water availability and extent have permanently impacted surface/groundwater interactions and sedimentation dynamics important in the sustenance and regeneration of riparian vegetation. While a significant portion

of this effluent flow infiltrates into the bed of the channel, groundwater levels in the Rio Salado Oeste study area currently range from approximately 30 to 100 feet below the land surface. As a direct results of the disconnection between surface and groundwater over the last century, the Salt River has changed from a braided and meandering streambed with a broad floodplain to a channel morphology shaped by sand and gravel mining, as well as uncharacteristic flood discharges that have scoured and incised the river.

Land Use Practices. Agriculture, urbanization and resource extraction have adversely affected the diversity and extent of the Salt River ecosystem. Historically, the perennial water source encouraged human settlement and agricultural practices that date back thousands of years. The Salt River also served as an important transportation route for Native Americans, missionaries, Spanish explorers, colonizers, miners, cattlemen, and settlers.

The water supply and hydropower benefits that the dams provided led to the economic development of the Phoenix metropolitan area. Phoenix grew from a settlement that supplied food and animal feed to the Army outposts and mines in the area to its current population of 3.2 million people. Agricultural land was rapidly being converted to urban uses to support this growth. Beginning in the late 1970s and early 1980s, sand and gravel mining operations were introduced. The demand for these construction and landscape materials is increasing along with the human population. Sand and gravel mining continues to this date along the Salt River within the study area. Today, the study area consists of a mixture of urban residential, commercial, industrial, agricultural, and open space land uses.

A rapid but declining rate of population growth is anticipated for the City of Phoenix and Maricopa County as a whole. Significant development of residential and non-residential land will be required to accommodate the projected growth. In the study area, existing land uses are primarily comprised of agriculture, industrial and low-density residential. It is anticipated that additional low-to-medium density residential development will take place due to the close proximity of the area to the city core. Existing vacant and agricultural land will likely be converted to residential uses.

Riparian Habitat. Like many rivers in the southwest, the Salt River once had a highly mobile channel that periodically changed location across a wide floodplain. Within this floodplain, the high water table supported extensive riparian forests of cottonwood, willow and mesquite. Subsurface flows and groundwater discharge supported biologically productive cienegas (seep marshlands). With the establishment and growth of the Phoenix metropolitan area, the Salt River has experienced severe and accelerated degradation and loss of riparian habitat. Upstream dams and increasing withdrawal of surface and groundwater flow (primarily attributed to a growing human population and agriculture) has changed the Salt River from a river with a highly available surface and subsurface flow to a primarily dry channel that flows only in response to storm runoff. The lower Salt River within the study area has perennial flow only in association with wastewater discharges from the 23rd Avenue Wastewater treatment plant. As a result of the aforementioned hydrological alterations, stands of native riparian habitat are rare along the lower Salt River, particularly in the study area.

As land within the lower Salt River watershed has been converted to other uses, most of the biological resources and native habitat in the study area have been lost. Degradation of the river bottom, channel banks and adjacent overbank areas due to changing land uses has significantly impacted the once biologically rich and diverse habitat associated with the river. Biologically rich mesquite bosque habitats have largely disappeared. Sand and gravel extraction has removed large volumes of sediment, leaving open pits with very little resource value that function as sediment traps.

Project Evolution, Purpose, and Rio Salado Oeste's Ecosystem Approach. The study area is currently experiencing negative impacts due to the rapid shift of land uses within the watershed. Urban development has increased impervious cover, resulting in increased peaks and volumes of runoff entering tributaries and the Salt River itself. This has led to erosion of channel beds and banks and increased destruction of the vegetative resources. Conversion of open space has resulted in the loss of overbank storage during flood events. Where water once overflowed the banks of the river during floods, flood protection measures (meant to protect former floodplains) have caused increased volumes of flow to be held within the channel, necessitating bank protection and channelization. This in turn has led to accelerated loss of resources within the channel and in overbank areas. Urban development has also brought increased population pressure to the study area. The increased human presence has resulted in soil compaction, increased damage to the environment due to vehicle usage, and the introduction of large amounts of litter and debris. Demographic projections indicate a continued high rate of development in the study area over the 50-year planning horizon. This trend suggests that development of the floodplain and subsequent channelization and loss of associated resources would be the likely outcome in the absence of measures taken to restore and set aside both the land and its associated habitats. If restoration efforts are delayed, the land needed for effective projects may no longer be available.

Step 3: Mapping Rio Salado Oeste's Partial Wetland Assessment Areas

To effectively evaluate the existing conditions, the study area was divided into manageable sections and quantified in terms of acres. This process, referred to as partial wetland assessment area (PWAA) mapping or "cover typing", required the District to define the differences between vegetative covers (e.g., mesquite wetlands, shrub lands, open water, and river bottom streams, etc.), hydrology and soils characteristics, and clearly delineate these distinctions on a map. The final classification system, based primarily upon dominant vegetation cover, captured "natural" settings and common land-use practices in a specific and orderly fashion that accommodated the USACE's plan formulation process. The District then undertook an effort to map each PWAA in the proposed study. A total of 19 cover types were identified and mapped across all five feasibility study areas (Table 1-2). The PARKS, SOILCEMENT and NEWSCRUB cover types are not applicable to the Rio Salado Oeste feasibility study.

Table 1-2. Cover Types Identified for the Arizona Riverine Functional Assessment Tool

NO.	CODE	DESCRIPTION
1	AGCROP	Farms and Croplands - Dairy, Cotton, and Alfalfa
2	CWWFOREST	Existing Cottonwood-Willow Forests in the Active Channel
3	DESERT	Desert Areas – Bare Earth, Cacti, Rabbitbush, Acacia
4	DITCHES	Existing Ditches
5	DRY RIVER BOTTOM	Existing Dry River Bottom Areas in the Active Channel - Largely Unvegetated
6	MESQUITE	Existing Mesquite Woodlands – on the Terraces and in the Active Channel
7	NEWCWWFOR	Newly Planted Cottonwood-Willow Forests in the Active Channel
8	NEWDRYRVRBOTTOM	Newly Developed Dry River Bottom Areas in the Active Channel - Largely Unvegetated
9	NEWMESQUIT	Newly Planted Mesquite Woodlands - on the Terraces and in the Active Channel
10	NEWOPENWAT	Newly Developed Open Water Areas in the Active Channel
11	NEWSCRUB	Newly Planted Scrub - Shrublands in the Active Channel
12	NEWWETRVRBOTTOM	Newly Developed Wetted River Bottom Areas in the Active Channel – Primarily Emergent Vegetation
13	OPENWATER	Existing Open Water Areas in the Active Channel - Inactive Sand and Gravel Operations
14	PARKS	Parks and Recreation Areas
15	SANDGRAVEL	Existing Sand and Gravel Operations/Extractions in the Active Channel
16	SCRUBSHRUB	Existing Scrub - Shrublands in the Active Channel – Rabbitbush, Quailbush, Ironwood, and Saltbush
17	SOILCEMENT	Existing Soil Cement Areas on the Slopes of the Active Channel
18	URBAN	Existing Residential, Industrial and Transportation Avenues
19	WETRVRBOTTOM	Existing Wetted River Bottom Areas in the Active Channel - Primarily Emergent Vegetation

For details regarding the total baseline acreages and quality of these PWAAs, refer to Chapter 3 of this report.

Step 4: The Arizona Riverine Functional Assessment Tool

Wetland Functions in the Arizona Riverine Model. The final version of the model contains 10 discrete functions. It is important to note that the functions described here were selected on the basis of their representation of ongoing critical ecosystem processes within the wetland

subclass. These functions, and the reasons supporting their inclusion in the characterization of arid riverine wetlands for the region, can be found in Table 1-3 below.

Table 1-3. Functions in the Arizona Riverine Functional Assessment Tool

CODE	NAME	DESCRIPTION
CHANNELDYN	Function 1: Maintenance of Characteristic Channel Dynamics	Physical processes and structural attributes that maintain characteristic channel dynamics. These include flow characteristics, bedload, in-channel coarse woody debris, and potential coarse woody debris inputs, channel dimensions, and other physical features (e.g. bank vegetation, slope).
WATSTORENR	Function 2: Dynamic Surface Water Storage/Energy Dissipation	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.
WATSTORLNG	Function 3: Long Term Surface Water Storage	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.
WATSTORSUB	Function 4: Dynamic Subsurface Water Storage	Availability of water storage beneath the wetland surface. Storage capacity becomes available due to periodic drawdown of water table.
NUTRIENT	Function 5: Nutrient Cycling	Abiotic and biotic processes that convert elements from one form to another; primarily recycling processes.
ELEMENTS	Function 6: Detention of Imported Elements and Compounds	The detention of imported nutrients, contaminants, and other elements or compounds.
DETPARTICL	Function 7: Detention of Particles	Deposition and detention of inorganic and organic particulates (>0.45 um) from the water column, primarily through physical processes.
PLANTS	Function 8: Maintain Characteristic Plant Communities	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 TVVs, shrubs, seedlings, saplings, and herbs and by the physical characteristics of the vegetation.
HABSTRUCT	Function 9: Maintain Spatial Structure of Habitat	The capacity of a wetland to support animal populations and guilds by providing heterogeneous habitats.

INTERSPERS	Function 10: Maintain Interspersion and Connectivity	The capacity of the wetland to permit aquatic organisms to enter and leave the wetland via permanent of ephemeral surface channels, overbank flow, or unconfined hyporheic gravel aquifers. The capacity of the wetland to permit access of terrestrial or aerial organisms to contiguous areas of food and cover.

The first four functions (Channel Dynamics, Surface Water Storage, Long Term Surface Water Storage and Subsurface Water Storage) comprise the hydrologic components of the functional assessment model. The next three functions (Nutrient Cycling, Elements and Compound Importation, and Particulate Detention) are the biogeochemical components of the functional assessment model. The last three functions (Plants, Habitat and Insterspersion/Connectivity) together complete the biological components of the functional assessment model.

Variables Associated with the Arizona Riverine Functional Assessment Model. Within each function of the model, a series of variables have been defined, and are used to relate the value of the wetland to the reference standard condition. Of the 25 variables developed, 14 could be measured in the field using simple sampling protocols. The remaining 11 variables were obtained through searches of historical records and Geographic Information System (GIS) database exercises. Refer to Step 5: Field Sampling for the Rio Salado Oeste study below to review the overall field sampling process and data gathering methods used for the study in greater detail.

FCI Model Formulas in the Arizona Riverine HGM Model. Once the E-Team participants had addressed the critical components (e.g., variables) that capture the essence of wetland functionality for the model, they set out to combine these variables in a mathematical model. Each variable was weighted in terms of "importance" in characterizing the function, and standard mathematical logic was used to generate the formulas. Below, the functions are provided with their associated variable combinations.

Hydrology Functions

Function 1: Maintenance of Characteristic Channel Dynamics
$(V_Q + V_{FPA} + V_{SED})/3$

Function 2: Dynamic Surface Water Storage/Energy Dissipation
$(V_{FREQ}*(V_{FPA}+((V_{TOPO}+V_{TVV}+V_{CWD})/3)/2))^{1/2}$

Function 3: Long Term Surface Water Storage
$(((V_{TOPO}*V_{FREQ})^{1/2})*(((1 - V_{PORE})+V_{SUBIN})/2))^{1/2}$

Function 4: Dynamic Subsurface Water Storage
$(V_{DEPSATSED})$

Biogeochemistry Functions

Function 5: Nutrient Cycling

$((V_{TVV}+(3* V_{AGSA})/4)+((V_{DECAY}*((V_{LITTER}+ V_{FWD}+ V_{CWD})/3))^{1/2}))/2$

Function 6: Detention of Imported Elements and Compounds

$(((V_{FREQ}+V_{SURFIN}+V_{SUBIN})/3)+((V_{AGSA}+V_{LITTER}+(1-V_{PORE}))/3)+V_{TVV})/3$

Function 7: Detention of Particles

$((2*V_{FPA})+V_{TOPO}+((V_{CWD}+V_{FWD}+ V_{SED}+V_{TVV})/4))/4$

Habitat Functions

Function 8: Maintain Characteristic Plant Communities

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:

$(((((V_{SPECRICH} +V_{WIS}+V_{INVASIVES})/3)*(V_{CANHERB}))^{1/2}) * V_{LANDBUFF})^{1/2}$

Function 9: Maintain Spatial Structure of Habitat

$(((V_{VEGSTRATA} +((V_{CWD}+V_{FWD}+V_{LITTER})/3))/2) * V_{LANDBUFF})^{1/2}$

Function 10: Maintain Interspersion and Connectivity

$(((V_{FREQ}+ V_{TOPO}+ V_{CONTIG}+ V_{TRIB})/4) * V_{LANDBUFF})^{1/2}$

It is important to note that the E-Teams for the five feasibility studies adapted the original formulas provided by the workshop participants as planning constraints and data availability issues were encountered. It should also be noted that the E-Teams chose to tailor the formula for Function 8 to address functional capacity variations among cover types. Thus, the maintenance of characteristic plant communities in Scrub-Shrublands, Wet River Bottom Areas, and Dry River Bottom Areas did not include measures of tree canopy cover (or shrub canopy cover in the latter two cover types).

Reference Standards for the Arizona Riverine Functional Assessment Model. By definition, reference standard sites represent the highest level of functional capacity (highest, sustainable level of functioning) across the suite of functions performed by the regional wetland subclass (riverine overbank in this case). Because these wetland ecosystems exhibited a wide range of conditions as a result of natural processes and anthropogenic disturbance, and few undisturbed wetland ecosystems or landscapes were known to exist post-impoundment, the HGM approach

established reference standards based on reference wetlands. Reference wetlands were actual wetland sites that represented the range of variability exhibited by regional wetlands as a result of natural processes and anthropogenic disturbance. When the E-Team established reference standards for the five feasibility studies, the geographic area from which these reference wetlands were selected became the model's reference domain. For details regarding the Arizona Riverine Functional Assessment model reference domain and selection of reference wetlands, refer to Chapter 3 of Webb, Burks-Copes and Henderson 2003.

Step 5: Field Sampling for the Rio Salado Oeste Study

Basic site characterization and data collection are the first steps in inventorying an ecosystem restoration site (USACE 2000; Fischenich 1999). Characterization for the subject study included gathering data on water quality, geochemistry, hydrology, fluvial geomorphology, substrate conditions, flora, and fauna, and to the greatest extent possible, identifications of underlying stressors in the region. In particular, land-use activities, physical habitat alterations, and invasive species were identified. In addition to the physical and chemical characteristics of the study area, land ownership and regulatory jurisdictions played an important role in determining opportunities for restoration. Much of this information was geographically-based and stored in a GIS database. As part of the basic site characterization, historical data on landscape-scale habitat conditions, land-use characteristics and ownership patterns was collected as well. Site- and landscape-level data were collected in the spring and fall of 2001. Historical data was obtained and reviewed during the winter of 2001. These datasets, in turn, were used to characterize the baseline conditions of the study area and the reference standard sites.

Several members of the E-Team participated in the field sampling efforts initiated in the early spring months of 2001. The 3-5 member field crews, facilitated by the ERDC, included members from 5 separate federal, state, and local agencies, as well as volunteers from the local community, and experts from nearby universities. For details regarding field sampling protocols, refer to Chapter 4 of Webb, Burks-Copes and Henderson 2003. The original field data is available in the Los Angeles District.

Step 6: Data Management and Statistical Analysis

Some limitations on the data collected during the functional assessment should be acknowledged. When data management problems arose, ERDC consulted with the E-Team prior to data handling, and solutions were devised with their knowledge and consent. This additional effort reduced the uncertainty in the findings, and allowed the E-Team to better delineate the wet and dry river bottom areas. Detailed notes and minutes were taken during these meetings to provide documentation for the assessment.

Step 7: Calculate Baseline Conditions

Once the baseline inventory was completed, the variable means/modes and the PWAA acreages were calculated, and the baseline conditions in terms of Functional Capacity Units (FCUs) were generated by multiplication. Strictly speaking, the means/mode values for each variable were applied to the Variable Subindex graphs (VSIs) as dictated by the model documentation (Webb,

Burks-Copes, and Henderson, 2003). A new VSI graph was developed for each variable based on the reference standard and reference site findings. The means for each variable at the Rio Salado Oeste site were then "scored" on the VSI graphs – providing a comparison of the baseline conditions to that of reference. The basic mathematical premise is fairly straightforward and easy to complete. For example, if the average percent of ground cover in the cottonwood-willow stands on-site was found to be 50 percent, the value "50" was entered into the "X-axis" on the Variable Subindex curve below, and the resultant VSI score (Y-axis) was recorded (VSI = 1.0) (Figure 3).

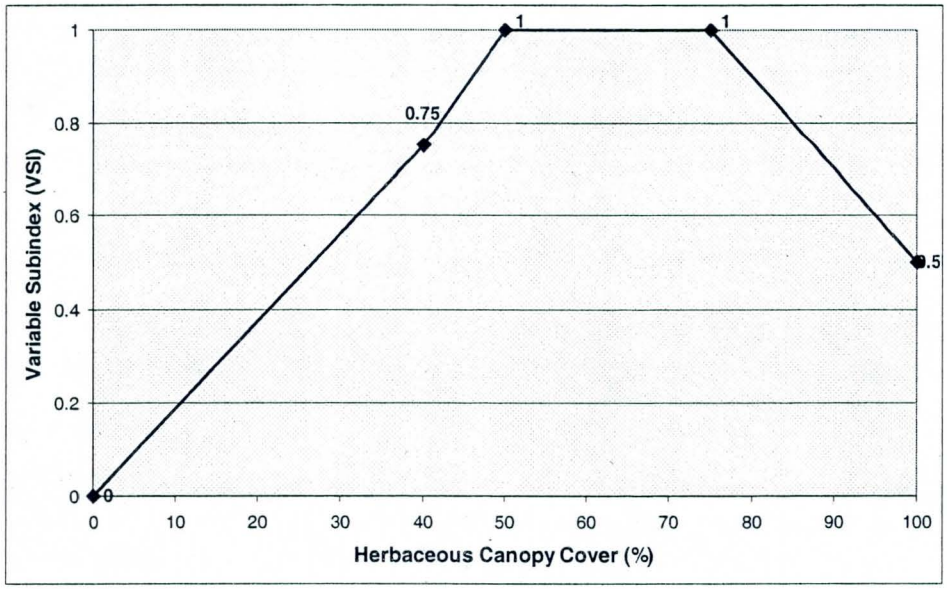


Figure 3. Example Variable Subindex (VSI) curve

The process was repeated for every variable in each PWAA for each of the 10 functional models. The individual VSI scores were entered into the FCI formula by PWAA, and individual cover type FCIs were generated. Each answer, referred to as the PWAA FCI, was then weighted by the relative area (RA)[4] of the PWAA, and combined with the answers from the remaining associated cover types in an additive fashion. The model's formula was considered to be the sum of the PWAA FCIs, arithmetically written as follows:

$$\mathbf{FCI}_{\text{Subclass Model}} = \sum (\mathbf{PWAA\ FCI} \times \mathbf{RA})_X$$

where:

[4] Relative Area: The relative area is a mathematical process used to "weight" the various applicable PWAAs on the basis of quantity. To derive the relative area of a model's PWAA for the study, the following equation was utilized: Relative Area = PWAA Area/Total Area where: PWAA Area = only those acres assigned to the PWAA of interest and Total Area = the sum of the acres utilized in the model

PWAA FCI = Results of the PWAA FCI calculation,
X = Number of PWAAs associated with the model, and
RA = Relative area of each PWAA.

The final step was to multiply the FCI result against the habitat acres (i.e., cover type acres associated with the model). The final results, referred to as FCUs, quantified the quality and quantity of the wetland conditions at the site for baseline. The details of this study's findings for baseline conditions are fully documented in Chapter 3 of this report.

Relative Area: The relative area is a mathematical process used to "weight" the various applicable PWAAs on the basis of quantity. To derive the relative area of a model's PWAA for the study, the following equation was utilized: Relative Area = PWAA Area/Total Area where: PWAA Area = only those acres assigned to the PWAA of interest Total Area = the sum of the acres utilized in the model

Step 8: Rio Salado Oeste's Goals, Objectives, Project Life, and Target Years

In an attempt to generate quantifiable objectives for the study, the District set out specific ecosystem goals, and developed a series of performance measures to assess the success of the ecosystem restoration designs.

Project Goals. The primary purpose of the Rio Salado Oeste feasibility study is ecosystem restoration. The water and related land resource problems and opportunities identified in this study are stated as specific planning objectives to provide focus for the formulation of alternatives. These planning objectives reflect the problems and opportunities and represent desired positive changes in the without-project conditions. These objectives are as follows:

- Restore native riparian, wetland, and floodplain habitats and manage undesirable plant, fish and wildlife species through the year 2058.
- Reduce flood damages to infrastructure and structures through the year 2058.
- Improve passive recreation and environmental education opportunities within the study area.

Selection of a Project Life and Target Years (TYs). Given these goals and objectives, the District designated a "Project Life" of 50 years for the study, and asked the E-Team to develop a series of TYs within this 50-year setting to guide the projections of both Without-Project and With-Project activities. Five TYs were defined by the E-Team:

1. TY = "0" refers to the baseline condition, or the 2002 calendar year.

2. TY = "1" refers to the first year of groundbreaking activities, or the 2008 calendar year.

3. TY = "6" was chosen to capture 5 full years of vegetative growth under the proposed With-Project Conditions (e.g., the 2013 calendar year).

4. TY = "26" was selected to capture 25 full years of vegetative growth under the With-Project Conditions (e.g., the 2033 calendar year).

5. TY = "51" was chosen to capture 50 full years of vegetative growth under With-Project Conditions (e.g., the 2058 calendar year).

Step 9: Rio Salado Oeste's Without-Project Conditions

To develop plans for a community or region, it becomes necessary to predict both the short-term and long-term future conditions of the environment (USACE 2000). Forecasting, the process of developing these predictions, is undertaken to identify patterns in natural systems and human behavior, and to discover relationships among variables and systems, so that the timing, nature, and magnitude of change in future conditions can be estimated. Though many forecasting methods can be used in a standard assessment application such as functional assessment, a judgment-based method, supported by the scientific and professional expertise of the evaluation team, is often relied upon to forecast the effectiveness of ecosystem restoration alternatives, rate project performance, and determine many other important aspects of both Without- and With-Project conditions.

The Without-Project condition is universally regarded as a vital and important element of the evaluation (USACE 2000). The future without-project condition is the same as the "no action" alternative, and describes what is expected to happen in the absence of federal or non-federal action. Under this alternative, the Corps of Engineers would take no action to provide ecosystem restoration within the study area, nor to develop plans with potential incidental benefits associated with flood damage reduction, recreation, and water quality and supply. The no action alternative assumes the future will bring change, despite a lack of Corps participation. No single element is more critical to the planning process than the prediction of the most likely future conditions anticipated for the study area if no action is taken as a result of the study.

Most federal agencies use annualization as a means to display benefits and costs, and ecosystem restoration analyses should provide data that can be directly compared to the traditional benefit: cost analyses typically portrayed in standard evaluations of this nature. Federal projects are evaluated over a period of time that is referred to as the "life of the project" and is defined as that period of time between the time that the project becomes operational and the end of the project life as dictated by the construction effort or lead agency. However, in many cases, gains or losses in wildlife habitat may occur before the project becomes operational and these changes should be considered in the assessment. Examples of such changes include construction impacts, implementation and compensation plans, and/or other land-use impacts. Ecosystem restoration analyses incorporate these changes into their evaluations by using a "period of analysis" that includes pre-start impacts. However, if no pre-start changes are evident, then the "life of the project" and the "period of analysis" are the same. Functional Capacity Units (FCUs) are annualized by summing FCUs across all years in the period of analysis and dividing the total (cumulative FCU) by the number of years in the life of the project. In this manner, pre-start changes can be considered in the analysis. The results of this calculation are referred to as Average Annual Functional Capacity Units (AAFCUs).

The assumptions that went into the projection of future conditions for the Rio Salado Oeste study area under the "No Action Alternative" are reported in Chapter 4 of this report. Results, in terms of AAFCUs as well as expectations of change in terms of FCIs and acres for the study are fully documented therein.

Step 10: Rio Salado Oeste's With-Project Scenarios

1. No Action	
2. Storm water and Channel: This alternative includes the modification of existing storm-water outfall areas to improve retention and water spreading as well as increasing the existing habitat currently supported by these outfalls. It also includes modification and/or restructuring of the primary conveyance channel to a more natural state by grading and terracing the river corridor from 19th avenue to 83rd avenue. No additional water source is included in this alternative other than temporary irrigation to establish vegetation.	Cottonwood/Willow: 66 Mesquite: 43 Wetland: 28 outfalls 17 Lchannel
3. Storm water, Channel, Water Supply, Cottonwood, Mesquite, Invasive: This alternative includes the features described in Alternative 2 and adds a supplemental water supply in the form of effluent. At locations identified as suitable throughout the project area cottonwood/willow and mesquite cover types will be restored. This alternative would also address the management, control and removal of invasive species within the study area.	Cottonwood/Willow: 348 Mesquite: 409 Wetland: 28 outfalls 34 Lchannel
4. Storm water, Channel, Water Supply, Cottonwood, Mesquite, Invasive, Emergent: This alternative adds restoration of emergent wetlands at the existing lake in the channel immediately downstream of 19th Avenue.	Cottonwood/Willow: 348 Mesquite: 409 Wetland: 33 outfalls 34 channel
5. Storm water, Channel, Water Supply, Cottonwood, Mesquite, Invasive, Emergent, Lake: Added to this alternative is lake restoration at the existing gravel pits at 29th and 37th Avenues.	Cottonwood/Willow: 375 Mesquite: 417 Wetland: 33 outfalls 43 Lakes 34L channel Open/Water: 40
5A. Wetland restoration in lieu of permanent open water and lakes: In lieu of lake restoration this includes regrading of the existing gravel pits to restore them to the floodplain and restoration of emergent wetland and riparian areas.	Cottonwood/Willow: 375 Mesquite: 417 Wetland: 33 outfalls 123 Gravel pits 34 channel
5B. This alternative is a hybrid of 5 and 5A: including restoration of one gravel pit to a wetland/riparian complex and the other to include the lake.	Cottonwood/Willow: 375 Mesquite: 417 Wetlands: 33 acres outfalls 103 lakes 34 Lchannel Open/Water: 20

Chapter 2: Baseline Conditions

Baseline Acres

The study area comprises 3,148 acres and is covered predominantly in scrubshrub (1,566 acres; 49.7%), sand and gravel operations (761 acres; 21.3%) and urban areas (327 acres; 10.4%). Riparian and wetland cover types do occur, but currently comprise a minor portion of the study area. The District identified 19 distinct cover types land use categories for the reference domain, though only nine existed at the onset of the study (i.e., scrubshrub, sand and gravel operations, urban areas, open water, agricultural croplands, cottonwood-willow forest, dry river bottom, wet river bottom and ditches). Of these nine, four (i.e., CWWFOREST, DRY RIVER BOTTOM, WETRVRBOTTOM and SCRUBSHRUB) were associated with the FCI models and were therefore used to evaluate baseline conditions. The majority of existing cover types have been degraded because of a lack of water or due to other anthropogenic activities. A complete listing of baseline cover types and their respective acreages is presented in Table 2-1.

Table 2 – 1. Baseline Acres and Cover Types for Rio Salado Oeste

CODE	DESCRIPTION	BASELINE ACRES (TY 0)
AGCROP	Farms and Croplands in the Uplands – Dairy, Cotton, and Alfalfa	133
CWWFOREST	Existing Cottonwood-Willow Forests in the Active Channel	112
DESERT	Desert or bare earth	0
DITCHES	Ditches in the Uplands	3
DRY RIVER BOTTOM	Existing Dry River Bottom Areas in the Active Channel - Largely Unvegetated	66
MESQUITE	Existing Mesquite Woodlands - on the Terraces and in the Active Channel	0
OPENWATER	Existing Open Water in the Active Channel - Inactive Sand and Gravel Operations	240
PARKS	Parks and Recreation Areas	0
SANDGRAVEL	Existing Sand and Gravel Operations/Extractions in the Active Channel	671
SCRUBSHRUB	Existing Scrub - Shrublands in the Active Channel - Rabbitbush, Quailbush, Ironwood, and Saltbush	1,566
SOIL CEMENT	Existing Soil Cement Areas on the Slopes of the Active Channel	0
WETRVRBOTTOM	Existing Wetted River Bottom Areas in the Active Channel - Primarily Emergent Vegetation	30
URBAN	Existing Residential, Industrial and Transportation Avenues in the Uplands	327

US Army Corps of Engineers
Los Angeles District

RIO SALADO OESTE
F4 MILESTONE
Salt River-Phoenix, Arizona

Appendix J
Design and Cost Estimate

March 2005

U.S. ARMY CORPS OF ENGINEERS, LOS ANGELES DISTRICT
PLANNING DIVISION, WATER RESOURCES BRANCH
P.O. BOX 532711
LOS ANGELES, CALIFORNIA 90053-2325

DESIGN APPENDIX
FOR
RIO SALADO OESTE INTERIM FEASIBILITY REPORT
PHOENIX, ARIZONA

January 2005

APPENDIX – DESIGN FOR RIO SALADO OESTE SALT RIVER RESTORATION PROJECT
INTERIM FEASIBILITY REPORT
PHOENIX, ARIZONA

CONTENTS

1.0		OBJECTIVE	3
2.0		STUDY AREA	3
3.0		DESIGN CRITERIA	3
	3.1	Structural Requirements	3
	3.2	Hydrology and Hydraulic Requirements	3
	3.3	Geotechnical Requirements	4
	3.4	Environmental Considerations	4
	3.5	Contaminants	4
4.0		DESIGN FEATURES	4
	4.1	Channel Restoration	4
	4.2	Wetland	5
	4.3	Control Invasive Vegetation	5
	4.4	Planting	5
	4.5	Drop Structure	5
	4.6	Water Distribution System	6
5.0		CONSTRUCTABILITY	6
	5.1	Construction Materials	6
	5.2	Access Roads	6
6.0		UTILITY RELOCATION	7
7.0		CONSTRUCTION TIME OF THE RECOMMENDED PLAN	7
8.0		OPERATION AND MAINTENANCE REQUIREMENTS	7
	8.1	Structures	6
	8.2	Plants	7
9.0		TABLE: PROPOSED ALTERNATIVES' DESIGN FEATURES	7
10.0		CITY OF PHOENIX WATER DISTRIBUTION SYSTEM	8

1.0 OBJECTIVE

The primary objective the Rio Salado Oeste project is to establish the feasibility of environmental restoration, flood damage reduction, and recreation along the Salt River in Phoenix, Arizona. The purpose of this appendix is to present feasibility study results of the civil design effort. Design data and calculations were developed sufficient to determine the technical and economic feasibility of each alternative and in the event the project is authorized, to provide a base design leading to the development of the construction plans and specifications.

2.0 STUDY AREA

The Rio Salado Oeste Salt River Restoration project is located along the Salt River, southwest of Phoenix, Arizona, within Maricopa County, between 19th and 83rd Avenues. The Salt River (Rio Salado in Spanish) is a major tributary to the Gila River in Arizona. The river originates in eastern Arizona and flows westward to its confluence with the Gila River west of downtown Phoenix. The study area is located between the authorized Rio Salado project area and the Tres Rios Feasibility Study area. The Oeste study area is approximately seven miles in length, averages 2 miles in width, and encompasses approximately 10,000 acres. However, the project area is a smaller extent including the 100-year floodplain, which is near an average of ¾ mile width and nearly 3200 acres.

3.0 DESIGN CRITERIA

3.1 Structural Requirements

The structural materials required for storm drain piping and outlet structures, involves reinforce concrete pipe (RCP), gravel, riprap, reinforce concrete, and grouted stone.

The structural material required for the drop structure at 35th Avenue involves roller compacted concrete (RCC) and compacted back fill. These are rigid materials that have been successfully used before on previous projects under these types of hydraulic conditions.

The structural requirements for the bank stabilization and concrete spillway include static and dynamic stability, refer to Geotechnical Appendix for details.

3.2 Hydrology and Hydraulic Requirements

Hydrology and hydraulic design criteria are discussed in their respective appendices. The Hydrology Appendix provides the design discharges for the existing drainage structure that discharge into the study reaches.

Evaluations of the hydraulic considerations of the low flow channel and drainage areas are discussed in the Hydraulic Appendix.

3.3 Geotechnical Requirements

Two stone borrow sites have been identified as sources of construction material and are available for use, in the event an engineering design is proposed for the project. Two quarries have provided stone for previous Corps flood control projects.

3.4 Environmental Considerations

The project area includes approximately 7 miles of river channel and encompasses 3147 acres within the 100-year floodplain. 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 1500 acres. The scarcest is cottonwood-willow forest extant within merely 112 acres of which salt cedar dominates.

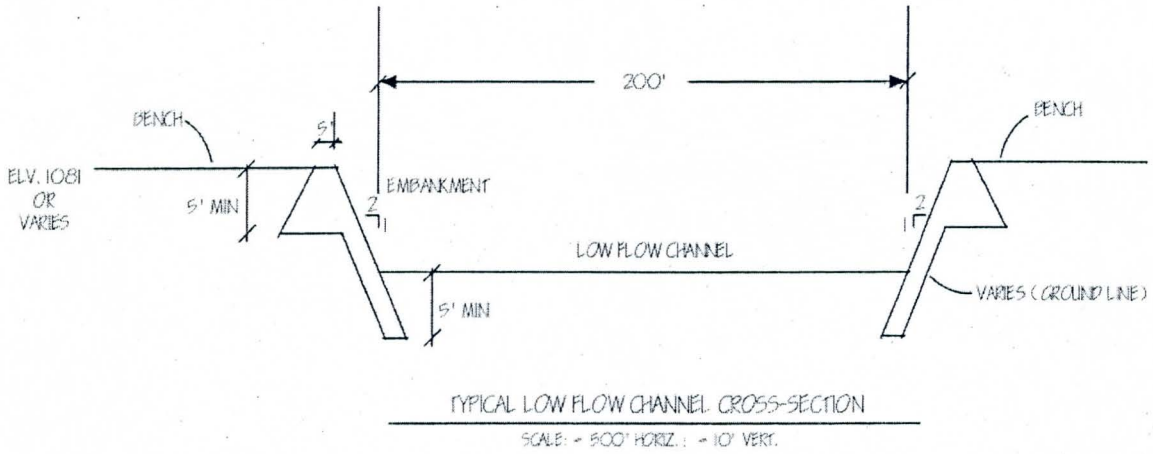
3.5 Contaminants

Although previous reports identified the possible presence of DDT downstream of 51st Avenue in the Salt River, nothing has been recently identified. In addition no known contaminated sites exist within the project area.

4.0 DESIGN FEATURES

4.1 Channel Restoration

Reshaping the Salt River riverbed is required through the entire project reach to restore a natural river channel. Channel restoration will be accomplished through grading and terracing of an area within the 10-year discharge area of inundation and following historic channel conditions. This includes a low flow channel design for the 5-year return period discharge (20,200 cfs) and is also assumed that the final channel may meander slightly and be braided as it was historically. This includes a total cutting and fill volume of approximately 660,000 cubic yards. It has been assumed that materials from reshaping will be disposed of onsite throughout the project area to form terraces and fill depressions and abandoned sand and gravel pits. The locations of the riverbed reshaping are shown _____.



TYPICAL LOW FLOW CHANNEL CROSS-SECTION

SCALE: 1" = 500' HORIZ.; 1" = 10' VERT.

4.2 Wetland

Wetlands are restored throughout the project area with a total area of approximately 190 acres. The locations of the wetlands are shown on figures _____. Typical cross section of restored new wetland is shown_____.

4.3 Control Invasive Vegetation

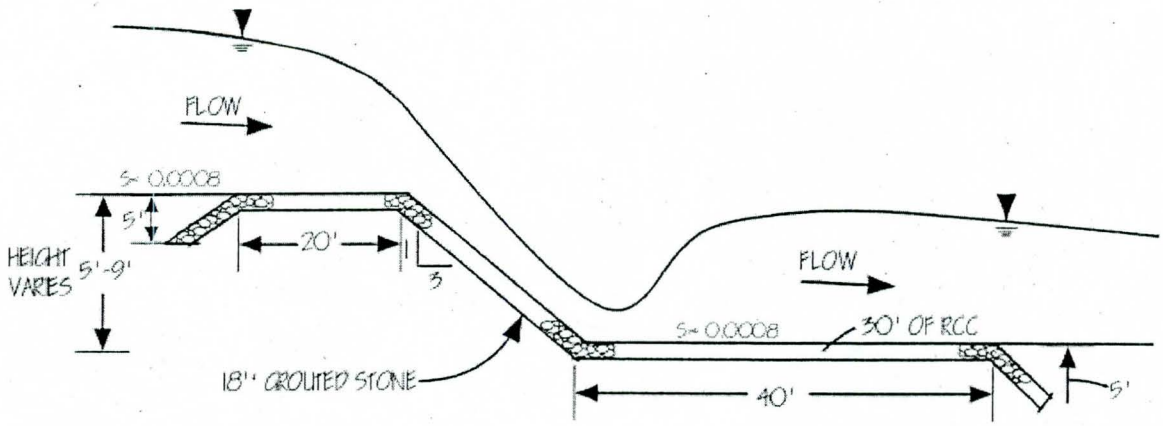
Control invasive vegetation is required in the vicinity of 37th Avenue where there is an existing stand of Salt Cedar and 43rd Avenue where there is a stand of Arundo with a total area of approximately 120 acres. The locations will be defined in the next phase of the study.

4.4 Planting

Planting includes approximately 375 acres of Cottonwood/ Willow and 417 acres of Mesquite. The locations of the plantings are shown on the project plates_____.

4.5 Drop Structure

A drop structure will be constructed down stream of the 35th Avenue Bridge. This structure is design to protect the bridge abutments and footings from damage during a flood event. That drop structure follows the same design as those constructed for the Rio Salado Project upstream and is shown on Figure____



DROP STRUCTURE DETAIL

not to scale

4.6 Water Supply and Distribution System

Description of the water supply and distribution system is attached at the end of this report. It provides detailed discussion of the proposed system provided by the project sponsor, City of Phoenix.

5.0 CONSTRUCTABILITY

5.1 Construction Materials

The construction materials required for the design features described above include soil and gravel for structural fill, soil and soil cement, cement, water, concrete, clay, PVC pipe, pumps and specified plants. All of these materials are available locally. Plants can be purchased locally or can be grown locally from native seed sources in advance of up to two years to develop healthy rootstock.

5.2 Access Roads

Recreational trails on both sides of the channel, and throughout will be used as access roads for operation and maintenance purposes. Specific alignment of access roads will be determined in the PED phase but is anticipated to be at the major road crossings such as 19th, 35th, 51st, and 67th Avenues.

6.0 UTILITY RELOCATION

No utility relocation has been identified in the study. Any possible utility relocation will be defined in the PED phase. Local sponsor will be responsible for constructing the utility relocation.

7.0 CONSTRUCTION TIME OF RECOMMENDED PLAN

Construction time of the recommended plan is being estimated to be approximately 4 years.

8.0 OPERATION AND MAINTENANCE REQUIREMENTS

8.1 Structures

Operational inspections for structural cracking and functional capability are made periodically, with at least one official annual inspection, and as needed during the flood season. Inspections should include unwanted wild plants that if allowed to grow may exacerbate a structural crack. These plants are controlled by cutting or spray.

8.2 Plants

Replacement for plants will be required due to occasional flooding events and other natural causes. To support the plantings over the life of the project, the water budget and estimated annual costs for the selected plan are included in the Cost Engineering Appendix.

9.0 TABLE OF PROPOSED ALTERNATIVES' DESIGN FEATURES

DESIGN FEATURES	ALTERNATIVES					
	2	3	4	5	5A	5B
1. Channel Restoration	X	X	X	X	X	X
2. Stormwater Outfall	X	X	X	X	X	X
3. Wetland Ponds	X	X	X	X	X	X
4. Clearing and Grubbing	X	X	X	X	X	X
5. Planting (including temporary irrigation)	X	X	X	X	X	X
6. Grade Control Structure	X	X	X	X	X	X
7. Debris Removal	X	X	X	X	X	X
8. Inspections and Surveys	X	X	X	X	X	X
9. Invasive Species Control	X	X	X	X	X	X
10. Wetlands	X	X	X	X	X	X
11. Channel	X	X	X	X	X	X
12. Water Supply		X	X	X	X	X
13. Additional Irrigation		X	X	X	X	X
14. Effluent Water		X	X	X	X	X
15. Emmergent Wetlands			X	X	X	X
16. Lake Restoration				X		
17. Restoration of Two Gravel Pit Lakes and Wetland/ Riparian					X	
18. Restoration of one Gravel Pit Lake and one Wetland/Riparian						X
19. Pump Station		X	X	X	X	X
20. Electronic Flow Regulated Valves		X	X	X	X	X
21. Reservoir		X	X	X	X	X
22. Ground Water Pond/Reservoir on Overbank		X	X	X	X	X
23. Waterline Pipes		X	X	X	X	X
24. Waterline Pipes Loops		X	X	X	X	X
25. Bridge Crossing		X	X	X	X	X
26. Terrace and LFC Canal Delivery Conveyance Channels		X	X	X	X	X
27. Overbank Canal Delivery Conveyance Channels		X	X	X	X	X
28. Waterfall to Move Water from Overbank to Terrace		X	X	X	X	X
29. Internal Drainage Conveyance Channels		X	X	X	X	X
30. Waste & Tire Removal		X	X	X	X	X
31. Supply Well		X	X	X	X	X
32. Monitoring Wells		X	X	X	X	X

10.0 CITY OF PHOENIX: RIO SALADO OESTE WATER DISTRIBUTION SYSTEM

Introduction:

Before the turn of the 20th century the Salt River was one of the few perennially watered riparian areas of the Sonoran desert with highly productive cottonwood, willow, and mesquite forest. These habitats were once rich in ecological diversity and supported a wide variety of wildlife species. Today, the River is in a state of environmental degradation from water projects constructed upstream. The River's hydrology has effectively been eliminated, taking with it the highly valued native riparian ecosystem. With virtually no flows in the river, except during storms and periodic upstream dam releases, a reliable water supply and distribution system is needed to support the Rio Salado Oeste Project (Oeste). The primary objective is to restore a portion of the Salt River riparian ecosystem.

At the time of this report, the United States Army Corps of Engineers (Corps of Engineers) and the City of Phoenix are developing the Rio Salado Environmental Restoration Project (Rio Salado) between 19th Avenue and 28th Street. The Tres Rios project which runs from 83rd Avenue to about 117th Avenue is soon to begin construction. Oeste, between 19th and 83ed Avenues, will employ many of the same environmental restoration principals that were developed for the Rio Salado and Tres Rios projects. The Rio Salado project employs ground water to sustain a variety of project habitat features, while Tres Rios, will be supported by reclaimed water from the City's 91st Avenue Water Reclamation Plant.

Water Supply Alternatives:
Three water source alternatives were evaluated for Oeste. The first was to maximize ground water pumping from the Rio Salado project wells and deliver by either pipe or open channels to Oeste. Rio Salado drilled five wells into the shallow aquifer and is currently evaluating wellhead treatment for at least two wells to remove volatile organic compounds (VOC). The upper aquifer lies close to the surface and is about 300-400 feet thick. This ground water is under utilized and according to the City's Water Services Department, is not suitable for urban water supplies. It contains varying concentrations of pollutants resulting from agricultural, urban, and adjacent landfill impacts making it available for environmental restoration purposes.

The Rio Salado wells can yield, if pumped 24 hours a day, 7 days a week, approximately 12.5 mgd. This could provide the Oeste Project with approximately 5.7 mgd to 8 mgd if piped or 4.5 mgd to 6.5 mgd if conveyed in open channels.

There are concerns however with using the Rio Salado supply wells. The main River channel or a low flow channel (LFC) could be used for conveyance reducing construction cost, but a substantial pump would be required in the River to move the water into Oeste's distribution system. Plus, if the water were to be conveyed through open channels, it is estimated that evaporation and percolation losses would be 20%-30% of the piped amount.

These losses could be reduced if the water was piped, but could double the conveyance cost of getting water from Rio Salado to Oeste compared to using an open channel delivery system. Trenching though the overbanks in the Rio Salado involves a high degree of waste removal, over excavation for structural stability, and more expensive construction methods to reduce impacts to existing landfills such as, double containment pipes to capture water that could result from a line break.

The cone of depression that could result and the impact to one of the contaminated groundwater plumes that exist within close proximity of the area is of critical concern. This would affect water quality and quantity for the current Rio Salado project and the future Oeste project. If this happened it could affect the Rio Salado wellhead treatment technology, possibly requiring a modification to respond to the introduction of new constituents. Legally there would be risks associated with drawing a contaminated groundwater plume into the area where it could affect the water quality of area wells.

The cone of depression concerns, conveyance costs, increases in Rio Salado pump maintenance costs (a 33% reduction in the pump's useful life expectancy due to the longer run times would increase replacement costs). Add to these the costs associated with the Rio Salado treatment operations, increase in hazardous material removal from the treatment facilities, and the potential water table drawdown concluded this alternative was too costly for further consideration.

The second alternative looked at duplicating what was done for the Rio Salado project and installing new supply wells for Oeste. The most critical issue with this alternative is the relationship Oeste's water supply would have with the City's conservation requirements.

The average daily demand for the Rio Salado is approximately 4.35 million gallons per day (mgd) with a peak demand of approximately 6.5 mgd.

State mandated conservation requirements, limits water use on a per capita basis and limits the total amount of groundwater available for the City's future use. Groundwater and most surface water use is calculated every year to evaluate compliance with the City's "gallons per capita per day" (GPCD) water use limitation. In 2003, the target water use rate for the City was 215 GPCD. This conservation requirement becomes progressively more restrictive in future years. The expected target GPCD will decrease from an estimated 209 GPCD in 2005, to 202 GPCD in 2010.

The City must also comply with groundwater use limitations that are part of the 100-year Assured Water Supply (AWS) Designation. The AWS designation quantifies a limited groundwater supply that is intended to serve as a "backup" water supply to offset reductions in surface water availability during times of drought. This backup groundwater supply equates to less than 10 percent of total water use annually.

The key concerns with pumped water are as follows:

- Any recovered effluent credits could potentially reduce the volume of water available for the Rio Salado project over the long-term. Availability of these credits is tied to the amount of effluent that the Roosevelt Irrigation District (RID), an agricultural area in southwest Phoenix, is willing to take each year based on an agricultural demand. RID has not yet demonstrated an ability to use enough effluent consistently to generate credits for both the Rio Salado and Oeste projects over a long period. It is estimated that Oeste's needs could result in a tripling of the demand for these credits.

- If groundwater is pumped (either in the form of incidental recharge credits or the allowance credit, this water will be charged against the GPCD conservation requirement as discussed above. The Oeste demand alone would increase the City of Phoenix's per-capita rate by 6 GPCD, which could create a compliance concern with the state limit.

- Recovered Central Arizona Project (CAP) credits were deemed impractical for Rio Salado, and the same applies to Oeste. This water, like groundwater, would be subject to the GPCD conservation requirements. In addition, the cost to the project in acquiring and storing this water would be substantial. Phoenix is relying on CAP supplies to meet future potable system demands that would be used more efficiently in other areas of the City.

To protect effluent and groundwater credits, and to avoid conservation compliance issues, the use of pumped groundwater for Oeste should be considered only for: 1) maintaining a certain water quality for selected project features; and 2) maintaining system redundancy (in the event of loss of direct effluent during an unplanned outage).

For the third alternative the City of Phoenix Water Services Department evaluated their 91st Avenue and 23rd Avenue Water Reclamation Plants for a sustainable water source. The City determined that 8 million gallons per day (mgd) could be directed to the Oeste project from the 23rd Avenue Water Reclamation Plant if certain conditions could be met. The 91st Avenue plant was determined to be too costly to deliver water up gradient to the far east reaches of Oeste. Supplemental water could come from a variety of underground sources including: 1) effluent credits "recovered" (pumped) from within the area of hydrologic impact of the RID Groundwater Savings Facility; 2) incidental recharge credits associated with increased recharge from project implementation; 3) groundwater (based on the City's Assured Water Supply allowance); and 4) recovered credits for Central Arizona Project water (stored by the City). The use of pumped water (rather than direct effluent) has several limitations. One of these relates to the City's ability to comply with state mandated water conservation requirements. Storm water is also considered and may prove sufficient to support ephemeral wetlands or riparian habitat in portions of the project, but because it is not a reliable water source it is only identified as a supplement to the effluent.

To obtain the 8 mgd for Oeste the City would have to deliver 1 mgd to Peterson's Farm located north of the River west of 43rd Avenue and 30,000 acre-feet per year to the RID.

Currently the City delivers 10 mgd to the Peterson Farm via open channels to achieve their 1 mgd delivery arrangement. The open channels are subject to high losses from percolation and evaporation. The current water delivery system is not controlled by a valve so Water Services typically provides a surplus of water to the Peterson Farm, Peterson uses what he needs, and returns the unused portion into a canal that discharges from the north bank into the Salt River at 43rd Avenue. The RID obligations are delivered right from the Plant under a separate conveyance system.

In order to reduce the delivery of effluent to Peterson's Farm from the current 10 mgd to a proposed 1 mgd which would then provide Oeste the balance, a pump station is needed at the 23rd Avenue Water Reclamation Plant and a pipe installed to deliver the 1 mgd to Peterson's Farm. To accommodate large diurnal variations in flows from the water reclamation plant, it is recommended Oeste install a 20 mgd pump station.
The Selected Alternative:

The water supply and distribution system is critical to the success and sustainability of the Oeste Environmental Restoration Project. A sufficient quantity and adequate quality of water must be available to maintain the viability of the various habitat types that are being considered for Oeste. The primary water supply for the Oeste project is effluent obtained directly from the 23rd Avenue Water Reclamation Plant. Supplemental water could come from a variety of underground sources including: 1) effluent credits "recovered" (pumped) from within the area of hydrologic impact of the RID Groundwater Savings Facility; 2) incidental recharge credits associated with increased recharge from project implementation; 3) groundwater (based on the City's Assured Water Supply allowance); and 4) recovered credits for Central Arizona Project water (stored by the City).

Treated effluent from the City's 23rd Avenue Water Reclamation Plant and one ground water well have been identified as the primary water sources for Oeste. The use of pumped water (rather than direct effluent) has several limitations. One of these relates to the City's ability to comply with state mandated water conservation requirements as discussed above. Secondary influxes of dry weather flows and storm water flows from the network of storm drains that empty into the River, residual Rio Salado flows, and discharges east of 35th Avenue on the north bank from the 23rd Avenue Water Reclamation Plant and at 43rd Avenue on the north bank are also included.

The sustainable water supply and distribution system consists of the following features:

- (1) 20 MGD Pump Station
- (1) Supply well
- (2) Monitoring Wells
- (6) Electronic Flow Regulated Valves
- (5) Reservoirs
- (5) Pump stations
- Open channel canals
- Irrigation system
- Pressurized distribution piping

Design Assumptions:

The following design assumptions were made for the water supply and distribution system:

Project Water will be a combination of:

- 8 mgd (or 8,976 acre-feet per year) of reclaimed water from the 23rd Avenue Water Reclamation Plant.
- 1.85 mgd (or 2,075 acre-feet per year) from a ground water supply well. The well will be used for maintaining system redundancy in case of a direct lose of effluent during an unplanned outage and to provide water for the reservoir/urban fishing pond.
- 3.35 mgd (or 3,762 acre-feet per year) residual from Rio Salado when all wells are pumping to design capacity.
- 2 mgd (or 2,252 acre-feet per year) which is 50% of the storm water collection capacity.
- 7.1 mgd (or 7,966 acre-feet per year) as an average discharge from the 23rd Avenue Water Reclamation Plant to the River just east of 35th Ave. (This quantity is subject to diurnal variations. Historically, in fall and winter, has recorded peak flows over 50 mgd and on some days during the summer months as low as 0 mgd).
- The sustained 8 mgd reclaimed water is made available through a construction of a pressurized pipeline that will furnish 1mgd to a farm west of 43rd Avenue.
- The maximum velocity for all pressure and gravity pipelines will be 5 feet per second (fps); limiting the velocity in small pipes (<24 inches in diameter) to 5 fps is a commonly accepted engineering practice so as to reduce head loss and surge potential.
- The head requirements for the pump stations will be determined using the Hazen-Williams equation with a friction factor of 130. It is a commonly accepted engineering practice to accept this friction factor as a good average factor for the lifetime of most pipeline materials.
- Manning's equation will be used to calculate the capacity of all of the gravity pipelines using a friction factor of n=0.013. It is a commonly accepted engineering practice to accept this friction factor as a good average factor for the lifetime of most pipeline materials.
- Hydraulic Institute Standards will be met for the pump station configurations.

Water Supply for Each Reach:

The water distribution system will be a series of traditional and nontraditional irrigation methods. It is envisioned that water will be pumped from reservoirs along the banks into canals located on the banks or into a pressurized irrigation system. The canal water will move via gravity from along the over banks down spillways, waterfalls, channels, or

piped to open ponds and wetlands along the terrace, then down to the perennial stream and ponds of the main river channel.

The wetlands, open ponds, and streams will be lined with either fine-grained soils or synthetic materials to reduce percolation and enhance horizontal migration of water to create a saturated soil profile. This wetted margin is needed to sustain riparian vegetation. Careful attention is needed to optimize plant densities to mitigate overcrowding, encroachment from exotics, and improved vector control. Design considerations will be made to control mosquito larva infestation by fluctuating water levels, increasing water movement, developing and managing appropriate planting densities and providing adequate access points for chemical applications.

The water distribution system should be designed to provide an uninterrupted supply of water to the open water features (reservoirs, ponds, wetlands, and canals) as well as meet the irrigation demands of the various habitat types throughout Oeste. To meet these goals, the water distribution system will have a built in redundant connection by discharge piping and isolation valves so that if any of the reservoirs are taken out of service, water can still be delivered to the various habitats. Based on this approach, a reservoir may provide a supply of water to any of the features and the pressurized irrigation system. The advantages of this system are as follows:

- Facilitates adding additional reservoirs if needed in the future.
- Facilitates delivery of water to all features if a reservoir is out of commission.

Generally, water will be delivered from the 23rd Avenue Water Reclamation Plant by a 20 mgd pump station conveyed through a pipe directly to Oeste's reservoirs. Electronically controlled flow regulated valves will adjust the flow of water from the plant to match the demand by the irrigation or the canal system.

Pump Station Requirements and Demand:

The pump station requirements are based on the available effluent that exist from the 23rd Avenue Water Reclamation plant after 1 mgd is delivered to Peterson's Farm and the RID receives their 30,000 acre-feet per year. Based on these conditions, a pipeline and reservoir network will be designed to provide a supply of water for the overall Project. The pump station will be equipped to vary the output of the reclaimed water to match the demand requirements. However, there will be a limit to the maximum supply that can be delivered based on plant output and City's prior water delivery commitments.

Supply Well Equipping:

The following assumptions are made for equipping the supply well:

- The well pump will be vertical turbine pump for cost efficiencies. Their life cycle cost are lowest based on installation, ease of operation and long-term maintenance. Similar pumps were installed in the Rio Salado providing familiarity for maintenance staff and an inventory of replacement parts.
- The supply well, associated appurtenant equipment and the electrical equipment will be located in a secured structure. The structure will have an open air roofing system

that will protect the components from ultraviolet rays and vandalism. Individual climate control units will maintain the required operating temperatures of the electrical equipment.

- The well will include a flow meter and low-flow sampling port to monitor the quantity and quality of groundwater that is extracted because monitoring will be part of the City's Arizona Pollution Discharge Elimination System (AZPDES)

Supply Well Location:

The supply well location will depend upon available hydrology, real estate, utilities, access for installation, and maintenance of the well. Water quality and locating the well within the zone of influence must also be considered.

Hydrogeology:

The Rio Salado Project lies within the Salt River Valley (SRV) sub-basin of the Phoenix Active Management Area. The Project area is underlain by alluvium primarily consisting of unconsolidated to semi-consolidated clays, silts, sands, and gravels. The alluvium is subdivided into three major units: the upper alluvial unit (UAU), the middle alluvial unit (MAU), and the lower alluvial unit (LAU). These units vary in thickness across the SRV, with a general thickening toward the center of the SRV, northwest of the Project area. Depth to groundwater varies seasonally due to the effects of production and irrigation wells.

The UAU typically consists of unconsolidated coarser grained material providing unconfined groundwater conditions. Based on boring logs from wells within the Rio Salado study area between 19th Avenue and 28th Street, the UAU consists primarily of coarse sands, gravels, and boulders with interblended clay and silt. The MAU is characterized by generally finer grained sediments and a lack of gravel. The MAU is a semi confined aquifer. The contact between these two units ranges between 175 and 250 feet below ground surface within the Project area.

Groundwater Availability:

Groundwater from the UAU will be the primary source of water for Oeste's urban fishing pond and to maintain water quantity during unplanned water reclamation plant shut downs or diurnal fluctuations. The reliability of the quantity and quality of this water is critical to its success.

Currently, it is estimated the well will supply approximately 1.85 mgd. A series of pump test conducted by the Corps for the Rio Salado project indicate the UAU is showing a decrease in groundwater elevation and there is data indicating that over the past 25 years groundwater elevations within Rio Salado and Oeste areas have decreased approximately 15 to 20 feet. One well, for example, not far from the Rio Salado and Oeste projects has dropped about 4.5 feet per year between 1993 and 2000.

Groundwater Quality:

To a large extent, ground water sampling has shown in the Rio Salado project that the UAU is likely to be contaminated with many industrial compounds negatively impacting the aquifer. Groundwater quality in the eastern half of Oeste has been impacted by

hydrocarbon releases and elevated concentrations of 1,1-DCE. The southwestern area of Oeste, indicate elevated concentrations of total dissolved solids and nitrates as concerns. A DCE plume from an unknown source is positioned along the south side of the River near the Del Rio Landfill, 8th Street to 14th Streets, and crosses over to the north side of the River near the 19th Avenue Landfill.

The UAU is highly impacted by contamination with fewer impacts on the MAU and the LAU. The main chemicals of concern (COC) are tetrachloroethene (PCE), trichloroethylene (TCE), 1,1-dichloroethene (DCE), and chromium. Other chemicals of less concern include nitrate and BTEX. Several sites near the Rio Salado Project area have been impacted by at least one of the COCs.

The Corps installed monitoring wells for the Rio Salado project in 1999 and 2001 to characterize the groundwater contamination near the production wells sites. Several of these have exceeded the state and federal water quality standards for volatile organic compound (VOC). Concentrations of DCE in some exceeded the Arizona Department of Environmental Quality (ADEQ) Fish Consumption (FC) standard. PCE has repeatedly been detected at concentrations exceeding the maximum concentration level (MCL) in monitoring wells located just north of Lower Buckeye Road and west of 7th Avenue. Chromium concentrations have also been reported to frequently exceed the MCL's.

Preliminary information on Oeste and the more extensive groundwater sampling program done for Rio Salado anticipate that some form of wellhead treatment may be required for Oeste. An evaluation of the wellhead treatment cost must be weighted against acquiring real estate outside the immediate project boundaries, but within the cone of depression for a well installation, and the cost of a conveyance system to deliver the water to the project.

Access/Right-of-Way/Utility Constraints:

The well must be accessible to heavy equipment for well maintenance, rehabilitation, and replacement. The wellhead treatment compound, if needed must be accessible to heavy equipment to install, maintain, and supply the treatment units. The preferred well location would be within the Project area adjacent to a major arterial street down river of the ground water reservoir to capture water in the River. Electrical power is required at the well and all pump station locations but should not drastically affect the location.

Recommended Well Location:

It is probable that water from the proposed supply well will not meet the AZPDES water quality criteria used for permitting and may match the water quality seen in the Rio Salado project. With the UAU identified as the primary source of supply water for pond and make up water, some factors will impact the time it will take for the well to be affected. These factors include:

- Available real estate
- Access to install and maintain the well
- Water production of the well/flow rate
- Length of time the well will operate daily/annually
- Existing groundwater treatment and impacts on contamination

- Hydrologic properties of the upper alluvial unit
- Changes in water levels induced by Rio Salado water entering the Project and the pumping of the well

The driving forces in locating the well will be access, real estate availability, installation parameters, piping distance, and the potential for wellhead treatment system.

Until additional ground water test data is available, at this time the supply well location is uncertain, but near 35th Avenue is initially desired. Additional wells may be required beyond the one proposed due to limitations in the capacity of the well yield, operation criteria, and water quality constraints.

Water Quality Considerations:

The discharge of groundwater and effluent to the Oeste Project will be regulated by two sets of standards from the Arizona Administrative Code; Title 18, Chapter 11, Article 1 – Water Quality Standards for Surface Waters; and Title 18, chapter 11, Article 4 – Aquifer Water Quality Standards. The designated uses for this reach of the Salt River include aquatic and wildlife warm water, partial body contact, and fish consumption. The surface water quality standards that are applicable for these designated uses must be met at the point of discharge to the Salt River.

Water quality should be taken into account with regard to impacts on the plant life, water supply and distribution infrastructure. As an example, water with high total dissolved solids (TDS) may be deleterious to certain vegetative species as well as increase maintenance and operations costs to the pipelines, pump stations, and other water delivery components.

Distribution System:

Reclaimed water and ground water will be held in reservoirs. The water will flow, by gravity, to an adjacent pump station. The pump stations will then pump water to the water supply systems along the overbank and terrace areas. Piping installed along the overbank area will distribute water across the Project site. At specific locations, surface or subsurface water turnout structures will deliver water to the terrace area. The pump station locations will be based on water demand zones and habitat needs, available real estate, piping distances, public and maintenance access. The preliminary locations are:

- North side 35th Avenue (ground water pond/reservoir)
- North side 51st Avenue
- North side 75th Avenue
- South side 35th Avenue
- South side 51st Avenue

There will be two sets of criteria for the pump stations: 1) pressure and flow requirements for a permanent drip irrigation system on the overbanks and a temporary system on the terrace, and 2) pressure and flow requirements for the supplemental water delivery system. During the startup period a large daily volume of water will be required to meet the plant establishment demand of the various habitat zones. Higher volumes and

pressures will be required to water larger zones once plant maturity has occurred. The design elements that are part of the pressurized system include:

- Pipeline from the reservoir to the pump stations
- Pump stations
- Pressure distribution pipelines
- Turnout structures at the terrace area (surface and subsurface)
- Localized distribution system

Design Assumptions

The following design assumptions are made for the pressure distribution system:

- Pump intake design will be in accordance with the Hydraulic Institute standards, an accepted engineering standard for pump stations.
- Pumps will be vertical turbine type pumps because of ease of maintenance, and a preference by the City.
- A standby pump will be provided for each pump type; this is a commonly accepted engineering practice that allows for minimal down time during required maintenance. Use of a stand by pump is more cost effective than frequent switching between pumps because the latter requires additional instrumentation and control.
- Pump motors will be high-efficiency, 480-volt, three-phase and will be constant speed to reduce power costs and maintenance requirements.
- No backup power will be provided since power loss for a relatively short period of time (<24 hours) should not significantly impact the Project.

Water Distribution System:

Distribution piping will be installed in the overbank area for the entire reach of the Project. The piping will be designed to withstand a constant system pressure. Turnout structures, at strategic locations, will convey the water from the overbank to the terrace by surface or subsurface means. Automated Control Valves should be installed at turnouts to allow a supply of water to be delivered to individual areas from a remote location.

To maintain a level of system redundancy, pipes will be attached to the bridge structures at 35th Avenue, and 51st Avenue. This will interconnect reservoirs and pump stations on opposite sides of the river.

Several types of material for the distribution system piping will be considered. The potential piping materials are:

- Ductile iron pipe (DIP)
- High-density polyethylene (HDPE)
- Polyvinyl chloride pipe (PVC)

Pump Station Capacity:

The pump stations will be designed to meet the water demand requirements for the specific habitat zones they will be responsible for. The system should operate off of

system pressure. A desired pressure in the system should be targeted. Once a system pressure drops below an acceptable value, the pumps should turn on to pressurize the system and turn off at a predetermined maximum pressure. The pump stations should be sized to meet the different pressure requirements of the temporary/establishment irrigation system and the longer-term supplemental water system. As a result of the different pressure requirements for these two systems, there should be two dedicated pumps, one for the temporary irrigation system and one for the supplemental water and permanent irrigation systems.

The pump stations are planned to be pre-engineered stations similar to stations that are in the Rio Salado project. Water will be conveyed from the reservoirs through a gravity pipeline to a wet well. The pumps will be installed above the wet well and will use adjustable-frequency-drive units. These stations will have local controls and will be housed outside. These stations will be located in similar enclosures as were used in the Rio Salado Project, with minor aesthetic changes to integrate the Oeste project design vernacular.

Pump Station Aesthetics:

The pump stations should be adjacent to the public staging areas and associated reservoirs. The functional nature of the enclosure requires close access to a stable road surface for routine maintenance with some screening of the equipment to improve aesthetics, reduce equipment noise, ultra violet ray damage and vandalism.

The aesthetic objectives for pump stations are as follows:

- Minimize straight lines and regular forms to increase shadow opportunities (thereby decreasing apparent mass) and to preventing a structured silhouette against the skyline. The overall aesthetic approach to these structures will be based on preserving the pretense of an existing natural environment separate from the built environment.
- Maximize landscape screening where practicable.
- Coordinate sitting issues to minimize adjacency to pedestrian elements and interpretive areas while also assuring the system can operate at peak efficiency.
- Investigate the use of recycled materials and/or green building technologies such as; reused river ruins, recycled steel, and tires.
- Maximize built shading opportunities and dark colors to better blend the structure with the natural environment.
- Maintain a rustic aesthetic consistent with the project objectives by using exposed weathered metal, and raw masonry elements, and/or natural stone.

Open Channel Distribution System:

Delivering water from the reservoirs along the overbank to the terrace and wetlands is proposed to be predominately with open canals. The canals will deliver water from the reservoirs using gravity flow whenever possible. Canals will be located where possible on the overbank and terrace levels to provide water to the wetlands and surface-irrigated vegetation in select habitats such as the cottonwood-willow and emergent zones adjacent

to the wetlands. The canals and waterfalls can increase habitat value by adding movement to the water thus increasing the dissolved oxygen levels, cooling the water, and altering the adjacent microclimates by increasing humidity.

Design Assumptions:

The following criteria and assumptions will be used to design the canal system:

- As a safety measure, a minimum horizontal separation of 5-feet should be maintained between the maintenance road and all canals plus a maximum gradient of 20:1 should be provided at the edge or near the canal. Canals will be designed to meander where feasible for natural purposes. Other features, such as small waterfall-like drops, crossings, pools, etc., will be provided where reasonable as determined in the detail design phases. The canal cross section design should also maintain a minimum flow depth of approximately 6 inches, a velocity ranging between 2 fps and 6 fps, with the ability of providing occasional high-velocity zones to imitate the audio, visual, and functional effects of a natural stream. To replicate a natural stream bed and achieve the desired cross section, construction materials from the River that includes river rock, cobbles, and/or concrete river ruins should be employed.
- In the overbank areas, canals should be lined with an impermeable liner to prevent seepage. Maintaining the required water supply is crucial to the success of the Oeste Project and saturation of the soils behind the riverbanks could jeopardize bank stability in places. The canals should be located approximately 6 to 8 feet from the top of the riverbank slope. In areas that are identified to be more susceptible to erosion from flood flows, the canals and other overbank facilities will be located as far away as possible from the top of the bank. Canals located between the maintenance road and the top of slope of the riverbank on the overbank level can also function as a barrier for safety purposes between pedestrians and the bank's slope.
- On the terrace level, all canals will be lined with a low permeable liner to prevent seepage, except reaches where a "leaky" canal is specifically desired for subsurface irrigation purposes. This may occur adjacent or near some wetlands to help saturate the soils in aquatic or emergent zone habitats. To improve protection of the canals, separation between the canals and flood conveyance features such as a low flow channel will be maintained. In most locations, the canals will be located on the outside edge of the terrace. Where canals are located adjacent to wetlands they should be located between the wetlands and the riverbank. This arrangement can help augment the gravity water flow delivery system to the wetlands.

Open Canal System:

Canals will typically be located along the overbank and terrace levels between 19th Avenue and 83rd Avenue. Further geotechnical investigations and project boundaries may provide information limiting the actual extent of the open canal system.

The canals located on the southern terraces and overbanks will be fed from two reservoirs located at 35th and 51st Avenues and the river. In general, west of 51st Avenue the existing grades in the overbank parallel the riverbed grades, sloping downward in a westerly direction. Preliminary investigation indicates that gravity flow is possible west of 51st

Avenue. Where gravity flow is not possible a pump station could be installed to deliver water where needed.

The canals located on the northern terraces and overbanks will be fed by three reservoirs, located at 35th Avenue, 51st Avenue and 75th Avenue and the river. Gravity delivery of water from these reservoirs is possible west of 51st Avenue for the entire northern reach. As along the south reaches, in locations where gravity becomes an exception, a small pump station could be assigned to deliver the water.

From the standpoint of delivery, operation, and maintenance it is desirable to have consistent flow conditions throughout the open canal system. However, a uniform canal appearance is not generally acceptable for an environmental restoration project because it detracts from the natural stream effect. Desirable velocities will need to consider the require slopes and actual slope of the terrain. Velocities of 2 fps are permissible but flow velocities in excess of 3 fps are more desirable. Higher velocities are a deterrent to sediment buildup and to plant and algae growth. Fast moving, noisy, tumbling water also increases dissolved oxygen levels, cools the water and provides for better vector control. Oeste should optimize opportunities for high velocity small waterfalls to improve ecosystem restoration value, vector control, aesthetics, and maintenance. This may require the installation of some small pump stations. The location, quantity, practicality, and feasibility of these pumps, if they are necessary, will be determined during the design phase.

On the terrace level, the canals should complement the layout of the wetlands. The proposal for the wetland design will be to operate them in series such that the upstream wetland pond overflows into the next lower elevated pond and so on. The concept for the canal is for them to feed the wetlands. To improved operations the canals may also be used as a bypass water source for each terrace wetland in case a given pond needs to be taken offline for maintenance or repairs. Drops and grade breaks in the vertical alignment should be incorporated to minimize grading and optimize the habitat value the canals offer.

It is unlikely the canals will flow continuously within the terrace and overbank levels from one end of the site to the other. Naturally undulating grades, waste pockets, and other constraints may limit the extent the canals can be located. The goal is to align the canals to follow the natural grades as much as possible and to limit the earthwork efforts. Typically, the terrace-level canals flow from east to west but anticipate there will be exceptions. The design grades for the gravity canals and pipeline system will not be determined until the project is in detailed design.

Canal Hydraulics

The canals will be designed to carry the peak demand for the proposed wetlands ponds for select habitats zones. At this conceptual phase, the minimum demand for a given reach is between 0.20 cubic feet per second (cfs) and the maximum demand of about 5.05 cfs. This results in canal top widths for a trapezoidal section ranging from 5 feet to 12 feet. The design velocity and flow-depth will be sized to prevent erosion from velocities over 6.0 fps, and prevent water quality and maintenance problems associated with velocities under 2.0 fps.

In areas where sufficient nuisance water exists, storm water nuisance flows will be captured in the canal system as an additional water source. Diversion weirs designed at the outfalls will help direct the water to these locations. Water delivered to the wetlands can be achieved through a system of diversion weirs.

To reduce percolation and potential structural problems to the overbank slopes it is proposed that all of the overbank canals and some of the terrace-level canals be lined with a low permeable lining system. Lining system alternatives will be selected to provide aesthetic enhancement and promote a natural system. Various alternatives should be investigated that will allow for river rock and sand (or other natural covering) to be placed over the liner to provide a solution that meets both the hydraulic, environmental, and aesthetic design criteria.

Overbank Canal:

The water supply and distribution system on the overbank areas will be composed of channels that vary in width and depth and make their way along the overbank areas. The canals may periodically cross underneath the maintenance road and trail system to allow the streams to be viewed, heard, studied, and experienced. This system is envisioned as a stream channel lined with river rock materials punctuated periodically by a large salvaged rock outcropping, boulder, and/or salvaged concrete river ruins set to mimic a natural boulder outcropping. The system may incorporate a variety of alternative uses for recycled concrete river ruins to create check dams, drop structures, and augment grade changes.

Overbank to Terrace Canal:

The water supply and distribution system transition from overbank to terrace level will capture the sound and visual effects of splashing water. These transitions will be strategically located to provide the necessary quantity of water to the terrace area delivery system and ultimately to the wetlands.

Both native stone and concrete river ruins that are discovered during the excavation of the wetland ponds and other construction activities should be incorporated to create the desired effects, reduce waste removal fees, and exhibit to visitors how recycled materials can be used effectively in the physical environment. These spillways are not envisioned to encroach into the river channel and should be designed to complement the natural grade and hydraulic flows against the embankment.

Terrace Canal:

The water supply and distribution system on the terrace areas will be composed of a wide variety of diverse delivery systems. The backbone of the delivery system will be very similar to that of the overbank area: meandering stream channels that vary in width and depth and snake their way along the terrace areas. The channel design on the terrace, like that of the overbank, is meant to reflect a naturally occurring babbling brook, creek or streambed.

This main system should be designed with river rock materials punctuated periodically by a large salvaged rock or concrete river ruin outcroppings, boulder, and/or salvaged concrete slabs set to appear as a naturally occurring boulder outcropping. It is envisioned

that this system would use these same materials to create check dams, drop structures, spillways, and grade changes along the channel.

In addition to the main channel, the terrace delivery system will also consist of "rill irrigation". These rills would occur off the main channel and deliver water in a network of small cut, possibly braided channels that would feed the terrace areas. The main purpose of the rills is to help saturate soils beyond the reaches of the wetland pond areas. If manually controlled and operated, these features could produce a controlled flood through selected vegetation to assist in natural recruitment that depends on periodic flooding to reproduce.

Water Delivery:

Design Assumptions

The prevalent assumptions and approaches for Oeste's water delivery irrigation systems are:

1. Water for the Project's wetland features will be supplied from a ground water well reclaimed effluent from the 23rd Avenue Water Reclamation Plant, Rio Salado residual, storm outfall structures, and other discharges delivered by a surface (canal) and subsurface (pipe) delivery systems. This watering system can be used to irrigate specific habitat vegetation whenever the site and soil conditions are appropriate, both on the overbank as well as in the terrace areas.

2. Delivering water to the varies habitat zones may be accomplished through a variety of methods including flooding, rill ditches, constructed perched aquifers, and two different drip irrigation system concepts. The two drip systems include a long-lasting "hard pipe" drip irrigation system to irrigate the overbanks, and a temporary plant establishment irrigation system for irrigated species on the terrace and slope areas, composed primarily of PVC piping.

3. Both proposed drip irrigation systems will consist of a combination of methods and devices including pressure-compensating emitters, micro sprays, and pressure-compensating bubblers. The exact combination and use of these devices in each of the habitats will be determined during the systems' detailed design phase. The drip irrigation systems will be designed to meet City of Phoenix Parks and Recreation standards.

4. The main infrastructure (reservoirs, pump stations, transmission pipelines, etc.) will be sized to provide a sustainable water supply. The system will be configured to provide an appropriate level of redundancy to ensure water delivery in the event of equipment or well failures. The sustainable water supply is defined as the amount of water necessary to keep the vegetation living during the month of July

Specific recommendations for the methods and approach that will be followed during design will include the combination of the following techniques.

Overbank Areas

5. The overbank areas will be irrigated mostly with a combination of pressure-compensating emitters, bubblers, and micro sprays using the hard pipe (PVC pipe)

irrigation concepts designed to City of Phoenix Parks and Recreation standards. A few focus areas on the overbanks could also be irrigated using the surface (canal, or rill) water supply system.

Terrace Areas:

The terrace area may use a combination of irrigation approaches:

- Temporary drip system for establishment of vegetation
- Subsurface liners to create an artificially perched aquifer
- Canal or Rill (ditch or flood)
- Water harvesting polymer or polymer type products

Temporary Drip System:
The intent is to build from the "backbone"; water source infrastructure, mainline, and control system of the overbank irrigation system, but to use small-diameter flexible polyethylene lateral pipe and drip emitters. It is intended to be in operation for about an 18 to 24-month establishment/growth period of the containerized plant materials. This approach is anticipated to be used on specific terrace areas to start plantings that need a reliable water source during establishment or they would likely parish. This was done on the Rio Salado to align with the Corp's policy guidance of minimizing and eventually eliminating the amount of irrigation on the terrace and the local sponsor's concern of high mortality during the first few years of establishment.

Perched Aquifer:
The perched aquifer system relies on the creation of a low permeable layer below the ground that will retain water at a certain level. The perched aquifer is created within the proposed wetland and extends beyond the edges of the wetland ponds. This aquifer is perched through the use of engineered liner systems consisting of geotextile fabrics, clay, and local soils or a combination of these materials to produce impervious and semi-impervious layers that lie below the surface creating the perched aquifer effect. This water system is highly desirable in maintaining the cottonwood-willow habitats associated with wetlands. The relatively shallow depth of the naturally occurring aquifer within the river channel also presents itself as a long-term potential water source for Oeste. As a design goal, the irrigation system will be selected on the ability to facilitate and encourage deep rooting by appropriate plant materials such that the existing and naturally occurring aquifer will sustain the desired project habitats. The water for these perched aquifers could be generated through the wetland water delivery system, and potentially augmented with dry-weather flows and storm water runoff in select locations and under appropriate conditions. These areas should comprise a mosaic of indigenous riparian vegetative types producing a cottonwood-willow gallery forest and open water wetland marsh habitats.

These perched aquifer areas will also serve as an incubator for seed germination by the cottonwood and willow over story through the man-made and controlled flooding that these areas should be designed to receive. This system should not be considered within 50 feet of an excavated channel if bank stability is an issue. These systems, as with the rill system, are in harms way and could experience catastrophic damage by flood events.

A cost analysis should be conducted after further engineering data can be collected and evaluated to determine the practicality and life cycle cost..

Rill/Flooding:
Rill/flooding delivery consists of ditches that have been formed, or bladed, into the natural soil to channel water towards vegetation planted along the banks and within their wet zones. These natural ditches, or rills, may or may not be lined to contain and direct the flow of water. However, the system is envisioned as one that allows leakage and percolation of the water source to aid in feeding the surrounding plant materials and to create wet zones. The use of rills within the terrace areas and at existing storm water outfalls will be one of the water supply methods for these planting zones. It is envisioned that the method of diverting water into these rills will be controlled and regulated by check dams and diversion structures that force storm water or canal water into the rills to create the leaky canal system that make up the rill irrigation system. The rill technique should be designed to supply some water to those areas that lie outside of the lined wetland pond areas and to optimize the water coming out of the storm water outfalls. These systems may be severely impacted by significant flood events, but their low initial development cost, routing, and ease of recreating them allows for quick restoration or even to rerouted as Oeste's vegetation and habitats develop and matures.

Polymers:

A possible solution for areas that fall beyond the reaches of an irrigation system or possibly in lieu of a temporary establishment system is amend the planting mix with a polymer or polymer type product. Polymers are tiny molecules strung in long repeating chains. These tiny pellets or sponges absorb water many times there their size then release it slowly to the plant material by means of soil capillary action and pressures. In the landscape industry these are typically synthetic, but there are also natural polymer type products that could be researched.

Driwater is a natural product that is placed around individual plants during the planting operation, in either a PVC tube that can be monitored and reloaded, or in a biodegradable quart carton. The unit and the plant are wetted to activate the product. it then releases absorbed water and the Driwater product biodegrades. Driwater was used fairly successfully along the Las Vegas Wash project without the need for a temporary irrigation system, but for a large planted area it has been reported to be expensive and highly labor intensive to maintain.

The Corp and City are currently evaluating several alternatives to irrigation on a demonstration project initiated in May 2004 between 18th and 20th Streets on the south bank of the Rio Salado project. Four different plant backfill material receipts were used on 350 1-gallon containerized trees. The alternatives included polymers, Driwater, fine grained soil with a polymer additive from a local sand and gravel operator, and native backfill. Over the next several years the Corps will monitor each tree and their selected backfill material to determine if a temporary irrigation system is needed through the plant establishment period.

Slope Areas:

Slope areas leading down to the terrace should be seeded with grasses and forbs to increase habitat values, assist in erosion control, and improved aesthetics. One alternative which is being implemented on Rio Salado and needs to be reviewed once activated is to supply water to a limited area of these seeded slopes using lower-pressure, shorter-radius rotor sprinklers on short risers located at the top of the overbank. The use of this method, as in the Rio Salado, should be very focused and selective. It is envisioned to be concentrated in areas composed of inert debris and other waste sites where removal of the material would be cost prohibitive or unwise and the area should be mitigated to visually mask undesirable views and potential erosion zones. This technique should be evaluated for it's relation to Oeste's overall restoration goals, project terrain, visibility, and the habitat zones.

Supervisory Control and Data Acquisition (SCADA):

Overview:

It is intended that the Rio Salado SCADA system will integrate with Oeste's water delivery system. The Rio Salado SCADA computer located in the Rio Salado Maintenance Facility monitors and provides supervisory control for remote sites, including the production well, reservoirs, irrigation pump stations, and canal transfer pump stations. Communication between each remote site and the SCADA computer may match the Rio Salado project using a spread-spectrum radio link, which does not require licensing, or possibly a telephone connection.

Design Assumptions:

It will need to be determined if radio or telephone is the most feasible communication link between the Supervisory Control and Data Acquisition (SCADA) computer, the central irrigation controller located at the Rio Salado Maintenance Facility, and the various remote sites in Oeste. This is verified by a radio survey and cost comparison for the telephone connection. The radio survey consists of two major tasks: (1) modeling each radio link to determine if it has adequate radio strength; and (2) verifying the model by field-measuring radio signal strength for each link. The telephone connection will be based on the City's ability to procure telephone communications into some of the more remote areas of Oeste and what these capital cost would be.

Dry Weather Flows:

The majority of the storm drain outfalls in Oeste have stormwater discharge only after a rainfall event. However, regular discharges of a significant quantities, have been observed in dry weather conditions at the northeast side of 35th Avenue where the 23rd Avenue Water Reclamation Plant discharges and at 43rd Avenue where tail water from Peterson's Farm discharges to the River.

Reuse of a portion of the stormwater flow poses some design challenges. These challenges include designing flow-splitting structures (splitter boxes), variable-flow-rate canals, and variable-flow-rate wetlands ponds. Splitter boxes are structures that allow

small nuisance flows to be diverted from the storm water channel into the water supply canals while allowing larger damaging flows, such as storm runoff, to flow directly to the River without overloading the canals and endangering the integrity of the canals or wetlands. The design challenge is to optimize these available flows, when and where possible. The maximum peak startup canal flow is estimated to be only 5.0 cfs (3.2 mgd) and the maximum sustaining canal flow is only 3.0 cfs (1.9 mgd). Dry weather flows for some of the outfalls may exceed the total water demand for portions of Oeste.

Stormwater Quality:

The majority of pollutants in stormwater are contained in the first flush after runoff begins. First flush describes the washing action that stormwater has on the watershed. Pollutants that are deposited on impervious surfaces during dry periods are transported by the initial runoff, creating a high-pollutant load at the early stages of runoff. After the first flush, the pollutant load decreases significantly for many of the pollutants, even if the flow rate increases. Capturing the first flush can treat the majority of pollutants i.e. petroleum compounds, metals, sediment, litter and trash. It should be noted that some pollutants behave differently than others and as such the first flush concept is applicable in varying degrees.

The concept of first flush is a highly variable, often misunderstood concept. The metropolitan Phoenix area does not have accepted guidelines that establish a recommended level of pollutants that should be removed during rainfall events. A commonly accepted threshold is to treat runoff from the 90th percentile storm to represent the first flush. A study was completed in 1997 for the Flood Control District of Maricopa County (FCDMC), in which 50 years of rainfall data was listed for the Phoenix metropolitan area. The data reveals that 90 percent of all storms recorded during the period from 1945 to 1995 were less than or equal to 0.37 inches in depth.

Trash Removal:

Stormwater generated from the upstream watershed will contain floating and suspended debris. Capturing a majority of this debris as it enters Oeste is desired for aesthetics, public health, maintenance, operations and hydraulic functions of the wetlands, and canals.

In the Rio Salado project some stormwater outfalls were outfitted with trash removal structures. These structures were constructed from concrete river ruins salvaged from the site and have hidden screens and openings that let water pass through. The structures have a basin on the upstream side of the openings that collect floating and suspended debris. These features also provide a visually pleasing water feature during dry weather non-storm flows. Monitoring the Rio Salado trash removal structures over several years will provide historical data on the merits of their success and application for Oeste.

To concentrate the floating and suspended debris, the trash removal structures can also be used as a splitter-box type feature. A finite amount of water can be diverted through the trash removal structure, using a bypass weir system and spillway. These weirs divert a predetermined amount of the flows generated from the stormwater outfalls through the trash removal system, but still allow large storm flows to pass through to the primary River channel. The amount of flow diverted is determined during the detailed design

phase and will vary from outfall to outfall depending on its size and design discharge. Although the discharge volume has not yet been quantified, it is desired to be equivalent to the first flush or greater.

Operation and Maintenance:

Water Supply and Distribution System Operations/Maintenance

Operations and maintenance considerations for the water supply and distribution system are:

- Periodic maintenance will be required on the well submersible pumps. Periodically the pumps will need to be pulled from the wells and inspected. It is anticipated that this level of inspection would mirror Rio Salado and likely occur once every two years.
- If wellhead treatment is required, the required maintenance for this facility will increase significantly. It is anticipated the regime would be similar to the Rio Salado well head treatment facilities maintenance requirements and would include maintaining equipment, replacing filters, and daily facility monitoring.
- It is anticipated that required maintenance for the reservoirs themselves should be minimal. Additional upkeep and maintenance of the plant material will be ongoing and as monitoring and adaptive management principals are adapted could involve a variety of maintenance responsibilities. As the Rio Salado reservoir shells are monitored and the cost and functional operations of the liner material is further evaluated, additional components like a leak detection monitoring system may be warranted for Oeste.
- The pump stations will require routine preventative maintenance including all the electrical and mechanical equipment. Maintenance should include exercising valves, lubricating pumps, and monitoring electrical devices for adequate power draws.

Canal Overbank: The use of the river rock in association with the channel will create pockets for dirt and debris to accumulate and may require periodic flushing/cleanings to minimize debris and potential odors.

The manually operated rill irrigation system will require periodic maintenance to ensure that it is operating effectively. The rill irrigation system is a dynamic system and has the propensity to meander in response to the flow of water pushed through the system. Because these systems would not typically be lined with a geotextile or liner material, when the river floods the terrace areas, the rills may need to be reestablished.

- Collection and removal of trapped debris from the basin floor and the debris screen.
- Inspection of debris screen for signs of corrosion, damage from high flows, or detachment from trash rack structure.
- Inspection of trash rack structure for indications of staining, damage from high flows, vandalism, or movement of concrete block/rock that might indicate a reduction in the stability of the structure.

- The trash rack aesthetic operations and maintenance issues will be in replacement of the screen and mesh once the metal screen has surpassed its submerged life cycle.
- The spillway should be monitored to ensure that undercutting by the channel is not eroding the stability of the structure.
- The headwall treatment should be monitored to ensure that undercutting by the flows that are coming out of the associated storm drains is not eroding the stability of the headwall treatment or the structure.
- The concrete spillway should be monitored to ensure stability of the structure(s).
- Rodent control and repair of rodent damage
- Vandalism control and repair of vandalism damage
- Water supply scheduling in accordance with local and real-time Et rates
- Filtration system and lateral flushing procedures
- Fertilizer injection if provided
- Chemical (chlorine) injection for emitter maintenance
- Emitter operational check procedures
- Sprinkler performance evaluation and sprinkler operation check procedures

BASIS OF COST ESTIMATES
RIO SALADO OESTE
FEASIBILITY REPORT
F4 DRAFT

SALT RIVER
PHOENIX, AZ

February 2005

The purpose of this Basis of Cost Estimate is to document the sources of data and assumptions used in developing the study cost estimates for the alternatives formulated in the Rio Salado Oeste Feasibility Study.

Where possible, unit cost information was established from actual cost data provided by manufacturers. Additional data and lessons learned were derived from the Rio Salado project currently under construction.

A. CONSTRUCTION COSTS

1. Excess Excavated Material: It is assumed that all excess material will be utilized on site throughout the project area for reshaping of the floodplain.

2. Contingency: A 25% contingency was included, in accordance with Corps of Engineers regulations for feasibility study construction cost estimates.

3. Planning, Engineering & Design (PED) and Engineering During Construction (EDC): The PED and EDC were 10% and 1%, respectively.

4. Supervision & Administration (S&A): A 7% S&A cost was taken on the construction cost. This percentage is required by the Corps of Engineers regulations.

B. OPERATION AND MAINTENANCE COSTS

The restoration is designed with the intent to restore ecosystem functions and be a self-sustaining natural riparian ecosystem. However, as in any manmade, controlled system, maintenance will be required.

1. Invasive Control: $60/acre as provided by invasive control companies. This applies for both Salt Cedar and Arundo.

2. Restored Channel:

i. Grading – Assume once every 20 years a volume equal to ½ of the initial construction quantity or 330,000 c.y.

ii. Estimated at $4/c.y.

3. Storm water Wetlands: Regrading and excavation will be required once every 10 years. Assume 50% of construction quantity or approximately 75,000 c.y.

4. Irrigation System Maintenance: Assume $1000 per acre repair and replacement of irrigation infrastructure.

5. Associated Cost, Water Supply: Assumed cost similar to that of Central Arizona Project water $106/acre-ft as recommended by City of Phoenix Water Services Department.

7. Replanting and replacement cost: Assumed 25% of planting/irrigation will require replacement after a flood event.

8. Lakes: Assume that excavation and regrading would be required once every 20 years, 40 acres at 10 ft depth. Approximately 645,000 cy at $7/cy.

C. RECREATION COSTS

Recreation Cost estimates are not yet finalized. They will be completed prior to the Alternative Formulation Briefing. Estimates for the recreation features are based upon known costs for the Rio Salado project currently under construction.

Tables

1. Ecosystem Restoration Alternative Cost Estimates
2. Water Supply and Distribution Cost Estimates

PRELIMINARY FEASIBILITY COST ESTIMATES
RIO SALADO OESTE

Alternative 2

Storm water and Channel: This alternative includes the modification of existing storm-water outfall areas to improve retention and water spreading as well as increasing the existing habitat currently supported by these outfalls. It also includes modification and/or restructuring of the primary conveyance channel to a more natural state. This could include grading and terracing the river corridor from 19th avenue to 83rd avenue. No additional water source is included in this alternative.

		Quantity	UOM	Unit Cost		TOTALS
Channel Restoration		660,000	CY	$4		**$2,640,000**
Stormwater Outfall						
	Grading/Excavation	414	CY	$7		$2,898
	Concrete	51.8	CY	$ 100.00		$5,180
	Cobble	2800	SQ FT	$7		$19,600
	Weir	1.5	CY	$ 100.00		$150
	V-ditch	18.5	CY	$7		$129.50
					Subtotal	$27,957.50
		8	**Stormwater Outfalls**			**$223,660.00**
Wetland Ponds						
	Grading/Excavation	149,890	CY	$7.00		$1,049,230.00
	Liner (12" of fines)	45,128	CY	$8		$361,024.00
	Hydroseeding	28	ACR	$4,500		$126,000.00
			Wetland Ponds			**$1,536,254.00**
Clearing/grubbing (trees, grasses etc.)		36	ACR	$5,000		**$180,000.00**
Cottonwood/willow (1 gal.)						
	Planting	66	ACR	$5,205		$343,530.00
	Irrigation		ACR	$8,800		$580,800.00
			Cottonwood Willow			**$924,330.00**
Mesquite Bosque (1 gal.)						
	Planting	43	ACR	$6,950		$298,850.00
	Irrigation		ACR	$8,800		$378,400.00
			Mesquite Bosque			**$677,250.00**
Grade Control Structure						
	RCC (2400cy/structure from Rio Salado)	2,400	CY	$ 100.00		**$240,000.00**
Subtotal Construction						$6,421,494.00
Debris removal			LS	2%		**$128,429.88**
Water Supply and Distribution			LS			**$0.00**

	Subtotal		**$6,549,923.88**
Real Estate Assumptions	Contingency	25%	$1,637,480.97
8 1 acre each outfall	PED	10%	$654,992.39
945 945 acres easement-channel	EDC	1%	$65,499.24
137 137 acres habitat	S&A	7%	$425,745.05
	Construction		**$9,333,641.53**

Real Estate		1080	ACR	$20,000.00		$21,600,000.00
				Contingency	25%	$5,400,000.00
				Real Estate		**$27,000,000.00**

Alternative 2 Including Real Estate **$36,333,641.53**

PRELIMINARY FEASIBILITY COST ESTIMATES
RIO SALADO OESTE

Alternative 2

Monitoring and Adaptive Management	4%	**$1,453,345.66**

Operation and Maintenance	**Cost**
Replacement Cost (assume 25% of planting/irriation) requiring replacment after flood event)	**$400,395.00**
Invasive Species Control: Assume annual removal of exotic species. $60/acre	**$8,220**
Wetlands: Regrading and excavation required once every 10 yrs. Assume 50% of constructoin quantity. ~75,000 cy.	**$525,000**
Channel: Assume regrading once every 20 years of 50% the original construction quantity or 330,000 cy.	**$ 1,320,000.00**

No Water Cost- All stormwater
Irrigation costs included under mesquite and cottonwood, assume temporary irrigation to establish vegetation.

Construction Duration
1 year channel restoration
1 year stormwater wetland and associated habitat
Total 2 year construction

PRELIMINARY FEASIBILITY COST ESTIMATES
RIO SALADO OESTE

Alternative 3

Storm water, Channel, Water Supply, Cottonwood, Mesquite, Invasive: This alternative includes the features described in alternative 2 and ads a supplemental water supply in the form of effluent. At locations identified as suitable throughout the project area cottonwood/willow and mesquite cover types will be restored. This alternative would also address the management, control and removal of invasive species within the study area. Two types of irrigation (drip and flood) will be evaluated for each.

		Quantity	UOM	Unit Cost		TOTALS
Channel Restoration		660,000	CY	$4		**$2,640,000**
Stormwater Outfall						
	Grading/Excavation	414	CY	$7		$2,898
	Concrete	51.8	CY	$ 100.00		$5,180
	Cobble	2800	SQ FT	$7		$19,600
	Weir	1.5	CY	$ 100.00		$150
	V-ditch	18.5	CY	$7		$129.50
					Subtotal	$27,957.50
		8	**Stormwater Outfalls**			**$223,660.00**
Wetland Ponds						
	Grading/Excavation	149,890	CY	$7.00		$1,049,230.00
	Liner (12" of fines)	45,128	CY	$8		$361,024.00
	Hydroseeding	28	ACR	$4,500		$126,000.00
			Wetland Ponds			**$1,536,254.00**
Clearing/grubbing (trees, grasses etc.)		36	ACR	$5,000		**$180,000.00**
Cottonwood/willow (1 gal.)						
	Planting	343	ACR	$5,205		$1,785,315.00
	Irrigation		ACR	$ 8,800.00		$3,018,400.00
		Cottonwood/willow				**$4,803,715.00**
Mesquite Bosque (1 gal.)						
	Planting	244	ACR	$6,950		$1,695,800.00
	Irrigation		ACR	$8,800		$2,147,200.00
		Mesquite bosque				**$3,843,000.00**
Mesquite Xeric		160	ACR	$2,700		$432,000.00
			ACR	$ 8,800.00		$1,408,000.00
						$1,840,000.00
Grade Control Structure						
	RCC (2400/structure from Rio Salado)	2,400	CY	$ 100.00		**$240,000.00**
Invasive Removal						
	Arundo Removal	10	ACR	$ 30,000.00		**300,000**
	Salt Cedar Removal	110	ACR	$ 5,000.00		**550,000**
Subtotal construction						16,156,629

PRELIMINARY FEASIBILITY COST ESTIMATES
RIO SALADO OESTE

Alternative 3

Debris removal			LS	2%		**$323,132.58**
Water Supply and Distribution						**$17,080,500.00**
				Subtotal		**$33,560,261.58**
				Contingency	25%	$8,390,065.40
				PED	10%	$3,356,026.16
				EDC	1%	$335,602.62
				S&A	7%	$2,181,417.00
				Construction		**$47,823,372.75**
Real Estate		1383	ACR	$20,000.00		$27,660,000.00
Real Estate	water supply/distribution	20	ACR	$40,000.00		$800,000.00
				Contingency	25%	$ 7,115,000.00
				Real Estate		**$35,575,000.00**
				Alternative 3 Including Real Estate		**$83,398,372.75**

Monitoring and Adaptive Mngt 4% **Cost** **$1,912,934.91**

PRELIMINARY FEASIBILITY COST ESTIMATES
RIO SALADO OESTE

Alternative 3

Operation and Maintenance

Replacement Cost (assume 25% of planting/irriation) requiring replacment after flood event)		**$2,621,678.75**	
Invasive Species Control: Assume annual removal of exotic species. $60/acre		**$46,500**	775 acres
Wetlands: Regrading and excavation required once every 10 yrs. Assume 50% of constructoin quantity. ~75,000 cy.		**$ 525,000.00**	
Channel: Assume regrading once every 20 years of 50% the original construction quantity or 330,000 cy.		**$ 1,320,000.00**	
Water Supply		**$734,000**	annually
Irrigation Maintenance: Assume annually $1000 per acre repair and replacement of irrigation infrastructure		**$ 747,000.00**	747 acres
Associated Costs			
Water	2941 106	**$ 311,746.00**	
$106/acre foot CAP cost applied to effluent, as per Steve Rossi.			
Delivery System to Peterson Farms			
Electric flow regulated valve	$ 50,000.00	**$ 612,000.00**	
3750 lf 10" pipe	$ 562,000.00		

Construction Duration
1 year channel restoration simultaneous with water supply and distribution
1 year stormwater restoration
18 months additional habitat restoration
Total 3.5 years construction

PRELIMINARY FEASIBILITY COST ESTIMATES
RIO SALADO OESTE

Alternative 4

Storm water, Channel, Water Supply, Cottonwood, Mesquite, Invasive, Emergent: This alternative adds restoration of emergent wetlands at the existing lake in the channel immediately downstream of 19th Avenue.

		Quantity	UOM	Unit Cost		TOTALS
Channel Restoration		660,000	CY	$4		**$2,640,000**
Stormwater Outfall						
	Grading/Excavation	414	CY	$7		$2,898
	Concrete	51.8	CY	$ 100.00		$5,180
	Cobble	2800	SQ FT	$7		$19,600
	Weir	1.5	CY	$ 100.00		$150
	V-ditch	18.5	CY	$7		$129.50
					Subtotal	$27,957.50
		8	**Stormwater Outfalls**			**$223,660.00**
Wetland Ponds						
	Grading/Excavation	149,890	CY	$7.00		$1,049,230.00
	Liner (12" of fines)	45,128	CY	$8		$361,024.00
	Hydroseeding	28	ACR	$4,500		$126,000.00
			Wetland Ponds			**$1,536,254.00**
Clearing/grubbing (trees, grass		36	ACR	$5,000		**$180,000.00**
Emergent Wetlands						
	Grading/Excavation	8,059	CY	$7		$56,413
	Liner (12" of fines)	8,059	CY	$8		$64,472
		5	ACR			**$120,885**
Cottonwood/willow (1 gal.)						
	Planting	343	ACR	$5,205		$1,785,315.00
	Irrigation		ACR	$8,800		$3,018,400.00
		Cottonwood Willow				**$4,803,715.00**
Mesquite Bosque (1 gal.)						
	Planting	244	ACR	$6,950		$1,695,800.00
	Irrigation		ACR	$8,800		$2,147,200.00
		Mesquite bosque				**$3,843,000.00**
Mesquite Xeric						
	Planting	160	ACR	$2,700		$432,000.00
	Irrigation		ACR	$8,800		$1,408,000.00
		Mesquite-xeric				**$1,840,000.00**
Grade Control Structure						
	RCC (2400/structure from Rio Salado)	2,400	CY	$ 100.00		**$240,000.00**

PRELIMINARY FEASIBILITY COST ESTIMATES
RIO SALADO OESTE

Alternative 4

Invasive Removal						
	Arundo Removal	10	ACR	$ 30,000.00		**300,000**
	Salt Cedar Removal	110	ACR	$ 5,000.00		**550,000**
Subtotal Construction						16,277,514
Debris removal			LS	2%		**$325,550.28**
Water Supply and Distribution			LS			**$17,080,500.00**
				Subtotal		**$62,143,564.28**
				Contingency	25%	$15,535,891.07
				PED	10%	$6,214,356.43
				EDC	1%	$621,435.64
				S&A	7%	$4,039,331.68
				Construction		**$88,554,579.10**

Real Estate		1383	ACR	$20,000.00		$27,660,000.00
	water supply/distribution	20	ACR	$40,000.00		$800,000.00
				Contingency	25%	$ 7,115,000.00
						$35,575,000.00
				Alternative 3 w/Real Estate		**$124,129,579.10**

Operation and Maintenance

Monitoring and Adaptive Management 4% **$3,542,183.16**

Replacement Cost (assume 25% of planting/irriation) requiring replacment after flood event **$2,621,678.75**

Inspection and Surveys: Assume annually there will be inspection and ecological surveys to monitor habitat response. $60/acre **$46,800** 780 acres

Invasive Species Control: Assume annual removal of exotic species. $60/acre **$46,800** 780 acres

Wetlands: Regrading and excavation required once every 10 yrs. Assume 50% of constructoin quantity. ~75,000 cy. **$525,000**

Channel: Assume regrading once every 20 years of 50% the original construction quantity or 330,000 cy. **$ 1,320,000.00**

PRELIMINARY FEASIBILITY COST ESTIMATES
RIO SALADO OESTE

Alternative 4

Water Supply **$733,800** annually

Irrigation Maintenance: Assume annually $1000 per acre repair and replacement of irrigation infrastructure **$ 747,000.00** 747 acres

Associated Cost

	Acre Feet		
Water	3118	106	**$ 330,508.00**

$106/acre foot CAP cost applied to effluent, as per Steve Rossi.

Delivery System to Peterson Farms **$ 612,000.00**

Electric flow regulated valve	$ 50,000.00
3750 lf 10" pipe	$ 562,000.00

Construction Duration

1 year channel restoration simultaneous with water supply and distribution
1 year stormwater restoration
18 months additional habitat restoration
Total 3.5 years construction

PRELIMINARY FEASIBILITY COST ESTIMATES
RIO SALADO OESTE

Alternative 5

Storm water, Channel, Water Supply, Cottonwood, Mesquite, Invasive, Emergent, Lake: Added to this alternative is lake restoration at the existing gravel pits at 29th and 37th Avenues.

		Quantity	UOM	Unit Cost		TOTALS
Channel Restoration		660,000	CY	$4		**$2,640,000**
Stormwater Outfall						
	Grading/Excavation	414	CY	$7		$2,898
	Concrete	51.8	CY	$ 100.00		$5,180
	Cobble	2800	SQ FT	$7		$19,600
	Weir	1.5	CY	$ 100.00		$150
	V-ditch	18.5	CY	$7		$129.50
					Subtotal	$27,957.50
		8	**Stormwater Outfalls**			**$223,660.00**
Wetland Ponds						
	Grading/Excavation	149,890	CY	$7.00		$1,049,230.00
	Liner (12" of fines)	45,128	CY	$8		$361,024.00
	Hydroseeding	28	ACR	$4,500		$126,000.00
			Wetland Ponds			**$1,536,254.00**
Clearing/grubbing (trees, grasses etc		36	ACR	$5,000		**$180,000.00**
Emergent Wetlands						
	Grading/Excavation	20,952	CY	$7		$146,664
	Liner (12" of fines)	20,952	CY	$8		$167,616
		13	ACR			**$314,280**
Cottonwood/willow (1 gal.)						
	Planting	378	ACR	$5,205		$1,967,490.00
	Irrigation		ACR	$ 8,800.00		$3,326,400.00
		Cottonwood/willow				**$5,293,890.00**
Mesquite Bosque (1 gal.)						
	Planting	244	ACR	$6,950		$1,695,800.00
	Irrigation			$8,800		$2,147,200.00
		Mesquite bosque				**$3,843,000.00**
Mesquite Xeric						
	Planting	168	ACR	$2,700		$453,600.00
	Irrigation		ACR	$8,800		$1,478,400.00
		Mesquite-xeric				**$1,932,000.00**
Fishing Lakes (2 lakes)		20	ACR			
	Cut and Fill	5,384,072	CY	$7		$37,688,504
	Liner (40" multi-layer)	212,747	CY	$40		$8,509,880
		Fishing lakes				**$46,198,384**

PRELIMINARY FEASIBILITY COST ESTIMATES
RIO SALADO OESTE

Alternative 5

Grade Control Structure						
	RCC (2400/structure from Rio Salado)	2,400	CY	$ 100.00		**$240,000.00**
Invasive Removal						
	Arundo Removal	10	ACR	$ 30,000.00		**300,000**
	Salt Cedar Removal	110	ACR	$ 5,000.00		**550,000**
Subtotal construction						63,251,468
Debris removal				2%		**$1,265,029.36**
Water Supply and Distribution						**$22,220,000.00**
				Subtotal		$86,736,497.36
				Contingency	25%	$21,684,124.34
				PED	10%	$8,673,649.74
				EDC	1%	$867,364.97
				S&A	7%	$5,637,872.33
				Construction		**$123,599,508.74**

Real Estate		1528	ACR	$20,000.00		$30,560,000.00
	water supply/distribution	20	ACR	$40,000.00		$800,000.00
				Contingency	25%	$7,840,000.00
				Real Estate		**$39,200,000.00**
			Alternative 5 with	**Real Estate**		**$162,799,508.74**

Operation and Maintenance **Cost**

Monitoring and Adaptive Management **4%** **$4,943,980.35**

Replacement Cost (assume 25% of planting/irriation) requiring replacment after flood event **$2,767,222.50**

Invasive Species Control: Assume annual removal of exotic species. $60/acre **$49,860** 831 acres

Wetlands: Regrading and excavation required once every 10 yrs. Assume 50% of constructoin quantity. ~75,000 cy. **$525,000**

Channel: Assume regrading once every 20 years of 50% the original construction quantity or 330,000 cy. **$ 1,320,000.00**

Water Supply **$1,081,320** annually

Irrigation Maintenance: Assume annually $1000 per acre repair and replacement of irrigation infrastructure **$ 790,000.00** 790 acres

PRELIMINARY FEASIBILITY COST ESTIMATES
RIO SALADO OESTE

Alternative 5

Lakes: Assume excavation/regrading once every 20 years, 40 acres, 10 ft depth. 644688 cy $7 cy **$4,512,816**

Associated Costs

	Acre Feet			
Water	6168	106	**$**	**653,808.00**

$106/acre foot CAP cost applied to effluent, as per Steve Rossi.

Delivery System to Peterson Farms		**$**	**612,000.00**
Electric flow regulated valve	$ 50,000.00		
3750 lf 10" pipe	$ 562,000.00		

Construction Duration

1 year channel restoration simultaneous with water supply and distribution
1 year stormwater restoration
2 years lake restoration
18 months habitat restoration overlaps with lake restoration
Total 4 years construction

PRELIMINARY FEASIBILITY COST ESTIMATES
RIO SALADO OESTE

Alternative 5A

Storm water, Channel, Water Supply, Cottonwood, Mesquite, Invasive, Emergent, Lake: Instead of restoration of both gravel pit lates to permanent water for fishing this alternative includes regrading to incorporate the pits to the floodplain and restoration of wetland and riparain habitat.

		Quantity	UOM	Unit Cost		TOTALS
Channel Restoration		660,000	CY	$4		**$2,640,000**
Stormwater Outfall						
	Grading/Excavation	414	CY	$7		$2,898
	Concrete	51.8	CY	$ 100.00		$5,180
	Cobble	2800	SQ FT	$7		$19,600
	Weir	1.5	CY	$ 100.00		$150
	V-ditch	18.5	CY	$7		$129.50
					Subtotal	$27,957.50
		8	**Stormwater Outfalls**			**$223,660.00**
Wetland Ponds						
	Grading/Excavation	149,890	CY	$7.00		$1,049,230.00
	Liner (12" of fines)	45,128	CY	$8		$361,024.00
	Hydroseeding	28	ACR	$4,500		$126,000.00
			Wetland Ponds			**$1,536,254.00**
Clearing/grubbing (trees, grasses etc.)		36	ACR	$5,000		**$180,000.00**
Emergent Wetlands						
	Grading/Excavation	20,952	CY	$7		$146,664
	Liner (12" of fines)	20,952	CY	$8		$167,616
		13	ACR			**$314,280**
Cottonwood/willow (1 gal.)						
	Planting	378	ACR	$5,205		$1,967,490.00
	Irrigation		ACR	$ 8,800.00		$3,326,400.00
		Cottonwood/willow				**$5,293,890.00**
Mesquite Bosque (1 gal.)						
	Planting	244	ACR	$6,950		$1,695,800.00
	Irrigation		ACR	$8,800		$2,147,200.00
						$3,843,000.00
Mesquite Xeric						
	Planting	168	ACR	$2,700		$453,600.00
	Irrigation		ACR	$8,800		$1,478,400.00
		Mesquite-xeric				**$1,932,000.00**
Lake Restoration						
Cut and Fill		3,000,000	CY	$7		$21,000,000
Emergent Wetlands						
Liner (12" of fines)		64,469	CY	$8		$515,752
Hydroseeding		40	ACR	$4,500		$180,000
		Wetland Restoration				**$21,695,752**

PRELIMINARY FEASIBILITY COST ESTIMATES
RIO SALADO OESTE

Alternative 5A

Grade Control Structure						
	RCC (2400/structure from Rio Salado)	2,400	CY	$ 100.00		**$240,000.00**
Invasive Removal						
	Arundo Removal	10	ACR	$ 30,000.00		**$ 300,000.00**
	Salt Cedar Removal	110	ACR	$ 5,000.00		**$ 550,000.00**
subtotal construction						38,748,836
Debris removal			%	2%		**$774,976.72**
Water Supply and Distribution			LS			**$22,220,000.00**

Subtotal		**$61,743,812.72**
Contingency	25%	$15,435,953.18
PED	10%	$6,174,381.27
EDC	1%	$617,438.13
S&A	7%	$4,013,347.83
Construction		**$87,984,933.13**

Real Estate		1528	ACR	$20,000.00		$30,560,000.00
		20	ACR	$40,000.00		$800,000.00
				Contingency	25%	$7,840,000.00
						$39,200,000.00
				Alternative 5A with RE		**$127,184,933.13**

Operation and Maintenance		**Cost**	
Monitoring and Adaptive Management	4%	**$ 3,519,397.33**	
Replacement Cost (assume 25% of planting/irriation) requiring replacment after flood event)		**$ 2,767,222.50**	
Invasive Species Control: Assume annual removal of exotic species. $60/acre		**$49,860**	831 acres
Wetlands: Regrading and excavation required once every 10 yrs. Assume 50% of constructoin quantity. ~75,000 cy.		**$525,000**	
Channel: Assume regrading once every 20 years of 50% the original construction quantity or 330,000 cy.		**$ 1,320,000.00**	
Water Supply		**$ 1,051,300.00**	
Irrigation Maintenance: Assume annually $1000 per acre repair and replacement of irrigation infrastructure		**$ 790,000.00**	790 acres
Lakes/Wetlands: Assume excavation/regrading once every 20 years of 1 ft material from 40 acres of wetlands or 5,000 cy		**$455,000**	40 acres

PRELIMINARY FEASIBILITY COST ESTIMATES
RIO SALADO OESTE

Alternative 5A

	Acre Feet			
Water	7709	106	**$**	**817,154.00**
$106/acre foot CAP cost applied to effluent, as per Steve Rossi.				
Delivery System to Peterson Farms			**$**	**612,000.00**
Electric flow regulated valve		$ 50,000.00		
3750 lf 10" pipe		$ 562,000.00		

Construction Duration
1 year channel restoration simultaneous with water supply and distribution
1 year stormwater restoration
2 years lake restoration
18 months habitat restoration overlaps with lake restoration
Total 4 years construction

PRELIMINARY FEASIBILITY COST ESTIMATES
RIO SALADO OESTE

Alternative 5B

Storm water, Channel, Water Supply, Cottonwood, Mesquite, Invasive, Emergent, Lake: This alternative is similar to 5 and 5A. However it includes the restoration of one gravel pit to a lake and the other to a wetland/riparian area.

		Quantity	UOM	Unit Cost		TOTALS
Channel Restoration		660,000	CY	$4		**$2,640,000**
Stormwater Outfall						
	Grading/Excavation	414	CY	$7		$2,898
	Concrete	51.8	CY	$ 100.00		$5,180
	Cobble	2800	SQ FT	$7		$19,600
	Weir	1.5	CY	$ 100.00		$150
	V-ditch	18.5	CY	$7		$129.50
					Subtotal	$27,957.50
		8	**Stormwater Outfalls**			**$223,660.00**
Wetland Ponds						
	Grading/Excavation	149,890	CY	$7.00		$1,049,230.00
	Liner (12" of fines)	45,128	CY	$8		$361,024.00
	Hydroseeding	28	ACR	$4,500		$126,000.00
			Wetland Ponds			**$1,536,254.00**
Clearing/grubbing (trees, grasses etc.)		36	ACR	$5,000		**$180,000.00**
Emergent Wetlands						
	Grading/Excavation	20,952	CY	$7		$146,664
	Liner (12" of fines)	20,952	CY	$8		$167,616
		13	ACR			**$314,280**
Cottonwood/willow (1 gal.)						
	Planting	378	ACR	$5,205		$1,967,490.00
	Irrigation		ACR	$ 8,800.00		$3,326,400.00
		Cottonwood/willow				**$5,293,890.00**
Mesquite Bosque (1 gal.)						
	Planting	244	ACR	$6,950		$1,695,800.00
	Irrigation		ACR	$8,800		$2,147,200.00
						$3,843,000.00
Mesquite Xeric						
	Planting	168	ACR	$2,700		$453,600.00
	Irrigation		ACR	$8,800		$1,478,400.00
		Mesquite-xeric				**$1,932,000.00**
Lake Restoration (Wetland)						
Cut and Fill		1,500,000	CY	$7		$10,500,000
Emergent Wetlands						
Liner (12" of fines)		32,235	CY	$8		$257,880
Hydroseeding		20	ACR	$4,500		$90,000
		Wetland Restoration				**$10,847,880**

PRELIMINARY FEASIBILITY COST ESTIMATES
RIO SALADO OESTE

Alternative 5B

Fishing Lake (1 lakes)		20	ACR			
	Cut and Fill	2,692,036	CY	$7		$18,844,252
	Liner (40" multi-layer)	106,373	CY	$40		$4,254,920
		Fishing lake				**$23,099,172**
Grade Control Structure						
	RCC (2400/structure from Rio Salado)	2,400	CY	$ 100.00		**$240,000.00**
Invasive Removal						
	Arundo Removal	10	ACR	$ 30,000.00		**$ 300,000.00**
	Salt Cedar Removal	110	ACR	$ 5,000.00		**$ 550,000.00**
subtotal construction						51,000,136
Debris removal			%	2%		**$1,020,002.72**
Water Supply and Distribution			LS			**$22,220,000.00**
				Subtotal		$74,240,138.72
				Contingency	25%	$18,560,034.68
				PED	10%	$7,424,013.87
				EDC	1%	$742,401.39
				S&A	7%	$4,825,609.02
				Construction		**$105,792,197.68**
Real Estate		1528	ACR	$20,000.00		$30,560,000.00
	water supply/distribution	20	ACR	$40,000.00		$800,000.00
				Contingency	25%	$ 7,840,000.00
						$39,200,000.00
				Alternative 5B w/RE		**$144,992,197.68**

Operation and Maintenance		**Cost**	
Monitoring and Adaptive Management	4%	**$4,231,687.91**	
Replacement Cost (assume 25% of planting/irriation) requiring replacment after flood event)		**$2,767,222.50**	
Invasive Species Control: Assume annual removal of exotic species. $60/acre		**$49,860**	831 acres
Wetlands: Regrading and excavation required once every 10 yrs. Assume 50% of constructoin quantity. ~75,000 cy.		**$525,000**	
Channel: Assume regrading once every 20 years of 50% the original construction quantity or 330,000 cy.		**$ 1,320,000.00**	
Water Supply		**$ 1,051,300.00**	

PRELIMINARY FEASIBILITY COST ESTIMATES
RIO SALADO OESTE

Alternative 5B

			$ 790,000.00	790 acres
Irrigation Maintenance: Assume annually $1000 per acre repair and replacement of irrigation infrastructure				
			$227,500	20 acres
Lakes/Wetlands: Assume excavation/regrading once every 20 years of 1 ft material from 20 acres of wetlands or 32500 cy				
		322344 cy		$7
Lakes: Assume excavation/regrading once every 20 years, 20 acres, 10 ft depth.			**$ 2,256,408.00**	

Associated Costs

	Acre Feet			
Water	7650	106	**$ 810,900.00**	
$106/acre foot CAP cost applied to effluent, as per Steve Rossi.				

Delivery System to Peterson Farms		**$**	**612,000.00**
Electric flow regulated valve	$ 50,000.00		
3750 lf 10" pipe	$ 562,000.00		

Construction Duration
1 year channel restoration simultaneous with water supply and distribution
1 year stormwater restoration
years lake restoration
18 months habitat restoration overlaps with lake restoration
Total 4 years construction

Rio Salado Oeste Feasibility Study, Alternative Design and Cost Estimates

Project Features	Feature	Material / Acre	Unit Cost	Cost / Acre	Notes
Cottonwood/Willow Habitat Area	Pole Plantings	48	$20.00	$960.00	80% Total Trees (Cottonwood/Willow)
	5 Gallon containers	12	$35.00	$420.00	20% Total Trees (Cottonwood/Willow)
	1 gallon containers	5	$15.00	$75.00	Shrubs
	Hydroseeding	1	$3,750.00	$3,750.00	75% coverage @ $5000 per acre
Mesquite Habitat Area	5 gallon containers	110	$35.00	$3,850.00	Velvet/Screwbean Mesquite
	1 gallon containers	40	$15.00	$600.00	Shrubs
	Hydroseeding	1	$2,500.00	$2,500.00	50% coverage @ $5000 per acre
Project Features	**Feature**	**Material / Acre**	**Unit Cost**	**Cost / Acre**	**Notes**
XERIC	5 gallon containers	30	$35.00	$1,050.00	
	1 gallon containers	10	$15.00	$150.00	
	Hydroseeding	1	$1,500.00	$1,500.00	30% coverage @ $5000 per acre

WATER SUPPLY AND DISTRIBUTION
COST ESTIMATES

RIO SALADO OESTE
FEASIBILITY REPORT
F4 DRAFT

SALT RIVER
PHOENIX, AZ

February 2005

RIO SALADO OESTE WATER DISTRIBUTION COST ESTIMATE
Alternative No's 3 and 4

ITEM NO.	DESCRIPTION	UNIT	QTY.	UNIT PRICE	TOTAL
1	20 mgd Pump Station (includes: mechanical, electrical, enclosure, & site work)	L.S.	1	$3,000,000	$3,000,000
2	Electronic Flow Regulated Valve to deliver water to Peterson's Farm (includes: mechanical, electrical, concrete, valve, & site work)	L.S.	1	$50,000	$50,000
3	Electronic Flow Regulated Valves to deliver water to Reservoirs (includes: mechanical, electrical, concrete, valve, & site work)	L.S.	3	$50,000	$150,000
4	Pump Station (includes: mechanical, electrical, enclosure, & site work)	L.S.	3	$500,000	$1,500,000
5	Reservoir (includes: excavation, sub base, liner, trench wall, & edge treatment)	L.S.	2	$350,000	$700,000
6	Ground Water Pond/Reservoir on Overbank (includes: excavation, sub base, liner, trench wall, & edge treatment)	L.S.	1	$350,000	$350,000
7	20" Waterline Pipe (includes trenching, shading, valves, joints, backfill and compaction)	L.F.	13,200	$150.00	$1,980,000
8	16" Waterline Pipe (includes trenching, shading, valves, joints, backfill and compaction)	L.F.	26,500	$125.00	$3,312,500
9	10" Waterline Pipe Loop (includes trenching, shading, valves, joints, backfill and compaction)	L.F.	16,000	$90.00	$1,440,000
10	Bridge crossing of 16" Waterline (includes: waterline, & attachments)	L.S.	2	$300,000	$600,000
11	Bridge crossing of 10" Waterline (includes: waterline, & attachments)	L.S.	2	$200,000	$400,000
12	8" Waterline Pipe to existing outfall structures to supplement current conditions (includes: trenching, shading, valves, joints, backfill and compaction)	L.F.	5,000	$75.00	$375,000
13	Overbank Canal Delivery Conveyance Channels (includes: trenching, sub base, soil liner, and edge treatment)	L.F.	45,000	$35.00	$1,575,000

14	Terrace and LFC Canal Delivery Conveyance Channels (includes: trenching, sub base, soil liner, and edge treatment)	L.F.	60,000	$20.00	$1,200,000
15	Waterfall to Move Water from Overbank to Terrace and/or Terrace to LFC (includes: excavation, sub base, liner, concrete river ruins used for waterfalls & weirs)	L.S.	3	$75,000	$225,000
16	Internal Drainage Conveyance Channels in response to Full-scale project Development (includes excavation, concrete ruin riprap, pipes, and headwalls)	EA	20	$15,000	$300,000
18	Waste & Tire Removal (includes: over excavation, cleaning/cutting, segregation, soil processing, and hauling waste to landfills)	L.S.			$1,000,000
19	Supply Well (includes: pump, mechanical, electrical, concrete, valves, enclosure, & site work)	EA	1	$500,000	$500,000
20	Monitoring Wells (includes: pump, concrete, & site work)	EA.	2	$45,000	$90,000
21	**GRAND TOTAL**				**$18,747,500**

ASSUMPTIONS:

1). 8 mgd from the 23rd Ave. WWTP
2). Water will be delivered to Peterson's Farm via pipe.
3). Gravity flows (canals & pipes) west of +/- 51st Ave.
4). 8 outfalls to receive supplemental water.
5). Redundant connections to all reservoirs via 10" loop line.
6). Waste removals for water distribution infrastructure and reservoirs only.

NOT INCLUDED:

1). Land or Right of Way Acquisition
2). Hazardous Material removals
3). Construction Phasing Impacts
4). Operations and maintenance access to the outfalls
5). Pressurized irrigation system
6). Wellhead Treatment
7). Soft cost i.e. design, Building Safety reviews and permits, utility connections, construction administration, or Environmental permits.

RIO SALADO OESTE WATER DISTRIBUTION COST ESTIMATE
Alternative No's 5 and 5a

ITEM NO.	DESCRIPTION	UNIT	QTY.	UNIT PRICE	TOTAL
1	20 mgd Pump Station (includes: mechanical, electrical, enclosure, & site work)	L.S.	1	$3,000,000	$3,000,000
2	Electronic Flow Regulated Valve to deliver water to Peterson's Farm (includes: mechanical, electrical, concrete, valve, & site work)	L.S.	1	$50,000	$50,000
3	Electronic Flow Regulated Valves to deliver water to Reservoirs (includes: mechanical, electrical, concrete, valve, & site work)	L.S.	5	$50,000	$250,000
4	Pump Station (includes: mechanical, electrical, enclosure, & site work)	L.S.	5	$500,000	$2,500,000
5	Reservoir (includes: excavation, sub base, liner, trench wall, & edge treatment)	L.S.	4	$350,000	$1,400,000
6	Ground Water Pond/Reservoir on Overbank (includes: excavation, sub base, liner, trench wall, & edge treatment)	L.S.	1	$350,000	$350,000
7	20" Waterline Pipe (includes trenching, shading, valves, joints, backfill and compaction)	L.F.	13,200	$150.00	$1,980,000
8	16" Waterline Pipe (includes trenching, shading, valves, joints, backfill and compaction)	L.F.	26,500	$125.00	$3,312,500
9	10" Waterline Pipe Loop (includes trenching, shading, valves, joints, backfill and compaction)	L.F.	37,000	$90.00	$3,330,000
10	Bridge crossing of 16" Waterline (includes: waterline, & attachments)	L.S.	2	$300,000	$600,000
11	Bridge crossing of 10" Waterline (includes: waterline, & attachments)	L.S.	2	$200,000	$400,000
12	8" Waterline Pipe to existing outfall structures to supplement current conditions (includes: trenching, shading, valves, joints, backfill and compaction)	L.F.	5,000	$75.00	$375,000
13	Overbank Canal Delivery Conveyance Channels (includes: trenching, sub base, soil liner, and edge treatment)	L.F.	25,000	$35.00	$875,000

14	Terrace and LFC Canal Delivery Conveyance Channels (includes: trenching, sub base, soil liner, and edge treatment)	L.F.	35,000	$20.00	$700,000
15	Waterfall to Move Water from Overbank to Terrace and/or Terrace to LFC (includes: excavation, sub base, liner, concrete river ruins used for waterfalls & weirs)	L.S.	5	$75,000	$375,000
16	Internal Drainage Conveyance Channels in response to Full-scale project Development (includes excavation, concrete ruin riprap, pipes, and headwalls)	EA	30	$15,000	$450,000
18	Waste & Tire Removal (includes: over excavation, cleaning/cutting, segregation, soil processing, and hauling waste to landfills)	L.S.			$1,500,000
19	Supply Well (includes: pump, mechanical, electrical, concrete, valves, enclosure, & site work)	EA	1	$500,000	$500,000
20	Monitoring Wells (includes: pump, concrete, & site work)	EA.	2	$45,000	$90,000
21	**GRAND TOTAL**				**$22,037,500**

ASSUMPTIONS:

1). 8 mgd from the 23rd Ave. WWTP
2). Water will be delivered to Peterson's Farm via pipe.
3). Gravity flows (canals & pipes) west of +/- 51st Ave.
4). 8 outfalls to receive supplemental water.
5). Redundant connections to all reservoirs via 10" loop line.
6). Waste removals for water distribution infrastructure and reservoirs only.

NOT INCLUDED:

1). Land or Right of Way Acquisition
2). Hazardous Material removals
3). Construction Phasing Impacts
4). Operations and maintenance access to the outfalls
5). Pressurized irrigation system
6). Wellhead Treatment
7). Soft cost i.e. design, Building Safety reviews and permits, utility connections, construction administration, or Environmental permits.

DRAFT RECREATION PLAN
COST ESTIMATE

RIO SALADO OESTE
FEASIBILITY REPORT
F4 DRAFT

SALT RIVER
PHOENIX, AZ

February 2005

Component	Quantity	Unit Cost	Total
Access Point, Maintenance Facility and Edu. Center (51st Ave.)	**1**	**$430,378**	**$430,378**
Parking lot	130 spaces	$1000/space	$130,000
Restroom facility	1	$150,000 each	$150,000
Drinking fountain	2	$5,000 each	$10,000
Picnic shelter (large)	1	$60,000 each	$60,000
Benches Custom	2	$1,500 each	$3,000
Recycled	5	$800 each	$4,000
Lighting	2	$4,000 each	$8,000
Interpretive guidance and media	6	$300 each	$3,600
Trail overlook shelter with railings (large)	1	$40,000 each	$40,000
Gates	2	$7,720 each	$15,440
Walks (paved)	500	$3.00/sf	$1,500
Fencing	150	$16.25/ LF	$2,438
Picnic tables	5	$75.00 each	$375
Entrance, directional and marker signs	10	$100 each	$1,000
Public telephone	2	$250 each	$500
Trash receptacles	7	$75 each	$525
Maintenance Facility * (100% sponsor cost)	1	$40,000 each	$40,000
Visitor Center/ Interpretive Center * (100% sponsor cost)	1	$650,000 each	$650,000
Access Points (35th, 67th, 83rd)	**3**	**$285,645**	**$856,935**
Parking lot	60 spaces	$1000/space	$60,000
Comfort station (with small shelter, toliet, faucet and drinking fountain)	1	$25,000 each	$125,000
Picnic structure (large)	1	$60,000 each	$60,000
Benches Custom	2	$1,500 each	$3,000
Recycled	5	$800 each	$4,000
Lighting	1	$4,000 each	$4,000
Interpretive guidance and media	3	$300 each	$900
Trail overlook shelter with railings (medium)	1	$20,000 each	$20,000
Gates	1	$7,720 each	$7,720
Picnic tables	2	$100 each	$200
Entrance, directional and marker signs	5	$100 each	$500
Public telephone	1	$250 each	$250
Trash receptacles	1	$75 each	$75
Entrance Station	1	$40,000 each	$40,000
Multipurpose trails (Both banks, plus interpretive loops throughout project area. Used also for maintenance roads.)			
Trail Signage (interpretive guidance media every 1/4 mile)	192	$300 each	**$57,000**
24 miles of stabilized D.G	126,720	$.90/ sf.	**$114,048**
24 miles of paved interpretive	126,720	$3.00/ sf.	**$380,160**

*100 % Non-Federal Cost

Culverts (assume 1 at each outfall)	9	$15,000 each	**$135,000**
Bridges (medium, assume 1 at each outfall)	9	$3,630 each	**$32,670**
Trail viewing shelters (for possible birdviewing, classrooms,etc placed throughout project area)	4	$200,000	**$800,000**
Shade structure (medium)	4	$30,000 each	**$120,000**
Overlook with railing (medium)	4	$20,000 each	**$80,000**
Outdoor classroom*: (1 at each site) (100% sponsor cost)			
Large Formal (30-70 people)	1	$75,000 each	$75,000
Medium Formal (20-40 people)	1	$40,000 each	$40,000
Small Informal (5-15 people)	2	$20,000 each	$40,000
Vegetation restoration		Subtotal	**$303,000**
Willow			
36" box	50	$800 each	$40,000
24" box	110	$200 each	$22,000
15 gallon	250	$70 each	$17,500
5 gallon	400	$30 each	$12,000
Mesquite			
36" box	50	$800 each	$40,000
24" box	110	$200 each	$22,000
15 gallon	250	$70 each	$17,500
5 gallon	400	$30 each	$12,000
Riparian seed mix	100,000 sf	$.10/sf	$10,000
Irrigation system (for establishment)		LS	$110,000
Maintenance			**$93,000**
Grading and landform	464,640 sf	$.10/sf.	$46,500
Clearing/ grubbing	46,4640 sf	$.10/sf.	$46,500
Operations and Maintenance *(100% non-federal cost)		Annual	$1,500,000
O&M First time cost (furniture, fixtures, vehicles, radios) *(100% n.f.c)			$500,000
SUBTOTAL			**$3,402,191**
Contingency		25%	850547.75
Planning, Engineering and Design		10%	340219.1
EDC		1%	34021.91
Supervision and Administration		7%	238153.37
TOTAL COST SHARABLE AMT.			**$4,865,133**

Amenities 100% Non- Federal Sponsor Cost			**$2,845,000**

*100 % Non-Federal Cost

FORTHCOMING

US Army Corps of Engineers
Los Angeles District

RIO SALADO OESTE
F4 MILESTONE
Salt River-Phoenix, Arizona

Appendix L
Recreation

March 2005

U.S. ARMY CORPS OF ENGINEERS, LOS ANGELES DISTRICT
PLANNING DIVISION, WATER RESOURCES BRANCH
P.O. BOX 532711
LOS ANGELES, CALIFORNIA 90053-2325

RIO SALADO OESTE

Note that this is a draft Appendix and the recreation plan will be finalized post F4 Milestone.

Recreation and Environmental Education Component

Table of Contents

INTRODUCTION	**1**
RECREATION FEATURES	**5**
Existing Recreation Opportunities	5
Future Opportunities	6
The Bank Experience	7
The Terrace Experience	8
The Channel Experience	9
VISITATION ESTIMATES	**10**
Annual Visitation	10
Future Visitation Growth	11
Potential Visitor Impact	12
POINT VALUE ASSESSMENT	**13**
Point Value Estimates for Recreation	13
Assessment Panel Members	14
Point Value Criteria for Environmental Education	15
Point Value Estimates for Environmental Education	16
Assessment Panel Members	17
ENVIRONMENTAL EDUCATION PROGRAM	**18**
Objectives	18
Partnerships	19
School Curriculum	19
Guided Nature Walks	19
PRELIMINARY COST ESTIMATES	**20**

1

INTRODUCTION

The United States Army Corps of Engineers and the city of Phoenix, have entered into a contract for a Feasibility Study of an environmental restoration project known as Rio Salado Oeste, Arizona, on the Salt River between 19th and 83rd Avenues. The river is virtually dry and has suffered an almost total loss of native habitat as a result of early 20th century reclamation projects. This desert riparian habitat is a critical and diminishing resource throughout Arizona.

The Rio Salado Oeste study area is approximately three miles west of downtown Phoenix. The upstream boundary is located at 19th Avenue. The study area extends west approximately seven miles.

2

RECREATION FEATURES

"A planning objective of the Rio Salado Oeste Feasibility Study is to *"increase environmental education and passive recreation opportunities incidental to the restoration effort."* To that end, the goal of the Recreation and Environmental Education Component is to *provide opportunities for visitors of all ages and backgrounds to enjoy this unique resource while developing an awareness, knowledge, and understanding of desert riparian habitat and its relationship to the surrounding environment. Additionally, it presents an opportunity to acknowledge and understand the influence the of the Salt River had on the environment and cultures throughout history."*

Existing Recreation Opportunities

On the western border of the study area lies Estrella Mountain Regional Park. The park is owned and managed by Maricopa County Parks and Recreation Department. The rugged and scenic Sierra Estrella mountains are the most dominant feature 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.

The County has developed a master plan for the 19,200 acre park, located approximately 20 miles southwest of downtown Phoenix. The master plan envisions the preservation of scenic desert wilderness areas while incorporating sensitive development of recreational facilities and activities. The Plan accommodates the expected annual demand of 1 million visitors while insuring that the existing Sonoran Desert environment remains in its existing condition. In fact, 90 percent of the park will remain essentially untouched. The remaining 10 percent will be sensitively utilized for educational, camping, picnicking, and sporting activities.

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, comprises 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 Maricopa County Flood District 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 will benefit Rio Salado Oeste, Rio Salado, and Rio Salado Oeste with a major non-motorized travelway connecting the three river restoration projects to the other valley areas.

Future Opportunities

The Rio Salado Oeste project provides a unique opportunity to enhance resource-based recreation and environmental education. The restoration of the dry Salt river channel will bring a riparian open space feature to the rapidly expanding Laveen and Estrella Planning Areas. Rio Salado Oeste will provide a habitat and recreational connection to the desert riparian habitat corridor created by the Rio Salado and Tres Rios Projects. By connecting the seven-mile gap between the two projects, Rio Salado Oeste will enhance the unique recreation and education opportunities for residents and out-of-town visitors. Drawing on a population base of over two million in the Valley, it is estimated that visitation to the Rio Salado Oeste project will exceed 150,000 annually. Primary use times for this unique resource would coincide with the "visitor season" between October and May when temperatures are moderate.

The goal of the environmental education and recreation component is to provide opportunities for visitors of all ages, abilities, and backgrounds to enjoy this unique resource while developing an awareness, knowledge and understanding of desert riparian habitat and its relationship to the surrounding environment. Additionally, it presents an opportunity to acknowledge and understand the influence of Salt Rivers on the environment and cultures throughout the Valley's history. Visitors to this day-use area can participate in a variety of pursuits from enjoying scenic views, picnicking with the family, learning about the habitat, or exploring the resource on foot, by bicycle or horseback. Recognizing our diverse society, the Rio Salado Oeste project will have design components ranging from areas adapted for special needs to multi-lingual signage.

For planning purposes the features have been divided into three primary areas: ***The Bank, The Terrace***, and ***The Channel***. Each of these areas provides a different venue for recreational opportunities which coincide with learning opportunities allowing participants to *learn, see* and *experience* the resource first-hand.

The Bank provides recreational experiences including hiking, biking, and horseback riding to scenic overlooks, and leisure walking. Abundant educational opportunities will be accommodated by constructed features which will interpret cultural, biological, and ecological themes related to the restored desert riparian habitat.

The Terrace is the area where the habitat has a permanent water source to create a self-sustaining ecosystem. This area will provide more limited and controlled recreational and educational experiences, such as bird watching and guided nature walks.

The Channel represents an area seeming to be relatively unaltered by humans, and will undergo physical changes in response to seasonal river flows and flooding. People will enter this zone on its terms, and it will contain few manmade features, allowing one to observe the natural forces of land and water that define and shape desert rivers and associated habitat.

The Bank Experience

Rio Salado Oeste will provide a variety of recreation opportunities for users. Those visiting the project will be able to arrive by private vehicle or alternate mode of transportation, including horse, public transit or bicycle. Users would enter at one of five primary access points along *The Bank* at 35th Avenue, 51st Avenue, 67th Avenue, or 83rd Avenue. These points coincide with existing river crossings or roads. Amenities at each access point will vary, but may include: parking; restroom facilities; water fountains; shade structures; site furniture; and appropriate lighting. Each access point as a trailhead will provide appropriate signage and a orientation kiosk or visitor center to give visitors an overview of the activities and experiences available and orient users to the sensitivity of the area and appropriate uses and expectations. All improved facilities will be designed to provide accessibility to all members of the community.

Opportunities available at ***The Bank*** will include:

Trails:

Multi-use non-motorized trails will allow visitors to explore ***The Bank*** on foot, horseback, or bicycle. The hard surface trail will accommodate a variety of cycling activities allowing travel along the entire project. Natural surface trails will traverse the bank leading foot traffic, equestrians and mountain bicyclists to scenic overlooks or loops throughout the area. Additionally, a barrier free trail will be provided for users with limited mobility. Interpretive trails will allow for self-guided tours of the area.

The Sun Circle Trail will be established through the bank area. Extending through other areas of the Valley, the Sun Circle Trail will serve as a non-motorized transportation corridor providing access to Rio Salado Oeste from central and south Phoenix and the East Valley along the ***Rio Vista Trail*** and from the West Valley along the West Valley Recreation Corridor.

Scenic Overlooks:

Accessible locations along the roadways and trails will allow for family picnicking, informal play and scenic vistas of the surrounding landscape. More secluded areas will accommodate informal seating and meditation areas.

Education Opportunities:

An opportunity exists for a major Interpretive Center to furnish visitors programmatic information regarding the restoration of the habitat, the water cycle, an historical perspective of the rivers, and the flora and fauna within the project area. Additionally, there will be exhibits, signage, and multimedia displays.

Outdoor Gathering Area:

Gathering areas will be provided for groups to attend lectures by special interest speakers.

Staging Areas:

Areas will be designed for groups and classes to gather and prepare for a learning experience at the Rio Salado Oeste Project.

The Terrace Experience

The Terrace is the true sensitive habitat of the Rio Salado Oeste Project, and will provide visitors unique opportunities to view, enjoy and experience a restored desert riparian habitat. This area will allow one to explore wetland habitats and surrounding cottonwood/willow forests. Areas within *The Terrace* will be designated as sanctuary or conservation areas, with restricted public use, allowing for the protection of biologically sensitive animals and plant life. Natural surface trails will lead visitors to *The Terrace* from *The Bank*, and perhaps allow for occasional crossings of *The Channel*, expanding opportunities to explore more river habitat. Visitors to the area will leave with a heightened awareness of the fragile relationship between water availability and habitat in the desert.

Opportunities available at ***The Terrace*** will include:

Trails:

Trails will provide a transition from *The Bank* to the more sensitive *Terrace Habitat* and will be available for staff-guided hikes, research activities and wildlife watching. A barrier-free interpretive trail will be provided featuring multi-lingual signage regarding the project.

Scenic Overlooks:

Locations along *The Terrace* will allow scenic vistas of the restored river bed and surrounding landscape.

Habitat Views:

Special areas will provide wildlife blinds allowing visitors an opportunity to observe wildlife in its restored natural habitat without disturbing the seclusion needed by most. Interpretive signage will be provided.

Demonstration Walks:

Pathways along *The Terrace* will provide visitors insight into the inner workings of a habitat restoration project and its role in water conservation. Special "wetlands" walks or trails to areas featuring aquatic habitat will be provided as appropriate to the season and species.

Research Areas:

These unique study areas will allow opportunities for educational institutions to conduct long- and/or short-term research into the unique workings of the Rio Salado Oeste project including water conservation, riparian areas, and habitat restoration.

Bird Watching:

These unique areas will allow opportunities for novice and experienced bird watchers to view and learn about the variety of waterfowl, birds of prey, migratory and song birds that will find sanctuary within the Rio Salado Oeste habitat.

Urban Fishing:

When water quality and habitat features allow, ponds providing habitat for fish may allow anglers opportunities to fish.

Outdoor Classrooms:

Areas will be designed for groups and classes of up to 50 to assemble for programmatic learning experiences.

The Channel Experience

The Channel will provide equestrian opportunities. *The Channel* will be accessible by the trail system from *The Bank* at select locations along *The Terrace*. At each transition point to *The Terrace*, appropriate signage will inform visitors of the new habitat they are entering, and any user restrictions and expectations. *The Channel* will provide opportunities for environmental education and developing an understanding of how the habitat has been restored. Some areas of *The Channel* may be designated as "sensitive" habitat, and will be protected from public impacts.

3

VISITATION ESTIMATES

Annual Visitation

The Rio Salado Oeste Recreation and Environmental Education Component is planned to provide high quality experiences in an outdoor setting unique to the Phoenix metropolitan area. The unparalleled desert river restoration project provides an outstanding prospect for physical and programmatic activities, yet also places a great responsibility upon the sponsoring agencies to design and manage these activities for sustainability of the restoration. From the outset of the project it will be realized that the overriding concern will be to create conditions favorable to the return of the natural systems formerly associated with the river, and that human use will be secondary. However, it is also of great value to the project that the public have the opportunity within this constraint to experience, enjoy, and learn from the river.

How to best achieve this balance is worthy of much additional study and is beyond the scope of this initial effort; however, some basic assumptions must be made in order to determine preliminary cost estimates and to serve as the basis for design. These assumptions are: (1) the Army Corps of Engineers will accept that Environmental Education is a project value, (2) the City of Phoenix will assume operational control of the recreational and environmental education functions.

Due to the location of the project and the intimacy of the expected recreation and education experience, it is projected that most visitors will arrive by private vehicle. However, in order to mitigate potential environmental impacts from increased traffic, facilities will be developed that promote alternative transportation and energy efficiency. Initial capacity of the parking facilities will be designed for not more than 250 vehicles in order to limit the potential impact of human activities upon the restoration project.

Based on historical data maintained by the City of Phoenix for resource-based recreational sites, it is estimated that 2.75 visitors arrive in each private vehicle. Additionally, an estimated one visitor per four vehicles arrives at a site by an alternate mode of transportation including bicycle, foot traffic and public transportation. It would be a legitimate goal of the Recreation/Education component to increase the ratio of visitors arriving by alternate means such as busses.

In the Valley of the Sun, visitation to outdoor recreational sites coincides with temperature. Visitation occurs in two seasons: WINTER (October through May); and SUMMER (June through September.) The WINTER months in the Valley have maximum average temperatures of 87 degrees. Visitors from around the world come to Phoenix during this time, and numerous "winter residents" arrive. SUMMER months bring hot sunny days and occasional afternoon thunderstorms. Temperatures average 102 degrees, making the early mornings and evenings the best time for outdoor activities.

Anticipated visitation at Rio Salado Oeste is based on use projections during PRIME TIME and NON-PRIME TIME throughout the year. PRIME TIME includes weekends and holidays. NON-PRIME TIME is weekdays. A typical visit to Rio Salado Oeste is expected to span three hours, although many visits will be longer, and some much shorter. Turnover refers to the number of times a parking space will be filled daily.

Below is a breakdown of anticipated visitation during WINTER and SUMMER.

WINTER 79% of annual use

PRIME TIME	70 days	1.5 turnovers	78,750visitors
NON-PRIME TIME	170 days	0.5 turnover	63,750visitors
		Winter	**142,500**

SUMMER 21 % of annual use

PRIME TIME	28 days	1 turnovers	21,000visitors
NON-PRIME TIME	92 days	0 .25 turnover	17,250visitors
		Summer	**38,250**

TOTAL ANNUAL VISITATION **180,750**

Future Visitation Growth

The Rio Salado Oeste project is located in an area of Phoenix that is under tremendous population growth pressure. The area from 27th Avenue to the west, city limits south of Interstate 10, and north of the Salt River (the Estrella Village Planning Area) is expected to have a population of approximately 100,000 when fully developed in about 15 years. The Laveen Village Planning Area (between the river and South Mountain from 27th Avenue to the Gila River Indian Community) adjoins the project area to the south and east of 83rd Avenue and will be home to approximately 95,000 new residents. Obviously, the existing rural, open character of the landscape in these parts of the City will change greatly with the addition of almost 200,000 people. This new population will be living within approximately 7 miles of the project. Efforts are underway to plan a network of trails and pathways to connect future parks within the area and to provide linkages to the Salt River throughout its Phoenix reach.

As the population grows, and the Rio Salado Oeste project matures, visitation to the resource is anticipated to increase. It is anticipated that WINTER PRIME TIME visitation will be at facility capacity with additional growth from those visiting the resource through alternative means such as improved trail linkages. Growth in this time period could increase by 50% over 50 years, for a total increase of 39,375 visitors.

The greatest increase over time will be during the four summer months. The City of Phoenix has documented changes in user patterns during the summer months with other resource-based facilities. As trees mature providing more shade and facilities are at capacity during WINTER

PRIME TIME, visitors will seek alternative times to enjoy Rio Salado Oeste. It is anticipated that visitation during the summer will increase by 150% over 50 years for a total increase of 57,375 visitors.

Overall visitation increase for the resource over 50 years is projected to be approximately 96,750.

Potential Visitor Impact

While these numbers are relatively large and may be seen as potentially threatening to the success of the restoration project, it should be born in mind that the project will be constructed in proximity to over 2,500,000 people. Within the life of the project the population of metropolitan Phoenix is projected to increase to approximately 4,700,000.

The City of Phoenix has vast experience with large numbers of visitors to its resource-based recreation sites. The Summit Trail at Squaw Peak currently has about 500,000 hikers a year; the Echo Canyon Trail on Camelback Mountain carries approximately 300,000 hikers each year, and South Mountain Park, the largest municipal park in the nation, has approximately 3,000,000 visitors each year, most of whom use some portion of the natural areas.

Rio Salado Oeste must be artfully designed and carefully managed. The discussion in earlier chapters regarding the functions of the recreation and environmental education improvements stressed the intent to segregate the visitor experiences from the core restoration of the river channel where critical habitat is likely to occur. By providing visitor-related improvements at locations appropriate to the specific habitat, environmental education and recreation functions can serve as an integral part of the project. Indeed, the education and recreation components of the project are much more likely to enhance the restoration by building an informed and supportive base of popular opinion than they are likely to degrade the project by overcrowding facilities and disrupting natural functions.

Nonetheless, visitors must be carefully managed to prevent adverse effects to the project and other adjacent property owners. The presumption is that the visitor management program will include Phoenix Park Ranger coverage for the project area in addition to the design features already discussed.

4

Point Value Assessment

One of the Specific Planning Objectives stated in the Rio Salado Oeste Feasibility Study is to "increase environmental education and passive recreation opportunities". The vision for these opportunities is described in detail in Chapter One, *Description of Recreation Features.* This vision is in compliance with the Corps' mission statement and its *Recreation Operations and Maintenance Policies,* (ER 1130-2-550).

There is an inherent difficulty in determining the values of environmental education and recreation when they are considered separate experiences. The dichotomy of the two is not as easily determined as it might seem. As an example, a recent survey by Arizona State Parks lists *visiting historic/archeological sites, retracing historic/prehistoric routes, and wildlife viewing/ bird watching* as three of the six most important activities for users of non-motorized trails. *Day hiking, walking*, and *backpacking* are the other three. It would be a logical deduction that the environmental education experience and the resource-based recreation experience are virtually inseparable. Indeed, the currently popular "ecotourism" trend is built upon the premise that first-hand learning experiences are rewarding not only as an educational experience but also as healthful, stimulating recreation. The education experience **is** recreation, in other words.

Nonetheless, an attempt to logically separate the facilities supportive of the individual experiences is presented in this chapter.

Point Value Estimates for Recreation

(A) RECREATION EXPERIENCE

Total possible points: 30 scored points: 29

Numerous high quality value activities to include: habitat restoration; riparian resource areas; water conservation areas; flora and fauna sanctuary and conservation areas; study areas; urban fishing opportunities; outdoor classroom; birding; interpretive opportunities and scenic overlooks.

Some general activities to include: hiking; horseback riding; cycling; fishing and picnicking.

(B) AVAILABILITY OF OPPORTUNITY

Total possible points: 18 scored points: 12

The Rio Salado and Tres Rios Projects will be connected by Rio Salado Oeste and will present similar types of activities. Rio Salado Oeste will provide a vital wildlife corridor connecting the two other projects and offering continuous riparian habitat, and spreading out impacts of visitor use. No other similar activities exist within one hour travel time. The nearest *water-based* recreation sites with a natural riparian habitat are located well over an hour and a half away, which are the Salt River Recreation Area and Verde River Recreation Area in the Tonto National Forest, northeast of the valley.

(C) CARRYING CAPACITY

Total possible points: 14 scored points: 14

Ultimate facilities to achieve intent of selected alternative. Areas within Rio Salado Oeste will be designed and managed to provide for recreational experiences while preserving the resource.

(D) ACCESSIBILITY

Total possible points: 18 scored points: 18

Good access, high standard road to site; good access within site. Rio Salado Oeste is located within a major metropolitan area with access to the interstate highway system, ultimately integrated with public transportation routes, traffic thoroughfares, and a planned system of neighborhood and regional trail linkages.

(E) ENVIRONMENTAL

Total possible points: 20 scored points: 17

High esthetic quality to include: geology; hydrology of project; topography; water resources; vegetation; and wildlife. Efforts are currently being made by local and federal governments to mitigate any existing negative factors of illegal dumping.

TOTAL POSSIBLE POINTS: 100 TOTAL SCORED POINTS: 90

Point Value Criteria for Environmental Education

In keeping with the Corps of Engineers Recreation Operations and Maintenance Policies (ER1130-2-550), environmental education has been conceived as an inherent part of the recreation experience at Rio Salado Oeste. Chapter One of this report, *Description of Recreation Features*, describes the unique features that will be created in the project to provide opportunities to learn about the natural and built environment, as well as the influence the area rivers have had on the cultural activities of humans. These features include interpretive areas and trails, orientation areas/visitor center, outdoor classrooms and staging areas, and interpretive centers.

The conceptual interpretive education program is described in Chapter 3. A vital part of the education experience at Rio Salado Oeste will be the physical features constructed to facilitate the interpretation of the project. Many of the features will be relatively minor in cost and scope, and will serve to offer information on an informal and relatively unstructured basis, but the major public facilities will be specifically devoted to environmental education.

Proposed Point Value Criteria

Formal Programs: 15 points possible

These are facility-based programs almost entirely dependent upon the built environment for basic infrastructure such as electricity, water and communications for comfort, security, or other conditions such as light and sound. Such programs may utilize computer-generated or -displayed graphics, projected photographic images, interactive technology, delicate or valuable displays, and climate-controlled indoor spaces for laboratories, lecture areas, and theaters.

Individual/Informal Interpretive Opportunities: 15 points possible

These programs take advantage of the site's natural environment and may be heavily dependent upon signage and displays for the presentation of written or recorded words, photographs and illustrations, and other visual, auditory, tactile and olfactory sensations.

Research Potential: 15 points possible

In order for the education opportunity to be as complete as possible, the potential to conduct original and continuing research should be valued. Consideration should be given to the proximity of major universities and other institutional research stations, the uniqueness of the project, the potential for participation by local students, and the applicability of the potential research to help solve or remedy local, regional and national issues.

Partnering Opportunities: 15 points possible

In order to increase efficiency and to provide as wide a range of experiences and information as possible, all opportunities for partnering in environmental education should be considered. Potential partners include concerned agencies and other governmental entities, non-profit organizations, schools and universities, youth and service organizations, local planning committees, and private citizens.

Proximity of Experience: 20 points possible

The number of people within a reasonable driving or commuting distance would indicate a relative value in terms of potential visitors. Also to be considered are opportunities for ecotourism values for long-distance travelers and tourists.

Opportunity for Varied and Unique Environmental Education Opportunities: 20 points possible

Diversity of habitat types, landscapes, cultural influences, agency involvement, research subjects, volunteer projects and other opportunities should be considered.

Total points: 100 possible

Point Value Estimates for Environmental Education

(A) Formal Programs

Total possible points: 15 **Scored points: 15**

The potential number, kind, and quality of the formal programs that may be offered are virtually unlimited. Program possibilities include exploring the full range of ecosystems and landscapes at Rio Salado Oeste, cultural impacts on the ecosystem, living history programs and events, water education, interactive exhibits, research laboratories, and museum-type exhibits.

(B) Individual/Informal Interpretive Opportunities

Total possible points: 15 **Scored Points: 14**

The wide range of natural and constructed systems within the project, the ready access into and through the site, and the great extent of the site allow for a large potential informal and self-guided interpretive program.

(C) Research Potential

Total possible points: 15 **Scored Points: 13**

The proximity to a major research institution, Arizona State University, local community colleges, agencies such as Arizona Game and Fish, and the local facilities of Federal agencies such as the Corps of Engineers are highly conducive to research potential for the project. The project itself is unique in the region, if not the nation, and as such would certainly provide opportunities for local and regional solutions.

(D) Partnering Opportunities

Total possible points: 15 **Scored Points: 15**

Rio Salado Oeste offers a unique opportunity for partnering due to the involvement of several different agencies and intense interest in the project by many other government, commercial, and private interest. Current partners include the Corps of Engineers, City of Phoenix, Flood Control District of Maricopa County, and Arizona Game and Fish. Other potential partners may include, but not be limited to, universities, schools and parent groups, local history groups, local conservation interest organizations, trail user clubs and organizations, birding clubs, professional organizations, and commercial sponsors.

(E) Proximity of Experience

Total possible points: 20 **Scored Points: 20**

The location of the project only a few miles from downtown Phoenix puts approximately 2,500,000 people within an hour drive of the unique opportunity to experience the many wonders that will be Rio Salado Oeste.

(F) Opportunity for Varied and Unique Environmental Education Experiences

Total possible points: 20 **Scored Points: 18**

The combination of the constructed wetlands, the river channel, terrace, and bank experiences along with the other unique experiences afforded by visitor centers and interpretive programs, trail systems, observation points, research projects, volunteer projects, and unique cultural exhibits to make Rio Salado Oeste one of the most diverse and unique projects in the nation.

TOTAL POINTS POSSIBLE: 100
TOTAL POINTS SCORED: 95

5

ENVIRONMENTAL EDUCATION PROGRAM

Objectives

The purpose of the Environmental Education Program will be to provide visitors with educational information to understand and enhance the Rio Salado Oeste experience. The program will include educational information presented in a creative and exciting way. The objectives are defined in terms of what the visitor will learn while at Rio Salado Oeste.

The program is structured so visitors will learn the following:

The site is a constructed habitat restoration project that has multiple uses.

Rio Salado Oeste can benefit people

Complex ecological interactions occur among the organisms in a habitat restoration project including microorganisms, aquatic insects, plants, birds and other wildlife.

Wildlife can best be seen when visitors blend in quietly with nature.

To more fully experience the restored environment, the visitor should rely not only on sight but also on hearing, touch and smell.

People play the major role in Phoenix's urban water cycle.

A desert riparian area is a unique and limited resource to be appreciated and respected.

These learning objectives will be realized through the construction of physical features such as an environmental education center with major interpretive displays and exhibits, interpretive trails, and various view points located around the Rio Salado Oeste project and the development of interpretive signs, displays, and supplemental materials.

Partnerships

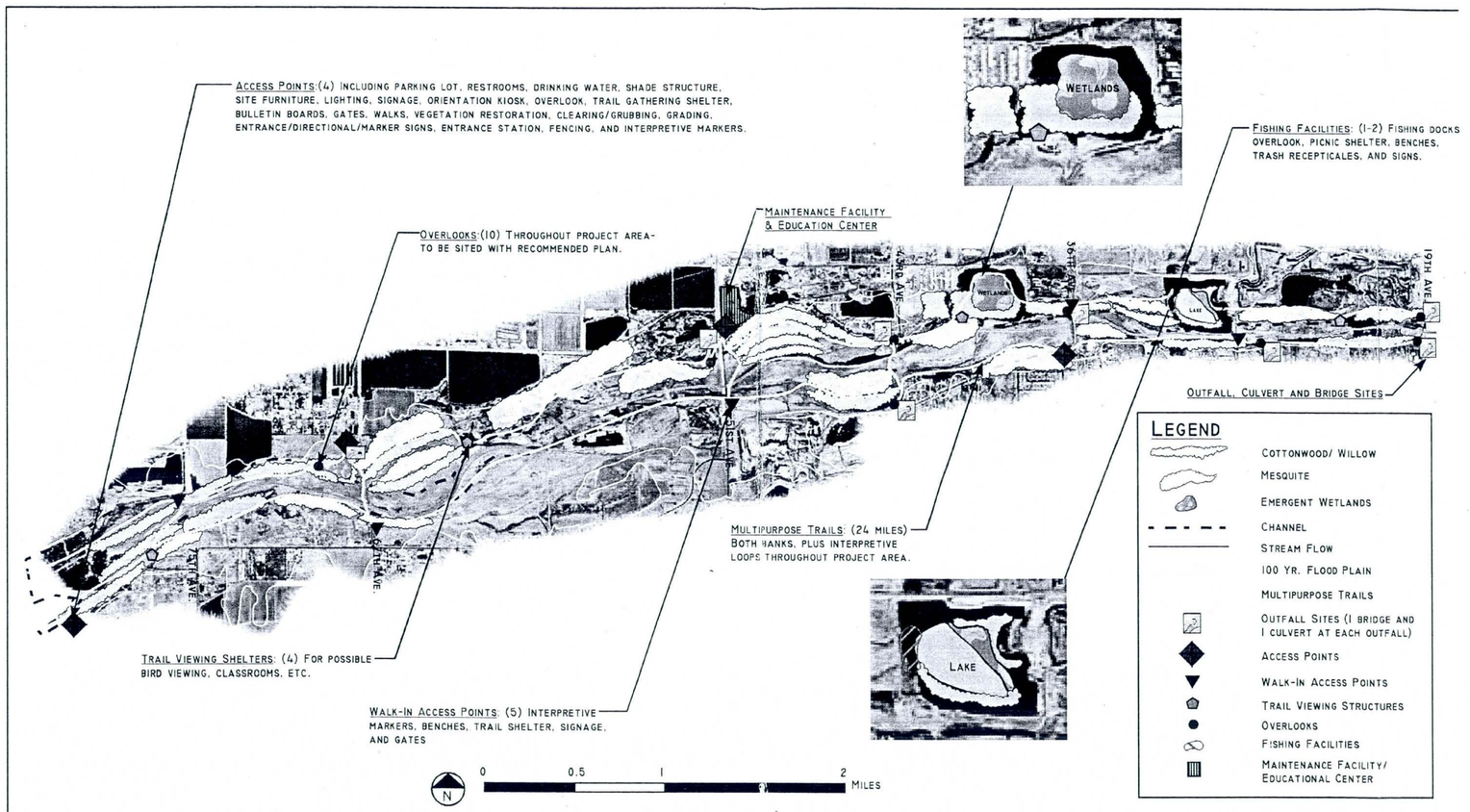
School districts, organizations, and individuals within the community as well as other governmental agencies will wish to become more involved with the Rio Salado Oeste Interpretive Education Program. They may fund or manage certain public use features and / or provide volunteer services. Individual volunteers and student programs may be organized to help with planting and replanting within the Rio Salado Oeste Project. School districts and local organizations that become partners could set up or rotate interpretive displays within the facility. A cascade effect will also be put into place. The vision is to incorporate students and programs from the universities, community colleges, high schools, elementary schools, and pre-schools, each educational level providing mentoring to the next.

School Curriculum

Support materials for school curriculum would be developed for pre- and post- visit activities as well as for onsite visits. These could include a packet of teaching materials to provide some hands on experience prior to a class visit. The packet could contain wildlife specimens, maps, diagrams, field guides for plant and animal identification, water-quality testing kits, and perhaps dip nets for viewing and identifying species during the visit. The curriculum would also be presented in an outdoor classroom setting at the site.

Guided Nature Walks

A monthly schedule of guided nature walks could become a part of the interpretive education program. These walks could be developed and led by volunteers. Environmental and wildlife organizations such as the Phoenix Audubon Society, Sonoran Anthropod Studies Institute, and the Arizona Native Plant Society as well as agencies such as the Arizona Game and Fish Department could periodically sponsor events which would be open to the general public.



City of Phoenix

RIO SALADO OESTE ECOSYSTEM RESTORATION CONCEPTUAL PLAN
RECREATION PLAN

U.S. ARMY CORPS OF ENGINEERS PARTNERING WITH THE CITY OF PHOENIX, ARIZONA

NOTES:

DRAWN BY: F.J. 7-20-04

US Army Corps of Engineers
Los Angeles District

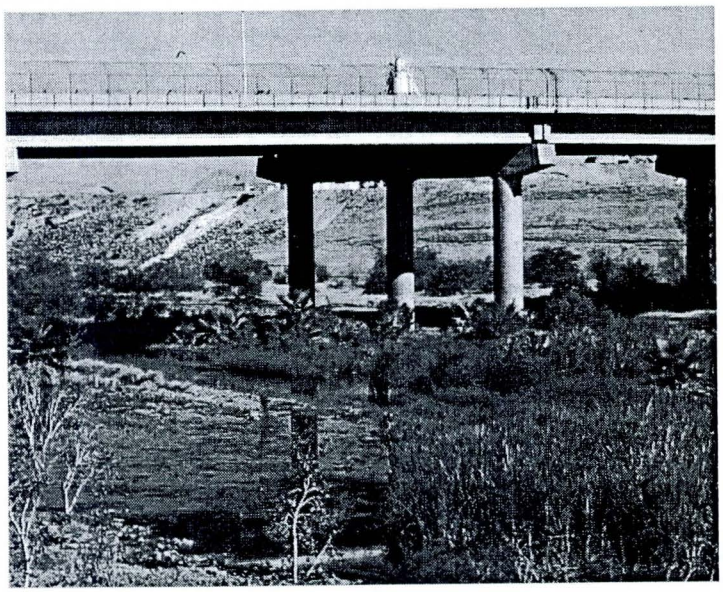
RIO SALADO OESTE
F4 MILESTONE
Salt River-Phoenix, Arizona

Appendix M
Wetland Restoration

March 2005

U.S. ARMY CORPS OF ENGINEERS, LOS ANGELES DISTRICT
PLANNING DIVISION, WATER RESOURCES BRANCH
P.O. BOX 532711
LOS ANGELES, CALIFORNIA 90053-2325

Río Salado Oeste: Salt River Phoenix, Arizona



Final Report on Wetland Restoration

WASS Gerke and Associates, Inc

August 2003

Prepared for U.S. Army Corps of Engineers

Phoenix Branch Office - Los Angeles District

RIO SALADO OESTE
Wetland Restoration Report

WASS Gerke and Associates

August 2003

INTRODUCTION

The Rio Salado Oeste project site is located along the Salt River in western Phoenix, Arizona. The study area extends from 19th Avenue to 83rd Avenue within the 100-year floodplain. Land use in the river and along the banks is characterized by residential housing, sand and gravel extraction, automotive recycling, debris disposal at permitted and non-permitted landfill areas, and agricultural fields. Water sources to the project area mainly consist of effluent from the nearby 23rd Avenue WWTP, stormwater drainage, pumped groundwater from dewatering wells, and agricultural tailwater. This report describes 14 outfalls that deliver these flows on a periodic or semi-continuous basis to the Rio Salado Oeste reach of the Salt River. The goal is to assess the opportunities each outfall provides with respect to restoring, preserving, and/or creating sustainable habitat features and to provide concept level ideas for implementation. Further, the potential to realize planned or incidental water quality benefits at each outfall is also assessed at the conceptual level.

BACKGROUND

Historically, the Salt River was a perennial stream. Flow originated in the White Mountains in eastern Arizona with the highest flows typically coinciding with the runoff generated by spring snow melt in the contributing watershed. During the early 1900's

dams were constructed to store and divert river flows into canals for agricultural use, urban development, and flood control as Phoenix grew into one of the largest metropolitan areas in the Southwestern United States. The upstream series of dams have effectively reduced base flows on the river, such that the riparian vegetation historically associated with the Salt River has been destroyed.

Phoenix was developed into an urban city, built from sand and gravel mined from the dry river. In the early days, exhausted gravel pits were used as landfills for municipal and construction debris. The twentieth century left the Salt River in the Phoenix area void of high value riparian vegetation, scarred with pits, and scattered with toxic and non-toxic trash and debris.

With the exception of dam releases, river flows from the mountains were replaced with concrete pipes discharging urban stormwater, agricultural tailwater, and treated municipal and industrial wastewater into the Salt River in and around Phoenix. By the 1980's the quality of water in the river could be characterized by high levels of heavy-metals and pesticides. Improved treatment for municipal and industrial wastewater, the increased use of environmentally friendly pesticides, and stormwater management practices enacted within the watershed have dramatically improved the quality of such discharges. Currently, these discharges support vegetative communities that range from xeric to riparian in nature and provide moderate habitat values at areas proximal to the outfalls. The aerial extent and vegetative character at these sites are dependent upon the temporal occurrence and amount of flow, and the character and quality of the surrounding soils.

The availability of land and water in the Oeste project area allows many opportunities to enhance, restore, or create riparian habitats associated with these outfalls in the Salt River. These efforts will also likely result in water quality improvements to several of the discharges because of the physical, biological, and chemical reactions that take place within the wetland environment. At a minimum, one can likely expect a decrease in oxygen-demanding substances, attenuation and bioconversion of organic compounds including some pesticides, and attenuation/removal of select heavy metals via metal-sulfide complexation which can render them biologically unavailable.

INVESTIGATIONS

Field investigations conducted during May and June 2003 of the study area consisted of visual inspection of surface waters and vegetative communities associated with 14 outfalls that discharge to the Rio Salado Oeste reach of the Salt River. These outfalls provide stormwater, agricultural, and wastewater runoff to the river and were located (GPS coordinates) and characterized based on the following elements:

- presence and character of vegetation: hydro-riparian, meso-riparian, xero-riparian;
- visual assessment of soils in the immediate area of the outfall: clay/silt, sand, gravel/cobbles;
- presence and aerial extent surface water at each outfall.

RESTORATION OPPORTUNITIES

Based on the results of the findings, recommendations can be made whether existing vegetative communities might be restored, created, or preserved. Restoration is recommended at outfalls where vegetative communities are characterized by a mixture of native and non-native species. Restoration and creation is recommended at locations where water appears to be available, soils are capable of retaining sufficient moisture, e.g. the presence of silts and/or clays, and little to no native vegetation is present. Preservation is recommended at outfalls with predominately native vegetation (or at least non-invasive exotics) with limited soil and/or water conditions to support native vegetation.

In general, active restoration activities will likely include the following:

- Addition of soils or amendment of existing site soils;
- Selective removal of exotics, primarily salt cedar (*T. ramosissima*) and giant reed (*Arundo donax*);
- Clearing, grubbing, grading, and excavation to removal of material, increase open water areas, increase emergent marsh areas, and to route water for irrigation;
- Construction of energy dissipation, flow metering, and flow routing structures.

The following sections will now provide photographs and narratives regarding the findings and specific restoration recommendations for each outfall site.

FINDINGS AND RECOMMENDATIONS

The 14 outfalls investigated within the Rio Salado Oeste study area are provided in **Figure 1** which depicts the name and location given to each outfall. Field investigations were performed to document the type of outfall structure, vegetation, and soil, and to comment on its restoration potential. Field data sheets for each location are included in **Appendix A**.

Vegetation at each location was divided into three categories: hydro-riparian, meso-riparian, and xero-riparian. Hydro-riparian communities were delineated based on the presence of perennial water, distance from water source, and several indicator species. Meso-riparian communities were based on the presence of shallow (or perched) groundwater, intermittent flow, or indicator species. Xero-riparian areas contained many of the same species as the uplands, but the plants occurred at a higher density and were typically larger.

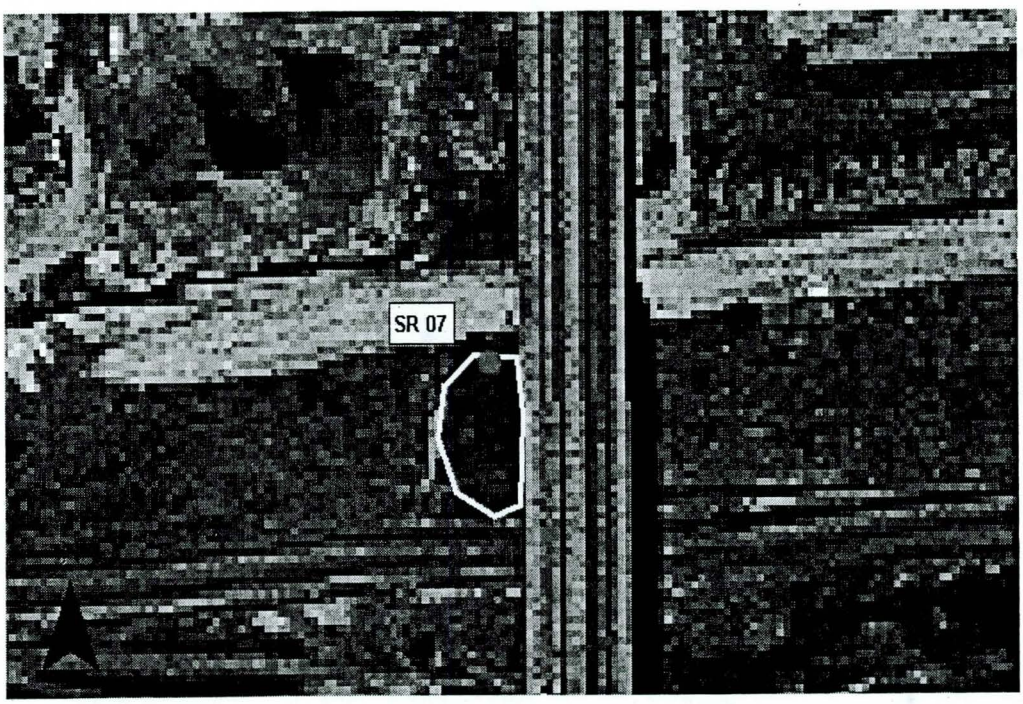
SR 07

Outfall SR 07 is a 54-inch concrete culvert with a trash screen situated on the north side of the Salt River channel immediately upstream from the 19th Avenue Bridge at N33° 24' 68.0", W112° 05' 98.5". Annually, the amount of flow expected at this site due to precipitation is approximately 79 acre-ft per year (AF/Yr). At the time of the site visit, a small amount of flowing water from the outfall supported a stand of cattails (*Typha sp.*) immediately below the concrete apron of the outfall. Meso-riparian species included Shoestring acacia (*Acacia stenophylla.*), Desert broom (*Baccharis sarothroides*), and

Chilean mesquite (*Prosopis sp*). The xero-riparian species surrounding the area were unidentified annual grasses, Russian thistle (*Salsola iberica*), and eucalyptus. Soils at this site were primarily sand with some silt.

SR 07: North bank west of 19th Avenue

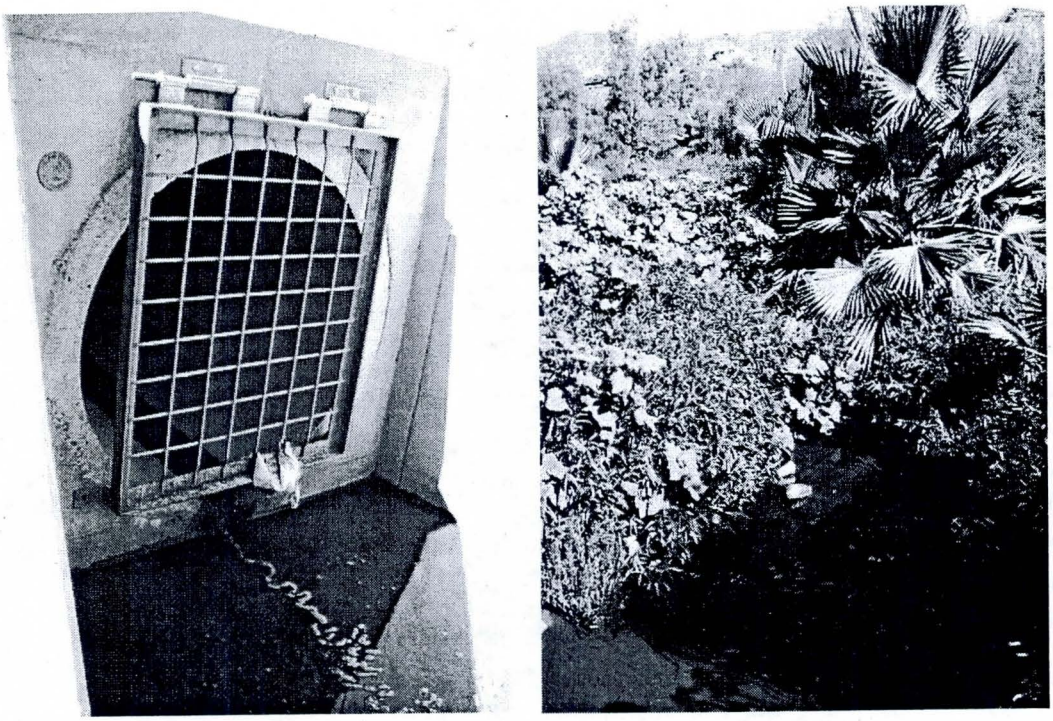
Outfall SR 07 has a relatively robust meso-riparian community. The site appears to have ideal water supply and soil conditions for the creation of a mesquite bosque. Additional opportunities include removal of trash and debris, and planting of native mesquite (*P. juliflora* var. *velutina*), Paloverde (*Cercidium sp.*), and appropriate ground cover species.



Aerial extent of vegetation at SR 07

SR 31

Outfall SR 31 is a 60-inch concrete culvert with a trash screen, located on the south side of the Salt River channel near 19th Avenue at N33° 24'59.6" W112° 06'00.5". The annual stormwater runoff flow estimate for this outfall is approximately 231 AF/Yr. Below the outfall was a small pool (5 to 10 feet) of open water approximately 2-3 feet deep. Meso-riparian species surrounding the pool included velvet mesquite (*Prosopis juliflora* var. *velutina*), salt cedar (*Tamarix ramosissima*), palm (*Washingtonia sp.*), exotic emergent likely wild taro (*Colocasia esculenta*) and Paloverde (*Cercidium sp.*). Salt bush (*Atriplex sp.*), salt cedar (*T. ramosissima*), and Paloverde (*Cercidium sp.*) were also categorized as meso-riparian species at this site. Soil types included clay/silt and some sand.



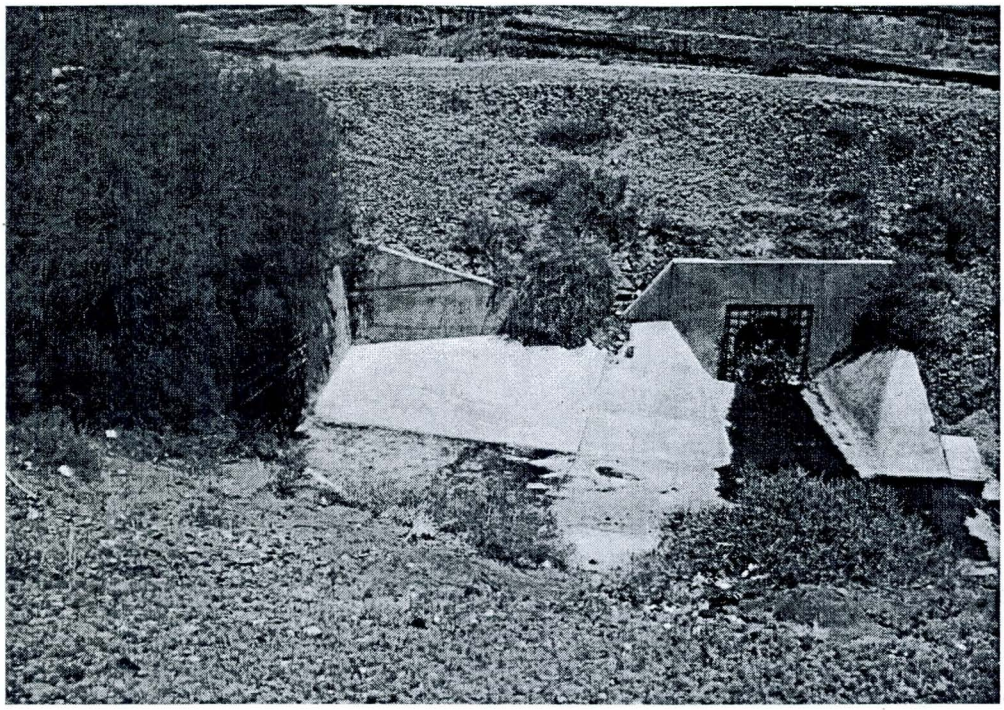
SR 31: South bank west of 19th Avenue

Outfall SR 31 has standing water and lush vegetation. The site has potential, due to the water supply and low permeability soils, for the development of a wetland and riparian corridor. Restoration could be achieved with exotics removal, mainly palm and an unidentified emergent plant (likely wild taro), and replacement with native bulrush and sedges. Minor excavation at this outfall could also be used to create a wetland pond and riparian corridor which would allow additional planting areas for willow and cottonwood trees, as well as mid- and under-story riparian vegetation.

Aerial extent of vegetation at SR 31

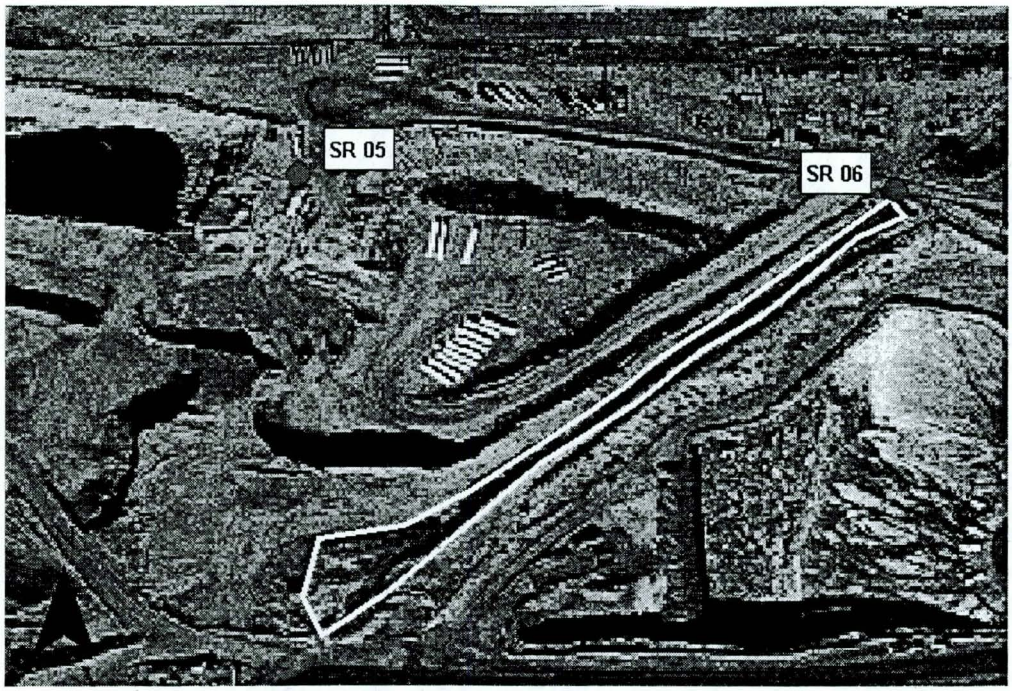
SR 06

Outfall SR 06 is a 78-inch concrete culvert with an open channel both upstream and downstream near 22nd Avenue on the north side of the Salt River channel at N33° 25'01.3" W112° 06'59.1". Estimated runoff to this outfall is approximately 561 AF/Yr, but none of the flow reaches the Salt River channel, instead it is routed into a large sand and gravel pit and allowed to infiltrate or otherwise evaporate. An area of approximately 50 ft^2 of standing water between 0-2 feet deep was located below the outfall. Hydro-riparian species included flat-sedge (*Cyperus sp.*), Fremont cottonwood (*Populus fremontii*) Gooding's willow (*Salix gooddingii*), and eucalyptus. Desert broom (*Baccharis sp.*) dominated the meso-riparian community at this site. The xero-riparian species included unidentified annual grasses, Paloverde (*Cercidium sp.*), and salt bush (*Atriplex sp.*). Soils at the site included clay/silt, sand, gravel, and cobble.



SR 06: North bank at 25th Avenue

SR 06 is located within the property of Rinker Materials sand and gravel mine between the 19th Avenue and 27th Avenue on the northern side of the Salt River. This outfall currently receives dry-weather flows and stormwater runoff via vegetated open-channels. SR 06 discharges to sand and gravel pits where the water either infiltrates or evaporates. At this time, the restoration recommendation is to maintain and protect the open channel conveyances leading to the outfall. If land use and ownership changes in the future, the area may provide habitat features that could be used for trail alignments for access to the project.



Aerial extent of vegetation at SR 06

SR 05

Outfall SR 05 included a pair of concrete pipes emptying into a single, large concrete spill pad on the north side of the Salt River channel near 25th Avenue at N33° 25'01.7" W112° 06'78.5". Almost 125 AF/Yr of stormwater runoff was estimated to discharge from this outfall. At the time of the visit, standing water encompassed an area of approximately 20 ft^2 below the spill pad. From the spill pad water discharges to an isolated gravel pit where it infiltrates and or evaporates. Only xero-riparian species such as salt bush (*Atriplex sp.*), unidentified annual grasses, and Paloverde (*Cercidium sp.*) were documented at this site. The dominant soil type was gravel/cobble.

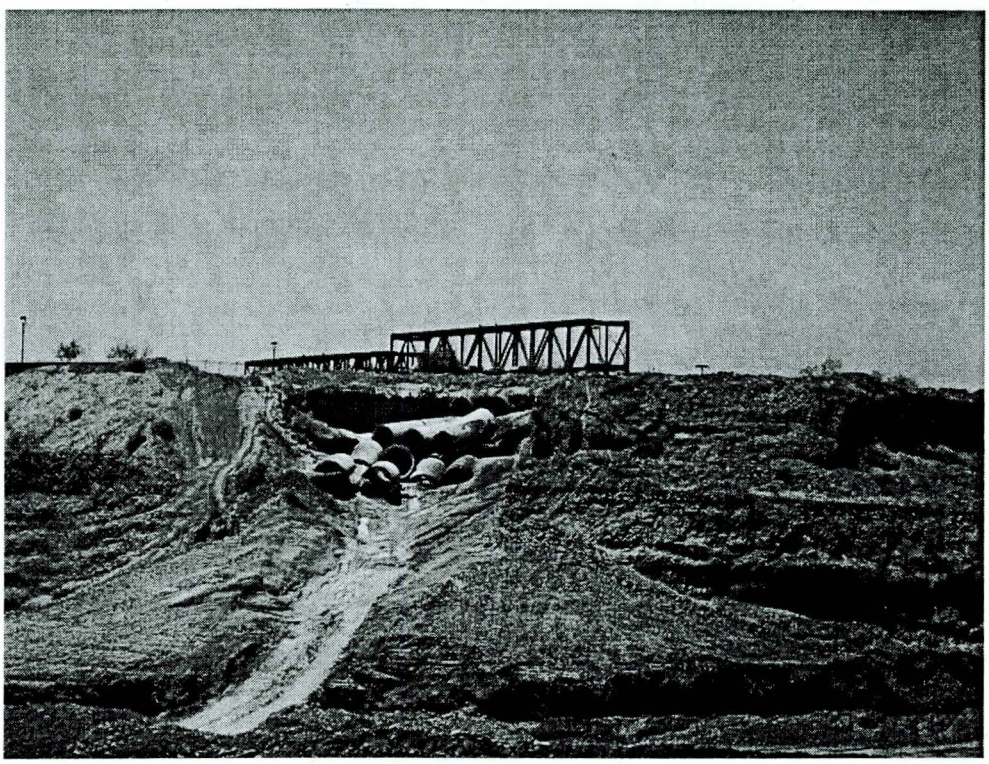
SR 05: North banks at 23rd Avenue

SR 05 is also located within the property of Rinker Materials sand and gravel mine on the north side of the Salt River. The outfall receives dry-weather flows and stormwater runoff. SR 05 also discharges to sand and gravel pits where the water infiltrates or evaporates. Currently, the restoration recommendation is to maintain and protect the open channel conveyances leading to the outfall. Little to no vegetative community exists at this outfall; therefore, an aerial photo is not available for this site.

SR 04

Outfall SR 04 included four 84-inch concrete pipes on the north side of the Salt River channel near 27th Avenue at N33° 24'86.5" W112° 06'98.8". Although this outfall is estimated to discharge 341 AF/Yr, no standing water was visible at the outfall, but open

water was present upstream in an open channel. Meso and xero-riparian vegetation was observed at this site and consisted of species such as Paloverde (*Cercidium sp.*), desert broom (*Baccharis sp.*), Gooding's willow (*Salix gooddingii*), and unidentified annual grasses were found upstream in the invert and side slopes of the open approach channel. The dominant soil types at this site were clay/silt and gravel.

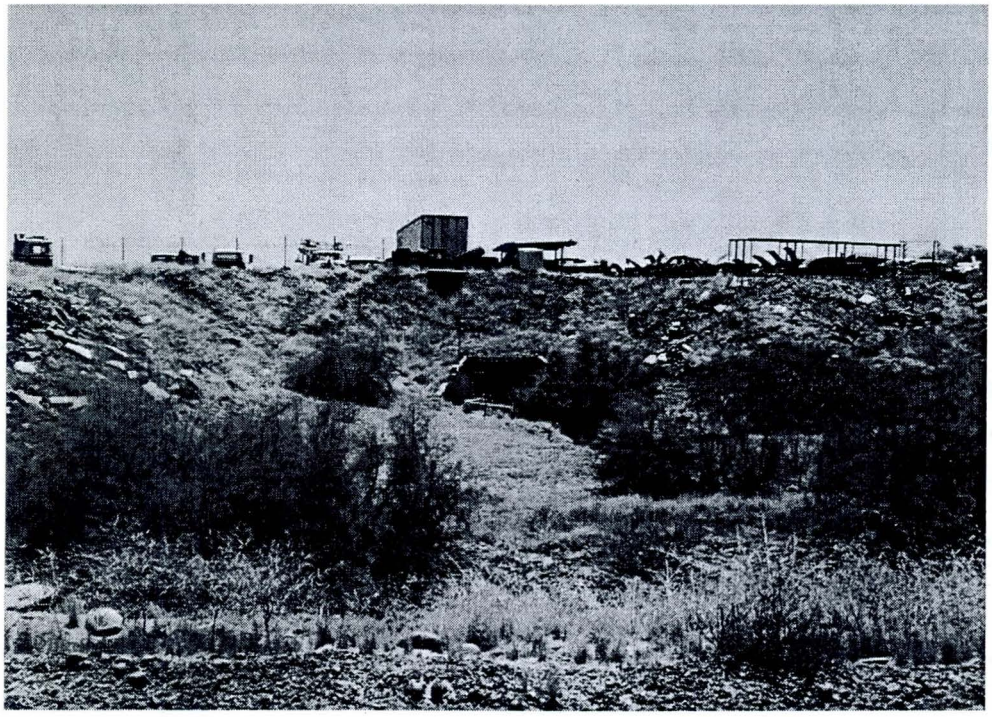


SR 04: North bank near 27th Avenue

SR 04 is also located within the property of Rinker Materials sand and gravel mine on the north side of the Salt River near 27th Avenue. The outfall receives dry-weather flows and stormwater runoff. SR 04 also discharges to sand and gravel pits where the water infiltrates or evaporates. The restoration recommendation is also to maintain and protect the open channel conveyances. Little to no vegetative community exists at this outfall location; therefore, an aerial photo is not available for this site.

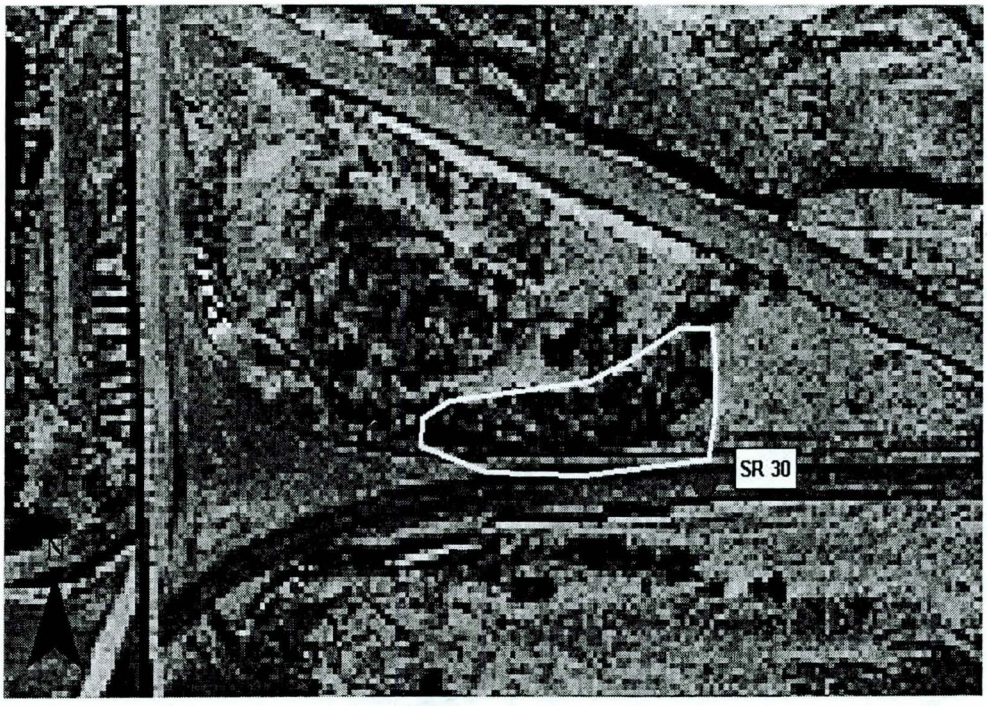
SR 30

Outfall SR 30 is a USGS gauge site (flow and quality) and consists of a large, 108-inch concrete culvert with a trash screen located on the south side of the Salt River channel near 27th Avenue at N33° 24'59.5" W112° 06'98.0". Up to 196 AF/Yr of stormwater flow is estimated to be discharged at this outfall. Minimal standing water (a pool of less than 5 feet across, and less than 6-inches deep) was visible at the site. Saltcedar (*T. ramosissima*) dominated the hydro-riparian vegetation at 27th Avenue. Desert broom (*Baccharis sp.*) and Paloverde (*Cercidium sp.*) were also present and comprise the meso to xero-riparian community at this site. The main soil types were sand and gravel/cobble. A review of the water quality data collected by the USGS for this site indicates a high potential to experience elevated heavy-metal and suspended solids concentrations in flows from this outfall (USGS 1995).



SR 30: South bank east of 27th Avenue

Historically, this outfall has produced significant heavy-metal concentrations and sediment loads. As such, this site could be outfitted with a treatment wetland system designed to manage sediments and the associated heavy-metals. Energy dissipation will likely need to be provided at the upstream end of the treatment wetland, as well as, access to an area that would be designed for periodic sediment removal. Given the potential for high energy flows at this site, the energy dissipation would also serve to route excessive flows to the main channel. Because this outfall flows only in response to storm events, it is recommended that project infrastructure be designed to supply an additional water source to maintain the treatment wetland and riparian area



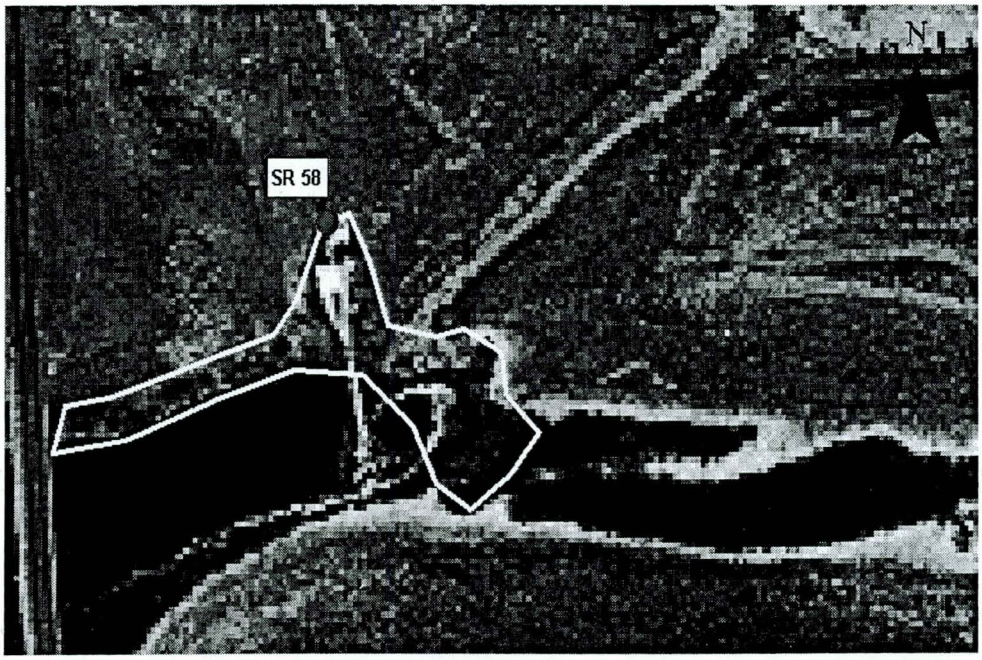
Aerial extent of vegetation at SR 30

SR 58

Outfall SR 58 is a 60-inch concrete culvert with rock gabions located on the north side of the Salt River channel northeast of 35th Avenue at N33° 24'74.6" W112° 07'99.1". This outfall appears to flow in response to discharges of filtered effluent from the City of Phoenix 23rd Avenue Waste Water Treatment Plant (WWTP). Both standing and flowing water were apparent at this location at the time of the site visit. The size of the pool immediately below the outfall fluctuates over the course of the year as evidence by dried alga along the perimeter of the water body. At the time of the site visit, the pool was approximately 100 ft^2, four feet deep, and fed into a large water body in the Salt River channel. Lush vegetation surrounded the outfall including cattail (*Typha sp.*), velvet mesquite (*P. juliflora* var. *velutina*), salt cedar (*T. ramosissima*) and Paperflower (*Psilostrophe sp.*). Brittle-bush (*Encelia sp.*) dominated the meso-riparian community at this site. Soil types included clay/silt and gravel/cobble.

SR 58: North banks east of 35th Avenue

Outfall SR 58 discharges a large, and currently un-quantified, amount of effluent year-round. The effluent has created a large lake that extends a quarter to one-half mile downstream. The banks of the lake offer enhancement potential by replacing the non-native invasive grasses with bulrush, cattail, and native sedges. Because the area of inundation varies on a temporal basis, perimeter vegetation selection should include facultative as well as obligate wetland species. Consideration should also be given to augmenting the outfall area with cottonwood and willow tree species as long as appropriate soil conditions are present or created.

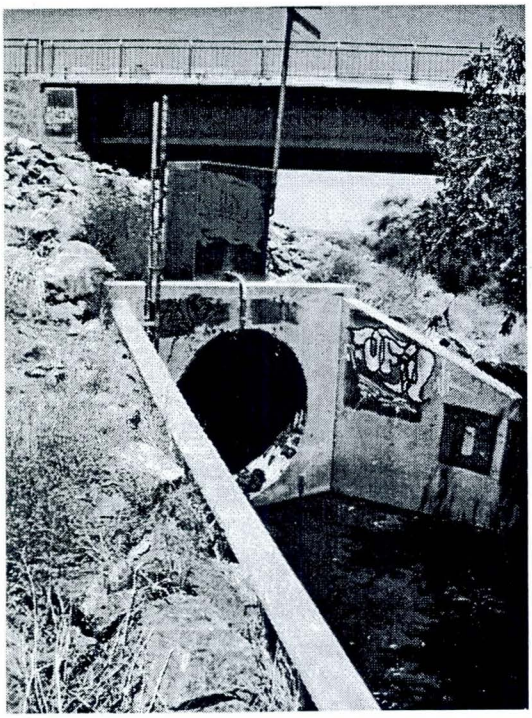


Aerial extent of vegetation at SR 58

SR 03

Outfall SR 03 is a 75-inch concrete culvert located on the north side of the Salt River channel, northwest of the 35th Avenue Bridge at N33° 24'71.9" W112° 08'07.3". Approximately 224 AF/Yr of stormwater runoff is estimated to be discharged from this

outfall. At the time of the site visit a small pool existed below this outfall structure, and routed into the same in-channel large water body as SR 58. Hydro-riparian species were present at this site including Freemont cottonwood (*P. fremontii*) and Gooding's willow (*S. gooddingii*). Palm (*Washingtonia sp.*) and Paloverde (*Cercidium sp.*) were also present. The dominant soil type was gravel/cobble.



SR 03: North banks west of 35th Avenue

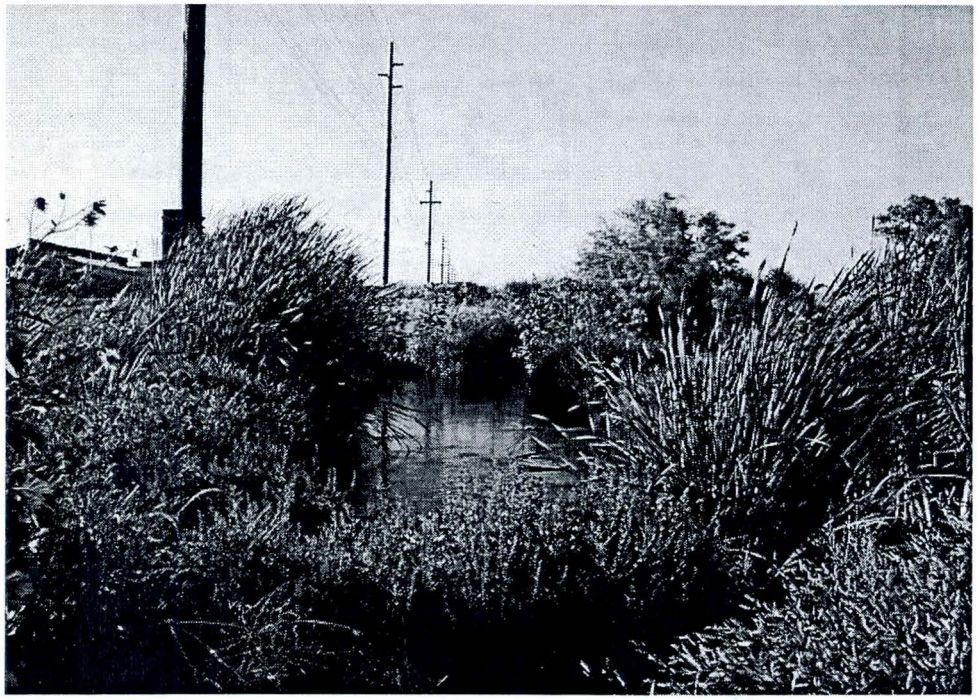
Outfall SR 03, north bank west of 35th Avenue, appears to have sufficient water to support hydro-riparian trees including native willows which could be established along the wetted perimeter. The site could also be restored by the removal of trash, non-native palm trees, and the establishment of a small pocket-forest of cottonwood trees. In both cases native mid- and under-story vegetation should be augmented as well.

Aerial extent of vegetation at SR 03

SR 02

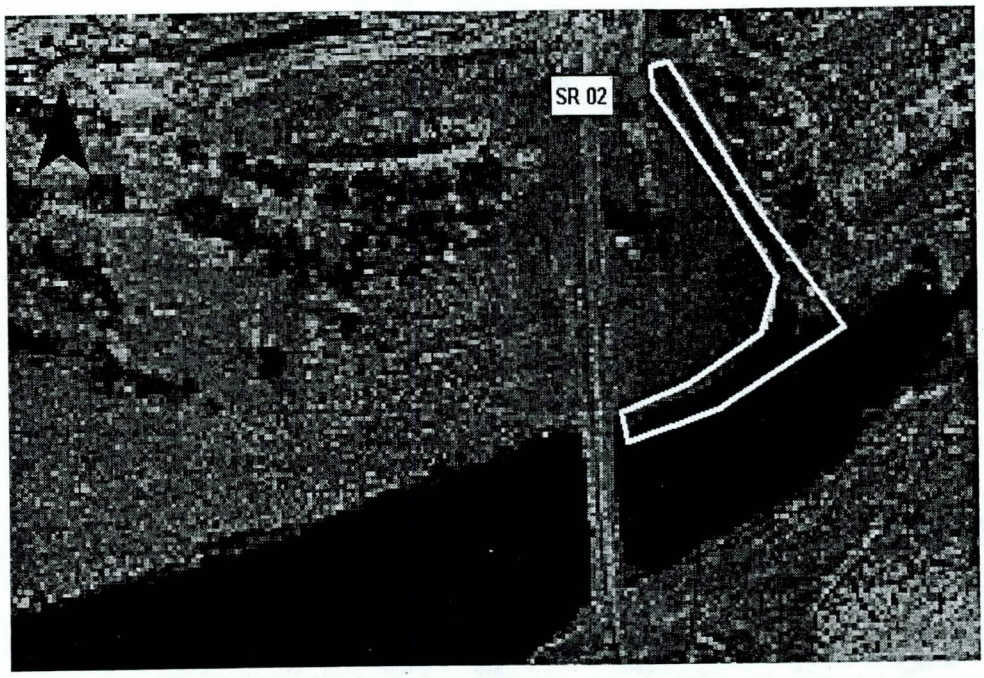
Outfall SR 02 is a 90-inch concrete culvert flowing into an unlined canal on the north side of the Salt River channel, near the 43rd Avenue alignment at N33° 24'57.7" W112° 09'08.0". This outfall receives an undocumented amount of irrigation tailwater from Peterson's farm (effluent reuse from the 23rd Avenue WWTP). It is also estimated that up to 274 AF/Yr of stormwater runoff can be discharged from this outfall. At the time of the site visit, both standing and flowing water were visible and flow is routed into a common, large pool of water in the river channel. This pool becomes channelized at the downstream end and continues downstream with intermittent open-water and marsh areas extending all the way to the 51st Avenue Bridge at times of the year. Several hydro-riparian species surround this important water-body, including cattail (*Typha sp.*), salt cedar (*T. ramosissima*), castor bean (*Ricinus sp.*), and sunflower (*Heloanthus sp.*). The meso-riparian species at the site include Paloverde (*Cercidium sp.*), Salt bush (*Atriplex*

sp.), Brittle-bush (*Encelia sp.*), and Russian thistle (*Salsola sp.*). The soil types at this site include sand and gravel/cobble.



SR 02: North bank at 43rd Avenue

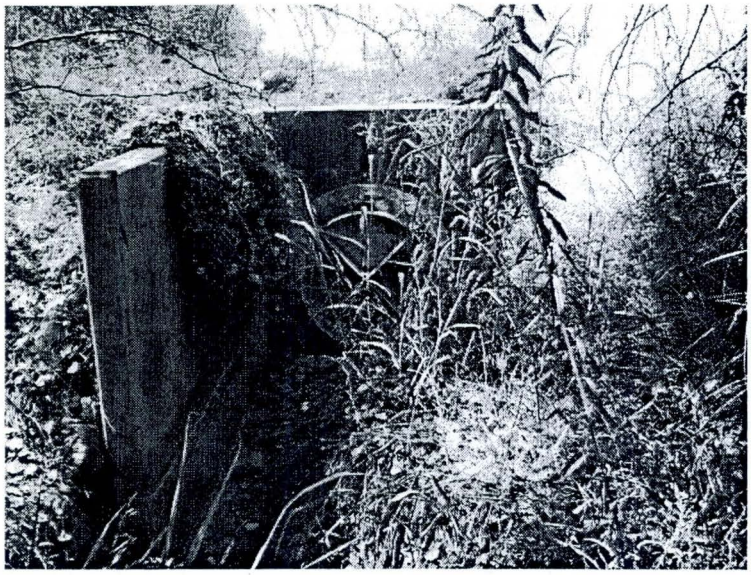
Outfall SR 02 is an unlined canal entering from Peterson farms. The water supply at this location supports a corridor of riparian plants, and lake that extends from one-quarter to nearly one mile. Restoration opportunities include planting willows and cottonwoods along the banks of the riparian corridor. In addition, non-native grasses could be selectively replaced with bulrush, cattail, and native sedges. The potential exists at this outfall to divert a portion of the flow downstream several meters from the toe of the north bank to an area that appears to have at one time supported a willow forest. Restoration in that area includes supplying water and plantings. The majority of existing dead snags in that area should be left in place.

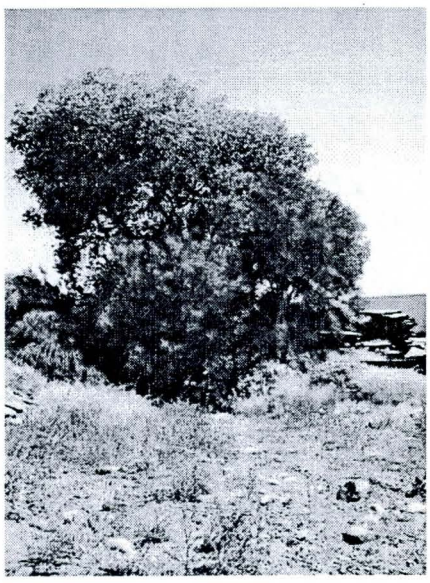


Aerial extent of vegetation at SR 02

SR 48a

Outfall SR 48a is a 48-inch concrete storm drain with a flood gate on the south side of the Salt River channel near 43rd Avenue, approximately 50 feet west of 48b. No water was visible at this outfall and an estimate of annual discharge is not currently available. Several large hydro-riparian trees currently exist including cottonwood (*P. fremontii*), willow (*S. gooddingii*), Paloverde (*Cercidium sp.*), and mesquite (*Prosopis sp.*). Annual grasses surrounded the site. The dominant soil type was clay/silt with some small gravel.

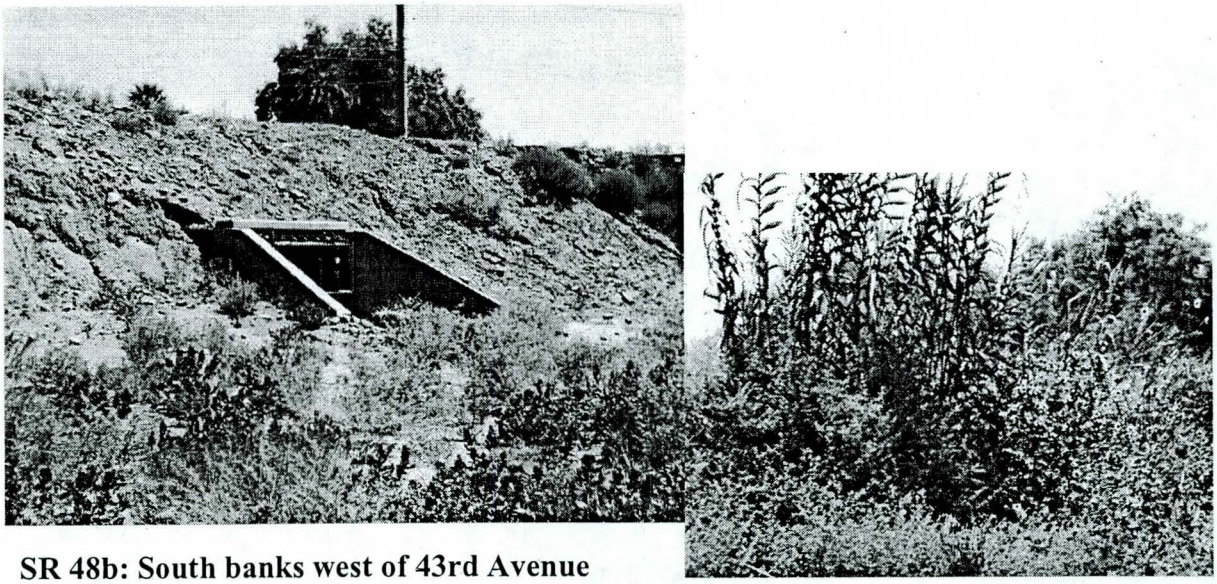




SR 48a: South bank at 43rd Avenue

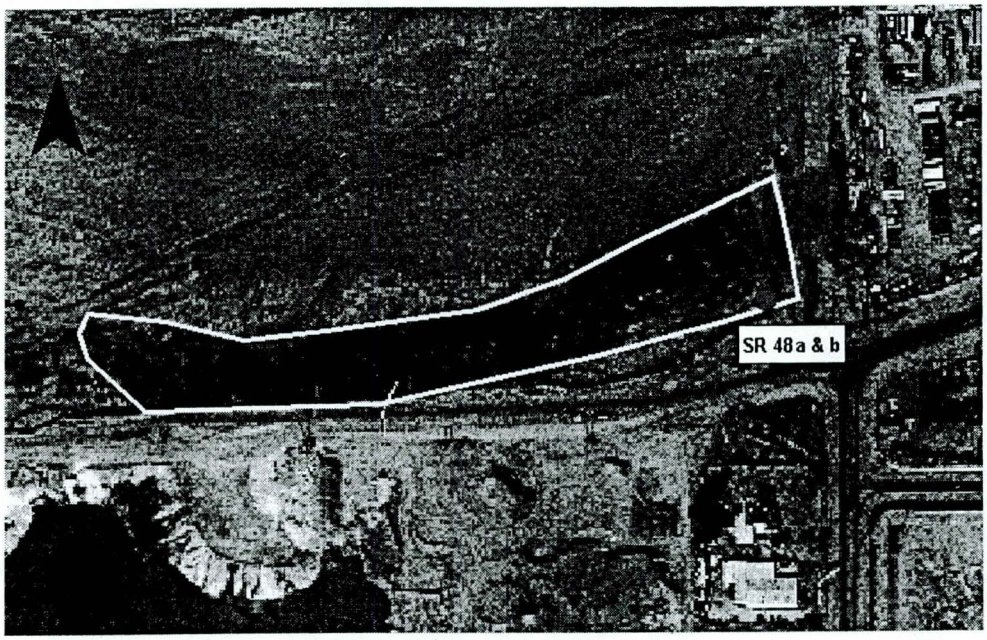
SR 48b

Outfall SR 48b is a large concrete culvert with a flood gate on the south side of the Salt River channel near 43rd Avenue at N33° 24'23.1" W112° 09'08.6". At this time, no information is available with respect to anticipated annual flow volumes from this outfall. At the time of the site visit, no standing water was visible immediately adjacent to the outfall, but standing water was found about 25 feet away in a small channel. Salt cedar (*T. ramosissima*), salt bush (*Atriplex sp.*), Giant Reed (*Arundo donax*), mesquite (*Prosopis sp.*) and Sunflower (*Helianthus sp.*) were the dominant hydro-riparian species at this site. The meso-riparian community consisted mainly of desert broom (*Baccharis sp.*) and unidentified grasses. Clay/silt and sand were the main soils at this outfall.



SR 48b: South banks west of 43rd Avenue

Outfalls SR 48a and 48b appear to deliver sporadic flows to an area of the river bottom that possesses low permeability soils. These soils appear to retain moisture between flow events. The existing community at these outfalls should be restored to reduce the Arundo population and increase native hydro- and meso-riparian species. Reeds (bulrush, spike-rush, horsetail rush, and sedges) could be planted in the shallow standing water and mesquite bosque established to surround the immediate area.



Aerial extent of vegetation at SR 48a & b

SR 47

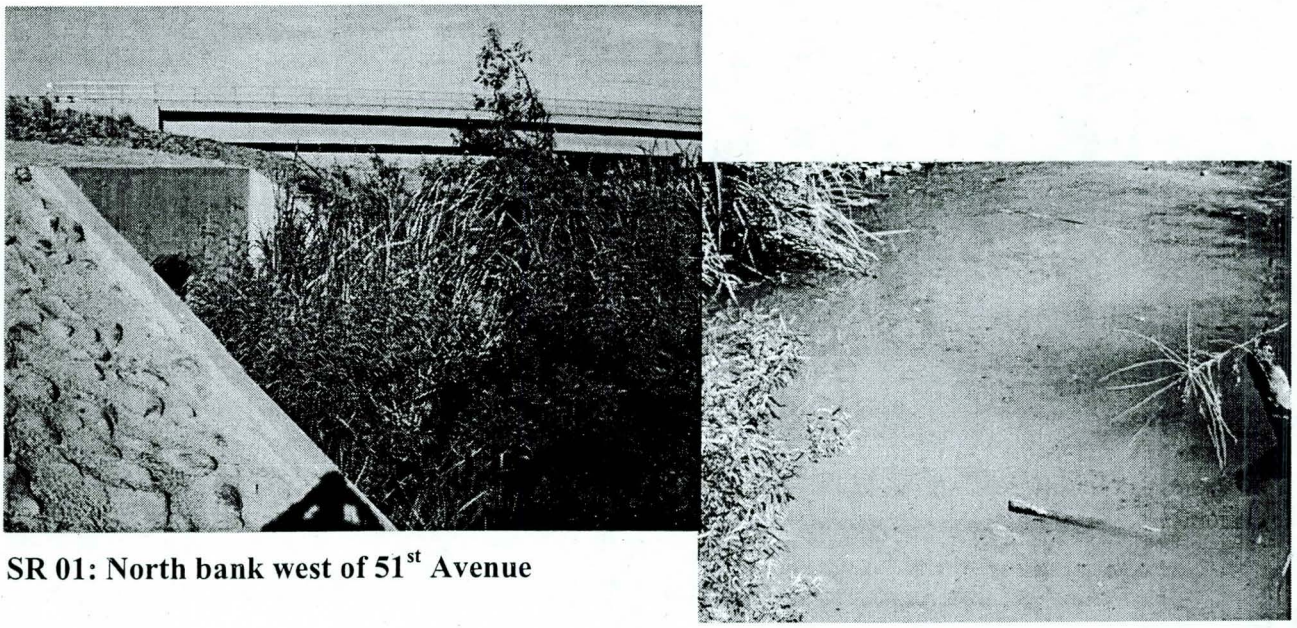
Outfall SR 47 is a 48-inch culvert on the north side of the Salt River channel just west of 51st Avenue, 50 feet north of SR 01, at N33° 24'52.6" W112° 10'17.4". At this time, no flow estimate is available for this outfall and no standing water was visible at this site during the visit. No hydro-riparian species were evident, but annual grasses and brittle-bush (*Encelia sp.*) were found nearby. The dominant soils were sand and gravel.

SR 47: North banks west of 51st Street

Outfall SR 47 appears to be dry the majority of the year, passing short duration high energy flow events periodically. Trash removal is recommended, at this site. Due to the lack of available water supply and high scour potential during flow events, no restoration is recommended for this site. Creation could be considered pending a thorough investigation of the need for energy dissipation and the provision of a supplemental water source and appropriate soils.

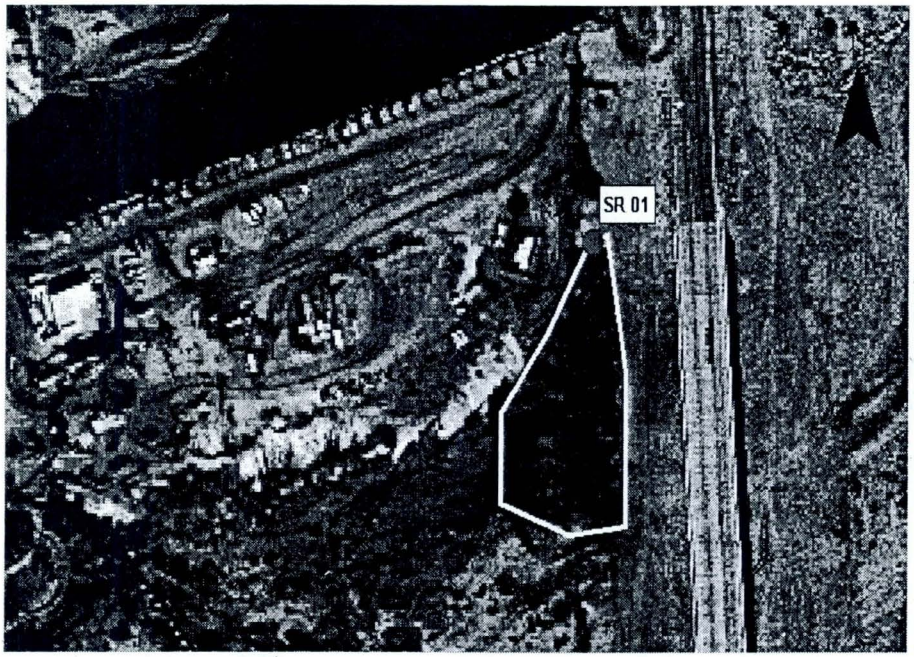
SR 01

Outfall SR 01 is a 96-inch culvert without a trash screen on the north side of the Salt River channel near 51st Avenue at N33° 24'525" W112° 10'174". The stormwater runoff discharged from this outfall on an annual basis is approximately 274 AF/Yr. A small pond of standing water approximately 3-4 feet deep was present directly below the outfall. Hydro-riparian vegetation existed within 5-10 feet of the standing water that included: cattail (*Typha sp.*), willow (*S. gooddingii*), Paloverde (*Cercidium sp.*), mesquite (*Prosopis sp.*) and Sunflower (*Helianthus sp.*). Meso-riparian species at this site included unidentified annual grasses, desert broom (*Baccharis sp.*), and Paperflower (*Psilostrophe sp.)*. Silt and gravel/cobble were the dominant soil types at this site. As was the case with the majority of the outfalls visited, trash and debris occupy significant portions of the sites and any restoration activities should include removal of such materials.



SR 01: North bank west of 51st Avenue

Outfall SR 01 has a variety of native willow and cattails surrounding the open water. Protection/preservation is suggested for the immediate region. Nearby salt cedar could be replaced with bulrush and spike rush (e.g. *Schoenoplectus martine, Eleocharis sp.*) in moist soils and mesquite in drier regions. An under-story/groundcover dominated by *Anemopsis californicus* (Yerba Manza) could likely be established under the canopy species. If desired and pending a site specific water budget, flow may be available or could be supplied via project infrastructure that could be routed from this location to support downstream features such as a cottonwood forest or mesquite bosque.

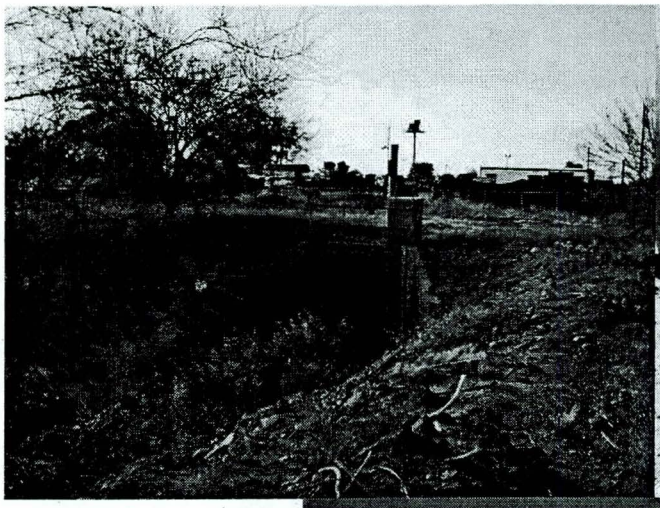


Aerial extent of vegetation at SR 01

SR 49 & SRP 67th Avenue Drain

Outfall SR 49 & the SRP 67th Avenue drain consists of two open, concrete-lined channels leading from 96-inch concrete culverts on the north side of the Salt River channel near 67th Avenue at N33° 24'01.0" W112° 12'24.9". Both channels transport a combination of

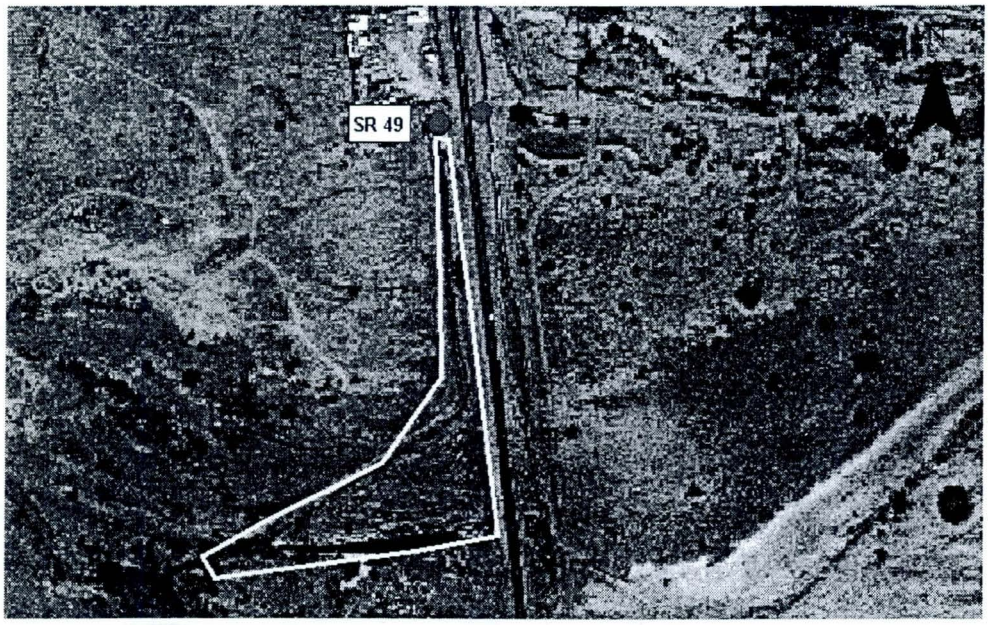
agricultural and urban runoff to the Salt River channel over the course of any given year. It is estimated that the stormwater runoff discharged from these outfalls is approximately 558 AF/Yr. In addition, 1,044 AF/Yr of irrigation water is discharged from the SRP 67th Avenue Drain. No water was visible in the channel on the west side of 67th Avenue (SR 49), but flowing water was apparent in the eastern channel (SRP drain). Both channels empty into a standing pool of water on the west side of 67th Avenue. Hydro and meso-riparian species currently present included: Paloverde (*Cercidium sp.*), desert broom (*Baccharis sp.*), Canyon Ragweed (*Ambrosia ambrosioides*), salt cedar (*T. ramosissima*), and mesquite (*Prosopis sp.*). The dominant soil type is clay/silt.



SR 49:
North bank west of 67th Avenue

SRP 67th Avenue Drain:
North bank east of 67th Avenue

Outfalls SR 49 and the SRP 67th Avenue drain discharge into open channels that enter the Salt River from the north bank. The SRP 67th Avenue drain flows regularly with agricultural return flows, while SR 49 typically flows in response to runoff generating storm events. During the site visit the water appeared muddy in color, and as such, sediment removal would likely improve water quality. This is especially so since pesticides and other organic contaminants are often bound to the sediment in agricultural tail water. Restoration through the creation of a treatment wetland area is recommended to reduce sediment loads. Such a system would likely entail the creation of a forebay structure to dissipate energy, route flows, and provide initial settling. Water would then flow to a densely vegetated emergent marsh area designed for sediment removal. Treated water would be discharged into the existing open channel system and ultimately the existing riparian area located approximately ¼-mile downstream of 67th Avenue. Restoration of the existing riparian area would entail exotic plant removal, debris removal, and establishment of additional native vegetation.



Aerial extent of vegetation at SR 49

RECOMMENDATIONS

Table 1 lists the recommendation for each site.

Table 1: Site specific recommendations

Site ID	*Location*	*Create*	*Enhance*	*Protect*	*Comments*
SR 07	19th Avenue NW		X		Trash removal and increase natives; enhance mesquite bosque and Paloverde complex
SR 31	19th Avenue SW	X	X		Wetland and riparian corridor
SR 06	22nd Avenue N			X	Protect Upstream Conveyance Channel Vegetation
SR 05	25th Avenue N			X	Protect Upstream Conveyance Channel Vegetation
SR 30	27th Avenue SE	X	X	X	Trash removal, limited potential for increasing habitat, Create Treatment Wetlands for Water Quality Improvements
SR 04	27th Avenue N			X	Protect Upstream Conveyance Channel Vegetation
SR 58	35th Avenue NE		X		Augment wetland plant species with bulrush and cattails
SR 03	35th Avenue NW		X	X	Replacement of palm with willow and cottonwood
SR 02	43rd Avenue N	X	X	X	Add cottonwood and willow trees in the channel banks and bulrush and cattails in the shallow muds. Create diversion channel to historic forest area adjacent to N. bank.
SR 40	43rd Avenue S		X		Remove exotics (Arundo and salt cedar)

Table 1 cont'd

Site ID	*Location*	*Create*	*Enhance*	*Protect*	*Comments*
SR 01	51st Avenue NW		X	X	Trash removal, bar screening, bulrush, cattails, cottonwood, willow.
SR 47	51st Avenue (50 ft North of SR 01)		X	X	Trash removal only
SR 49	67th Avenue	X	X		Trash removal and the development of a settling pond to remove fine sediments from agriculture.

WATER SUPPLY VERSUS AERIAL EXTENT OF EXISTING HABITAT

The annual amount of water discharged from each outfall as estimated from regional regression equations for precipitation and gauge data for dry-weather flows was compared to the aerial extent of existing habitat (vegetative cover) in an attempt to develop a predictive relationship for subsequent restoration efforts to be focused at outfalls throughout the Oeste Reach of the Rio Salado. If one includes the combined data set for both precipitation and dry-weather flows, no real trend appears ($R^2 = 0.53$). Given that the annual precipitation is only on the order of 9 inches per year, the result indicates that a substantial amount of dry-weather flows enter this reach of the river and that dry-weather discharges such as those from the 23rd Avenue WWTP or from Peterson Farms (SR 02) likely support more vegetation than from runoff generating storm events. When the data set is reduced to include only those outfalls that receive storm water flows (Table 2), the relationship improves dramatically ($R^2 = 0.95$) as seen in Figure 2.

Table 2. Area versus existing habitat acreage at outfalls with runoff estimates.

Outfall Name	Existing Habitat (Acres)	Annual Runoff Amount (Acre-Ft)
SR 01	1.6	274
SR 03	0.9	224
SR 07	0.1	79
SR 30	0.6	196
SR 31	1.3	231
SR 49	3.5	558

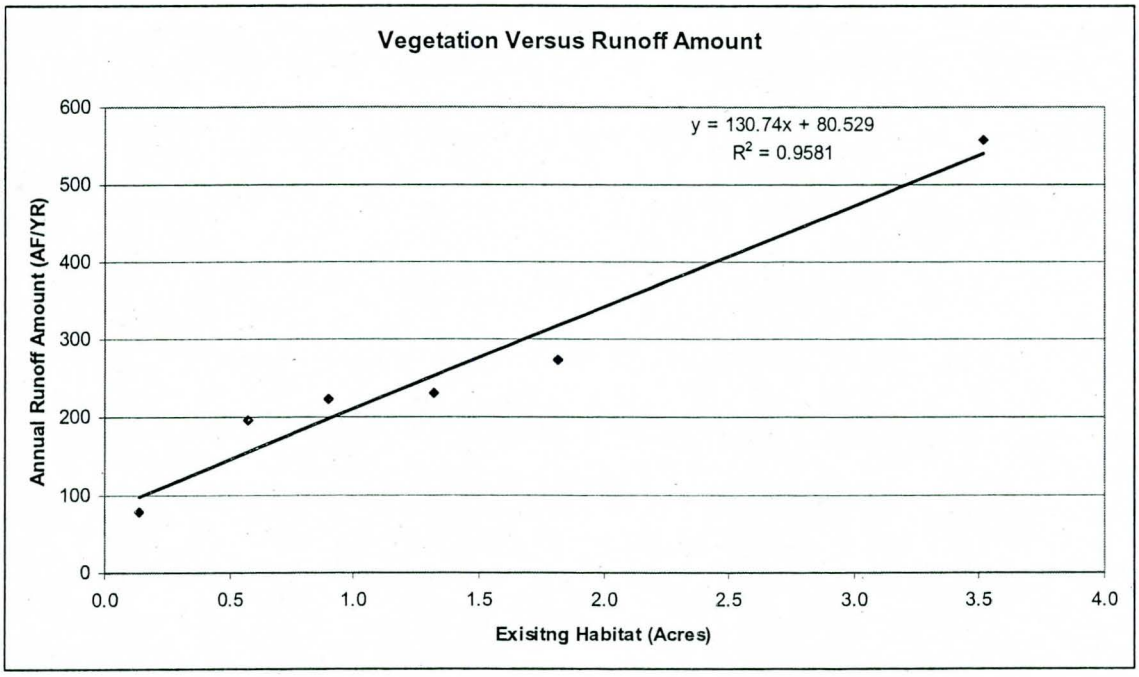


Figure 2. Plot of the existing habitat acres versus the annual runoff estimated for selected outfalls into the Oeste reach of the Rio Salado. Outfalls receiving process water from Sand and Gravel Operations were not included.

Although the relationship developed can likely be used to guide restoration activities associated with the outfalls, the data reveal how important dry weather discharges have been and continue to be to the development and sustenance of riparian habitat associated with outfalls. As such, it is recommended that restoration designs consider a means of supplying supplemental project water to sustain existing habitat should the dry weather

discharges be eliminated through future conservation measures or changes in the land use enacted in the contributing watershed.

OPERATIONS & MAINTENANCE ROADWAY ACCESS TO OUTFALL AREA(S)

High quality riparian habitat is located downstream of several outfalls in the Oeste reach of the Rio Salado. Such existing habitat, if preserved and augmented, could form the basis for full-scale restoration efforts. Because these features are located along the bank of the project, conflicts can occur between the operations and maintenance (O&M) roadway alignment and the discharge from the outfall(s). The conflict arises when high energy discharges from the outfall scour/erode the O&M roadway features placed downstream of the outfall, or roadways are impassable due to flow depth or velocity.

This section focuses upon ways of minimizing such conflicts through alignment, design, and operational methods. Careful thought in the conceptual stages of the Rio Oeste should be used to route the alignment of the O&M roadway through the project. Questions to be answered and or considered include: does the sponsor really need all-weather access to both sides of each outfall; does the alignment necessarily need to be downstream of the outfall discharge point or can the alignment route on the bank side of the outfall; does O&M access have to be contiguous along both sides of the channel?

If it is determined that all-weather access is required immediately adjacent to or downstream of the outfalls then there are several options to be considered in the conceptual phase that if adopted at that time can result in cost-effective solutions that maintain the character and extent of the existing habitat. Such considerations include

bridging the outfall, re-routing a portion of the high energy flows, and provision of energy dissipation structures. Such solutions can be independent or considered together to derive the desired result during design. In all cases, the overall goal is to provide adequate access to the outfall while preserving, and in some instances, restoring riparian habitat.

Finally, some consideration should be given to the use of "wet" crossings at outfalls that have minimal potential to discharge high energy flows to the project. Such a crossing (albeit was likely not an engineered crossing) is currently established at the SR 02 outfall (North bank, at 43rd Avenue). Such crossings are characterized by hard rock bottoms with 0 to 16 inches of flow depth. Although not a pedestrian crossing, such features can be used in areas of the project where visitation is restricted to O&M or project personnel.

In summary, there are several outfalls that discharge to the Rio Salado Oeste project that currently support riparian habitat. As the project develops, there will be times when access to these structures will be required for operation and maintenance activities, and at selected areas, by public visitors. Paramount is the ability of these structures to pass large flows while not destroying access point(s) or the existing riparian habitat. Special attention during the conceptual design phase of this project to these areas must be given by the design team so that economical and functional access will be provided. If consideration is left until the final design phases, costs alone may sway the team and result in loss of existing habitat.

CONCLUSIONS

Appropriate soil characteristics, water supply and quality are essential elements of riverine based ecosystem restoration. Paramount to guiding the development of restoration recommendations is the premise not to degrade desirable habitat areas that are currently associated with a given existing outfall. Prior to implementing any of the recommendations contained within this report, site specific water budgets should be refined to ensure that enhancement is realistic given the amount of water delivered at an outfall. Such information can also be used to assess the need for augmenting dry-weather and stormwater discharges with project infrastructure and water supply. This is especially important for outfalls like SR 02 (N. Bank at 43rd Avenue) where there may be an opportunity to divert a portion of the existing flows to an area that appears to have historically supported a riparian area. Further, the need for importing soil to a site or amending existing soils must also be defined on a site-specific basis and supported by appropriate agronomic testing and water holding analyses prior to implementing restoration enhancement or creation efforts. At least one potential borrow site has been tentatively identified (pending quality and engineering analyses) at the Rinker Materials facility located in the NW quadrant of 19th Avenue and the Salt River. Lastly, the water quality discharged from outfalls that serve agricultural (SRP 67th Ave. Drain) and industrial land use's (SR 30) should be determined so natural treatment system(s) can be designed and constructed if desired.

Literature Cited

Kearny, T.H., R.H. Peebles, and Collaborators, 1997. *Arizona Flora.* University of California Press, Los Angeles, CA.

USGS, 1995. Statistical Summary of Select Physical, Chemical, and Microbial Characteristics, and Estimates of Constituent Loads in Urban Stormwater, Maricopa County. Thomas Lopes *et al.*

Figure 1 Outfall Location Map
Appendix A Field Data Sheets

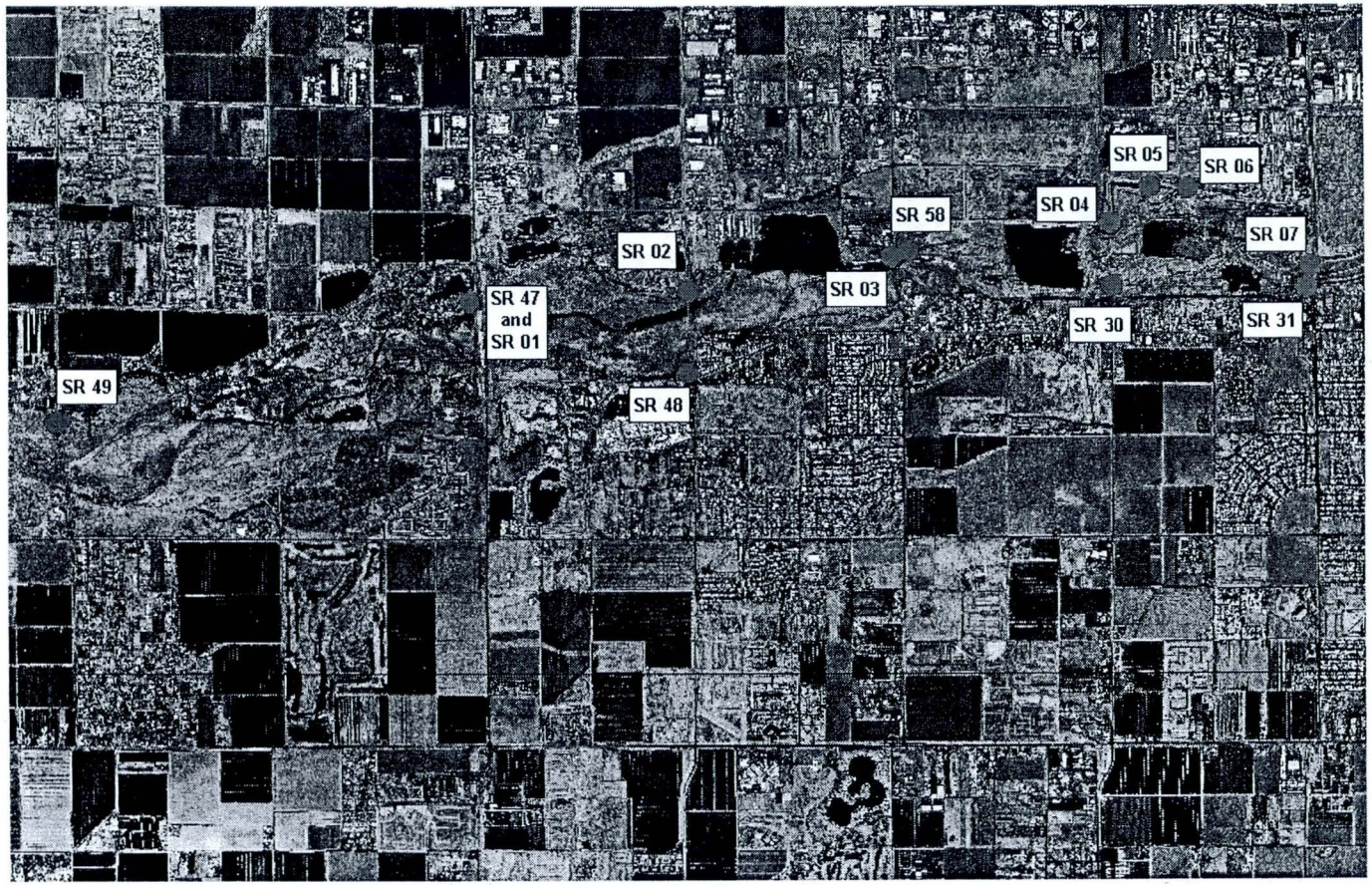


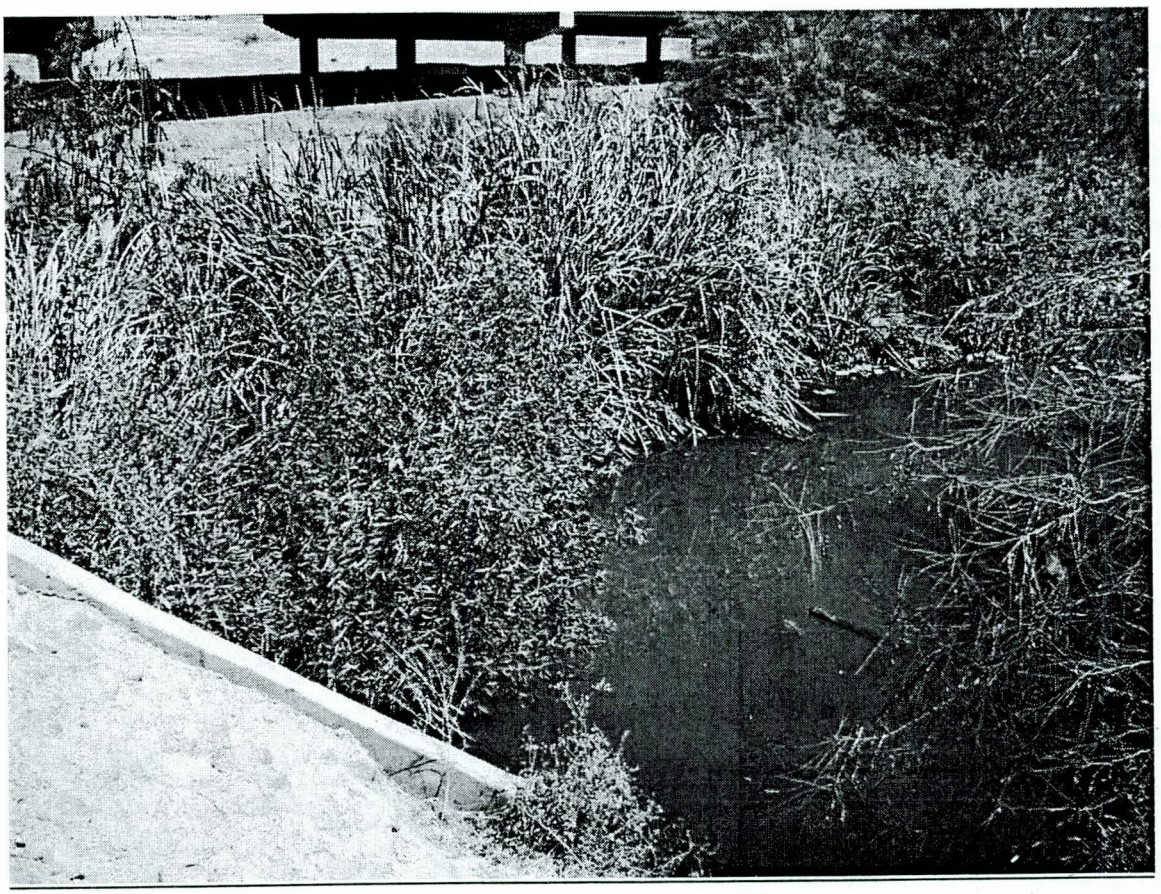
Figure 1. Rio Salado Oeste Outfall Location Map

APPENDIX A – Field Data Sheets

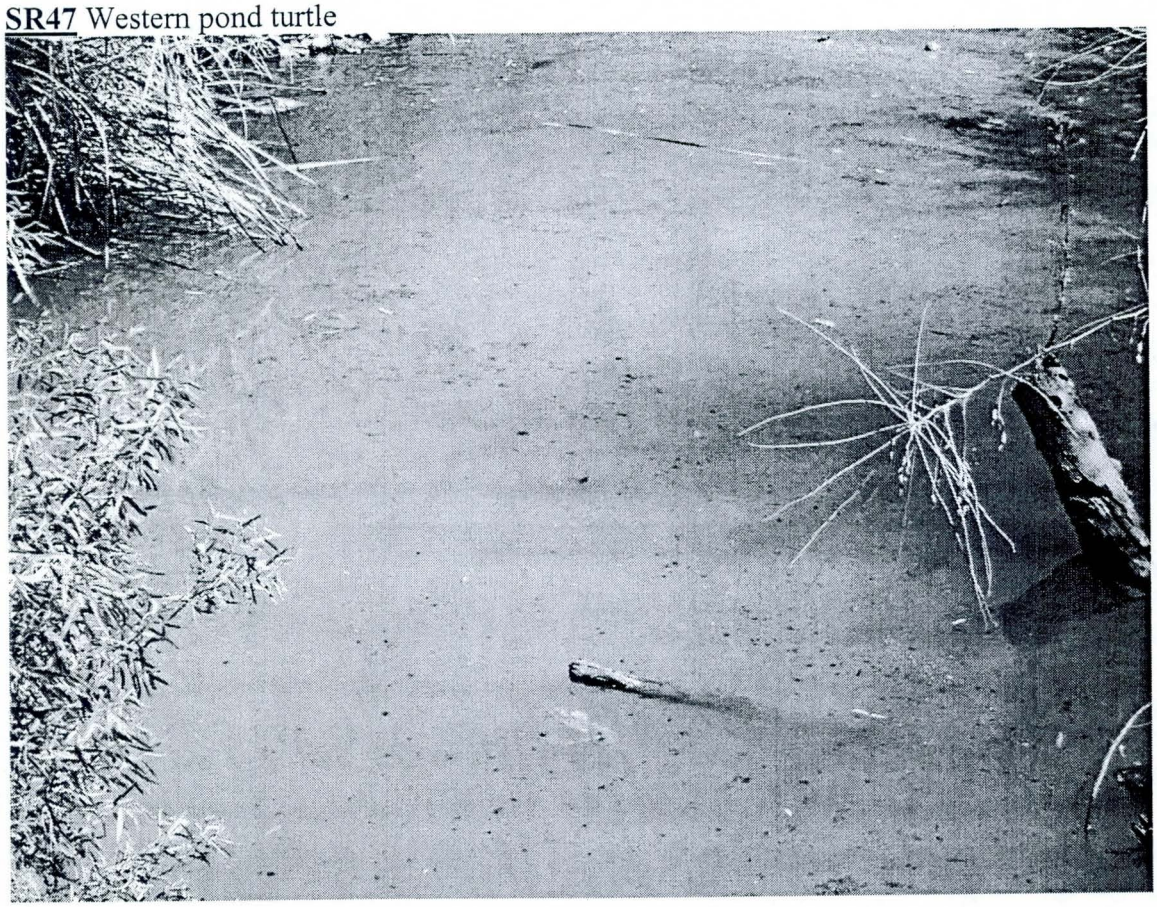
Stormwater Outfall field notes from 6-23-2003
Rio Salado Oeste

SR 47 51st Avenue and Salt River—North side 50 feet north of SR 01

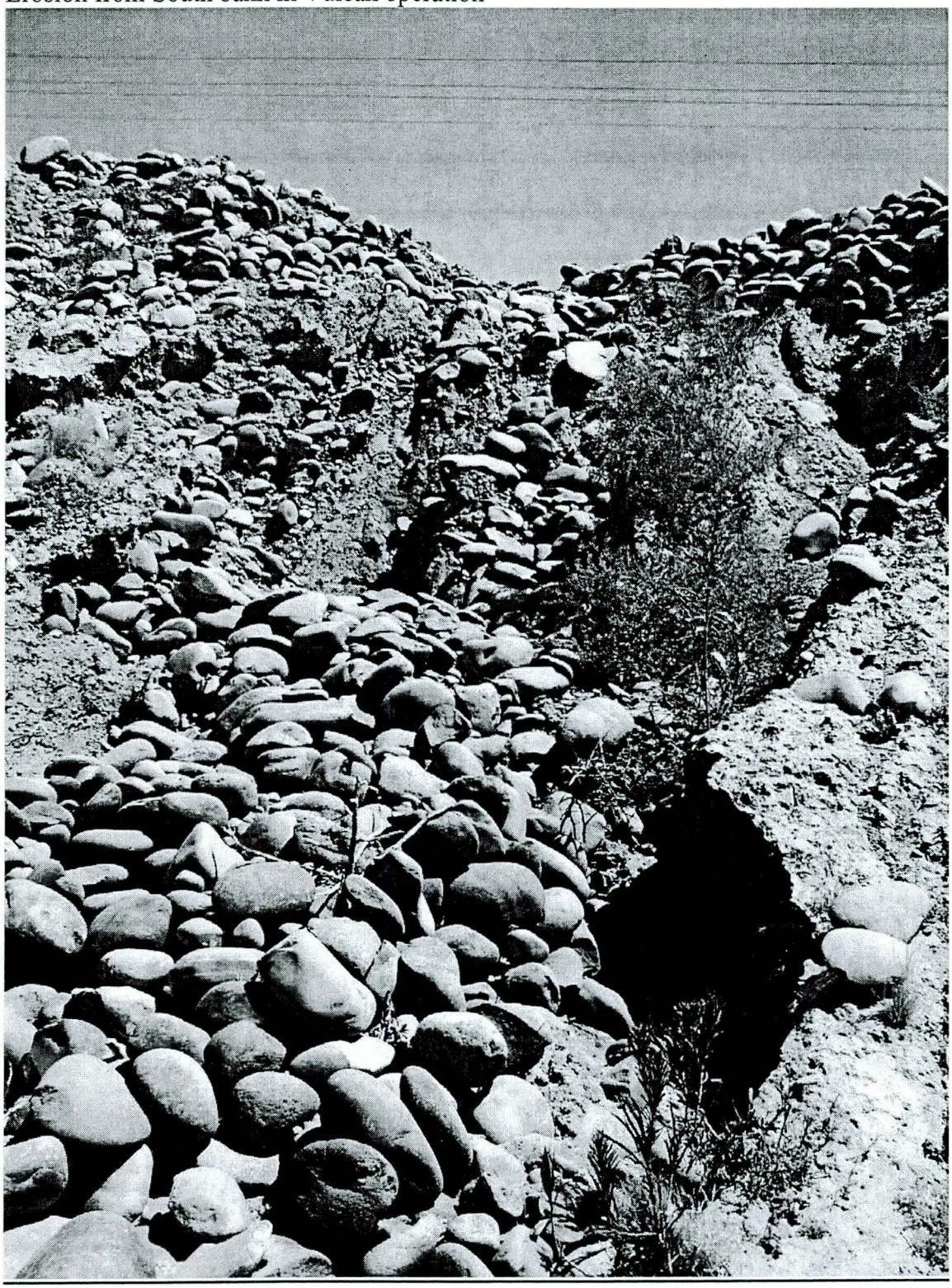
SR 47 Vegetation (good) — cattails, reeds, etc.



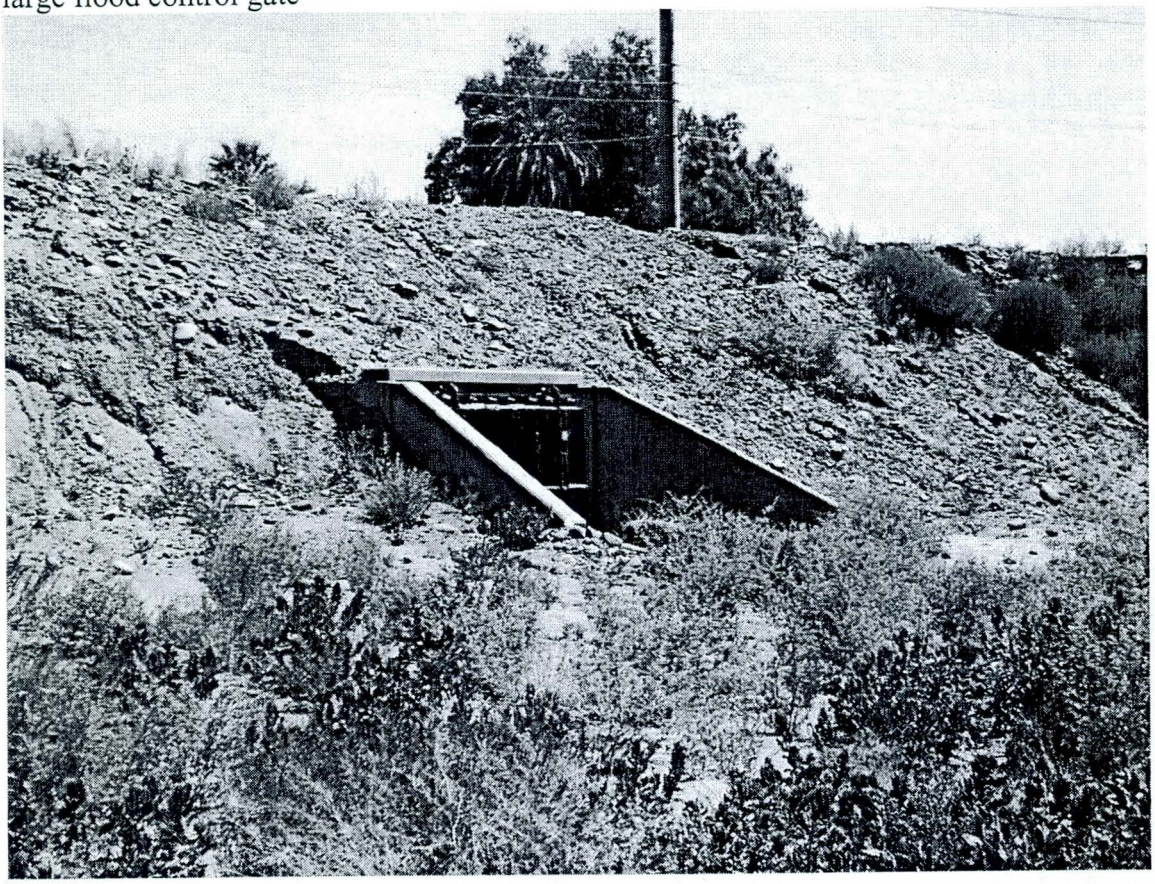
SR47 Western pond turtle



45th Avenue and Salt River
Erosion from South bank in Vulcan operation

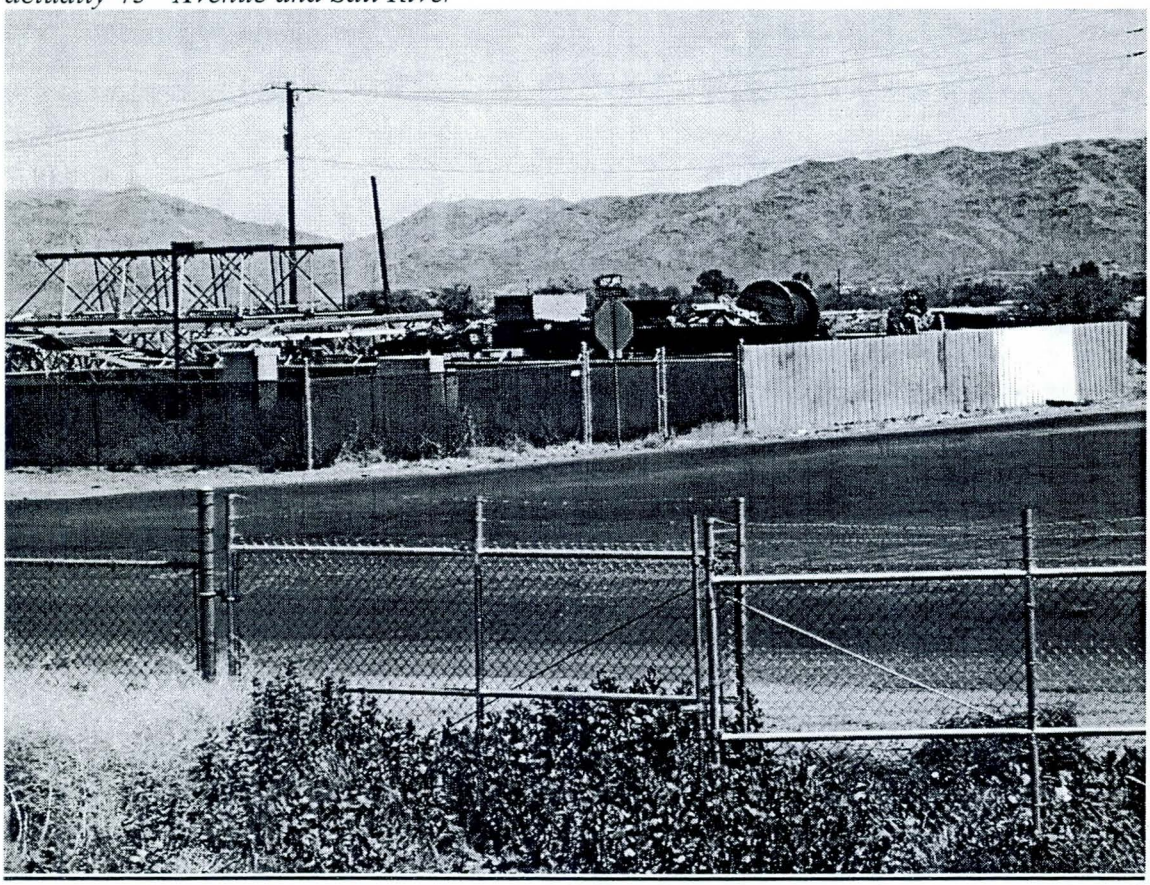


SR 48 45th Avenue and Salt River—South Side
actually 43rd Avenue and Salt River
large flood control gate

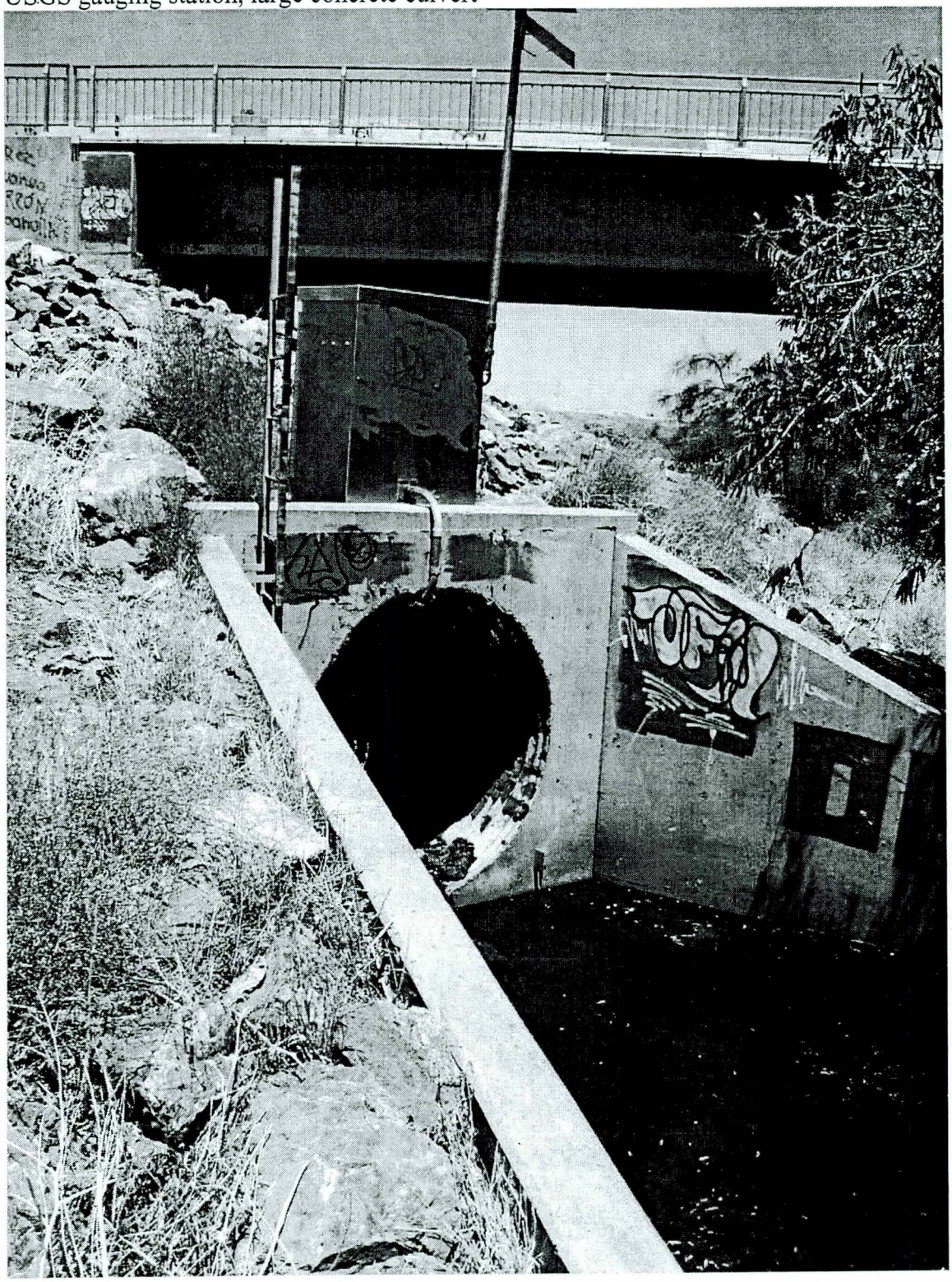


SR 48 45th Avenue and Salt River—South Side
actually 43rd Avenue and Salt River
standing water and lots of vegetation—some Arundo, reeds,

SR 48 45th Avenue and Salt River—South Side
actually 43rd Avenue and Salt River



SR 03 35th Avenue and Salt River—North Side
USGS gauging station, large concrete culvert

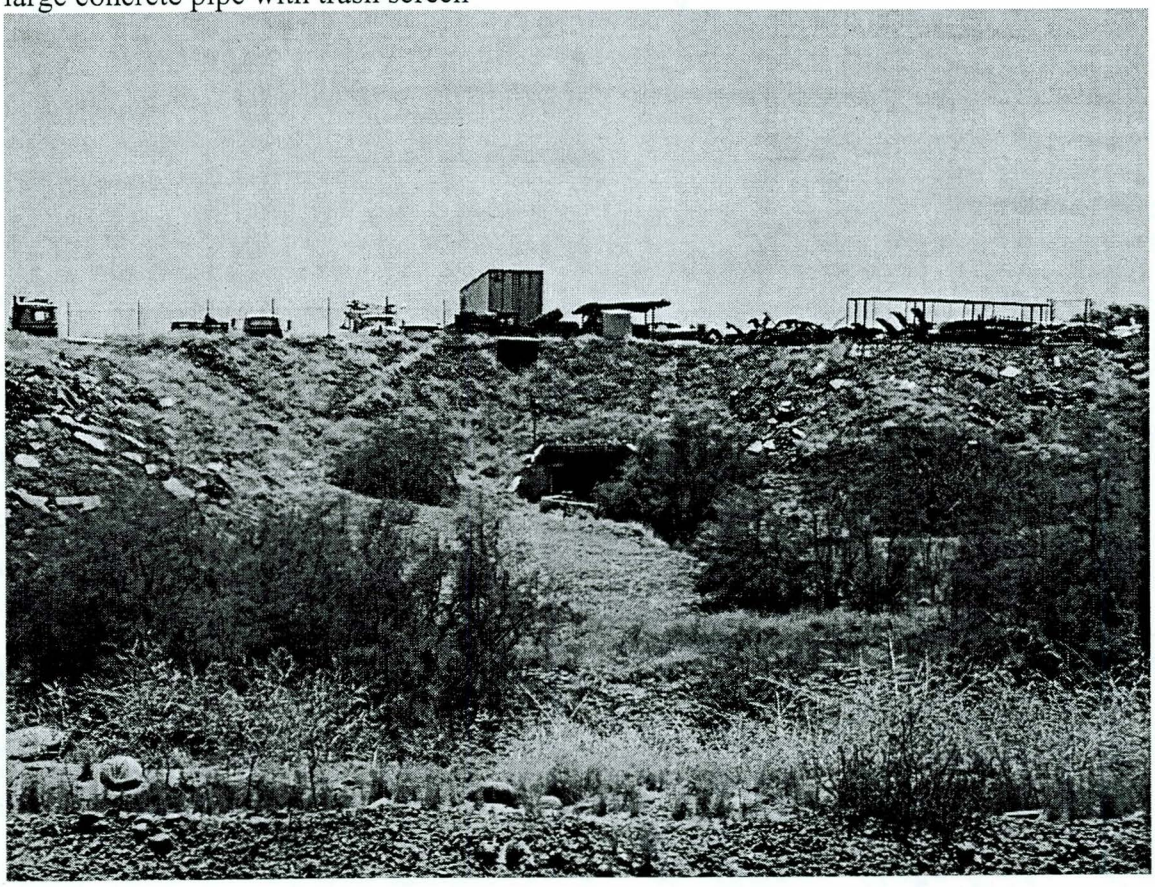


SR 03 35th Avenue and Salt River—North Side
Flowing water and pond
Good vegetation including cottonwood, palo verde, willow, and cattails

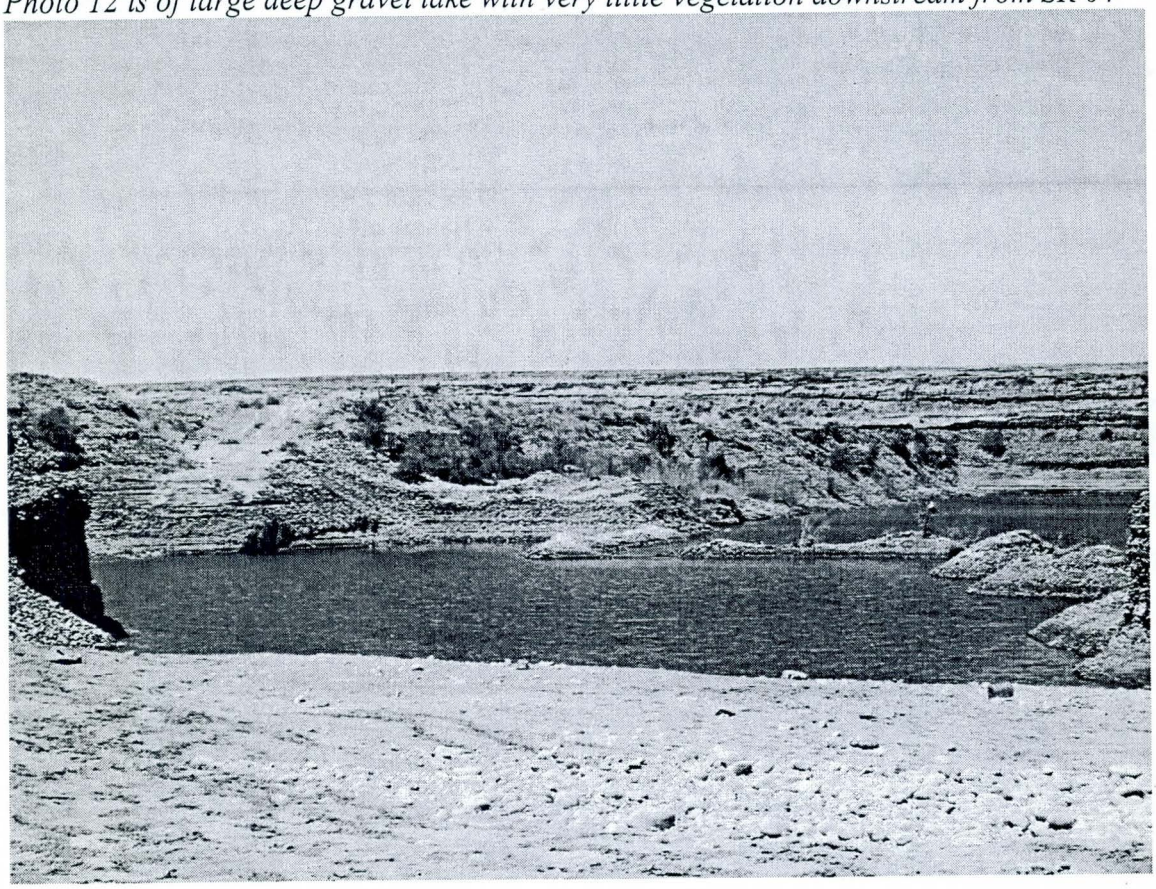
SR 30

27th Avenue and Salt River—South Side

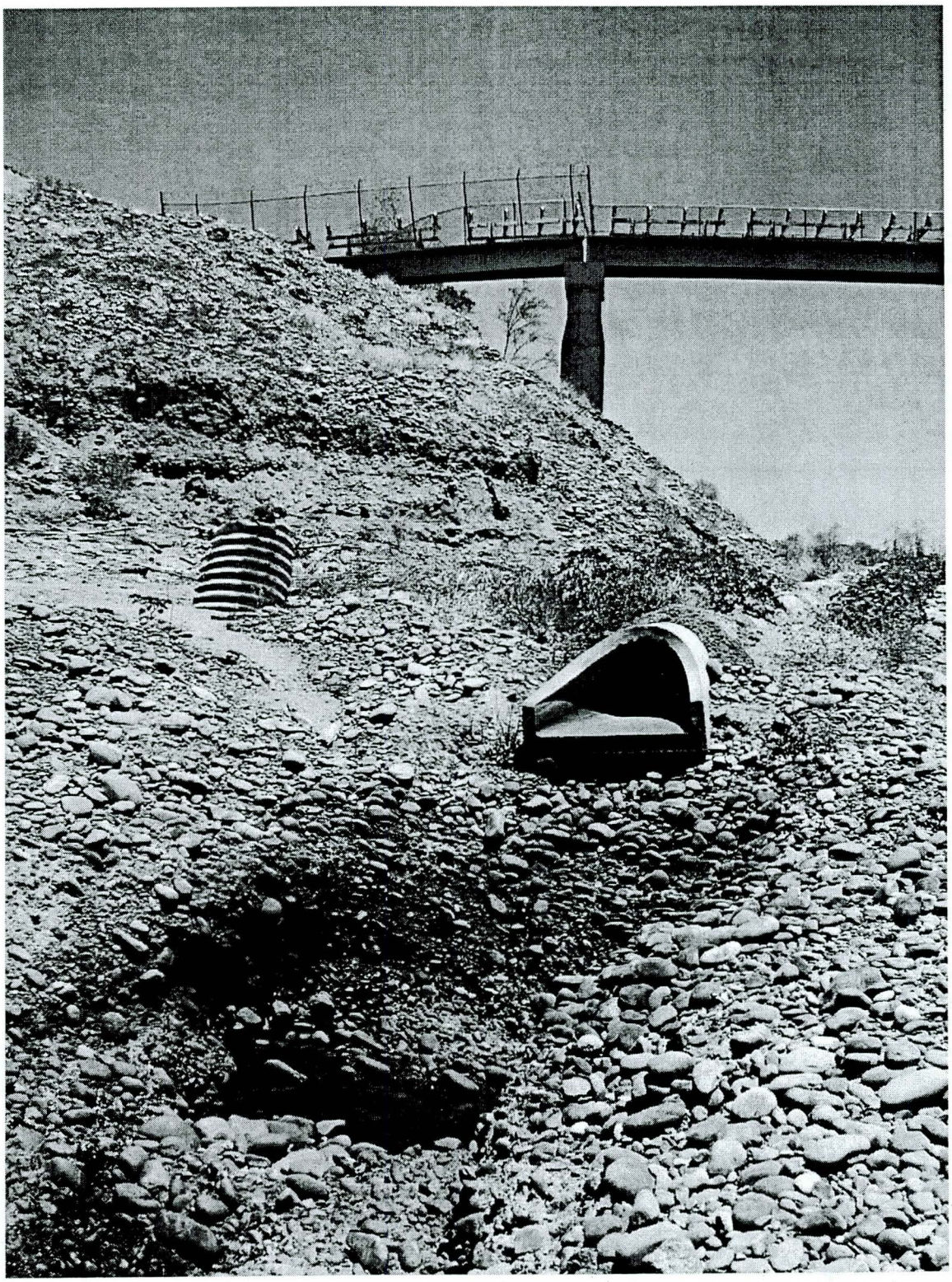
large concrete pipe with trash screen



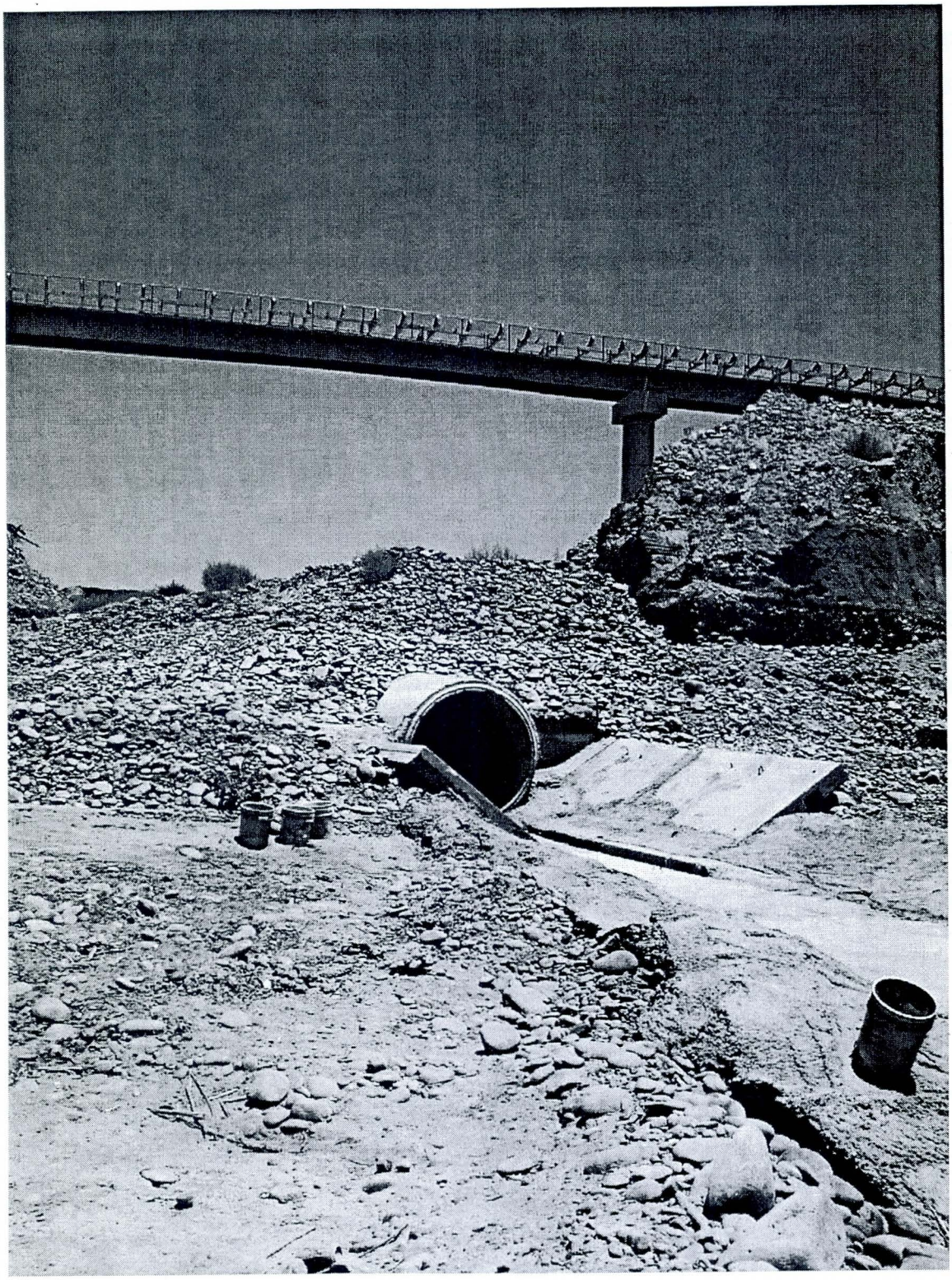
SR 04 27th Avenue and Salt River—North Side
flowing water north of River channel, directly adjacent to gravel mining operation
Photo 12 is of large deep gravel lake with very little vegetation downstream from SR 04



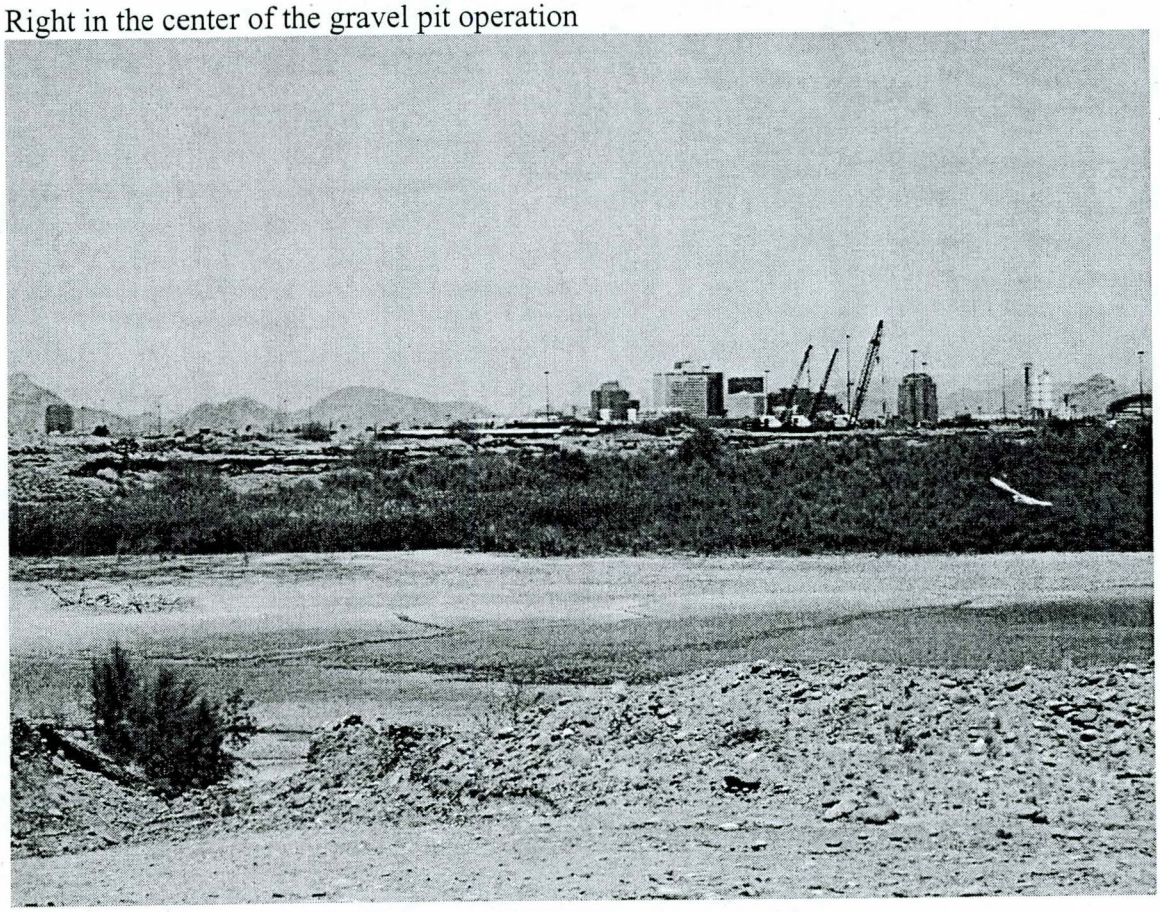
Sand and Gravel drain north side west of conveyer



Sand and gravel culvert, south west of conveyer



SR 05 25th Avenue and Salt River—North Side
couldn't find where the outfall started, but we think we found where both SR 05 and 06 empty into large gravel pit with deep water
Think that Photo #8 is a large open water wetland cause from the outfall.
Right in the center of the gravel pit operation



SR 06
22nd Avenue and Salt River—North Side
same as SR 05, we think we may have found where water empties, but couldn't determine exactly where the water originated.

SR 07 19th Avenue and Salt River—North Side
large round concrete culvert with trash screen
small communities of plants (reeds, cattail, etc)
a little flowing water