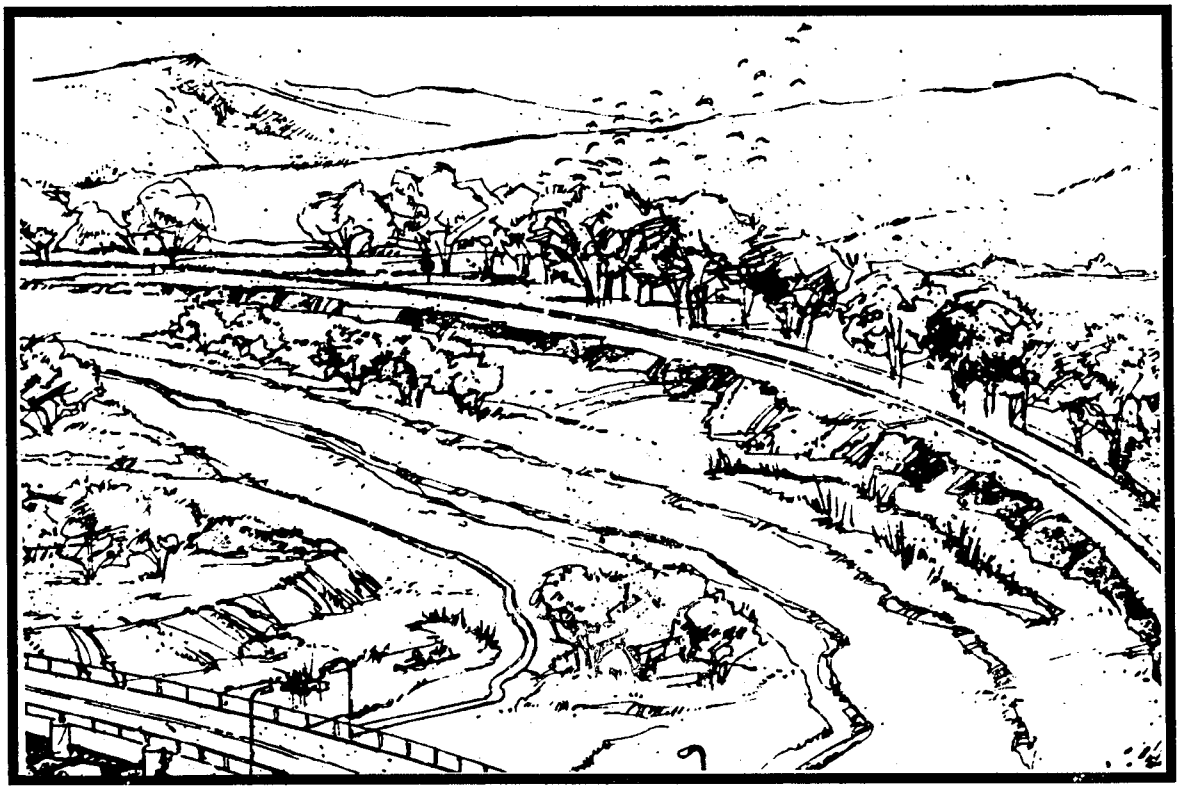
DICK PETRBAULT
6/97

RIO SALADO

FEASIBILITY REPORT



SALT RIVER, ARIZONA

Documentation in Support of F4 Milestone

US ARMY CORPS
OF ENGINEERS
Los Angeles District
South Pacific Division

MAY 1997

RIO SALADO, SALT RIVER, ARIZONA

General Investigations
F4 Package
May, 1997

US Army Corps of Engineers
Los Angeles District
Planning Section C
3636 North Central Avenue, Suite 740
Phoenix, Arizona 85012-1936

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SECTION 1

Study Authority

This report presents the findings of a feasibility study of the Rio Salado, Salt River, Arizona. The Salt River is a significant tributary to the Gila River in the state of Arizona. A location map of the water shed is presented in Figure 1-1. This study has been conducted under the authority given in Public Law 761, Seventy-fifth Congress, known as Section 6 of the Flood Control Act of 1938. This authority, dated June 28, 1938, states "the Secretary of War (now Secretary of the Army) is hereby authorized and directed to cause preliminary examinations and surveys . . . at the following localities: . . . Gila River and tributaries, Arizona . . .".

Congress added renewed commitment to providing authority for the Corps to review prior reports in the State of Arizona by adopting House Resolution 2425. HR2425 states that "the Secretary of the Army is requested to review reports of the Chief of Engineers . . . . . .in the interest of environmental protection and restoration and related purposes." A copy of HR2425, adopted on May 17, 1994, is included as Figure 1-2.

Initial funding to begin a General Investigations, two-phase study were appropriated under the 1994 Senate Energy and Water Development Appropriations Bill. In this Bill, Congress directed the "Corps of Engineers to conduct a . . . study to investigate flooding and water quality problems in the Rio Salado area of the Salt River in Tempe and Phoenix. The study should consider water quality, recreation, and restoration of riparian habitat benefits as well as benefits traditionally displayed."

The Los Angeles District of the Corps of Engineers completed the first phase of the General Investigations study in March 1995. The results and conclusions of the first, reconnaissance, phase were presented in the Rio Salado, Salt River, AZ Reconnaissance Report, U.S. Army Corps of Engineers, Los Angeles District, South Pacific Division, March 1995. The recommendation of this report was that there was a Federal interest in proceeding to a second, feasibility phase of the General Investigation to explore "environmental restoration with incidental recreation . . . of the Salt River at Rio Salado, Tempe and Phoenix, Arizona". The Corps of Engineers Headquarters certified the reconnaissance report on June 19, 1995 giving the Los Angeles District authority to move into the feasibility phase.

FIGURE 1-2
HR2425

U.S. House of Representatives

COMMITTEE ON PUBLIC WORKS AND TRANSPORTATION

SUITE 2165 RAYBURN HOUSE OFFICE BUILDING
WASHINGTON, DC 20515
(202) 225-4472

COMMITTEE ON PUBLIC WORKS AND TRANSPORTATION
U.S. HOUSE OF REPRESENTATIVES
WASHINGTON, D.C.

RESOLUTION

State of Arizona
Docket 2425

Resolved by the Committee on Public Works and Transportation of the United States House of Representatives, That, the Secretary of the Army is requested to review the reports of the Chief of Engineers on the State of Arizona, published as House Document 331, Eighty-first Congress, First Session; Senate Document 116, Eighty-seventh Congress, Second Session; Senate Document 127, Eighty-Seventh Congress, Second Session; House Document 625, Seventy-Eighth Congress, Second Session, House Document 648, Seventy-Eighth Congress, Second Session; Senate Document 63, Eighty-eighth Congress, Second Session; and other pertinent reports, to determine whether modifications of the recommendations contained therein are advisable at the present time, in the interest of flood damage reduction, environmental protection and restoration, and related purposes.

Adopted: May 17, 1994

ATTEST: NORMAN Y. MINETA, Chair

SECTION 2

PURPOSE AND SCOPE

General Purpose

This feasibility study provides an interim response to the study authority cited in Section 1. The study efforts were directed toward establishing the feasibility of environmental restoration with incidental recreation along the Salt River in Phoenix and Tempe, Arizona.

Specific Purpose

The specific purpose of this feasibility study is to develop alternatives and recommend an implementable solution to the identified water resources problems, i.e. environmental restoration with incidental recreation. This report is intended to be a complete decision document that presents the results of both the reconnaissance and feasibility phases of the General Investigation effort. This feasibility report is intended to accomplish the following tasks:

1) Provide a complete presentation of study results and findings, including those developed in the reconnaissance phase so that readers can reach independent conclusions regarding the reasonableness of recommendations;

2) Indicate compliance with applicable statutes, executive orders and policies; and

3) Provide a sound and documented basis for decisions makers at all levels to judge the recommended solution(s).

Study Scope

The reconnaissance phase of the General Investigation effort broadly covered water resource opportunities along the Salt River between Granite Reef and Gillespie Dams. The reconnaissance study area covered approximately 33 miles, including the metropolitan Phoenix area. The reconnaissance study area is presented in Figure 2-1. The opportunities explored during the reconnaissance phase included flood control, water quality, environmental restoration, and recreation. Upon conclusion of the reconnaissance phase of the study, a Federal interest was found in pursuing detailed feasibility studies of the environmental restoration with incidental recreation opportunities within the 33 mile reach of the Salt River (Reference 1).

The two local sponsors identified in the reconnaissance effort were the Cities of Tempe and Phoenix, Arizona. A key initial activity of the feasibility effort was to work with the local sponsors to identify the study area and focus on the environmental restoration opportunities, including incidental recreation, within the defined study area. Prior studies, reports, and existing information, as identified in Section III, was utilized to the maximum extent possible in identifying the study area.

Upon initiation of the feasibility effort, the entire 33 mile reach studied under the reconnaissance phase was evaluated for potential environmental restoration. As reported in the reconnaissance report, the entire 33 miles has experienced some degree of degradation. However, several areas are continuing to be impacted from sand and gravel mining, channelization, and other man made activities. Additionally, some areas within the 33 mile study area have limited interest from a local sponsor in participation of a cost-shared construction project. Therefore, after discussion with the local sponsors, two specific sites were identified which would be of immediate interest in a cost-shared construction project. Figures 2-2 and 2-3 present the study areas to be included in this study.

To accommodate the Federal and local interest in the long term restoration of the entire 33 mile reach, this feasibility report will provide an interim response, which focuses on the two immediate opportunities areas. The final feasibility report, to be submitted some time in the future, will address the other areas within the 33 mile study area.

Tempe Reach

As stated above, the study area of this interim feasibility report was limited to two specific sites. The first site is located in Tempe, Arizona, on portions of the Indian Bend Wash and the Salt River. This area, hereinafter referred to as the "Tempe Reach" is shown in Figure 2-2. In the Tempe Reach, the Corps of Engineers constructed the outlet channel for Indian Bend Wash from McKellips Road south to the Salt River, a distance of 1.3 miles. The construction was completed in 1977. The completed project consisted of a low flow channel and a terraced bench between two levees. By widening, deepening, and defining the channel, the construction removed an existing mesquite bosque and disturbed native vegetation. After construction, the entire outlet channel was left as bare earth.

The McKellips Road bridge crossing of the Indian Bend Wash is the upstream limit of the Tempe Reach. Existing dumped riprap in the low flow channel serves as the upstream limit. Between McKellips and Curry Roads, a municipal golf course now occupies the lands between the low flow channel and the outside levees. The golf course will remain in place. Restoration will be limited to the low flow channel in this section of Indian Bend Wash.

U. S. ARMY ENGINEERING DISTRICT

CORPS OF ENGINEERS

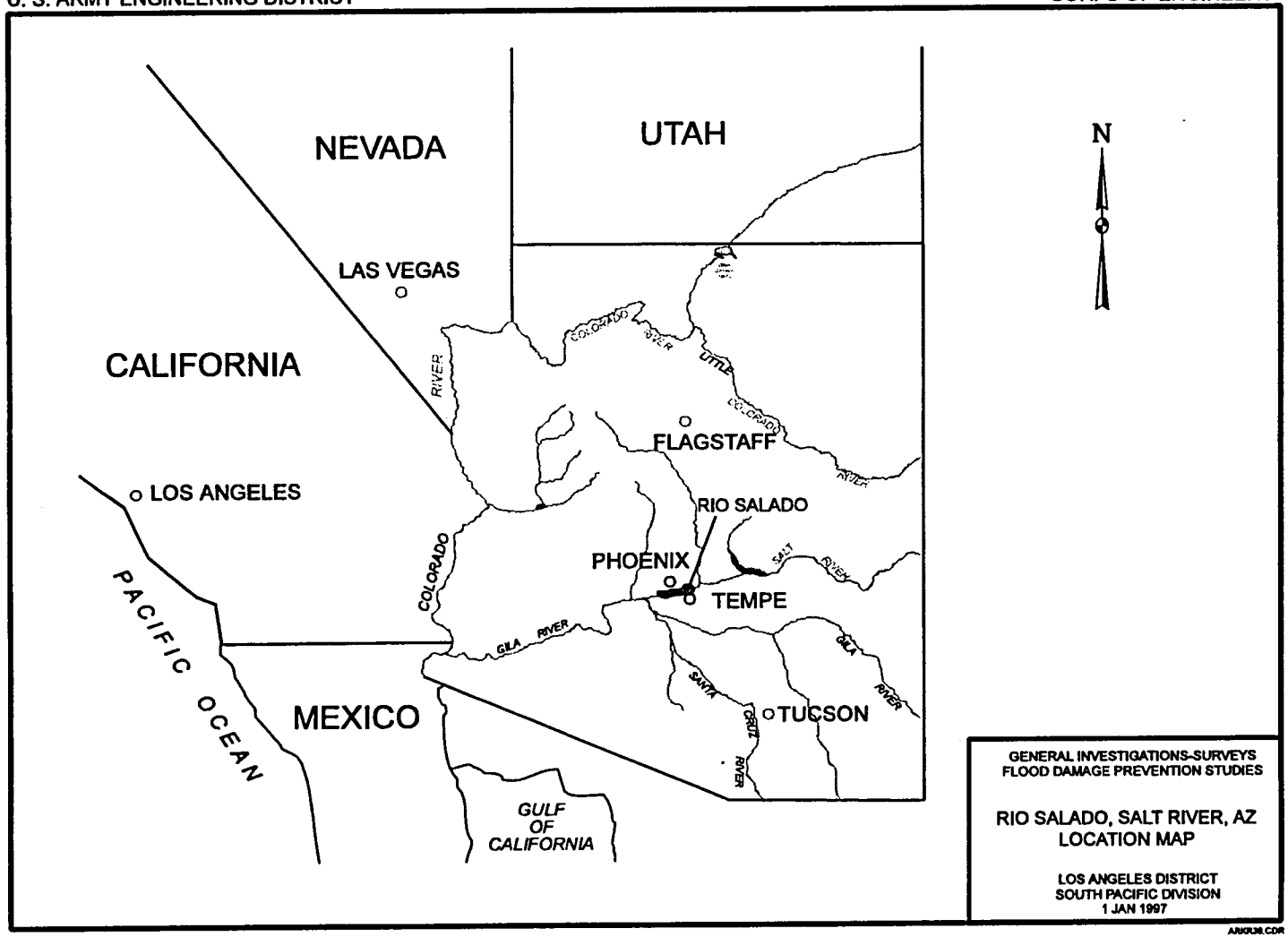
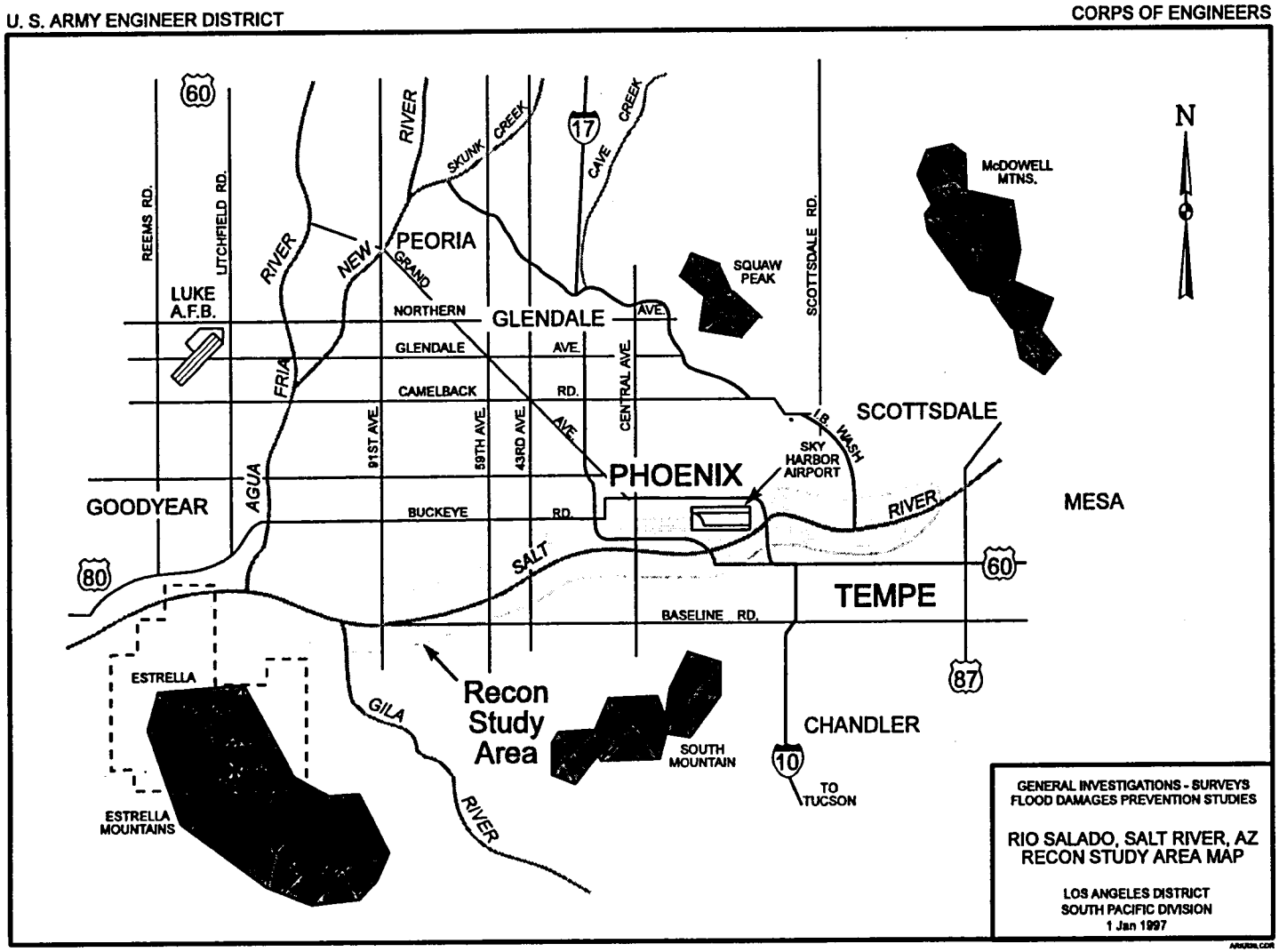


FIGURE 1-1
LOCATION MAP

FIGURE 2-1
RECONNAISSANCE STUDY AREA MAP



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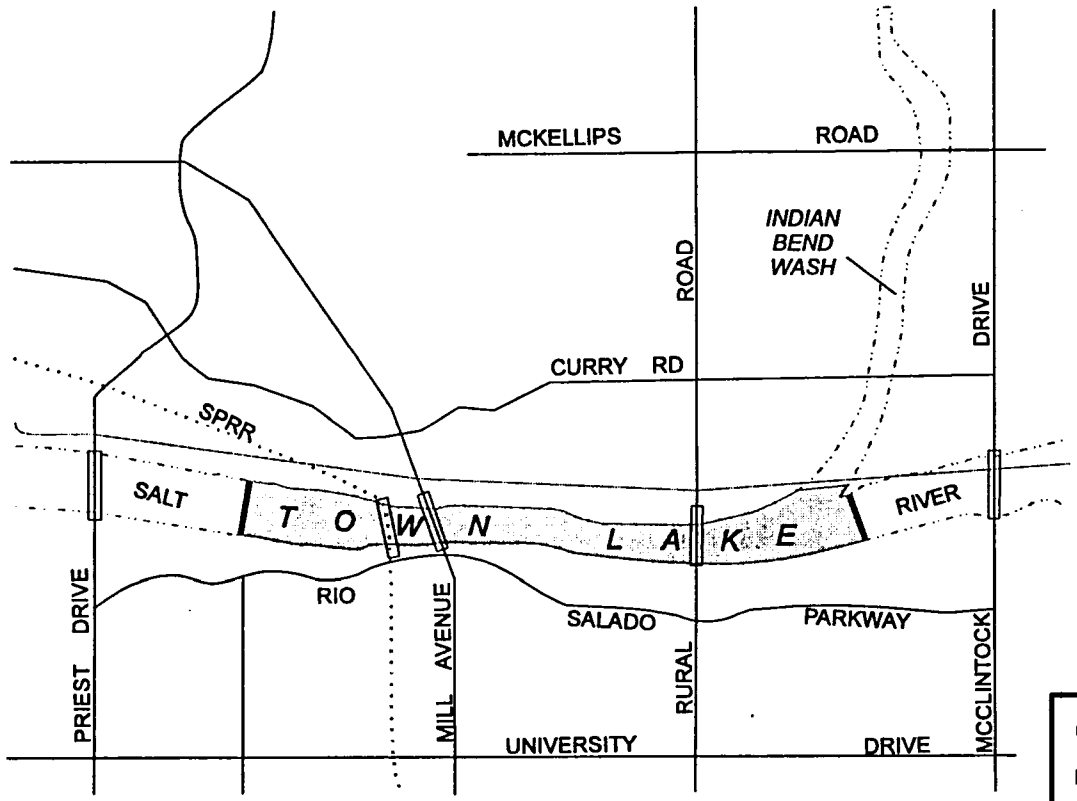
CORPS OF ENGINEERS



GENERAL INVESTIGATIONS-SURVEYS
FISH AND WILDLIFE HABITAT RESTORATION

RIO SALADO, SALT RIVER, AZ
TEMPE TOWN LAKE

LOS ANGELES DISTRICT
SOUTH PACIFIC DIVISION
1 JAN 1997

FIGURE 2-2
TEMPE REACH RESTORATION AREA MAP

Between Curry Road and the Salt River, the low flow channel and the bench between the outside levees remains bare dirt. In this section of Indian Bend Wash, restoration efforts will be examined for both on the bench and in the low flow channel.

The Tempe Reach also includes an area within the Salt River. McClintock Road bridge is the upstream limit of the study area within the Salt River and Priest Drive is the downstream limit. Within the Salt River portion of the study area, construction of Tempe Town Lake is expected to be completed in about two years.

Phoenix Reach

The second site studied in this interim feasibility report is located entirely on the Salt River within the City of Phoenix, Arizona. This is referred to as the "Phoenix Reach". The location of the Phoenix Reach is depicted in Figure 2-3. This portion of the Salt River has also experienced environmental degradation as a result of construction of upstream Federal water projects. In pre-settlement times, the Salt River was one of the few perennially-watered riparian areas of the Sonoran desert with highly productive cottonwood, willow, and mesquite habitats. These areas were rich in habitat diversity, supporting a wide variety of wildlife species. As the lower Salt River Valley became developed, riparian habitat was degraded significantly. The upstream Federal water projects curtailed year-round water flows and converted the once perennial Salt River into a dry river bed devoid of habitat.

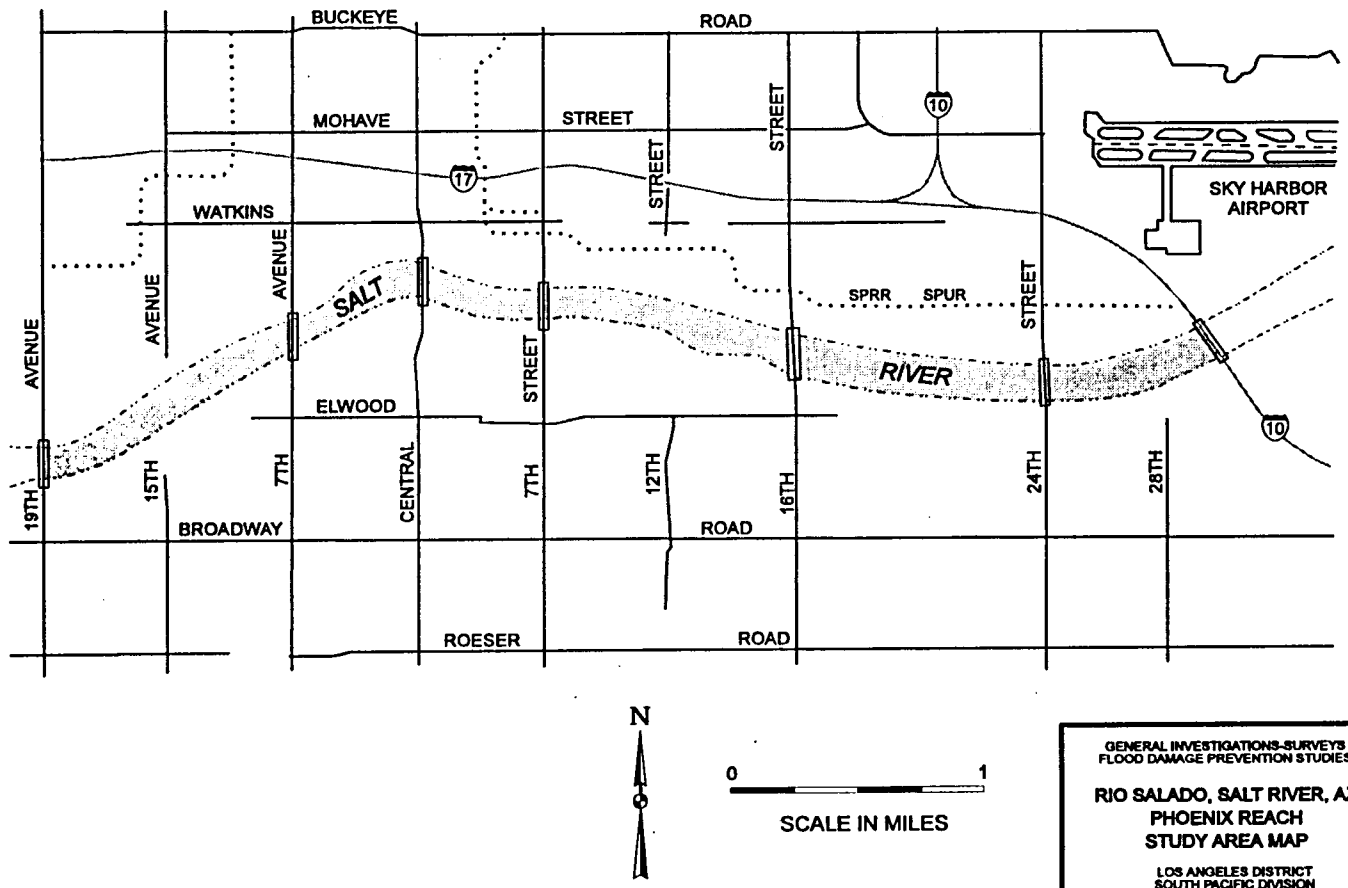
The Interstate 10 bridge is the upstream limit of the Phoenix Reach. A grade control structure on the downstream end of the bridge will serve as the starting point of the project. The 19th Avenue bridge was chosen as the downstream limit. At this location, a superfund remediation project is on-going for the 19th Avenue Landfill which is adjacent to the river. The total distance of the Phoenix Reach is approximately 5 miles. Old landfills and active gravel mining operations are present at many locations adjacent to the Phoenix Reach.

Scope Limitations

The results presented in this report are based on Corps criteria for determining Federal interest in developing and implementing solutions to water resource problems. The information presented in this report is to be used only to determine Federal interest and does not supersede or in any way affect the results of other studies conducted for other purposes.

U.S. ARMY ENGINEER DISTRICT

CORPS OF ENGINEERS



GENERAL INVESTIGATIONS-SURVEYS
FLOOD DAMAGE PREVENTION STUDIES

RIO SALADO, SALT RIVER, AZ
PHOENIX REACH
STUDY AREA MAP

LOS ANGELES DISTRICT
SOUTH PACIFIC DIVISION
1 JAN 1997

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FIGURE 2-3
PHOENIX REACH STUDY AREA MAP

SECTION 3

PRIOR STUDIES AND REPORTS

The Salt River has been extensively utilized for irrigation since prehistoric times. In the 1800's, settlers reestablished many historic irrigation canals that were constructed by the Hohokam Indians. Since then, the Phoenix metropolitan area has established itself around the river. With a population of nearly 2.6 million people, the river has presented many challenges. Because of this, the problems and opportunities of the Salt River has been studied extensively.

Including the Reconnaissance Report, various agencies and engineering consulting firms have conducted or published over 50 studies and reports on the Salt River since 1980. The topics of the reports or studies include water resources, flood control, recreation and urban development, and environmental assessment. A sample of the prior studies and reports are described by topic below.

Water Resources Type Studies or Reports.

The Maricopa Association of Governments completed an overall conceptual plan for a Salt River redevelopment in 1974 (Reference 2). The plan outlined water use and implementation recommendations and called for specific plans for two demonstration projects.

In 1978, the U.S. Army Corps of Engineers conducted a study which extended along the Salt River from the Gila River confluence to Granite Reef Dam (Reference 3). The study evaluated problems and alternative possibilities relating to flood control, waste water, flood water conservation, fish and wildlife recreation. The study focused especially on the 16-mile reach between 27th Avenue in Phoenix and Country Club Drive in Mesa.

The U.S. Army Corps of Engineers investigated water and related land resources issues in the Phoenix Metropolitan area in 1981 (Reference 4). Issues discussed include water quality, flood-control, water conservation, and Fish and Wildlife enhancement. None of the projects proposed by local agencies, with the exception of flood-control along the Salt and Gila Rivers, were found to warrant Federal interest.

A Rio Salado Development District was created in the late 1970's and early 1980's. Their function was to investigate and implement a regional redevelopment of the Salt River. Maricopa County voters defeated the resolution to create a tax authority for the District. However, the District did conduct several studies. A published memorandum in 1982 provides a basis for the determination of a source of water for the redevelopment project (Reference 5). The memo

identifies potential sources, gives general background on these sources, and provides a preliminary analysis of each.

Water Resources Associates, a private engineering consulting firm, conducted a study which evaluated the potential water sources and flood control options for a regional redevelopment of the Salt River in 1982 (Reference 6). Sources for domestic water include obtaining Central Arizona Project (CAP) allotment, obtaining water rights from surface and groundwater and from lands within the district. The source identified for aesthetic and recreational water was poor quality groundwater. Flood management plans were based on an existing condition scenario and also of an upstream flood control design condition.

Carr, Lynch Associates, a private engineering consulting firm, also conducted a study in 1982 which evaluated the potential water sources and flood control options for a regional project within the Salt River (Reference 7). This study included discussion on the physical structure of the project and its surrounding, the social structure, the economic situation, and water supply and flood-control.

In 1992, the U.S. Army Corps of Engineers completed the Central Maricopa County Reconnaissance Study (Reference 8). This study describes and analyzes flooding problems and water resource opportunities within the Phoenix metropolitan area to develop a wide range of alternatives that would reduce the severity, or totally eliminate these problems. Twenty three flooding problems were identified within Central Maricopa County. Two areas determined to have federal interest were a flood control project on the Dysart Drain near Luke Air Force Base, and water quality and environmental restoration project on the Salt River near 91st Avenue. The restoration project was Tres Rios which was not recommended to proceed to the feasibility phase.

The Bureau of Reclamation completed the Conceptual Design for the Tres Rios Demonstration Wetlands in 1993 (Reference 9). The design was completed in cooperation with the City of Phoenix, Arizona Game and Fish, ADEQ, Maricopa County Parks and Recreation, Maricopa County Flood Control District, and the EPA. The study evaluates methods for reclaiming water from sewage effluent from the 91st Avenue regional wastewater treatment plant and develops plans for using the reclaimed water directly or through exchange mechanisms. This report presents a conceptual design for a constructed wetland demonstration project designed to improve the quality of treated effluent currently being discharged to the Salt River.

Arizona State University completed a geomorphic assessment of the Salt River for the U.S. Army Corps of Engineers in 1994 (Reference 10). The assessment supports a reconnaissance-level geomorphologic evaluation of the Lower Salt River and a portion of the Gila River. The study discusses environmental history, hydrologic system, geomorphic system, and engineering features of the Salt River.

The City of Phoenix completed a report in 1994 which summarizes resulting problems and issues that are part of the setting of the present river as it passes through the City (Reference 11). The report includes resources and activities that will be the basis of the area's restoration.

The U.S. Army Corps of Engineers completed the reconnaissance phase of the Rio Salado, Salt River, Arizona in 1995 (Reference 1). The report included an assessment of the problems and opportunities and an evaluation of alternatives for a 33 mile portion of the Salt River. A preliminary environmental assessment and a detailed habitat evaluation of the study reach was included.

Flood Control Type Studies or Reports

The U.S. Army Corps of Engineers prepared a document in 1981 as a result of severe flooding along the Salt and Gila River (Reference 12). The flood damage reduction measures presented include discussion on flood proofing, relocation, floodplain regulations, preparedness planning, channel excavation and evaluation of hydraulic structures.

In 1989, Simons, Li & Associates, Inc, a private engineering consulting firm, prepared a report on the channelization of the Salt River through Tempe, Arizona (Reference 13). The study addresses issues related to channel design, determines appropriate hydraulic design criteria, and presents several alternative design concepts. The engineering analysis includes the evaluation of alternative river sections, alignments and profiles. In addition, the study identifies potential impacts due to the proposed changes.

The U.S. Army Corps of Engineers completed the Salt-Gila Reconnaissance Report in 1989 (Reference 14). This study focuses on the flooding problems and associated solutions downstream from the confluence of the Verde and Salt River to Gillispie Dam. It was determined that no analyzed solution was economically justified, therefore, the study did not proceed to the feasibility phase.

In 1994, the U.S. Army Corps of Engineers completed a bank stabilization study on the Salt River (Reference 15). The study focused on that portion of the Salt River located entirely within the Salt River Pima-Maricopa Indian reservation, east of Scottsdale, and within Maricopa County. Flood events in 1992 and 1993 caused erosion of landfill material into the Salt River. Several flood protection measures and alternatives were considered. The study concluded there was no Federal interest in participating in installation of bank stabilization at this location. With FEMA funding, the Salt River Pima-Maricopa Indian Community initiated construction of bank stabilization of two of the landfill sites which were studied.

The Flood Control District of Maricopa County completed a land use and structures inventory in 1994 (Reference 16). The inventory was published in a report which listed the various

structures, utilities, and land use conditions along the Salt and Gila Rivers from Granite Reef Dam to Gillespie Darn.

In 1996, the U.S. Army Corps of Engineers, in cooperation with the U.S. Bureau of Reclamation, completed the an analysis of various release plans for the operation of the modified Roosevelt Dam (Reference 17). As a result of this effort, new hydrology for the lower Salt and Gila Rivers was developed which showed significant reductions in discharges downstream.

Recreation and Urban Development Type Studies or Reports.

In 1978, the City of Tempe completed a preliminary design study which examined redevelopment alternatives of the Salt River through Tempe, Arizona (Reference 18). The alternatives presented were: 1) limited water facilities with a semi-desert environment, 2) maximum water facilities with a water oriented environment, and 3) a quasi-water oriented environment that envisions less water.

The City of Tempe completed the Rio Salado Plan in 1982 (Reference 19). This document is a guidance for the Tempe City Council and its Boards and Commissions in making decisions concerning development and use for all lands within and bordering the Salt River through Tempe. The plan includes a statement of goals and policies for the improvement, development and use of lands, relationships of various land uses, and description of methods and programs.

In 1983, the Rio Salado Development District completed an economic analysis of the impacts that a redeveloped Salt River would have on the economy of metropolitan Phoenix (Reference 20). The study quantifies, on an annual basis, new public dollar revenues derived from increased property and sales tax revenues and income generated by a redevelopment project from the sale and/or lease of publicly owned land in the project area. Conclusions from this study indicated that over a fifty year period, redevelopment of the Salt River corridor would provide $7.6 billion in public revenues and $2.4 billion in private benefits to the metropolitan region and the State of Arizona.

Carr, Lynch Associates, a private engineering consulting firm, completed a master plan for a regional redevelopment of the Salt River corridor in 1985 (Reference 21). The Master Plan involves a major reclamation of nearly 10,000 acres of land, including transformation of the present riverbed into a regional park, development of its banks, cultural and educational uses. This master plan document was never implemented.

Arizona State University College of Architecture & Environmental Design prepared a companion document to the City of Tempe Rio Salado Master Plan in 1988 (Reference 22). The ASU document combined development, organized sporting events, environmental concerns, economic interests and others to help guide future redevelopment initiatives.

In 1989, the City of Phoenix completed a South Village Redevelopment Plan (Reference 23). The plan established that redevelopment activities in this area of Phoenix must begin with rehabilitation and redevelopment of the Salt River as it passes through Phoenix.

In 1991, the City of Phoenix Planning Department completed an estimate of what the City would be like in the year 2015 (Reference 24). The estimate included discussion of the future role of the Salt River.

In 1992, CH2MHill, a private engineering consulting firm, completed an engineering analysis for the City of Tempe (Reference 25). The report presents the findings of a one-year study of engineering feasibility of creating a recreation lake as part of the a redevelopment of the Salt River corridor through Tempe. Alternative methods of lake construction, alternative projects for protecting the lake from runoff, and alternative water supplies were presented in the report.

CH2MHill completed a second document on a recreation lake for the City of Tempe in 1992, (Reference 26). This document continues the examination of the feasibility of a recreation lake within the Salt River in Tempe. The study includes information regarding the hydrogeology of the lake site and lake feasibility. The study discusses how much water is required to create and sustain a lake in the Salt River channel. The preferred lake alternative has a water surface of approximately 165 acres. The construction cost ranges from $18,600,000 to $23,600,000.

The City of Tempe completed a draft master plan of the public art and events to be displayed or held within the area redeveloped along the Salt River (Reference 27). This document includes an assessment analysis and recommendations regarding three primary areas of interest: public art, cultural facility development, and cultural animation including festivals, exhibitions and special events.

In 1994, the City of Tempe completed an economic impact analysis of a redevelopment project centering around a recreation lake and commercial developments only within Tempe (Reference 28). This economic analysis updated information previously presented in the analysis of the regional redevelopment created by the Rio Salado Development District in 1983. The updated Tempe report analyzed the one-time economic impact of constructing all redevelopment features including the recreation lake, and the effect of the redevelopment on the existing businesses in Tempe. If the entire redevelopment master plan is constructed, total construction costs including commercial buildings was estimated to be $952,800,000.

The City of Phoenix conducted an economic analysis in 1994 (Reference 29). The analysis included a listing of development activities necessary to initiate and sustain economic development within the Salt River area of Phoenix. The key to redevelopment outside of the river corridor was redevelopment of the river itself.

Environmental Assessment Type Studies or Reports

In 1987, Dames & Moore, a private engineering consulting firm, completed an investigation of the waste sites within the Salt River bed (Reference 30). The study was performed for the Rio Salado Development District. The study area extended completely through the Phoenix metropolitan area. The study recommends a plan for the complete investigation and remediation of waste sites and provides an order-of-magnitude cost estimate for the implementation of the plan. Sixty-three landfills or dump sites were identified. The projected cost for investigation and remediation of waste sites range from $49,500,000 to $90,800,000.

The Arizona Department of Transportation completed an environmental assessment of the impacts due to installation of the Red Mountain Freeway in 1987 (Reference 31). The freeway, since constructed, passes alongside the Salt River from 52nd Street to McClintock Drive in Tempe. The assessment considers the likely impacts and effects of the alterative selected for design, right-of-way acquisition, and construction.

In 1990, Howard Needles Tammen and Bergendoff conducted a mitigation study (Reference 32). This document presents mitigation measures intended to replace habitat losses due to construction of the East Papago Freeway. The mitigation measures proposed in this document have since been constructed.

In 1990, the City of Tempe completed an environmental assessment of the installation of soil cement levees on the Salt River through Tempe (Reference 33). This environmental assessment is a follow-up to flood protection required by the location of the East Papago Freeway. The study area represents the second half of a channelization program that encompasses the Salt River floodplain from the Southern Pacific Railroad Bridge east to McClintock Drive.

SCS Engineers, a private engineering consulting firm, prepared an environmental assessment of three sites along the Salt River for the City of Phoenix in 1993 (References 34, 35, and 36). The sites included an area on the north bank of the river between 10th and 16th Streets and two areas on the south bank of the river between Central and 16th Street. These site screening studies were performed to obtain information regarding environmental concerns that may impact redevelopment of the sites. The assessments concluded that the areas contained evidence of old land filled areas and it was recommended that further field investigation be performed to evaluate the potential presence of contaminants. The additional investigations never took place.

As a part of the Rio Salado Reconnaissance Study, the U.S. Army Corps of Engineers completed an environmental evaluation in 1994 (Reference 1). The evaluation presents a brief synthesis of present conditions, active and passive location of landfill sites, potential mitigation of upper aquifer contamination, preservation and/or reconstruction of ecological habitats and potential opportunities for water resources recreation based on demand and economic feasibility. The study area covered 33 miles of the Salt River through the metropolitan Phoenix area. Included in

the evaluation was a field reconnaissance conducted to determine the present habitat values of the vegetation within the Salt River. A total of 29 sites were assessed during the field study.

EXISTING WATER PROJECTS.

Salt River Project System

Flows in the Salt River are controlled by a series of upstream dams built by the Bureau of Reclamation (BOR) and operated by the Salt River Project (SRP). The SRP system is comprised of six reservoirs and seven dams on the Salt and Verde Rivers as shown on Figure 3-1. The dams include Roosevelt Dam, Horse Mesa Dam, Mormon Flat Dam, Stewart Mountain Dam, Granite Reef Dam on the Salt River. On the Verde River, the dams are Horseshoe Dam and Bartlett Dam. The reservoirs receive runoff from a combined watershed of more than 12,600 square miles.

Roosevelt Dam is the oldest and largest in the SRP system. It was originally authorized by Congress in 1903 for water supply and power generation. The construction of the dam was completed in 1911. In 1978, Congress authorized the modification of Roosevelt Dam. The modifications were to include a new storage allocation for flood control. The modifications to the Dam began in 1989 and were completed in 1996. The Dam is expected to be operated under a new Water Control Manual (Reference 17) beginning in 1997.

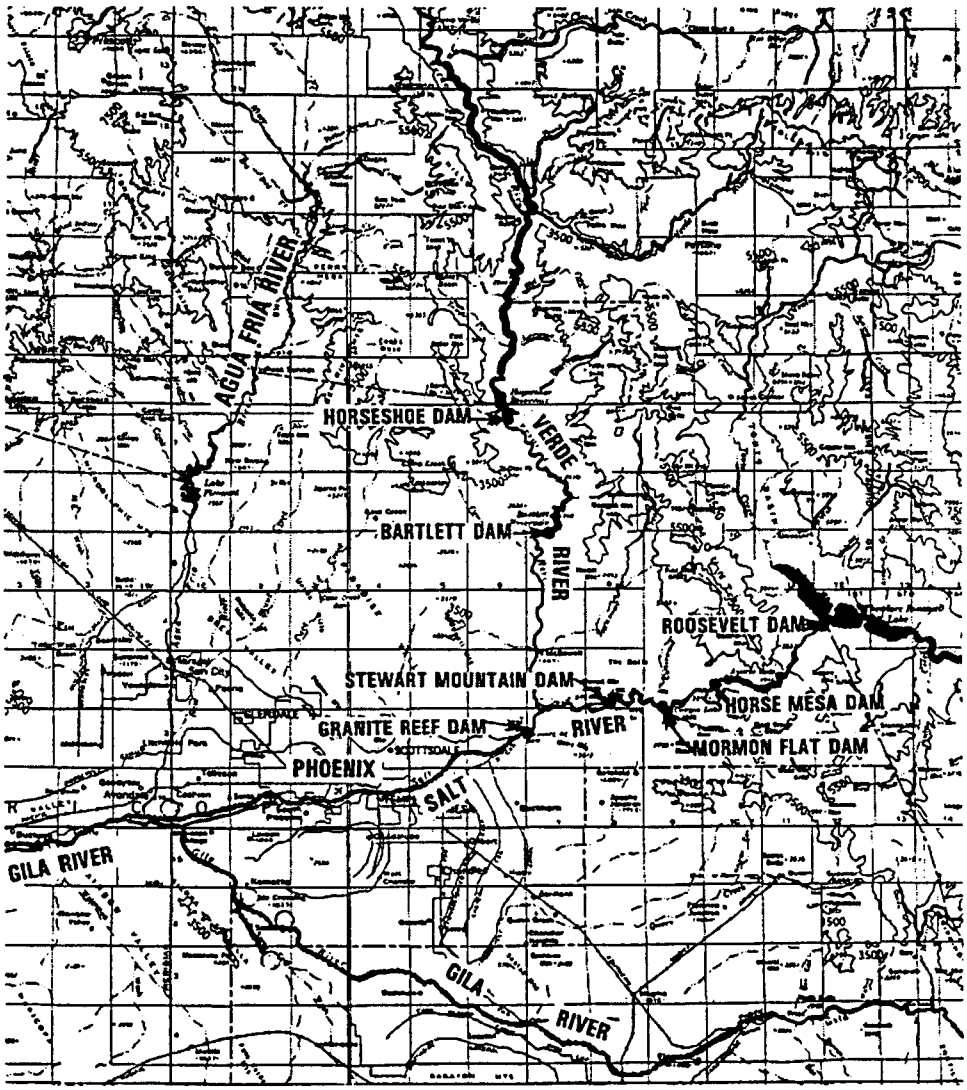
Indian Bend Wash.

In the Flood Control Act of 1965, the Corps of Engineers was authorized to construct the Indian Bend Wash Flood Control Project in Scottsdale and Tempe, Arizona. The construction of the project began in 1973 and was completed in 1982. The project included an inlet, collector and side channels, a siphon, a greenbelt floodway, and an outlet channel. The location of the project features are depicted on Figure 3-2.

The inlet is an earthen channel from Indian Bend Road south to McDonald Drive. The inlet collects flood flows and conveys them into the greenbelt floodway. A series of collectors and side channels collect flood waters that once were impounded behind the north bank of the Arizona Canal and conveys them into the earthen inlet. The greenbelt floodway is 7 miles long and varies from 480 to 1,100 feet wide. It extends from McDonald Drive south to McKellips Road. The greenbelt includes parks, golf courses, fishing lakes, trails and other recreational features. The outlet channel extends 1.3 miles from McKellips Road south to the Salt River.

FIGURE 3-1
SRP SYSTEM MAP

U.S. ARMY ENGINEER DISTRICT CORPS OF ENGINEERS



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GENERAL INVESTIGATIONS-SURVEYS
FLOOD DAMAGE PREVENTION STUDIES

RIO SALADO, SALT RIVER, AZ
SRP SYSTEM LOCATION MAP

LOS ANGELES DISTRICT
SOUTH PACIFIC DIVISION
1 JAN 1997

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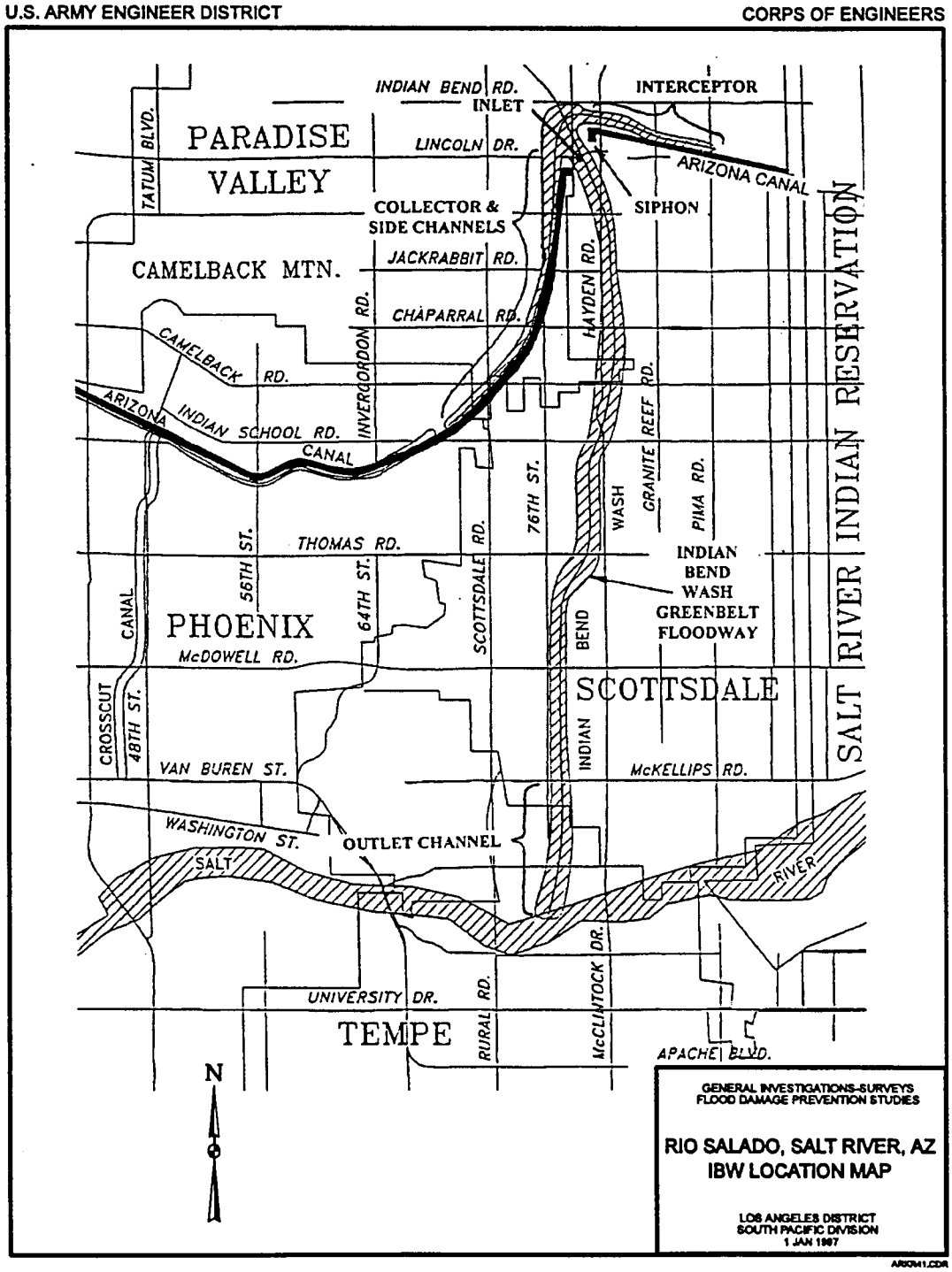
FIGURE 3-2
INDIAN BEND WASH FEATURE MAP



Tres Rios Demonstration Project

The Phoenix Metropolitan area is serviced by a regional wastewater treatment plant located at 91st Avenue and the Salt River. The plant discharges approximately 154 million gallons per day (mgd) of effluent to the Salt River. The treatment plant is operated by the City of Phoenix on behalf of the Multi-City Subregional Operating Group (SROG). SROG represents a consortium of cities including Phoenix, Mesa, Glendale, Tempe, Scottsdale, and Youngtown.

3-43. In 1992, the BOR was authorized by Sections 1605 and 1608 of Public Law 102-575 to participate in the development of a demonstrations wetlands project at the 91st Avenue plant. In 1995, the SROG and the BOR built the Tres Rios Demonstration Project within the floodway of the Salt River below the 91st Avenue plant. The location of this project is shown in Figure 3-3. The Tres Rios project provides final treatment of approximately 2 mgd of effluent. The project consists of 10 acres of constructed wetlands. The City of Phoenix and the BOR operated and monitor the wetlands, collecting water quality readings, water use readings, and plant and animal counts.

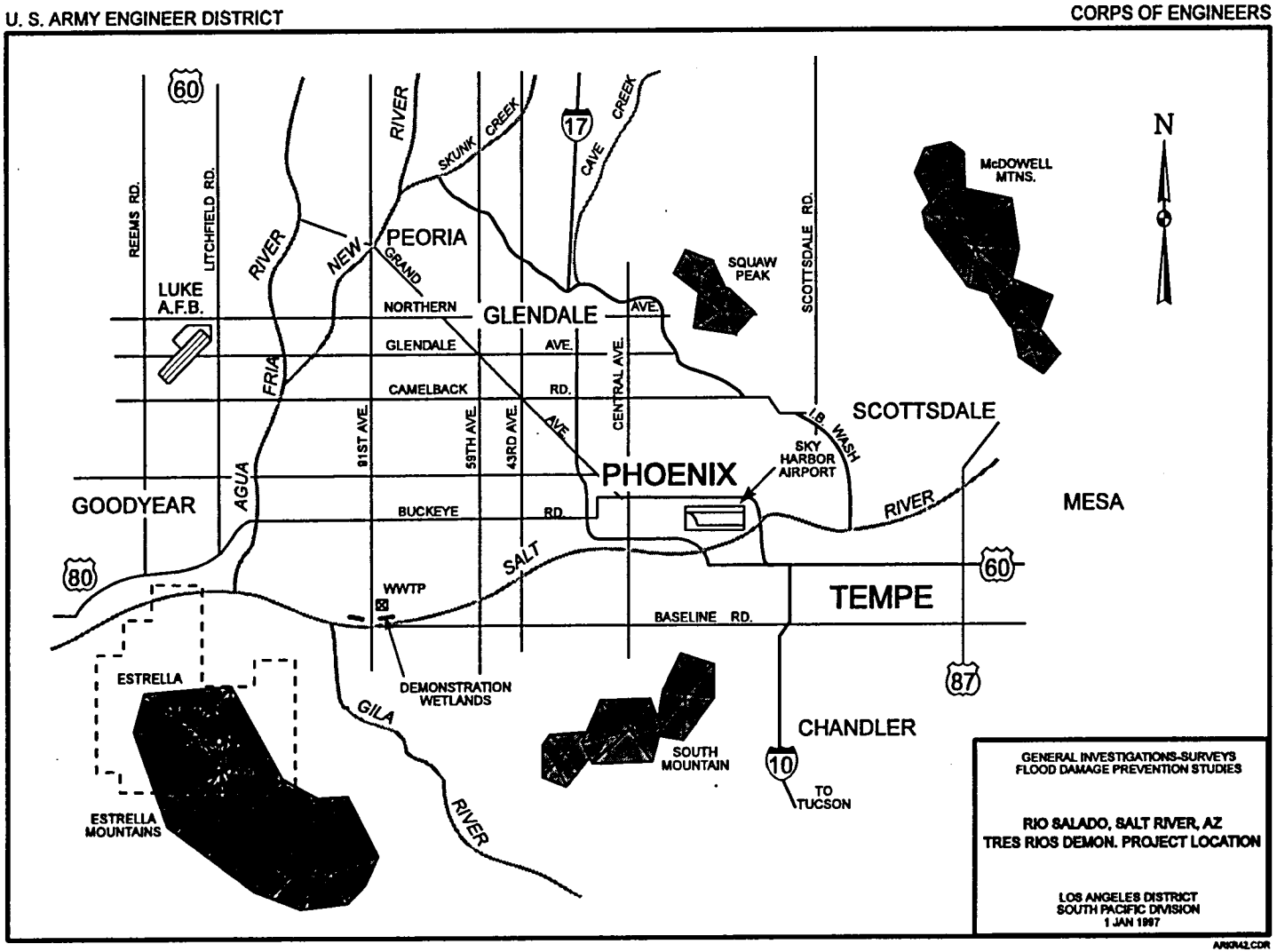
Salt River Channelization

In 1996, the Arizona Department of Transportation (ADOT) and the Maricopa County Flood Control District (MCFCD) completed channelization of the Salt River from 48th Street to Price Road, a distance of approximately 7.5 miles. The channelization included soil cement and gabion bank protection with grade control and drop structures. The channelization is designed to convey flood waters and eliminate erosion and channel migration. The design capacity is 250,000 cfs with one foot of freeboard at Rural (Scottsdale) Road bridge. The construction also included a construction of a defined confluence with Indian Bend Wash.

Tempe Town Lake

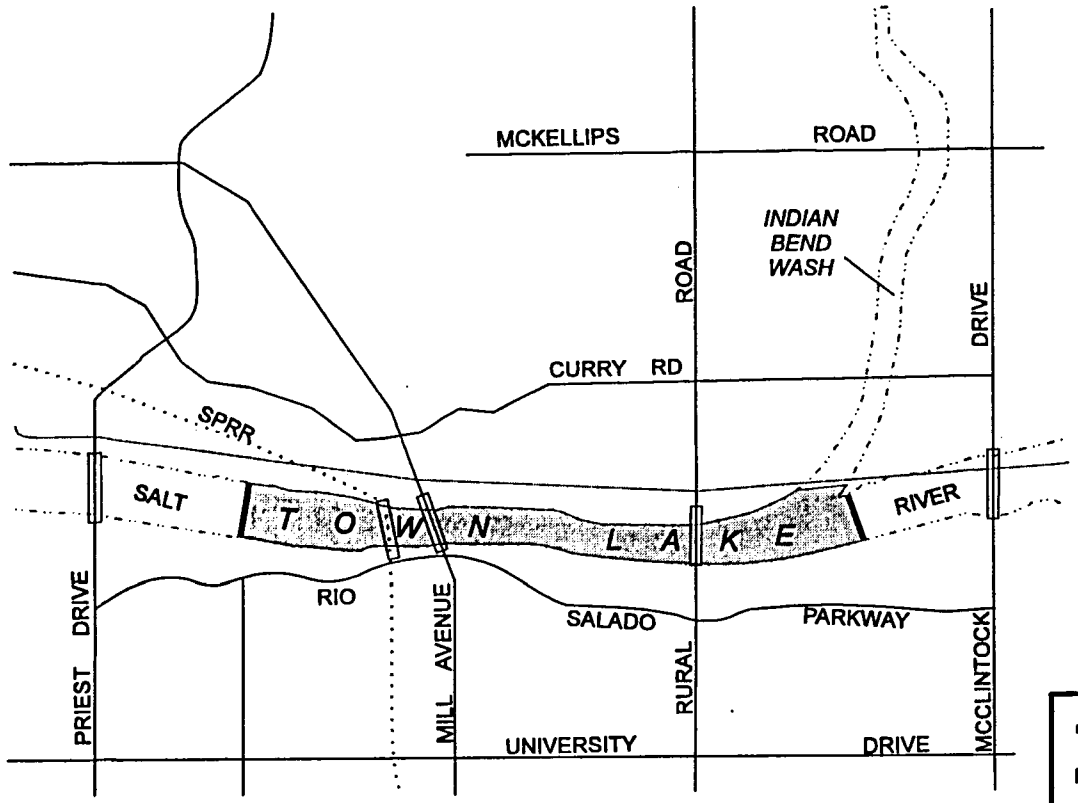
The City of Tempe, together with private developers, are proceeding with construction of Tempe Town Lake. The location of Town Lake is presented in Figure 3-4. The project will include installation of two inflatable dams within the Salt River bed. The dams are located approximately two miles apart at the Center Parkway alignment and just upstream of the confluence with Indian Bend Wash. The dams will contain a 200 acre lake that is approximately 600 feet wide with an average depth of 12 feet. The lake will contain approximately 3,500 acre-feet of water. The project features also include an extensive seepage control system which consists of multiple ground water pumps. As the lake infiltrates into the river bed, the pumps will recover the water and place it back into the lake. Together with a small amount of make-up water, the recovery system will keep the lake water surface at a constant elevation.

FIGURE 3-3
TRES RIOS DEMONSTRATION PROJECT LOCATION MAP



U.S. ARMY ENGINEER DISTRICT

CORPS OF ENGINEERS



GENERAL INVESTIGATIONS-SURVEYS
FISH AND WILDLIFE HABITAT RESTORATION

RIO SALADO, SALT RIVER, AZ
TEMPE TOWN LAKE

LOS ANGELES DISTRICT
SOUTH PACIFIC DIVISION
1 JAN 1987

FIGURE 3-4
TEMPE TOWN LAKE

Tempe Town Lake has not been constructed as of the writing of this F3 package. However, the City of Tempe indicates that the construction of the lake will begin in 1998. Land acquisition for the lake is nearly complete. A financing plan is in place. A manufacturer for the inflatable dams has been chosen. And final plans and specifications have been completed. Therefore, for the purposes of this Interim Feasibility Report, Tempe Town Lake is assumed to be in place for the purposes of establishing the without project condition.

SECTION 4

PROBLEMS AND OPPORTUNITIES

HISTORICAL CONDITIONS

The Salt River

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

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

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

The bottom lands of the Salt River supported a variety of vegetation, including trees, shrubs, marsh plants, and some grasses. Large cottonwood, willow, and alder trees grew along the margins of the river, and mesquite, greasewood, palo verde, and sagebrush covered the low terraces. Dense mesquite and other shrubs made crossing the bottom land impossible in places, while in other locations the vegetation was more scattered. There were several species of fish in the waters, similar to those found in the Gila River.

Large, dense mesquite forests or bosques are found along abandoned lakes, lake edges and river flood plains in southern Arizona. Mesquite bosques were once the most abundant riparian type in the Southwest. Most modern mesquite bosques are large (typically one mile long and 600 feet wide), but these are small compared to pre-development bosques which extended for miles. Mesquite bosques usually are found on the drier habitat types within the riparian continuum. The locations for this setting are flood plains or low terraces several yards above the stream bed, and up to 45 feet above the water table.

Indian Bend Wash

Historically, Indian Bend Wash contained abundant mesquite trees. Several areas included high quality, undisturbed, mesquite bosque communities that provided excellent riparian habitat. The wash did not flow perennially, thus cottonwoods and willows were not found along its length. The infrequent flows in the wash were a result of storm water that traveled off the alluvial plains to the wash by sheet flow. Soils were extremely fine grained and little stream meander or backwater areas existed.

At the confluence with the Salt River, the wash entered the river in an upper terrace of the river. Today, the bed of the wash is nearly 30 feet higher in elevation than the Salt River at the confluence. Being an upper terrace to the river, the confluence area also received some overland flood flows from the Salt River. The confluence area was particularly abundant in mesquite trees and served as an important habitat site for both the Salt River and the Indian Bend Wash. From this location, animals and birds could use either riparian corridor to migrate for food and water.

EXISTING (WITHOUT PROJECT) CONDITIONS

Beginning in the early 1900's, the historical conditions of the Salt River and Indian Bend Wash (IBW) were radically altered by man-made activities, including two significant Federal water projects. First, the U.S. Bureau of Reclamation constructed the Salt River Project (SRP) system, a series of dams in the Salt and Verde River watersheds. The water supply and hydropower benefits that the dams provided led to the economic development of the Phoenix metropolitan area. 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 2.6 million people. Despite the economic success of the SRP project, environmental impacts have resulted in the Salt River downstream.

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 river bed 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.

The second Federal project which contributed to the change in the historical conditions in the Salt River and Indian Bend Wash was the Indian Bend Wash flood control project. In the 1960's, urbanization in the area near IBW necessitated a flood control project on the wash. In response, the Corps of Engineers completed constructing the Indian Bend Wash project in the early 1980's. Although the wash itself and the surrounding area was encroached upon by urbanization and agriculture, the construction of the flood control project wiped out the remaining mesquite vegetation. In the confluence area with the Salt River. In its place, the 1.3 miles of IBW from McKellips Road to the confluence with the Salt was left barren earth. Only two mesquite trees survived the construction. Today, an important area linking two potential wildlife corridors remains barren amongst the surrounding urban areas.

The environmental impacts of the SRP system and the Indian Bend Wash Federal water projects on the historical conditions of the Salt River and Indian Bend Wash were significant. Additional man-made activities have led to a multitude of environmental problems within the two study reaches. The existing conditions in the Salt River and Indian Bend Wash are summarized in the following sections. Additional information on the various topics can be found in the Appendices to this Interim Feasibility Report.

Geology and Geomorphology

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

The Lower Salt River is associated with three pediment-inselberg complexes in the surrounding terrain: Spook, Papago and Bush Pediments. A pediment is usually an erosional ramp-like feature. It is a common feature found in most of the semiarid regions of the world. Pediments form at the base of mountains or extend outward from the base of an inselberg. The term inselberg refers to an isolated hill of solid rock.

Pediments can be characterized by two relatively easily identifiable qualities: (1) well-defined "break in slope" (a severe gradient change) between the pediment surface and the inselberg hill slope of the same rock type and (2) a bedrock surface, in some cases covered with a layer alluvium not more in thickness than 1 /100 of the width of the pediment. Geomorphologists are still uncertain as to how pediments form. One theory suggests that pediments are relic features formed when the climate was different and have not been altered since then. Another theory

suggests that pediments are caused by deep weathering of rock during moist periods followed by striping of the weathered material by erosion. Regardless of their formation processes, the slopes along the Lower Salt River appear to supply the river directly with small amounts of sediment compared to the direct fluvial inputs.

From Granite Reef Dam to the City of Tempe, the surrounding geology north and south of the river changes from bedrock outcroppings to valley fill and alluvium. Valley fill has been accumulating since the onset of the basin and range formation, so that in many portion of this reach of the river the fill is greater than 1000 feet deep. The underlying bedrock surface is below sea level in many areas. The valley fills tend to be more coarse near the mountain fronts, and more fine in the interior of the valley. Near the Salt River, the valley fills have been eroded as the river formed terraces during its evolution.

Most of the interior valley floor is covered by coarse to fine grained alluvium. This material has been continuously deposited by the shifting channels of streams draining the mountains. Sand and gravel, moderately well sorted and stratified, compose the bulk of the deposits left by the Salt River. These deposits are composed of well-rounded clasts and are locally interbedded with silts and clays. The fine sediments are derived from over bank flows.

From Tempe to the Agua Fria confluence with the Gila River, the channel is dominated by valley fills and alluvium. The water table is closer to the surface in the western portion of the study area because of shallow depths to bedrock and because of numerous relatively impermeable clay layers within the alluvium.

The geomorphologic history of the river is characterized by natural scour and fill events, floods, and channel shifts. However, urban development within the study reach has altered the channel from meandering to a straight channel with high banks in several reaches. The channel has shifted within the flood plain several times from the 1880's to present, meandering on the north side of the flood plain during some periods and on the south side during others. Channel shifts have distributed alluvial material across the entire width of the floodplain. The alluvium deposited by the river consists of cobbles, sands, silts and clays from numerous tributary streams within the watershed.

The river is dominated by scour and fill events which degrade the river in some areas and aggrade it in others. The scour and fill transportation of sediment has produced numerous thick deposits within the fluvial system: cobble lag surfaces, sand sheets (macro-forms), channel side bars, mid-channel bars, point bars and over bank deposits. Many of these deposits have recently been disturbed by intensive mining for sand and gravel. Mining of sediments alters later transportation events, by reducing the amount of material that can be transported by removal and compaction, loosening other sediments and sand pits serve as depositional traps for fine sediments.

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

For additional information concerning geology and geomorphology of the two study reaches, please refer to Appendix F, Geotechnical Analysis, and the Addendum to the Environmental Impact Statement (Reference 10).

Surface Water Hydrology

The Salt River is the largest tributary of the Gila River and drains a total area of approximately 13,200 square miles within the northern and eastern portions of the State of Arizona. The Salt River originates on the Eastern portion of the Mogollon Plateau, in the White Mountains, with peaks as high as 11,590 feet. Formed by the confluence of two westward flowing streams, the White and Black Rivers, the Salt drains directly into Modified Roosevelt lake where it is joined by Tonto Creek. The drainage area controlled by Modified Roosevelt Dam, which forms the lake, is approximately 5,800 square miles. The Salt River Project (SRP) operates four dams on the Salt River upstream of the Verde River confluence, including modified Roosevelt Dam as shown on Figure 3-1. Total water supply space behind these dams is 1.9 million ac-ft, with an additional 0.56 million ac-ft for flood control.

The Verde River is the principal tributary of the Salt River. The Verde River flows south from the Chino Valley and joins the Salt River upstream of the cities of Mesa, Tempe, and Phoenix. The Verde drains approximately 6700 square miles and is partially controlled by two water supply dams operated by SRP. The two dams provide a water supply space of 310,000 ac-ft.

Approximately 3 miles below the Verde and Salt River confluence, SRP operates the Granite Reef Diversion Dam. The purpose of this facility is to divert upstream reservoir releases into water supply canals. The canals cris cross the Phoenix metropolitan area furnishing water for agricultural and municipal uses. The total water supply space of the SRP system is 2.8 million ac-ft, not including the amount of water that is stored within the canal system.

Due to the large water supply space behind the SRP dams, the Salt River rarely flows through metropolitan Phoenix. The relative frequency of flow downstream of Granite Reef Dam is about once every three years, on the average, i.e. sustained flow through the project reach might occur during some portions of those years. To place that in perspective, if the current SRP system was operated under the current operation manual (Reference 17), water would have spilled over

Granite Reef dam only 34 times since 1888. Given this infrequency of flow events, Table 4-1 gives an estimated discharge-frequency values of the Salt River in the two study reaches.

TABLE 4-1
Salt River Discharge-Frequency Values

Return Period	Tempe Reach Peak Discharge (cfs)	Phoenix Reach Peak Discharge (cfs)
500-yr	243,000	240,000
200-yr	204,000	202,000
100-yr	169,000	166,000
50-yr	140,000	135,000
20-yr	90,000	87,000
10-yr	55,000	53,000
5-yr	20,500	20,200

Due to the SRP system, flows in the Salt River, when they do occur, do not follow a normally expected bell-shaped hydrograph. The flows do not rise to their peak and then fall to normal levels as the flood wave passes. Rather, when a release is made, the flow in the river is sustained at a certain level for many days. Only after the proper storage level in the SRP system is reached do the releases stop and flow in the Salt River ceases. As such, inundation duration in the Salt River is of prime concern to maintaining habitat within the river. Table 4-2 depicts an expected inundation duration for various discharge frequencies.

TABLE 4-2
Salt River Duration-Frequency Values (cfs)

Freq.	Peak	1-day	3-day	5-day	10-day	30-day	60-day
500-yr	240,000	190,000	100,000	70,000	46,000	25,000	14,000
200-yr	202,000	145,000	75,000	55,000	33,000	19,000	9,000
100-yr	166,000	100,000	60,000	40,000	25,000	15,000	7,000
50-yr	135,000	70,000	40,000	29,000	18,000	10,000	5,000
20-yr	87,000	40,000	22,000	15,000	10,000	5,300	2,800
10-yr	53,000	21,000	11,000	7,000	5,200	2,700	1,400
5-yr	20,200	8,000	3,500	2,100	1,500	800	0

Note: The above values display the discharge exceeded for specified duration. For the 5-yr frequency, a flow rate of 200 cfs is exceeded for 53 days.

Indian Bend Wash (IBW) drains approximately 90 square miles. The watershed is mostly urbanized and includes portions of Scottsdale, Phoenix, and Tempe. The outlet of IBW is the Salt River about midway between McClintock Road on the east and Rural Road on the west, see Figure 3-2. The improved channel was designed to convey a 100-yr discharge of 30,000 cfs. The improved channel also includes a low flow channel which was designed to convey a 5-yr discharge of 4,000 cfs.

Although there is sparse record available, there are no instances during which runoff from IBW did much more than wet the Salt River bed downstream of the confluence. Under most circumstances, water from IBW does not contain sufficient volume nor flow for long enough duration to fill the Salt River channel and flow downstream. However, estimates have been performed which describe how the runoff from the 10-yr and 5-yr events from IBW effect the Salt River. The results are displayed in Table 4-3 below. As shown, the impacts are minimal.

TABLE 4-3
Impact from IBW runoff to the Salt River

Location	Approx 5-yr Peak Discharge	Approx 10-yr Peak Discharge
IBW-Salt River Confluence	4,800 cfs	9,000 cfs
Salt River at Mill Avenue	370 cfs	1,500 cfs
Salt River at Central Avenue	0	140 cfs

Two significant side drains to the Salt River mainstem are the Old Cross Cut Canal and the Tempe Drain. The Old Cross Cut Canal was originally a part of the SRP canal system. Today it serves to drain flood waters to the Salt River just upstream of the Phoenix Reach. The confluence is approximately one-quarter mile west of 48th street on the north side of the Salt River. The drainage area is approximately 17 square miles. The discharge capacity of this side drain is approximately 5000 cfs. The Tempe Drain serves to drain storm water from within the urbanized portion of Tempe. It enters the Salt River from the south, along the west bound lanes of Interstate 10 bridge. The drainage area of the Tempe Drain is approximately 14 square miles. The capacity of the drain is 1100 cfs at 48th Street.

Similar to Indian Bend Wash, the impacts from runoff from the Old Cross Cut Canal and Tempe Drain to the Salt River are expected to be is minimal. The disparity in size (IBW drains about 5 times as much area) as well as the larger Salt River cross section, eliminates anticipated problems from drainage resulting from these two side drains.

There are numerous local side/storm drains which discharge into the Salt River and IBW. In the Tempe Reach, there are 17 side drains varying in size from 36 inches to 18 feet in diameter. The contributing drainage areas range in size from 0.03 to 2.87 square miles. The peak 100-yr discharge from any drain in the Tempe Reach ranges from 25 to 3200 cfs, while the average annual volume is expected to range from 1.7 to 210 ac-ft. All drains discharging into IBW appear to produce insignificant flows. The side drain data in the Tempe Reach is listed in Tables 3-5A and 3-7A of Appendix A, Hydrologic Analysis, of this report. The location of the outfall and the specific sizes of all side drains in the Tempe Reach can be found on Plate 5A in Section XII.

In the Phoenix Reach, there are 34 storm drains varying in size from 15 inches to 21 feet in diameter. The contributing drainage areas range in size from 0.05 to 13.87 square miles. The peak 100-yr discharge from any side drain in the Phoenix Reach is anticipated to range from 37 to 3,730 cfs. The anticipated average annual volume ranges from 2.5 to 900 ac-ft. All side drain data in the Phoenix Reach can be found in Tables 3-5B and 3-7B of Appendix A, Hydrologic Analysis. The location of the outfall and specific sizes of all side drains can be found on Plates 1A through 4A in Section XII of this report.

For additional information concerning surface water hydrology of the two study reaches, please refer to Appendix A, Hydrologic Analysis, of this report.

Surface Water Quality

The Environmental Protection Agency and the Arizona Department of Environmental Quality has set quality standards for surface waters in the Tempe and Phoenix Reaches. These standards vary depending on the designated use of the waterway. The current designated uses for the Indian Bend Wash portion of the Tempe Reach are "Aquatic and Wildlife (warm water fishery)",

"Partial Body Contact", and "Fish Consumption". For the Salt River portion of the Tempe Reach, the designated uses are "Aquatic and Wildlife (ephemeral)", and "Partial Body Contact". The current designated uses in the Salt River in the Phoenix Reach are "Aquatic and Wildlife (warm water fishery)" and "Partial Body Contact". The various water quality standards for the study reaches are given below in Tables 4-4, 4-5, and 4-6.

TABLE 4-4
Surface Water Quality Standards for the IBW Portion of Tempe Reach

	Fish Consumption	Partial Body Contact	Aquatic and Wildlife (warm water fishery) Acute/Chronic
Fecal Coliform (cfu/100ml)		4,000/1,000	4,000/1,000
Arsenic (ppb)	3.1 T	2,800 T	360 D/190 D
Mercury (ppb)	0.6 T	42 T	2.4 d/0.01 D
TCE (ppb)	78		20,000/1,300
PCE (ppb)	11	4,000	6,500/680
TCA (ppb)	160,000	13,000	2,600/1,600
Benzene (ppb)	120	470	2,700/180
Chloroform (ppb)	590	1,400	14,000/900

Note: Standards for Cadmium, Copper, Lead, Silver, and Zinc not shown. No standards for TSS, TDS, Chloride, Fluoride, Nitrate, or DBCP.

TABLE 4-5
Surface Water Quality Standards for the Salt River Portion of Tempe Reach

	Partial Body Contact	Aquatic and Wildlife (ephem.) Acute/Chronic
Fecal Coliform (cfu/100ml)	4,000/1,000	
Arsenic (ppb)	2,800 T	440 D/230 D
Mercury (ppb)	42 T	5 D/2.7 D
TCE (ppb)		20,000/1,300
PCE (ppb)	4,000	15,000/1,600
TCA (ppb)	13,000	2,600/1,600
Benzene (ppb)	470	
Chloroform (ppb)	1,400	

Note: Standards for Cadmium, Copper, Lead, Silver, and Zinc not shown. No standards for TSS, TDS, Chloride, Fluoride, Nitrate, or DBCP.

TABLE 4-6
Surface Water Quality Standards for the Salt River in the Phoenix Reach

	Partial Body Contact	Aquatic and Wildlife (warm water fishery) Acute/Chronic
Fecal Coliform (cfu/100ml)	4,000/1,000	4,000/1,000
Arsenic (ppb)	2,800 T	360 D/190 D
Mercury (ppb)	42 T	2.4 d/0.01 D
TCE (ppb)		20,000/1,300
PCE (ppb)	4,000	6,500/680
TCA (ppb)	13,000	2,600/1,600
Benzene (ppb)	470	2,700/180
Chloroform (ppb)	1,400	14,000/900

Note: Standards for Cadmium, Copper, Lead, Silver, and Zinc not shown. No standards for TSS, TDS, Chloride, Fluoride, Nitrate, or DBCP.

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

Storm runoff in the two study reaches is intermittent and highly variable. Generally, the observed surface water quality from storm drains is of poor quality. Concentrations of bacteria, metals, turbidity, petroleum products, and pesticides have been observed. Fecal coliform commonly exceeds water quality standards.

For additional information concerning surface water quality of the two study reaches, please refer to Appendix A, Hydrologic Analysis, of this report.

Ground Water Hydrology

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

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

The Phoenix AMA is comprised of portions of two distinct but interconnected alluvial groundwater basins, the West Salt River Valley (WSRV) and the East Salt River Valley (ESRV). These two basins are divided by subsurface geologic outcroppings located near Priest Road in Tempe. The Tempe Reach lies in the ESRV basin while the Phoenix Reach lies in the WSRV basin. In general, the ground water in these two basins are moving laterally toward extensive and deep depressions in some of the main aquifer systems. In the ESRV, major ground water

depressions are centered in the Scottsdale-Paradise Valley area, in east Mesa and north of the Santan Mountains. In the WSRV, a major depression is centered near Luke Air Force Base.

Within the two ground water basins, 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 part of the area north of the Salt River. 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 originates from this unit. 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 Phoenix metropolitan area. ADWR estimates that 50 percent of the total pumpage in the valley is from the MAU.

The UAU overlies the MAU and consists primarily of gravel, sand and silt. The amount of coarse-grained deposits 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 dewatering and large areas of poor quality water, only about 25 percent of groundwater pumped in the valley is from the UAU.

In the Phoenix Reach, the current ground water level is estimated to be at 1028 to 1042 MSL. Readings over the past 15 years have indicated that ground water levels in the both study reaches are rising. The current ground water levels shown on Plates 1A through 5A. For additional information concerning the ground water hydrology of the two study reaches, please refer to Appendix A, Hydrologic Analysis, of this report.

Ground Water Quality

When ground water pumping was initiated in the Phoenix metropolitan area in the 1920's, the ground water quality, although high in minerals, was considered to be of very good quality. Today, there are a number of ground water problems in the Salt River Valley. The problems associated with inorganic chemical constituents include high levels of chloride, TDS, nitrates and salinity. The problems associated with trace organic constituents include the pesticide DBCP and volatile halocarbons. Most of the regional problems are currently limited to ground water in the UAU. At this time little data exists with respect to the salinity levels of the water in the near surface aquifers.

Hundreds of incidents of volatile halocarbon contamination have been detected in the Phoenix metropolitan area. Volatile halocarbons are located in shallow ground water beneath several landfills along the Salt River, near industrial facilities, and beneath large sections of land formerly used for agricultural purposes. In some cases, the contamination is limited to plumes in

specific areas and can be associated with specific waste disposal practices, e.g. 19th Avenue and 27th Avenue landfills, or industrial activities, e.g. Motorola/52nd Street or Motorola/Mesa. These plumes are usually well defined and involve small amounts of ground water.

However, a large area of low level volatile halocarbon contamination (5 micrograms per liter) involving larger amounts of ground water has been delineated in the UAU. This area stretches from the Motorola/52nd Street Superfund Site to Sky Harbor Airport, west through downtown Phoenix and through the West Van Buren area, almost 9 miles. This area lies parallel with the Salt River, approximately 1 to 1.5 miles north of the river bed.

Because of high organic and volatile halocarbon concentrations and decreases in the use of land for agriculture, use of the ground water in the UAU for public consumption has dropped significantly. New water supply wells tap the higher quality ground water stored in the MAU or LAU have been replacing the shallow wells for several decades. Much of the shallow ground water is now only suitable for industrial or agricultural purposes. The deeper water is generally unaffected by agricultural and industrial practices and has lower salinity and nitrate concentrations.

For additional information concerning ground water quality of the two study reaches, please refer to Appendix A, Hydrologic Analysis, of this report.

Hydraulic Conditions

Multiple discharges "Without Project" overflow information for both the Indian Bend Wash (IBW) and Salt River was developed using HEC-2 models. The respective models were originally developed by the Michael Baker Jr., Inc. and Simons, Li and Associates companies. In 1996 the Michael Baker company was engaged by the Corps of Engineers to update both of the HEC-2 models specifically for use in this Feasibility effort.

The original Salt River HEC-2 model was predicated on aerial topography that was developed by the Michael Baker company in 1991 and 1993 in support of a 78-mile Floodplain Delineation Study of the Salt and Gila Rivers. The study was generated for the Flood Control District of Maricopa County (District). In order to reassess the study reach for current conditions, it was necessary to update both the City of Phoenix and City of Tempe's reaches (19th Avenue to the I-10 Freeway and Rural Road Bridge to McClintock bridge respectively). Consequently, the Michael Baker company, as stated above, was contracted to update the model. Major revisions to the model included: (1) Salt River channelization consisting of soil cement bank construction completed in 1996 in the vicinity of the 19th Avenue landfill approximately between River Mile Station (relative to the confluence of the Gila and Colorado Rivers) 211+52 to 212+27 including a grade control structure immediately downstream of 19th avenue; (2) March 1996 bank stabilization improvements along the right (north) side and adjacent to the Sky Harbor Airport

between Sta. 216+62 and Sta. 218+24; (3) New SR 153 Bridge in the vicinity of Sta. 218+98; and (4) New grade control structure just downstream of McClintock drive near Sta. 223+02.

Using the updated model for the Salt River, "without project" flood overflow information was developed for the Phoenix Reach bounded between Sta. 211+50 to Sta.216+50. Water surface profiles were determined using the peak discharges of the 5-, 10-, 20-, 50-, and 100-year frequency flood events, as listed in Table 4-1. Additionally, the inundation limits of the 100-yr peak discharge was determined. The 100-yr flood inundation limits are illustrated on Plates 1A through 4A in Section XII of this report.

In general, the "without project" flood overflow analyses for the Phoenix Reach of the Salt River indicated that, apart from in-stream mining operations and a few localized areas of low channel banks, there were minimal impacts to any significant structures; i.e., the 100-year peak flood discharge was well contained within an incised channel system.

There are seven transportation bridges that cross the Salt River in the Phoenix Reach, I-10, 24th Street, 16th Street, 7th Street, Central Avenue, 7th Avenue, and 19th Avenue. Additionally, there are two conveyor belts that are suspended above the river on piers. These lie at the approximate alignment of 12th Avenue and 18th Street. Two grade control structures are located in the Phoenix Reach. One is located just downstream of I-10 and a second grade control structure was installed immediately downstream of 19th Avenue.

In certain areas, the banks of the Salt River in the Phoenix Reach are lined. Gabions are present on the north bank from 3rd Avenue to Central Avenue, 7th Street to 16th Street, and 24th Street to I-10. Gabions are also in place on the south bank between 14th Avenue and 10th Avenue. Soil cement lines both the south and north banks from 19th Avenue to 15th Avenue. Rock has been placed on the south bank from 7th Street to 24th Street. The remaining areas of the Salt River are unlined.

Using the updated model for the Salt River, "without project" flood overflow information was also developed for the Tempe Reach bounded between Sta. 222+50 to Sta. 223+10. The model assumed that the rubber dams containing Tempe Town Lake were deflated so as not to impede flood waters. Water surface profiles were determined using the peak discharges of the 5-, 10-, 20-, 50-, and 100-year frequency flood events, as listed in Table 4-1. Additionally, the inundation limits of the 100-yr peak discharge was determined. The 100-yr flood inundation limits are illustrated on Plate 5A in Section XII of this report.

As with the Phoenix Reach, the "without project" flood overflow analyses for the Tempe Reach of the Salt River indicated that the 100-year peak flood discharge was well contained within an incised channel system. The banks of the Salt River through this reach are made of soil cement. In addition, a drop structure exists immediately downstream of McClintock Road Bridge.

Using the updated model for the Indian Bend Wash, "without project" flood overflow information was developed for the IBW portion of the Tempe Reach bounded between IBW Sta. 0+50 to Sta. 1+60. Water surface profiles were determined using the peak discharges of the 5- and 100-year frequency flood events, i.e. 4,000 cfs and 30,000 cfs, respectively. Additionally, the inundation limits of the 5- and 100-year peak discharge was determined. The 5- and 100-year flood inundation limits are illustrated on Plate 5A in Section XII of this report.

In comparing the original design (100-year) water surface profile for the IBW Outlet Channel (Ref 40), and the results from the updated model, it was determined that there was close agreement. In this particular study reach, other than a golf course, there has been minimal channel improvements since the project was designed and built 20 years ago. The analysis shows that the 100-year flood event is still fully contained within the IBW channel banks.

There are three transportation bridges that cross IBW within the Tempe Reach. These are State Highway 202, Curry Road, and McKellips Road. The highway is supported upon multiple piers. Curry and McKellips Road are low water culverts designed to pass the 5-yr event. If flood levels in IBW exceed the 5-yr event, they overtop the culverts and sheet across dip sections in the roadway. IBW contains a low flow channel within well defined banks. A triple drop structure is located at the confluence with the Salt River.

For additional information concerning the hydraulic conditions of the two study reaches, please refer to Appendix B, Hydraulic Analysis, of this report.

Landfills

Within the Phoenix Reach, it appears that there are 11 inactive landfills that once operated within the study area. For the most part, these operations filled areas of the river that had either naturally eroded or areas created by gravel mining. There are two active landfill operations within the Phoenix Reach. CalMat Properties, Inc. and United Metro Materials have active land filling operations within the Phoenix Reach of the study. Both parties are accepting inert construction debris and misc materials to fill in behind their sand and gravel extractions. It is not believed that these operation increase the potential to leach CERCLA hazardous substances into the underlying soils and groundwater. There is no active municipal waste land filling in the Phoenix Reach.

The inactive 19th Avenue municipal landfill, within the Phoenix Reach, is listed by EPA as a superfund site. The construction portion of the remedial action for this site was recently completed. The construction included soil cement bank stabilization of the Salt River to remove the landfill from the 100-year floodplain, installation of a grade control structure to minimize erosion of the channel into the landfill, a landfill cap, a landfill gas extraction system, two flare stations to incinerate the captured landfill gas, a perimeter drainage system, and and landscaping for mitigation of impacts to the Salt River. The Del Rio landfill is regulated under the State of

Arizona's WQARF authority. It is not listed under either the WQARF Priority List or EPA's National Priority List

Within the Tempe Reach, there are no inactive or active landfills immediately in or adjacent to the study reach. There are inactive landfills adjacent to the Salt River immediately upstream of McClintock Road. Two landfills referred to as SRP75 and SRP 78 once operated in the confluence area of IBW and the Salt River. These two landfills were found to contain inert construction debris. They were removed in their entirety during construction of State Highway 202.

Of the 11 inactive and 2 active landfills within the Phoenix Reach, 6 inactive and 2 active landfills have been delineated on Plates 1A through 4A in Section XII of this report. The remaining 5 inactive landfills are not depicted on the Plates because there is active gravel mining operations underway on the site. All eleven landfills are summarized in Table 4-7 below. For additional information concerning landfills within the two study reaches, please refer to the following areas within this report: Appendix A, Hydrologic Analysis; Appendix H, HTRW Assessments, or the Draft Environmental Impact Statement.

TABLE 4-7
Phoenix Reach Landfill Information

ID	Name	ADEQ ID#	Owner	Location	Status
A/A1	19th Avenue	C11508	City of Phoenix	N. bank of SR, east side of 19th Ave.	Inactive, superfund clean up resulted in capping materials with soil cement and fill
B	7th Avenue	C11511	James McDonald	N. bank of SR, west side of 7th Ave.	Inactive, capped with fill, vacant land on top
C	Rio Salado #8	C11561	United Metro	S. bank of SR, west side of 7th Ave.	Active, United Metro accepting construction debris
	Rio Salado #32	C11542	United Metro	S. bank of SR, east side of 7th Ave.	Inactive, gravel operations in progress on site
D	Central Avenue	C11505	United Metro	N. bank of SR, west side of Central Ave.	Inactive, vacant land on top of fill
E	Rio Salado #6	C11560	CalMat Properties	S. bank of SR, east side of Central Ave.	Inactive, vacant land on top of fill
	Rio Salado #3	C11539	(multiple owners)	N. bank of SR, 0.5 miles W. of 16th St.	Inactive, capped with gabion lining and fill, buildings situated on top
F	Del Rio	C11507	City of Phoenix	S. bank of SR, 0.25 miles W. of 16th St.	Inactive, listed Superfund site, capped with fill, City park and vacant land on top
	Rio Salado #27	C11538	CalMat Properties	0.25 miles W. of 24th St. on Raymond St.	Inactive, gravel operations in progress on site
	Rio Salado #28	C11536	CalMat Properties	0.5 miles W. of 24th St. on Raymond St.	Inactive, gravel operations in progress on site
	Rio Salado #29	C11537	CalMat Properties	NE corner of 16th St. and Elwood St.	Inactive, gravel operations in progress on site
G	CalMat Landfill		CalMat Properties	N. bank of SR, west side of 24th St.	Active, accepting construction debris
H	Rio Salado #26	C11535	Robert McIntyre	S. bank of SR, E. side of 24th St.	Inactive, auto wrecking yard situated on top of fill

Sand and Gravel Mining

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 the natural resource. The materials extracted from the river have been used extensively throughout the development of the Phoenix Metropolitan area. Currently, there are no active mining operations within the Tempe Reach. Within the Phoenix Reach, however, mining activities are on-going throughout the 5 mile long study area.

Within the Phoenix Reach, the mining within the Salt River bed itself is limited. A grand-fathered Section 404 Permit of the Clean Water Act to allow mining activity in the river channel recently expired in August, 1996. However, the river bed is actively used for mining haul roads. The material extraction within the Phoenix Reach is taking place outside of the channel on the adjacent over banks.

There are two mining operations in progress. These operations are owned by CalMat Properties and United Metro Materials. CalMat operates two pits located east of 16th Street. Their batching and sorting plants to make concrete and asphalt materials is located on the north bank of the river, east of 16th Street. CalMat intends to operate the plants and mine the pits for 10 to 15 more years. United Metro owns mineral rights and property west of Central Avenue and east of 24th Street. A third pit, owned by Robert Linsenmeyer was used most recently to provide materials for the construction of the 19th Avenue Landfill superfund cleanup operation.

A summary of the mining activity in the Phoenix Reach is given Table 4-8 below. The existing sand and gravel pits are depicted in Plates 1A through 4A in Section XII of this report. For additional information concerning the sand and gravel mining in the Phoenix Reach, please refer to Appendix F, Geotechnical Analysis, of this report.

TABLE 4-8
Phoenix Reach Sand and Gravel Mining

ID	Owner	Location	Status
A	James McDonald/Robert Linsenmeyer	N. bank of SR, E. side of 15th Ave.	Inactive. Most recently used in 1996.
B	United Metro	S. bank of SR, E. side of 15th Ave.	Inactive. Most recently used in 199-.
C	James McDonald	2000 ft. N. of SR, W. of 7th Ave.	Inactive. Most recently used in 199-.
D	United Metro	S. bank of SR, E. side of 7th Ave.	Inactive. Most recently used in 199-.
E	CalMat Properties	S. bank of SR, E. side of 16th St.	Active mining operations in progress.
F	CalMat Properties	N. bank of SR, E. side of 24th St.	Active mining operations in progress.
G	United Metro	1000 ft S. of SR, E. side of 24th St.	Active mining operations in progress.

Riparian Habitat

The existing condition of the riparian habitat within both reaches of the study have been extensively altered by the man-made activities discussed above. There is 880 acres in the Phoenix Reach and 110 acres in the Tempe Reach. Out of the entire 990 acres under consideration, only 4.6 acres contains what could be classified as a riparian habitat.

The Salt River below Granite Reef Diversion Dam is essentially devoid of vegetation. The river is dry most of the time, supporting little if any vegetation. Only disturbed riparian vegetation occurs on sand bars and terraces. The vegetation is primarily of low quality salt cedar (tamarisk) and desert broom with scattered cottonwood, seep willow and rabbit bush.

The habitat values of various sites along the Salt River were determined through the use of a "Habitat Evaluation Procedure" during the completion of reconnaissance efforts. The HEP analysis evaluated two riparian sites that lie in the Phoenix Reach. One site is located at the mouth of Tempe Drain, just east of I-10 bridge. This 4.6 acre site is intact and continuing to provide habitat for a number of birds despite its location near the interstate and airport. It contains willows, cottonwoods, and other riparian species. The effluent draining to the Salt River through the Tempe Drain provides the water source to support this habitat area. The second site was located in the Salt River on the east side of 19th Avenue. Although this site provided limited habitat value, this site was impacted during construction phase of the remedial action for the 19th Avenue landfill. The impacts were mitigated with a landscaping plan.

Indian Bend Wash contains a golf course on the bench upstream of Curry Road which is planted with bermuda grass, eucalyptus and other non-native trees. The bermuda grasses have invaded the low flow area and are now a maintenance problem for the golf course. Downstream of Curry Road, a few mesquite trees remain as visible reminders of the bosque that once occupied the area. Otherwise, the land is barren, composed of mostly river run stone.

As wildlife depend on the vegetation for food and/or cover, the lack of vegetation in the two study reaches makes the area unsuitable as wildlife habitat. Only small birds, small mammals, and reptiles tolerant of very disturbed conditions in a dry arid environment can inhabit the area. Examples of birds and mammals that may inhabit the area are the black-tailed jackrabbit, Merriams kangaroo rat, morning dove, longnose leopard lizard, and the short-horned lizard. There are no fish species living in the two study reaches. Additionally, no Threatened or Endangered Species inhabit the two study reaches.

While open space is a component of habitat, it is really only effective if interdispersed with habitat providing cover. For example, many hawks hunt in open areas. If all you have is barren areas, the value is very much less than if you have surrounding habitat with cover. Conversely, if only thick cover exists, some species are lost from the mix.

Several areas of existing habitat is shown on Plates 1A through 5A in Section XII of this report. Except for the site at the mouth of Tempe Drain, the existing habitat is of extremely low quality, made up of open water or scattered bushes. For additional information concerning the riparian habitat of the two study reaches, please refer to Appendix C, Economic Analysis or the Draft Environmental Impact Statement of this report.

Cultural Resources

The Salt River Valley has been witness to human activity for several thousand years. The Phoenix/Tempe metropolitan area especially. The prehistoric people who populated the Salt River Valley are called the Hohokam by archeologists. The Hohokam were an agricultural people and cotton and corn became important crops circa 500 A.D. The Hohokam culture was at its height circa 1200 A.D. and during this time platform mounds and village compounds were numerous and widespread. The Hohokam culture constructed over 500 miles of prehistoric canals in the Salt River Valley. Due to changes in rainfall patterns and other factors, the Hohokam culture collapsed around 1450 A.D. Soon thereafter, the Salt River Valley was visited by several Spanish expeditions. Catholic missionaries such as Father Eusebio Kino and Father Jacobo Sedelmayr wrote early passages about the area in the 1700's. The City of Phoenix however, was not established until 1870.

A records and literature search at the regional archaeological clearing house (State Historic Preservation Office, Phoenix),the Office of Cultural Resource Management at Arizona State University, and the Archaeologist for the City of Phoenix, indicate that no resources listed in, or eligible for, the National Register of Historic Places are recorded within the area of potential effects (APE) for the project.

The records search also indicates that the Tempe portion of the project has been studied as part of the Indian Bend Wash project in the 1970s. Archeological surveys identified one archeological site, AZ U:9:45, near the southern end of Indian Bend Wash. The site was tested by Arizona State Museum in 1974, and does not qualify for the National Register of Historic Places. Therefore, the Tempe portion of the project does not contain resources eligible for, or listed in the National Register of Historic Places.

The Phoenix portion of the APE, on the other hand has not been formally surveyed by qualified archeologists. The potential for intact cultural resources may be very low because this portion of the APE is very disturbed overall. Gravel mining has destroyed much of the river bank areas. The APE needs to be professionally surveyed regardless. In addition to identifying any unrecorded resources, the extent of disturbance in the APE needs to be formally documented. Undeveloped areas along the Salt River contain numerous archeological sites, and in many cases have been ranked as high sensitivity districts. There are several developed areas along the Salt River which have been ranked moderately sensitive, since they contain extensive evidence of

past Hohokam habitation sites and irrigation systems. Although in many cases no surface evidence remains, sub-surface materials are a possibility in undisturbed portions of the APE.

For additional information concerning the cultural resources of the two study reaches, please refer to the Draft Environmental Impact Statement accompanying this report.

Recreation

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. In the Phoenix Reach, the Salt River consists primarily of dry river bottom. As a result, virtually no recreation activity takes place. The only improved recreation area adjacent to the Salt River is 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 is currently no plans for expansion of the park, and visitation is not expected to increase in the absence of improvements to the Salt River.

In the Tempe Reach, there are several recreation facilities in the study area or in the near vicinity. A bike/walking path lies on the west bank of Indian Bend Wash. This path links the recreation features of the Scottsdale IBW greenbelt floodway to the City of Tempe. Additionally, the Rio Salado golf course lies on the bench within IBW from Curry to McKellips Road. Existing recreation facilities in the nearby vicinity include Indian Bend Park, Tempe Beach Park, B.B. Moeur Park, the North and South Bank (Salt River) Linear Parks and a wetlands wildlife habitat area.

The City of Tempe has begun construction of its Tempe Rio Salado Project, which will restore a five and one-half mile stretch of the Salt River from an unsightly utility corridor into a linear green belt. Central to this project will be Tempe Town Lake, see map on Figure 3-4. The lake will contain about 200 surface acres and 20,000 feet of shoreline and will support 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. An 80,000 square foot ice skating rink is also planned. Other possible recreational uses include soccer and major sports events, such as marathons.

Significant commercial development, including hotels and resorts, is also expected in the area. The City projects roughly 7 million square feet of mixed use development will take place over the next 25 to 30 years, representing about $1.2 billion in expenditures. This development will be supported substantially by the tourism generated by the project.

Recent estimates of recreation demand for the proposed activities surrounding Town Lake is shown to greatly exceed the available supply in the market area (Ref 42). Therefore, in order to determine the financial impact of the project, the focus of the study was to determine the capacity of the proposed facilities, rather than to project use based upon demand. Based upon the size and configuration of the

lake, the report recommended the following facilities: 208 slips for the rental of sail and electric boats, 24 slips for water taxis, tour boats and gondolas, two boat ramps which could launch 150 boats per day, and facilities for 52 paddle boats. In all, the lake capacity would be approximately 505 watercraft, or about 2.5 boats per surface acre of lake. Although projected visitation for the lake and surrounding recreation facilities was not included in the report, it is obvious that it would be substantial.

For additional information concerning existing recreation within the two study reaches, please refer to Appendix C, Economic Analysis, of this report.

Land Use/Real Estate

In the Phoenix Reach, there are 880 acres under consideration of improvement. There are only 8 different land owners that are potentially affected. The primary landowners include two sand and gravel mining operators (CalMat and United Metro), the City of Phoenix, and the Arizona Department of Transportation. Four private parties own 141.5 acres. The current land uses of the various parcels affected in the Phoenix Reach include superfund site, river channel, vacant land, manufacturing, gravel pits, landfills, quarry facilities, old landfill with park, and salvage yard.

In the Tempe Reach, there are 110 acres under consideration of improvement. There are only 5 different land owners that are potentially affected. The primary landowners include the Maricopa County Flood Control District, the City of Tempe, the Arizona State Board of Regents (ASU), and the U.S. Bureau of Land Management. The current land uses of the various parcels affected in the Tempe Reach include Indian Bend Wash, IBW & Golf Course, vacant, and Salt River channel.

For additional information concerning land use and real estate ownerships within the two study reaches, please refer to Appendix E, Real Estate Report, of this report.

SUMMARY OF PROBLEMS AND OPPORTUNITIES.

As shown in the discussion of the existing conditions, the problems associated with the two study reaches are significant. Federal dams constructed in the early 1900's in the upper Salt and Verde Rivers have limited flows in the lower Salt River through the Phoenix Metropolitan area. As a result, all historical downstream riparian habitat has been severely impacted. Only sporadic vegetation exists in the Salt River today. Open bodies of water supporting waterfowl and migratory species have been eliminated. Urbanization and construction of the Indian Bend Wash flood control project has eliminated high value riparian mesquite bosque communities. However, the opportunities to address some of the problems through environmental restoration do exist.

The Corps of Engineers constructed the outlet channel for Indian Bend Wash from McKellips Road south to the Salt River, a distance of 1.3 miles. The construction was completed in 1977. The completed project consisted of a low flow channel and a terraced bench between two levees. By widening, deepening, and defining the channel, the construction removed an existing mesquite bosque and disturbed native vegetation. After construction, the entire outlet channel was left as bare earth.

Restoration of the mesquite bosque and establishment of riparian wetlands in the Indian Bend Wash outlet channel can be achieved in the IBW portion of the Tempe Reach. McKellips Road bridge crossing of the Indian Bend Wash is the upstream limit of the restoration. Existing dumped riprap in the low flow channel will serve as the starting point. Between McKellips and Curry Roads, a municipal golf course now occupies the lands between the low flow channel and the outside levees. The golf course will remain in place while the restoration in the low flow channel may consist installation of a constructed wetland marsh habitat.

Between Curry Road and the Salt River, the low flow channel and the bench between the outside levees remains bare dirt. In this second reach, establishment of a mesquite bosque on the bench and wetlands in the low flow channel can be the focus of restoration efforts.

The confluence with the Salt River serves as the downstream limit of the Tempe Reach. At this location, construction of the upstream dam of Town Lake is planned to be in place in the next two years. Continuous flow through the wetlands in Indian Bend Wash can be gravity fed to the Salt River and accumulate upstream of the dam of Town Lake. The accumulated flow will support a wetland and riparian area in the Salt River. As the flows trapped upstream of the dam become excessive, a pumping system will remove overflows to a storm drain which will direct the flows around the Town Lake.

In the Phoenix Reach, riparian habitat restoration could replace valuable habitat lost as a result of construction of upstream Federal water projects. In pre-settlement times, the Salt River was one of the few perennially-watered riparian areas of the Sonoran desert with highly productive cottonwood, willow, and mesquite habitats. These areas were rich in habitat diversity, supporting a wide variety of wildlife species. As the lower Salt River Valley became developed, riparian habitat was degraded significantly. The upstream Federal water projects curtailed year-round water flows and converted the once perennial Salt River into a dry river bed devoid of habitat.

The Interstate 10 bridge is the upstream limit of the Phoenix portion of the Rio Salado feasibility study. A drop structure on the downstream end of the bridge will serve as the starting point of the project. The 19th Avenue bridge can serve as the downstream limit. At this location, a superfund cleanup project is just concluding that lined the banks with soil cement and capped an old landfill on the north bank of the river. The total distance of the study reach is approximately 5 miles. Old landfills and active mining operations occupy much of the study reach today.

The feasibility of restoring the river over this reach will be challenging. Surface water from storm drains and shallow aquifer ground water is of poor quality. The multiple landfills lining the study reach cause aesthetic and land use challenges as the vacant, contaminated areas affect the surrounding neighborhoods and ground water aquifers. Additionally, once the mining operations in the area are concluded, the final configuration of the abandoned pits will place additional land use burden for the community.

These problems, however, may become integral components of the environmental restoration of the river. Landfills adjacent to the river can have their exposure to river flows minimized by lining of the river along their boundaries where if the project were to induce erosion. Abandoned gravel pits can be incorporated as water features into a restoration plan. Incidental water quality improvement can be obtained through incorporation of wetlands into the restoration plan.

The primary constraint for the existence of cottonwood/willow, mesquite upland, and wetland marsh habitats in the two study reaches is the availability of water. It is essential to secure a water source in order to promote these habitat types within the study area. Once a water source has been identified, restoration of native riparian habitat on up to 110 acres in the Tempe Reach and 880 acres in the Phoenix Reach is possible.

Water quality, especially salinity, is another constraint for restoration of native riparian species. Continuous watering with electroconductivity (EC) values above 4 would likely present a problem for native trees, especially during their establishment period. Water sources will need to be tested to ensure they can meet the salinity tolerances for the habitat types or will need to be treated.

Riparian vegetation is important for several reasons: as a source of food and shade for wildlife, as a shade source for smaller order streams, as a natural bank stabilizer by preventing excessive erosion, and as a natural cleanser for water borne pollutants. A large restoration effort along a linear feature such as the Salt River or IBW will provide open space, cover, and the ability to migrate utilizing the linear wildlife corridor.

SECTION 5

PLAN FORMULATION

A. PLANNING OBJECTIVES

1. Federal Planning Objectives

The Corps ecosystem restoration philosophy and guidance gives a priority to projects for restoration of degraded ecosystem functions and values to a less degraded ecological condition. This includes the ecosystem hydrology, and its plant and animal communities. Ecosystem restoration activities examine the condition of the existing ecosystems, or portions thereof, and determine the feasibility of restoring degraded ecosystem structure, function, and dynamic processes to a less degraded, more natural condition. Such activities are most likely to address ecosystems associated with wetlands, riparian and aquatic systems. Generally, it will not be appropriate for the Corps to conduct ecosystem restoration activities on upland, terrestrial sites that are not closely linked to water and related land resources. Ecosystem restoration planning considers the roles of plant and animal species populations and their habitats in the larger context of community and ecosystem frameworks. Plans to address ecosystem restoration should be formulated, and measures for restoring ecological resources may be recommended, based on their monetary and non-monetary benefits. These measures do not need to exhibit net National Economic Development (NED) benefits and should be viewed on the basis of non-monetary outputs compatible with the Planning and Guidance selection criteria, and be offered for consideration and budget support. Planning studies must also look for opportunities to also contribute to NED when formulating plans for ecosystem restoration. Quantifiable economic benefits of restoration projects stem from changes in economic values associated with ecosystem improvement. Restoration projects which provide benefits such as water quality improvement, habitat restoration, recreation, flood damage reduction, etc., are likely to include both NED and environmental quality (EQ) benefits.

The Federal objective in water and related land resources project planning is to contribute to national economic development (NED) consistent with protecting the Nation's environment, pursuant to national environmental statutes, applicable executive orders and other Federal planning requirements. Water and related land resources project plans shall be formulated to alleviate problems and take advantage of opportunities in ways to contribute to this objective. Contributions to NED are increases in the net value of the national output of goods and services, expressed in monetary units.

Limited funding, planning resources, and study time necessitate giving priority to those alternatives which produce the greatest environmental output when compared to the cost of the

project. The anticipated value of the outputs of an ecosystem restoration alternative is the principal measure of the proposal's worthiness. An ecosystem restoration proposal must be justified on the basis of its contribution to restoring the structure or function, or both, of a degraded ecosystem, or parts thereof, when considering the cost of the proposal. The willingness of a non-Federal sponsor to share study and project costs and the general concurrence of the State and Federal resource agencies and environmental community are strong indicators of the reasonableness and worthiness of the recommended action.

2. Specific Planning Objectives

Through coordination with local and regional agencies, the public involvement process, site assessments, review of prior studies and reports including the Rio Salado Reconnaissance Study, and review of existing water projects, specific planning objectives were identified for this feasibility effort. The specific objectives for environmental restoration within the study area have been identified as follows:

A. Restore threatened and endangered species habitat.

B. Restore the study area to a more natural condition through the installation of plant species that are native to, and occurred historically, in riparian streams and washes in the region.

C. Secure water supplies which will sustain riparian habitat in the areas restored. Improve ground water quality.

D. Increase passive recreation opportunities incidental to the restoration .

E. Contribute to other qualitative environmental quality objectives.

B. PLANNING CONSTRAINTS

In order to develop environmental restoration alternatives that will best meet the established objectives, consideration of the existing constraints must be made. For the Tempe and Phoenix Reaches considered in this Interim Feasibility Study, the following planning constraints have been identified for consideration in developing alternatives.

1. FAA 10,000 Foot Open Water Constraint for Sky Harbor International Airport

The Federal Aviation Administration (FAA) has regulations that oppose open water within 10,000 feet of the end of the runway. This is to help prevent attracting waterfowl or larger birds. Airport operators have a responsibility to provide for safe operating areas for all aircraft using

their airport as well as an obligation to prevent unnecessary harm to wildlife. Any improvements planned within 10,000 feet of the airport runway must not create additional bird strike hazards (Refs 38, 39). Site specific layout of improvements and careful plant selection must be made. Most of the hazard is created by waterfowl and larger birds, therefore, improvements within this radius will not include wetlands, open water, or landing areas that are attractants to larger birds. This 10,000 foot constraint impacts the Phoenix reach between I-10 and 24th Street, and the Tempe reach from Priest Drive to approximately one-quarter mile upstream of Priest Drive.

2. Constructed Wetland Water Quality

Water to support and sustain riparian habitat is utilized to support plant growth and as a source of drinking water for wildlife. In addition, it is anticipated that the recreation features associated with this project will allow some limited human interaction with the restoration features. The water source will require a NPDES permit, in accordance with the Clean Water Act. In addition, there are several other potential water quality constraints related to the habitat restoration. These include salinity and temperature. Native trees, such as cottonwood trees, cannot tolerate high levels of salinity or total dissolved solids in their water source. This is especially important during their establishment period. In general, water with an electroconductivity (EC) value greater than 4 may present problems to the health of the habitat types. As they mature, they can withstand higher salinity levels. High water temperatures can also be detrimental to wetland functioning.

3. Impact on Plants from Peak Discharges and Long-Term Discharges

Cottonwood trees cannot withstand inundation for prolonged periods of time. Available information from resource agencies such as the Arizona Department of Game and Fish and the U.S. Fish and Wildlife Service indicate that cottonwood tree inundation periods in excess of 30 days may begin to impact the long term health of the tree. Continued inundation may be fatal. Other types of habitat such as mesquite trees, willow trees or wetland-marsh can withstand much greater inundation times. The study areas in both the Tempe and Phoenix Reaches are within the flood channels of the Salt River and IBW. Although flows in these channels are infrequent, the length of time that flows will inundate the restoration areas may be detrimental to sustained plant life, particularly the cottonwood trees. Additionally, the upstream dam of Tempe Town Lake impounds nuisance flows on its upstream side. Alternative plans must consider the inundation duration constraints for the types of plants considered in the restoration alternatives.

Converse to the long term inundation problem, is the need for riparian habitat to be occasionally inundated. This is natural for a riparian ecosystem. The occasional flooding provides opportunity for germination of seeds and provides flushing and cleansing benefits. With an artificial water supply, such as well water, this flushing becomes very important in removing salt or other solids in the water source that might accumulate in the soil matrix over time. Resource agencies have suggested an ideal flooding return interval of seven years for riparian habitat.

4. Avoid Project Induced Bank Erosion

It will be necessary to ensure that the Salt River banks remain stable. This is especially important in the vicinity of the existing 13 landfills that are adjacent to the river. Any increase in vegetation in the channel must not worsen scour or erosion at the bank. Within the Phoenix Reach, there are eleven inactive landfills that once operated within the study area. For the most part, these operations filled areas of the river that had either naturally eroded or areas created by gravel mining. The inactive landfills accepted both municipal and construction type wastes. Additionally, there are two active landfills within the Phoenix Reach that are accepting construction debris.

5. Leaching of Landfill Materials

Water supplies required to support the restoration alternatives must not recharge the aquifer so as to migrate contaminants from the existing landfills. This constraint is due to the potential for groundwater to rise into the landfill materials causing leaching of contaminants to the ground water table. This condition occurred from 1978 to 1981 when leachate was produced at two landfill sites immediately upstream of the Phoenix Reach. The leaching started when the water table rose as a result of recharging from the 1978 Salt River flooding. Salt River flows mixed with the landfill matter to produce leachate which migrated through the aquifer and contaminated local ground water and wells. Testing revealed an excess of common cations and anions. The most dangerous substance was a potential carcinogen, vinyl chloride. The water table declined in 1981, but contaminants had already effected the ground water.

6. Prevent Migration of Existing Ground Water Contamination

Much of the existing ground water below the Phoenix and Tempe Reaches is contaminated. The Tempe Reach is contaminated to point where it has been declared a Superfund Site by the EPA. By increasing the amount of water in the Salt River and IBW, there is a potential for adverse impacts to the existing contamination plumes. Alternatives being considered must assure that infiltration of water will not cause contamination plumes to migrate. Additionally, if the alternatives utilize ground water as a source to sustain vegetation, then pumping must not cause contamination plumes to migrate toward the project unless treatment of contamination is included as a project feature. Prior to construction it is anticipated that a well permit and aquifer protection permit will be required to be obtained from ADWR and ADEQ. Appropriate analysis will be required prior to obtaining these permits in order to address the impacts to the aquifer and existing contamination plumes.

7. Maintain Existing Flood Conveyance Capacity

The Salt River and IBW serve to convey flood waters through the metropolitan area. Their current capacity is based upon relatively barren conditions, free of vegetation and restoration features. Any alternatives considered must assure that there is no unacceptable compromise to the flood protection currently provided.

8. Prevent Restoration Waters from Creating Nuisances

Tempe Town Lake, in the without project condition, is being established by the City of Tempe for recreation and aesthetic purposes. In order to allow water based recreation, EPA and the ADEQ requires that the water quality be safe for partial body contact. This requirement is not one that is measured upon initial filling of the lake, rather it is a requirement that must be maintained continuously. The water flow system required to support the environmental restoration features should not reduce the water quality in the lake. Alternative plans for the Tempe Reach must prevent water required for the restoration in the Salt River or Indian Bend Wash from entering and mixing with the water that is already in the lake. In addition, restoration waters must be prevented from ponding on the upstream side of Tempe Town Lake to avoid inundating/drowning potential habitat.

In the Phoenix Reach, flows traveling past 19th Avenue may adversely impact activities within the river bed such as gravel mining. To alleviate these problems, alternatives in the Phoenix Reach may need to ensure that flows do not travel past 19th Avenue.

9. Real Estate Ownership of Sand and Gravel Mining Operations

There are two active sand and gravel mining operations within the Phoenix Reach study area. These two companies own real estate including vested mineral rights to operate within the City of Phoenix. These operations provide a needed product to the growing community, as well as employment opportunities to the area. As of August, 1996, mining within the ordinary high water mark of the Salt River must be permitted by Corps 404 Permit. Both mining companies have indicated that they will not continue mining within the river bed itself, but may continue operating their processing plants and gravel pits outside of the river channel for many years to come. Both operators maintain haul roads on their properties in the river bed. Any alternatives considered for the Phoenix Reach must be sensitive to the needs of the existing operations.

10. Impact of Noise on Habitat

Urban noise levels may limit the wildlife that utilize the restored areas. Due to intense urbanization along both the Tempe and Phoenix Reaches, noises in the study area are generated

from aircraft; ground transportation including trains, cars, buses, trucks, motorcycles; construction; and other urbanized sources of noise. In most cases, these types and levels of noises are considered acceptable to humans as indigenous noise associated with urban life. The habitat values may be impacted due to this condition.

11. Permitting Requirements

Alternative plans for within the Salt River and IBW must comply with Federal, State and local guidelines and regulations. Any structural improvements within the floodway must comply with Federal Clean Water Act guidelines. Any surface water that is discharged to the watercourses must meet National Pollutant Discharge Elimination System (NPDES) standards. If use of ground water as a source is intended, well permits will be required. An aquifer protection permit is anticipated to be required to ensure the water sources required to support the habitat do not have an adverse impact on the aquifer.

12. Water Supply Acquisition and Cost

Selection of the source of water, required for the project, involves numerous important decisions by the Cities of Phoenix and Tempe. These decisions include securing the water rights for the project and the associated cost of the water supply. The water rights within both reaches of the study area are currently under a variety of public and private ownerships. Alternatives considered must address the quantities of water required to sustain project features so that the local sponsors can obtain proper water rights, if necessary. Utilization of main stem Salt River or CAP flows may require obtaining surface water rights. Although both the City of Tempe and the City of Phoenix currently have a ground water right, utilization of ground water as a source to supply water to the restoration areas may require changes to the existing water right. An expanded discussion and analysis of water supply alternatives, considerations and costs is presented in **Appendix H, Water Supply Analysis and Cost**.

C. GENERAL MANAGEMENT MEASURES

As described above, there are many constraints associated with development of environmental restoration alternatives. However, through extensive coordination with local and regional agencies and numerous site assessments, the following general management measures have been identified for the two specific sites addressed in this study. These general measures, alone or in combination, have been selected because they will reasonably accomplish the specific restoration objectives that have been established for this study and address the identified planning constraints.

1. Vary the Mix of Plant and Habitat Types

By utilizing the plant species that are native to riparian streams and washes of Arizona, environmental outputs will be maximized for the study area. Arizona Game and Fish Department and the local office of the U.S. Fish and Wildlife Service were consulted to determine what plant species were native to Arizona riparian areas. The specific habitat types to be considered for use to create an optimal habitat community have been identified as follows:

A. Upland Mesquite Habitat
This habitat is dominated primarily by honey or velvet mesquite trees. They are normally found on the upper terraces of the floodplain, above the active flood channel.

B. Cottonwood and Willow Dominant Habitat
This habitat is dominated by a combination of cottonwood and willow trees. This plant community is found below the upper terrace of the floodplain. In active streams, this habitat is found along the edge of the active stream bed. In ephemeral streams, this habitat is found along the edge of where the two-year flood level would extend out from the middle of the channel.

C. Wetland-Marsh Habitat
This habitat consists primarily of cattails, bulrushes, and water cress. This community is located at the lowest elevations of the stream bed. In active streams, this habitat is found along the slowest moving portions of the water course or in backwater areas. In ephemeral streams, this habitat is found in shallow ponded water or heavily saturated soils.

D. Aquatic Strand/Scrub land
This habitat is associated with the low flow channel portion of the riparian habitat where the most frequent flows occur. It is below the flood terrace and contains aquatic vegetation if there is a perennial flowing portion of the channel. Adjacent to the aquatic vegetation within the low flow channel, a strand of native grasses and scrubs are typically found. Larger trees and upland species are typically not found in this habitat due to the more frequent flows and longer root saturation periods.

E. Open Space and Urban Park Type Habitat
This habitat type does not have specific plant species. It does have habitat value, as wildlife will utilize these areas to travel to other more valuable habitats. Predator species and raptors use open space for hunting. It only begins to have significant value, however, if part of an overall ecosystem with habitat types providing cover. This habitat can serve as a buffer between other habitats and non-habitat areas. Grasses usually present in parks will be used as a food source for some birds.

F. Other Land Uses
This habitat type has little or no value. It includes those areas needed for canals, recreation trails, service roads, parking areas, general landscaping, soil cement embankments, gravel pit bottoms, and other constructed features.

2. Vary Water Use

Environmental restoration within the Tempe and Phoenix Reaches will be accomplished by planting and establishment of different combinations of habitat types. By varying the amounts of the different habitats, a range of water supply requirements needed to support the various alternatives can be established. Studying a range of water demand will allow for consideration of a full range of alternative water sources and the associated costs for the water supply. The cost of the water supply requirements can then be included in the incremental cost analysis. The general water demands for use with different habitat restoration alternatives in this Feasibility Study have been identified as follows:

A. Low Water Demand
This alternative will have more mesquite upland habitat and less water consumptive habitat such as wetland marsh and aquatic strand. Water deliveries through unlined canals will be minimized. The wetlands that are incorporated into the plan will have an earth lining or synthetic liner installed to minimize infiltration losses.

B. High Water Demand
This alternative will be able to support more water consumptive wetland habitat. Infiltration from the wetlands will be encouraged so that additional cottonwood and willow habitat can be supported around each wetland area. The use of mesquite habitat will be emphasized in upland areas.

C. High Water Demand Plus Aquatic Strand/Stream
This alternative will utilize the same amount of water as the High Water Demand, plus the additional amount of water necessary to support a small flowing stream in the bottom of the low flow channel. The flowing stream will allow for aquatic strand/shrub type of habitat, more open water areas, and there is more potential for vegetation to become established on its own because of the increase in saturated soils. This will help take adevantage of the land required for the low flow channel and use it to provide a valuable habitat component.

3. Vary Areas to be Restored

For the Tempe Reach, there are approximately 80 acres available to be restored. This is divided between 20 acres in the low flow channel of IBW, 30 acres in the bench area of IBW, and 30

acres in the Salt River bottom. By varying the amount of areas to be restored, the amount of water needed to support the associated vegetation will vary. A full range of installation costs and operation and maintenance costs can be considered.

For the Phoenix Reach, the total acreage available for restoration is 880 acres. This total is divided between 550 acres in the Salt River bed and 330 acres in six different gravel pits. Similar to the Tempe Reach, by varying the amount of areas to be restored, a full range of water demand, installation costs, and O&M costs can be considered.

4. Installation of a Low Flow Channel

Restoration features within the river channel will be periodically subjected to flows from the Salt and Verde River system. In order to alleviate problems associated with long term inundation, the alternatives have been evaluated with and without the construction of a low flow channel. If a low flow channel is not constructed, inundation will be more frequent, and therefore plant survivability will be more frequently impacted than with a low flow channel. Installation of a low flow channel will increase the likelihood of plant survivability and reduce the burden of replacement costs after major flood events over the life of the project.

Alternatives that include a low flow channel will have all wetland-marsh, cottonwood-willow, and mesquite habitat types outside of the low flow channel, between the low flow channel and the main bank. The low flow channel will simulate the natural low flow channel that would be found in a natural riverine riparian area. The low flow channel provides opportunity for aquatic strand/shrub habitat type. It is anticipated that the banks associated with the low flow channel will require stabilizing to ensure the low flow channel is capable of functioning over the life of the project.

5. Continual Flow Measures for Wetlands

Continuous flow is required for proper wetland functioning. This helps to keep water temperatures lower, aerates the water to maintain dissolved oxygen, and helps minimize the build-up of organics in the bottom of the wetlands. The following measures could be implemented in order to satisfy this requirement:

A. Incorporate Wetlands in Water Distribution System
The wetlands could be incorporated as part of the overall water supply distribution system for the entire restoration alternative. Other habitat types could be supported by the water source supplying the wetlands and by the water outfall from the wetlands.

B. Provide By-Pass Pump Upstream of Tempe Town Lake
A pump at the upstream inflatable dam for Town Lake would eliminate several problems

and constraints. The pump would prevent water required for habitat restoration upstream of the lake from accumulating upstream of the lake and inundating/drowning the habitat or entering the lake. Nuisance flows generated from upstream of the lake could be prevented from inundating the restored habitat. The pump will provide a condition of continual, aerating water flow for the wetlands habitat, and prevent the accumulation of standing or stagnant water. The water level upstream of the lake could maintained at an optimal elevation for the wetland habitat. The downstream disposal location for the pumped water could be utilized as a water source for habitat restoration downstream of the lake.

6. Site Location of Habitat Areas

Site specific location of habitat areas must be included in development of the alternative plans. Improvements must consider utilizing nesting areas that are limited from public access, away from road crossings or recreation trails, so that noise impacts are minimized as much as possible. Other restoration features must be located to maximize the unique recreation opportunities provided by the alternatives.

Another measure will be incorporated in order to address the 10,000 foot FAA runway constraint. In order to avoid this constraint it will be necessary to avoid habitat types that might attract waterfowl or other larger birds within this 10,000 foot runway constraint. For the Phoenix reach, this would involve the area between I-10 and 24th Street. For the Tempe reach, this would include an area from Priest Drive to approximately one-quarter mile upstream of Priest Drive. The proposed method of compliance is to avoid restoration with any open water habitat in these areas. Therefore, these restoration areas would not include wetland-marsh habitat. Habitat that does not require open water would be considered acceptable.

7. Post Formulation Measures

Certain engineering features to address many of the identified constraints cannot be fully developed until after a specific plan has been identified. This is because of analysis that cannot be cost effectively performed until the plan is formulated. These measures, if required, would include those formulated to address potential leaching from existing landfills, impacts to existing groundwater contamination, and permitting requirements.

Management measures for these planning constraints depend largely upon the results of groundwater modeling which will be performed after the F4 milestone when a tentatively recommended plan has been identified. Plan specific information is required in order to perform the modeling. The results of the water budget analysis, presented in the Hydrology Appendix, will be utilized to estimate well locations, pumping rates, and infiltration quantities and locations. This specific information is required in order to obtain meaningfull data from the

groundwater modeling in assessing the potential project impacts.

D. ALTERNATIVE PLANS

1. Tempe Reach

As a result of the contraints and management measures discussed above, six alternatives were formulated for restoration of the Tempe Reach. The alternatives are described below including a summary of the measures that have been included in order to address the restoration opportunities and constraints. **Table 5-1** presents a general summary of the locations, habitat types, and areas that would be included in each of the alternatives. Additionally, **Figures 5-1 through 5-5** are provided to visually show Alternative IBW+SR(US + DS)/HW. This alternative has all of the features that are included in the other alternatives. Figures for the other alternatives have not been presented as all of their components may be found within **Figures 5-1 through 5-5**.

The alternatives for the Tempe reach do not include a low flow channel for the Salt River areas. Existing conditions or those included in the without project condition make a low flow channel impractical. Upstream of Town Lake, there is an existing grade control structure in the Salt River, immediately downstream of McClintock Drive, which provides channel stability. In addition the upstream dam of Town Lake acts like another grade control structure. When the dam is deflated to allow the passage of flood discharges the structure will only be approximately one-inch above the existing channel invert. These two structures are within less than one-half mile of each other and constrain design and construction of an entrenched low flow channel. Downstream of Town Lake, bedrock is shallow for the entire length of the Salt River between Town Lake and Priest Drive. Immediately downstream of Priest Drive bedrock exists at the invert elevation of the river acting as a natural grade control structure. These conditions also prevent a low flow channel downstream.

T1. No Action Alternative (NA)

Alternative NA is the No Action Alternative. The No Action Alternative will maintain the current without project conditions in the Tempe Reach. The low flow channel of IBW between McKellips Road and Curry Road will have very little habitat value with bermuda grasses continuing to invade. The IBW bench, between the low flow channel and the main bank, from Curry Road to the Salt River, will remain as bare earth. The Salt River bed upstream of Town Lake will remain barren cobbles. The habitat value of the entire 80 acres under consideration within the study area will be continue to be negligible.

T2. Alternative IBW/LW

Alternative T2 has been formulated to restore only areas within the IBW with low water use vegetation. This alternative would consist of restoration of the 30 acres on the bench of IBW between Curry Road and the confluence with the Salt River. The improvements would consist of 20 acres of mesquite upland habitat and 10 acres of open space habitat. The existing sprinkler irrigation system in place on the bench would be modified to support irrigation of the additional mesquite trees. The 50 acres of low flow channel in IBW, would continue to be of negligible habitat value. The alternative would not produce any excess water or outfall required to be diverted from Town Lake.

T3. Alternative IBW+SR(US+DS)/LW

Alternative T3 would restore areas in both Indian Bend Wash and the Salt River with low water use vegetation. In addition to the 30 acres of restoration in IBW proposed by Alternative T3, this alternative will also provide for restoration of the 60 acres in the Salt River upstream and downstream of Tempe Town Lake (30 acres each). The Salt River improvements would consist of 5 acres of mesquite upland habitat and 25 acres of open space habitat in each of the upstream and downstream areas. There would not be permanent irrigation to support the plants in the Salt River. A long establishment period would be utilized to allow the root structure of the trees to become established to the point where the plant could survive without permanent watering. In the remaining 25 acres of the Salt River, vegetation would be similar to the without project condition or the No Action alternative.

T4. Alternative IBW+SR(DS)/HW

Alternative T4 will restore IBW areas and the Salt River area downstream of Town Lake with high water use vegetation. This alternative would consist of installation of improvements to the entire 80 acres in the IBW portion of the Tempe Reach and the 30 acres downstream of town Lake. On the bench of IBW, between Curry Road and the confluence with the Salt River, the improvements would consist of 20 acres of mesquite upland habitat and 10 acres of open space habitat. The existing sprinkler irrigation system in place on the bench would be modified to support irrigation of the additional mesquite. In the low flow channel of IBW, the improvements would consist of 50 acres of wetland marsh habitat that would extend 1.3 miles from McKellips Road to the confluence with the Salt River. Overflow/outfall from the wetlands in the IBW low flow channel would be diverted through a pipe by gravity flow, along the north side of Town Lake, and discharged into the Salt river immediately downstream of Town Lake. The excess water from the IBW restoration would partially satisfy the water requirements for the restoration of the Salt River area downstream of Town Lake. Since this alternative emphasizes riparian habitat, it is considered a high water use alternative. The area within the Salt River upstream of Town Lake would remain in its present condition.

T5. Alternative IBW+SR(US+DS)/HW

Alternative T5 would maximize restoration opportunities in both IBW and the Salt River with high water use vegetation, see Figures 5-1 through 5-5. In addition to the 80 total acres of restoration areas available in IBW, this alternative will also provide for restoration of the 60 total acres of the Salt River available for restoration upstream and downstream of Town Lake. The IBW restoration would include 50 acres of wetland-marsh in the low flow channel, 20 acres of mesquite bosque on the bench, and 10 acres of open space. The alternative includes a gravity pipe to drain excess restoration waters from IBW to the upstream side of Town Lake. The Salt River restoration will provide for installation of 16 acres of wetland marsh habitat, 20 acres of cottonwood and willow dominant habitat, and 24 acres of open space habitat. The soils surrounding the wetlands will be allowed to saturate to support the cottonwood and willow trees without installation of permanent irrigation facilities. The alternative includes a pump and pipeline to remove excess water from upstream of Town Lake to the downstream side. A long establishment period will be utilized to allow the root structure of the trees to become established to the point where the plants could survive without permanent watering. In the remaining 24 acres, vegetation will be allowed to regenerate itself naturally to compliment the plantings or be utilized to take advantage of the recreation opportunities.

T6. Alternative SR DS/HW

This alternative would restore only the area downstream of Town Lake with high water use, riparian dominant habitat. The water supply could be provided, in part, by water from Tempe Town Lake. The alternative would consist of 10 acres of cottonwood willow habitat and 8 acres of wetland marsh, and 12 acres of open space.

2. Phoenix Reach

Initial Alternatives Considered and Selection of Low Flow Channel Capacity

Including the no action alternative, there were twenty-one (21) different initial alternatives developed for environmental restoration of the Phoenix Reach. This initial array of alternatives included differing sizes of low flow channels. The alternatives considered differing low flow channel widths including a 500 foot, 350 foot, 200 foot widths and no low flow channel alternatives.

The alternatives which were eliminated from further consideration were those alternatives that did not include a low flow channel or those that included a low flow channel greater than a 200 foot width (12,200 cfs capacity). The alternatives that did not include a low flow channel were eliminated because hydraulic analysis indicated that the flow velocities and associated scour

TABLE 5-1
TEMPE REACH ALTERNATIVE MATRIX

TEMPE ALTERNATIVES (HABITAT ACRES)								
Alternative	Restoration	Habitat Type						
	Area	MU	CW	WM	AS	O	Other	Total
	LF						50	50
T1. NA	B						30	30
	SR US						30	30
	SR DS						30	
	LF						50	50
T2. IBW/LW	B	20				10		30
	SR US						30	30
	SR DS							
	LF						50	50
T3. IBW+SR(US + DS)/LW	B	20				10		30
	SR US	5				25		30
	SR DS	5				25		30
	LF				50			50
T4. IBW+SR (DS) /HW	B	20				10		30
	SR US						30	30
	SR DS		10	8		12		30
	LF				50			50
T5. IBW+SR(US + DS)/HW	B	20				10		30
	SR US		10	8		12		30
	SR DS		10	8		12		30
	LF							
T6. SR (DS) / HW	B							
	SR US							
	SR DS		10	8		12		30

RESTORATION AREA
LF=IBW Low Flow Channel
B= IBW Bench
SR=Salt River
SRLF=Salt River Low Flow Channel
US=Upstream of Town Lake
DS=Downstream of Town Lake

HABITAT TYPE
MU=Mesquite Upland
CW=Cottonwood and Willow Dominant
WM=Wetland Marsh
AS=Aquatic Strand/Scrub
O=Open Space or Urban Park
Other=Canals, recreation trails, service roads, parking areas, landscaping, soil cement, gravel pits, etc.

ALTERNATIVE CODES: SR=Salt River, G=Gravel Pits, LFO=Low Flow equals Full Bottom, LF2=Low Flow equals 200 Feet, LF3.5=Low Flow equals 350 Feet, LF5=Low Flow equals 500 Feet, LW=Low Water Use, HW=High Water Use, S=Stream

RESTORATION AREA CODES: LF=Low Flow Channel, B=Bench, BK=Bank, OBK=Overbank, P=Park, G=Gravel Pits

HABITAT TYPE CODES: MU=Mesquite Upland, CW=Cottonwood and Willow Dominant, WM=Wetland Marsh, AS=Aquatic Strand/Scrub O=Open Space or Urban Park, Other=Canals, recreation trails, service roads, parking areas, landscaping.

ALTERNATIVE	RESTORATION AREA	HABITAT TYPES
NA=No Action	SRLF=Salt River Low Flow Channel	MU=Mesquite/Upland
LW=Low Water Use	B=Bench	CW=Cottonwood/Willow
HW=High Water Use	BK=Bank	WM=Wetland Marsh
HW+S=High Water Use + Stream	OBK=Overbank	AS=Aquatic Strand/Scrub
	P=Park/Gateway Areas	O=Open Space, Park Areas
	G=Gravel Pit Bottoms	Other=Canals, recreation trails, service roads, parking areas, landscaping soil cement, gravel pits, etc.

NOTE:Shading denotes that this is not applicable

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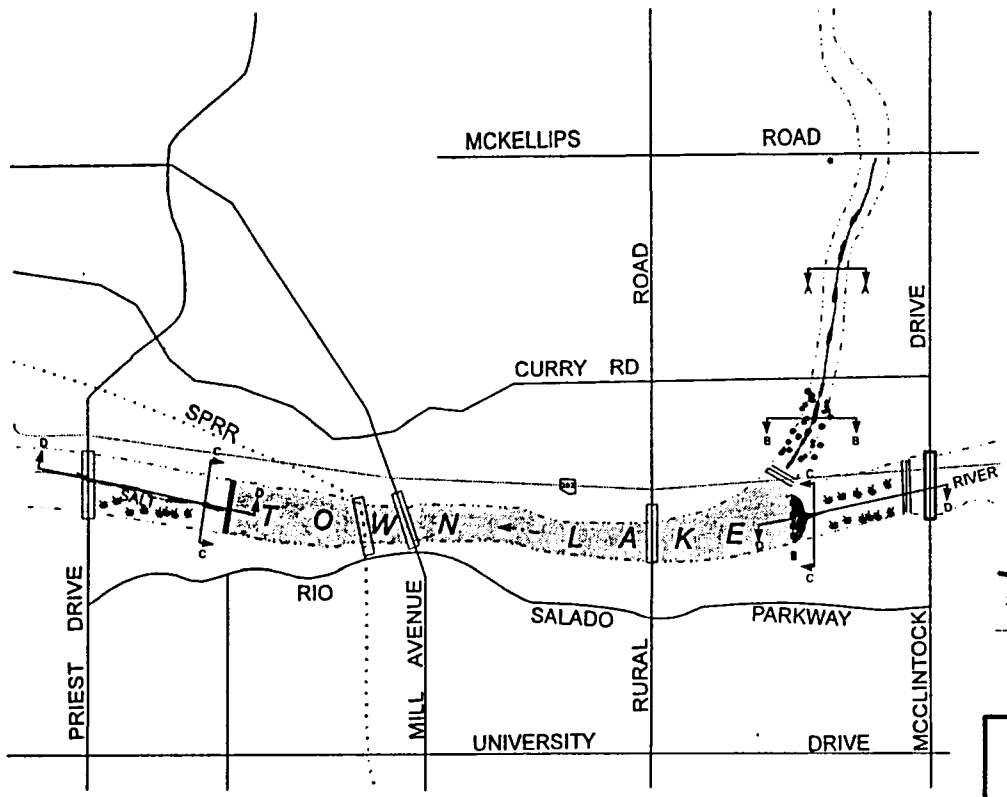

LEGEND

- MESQUITE HABITAT
- WETLAND/MARSH HABITAT
- COTTONWOOD/WILLOW HABITAT
- LOW FLOW STREAM
- TEMPE WELL NO. 6
- OVERFLOW PUMP STATION

GENERAL INVESTIGATIONS-SURVEYS
FISH AND WILDLIFE HABITAT RESTORATION
RIO SALADO, SALT RIVER, AZ
TEMPE REACH
ALTERNATIVE T5
IBW + SR(US + DS)/HW
LOS ANGELES DISTRICT
SOUTH PACIFIC DIVISION
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FIGURE 5-1
ALTERNATIVE T5
IBW + SR(US+DS)/HW

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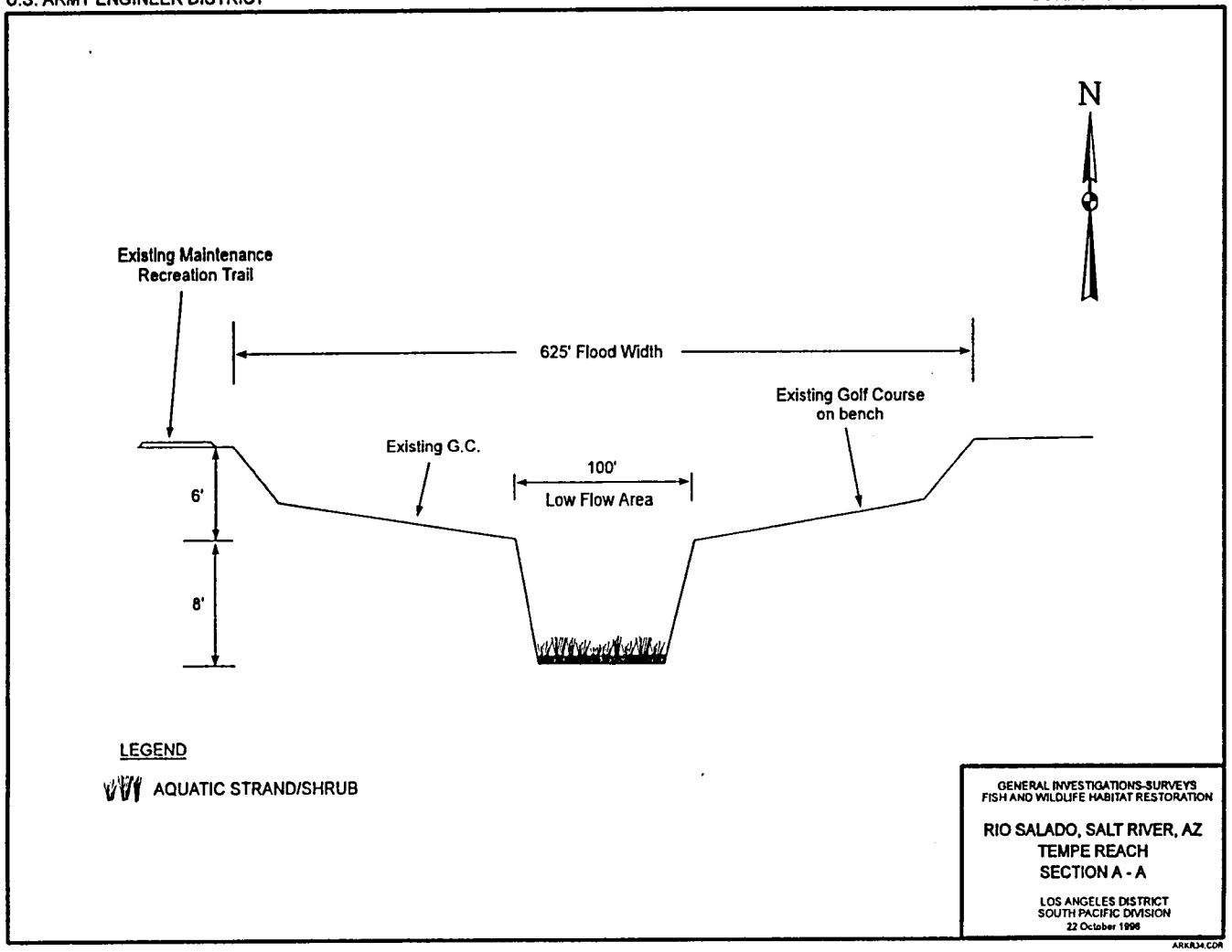

FIGURE 5-2
TEMPE REACH
SECTION A-A

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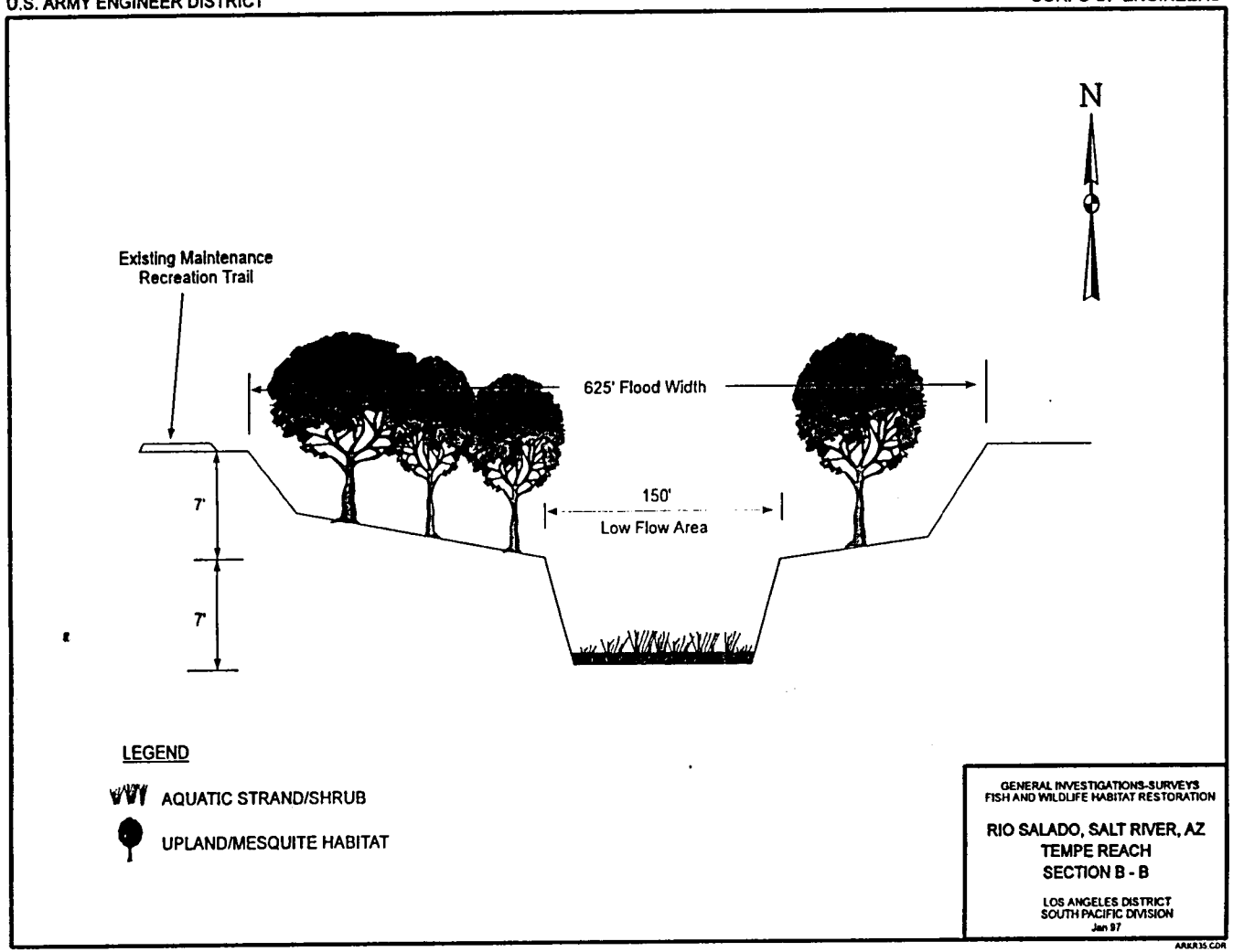

FIGURE 5-3
TEMPE REACH
SECTION B-B

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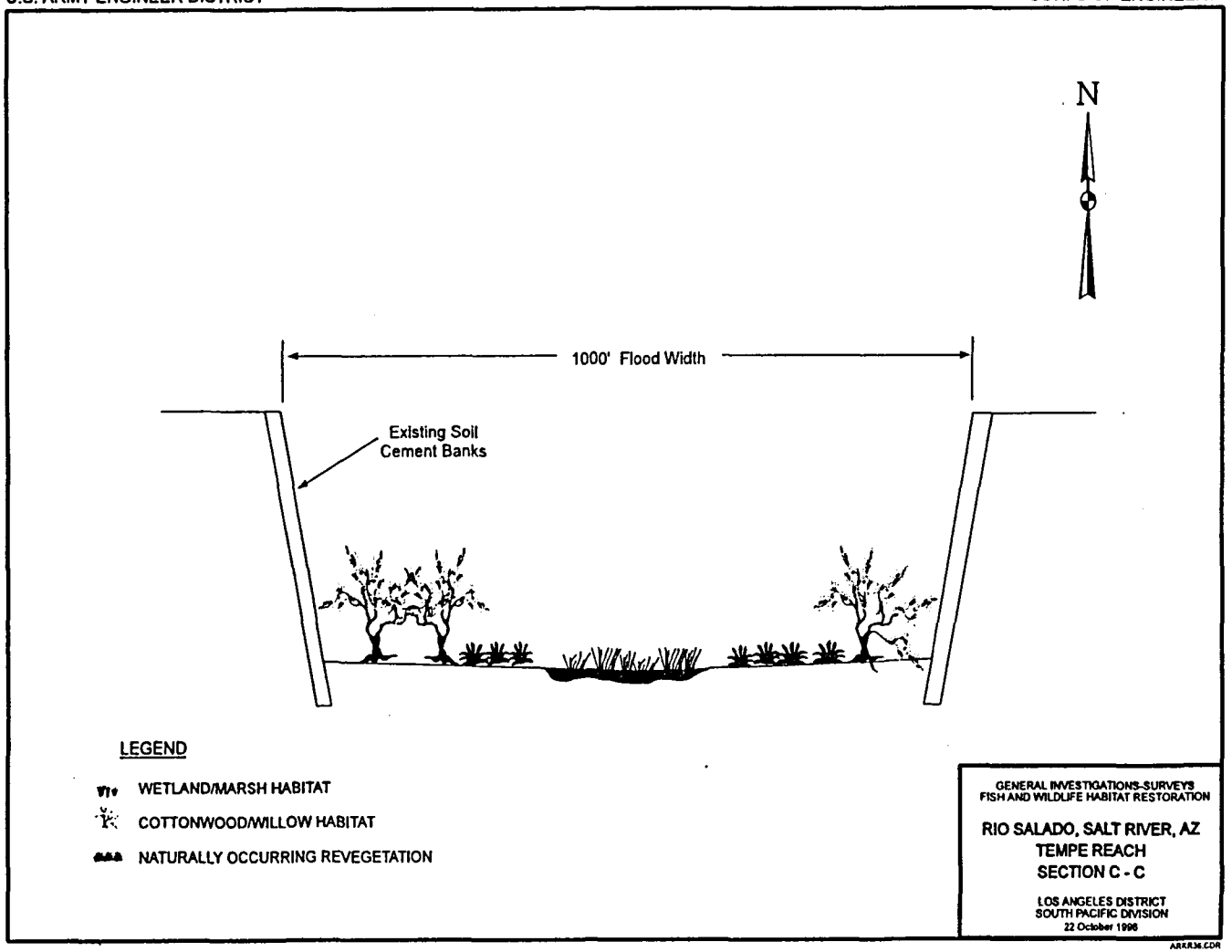

FIGURE 5-4
TEMPE REACH
SECTION C-C

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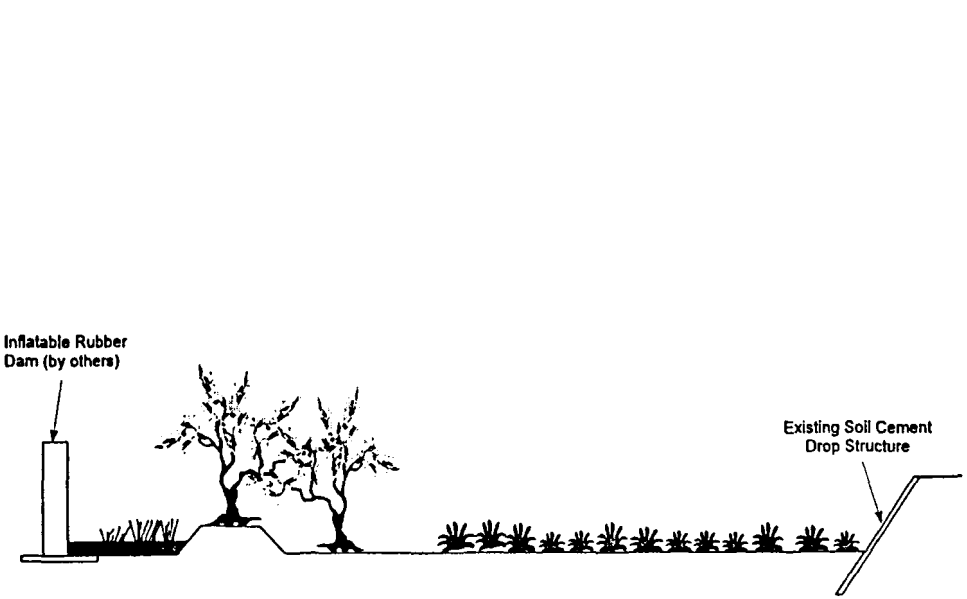

LEGEND

WETLAND/MARSH HABITAT

COTTONWOOD/WILLOW HABITAT

NATURALLY OCCURRING REVEGETATION

GENERAL INVESTIGATIONS-SURVEYS
FISH AND WILDLIFE HABITAT RESTORATION

RIO SALADO, SALT RIVER, AZ
TEMPE REACH
SECTION D - D

LOS ANGELES DISTRICT
SOUTH PACIFIC DIVISION
22 October 1996

ARKRJ7.CDR

FIGURE 5-5
TEMPE REACH
SECTION D-D

would subject the habitat restoration features to frequent damage unless a channel was constructed to minimize river flow impacts and convey the more frequent discharges. In addition, the inundation time of the restored habitats was an identified constraint that could be better controlled with inclusion of a low flow channel. The alternatives with low flow channels wider than 200 feet (>12,200 cfs) were eliminated because they would require additional river bottom land that could be used for restoration areas, they cost more, and did not appear to meet the identified planning constraints as well as the selected low flow channel capacity.

The selection of the low flow channel capacity was primarily based on minimizing the frequency of 30-day flow durations exceeding the capacity of the low flow channel. This 30-day duration constraint was intended to prevent the root structure of the cottonwood trees from being inundated for a length of time that might be fatal. The 12,200 cfs low flow channel would have flood discharges exceeding this 30 day constraint on a return interval of 83 years. Peak flows, exceeding the 12,200 cfs capacity of the low flow channel, would have an estimated return interval of 3.85 years for a 6-hour average maximum discharge and a return period of 6.67 years for a 1-day average maximum discharge. This matched well with the recommended seven year flood return interval of the riparian habitat for flushing and duplication of natual conditions. Based on these technical criterias, the 12,200 cfs low flow channel capacity is recommended.

Based on this screening of the initial array of alternatives, a total of nine alternatives, including a no action alternative, were forwarded for further consideration and incremental analysis evaluation. These alternatives included a 200 foot wide (12,200 cfs) low flow channel. A description of each alternative is presented below. **Table 5-2** presents a general summary of the locations, habitat types, and areas that would be included in each of the alternatives. **Figures 5-6 through 5-12** are provided to conceptually depict the Alternative T9 (SR+G/HW+S). Figures for the other alternatives were not created as all of their concept components may be found on the figures provided.

P1. No Action Alternative (NA)

Alternative NA is the No Action Alternative. This alternative will maintain the future without project conditions in the Phoenix Reach. The 550 acres of the Salt River bed from I-10 bridge to 19th Avenue will remain almost entirely barren cobbles. The 330 acres of gravels pits (G) will remain as unsightly, unused hazard areas. The habitat value of the entire 880 acres under consideration will be continue to be negligible.

P2. Alternative SR/LW

Alternative P2 will restore the Salt River portion of the Phoenix Reach with low water use vegetation. This alternative would include the construction of a 200 foot wide low flow channel but would not incorporate the gravel pits. The restoration would consist of 20 acres of mesquite habitat, 80 acres of cottonwood and willow habitat, 40 acres of wetlands, and 120 acres of open space on the constructed bench in the Salt River bottom. No improvements would be placed in

the low flow channel itself, this area would remain as 130 acres of open space. Restoration on the banks of the river would consist of 35 acres of open space. 50 feet of overbank on each side of the river would be incorporated into the restoration. Restoration on the overbanks would consist of 30 acres of mesquite habitat and 20 acres of open space. Also included in the restoration would be 50 acres of urban park type habitat that would serve as gateway areas or access locations to the restoration areas.

P3. Alternative SR/HW

Alternative P3 will restore the Salt River portion of the Phoenix Reach with higher water use vegetation involving more riparian habitat. This alternative would include the construction of a 200 foot wide low flow channel, but would not incorporate the gravel pits. The restoration would consist of 160 acres of cottonwood and willow habitat and 100 acres of wetlands on the bench in the Salt River bottom between the low flow channel and the bank. No improvements would be placed in the low flow channel itself, this area would remain as 130 acres of open space. Water to support the vegetation on the benches would be brought down from the overbanks. Around the water delivery system, 5 acres of cottonwood and willow habitat would be established. The banks will also support 30 acres of open space. On the overbank area, 50 feet of overbank on each side of the river would be incorporated into the restoration. Open canals or ditches will also serve to deliver water along the overbanks. Restoration on the overbanks would consist of 10 acres of mesquite habitat, 20 acres of cottonwood and willow habitat, and 10 acres of open space. Also included in the restoration would be 50 acres of urban park type habitat that would serve as Gateway Areas and access locations to the project site.

P4. Alternative SR/LW+S

Alternative P4 will restore the entire Phoenix Reach with lower water use vegetation. This alternative would include construction of a 200 foot wide low flow channel and include a perennial low flow stream to create aquatic strand/shrub habitat. The restoration would consist of 50 acres of mesquite upland habitat, 80 acres of cottonwood and willow habitat, and 40 acres of wetland marsh habitat on the constructed bench in the river bottom. No improvements would be placed in the low flow channel itself, this area would consist of 130 acres of aquatic strand/shrub associated with the stream in the low flow channel. Water to support the restoration in the river bottom will be brought down from the overbanks. Around the water delivery system, 5 acres of cottonwood and willow habitat would be established. The banks will also support 40 acres of open space. Above the banks, 50 feet of overbank on each side of the river would be incorporated into the restoration. Open canals or ditches will also serve to deliver water on the overbanks. Restoration on the overbanks would consist of 45 acres of mesquite habitat 35 acres of open space. Also included in the restoration would be 30 acres of urban park type habitat that would serve as "Gateway Areas" to the project site.

P5. Alternative SR/HW+S

Alternative P5 will restore the Salt River portion of the Phoenix Reach with high water use vegetation. This alternative would include construction of a 200 foot wide low flow channel, and the amount of water supply for this alternative would be sufficient to support a low flow, permanently flowing stream in the low flow channel. The stream would provide aquatic strand/shrub habitat similar to the low flow portion of a natural riparian system. This alternative would not incorporate the gravel pits. The restoration would consist of 160 acres of cottonwood and willow dominant habitat and 100 acres of wetlands on the constructed bench in the Salt River bottom. The low flow channel with stream would create 130 acres of aquatic strand/shrub habitat within the low flow channel adjacent to the stream. Water to support the vegetation in the bottom will be brought down from the overbank area. Around the water supply delivery system, 5 acres of cottonwood and willow habitat would be established. The banks will also support 30 acres of open space. Above the banks, 50 feet of overbank on each side of the river would be incorporated into the restoration. Open canals or ditches will also serve to deliver water on the overbanks. Restoration on the overbanks would consist of 10 acres of mesquite habitat, 20 acres of cottonwood and willow habitat, and 10 acres of open space. Also included in the restoration would be 50 acres of urban park type habitat that would serve as "Gateway Areas" to the project site.

P6. Alternative SR+G/LW

Alternative P6 will restore the entire Phoenix Reach, including the Salt River and the gravel pits, with lower water use vegetation and minimize riparian habitat. This alternative would include construction of a 200 foot wide low flow channel and cut back the banks in the area of the existing gravel pits so that additional bench area is created. The restoration would consist of 50 acres of mesquite upland habitat, 80 acres of cottonwood and willow habitat, 40 acres of wetlands and 120 acres of open space on the constructed bench in the Salt River bottom. No improvements would be placed in the low flow channel itself, this area would remain as 130 acres of open space. The restoration on the banks would consist of 45 acres of open space. Above the banks, 50 feet of overbank on each side of the river would be incorporated into the restoration. Restoration on the overbanks would consist of 45 acres of mesquite habitat and 35 acres of open space. Also included in the restoration would be 50 acres of urban park type habitat that would serve as "Gateway Areas" to the project site. Within the gravel pits themselves, an additional 10 acres of cottonwood and willow habitat will be created.

P7. Alternative SR+G/HW

Alternative P7 will restore the entire Phoenix Reach, including the Salt River and the gravel pits, with high water use vegetation emphasizing riparian habitat. This alternative would include construction of a 200 foot wide low flow channel and include the areas of the gravel pits. The

restoration would consist of 30 acres of mesquite upland habitat, 160 acres of cottonwood and willow habitat, and 100 acres of wetland marsh habitat on the constructed bench in the river bottom. No improvements would be placed in the low flow channel itself, this area would remain as 130 acres of open space. Water to support the vegetation in the river bottom will be brought down from the overbanks. Around the water delivery system, 5 acres of cottonwood and willow habitat would be established. The banks will also support 40 acres of open space. Above the banks, 50 feet of overbank on each side of the river would be incorporated into the restoration. Open canals or ditches will also serve to deliver water on the overbanks. Restoration on the overbanks would consist of 25 acres of mesquite habitat, 20 acres of cottonwood and willow habitat, and 25 acres of open space. Also included in the restoration would be 50 acres of urban park type habitat that would serve as "Gateway Areas" to the project site. Within the gravel pits themselves, an additional 10 acres of cottonwood and willow habitat will be created. It may be necessary to create additional bench area within the gravel pits in order to support the habitat. The steep banks of the gravel pits may also need to have their slopes reduced.

P8. Alternative SR+G/LW+S

Alternative P8 will restore the entire Phoenix Reach, including the Salt River and the gravel pits, with lower water use vegetation. This alternative would include construction of a 200 foot wide low flow channel, cutting back the banks in the area of the existing gravel pits so that additional bench area is created, and supplying the amount of water needed to support a low flow rate, permanently flowing stream in the low flow channel. The restoration would consist of 50 acres of mesquite upland habitat, 80 acres of cottonwood and willow habitat and 40 acres of wetlands on the constructed bench in the river bottom. The stream in the low flow channel will create 130 acres of aquatic strand/shrub habitat. Water to support the vegetation in the bottom and the stream will be brought down from the overbanks in delivery system. Around the open channel distribution system, 5 acres of cottonwood and willow habitat would be established. The banks will also support 120 acres of open space. Above the banks, 50 feet of overbank on each side of the river would be incorporated into the restoration. Open canals or ditches will also serve to deliver water on the overbanks. Restoration on the overbanks would consist of 45 acres of mesquite habitat and 35 acres of open space. Also included in the restoration would be 50 acres

of urban park type habitat that would serve as "Gateway Areas" to the project site. Within the gravel pits themselves, an additional 10 acres of cottonwood and willow habitat will be created.

P9. Alternative SR+G/HW+S

Alternative P9 will restore the entire Phoenix Reach, including the Salt River and the gravel pits, with high water use vegetation. This alternative would include construction of a 200 foot wide low flow channel, cutting back the banks in the area of the existing gravel pits so that additional

bench area is created, and supplying the amount of water needed to support a low flow rate, permanently flowing stream in the low flow channel. The restoration would consist of 30 acres of mesquite upland habitat, 160 acres of cottonwood and willow habitat and 100 acres of wetlands on the constructed bench in the river bottom. The stream in the low flow channel will create 130 acres of aquatic strand/shrub habitat. Water to support the vegetation in the bottom and the stream will be brought down the banks in delivery system. Around the open channel distribution system, 5 acres of cottonwood and willow habitat would be established. The banks will also support 40 acres of open space. Above the banks, 50 feet of overbank on each side of the river would be incorporated into the restoration. Open canals or ditches will also serve to deliver water on the overbanks. Restoration on the overbanks would consist of 25 acres of mesquite habitat, 20 acres of cottonwood and willow habitat, and 25 acres of open space. Also included in the restoration would be 50 acres of urban park type habitat that would serve as "Gateway Areas" to the project site. Within the gravel pits themselves, an additional 10 acres of cottonwood and willow habitat will be created.

TABLE 5-2
PHOENIX REACH ALTERNATIVE MATRIX

PHOENIX ALTERNATIVES (HABITAT ACRES)								
Alternative	Restoration	Habitat Type						
	Area	MU	CW	WM	AS	O	Other	Total
	LF						400	37200
	B						0	0
P1. NA	BK						40	3640
	OBK						60	5280
	P						50	4350
	G						0	0
	LF					130		11050
	B	20	80	40		120	10	22950
P2. SR/LW	BK					35	5	3400
	OBK	30				20	10	5100
	P					50		4250
	G							0
	LF					130		10920
	B		160	100			10	22680
P3. SR/HW	BK		5			30	5	3360
	OBK	10	20			10	20	5040
	P					50		4200
	G							0
	LF				130	0		10770
	B	20	80	40		120	10	22140
P4. SR/LW+S	BK					35	5	3280
	OBK	30				20	10	4920
	P					50		4100
	G							0
	LF				130	0		1040
	B		160	100			10	2160
P5. SR/HW+S	BK		5			30	5	320
	OBK	10	20			10	20	480
	P					50		400
	G							0
	LF					130		10530
	B	50	80	40		120	10	24300
P6. SR+G/LW	BK					45	5	4050
	OBK	45				35	30	8910
	P					50		4050
	G		10				230	19440
	LF					130		10400
	B	30	160	100			10	24000
P7. SR+G/HW	BK	5	40			5		4000
	OBK	25	20			25	40	8800
	P					50		4000
	G		10				230	19200

TABLE 5-2
PHOENIX REACH ALTERNATIVE MATRIX

PHOENIX ALTERNATIVES (HABITAT ACRES)								
Alternative	Restoration Area	Habitat Type						
		MU	CW	WM	AS	O	Other	Total
P8. SR+G/LW+S	LF				130	0		10380
	B	50	80	40		120	10	23700
	BK					45	5	3950
	OBK	45				35	30	8690
	P					50		3950
	G		10				230	18960
P9. SR+G/HW+S	LF				130	0		10250
	B	30	160	100			10	23400
	BK	5	40				5	3900
	OBK	25	20			25	40	8580
	P					50		3900
	G						230	17940

NA=No Action
LW=Low Water Use
HW=High Water Use
HW+S=High Water Use + Stream
LW+G=Low Water Use + Gravel Pits
HW+G=High Water Use + Gravel Pits
HW+G+S=High Water Use + Gravel Pits + Stream
LW+G+S=Low Water Use+Gravel Pits+Stream

LF=Low Flow Channel
B=Bench
BK=Bank
OBK=Overbank
P=Park/Gateway Areas
G=Gravel Pit Bottoms

MU=Mesquite/Upland
CW=Cottonwood/Willow
WM=Wetland Marsh
AS=Aquatic Strand/Scrub
O=Open Space, Park Areas
Other=Canals, recreation trails, service roads, parking areas, landscaping soil cement, gravel pits, etc.

NOTE:Shading denotes that this is not applicable.

FIGURE 5-6
ALTERNATIVE P9
SR + G/LF2/HW+S

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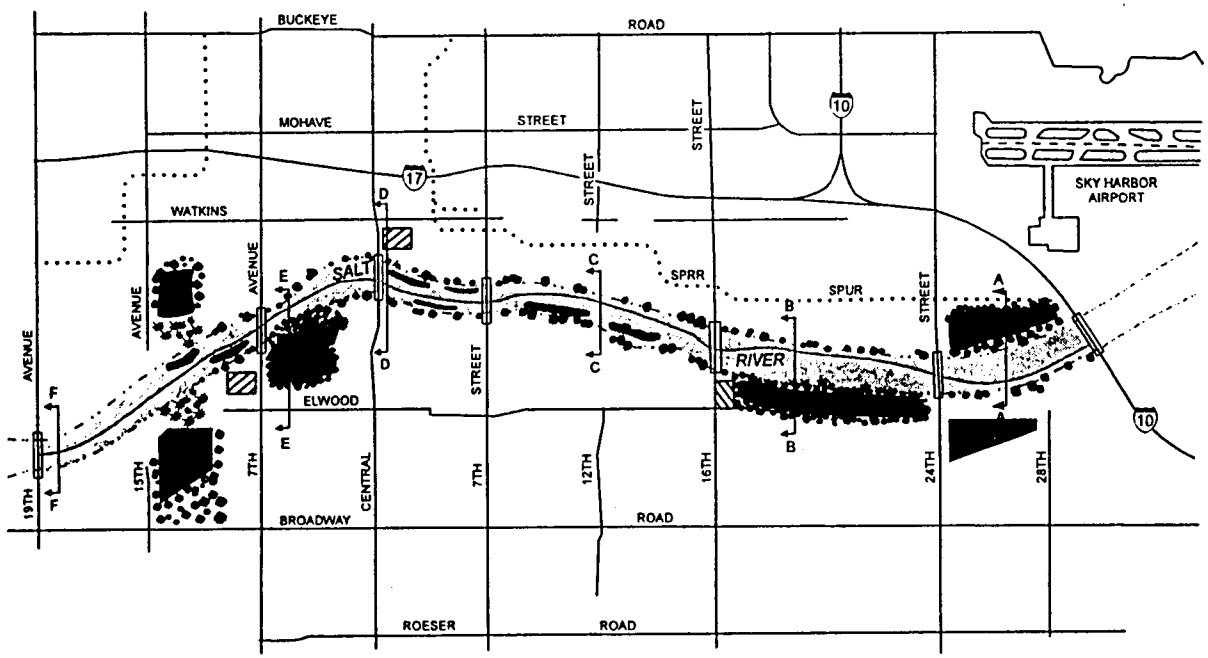

LEGEND

- MESQUITE HABITAT
- WETLAND/MARSH HABITAT
- COTTONWOOD/WILLOW HABITAT
- GRAVEL PIT BASIN/WATER FEATURE
- LOW FLOW STREAM
- PARK/GATEWAY AREA

N

0 — 1

SCALE IN MILES

GENERAL INVESTIGATIONS-SURVEYS
FISH AND WILDLIFE HABITAT RESTORATION

RIO SALADO, SALT RIVER, AZ
PHOENIX REACH
ALTERNATIVE P9
SR + G/LF2/HW + S

LOS ANGELES DISTRICT
SOUTH PACIFIC DIVISION
May 97

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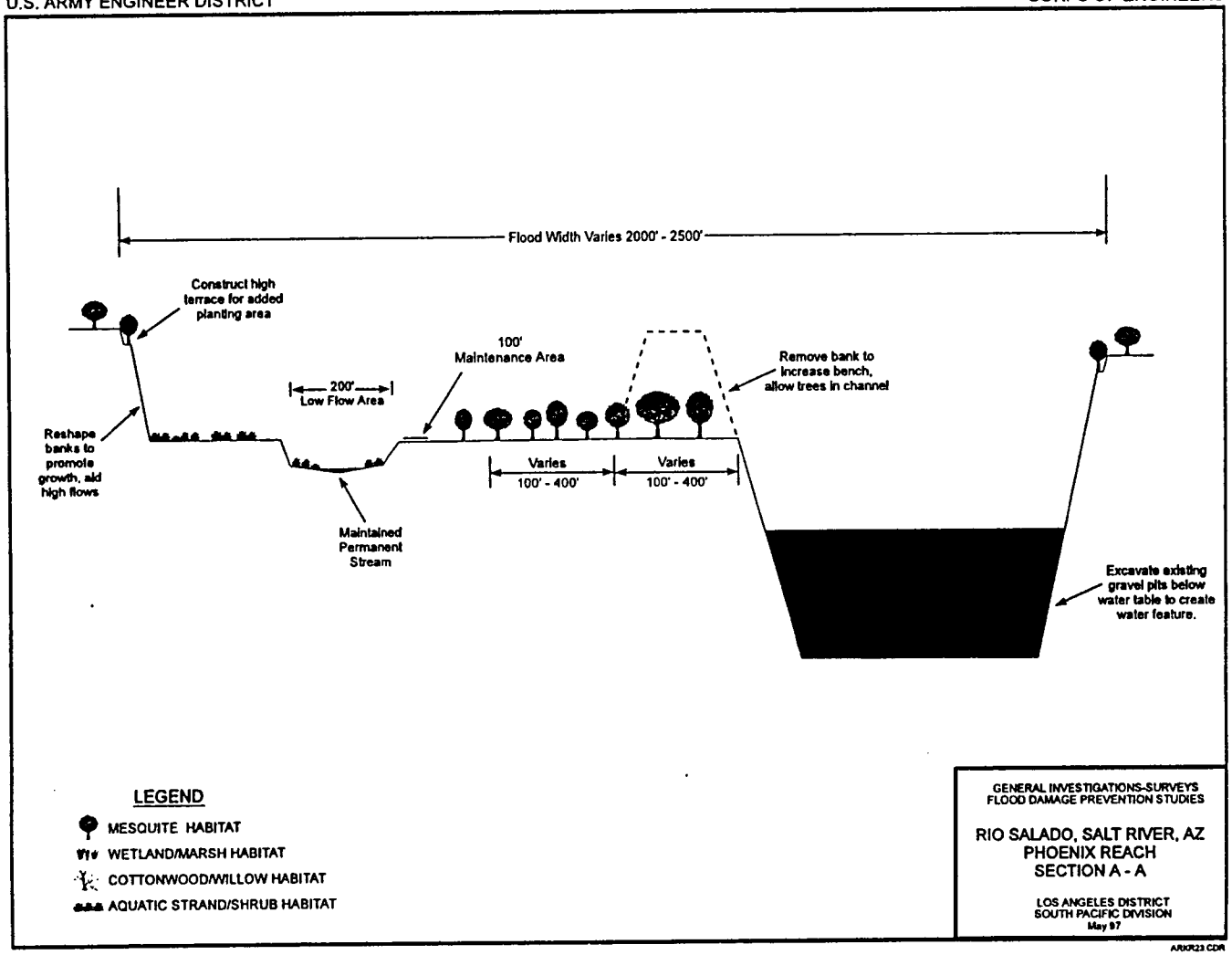

FIGURE 5-7
PHOENIX REACH
SECTION A-A

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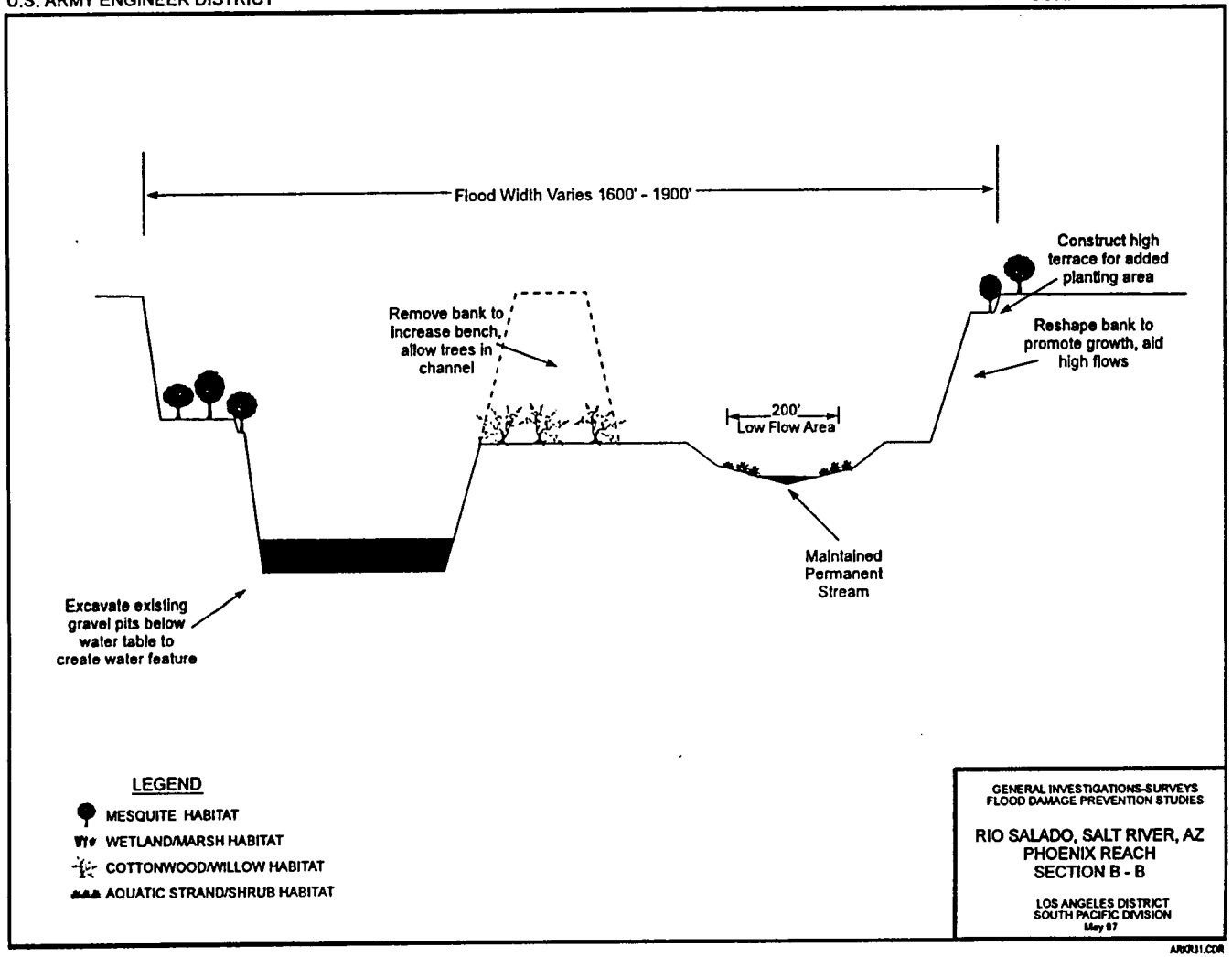

FIGURE 5-8
PHOENIX REACH
SECTION B-B

U.S. ARMY ENGINEER DISTRICT

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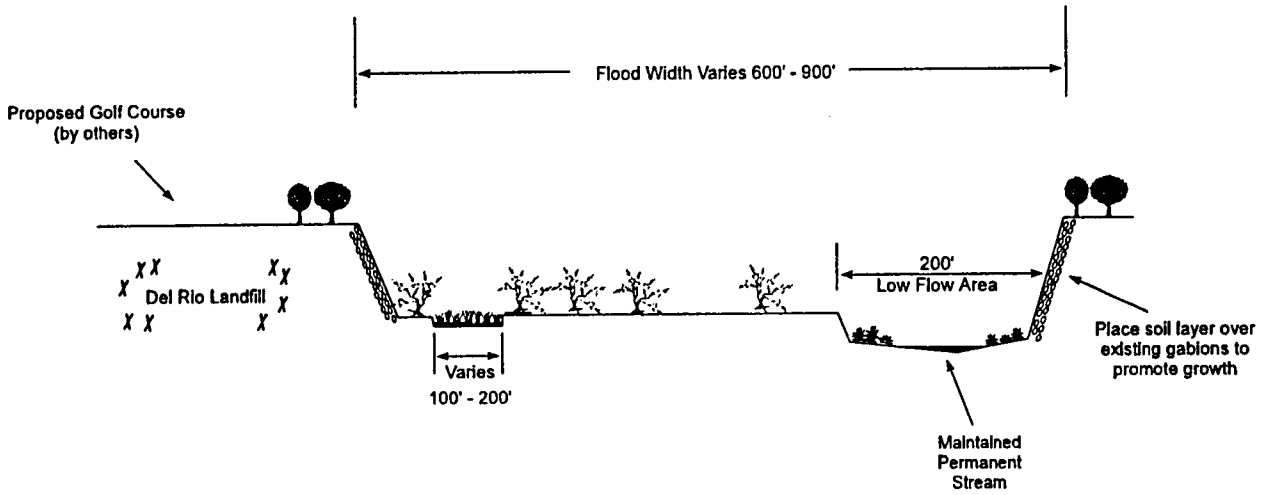

LEGEND

- MESQUITE HABITAT
- WETLAND/MARSH HABITAT
- COTTONWOOD/WILLOW HABITAT
- AQUATIC STRAND/SHRUB HABITAT

GENERAL INVESTIGATIONS-SURVEYS
FLOOD DAMAGE PREVENTION STUDIES

RIO SALADO, SALT RIVER, AZ
PHOENIX REACH
SECTION C - C

LOS ANGELES DISTRICT
SOUTH PACIFIC DIVISION
May 97

ARKR29.CDR

FIGURE 5-9
PHOENIX REACH
SECTION C-C

U.S. ARMY ENGINEER DISTRICT

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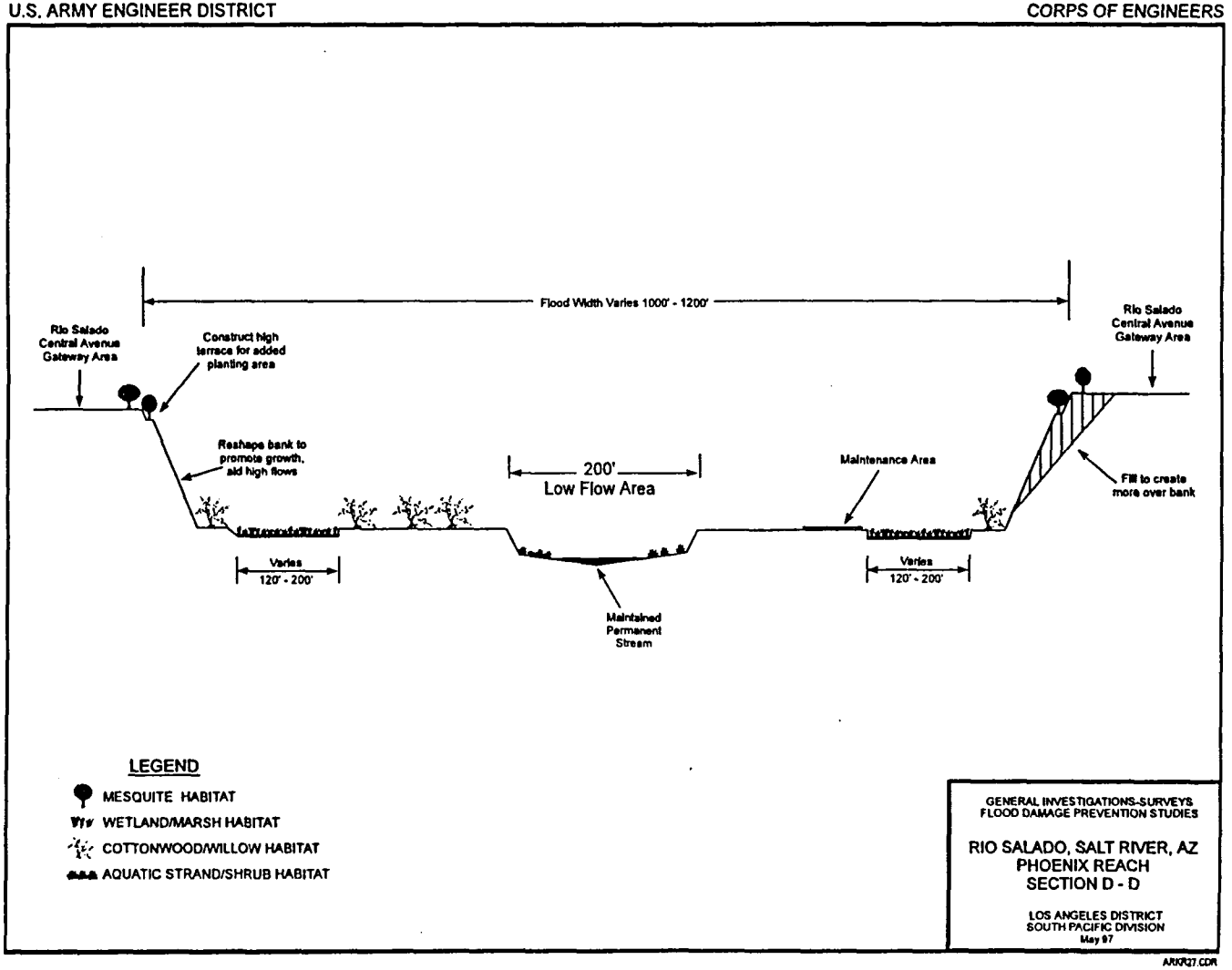
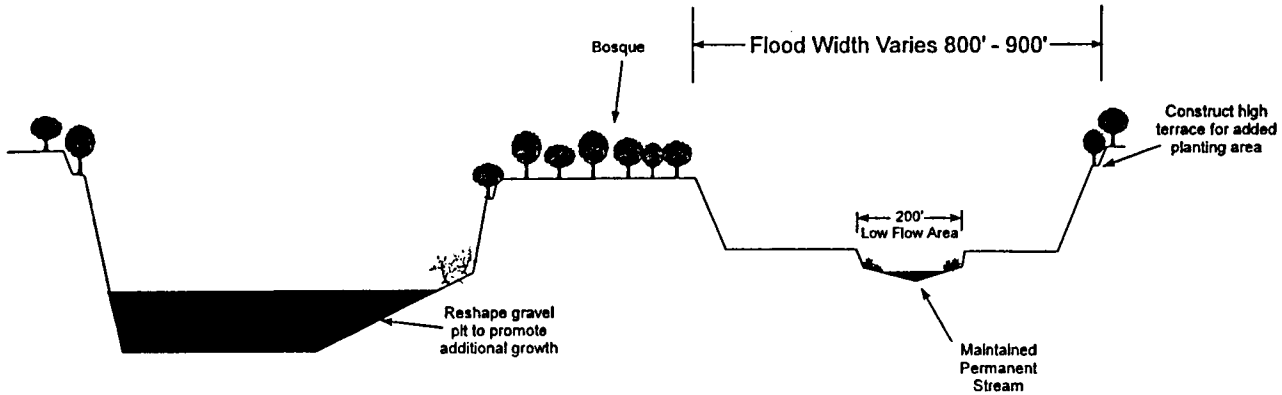


FIGURE 5-10
PHOENIX REACH
SECTION D-D

FIGURE 5-11
PHOENIX REACH
SECTION E-E

U.S. ARMY ENGINEER DISTRICT

CORPS OF ENGINEERS



LEGEND

- MESQUITE HABITAT
- WETLAND/MARSH HABITAT
- COTTONWOOD/WILLOW HABITAT
- AQUATIC STRAND/SHRUB

GENERAL INVESTIGATIONS-SURVEYS
FLOOD DAMAGE PREVENTION STUDIES

RIO SALADO, SALT RIVER, AZ
PHOENIX REACH
SECTION E - E

LOS ANGELES DISTRICT
SOUTH PACIFIC DIVISION
May 97

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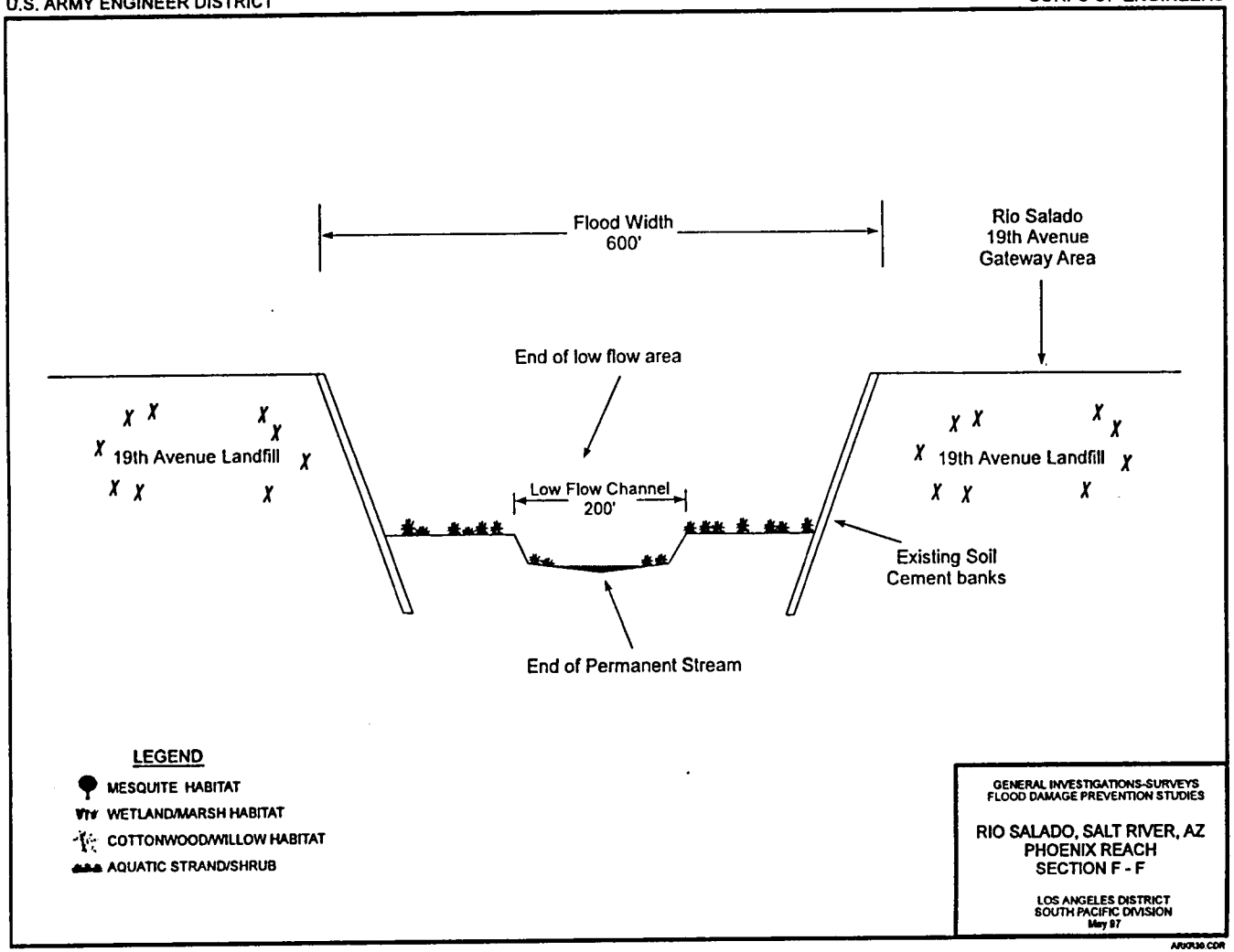


FIGURE 5-12
PHOENIX REACH
SECTION F-F

E. BENEFITS OF ALTERNATIVES

Habitat Analysis

An assessment of habitat value was performed for each of the proposed types of restoration habitat included in the alternatives. A modified habitat evaluation procedure analysis was conducted. The evaluation of the proposed types of habitat included consideration of their location within the study area, acreage and anticipated habitat units. The evaluation of the riparian ecosystem habitat types was based upon criteria established during the reconnaissance study. The evaluation was based upon accepted methodologies and performed by a team of personnel with professional experience and qualifications in the Southwestern Sonoran Desert area of Arizona.

A Habitat Suitability Index (HSI) was assigned to each of the habitat types for the IBW and Salt River areas. The HSI is number between 0.0 and 1.0. It was assigned to each habitat type to reflect the average value of the habitat that is expected over the life of the project. The assigned HSI value takes into account the relative value of the habitat areas within the urban environment, the value at project year one, the value when mature, and the value over time considering replacement of habitat when required due to flood damages or other habitat maintenance replacement. The HSI value was then multiplied by the number of acres for each habitat type to establish a Habitat Unit (HU). The total Habitat Value (HV) for each alternative was based on a summation of the HU's for each type of habitat in the alternative. **Tables 5-3 and 5-4** present the results of the habitat assessment analysis.

The results of the habitat evaluation indicates that the high water use alternatives yield greater habitat units than the low water use alternatives. All four of the high water use alternatives resulted in higher habitat units than any of the four low water use alternatives. This is indicative of the value of alternatives emphasizing riparian habitat. For the Tempe reach, the alternative resulting in the highest habitat benefit is T5 with 71 habitat units. For the Phoenix reach, the alternative yielding the highest habitat benefit is Alternative T9 with 361.5 habitat units.

TABLE 5-3
TEMPE ALTERNATIVES HABITAT EVALUATION MATRIX

TEMPE ALTERNATIVES HABITAT EVALUATION										
Alternative	Restoration	Habitat Type								
	Area	MU			CW	WM	AS	O	Other	Total
	LF								50	50
T1. NA	B								30	30
	SR US								30	30
	SR DS								30	
Total (Acres)		0	0	0	0	0	0	0	140	110
Habitat Suitability Index (HSI)										
Habitat Units (HU)		0	0	0	0	0	0	0	0	0
	LF								50	50
T2. IBW/LW	B	20						10		30
	SR US								30	30
	SR DS									
Total (Acres)		20	0	0	0	0	0	10	80	110
Habitat Suitability Index (HSI)		0.6			0.4			0.2	0	
Habitat Units (HU)		12	0	0	0	0	0	2	0	14
	LF								50	50
T.3 IBW+SR(US + DS)/LW	B	20						10		30
	SR US		5					25		30
	SR DS			5				25		30
Total (Acres)		20	5	5	0	0	0	60	50	140
Habitat Suitability Index (HSI)		0.6	0.4	0.5		0.4		0.2	0	
Habitat Units (HU)		12	2	2.5	0	0	0	12	0	28.5
	LF						50			50
T4. IBW+SR DS /HW	B	20						10		30
	SR US								30	30
	SR DS									
Total (Acres)		20	0	0	10	8	50	10	30	110
Habitat Suitability Index (HSI)		0.6			0.6	0.7	0.58	0.2	0	
Habitat Units (HU)		12	0	0	6	5.6	29	2	0	54.6
	LF						50			50
T5. IBW+SR(US + DS)/HW	B	20						10		30
	SR US				10	8		12		30
	SR DS				10	8		12		30
Total (Acres)		20	0	0	20	16	50	34	0	140
Habitat Suitability Index (HSI)		0.6			0.6	0.7	0.58	0.2		
Habitat Units (HU)		12	0	0	12	11.2	29	6.8	0	71
	LF									
T6. SR DS / HW	B									
	SR US									
	SR DS				10	8		12		30
Total (Acres)		0	0	0	10	8	0	12	0	30
Habitat Suitability Index (HSI)					0.6	0.7		0.2		
Habitat Units (HU)		0	0	0	6	5.6	0	2.4	0	14

TABLE 5-3
TEMPE ALTERNATIVES HABITAT EVALUATION MATRIX

RESTORATION AREA	**HABITAT TYPE**
LF=IBW Low Flow Channel	MU=Mesquite Upland
B= IBW Bench	CW=Cottonwood and Willow Dominant
SR=Salt River	WM=Wetland Marsh
SRLF=Salt River Low Flow Channel	AS=Aquatic Strand/Scrub
US=Upstream of Town Lake	O=Open Space or Urban Park
DS=Downstream of Town Lake	Other=Canals, recreation trails, service roads, parking areas, landscaping, soil cement, gravel pits, etc.

ALTERNATIVE CODES: SR=Salt River, G=Gravel Pits, LFO=Low Flow equals Full Bottom, LF2=Low Flow equals 200 Feet, LF3.5=Low Flow equals 350 Feet, LF5=Low Flow equals 500 Feet, LW=Low Water Use, HW=High Water Use, S=Stream

RESTORATION AREA CODE LF=Low Flow Channel, B=Bench, BK=Bank, OBK=Overbank, P=Park, G=Gravel Pits

HABITAT TYPE CODES: MU=Mesquite Upland, CW=Cottonwood and Willow Dominant, WM=Wetland Marsh, AS=Aquatic Strand/Scrub O=Open Space or Urban Park, Other=Canals, recreation trails, service roads, parking areas, landscaping.

ALTERNATIVE	**RESTORATION AREA**	**HABITAT TYPES**
NA=No Action	SRLF=Salt River Low Flow Channel	MU=Mesquite/Upland
LW=Low Water Use	B=Bench	CW=Cottonwood/Willow
HW=High Water Use	BK=Bank	WM=Wetland Marsh
HW+S=High Water Use + Stream	OBK=Overbank	AS=Aquatic Strand/Scrub
	P=Park/Gateway Areas	O=Open Space, Park Areas
	G=Gravel Pit Bottoms	Other=Canals, recreation trails, service roads, parking areas, landscaping soil cement, gravel pits, etc.

NOTE:Shading denotes that this is not applicable.

TABLE 5-4
PHOENIX ALTERNATIVES HABITAT EVALUATION MATRIX

PHOENIX ALTERNATIVES HABITAT EVALUATION									
Alternative	Restoration	Habitat Type							
	Area	MU	CW		WM	AS	O	Other	Total
	LF							400	400
	B							0	0
P1. NA	BK							40	40
	OBK							60	60
	P							50	50
	G							0	0
Total (Acres)		0	0	0	0	0	0	550	550
Habitat Suitability Index (HSI)									
Habitat Units (HU)		0	0	0	0	0	0	0	0
	LF						130		130
	B	20	80		40		120	10	270
P2. SR/LW	BK						35	5	40
	OBK	30					20	10	60
	P						50		50
	G								0
Total (Acres)		50	80	0	40	0	355	25	550
Habitat Suitability Index (HSI)		0.5	0.5	0	0.6		0.2	0	
Habitat Units (HU)		25	40	0	24	0	71	0	160
	LF						130		130
	B		160		100			10	270
P3. SR/HW	BK		5				30	5	40
	OBK	10	20				10	20	60
	P						50		50
	G								0
Total (Acres)		10	185	0	100	0	220	35	550
Habitat Suitability Index (HSI)		0.5	0.6	0	0.6		0.25	0	
Habitat Units (HU)		5	111	0	60	0	55	0	231
	LF					130	0		130
	B	20	80		40		120	10	270
P4. SR/LW+S	BK						35	5	40
	OBK	30					20	10	60
	P						50		50
	G								0
Total (Acres)		50	80	0	40	130	225	25	550
Habitat Suitability Index (HSI)		0.5	0.6	0	0.6	0.5	0.25	0	
Habitat Units (HU)		25	48	0	24	65	56.25	0	218.25
	LF					130	0		130
	B		160		100			10	270
P5. SR/HW+S	BK		5				30	5	40
	OBK	10	20				10	20	60
	P						50		50
	G								0
Total (Acres)		10	185	0	100	130	90	35	550
Habitat Suitability Index (HSI)		0.5	0.7	0	0.7	0.6	0.3	0	
Habitat Units (HU)		5	130	0	70	78	27	0	309.5

TABLE 5-4
PHOENIX ALTERNATIVES HABITAT EVALUATION MATRIX

PHOENIX ALTERNATIVES HABITAT EVALUATION

Alternative	Restoration Area	Habitat Type: MU	CW	WM	AS	O	Other	Total
	LF					130		130
	B	50	80	40		120	10	300
P6. SR+G/LW	BK					45	5	50
	OBK	45				35	30	110
	P					50		50
	G		10				230	240
Total (Acres)		95	80	10	40	0	380	275	880
Habitat Suitability Index (HSI)		0.5	0.5	0.7	0.6		0.2	0	
Habitat Units (HU)		47.5	40	7	24	0	76	0	194.5
	LF					130		130
	B	30	160	100			10	300
P7. SR+G/HW	BK	5	40	0		5		50
	OBK	25	20			25	40	110
	P					50		50
	G		10				230	240
Total (Acres)		60	220	10	100	0	210	280	880
Habitat Suitability Index (HSI)		0.5	0.6	0.7	0.6		0.25	0	
Habitat Units (HU)		30	132	7	60	0	52.5	0	281.5
	LF					130	0		130
	B	50	80	40		120	10	300
P8. SR+G/LW+S	BK					45	5	50
	OBK	45				35	30	110
	P					50		50
	G		10				230	240
Total (Acres)		95	80	10	40	130	250	275	880
Habitat Suitability Index (HSI)		0.5	0.6	0.7	0.6	0.5	0.25	0	
Habitat Units (HU)		47.5	48	7	24	65	62.5	0	254
	LF					130	0		130
	B	30	160	100				10	300
P9. SR+G/HW+S	BK	5	40					5	50
	OBK	25	20				25	40	110
	P						50		50
	G			10				230	240
Total (Acres)		60	220	10	100	130	75	285	880
Habitat Suitability Index (HSI)		0.5	0.7	0.7	0.7	0.6	0.3	0	
Habitat Units (HU)		30	154	7	70	78	22.5	0	361.5

NA=No Action	LF=Low Flow Channel	MU=Mesquite/Upland
LW=Low Water Use	B=Bench	CW=Cottonwood/Willow
HW=High Water Use	BK=Bank	WM=Wetland Marsh
HW+S=High Water Use + Stream	OBK=Overbank	AS=Aquatic Strand/Scrub
LW+G=Low Water Use + Gravel Pits	P=Park/Gateway Areas	O=Open Space, Park Areas
HW+G=High Water Use + Gravel Pits	G=Gravel Pit Bottoms	Other=Canals, recreation trails, service
HW+G+S=High Water Use + Gravel Pits + Stream		roads, parking areas, landscaping
LW+G+S=Low Water Use+Gravel Pits+Stream		soil cement, gravel pits, etc.

NOTE: Shading denotes that this is not applicable.

F. COST OF ALTERNATIVES

A cost estimate was prepared for each of the restoration alternatives. The detailed cost estimate for each of the alternatives is presented in **Appendix G, Design and Cost**. A description of the primary cost items included in the alternatives is as follows:

Infrastructure Improvements: For the Phoenix reach this consisted primarily of the low flow channel. The low flow channel helps reduce damages to the primary restoration features from peak discharges and inundation. The estimate for the low flow channel includes excavation, concrete grade control structures and soil cement or concrete stabilized alluvium for the low flow channel bank and toe down protection. Preliminary design details for this low flow channel are presented in **Appendix B, Hydraulics**. The primary infrastructure requirements for Tempe include pipe drains and a pump for the high water alternatives. A gravity drain pipe is required to divert IBW restoration outfall water upstream or downstream of Town Lake. A pump and drain pipe are required to bypass water from the Salt River upstream of Town Lake to the downstream restoration area. This provides a continuos flow for the wetland marsh, maintains the optimal water level upstream, and prevents undesireable inundation habitat.

Habitat Creation: The estimate includes cost per acre to plant and establish the various types of restoration habitat types. These include mesquite bosque, cottonwood-willow dominant, and wetland-marsh.

Water Supply: The estimated first cost of developing the water supply, annual cost of water, and annual OMRR&R costs related to water for each of the alternatives have been included in the estimate. An analysis of water supply alternatives and costs has been conducted by both Tempe and Phoenix. The water supply analysis for Tempe and Phoenix are presented in **Appendix H, Water Supply Analysis and Cost**. It is important to note that the cost of developing the water supply and the associated O&M costs are highly dependant upon treatment costs. For this estimate, the maximaum possible anticipated cost of water has been included for the Phoenix Reach. Water quality of the groundwater in the aquifer could significantly reduce the costs if treatment costs can be eliminated.

PE&D and S&A Costs: The estimate includes estimates for pre-construction, engineering and design costs and estimates for supervision and administration during construction.

Annual Habitat OMRR&R: The estimate includes an estimated amount for replacement and maintenance of the restored habitat. This includes plant replacement and related costs.

Costs which have not been included in the estimate at this time include real estate, the water distribution system (ie. irrigation), and O&M features such as maintenance roads. The real estate costs in the river have been determined to have a minimal cost. Design and cost of the water conveyance system to support the habitat will be developed upon selection of the tentatively

selected plan so that a conveyance/irrigation system can be developed specifically for that plan.

A summary of the total economic cost for each of the alternatives is presented in **Tables 5-5 and 5-6**. The total economic cost is presented in the form of an annual cost for each alternative. The total annual cost is the sum of the annualized total gross investment and the annual operation and maintenance costs The total gross investment includes the total first cost plus interest during construction. The annual operation and maintenance costs include those annual costs estimated for water supply and for habitat. The economic costs have been calculated for an assumed 50-year project life at an amortization rate of 7.375%.

Table 5-5
Tempe Reach
Costs by Alternative (in $1,000s)

Alternative	First Cost	Interest During Construction*	Gross Investment	Interest & Amortization**	OMRR&R	Total Annual Cost
T1	NA					
T2	$1,239	$45	$1,284	$97	$65	$162
T3	$1,387	$50	$1,437	$109	$84	$193
T4	$2,723	$99	$2,822	$214	$315	$529
T5	$4,756	$172	$4,928	$374	$440	$814
T6	$1,930	$70	$2,000	$152	$149	$301

** One year construction period assumed for all alternatives*
*** 7 3/8%, 50 Years*

Table 5-6
Phoenix Reach
Costs by Alternative (in $1,000s)

Alternative	First Cost	Interest During Construction*	Gross Investment	Interest & Amortization**	OMRR&R	Total Annual Cost
P1	NA					
P2	$42,174	$3,110	$45,284	$3,438	$1,223	$4,661
P3	$57,465	$4,238	$61,703	$4,684	$2,672	$7,356
P4	$58,491	$4,314	$62,805	$4,768	$2,555	$7,323
P5	$68,383	$5,043	$73,426	$5,574	$4,016	$9,590
P6	$43,646	$3,219	$46,865	$3,558	$1,366	$4,924
P7	$62,896	$4,639	$67,535	$5,127	$3,223	$8,350
P8	$60,272	$4,445	$64,717	$4,913	$2,734	$7,647
P9	$77,186	$5,692	$82,878	$6,292	$4,555	$10,847

** Two year construction period assumed for all alternatives*
*** 7 3/8%, 50 Years*

G. ALTERNATIVE SCREENING

Incremental Analysis

An incremental cost analysis was performed on the alternatives utilizing the results of the habitat benefit analysis and the estimated annual costs of the alternatives. Detailed discussion of the incremental cost analysis are presented in **Appendix C, Economics.**

The results indicate the strong dependancy of water supply in maximizing the increases in habitat benefits for this type of an ecosystem. The high water use alternatives, emphasizing riparian habitat, produce significantly higher habitat value units than the low water alternatives. Not suprisingly, the cost of the high water use alternatives are also significantly higher. This is due to the first cost of developing the water source and the annual cost of supplying the water demand.

Tempe Reach

As presented in **Appendix C, Economics**, the cost effectiveness and incremental cost analysis evaluation yielded three alternatives in the Tempe reach for final selection consideration. These were the T1 (No Action Alternative), T3 (Alternative IBW+SR(US+DS)/LW), and Alternative

T5 (IBW+SR(US+DS)/HW). The other three alternatives were dropped from further consideration because their average incremental cost was higher than Alternative T3. The final incremental cost analysis results for Tempe are presented in **Table xx**. The two most cost effective alternatives are T3 and T5. The primary difference between the two alternatives is the use of low water versus high water vegetation.

Table 5-7
Tempe Reach
Final Incremental Cost Analysis Results

Alternative	Annual Costs ($1,000s)	HUs	Incremental Cost ($1,000s)	Incremental Output	Incremental Avg. Cost ($1,000s)
T1	0	0	0	0.0	0
T3	$193	28.5	$193	28.5	$6.77
T5	$814	71	$621	42.5	$14.61

Phoenix Reach

None of the Phoenix alternatives provide the same level of output for different costs or have the same costs for different levels of output, so no alternatives were eliminated from consideration based upon these criteria. **Table 5-8** below displays the incremental cost of the least cost alternatives.

Table 5-8
Phoenix Reach
Incremental Cost Analysis for Least Cost Alternatives

Alternative	Annual Costs ($1,000s)	HUs	Incremental Cost ($1,000s)	Incremental Output	Incremental Avg. Cost ($1,000s)
P1	0	0	0	0	0
P2	$4,661	160	$4,661	160	$29.13
P6	$4,924	195	$263	35	$7.51
P4	$7,323	218	$2,399	23	$104.30
P3	$7,356	231	$33	13	$2.54
P8	$7,647	255	$291	24	$12.13
P7	$8,350	281	$703	26	$27.04
P5	$9,590	311	$1,240	30	$41.33
P9	$10,847	348	$2,497	48	$33.97

Based upon the final incremental cost analysis, alternatives P6 and P9 were determined to be most cost effective. The incremental average annual cost of achieving 195 habitat units under P6 is $25,250, which is less than the incremental average annual cost of implementing any of the other alternatives under consideration. For example, the incremental average annual cost of implementing alternative P2 is $29,130. The incremental average annual cost of achieving more habitat units than those provided by alternative P6 is $38,710 under alternative P9. This is less than the average annual cost of achieving additional habitat units under any of the other remaining alternatives. For example, alternative P4 provides an additional 23 habitat units relative to P6 at an incremental cost of nearly $2.4 million. The resulting incremental average annual cost is therefore $104,300. In other words, to achieve more output than alternative P6, one can implement alternative P4 and achieve an additional 23 habitat units, but the average annual cost for each of those habitat units is $104,300. This is more than $65,000 per habitat unit greater than the incremental average annual cost of achieving an additional 153 habitat units under alternative P9. **Table 5-9** summarizes the results of the incremental cost analysis for the Phoenix Reach.

Table 5-9
Phoenix Reach
Final Incremental Cost Analysis Results

Alternative	Annual Costs ($1,000s)	HUs	Incremental Cost ($1,000s)	Incremental Output	Incremental Avg. Cost ($1,000s)
P1	0	0	0	0	0
P6	$4,924	195	$4,924	195	$25.25
P9	$10,487	329	$5,923	153	$38.71

The incremental cost analysis indicates that alternatives P6 and P9 are cost effective. P6 [SR+G/LW] restores both the Salt River and the gravel pit areas with low water use vegetation. Alternative P9 is the most comprehensive alternative and features the establishment of high water use vegetation along the Salt River and in the gravel pit areas, and also includes a perennial stream in the low flow channel.

No comparison can be made between the results of incremental analysis results for habitat units in the Southwest Sonoran Desert and elsewhere in the United States. Due to the scarceness of riparian habitat in the southwest, any increases are considered more valuable and significant than habitat values elsewhere. In addition, riparian habitat is considered the fastest disappearing forest type in the United States.

H. RECOMMENDED PLAN

Tempe Reach

The recommended plan for the Tempe Reach is Alternative T5 (IBW+SR(U+D)/HW). This is the most comprehensive plan analyzed. It includes restoration of Indian Bend Wash and the Salt River both

upstream and downstream of Tempe Town Lake with high water use vegetation. This plan is recommended because it most closely meets the planning objectives identified for this study, including:

Restoration of threatened and endangered species habitat
Restoration of the Study Area to a more natural condition through the installation of plant species that are native to, and occurred historically, in riparian streams and washes in the region
Increase recreation opportunities
Contribute to other qualitative environmental quality objectives

The recommended alternative also includes more of the selected management measures, including:

Varied mix of plant and habitat types
Maximizes use of areas available for restoration
Includes continual flow measures for wetlands

The recommended alternative features restoration of 20 acres of mesquite upland habitat, 20 acres of cottonwood and willow habitat, 16 acres of wetlands, 50 acres of aquatic strand/scrub habitat, and 34 acres of open space habitat. The average annual cost per habitat unit is approximately $11,500. Although this average cost is substantially higher than that for Alternative T3 ($6,700/HU), it provides nearly 2.5 times the number of total habitat units. The conceptual habitat restoraiton plan for the Tempe Reach is presented on **Plates 5-5 and 5-6.**

Phoenix Reach

The recommended plan for the Phoenix Reach is Alternative P9. This is the most comprehensive plan analyzed. It includes restoration of the Salt River and gravel pits with high water use vegetation, as well as a perennial stream within a constructed low flow channel. This plan is recommended because it meets more of the planning objectives and identified management measures listed above.

The restoration would consist of 60 acres of mesquite upland habitat, 230 acres of cottonwood and willow habitat, 100 acres of wetlands, 130 acres of aquatic strand/scrub habitat, and 75 acres of open space habitat.

The cost of this alternative is significantly higher than many of the other alternatives. To achieve a more desirable habitat mix requires greater water use, both for higher water use vegetation and the flowing stream. For example, use of higher water use vegetation requires an additional first cost exceeding $15 million, in addition to over $1.4 million more in annual operation and maintenance costs. Similarly, adding the perennial stream results in an increase of more than $14 million in total first cost and over $2.4 million in annual O&M costs. These cost factors must be weighed against the benefits. In addition to providing the greatest number of total habitat acres, this alternative provides a more optimal mix of habitat relative to the other alternatives considered. The conceptual habitat restoration plan for the Phoenix Reach is presented on **Plates 5-1 through 5-4.**

Recreation Plan

The recreation plan formulated for the Rio Salado restoration plan is based upon maximizing the

unique, resource based, passive recreation and environmental education opportunities provided by the restoration plan. The riparian habitat created as a result of the restoration plan is unlike any other resource within the metropolitan area. The specific objectives of the recreation plan include:

1. Ensure recreation features are incidental to the primary restoration purpose.

2. Provide opportunities for visitors of all physical capabilities to enjoy the resource.

3. Develop an awareness, knowledge and understanding of desert riparian habitats.

4. Share the important role of the Salt River in the history and development of the Valley.

5. Create a wide variety of passive means to enjoy the resource including viewing, picknicking, education, or exploring by foot, horseback or bicycle.

The recreation analysis is presented in **Appendix I, Recreation**. This appendix includes the recreation demand and visitation analysis, description of the formulated recreation features and a summary of the estimated recreation costs. The estimated economic value of the recreation plan and the conversion to the recreation plan benefit-to-cost ratio is presented in **Appendix C, Economics**.

The total annual recreation value for the recreation plans are $17,901,000 for Tempe and $4,125,000 for Phoenix. The estimated costs for the recreation plans are presented in **Table 5-10**. The benefit-cost analysis results fo rthe recreation plans are presented in **Table 5-11**.

Table 5-10
Recreation Analysis
Estimated Costs

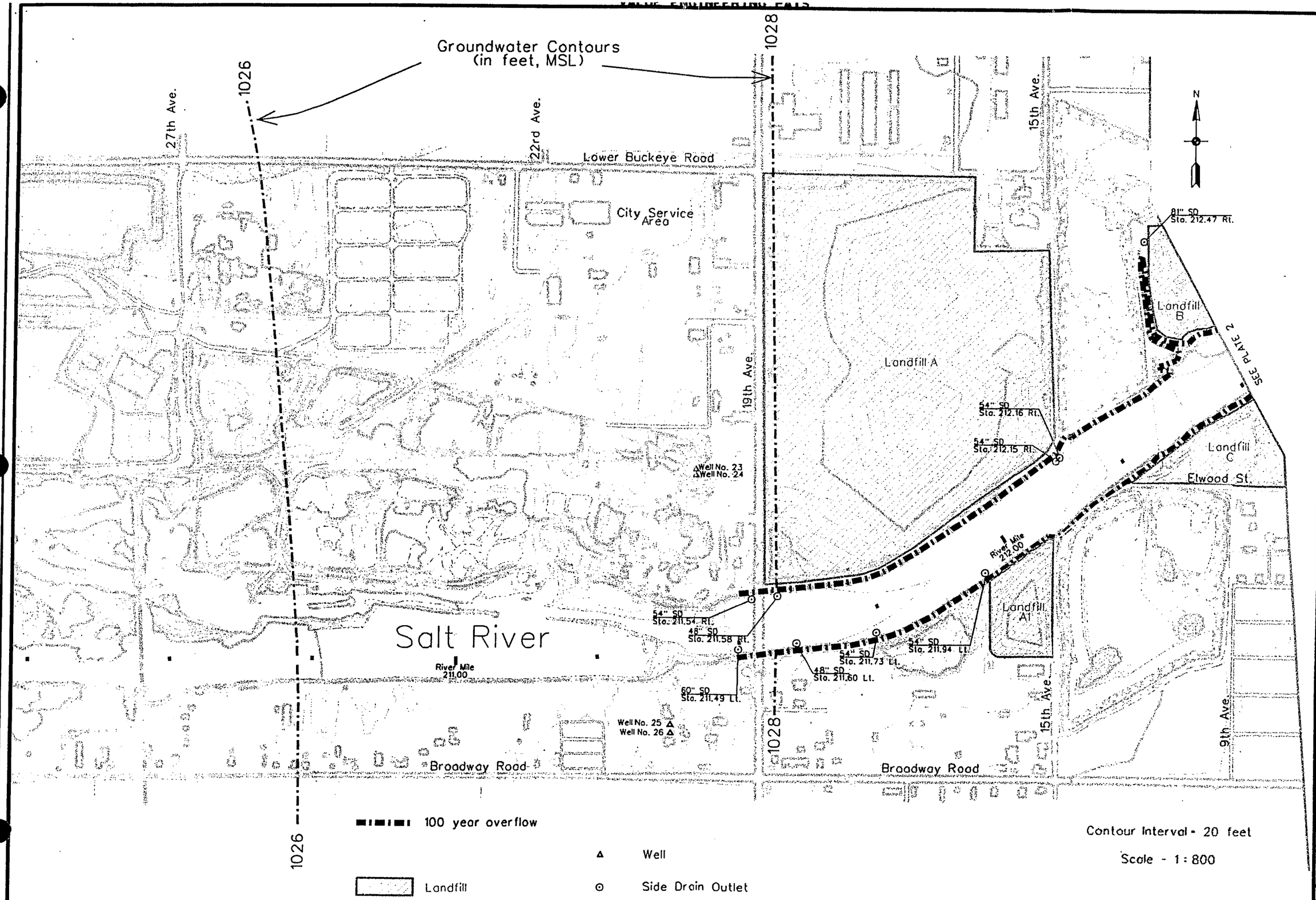
	Tempe Reach	Phoenix Reach	Total
First Cost	$4,413,000	$5,000,000	$9,413,000
Interest During Construction*	$160,000	$181,000	$341,000
Gross Investment	$4,573,000	$5,181,000	$9,754,000
Annual Cost**	$347,200	$393,300	$740,500
O&M***	$1,323,900	$1,500,000	$2,823,900
Total Annual Cost	$1,671,100	$1,893,300	$3,564,400

** One year construction period assumed*
*** 7 3/8%, 50 Years*
**** Tempe O&M cost estimate based upon Phoenix O&M/Total First Cost percentage*

The total first cost of construction of $9.4 million exceeds ten percent of the combined $82 million cost of the recommended plans for the Phoenix and Tempe reaches. Corps guidance limits total recreation expenditures to 10% of total project costs. Recreation plans were developed by the cities of Tempe and Phoenix prior to having knowledge of what the recommended restoration plans and their respective costs were going to be.

Table 5-11
Recreation Analysis
Benefit/Cost Analysis

	Tempe Reach	Phoenix Reach	Total
Annual Benefit	$17,901,000	$4,125,000	$22,026,000
Annual Cost	$1,671,100	$1,893,000	$3,564,400
Net Benefits	$16,229,900	$2,232,000	$18,461,900
B/C Ratio	10.71	2.18	6.18



SAFETY PAYS

SYMBOL	DESCRIPTIONS	DATE	APPROVAL
	REVISIONS		

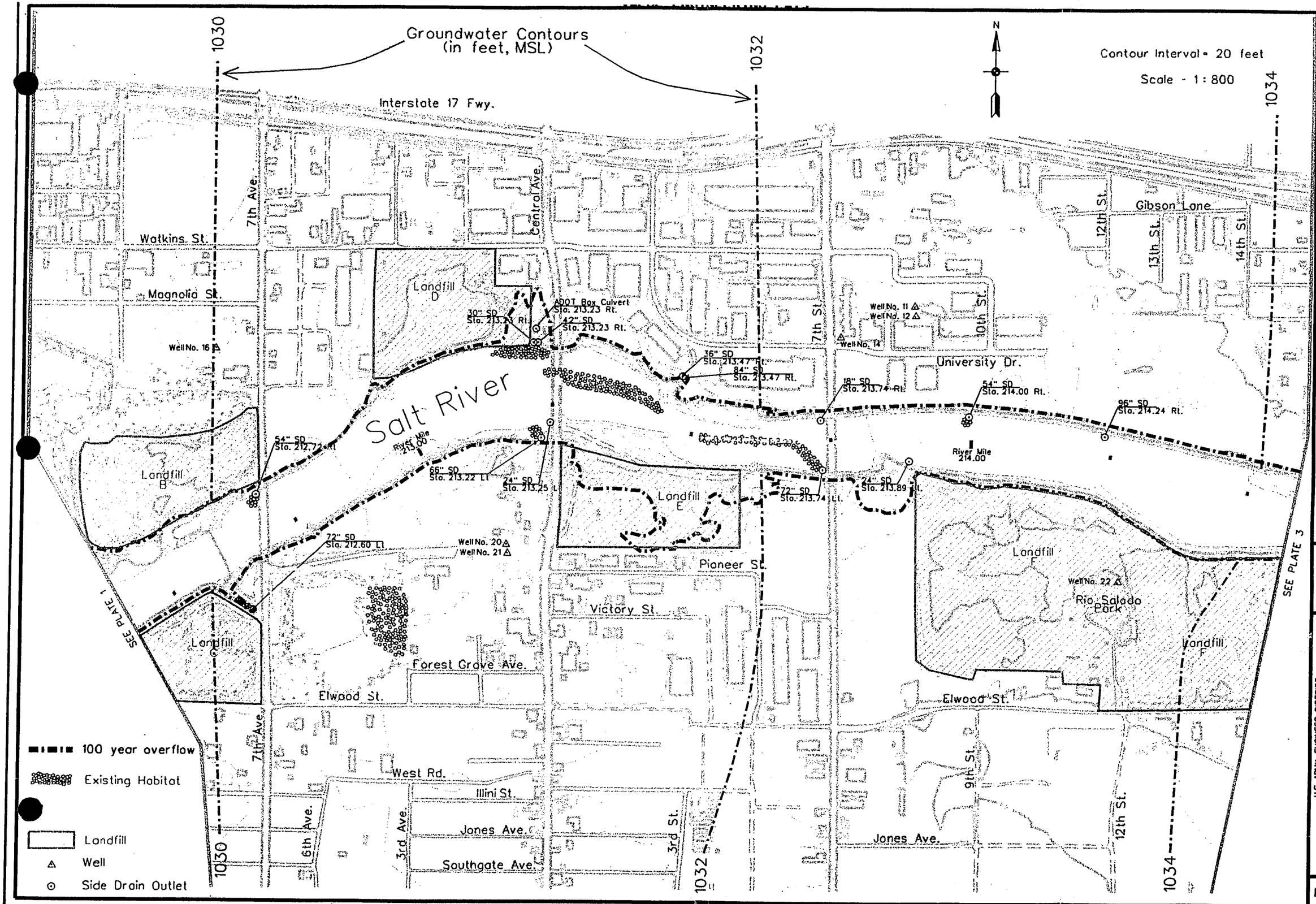
RIO SALADO, ARIZONA
FEASIBILITY REPORT

RIVER MILE 211.00 TO 212.51
EXISTING CONDITIONS

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

DESIGNED BY:
DRAWN BY:
CHECKED BY:
SUBMITTED BY:
CHIEF, EDS BRANCH
CADD FILE NAME:
DISTRICT FILE NO.
SPEC. NO.

PLATE 1A



SYMBOL	DESCRIPTION	DATE	APPROVAL
	REVISIONS		

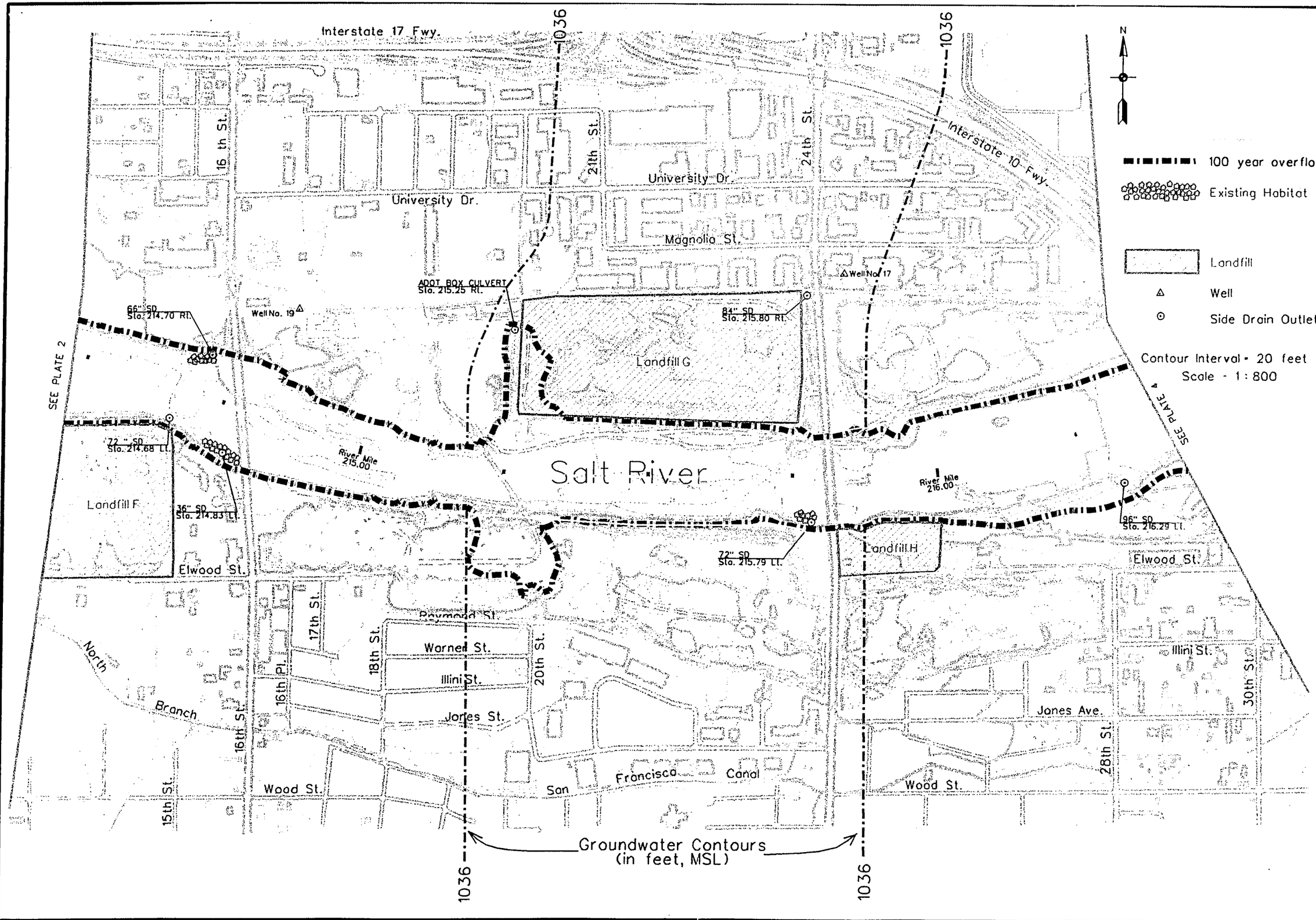
RIO SALADO, ARIZONA
FEASIBILITY REPORT
RIVER MILE 212.40 TO 214.58
EXISTING CONDITIONS

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

DESIGNED BY:
DRAWN BY:
CHECKED BY:
CADD FILE NAME:
SUBMITTED BY:
XXX
CHIEF, XXX BRANCH
DISTRICT FILE NO.
SPEC. NO.

PLATE 2A

SAFETY PAYS



SYMBOL	DESCRIPTIONS	DATE	APPROVAL

REVISIONS

RIO SALADO, ARIZONA
FEASIBILITY REPORT

RIVER MILE 214.49 TO 216.40

EXISTING CONDITIONS

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

DESIGNED BY:
DRAWN BY:
CHECKED BY:

SUBMITTED BY:

XXX
CHIEF, XXX BRANCH

CADD FILE NAME:

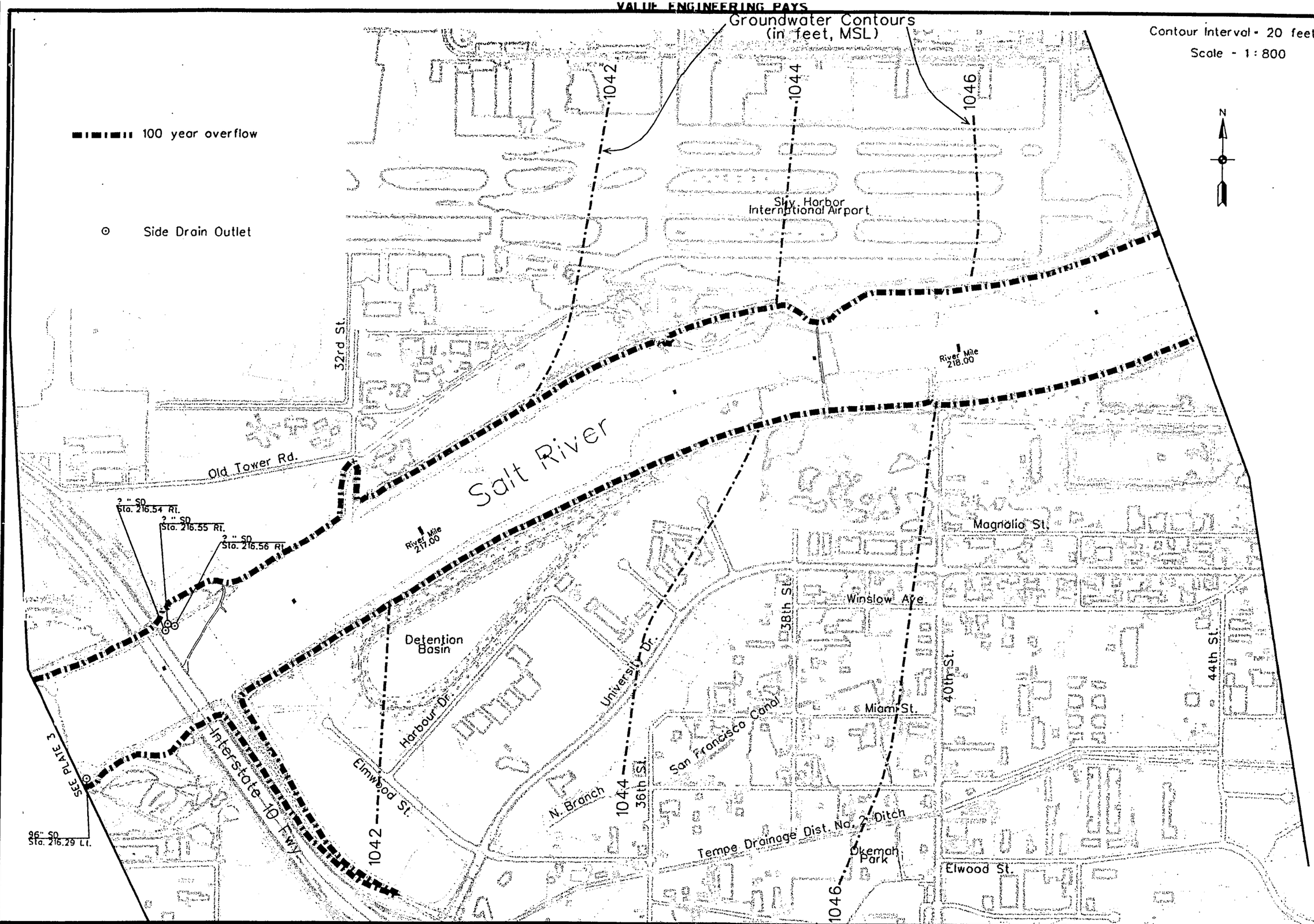
DISTRICT FILE NO.

SPEC. NO.

PLATE 3A

SAFETY PAYS

VALUE ENGINEERING PAYS



SYMBOL	DESCRIPTIONS	DATE	APPROVAL
	REVISIONS		

RIO SALADO, ARIZONA
FEASIBILITY REPORT

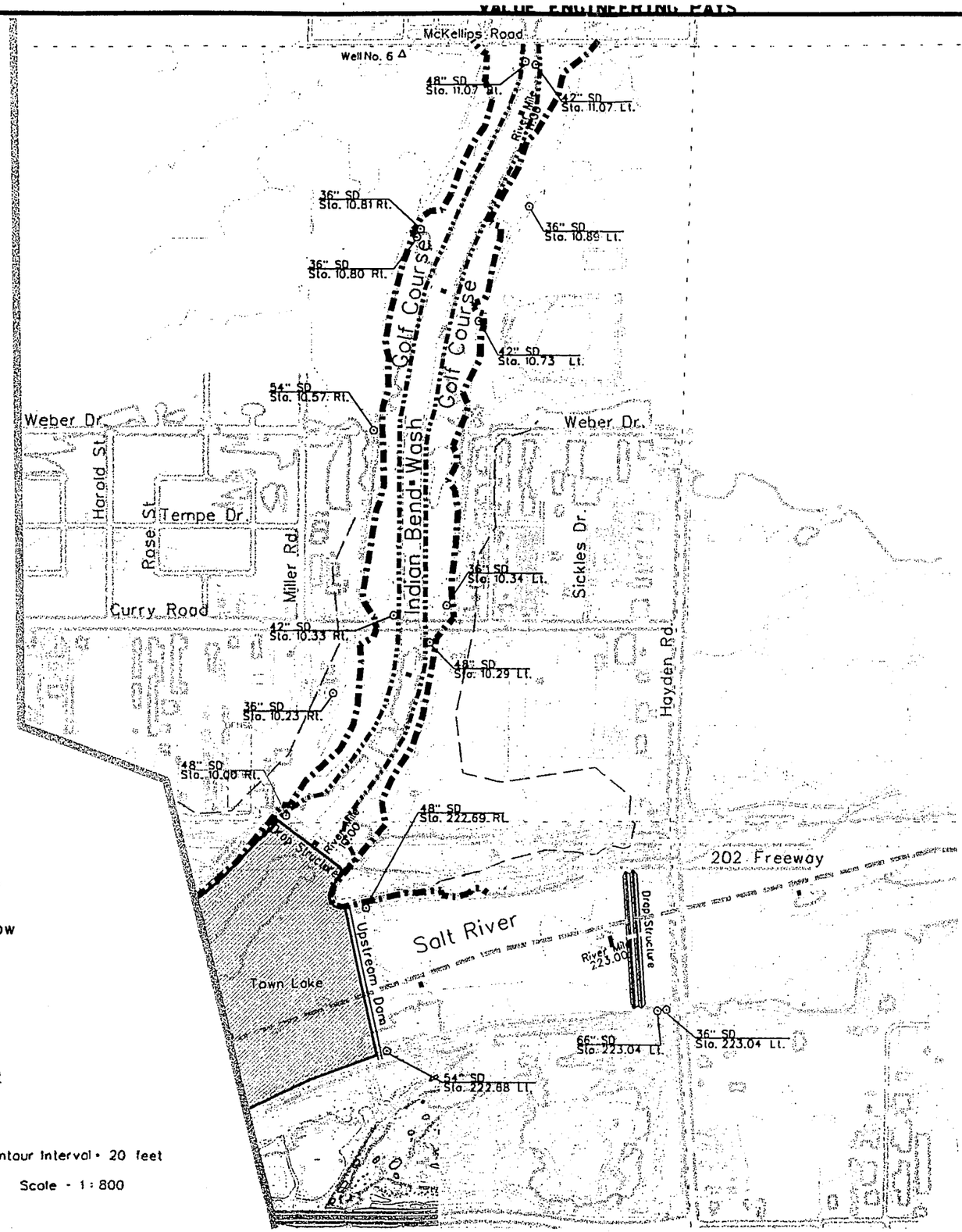
RIVER MILE 216.29 TO 217.00
EXISTING CONDITIONS

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

DESIGNED BY:
DRAWN BY:
CHECKED BY:
CADD FILE NAME:
SUBMITTED BY:
CHIEF, PLN. BRANCH
DISTRICT FILE NO.
SPEC. NO.

PLATE 4A

SAFETY PAYS



5 year overflow

100 year overflow

Well

Side Drain Outlet

Contour Interval = 20 feet

Scale - 1 : 800

SYMBOL	DESCRIPTIONS	DATE	APPROVAL
	REVISIONS		

RIO SALADO, ARIZONA
FEASIBILITY REPORT
TEMPE REACH
EXISTING CONDITIONS

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

DESIGNED BY:
DRAWN BY:
CHECKED BY:

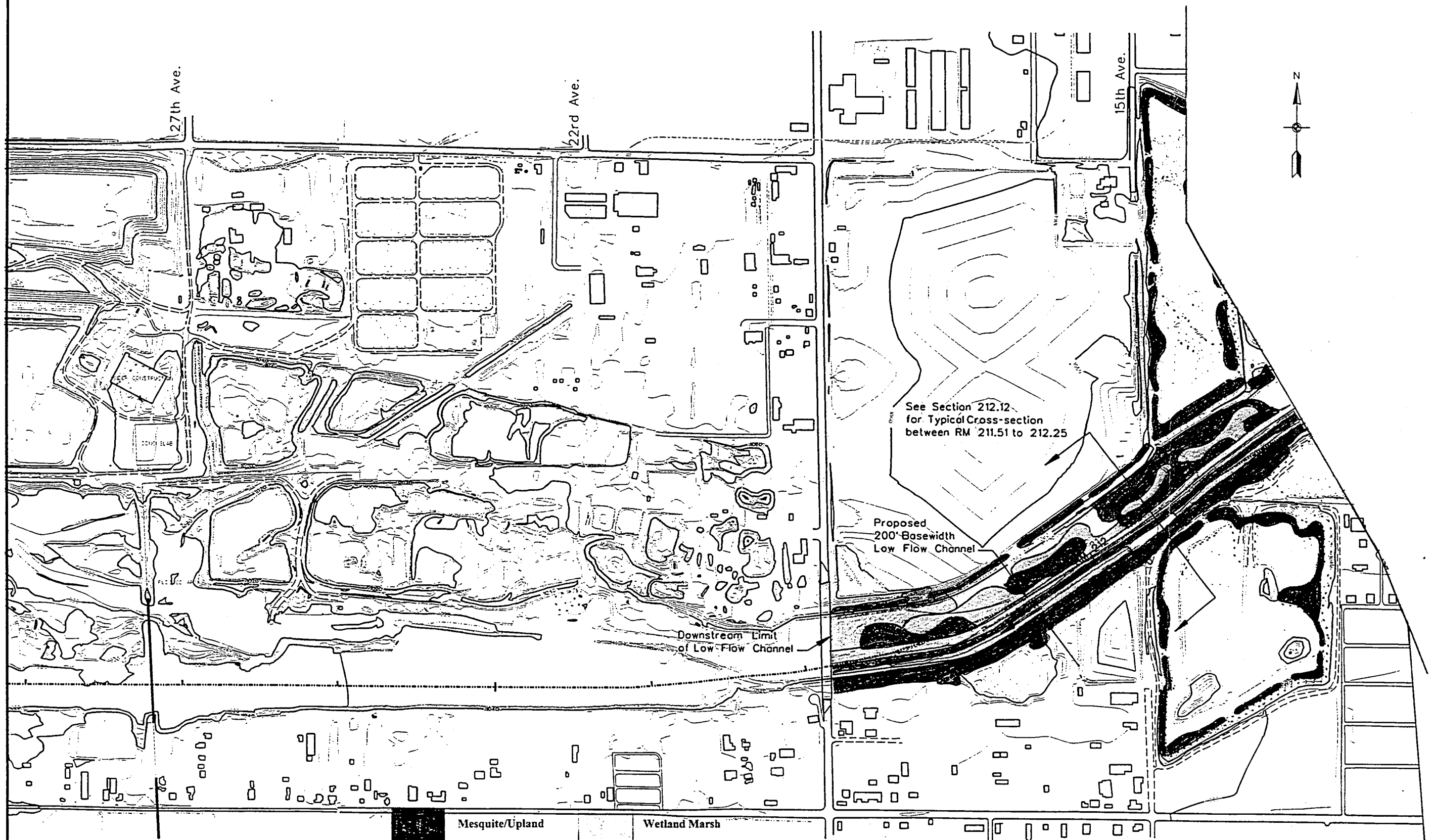
SUBMITTED BY:
XXX
CHIEF, XXX BRANCH

DISTRICT FILE NO. 2507

SPEC. NO. DACW09-96-B-0007

CADD FILE NAME:

PLATE 5A



Mesquite/Upland

Cottonwood/Willow

Aquatic Strand/Scrub

Wetland Marsh

Open Space, Park Areas

Other project elements shall include canals, recreation trails, service roads, parking areas, soil cement, gravel pits, etc.

Note: SR (Salt River) numbering system shown for City of Phoenix.
SD - Side Drain

SYMBOL	DESCRIPTIONS	DATE	APPROVAL
	REVISIONS		

RIO SALADO, ARIZONA
FEASIBILITY REPORT

RIVER MILE 211.00 TO 212.51

PROPOSED PROJECT AREA

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

DESIGNED BY:
DRAWN BY:
CHECKED BY:

SUBMITTED BY: XXX
CHIEF, XXX BRANCH

DISTRICT FILE NO. 2507

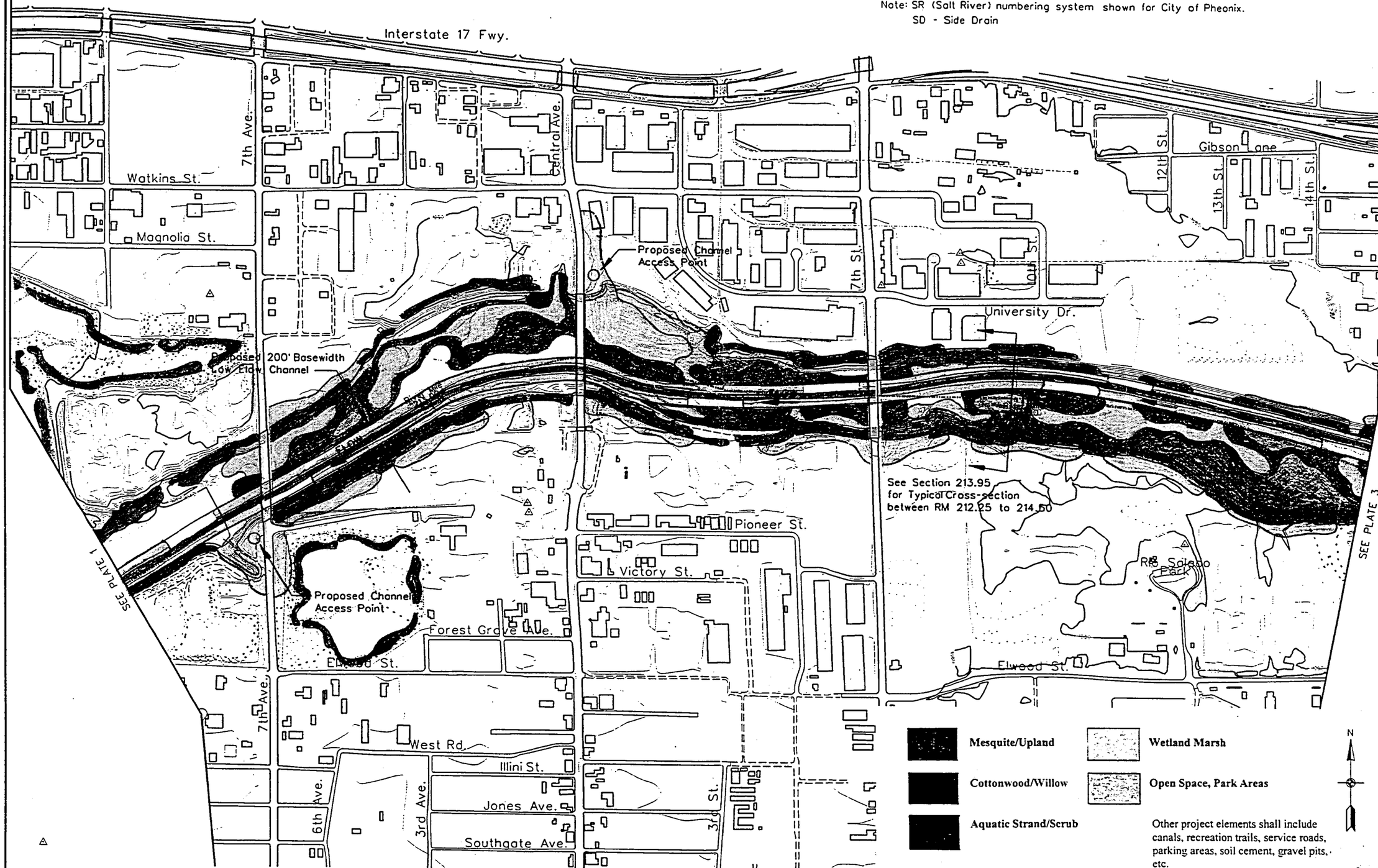
SPEC. NO. DACW09-98-B-0007

CADD FILE NAME:

PLATE 5-1

Contour Interval = 20 feet
Scale : 1" = 400'

Note: SR (Salt River) numbering system shown for City of Pheonix.
SD - Side Drain



Other project elements shall include canals, recreation trails, service roads, parking areas, soil cement, gravel pits, etc.

SYMBOL	DESCRIPTIONS	DATE	APPROVAL
	REVISIONS		

RIO SALADO, ARIZONA
FEASIBILITY REPORT

RIVER MILE212.46 TO 214.52

PROPOSED PROJECT AREA

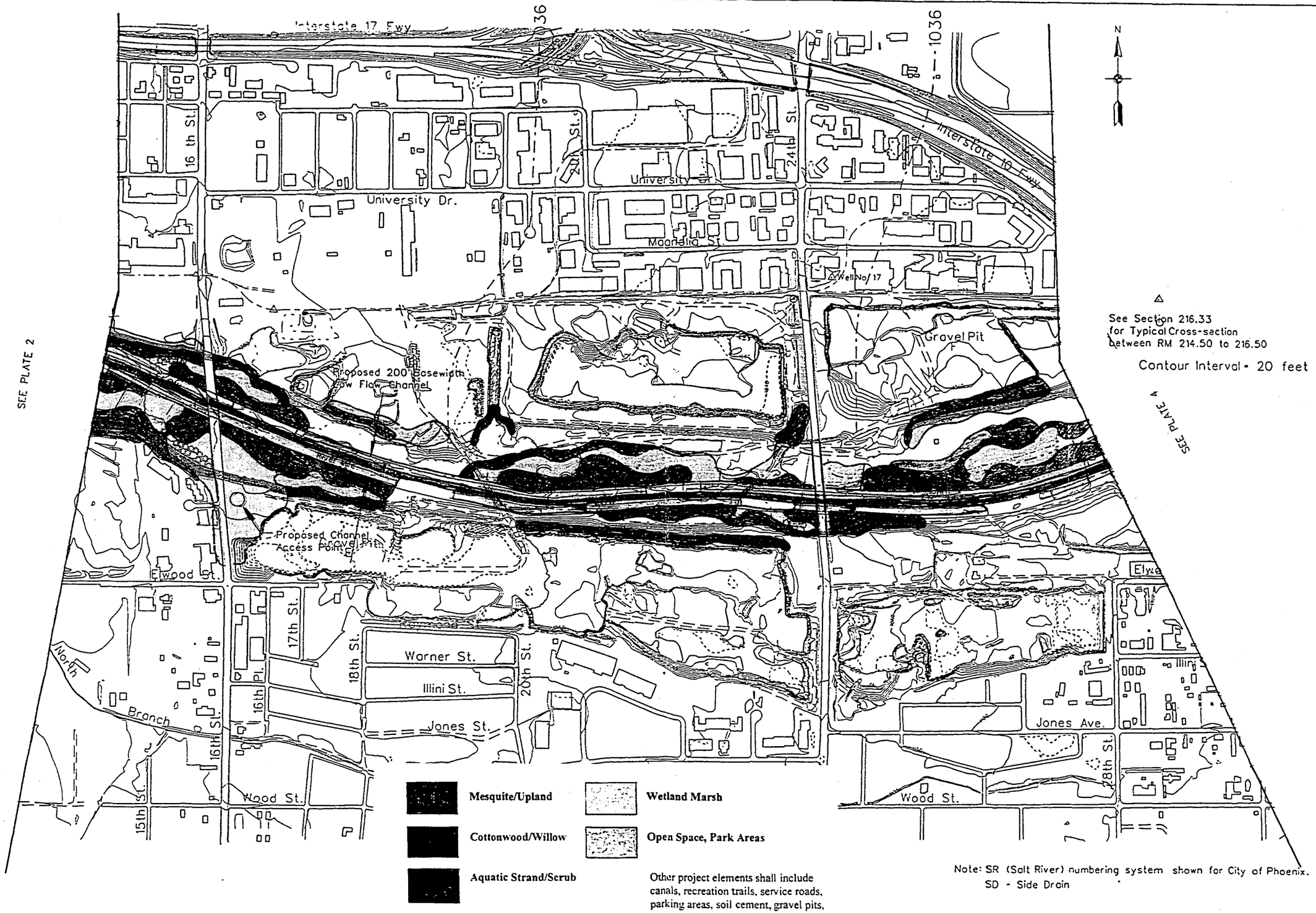
U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

DESIGNED BY:
DRAWN BY:
CHECKED BY:

SUBMITTED BY:
XXX
CHIEF, XXX BRANCH

DISTRICT FILE NO. 280/
SPEC. NO. DACW09-98-B-0007
CADD FILE NAME:

PLATE 5-2



SYMBOL	DESCRIPTIONS	DATE	APPROVAL
	REVISIONS		

RIO SALADO, ARIZONA
FEASIBILITY REPORT

RIVER MILE 214.52 TO 216.33

PROPOSED PROJECT AREA

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

DESIGNED BY:
DRAWN BY:
CHECKED BY:

SUBMITTED BY: XXX
CHIEF, XXX BRANCH

DISTRICT FILE NO. 2001

SPEC. NO. DACW09-98-R-0007

CADD FILE NAME:

PLATE 5-3

VALUE ENGINEERING PAYS

Contour Interval = 20 feet

Scale - 1" : 400'

N

Sky Harbor International Airport

32nd St.

Old Tower Rd.

Salt River

N 882,000

River Mile 218.00

River Mile 217.00

See Section 216.33 for Typical Cross-section between RM 214.50 to 216.50

Upstream Limit of Low Flow Channel

Proposed Low Flow Channel

Detention Basin

Harbour Dr.

University Dr.

Elmwood St.

Interstate 10

SEE PLATE 3

N. Branch

36th St.

38th St.

Winslow Ave.

Miami St.

San Francisco

Temple Drainage Dist. No. 2

Magnolia St.

40th St.

44th St.

Okeh Park

Mesquite/Upland

Cottonwood/Willow

Aquatic Strand/Scrub

Wetland Marsh

Open Space, Park Areas

Other project elements shall include . canals, recreation trails, service roads, parking areas, soil cement, gravel pits, etc.

SYMBOL	DESCRIPTIONS	DATE	APPROVAL
	REVISIONS		

RIO SALADO, ARIZONA
FEASIBILITY REPORT

RIVER MILE 216.33 TO 218.33

PROPOSED PROJECT AREA

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

DESIGNED BY:
DRAWN BY:
CHECKED BY:

SUBMITTED BY:
XXX
CHIEF, XXX BRANCH

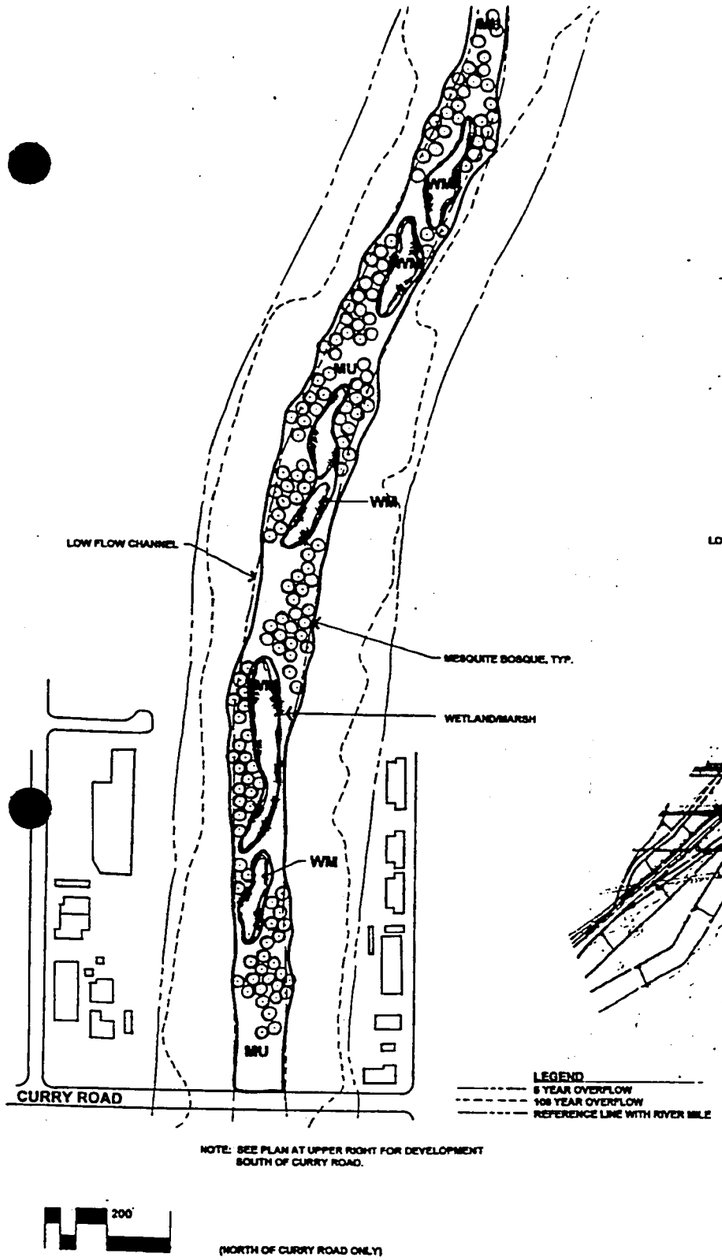
DISTRICT FILE NO. 2607

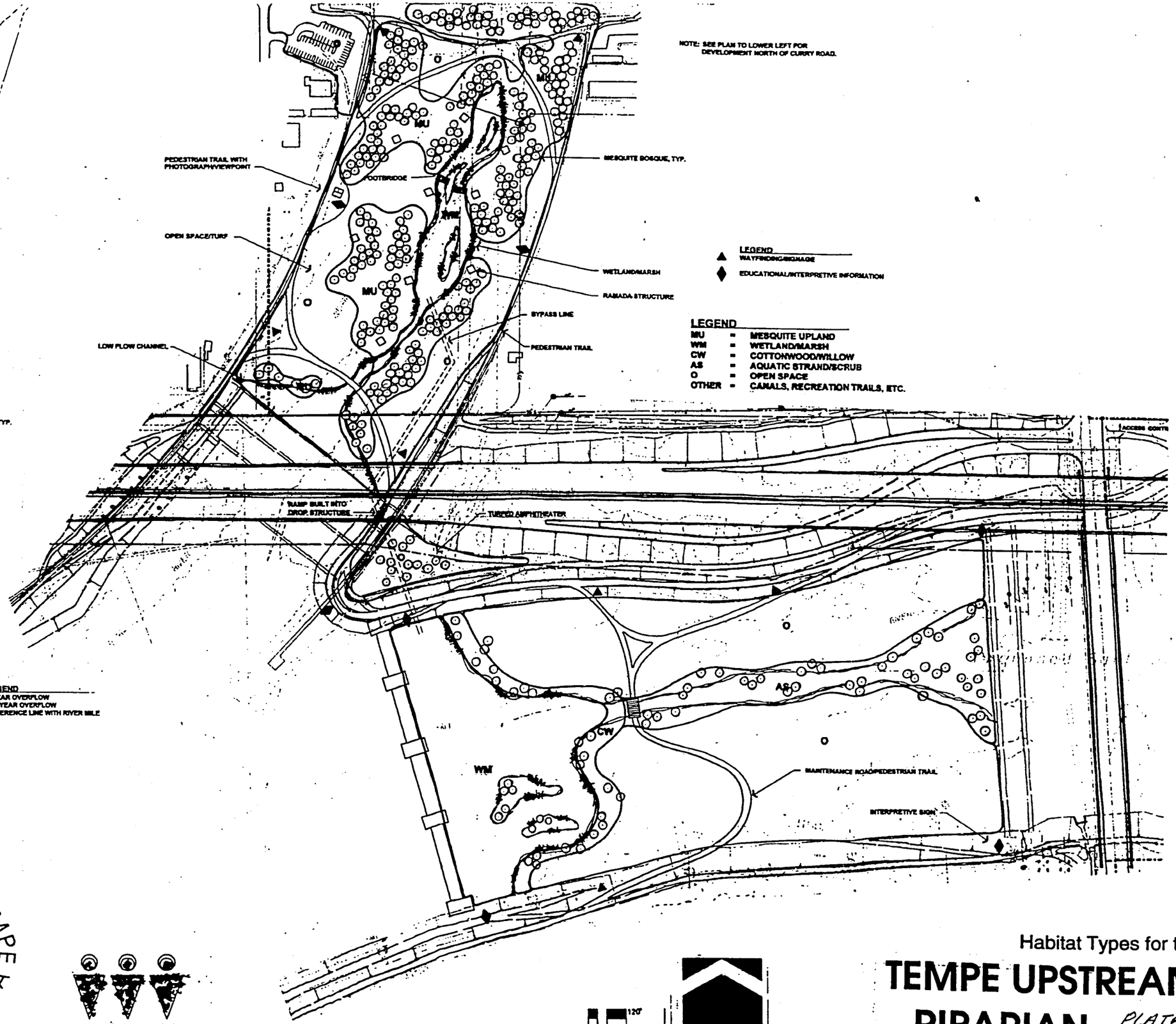
SPEC. NO. DACW09-98-D-0007

CADD FILE NAME:

SAFETY PAYS

PLATE 5-4





tempe rio salado

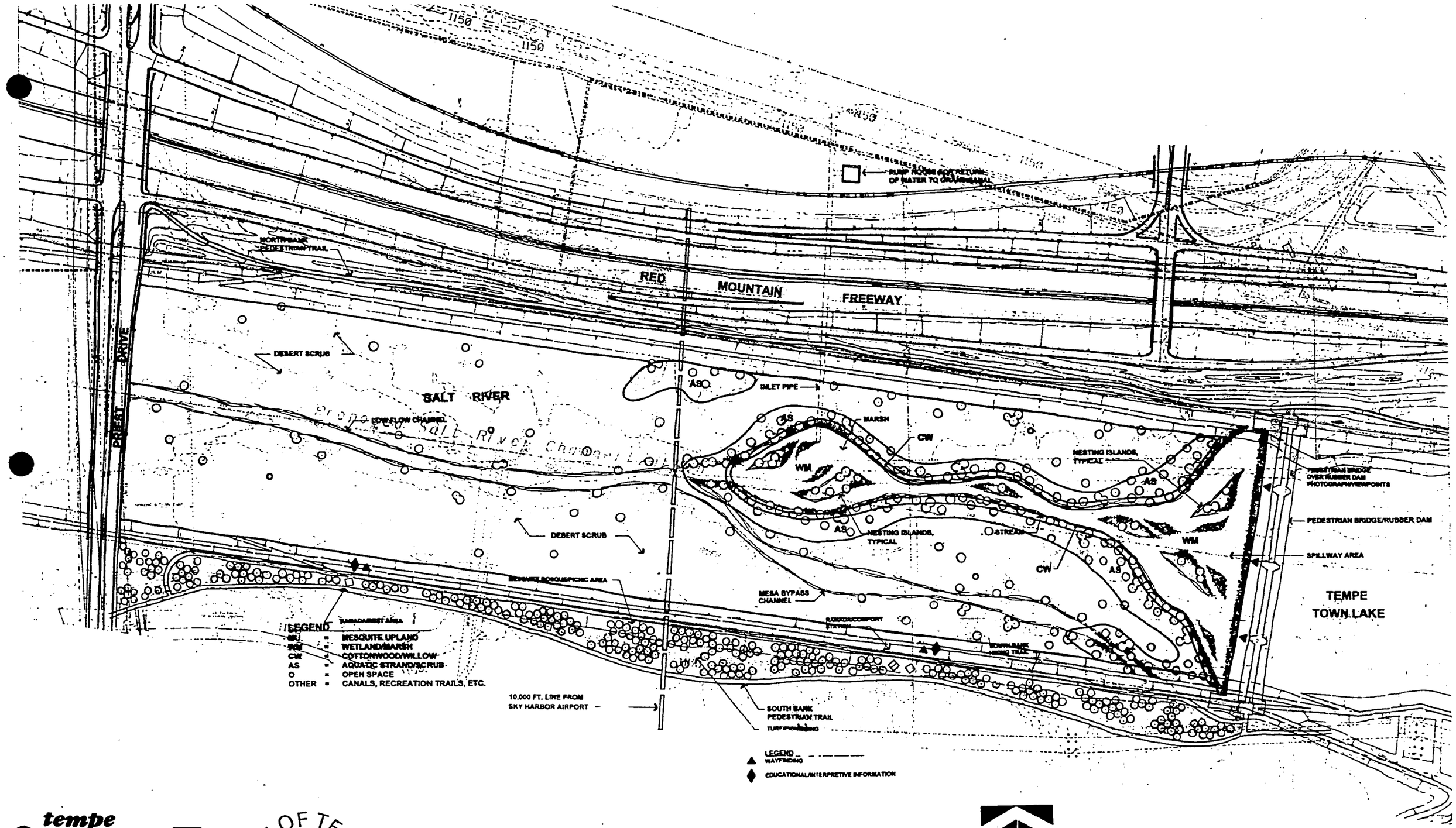
CITY OF TEMPE ARIZONA
Community Development Department

Logan Simpson & Dye

Habitat Types for the

TEMPE UPSTREAM RIPARIAN

PLATE 5-5



tempe rio salado

CITY OF TEMPE ARIZONA
Community Development Department

Logan Simpson & Dye

05/13/97

Habitat Types for the

TEMPE DOWNSTREAM RIPARIAN

PLATE 5-6

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RIO SALADO, SALT RIVER
ARIZONA

APPENDIX A

HYDROLOGY

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT
SOUTH PACIFIC DIVISION
MAY 1997

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I. INTRODUCTION

As directed by Congress, the Corps of Engineers undertook the Rio Salado, Salt River, Arizona, Feasibility Study. The purpose of the Feasibility Phase is to conduct necessary studies to determine the feasibility of restoring riparian habitat along the Salt River at Rio Salado. This Hydrology Appendix presents the findings from the hydrology sub-task of the feasibility study. Within this Chapter is a description of the upstream drainage area of the Salt River, as well as the study area, study alternatives, and the organization of this report.

1.1 ORGANIZATION OF THE HYDROLOGY APPENDIX

This report is organized into six Chapters. Chapter 1 introduces the study area, study alternatives, and organization of the Hydrology Appendix. Chapter 2 presents hydrology of the mainstem Salt River, including discharge frequency analysis and quantification of the duration and frequency of inundation resulting from upstream spills over Granite Reef Diversion Dam. This Chapter also contains additional hydrologic analysis to support the design and construction of a low-flow channel within the mainstem Salt River channel through the Phoenix reach. Topics include an estimate of the duration and frequency of innundation of the low-flow channel itself, as well as a conceptual description of the location and capacity of sources to create and sustain a perennial stream within the low-flow channel. Chapter 3 presents an evaluation of runoff from major side drains to the Salt River in the Study Area. Volume-Frequency analysis of local storm drains to the Salt River and Indian Bend Wash in the vicinity of Tempe Cienega, and to the Salt River along the Rio de Vida (Phoenix vicinity) is included in Chapter 3, along with an estimation of average annual runoff from these local storm drains. Groundwater Analysis is presented in Chapter 4. This includes the discussion of hydrogeologic setting and hydrologic system of the study area, current groundwater condition in Tempe and Phoenix area, and a presentation of the development of a groundwater flow model for the study. Chapter 5 presents the Water Sources Analysis. In this chapter, Salt River flood water, urban storm runoff water, Salt River Project water, and groundwater were evaluated as the potential sources. Chapter 6 presents Water Quality Analysis which includes water quality criteria, surface water quality, and groundwater quality. The water budget analysis for wetland restoration is presented in Chapter 7. Topics discussed in this chapter include the water budget for the Tres Rios demonstration wetlands, plant consumption rates from published papers, generalized water budget estimates for wetlands, proposed action and project alternatives, along with water budget analysis for these alternatives.

1.2 SALT RIVER DRAINAGE AREA

The Salt River is the largest tributary of the Gila River and drains a total area of approximately 13,700 sq.mi. within the northern and eastern portions of the State of Arizona. A map of the Salt River and tributaries is shown in Figure 1-1. The Salt River originates on the eastern portion of the Mogollon Plateau, in the White Mountains, with peaks as high as 11,590 feet (Baldy Peak). Formed by the confluence of two westward flowing streams, the White and Black rivers, the Salt River drains

directly into Modified Theodore Roosevelt Lake where it is joined by Tonto Creek. The drainage area controlled by Modified Theodore Roosevelt Dam, which forms the lake, is approximately 5,800 sq. mi. The Salt River Project (SRP) operates four dams on the Salt River upstream of the Verde River confluence, including Modified Theodore Roosevelt Dam. Water stored is allocated for hydropower, municipal and industrial supply, as well as agriculture. In addition, the modifications to Theodore Roosevelt Dam include an allocation for flood control. The total space for water supply storage behind these dams is approximately 1.9 million ac-ft, with an additional 0.56 million ac-ft for flood control.

The Verde River flows south from the Chino Valley, and joins the Salt River upstream of the cities of Mesa, Tempe, and Phoenix. The Verde drains approximately 6700 sq.mi. and is partially controlled by two water supply structures operated by the SRP. Horseshoe Dam (the most upstream structure) and Bartlett Dam (approximately 25 mi. upstream of the confluence with the Salt River) provide an additional water supply space of approximately 310,000 ac-ft. The Verde River is the principal tributary of the Salt River. Sycamore Creek (which drains 164 sq.mi) enters the Verde River downstream of Bartlett Dam, and is thus the largest uncontrolled tributary of the Verde River and Salt River.

Granite Reef Diversion Dam is located about 3 mi. downstream of the Salt-Verde confluence, and is the most downstream SRP dam. The purpose of this facility is to divert upstream reservoir releases into the Arizona Canal (for the area north of the Salt River), and the South Canal (for the area south of the Salt River). Only during periods of high flows does water pass over the dam and continue down the Salt River. Studies conducted during the recent hydrologic investigation to develop a water control plan for Modified Theodore Roosevelt[1] indicated that since 1889 there would have been 34 years (out of 105) during which water would have spilled over Granite Reef Diversion Dam, if the current configuration, including Modified Theodore Roosevelt Dam, would have been in place. The resulting frequency of spills is approximately once every 3 years, on the average. During most years there is little runoff in the river below Granite Reef Diversion Dam. When water is spilled over Granite Reef Diversion Dam, the flow is typically sustained for several days or more, and of significant magnitude. For example, the "median" simulated spill, had a peak discharge of 28,000 ft^3/s, a 5-day average flow rate of 15,000 ft^3/s, and a 10-day average flow rate of 10,000 ft^3/s.

1.3 STUDY AREA

Plates 1A through 5A are strip maps of the Salt River, extending from the downstream end of Rio de Vida near 19th Avenue to the upstream end of Tempe Cienega. These maps display information

---

[1] SECTION 7 STUDY FOR MODIFIED ROOSEVELT DAM, ARIZONA (MODIFIED THEODORE ROOSEVELT DAM), HYDROLOGIC EVALUATION OF WATER CONTROL PLANS, SALT RIVER PROJECT TO GILA RIVER AT GILLESPIE DAM, U.S. ARMY CORPS OF ENGINEERS, LOS ANGELES DISTRICT, MARCH. Simulations of the historic period from 1889-1993 were performed within the Section 7 Study as if the current S RP system were in place and operated according as it is today. The results of that simulation determined the magnitude and frequency of "spills" over Granite Reef Dam. The term "spills" denotes occasions when water released from the upstream SRP dams is wasted over Granite Reef Dam. For further details see the referenced report.

on 100-year overflow boundaries, stationing, well locations, and side drain locations (including stationing and local identification numbers) for existing conditions. These Plates are located within the main report and will be referred to throughout this appendix when information from these plates is important to the reader's understanding.

The study area consists of approximately twenty-eight miles of the Salt River from the eastern boundary of Tempe, at McClintock Road, through the City of Phoenix, to the confluence of the Salt, Gila and Agua Fria Rivers in Maricopa County, Arizona. A location map, including the study area is shown in Figure 1-2. Along the periphery of the fourteen mile reach of the Salt River from the Mesa/Tempe boundary to 40th Avenue in Phoenix the area is now highly urbanized. The next eight miles consist of agricultural and residential areas, interspersed with occasional industrial development. The remaining six miles is largely undeveloped. In the pre-settlement times, prior to 1900, the river was one of the few perennially-watered riparian areas of the Sonoran desert, with highly-productive cottonwood, willow and mesquite habitats. These areas were rich in habitat diversity, supporting a wide variety of wildlife species. As the lower Salt River valley became developed, riparian habitat has degraded significantly. Degradation is largely attributable to the construction of upstream Federal dams which curtailed year-round water flows and converted the once perennial Salt River into a dry river bed devoid of habitat. During the 1980's a Corps of Engineers flood control project at Indian Bend Wash displaced the last remnant of a mesquite bosque community that once occupied the region.

The study area includes the proposed Tempe Cienega, a wetland restoration project in the Salt River approximately 350 feet upstream of the Indian Bend Wash, and a constructed wetland and mesquite bosque habitat in Indian Bend Wash within the City of Tempe (Figure 1-2 shows the location and extent of the Tempe Cienega and Plate 5A provides more detailed information in this vicinity).

In addition, the study area contains the Rio de Vida, a wetland restoration project within the Salt River channel extending from the I-10 bridge spanning the Salt River to the 19th Avenue bridge (refer to Figure 1-2 for location and Plates 1A - 4A for more detailed information).

Several significant side drainage features deliver surface runoff to the Salt River within the study area, along with a network of local storm drains. The significant side drains for which a hydrologic evaluation was made in this study include Indian Bend Wash, the Old Cross Cut Canal, and the Tempe Drain (Tempe Drainage District No. 2 Ditch) or 48th Street Drain. The confluences of both Indian Bend Wash and the Tempe Drain with the Salt River are shown on Plates 5A and 4A. The confluence of Old Cross Cut Canal with the Salt River is about 1/4 mile west of 48th Street, and does not appear on the strip maps.

There are 5 side drains which outlet to the Salt River (or are planned) in the reach of the Salt River included in the Tempe Cienega[2]. Of these, SR-08 will be relocated upstream of Town Lake when it is constructed, and SR-11 will be connected to deliver runoff from a portion of the area now draining

[2] Designated by the City of Tempe as SR-08 through SR-12. Refer to Plate 5A for location.

to SR-10. In addition, there are 12 minor side drains which outlet (or are planned to discharge) to the Indian Bend Wash reach of the Tempe Cienega[3]. One of these drains, IB-06, will actually discharge to the Salt River after the construction of Town Lake. IB-12, a proposed Arizona Department of Transportation (ADOT) drain is planned, but not yet constructed. Information on the side drains which discharge to the Salt River and Indian Bend Wash in the vicinity of Tempe Cienega is shown in Table 1-1. Because of the minimal size and drainage area of the side drains which discharge to Indian Bend Wash, a hydrologic evaluation of resulting surface runoff from the smallest drainage areas has not been made at this time.

Within the reach of the Salt River referred to as Rio de Vida, 34 side drains discharge local runoff. Of these, 24 drain sufficient area to justify a hydrologic evaluation[4]. Information concerning the 24 side drains for which runoff was estimated is given in Table 1-2. Additional information to determine whether the runoff from the remaining 10 side drains is sufficient to include them in project evaluation and design is being sought. Current information indicates that the remaining 10 drains convey runoff from small local areas, such as landfills, to the Salt River.

1.4 STUDY ALTERNATIVES

During the Reconnaissance Study, measures were identified that would restore riparian habitat that was lost as a result of Federal water control projects. The results of the reconnaissance study support additional Federal (Corps) involvement in detailed studies of riparian habitat restoration measures at two locations, Tempe Cienega and Phoenix Rio de Vida (refer to Figure 1-2). In addition to riparian habitat benefits, water quality and incidental recreation benefits have also been identified.

Tempe Cienega restores habitat lost as a result of the construction of Indian Bend Wash and upstream Federal Dams. Tempe Cienega restores scarce wetland, riparian and mesquite bosque vegetation and consists of a restored wetland in the Salt River channel upstream of the Tempe Town Lake impoundment structure, and a restored wetland and mesquite bosque habitat in Indian Bend Wash within the City of Tempe.

Phoenix Rio de Vida restores habitat lost as a result of construction of upstream Federal Dams. The Rio de Vida restores scarce wetland, riparian vegetation, and wildlife habitat. Incidental benefits are recreation, improved water quality, and urban re-development. Rio de Vida, Spanish for River of Life, is intended to bring life back into the Salt River. The project is located between the I-10 bridge and 19th Avenue bridge.

Upon completion of the Reconnaissance Study, the Corps began a more detailed investigation of alternatives. Proposed action and project alternatives formulated and screened in this Feasiblity Study

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[3] Designated by the City of Tempe as IB-01 through IB-12. Refer to Plate 5A for location.

[4] Designated by the City of Phoenix as SR-07 through SR-39, *not* inclusive. Locations of all 34 side drain outlets are indicated on Plates 1A - 4A. Local drainage from sources such as landfills does not appear with SR designations.

are described in detail in the main report, and are listed in Chapter 7 of this Appendix.

TABLE 1-1. SIDE DRAIN INFORMATION - TEMPE CIENEGA[1]

ID	PIPE DIAMETER	DRAINAGE AREA		LAND USE TYPE		RUNOFF COEFF.
				High Runoff[2]	Low Runoff[3]	
	(in)	(acres)	(sq.mi.)	(%)	(%)	
SALT RIVER SIDE DRAINS						
SR-08[4]	54	1835	2.87	68	32	0.48
SR-09	30	78	0.12	7	93	0.07
SR-10[5]	36	668	1.04	29	71	0.25
SR-11[6]	66					
SR-12[7]	18 ft	978	1.53	63	37	0.44
INDIAN BEND WASH SIDE DRAINS						
IB-01	42	0.38	0.0006	100	0	0.95
IB-02	36	19	0.03	17	83	0.16
IB-03	42	27	0.04	0.5	99.5	0.002
IB-04	36	0.77	0.001	100	0	0.95
IB-05	48	66	0.10	59	41	0.61
IB-06[8]	48	10	0.02	100	0	0.95
IB-07	48	1.3	0.002	100	0	0.95
IB-08	2x36	25	0.04	93	7	0.85
IB-09	54	19	0.03	84	16	0.75
IB-10	42	58	0.09	67	33	0.50
IB-11	36	3.8	0.006	74	26	0.56
IB-12	48	6.3	0.01	60	40	0.55

NOTE:
Locations of side drain outlets to the Salt River and Indian Bend Wash in vicinity of the Tempe Cienega are shown on Plate 5A. City of Tempe side drain designations are included on Plate 5A. The designated side drain information is applicable to this reach only. The designations are not unique.
Runoff Coeff. is simply the ratio of effective rainfall to incident rainfall and reflects the % of impervious cover.

[1] Information provided by City of Tempe, 1996.
[2] Includes commercial, industrial, street, high density residential, some low density residential, and other urban development.
[3] Includes vacant land, parks, low density residential, and urban areas with 5- and 10-yr, 24-hour on-site retention.
[4] Drain outlet will be moved to location shown on Plate 5A due to construction of Town Lake. Outlet size will be reduced from existing 66 inches to 54 inches as indicated.
[5] Much of drainage area stored in detention basins, on-site retention, etc. A portion of the active area will drain to SR-11 in future.
[6] Not determined - area not yet connected. In future may include SR-10 drainage area.
[7] ADOT tunnel in vicinity of Price Road. Exact location not shown on Plate 5A. Total contributing drainage area not known at time of writing. Area shown is for City of Tempe only.
[8] Future ADOT drain. Exact location not shown on Plate 5A.

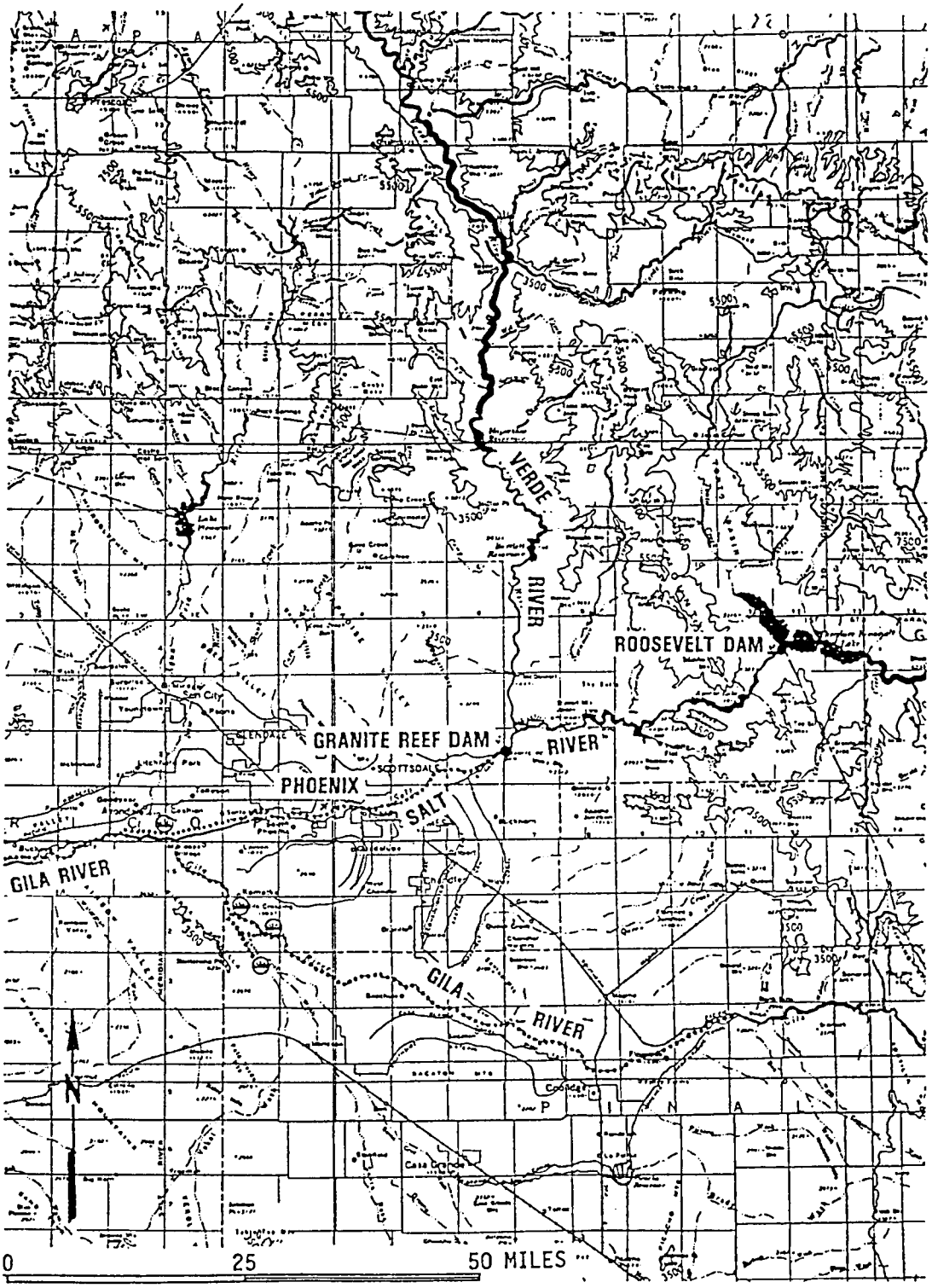
TABLE 1-2. SIDE DRAIN INFORMATION - RIO DE VIDA[1]

ID	PIPE DIAMETER	DRAINAGE AREA		LAND USE			RUNOFF COEFF.
				Urban	Agriculture	Open	
	(in)	(acres)	(sq.mi.)	(%)	(%)	(%)	
SR-07	54	633	0.99	94	3	3	0.64
SR-08	96	3638	5.68	85	3	12	0.41
SR-09	81	609	0.95	98	1	1	0.62
SR-10	54	989	1.55	94	0	6	0.44
SR-11	30	30	0.05	100	0	0	0.84
SR-12	42	122	0.19	100	0	0	0.47
SR-13[2]	21 ft	8879	13.87	95	0	5	0.33
SR-14	36	26	0.04	100	0	0	0.74
SR-15	84	1234	1.93	94	0	6	0.43
SR-16	54	68	0.11	100	0	0	0.85
SR-17	96	750	1.17	90	0	10	0.58
SR-18	66	4190	6.55	99	0	1	0.57
SR-19[2]	21 ft	2784	4.35	91	0	9	0.48
SR-20	84	3577	5.59	90	0	10	0.44
SR-21	90	641	1.00	95	0	5	0.90
SR-31	72	1918	3.00	47	32	21	0.22
SR-32	72	1008	1.58	76	11	13	0.38
SR-33	66	886	1.38	85	0	15	0.43
SR-34	15	21	0.03	74	0	26	0.47
SR-35	72	1668	2.61	65	5	30	0.29
SR-36	72	1270	1.98	67	5	28	0.25
SR-37	36	336	0.53	85	0	15	0.44
SR-38	72	1192	1.86	56	49	5	0.22
SR-39	96	2981	4.66	68	23	9	0.39

NOTE:
Locations of designated side drain outlets to Salt River near Rio de Vida are shown on Plates 1A - 4A. City of Phoenix side drain designations are included on Plates 1A - 4A. The designated side drain information is applicable to those reaches only. The designations are not unique. Side drains from localized areas such as landfills, which generate little runoff are shown on Plates 1A - 4A, but not included in this table, and ensuing surface water evaluations.
Runoff Coeff. is simply the ratio of effective rainfall to incident rainfall and reflects the % of impervious cover.

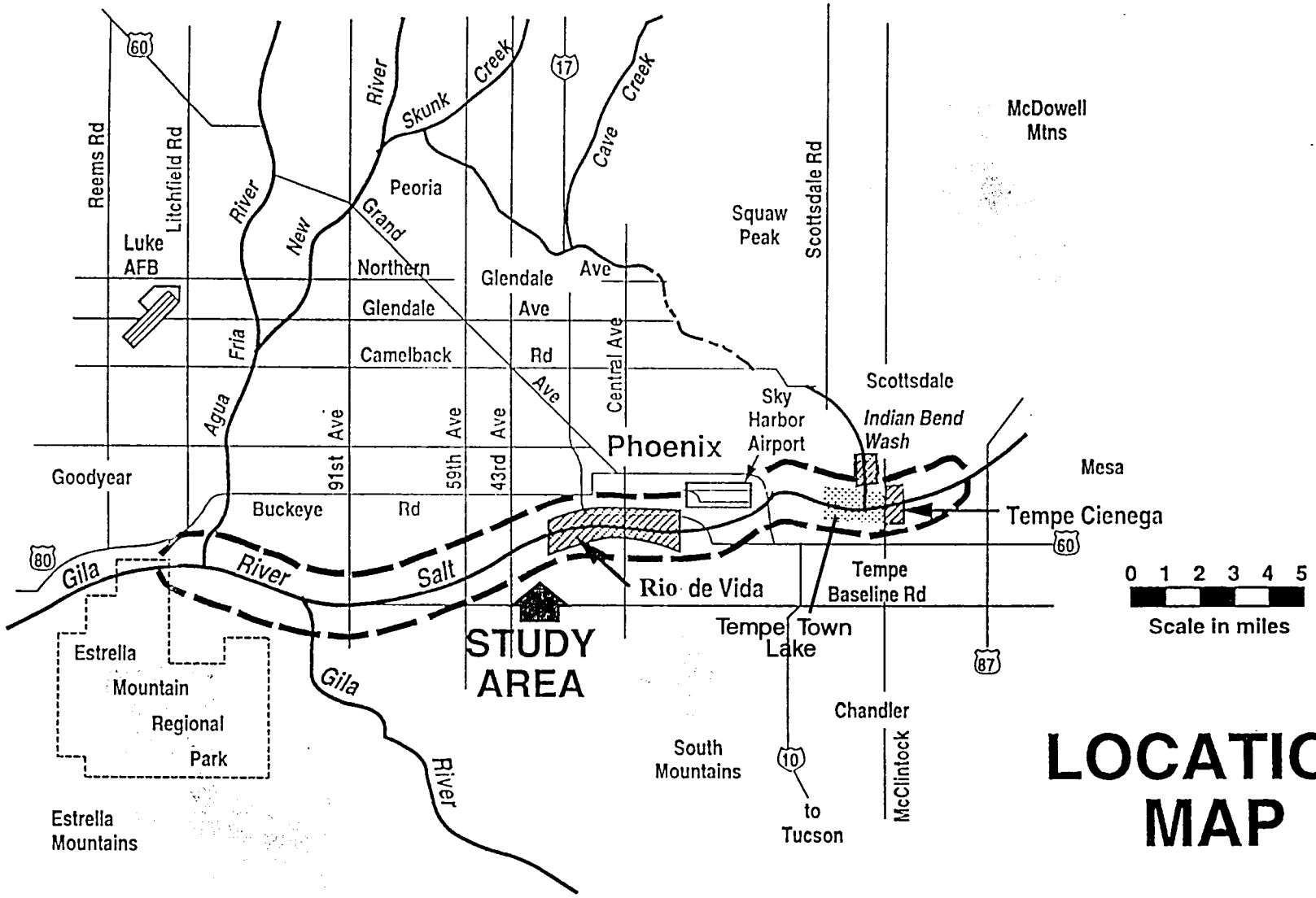
[1] City of Phoenix NPDES Permit, Source : Woodward-Clyde, 3 Nov 1992.
[2] Total contributing drainage area unknown. According to ADOT sources, the area is 44 sq. mi. Based upon COE studies, the drainage area is about 22 sq. mi., excluding area above the Arizona Canal Diversion Channel, which is generally not contributory. Area shown is from City of Phoenix.

REGIONAL DRAINAGE MAP



6/51087412M

FIGURE 1-1



LOCATION MAP

6/51087410M

FIGURE 1-2

II. SURFACE WATER HYDROLOGY OF THE SALT RIVER MAINSTEM

2.1 DISCHARGE FREQUENCY ANALYSIS

The Salt River is controlled by 6 major dams which impound water for hydroelectric power generation, water supply, and flood control purposes. The total water supply and flood control storage space behind these dams is approximately 2.8 million ac-ft. These dams are operated by the Salt River Project and divert all flow reaching Granite Reef Diversion Dam from the Salt River during most years. Simulation of SRP system operation for the period 1888-1995 indicated that water would have spilled over Granite Reef Diversion Dam to the Salt River during 34 of those 105 years, if the current configuration of the SRP system, including Modified Theodore Roosevelt Dam, were in place. The relative frequency of spilling is about once every 3 years, on the average, i.e. sustained flow through the project reach might occur during some portions of those years. The maximum rate of flow for each of those spills was determined based upon a water control plan developed for the flood control pool at Modified Theodore Roosevelt Dam. The development of that plan and the resulting analysis is described in a March 1996 Corps of Engineers report prepared by the Los Angeles District titled, "SECTION 7 STUDY FOR MODIFIED ROOSEVELT DAM, ARIZONA (THEODORE ROOSEVELT DAM), HYDROLOGIC EVALUATION OF WATER CONTROL PLANS, SALT RIVER PROJECT TO GILA RIVER AT GILLESPIE DAM", and referred to hereafter as "The Section 7 Study". Discharge-frequency values resulting from implementation of the recommended plan are presented in Table 2-1 of this report.

2.2 INUNDATION DURATION FREQUENCY ANALYSIS

Due to the magnitude of inflows to the SRP reservoirs, spills over Granite Reef Diversion Dam are expected to occur about once every three years on the average, based upon a period-of-record simulation. During some of the years when spills occur, sustained flow in the Salt River will result, which might damage or destroy the restored habitat. An evaluation of simulated spills determined within the hydrology study was performed to establish flow rates which would be **exceeded** for specified durations. Based upon inspection of synthetic N-year flood hydrographs, a set of curves depicting threshold discharges which would be exceeded for specific durations and frequencies was prepared (Figure 2-1). These results for the Salt River near Rio de Vida (reference location, Central Avenue) are summarized in Table 2-2. No attempt was made to define these threshold discharges for specific reaches of the Salt River, since sustained flows of durations equalling or exceeding a day are unlikely to be attenuated or significantly altered by channel cross-section variations or exfiltration.

2.3 LOW FLOW CHANNEL HYDROLOGY.

2.3.1 Inundation-Duration-Frequency. A low-flow channel within the Salt River has been proposed, with a conveyance capacity of 12,200 ft^3/s, a natural bed with a base width of 200 ft, and soil cemented side slopes extending 5 ft below grade, to be excavated to as much as 20 ft below existing channel grade. This low flow channel will begin near the I-10 Freeway in the City of Phoenix and continue downstream until 19th Avenue where it will daylight to the existing channel. The low-flow channel will maintain a slope of about 0.08% along its 5.04 mi length, excluding drop structures, resulting in non-erodible flow velocity during the design discharge. Environmental restoration features will be located on benches astride the low-flow channel. The channel alinement, typical cross-section design details and profile are presented in the Hydraulics Appendix.

The purpose of this low-flow channel is to convey frequent flood-flows through the Phoenix reach of the environmental restoration project, thus preventing or reducing inundation damage to the accompanying wetlands.

Based upon discharge-frequency information developed for The Section 7 Study, *the frequency and duration of flood-flows exceeding the low-flow channel capacity has been estimated*[5]. This information is displayed in Table 2-3, along with additional information concerning the estimated frequency and upstream source of flood-flows in the Salt River.

2.3.2 Perennial Stream Characteristics. In addition to the areas within the Salt River channel scheduled for environmental enhancement[6], a perennial stream will be incorporated into the low-flow channel. This stream will be maintained by pumped groundwater and allowed to meander naturally within the confinements of the low-flow channel. Aquatic strips alongside the perennial stream will be supported by the surface flow and resulting percolation; however, the low-flow channel will be kept clear of any vegetation which presents an obstacle or hindrance to the design hydraulic capacity. Ideally, flow rates within the low-flow channel will be between 5 and 10 ft^3/s throughout the project reach (i.e., between the I-10 Freeway on the east and 19th Avenue on the west). An evaluation of the quantity of water necessary to maintain such a perennial stream has been conducted and the investigation and results are summarized herein.

2.3.2.1 *Channel Geometry.*. In order to estimate losses from the perennial stream due to evapotranspiration and infiltration, it was necessary to establish the surface area and wetted perimeter of the stream. Knowledge of these channnel characteristics required a conceptual analysis of the perennial stream geometry, including cross-section and length. Based in-part upon guidance provided in EM1110-2-1418, 31 Oct94, section 5-9. "Meander Geometry", and Appendix B, section B-2, "Tentative Guide to Width-Discharge Relationships for Erodible Channels", hydraulic characteristics of the perennial stream including channel geometry were estimated.

The existing Salt River channel is composed of erodible material overlain by cobbles, boulders, and other large diameter, often irregular, miscellaneous stone. This matrix of bed material produces an armoring effect during flood conditions. Excavation of the existing channel to construct the low-flow channel is expected to result in a natural bed with similar characteristics. Hence, a relatively small perennial stream is not expected to have sufficient energy, especially within the low-flow channel, with a 0.08% engineered bed-slope, to create a hydraulically- efficient cross-section. In addition due to flood flows resulting from spills and/or releases from the upstream Salt River Project dams, the perennial stream will be washed out approximately once every three years on the average, forcing the perennial stream flow path to be reestablished periodically. As a consequence, the perennial stream cross-section is expected to be relatively shallow, due to erosion of finer material within the course matrix, and to meander within the low-flow channel confines.

2.3.2.1.1 CROSS-SECTION DIMENSIONS. Based upon regime equations (Lacy) and empirical relationships for channel width vs. discharge, a discharge of 10 ft^3/s might be expected to establish a channel between 6 ft. and 10 ft in width. However, comparison of the estimated channel velocity and the

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[5] The results presented are based upon data generated within The Section 7 Study and summarized in Table 2-2 of this report, for the Salt River at Central Avenue, which lies between the upstream and downstream extent of the proposed low-flow channel.

[6] Wetlands will be introduced and maintained upon benches astride the low-flow channel.

resulting depth of flow computed using Manning's equation[7] indicate that the combination would not be capable of creating the cross-section necessary to convey this flow. As a result, the shallow, low-velocity flow was assigned a cross-section width of 20 ft, which combined with the average depth of approximately 0.7 ft, reproduces the desired flow rate more realistically.

2.3.2.1.2 SINUOSITY. The surface area and wetted area of the perennial stream will drive losses due to evapotranspiration and infiltration. Observations of natural streams have led to the general conclusion that stream sinuosity is proportional to the width of the river - both large and small streams "appear" similar on maps, such that the appearance gives no clue to the actual scale. Based upon this type of observation, Hey (1984) suggested that

$$L = 2\pi w, \text{ where}$$

w = channel width, and

L = channel length between inflection points.

For a channel with a width of 20 ft, the length would be about 130 ft, while a channel 10 ft wide would have a length of about 63 ft.

The amplitude of meander is variable and controlled to some extent by the valley bottom width. In this case the valley bottom width would be substituted for by the width of the low-flow channel (200 ft). The ratio of amplitude to wavelength is commonly between 0.5 and 1.5. As a consequence, the amplitude could be as low as approximately 30 ft (10-ft wide channel), and as wide as 195 ft (20-ft wide channel). Since the bottom width of the low-flow channel is 200 ft, and the maximum meander amplitude is 195 ft, a "full" meander pattern should be possible.

The radius of curvature for meanders is commonly in the range of 2-3 times the channel width; for a 20-ft wide channel, the radius of curvature would be between 40 and 60 ft, which is consistent with the amplitude of meanders.

Based upon channel geometry as described above, the ratio of the length of ½ of the wavelength to the horizontal distance is about 1.5 for a range of varying amplitude waves[8]. Using this ratio, the total stream length of the meandering perennial channel, circumscribed within the low-flow channel, would be about 7.5

The total surface area of the perennial channel is the product of the length and the cross-sectional width (7.5 mi x 20 ft), which is 18.2 acres, or 3.6 acres/mi of low-flow channel.

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[7] The depth-velocity characteristics were computed using a Manning's roughness coefficient (n) of 0.45. The low-flow channel roughness for the design discharge (12,200 ft^3/s) was increased due to scale effects. A discharge of only 10 ft^3/s would have an accompanying depth of only 3-4 inches. The surface irregularities would therefore be greater than the actual flow depth. To account for this scale effect, the "n" value was increased by 50% for determination of the geometric characteristics of the pereniall stream.

[8] The circumference of a single meander loop (1/2 wave) is $2\pi R$ (R is radius of curvature, between 40 and 60 ft); thus; the ½ wave arc is πR, and the linear distance is 2R. Thus the ratio of arclength of the meandering channel to the linear distance is $\pi R/2R$, or $\pi/2$. This ratio is about 1.5 for application purposes, because the transition for each cycle flattens the wave from a semicircle as described in the preceding.

2.3.2.2 *Channel Losses.*

2.3.2.2.1 INFILTRATION. Studies conducted during the Central Arizona Water Control Study (Hydrology report published by the Los Angeles District, US Army Corps of Engineers in May 1982) indicated that the percolation rate of the Salt River reached a limiting value of 0.2 in/ (~ 0.2 ft^3/s, since 1 ft^3/s per wetted acre ~ 1in/hr) during flood flows. In addition, these studies determined that the initial percolation rate was about 1.3 in/hr. Data from Tres Rios wetlands[9] indicate that the infiltration rate from the wetlands is about 0.56 in/hr. Using the initial infiltration rate as a benchmark for "start-up" conditions and the Tres Rios infiltration rate as an estimator of the "steady-state" conditions, after the perennial stream had been established , loss rates ranging from 24 ft^3/s to 10 ft^3/s were established. These rates are equivalent to 5- and 2- ft^3/s per mile of low-flow channel. **Note: 1 MGD = 1.55 ft^3/s.**

To establish the perennial stream, 5 replenishment locations were established, beginning at the upstream limit of the project, the Salt River at the I-10 Freeway. Since that location is the project origin, the capability of delivering 10 ft^3/s (6.45 MGD) to the low-flow channel is necessary. Based upon the infiltration losses during "start-up", each subsequent replenishment site would be located 1 mi downstream and capable of delivering an additional 5 ft^3/s (3.23 MGD) to the low-flow channel. It will likely be necessary to "phase" downstream replenishment after the upstream perennial stream is well-enough established to appear as surface flow at the following replenishment location. Otherwise a series of disconnected streams might evolve with resulting wasted water. After the perennial stream has been established for a sufficient time period, perhaps as much as several weeks, the infiltration rate should decrease and replenishment can be reduced. The initial source would remain the same, i.e. 10 ft^3/s (6.45 MGD), but the downstream replenishment sources can be cut back. Based upon Tres Rios data, the infiltration losses should diminish to 2 ft^3/s per low-flow channel mile (3.23 MGD), and the required replenishment can be similarly reduced. Tables 2-4 and 2-5 summarize the locations and capacities for replenishment , along with the intermediate and cumulative infiltration losses during "start-up" and "steady-state" conditions. Figure 2-2 depicts the a conceptual analysis of infiltration losses and the suggested replenishment scheme.

2.3.2.2.2 EVAPOTRANSPIRATION.. In addition to infiltration losses from the perennial stream, water will be lost from the surface of the stream due to evaporation. There is little data to compare losses from a moving stream to losses from a standing body of water, but it is likely that the processes are similar. There might be less energy transfer due to heating of the surface-in-motion, yet the water is much shallower than lakes from which evaporation pan data is available, hence it has a much flatter temperature gradient. In addition, wind is known to increase evaporation, so it might be reasonable to infer that the motion of the water along the air-water interface is akin to this process. Data from the Tres Rios wetlands, which was similar to (but less than) rates for surface water evaporation in central Arizona suggested a rate of 6 GPM for a 2.2 acre site, which is equivalent to 4.4 ft/yr. A variety of sources (e.g. Chow's "Handbook of Applied Hydrology") indicate that surface water evaporation rates in this vicinity range from 5.5 to 5.7 ft/yr.

The perennial stream will sustain an aquatic strip alongside the meandering channel which will also consume water. It is likely that this "strip" will encompass an area similar in size (considering that it will likely develop along both banks) to the perennial channel. Agricultural data for the same area (based on Alfalfa, again from Chow's "Handbook...") suggest consumptive use of 4.4 ft/yr. Because the Tres Rios evaporation figure was somewhat low, the total evapotranspiration rate applied to the perennial stream was the sum of the surface

[9] Tres Rios is a managed wetland project, including an unlined portion within the Salt River fed by effluent from the 91st Ave. Sewage Treatment Plant. Data from this unlined prototype was used within this study.

water evaporation from central Arizona and the consumptive use for Alfalfa cited above, or approximately 10 ft/yr. This quantity is **about two orders-of-magnitude less** than the losses resulting from infiltration- 10 ft/yr over 18.2 acres is equivalent to 0.25 ft^3/s or 0.161 MGD, hence it is insensitive to approximations. Since most of the evapotranspiration losses will occur durning the warmest months of the year, losses will be higher than 0.25 ft^3/s during those periods. Therefore, the replenishment rate for these warm weather periods was increased to 1.0 ft^3 /s (0.65 MGD) to offset the higher evapotranspiration rates. Losses to account for evapotranspiration from the perennial stream and surrounding aquatic strip were increased to 1.0 ft^3/s likewise. Tables 2-4 and 2-5 include replenishment for evapotranspiration in the 5.04 mi low-flow channel project reach.

Actual infiltration within the constructed Salt River Low-flow Channel will vary both laterally and longitudinally, as well as temporally. It might be desirable to design the replenishment system to have excess capacity in order to establish the perennial stream earlier or with more certainty. Reduction of replenishment would be made based upon an active monitoring system, especially during period of stream formation. Adjustments might have to be made to compensate for seasonal variations due to climatic factors, such as temperature and rainfall, which would alter the stream characteristics from those desired.

TABLE 2-1. DISCHARGE FREQUENCY VALUES FOR THE SALT RIVER

LOCATION	RETURN PERIOD						
	500-YR	200-YR	100-YR	50-YR	20-YR	10-YR	5-YR
PEAK DISCHARGES (ft^3/s) IN SALT RIVER AT:							
CP-40	250,000	210,000	175,000	150,000	100,000	60,000	22,000
CP-109	246,000	207,000	172,000	145,000	95,000	58,000	21,000
CP-110	243,000	204,000	169,000	140,000	90,000	55,000	20,500
CP-111	240,000	202,000	166,000	135,000	87,000	53,000	20,200
CP-112	237,000	200,000	164,000	132,000	84,000	51,000	20,000
CP-113	235,000	198,000	162,000	130,000	82,000	49,000	19,500

NOTE:
Flow in Salt River anticipated about once in three years. During other times the river is dry, except for locally wetted areas near side drains.

DEFINITIONS:
CP-40, at Granite Reef Dam
CP-109, at Gilbert Road
CP-110, at Mill Avenue Bridge
CP-111, at Central Avenue
CP-112, at 67th Avenue
CP-113, *just* above confluence with Gila River

TABLE 2-2. INUNDATION-DURATION-FREQUENCY: SALT RIVER NEAR RIO DE VIDA

DURATION	FREQUENCY, years						
	500	200	100	50	20	10	5
DISCHARGE EXCEEDED FOR SPECIFIED DURATION, SALT RIVER AT CENTRAL AVENUE[1]							
Peak[2]	240,000	202,000	166,000	135,000	87,000	53,000	20,200
1-Day	190,000	145,000	100,000	70,000	40,000	21,000	8000
3-Day	100,000	75,000	60,000	40,000	22,000	11,000	3500
5-Day	70,000	55,000	40,000	29,000	15,000	7000	2100
10-Day	46,000	33,000	25,000	18,000	10,000	5200	1500
30-Day	25,000	19,000	15,000	10,000	5300	2700	800
60-Day	14,000	9000	7000	5000	2800	1400	(0)[3]

[1] Discharges exceeded for specified frequencies, with durations greater than or equal to 1-day, are approximately equal throughout Rio de Vida project reach. Central Avenue is used as a reference location.

[2] Values from Table 2-4, SECTION 7 STUDY FOR MODIFIED ROOSEVELT DAM, ARIZONA (THEODORE ROOSEVELT DAM), HYDROLOGIC EVALUATION OF WATER CONTROL PLANS, SALT RIVER PROJECT TO GILA RIVER AT GILLESPIE DAM, U.S. Army Corps of Engineers, March 1996.

[3] During the 5-year event, the upstream release from the Salt River Project reservoirs does not last for 60-days. A flow rate of approximately 200 ft^3/s is exceeded for 53-days during this event. Results are based upon simulation of Balanced Hydrographs. Please refer to previous note for the information source.

TABLE 2-3. INUNDATION-DURATION-FREQUENCY: SALT RIVER LOW-FLOW CHANNEL NEAR RIO DE VIDA

SOURCE	LOCATION	DURATION 12,200 ft^3/s EXCEEDED[1]	ANNUAL EXCEEDANCE FREQUENCY
Salt River	Outflow from Roosevelt Dam	Instantaneous	12.5 Years
Verde River	Outflow from Bartlett Dam	Instantaneous	4.35 Years
Salt River	Below Granite Reef Diversion Dam[2]	Instantaneous	3.85 Years
		1-day	6.67 Years
		3-day	11.1 Years
		5-day	17.2 Years
		10-day	34.5 Years
		30-day	83.3 Years
		60-day	333 Years

[1] "Instantaneous" actually represents the 6-hour average maximum discharge based upon simulation criteria in the Modified Roosevelt Water Control Study.
[2] This location provides adequate information for the project reach. Flood discharges for durations ≥ 1-day are not attenuated significantly.

TABLE 2-4. CONCEPT WELL LOCATION/CAPACITY TO SUSTAIN 10 FT^3/S IN RIO SALADO PERENNIAL CHANNEL

LOCATION[1]	WELL CAPACITY	
	START-UP (MGD)	STEADY-STATE (MGD)
216.5 (I-10 FREEWAY)	6.45	6.45
215.5	3.23	1.30
214.5	3.23	1.30
213.5	3.23	1.30
212.5	3.23	1.30
	0.65[2]	0.65[2]
DAILY SUPPLY	**20.02**	**12.30**
ANTICIPATED FLOW REMAINING AT PROJECT OUTLET (19th Avenue)		
211.5	**5 ft^3/s**	**8 ft^3/s**

NOTES:
1 MGD = 1.55 ft^3/s, therefore 6.45 MGD = 10 ft^3/s.
Well replenishment locations are based upon sustaining a minimum of 5 ft^3/s during Start-up. Based upon expected channel percolation rates, 5 ft^3/s will be lost each mile.
The reach length of the low flow channel is 5.04 However, because the perennial stream introduced into the low-flow channel is expected to meander naturally, the length of the perennial stream has been increased to ≈ 7.5 miles for computation purposes.
Start-up conditions are expected to last for several days to a few weeks, with Steady-state conditions established thereafter. Hence, there will be a transition period during which well pumping can be cut back. Initially, water will likely have to be introduced in phase, from upstream to downstream, as the stream penetrates to the next replenishment location.

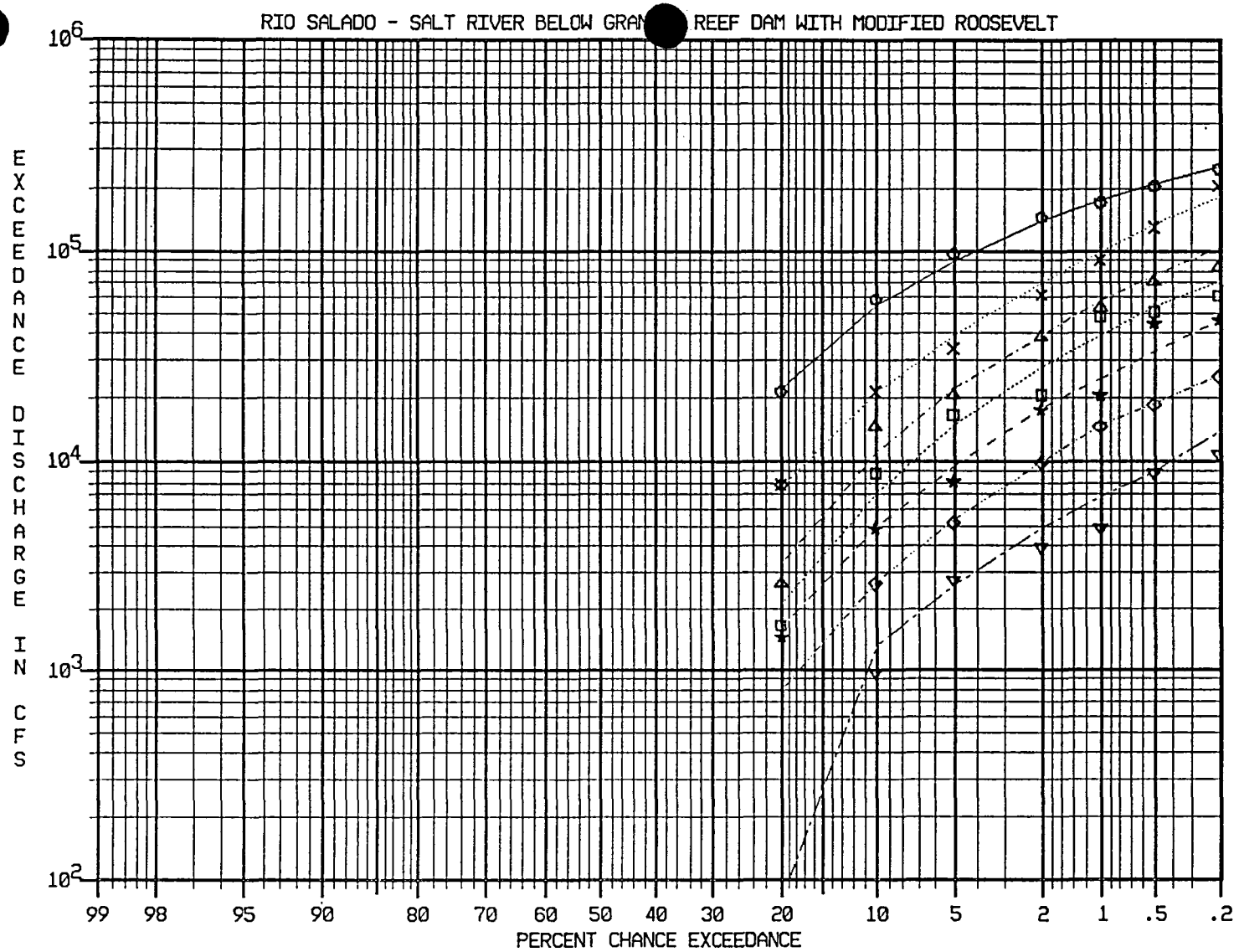
[1] Stationing in river miles.
[2] Anticipated warm weather replenishment to offset evapotranspiration losses in 5 mile reach.

TABLE 2-5. ESTIMATED INFILTRATION LOSSES FROM RIO SALADO PERENNIAL STREAM.

LOCATION		LOSS, MGD	
FROM RIVER MILE	TO RIVER MILE	START-UP[1]	STEADY-STATE[2]
216.5 (I-10 Freeway)	215.5	3.23	1.30
215.5	214.5	3.23	1.30
214.5	213.5	3.23	1.30
213.5	212.5	3.23	1.30
212.5	211.5 (19th Avenue)	3.23	1.30
216.5	211.5	0.65[3]	0.65[3]
ACCUMULATED LOSSES		**16.8**	**7.15**

NOTES:
1 MGD = 1.55 ft^3/s, therefore 3.23 MGD = 5 ft^3/s and 1.30 MGD = 2 ft^3/s.
1 in/hr ≈ 1ft^3/s/wetted acre.
The reach length of the low flow channel is 5.04 However, because the perennial stream introduced into the low-flow channel is expected to meander naturally, the length of the perennial stream has been increased to ≈ 7.5 miles for computation purposes.
Start-up conditions are expected to last for several days to a few weeks, with Steady-state conditions established thereafter. Hence, there will be a transition period during which well pumping can be cut back. Initially, water will likely have to be introduced in phase, from upstream to downstream, as the stream penetrates to the next replenishment location.

[1] Based upon average infiltration rate of 1.3 in/hr (1.3 ft^3/s/wetted acre), uniformly distributed across the low-flow channel from I-10 to 19th Avenue.
[2] Based upon Tres Rios infiltration rate of 0.56 in/hr (0.56 ft^3/s/wetted acre), uniformly distributed across the low-flow channel from I-10 to 19th Avenue. Previous studies of the Salt River percolation capacity during floods have indicated a limiting rate of 0.2 in/hr.
[3] Anticipated warm weather losses resulting from evapotranspiration in the 5 mile reach of the low-flow channel from River mile 216.5 to 211.5..



○	PEAK	★	10-DAY DURATION
×	1-DAY DURATION	◇	30-DAY DURATION
△	3-DAY DURATION	▽	60-DAY DURATION
□	5-DAY DURATION		

FIGURE 2-1

RIO SALADO
PERENNIAL STREAM CONCEPT

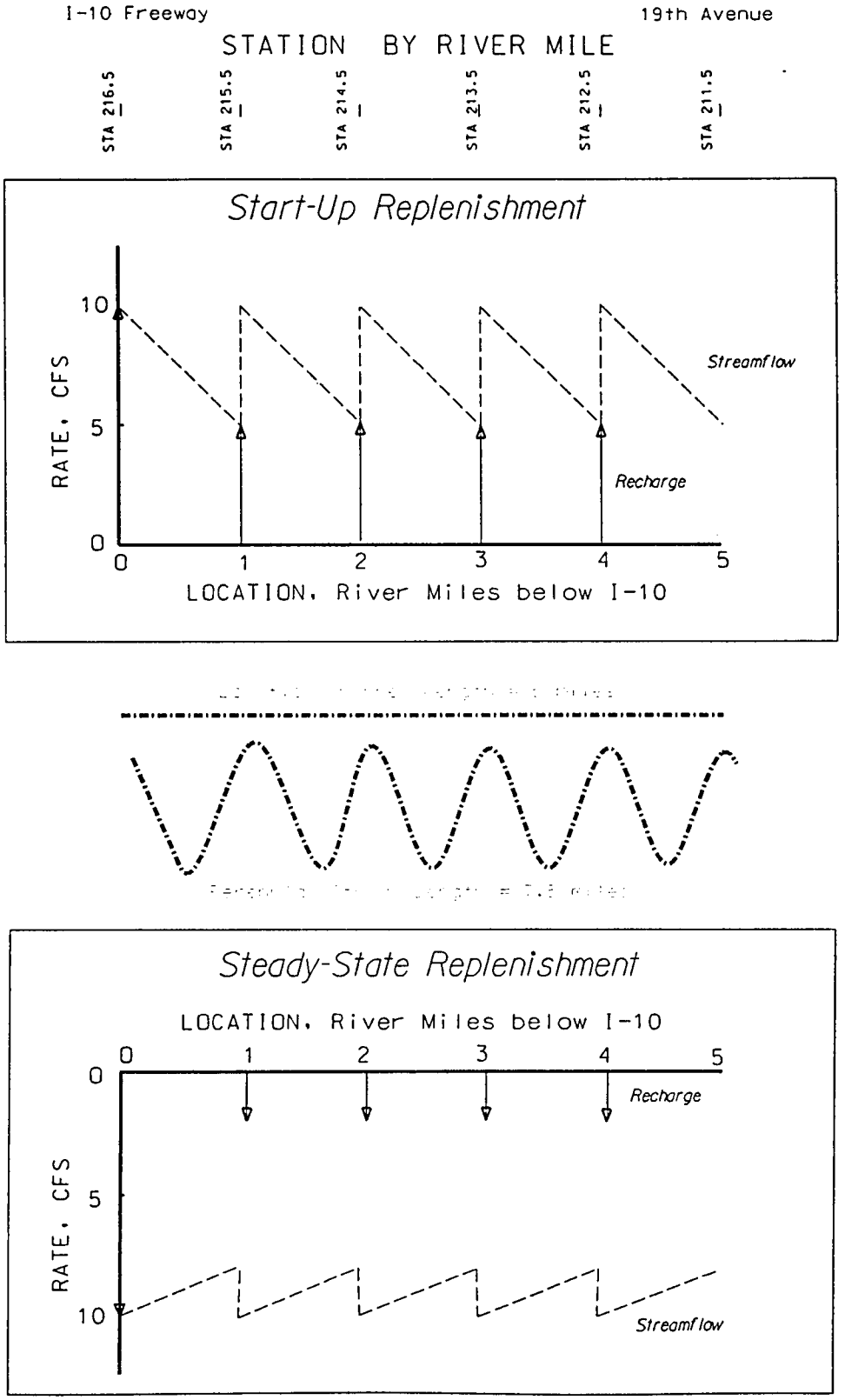


FIGURE 2-2

III. SURFACE WATER HYDROLOGY OF SIDE DRAINS

3.1 GENERAL

Surface water runoff from side drains to the Salt River has been evaluated in order to characterize the potential for damage to the restored habitat areas as well the potential for supporting or nourishing restored habitat. The discussion of surface water impacts included runoff from three significant side drain features - Indian Bend Wash, Old Cross Cut Canal, and the Tempe Drain or 48th Street Drain. The Tempe Cienega includes some restoration in the downstream portion of Indian Bend Wash, as well as in the Salt River just upstream of Tempe Lakes (just above the mouth of Indian Bend Wash). Design discharges, as well as discharge-frequency relationships for Indian Bend Wash were established during the analysis and design of the Indian Bend Wash project. The focus of the surface water evaluation of the three major side drains was the *determination of potential impact on the downstream restoration features.* Especially important in this context was the magnitude of runoff from these major drains, the quantity which might reach the Rio de Vida, and the frequency of this runoff reaching the Rio de Vida.

To provide information for design of Tempe Cienega and Rio de Vida wetland features which might safely pass locally damaging flows, peak N-year flow rates for storm drains which outlet directly to the restored wetlands were established. To provide information concerning the quantity of surface water available for nourishment of restored habitat, N-year 24-hour volumes and average annual volumes were estimated for applicable storm drains within the Tempe Cienega and Rio de Vida project reaches.

The frequency and volume of surface water runoff from 4 storm drains which discharge to the Salt River and 5 storm drains which discharge to Indian Bend Wash near the Tempe Cienega, as well as 24 storm drains which outlet to the Salt River in the reach referred to as Phoenix Rio de Vida, were estimated during this study.

Surface water hydrology for Tempe Cienega and Rio de Vida side drains is presented in two sections. The first section (3.2) considers the potential impact of runoff from the major side drains on restored habitat. The second section (3.3) presents an analysis of peak discharges from local side drains in the Tempe Cienega and Rio de Vida project reaches, as well as the frequency and volume of runoff from the side drains.

3.2 INDIAN BEND WASH, OLD CROSS CUT CANAL, AND TEMPE DRAIN

3.2.1 Indian Bend Wash (IBW). IBW drains approximately 90 sq.mi. of mostly urbanized watershed, including Scottsdale and a portion of the City of Phoenix, into the Salt River. The outlet to the Salt River ia about midway between Hayden Road on the east and Scottsdale Road on the west.

To estimate the impact of runoff from IBW to the Salt River, simulations of several flood events were performed using the most recent channel configuration information for the Salt River, including modifications for future channelization and bank protection provided by the Flood Control District of Maricopa County (FCDMC). Based upon volume-frequency relationships developed during the Central Arizona Water Control Study (CAWCS) and published in the May 1982 CAWCS hydrology report, it appears that a 10-year flood hydrograph from IBW (peak discharge = 9000 ft^3/s) would be reduced to 1500 ft^3/s at Mill Avenue and 140 ft $/s^3$ at Central Avenue and disappear shortly downstream. The 5-year flood hydrograph (peak discharge = 4800 ft^3/s) would be reduced to 370 ft^3/s at Mill Avenue and disappear before Central Avenue.

Typically, storms which produce sufficient precipitation and runoff from the 13,000 sq. mi. Salt River watershed to generate spills past Granite Reef Dam do not result in significant precipitation in the downstream Phoenix metropolitan area and runoff from IBW. The estimates above were based upon the non-concurrence of the IBW runoff with mainstem Salt River flows.

Since excess flow from the Salt River is expected to spill over Granite Reef Dam approximately once every 3 years on the average, and the 5-year discharge from these spills is expected to exceed 20,000 ft^3/s, there is little purpose in providing protection from IBW flows, which are both much smaller in magnitude and less frequent.

Finally, although there is sparse record available, there are no instances during which runoff from Indian Bend Wash (or any of the major side drains) did much more than wet the channel downstream of the confluence. Under most circumstances, water from these side drains does not contain sufficient volume nor flow for long enough duration to fill the Salt River channel and flow downstream.

3.2.2 Old Cross Cut Canal. The Old Cross Cut Canal was originally part of the SRP canal system and was built to transfer water from the Arizona Canal southerly to the Grand Canal. Today it serves primarily to drain floodwaters intercepted by the Arizona Canal, and local runoff downstream from the Arizona Canal, to the Salt River. The confluence with the Salt River is approximately one-quarter mile west of 48th Street on the north side of the Salt River. The drainage area is approximately 17 sq. mi., of which about 20% is rugged and steep mountainous area, including Camelback Mountain (elevation 2700 feet with a slope of about 60%), and Papago Mountain Park, which although rugged is much flatter with a slope of about 5 %. The remainder of the drainage area is densely populated urban valley area, with slopes of about 1%.

Discharges in the Old Cross Cut Canal, as expected, are considerably smaller than discharges in IBW, and because of the disparity in size (IBW drains about 5 times as much area), the resulting runoff volume is also much smaller. Consequently, the impact of runoff from the Old Cross Cut Canal on Salt River habitat restoration is expected to be less.

3.2.3 Tempe Drainage District No. 2 Ditch (48th Street Drain). This open channel drains an area similar in size to the Old Cross Cut Canal (approximately 14 sq. mi.). The contributing area is

highly urbanized area within the City of Tempe. The capacity of the drain is 1100 ft^3/s at 48th Street, and it enters the Salt River from the south in the vicinity of the I-10 Freeway (near 32nd Street). Runoff to the ditch from the City of Tempe is curtailed as a result of on-site detention requirements. Downstream from the Tempe city limits some runoff from the City of Phoenix doubtlessly enters the ditch. Based upon regional relationships developed within this study and displayed in Figure 3-1[10], it appears that the channel can convey a peak flow of about a 10-year frequency. This may be an underestimate, if detention requirements are effective.

3.3 LOCAL SIDE DRAINS

3.3.1 General. There are 17 local side/storm drains which discharge to the Tempe cienega and 34 side drains which discharge to the Rio de Vida. Of these, 9 side drains which discharge to the Tempe Cienega and 24 storm drains which discharge to Rio De Vida encompassed drainage areas of sufficient size (> 20 acres) to have been included in this evaluation. The contributing drainage areas for those drains evaluated ranged in size from 0.03 sq.mi. (21 acres) to 13.87 sq.mi. (8879 acres). Outlet sizes for these drains were as small as 15 inches in diameter (City of Phoenix designation, SR-34), and as large as 21 feet in diameter (City of Phoenix designation, SR-13 and SR-19). The area drained is intensely developed urban landscape, with runoff coefficients estimated to vary from 0.002 to 0.95. Retention requirements in the City of Tempe significantly reduce the runoff from some of the contributing area. Information about the drain size, location, and contributing drainage area size and characteristics was provided by the cities of Tempe and of Phoenix[11] (Tables 1-1 and 1-2). The outlets to the Salt River and Indian Bend Wash are shown on Plates 1-A through 5-A. In addition, Plates 6 and 7 depict the contributing drainage area of the side drains in the vicinity of Rio de Vida and Tempe Cienega. Initial estimates of runoff had been made in the Rio Salado, Salt River, Az Reconnaissance Report, prepared by the Los Angeles District Corps of Engineers, dated March 1995. The information contained within that report was updated based upon the most recent information. *However, the construction and connection of side drains is a dynamic process, and some of the information presented herein may be incomplete or out of date.*

Very little information is available from which definitive estimates of runoff for these side drains can be made. The FCDMC has a network of gages which can be used to monitor precipitation and runoff in municipal drains. However, inspection of the data indicates that the information is often conflicting, e.g. the runoff is greater than the incident rainfall. In addition, there is an inconsistency between the estimated runoff coefficients and the quantity of runoff resulting from recorded rainfall. There are numerous possible explanations for these inconsistencies, including faulty ratings, inaccurate drainage areas, non-representative rainfall, improper rainfall gage location, etc. Rainfall-runoff information from selected locations is included in Tables 3-1 and 3-2.

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[10] The development of the curves in Figure 3-1 is discussed in Section 3.3, which follows.

[11] Tempe Cienega: informal information from the City of Tempe, including drainage area maps and tabulations of side drain locations, outlet sizes, drainage area sizes and land use.
Rio de Vida: "APPENDIX 1 - OUTFALLS, CITY OF PHOENIX NPDES - PART 2", prepared by Woodward-Clyde Consultants, dated 3 November 1992.

The procedure followed in this evaluation included the following steps:

1) Development of N-year 6- and 24-hour precipitation depths for the vicinity from NOAA Atlas II, Volume VIII - Arizona. Table 3-3 summarizes these results.

2) Based upon this information, development of a critical duration storm for production of peak and volume information. The conclusion, based upon inspection of step 1 rainfall depths, was that most of the effective precipitation was contained within the maximum 6-hour period. Hence, a local thunderstorm, patterned after the 1954 Queen Creek Storm (referred to by the Los Angeles District as the Greater Arizona Standard Project Summer Thunderstorm), was used to generate hyetographs for computation of peak and volume runoff. The 6- and 24-hour precipitation depths were utilized to extend the 6-hour depth to 7-hours, the duration of the pattern storm. The 7-hour precipitation depths are also contained in Table 3-3.

3) Rainfall-runoff modeling (HEC-1) was used to estimate N-year peak discharges and maximum 24-hour runoff volumes for an 8-drain sample of side drains. The sample was selected arbitrarily to provide a wide range of drainage area sizes. Peak discharges and 24-hour volumes for the 8-drain sample were regressed against drainage area to provide a family of frequency curves from which values for the other drains might be estimated. Because of the poor correlation between runoff coefficients and effective rainfall, and the relatively small variance between regressed discharge-drainage area curves, estimates for peak flow and volume were **not** adjusted for varying runoff coefficients. *Consideration was given to modifying runoff from the City of Tempe due to retention requirements. As considered appropriate, adjustments to the "effective" drainage area, i.e. the area directly conducive to surface runoff, were made.*

4) Rainfall-runoff parameters were taken from previous Los Angeles District studies in the Phoenix area. These parameters were modified to produce an N-year set of discharge-frequency values (N = 2, 5, 10, 25, 50, and 100) which were equivalent to results previously calculated for the large ADOT storm drains which collect runoff upstream of the Papago Freeway (I-10) and convey that flow to the Salt River. The modified parameters used to reproduce discharges for the ADOT drains were generalized to the remaining drains in the 8-drain sample. Since the 7-hour rainfall represented approximately 85% or more of the 24-hour rainfall depths, the runoff volume resulting from simulation of the maximum 7-hour rainfall was considered to be the maximum 24-hour runoff volume. The amount and intensity of rainfall during the remaining 17-hours would not produce any significant additional runoff.

5) Annual runoff volumes were estimated in two phases and then combined -

- Integration of maximum annual runoff resulting from N-year rainfall-runoff computations, and
- Integration of partial duration runoff resulting from rainfall-runoff computations of events more frequent than the 2-year event (average annual maximum).

The first phase represents the runoff from the series of annual maximum storm events. The second phase represents the runoff from events other than the annual maximum. Combined, this provides a means of estimating average annual runoff. This procedure was selected as an alternative to computing the average annual runoff based simply upon the average annual rainfall and coefficient of runoff. The latter process tends to overestimate runoff potential. Attempts to exclude less intense storms from the process were made in the reconnaissance study; however, data provided by the FCDMC indicates that, because of the impervious cover, runoff occurs during rainfall events of very low intensity. However, estimating the runoff volume by applying the runoff coefficient directly to rainfall produces runoff greatly exceeding the observed runoff. As a consequence, the full range of rainfall for frequent events (partial duration) was evaluated.

3.3.2 Peak Discharges.

3.3.2.1 *Rainfall-runoff Parameters*[12]. The following values were taken from previous studies in the Phoenix vicinity and generalized to the 8-drain sample:

- Basin n - .075 (urbanized areas below Grand Canal were assigned n-values up to 0.15.
- Phoenix Valley S-graph

[12] Re: ARIZONA CANAL DIVERSION CHANNEL, DREAMY DRAW TO CUDIA CITY WASH, ECONOMIC ANALYSIS, FINAL, March 1987, Appendix 1, Hydrologic Analysis, US Army Corps of Engineers, Los Angeles District.

- HEC Loss Rate (SPF computations):

  DLTKR - 1.0
  STRKR - 0.38
  RTIOL - 2.0
  ERAIN - 0.0
  RTIMP - Ranged from 20% u/s of Arizona Canal to 50% d/s of Arizona Canal.

These basic SPF parameters were modified as required to produce a consistent set of N-year discharges. The following table portrays these modifications.

FLOOD FREQUENCY, years

	100	50	25	10	5	2	<2
DLTKR	1.0	1.5	1.5	1.5	1.5	1.5	1.5
STRKR	0.38	0.60	0.75	0.8	0.8	0.8	0.8
RTIOL	2.0	2.0	2.0	2.0	2.0	2.0	2.0
ERAIN	0.0	0.0	0.0	0.0	0.0	0.0	0.0
RTIMP[1]	100	67	50	33	33	33	33

[1] % of basin development as reflected in runoff coefficients. E.g., 100% indicates that the actual weighted runoff coefficient for any subarea represented the relative amount of impervious area. As intensity of precipitation decreases, the relative impact of impervious cover may decrease if not directly connected to storm drain system. Hence for more frequent events only 33% of the impervious area was considered to be effective, i.e. the runoff coefficient was multiplied by 0.33 to determine the weighted runoff coefficient.

3.3.2.2 *Guide to Development of N-year Discharges.* Previous studies in the Phoenix vicinity have resulted in the following relationships between Standard Project Flood (SPF) peak discharges and N-year peak discharges:

TABLE 3-7B. TWENTY-FOUR HOUR VOLUME-FREQUENCY AND AVERAGE ANNUAL RUNOFF VOLUMES FOR SIDE DRAINS - RIO DE VIDA

SUBAREA	DA, mi^2	PIPE SIZE, in	TWENTY-FOUR HOUR VOLUME, ac-ft						AVERAGE ANNUAL RUNOFF, ac-ft	Estimated Capacity, ac-ft[1]
			100-yr	50-yr	25-yr	10-yr	5-yr	2-yr		
SR-07	0.99	54	121	97	60	42	30	15	80	218
SR-08	5.69	96	645	476	298	198	119	54	440	992
SR-09[2]	0.95	81	141	95	65	46	36	18	79	595
SR-10	1.55	54	198	139	91	60	40	20	130	218
SR-11	0.05	30	6.0	4.6	3.0	2.0	1.6	0.9	4	44
SR-12[2]	0.19	42	26	18	12	7.9	6.0	4.0	16	109
SR-13[2]	13.87	21 (ft)	1535	974	631	411	303	125	900	6940
SR-14	0.04	36	4.8	3.6	2.4	1.5	1.2	0.7	3.2	75
SR-15	1.93	84	258	176	109	77	50	26	160	694
SR-16	0.11	54	13	10	6.1	4.4	3.6	1.9	8.5	218
SR-17	1.17	96	145	109	69	48	32	17	100	992
SR-18[2]	6.55	66	885	587	395	262	202	101	500	377
SR-19	4.35	21 (ft)	536	377	238	159	97	24	350	6940
SR-20	5.59	84	654	466	298	198	137	54	420	694
SR-21	1.00	90	123	97	60	42	30	16	82	813
SR-31[2]	3.00	72	343	222	145	137	75	30	240	476
SR-32[2]	1.58	72	204	136	89	63	48	22	135	476
SR-33	1.32	66	159	119	76	53	34	18	110	377

RATIO OF SPF/N-year PEAK DISCHARGE

N-year flood	N-year adjustment[13]
SPF	100
100	45
50	32
25	21
10	12

NOTE:
No estimates for events <10-year. Rainfall-runoff parameters for events <10-years were set to the 10-year values.

3.3.2.3 *Subarea Characteristics.* Based upon City of Phoenix NPDES Maps and previous studies, the following hydrologic characteristics were developed for the 8-drain sample.

SUBAREA	DA, sq.mi.	L, mi	L_{CA}, mi	S, ft/mi[(1)]	n
SR-09	0.95	4.78	2.67	15	.075
SR-12	0.19	1.17	0.73	15	.075
SR-13	13.87	8.43	6.13	15	.075
SR-18	6.55	9.35	2.40	15	.075
SR-31	3.00	3.40	2.19	15	.075
SR-32	1.58	3.88	2.29	15	.075
SR-34	0.03	0.63	0.61	15	.075
SR-37	0.53	1.70	1.54	15	.075

(1) General slope of drainage area to Salt River, accounting for network of side drains, is approximately 15 feet/mile.

[13] Adjustment in % SPF

3.3.2.4 *Results*. N-year peak discharges for each of the sample drains are presented in Table 3-4. These results were plotted versus drainage area size and a set of N-year peak discharge/drainage area curves was generated. To aid in providing a consistent set of relationships and to enhance the range established, IBW values were also included. The resulting family of curves (please refer to Figure 3-1) was then used to estimate peak flows for all of the remaining side drains (see Tables 3-5A and 3-5B). Side drain capacity was estimated based upon general ground slope, culvert size, and generalized flow characteristics for RCCP. This information is included in Tables 3-5A and 3-5B, in order to estimate the relative quantity of flow which may discharge to the project reaches during significant local storms, and provide a range of discharges for design of localized protection to the restored habitat. In general, discharges exceeding the 5-year peak flow would exceed the discharge capacity for about half of the Rio de Vida side drains. Many side drains to Tempe Cienega are impacted by retention storage, and hence indicate an extremely high level of protection compared to typical design of storm drains. Figure 3-2 shows a discharge capacity versus pipe diameter rating curve developed from the available data.

3.3.3 Volumes.

3.3.3.1 *N-year 24-hour Runoff Volume*. Based upon hydrologic simulation of N-year events for the 8-drain sample, maximum 24-hour average discharges associated with the peak flow rates were also determined. These N-year, 24-hour average discharges are displayed in Table 3-6. In the same manner as for peak discharges, a set of N-year, 24-hour discharge versus drainage area curves was prepared (please refer to Figure 3-3). Utilizing these curves, N-year, 24-hour volumes were estimated for each of the other side drains. These results are shown in Tables 3-7A and 3-7B.

3.3.3.2 *Average Annual Runoff Volume*. Average annual volume includes the maximum volume from each year (annual exceedance series) as well as volume from lesser events, referred to descriptively herein as partial duration events. The combination of both of these series, averaged over N-years, provides an estimate of the average annual volume.

3.3.3.2.1 ANNUAL MAXIMUM RUNOFF. To estimate the annual runoff volume from the annual exceedance series, the N-year, 24-hour runoff volumes generated from the 8-drain sample and converted to ac-ft, were plotted versus a range of drainage area sizes between 0.02 and 100 sq.mi. (refer to Table 3-8 and Figures 3-4a through 3-4e), and subsequently integrated over the range of probabilities. Table 3-9 summarizes the computations of annual maximum runoff for this range of drainage area sizes.

3.3.3.2.2 ANNUAL PARTIAL DURATION RUNOFF. Little runoff was expected to occur during periods of light rainfall. However, information obtained[14] for three side drains to the Salt River (designated as SR-03, SR-21, and SR-45) along with IB-08, a side drain to Indian Bend Wash, indicate that runoff occurs throughout a full range of precipitation. For each of these drains,

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[14] Stormwater Quality Report, December 1994 through February 1996, for City of Phoenix, Arizona, Volume II, Storm Hydrographs, by FCDMC

the FCDMC had generated hydrographs and hyetographs during a series of recent rainfall events. From this information, the ratio of effective rainfall to incident rainfall was calculated. In all cases, this ratio is significantly less that the runoff coefficient, but does not appear to be a function of rainfall amount. To supplement these results, runoff from a small urbanized area which drains to the Salt River (Salt River Tributary No. 2[15]) was also investigated. The results for both the FCDMC side drains and Salt River Tributary No. 2 are similar and have been presented in Table 3-1 and 3-2. In addition, the FCDMC informally provided corresponding information for an additional 12 sites. While data for these sites confirmed the foregoing results, the information was of dubious computational value since so much of it was conflicting, i.e. the runoff exceeded the incident rainfall. However, for five of those sites, the rainfall and runoff information was consistent, and confirmed the results shown in Table 3-1 and 3-2.

Daily Precipitation for the Phoenix vicinity was readily available for the period from July 1948 - July 1995 on a CDROM[16]. For the purpose of computing runoff volume, daily rainfall totals were considered to be adequate. There is likely to be a seasonal variation in the intensity of rainfall and conduciveness of the basin to absorb rainfall; however, seasonal effects were not factored into this evaluation.

The daily precipitation records from the 1948-1995 period for the National Weather Service gage at the Phoenix airport (Sky Harbor) were collected and analyzed. During this period there were 380 days[17] when the precipitation equalled or exceeded 0.25 in. and 176 days when the precipitation equalled or exceeded 0.50 in. The greatest annual precipitation occurred in 1993 (15.08 in.) and the greatest annual amount of precipitation equalling or exceeding 0.50 in. per day was 9.42 in. in 1951. The average annual precipitation for the 38 complete years was 8.00 in. and the average annual amount of precipitation exceeding 0.50 in. per day was 4.21 in. The maximum daily precipitation listed was 2.70 inches on July 24, 1992. According to Sellars, et al, Arizona Climate, the First 100 Years, the highest daily precipitation value is 2.73 inches in August 1951. Table 3-10 presents daily exceedances for threshold daily rainfall amounts as well as an average annual summary of the results.

Average annual precipitation in the Phoenix metropolitan area is 7.66 inches[18]. The number of days in which rainfall amounts exceeded a threshold value were determined for a range of daily rainfall

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[15] United States Geological Survey Gage number 09512180, period of record 1963-1965. The gage was located on the left bank of the Salt River at the southwest corner of the Motorola, Inc. plant, 3 1/2 miles southwest of Scottsdale and 5.8 miles east of Phoenix Post Office at that time. It may have been destroyed by the floods of December 1965 and January 1966.

[16] Leased by the Los Angeles District from HYDROSPHERE ©

[17] These numbers reflect the 38 years during which observations for each day were made. During other years the record was incomplete and thus not used for computational purposes.

[18] Source: National Weather Service, 30-year normal annual precipitation (1961-1990) @ Sky Harbor Airport.

totals, from 0.1 inches to 2.7 inches (the maximum recorded rainfall event). The results are displayed in Figure 3-5.

From Figure 3-5 discrete rainfall amounts for daily events between 0.0 inches and 1.2 inches[19] were selected. The selected rainfall amounts were 0.25 inches (380 exceedances or 10 per year), 0.50 inches (176 exceedances or 4.6 per year), 0.75 inches (110 exceedances or 2.9 per year), and 1.00 inches (58 exceedances or 1.5 per year). As indicated, the number of these exceedances (occurrences) for each interval was divided by 38 to compute the average annual number of exceedances. Simulated runoff hydrographs for each of these rainfall interval amounts were generated using the HEC-1 model for the 8-drain sample with 2-year rainfall-runoff parameters. Twenty-four hour runoff volumes for each rainfall event are shown in Table 3-11. Average annual runoff volumes for the rainfall intervals were then computed by multiplying the end-of-interval volume by the "average" or representative number of annual exceedances in the interval (please refer to Table 3-12). The annual volume of runoff from the 8-drain sample for events more frequent than the 2-year event, i.e. smaller than, was regressed against drainage area size and an approximate curve was generated (refer to Figure 3-6). The average annual runoff volume curve for the 8-drain sample computed previously (refer to Table 3-8 and Figures 3-4a through 3-4e) was combined with this relationship to develop a combined average annual runoff curve (refer to Figure 3-7). The combined curve was used to estimate average annual runoff for all the side drains, and the results included in Table 3-7.[20] In general, average annual runoff volumes amount to between 15 and 20 % of the incident rainfall, or between 1 and 1.5 inches per year.

Based upon previous studies of urban runoff, impervious cover becomes less efficient for less intense storms, especially when the impervious cover is not *directly connected* to a storm drain system. To account for this, studies conducted in the Los Angeles Drainage Area (in highly urbanized locales with slopes much greater that the Phoenix area, thus more conducive to production of runoff) a relationship comparing the percentage of *effective* impervious area to *total* impervious area was developed. This relationship indicated that an impervious area of 50% would have an effective impervious area of 35%. Applying this proportion to the amount of annual runoff-producing rainfall (events exceeding 0.10 inches/day) results in an estimated excess of approximately 1 inch in the Phoenix metropolitan area, a comparatively consistent result.

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[19] The 6-hour, 2-year, point precipitation depth for Phoenix vicinity is 1.2 inches. The 2-year frequency event may be considered as the average annual maximum event. Hence any 6-hour event <1.2 inches would be expected to occur more than once a year, on the average. Runoff from such events has been categorized as "partial duration" runoff.

[20] Side drains in the vicinity of the Tempe Cienega are impacted by retention storage. In several instances, the effective drainage area was reduced to account for this factor. The runoff coefficient for the 8-drain sample averaged about 0.44 or 44% (refer to Tables 1-2 and 3-4). In some instances, the runoff coefficient for side drains to the Tempe Cienega was much lower; in other instances, the coefficients greatly exceeded this amount. For those cases, the effective area was decreased or increased proportionally.

TABLE 3-1. SUMMARY OF SELECTED RAINFALL RUNOFF INFORMATION FOR PHOENIX SIDE DRAINS[1]

FLOOD EVENT	PARAMETER	SIDE DRAIN ID			
		SR-03	SR-21	SR-45	IB-08
		SIDE DRAIN AREA, sq mi			
		2.90	0.98	1.24	0.95
		RUNOFF COEFFICIENT			
		0.45	0.90	0.50	0.85
5Dec94	Rainfall	0.40			0.84
	Runoff	8.0			4.5
	%Effective	12.9			42.6
4Jan95	Rainfall	0.40	0.45		0.40
	Runoff	8.2	13.7		8.5
	%Effective	13.3	58.2		41.9
25Jan95	Rainfall		0.10		0.20
	Runoff		5.78		5.00
	%Effective		(110)[2]		49.3
6Mar95	Rainfall				0.84
	Runoff				19.7
	%Effective				46.3
11Mar95	Rainfall	0.08			0.16
	Runoff	1.4			4.4
	%Effective	11.3			54.3
11Jul95	Rainfall				0.06
	Runoff				0.6
	%Effective				19.7
11Aug95	Rainfall				0.11
	Runoff				1.73
	%Effective				31.0
14Aug95	Rainfall	0.16		1.0	
	Runoff	0.6		1.5	
	%Effective	4.1		2.3	
19Aug95	Rainfall	0.09	0.26	0.26	0.16
	Runoff	1.0	11.4	1.2	2.5
	%Effective	7.2	83.9	7.0	30.8

TABLE 3-1. continued

FLOOD EVENT	PARAMETER	SIDE DRAIN ID			
		SR-03	SR-21	SR-45	IB-08
		SIDE DRAIN AREA, sq mi			
		2.90	0.98	1.24	0.95
		RUNOFF COEFFICIENT			
		0.45	0.90	0.50	0.85
7Sep95	Rainfall	0.16			
	Runoff	1.5			
	%Effective	6.1			
27Sep95[3]	Rainfall	0.94	0.25	0.25	0.30
	Runoff	14.8	11.1	1.4	22.0
	%Effective	10.2	84.9	8.5	(144.7)[2]
1Nov95	Rainfall	1.30	0.80	0.85	
	Runoff	18.8	22.5	1.8	
	%Effective	9.4	53.8	3.2	
1Feb96	Rainfall	0.22	0.16	0.16	0.02
	Runoff	4.6	2.3	0.27	5.5
	%Effective	13.5	27.5	2.6	(542.8)[2]
Results	**Average, %EFF**	**9.8**	**61.6**	**4.7**	**39.5**
	Highest	13.3	84.9	8.5	54.3
	Lowest	4.1	27.5	2.3	19.7
	Σ Rainfall, in	3.75	1.92	2.52	2.77
	Σ Runoff, ac-ft	58.90	61.00	6.170	46.93
	Average, %EFF	**10.1**	**60.8**	**3.7**	**33.4**

NOTES:
Rainfall depths in inches.
Runoff volumes in ac-ft.
[1] STORMWATER QUALITY REPORT, December 1994 through February 1996, for City of Phoenix, Arizona, Volume II, Storm Hydrographs, by Flood Control District of Maricopa County.
[2] Impossible outcome. Apparently the precipitation amount is too low.
[3] Storm occurred during the night of 27Sept/morning of 28Sept.

TABLE 3-2. SUMMARY OF SELECTED RAINFALL RUNOFF INFORMATION FOR PHOENIX SIDE DRAINS - SALT RIVER TRIBUTARY 2

SALT RIVER TRIB 2 @ PHOENIX DRAINAGE AREA = 0.04 sq mi RUNOFF COEFFICIENT = 0.80[1]					
DATE	**PARAMETER**		**DATE**	**PARAMETER**	
Aug 1963	Rainfall	2.29	Apr 1964	Rainfall	0.15
	Runoff	2.7		Runoff	0.04
	%Effective	55.3		%Effective	12.5
Sep 1963	Rainfall	0.22	May 1964	Rainfall	0.02
	Runoff	0.2		Runoff	0.00
	%Effective	42.6		%Effective	0.0
Oct 1963	Rainfall	1.46	Jun 1964	Rainfall	0.00
	Runoff	2.0		Runoff	0.00
	%Effective	64.2		%Effective	NA
Nov 1963	Rainfall	0.91	Jul 1964	Rainfall	0.46
	Runoff	0.46		Runoff	1.2
	%Effective	23.7		%Effective	(122)[2]
Dec 1963	Rainfall	0.00	Aug 1964	Rainfall	1.69
	Runoff	0.0		Runoff	2.0
	%Effective	NA		%Effective	55.5
Jan 1964	Rainfall	0.15	Sep 1964	Rainfall	2.08
	Runoff	0.24		Runoff	2.9
	%Effective	75.0		%Effective	65.4
Feb 1964	Rainfall	0.00	Oct 1964	Rainfall	0.17
	Runoff	0.00		Runoff	0.08
	%Effective	NA		%Effective	22.1
Mar 1964	Rainfall	0.55	Nov 1964	Rainfall	0.48
	Runoff	0.32		Runoff	0.30
	%Effective	27.3		%Effective	29.3
Dec 1964	Rainfall	0.93	Apr 1965	Rainfall	1.62
	Runoff	0.54		Runoff	1.40
	%Effective	27.2		%Effective	40.5

TABLE 3-2. (continued)

SALT RIVER TRIB 2 @ PHOENIX

DRAINAGE AREA = 0.04 sq mi

RUNOFF COEFFICIENT = 0.80[1]

DATE	PARAMETER		DATE	PARAMETER	
Jan 1965	Rainfall	1.54	May 1965	Rainfall	0.15
	Runoff	1.00		Runoff	0.12
	%Effective	30.4		%Effective	37.5
Feb 1965	Rainfall	1.20	Jun 1965	Rainfall	1.20
	Runoff	1.60		Runoff	1.20
	%Effective	62.5		%Effective	46.9
Mar 1965	Rainfall	1.36	Jul 1965	Rainfall	0.50
	Runoff	1.90		Runoff	0.02
	%Effective	65.5		%Effective	1.9

Σ Rainfall = 19.13 inches

Σ Runoff = 20.22 ac-ft

Weighted Runoff Coefficient = 49.5%

NOTES:

Rainfall depths in inches. Source: National Weather Service Gage at Sky Harbor Airport

Runoff volumes in ac-ft. Source: USGS Water Supply Paper for Arizona, 1964.

The data presented is from a discontinued USGS gage which, according to USGS notes, was located on the left bank of the Salt River at the southwest corner of the Motorola, Inc. plant, 31/2 miles southwest of Scottsdale and 5.8 miles east of Phoenix Post Office at that time. It may have been destroyed by the floods of December 1965 and January 1966.

[1] Additional anecdote in USGS Water Supply Paper for Arizona, 1964.

[2] Impossible outcome. Apparently the precipitation amount is too low.

TABLE 3-3. POINT PRECIPITATION-DURATION-FREQUENCY VALUES FOR PHOENIX VICINITY

FREQUENCY, yrs	POINT PRECIPITATION DEPTH, inches[1]		
	6-hour duration	7-hour duration[2]	24-hour duration
2	1.2	1.23	1.4
5	1.7	1.75	2.0
10	2.0	2.05	2.3
25	2.3	2.38	2.8
50	2.7	2.78	3.2
100	3.1	3.22	3.8
SPS	6.36[3]		

[1] Source: NOAA Atlas II, Volume VIII-Arizona

[2] Interpolated value based upon 6-hour and 24-hour values

[3] Central Value: SPS Duration = 7 hours - Greater Arizona Standard Project Summer Thunderstorm.

TABLE 3-4. PEAK DISCHARGE-FREQUENCY VALUES FOR 8-DRAIN SAMPLE

Subarea	Drainage Area, mi^2	Peak Discharge, ft^3/s						
		SPF	100-yr	50-yr	25-yr	10-yr	5-yr	2-yr
SR-09	0.95	1050	508	360	253	178	138	71
SR-12	0.19	420	200	145	103	74	56	26
SR-13	13.87[1]	8230	3730	2420	1580	1050	766	295
SR-18	6.55	5630	2685	1850	1266	865	661	314
SR-31	3.00	3460	1560	1050	703	623	370	148
SR-32	1.58	1850	862	594	409	292	221	100
SR-34	0.03	73	37	27	20	14	11	5
SR-37	0.53	872	400	278	192	137	102	43

NOTE:
The subareas referred to were arbitrarily selected from City of Phoenix NPDES summary prepared by Woodward-Clyde Consultants, and dated November 11, 1992. The subarea numbers are designations of outfalls to the Salt River in the vicinity of the Rio de Vida. This 8-drain sample provided a range of drainage area sizes and locations, the hydrologic information for which was used to develop an estimation procedure for all outfalls to the Salt River in the project reach. Discharges for each frequency flood were computed using HEC-1, n-year 7-hour precipitation distributed according to the Queen Creek 1954 thunderstorm pattern, with basin parameters defined from City of Phoenix NPDES maps.

[1] Actual contributing drainage area may be greater. The area shown was based upon City of Phoenix NPDES Permit summary information, and is consistent with studies performed by the COE for this area.

TABLE 3-5A. PEAK DISCHARGE-FREQUENCY VALUES FOR SIDE DRAINS - TEMPE CIENEGA

SUBAREA	DA[1], mi²	PIPE SIZE, in	PEAK DISCHARGE, ft³/s						Estimated Capacity, ft³/s[2]
			100-yr	50-yr	25-yr	10-yr	5-yr	2-yr	
SALT RIVER SIDE DRAINS									
SR-08[3]	2.87	54	3200	1700	850	560	350	150	110
SR-09	0.12/0.02	30	25	19	14	10	8	4	22
SR-10[4]	1.04/0.52	36	390	290	200	140	100	43	39
SR-11[5]		66							190
SR-12	1.53[6]	18 ft	995	695	535	345	225	105	2800[7]
INDIAN BEND WASH SIDE DRAINS									
IB-01	0.0006	42							55
IB-02	0.03	36							38
IB-03	0.04	42							55
IB-04	0.001	36							38
IB-05	0.10	48	90	68	48	37	28	14	80
IB-06	0.02/0.04	48	43	32	23	17	13	6	80
IB-07	0.002	48							80
IB-08	0.04/0.08	2x36	76	56	40	31	23	12	76
IB-09	0.03/0.06	54	60	45	31	25	19	9	110
IB-10	0.09	42	81	61	44	34	26	13	55
IB-11	0.006	36							38
IB-12	0.01	48							80

NOTES:
Discharges developed from generalized discharge vs. drainage area curves for n-year frequency runoff.
Shaded areas indicate approximate frequency or range of frequencies equivalent to drain capacity.
No data generated for areas considered too small due to size or on-site retention storage.

(1) Where 2 drainage areas are shown, the 1st is the total area, the 2nd is the effective area based upon runoff coefficient comparison to 8-drain sample (average for 8-drain sample, 0.44).
(2) Capacity estimated from pipe discharge vs. pipe diameter rating curve developed for nominal sizes.
(3) Future relocation of Dorsey Lane storm drain. Estimated runoff expected to be reduced when relocated.
(4) Future runoff from this drainage area expected to be reduced.
(5) Not connected yet. Contributing drainage area not yet determined.
(6) Contributing drainage area is more than shown, but unknown at the time of this report. The area shown is from City of Tempe NPDES Permit summary.
(7) Actual capacity less, since this is a forced drain, i.e. operates under pressure.

TABLE 3-5B. PEAK DISCHARGE-FREQUENCY VALUES FOR SIDE DRAINS - RIO DE VID

SUBAREA	DA, mi^2	PIPE SIZE, in	PEAK DISCHARGE, ft^3/s						Estimated Capacity, ft^3/s[1]
			100-yr	50-yr	25-yr	10-yr	5-yr	2-yr	
SR-07	0.99	54	700	500	350	240	170	70	110
SR-08	5.69	96	2900	2000	1500	1000	600	250	500
SR-09[2]	0.95	81	508	360	253	178	138	71	300
SR-10	1.55	54	1000	700	540	350	230	100	110
SR-11	0.05	30	50	40	28	21	17	7.5	22
SR-12[2]	0.19	42	200	145	103	74	56	26	55
SR-13[2]	13.87	21 (ft)	3730	2420	1580	1050	766	295	3500
SR-14	0.04	36	42	32	23	17	14	6.1	38
SR-15	1.93	84	1200	900	650	420	280	130	350
SR-16	0.11	54	100	72	50	40	30	15	110
SR-17	1.17	96	800	600	400	280	190	80	500
SR-18[2]	6.55	66	2685	1850	1266	865	661	314	190
SR-19	4.35	21 (ft)	2300	1700	1300	800	500	210	3500
SR-20	5.59	84	2900	2000	1500	1000	600	250	350
SR-21	1.00	90	690	500	360	240	170	70	410
SR-31[2]	3.00	72	1560	1050	703	623	370	148	240
SR-32[2]	1.58	72	862	594	409	292	221	100	240
SR-33	1.32	66	850	600	450	290	200	85	190
SR-34[2]	0.03	15	37	27	20	14	11	5	18
SR-35	2.61	72	1600	1100	800	510	330	150	240
SR-36	1.90	72	1100	850	600	400	270	110	240
SR-37[2]	0.53	36	400	278	192	137	102	43	39
SR-38	1.86	72	1050	800	590	390	265	105	240
SR-39	4.66	96	2500	1800	1400	900	500	220	500

NOTES:
Discharges developed from generalized discharge vs. drainage area curves for n-year frequency runoff.
Shaded areas indicate approximate frequency or range of frequencies equivalent to drain capacity.

[1] Capacity estimated from pipe discharge vs. pipe diameter rating curve developed for nominal sizes.

[2] Discharges for designated subareas computed using HEC-1 model. Results were then used to develop generalized discharge vs. drainage area curves for n-year frequency runoff.

TABLE 3-6. TWENTY-FOUR-HOUR AVERAGE DISCHARGE-FREQUENCY VALUES FOR 8-DRAIN SAMPLE

Subarea	Drainage Area, mi^2	Twenty-four-hour Average Discharge, ft^3/s						
		SPF	100-yr	50-yr	25-yr	10-yr	5-yr	2-yr
SR-09	0.95	147	71	48	33	23	18	9
SR-12	0.19	28	13	9	6	4	3	2
SR-13	13.87	1730	774	491	318	207	153	63
SR-18	6.55	937	446	296	199	132	102	51
SR-31	3.00	391	173	112	73	69	38	15
SR-32	1.58	222	103	68	45	32	24	11
SR-34	0.03	4	2	1.4	0.9	0.6	0.5	0.3
SR-37	0.53	73	33	22	14	10	8	3

NOTE:
The subareas referred to were arbitrarily selected from City of Phoenix NPDES summary prepared by Woodward-Clyde Consultants, and dated November 11, 1992. The subarea numbers are designations of outfalls to the Salt River in the vicinity of the Rio de Vida. This 8-drain sample provided a range of drainage area sizes and locations, the hydrologic information for which was used to develop an estimation procedure for all outfalls to the Salt River in the project reach. Discharges for each frequency flood were computed using HEC-1, n-year 7-hour precipitation distributed according to the Queen Creek 1954 thunderstorm pattern, with basin parameters defined from City of Phoenix NPDES maps.

TABLE 3-7A. TWENTY-FOUR HOUR VOLUME-FREQUENCY AND AVERAGE ANNUAL RUNOFF VOLUMES FOR SIDE DRAINS - TEMPE CIENEGA

SUBAREA	DA[1], mi²	PIPE SIZE, in	TWENTY-FOUR HOUR VOLUME, ac-ft						AVERAGE ANNUAL RUNOFF, ac-ft	Estimated Capacity, ac-ft[2]
			100-yr	50-yr	25-yr	10-yr	5-yr	2-yr		
SALT RIVER SIDE DRAINS										
SR-08	2.87	54	340	258	149	105	61	34	210	218
SR-09	0.12/0.02	30	2.6	1.8	1.2	0.8	0.6	0.4	1.7	44
SR-10	1.04/0.52	78	60	46	30	20	15	8	43	75
SR-11[3]		66								377
SR-12	1.53	18 ft	198	139	89	60	40	20	125	5550
INDIAN BEND WASH SIDE DRAINS										
IB-01	0.0006	42								109
IB-02	0.03	36								75
ID-03	0.04	42								109
IB-04	0.001	36								75
IB-05	0.10	48	12	9.1	5.8	4.0	3.2	1.7	8.0	159
IB-06	0.02/0.04	48	4.8	3.6	2.4	1.5	1.2	0.7	3.3	159
IB-07	0.002	48								159
IB-08	0.04/0.08	2x36	9.9	7.3	4.6	3.2	2.6	1.4	6.6	150
IB-09	0.03/0.06	54	7.3	5.4	3.5	2.5	1.8	1.0	5.0	218
IB-10	0.09	42	11	8.1	5.2	3.6	2.6	1.6	7.1	109

TABLE 3-7A. continued

SUBAREA	DA[1], mi²	PIPE SIZE, in	TWENTY-FOUR HOUR VOLUME, ac-ft						AVERAGE ANNUAL RUNOFF, ac-ft	Estimated Capacity, ac-ft[2]
			100-yr	50-yr	25-yr	10-yr	5-yr	2-yr		
IB-11	0.006	36								15
IB-12	0.01	48								159

NOTE:
N-year runoff volumes developed from generalized discharge vs. drainage area curves for n-year frequency 1-day runoff.
average annual runoff volumes developed from average annual runoff volume vs. drainage area curves.
No data generated for areas considered too small due to size or on-site retention storage.

[1] Where 2 drainage areas are shown, the 1st is the total area, the 2nd is the effective area based upon runoff coefficient comparison to 8-drain sample (average for 8-drain sample, 0.44).
[2] Twenty-four hour capacity (volume) estimated from pipe discharge vs. pipe diameter rating curve developed for nominal sizes. Figure represents the volume if flowing full for 1-day. Total 24-hour volume expected to reach the Salt River.
[3] Not connected yet. Contributing drainage area not yet determined.

TABLE 3-7 B. continued

SUBAREA	DA, mi^2	PIPE SIZE, in	TWENTY-FOUR HOUR VOLUME, ac-ft						AVERAGE ANNUAL RUNOFF, ac-ft	Estimated Capacity, ac-ft[1]
			100-yr	50-yr	25-yr	10-yr	5-yr	2-yr		
SR-34[2]	0.03	15	4.0	2.8	1.8	1.2	1.0	0.6	2.5	36
SR-35	2.61	72	327	228	139	99	60	31	200	476
SR-36	1.90	72	238	159	105	75	46	26	155	476
SR-37[2]	0.53	36	65	44	28	20	16	6.0	44	77
SR-38	1.86	72	228	155	99	73	45	24	150	476
SR-39	4.66	96	555	397	258	161	99	48	370	992

NOTE:
N-year runoff volumes developed from generalized discharge vs. drainage area curves for n-year frequency 1-day runoff.
average annual runoff volumes developed from average annual runoff volume vs. drainage area curves.

[1] Twenty-four hour volume estimated from pipe discharge vs. pipe diameter rating curve developed for nominal sizes. Total 24-hour volume expected to reach the Salt River.
[2] Twenty-four hour capacity (volume) estimated from pipe discharge vs. pipe diameter rating curve developed for nominal sizes. Figure represents the volume if flowing full for 1-day. Total 24-hour volume expected to reach the Salt River.

TABLE 3-8. MAXIMUM 24-HOUR RUNOFF VOLUME DETERMINATION

ANNUAL EXCEEDANCE PROBABILITY[1]	DRAINAGE AREA, sq. mi.				
	0.02	0.10	1.00	10.0	100
	MAXIMUM 24-HOUR RUNOFF VOLUME, ac-ft				
SPF[2]	5.0	26	320	3100	19,000
0.01	2.4	12	120	1200	7700
0.02	1.8	9.3	97	790	4800
0.04	1.2	5.8	60	500	2800
0.10	0.8	4.0	42	340	1200
0.20	0.6	3.3	30	190	560
0.50	0.4	1.7	15	83	200

[1] Indicates the probability that 24-hour runoff volume will be equalled or exceeded in a given year.
[2] SPF frequency assigned to be 500-yrs, or .002 % chance of being exceeded in any year.

TABLE 3-9. DETERMINATION OF AVERAGE ANNUAL RUNOFF VOLUMES FROM ANNUAL MAXIMUM RAINFALL-RUNOFF SIMULATION - SIDE DRAINS TO SALT RIVER, PHOENIX VICINITY

PROBABILITY RANGE[1]	DRAINAGE AREA, sq mi				
	0.02	0.10	1.00	10.0	100
	RUNOFF VOLUME, ac-ft				
0.0 - 0.1 (0.10)	1.4 (.14)	7.0 (.70)	70 (7.0)	600 (60)	3000 (300)
0.1 - 0.2 (0.10)	0.70 (.07)	3.6 (.36)	36 (3.6)	260 (26)	800 (80)
0.2 - 0.3 (0.10)	0.56 (.06)	3.0 (.30)	27 (2.7)	180 (18)	500 (50)
0.3 - 0.4 (0.10)	0.50 (.05)	2.5 (.25)	22 (2.2)	140 (14)	400 (40)
0.4 - 0.5 (0.10)	0.50 (.05)	2.0 (.20)	17 (1.7)	100 (10)	300 (30)
0.5 - 1.0 (0.50)	0.20 (.10)	0.80 (.40)	7.0 (3.5)	40 (20)	100 (50)
AVERAGE ANNUAL RUNOFF VOLUME, ac-ft					
Σ[2]	0.47	2.21	20.7	148	550

[1] The number in parentheses is the difference in range, which is used to weight the volume of runoff in each interval.
[2] Sum of weighted annual volume of runoff for each probability interval.

TABLE 3-10. ESTIMATION OF ANNUAL PRECIPITATION CONTRIBUTING TO SIDE DRAIN RUNOFF

YEAR[1]	NO. OF DAYS OF PRECIP ≥			ANNUAL PRECIP, inches				
	0.25 in	0.50 in	1.00 in	Year	≥ 0.25[3]	≥ 0.50[3]	≥ 1.00[3]	Maximum
1948	4	2	0	NA	1.81	1.27	0.00	NA
1949	10	3	0	6.24	4.04	1.89	0.00	0.74
1950	4	3	0	3.96	2.41	2.05	0.00	0.75
1951	13	10	1	12.82	10.36	9.42	1.19	2.43
1952	15	5	2	11.06	8.04	4.94	2.20	1.16
1953	3	0	0	2.85	1.10	0.00	0.00	0.48
1954	5	2	0	4.66	2.12	1.18	0.00	0.63
1955	10	8	2	11.08	8.81	8.03	3.95	2.00
1956	5	1	1	3.33	2.56	1.00	1.00	1.00
1957	10	3	0	7.62	4.85	2.27	0.00	0.85
1958	10	5	3	8.90	6.80	5.97	4.53	2.15
1959	9	6	1	7.83	5.36	4.49	1.39	1.[illegible]
1960	7	2	0	4.94	3.49	1.49	0.00	0.90
1961	8	3	1	5.78	4.08	2.33	1.15	1.15
1962	5	1	0	4.71	2.48	0.94	0.00	0.94
1963	10	4	1	7.26	5.51	3.39	1.46	1.46
1964	9	2	1	6.68	4.65	2.41	1.47	1.47
1965	17	7	5	13.54	9.95	6.85	5.53	1.20
1966	9	3	1	7.10	5.96	3.97	2.69	2.69
1967	12	6	3	9.79	8.88	6.77	4.04	1.77
1968	9	1	0	NA	3.14	0.71	0.00	NA
1972	7	4	2	NA	5.99	4.67	2.09	NA
1973	11	4	0	6.20	4.99	2.25	0.00	0.61
1974	10	7	3	9.54	7.38	6.28	3.58	1.30
1975	6	2	0	4.51	2.95	1.48	0.00	0.80
1976	11	5	1	6.92	5.73	3.64	1.01	1.01
1977	3	1	0	3.22	1.56	.50	0.00	0.50
1978	19	8	0	13.17	11.17	6.60	0.00	1.[illegible]

TABLE 3-10. continued

YEAR[1]	NO. OF DAYS OF PRECIP ≥			ANNUAL PRECIP, inches				
	0.25 in	0.50 in	1.00 in	Year	≥ 0.25[3]	≥ 0.50[3]	≥ 1.00[3]	Maximum
1979	7	4	2	7.30	5.45	4.41	3.16	1.98
1980	10	1	0	5.83	3.86	.70	0.00	0.70
1981	12	7	0	7.48	6.70	5.00	0.00	0.96
1982	12	5	2	NA	7.22	4.44	2.56	NA
1983	11	7	4	12.50	9.30	7.40	5.11	1.61
1984	16	9	4	14.43	11.81	9.34	5.91	2.44
1985	10	5	0	NA	5.51	3.63	0.00	NA
1986	10	3	1	7.36	4.56	2.32	1.18	1.18
1987	10	6	1	7.96	6.38	4.73	1.03	1.03
1988	8	5	1	7.02	5.99	4.93	2.09	2.09
1989	7	6	2	6.62	5.95	5.65	2.75	1.60
1990	6	3	3	NA	4.79	3.73	3.73	NA
1991	14	7	2	10.02	8.26	5.82	2.43	1.40
1992	16	7	4	13.79	11.55	8.12	**6.02**	**2.70**
1993	**21**	9	4	**15.08**	**13.92**	8.81	5.84	2.24
1994	7	4	0	4.96	3.66	2.55	0.00	0.86
1995	2	0	0	NA	0.53	0.00	0.00	NA
SUBTOTALS								
1948-1995	380[2]	176[2]	58[2]	304.06[2]	232.62[2]	159.92[2]	7.07[2]	51.41[2]
ANNUAL AVERAGES								
1948-1995	**10.0**	**4.63**	**1.53**	**8.00**	**6.12**	**4.21**	**1.86**	**1.35**

[1] Data taken from National Weather Service Gage at Phoenix Airport.
[2] Results apply to complete years only. When precipitation for year is incomplete, NA is indicated in columns below, and/or the subtotals reflect only complete year results.
[3] Annual total precipitation for days when rainfall equalled or exceeded given amount.

TABLE 3-11. TWENTY-FOUR-HOUR AVERAGE PARTIAL DURATION[1] VALUES FOR 8-DRAIN SAMPLE

SUBAREA	DRAINAGE AREA, mi^2	Twenty-four Hour Precipitation Depth, inches			
		0.25	0.50	0.75	1.00
		TWENTY-FOUR HOUR RUNOFF VOLUME, ac-ft			
SR-09	0.95	2.5	5.1	8.0	12
SR-12	0.19	0.4	0.8	1.2	2.1
SR-13	13.87	20	41	61	85
SR-18	6.55	17	33	50	74
SR-31	3.00	3.2	6.4	8.4	18
SR-32	1.58	2.5	5.1	8.0	15
SR-34	0.03	0.1	0.1	0.2	0.3
SR-37	0.53	0.6	1.1	1.7	3.7

NOTE:
The subareas referred to were arbitrarily selected from City of Phoenix NPDES summary prepared by Woodward-Clyde Consultants, and dated November 11, 1992. The subarea numbers are designations of outfalls to the Salt River in the vicinity of the Rio de Vida. This 8-drain sample provided a range of drainage area sizes and locations, the hydrologic information for which was used to develop an estimation procedure for all outfalls to the Salt River in the project reach. Data was derived using HEC-1 simulation procedures identical to those employed for 2-year runoff.

[1] Data presented in this table is for events more frequent than the 2-year event.

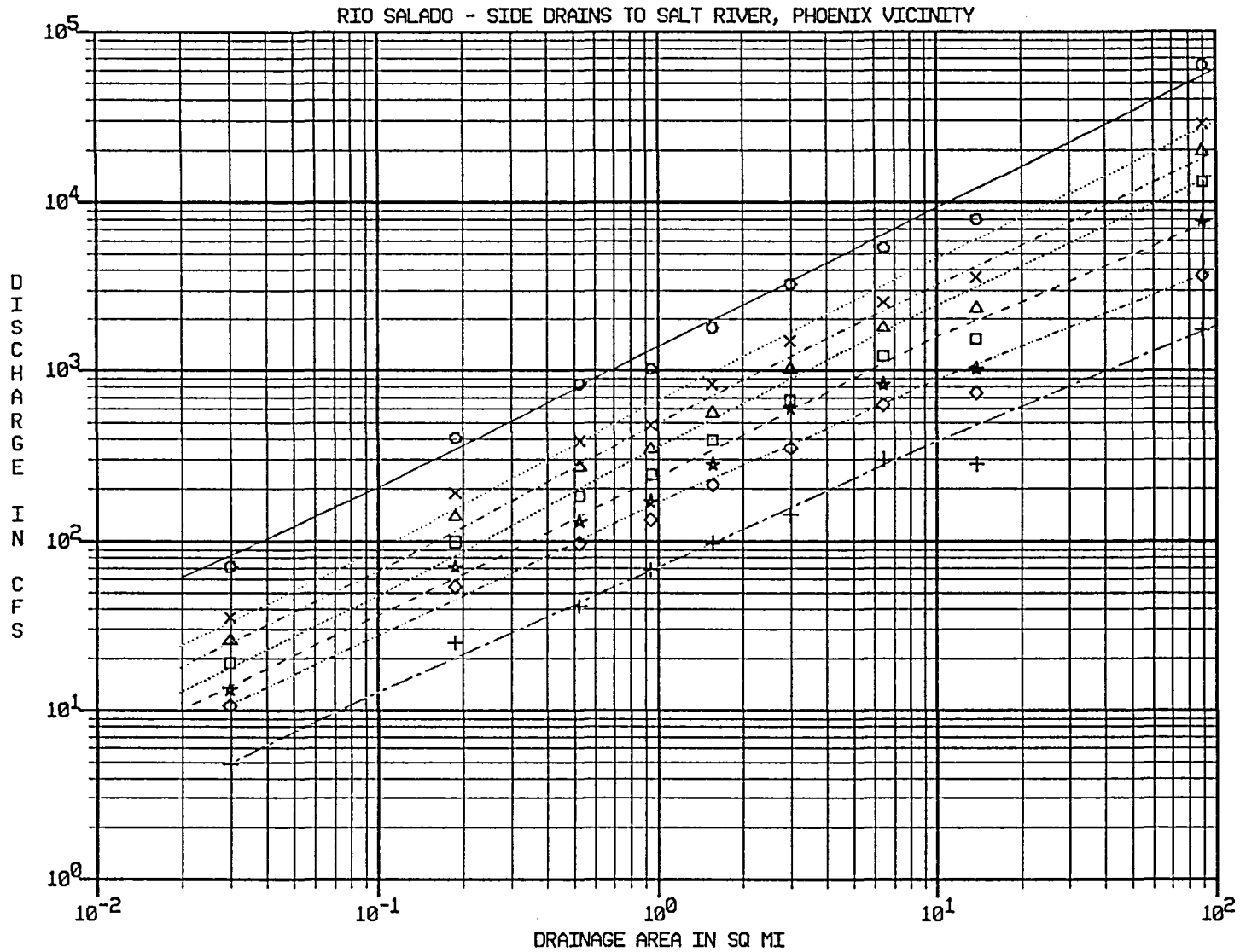
TABLE 3-12. ANNUAL AVERAGE PARTIAL DURATION[1] RUNOFF FOR 8-DRAIN SAMPLE

SUBAREA	DRAINAGE AREA, mi^2	Twenty-four Hour Precipitation Depth, 0.50 in	1.00 in	Σ ANNUAL RUNOFF VOLUME, ac-ft
		Annual No. of Interval Occurrences		
		10	*2.9*	
		ANNUAL RUNOFF VOLUME, ac-ft[2]		
SR-09	0.95	51.0	34.8	85.8
SR-12	0.19	8.0	6.1	14.1
SR-13	13.87	410	246	656
SR-18	6.55	330	215	545
SR-31	3.00	64.0	52.2	116.2
SR-32	1.58	51.0	43.5	84.5
SR-34	0.03	1.0	.9	1.9
SR-37	0.53	11.0	10.7	21.7

NOTE:
The subareas referred to were arbitrarily selected from City of Phoenix NPDES summary prepared by Woodward-Clyde Consultants, and dated November 11, 1992. The subarea numbers are designations of outfalls to the Salt River in the vicinity of the Rio de Vida. This 8-drain sample provided a range of drainage area sizes and locations, the hydrologic information for which was used to develop an estimation procedure for all outfalls to the Salt River in the project reach. Data was derived using HEC-1 simulation procedures identical to those employed for 2-year runoff.

[1] Data presented in this table is for events more frequent than the 2-year event.
[2] Volumes based on product of average no. of events per year in the each interval, times the 24-hour runoff volume resulting from the designated precipitation.

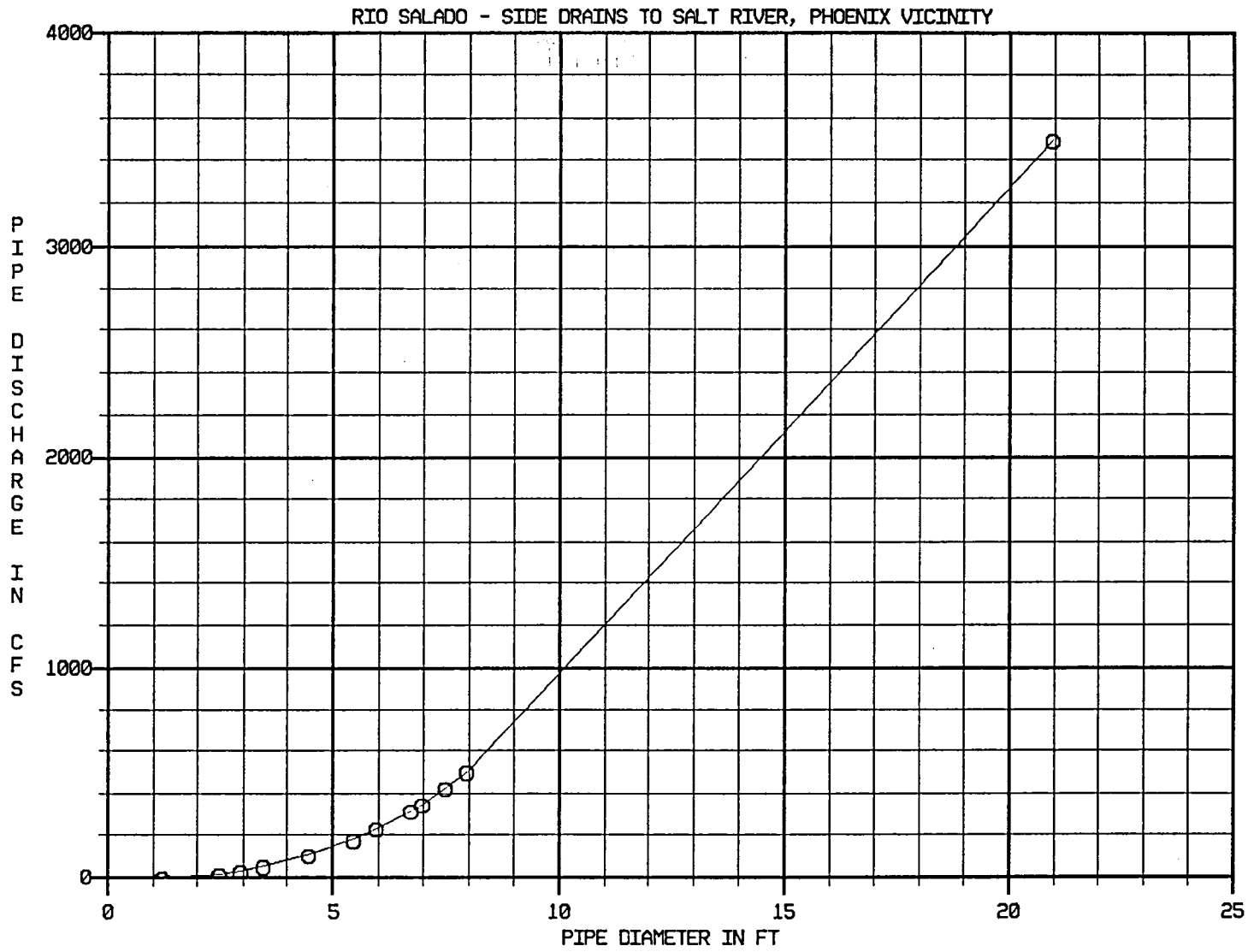
10DEC96 09:16:37
PEAKCRVS.DSS



○ 8-DRAIN SAMPLE SPF PEAK
× 8-DRAIN SAMPLE 100-YR PEAK
△ 8-DRAIN SAMPLE 50-YR PEAK
□ 8-DRAIN SAMPLE 25-YR PEAK
★ 8-DRAIN SAMPLE 10-YR PEAK
◇ 8-DRAIN SAMPLE 5-YR PEAK
+ 8-DRAIN SAMPLE 2-YR PEAK

FIGURE 3-1

17DEC96 10:10:01
CAPACITY.DSS

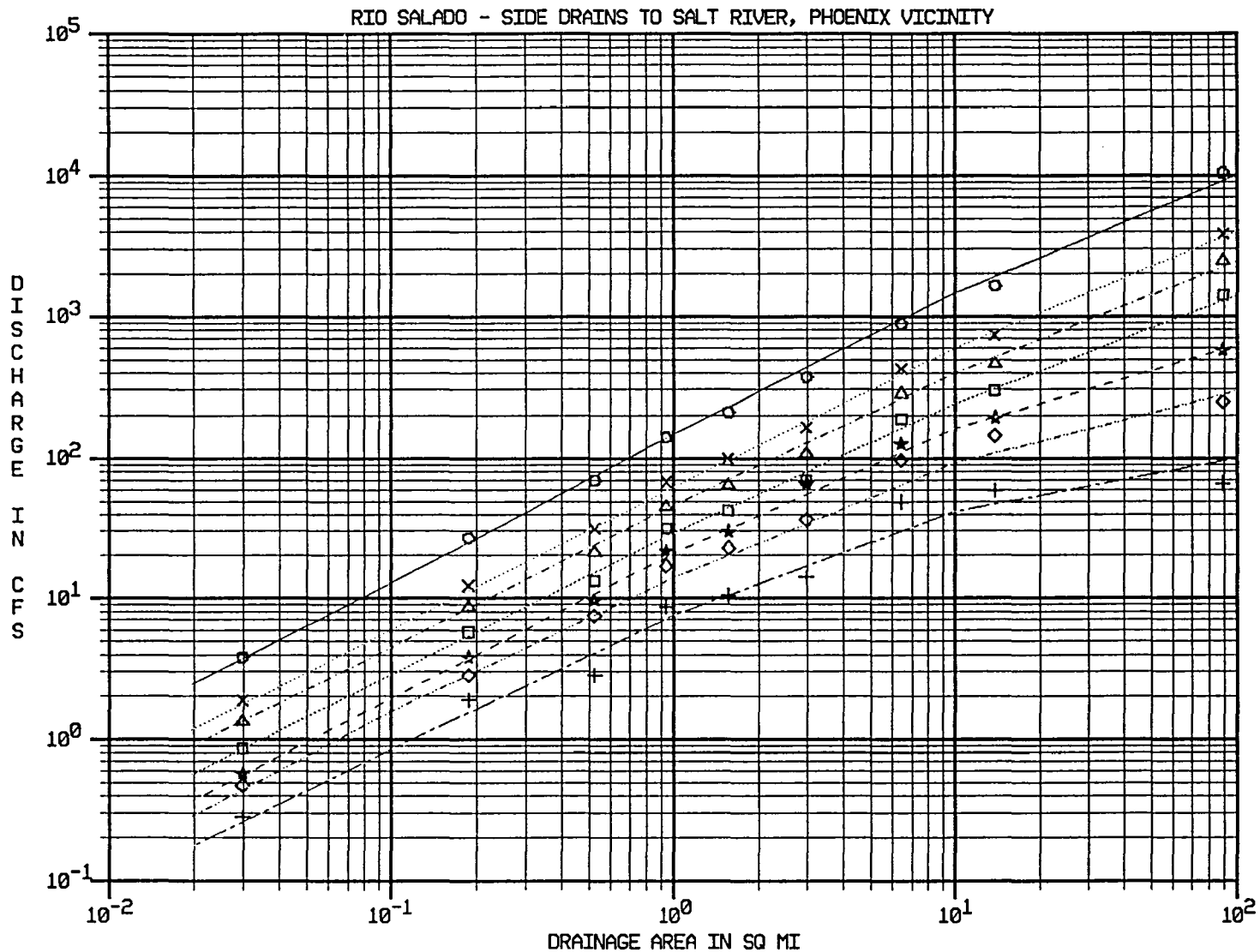


O ESTIMATED DISCHARGE

——— GENERALIZED RELATIONSHIP

FIGURE 3-2

10DEC96 13:53:52
1DAYCRVS.DSS



○ 8-DRAIN SAMPLE SPF 1-DAY FLOW
× 8-DRAIN SAMPLE 100-YR 1-DAY FLOW
△ 8-DRAIN SAMPLE 50-YR 1-DAY FLOW
□ 8-DRAIN SAMPLE 25-YR 1-DAY FLOW
★ 8-DRAIN SAMPLE 10-YR 1-DAY FLOW
◇ 8-DRAIN SAMPLE 5-YR 1-DAY FLOW
+ 8-DRAIN SAMPLE 2-YR 1-DAY FLOW

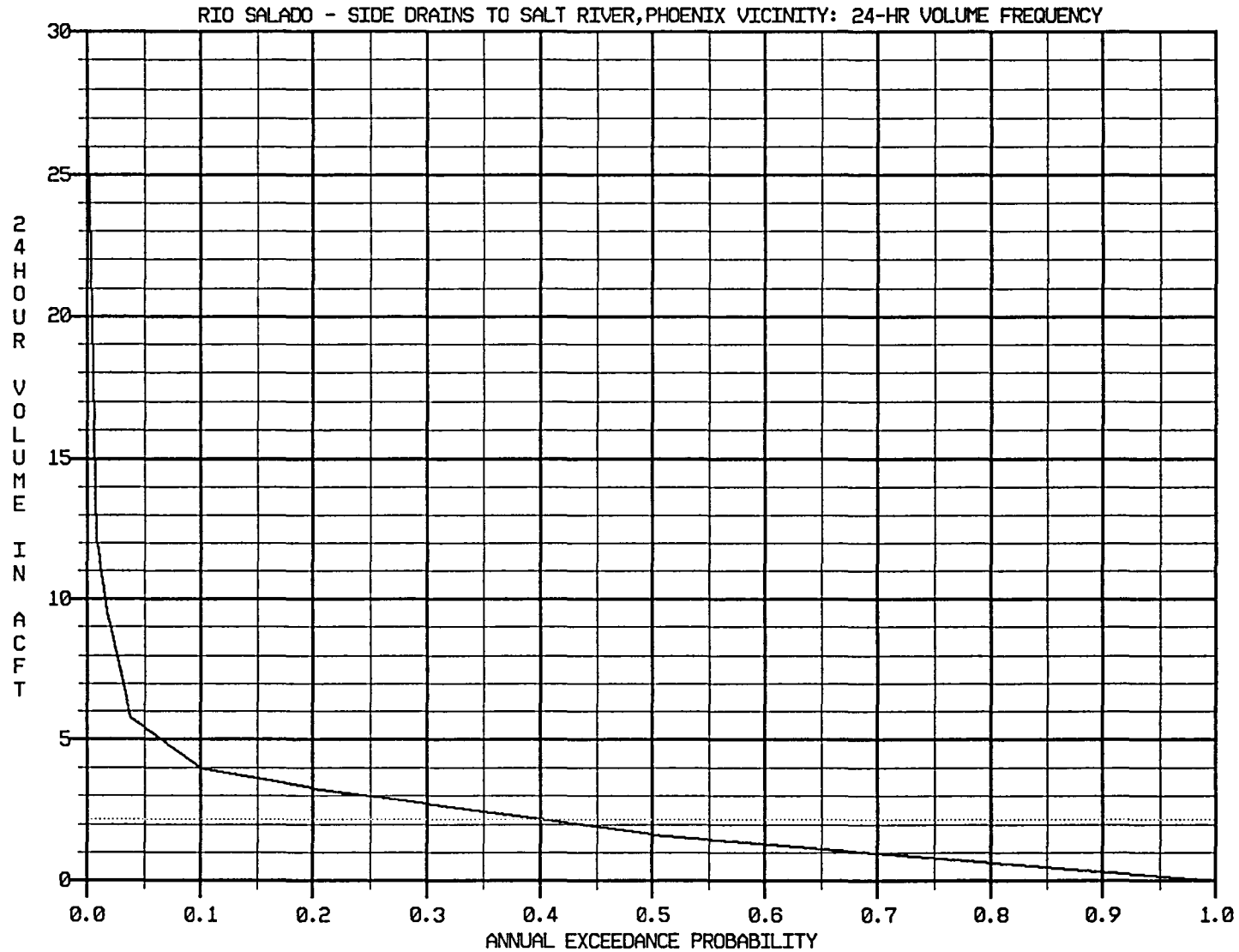
FIGURE 3-3

19DEC96 11:59:02
INT AT.DSS

SIDE DRAIN AREA = 0.02 sq mi

FIGURE 3-4a

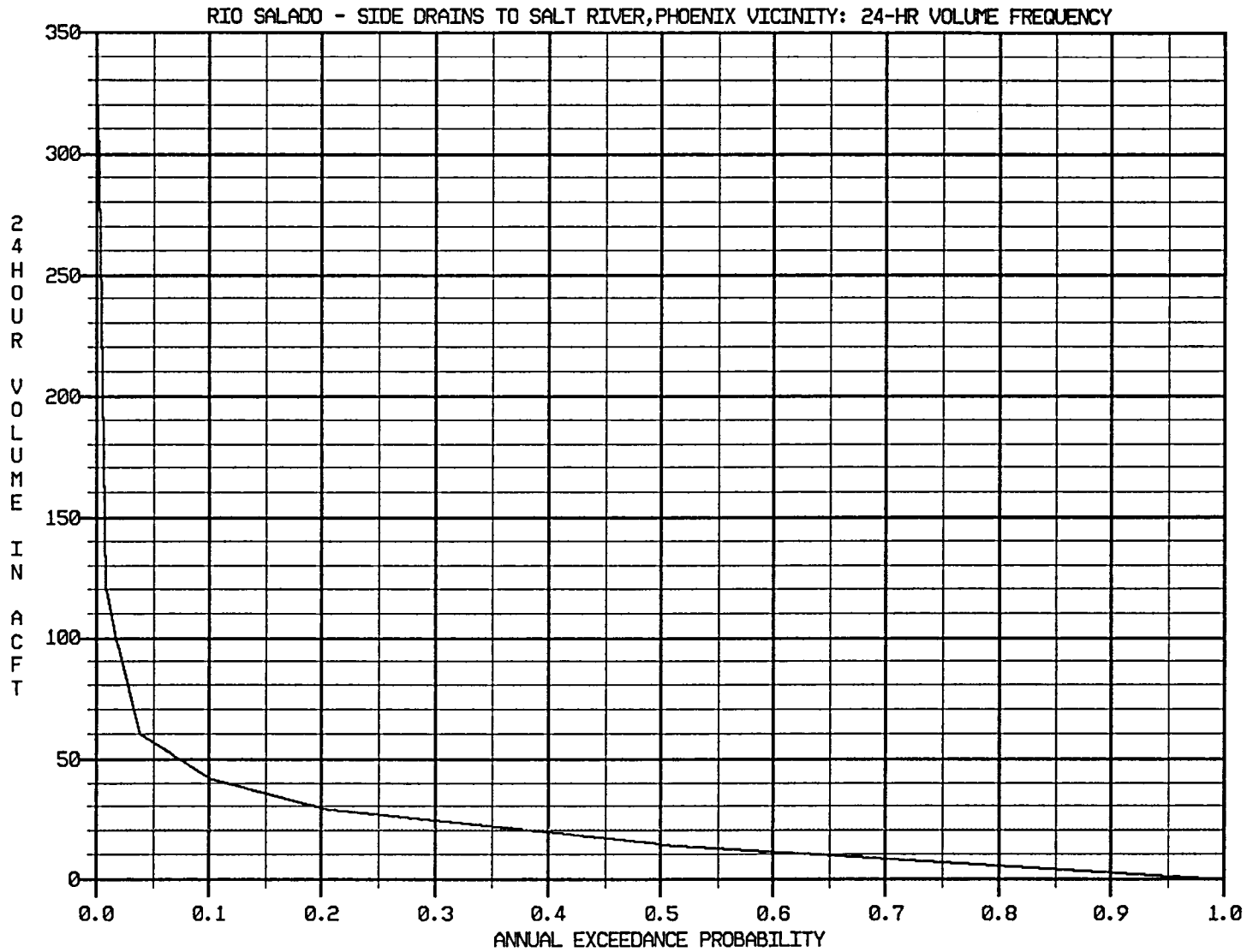
19DEC96 12:00:38
INTEGRAT.DSS



SIDE DRAIN AREA = 0.10 sq mi

FIGURE 3-4b

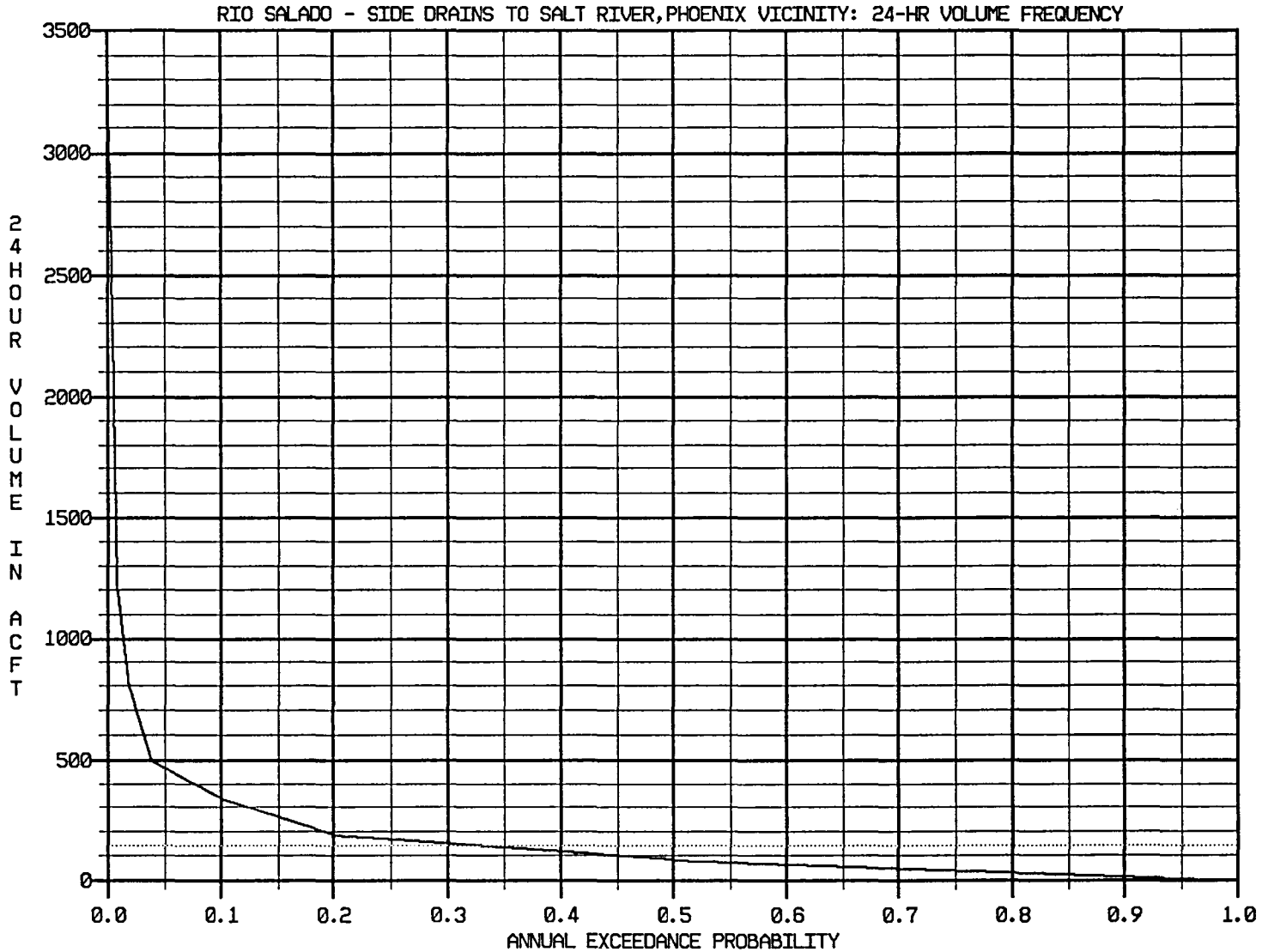
19DEC96 12:02:34
IN[illegible]AT.DSS



SIDE DRAIN AREA = 1.00 sq mi

FIGURE 3-4c

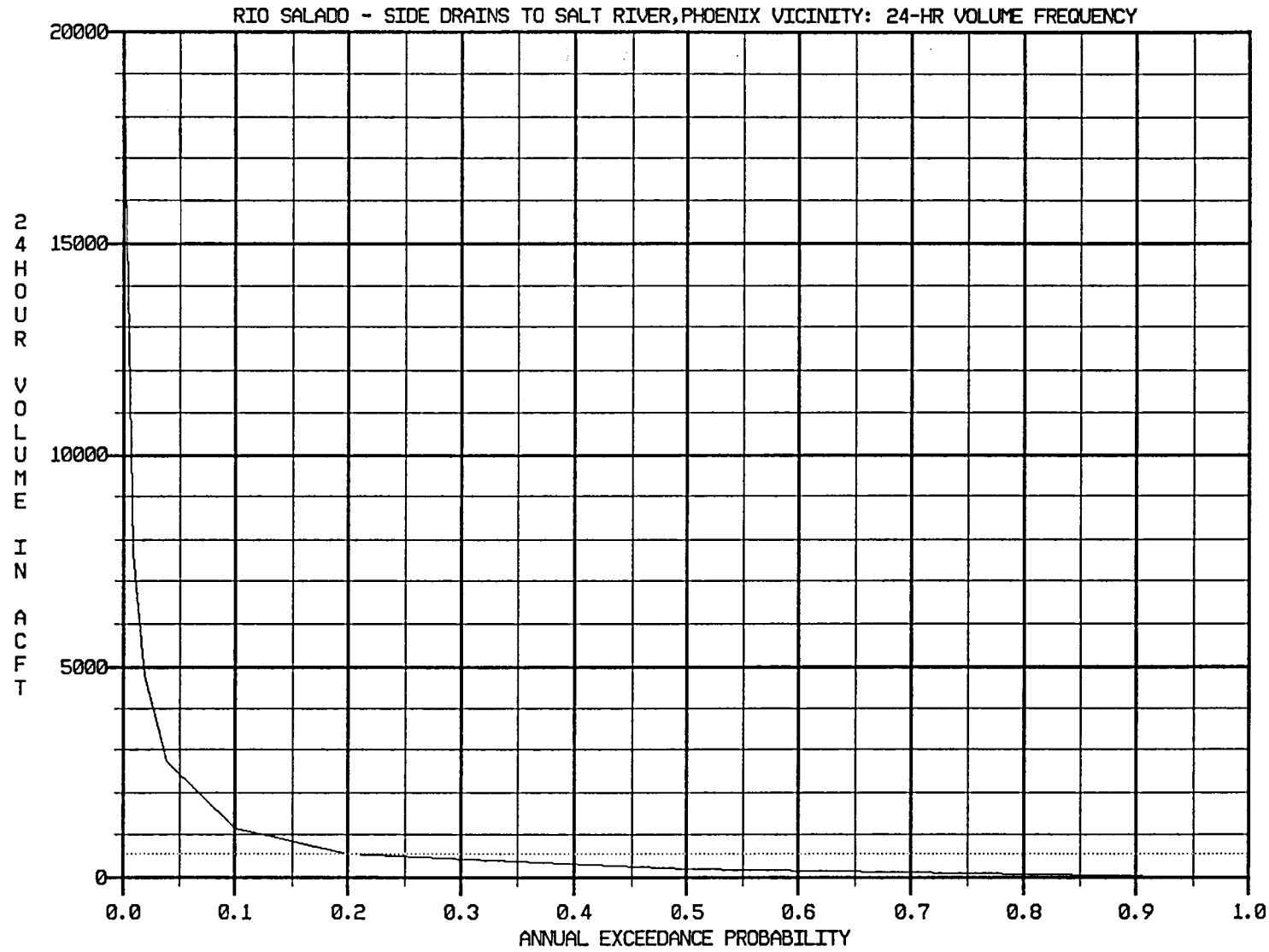
19DEC96 12:04:20
INTEGRAT.DSS



SIDE DRAIN AREA = 10.0 sq mi

FIGURE 3-4d

20DEC96 13:41:52
IN[illegible]AT.DSS



SIDE DRAIN AREA = 100 sq mi

FIGURE 3-4e

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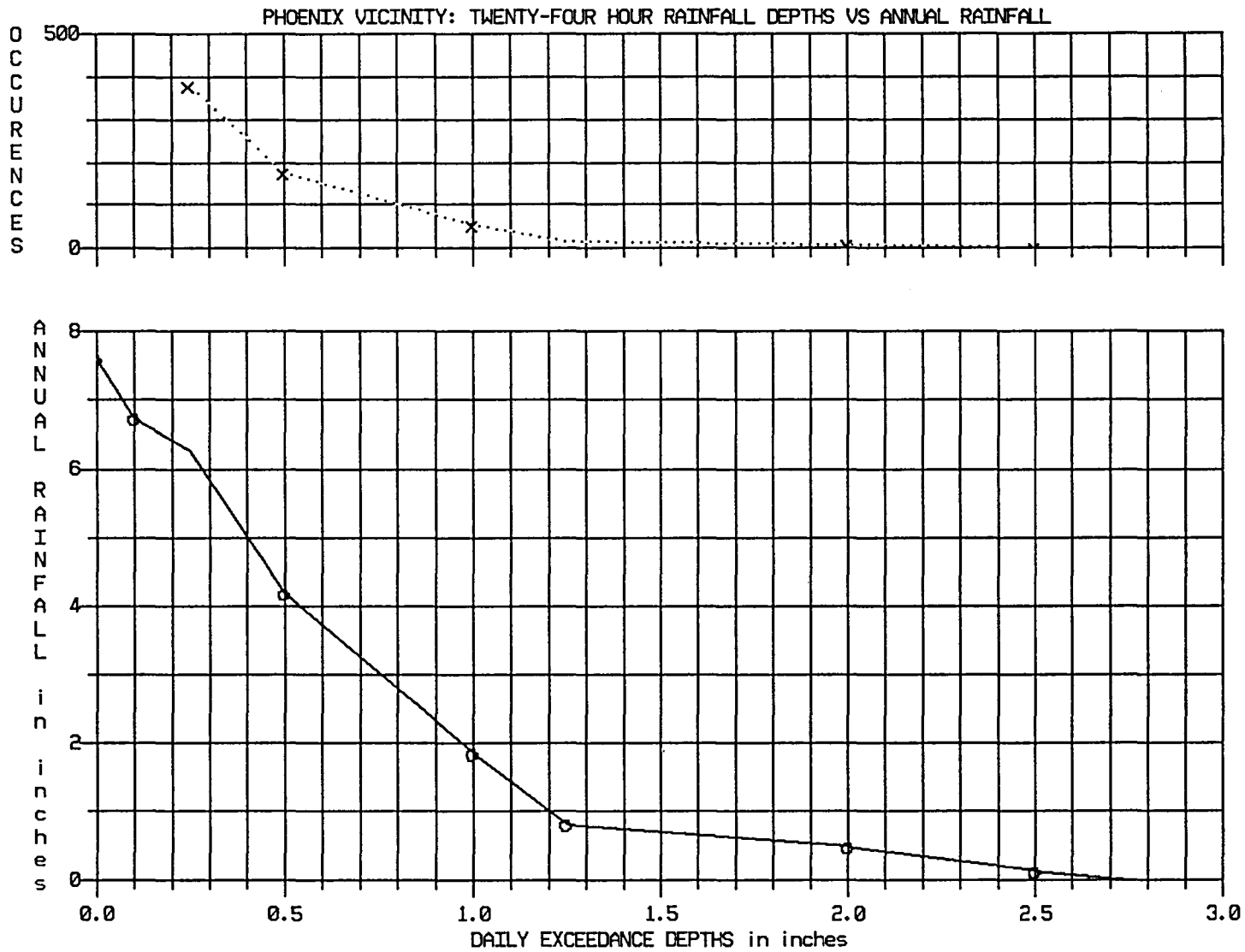
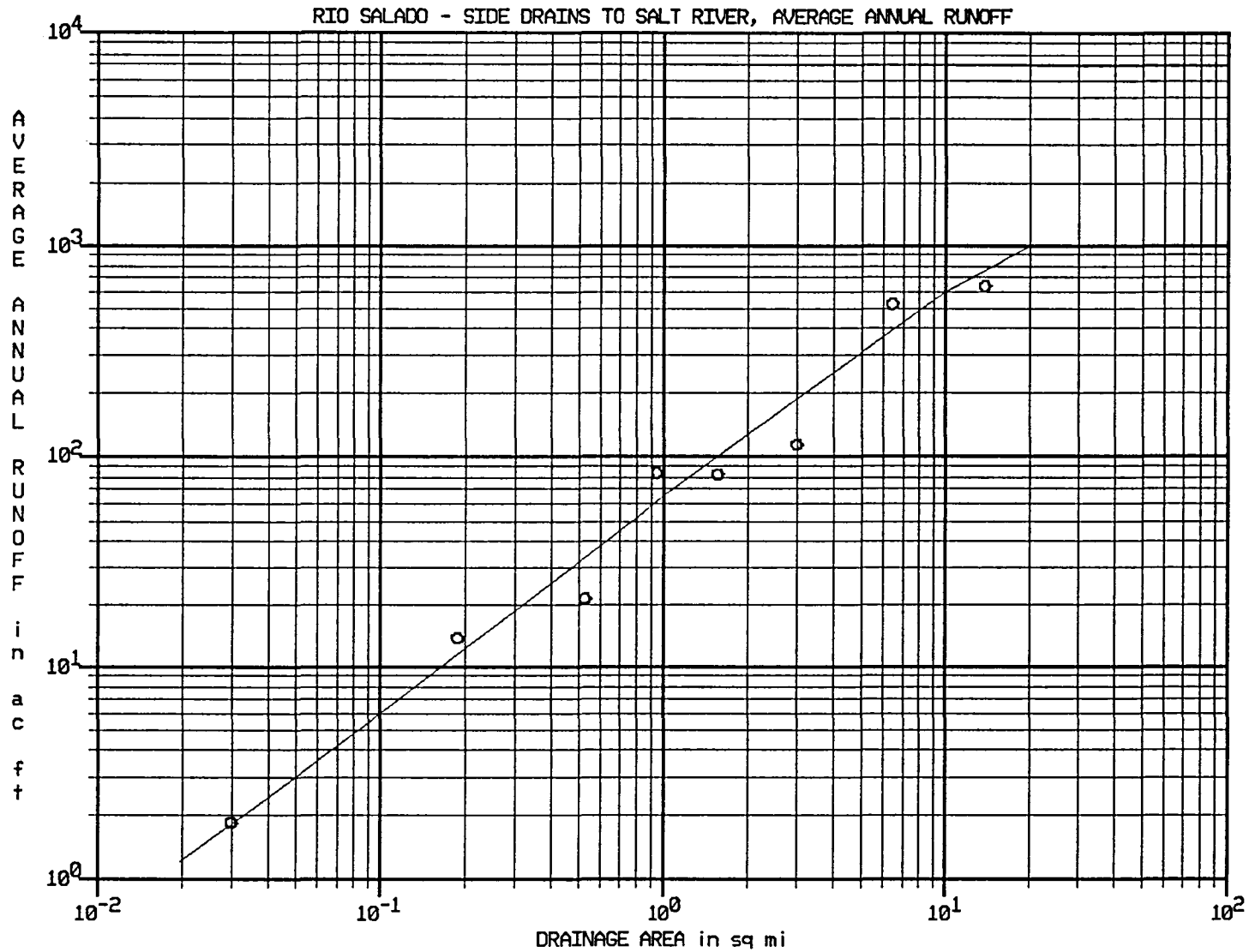


ANNUAL RAINFALL TOTAL FOR DAILY EXCEEDANCE DEPTHS in inches

OCCURENCES FROM NWS RAINFALL GAGE

FIGURE 3-5

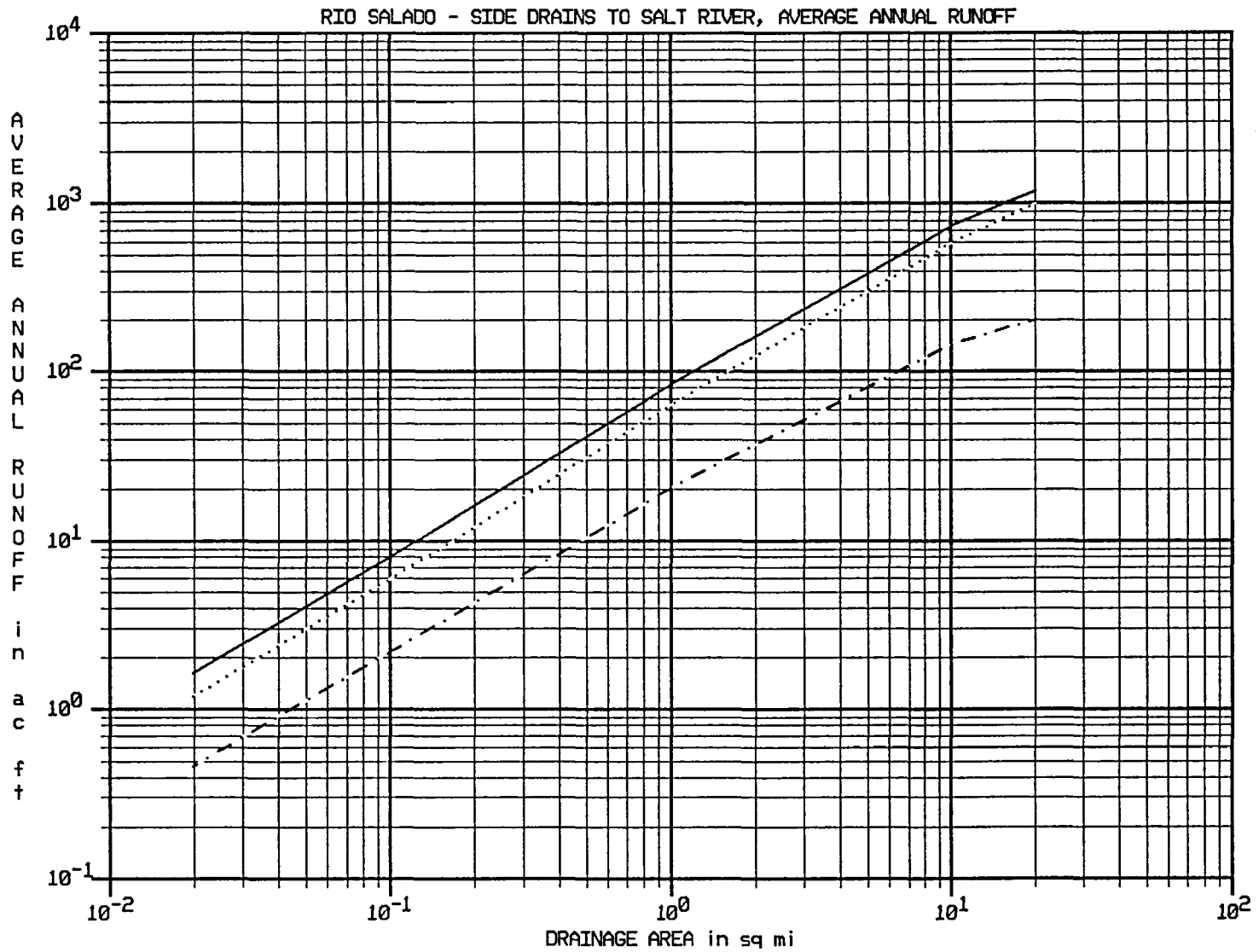
31DEC96 11:40:05
AV[illegible]AL.DSS



——— PARTIAL DURATION AVERAGE ANNUAL RUNOFF, APPROXIMATE CURVE
o PARTIAL DURATION AVERAGE ANNUAL RUNOFF, 8-DRAIN SAMPLE

FIGURE 3-6

31DEC96 11:55:22
AVANNUAL.DSS



——————— AVERAGE ANNUAL RUNOFF, COMBINED CURVE
..... PARTIAL DURATION AVERAGE ANNUAL RUNOFF, APPROXIMATE CURVE
·—·—·—·—·· ANNUAL MAXIMUM AVERAGE ANNUAL RUNOFF

FIGURE 3-7

IV. GROUNDWATER ANALYSIS

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 4-1. In this section, the hydrogeologic setting and hydrologic system of the Salt River Valley (SRV) will be first discussed. Then, the current groundwater condition at the Tempe area and the Phoenix area of the Rio Salado Project will be presented. Finally, a groundwater flow model will be presented; the model will be used to assist in the wetland restoration of the Rio Salado Project.

4.1 HYDROGEOLOGIC SETTING

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 estimates 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 4-2 shows the Salt River Valley generalized groundwater cross-section. The location of the cross-section is shown in Figure 4-1.

4.2 HYDROLOGIC SYSTEM

4.2.1 Predevelopment Hydrologic System

The predevelopment hydrologic system of the Salt River Valley is described by the Arizona Department of Water Resources (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 4-1 and the components are described below.

4.2.2 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.

4.2.3 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.

4.2.4 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.

4.2.5 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.

4.2.6 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.

4.2.7 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).

4.2.8 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.

4.3 CURRENT GROUNDWATER CONDITION IN TEMPE AREA

Figure 4-3 shows three well hydrographs in Tempe area. The locations of these wells are shown in Figure 4-1. As shown in these hydrographs, the groundwater elevations are generally moving up in this area. The general groundwater elevation contours in Indian Bend Wash area are shown in Plate 5A. The groundwater elevation contours are generated using a groundwater flow model that was calibrated to the current groundwater conditions. The development of the groundwater flow model is presented in a latter section, Section 4.5.

The City of Tempe is planning a major urban redevelopment project at the confluence of Indian Bend Wash and the Salt River. The Tempe Town Lake project is a plan for converting several miles of dry river bed into a recreation lake. The 200-acre riparian habitat/recreation lake will extend from about 1,500 feet west of Mill Avenue, east to the Indian Bend Wash. The physical components of Town Lake include the dams or impoundment structures-the main downstream dam and the upstream dam which will serve to establish the extent of the lake, seepage control and lining system, and others. Three types of seepage control features may be used for the facility: (1) a soil/bentonite slurry wall around the approximate downstream (west) half of the lake; (2) high-capacity seepage control wells, the water from which will be returned to the lake to maintain the lake surface water level; and (3) infiltration rate reduction materials that may be placed on the river bottom in the upstream (east) half of the lake to reduce seepage losses from the lake. After the construction of the lake, the local groundwater conditions will be affected. The City of Tempe is currently investigating the hydrologic impact due to the lake.

4.4 CURRENT GROUNDWATER CONDITION IN PHOENIX AREA

Figure 4-4 shows three well hydrographs in Phoenix area. The locations of these wells are shown in Figure 4-1. Similar to the Tempe area well hydrographs, the groundwater elevations are generally moving up. The general groundwater elevation contours in Phoenix area are shown in Plates 1A through 4A.

4.5 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 study area was developed to assist in the wetland restoration, groundwater infiltration, and drawdown analysis. General model characteristics are presented in this section below.

4.5.1 Model Grid

The site specific model grid is 70 rows by 100 columns, with 3 layers and is aligned with the local baseline and meridian. The north and south boundaries of the model are Mc Dowell Road and Dobbins Road respectively, while the east and west boundaries are 40th Street and 51st 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 70 square miles.

4.5.2 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.

4.5.3 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, $H_{i,j,k}$.

4.5.4 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:

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

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

4.5.5 Water Levels

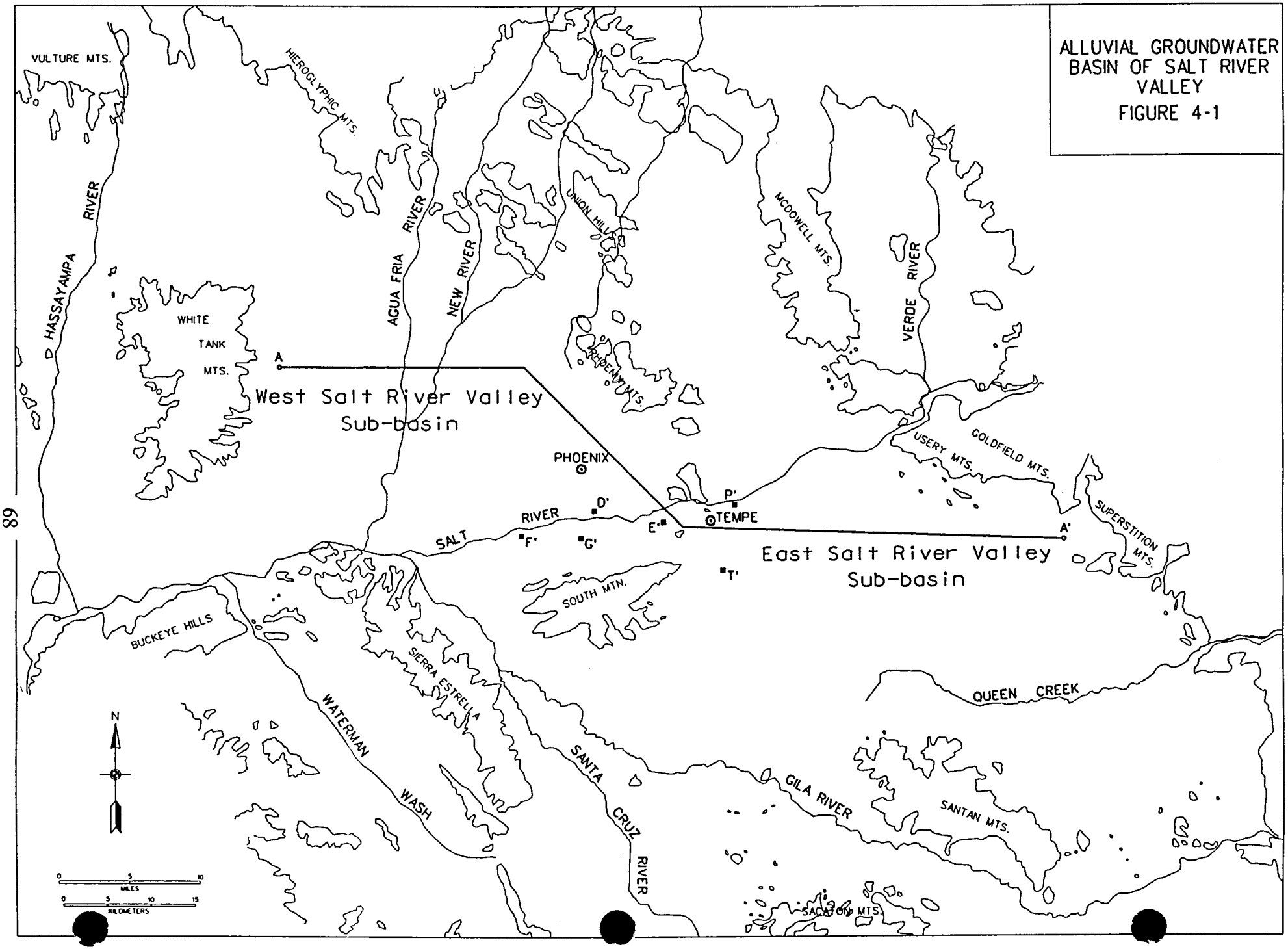
The water-level data for the steady-state model simulation was adapted mainly from the depth to water map constructed by Lee (1905), and predevelopment water level maps constructed by Anderson (1968), and by Thomsen and Baldys (1985). The selected water level contours were then digitized and introduced 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. The measured water level data are shown in the following table.

4.5.6 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.

TABLE 4-1, ESTIMATED PREDEVELOPMENT GROUNDWATER BUDGET FOR SRV

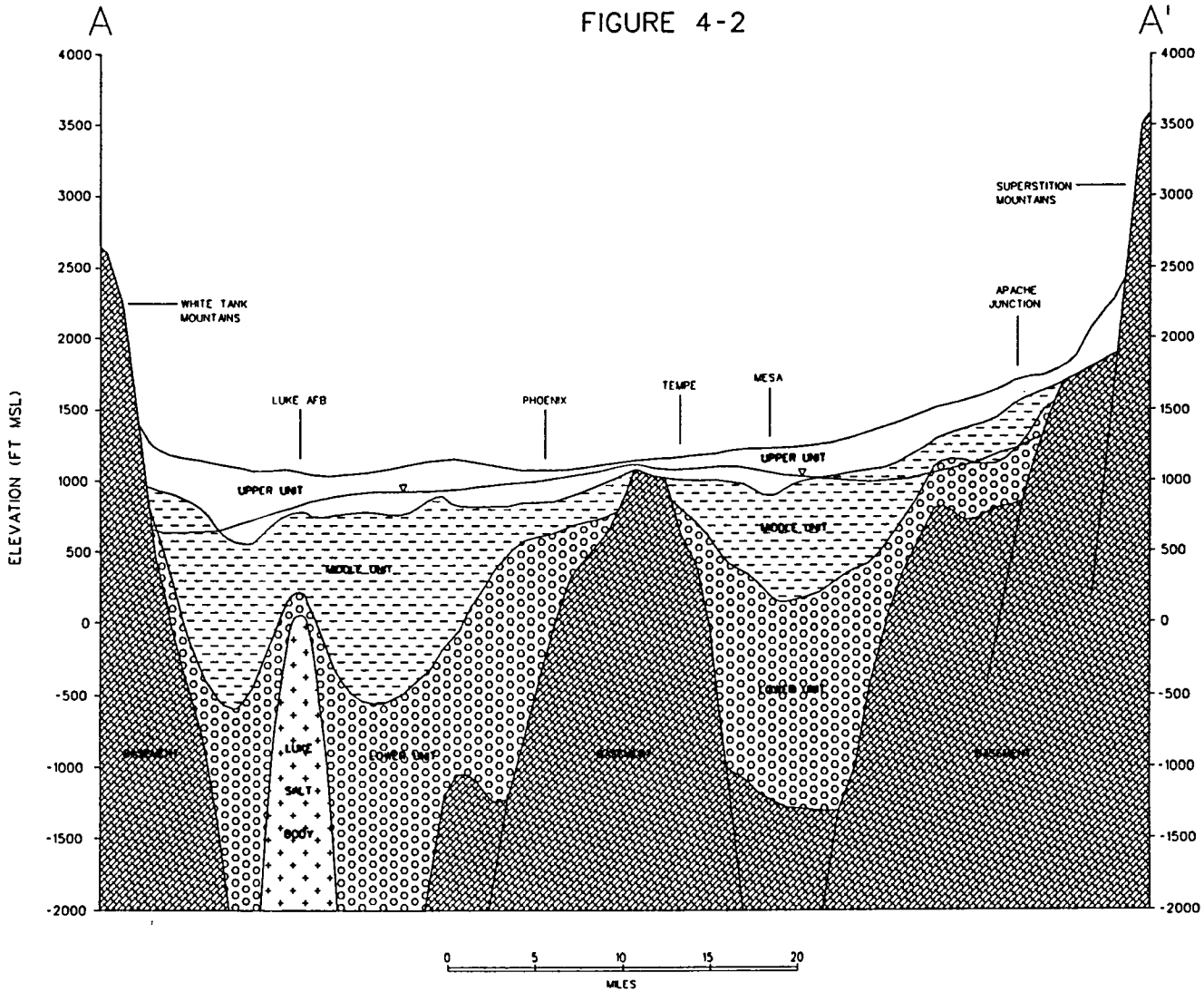
Source of Inflow to SRV	Volume (ac-ft/yr)
Stream Channel Recharge	100,000
Groundwater Inflow	30,000
Mountain Front Recharge	10,000
Total Inflow	140,000
Groundwater Discharge to Stream Channel	60,000
Evapotranspiration	76,000
Total Outflow	140,000



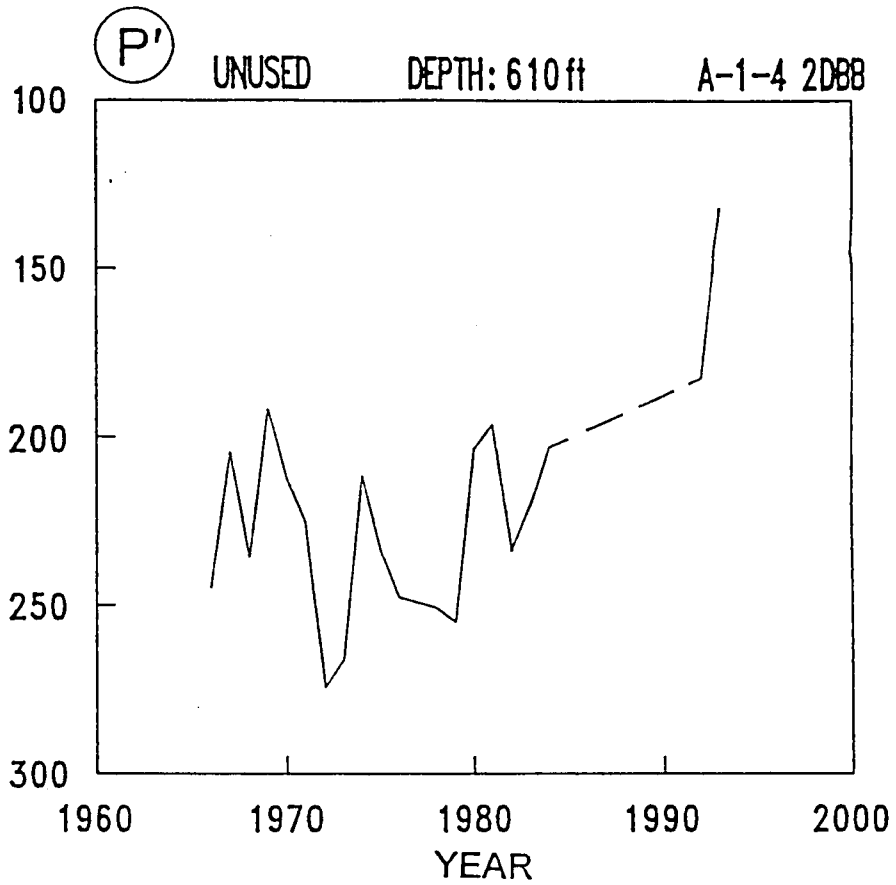
ALLUVIAL GROUNDWATER BASIN OF SALT RIVER VALLEY
FIGURE 4-1

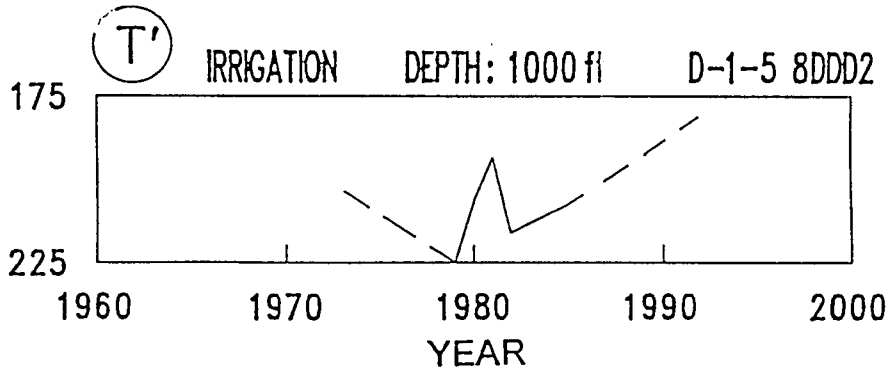
SALT RIVER VALLEY GENERALIZED GORUNDWATER AND GEOLOGIC CROSS SECTION

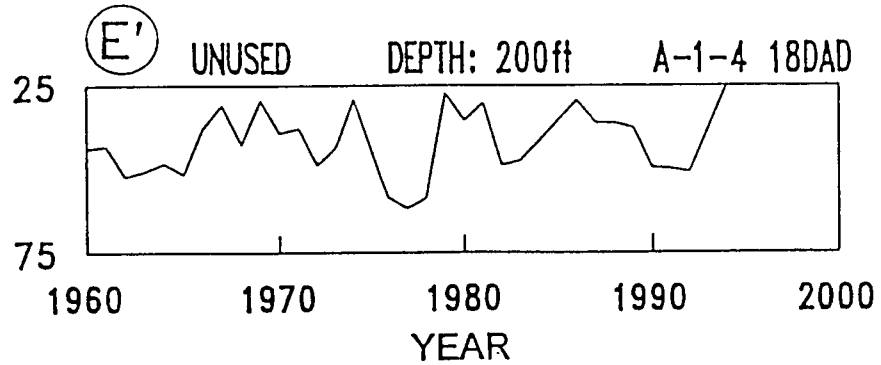
FIGURE 4-2



VERTICAL EXAGGERATION = 34.5 X

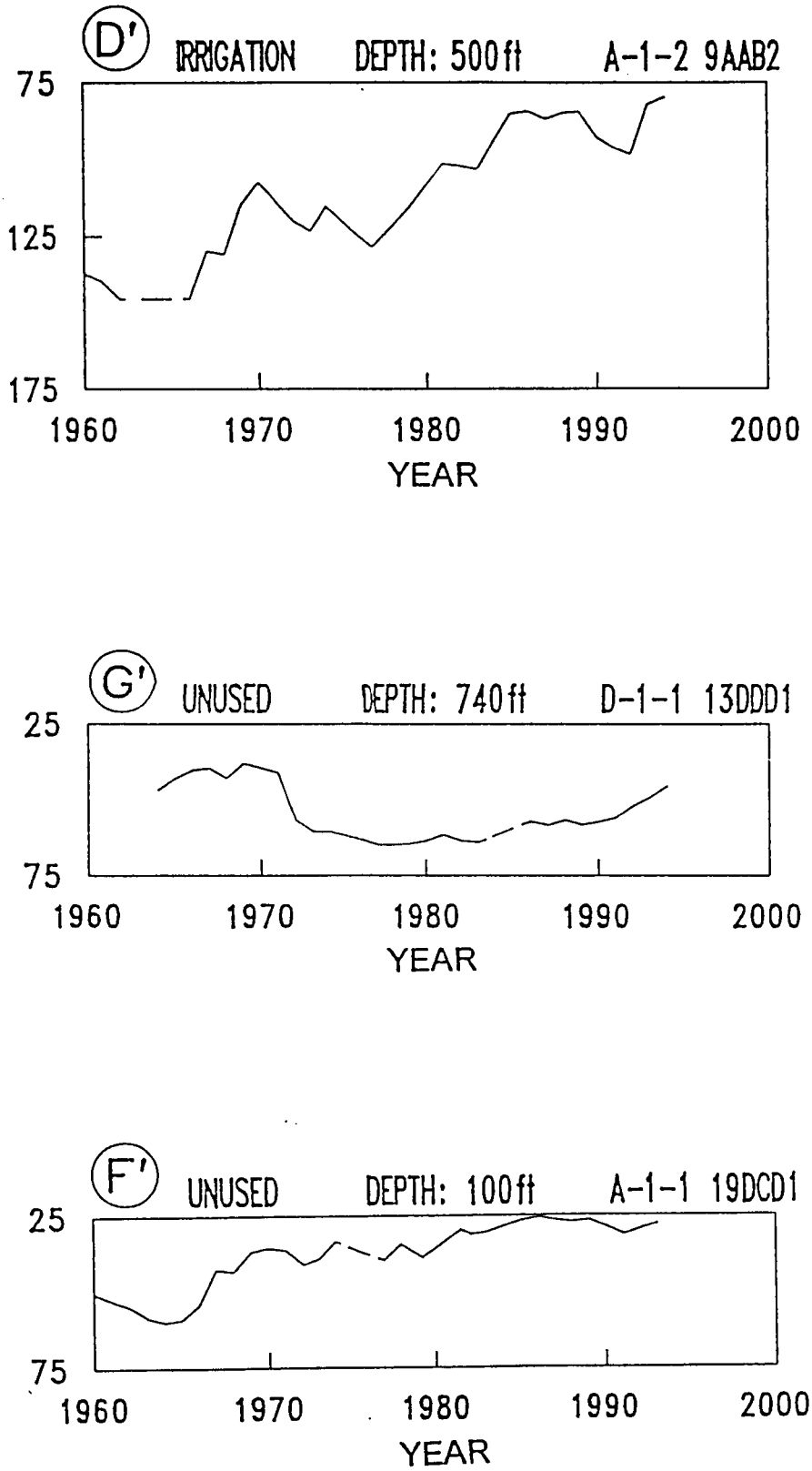






WELL HYDROGRAPH - WATER LEVEL IN FEET BELOW LAND SURFACE
TEMPE AREA

Figure 4-3



WELL HYDROGRAPH - WATER LEVEL IN FEET BELOW LAND SURFACE

PHOENIX AREA

Figure 4-4

V. WATER QUALITY ANALYSIS

The purpose of this section is to describe, based on existing data, surface and groundwater quality in the Rio Salado project study area. The Rio Salado study area is defined to be the area in the vicinity of the Gila River from the confluence with the Agua Fria River, upstream through the City of Phoenix to the eastern boundary of the City of Tempe. The study area is shown on Figure 1-2.

The report begins with a discussion of some of the state and federal water quality standards, follows with discussion of the quality of surface and groundwater in the study area.

In summary, this investigation found that there are significant surface and groundwater quality problems in the study area. The quality of urban storm runoff from the Phoenix metropolitan area is highly variable, but is generally of poor quality and frequently exceeds water quality standards for bacteria, pesticides, petroleum products, metals, and nutrients. The quality of this urban runoff is summarized in Tables 5-4 and 5-5. Much of the shallow groundwater in the vicinity of the western part of the project has elevated levels of TDS, chloride, and nitrate and areas of high and low levels of volatile halocarbons are present in many areas. These areas were located and are shown on Plates 1A through 5A of the main report.

5.1 WATER QUALITY CRITERIA

The Environmental Protection Agency (EPA) and the State of Arizona have established water quality criteria which vary for parameters depending on the designated use of the water. Uses fall into one of the following categories:

Designated Uses	
A&Wc	Aquatic and Wildlife (cold water fishery)
A&We	Aquatic and Wildlife (ephemeral)
A&Wedw	Aquatic and Wildlife (effluent dominated water)
A&Ww	Aquatic and Wildlife (warm water fishery)
AgL	Agricultural Livestock Watering
AgI	Agricultural Irrigation
DWS	Domestic Water Source
FBC	Full Body Contact
PBC	Partial Body Contact
FC	Fish Consumption
WTP	Water Treatment Plant
WWTP	Waste Water treatment Plant

Arizona has established designated uses for navigable waters within the Rio Salado study area including the Salt River and Indian Bend Wash. Designated uses for these streams include partial body contact, fish consumption, aquatic and wildlife categories, and agricultural categories. These uses by stream reach are shown below in Table 5-1. Criteria for selected parameters are summarized in Table 5-2. For some parameters the water quality criteria are determined from characteristics of the water source. For example, the ammonia criteria is a function of designated use, water temperature, and pH. For several metals, the criteria for aquatic and wildlife uses is based on designated use and water hardness (measured as $CaCO_3$) and must be computed with an equation with water hardness as an input variable. The equations needed to calculate the criteria for these metals and criteria for other parameters not shown in Table 5-2 are contained in Arizona Administrative Code (ADEQ), Title 18, Ch. 11, Appendix A.

5.2 SURFACE WATER QUALITY

This section describes the quality of surface water in the Rio Salado Study area. Sources of surface water include runoff from the Salt River and Indian Bend Wash watersheds, urban storm runoff from the Cities of Tempe and Phoenix, and sewage effluent from municipal waste water treatment plants.

Water supply for the City of Phoenix is 5% from local ground water, 20% from Central Arizona Canal (CAP) at Union Hills, and 75% Salt River Project (SRP) and Verde Plant (10 MGD) at the Verde and Salt River confluence. There are five drinking water treatment plants, one near Fountain Hills, one at 7th Street & Indian Hills. The others are not in the scope of this study. The Colorado River Water is higher in sulfates (SO_4) and calcium carbonate ($CaCO_3$). The SRP water is about potable quality. The total water supply to the City of Phoenix is approximately 250 MGD during the winter.

City of Tempe relies heavily on Salt River Project water supply; SRP provides 95% of the city's demand and the rest 5% comes from CAP. Groundwater is only for emergency supply.

5.2.1 Salt River

The Salt River is the largest tributary of the Gila River and drains an area of approximately 13,700 mi^2 within the northern and eastern portions of the State of Arizona. The topography of the drainage area is extremely irregular and rugged, with elevations commonly to more than 7000 feet, and, at San Francisco Mountain in the Verde River basin, to more than 12,000 feet. The Verde River is the main tributary of the Salt River and includes 6,620 mi^2 of the Salt River drainage.

Flow originating from the Salt River watershed upstream of the Phoenix metropolitan area is generally of good quality. Salt River flows maintain a sodium chloride character both above and below Roosevelt Dam. This is due to salt springs upstream of Roosevelt lake which contribute water high in mineral content. Verde River water has a lower TDS content than Salt River water and tends to lower the overall TDS content in flows downstream of their confluence. SRP reported TDS concentrations in the Salt and Verde Rivers above Granite Reef Dam as averaging 550 mg/l and 280 mg/l respectively in 1989 (Graf 1994) and ranged from 990 to 1,460 mg/l in the Salt River above Roosevelt Lake in 1993 (SRP,1993). Table 5-3 presents selected results from recent water quality sampling on the Salt River in the Phoenix area. These samples were taken prior to and during the

high flows of January and February 1993. High levels of fecal coliform and fecal streptococci where detected in the first sample taken in August 1992.

5.2.2 Urban Storm Runoff

5.2.2.1 *Phoenix Area.* Storm runoff from the Phoenix metropolitan area can contribute to both surface and groundwater degradation in the study area. Much of the metropolitan area is drained by storm sewers which discharge directly into the Salt River. Estimates of the runoff from these areas is presented in Tables 7 and 8. In other areas, urban runoff is collected into percolation basins or discharged into dry wells. Concentrations of bacteria, metals, turbidity, petroleum products, pesticides and nutrients, and pesticides in urban storm runoff commonly exceeded water quality standards. Because of the intermittent and high variability of rainfall and runoff in central Arizona, quality of urban runoff in the study area is also highly variable but is generally of poor quality.

The USGS (Lopes, 1992) investigated the properties of urban storm runoff in Maricopa County. Storm runoff samples were collected from four drainage basins with residential, light-industrial, heavy-industrial, and undeveloped land uses. Three of the basins are tributary to the Salt River and have outfalls on or contribute to a outfall within the Rio Salado study area. These three basins are located at 48th Street, 27th Avenue, and a channel at South Mountain Park, and represent light industry, heavy industry, and undeveloped areas. The fourth basin is tributary to the Agua Fria River and is primarily residential. Selective mean concentrations for all four basins were: fecal coliform, 4,800 colonies per 100 milliliters; fecal streptococci, 9,100 colonies per 100 milliliters; dissolved solids, 81 mg/l and suspended solids, 607 mg/l. The largest concentrations of constituents were from 27th Avenue which represents an heavy industrial area. The insecticides DDT and DDE were also measured from the 27th Avenue basin. These are probably residual insecticides from the 1950's and 1960's when large areas of the Phoenix metropolitan area were still used for agriculture. Complete summary statistics for the USGS study are presented in Table 5-4.

5.2.2.1 *Tempe Area.* CH2M Hill estimated the average annual pollutant concentrations for runoff from areas draining through the City of Tempe. These estimates are presented in Table 5-5 and show high levels of fecal coliform.

5.2.3 Reclaimed Water

5.2.3.1 *Phoenix Area.* Reclaimed water in the Phoenix area includes the treated water from two waste water treatment plants namely, 23rd Avenue Waste Water Treatment Plant and 91st Avenue Waste Water Treatment Plant. Water quality conditions of these two treatment plants are discussed in this section.

(a). <u>23rd Avenue Waste Water Treatment Plant</u>. The 23rd Avenue Plant treats 55 to 58 MGD of waste water with advanced secondary treatment and dechlorination. The capacity of the treatment plant is 63 MGD. Table 5-6 summarizes three months of monitoring reports for the treatment plant's discharge.

Currently about 50% of the discharge is being diverted by a local farmer and the remaining water goes to the Salt River. This farmer uses what is needed, and then discharges the rest into the Salt River at 43rd Ave. Roosevelt Irrigation District (RID) is also working with the City to purchase (exchange) water from this treatment facility. When this occurs, the entire outflow will be used for some form of irrigation during periods of high demand. During the dry, harvest, and stand periods of October through February, however, the water will be discharged to the Salt River. Thus the 57 MGD will be discharged to the Salt River during approximately 5 months out of 12. The remaining months may yield as low as zero flow. The discharge location of the treatment plant is at 35th Avenue.

(b). 91st Avenue Waste Water Treatment Plant. The 91st Avenue Plant has three modules. One has a 30 MGD capacity to treat with biodenitrification, and the other two do not. The source water has a nitrogen content of 25 mg/l, part as nitrate and part as ammonia. The City intends to increase the plant capacity by 30 MGD, and add biodenitrification within three years. Because some of the discharge is to a river, the strict standards require the discharge to support fish life. Items of specific concern are nitrate levels, and household poisons such as Diaznon. Table 5-6 summarizes three months of monitoring reports for the treatment plant's discharge.

Discharge of the treated water is to the Palo Verde Nuclear Generating Plant (currently 20-40 MGD with rights to take more), and the Salt River. The Buckeye Irrigation District diverts the Salt River flow at 47th Ave (about four miles downstream from the treatment plant), however they do not necessarily have explicit rights to this water. Concerns facing the operation of the nuclear plant are the degrading water quality from the water treatment plant. Two discharge alternatives are being considered by the City: (1) underground recharge on the Agua Fria River (AFR),and (2) irrigation of the local Gila Indian Reservation in exchange for CAP water. In summary, this water is slated for useful purposes at present and in the future, however the Corps' creation of a wetlands as a preliminary treatment to the City's Aquifer Storage Recovery alternative may be beneficial.

5.2.3.2 *Tempe Area.* The City of Mesa has a Waste Water Treatment Plant just upstream of Price Road. This is being planned for extensive expansion that will discharge lots of effluent to the Salt River. This may travel as far as Town Lake.

(a). Kyrene Waste Water Treatment Plant. Kyrene Waste Water Treatment Plant treats domestic waste for the City of Tempe and has a capacity of 3.25 MGD. The City of Tempe discharges effluent from the Kyrene treatment facility to the Salt River via the Tempe Drain at I-10. The treated effluent meets NPDES permit; the discharge rate is from 0 to 3 MGD.

5.3 GROUNDWATER QUALITY

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 4-1. There are a number of groundwater quality problems in the Salt River Valley. In this section, groundwater quality issues were discussed based on inorganic chemical constituents and trace organics.

5.3.1 Inorganic Chemical Constituents

The regional groundwater problems associated with inorganic chemical constituents were described in the MAG 208 Water Quality Management Program (Schmidt, 1979). Most of the inorganic problems can be traced to natural factors and long-term irrigation practices. High salinity, chloride and nitrate concentrations are commonly found in shallow groundwater beneath irrigated or formerly irrigated land (Schmidt, 1983). All three constituents are high in the study area, chloride and TDS are especially high at the western end of the study area north of the confluence of the Salt and Verde River. Nitrate levels are greater than 25 mg/l throughout the area west of Central Avenue. A pocket of 90 mg/l concentrations is located northeast of Tolleson. Table 5-7 summarizes the public health effects of excess levels of chloride, TDS, and nitrates and Table 5-8 summarizes the effect on agriculture.

5.3.2 Trace Organics.

Over the past 15 years, a large number of significant instances of shallow groundwater degradation by organic constituents have been detected in the Rio Salado study area. The most significant instances involve the pesticide DBCP or volatile halocarbons. At several well sites in the study area (SRP, 1993) and beneath present or former citrus orchards near Mesa and Gilbert, DBCP has been detected at concentrations exceeding the drinking water maximum contaminant level (MCL). DBCP is a pesticide that was used extensively on citrus groves in Maricopa County. DBCP is now a suspected carcinogen and is no longer used for agricultural purposes in Arizona (SRP, 1993).

Hundreds of incidents of volatile halocarbon contamination have been detected in the Rio Salado study area. Volatile halocarbons are located in shallow groundwater beneath several landfills along the Salt River, near industrial facilities, and beneath large sections of the Phoenix metropolitan area. In some cases of volatile halocarbon contamination the problems are limited to plumes in specific areas and can be associated with specific waste disposal practices (examples: 19th Ave. and 27th Ave Landfills) or industrial activities (examples: Motorola 56th and Motorola Mesa). These plumes are usually well defined and involve small amounts of groundwater. However, a large area of low level volatile halocarbon contamination involving larger amounts of water has also been delineated. This area stretches from the Motorola 52nd Street Superfund site to Sky Harbor Airport, west through downtown Phoenix and through the West Van Buren area, almost to Tolleson. There are many plumes and many possible sources. Attempts are being made through state and federal remediation programs such as the Water Quality Assurance Revolving Fund (WQARF) and the EPA's Superfund program to define the extent of contamination and to implement remediation. Because of the size of the affected area it is difficult to partition the problem areas into specific sites with identified parties. Table 5-9 summarizes the identified problems at each site. Open and closed landfills along the Salt River are listed in TableS 5-10 and 5-11.

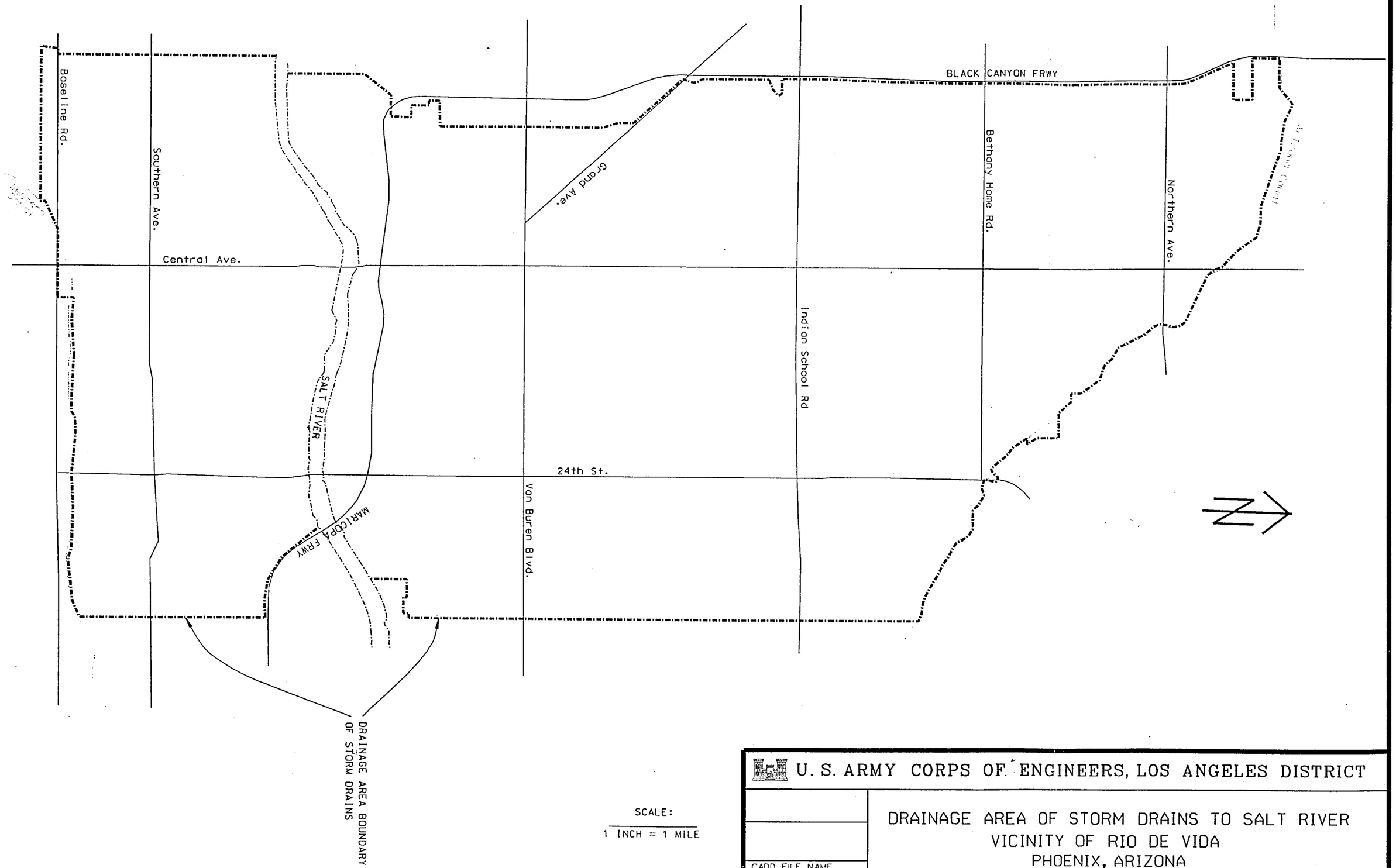
Because of high organic (nitrate, chloride, and TDS) and volatile halocarbon concentrations and decreases in the use of land for agriculture , use of shallow groundwater in the Rio Salado study area for public consumption has dropped significantly, and will continue to decrease. New water supply wells which tap the higher quality groundwater stored in the Lower and Middle Alluvial Units have been replacing the shallow wells for several decades. Much of the shallow groundwater is now only suitable for industrial or agricultural purposes. The deeper water is generally unaffected by irrigation

and industrial practices and has lower salinity and nitrate concentrations. An important issue in the Salt River Valley is protection of the higher quality water stored in the deeper aquifers from the poorer quality water in the upper aquifer.

Other causes of groundwater quality degradation in the study area are leaking underground storage tanks, dry wells which extend close to or into the upper part of shallow aquifers, settling basins, and well construction practices.

TABLE 5-1, DESIGNATED USES OF WATERWAYS WITHIN THE RIO SALADO STUDY AREA

Reach	Designated Uses
Salt River (2 km below Granite Reef Dam to the I-10 bridge)	Aquatic and Wildlife (ephemeral) Partial Body Contact
Salt River (I-10 bridge to the 23rd Avenue WWTP)	Aquatic and Wildlife (warm water fishery) Partial Body Contact
Salt River (23rd Avenue WWTP to the Gila River Confluence)	Aquatic and Wildlife (effluent dominated water) Partial Body Contact Fish Consumption Agricultural Irrigation Agricultural Livestock Watering
Indian Bend Wash	Aquatic and Wildlife (warm water fishery) Partial Body Contact Fish Consumption
Indian Bend Wash Lakes	Aquatic and Wildlife (warm water fishery) Partial Body Contact Fish Consumption
Source: Arizona Administrative Code, ADEQ, Title 18, Ch.11, Appendix A.	



SCALE:

1 INCH = 1 MILE

U. S. ARMY CORPS OF ENGINEERS, LOS ANGELES DISTRICT

CADD FILE NAME

DRAINAGE AREA OF STORM DRAINS TO SALT RIVER
VICINITY OF RIO DE VIDA
PHOENIX, ARIZONA

Plate 7

RIO SALADO, SALT RIVER
ARIZONA

APPENDIX B

HYDRAULICS

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT
SOUTH PACIFIC DIVISION
MAY 1997

CESPL-ED-HH (335-2-5c) 22 May 1997

MEMORANDUM FOR CESPL-PD-WC, ATTN: Mike Ternak

SUBJECT: Hydraulic Section F4 Support Documentation for the Rio Salado, Salt River, Arizona, Feasibility Study

1. References:

a. LAN Service Request, dated 2 October 1996 by the Study Manager (John Ryan; CESPL-PD-WC).

b. Discharge frequency values (provided by CESPL-ED-HE) based on the Modified Roosevelt Dam Water Control Plan and new Salt/Gila River Hydrology dated 29 February 1996.

c. Topographic Mapping for Hydraulic Model of the Salt River and Indian Bend Wash; prepared by Michael Baker Jr. Inc., dated 1996 with a scale of 1"=400' and contour interval of 4 feet (NGVD 1929).

d. HEC-2 Model of the Salt River and Indian Bend Wash; prepared by Michael Baker Jr. Inc., dated 1996.

e. Draft Sediment Trend Analysis, Salt River Between Granite Reef Dam and the Confluence with the Gila River, prepared by Kimley-Horn and Associates, Inc., dated December 1996.

f. Gila River Basin, Arizona - Indian Bend Wash - Design Memorandum No. 1 - General Design Memorandum Phase II Project Design for Indian Bend Wash, CESPL, dated May 1975.

2. This memorandum documents Hydraulics Section's hydraulic design data for with-project conditions for the Rio Salado Feasibility Study. Specifically, the data describes Hydraulics Sections's support of the detailed study for restoring riparian habitat at the two locations of Phoenix Lago de Vida and Tempe Cienega. The information contained in this memorandum is intended to be incorporated directly into the documentation package for the F4 milestone, and later into the hydraulic technical appendix for the feasibility report. This particular study effort was conducted for the sole purpose of assisting in making cost estimates for economic analysis of with-project conditions. Detailed hydraulic documentation and calculations are maintained in the Hydraulics Section files.

General

3. The study area is located within the Salt River and Indian Bend Wash in the cities of Phoenix and Tempe, Arizona. Both the Salt River and Indian Bend Wash are existing flood control channels with a minimum 100-year event conveyance capacity. These channels are trapezoidal

in shape with soil cement bank protection at several locations. The channel beds are natural and generally consist of sand, gravel, and cobbles. The depth of the Salt River varies from 20 to 30 feet (ft) with basewidths of between 500 to 1000 ft wide. The depth of Indian Bend Wash varies from 15 to 25 ft over an average basewidth of 600 ft. For Indian Bend Wash, a low flow channel is located in the center of the low flow thalweg. Both river reaches contain grade control structures.

4. Environmental restoration is proposed by planting vegetation in the existing channel bed of the Salt River and Indian Bend Wash without affecting the channel capacity. A low flow channel is also proposed to increase the channel capacity and prevent inundation damages to the vegetation during low flow events. Environmental restoration is proposed at two locations: (1) Lago de Vida, a 5 mile long reach of the Salt River within the city of Phoenix; and (2) Tempe Cienega, two reaches within the Salt River and one reach within Indian Bend Wash for a total length of approximately 2.5 miles in the city of Tempe.

5. During coordination efforts with the Study Manager (Mike Ternak; CESPL-PD-WC) it was determined that the following hydraulic tasks needed to be accomplished: (1) determine a low flow discharge to be contained in a low flow channel such that the restoration area will not be damaged by either flood inundation or uprooting; (2) size the low flow channel for the above discharge; (3) determine the maximum Manning's roughness coefficient (n value) that can be used in the environmental restoration areas without affecting the channel capacity and then correlate this derived roughness coefficient with plant density; and (4) determine how often these environmental restoration areas would be uprooted because of high flows.

Hydrology

6. Discharge frequency values throughout the Lago de Vida project reach were based on the information contained in the Modified Roosevelt Dam Water Control Plan supplied by the Hydrologic Engineering Section (reference b). A maximum low flow discharge of 12,200 cubic feet per second (cfs) was agreed upon by the study team as being the design target discharge based on a step 4 release schedule found in the Modified Roosevelt Dam Water Control Diagram (Plate 11 in the Hydrology Appendix). This particular discharge corresponds to between a 50- and 100-year event for flow duration times of 30 days. However, in terms of peak flows, a discharge of 12,200 cfs corresponds to less than a 5-year flood event. Note, the 100-year peak discharge on the Salt River is 166,000 cfs.

7. A maximum low flow discharge of 4,000 cfs had previously been incorporated into the Indian

Bend Wash project. The wash already has a capacity to pass a 100-year peak discharge of 30,000 cfs.

Low Flow Channel Geometry and Alignment

8. **General**. The study team decided that a low flow channel need only be designed for the Lago de Vida reach; the existing channel configuration would satisfy the Tempe Cienega reach. The low flow channel would be designed to convey the maximum low flow discharges discussed above (12,200 cfs for Lago de Vida and 4,000 cfs for Indian Bend Wash). Based on preliminary sediment transport information, 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 would be designed to meander across the existing channel bed in order to avoid the proposed channel access points (see Figures 1 to 7). The low flow channel velocity was limited to 6 feet per second (ft/s) to avoid the potential for scouring of the bed.

9. **Lago de Vida**. The Lago de Vida study reach is located within the Salt River bed from the 19th Avenue bridge (downstream limit) to the I-10 bridge (upstream limit). The existing channel has a slope of 0.002 (ft/ft) with an average channel basewidth of 500 ft to 900 ft. The proposed low flow channel was designed as an entrenched trapezoidal channel with a basewidth of 200 ft. An inlet structure to the low flow channel will be located at the upstream end to collect low flows. The low flow channel will daylight to the natural stream grade at the downstream end. The channel incorporated side slopes of 2:1 (horizontal to vertical) and would be lined with soil cement. The channel invert thalweg would remain earthen. The side slopes would extend 5 ft below the bottom of the low flow channel to protect the side slopes from scour. The low flow channel depth would vary from 9.5 ft to 15 ft depending on the local topography. The proposed low flow channel would be fully entrenched throughout most of the reach except for about half a mile at the downstream end where 2 to 4 ft levees would have to be built to contain the low flows. The proposed low flow channel slope would be 0.0008 (ft/ft). The *n* value for the low flow channel was judged to be 0.030. A series of 5 drop structures with varying drop heights from 7.0 to 5.4 ft would be utilized to prevent the flow from exceeding 6 ft/s and lessen the threat to erosion of the earthen low flow channel bed. The drop structures would need only extend across the low flow channel. A continuous discharge of 10 cfs was assumed to flow within the low flow channel for environmental reasons; this discharge can be expected to meander within the low flow channel. Note, it is highly probable that any growth within the low flow channel will be uprooted during any significant high flows. See Figure 8 for the existing and proposed channel profile. Table 1 summarizes the low flow channel hydraulic design data.

Table 1. Low Flow Channel Hydraulic Design					
Discharge (cfs)	Length (ft)	Basewidth (ft)	Flow Depth (ft)	Velocity (ft/s)	Topwidth @ Flow Depth (ft)
12,200	26,400	200	9.5	5.9	238

10. **Tempe Cienega**. Tempe Cienega consists of three reaches: (1) the Salt River from Priest Drive to Mill Avenue (0.5 mile); (2) the Salt River from the confluence with Indian Bend Wash to McClintock Road (0.5 mile); and (3) Indian Bend Wash from the confluence with the Salt River to McKellips Road (1.5 miles). The study team determined that a low flow channel would not be required for any of these reaches because of the following reasons: (1) they are relatively short; (2) the existing grade is fairly flat and levees would have to be built to contain a low flow channel; and (3) in the case of Indian Bend Wash a low flow channel already exists. Since extra channel capacity would not be provided by any low flow channel, a maintained 200-ft wide vegetation free corridor within the channel bed would be required in the two reaches of the Salt River to prevent a total choking of the river from any environmental restoration features. This maintained 200-ft wide corridor is shown in Figures 5 to 7 as dashed lines near the center of the channel in order to indicate future design flexibility in the final alignment. The Salt River banks within these reaches may need to be lined with soil cement to prevent prolonged low flow impingement. The existing Indian Bend Wash low flow channel would be required to be kept fairly clear and well-maintained. See figure 9 to 11 for the existing channel profiles.

Determination of Manning's Roughness Coefficient

11. **General**. 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. The 100-year discharges of 166,000 cfs for the Salt River and 30,000 cfs for Indian Bend Wash were first used to determine their initial channel capacities. Then the *n* value was varied horizontally across each cross-section; i.e., the *n* value was set equal to 0.030 for the low flow channel segment while it was varied for the vegetated area. A rating table was created by incrementally raising the *n* value for the vegetated area. The maximum *n* value for the vegetated area for each typical cross-section corresponded to the *n* value where there was no increase in the water surface elevation between the original *n* value and the rougher *n* value. The percent of obstruction was calculated using the following formula:

$$n \; n_o \left(\frac{1}{1 \;\; \% \; obstruction} \right)$$

where n = new n value
n_o = original n value
% obstruction = percent of the area blocked, or density of vegetation

Note, these calculations were based only on normal depth assumptions and will need to be refined for any future design by using a backwater model.

12. **Lago de Vida**. Three typical cross-sections were used to represent the Lago de Vida reach (see Figures 12 to 14). Section 212.12 was determined to be a representative cross-section between Station 211.51 to 212.25, while Section 213.95 was determined to represent cross-section channel geometry between Station 212.25 to 214.50, and Section 216.33 was determined to represent the channel between Station 214.50 to 216.50. From Table 2, the maximum n value for the vegetated area for Station 212.12 was found to be 0.047 since this corresponded to the maximum n value where there would be no change in water surface elevation between the original n value and the rougher n value. The corresponding percentage of blockage was found to be 30%. For Station 213.95 and 216.33 (Tables 3 and 4), the maximum obstructive n values were determined to be 0.059 and 0.100, respectively. The corresponding percentage of obstruction were found to be 41% and 65%, respectively. Note, however, that the above method of determining the maximum n value was modified for the cross-section at Station 216.33 and treated as a special case because the n value of 0.100 was determined as already being reasonably high enough.

Table 2. Normal Depth Calculations for Station 212.12			
Manning's *n* value	CWSEL (ft)	Avg. Velocity (ft/s)	% obstruction (density)
.033 (original)	1046.9	13.9	0
.033 (w/ new low flow)	1044.8	14.4	0
.047	1046.8	13.0	30
.05	1047.1	12.8	34
.06	1048.8	12.2	45

Table 3. Normal Depth Calculations for Station 213.95			
Manning's *n* value	CWSEL (ft)	Avg. Velocity (ft/s)	% obstruction (density)
.035 (original)	1073.5	11.2	0
.035 (w/ new low flow)	1068.0	12.1	0
.05	1071.4	10.4	30
.059	1073.6	9.5	41
.063	1074.4	9.1	44

Table 4. Normal Depth Calculations for Station 216.33			
Manning's *n* value	CWSEL (ft)	Avg. Velocity (ft/s)	% obstruction (density)
.035 (original)	1096.0	11.7	0
.035 (w/ new low flow)	1090.6	13.2	0
.050	1091.7	12.2	30
.070	1092.7	11.4	50
.090	1093.3	10.9	61
.100	1093.6	10.7	65
.150	1094.5	10.2	77
.200	1095.0	9.8	83

13. **Tempe Cienega.** Three typical cross-sections were used to represent the Tempe Cienega reach (see Figures 15 to 17). Section 220.73 was determined to be a representative cross-section downstream of Tempe Lakes from Priest Drive to Mill Avenue, while Section 222.93 was determined to represent cross-section channel geometry upstream of Tempe Lakes from the Indian Bend Wash confluence to McClintock Road, and Section 1.326 was determined to represent the typical channel condition for Indian Bend Wash from the Salt River confluence to McKellips Road. For cross-sections 220.73 and 222.93, a 200-foot wide clear area was assumed near the center of the channel to convey low flows; the rest of the channel bed was assumed to have vegetation. The existing low flow channel for Indian Bend Wash was assumed clear and free of large debris; the rest of the channel bed was assumed to have vegetation. Note, since there is no provision for a low flow channel in these reaches, no extra channel capacity will be gained. Consequently, these clear areas will need to be maintained such that all low flows will not be allowed to impinge on the banks. Tables 5 to 7 show the results of the normal depth calculations with varying *n* values for the vegetated areas. Tables 5 to 7 also indicate maximum derived *n* values of 0.037 to 0.041 for the condition in which the water surface elevation stays below the water surface elevation of the original channel conditions. However, the maximum *n* value of 0.100 for the vegetated area can be used for three reasons: (1) the reaches are relatively short; (2) the channel will not have significant vegetation upstream and downstream of the Tempe Cienega reach; and (3) higher flows will most likely uproot the vegetation (which will lower the *n* value close to the original conditions).

Table 5. Normal Depth Calculations for Station 220.73			
Manning's *n* value	CWSEL (ft)	Avg. Velocity (ft/s)	% obstruction (density)
.035 (original)	1146.0	11.0	0
.040	1145.9	11.0	13
.041	1146.1	10.9	15

Table 6. Normal Depth Calculations for Station 222.93			
Manning's *n* value	CWSEL (ft)	Avg. Velocity (ft/s)	% obstruction (density)
.035 (original)	1163.5	13.8	0
.037	1163.6	13.7	5

Table 7. Normal Depth Calculations for Indian Bend Wash - Station 1.326			
Manning's *n* value	CWSEL (ft)	Avg. Velocity (ft/s)	% obstruction (density)
.035 (original)	1187.7	10.2	0
.040	1187.78	10.1	13
.050	1187.95	9.8	30

Maintenance Considerations

14. **General.** Periodic clearing of the low flow channel would be necessary to maintain the existing channel capacity. The maximum *n* value corresponding to the vegetated area must be monitored in order to insure that this condition is met. Vegetation growth, percent of obstruction, and plant density correlated to this *n* value will be developed in order to insure that this monitoring process can be successfully implemented. It should be recognized that all

vegetated areas are potentially subject to damage from long periods of flood inundation and/or uprooting.

15. **Lago de Vida.** In the Lago de Vida reach, a cursory method was used to estimate when the vegetation in the environmental restoration area would become uprooted. First of all, it was assumed that the vegetation would uproot when the velocity in the vegetated area exceeds 6.0 ft/s. Using this assumption, a series of increasing discharges was tested for the typical cross-sections until a velocity of 6.0 ft/s was reached in these vegetated areas. In addition, an *n* value for the vegetated area targeting a 0 ft increase in water surface elevation was used. For example, an *n* value of 0.047 was used for Station 212.12. This value corresponded to a computed water surface elevation which was approximately equal to the original without-project water surface elevation. Next a discharge value was computed that incorporated the threshold velocity of 6.0 ft/s and the corresponding *n* value associated with the vegetated area is tabulated. The resultant uprooting discharge identified as Q_{uproot} is shown in Table 8.

16. In cases where the target velocity of 6.0 ft/s is never reached in the vegetated area (because of a high *n* value), a maximum *n* value of 0.100 was used. This corresponded to a 65% obstruction in conveyance area. Given that the 100-year discharge average channel velocity (without-project) would most likely uproot most, if not all, vegetation within the channel, this particular velocity threshold was used to indicate when the vegetation in the with-project channel condition would become uprooted (Q_{uproot}), i.e., a series of discharges were evaluated until the with-project average channel velocity exceeded the 100-year discharge without-project average channel velocity. For example, the 100-year discharge average velocity for Station 216.33 was determined to be 10.7 ft/s (using an *n* value of 0.100); this particular velocity is exceeded in the vegetated cross-section area when the discharge exceeds 25,000 cfs. Note, it is expected that the vegetated area *n* value will decrease when the vegetation becomes uprooted.

17. **Tempe Cienega.** It was assumed that the vegetation in this area will get uprooted when the velocity within the 200-ft clear area (or the existing low flow channel for Indian Bend Wash) exceeds 6.0 ft/s. The discharges associated with this value are on the average lower than those found in the Lago de Vida reach since a low flow channel will not be excavated for extra conveyance capacity in this reach. The resulting uprooting discharges are tabulated in Table 8. Again, as for the Lago de Vida reach, it is very likely that the vegetated area *n* value will decrease when eventual uprooting occurs.

Table 8. Table of Q_{uproot}		
Station	Manning's n	Q_{uproot} (cfs)
212.12	.047	70,000
213.95	.059	45,000
216.33	.100	25,000
220.73	.100	32,000
222.93	.100	4,000
1.326 (Indian Bend Wash)	.100	12,000

Proposed Work for the F5 Milestone

18. For the F4 milestone, normal depth was used to calculate the hydraulic design criteria; a backwater model (HEC-2 or RAS) will be used to refine the hydraulic design criteria in support of the F5 milestone. In addition, the determination of maximum *n* values and maintenance considerations for the environmental restoration will also be updated by modifying existing HEC-2 models for both the Salt River and Indian Bend Wash (reference d).

19. At this particular phase of the study, no additional effort has been expended by the Hydraulics Section toward the assessment of the without project sediment baseline conditions on either the Lago de Vida or Tempe Cienega reaches. An existing HEC-6 model (reference e) is expected to be updated during the F5 study phase to take into account the recent channel improvements and the revised hydrology for the study reaches. In addition, the proposed environmental restoration and low flow channels will need to be incorporated into the other study models.

Encl

Rene Vermeeren, PE
Chief, Hydraulics Section

CF:

CESPL-ED-H
CESPL-ED-HH (4)

VERMEEREN
CESPL-ED-HH

MASHBURN
CESPL-ED-HH

CRISOSTOMO
CESPL-ED-HH
"f4memo.wpd"

DEPARTMENT OF THE ARMY
LOS ANGELES DISTRICT, CORPS OF ENGINEERS
ARIZONA-NEVADA AREA OFFICE
3636 NORTH CENTRAL AVENUE, SUITE 760
PHOENIX, ARIZONA 85012-1936

REPLY TO
ATTENTION OF:

March 27, 1997

Office of the Chief
Regulatory Branch

Salt River Sand & Rock
C/O Kimley-Horn and Associates, Inc.
ATTN: Mr. William D. Mathews
7600 North 15th Street, Suite 250
Phoenix, Arizona 85020

File Numbers: 944-1119-RWF, 944-1121-RWF, 944-1122-RWF, 944-1137-RWF, 944-1167-RWF, 954-0380-RWF, 944-1208-RWF, 944-1207-RWF, 944-1136-RWF, 944-1133-RWF, 944-1129-RWF, 944-1123-RWF, 944-1166-RWF

Dear Mr. Mathews:

The Corps of Engineers (Corps) has received your draft sediment trend analysis provided under letter of transmittal dated January 3, 1997. This document was developed as a mechanism to characterize expected changes to the channel bed profile of the Salt River resulting from the activities of the aggregate mining industry. The draft sediment trend analysis was executed as a means to address cumulative impact concerns expressed by the public during the Section 404 (Clean Water Act) public notice process for the aggregate mining industry's activities in the Salt River between Granite Reef Dam and the confluence with the Gila River, Maricopa County, Arizona.

You introduce the draft sediment trend analysis by stating that the modeling used to develop the document was performed in a way that would not allow for the indiscriminate application of the results for specific localized design decisions. We understand that this document is of a broad nature and we have, therefore, approached the review with the understanding that the results are not site specific, but only serve to generalize the expected changes to channel bed profiles.

Through our review of your draft sediment trend analysis, we support your overall findings that the Salt River channel bed profile has, and is expected to continue to be, degraded as a direct result of human influences, including those of the aggregate mining industry. Your report states that the channel bed profile degradation trend has been set in motion by human influences. You also state that this trend and is expected to continue even without the additional impacts of the aggregate mining industry, which you indicate would serve to accelerate this channel profile degradation trend.

During our review of your draft sediment trend analysis, we have learned that the aggregate mining interests, which you represent, have unanimously agreed to reduce their mining depth proposal from that which was originally indicated on the Section 404 applications. We understand that the aggregate mining industry is now proposing to limit excavation to uniform 20 foot depth. The Corps assumes that this departure from the mining depths represented in the aggregate mining industry requests for Section 404 authorization means that the level of expected impacts resulting from the original mining plans was expected to be unacceptable when viewed on a cumulative basis.

You conclude from the draft sediment trend analysis that the level of additional channel degradation associated with the now proposed 20 foot maximum mining depths may be manageable when assessed from a cumulative impact standpoint. You qualify this statement by asserting that the resulting additional channel degradation may be properly addressed through a program of monitoring and through development of specific countermeasures for infrastructure potentially at risk.

We understand that the basis of the modeling used to develop the draft sediment trend was topographic mapping obtained in 1991 and 1992. The Salt River has since been subject to channel altering events such as flows from upstream dam releases and mechanical manipulation, which undoubtedly have affected the elevation of the channel bed since the gathering of the 1991-1992 information. Such channel altering events may directly effect your now proposed 20 foot mining depth assumptions. We have also noticed that the sediment trend analysis does not include a complete inventory all structures within the study area, especially flood control structures.

We request that you complete the inventory of infrastructure within the study area and obtain aerial photography and contour mapping of the reach of the Salt River between Granite Reef Dam and the confluence with the Gila River which represent current channel conditions. This information should be the basis for performing a detailed site specific analysis of the impacts expected to result from each aggregate mining operation. This site specific analysis should result in the identification of expected localized impacts and potential countermeasures which may be employed to mitigate unavoidable impacts. On this basis, the permits for your clients will be issued. We will not issue permits until this work is complete. If you have questions please contact Ron Fowler at (602) 640-5385 x 226.

Sincerely,

ORIGINAL SIGNED BY

Cindy Lester
Chief, Arizona Section
Regulatory Branch

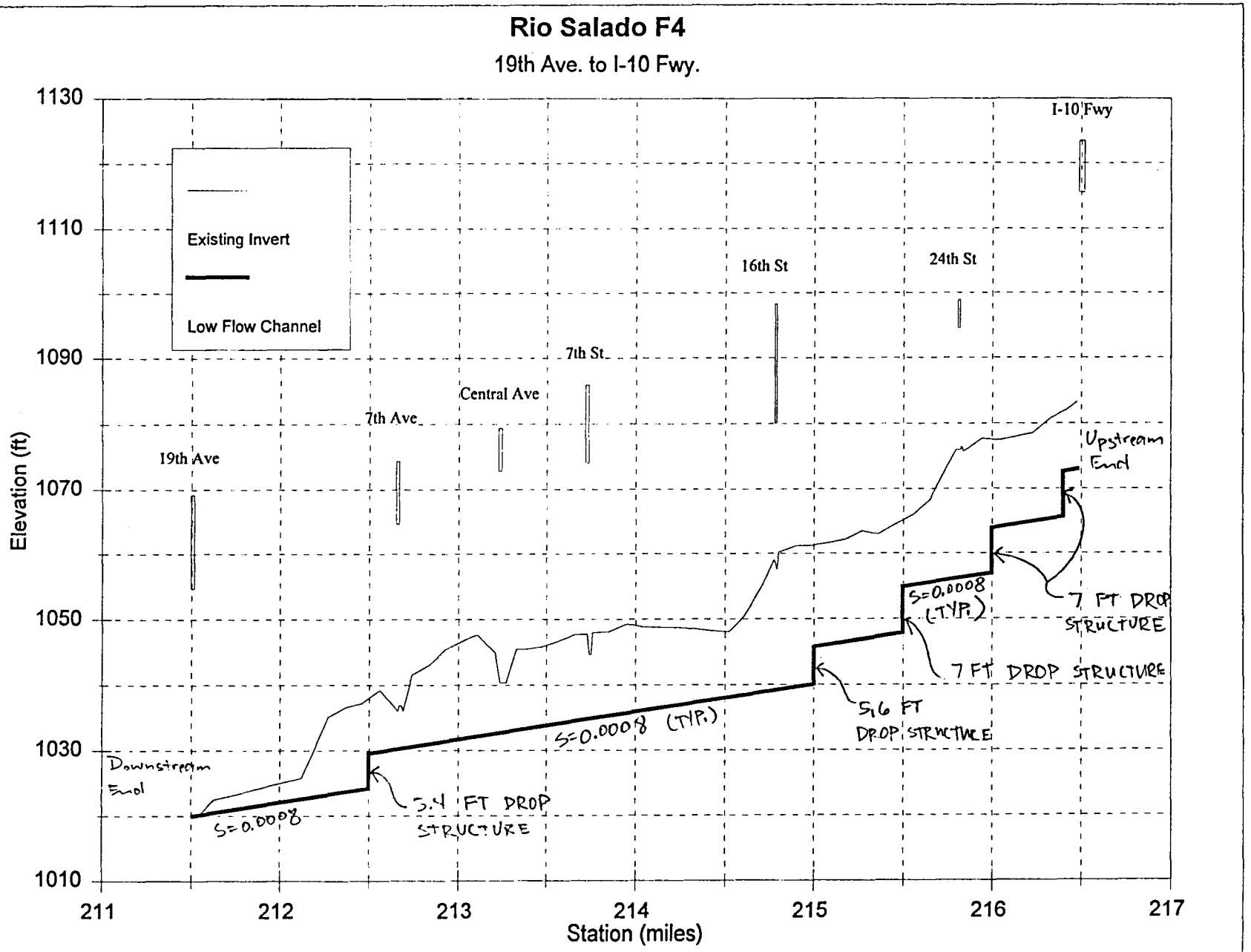

Rio Salado F4
19th Ave. to I-10 Fwy.
Existing Invert
Low Flow Channel
19th Ave
7th Ave
Central Ave
7th St
16th St
24th St
I-10 Fwy
Elevation (ft)
1130
1110
1090
1070
1050
1030
1010
211
212
213
214
215
216
217
Station (miles)
Downstream End
Upstream End
S=0.0008
3.4 FT DROP STRUCTURE
S=0.0008 (TYP.)
5.6 FT DROP STRUCTURE
S=0.0008 (TYP.)
7 FT DROP STRUCTURE
7 FT DROP STRUCTURE

FIGURE 8

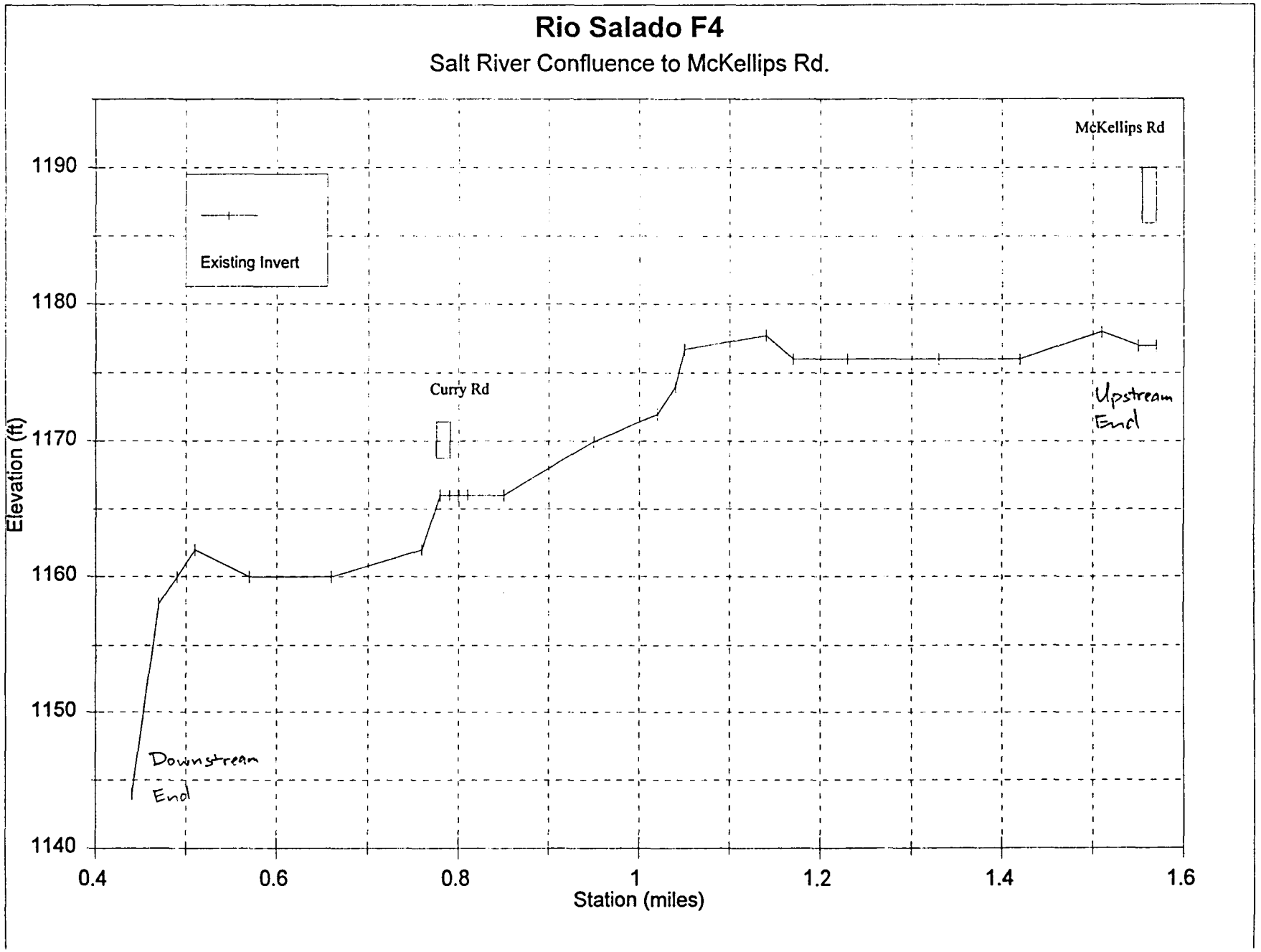

Rio Salado F4
Salt River Confluence to McKellips Rd.
McKellips Rd
Existing Invert
Curry Rd
Upstream End
Downstream End
Elevation (ft)
1190
1180
1170
1160
1150
1140
0.4
0.6
0.8
1
1.2
1.4
1.6
Station (miles)

FIGURE 9

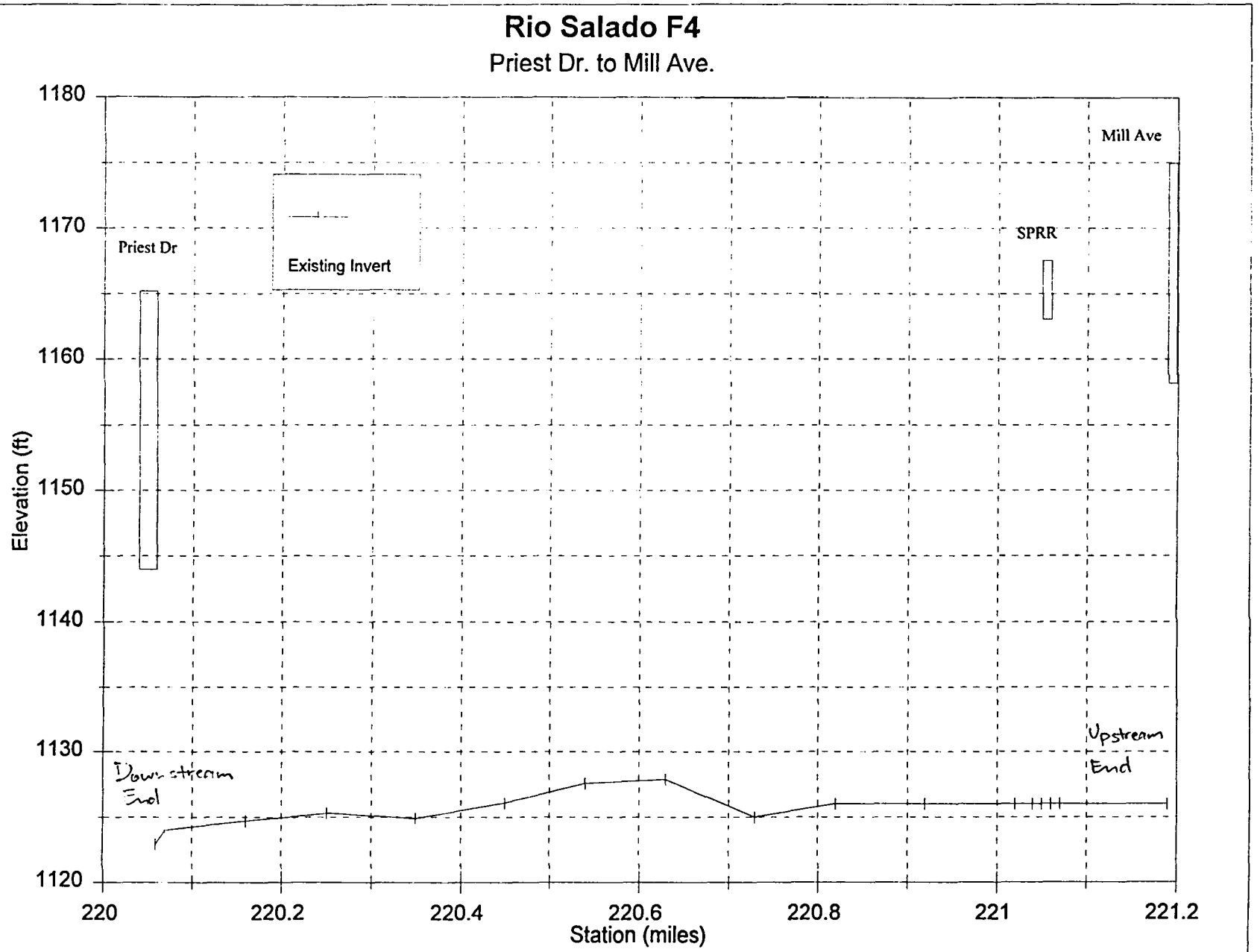

Rio Salado F4
Priest Dr. to Mill Ave.
Elevation (ft)
1180
1170
1160
1150
1140
1130
1120
Priest Dr
Existing Invert
SPRR
Mill Ave
Downstream End
Upstream End
220
220.2
220.4
220.6
220.8
221
221.2
Station (miles)

FIGURE 10

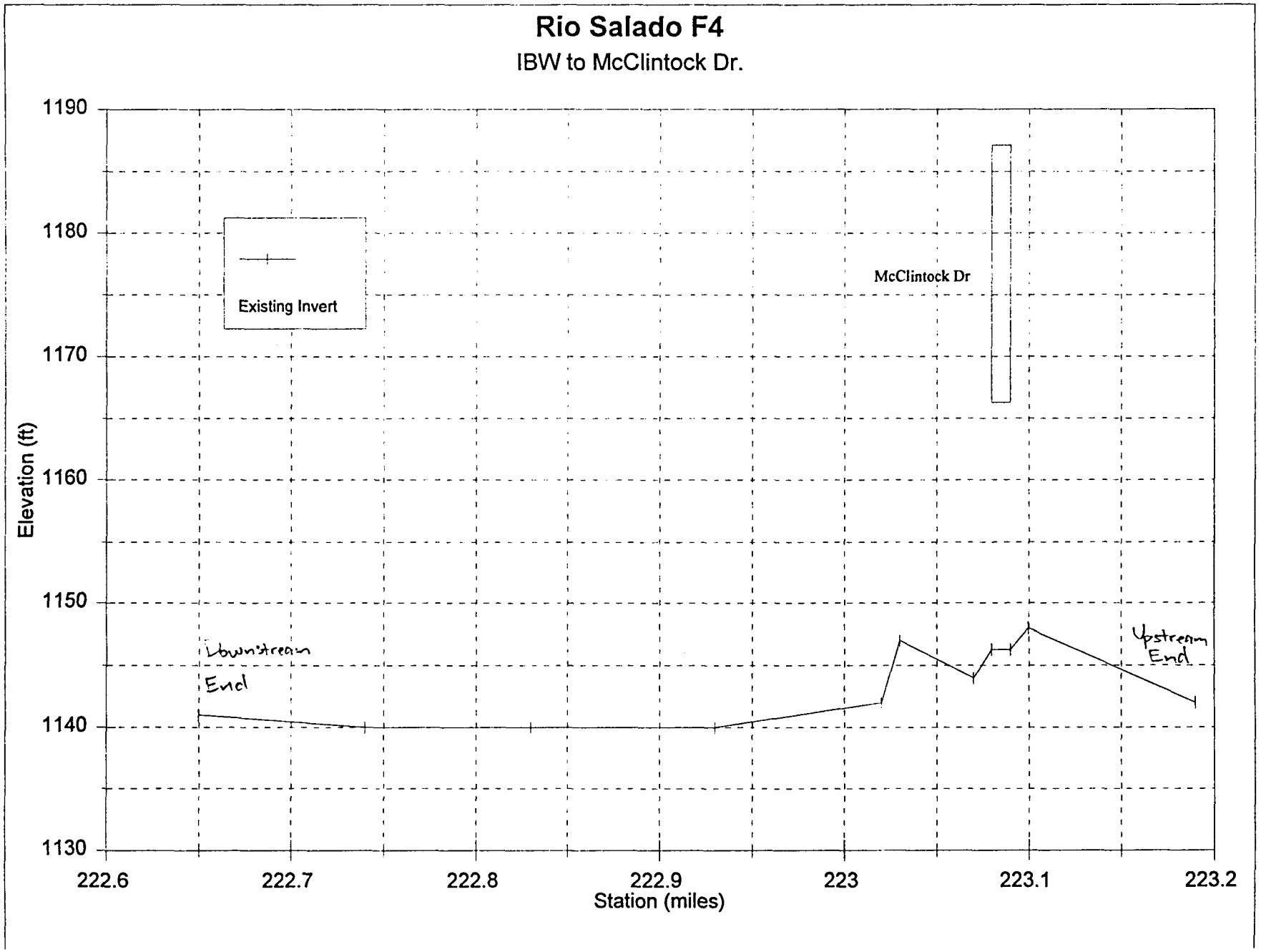

Rio Salado F4
IBW to McClintock Dr.
Elevation (ft)
1190
1180
1170
1160
1150
1140
1130
Existing Invert
McClintock Dr
Downstream End
Upstream End
222.6
222.7
222.8
222.9
223
223.1
223.2
Station (miles)

FIGURE 11

Rio Salado F4

Sta. 212.12

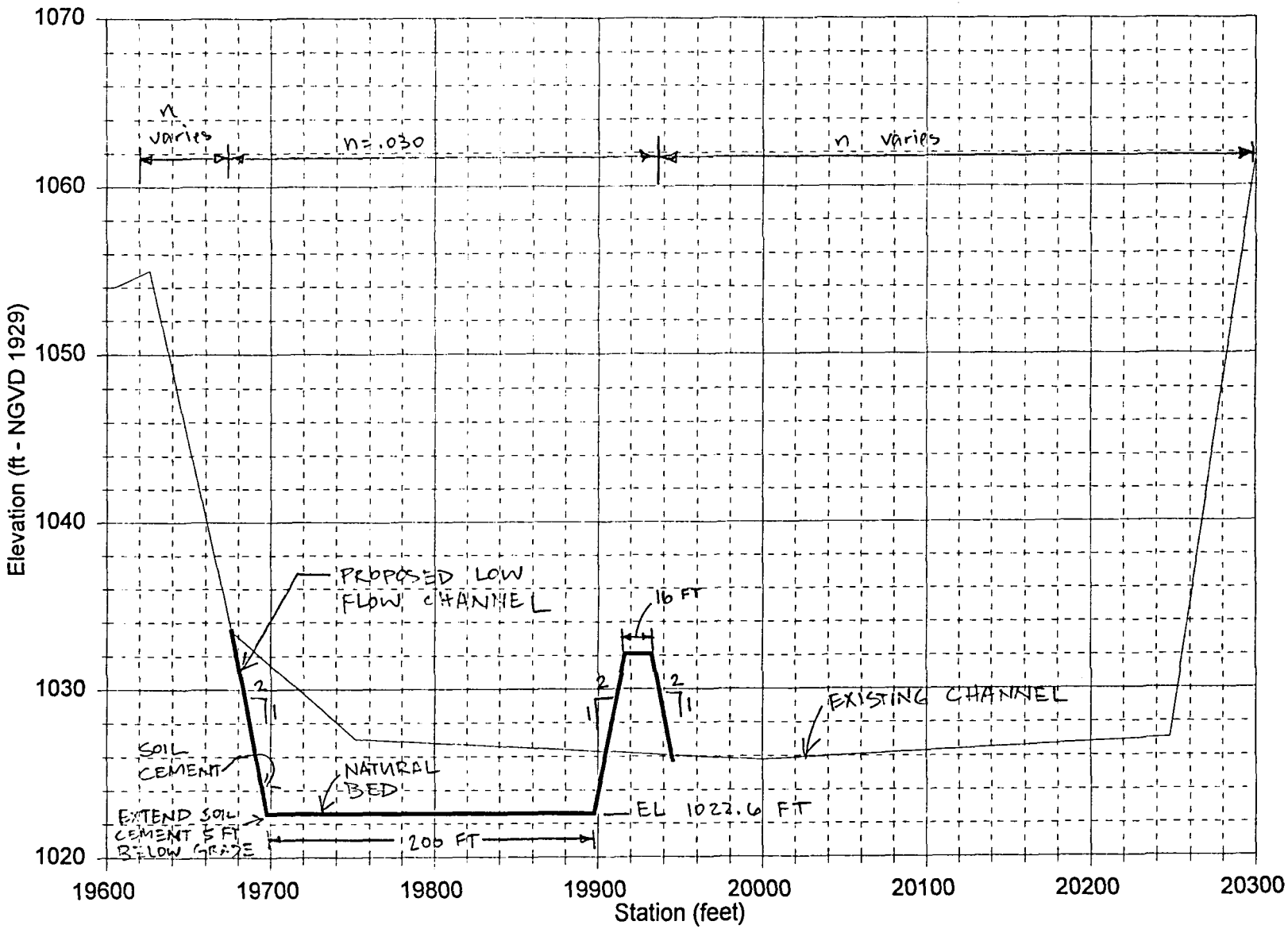


FIGURE 12

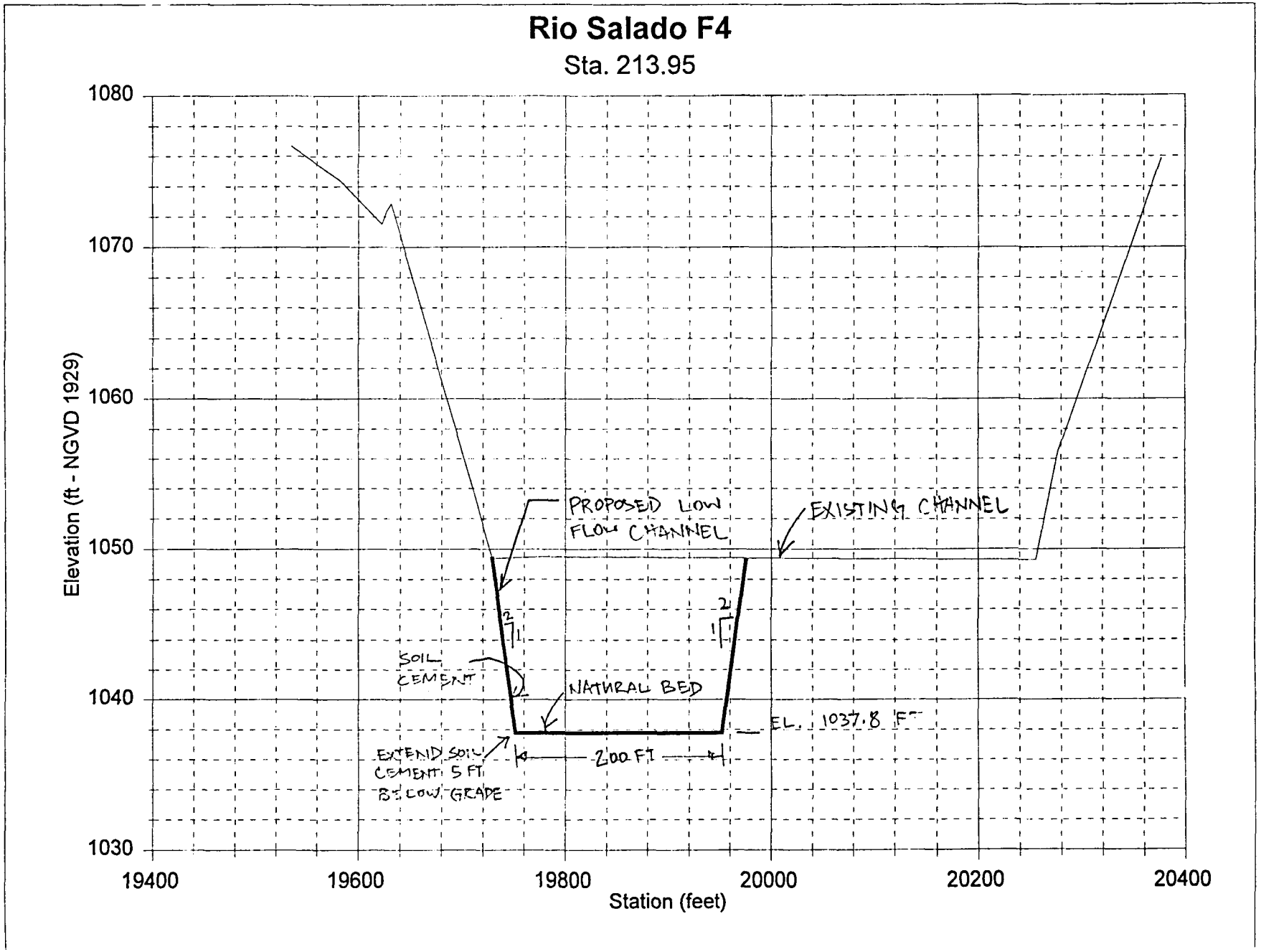

Rio Salado F4
Sta. 213.95
Elevation (ft - NGVD 1929)
1080
1070
1060
1050
1040
1030
19400
19600
19800
20000
20200
20400
Station (feet)
PROPOSED LOW FLOW CHANNEL
EXISTING CHANNEL
2
1
2
1
SOIL CEMENT
NATURAL BED
EL. 1037.8 FT
EXTEND SOIL CEMENT 5 FT BELOW GRADE
200 FT

FIGURE 13

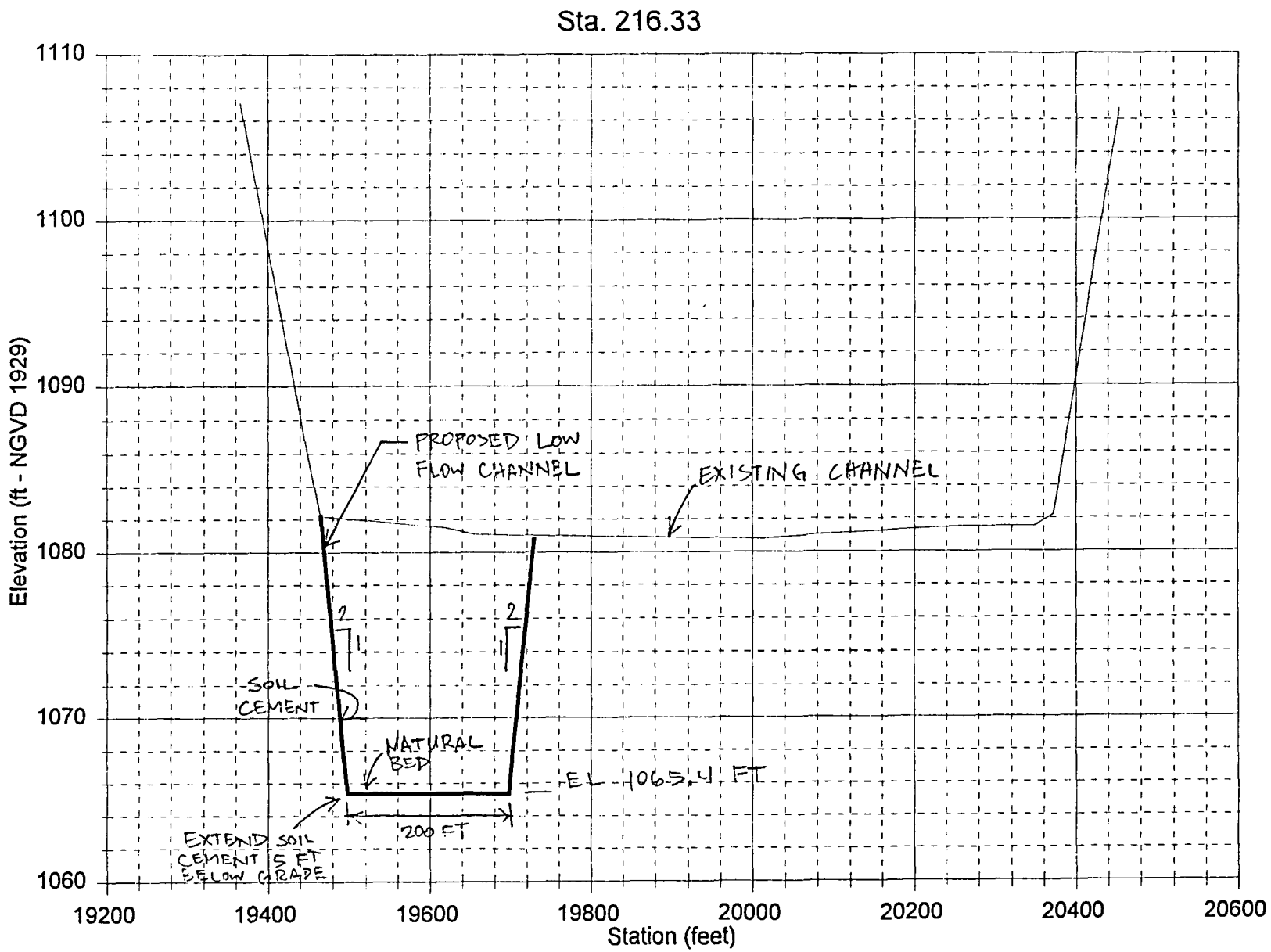

Rio Salado F4
Sta. 216.33
Elevation (ft - NGVD 1929)
1110
1100
1090
1080
1070
1060
19200
19400
19600
19800
20000
20200
20400
20600
Station (feet)
PROPOSED LOW FLOW CHANNEL
EXISTING CHANNEL
2
1
2
1
SOIL CEMENT
NATURAL BED
EL 1065.4 FT
200 FT
EXTEND SOIL CEMENT 5 FT BELOW GRADE

FIGURE 14

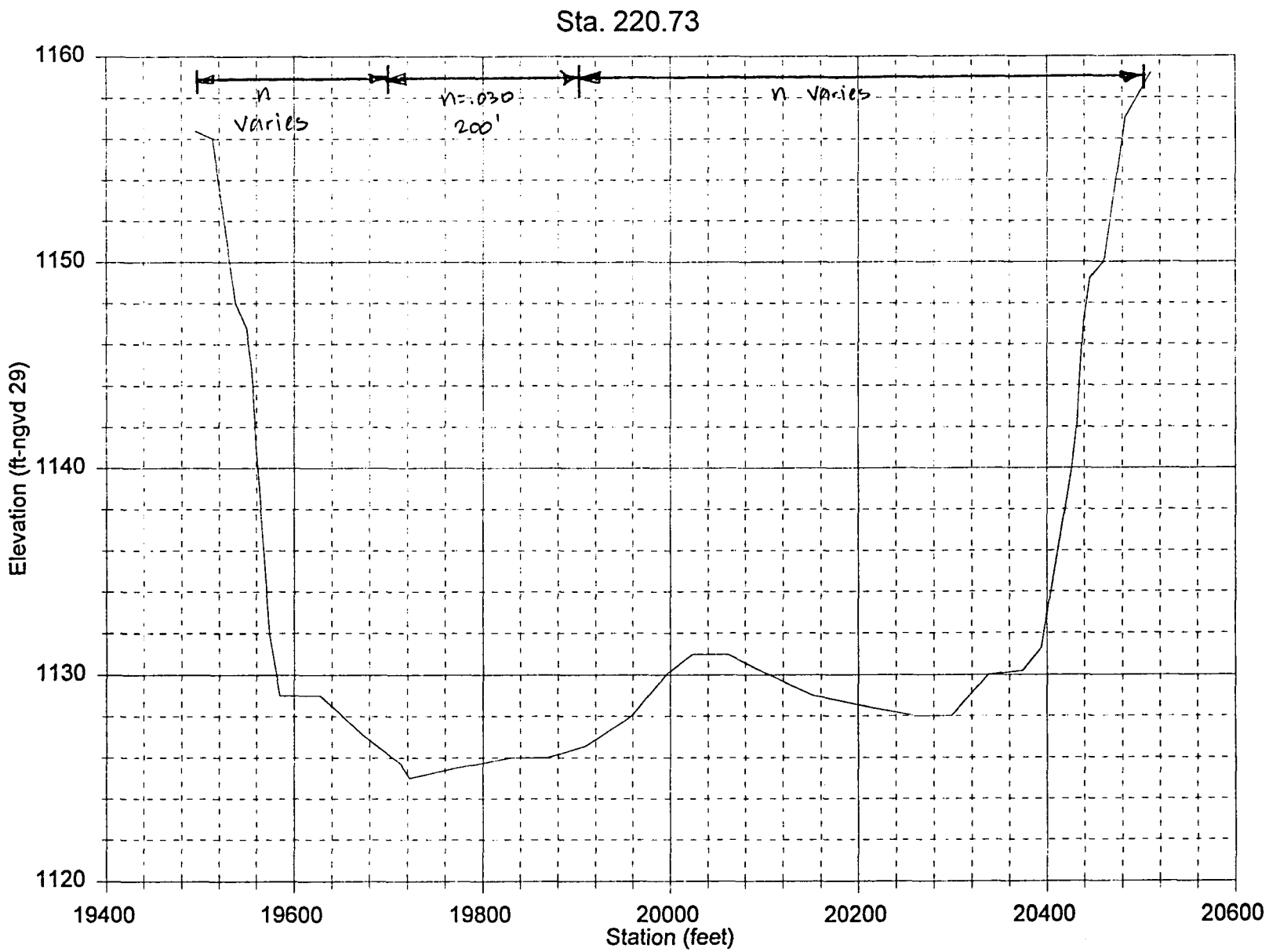

Rio Salado F4
Sta. 220.73
n varies
n=.030
200'
n varies
1160
1150
1140
1130
1120
Elevation (ft-ngvd 29)
19400
19600
19800
20000
20200
20400
20600
Station (feet)

FIGURE 15

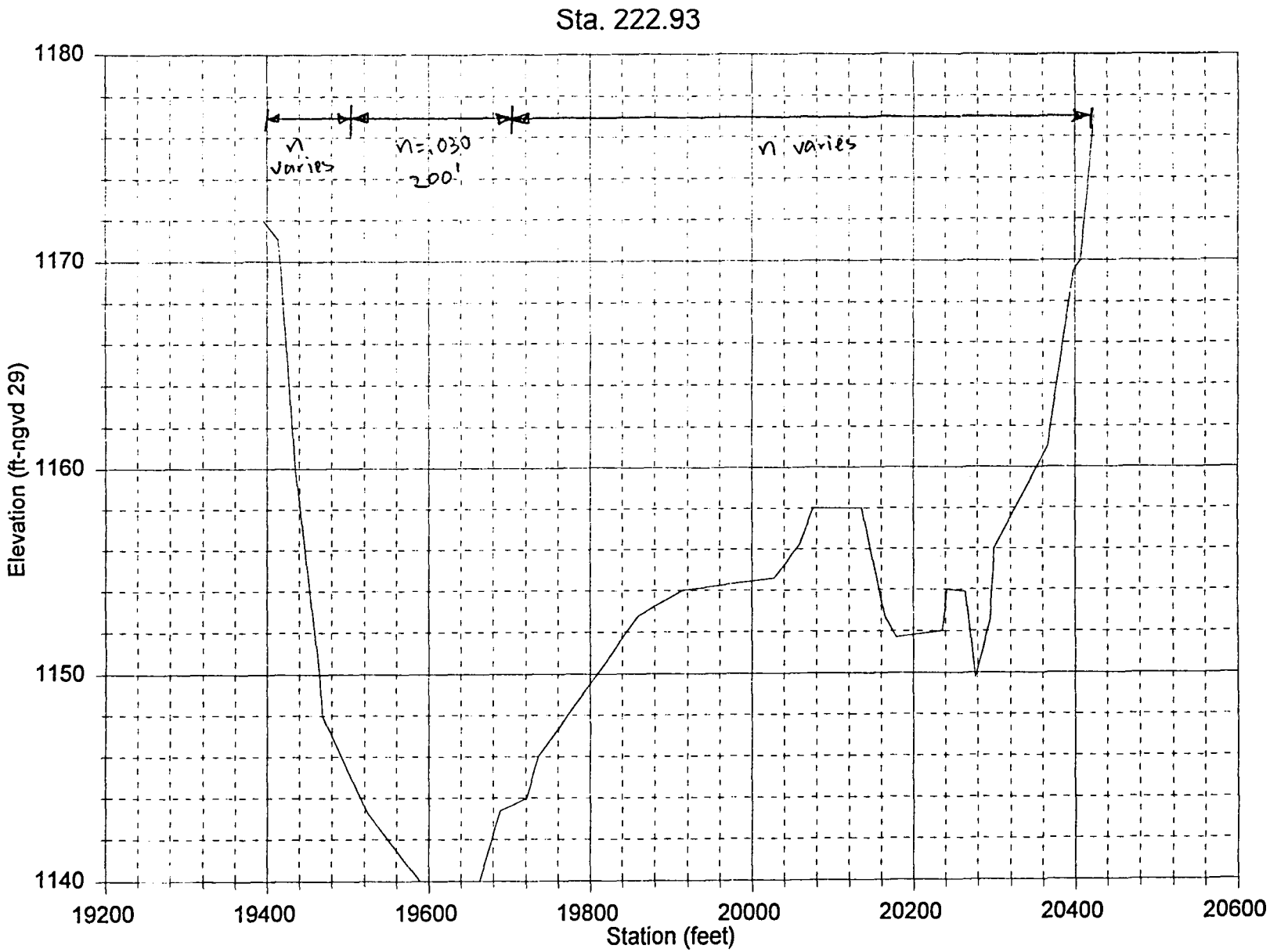

Rio Salado F4
Sta. 222.93
Elevation (ft-ngvd 29)
1180
1170
1160
1150
1140
19200
19400
19600
19800
20000
20200
20400
20600
Station (feet)
n varies
n=.030
200'
n varies

FIGURE 16

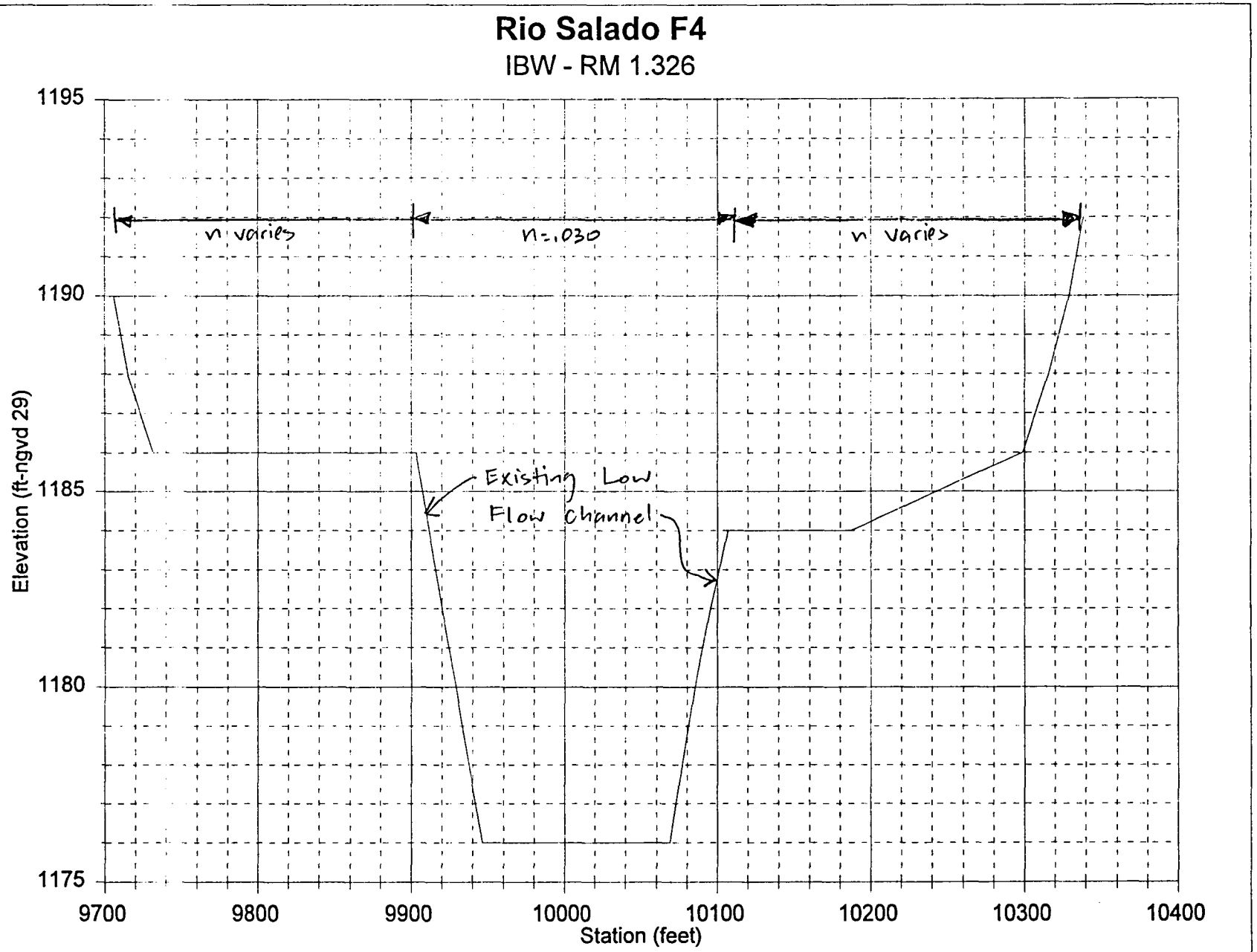

Rio Salado F4
IBW - RM 1.326
1195
1190
1185
1180
1175
Elevation (ft-ngvd 29)
9700
9800
9900
10000
10100
10200
10300
10400
Station (feet)
n varies
n=.030
n varies
Existing Low Flow Channel

FIGURE 17

sla Simons, Li & Associates, Inc.
Water Resources & Civil Engineering Consultants

RECEIVED
FEB 25 1997
REGULATORY BRANCH
PHOENIX FIELD OFFICE

Mr. Ron Fowler
U.S. ARMY CORPS OF ENGINEERS
3636 North Central Avenue, Suite 740
Phoenix, Arizona 85012-1936

Subject: **Review of Salt River Sand and Gravel Mining Analysis for 404 Application**
Contract No. DACW09-95-D-0003
Delivery Order No. 21

Dear Mr. Fowler:

According to the Scope of Work for the contract referenced above, Simons, Li & Associates, Inc. has completed review of the following materials submitted for the subject application:

1. Draft Sediment Trend Analysis Salt River Between Granite Reef Dam and the Confluence with the Gila River.

2. Draft Sediment Trend Analysis, Appendices; Salt River between Granite Reef Dam and the Confluence with the Gila River (including HEC-6 Model Data).

On February 5, 1997, we presented our review results to you at your office You confirmed our concerns on the following key issues:

1. Topographic data are outdated (1991-1992) and should be updated or verified. Several floods occurred after mapping and many channel reaches have been modified by construction and mining. This will impact the results of hydraulic and sediment analyses for both pre- and post-mining conditions.

2. Evaluation of sediment by size is critical to sand and gravel mining impact analysis. The sediment inflow assumptions shown in the report are questionable considering that particles larger than medium sand size can be effectively trapped by Granite Reef Dam for all flow conditions. In addition, there are several flood control dams upstream of Granite Reef Dam which will significantly reduce the sand and gravel supply to the proposed mining reach. Trapping efficiency for eacb particle size within various proposed mining pits should be also analyzed as part of channel response analysis.

3. Because of significant deficiency of sand and gravel supply to the proposed mining reach, the proposed extraction must pose significant long-term effects on channel stability and in stream structures. The continuous flow analysis results shown in the report may not fully represent the ultimate sediment deficiency conditions. Additional sediment budget analysis

for short- and long-term channel responses considering ultimate sediment inflow deficiency must be conducted to identify potential effects due to significant extraction.

4. As part of general impact analysis, potential changes in hydraulic characteristics and channel flow patterns (e.g. main channel migration, divided flow formation, low flow incision, ...) must be evaluated to identify bank stability and structural safety issues.

5. Existing developments and structures adjacent to the river along the study reach rely heavily on the existing levee/bank protection and grade control structures for flood and erosion hazard prevention; these facilities must be included in the sand and gravel mining impact evaluation (refer to Tables 3 and 4). The proposed mining activities will endanger those which do not have sufficient toedown depths and may increase the risk of failure for those which were properly designed and constructed.

6. Since this report intends to document general impacts rather than assessment of erosion hazard of each specific structure, Tables 3 and 4 should be revised or replaced to avoid implication of the structural safety. These tables are not sufficient for one to conclude which structures are safe under proposed mining conditions since they are derived from a rough sediment routing model. The general model with insufficient space and time resolution can not reflect maximum erosion depths at each structure location during the critical headcut period. The erosion depths could be changed significantly due to horizontal and vertical variation of future sand and gravel extraction as well as the phases of mining. Furthermore, the tolerance elevation for each structure requires confirmation by additional structural analysis and/or owner consent. Even though the tolerance level could be under the degraded channel bed, it may not leave sufficient toedown for erosion protection against other future floods.

7. Sediment sizes and hydraulic characteristics are the fundamental information for sediment transport analysis. Considering large variations in channel geometry, channel gradient, and soil gradation existing along the Salt River study reach for both pre- and post-mining conditions, the model input data should be refined to properly represent the system and to produce reliable results for sand and gravel mining impact evaluation.

8. Although the existing Salt River has an overall degradation trend, natural armoring may occur to reduce the rate of degradation. The report shows that the degradation magnitude will significantly increase by proposed mining activities. The report should also address the potential disturbance of armor layer formation due to sand and gravel extraction.

In addition to key issues listed above, the following detailed comments were compiled for your reference:

1. Section 1.0 Introduction, last paragraph: Model resolution should be improved even though the model objectives are to analyze general channel response and sand and gravel mining impacts only (see Item 7 above). In addition to models, other analyses on sediment budgets, banks, drainage patterns must be included in the report in order to evaluate sand and gravel mining effects (see Items 3 and 4 above).

2. Figure 1: This figure should be expanded to show proposed mining plot plans and the mining boundaries relative to channel banks and structures. The figure should show existing structures including channelization and erosion control structure. River miles should be shown in this general map for cross reference to other tables and figures.

3. Section 2.0 Historical Conditions, last sentence: This sentence is incorrect; sand and gravel mining impacts have affected the Salt River morphology significantly and future mining will continue to lower the river bed since the river has extremely limited ability to restore itself.

4. Section 3.0 Study Approach: The model approach should be supplemented with other technical analyses in order to identify potential channel responses to proposed sand/gravel mining activities (see discussions above).

5. Section 4.0 Methodology, "Hydraulics" second paragraph: The first sentence is incorrect; aerial photos are important to identify the existing channel characteristics and potential changes due to sand and gravel mining. Hydraulic features of the existing channel and the expected changes due to mining should be documented in order to asses potential sediment transport changes and river responses.

6. Section 4.0 Meethodology, "Hydraulics" third paragraph: explain what changes were made to the bridge data.

7. Section 4.0 Methodology, "Sediment Transport" first paragraph: Soils report should be submitted for review with sampling locations identified.

8. Table 1: Average mining depths do not match the model input data. Provide dredging elevations and boundaries (overlay on the topographic maps) so one can check the model input data.

9. Section 4.0 Methodology, "Sediment Transport" second paragraph: The sensitivity analysis using one single coarser soils sample for the entire study reach did not offer conservative evaluation; you should run the model using a coarser sample in the highly erosive area (e.g. upstream pit boundary) and a finer sample in the slow deposition areas (e.g. within the pit).

10. Section 4.0 Methodology, "Sediment Transport" fourth and fifth paragraphs and Figure 4: The sediment trapping efficiency depends on particle size; it is expected that most of medium sand and larger particles will be trapped in the Granite Reef Dams further upstream of this dam. The last three sentences imply that the reach immediately downstream of Granite Reef Dam has attained an "equilibrium" sediment inflow-outflow condition. Please justify this assumption and provide documentation. It is important to re-evaluate the sediment inflow calculations based on the above discussions and revise the sediment transport analysis using the revised sediment inflow data. Sensitivity analysis should be performed considering possible sediment supply reduction.

11. Section 4.0 "Hydrology" first paragraph: The sand and gravel mining effects should be investigated using a hydrograph with the 100 year design hydrograph leading historical flows. This will result in more conservative estimates of the maximum degradation depth at each structural location than the one presented in the report.

12. Table 4 and Figures 24 - 31: Show initial channel bed elevations for mining condition; do not use the pre-mining elevations. Show degradation depths relative to pre-mining elevations rather than relative to initial dredging elevations. The mining effects can not be identified without revision for reference elevation. The worst condition degradation for sections within pits should appear after dredging at the beginning of the flood (the degradation depth should be the dredging depth).

13. Tables 3 and 4: The structural safety evaluation is not sufficient as discussed in Items 5 and 6 of the key issues; we recommend to present tolerance elevations and structural safety conclusions when proper data are available and more detailed modeling and analysis are performed.

14. Appendices:

    a. Topographic maps with section locations, mining limits, and structural locations should be included for review. Channel geometry with dredging limits and conveyance limits should be shown on section and plan views and movable bed boundaries should be identified and explained.

    b. NC Cards should be checked; the Manning's n values are not properly defined for main channel and overbank areas.

    c. HD Cards do not show dredging elevations consistent with table 1 in the report.

    d. Explain sediment load tables.

e. Display the sediment transport computation parameters including the hydraulic and soils information.

f. Expansion and contraction coefficient for mining conditions must be justified.

g. 20 maximum computation steps were reached in many cross sections and during many time steps; this may indicate "errors" in computations; please check.

This concludes our review of the draft reports. Please contact me at (714) 513-1280 if you need further explanation of these comments.

Sincerely,
SIMONS, LI & ASSOCIATES, INC.

Lan-Yin Li Weber, Ph.D, P.E.
Vice President and Senior Program Manager

Draft Sediment Trend Analysis

Salt River

between Granite Reef Dam and the confluence with the Gila River

Prepared for:
404(b)(1) Applicants on the Salt River

091137.00
December, 1996
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Kimley-Horn
and Associates, Inc.
Engineering, Planning, and Environmental Consultants

Draft Sediment Trend Analysis

Salt River

between Granite Reef Dam and the confluence with the Gila River

Prepared for:
404(b)(1) Applicants on the Salt River

091137.00
December, 1996
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1.0 Introduction

Summary

Kimley-Horn and Associates, Inc. has been retained by several sand and gravel operators in the Salt River to pursue permits as described in Section 404 of the Clean Water Act. As part of the permit application and public notice process, comments were made by several reviewing agencies regarding the cumulative impacts of sand and gravel mining in the Salt River on the channel bed profile and related potential impacts to infrastructure crossing the river. This study is prepared in response to these comments and is limited to an evaluation of channel bed profile changes as projected through the use of standard sediment transport modeling and the application of these results to interpret potential impacts to infrastructure crossings.

Background

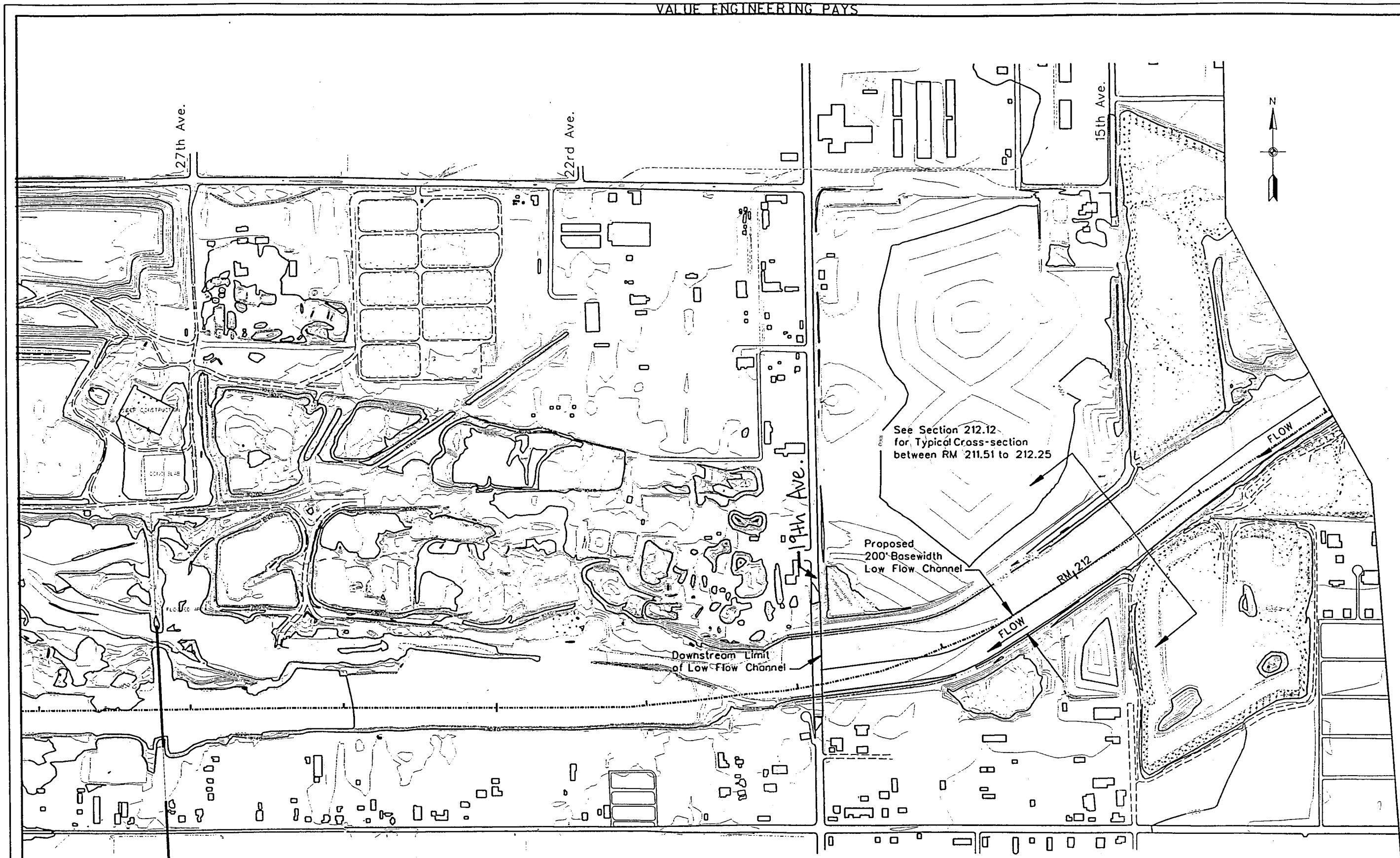
The sand and gravel industry has a long history of mining from the rivers of Arizona. The Salt River through central Phoenix has been a location where high quality sand and gravel resources are located in the river bed, and has been a very desirable location due to the ephemeral nature of the river and the proximity to local markets. .

New judicial interpretation of Section 404 of the Clean Water Act has led to the inclusion of sand and gravel mining as a jurisdictional activity. As a result, 404 permit applications and supporting documentation was previously submitted for a number of sand and gravel operations in the Salt River. Several agencies that commented on the applications suggested that a sediment transport analysis be undertaken that considers the cumulative impacts of mining activities on channel bed profile. This sediment trend analysis is in response to these requests and is a compilation of reasonable projections of channel bed change. The analysis includes nearly 38 miles of the Salt River system from Granite Reef Dam to the confluence with the Gila River (See Figure 1). This is the first comprehensive sediment transport model developed for this extended reach of the Salt River system.

Kimley-Horn and Associates, Inc. prepared this sediment trend analysis. West Consultants, Inc. assisted with the development of the HEC-6 model. Western Technologies, Inc. was retained to obtain sediment samples and gradations.

This report summarizes the analysis of the sediment transport trends of the Salt River as measured through the cumulative impacts of additional mining activity. These results provide a projection of channel bed profile change, but do not take into consideration

local scour, which is highly independent of sediment balance and transport functions. The modeling has been performed at a resolution that would not allow for the indiscriminate application of these results for subsequent localized design decisions. Due to this reason, and other simplifying assumptions which are described below, these results should not be applied for uses outside the scope of this analysis.



Note: SR (Salt River) numbering system shown for City of Phoenix.
SD - Side Drain

SYMBOL	DESCRIPTIONS	DATE	APPROVAL
	REVISIONS		

RIO SALADO, ARIZONA
FEASIBILITY REPORT

RIVER MILE 211.00 TO 212.51

PROPOSED PROJECT AREA

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

DESIGNED BY:
DRAWN BY:
CHECKED BY:

SUBMITTED BY:
XXX
CHIEF, XXX BRANCH

CADD FILE NAME:

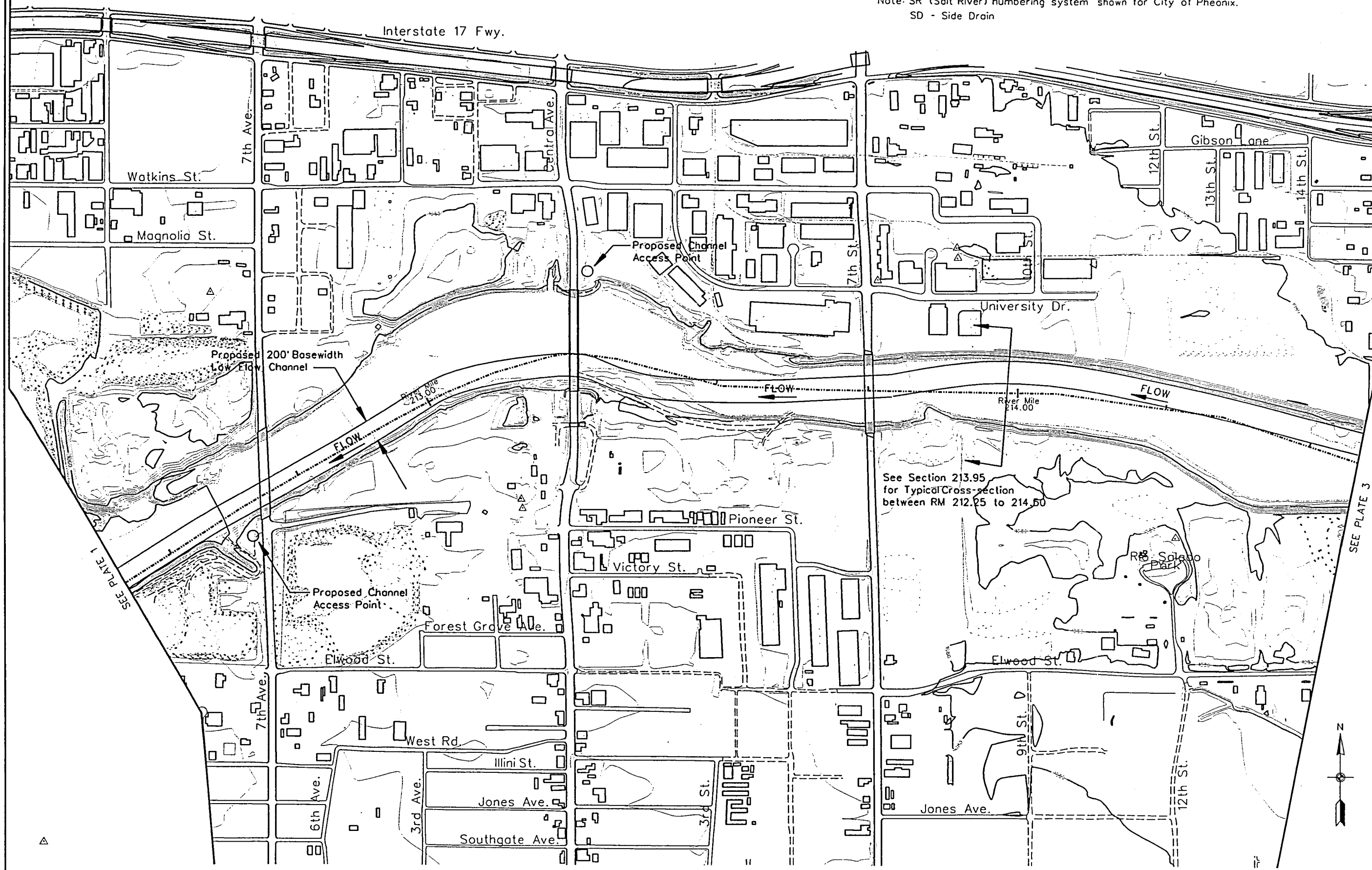
DISTRICT FILE NO. 2607

SPEC. NO. DACW09-98-B-0007

FIGURE 1

Contour Interval = 20 feet

Note: SR (Salt River) numbering system shown for City of Pheonix.
SD - Side Drain



SYMBOL	DESCRIPTIONS	DATE	APPROVAL

REVISIONS

RIO SALADO, ARIZONA
FEASIBILITY REPORT

RIVER MILE212.46 TO 214.52

PROPOSED PROJECT AREA

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

DESIGNED BY:
DRAWN BY:
CHECKED BY:

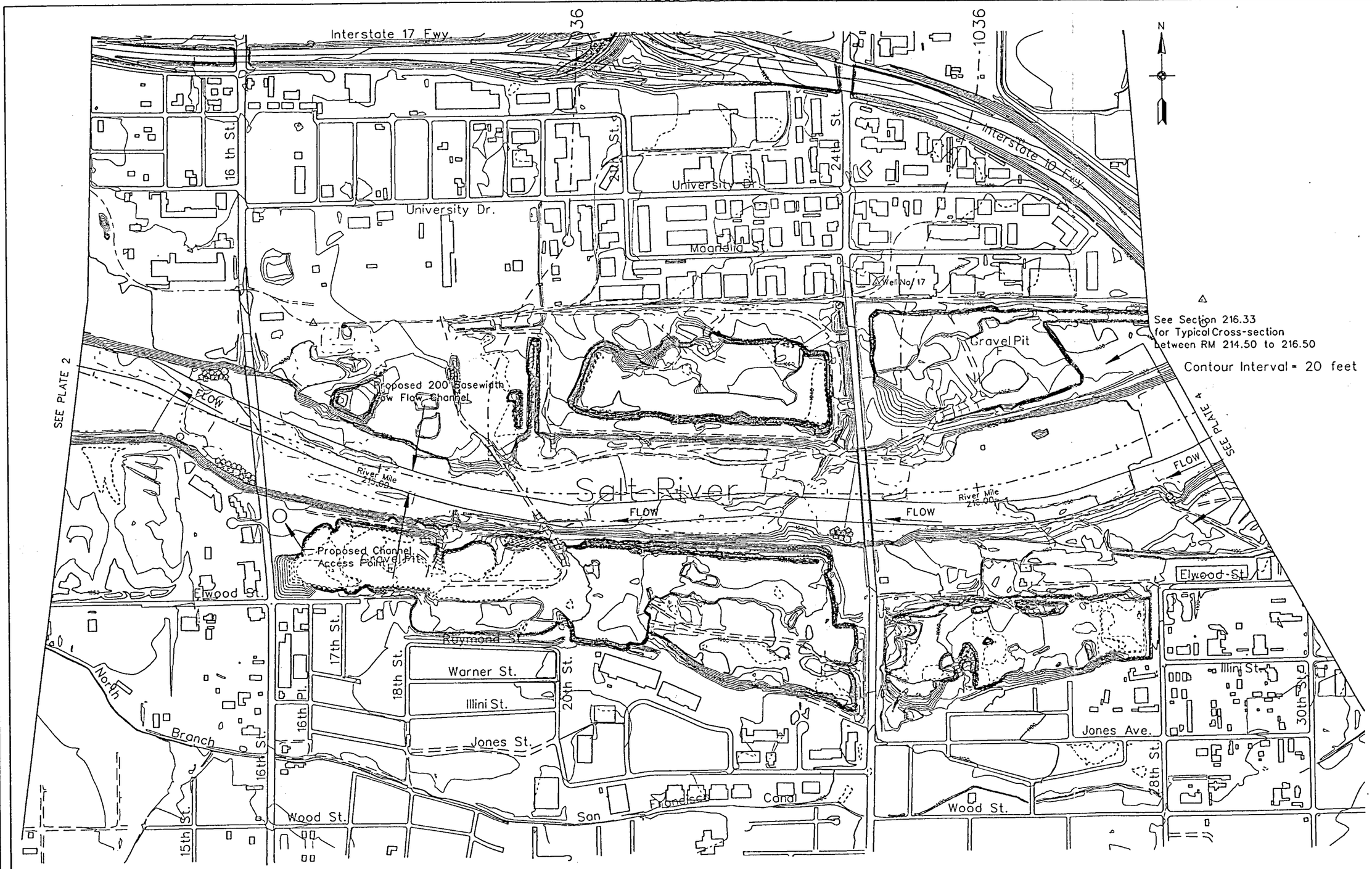
SUBMITTED BY: XXX
CHIEF, XXX BRANCH

DISTRICT FILE NO. 2607

SPEC. NO. DACW09-96-B-0007

CADD FILE NAME:

FIGURE 2



Note: SR (Salt River) numbering system shown for City of Phoenix.
SD - Side Drain

SYMBOL	DESCRIPTIONS	DATE	APPROVAL
	REVISIONS		

RIO SALADO, ARIZONA
FEASIBILITY REPORT

RIVER MILE 214.52 TO 216.33

PROPOSED PROJECT AREA

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

DESIGNED BY:
DRAWN BY:
CHECKED BY:

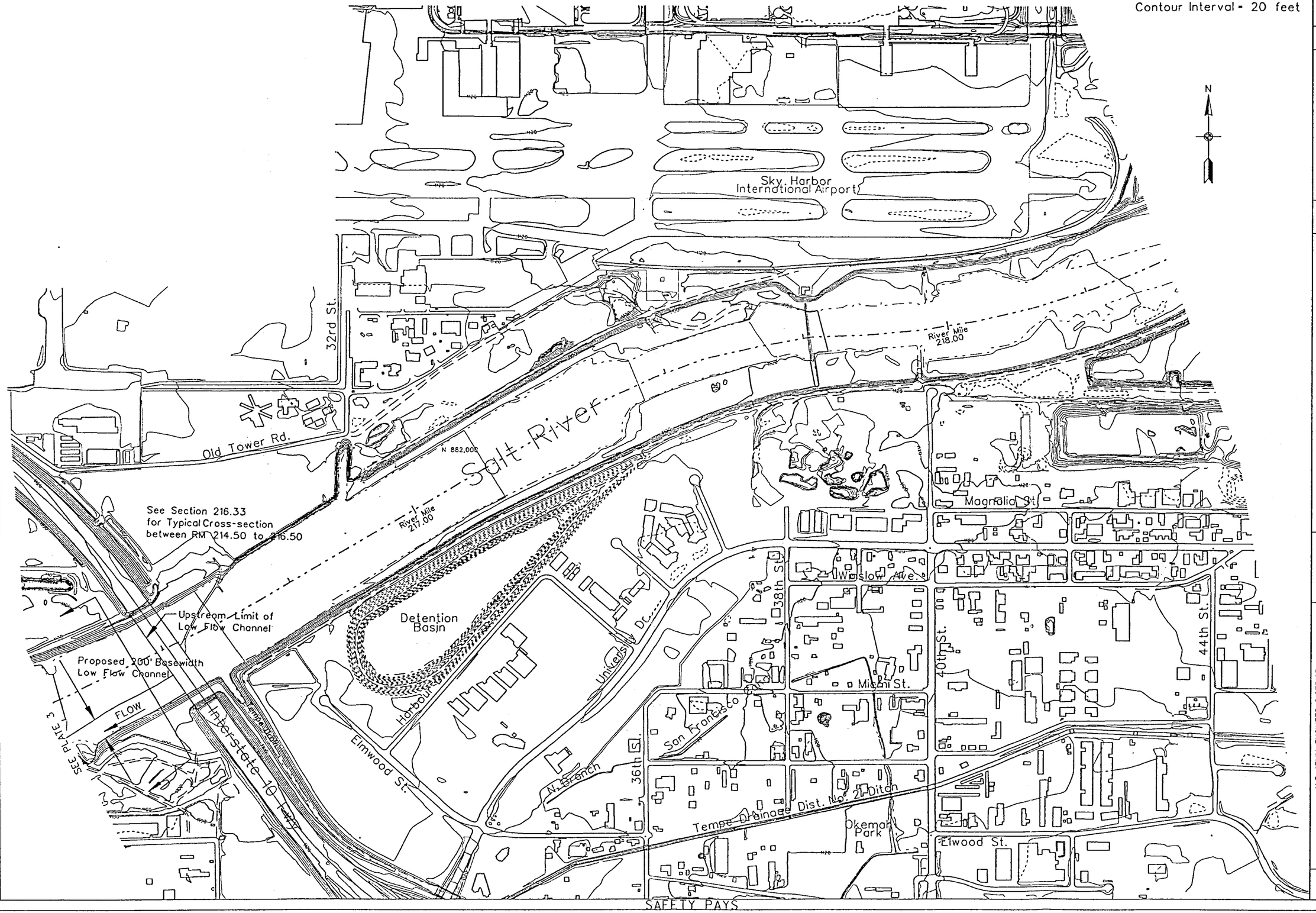
SUBMITTED BY:
XXX
CHIEF, xxx BRANCH

DISTRICT FILE NO. 2601

SPEC. NO. DACW09-95-B-0007

CADD FILE NAME:

FIGURE 3



STYLE	DESCRIPTIONS	DATE	APPROVAL
	REVISIONS		

RIO SALADO, ARIZONA
FEASIBILITY REPORT

RIVER MILE 216.33 TO 218.33

PROPOSED PROJECT AREA

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

DESIGNED BY:
DRAWN BY:
CHECKED BY:

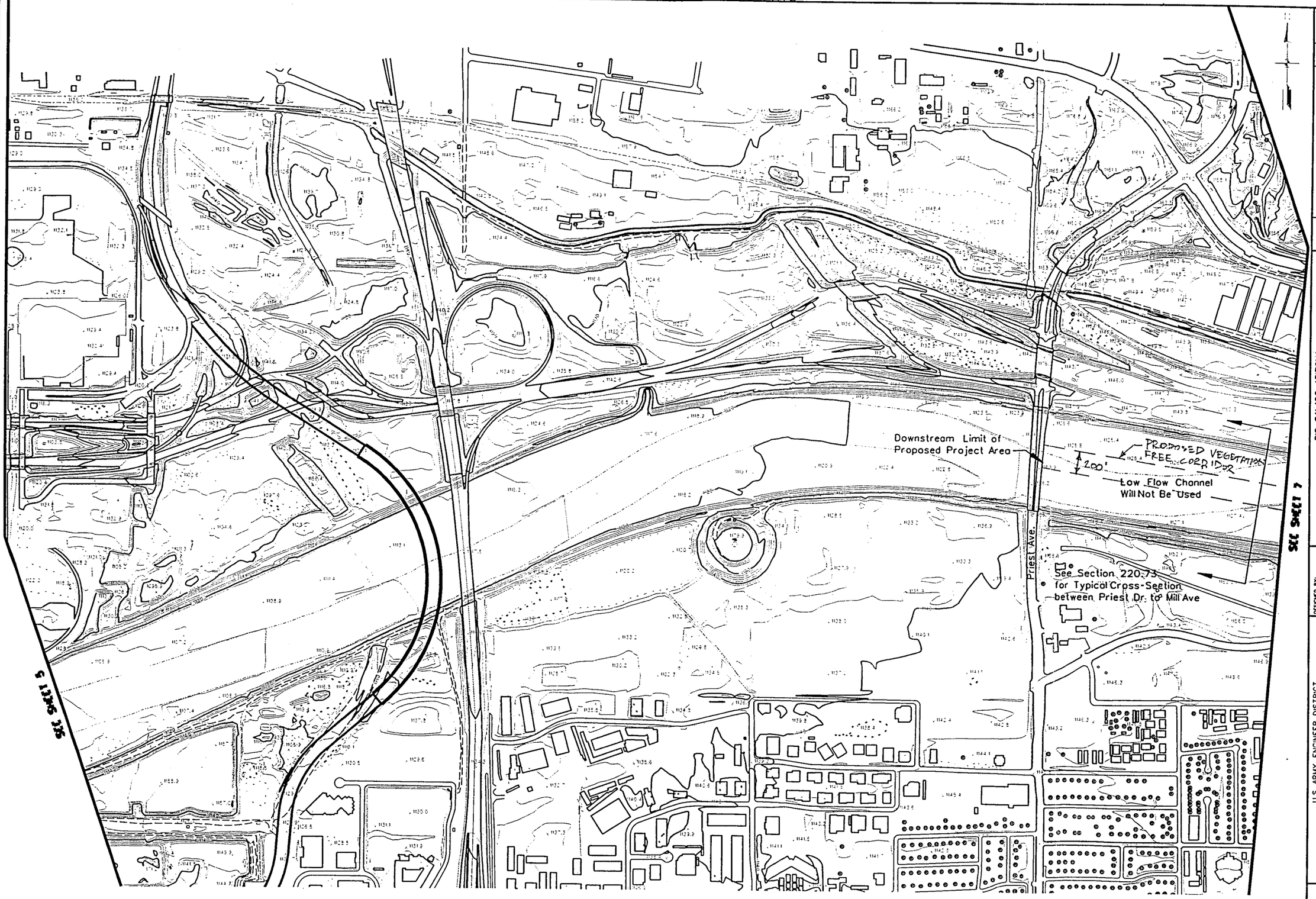
SUBMITTED BY:
XXX
CHIEF, XXX BRANCH

DISTRICT FILE NO. 2601

SPEC. NO. DACW09-98-B-0007

CADD FILE NAME:

FIGURE 4



SYMBOL	DESCRIPTIONS	DATE	APPROVAL
	REVISIONS		

RIO SALADO, ARIZONA
FEASIBILITY REPORT

RIVER MILE 218.33 TO 220.45

PROPOSED PROJECT AREA

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

DESIGNED BY:
DRAWN BY:
CHECKED BY:

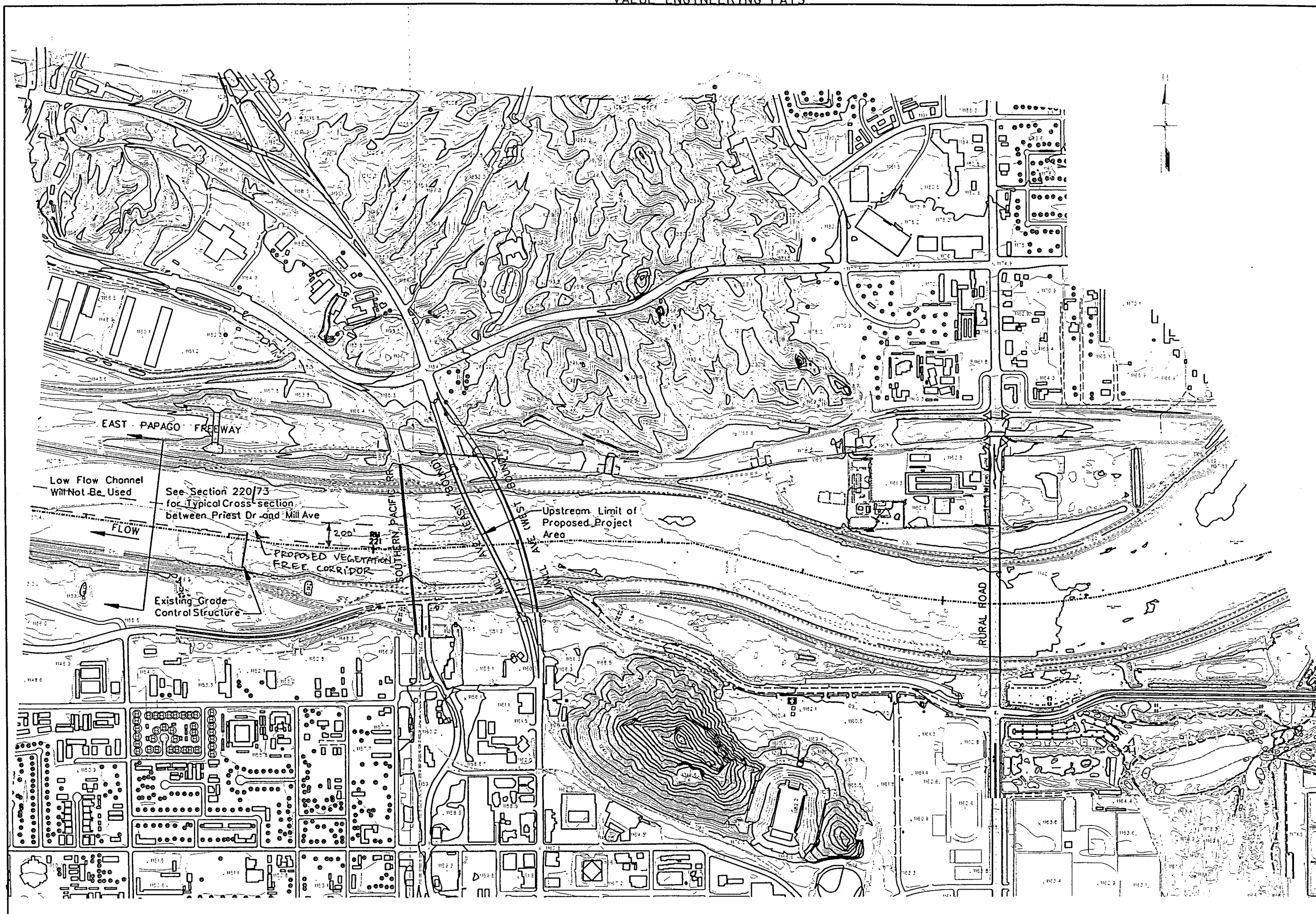
SUBMITTED BY:
XXX
CHIEF, XXX BRANCH

DISTRICT FILE NO. 2607

SPEC. NO. DACW09-98-B-0007

CADD FILE NAME:

FIGURE 5



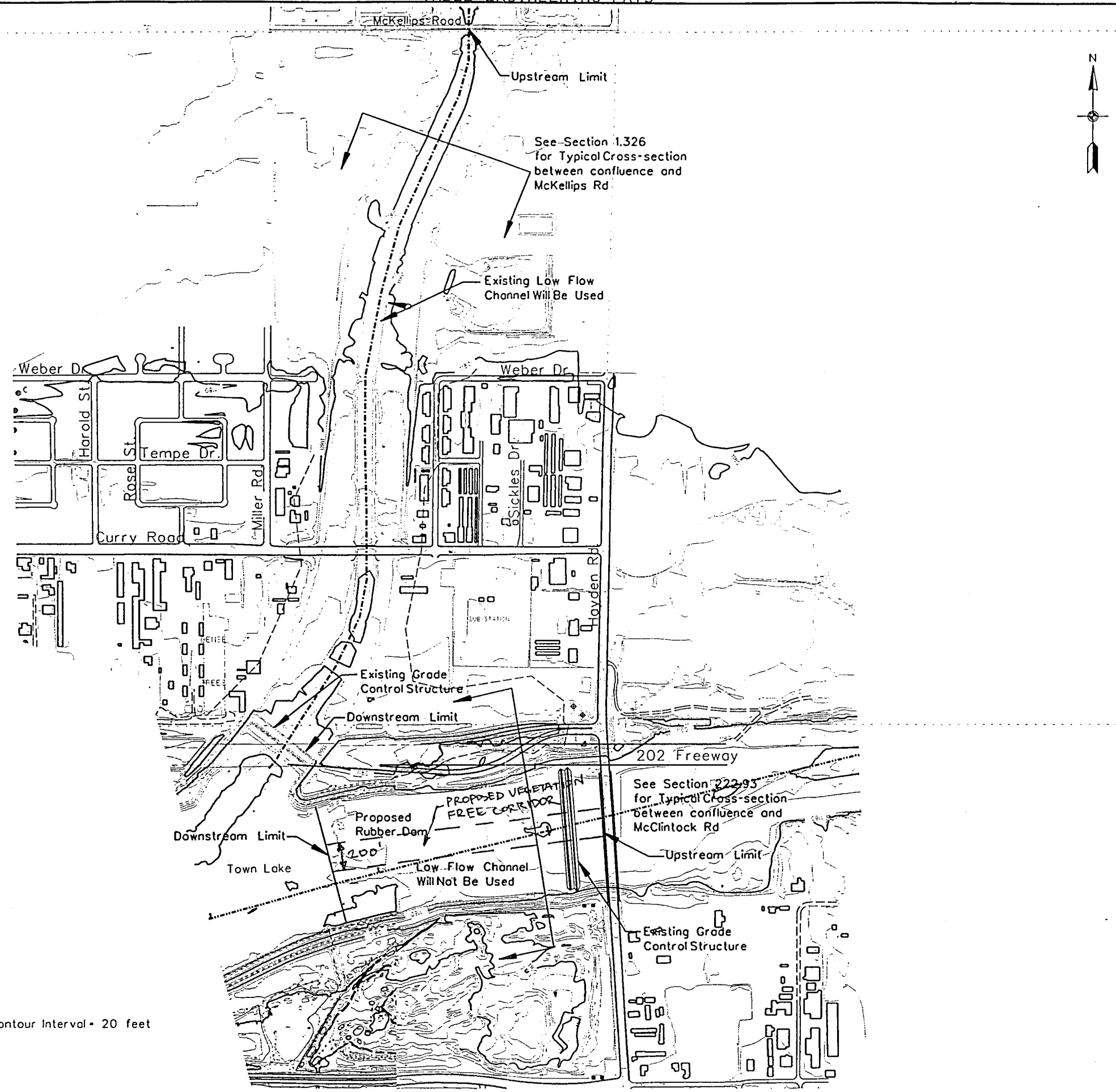
SYMBOL	DESCRIPTIONS	DATE	APPROVAL
	REVISIONS		

RIO SALADO, ARIZONA
FEASIBILITY STUDY
RIVER MILE 220.45 TO 222.55
PROPOSED PROJECT AREA

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

DESIGNED BY:
DRAWN BY:
CHECKED BY:
SUBMITTED BY:
XXX
CHIEF, XXX BRANCH
DISTRICT FILE NO. 2607
SPEC. NO. DACW09-98-B-0007
CADD FILE NAME:

FIGURE 6



Contour Interval = 20 feet

SYMBOL	DESCRIPTIONS	DATE	APPROVAL
	REVISIONS		

RIO SALADO, ARIZONA
FEASIBILITY REPORT

RIVER MILE 222.55 TO 223.19

PROPOSED PROJECT AREA

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

DESIGNED BY:
DRAWN BY:
CHECKED BY:

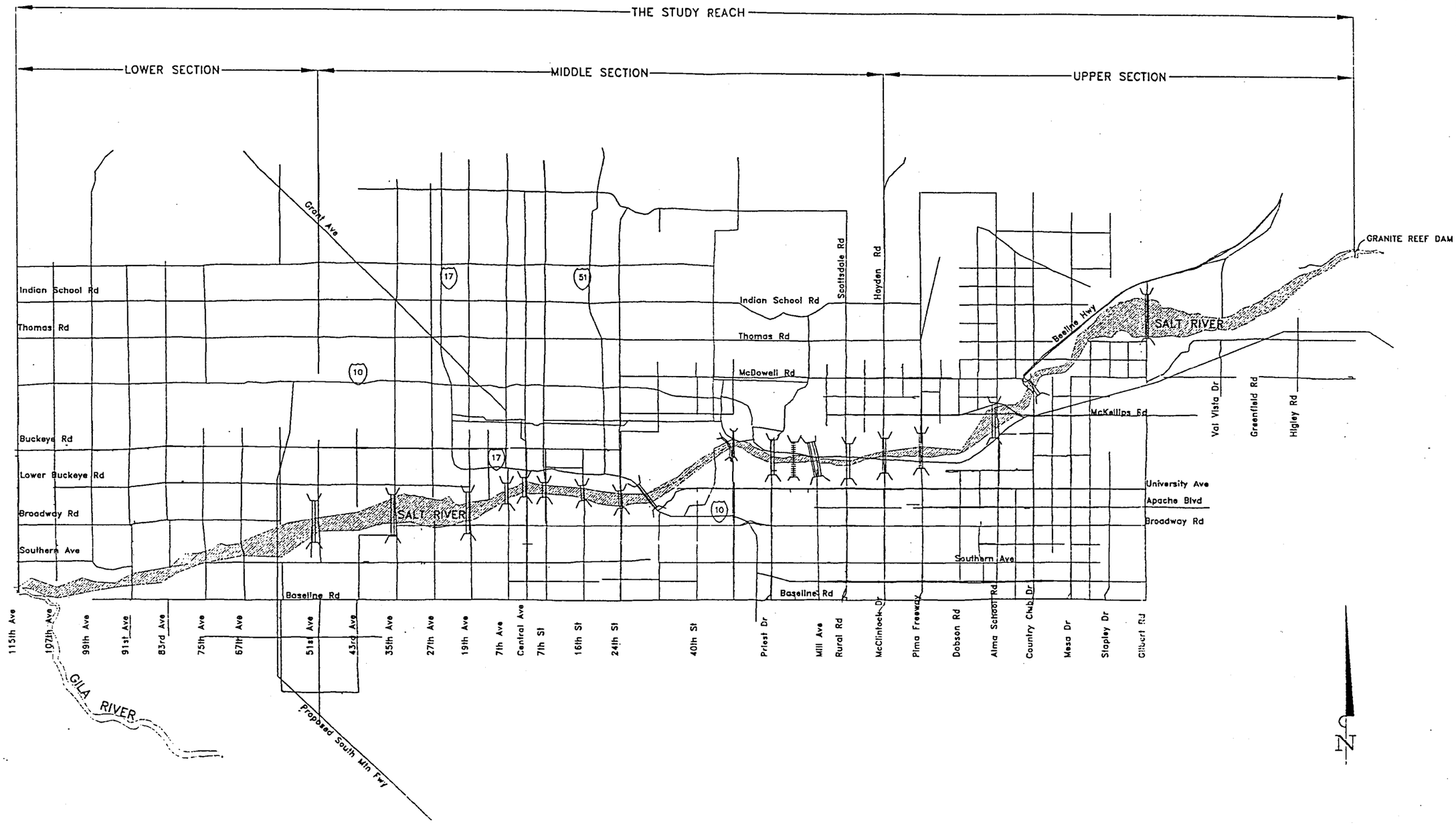
SUBMITTED BY:
XXX
CHIEF, XXX BRANCH

CADD FILE NAME:

DISTRICT FILE NO. 2607

SPEC. NO. DACW09-96-B-0007

FIGURE 7



Kimley-Horn and Associates, Inc.

STE. 250 7600 N. 16TH STREET
PHOENIX, ARIZONA 85020
Phone (602) 944-5500

FIGURE 1
THE STUDY AREA

PROJECT NO.:	091137.01
DESIGNED/DRAWN:	JJL
CHECKED:	DJR
SCALE:	NTS
DATE:	12-26-96

C:\TEMP\D\JOE\ASITE1 Thu Dec 26 09:04:08 1996

2.0 Historic Conditions

The Salt River system through Phoenix has been significantly impacted by human imposed changes to the river and watershed. These impacts include:

Upstream Control Structures - Construction of upstream dams and reservoirs has made the Salt River system ephemeral. It has also led to the capture of sediments at the control structures for a significant portion of the watershed. This has reduced the supply of sediments to recharge the river system and promoted degradation downstream of Granite Reef Dam. The control structures also influence the system hydrology such that the types of flows the river system receives downstream of Granite Reef Dam are generally flood release flows.

Channelization and Bank Protection - Significant segments of the Salt River system through central Phoenix have been channelized for the purposes of flood control. Portions of both the north and south banks have been protected to inhibit lateral erosion. The resulting increases in velocity and flow depth have increased the sediment transport capacity of these river reaches. Furthermore, the reduction in the overbank flow has limited the sediment supply to the main channel and promoted degradation of the channel.

Bridges and Crossings - The construction of bridged roadway crossings has concentrated flood flows through the bridge openings. The roadway crossings have created contracted flow hydraulics at the bridges, with local scour affects at the piers and abutments. Furthermore, the approach embankments have blocked overbank flow at the bridge crossings, further constricting flow and increasing velocities at the bridges. Some of the early bridges included approaches built on piers to allow large flood events to effectively flow in the overbanks of the Salt River. This type of overbank flow to relieve the bridge is no longer provided at the bridge crossings.

Urbanization of the Watershed - Urbanization of the watershed along the banks of the Salt River has diminished sediment supply into the study reach from adjacent lands. The urbanization has also contributed to the pressure for channelization and bank protection, which has the effects described above.

Sand and Gravel Mining - Sand and gravel mining within the active bed has led to the creation of low flow channels and has influenced the location of the main channel flow. The pits and excavations by mining operations can capture

sediment during flood flows. The cut slopes and bed changes can also be somewhat unstable as they are reshaped by river flows.

System Hydrology - The Salt River system is now an ephemeral stream due to upstream dam construction. The only perennial flow in the reach is artificial and is a result of irrigation tailwater return and effluent discharge. Other flows are generally a result of rainfall events, or limited releases from the Salt River Project system.

Collectively these changes have significantly altered the river environment, hydrology, hydraulics, morphology, and sediment balance from its natural state. These alterations have been documented by others who have reported on the historical trend of degradation in the Salt River system. Based on the previously mentioned changes to the Salt River system, the reported degradation is not surprising and is the result of many impacts to the system.

Attempts at the development of a comprehensive, river management system have been sporadic, and continue to be heavily influenced by created needs. The most notable recent example of this is the Rio Salado initiatives by the City of Tempe which have attempted to create an urban river park setting in the Salt River system. The Salt River system has been managed historically by passive management tools that have been premised to a certain degree on limited self protection and to a certain degree on allowing reasonable impacts to all shared users of the system. For example, current floodplain management regulations for the river are premised on encroachment zones that provide for limited impact to flood stage and velocity. This provides for flood protection while allowing continued managed growth.

Human imposed changes have evolved sporadically, and have also introduced potential spatial and operational conflicts between adjacent uses. The evolution of use in the Salt River system has been in response to multiple individual interests, all of which impact adjacent users. Elimination of sand and gravel mining activities will not change this situation or result in a balanced or restored Salt River system.

3.0 Study Approach

The purpose of the study is to evaluate the impacts that additional sand and gravel mining activities could have on channel bed profile changes in the Salt River system. This is accomplished by developing two sediment transport models using the US Army Corps of Engineers Engineering Model HEC-6. The first model is a "without additional mining" model and the second model is a "with additional mining" model.

Without Additional Mining - Includes modeling of "current" conditions on the Salt River system. It is based on the same topographic mapping being used by the Flood Control District of Maricopa County for a flood plain mapping study for the Salt River system. The without additional mining model includes modeling of existing bridges, grade control structures, bank stabilization, and channelization projects.

With Additional Mining - Differs from the without additional mining model only by incorporating the anticipated additional mining activities. The initial model development is based on the sand and gravel withdrawals as enumerated in the public notices for all applications submitted on the Salt River system. Through conversations with the applicants it was determined that several applications have been withdrawn, leaving only fifteen active permit applications. Reduced mining withdrawals were then considered as part of the alternatives analysis for the 404(b)(1) guidelines documentation. The results of the alternatives analysis were used to develop the model based on an average depth of mining of twenty feet for all applicants. This represents a reduction in the withdrawal volume of approximately seventy-five percent from the amount in the public notices and a reduction in the mining area of approximately forty percent. It is important to note that this average depth was agreed to by involved Kimley-Horn clients. There are three applicants in the Salt River system not represented by Kimley-Horn. For the purposes of this study, these three applicants have been held to the same average depth constraint as the other applicants in the Salt River system. It is possible that they might choose to request a mining depth and volume greater than the twenty foot average. The results of this analysis can be revised to reflect those changes and any subsequent changes in mining volumes requested by other applicants in the Salt River system.

The overall goal of developing the two models is to determine the impacts of sand and gravel mining on the Salt River system. These impacts include potential degradation of the channel bed and potential exposure of bridge foundations, underground utilities, and other infrastructure crossing the Salt River.

4.0 Methodology

General

The sediment trend analysis was conducted through use of the US Army Corps of Engineers' general engineering computer program, HEC-6, Scour and Deposition in Rivers and Reservoirs. HEC-6 is a one dimensional sediment transport program that can be used to project variations in channel bed elevations. The model uses a set of standard transport equations that quantify the predicted sediment transport capacity of a channel for varying hydraulic conditions. HEC-6 compares the estimated suspended sediment load with the estimated sediment transport capacity and either suspends or deposits material on the channel bed, such that the estimated sediment capacity equals the estimate of the suspended sediment load. For this analysis, the sediment transport equation by Yang is used with the full ten size classes of sand and gravel.

The HEC-6 model is driven by geometric and hydraulic data, similar to that which is used in a standard backwater model such as HEC-2. It is further augmented with data that describes channel soil gradations, inflowing suspended sediment load, active bed limits, channel bed hard points, channel excavation, and a continuous record of flow for the period of simulation.

Hydraulics

HEC-6 makes certain simplifying assumptions in its hydraulic calculations and cannot model certain complex hydraulic situations. Due to these simplifying assumptions, it is necessary to first establish a representative backwater model for use in developing a proper HEC-6 model. The representative backwater model for this analysis was developed using a combination of HEC-2 and HEC-RAS backwater computation software.

Since the purpose of this analysis is to evaluate trends in channel bed profile change, it was not determined to be necessary to commission new aerial photography. Recent topographic mapping of the Salt River system would suffice in establishing a baseline geometry. The Flood Control District of Maricopa County (the District), is currently developing revised floodplain mapping of the Salt River system. The District provided the base topographic mapping (1"= 400' scale) which was flown in 1991 and 1992, and the coded cross sections from the HEC-2 model currently under development. The data provided by the District is from a project in progress, however, and should not be interpreted as being representative data from which to predict regulatory flood elevations. The District's topography provides a reasonable continuous baseline geometry for use in this analysis.

The District data was provided as an HEC-2 input file, and was converted to an HEC-RAS input file to facilitate the checking and modification of the base data as necessary to develop channel hydraulic profiles. In general, the base data was found to be reasonable, with the most significant modifications occurring at bridge sections to take advantage of the more powerful bridge analysis routines of HEC-RAS. The HEC-RAS model was then run for multiple flood profiles to develop rating curves for the study reach. The rating curve at the downstream boundary of the model (River Mile 199.91 approximately 115th Avenue) was developed in HEC-RAS as shown in Figure 2.

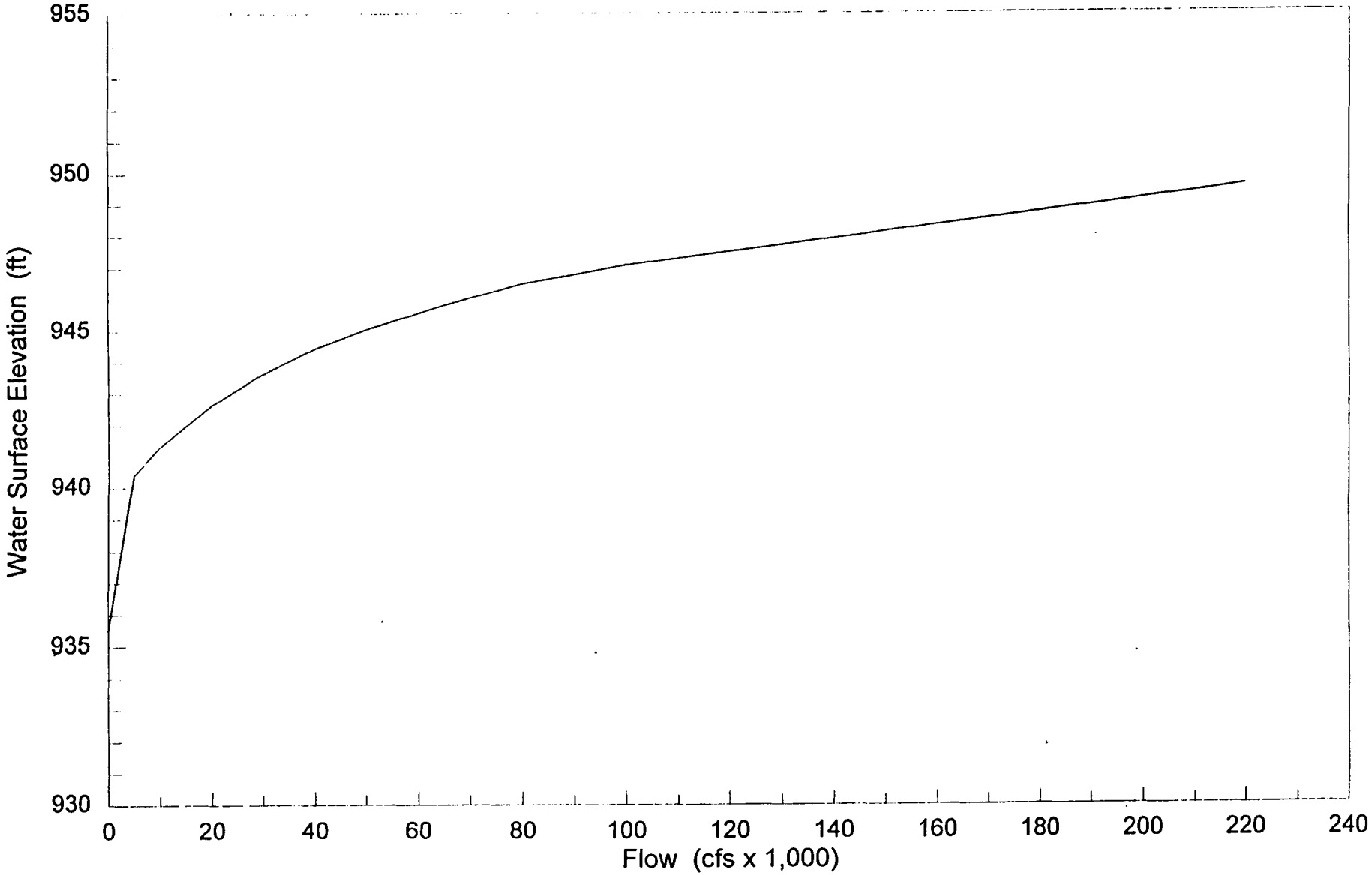
Following the development of a representative hydraulic model in HEC-RAS, the original HEC-2 model code was modified to incorporate changes determined to be necessary in the HEC-RAS analysis and to simulate the backwater influences of bridges in a compatible format to HEC-6. The revised HEC-2 model code was then imported into the HEC-6 model and further modified. The number of cross sections in the HEC-6 model were reduced to provide at least one representative section every one half mile. This reduction in the total number of sections allowed for a reasonable representation of the channel without exceeding the total number of cross sections allowed by HEC-6. Finally, the HEC-6 model was run and calibrated to the rating curves from the HEC-RAS model. Head loss for bridges and other complex hydraulics that cannot be directly solved in HEC-6 were simulated by artificially increasing the losses in HEC-6. The HEC-6 model was revised until the hydraulics were determined to be basically within ten percent (10%) of those in the HEC-RAS model at every cross section in the HEC-6 model.

Sediment Transport

The HEC-6 input variables for sediment are based on near surface sediment samples taken from the Salt River system for this analysis in October 1996. Samples were collected and gradations performed by Western Technologies Inc. and the results are reported in two letter reports, dated October 24, 1996 and October 28, 1996. The samples were taken at approximately one-half mile intervals throughout the study area, with one representative sample taken at each sampling location. The test results are shown in Figure 3. High and low "outliers" were then evaluated for inclusion or dismissal based on how representative they were with comparison to adjacent sampling locations. As a whole, the samples are representative of the low to moderately coarse material in the bed. Large diameter material, which is not evident in the sampling results, is likely to be a small percentage of the active bed and not large enough to resist the overall degradation during high flows.

Salt River Sediment Trend Analysis

Figure 2 - Rating Curve at River Mile 199.91



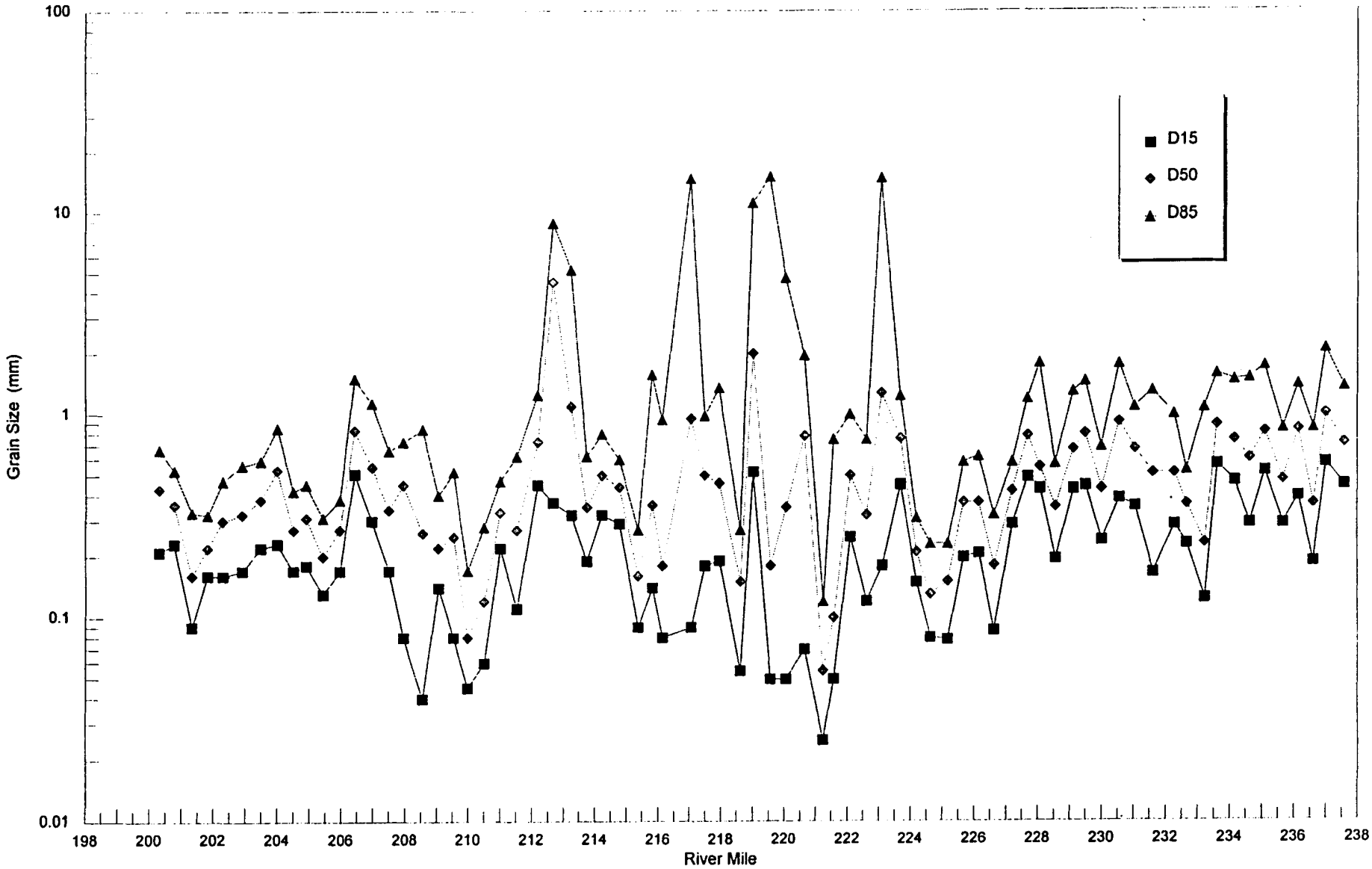
Salt River Sediment Trend Analysis
Table 1 - Sand and Gravel Mining Summary

17-Dec-96
mining.wk4

Applicant Name	River Mile	Permit Application Number	Total Mining Area (ac)	Total Mining Volume (cy)	Average Mining Depth (ft)
Cashway Concrete and Mesa Materials/	201.81	944-1129-00-RWF			
91st Ave.	201.99	944-1208-00-RWF			
	202.29		49	1,581,645	20.0
BCW Inc./ 75th Ave. and Sunland/ 67th	203.96	944-1049-00-RWF			
Ave.	204.34	944-1207-00-RWF			
	204.78				
	204.97				
	205.15		137	4,421,452	20.0
Pioneer Sand/ 59th Ave. and Cashway	206.03	944-1136-00-RWF			
Concrete/ 51st Ave.	206.51	944-0380-00-RWF			
	206.79				
	206.88				
	207.07				
	207.27		168	5,423,609	20.0
Phoenix Ready Mix/ 37th Ave.	208.48	944-1054-00-RWF			
	208.95				
	209.33		66	2,127,660	20.0
United Metro/ 19th Ave.	210.07	944-1166-00-RWF			
	210.36				
	210.64				
	210.93				
	211.21		80	2,581,673	20.0
Salt River Sand & Rock/ Dobson Rd.	224.43	944-1120-00-RWF			
	224.81				
	225.28				
	225.66				
	226.04				
	226.23		55	1,771,739	20.0
Chandler Ready Mix/ Country Club Rd.	227.08	964-0011-00-RWF			
	227.46				
	227.63		15	483,051	20.0
Salt River Sand & Rock/ Country Club Rd.	227.88	944-1119-00-RWF			
and United Metro/ Beeline Hwy	228.17	944-1167-00-RWF			
	228.64				
	229.12		85	2,741,935	20.0
Salt River Sand & Rock/ Beeline Hwy	230.09	944-1121-00-RWF			
	230.47				
	230.94				
	231.32		170	5,479,452	20.0
Chandler Ready Mix/ Lehi Rd.	232.74	944-1137-00-RWF			
	233.03		15	484,262	20.0
Salt River Sand & Rock/ Higley Rd.	233.95	944-1122-00-RWF			
	234.53				
	235.01				
	235.38				
	235.67		60	1,935,484	20.0
TOTALS			900	29,031,961	20.0

Salt River Sediment Trend Analysis

Figure 3 - Sediment Test Results



Based on visual observations and previous sampling, a sensistivity analysis was conducted to quantify the affects of large diameter material on channel degradation trends. CMG Drainage Engineering provided a soil sample obtained near Center Street in Mesa in 1988. This gradation was used as representative of the entire study reach and run in the HEC-6 model. While the gradation was considerably more coarse, it did not significantly change the HEC-6 results. The change in the average bed was a decrease in the total degradation of approximately 0.5 feet over the entire period of record. The change in gradation also shifted the areas of minimum and maximum degradation at many of the cross sections. Based on this sensitivity analysis, the gradations based on the soil samples were determined to be adequate for this analysis.

To include the mining operations in the HEC-6 model, a dredging template was coded for the HEC-6 cross sections at which mining is proposed in the 404 permit applications. The depth of dredging and volume of dredging were determined by HEC-6 iterations until the volume excavated by the model was within five percent (5%) of the volume of material that is proposed in the permit applications. Since the rate at which the mining will occur is only limited by the length of time for the permit, the entire volume of dredging was modeled in the first time step. This approach allows for an analysis of how the river responds at the conclusion of the permitted period. Table 1 shows a summary of the mining operations which were modeled in the with additional mining model.

The HEC-6 model requires an inflowing sediment load curve, however, our literature research produced no accounts of inflowing sediment load at Granite Reef Dam. As the study was initially envisioned, a peak flow analysis close to a 25-year event was anticipated and it was determined that a clear water inflow assumption at Granite Reef Dam would be reasonable based on the lack of available data and generally low flow levels. However, the Corps of Engineers regulatory section requested a peak flow analysis similar to a 100-year event, which made the clear water assumption unreasonably conservative for large flows. An alternative approach was developed. An analysis was conducted to determine the approximate equilibrium sediment load based on the channel's transport capacity near Granite Reef Dam. A sediment load of zero (0) tons per day of sediment (clear water assumption) was used for the entire period of flow record to conduct the analysis. The average amount of suspended sediment load exiting the reach just downstream of Granite Reef Dam was determined in HEC-6 and compared to the inflowing sediment load. The inflowing sediment load was then increased until the amount exiting the reach was equal to the amount entering the reach. This calculated sediment load near Granite Reef Dam is the calculated equilibrium sediment load for the upstream reach.

Next, the inflowing sediment load curve for the HEC-6 model was developed to account for the sediment trapped by Granite Reef Dam. The inflowing sediment load was modeled at zero (0) tons per day for flows up to 1,000 cfs, which represents a clear water assumption for all low flows. The inflowing sediment load for 10,000 cfs was modeled at one half of the calculated equilibrium sediment load. Finally, the full calculated equilibrium sediment load was modeled for 220,000 cfs. This transition represents the reduced trap efficiency of the dam at higher flow rates when the dam is under greater submergence. The inflowing sediment load curve used in the HEC-6 model and the calculated equilibrium sediment load are both shown in Figure 4.

Hydrology

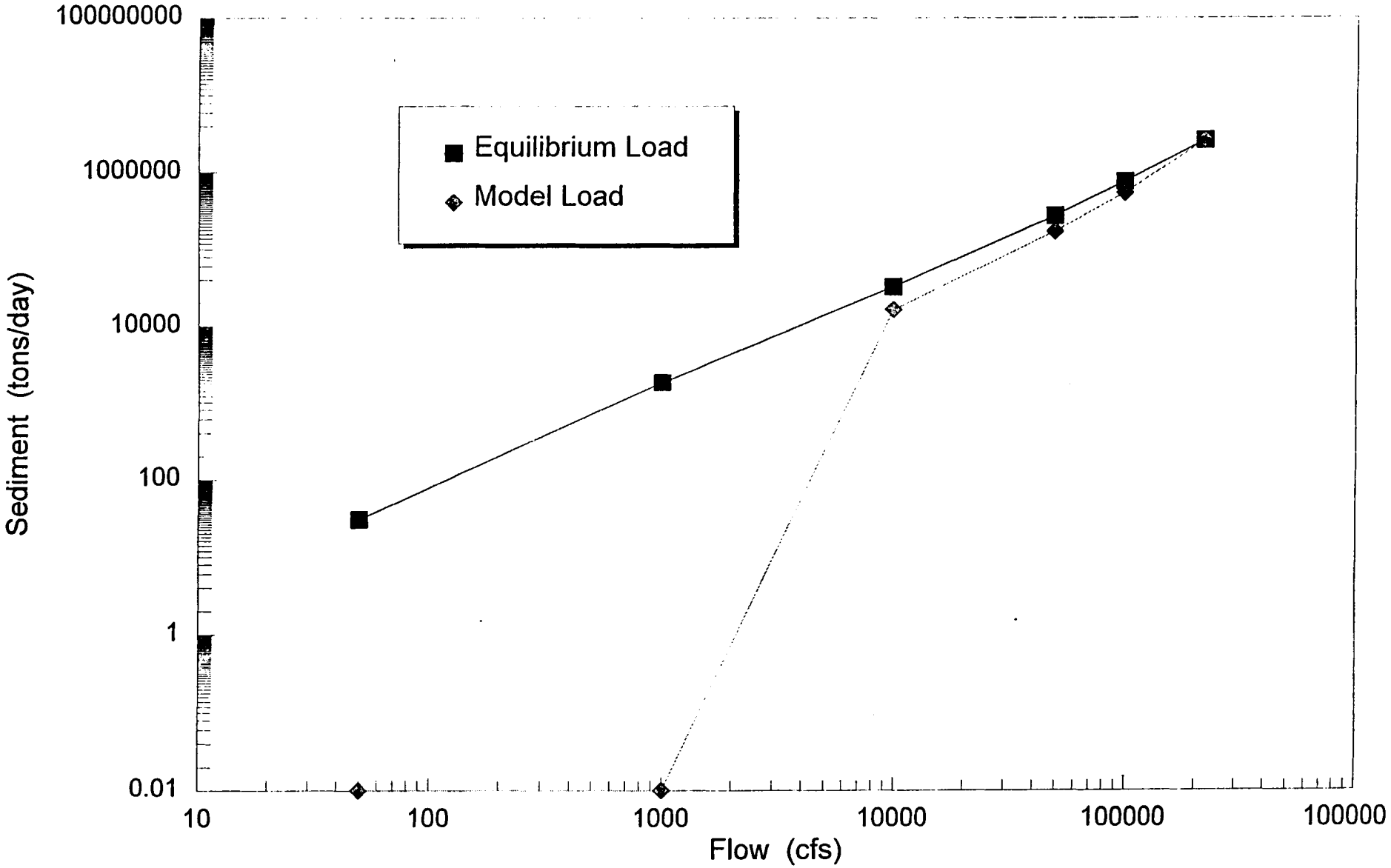
The HEC-6 model is typically not run for a single peak flow, since sediment transport and channel shaping functions are heavily influenced by the more frequent low intensity flows. Based on discussions with the Corps of Engineers, it was agreed that the impacts of mining would be simulated for a ten year period of record and a peak flow event approximating the 100-year peak flow.

Flow data at Granite Reef Dam were obtained for a fifty year period of record and analyzed for average daily flows and total annual flow volume. Within the 50 years of data, a representative ten year period of record (1983 - 1992) was then selected. The representative flows were analyzed using a sediment weighted histogram generator utility program. The program combines the flows over the ten-year period into a smaller number of simultaneous flows. This preserves the flow volume and the sediment transport potential, but requires significantly less computation time. Flows less than 50 cfs were then eliminated because very small flows will seep into the channel bottom and do not cause sediment transport in the channel. Figures 5 through 14 show the histogram data which was used in the HEC-6 model.

A hydrograph of the peak flow event was then added at the end of the ten-year flow period. The peak flow event is a single storm event with a peak discharge of 215,000 cfs and a hydrograph shape based on the documented shape of the 1980 flood hydrograph in the Salt River system below Granite Reef Dam. Figure 15 shows the 1980 flood hydrograph and the synthetic hydrograph used for the peak event in the HEC-6 model.

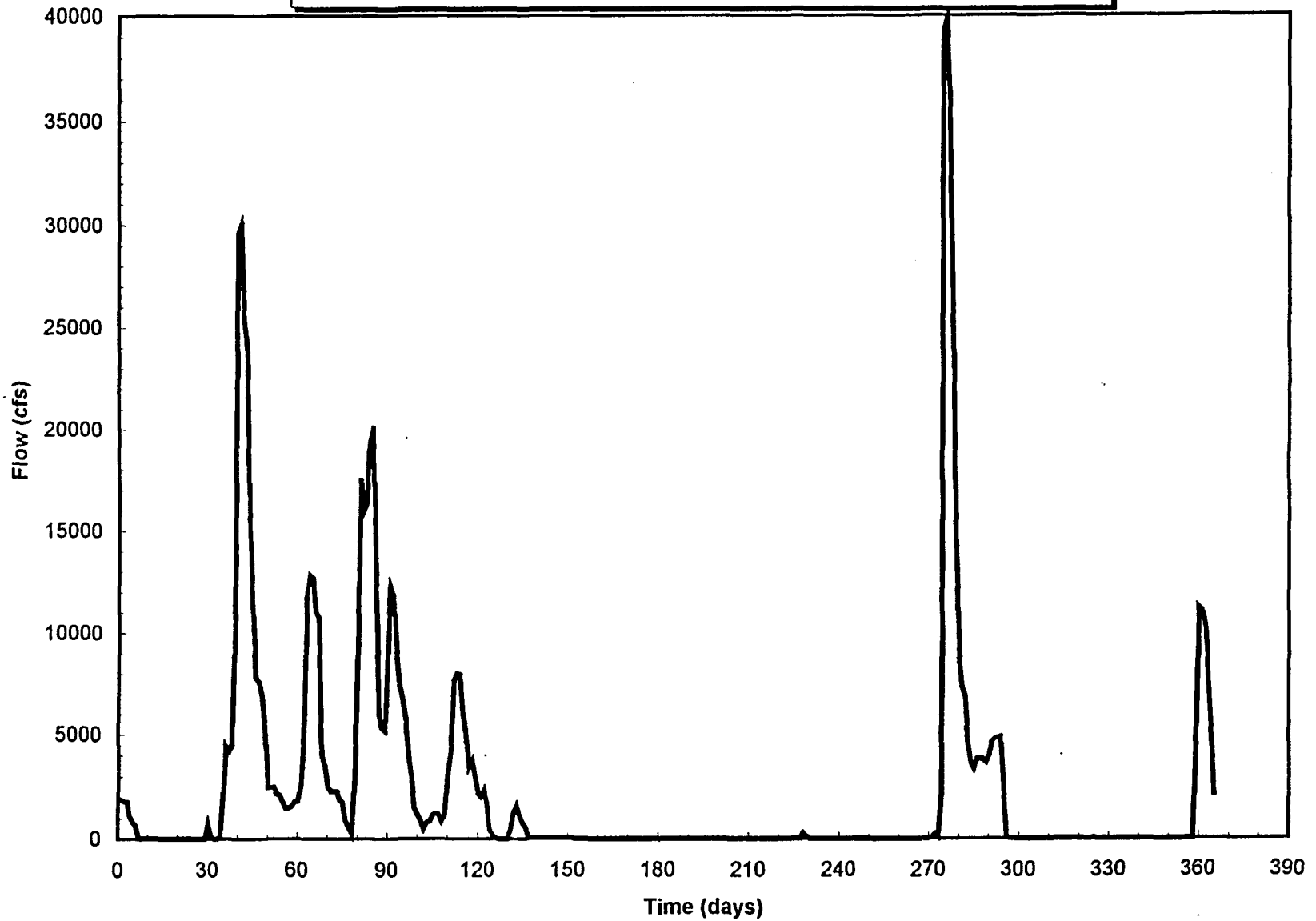
Salt River Sediment Trend Analysis

Figure 4 - Equilibrium Sediment Load at Granite Reef Dam



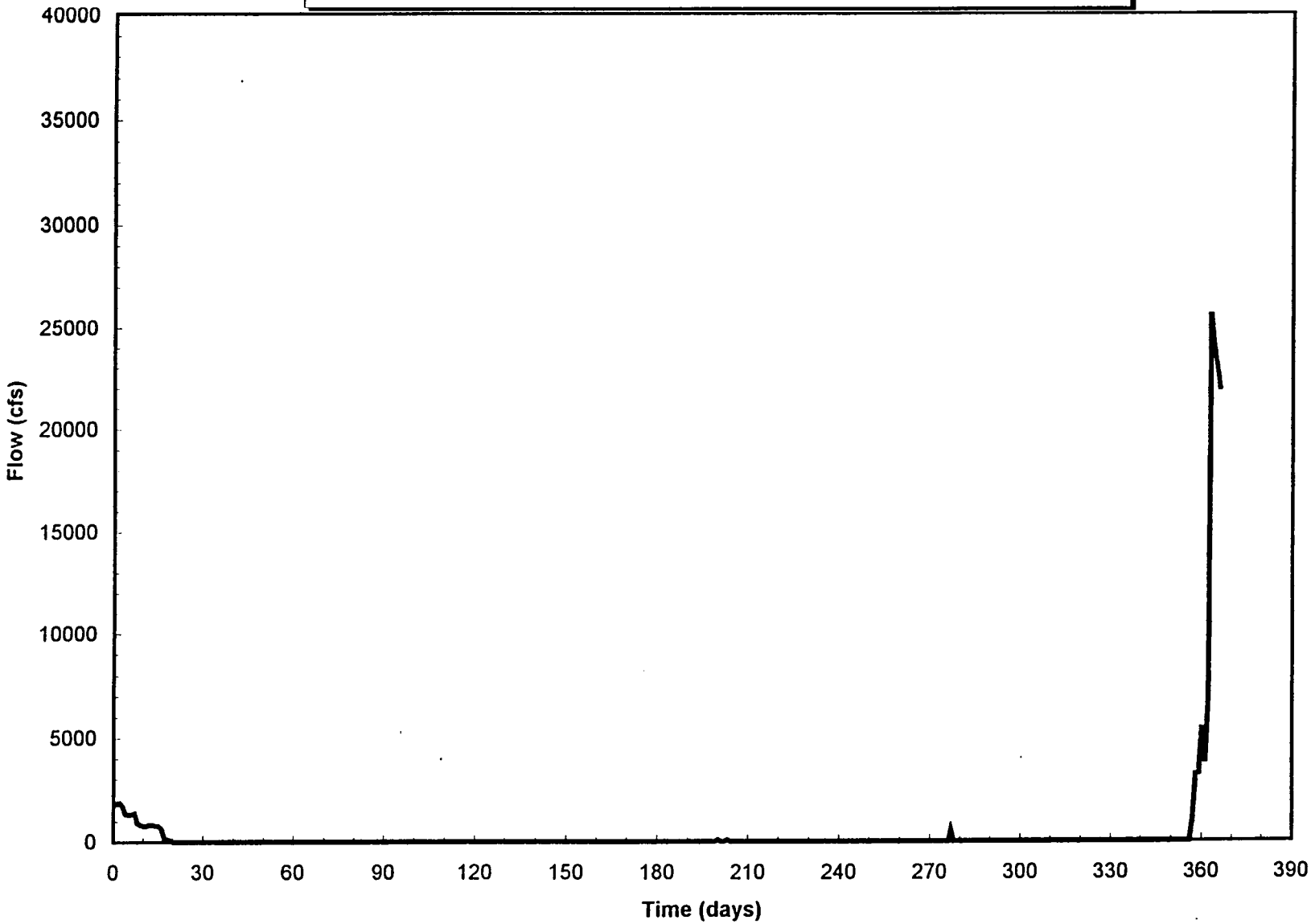
Salt River Sediment Trend Analysis

Figure 5 - 1983 Discharge Histogram



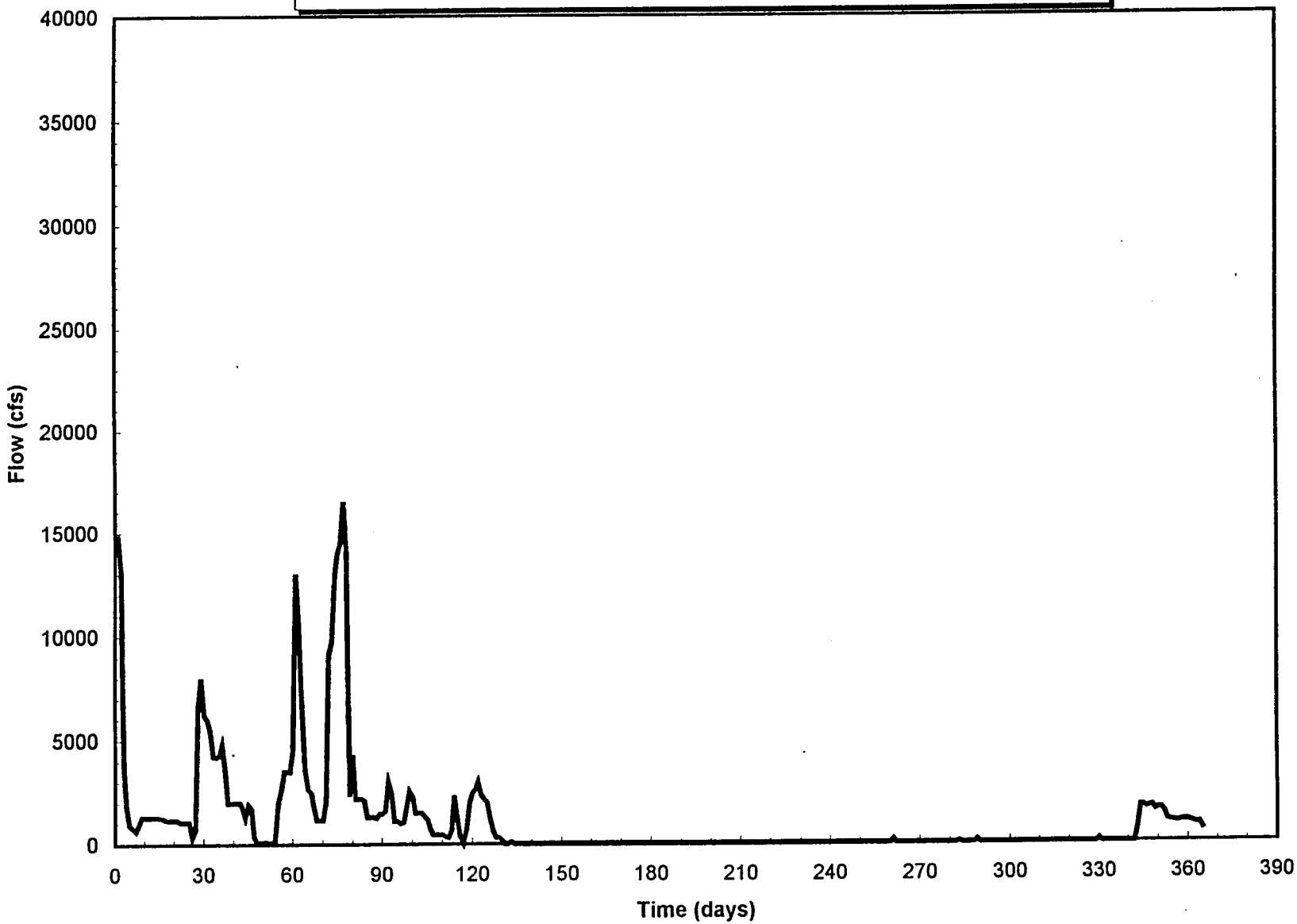
Salt River Sediment Trend Analysis

Figure 6 - 1984 Discharge Histogram



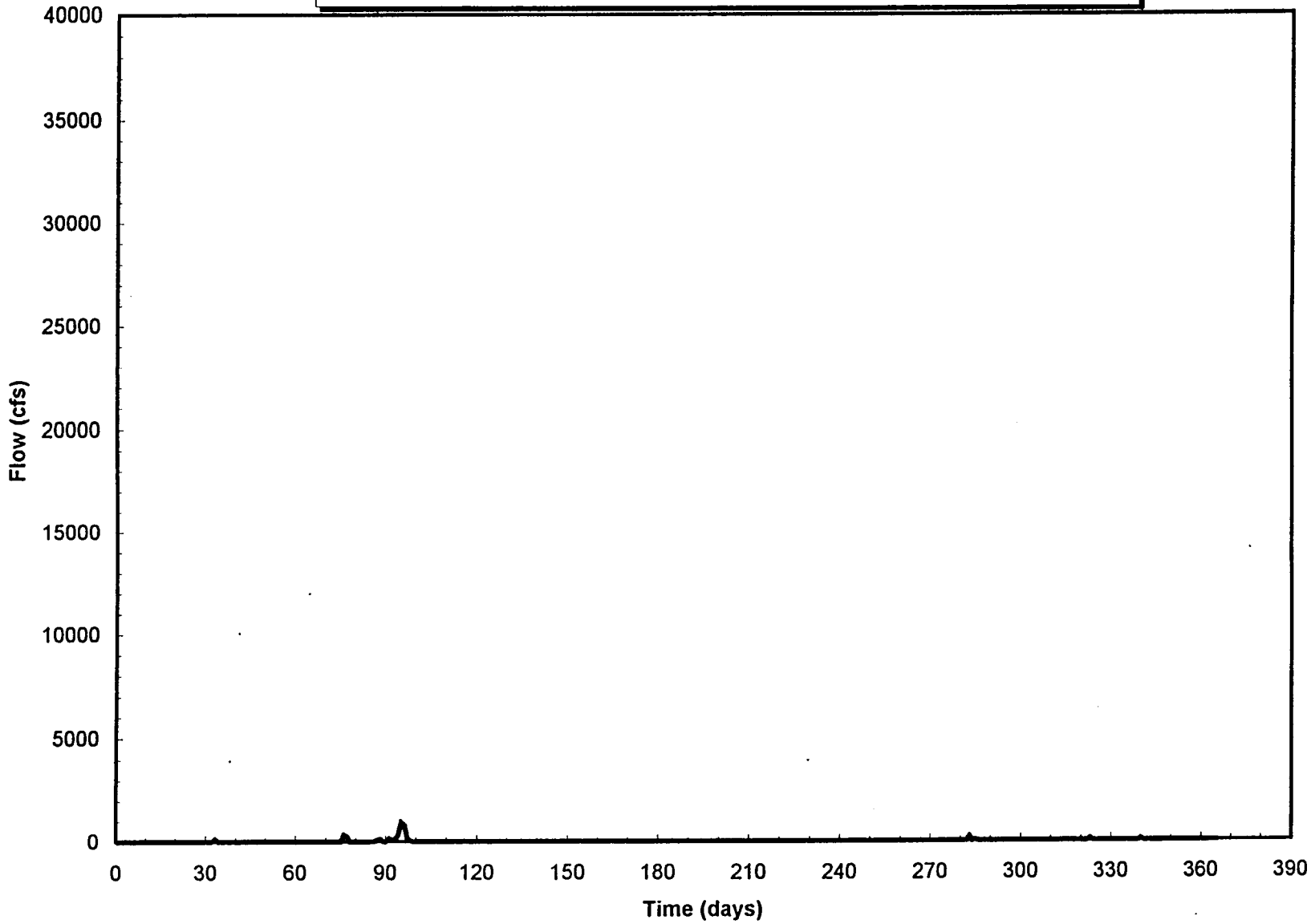
Salt River Sediment Trend Analysis

Figure 7 - 1985 Discharge Histogram



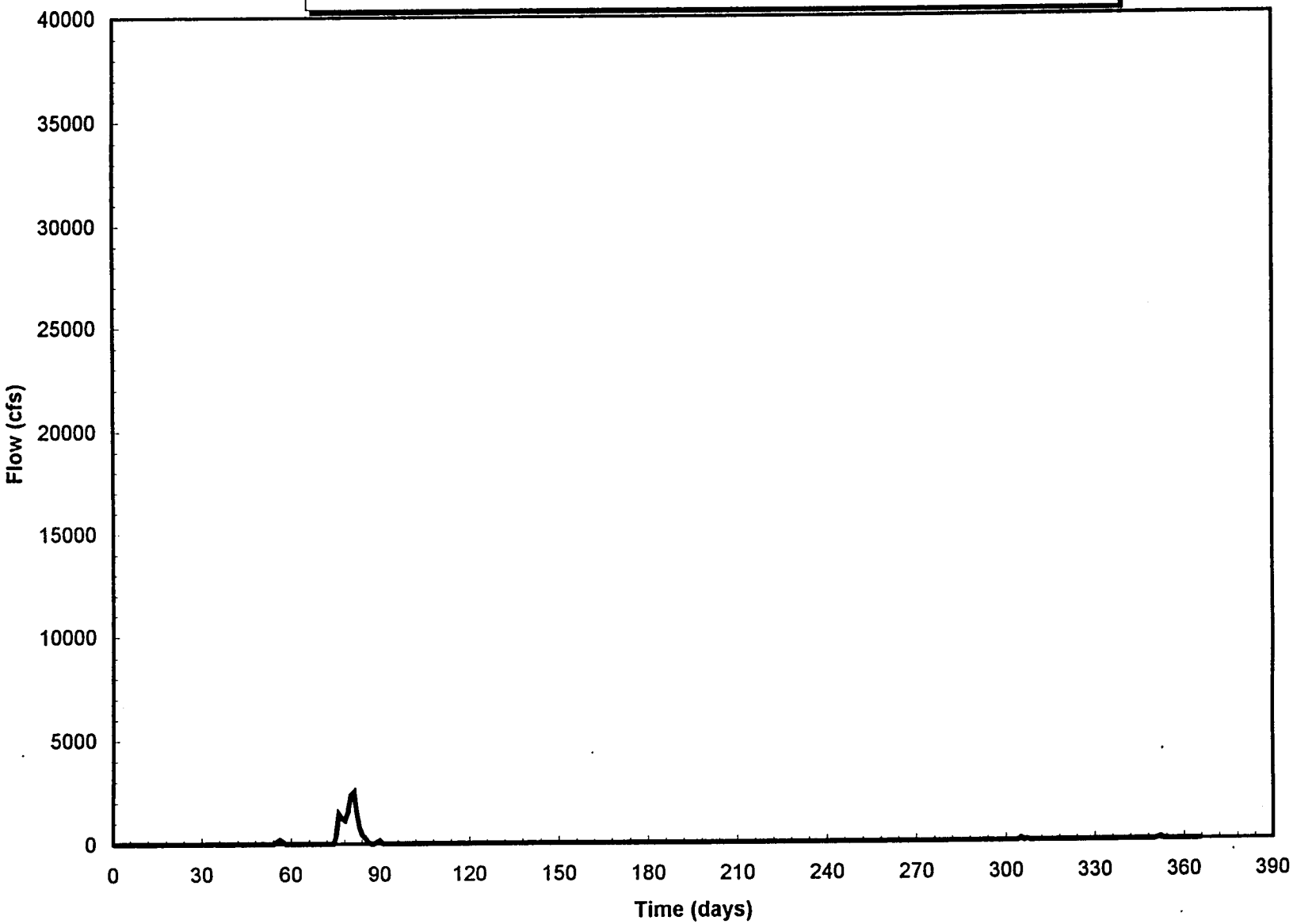
Salt River Sediment Trend Analysis

Figure 8 - 1986 Discharge Histogram



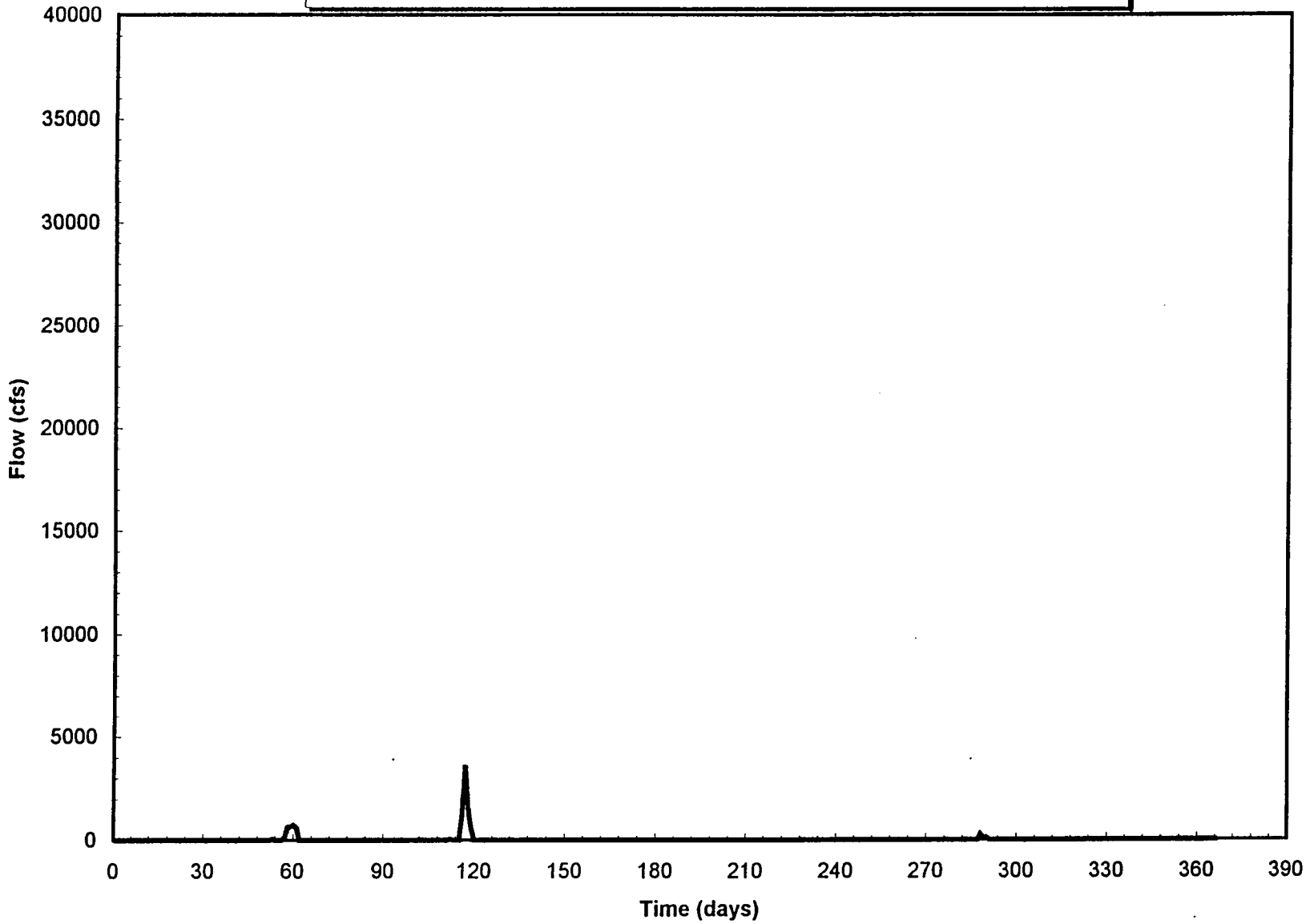
Salt River Sediment Trend Analysis

Figure 9 - 1987 Discharge Histogram



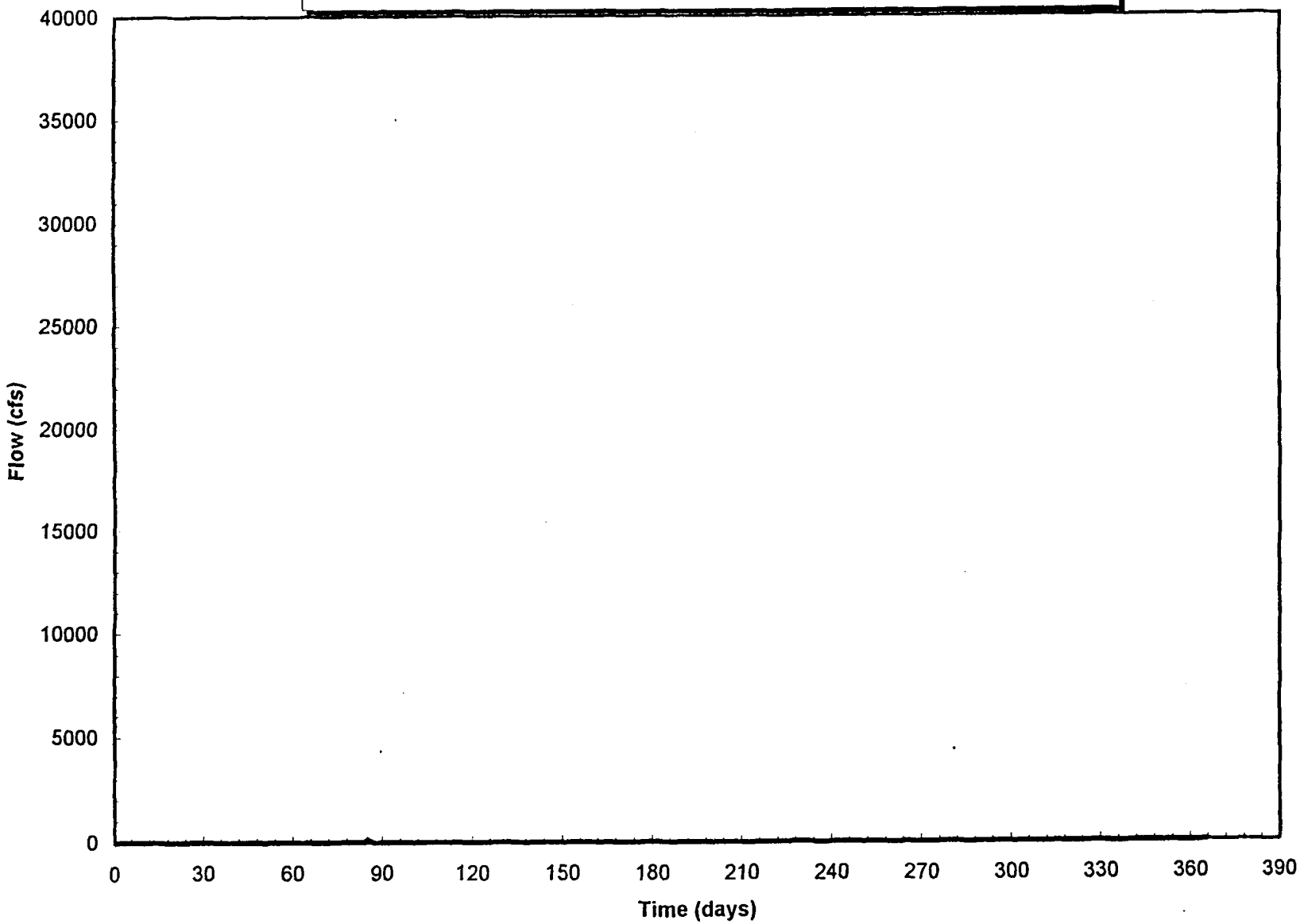
Salt River Sediment Trend Analysis

Figure 10 - 1988 Discharge Histogram



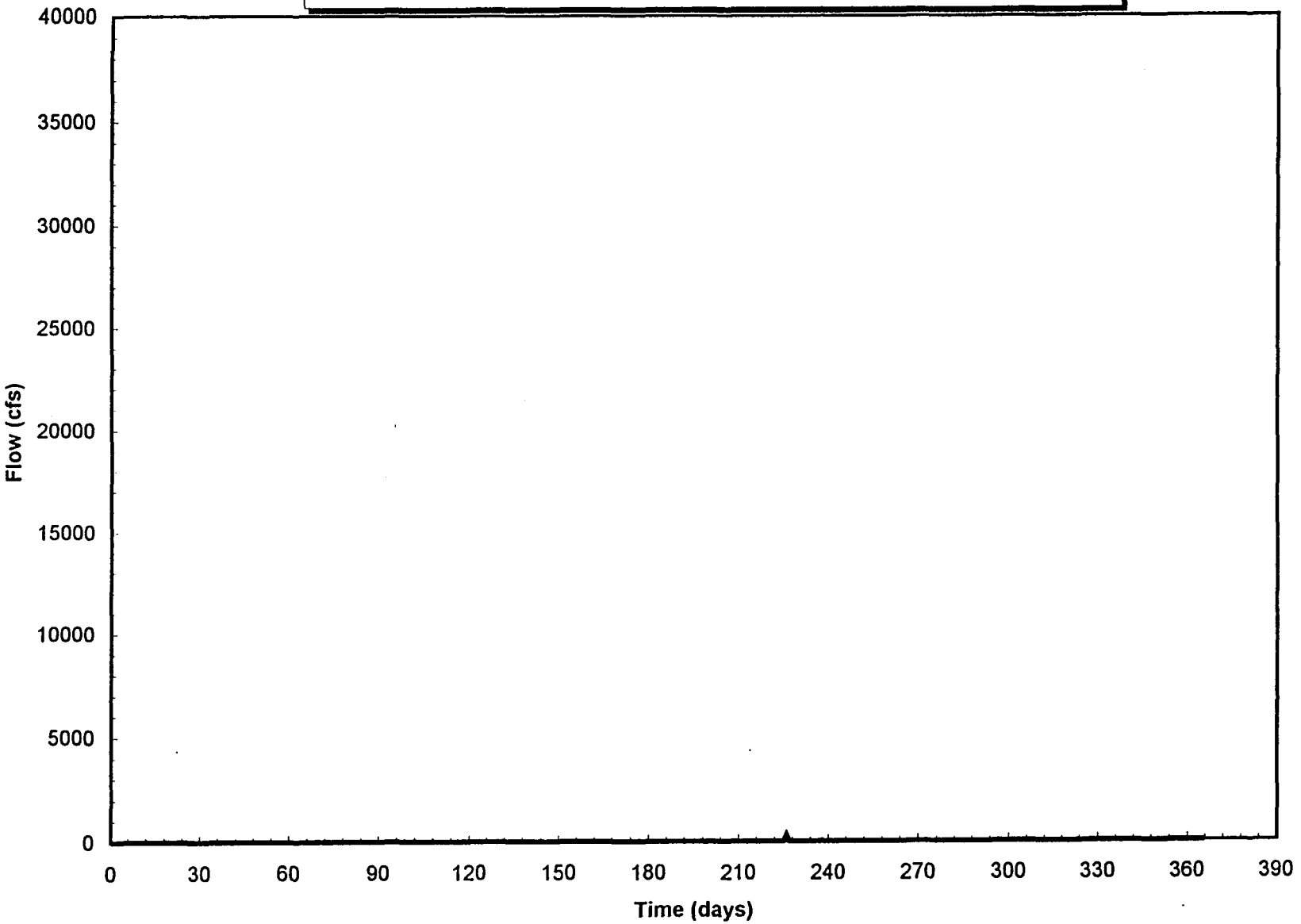
Salt River Sediment Trend Analysis

Figure 11 - 1989 Discharge Histogram



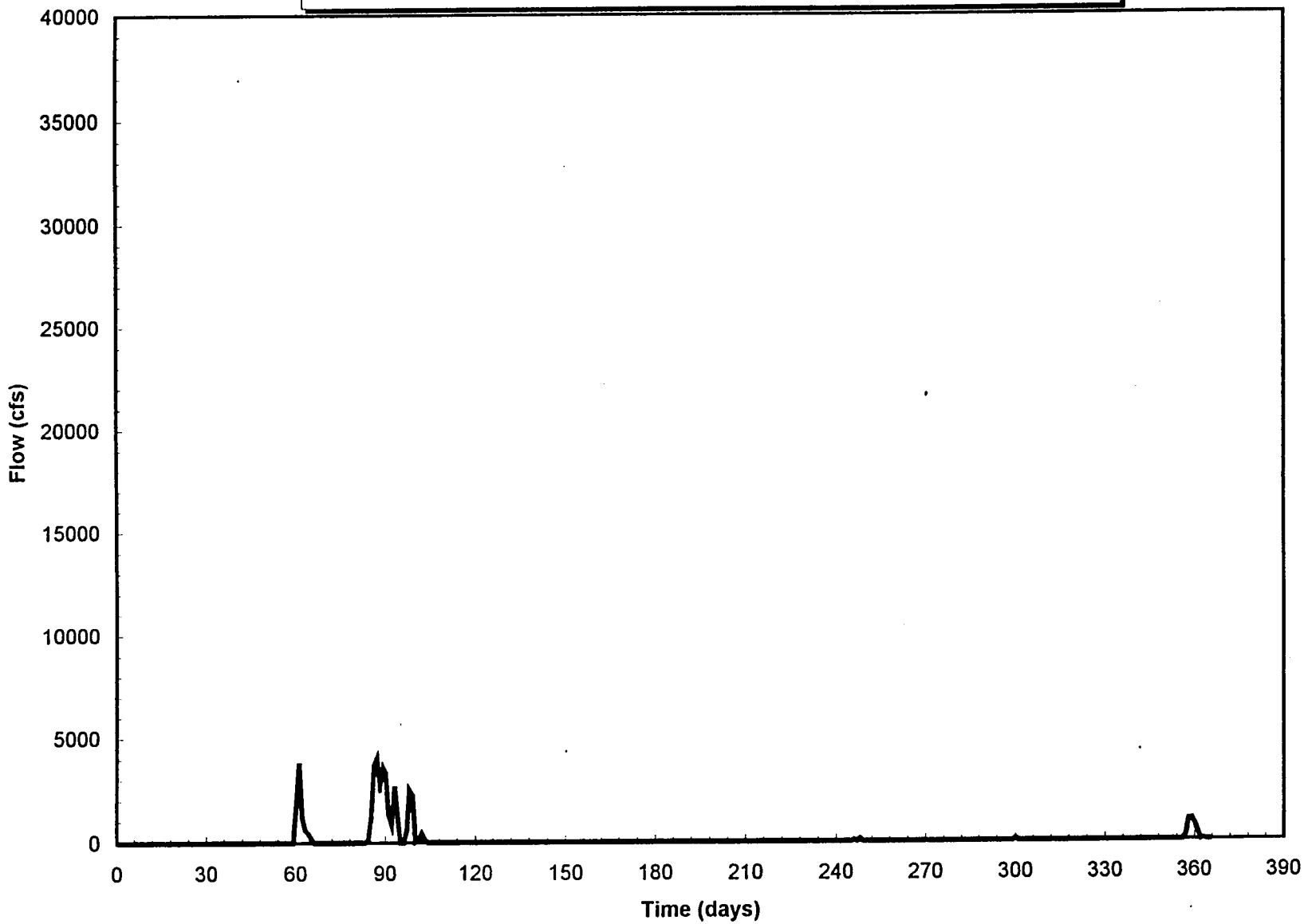
Salt River Sediment Trend Analysis

Figure 12 - 1990 Discharge Histogram



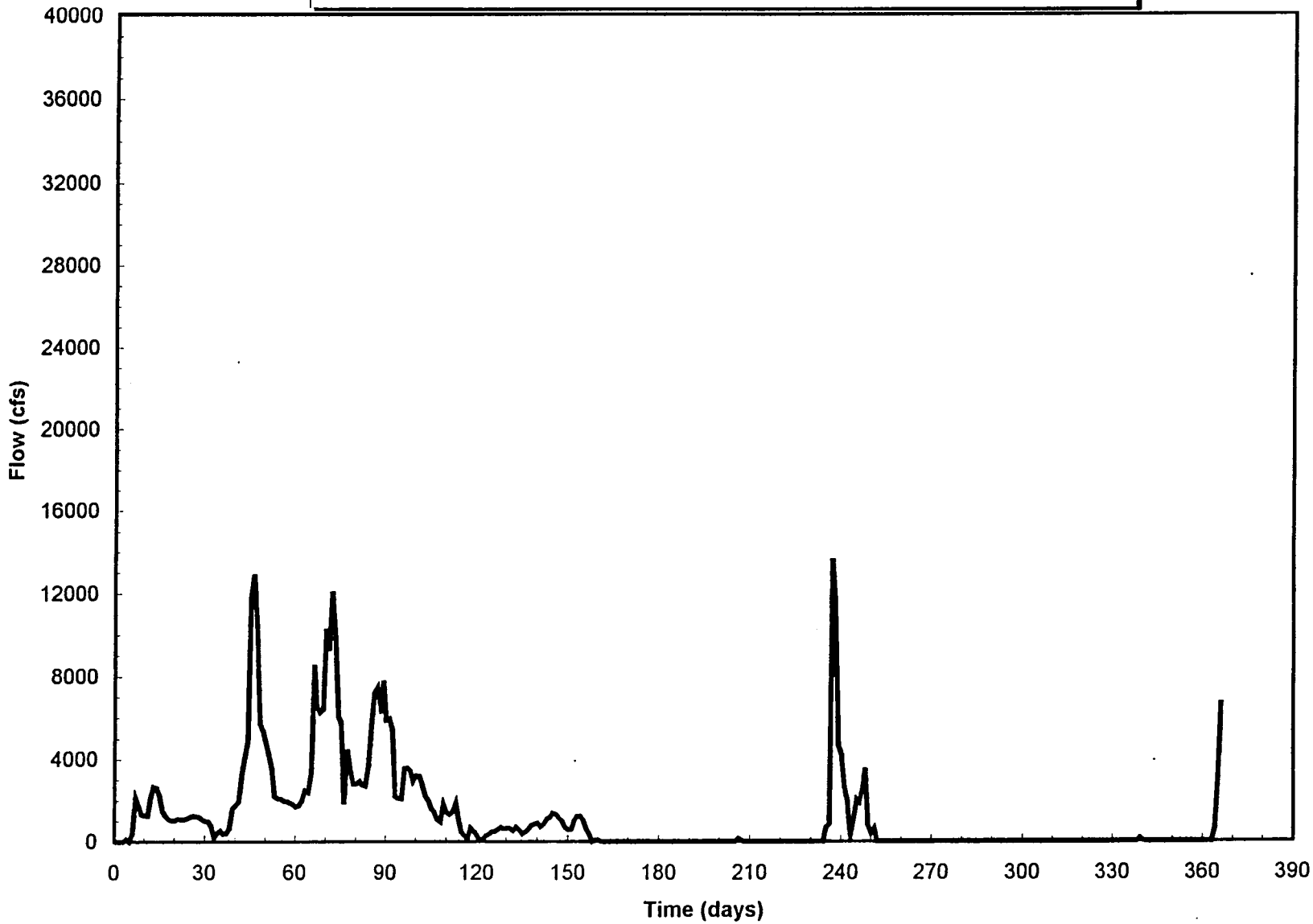
Salt River Sediment Trend Analysis

Figure 13 - 1991 Discharge Histogram



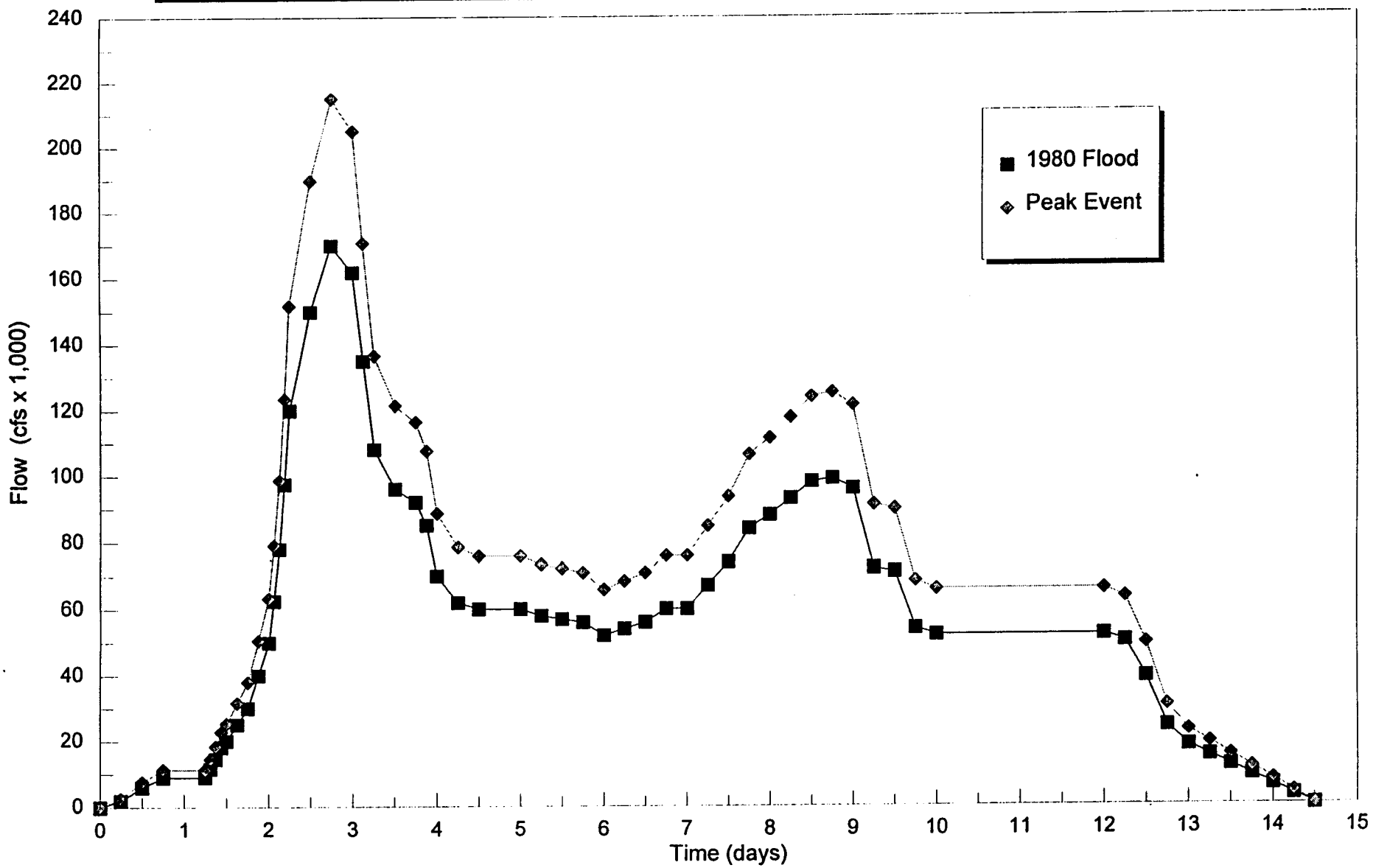
Salt River Sediment Trend Analysis

Figure 14 - 1992 Discharge Histogram



Salt River Sediment Trend Analysis

Figure 15 - Peak Event Hydrograph



5.0 Analysis of Results

General

The results of the two HEC-6 models were analyzed by coding HEC-6 to write output at the beginning of the model, at the end of each year of simulation, at the peak flow of the peak event, and at the end of the peak event. This HEC-6 output was then used to develop a table of average bed elevations at each cross section. Since the purpose of this study is to analyze sediment trends, the data was then adjusted using three point averaging. This provides a truly average bed result and facilitates the analysis of the results based on trends in the channel bed elevation. These average beds were then tabulated and graphed to facilitate the analysis of the bed changes during the simulation, the final bed elevations, and the lowest bed elevations.

Without Additional Mining

The without additional mining model shows a trend of minor aggradation in approximately 9.6 miles of the study reach from the confluence with the Gila River to 35th Avenue. The lowest bed elevations for fourteen out of twenty-six cross sections in the lower section occur at the beginning of the period of record. Sixteen out of twenty-six cross sections show some aggradation at the end of the period of record. The median aggradation amount for this lower section is 0.3 feet.

The middle 13.6 miles of the study reach between 35th Avenue and McClintock Drive are highly channelized and stabilized. The results reflect these conditions and show limited degradation over the period of record. Thirty-eight out of forty-seven cross sections in the middle section show degradation at the end of the period of record, however, the median degradation is only 1.6 feet.

The upper 14.5 miles between McClintock Drive and Granite Reef Dam are influenced by the sediment trapping efficiency of Granite Reef Dam and the upstream reservoirs. This is evident since thirty-one out of forty-two cross sections show degradation. The median amount of degradation over the period of record for the upper section is 2.4 feet. Moreover, the median amount of degradation for the 7.5 miles nearest to Granite Reef Dam is 4.2 feet.

These trends show that the Salt River system downstream of Granite Reef Dam is degrading, even without additional mining. The greatest degradation is shown in the upper section, with some degradation occurring in the middle section. The lower section,

however, shows some minor aggradation. The median degradation for the total study reach without additional mining is 1.5 feet.

With Additional Mining

The with additional mining model shows trends which can be analyzed based on the same three sections of the study reach used for the without additional mining analysis. The lower section shows degradation due to the influences of mining. The lowest bed elevations for sixteen out of twenty-six cross sections in the lower section occurred at the end of the first year. Furthermore, every cross section shows some degradation after the first year, with a median degradation after the first year of 7.2 feet. It can be seen, however, that the bed elevations partially recover at nineteen out of twenty-six cross sections over the remainder of the period of record. The median aggradation for the remainder of the period of record is 0.3 feet. The total median degradation over the period of record in the lower section is 5.1 feet.

The results in the middle section show reduced degradation due to the channelization and stabilization and due to the absence of additional mining activities in this section. Although forty-four out of forty-seven cross sections show degradation, the median degradation is only 3.3 feet, or a net additional median degradation of 1.7 feet.

The upper section is still influenced by Granite Reef Dam, however, the additional mining activities increase the degradation of the channel bed. Thirty-eight out of forty-two cross sections show degradation in the upper section. Twenty-two out of forty-two cross sections show some aggradation after the first year, with the median aggradation being 0.2 feet. The median amount of degradation over the period of record for the upper section is 9.3 feet, or a net additional median degradation of 6.9 feet. These results in the upper section show that mining increases degradation, however, they also show that the bed has a tendency to recover some of the degradation during the period of record. The section nearest to Granite Reef Dam, however, continues to degrade throughout the period of record, because of the sediment trapping efficiency of Granite Reef Dam.

The median degradation for the total study reach with additional mining is 4.0 feet or a net increase of 2.5 feet for the entire reach based on median values. The results of the HEC-6 models as described above are also summarized in Table 2.

Infrastructure

Once the average bed elevations were analyzed, it was necessary to project the effects the channel bed elevation changes could have on infrastructure crossing the Salt River. Plans for utility crossings, bridges, at grade crossings, and grade control structures in the study reach were researched and obtained when available. This resulted in data on

approximately 150 crossings of the Salt River, of which approximately 100 crossings were buried in the channel. The other 50 crossings are either overhead power lines without utility poles in the channel or are attached to the superstructure of a bridge. All identified utility crossings are listed in Table 3 and Table 4. They are located at the nearest cross section in the HEC-6 model. For the buried crossings, estimates of foundation types, depths, and other parameters were also determined for use in evaluating the effects of degradation. For bridges with spread footings, the top of the footing was identified. For bridges with caissons or piles, the tip of the pile/caisson was identified. For grade control structures, the downstream toe elevation was identified. For utility crossings, the top of the utility was identified. Lacking specific structural stability data, it was necessary to develop guidelines to determine threshold values for infrastructure that could be threatened by degradation as a result of additional mining. A comparative tolerance elevation was calculated at each crossing, to be compared to the channel bed elevation. Bridges were determined to require at least one-half of the remaining embedment or 15' of embedment, whichever is greater. Grade control structures were determined to require bed elevations higher than the downstream toe elevation. Utility crossings were determined to require one-half of the remaining embedment or 5' of embedment, whichever is greater.

It is important to note that the owners of these utility crossings have varied policies regarding allowable degradation at their structures. Kimley-Horn has discussed the study assumptions with all of the utility owners and some have provided input into the development of these comparative tolerance elevations. The definition of the comparative tolerance elevations was based primarily on a need for a consistent, quantitative way of grouping infrastructure into facilities which are potentially at risk and infrastructure not likely to be at risk.

The analysis of risk potential at the infrastructure crossings was based on the thalweg (lowest point) of the channel. This was necessary since the channel can meander significantly within the active bed of the Salt River. The results for each set of output were then compared to determine the worst case degradation at each cross section. This approach means that in the areas where the channel recovers from the effects of mining over the period of record, only the lowest bed elevations are used for comparison to the infrastructure.

The final results for the without additional mining model are reported in Table 3 and Figure 16 through Figure 23. The final results for the with additional mining model are reported in Table 4 and Figure 24 through Figure 31. Each of the figures shows five miles of the study reach, with the thalweg elevation, worst case bed elevation, and the final bed elevations. The tip/toe elevations of all of the buried utility crossings are also shown, with the comparative tolerance elevations shown for comparison to the degraded channel bed elevations.

The list of infrastructure potentially at risk due to the degradation in the without additional mining model is in Table 5. The list of infrastructure potentially at risk due to the degradation in the with additional mining model is in Table 6.

Salt River Sediment Trend Analysis
Table 2 - Summary of Results

26-Dec-96
hec6sum.wk4

Section Name	Section Description	Approximate Reach Length (miles)	Total Median Degradation Without Additional Mining (ft)	Total Median Degradation With Additional Mining (ft)	Total Median Degradation Difference (ft)
Lower	From Gila River Confluence to 35th Avenue	9.6	0.3	-5.1	5.4
Middle	From 35th Avenue to McClintock Drive	13.6	-1.6	-3.3	1.7
Upper	From McClintock Road to Granite Reef Dam	14.5	-2.4	-9.3	6.9
Total	From Gila River Confluence to Granite Reef Dam	37.7	-1.5	-4.0	2.5

Salt River Sediment Trend Analysis
Table 3 - Results Without Additional Mining

26-Dec-96
womine.wk4

Approx. River Mile	Description	Starting Channel Elevation	Bed Change Worst Case (ft)	Bed Change End of Run (ft)	Worst Case Elevation	End of Run Elevation	Toe or Tip Elevation	Comparative Tolerance Elevation	At Risk? (Y/N)
199.91		932.10	-0.44	-0.21	931.66	931.89			
200.30	20" El Paso Natural Gas pipeline	937.70	-0.12	0.21	937.58	937.91	922.00	929.85	N
200.77		936.90	-0.28	0.12	936.62	937.02			
201.33		943.00	0.00	1.40	943.00	944.40			
201.81		946.00	0.00	1.98	946.00	947.98			
201.99		948.70	0.00	2.57	948.70	951.27			
202.29	12 KV SRP distribution line	955.50	0.00	2.39	955.50	957.89	no poles		
202.29	91st Avenue At GradeCrossing	955.50	0.00	2.39	955.50	957.89	955.50	953.50	N
202.80		956.40	0.00	2.78	956.40	959.18			
203.29	500 KV SRP transmission line	960.70	0.00	3.16	960.70	963.86	no poles		
203.96		964.10	0.00	1.49	964.10	965.59			
204.34	69 KV SRP transmission line	969.30	0.00	0.82	969.30	970.12	937.00	952.00	N
204.78		967.60	0.00	0.45	967.60	968.05			
204.97		973.30	0.00	1.33	973.30	974.63			
205.15	12 KV SRP distribution line	973.10	-0.42	-0.20	972.68	972.90	no poles		
205.15	67th Avenue At Grade Crossing	973.10	-0.42	-0.20	972.68	972.90	973.10	971.10	N
205.15	12" City of Phoenix water line	973.10	-0.42	-0.20	972.68	972.90	966.00	971.00	N
206.03		984.50	0.00	0.01	984.50	984.51			
206.51	230 KV and 69 KV SRP transmission lines	981.80	0.00	1.88	981.80	983.68	no poles		
206.79		981.80	0.00	5.43	981.80	987.23			
206.88		981.70	0.00	4.06	981.70	985.76			
207.07		992.80	-0.44	-0.44	992.36	992.36			
207.27		993.30	-3.57	-3.57	989.74	989.74			
207.49	54" City of Phoenix sewer siphon	992.20	-2.58	-2.58	989.62	989.62	955.00	973.60	N
207.49	51st Avenue Bridge	992.20	-2.58	-2.58	989.62	989.62	925.00	958.60	N
207.49	8" Santa Fe Petroleum Pipeline (SPPL)	992.20	-2.58	-2.58	989.62	989.62	attached to bridge		
207.49	48" City of Phoenix sewer siphon	992.20	-2.58	-2.58	989.62	989.62	956.00	974.10	N
207.49	12 KV SRP distribution line	992.20	-2.58	-2.58	989.62	989.62	no poles		
207.49	6" Santa Fe Petroleum Pipeline (SPPL)	992.20	-2.58	-2.58	989.62	989.62	attached to bridge		
207.99	16" El Paso Natural Gas pipeline	999.90	-1.59	-1.59	998.31	998.31	987.20	993.55	N
207.99	Two 230 KV WAPA transmission lines	999.90	-1.59	-1.59	998.31	998.31	no poles		
208.48	12 KV SRP distribution line	1007.60	-3.10	-2.99	1004.50	1004.61	no poles		
208.48	69 KV SRP transmission line	1007.60	-3.10	-2.99	1004.50	1004.61	978.00	992.80	N
208.95		1013.80	-6.44	-6.02	1007.36	1007.78			

Salt River Sediment Trend Analysis
Table 3 - Results Without Additional Mining

26-Dec-96
womine.wk4

Approx. River Mile	Description	Starting Channel Elevation	Bed Change Worst Case (ft)	Bed Change End of Run (ft)	Worst Case Elevation	End of Run Elevation	Toe or Tip Elevation	Comparative Tolerance Elevation	At Risk? (Y/N)
209.33		1012.00	-8.03	-6.19	1003.97	1005.81			
209.54	35th Avenue Bridge	1009.40	-6.04	-5.34	1003.36	1004.06	930.00	969.70	N
209.54	48" City of Phoenix water line	1009.40	-6.04	-5.34	1003.36	1004.06	1008.00	1013.00	Y
210.07		1018.50	-2.24	-2.24	1016.27	1016.27			
210.36		1017.40	0.00	0.63	1017.40	1018.03			
210.64		1017.70	0.00	1.88	1017.70	1019.58			
210.93		1018.70	0.00	2.79	1018.70	1021.49			
211.21		1021.10	0.00	1.19	1021.10	1022.29			
211.37		1027.10	0.00	0.49	1027.10	1027.59			
211.41		1028.00	-1.06	-1.06	1026.94	1026.94			
211.45	12 KV SRP distribution line	1027.10	-1.77	-1.77	1025.33	1025.33	attached to bridge		
211.45	19th Ave Bridge	1027.10	-1.77	-1.77	1025.33	1025.33	915.00	967.50	N
211.45	GCS downstream of 19th Avenue	1027.10	-1.77	-1.77	1025.33	1025.33	980.83	980.83	N
211.45	8" and 20" City of Phoenix water lines	1027.10	-1.77	-1.77	1025.33	1025.33	attached to bridge		
211.89		1029.90	-3.53	-3.53	1026.37	1026.37			
212.37		1036.60	-5.55	-5.55	1031.05	1031.05			
212.68	7th Ave Bridge	1036.90	-5.71	-5.41	1031.19	1031.49	945.00	990.95	N
213.26	US WEST telephone duct	1040.40	-3.28	-3.28	1037.12	1037.12	attached to bridge		
213.26	Central Avenue Bridge	1040.40	-3.28	-3.28	1037.12	1037.12	1010.00	1025.20	N
213.75	7th Street Bridge	1044.60	-1.21	-1.04	1043.39	1043.56	945.00	994.80	N
213.75	US SPRINT telephone duct	1044.60	-1.21	-1.04	1043.39	1043.56	attached to bridge		
213.75	10" Southwest Gas gas pipeline	1044.60	-1.21	-1.04	1043.39	1043.56	1042.00	1047.00	Y
214.14		1048.70	0.00	1.42	1048.70	1050.12			
214.52		1048.00	0.00	1.95	1048.00	1049.95			
214.79	36" City of Phoenix water line	1057.60	0.00	2.10	1057.60	1059.70	1038.00	1048.40	N
214.79	16th Street Bridge	1057.60	0.00	2.10	1057.60	1059.70	950.00	1004.40	N
214.79	36" City of Phoenix water line	1057.60	0.00	2.10	1057.60	1059.70	1043.00	1050.90	N
214.79	12KV SRP distribution line	1057.60	0.00	2.10	1057.60	1059.70	attached to bridge		
215.09		1061.70	-0.67	-0.58	1061.03	1061.12			
215.65		1068.30	-3.64	-3.35	1064.66	1064.95			
215.82	24th Street Bridge	1076.00	-4.66	-4.41	1071.34	1071.59	1013.00	1044.50	N
216.29		1080.80	-4.34	-4.14	1076.46	1076.66			
216.33	GCS downstream of I-10	1082.00	-2.42	-2.33	1079.58	1079.67	1075.50	1075.50	N
216.37		1080.80	-2.26	-2.08	1078.54	1078.72			

Salt River Sediment Trend Analysis

Table 3 - Results Without Additional Mining

26-Dec-96

womine.wk4

Approx. River Mile	Description	Starting Channel Elevation	Bed Change Worst Case (ft)	Bed Change End of Run (ft)	Worst Case Elevation	End of Run Elevation	Toe or Tip Elevation	Comparative Tolerance Elevation	At Risk? (Y/N)
216.52	I-10 Bridge	1083.20	-1.07	-0.81	1082.13	1082.39	1070.00	1068.20	N
217.00		1085.70	-3.32	-3.10	1082.38	1082.60			
217.82	APS transmission line	1101.30	-4.85	-4.64	1096.45	1096.66	1004.00	1044	N
217.86	GCS between I-10 and SR 153	1101.30	-7.35	-7.09	1093.95	1094.21	1057.20	1057.20	N
217.90	City of Phoenix water lines in Salt River	1101.30	-5.79	-5.31	1095.51	1095.99	varies		
217.90	City of Phoenix sewer lines in Salt River	1101.30	-5.79	-5.31	1095.51	1095.99	varies		
218.33		1102.70	-4.23	-4.03	1098.47	1098.67			
218.92	60" City of Phoenix water line	1112.80	-2.73	-2.73	1110.07	1110.07	1086.00	1098.50	N
218.92	GCS downstream of SR 153	1112.80	-2.73	-2.73	1110.07	1110.07	1075.40	1075.40	N
218.96	SR-153 Sky Harbor Expressway Bridge	1113.50	-2.47	-2.47	1111.03	1111.03	1037.00	1074.90	N
219.00		1112.80	-1.97	-1.97	1110.83	1110.83			
219.03	US WEST and AT&T telephone duct	1112.90	-1.29	-1.29	1111.61	1111.61	1097.50	1106.85	N
219.03	18" City of Phoenix sewer siphon	1112.90	-1.29	-1.29	1111.61	1111.61	1099.00	1106.85	N
219.03	12" Southwest Gas gas pipeline	1112.90	-1.29	-1.29	1111.61	1111.61	1096.00	1105.35	N
219.03	SR-143 Hohokam Freeway Bridge	1112.90	-1.29	-1.29	1111.61	1111.61	1045.00	1078.95	N
219.03	48" City of Phoenix sewer siphon	1112.90	-1.29	-1.29	1111.61	1111.61	1097.00	1105.85	N
219.51		1117.30	-1.33	-1.33	1115.97	1115.97			
220.04		1122.90	-1.66	-1.66	1121.24	1121.24			
220.06	69 KV SRP transmission line	1122.90	-1.56	-1.56	1121.34	1121.34	no poles		
220.06	69 KV APS transmission line	1122.90	-1.56	-1.56	1121.34	1121.34	no poles		
220.06	36" City of Tempe water line	1122.90	-1.56	-1.56	1121.34	1121.34	1116.00	1121.00	N
220.06	Priest Drive Bridge	1122.90	-1.56	-1.56	1121.34	1121.34	1100.00	1107.90	N
220.06	48" City of Tempe sewer siphon	1122.90	-1.56	-1.56	1121.34	1121.34	1116.00	1121.00	N
220.88	6" Southwest Gas gas pipeline	1126.00	-0.80	-0.80	1125.20	1125.20	1124.00	1129.00	Y
220.92	GCS downstream of Southern Pacific Railroad	1129.40	-0.40	-0.25	1129.00	1129.15	1101.00	1101.00	N
220.96	Southern Pacific Transportation Company line	1126.00	-0.60	-0.06	1125.40	1125.94	attached to bridge		
220.96	12 KV APS distribution line	1126.00	-0.60	-0.06	1125.40	1125.94	no poles		
220.96	MCI Communications line	1126.00	-0.60	-0.06	1125.40	1125.94	attached to bridge		
220.96	Southern Pacific Railroad Bridge	1126.00	-0.60	-0.06	1125.40	1125.94	1100.00	1111.00	N
221.19	APS distribution duct	1126.00	-0.69	-0.18	1125.31	1125.82	attached to bridge		
221.19	230 KV SRP transmission line	1126.00	-0.69	-0.18	1125.31	1125.82	no poles		
221.19	Old Mill Avenue Bridge	1126.00	-0.69	-0.18	1125.31	1125.82	1100.00	1113.00	N
221.19	12" City of Tempe reclaimed water line	1126.00	-0.69	-0.18	1125.31	1125.82	attached to bridge		
221.19	US WEST telephone duct	1126.00	-0.69	-0.18	1125.31	1125.82	attached to bridge		

Salt River Sediment Trend Analysis
Table 3 - Results Without Additional Mining

26-Dec-96
womine.wk4

Approx. River Mile	Description	Starting Channel Elevation	Bed Change Worst Case (ft)	Bed Change End of Run (ft)	Worst Case Elevation	End of Run Elevation	Toe or Tip Elevation	Comparative Tolerance Elevation	At Risk? (Y/N)
221.26	8" Southwest Gas gas line	1130.00	-0.17	-0.07	1129.83	1129.93	attached to bridge		
221.26	New Mill Avenue Bridge	1130.00	-0.17	-0.07	1129.83	1129.93	1114.00	1115.00	N
221.26	US WEST telephone duct	1130.00	-0.17	-0.07	1129.83	1129.93	attached to bridge		
221.26	6" AP&C Nitrogen Gas line	1130.00	-0.17	-0.07	1129.83	1129.93	attached to bridge		
221.26	12" City of Tempe water main	1130.00	-0.17	-0.07	1129.83	1129.93	attached to bridge		
221.70		1134.00	-0.61	-0.40	1133.39	1133.60			
222.09	Rural Road Bridge	1136.00	-0.79	-0.45	1135.21	1135.55	1085.00	1110.50	N
222.09	US WEST telephone cable	1136.00	-0.79	-0.45	1135.21	1135.55	attached to bridge		
222.09	21"/18" City of Tempe sewer siphon	1136.00	-0.79	-0.45	1135.21	1135.55	1126.00	1131.00	N
222.09	30" City of Tempe water line	1136.00	-0.79	-0.45	1135.21	1135.55	1125.00	1130.50	N
222.55	230 KV and 69KV SRP transmission lines	1139.00	-2.26	-1.97	1136.74	1137.03	no poles		
222.93	69 KV APS transmission line	1140.00	-1.90	-1.83	1138.10	1138.17	1046.00	1095	N
223.07	12" Southwest Gas gas pipeline	1150.00	-1.65	-1.65	1148.35	1148.35	1126.00	1137.00	N
223.07	36" City of Tempe water line	1146.30	-1.65	-1.65	1144.65	1144.65	1141.50	1146.50	Y
223.07	18" City of Mesa sewer siphon	1150.00	-1.65	-1.65	1148.35	1148.35	1126.50	1137.25	N
223.07	21" City of Mesa sewer siphon	1150.00	-1.65	-1.65	1148.35	1148.35	1127.00	1137.50	N
223.07	10" Southwest Gas gas pipeline	1150.00	-1.65	-1.65	1148.35	1148.35	1126.00	1137.00	N
223.09	GCS downstream of McClintock Drive	1146.30	-0.37	-0.37	1145.93	1145.93	1131.20	1131.20	N
223.11	McClintock Drive Bridge	1150.00	0.00	2.85	1150.00	1152.85	1046.00	1096.15	N
223.67	Loop 202, Red Mountain Freeway Bridge	1132.70	0.00	2.85	1132.70	1135.55	1010.00	1073.15	N
224.09	Loop 101, Pima Freeway Bridge	1152.00	0.00	7.13	1152.00	1159.13	1038.00	1095.00	N
224.25		1152.00	0.00	4.64	1152.00	1156.64			
224.43		1158.40	0.00	3.65	1158.40	1162.05			
224.81		1162.10	0.00	2.16	1162.10	1164.26			
225.28		1163.00	0.00	2.99	1163.00	1165.99			
225.66		1158.80	0.00	1.71	1158.80	1160.51			
226.04		1173.10	-2.62	-1.37	1170.48	1171.73			
226.23		1177.60	-3.53	-2.97	1174.07	1174.64			
226.48		1180.50	-2.89	-2.78	1177.61	1177.72			
226.52	GCS downstream of Alma School Road	1186.00	-0.11	-0.05	1185.89	1185.95	1161.00	1161.00	N
226.52		1186.00	-0.11	-0.05	1185.89	1185.95			
226.56	12 KV SRP distribution line	1180.50	-1.41	-1.37	1179.09	1179.13	no poles		
226.56	Alma School Road Bridges	1180.50	-1.41	-1.37	1179.09	1179.13	1148.00	1164.25	N
226.80	McKellips Road At Grade Crossing	1191.70	-2.54	-2.48	1189.16	1189.22	1191.70	1189.70	Y

Salt River Sediment Trend Analysis
Table 3 - Results Without Additional Mining

26-Dec-96
womine.wk4

Approx. River Mile	Description	Starting Channel Elevation	Bed Change Worst Case (ft)	Bed Change End of Run (ft)	Worst Case Elevation	End of Run Elevation	Toe or Tip Elevation	Comparative Tolerance Elevation	At Risk? (Y/N)
227.08		1194.10	-3.20	-2.88	1190.90	1191.22			
227.46		1194.10	-1.89	-1.47	1192.21	1192.63			
227.63	4" City of Mesa gas pipeline	1194.90	-0.73	-0.73	1194.17	1194.17	1175.20	1185.05	N
227.63	Country Club Drive Bridge	1194.90	-0.73	-0.73	1194.17	1194.17	1111.00	1152.95	N
227.88		1196.80	0.00	0.55	1196.80	1197.35			
228.17		1197.20	0.00	2.20	1197.20	1199.40			
228.64		1201.30	0.00	2.74	1201.30	1204.04			
229.12		1206.10	0.00	2.18	1206.10	1208.28			
229.40		1207.70	-1.45	-1.45	1206.25	1206.25			
229.68		1215.40	-2.88	-2.88	1212.52	1212.52			
230.09		1219.00	-5.84	-5.84	1213.16	1213.16			
230.47		1227.40	-7.35	-7.35	1220.05	1220.05			
230.94		1232.00	-9.83	-9.81	1222.17	1222.19			
231.32		1236.00	-9.92	-9.69	1226.08	1226.31			
231.56	Gilbert Road Bridge	1239.90	-8.01	-8.01	1231.89	1231.89	1159.00	1199.45	N
231.56	Two 230 KV WAPA transmission lines	1239.90	-8.01	-8.01	1231.89	1231.89	1230.50	1235.50	Y
231.89		1246.10	-5.70	-5.52	1240.40	1240.58			
232.45		1247.80	-3.48	-3.20	1244.32	1244.60			
232.74		1249.10	-2.43	-2.17	1246.67	1246.93			
233.03		1253.70	-2.30	-2.30	1251.40	1251.40			
233.51		1256.20	-3.57	-3.57	1252.63	1252.63			
233.95	Grusp canal crossing	1258.50	-4.22	-4.22	1254.28	1254.28	at grade		
234.53		1265.80	-4.08	-4.08	1261.72	1261.72			
235.01		1266.70	-4.11	-4.11	1262.59	1262.59			
235.38		1271.50	-2.98	-2.98	1268.52	1268.52			
235.67		1271.90	-2.38	-2.38	1269.52	1269.52			
236.05		1274.80	-2.02	-2.02	1272.78	1272.78			
236.43		1276.80	-3.45	-3.45	1273.35	1273.35			
236.81		1278.30	-5.62	-5.62	1272.68	1272.68			
237.19		1282.50	-7.04	-7.04	1275.46	1275.46			
237.59	69 KV SRP transmission line	1288.40	-8.03	-8.03	1280.37	1280.37	no poles		
237.59	21' CAP Canal siphon	1288.40	-8.03	-8.03	1280.37	1280.37	1258.40	1275.40	N

Salt River Sediment Trend Analysis

Table 4 - Results With Additional Mining (20 ft Average Depth)

26-Dec-96

wmine.wk4

Approx. River Mile	Description	Minimum Channel Elevation	Bed Change Worst Case (ft)	Bed Change End of Run (ft)	Worst Case Elevation	End of Run Elevation	Toe or Tip Elevation	Comparative Tolerance Elevation	At Risk? (Y/N)
199.91		932.10	-0.53	-0.28	931.57	931.83			
200.30	20" El Paso Natural Gas pipeline	937.70	-0.40	-0.07	937.30	937.63	922.00	929.85	N
200.77		936.90	-1.01	-0.67	935.89	936.23			
201.33		943.00	-0.79	-0.16	942.21	942.84			
201.81		946.00	-1.29	-0.37	944.71	945.63			
201.99		948.70	-2.67	-0.86	946.03	947.84			
202.29	12 KV SRP distribution line	955.50	-4.32	-1.93	951.18	953.57	no poles		
202.29	91st Avenue At GradeCrossing	955.50	-4.32	-1.93	951.18	953.57	955.50	953.50	Y
202.80		956.40	-5.22	-2.39	951.18	954.01			
203.29	500 KV SRP transmission line	960.70	-5.54	-2.64	955.16	958.06	no poles		
203.96		964.10	-6.71	-3.74	957.39	960.36			
204.34	69 KV SRP transmission line	969.30	-7.54	-4.88	961.76	964.42	937.00	952.00	N
204.78		967.60	-7.48	-5.36	960.12	962.24			
204.97		973.30	-6.82	-5.22	966.48	968.08			
205.15	12 KV SRP distribution line	973.10	-9.12	-8.27	963.98	964.83	no poles		
205.15	67th Avenue At Grade Crossing	973.10	-9.12	-8.27	963.98	964.83	973.10	971.10	Y
205.15	12" City of Phoenix water line	973.10	-9.12	-8.27	963.98	964.83	966.00	971.00	Y
206.03		984.50	-9.11	-8.56	975.39	975.94			
206.51	230 KV and 69 KV SRP transmission lines	981.80	-7.54	-7.49	974.26	974.31	no poles		
206.79		981.80	-3.26	-2.93	978.54	978.87			
206.88		981.70	-4.80	-4.80	976.90	976.90			
207.07		992.80	-8.88	-8.61	983.92	984.19			
207.27		993.30	-11.89	-11.75	981.41	981.55			
207.49	54" City of Phoenix sewer siphon	992.20	-11.11	-11.11	981.09	981.09	955.00	973.60	N
207.49	51st Avenue Bridge	992.20	-11.11	-11.11	981.09	981.09	925.00	958.60	N
207.49	8" Santa Fe Petroleum Pipeline (SPPL)	992.20	-11.11	-11.11	981.09	981.09	attached to bridge		
207.49	48" City of Phoenix sewer siphon	992.20	-11.11	-11.11	981.09	981.09	956.00	974.10	N
207.49	12 KV SRP distribution line	992.20	-11.11	-11.11	981.09	981.09	no poles		
207.49	6" Santa Fe Petroleum Pipeline (SPPL)	992.20	-11.11	-11.11	981.09	981.09	attached to bridge		
207.99	16" El Paso Natural Gas pipeline	999.90	-12.10	-12.10	987.80	987.80	987.20	993.55	Y
207.99	Two 230 KV WAPA transmission lines	999.90	-12.10	-12.10	987.80	987.80	no poles		
208.48	12 KV SRP distribution line	1007.60	-13.06	-13.06	994.54	994.54	no poles		
208.48	69 KV SRP transmission line	1007.60	-13.06	-13.06	994.54	994.54	978.00	992.80	N
208.95		1013.80	-15.09	-15.09	998.71	998.71			

Salt River Sediment Trend Analysis

Table 4 - Results With Additional Mining (20 ft Average Depth)

26-Dec-96
wmine.wk4

Approx. River Mile	Description	Minimum Channel Elevation	Bed Change Worst Case (ft)	Bed Change End of Run (ft)	Worst Case Elevation	End of Run Elevation	Toe or Tip Elevation	Comparative Tolerance Elevation	At Risk? (Y/N)
209.33		1012.00	-12.96	-12.63	999.04	999.38			
209.54	35th Avenue Bridge	1009.40	-11.04	-10.61	998.36	998.79	930.00	969.70	N
209.54	48" City of Phoenix water line	1009.40	-11.04	-10.61	998.36	998.79	1008.00	1013.00	Y
210.07		1018.50	-5.99	-5.54	1012.51	1012.96			
210.36		1017.40	-4.55	-3.13	1012.85	1014.27			
210.64		1017.70	-2.61	-1.59	1015.09	1016.11			
210.93		1018.70	-1.93	-1.93	1016.77	1016.77			
211.21		1021.10	-3.34	-3.34	1017.76	1017.76			
211.37		1027.10	-4.57	-4.57	1022.53	1022.53			
211.41		1028.00	-6.08	-6.08	1021.92	1021.92			
211.45	12 KV SRP distribution line	1027.10	-7.71	-7.71	1019.39	1019.39	attached to bridge		
211.45	19th Ave Bridge	1027.10	-7.71	-7.71	1019.39	1019.39	915.00	967.50	N
211.45	GCS downstream of 19th Avenue	1027.10	-7.71	-7.71	1019.39	1019.39	980.83	980.83	N
211.45	8" and 20" City of Phoenix water lines	1027.10	-7.71	-7.71	1019.39	1019.39	attached to bridge		
211.89		1029.90	-10.00	-10.00	1019.90	1019.90			
212.37		1036.60	-11.69	-11.69	1024.91	1024.91			
212.68	7th Ave Bridge	1036.90	-10.50	-10.50	1026.40	1026.40	945.00	990.95	N
213.26	US WEST telephone duct	1040.40	-6.89	-6.89	1033.51	1033.51	attached to bridge		
213.26	Central Avenue Bridge	1040.40	-6.89	-6.89	1033.51	1033.51	1010.00	1025.20	N
213.75	7th Street Bridge	1044.60	-3.30	-3.30	1041.30	1041.30	945.00	994.80	N
213.75	US SPRINT telephone duct	1044.60	-3.30	-3.30	1041.30	1041.30	attached to bridge		
213.75	10" Southwest Gas gas pipeline	1044.60	-3.30	-3.30	1041.30	1041.30	1042.00	1047.00	Y
214.14		1048.70	-0.17	-0.02	1048.53	1048.68			
214.52		1048.00	0.00	1.01	1048.00	1049.01			
214.79	36" City of Phoenix water line	1057.60	0.00	1.34	1057.60	1058.94	1038.00	1048.40	N
214.79	16th Street Bridge	1057.60	0.00	1.34	1057.60	1058.94	950.00	1004.40	N
214.79	36" City of Phoenix water line	1057.60	0.00	1.34	1057.60	1058.94	1043.00	1050.90	N
214.79	12KV SRP distribution line	1057.60	0.00	1.34	1057.60	1058.94	attached to bridge		
215.09		1061.70	-1.15	-0.89	1060.55	1060.82			
215.65		1068.30	-3.96	-3.62	1064.34	1064.68			
215.82	24th Street Bridge	1076.00	-4.89	-4.63	1071.11	1071.37	1013.00	1044.50	N
216.29		1080.80	-4.38	-4.18	1076.42	1076.62			
216.33	GCS downstream of I-10	1082.00	-2.45	-2.31	1079.55	1079.69	1075.50	1075.50	N
216.37		1080.80	-2.46	-2.19	1078.34	1078.61			

Salt River Sediment Trend Analysis

Table 4 - Results With Additional Mining (20 ft Average Depth)

26-Dec-96
wmine.wk4

Approx. River Mile	Description	Minimum Channel Elevation	Bed Change Worst Case (ft)	Bed Change End of Run (ft)	Worst Case Elevation	End of Run Elevation	Toe or Tip Elevation	Comparative Tolerance Elevation	At Risk? (Y/N)
216.52	I-10 Bridge	1083.20	-1.35	-1.08	1081.85	1082.12	1070.00	1068.20	N
217.00		1085.70	-3.48	-3.32	1082.22	1082.38			
217.82	APS transmission line	1101.30	-4.90	-4.73	1096.40	1096.57	1004.00	1044	N
217.86	GCS between I-10 and SR 153	1101.30	-7.24	-7.02	1094.06	1094.28	1057.20	1057.20	N
217.90	City of Phoenix water lines in Salt River	1101.30	-5.80	-5.46	1095.50	1095.84	varies		
217.90	City of Phoenix sewer lines in Salt River	1101.30	-5.80	-5.46	1095.50	1095.84	varies		
218.33		1102.70	-4.44	-4.35	1098.26	1098.35			
218.92	60" City of Phoenix water line	1112.80	-3.29	-3.29	1109.51	1109.51	1086.00	1098.50	N
218.92	GCS downstream of SR 153	1112.80	-3.29	-3.29	1109.51	1109.51	1075.40	1075.40	N
218.96	SR-153 Sky Harbor Expressway Bridge	1113.50	-3.14	-3.14	1110.36	1110.36	1037.00	1074.90	N
219.00		1112.80	-2.72	-2.72	1110.08	1110.08			
219.03	US WEST and AT&T telephone duct	1112.90	-2.51	-2.51	1110.39	1110.39	1097.50	1106.85	N
219.03	18" City of Phoenix sewer siphon	1112.90	-2.51	-2.51	1110.39	1110.39	1099.00	1106.85	N
219.03	12" Southwest Gas gas pipeline	1112.90	-2.51	-2.51	1110.39	1110.39	1096.00	1105.35	N
219.03	SR-143 Hohokam Freeway Bridge	1112.90	-2.51	-2.51	1110.39	1110.39	1045.00	1078.95	N
219.03	48" City of Phoenix sewer siphon	1112.90	-2.51	-2.51	1110.39	1110.39	1097.00	1105.85	N
219.51		1117.30	-3.00	-3.00	1114.30	1114.30			
220.04		1122.90	-4.00	-4.00	1118.90	1118.90			
220.06	69 KV SRP transmission line	1122.90	-3.52	-3.52	1119.38	1119.38	no poles		
220.06	69 KV APS transmission line	1122.90	-3.52	-3.52	1119.38	1119.38	no poles		
220.06	36" City of Tempe water line	1122.90	-3.52	-3.52	1119.38	1119.38	1116.00	1121.00	Y
220.06	Priest Drive Bridge	1122.90	-3.52	-3.52	1119.38	1119.38	1100.00	1107.90	N
220.06	48" City of Tempe sewer siphon	1122.90	-3.52	-3.52	1119.38	1119.38	1116.00	1121.00	Y
220.88	6" Southwest Gas gas pipeline	1126.00	-2.06	-2.06	1123.94	1123.94	1124.00	1129.00	Y
220.92	GCS downstream of Southern Pacific Railroad	1129.40	-1.02	-0.97	1128.38	1128.43	1101.00	1101.00	N
220.96	Southern Pacific Transportation Company line	1126.00	-0.85	-0.81	1125.15	1125.19	attached to bridge		
220.96	12 KV APS distribution line	1126.00	-0.85	-0.81	1125.15	1125.19	no poles		
220.96	MCI Communications line	1126.00	-0.85	-0.81	1125.15	1125.19	attached to bridge		
220.96	Southern Pacific Railroad Bridge	1126.00	-0.85	-0.81	1125.15	1125.19	1100.00	1111.00	N
221.19	APS distribution duct	1126.00	-1.35	-1.30	1124.65	1124.70	attached to bridge		
221.19	230 KV SRP transmission line	1126.00	-1.35	-1.30	1124.65	1124.70	no poles		
221.19	Old Mill Avenue Bridge	1126.00	-1.35	-1.30	1124.65	1124.70	1100.00	1113.00	N
221.19	12" City of Tempe reclaimed water line	1126.00	-1.35	-1.30	1124.65	1124.70	attached to bridge		
221.19	US WEST telephone duct	1126.00	-1.35	-1.30	1124.65	1124.70	attached to bridge		

Salt River Sediment Trend Analysis

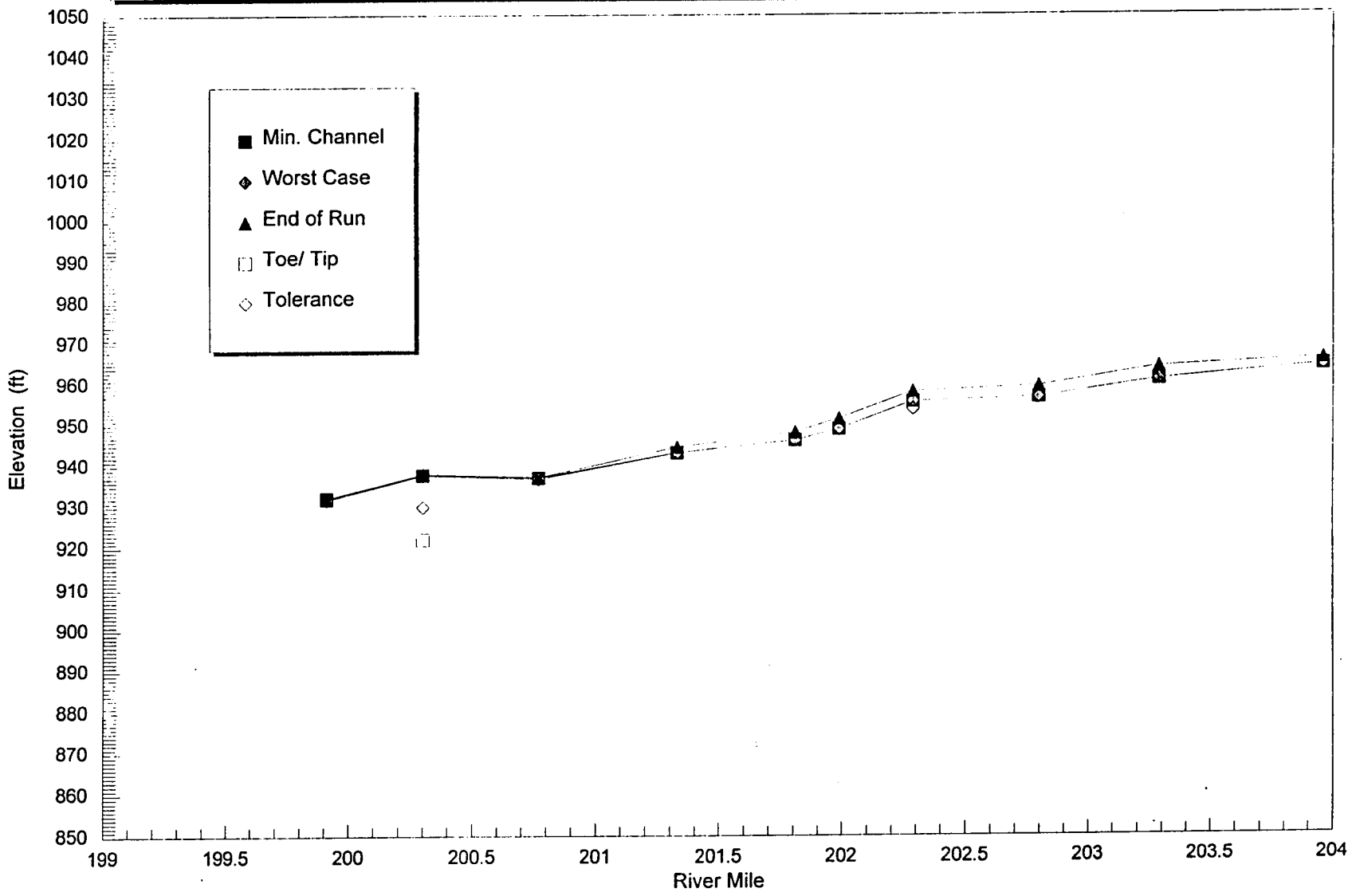
Table 4 - Results With Additional Mining (20 ft Average Depth)

26-Dec-96
wmine.wk4

Approx. River Mile	Description	Minimum Channel Elevation	Bed Change Worst Case (ft)	Bed Change End of Run (ft)	Worst Case Elevation	End of Run Elevation	Toe or Tip Elevation	Comparative Tolerance Elevation	At Risk? (Y/N)
221.26	8" Southwest Gas gas line	1130.00	-1.56	-1.56	1128.44	1128.44	attached to bridge		
221.26	New Mill Avenue Bridge	1130.00	-1.56	-1.56	1128.44	1128.44	1114.00	1115.00	N
221.26	US WEST telephone duct	1130.00	-1.56	-1.56	1128.44	1128.44	attached to bridge		
221.26	6" AP&C Nitrogen Gas line	1130.00	-1.56	-1.56	1128.44	1128.44	attached to bridge		
221.26	12" City of Tempe water main	1130.00	-1.56	-1.56	1128.44	1128.44	attached to bridge		
221.70		1134.00	-2.58	-2.30	1131.42	1131.70			
222.09	Rural Road Bridge	1136.00	-2.89	-2.50	1133.11	1133.50	1085.00	1110.50	N
222.09	US WEST telephone cable	1136.00	-2.89	-2.50	1133.11	1133.50	attached to bridge		
222.09	21"/18" City of Tempe sewer siphon	1136.00	-2.89	-2.50	1133.11	1133.50	1126.00	1131.00	N
222.09	30" City of Tempe water line	1136.00	-2.89	-2.50	1133.11	1133.50	1125.00	1130.50	N
222.55	230 KV and 69KV SRP transmission lines	1139.00	-5.07	-5.07	1133.93	1133.93	no poles		
222.93	69 KV APS transmission line	1140.00	-4.15	-4.15	1135.85	1135.85	1046.00	1095	N
223.07	12" Southwest Gas gas pipeline	1150.00	-3.46	-3.46	1146.54	1146.54	1126.00	1137.00	N
223.07	36" City of Tempe water line	1146.30	-3.46	-3.46	1142.84	1142.84	1141.50	1146.50	Y
223.07	18" City of Mesa sewer siphon	1150.00	-3.46	-3.46	1146.54	1146.54	1126.50	1137.25	N
223.07	21" City of Mesa sewer siphon	1150.00	-3.46	-3.46	1146.54	1146.54	1127.00	1137.50	N
223.07	10" Southwest Gas gas pipeline	1150.00	-3.46	-3.46	1146.54	1146.54	1126.00	1137.00	N
223.09	GCS downstream of McClintock Drive	1146.30	-0.50	-0.50	1145.80	1145.80	1131.20	1131.20	N
223.11	McClintock Drive Bridge	1150.00	0.00	2.49	1150.00	1152.49	1046.00	1096.15	N
223.67	Loop 202, Red Mountain Freeway Bridge	1132.70	0.00	4.33	1132.70	1137.03	1010.00	1073.15	N
224.09	Loop 101, Pima Freeway Bridge	1152.00	0.00	6.39	1152.00	1158.39	1038.00	1095.00	N
224.25		1152.00	-0.45	3.38	1151.55	1155.38			
224.43		1158.40	-4.34	1.66	1154.06	1160.06			
224.81		1162.10	-6.81	-0.75	1155.29	1161.35			
225.28		1163.00	-8.22	-0.76	1154.78	1162.24			
225.66		1158.80	-9.32	-2.76	1149.48	1156.04			
226.04		1173.10	-20.97	-14.37	1152.13	1158.73			
226.23		1177.60	-17.82	-14.37	1159.78	1163.23			
226.48		1180.50	-13.58	-12.49	1166.92	1168.01			
226.52	GCS downstream of Alma School Road	1186.00	-0.14	-0.11	1185.86	1185.89	1161.00	1161.00	N
226.52		1186.00	-0.14	-0.11	1185.86	1185.89			
226.56	12 KV SRP distribution line	1180.50	-1.64	-1.64	1178.86	1178.86	no poles		
226.56	Alma School Road Bridges	1180.50	-1.64	-1.64	1178.86	1178.86	1148.00	1164.25	N
226.80	McKellips Road At Grade Crossing	1191.70	-3.57	-3.48	1188.13	1188.22	1191.70	1189.70	Y

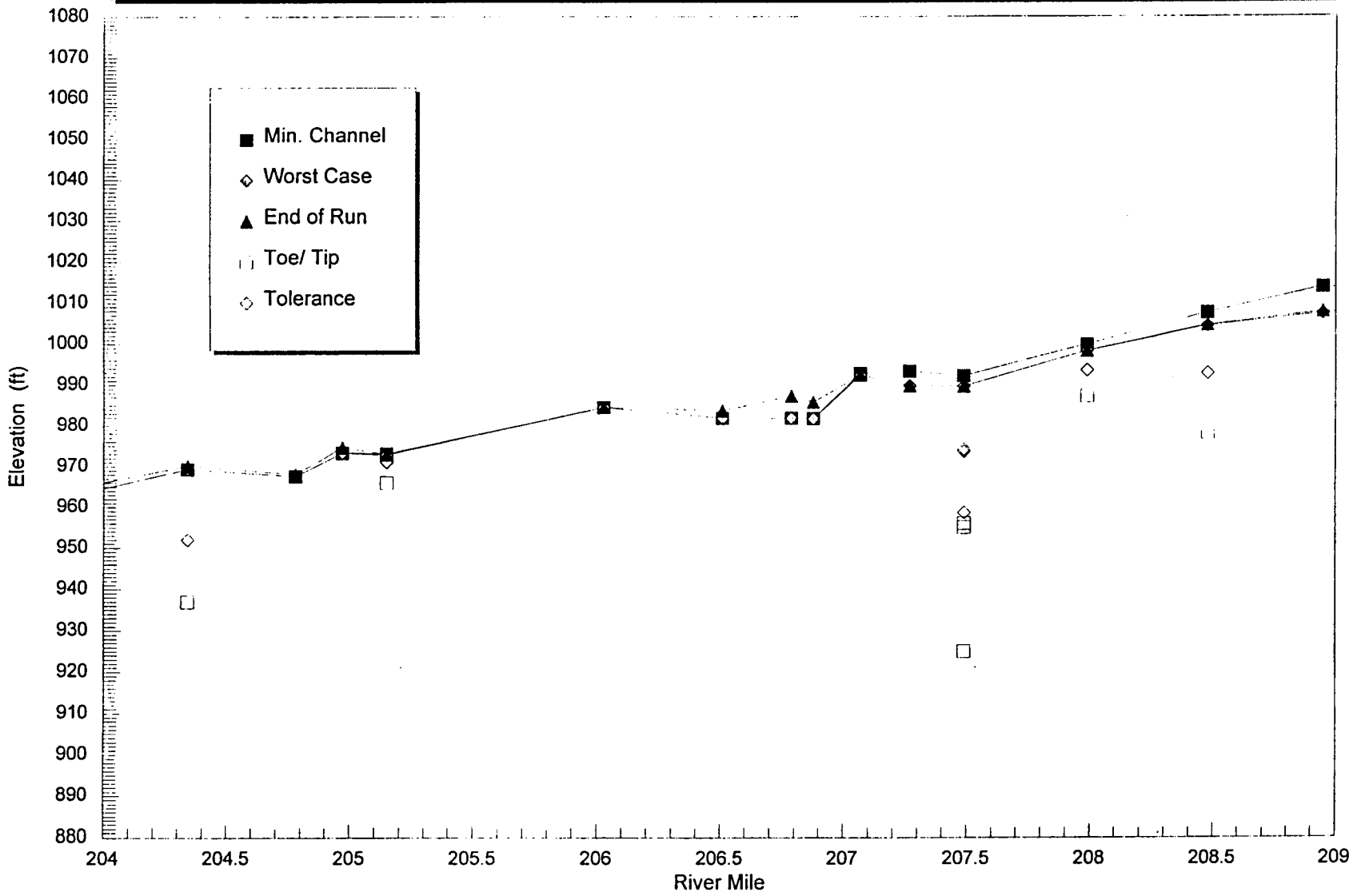
Salt River Sediment Trend Analysis

Figure 16 - Without Additional Mining: River Mile 199-204



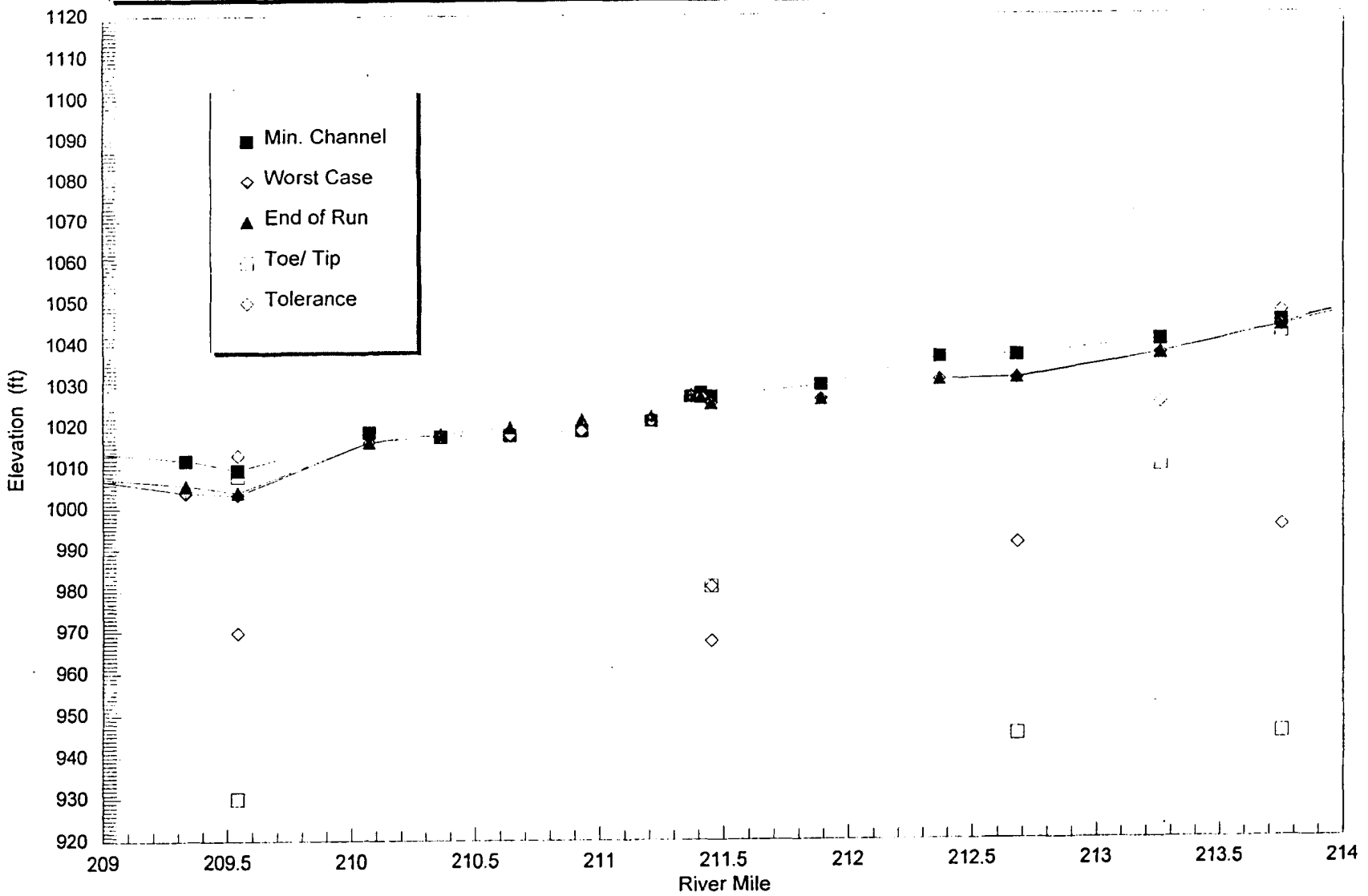
Salt River Sediment Trend Analysis

Figure 17 - Without Additional Mining: River Mile 204-209



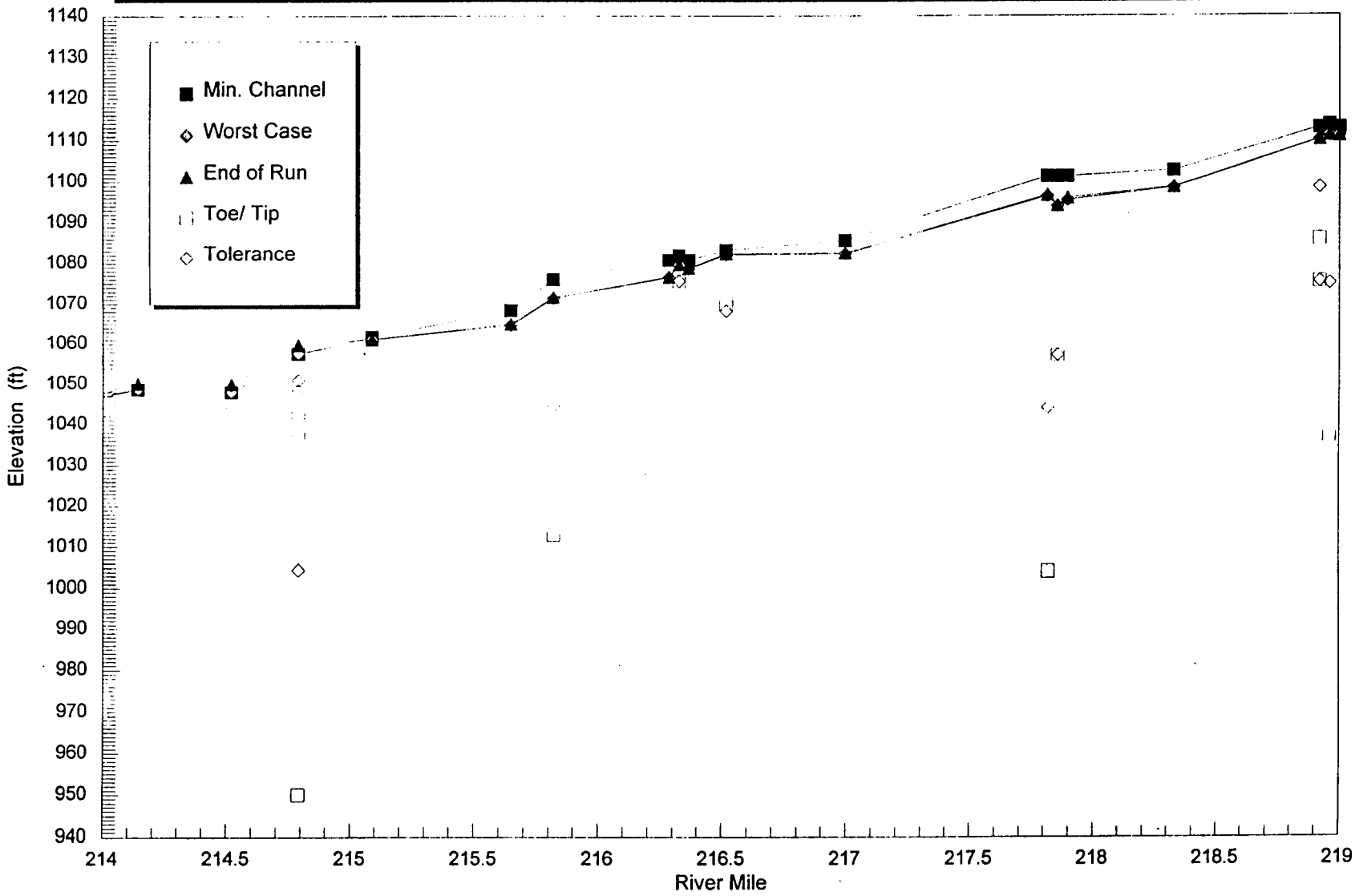
Salt River Sediment Trend Analysis

Figure 18 - Without Additional Mining: River Mile 209-214



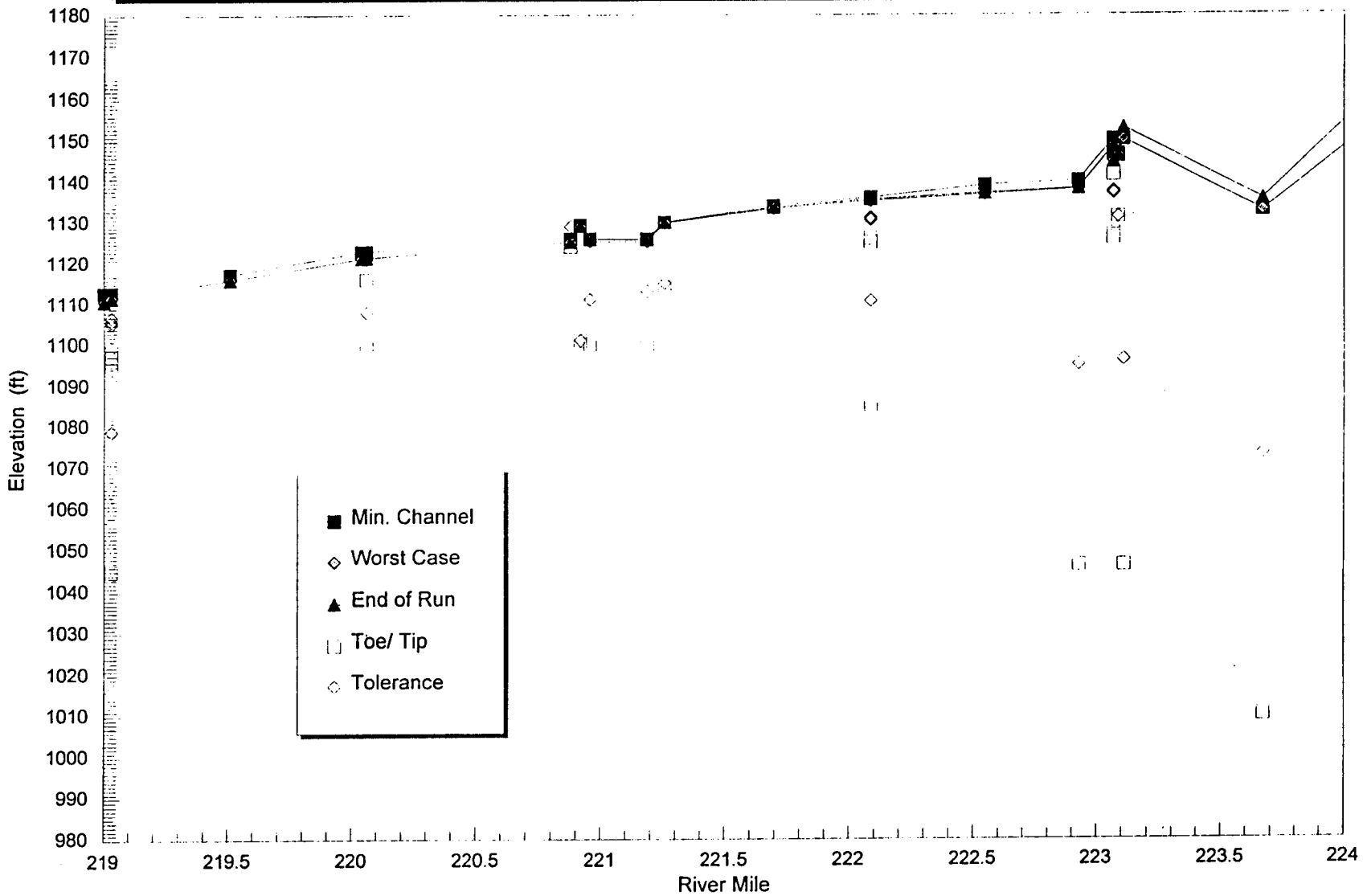
Salt River Sediment Trend Analysis

Figure 19 - Without Additional Mining: River Mile 214-219



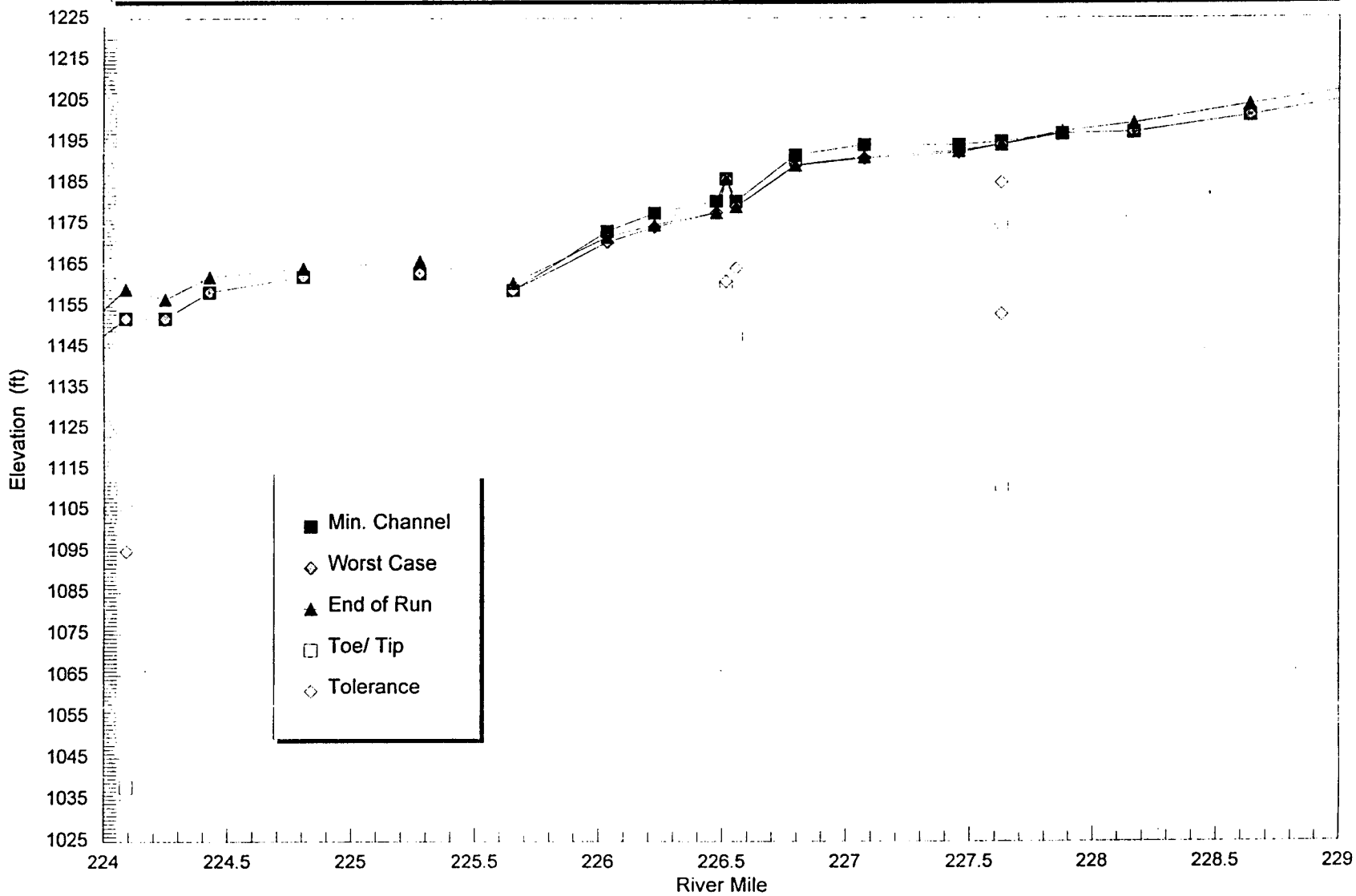
Salt River Sediment Trend Analysis

Figure 20 - Without Additional Mining: River Mile 219-224



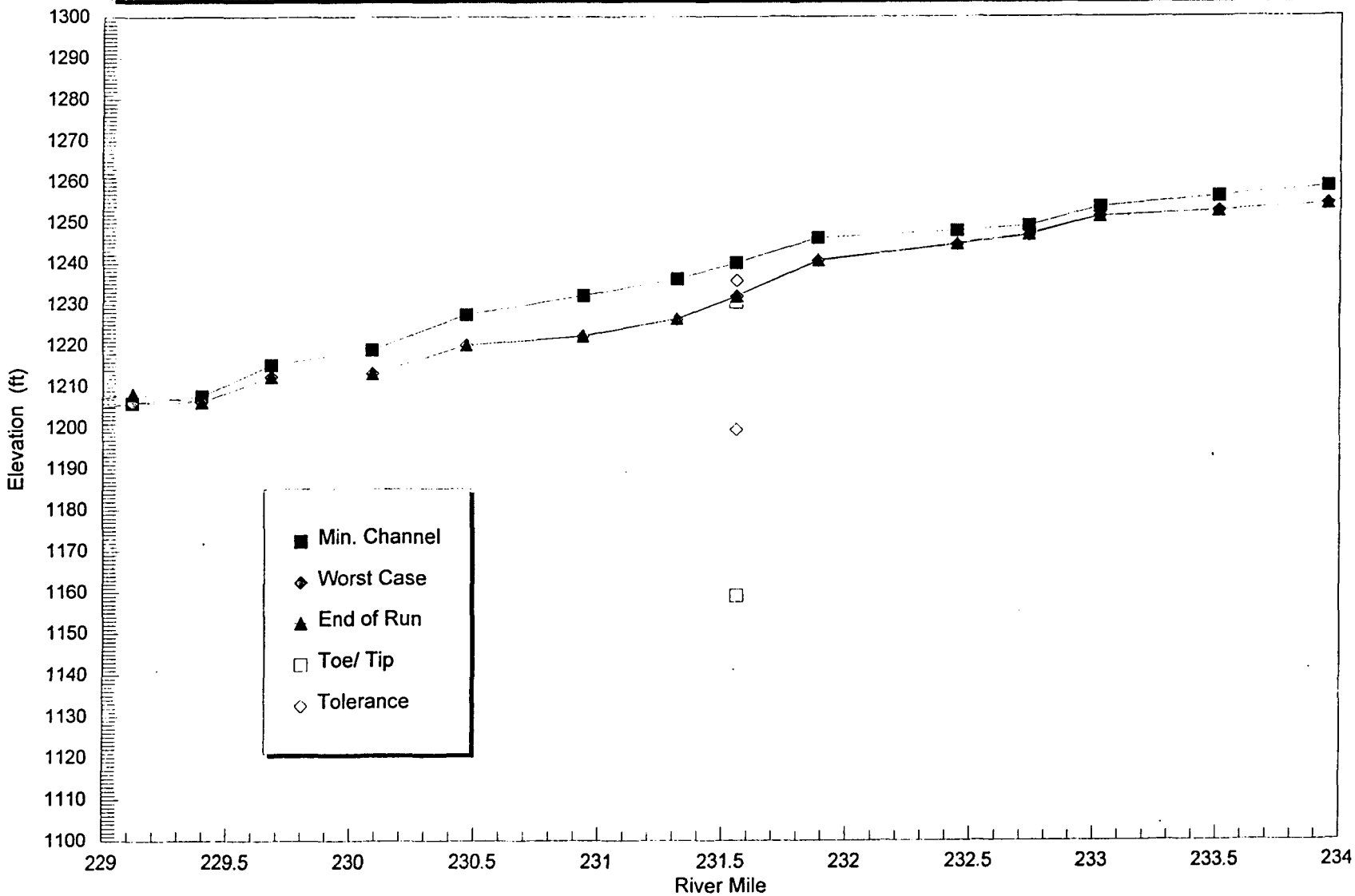
Salt River Sediment Trend Analysis

Figure 21 - Without Additional Mining: River Mile 224-229



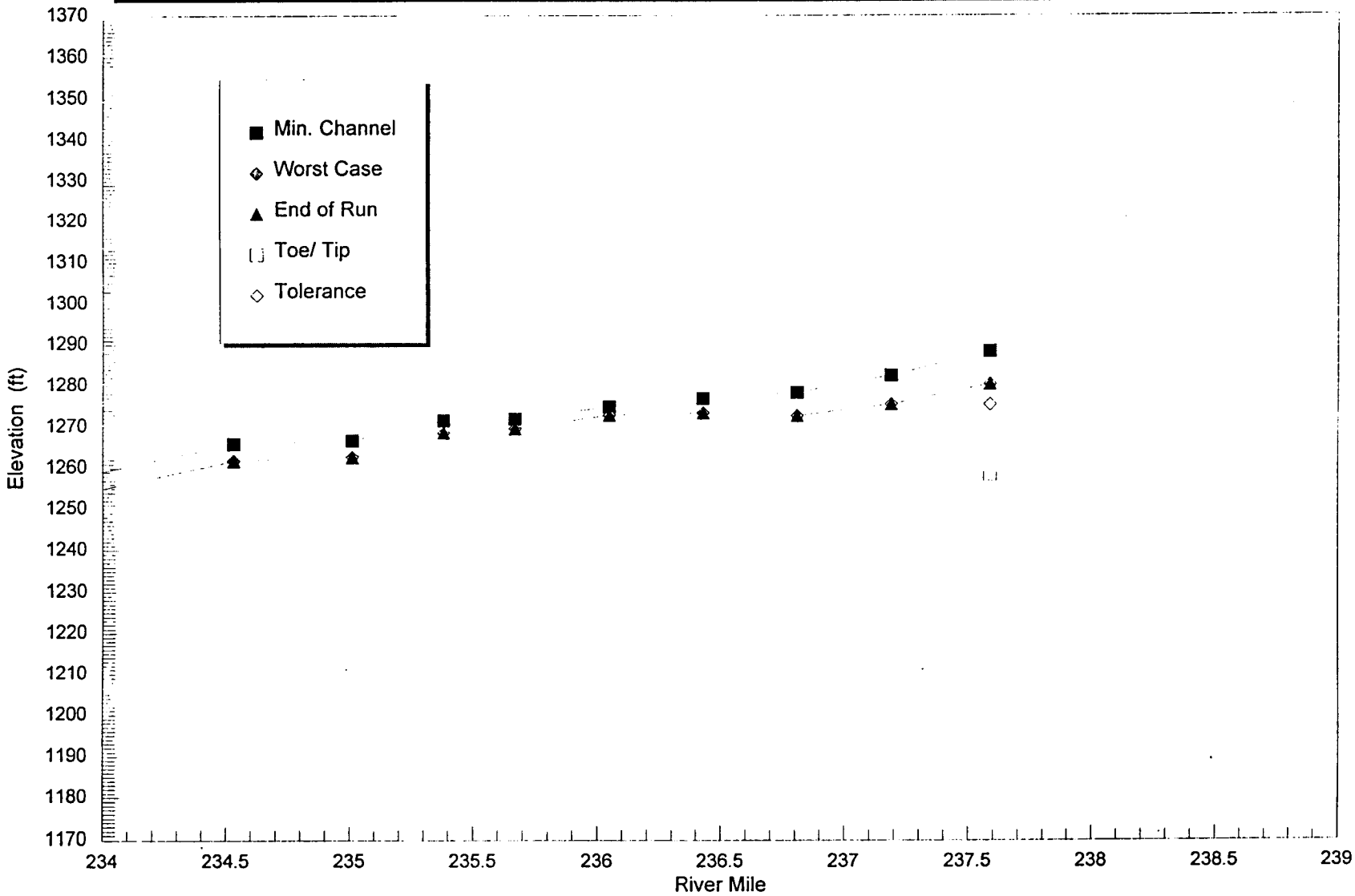
Salt River Sediment Trend Analysis

Figure 22 - Without Additional Mining: River Mile 229-234



Salt River Sediment Trend Analysis

Figure 23 - Without Additional Mining: River Mile 234-239



Salt River Sediment Trend Analysis

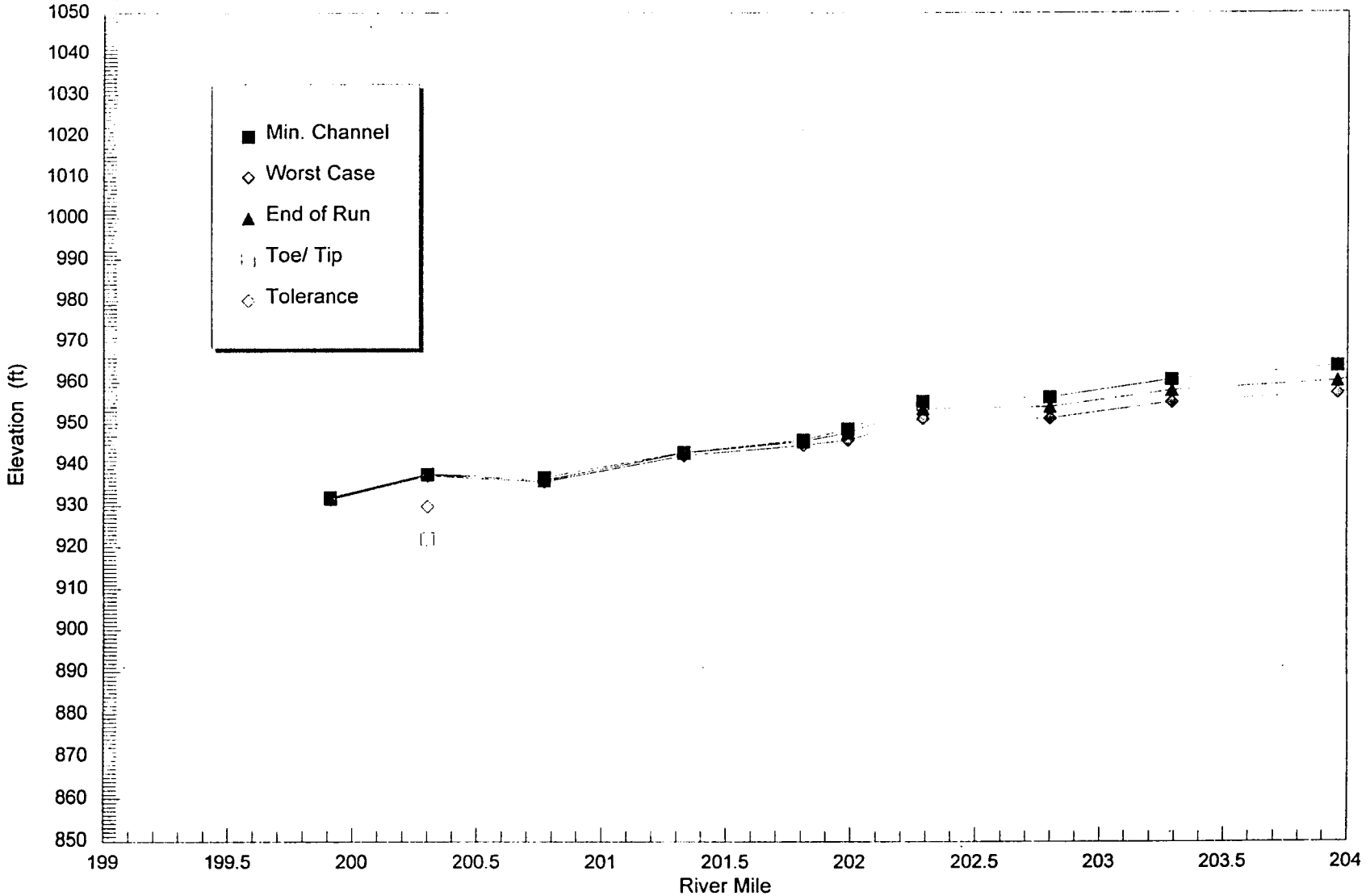
Table 4 - Results With Additional Mining (20 ft Average Depth)

26-Dec-96
wmine.wk4

Approx. River Mile	Description	Minimum Channel Elevation	Bed Change Worst Case (ft)	Bed Change End of Run (ft)	Worst Case Elevation	End of Run Elevation	Toe or Tip Elevation	Comparative Tolerance Elevation	At Risk? (Y/N)
227.08		1194.10	-5.64	-4.72	1188.46	1189.38			
227.46		1194.10	-4.78	-3.87	1189.32	1190.23			
227.63	4" City of Mesa gas pipeline	1194.90	-4.50	-3.13	1190.40	1191.77	1175.20	1185.05	N
227.63	Country Club Drive Bridge	1194.90	-4.50	-3.13	1190.40	1191.77	1111.00	1152.95	N
227.88		1196.80	-4.11	-2.16	1192.69	1194.64			
228.17		1197.20	-3.52	-1.54	1193.68	1195.66			
228.64		1201.30	-4.31	-2.25	1196.99	1199.05			
229.12		1206.10	-5.52	-3.56	1200.58	1202.54			
229.40		1207.70	-8.30	-6.18	1199.40	1201.53			
229.68		1215.40	-11.41	-8.23	1203.99	1207.17			
230.09		1219.00	-12.69	-10.35	1206.31	1208.65			
230.47		1227.40	-14.41	-11.93	1212.99	1215.47			
230.94		1232.00	-16.33	-14.66	1215.67	1217.35			
231.32		1236.00	-17.03	-16.02	1218.97	1219.98			
231.56	Gilbert Road Bridge	1239.90	-17.33	-17.33	1222.57	1222.57	1159.00	1199.45	N
231.56	Two 230 KV WAPA transmission lines	1239.90	-17.33	-17.33	1222.57	1222.57	1230.50	1235.50	Y
231.89		1246.10	-17.93	-17.93	1228.17	1228.17			
232.45		1247.80	-15.06	-15.06	1232.74	1232.74			
232.74		1249.10	-12.47	-12.47	1236.63	1236.63			
233.03		1253.70	-8.40	-8.40	1245.30	1245.30			
233.51		1256.20	-9.18	-9.18	1247.02	1247.02			
233.95	Grusp canal crossing	1258.50	-9.48	-9.48	1249.02	1249.02	at grade		
234.53		1265.80	-10.43	-10.43	1255.37	1255.37			
235.01		1266.70	-12.20	-12.20	1254.50	1254.50			
235.38		1271.50	-13.28	-13.28	1258.22	1258.22			
235.67		1271.90	-14.06	-14.06	1257.84	1257.84			
236.05		1274.80	-12.96	-12.96	1261.84	1261.84			
236.43		1276.80	-13.40	-13.13	1263.40	1263.67			
236.81		1278.30	-13.97	-13.36	1264.33	1264.94			
237.19		1282.50	-15.62	-13.66	1266.88	1268.84			
237.59	69 KV SRP transmission line	1288.40	-16.19	-13.66	1272.21	1274.74	no poles		
237.59	21' CAP Canal siphon	1288.40	-16.19	-13.66	1272.21	1274.74	1258.40	1275.40	Y

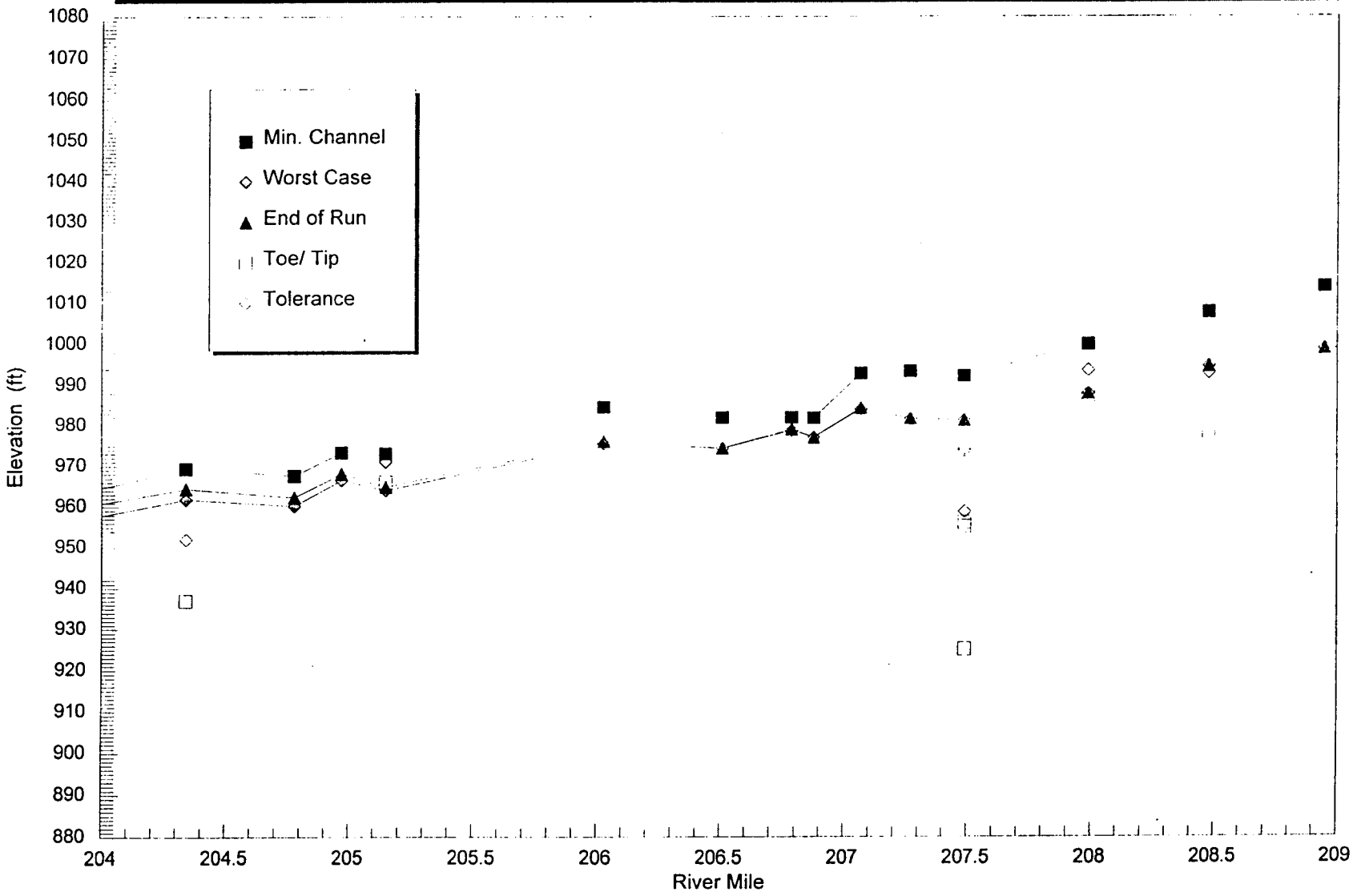
Salt River Sediment Trend Analysis

Figure 24 - With Additional Mining: River Mile 199-204



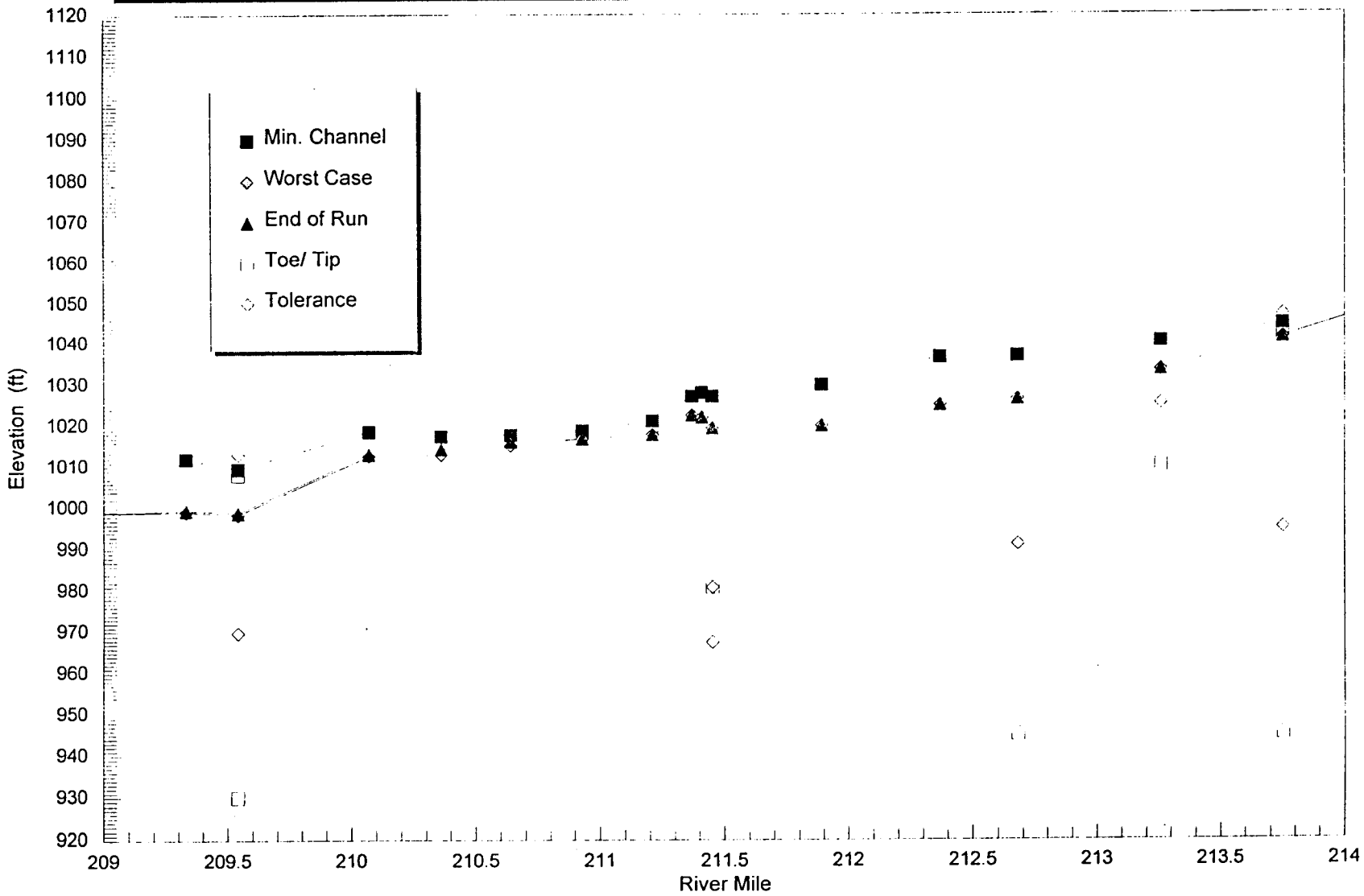
Salt River Sediment Trend Analysis

Figure 25 - With Additional Mining: River Mile 204-209



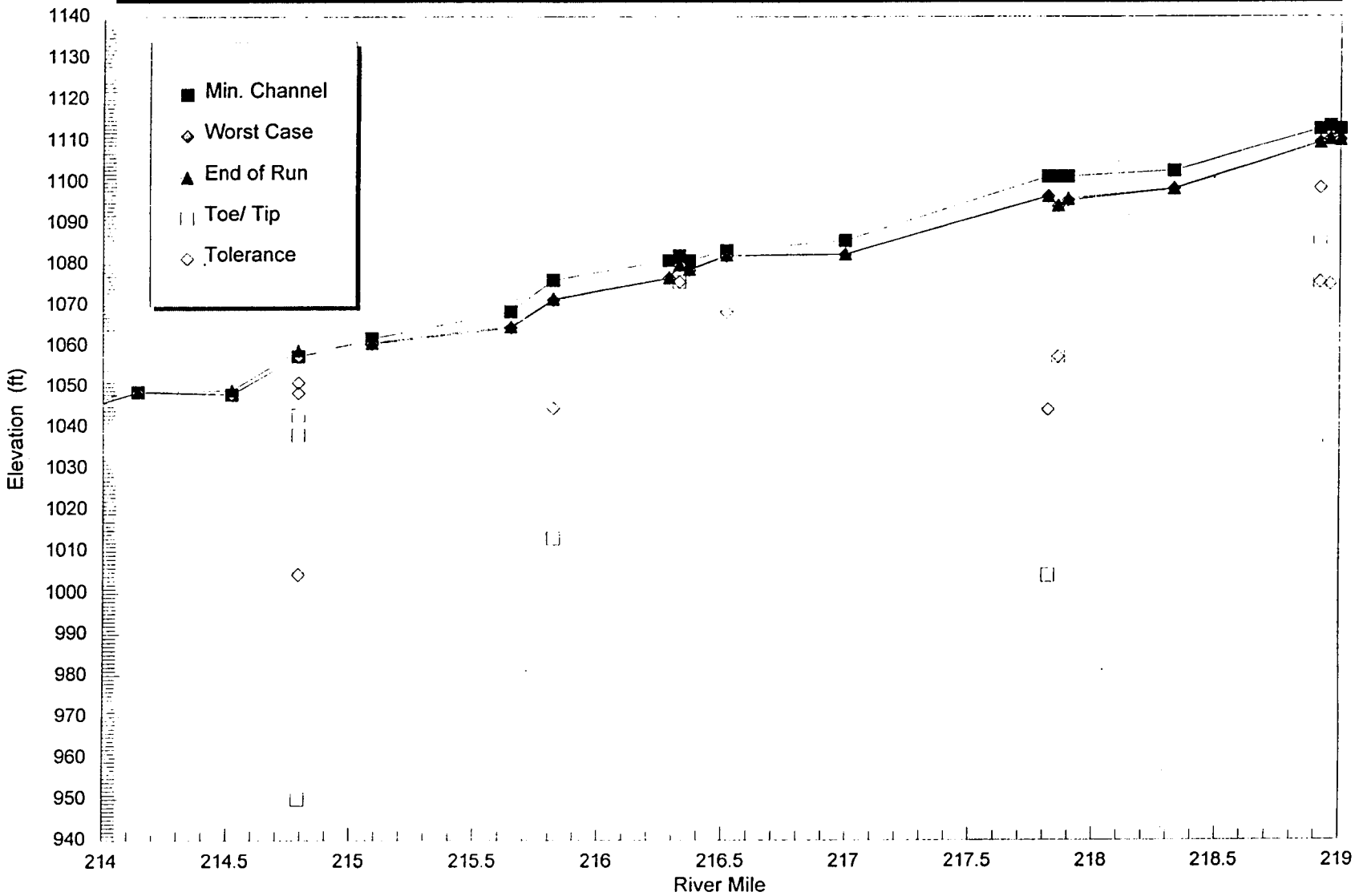
Salt River Sediment Trend Analysis

Figure 26 - With Additional Mining: River Mile 209-214



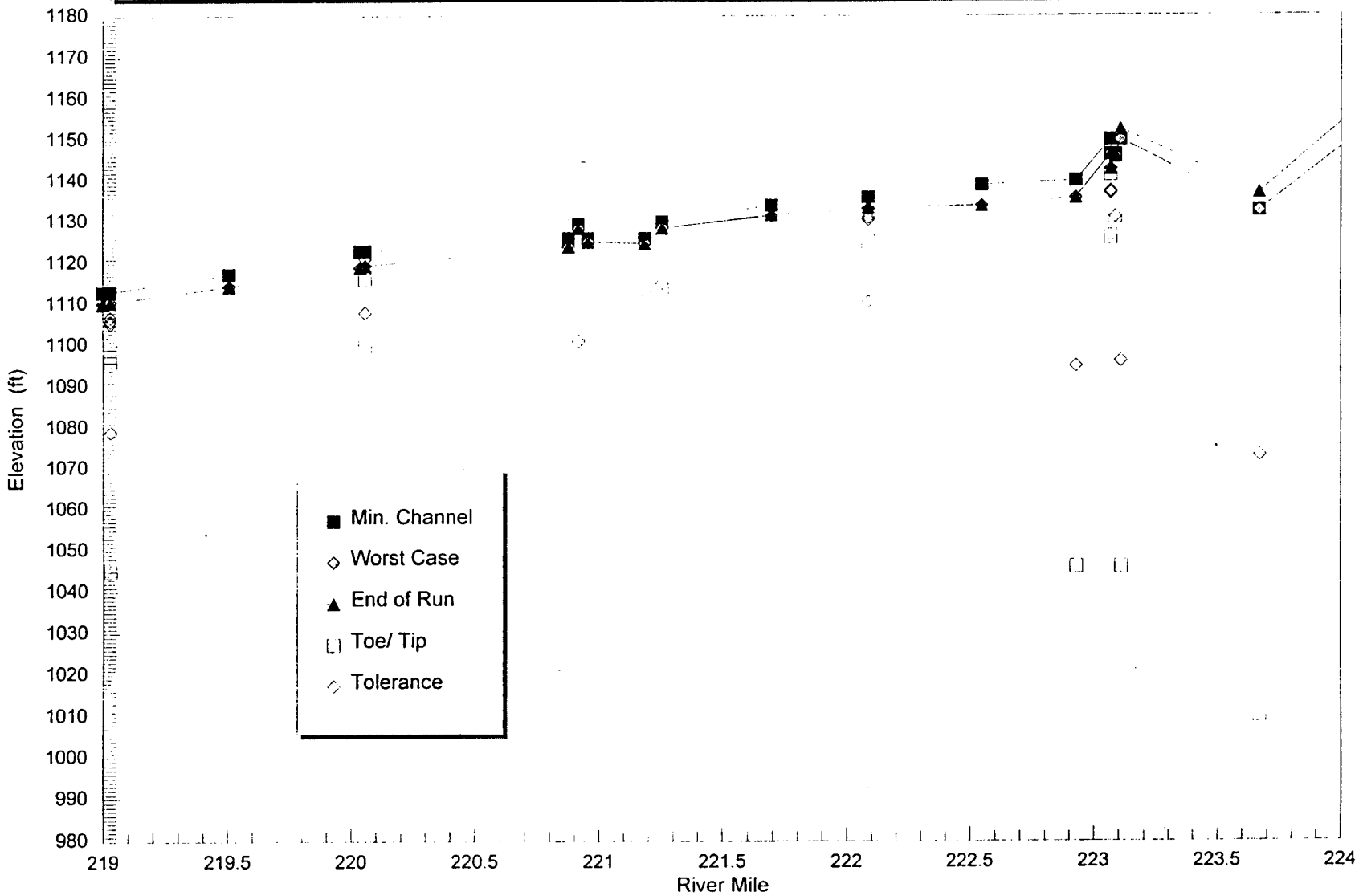
Salt River Sediment Trend Analysis

Figure 27 - With Additional Mining: River Mile 214-219



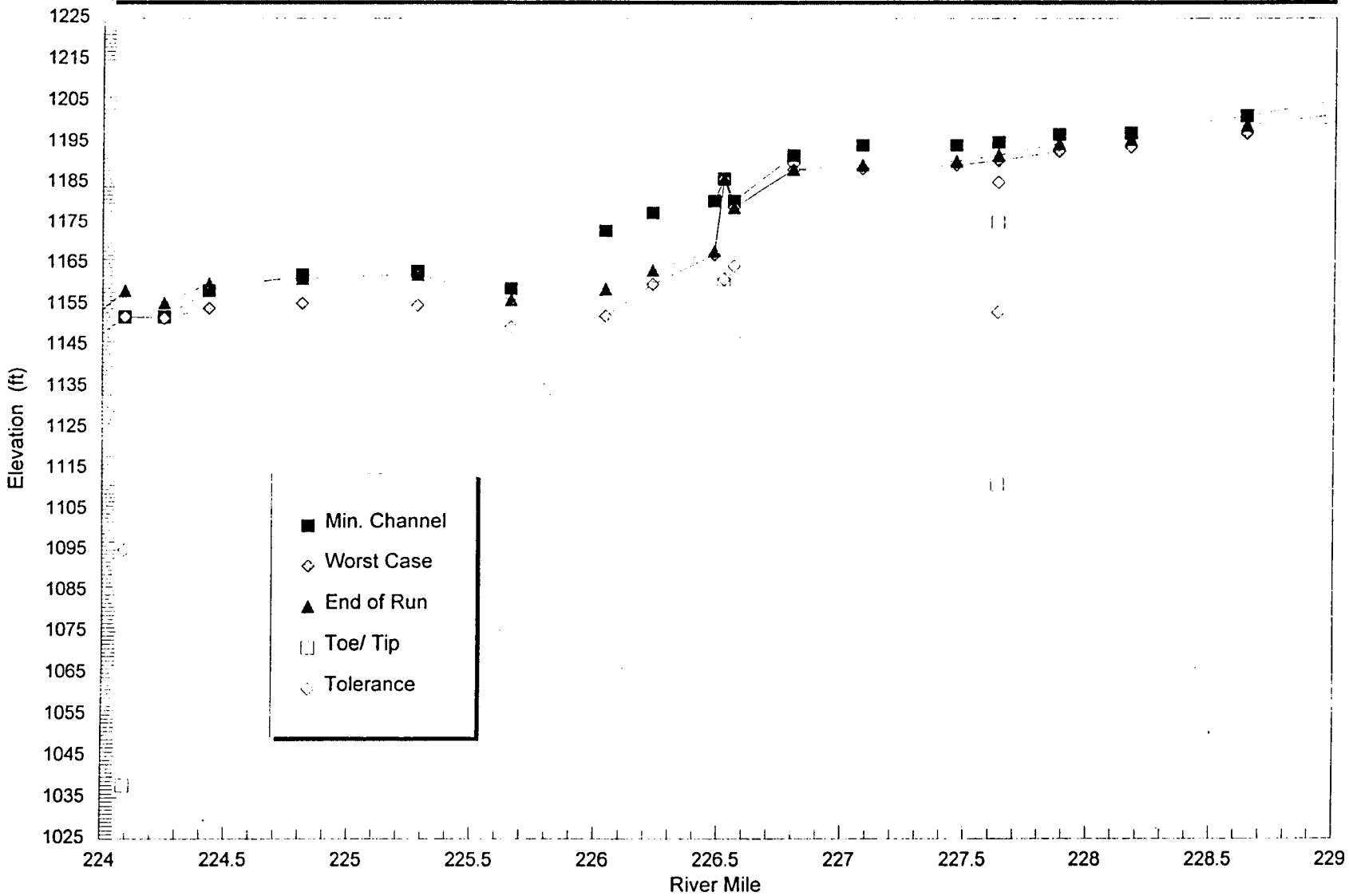
Salt River Sediment Trend Analysis

Figure 28 - With Additional Mining: River Mile 219-224



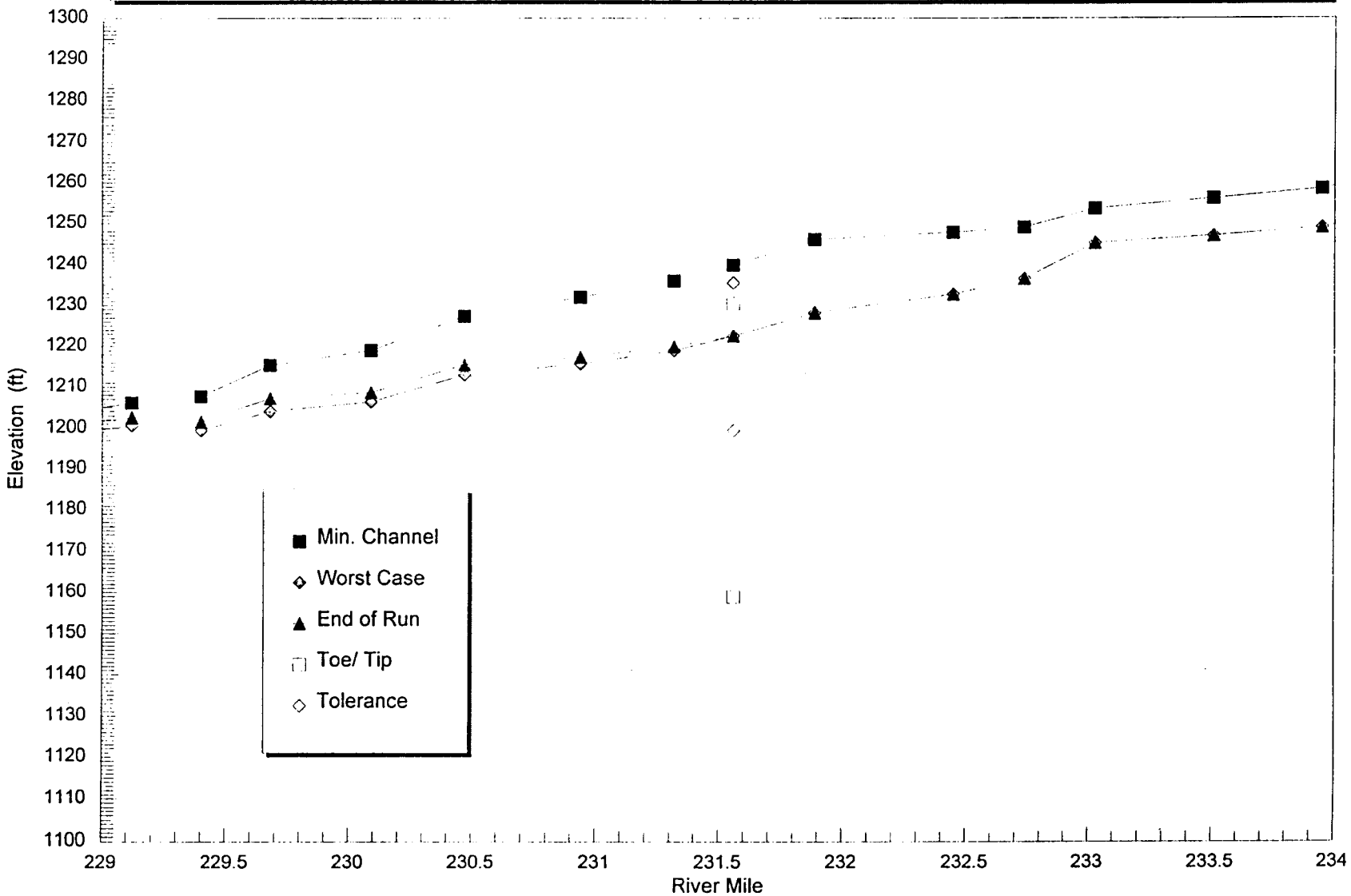
Salt River Sediment Trend Analysis

Figure 29 - With Additional Mining: River Mile 224-229



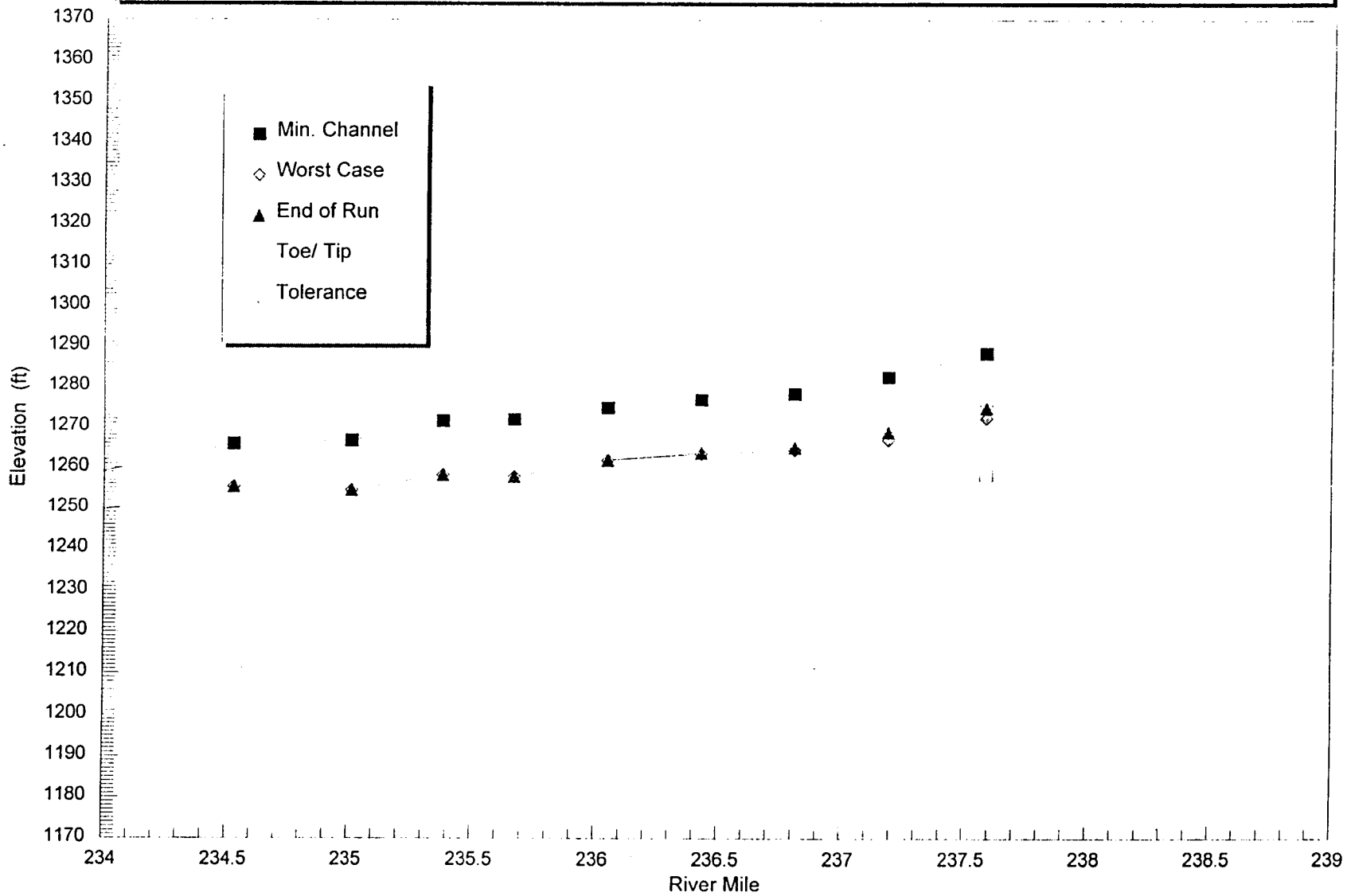
Salt River Sediment Trend Analysis

Figure 30 - With Additional Mining: River Mile 229-234



Salt River Sediment Trend Analysis

Figure 31 - With Additional Mining: River Mile 234-239



Salt River Sediment Trend Analysis
Table 5 - Infrastructure Potentially at Risk: Without Additional Mining

26-Dec-96
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Approx. River Mile	Description	Starting Channel Elev.	Worst Case Elevation	Toe or Tip Elevation	Comparative Tolerance Elevation	Calculated Starting Embedment	Calculated Remaining Embedment
209.54	48" City of Phoenix water line	1009.40	1003.36	1008.00	1013.00	1.40	0.00
213.75	10" Southwest Gas gas pipeline	1044.60	1043.39	1042.00	1047.00	2.60	0.00
220.88	6" Southwest Gas gas pipeline	1126.00	1125.20	1124.00	1129.00	2.00	0.00
223.07	36" City of Tempe water line	1146.30	1144.65	1141.50	1146.50	4.80	3.15
226.80	McKellips Road At Grade Crossing	1191.70	1189.16	1191.70	1189.70	0.00	0.00
231.56	Two 230 KV WAPA transmission lines	1239.90	1231.89	1230.50	1235.50	9.40	0.00

Salt River Sediment Trend Analysis
Table 6 - Infrastructure Potentially at Risk: With Additional Mining

Approx. River Mile	Description	Starting Channel Elev.	Worst Case Elevation	Toe or Tip Elevation	Comparative Tolerance Elevation	Calculated Starting Embedment	Calculated Remaining Embedment
202.29	91st Avenue At GradeCrossing	955.50	951.18	955.50	953.50	0.00	0.00
205.15	67th Avenue At Grade Crossing	973.10	963.98	973.10	971.10	0.00	0.00
205.15	12" City of Phoenix water line	973.10	963.98	966.00	971.00	7.10	0.00
207.99	16" El Paso Natural Gas pipeline	999.90	987.80	987.20	993.55	12.70	0.60
209.54	48" City of Phoenix water line	1009.40	998.36	1008.00	1013.00	1.40	0.00
213.75	10" Southwest Gas gas pipeline	1044.60	1041.30	1042.00	1047.00	2.60	0.00
220.06	36" City of Tempe water line	1122.90	1119.38	1116.00	1121.00	6.90	3.38
220.06	48" City of Tempe sewer siphon	1122.90	1119.38	1116.00	1121.00	6.90	3.38
220.88	6" Southwest Gas gas pipeline	1126.00	1123.94	1124.00	1129.00	2.00	0.00
223.07	36" City of Tempe water line	1146.30	1142.84	1141.50	1146.50	4.80	1.34
226.80	McKellips Road At Grade Crossing	1191.70	1188.13	1191.70	1189.70	0.00	0.00
231.56	Two 230 KV WAPA transmission lines	1239.90	1222.57	1230.50	1235.50	9.40	0.00
237.59	21' CAP Canal siphon	1288.40	1272.21	1258.40	1275.40	30.00	13.81

6.0 Conclusions and Recommendations

The purpose of this study was to evaluate the channel bed profile changes in the Salt River system due to additional sand and gravel mining activities and to determine the impacts these channel bed profile changes would have on infrastructure.

The results show that the Salt River system will continue to degrade with or without additional mining activities. Five utility crossings and one at grade crossing were determined to be potentially at risk without continued mining in the Salt River system.

Initial additional mining volumes resulted in significant levels of degradation and mining depths were limited to an average depth of up to 20 feet across the sites. This reduction in mining depth helped to reduce the degradation in the model with additional mining to an acceptable level. It also As a result, only five additional utility crossings and two additional at grade crossings were determined to be potentially at risk due to the impacts of additional mining. No bridges were determined to be potentially at risk due to the impacts of additional mining. The net impact of additional mining as compared to no additional mining was 5.4 feet of degradation in the lower section, 1.7 feet of degradation in the central section, and 6.9 feet of degradation in the upper section.

Based on the ongoing degradation of the Salt River system and our results indicating that degradation will occur with or without additional mining activities, we conclude that this level of additional degradation will be manageable. We also conclude that the additional degradation can be properly accounted for through a program of monitoring and the development of specific countermeasures for infrastructure potentially at risk as appropriate.

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RIO SALADO, SALT RIVER
ARIZONA

APPENDIX C

ECONOMICS

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT
SOUTH PACIFIC DIVISION
MAY 1997

US Army Corps of Engineers

Los Angeles District

RIO SALADO, ARIZONA FEASIBILITY STUDY

F4 ECONOMIC APPENDIX

Economics & Social Analysis Section
May 1997

RIO SALADO FEASIBILITY STUDY
ECONOMIC APPENDIX

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PURPOSE

The following presents an economic evaluation of the benefits and costs associated with riparian habitat restoration opportunities along Indian Bend Wash and the Salt River in central Maricopa County, Arizona.

METHODOLOGY

Methodology employed for this economic analysis is in accordance with current Principles and Guidelines and standard economic practices. 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 October 1996 price levels. The period of analysis is 50 years.

STUDY AREA

Nature of Problem

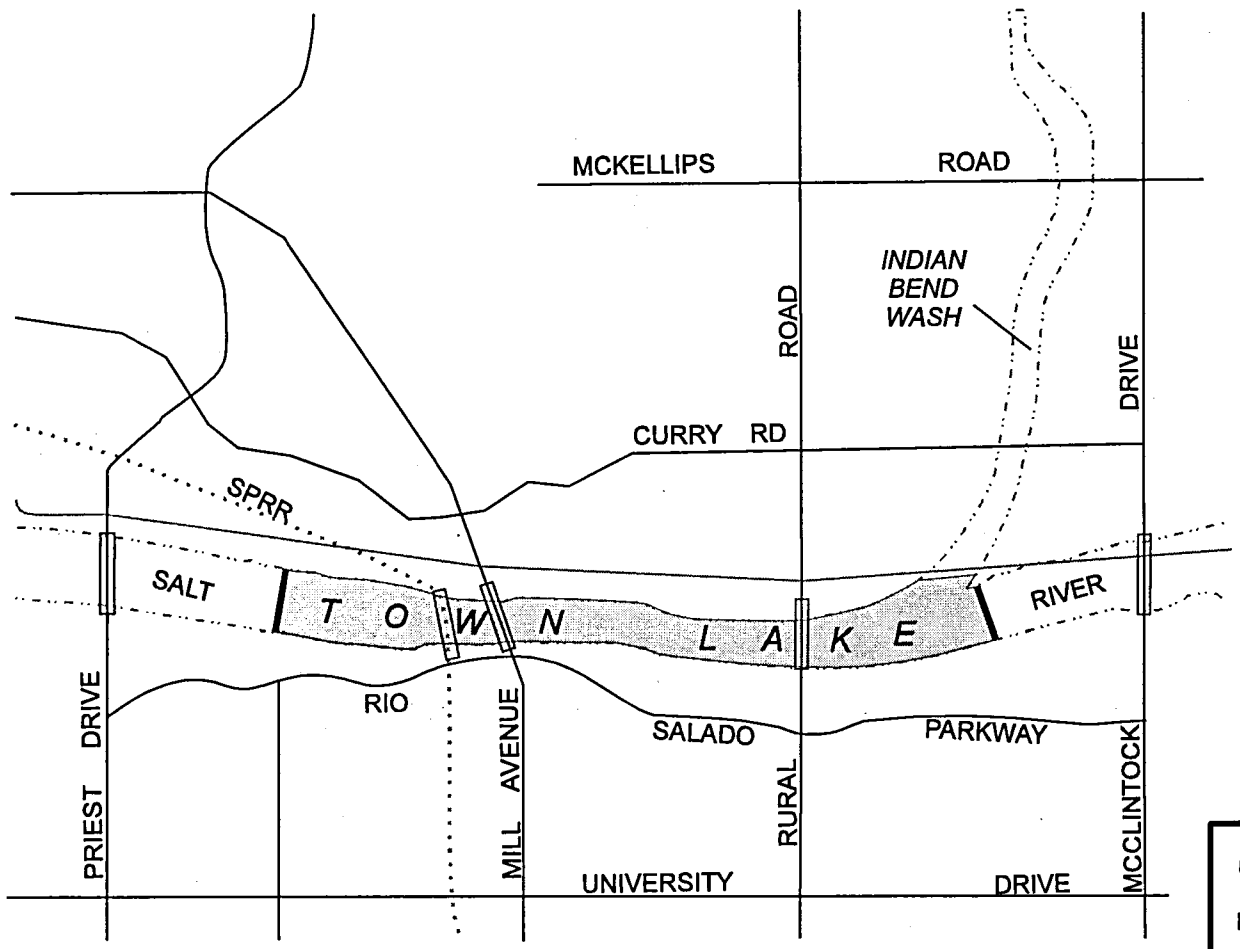
In pre-settlement times (prior to 1900) the Salt River was one of the few perennially-watered riparian areas of the Arizona Sonoran Desert, with highly productive cottonwood, willow and mesquite habitats. These areas were rich in habitat diversity, supporting a wide variety of wildlife species. As the lower Salt River valley became developed, riparian habitat degraded significantly. Degradation is largely attributable to the construction of upstream Federal dams which curtailed year-round water flows and converted the once perennial Salt River into a dry riverbed virtually devoid of habitat. During the 1980's a Corps of Engineers flood control project at Indian Bend Wash displaced the last remnant of a mesquite bosque community that once occupied the region.

During the Reconnaissance Study, approximately 28 miles of the Salt River extending through Phoenix, Tempe, and Maricopa County, Arizona were surveyed and analyzed to determine potential sites for environmental restoration and enhancement opportunities. Based upon this results of the Reconnaissance Study analysis, separate areas within Tempe and Phoenix were identified as being most suitable.

Tempe Portion of Study Area

In 1977, the Corps of Engineers completed construction of an outlet channel for Indian Bend Wash extending from McKellips Road south to the Salt River, a distance of about 1.3 miles. The completed project consisted of a low flow channel and a terraced bench between two levees. By widening, deepening and defining the channel, the construction removed an existing mesquite bosque and disturbed native vegetation. After construction, the entire outlet channel was left as bare earth. Restoration of the mesquite bosque and establishment of riparian wetlands in the IBW outlet channel was chosen to be the focus of the Tempe portion of the Rio Salado feasibility effort.

McKellips Road bridge crossing of IBW is the upstream limit of this study area (see Figure 1, page 2). Between McKellips and Curry Roads, a municipal golf course now occupies the lands between the low flow channel and the outside levees. The potential exists to establish a wetland in the low flow channel of this reach.



GENERAL INVESTIGATIONS-SURVEYS
FISH AND WILDLIFE HABITAT RESTORATION

RIO SALADO, SALT RIVER, AZ
TEMPE

LOS ANGELES DISTRICT
SOUTH PACIFIC DIVISION
1 JAN 1997

ARKR43.CDR

Between Curry Road and the Salt River, the low flow channel and the bench between the outside levees remains bare dirt. In this portion of the study area, establishment of a mesquite bosque on the bench and wetlands in the low flow channel will be the study focus.

Restoration opportunities have also been analyzed for the areas along the Salt River immediately upstream of the Tempe Town Lake upstream dam and immediately downstream of the downstream dam. Tempe Town Lake is planned to be in place within the next two years.

Phoenix Portion of Study Area

The Salt River extending through Phoenix is currently a dry river bed virtually devoid of habitat. The Reconnaissance Study identified the area from 32nd Street (the Interstate 10 bridge) to 19th Avenue as most suitable for a restoration project (see Figure 2, page 4). A drop structure on the downstream end of the I-10 bridge would serve as the starting point for a project. The 19th Avenue bridge was chosen as the downstream limit. At this location, a superfund cleanup project is nearing completion which has lined the banks of the Salt River with soil cement and capped an old landfill on the north bank of the river. The total distance of the study reach is approximately 5 miles.

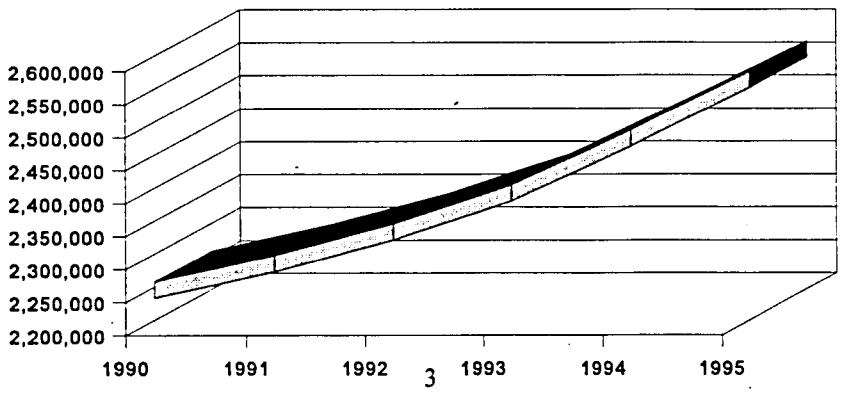
Old landfills and active mining operations occupy much of the study reach today. The multiple landfills cause aesthetic and land use challenges as the vacant, contaminated areas affect the surrounding neighborhoods and ground water aquifers. Additionally, once the mining operations in the area are concluded, the final configuration of the abandoned pits will place additional land use burden on the community. These concerns will be addressed when developing environmental restoration alternatives for the study area.

Population

The study area is located in central Maricopa County and extends through the cities of Phoenix and Tempe. These two cities, along with the remaining areas of Maricopa and Pinal Counties, comprise the Phoenix metropolitan statistical area (MSA). The Phoenix MSA population, which only totaled about 375,000 in 1950, is currently estimated at over 2.56 million. Figure 3 below shows the significant growth experienced from 1990 through 1995.

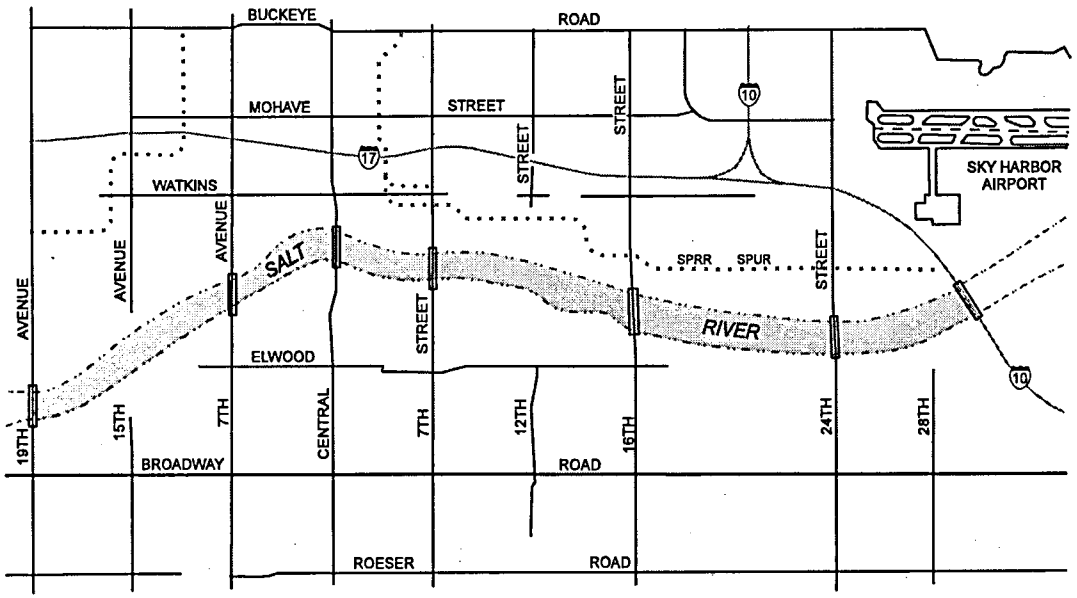
Figure 3

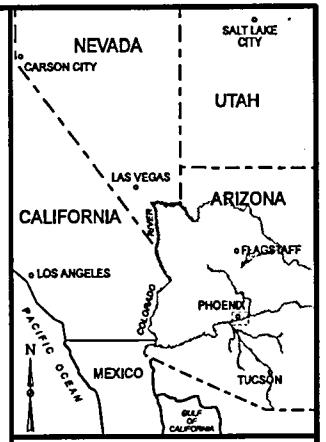
Phoenix MSA Population



U.S. ARMY ENGINEER DISTRICT

CORPS OF ENGINEERS





VICINITY MAP

SCALE 30 0 60 120 180 MILES

AREA COVERED BY MAP

N

0 1

SCALE IN MILES

GENERAL INVESTIGATIONS-SURVEYS
FLOOD DAMAGE PREVENTION STUDIES

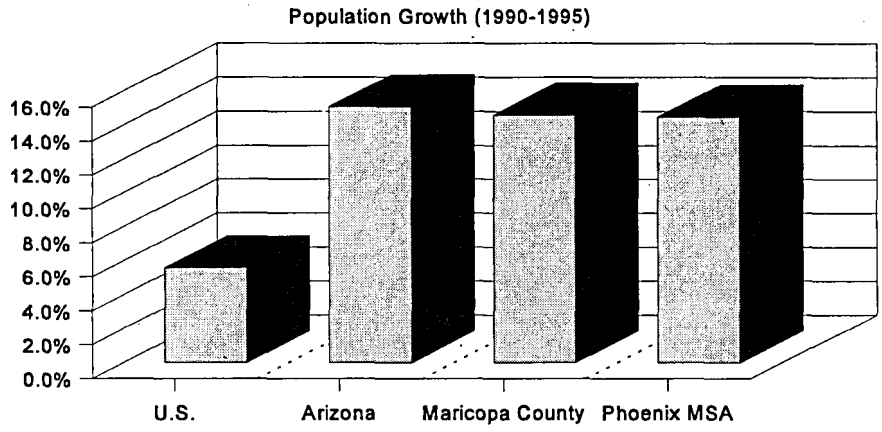
RIO SALADO, SALT RIVER, AZ
PHOENIX REACH
STUDY AREA MAP

LOS ANGELES DISTRICT
SOUTH PACIFIC DIVISION
1 JAN 1997

ARKR20B.CDR

As of 1995, the Cities of Phoenix and Tempe had populations of approximately 1,083,000 and 156,000, respectively. Combined, these two cities represent nearly half of the total Phoenix MSA population. As shown on Figure 4, the population growth within the study area has far surpassed the national average. In fact, the Maricopa County MSA has been growing at an annual compound rate of about 2.75 percent, or about 2.5 times the national average of 1.1 percent. Over the past five years, the City of Phoenix's population rank has jumped from ninth to seventh in the nation.

Figure 4



The U.S. Census projects that Arizona will continue to experience strong growth. State population is projected to climb from 4.2 million (July 1995) to over 6.4 million by the year 2025. This projected net gain ranks sixth in the nation, while the growth rate ranks fourth. By 2025, Arizona's population ranking is expected to climb from 23rd (1995) to 17th.

Employment & Economy

The Phoenix area population growth illustrated above has been due in part 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 65 percent of Arizona's workforce. 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 1 Greater Phoenix Employment by Industry	
Services	29.3%
Trade	24.5%
Government	14.3%
Manufacturing	12.3%
Finance, Insur., & Real Estate	7.5%
Construction	6.4%
Transport., Comm. & Utilities	5.3%
Ag. & Mining	0.4%

In the past three years, the number of new jobs in the area has totaled 34,800, 52,000, and 55,000, respectively. The largest increases have come in the construction, services and trade sectors. Information technology businesses have provided a large influx of employment to the area. As shown on Table 2 below, two high-tech firms, Motorola and Allied Signal Aerospace, are now among the area's five largest employers. New facilities for Intel, Motorola, Microchip Technology and Sumitomo are currently in the planning or building stages or have been recently completed.

Table 2 Greater Phoenix Largest Employers	
State of Arizona	34,000
Motorola	20,000
Maricopa County	11,975
Samaritan Health System	11,873
Allied Signal Aerospace Co.	10,500
City of Phoenix	10,227
America West Airlines	7,743
Arizona State University	7,500

The substantial growth in employment opportunities has helped maintain low unemployment rates in the Phoenix area. Unemployment in Phoenix was 3.7 percent in August 1996, well below the state rate of 5.4 percent and the national rate of 5.1 percent.

To accommodate the population expansion in the area, over 27,000 new single family homes were constructed in the greater Phoenix area in 1994 alone. This total was the highest in the western U.S. and second highest in the nation. According to information obtained from the City of Phoenix, over 30 percent of the housing stock has been constructed in the past ten 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. The average cost of a new single family home is about $112,500. 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

Riparian Habitat

The study area stretching through urbanized Tempe and Phoenix is essentially an expansive dry river bed dominated by large expanses of cobble and rubble. According to the Environmental Impact Statement (EIS), the Salt River through Tempe has been classified as "completely artificial", indicating it is 100% engineered and/or built channel with altered processes and sediment. In the Phoenix study area, the classification changes to "essentially artificial", indicating it displays 90% to 100% altered channel patterns and cross-sectional shapes or sediment characteristics as a result of human activities; a largely artificial channel due to engineered bed and/or banks including dredging but with few natural forms or processes remaining.

The few existing riparian communities in the Rio Salado area are currently supported by wastewater effluent, sporadic flood releases from upstream and local storm-water runoff. Only disturbed riparian vegetation occurs on sandbars and terraces. The vegetation is primarily salt cedar (tamarisk) and desert broom with scattered cottonwood, seep willow and rabbit brush. As wildlife depend on vegetation for food and/or cover, the lack of vegetation in the study area makes the area generally unsuitable as wildlife habitat. Only small birds, small mammals and reptiles tolerant of very disturbed conditions inhabit the study area.

HEP Analysis

The methodology utilized to assess environmental outputs for this study is called the Habitat Evaluation Procedure (HEP) analysis. HEP 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 HEP 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. There has been a considerable amount of research on developing techniques to quantify environmental outputs in monetary terms. A discussion of these methodologies is presented in the attached **Addendum**.

Evaluation of present riparian habitat conditions was based upon the following criteria used to estimate habitat quality of the Rio Salado study area: 1) whether species were threatened or endangered; 2) presence of a continual water source; 3) whether there was bird or wildlife species present; 4) the composition of species; 5) the density of species; 6) the height of existing vegetation; and 7) the presence of disturbances within and adjacent to the habitat. These criteria were applied to sites within the study area to estimate habitat values, expressed in terms of habitat units. Habitat units serve as a combined measure of habitat quantity and quality of a given site and are used for comparative purposes. Estimates of habitat units are arrived at by multiplying the habitat quality rating (on a scale of 0.1 to 1.0, with 1.0 being the highest value) by the number of acres of the site.

There are currently only about 4.6 acres of riparian vegetation (willows and cottonwoods) in and along Indian Bend Wash and the Salt River through the study area. This represents less than one percent of the total study area acreage, which ranges from 690 to 1020 acres, depending on whether gravel pit areas are included. As discussed in the Environmental Impact Statement, the quality of the habitat was valued as low (0.36 out a possible 1.0) based upon the criteria described above. Thus, habitat units under without-project conditions are estimated at 1.656 HU (4.6 acres x 0.36 HSI).

Potential Vegetation & Habitat

If a permanent water source could be provided to the channel, the EIS states that the study area could reasonably be expected to support three vegetation types:

1) Riparian desert scrub: Occupies the higher bench or terraces of the floodplain. Includes creosote, catclaw, bursage, saltbush, tamarisk and mesquite.

2) Riparian: Areas that receive perennial flows support a narrow banded riparian community dominated by cottonwood and willows. This plant community is found along the active streambed of the river or on the first terrace above the river. Riparian vegetation is considered a extremely rare and valuable habitat type in the southwest.

3) Freshwater marsh vegetation: Consists primarily of emergent aquatic vegetation such as cattails, bulrushes and occasionally water cress. This community is located at the lowest elevations of the river along the watercourse or in areas of shallow ponded water or heavily saturated soils.

These three vegetation types could be considered wildlife habitat types. Wildlife species generally associated with these habitat types are referenced in the EIS, which specifies that as much as 75 percent of all of Arizona's native wildlife depend on riparian/wetland systems during some portion of their life cycle. Riparian areas are critical to the survival of approximately 60 percent of the fish and wildlife species currently in jeopardy of extirpation from the state. Riparian and wetland areas are highly productive and support an abundant and diverse fish and wildlife community.

PROJECT ALTERNATIVES

General Management Measures

The following general management measures have been identified for the Phoenix and Tempe reaches.

1. Vary Plant/Habitat Selection

Habitat native to riparian streams and washes of Arizona have been identified and include Mesquite Upland (MU), Cottonwood and Willow Dominant (CW), Wetland Marsh (WM), Aquatic Strand/Desert Scrub (AS), Open Space and Urban Park Type (O), and Other Habitats (Other).

Open space habitat does not have a specific plant species, but is considered to have habitat value since wildlife will utilize the areas to travel to other more valuable habitats. These areas can serve as a buffer between other habitats and non-habitat areas.

Other habitat is defined as including areas needed for canals, trails, service roads, parking areas, general landscaping, soil cement embankments, gravel pit bottoms, etc., which are considered to have little or no habitat value.

2. Vary Water Use

By mixing the amounts of the different habitats, a range of water supply requirements needed to support the various alternatives can be established. Specific water demands for use in this study have been identified as: 1) Low Water Demand (LW), providing more mesquite upland habitat and less water consumptive habitat such as wetland marsh and aquatic strand; 2) High (HW) Water Demand, incorporating more water consumptive wetland habitat; and 3) High Water Demand Plus Aquatic Strand/Stream (Phoenix Reach Only), utilizing the same amount of water as the High Water Demand, plus the additional amount necessary to support a flowing stream in the bottom of the river bed.

3. Vary Areas to be Restored

The Tempe Reach contains approximately 140 acres available for restoration. The Phoenix Reach contains 880 available acres, including about 330 acres in six gravel pits.

Potential habitat areas include the low flow channel (LF), an in-channel bench (B), the channel banks (BK), the channel overbanks (OBK), park/gateway areas (P), and gravel pit bottoms (G).

4. Installation of Low Flow Channel (Phoenix Reach Only)

Restoration features within the river channel would be periodically subjected to flows from the Salt and Verde River system. In order to alleviate problems associated with long term inundation, the improvements within the Phoenix Reach were evaluated with and without the construction of a low flow channel. Without the channel, inundation will be more frequent, and therefore plant survivability will be effected. Based upon hydraulic and environmental criteria, a low flow channel width of 200 feet was selected and included in each of the final alternatives for the Phoenix reach.

5. Continual Flow Measures for Wetlands

Continuous flow is required for proper wetland functioning. In order to satisfy this requirement, the wetlands could be incorporated as part of the overall water supply distribution system for the entire restoration alternative. Alternatively, a pump at the upstream inflatable dam for Town Lake would provide a continual aerating water flow for the wetland habitat, and prevent the accumulation of standing or stagnant water.

6. Site Location of Habitat Areas

Site specific location of habitat areas must be included in development of alternative plans in order to optimize total habitat value.

Tempe Reach

There are six alternatives proposed for restoration of the Tempe reach. These alternatives are described below and summarized in an alternative matrix, Table 3. More detailed descriptions of each alternative are provided in the Main Report.

Table 3
Tempe Reach
Habitat Acres by Alternative

Alternative	Restoration Area	Habitat Type MU	CW	WM	AS	O	Other	Total
T1	LF						50	50
NA	B						30	30
	SR US						30	30
	SR DS						30	30
T2								
	LF						50	50
IBW/LW	B	20				10		30
	SR US						30	30
	SR DS						30	30
T3								
	LF						50	50
IBW+SR(US + DS)/LW	B	20				10		30
	SR US	5				25		30
	SR DS	5				25		30
T4								
	LF				50			50
IBW+SR (DS) /HW	B	20				10		30
	SR US						30	30
	SR DS		10	8		12		30
T5								
	LF				50			50
IBW+SR(US + DS)/HW	B	20				10		30
	SR US		10	8		12		30
	SR DS		10	8		12		30
T6								
	LF						50	50
SR DS / HW	B						30	30
	SR US						30	30
	SR DS		10	8		12		30

T1. Alternative NA

This is the No Action Alternative. The low flow channel along Indian Bend Wash and the Salt River bed immediately upstream and downstream of Town Lake will remain virtually barren, with negligible habitat value.

T2. Alternative IBW/LW

This alternative will restore Indian Bend Wash (IBW) areas only with low water use (LW) vegetation. Improvements would consist of 20 acres of mesquite upland habitat and 10 acres of open space habitat on the channel bench.

T3. Alternative IBW+SR(US+DS) /LW

This alternative restores areas in both Indian Bend Wash and the Salt River (SR) with low water use vegetation. In addition to the 30 acres of restoration for IBW, 60 acres would also be added in the Salt River upstream (US) and downstream (DS) of Town Lake (30 acres each). This additional 60 acres would include 10 acres of mesquite upland habitat and 50 acres of open space habitat.

T4. Alternative IBW+SR (DS) / HW

Alternative IBW+SR(DS) / HW will restore Indian Bend Wash areas and the Salt River downstream of Town Lake with high water use vegetation. This alternative would include restoration of the entire 80 acres of the IBW portion of the Tempe Reach and the 30 acres downstream of Town Lake. The IBW bench would include 20 acres of mesquite upland and 10 acres of open space habitat. The low flow channel of IBW would consist of 50 acres of wetland marsh. The Salt River portion of the Tempe Reach downstream of Town Lake would include 10 acres of cottonwood willow, 8 acres of wetland marsh, and 12 acres of open space habitat.

T5. Alternative IBW+SR (US+DS) / HW

This alternative would provide high water use vegetation in IBW, as well as both upstream and downstream of Tempe Town Lake in the Salt River. In addition to the habitat created under Alternative T4, Alternative T5 would provide an additional 10 acres of cottonwood willow, 8 acres of wetland marsh, and 12 acres of open space habitat upstream of Tempe Town Lake.

T6. Alternative SR (DS) / HW

Alternative T6 would provide high water use vegetation to the Salt River downstream of Town Lake. No restoration is provided under this alternative for IBW or the Salt River upstream of Town Lake.

Phoenix Reach

Including the no action alternative, there were 21 different alternatives developed for environmental restoration of the Phoenix Reach. This initial array included differing sizes of low flow channels ranging from 200 to 500 feet. The number of alternatives was reduced to 9 based upon hydraulic and environmental criteria. Specifically, it was determined that a minimum low flow channel width was required to alleviate high operation and maintenance costs associated with frequent flooding. However, alternatives with channel widths greater than 200 feet would: 1) require additional channel bottom land that could be used for restoration; 2) cost more; and 3) did not appear to provide significantly greater protection.

These remaining 9 alternatives are summarized below. More detailed descriptions can be found in the Main Report. Table 4 depicts the alternative matrix. Each cell contains an estimated number of acres by habitat type, according to the amount of water utilized and the location within the channel. Additional variables considered in the matrix include whether to incorporate gravel pit areas for restoration and whether to include a permanent surface stream within the low flow channel.

Table 4
Phoenix Reach
Habitat Acres by Alternative

Alternative	Restoration Area	Habitat Type MU	CW	WM	AS	O	Other	Total
P1	LF						400	400
	B						0	0
NA	BK						40	40
	OBK						60	60
	P						50	50
	G						0	0
P2	LF					130		130
	B	20	80	40		120	10	270
SR/LW	BK					35	5	40
	OBK	30				20	10	60
	P					50		50
	G							0
P3	LF					130		130
	B		160	100			10	270
SR/HW	BK		5			30	5	40
	OBK	10	20			10	20	60
	P					50		50
	G							0
P4	LF				130			130
	B	20	80	40		120	10	270
SR/LW+S	BK					35	5	40
	OBK	30				20	10	60
	P					50		50
	G							0
P5	LF				130			130
	B		160	100			10	270
SR/HW+S	BK		5			30	5	40
	OBK	10	20			10	20	60
	P					50		50
	G							0
P6	LF					130		130
	B	50	80	40		120	10	300
SR+G/LW	BK					45	5	50
	OBK	45				35	30	110
	P					50		50
	G		10				230	240
P7	LF					130		130
	B	30	160	100			10	300
SR+G/HW	BK	5	40			5		50
	OBK	25	20			25	40	110
	P					50		50
	G		10				230	240
P8	LF				130			130
	B	50	80	40		120	10	300
SR+G/LW+S	BK					45	5	50
	OBK	45				35	30	110
	P					50		50
	G		10				230	240
P9	LF				130			130
	B	30	160	100			10	300
SR+G/HW+S	BK	5	40				5	50
	OBK	25	20			25	40	110
	P					50		50
	G						230	230

P1. Alternative NA

Alternative NA is the No Action alternative, which maintains the future without project conditions within the Phoenix Reach. The 550 acres of the Salt River (SR) from the I-10 Bridge to 19th Avenue will remain barren cobbles, and the 330 acres of gravel pits (G) will remain unsightly, unused hazard areas. The habitat value of the entire 880 acres will continue to be negligible (currently estimated at less than two habitat units (HUs).

P2. Alternative SR/LW

Alternative SR/LW will restore the Salt River portion of the Phoenix reach with low water use vegetation. Most of the reach would remain as open space, other than approximately 140 acres on the channel bench and about 30 acres on the channel overbank. No improvements would be placed in the low flow channel itself; this area would remain as open space. This alternative does not incorporate the gravel pit areas.

P3. Alternative SR/HW

This alternative will restore the Salt River portion of the Phoenix reach with higher water use vegetation involving more riparian habitat. Relative to Alternative P2, this alternative provides more acreage of non open-space habitat, including substantially more cottonwood-willow and wetland-marsh habitat.

P4. Alternative SR/LW+S

Alternative SR/LW+S is similar to Alternative P2, but also incorporates a permanent flowing stream in the low flow channel. This alternative is expected to provide additional aquatic-strand type habitat within the low flow channel.

P5. Alternative SR/HW+S

Alternative SR/HW+S is similar to Alternative P3, but also incorporates a permanent flowing stream in the low flow channel. This alternative is expected to provide additional aquatic-strand habitat within the low flow channel.

P6. Alternative SR+G/LW

This alternative would restore the Salt River in the same manner as Alternative P2. In addition, this alternative would include restoration of three gravel pits in the study area. The banks of the gravel pits would be cut back to create additional bench area for restoration.

P7. Alternative SR+G/HW

This alternative would restore the Salt River in the same manner as Alternative P3. In addition, this alternative would include restoration of three gravel pits in the study area.

P8. Alternative SR+G/LW+S

This alternative would restore the Salt River in the same manner as Alternative P4. In addition, this

alternative would include restoration of three gravel pits in the study area.

P9. Alternative SR+G/HW+S

This alternative would restore the Salt River in the same manner as Alternative P5. In addition, this alternative would include restoration of three gravel pits in the study area.

BENEFITS

Overview

In order to evaluate environmental quality (EQ) benefits, a community-based HEP analysis was conducted. As described in the Without Project Conditions Section, existing vegetation in the study area is negligible and of poor quality (less than 2 HUs). Since habitat in the study area is virtually non-existent, all of the alternatives under consideration represent a vast improvement over without project conditions.

The proposed habitat acreage for each alternative are detailed in Tables 3 and 4. In order to estimate habitat units for each alternative, HSIs were developed and applied to the total number of acres for each habitat type. Habitat units for all habitat types were summed to derive total habitat values for each alternative.

Development of HSIs

HSI values were derived by consensus from a team of personnel with professional experience and qualifications in the Southwestern Sonoran Desert area of Arizona. The evaluation of HSIs for the proposed habitat types was alternative-based and included consideration of the location of the habitat within the study area, amount of available water under the alternative, total acreage of the habitat type, and the diversity of habitat under the alternative. HSI's were assigned to reflect the average value of habitat that is expected over the life of the project. This takes into consideration the value at project year one, the value when mature, and the value over time considering replacement of habitat when required due to flooding or other habitat maintenance replacement.

Habitat Units By Alternative

Tables 5 and 6 summarize habitat units by habitat type for each alternative for the Tempe and Phoenix reaches, respectively. As shown on Table 5, the No Action alternative for the Tempe Reach provides virtually no habitat, and therefore habitat units are assumed to be zero. Habitat units for Alternatives T2 through T6 range from 14 HUs for Alternatives T2 and T6 to 71 HUs for Alternative 5. Alternative 5 would restore Indian Bend Wash and the areas both upstream and downstream of Tempe Town Lake with high water use vegetation.

For the Phoenix Reach, existing habitat is also negligible under the No Action alternative. Habitat Units under Alternatives 2 through 9 range from 160 HUs for Alternative P2 to 348 HUs for Alternative P9. Alternative P9 restores the Salt River and gravel pit areas with high water use vegetation, and also incorporates a perennial flowing stream in the low flow channel.

Table 5
Tempe Reach
HEP Analysis Results

Alternativ	MU	CW	WM	AS	O	Other	Total
T1 (NA)							
Acres						140	140
HSI						0	
HU						0	
T2							
Acres	20				10	110	140
HSI	.6				.2	0	
HU	12				2	0	**14**
T3							
Acres	30				60	50	140
HSI	.55				.2	0	
HU	16.5				12	0	**28.5**
T4							
Acres	20			50	10	60	140
HSI	.6			.58	.2	0	
HU	12			29	2	0	**43**
T5							
Acres	20	20	16	50	34	0	140
HSI	.6	.6	.7	.58	.2	0	
HU	12	12	11.2	29	6.8	0	**71**
T6							
Acres		10	8		12	110	140
HSI		.6	.7		.2	0	
HU		6	5.6		2.4	0	**14**

Table 6
Phoenix Reach
HEP Analysis Results

Alternativ	MU	CW	WM	AS	O	Other	Total
P1 (NA)							
Acres						550	550
HSI						0	
HU						0	
P2							
Acres	50	80	40		355	25	550
HSI	.5	.5	.6		.2	0	
HU	25	40	24		71	0	**160**
P3							
Acres	10	185	100		220	35	550
HSI	.5	.6	.6		.25	0	
HU	5	111	60		55	0	**231**
P4							
Acres	50	80	40	130	225	25	550
HSI	.5	.6	.6	.5	.25	0	
HU	25	48	24	65	56	0	**218**
P5							
Acres	10	185	100	130	90	35	550
HSI	.6	.7	.7	.6	.3	0	
HU	6	130	70	78	27	0	**311**
P6							
Acres	95	90	40		380	275	880
HSI	.5	.52	.6		.2	0	
HU	48	47	24		76	0	**195**
P7							
Acres	60	230	100		210	280	880
HSI	.5	.6	.6		.25	0	
HU	30	138	60		53	0	**281**
P8							
Acres	95	90	40	130	250	275	880
HSI	.5	.61	.6	.5	.25	0	
HU	48	55	24	65	63	0	**255**
P9							
Acres	60	230	100	130	75	285	880
HSI	.5	.7	.7	.6	.3	0	
HU	30	154	7	78	23	56	**348**

COSTS

Overview

Preliminary cost estimates were provided by Cost Engineering. These estimates do not incorporate all costs associated with each alternative. Instead, the focus of these cost estimates was to provide adequate information on key cost variables in order to perform the incremental cost analysis and select recommended plans for the Phoenix and Tempe Reaches. These key cost components include:

Low Flow Channel (Phoenix Reach)
Habitat Development by Habitat Type
Water Supply and Treatment Costs
Pumps/Pipes (Tempe Reach)
OMRR&R (Habitat and Water Supply)

Some costs which were excluded from the analysis included real estate, the water conveyance system to support the habitat, maintenance roads, etc. Real estate costs will be minimal for all alternatives, since almost all improvements for each alternative are located within the river. Water conveyance systems, maintenance roads, and other features were assumed to be similar for all alternatives, and were deemed unlikely to have a significant impact on plan evaluation.

Tempe

Table 7 details first costs and annual costs by alternative for the Tempe Reach.

Table 7
Tempe Reach
Costs by Alternative (in $1,000s)

Alternative	First Cost	Interest During Construction*	Gross Investment	Interest & Amortization**	OMRR&R	Total Annual Cost
T1	NA					
T2	$1,239	$45	$1,284	$97	$65	$162
T3	$1,387	$50	$1,437	$109	$84	$193
T4	$2,723	$99	$2,822	$214	$315	$529
T5	$4,756	$172	$4,928	$374	$440	$814
T6	$1,930	$70	$2,000	$152	$149	$301

** One year construction period assumed for all alternatives*
*** 7 3/8%, 50 Years*

Phoenix

Table 8 details first costs and annual costs by alternative for the Phoenix Reach.

Table 8
Phoenix Reach
Costs by Alternative (in $1,000s)

Alternative	First Cost	Interest During Construction*	Gross Investment	Interest & Amortization**	OMRR&R	Total Annual Cost
P1	NA					
P2	$42,174	$3,110	$45,284	$3,438	$1,223	$4,661
P3	$57,465	$4,238	$61,703	$4,684	$2,672	$7,356
P4	$58,491	$4,314	$62,805	$4,768	$2,555	$7,323
P5	$68,383	$5,043	$73,426	$5,574	$4,016	$9,590
P6	$43,646	$3,219	$46,865	$3,558	$1,366	$4,924
P7	$62,896	$4,639	$67,535	$5,127	$3,223	$8,350
P8	$60,272	$4,445	$64,717	$4,913	$2,734	$7,647
P9	$77,186	$5,692	$82,878	$6,292	$4,555	$10,847

** Two year construction period assumed for all alternatives*
*** 7 3/8%, 50 Years*

INCREMENTAL COST ANALYSIS

Table 9 below summarizes average annual costs and habitat units by alternative.

Table 9
Summary
Annual Costs & Habitat Units by Alternative

Alternative	Annual Costs ($1,000s)	HUs	Alternative	Annual Costs ($1,000s)	HUs
T1	NA	NA	P1	NA	NA
T2	$162	14	P2	$4,661	160
T3	$193	29	P3	$7,356	231
T4	$529	43	P4	$7,323	218
T5	$814	71	P5	$9,590	311

T6	$301	14	P6	$4,924	195
			P7	$8,350	281
			P8	$7,647	255
			P9	$10,847	348

To perform the incremental cost analysis, the above data were input into a computer program called *Cost Effectiveness and Incremental Cost Analysis, Beta Version 2.6.* This program, which was developed by the U.S. Army Corps of Engineers, Institute for Water Resources, sequentially identifies efficient alternatives and alternative combinations, eliminating those which produce fewer habitat units at the same cost, or which produce the same habitat units at a higher cost. Efficient alternatives are plotted on a curve which details incremental increases in habitat units which can be achieved for incremental increases in expenditures. This data, along with other qualitative factors, can be used as a basis for evaluating alternatives and selecting of a recommended plan.

Separate incremental cost analyses were performed for both the Phoenix and Tempe reaches, as well as in combination. The following sections summarize the results:

Tempe Reach

Of the six Tempe alternatives, T6 was eliminated from consideration, since it produces the same level of output (14 HUs) as alternative T2, but costs nearly twice as much. Table 10 displays incremental costs per output for the least cost alternatives.

Table 10
Tempe Reach
Incremental Cost Analysis for Least Cost Alternatives

Alternative	Annual Costs ($1,000s)	HUs	Incremental Cost ($1,000s)	Incremental Output	Incremental Avg. Cost ($1,000s)
T1	0	0	0	0.0	0
T2	$162	14	$162	14.0	$11.57
T3	$193	28.5	$31	14.5	$2.14
T4	$529	43	$336	14.5	$23.17
T5	$814	71	$285	28.0	$10.18

Of the remaining least-cost alternatives, T3 and T5 were identified as the most cost effective, based upon the incremental cost analysis. The average annual cost per output for T2 is $11,570, relative to only $6,770 for T3. The average annual incremental cost of achieving an additional 14.5 HUs under alternative T4 (relative to T3) is $23,170, whereas the average annual incremental cost of achieving an additional 42.5 HUs under alternative T5 (relative to T3) is only $14,610. Table 11 summarizes the results of the incremental cost analysis for the Tempe Reach.

Table 11
Tempe Reach
Final Incremental Cost Analysis Results

Alternative	Annual Costs ($1,000s)	HUs	Incremental Cost ($1,000s)	Incremental Output	Incremental Avg. Cost ($1,000s)
T1	0	0	0	0.0	0
T3	$193	28.5	$193	28.5	$6.77
T5	$814	71	$621	42.5	$14.61

The incremental cost analysis indicates that the two most cost effective alternatives are alternatives T3 [IBW+SR(U+D)/LW] and T5 [IBW+SR(U+D)/HW]. These alternatives provide restoration to all three parts of the Tempe study area, including Indian Bend Wash and the Salt River both upstream and downstream of Tempe Town Lake. These alternatives are differentiated based upon the use of high vs. low water use vegetation.

Phoenix Reach

None of the Phoenix alternatives provide the same level of output for different costs or have the same costs for different levels of output, so no alternatives were eliminated from consideration based upon these criteria. Table 12 below displays the incremental cost of the least cost alternatives.

Table 12
Phoenix Reach
Incremental Cost Analysis for Least Cost Alternatives

Alternative	Annual Costs ($1,000s)	HUs	Incremental Cost ($1,000s)	Incremental Output	Incremental Avg. Cost ($1,000s)
P1	0	0	0	0	0
P2	$4,661	160	$4,661	160	$29.13
P6	$4,924	195	$263	35	$7.51
P4	$7,323	218	$2,399	23	$104.30
P3	$7,356	231	$33	13	$2.54
P8	$7,647	255	$291	24	$12.13
P7	$8,350	281	$703	26	$27.04
P5	$9,590	311	$1,240	30	$41.33
P9	$10,847	348	$2,497	48	$33.97

Based upon the final incremental cost analysis, alternatives P6 and P9 were determined to be most cost effective. The incremental average annual cost of achieving 195 habitat units under P6 is $25,250, which is less than the incremental average annual cost of implementing any of the other alternatives under consideration. For example, the incremental average annual cost of implementing alternative P2 is $29,130. The incremental average annual cost of achieving more habitat units than those provided by alternative P6 is $38,710 under alternative P9. This is less than the average annual cost of achieving additional habitat units under any of the other remaining alternatives. For example, alternative P4 provides an additional 23 habitat units relative to P6 at an incremental cost of nearly $2.4 million. The resulting incremental average annual cost is therefore $104,300. In other words, to achieve more output than alternative P6, one can implement alternative P4 and achieve an additional 23 habitat units, but the average annual cost for each of those habitat units is $104,300. This is more than $65,000 per habitat unit greater than the incremental average annual cost of achieving an additional 153 habitat units under alternative P9. Table 13 summarizes the results of the incremental cost analysis for the Phoenix Reach.

Table 13
Phoenix Reach
Final Incremental Cost Analysis Results

Alternative	Annual Costs ($1,000s)	HUs	Incremental Cost ($1,000s)	Incremental Output	Incremental Avg. Cost ($1,000s)
P1	0	0	0	0	0
P6	$4,924	195	$4,924	195	$25.25
P9	$10,487	329	$5,923	153	$38.71

The incremental cost analysis indicates that alternatives P6 and P9 are cost effective. P6 [SR+G/LW] restores both the Salt River and the gravel pit areas with low water use vegetation. Alternative P9 is the most comprehensive alternative and features the establishment of high water use vegetation along the Salt River and in the gravel pit areas, and also includes a perennial stream in the low flow channel.

Phoenix and Tempe Reaches (Combined)

The Incremental Cost Analysis software was utilized to analyze alternatives for Phoenix and Tempe reaches simultaneously. This included analysis of all possible combinations between the Phoenix and Tempe alternatives. Twenty three (23) least cost alternatives were identified. Table 14 displays the results of the final incremental cost analysis for both reaches.

Table 14
Rio Salado Study Area (Both Reaches)
Final Incremental Cost Analysis Results

Alternative	Annual Costs ($1,000s)	HUs	Incremental Cost ($1,000s)	Incremental Output	Incremental Avg. Cost ($1,000s)
P1/T1	0	0	0	0	0
P1/T3	$193	29	$193	29	$6.66

P1/T5	$814	71	$621	42	$14.79
P6/T5	$5,738	266	$4,924	195	$25.25
P9/T5	$11,661	400	$2,497	48	$38.71

The cost effective alternatives shown above are simply combinations of those identified for the respective reaches.

RECOMMENDED PLAN

Tempe Reach

The recommended plan for the Tempe Reach is Alternative T5 [IBW+SR(U+D)/HW]. This is the most comprehensive plan analyzed. It includes restoration of Indian Bend Wash and the Salt River both upstream and downstream of Tempe Town Lake with high water use vegetation. This plan is recommended because it most closely meets the planning objectives identified for this study, including:

Restoration of threatened and endangered species habitat
Restoration of the Study Area to a more natural condition through the installation of plant species that are native to, and occurred historically, in riparian streams and washes in the region
Increase recreation opportunities
Contribute to other qualitative environmental quality objectives

This alternative features restoration of 20 acres of mesquite upland habitat, 20 acres of cottonwood and willow habitat, 16 acres of wetlands, 50 acres of aquatic strand/scrub habitat, and 34 acres of open space habitat. The average annual cost per habitat unit is approximately $11,500. Although this average cost is substantially higher than that for Alternative T3 ($6,700/HU), it provides nearly 2.5 times the number of total habitat units.

Phoenix Reach

The recommended plan for the Phoenix Reach is Alternative P9. This is the most comprehensive plan analyzed. It includes restoration of the Salt River and gravel pits with high water use vegetation, as well as a perennial stream within a constructed low flow channel. This plan is recommended because it most closely the planning objectives listed above.

The restoration would consist of 60 acres of mesquite upland habitat, 230 acres of cottonwood and willow habitat, 100 acres of wetlands, 130 acres of aquatic strand/scrub habitat, and 75 acres of open space habitat.

The cost of this alternative is significantly higher than many of the other alternatives. To achieve a more desirable habitat mix requires greater water use, both for higher water use vegetation and the flowing stream. For example, use of higher water use vegetation requires an additional first cost exceeding $15 million, in addition to over $1.4 million more in annual operation and maintenance costs. Similarly, adding the perennial stream results in an increase of more than $14 million in total first cost and over $2.4 million in annual O&M costs. These cost factors must be weighed against the benefits. In addition to providing the

greatest number of total habitat acres, this alternative provides a more optimal mix of habitat relative to the other alternatives considered.

RECREATION ANALYSIS

Without Project Conditions

As demonstrated earlier in this report, the Phoenix area has experienced rapid population growth. As the Phoenix MSA population has now expanded to over 2.5 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. Urban fishing was also identified as a potential recreation opportunity in the study area, contingent upon the availability of a water source with sufficient water quality.

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 which 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 15 miles west of Gila Bend.
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 Regional Park: 18,000 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
- Rio Salado Industrial Park
- Encanto Park
- Hayden Park
- Nuestro Park
- Harmon Park
- Alkire Park
- Canal Park
- Eldorado Park
- Chapparal 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

South Mountain Park and Papago Park are two of the largest recreation areas listed above which are nearby the study area. 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. Data provided by the City of Phoenix shows that approximately 2 million people visit the park each year.

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, a zoo, botanical gardens, a state historical museum, two golf courses, an archery shooting range, nature trails and restrooms. Annual visitation at this park has exceeded 2 million the past two years.

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 the past several years.

Existing Recreation Resources in Study Area

Phoenix Portion of 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. In the Phoenix portion of the study area, the Salt River consists primarily of dry river bottom. As a result, virtually no recreation activity takes place. The only improved recreation area adjacent to the Salt River is 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 is 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	NA	63 acres, with fishing lagoon, 18 hole golf course, club house, swimming pool, racquetball, tennis, basketball, softball, childrens play area
Echo Canyon	300,000	387 acres, with hiking trails, mountain biking, horseback riding

Tempe Portion of Study Area

In the Tempe portion of the study area, existing recreation facilities include Indian Bend Park, Tempe Beach Park, B.B. Moeur Park, the North and South Bank Linear Parks and a wetlands wildlife habitat area.

Tempe Beach Park is a 15 acre park located just south of Rio Salado Parkway on the south side of the Salt River in Tempe. Features include a swimming pool, a lighted softball field, lighted basketball court, picnic tables, grills, playground equipment and restrooms. The park also has a private art center with a gallery and sculpture garden. The City of Tempe estimates annual visitation at the park at about 29,000.

Indian Bend Park is an eight-acre neighborhood park located along Indian Bend Wash upstream of its confluence with the Salt River. Features include picnic tables, grills, playgrounds and lighted tennis courts. Annual visitation is approximately 18,000.

B.B. Moeur Park is located north of the Salt River between Mill Avenue and Curry Road. Formerly a rest area, this park now contains picnic tables, grills, ramadas, and restrooms. It is approximately ten acres in size. Visitation is approximately 18,000 per year.

Linear Parks are located along the Salt River downstream of the confluence between the Salt River and Indian Bend Wash. The North Bank Linear Park is currently under construction and is expected to be completed by early 1997. Picnic ramadas are located near the east end of the site near Mill Avenue. A concrete bike path meanders through the park above the river levee, tying in to the existing sidewalk along the east side of Prist Drive. Completion of the east end of the park will link to Indian Bend Park.

The South Bank bike path and lighting were completed in 1996. Shaded grassy parks, desert bike paths, pedestrian trails, ramadas and recreation areas will eventually line the river's edge. These parks will be adjacent to Tempe Town Lake, which is currently under construction (see details on Tempe Town Lake in next section).

Phase 1 of a 20-acre wetlands wildlife habitat site has been completed and is maintained by volunteers of the Salt River Project. The site is located south of the Salt River just east of State Route 143. A future Phase 2 will include an educational ramada, walking paths and signage. The habitat provides refuge for birds, fish and native plants.

Thirteen acres of mesquite bosque habitat have also been established north of the Salt River between Mill and College Avenues. Planted in 1993, this site provides a natural preserve for desert wildlife. There is a canal along the north bank of the project area. Trees and vegetation are watered by controlled irrigation lines. Arizona State University researchers monitor the area for survivability of native plants, and volunteers

maintain the park by pulling out non-native plants. Most of the trees are native mesquite. Cottonwoods in the park are now found in areas near the irrigation lines. This habitat area has limited public access (only about 10 visitors per day). However, a representative from the City of Tempe indicated that picnic areas, trails and restrooms may be added at a later time.

Future Recreation Facilities

The City of Tempe has begun construction of its Tempe Rio Salado Project, which will restore a five and one-half mile stretch of the Salt River from an unsightly utility corridor into a linear green belt. Central to this project will be Tempe Town Lake. The lake will be 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 will be retained through the use of a system of rubber dams which can be deflated during significant floods. The lake will be initially filled with water purchased from the Salt River Project. An extensive ground water pump system will capture any water that infiltrates, leaving only a small amount of make-up water which will be needed to account for evaporation.

The lake will contain about 200 surface acres and 20,000 feet of shoreline and will support 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. An 80,000 square foot ice skating rink is also planned. Other possible recreational uses include soccer and major sports events, such as marathons.

Significant commercial development, including hotels and resorts, is also expected in the area. The City projects roughly 7 million square feet of mixed use development will take place over the next 25 to 30 years, representing about $1.2 billion in expenditures. This development will be supported substantially by the tourism generated by the project.

In the report, *Town Lake Capacity and Needs Study: Rio Salado Project* prepared by BRW Inc., Moffatt & Nichol Engineers (1996), recreation demand for the proposed activities is shown to greatly exceed the available supply in the market area. Therefore, in order to determine the financial impact of the project, the focus of the study was to determine the capacity of the proposed facilities, rather than to project use based upon demand. Based upon the size and configuration of the lake, the report recommended the following facilities: 208 slips for the rental of sail and electric boats, 24 slips for water taxis, tour boats and gondolas, two boat ramps which could launch 150 boats per day, and facilities for 52 paddle boats. In all, the lake capacity would be approximately 505 watercraft, or about 2.5 boats per surface acre of lake. Although projected visitation for the lake and surrounding recreation facilities was not included in the report, it is obvious that it would be substantial.

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, there are currently no significant natural wetlands areas. Most of the existing parks are small community parks. The larger regional parks are located in desert mountain terrain and not in riparian habitat areas. This lack of riparian habitat areas 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, feeding 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.

The study area is located in the middle of the Phoenix metropolitan area, which has a population exceeding 2.5 million. Portions of the study area are located within minutes of downtown Phoenix and Tempe, 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 state-wide

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, picnicking, and potentially urban fishing. In addition, interpretive centers and look-out 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); urban fishing (29); 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.

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 2.43 million between 1990 and 1995 (or by nearly 15 percent), and is expected to reach 2.7 million by the year 2000. Arizona state population is projected to climb from its current level of about 4.2 million to 5.7 million over the next 25 years, representing a 35 percent increase. 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 and 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 and Recreation Long Range Plan (1988)* describes national standards which have been established for various types of recreation. These standards indicate desired and ideal service levels on a per capita basis. The desired level is the low national standard, as set by the National Recreation and Parks

Association (NRPA). The ideal level is the high national standard, which is also established by the NRPA. These standards can be applied to population statistics to determine whether the service area is lacking in recreation resources, based upon national standards. The following table summarizes some of the data included in the Long Range Plan.

Facility	Current Svc. Level*	Desired Level	Ideal Level
Close to Home Parks	2.7 Acres/1,000	6.25 acres/1,000	10.5 acres/1,000
Hiking Trails	1 mile/10,000	1 mile/8,000	1 mile/4,000
Equestrian Trails	1 mile/10,000	1 mile/8,000	1 mile/6,250
Bike Trails	1 mile/9,500	1 mile/2,000	1 mile/1,200

** City of Phoenix Only*

As the above data indicates, the Phoenix area lacks sufficient recreation resources. Unless a significant number of recreation facilities are built, the projected population growth will make the existing deficit become worse.

With Project Conditions

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 judgementally 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), "Because 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 the 1996 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 (1996) can range from $2.50 to $7.53 per recreation day.

Tempe Recreation Plan

Recreation Project Features

The City of Tempe has developed a preliminary Recreation Plan for the Tempe Reach. A copy of the analysis conducted by the City is included in the Recreation Appendix of the F4 Package. Please refer to this document for a detailed description of the proposed recreation plan.

The proposed restoration for the Tempe Reach will provide a unique opportunity for recreation and environmental education. Upstream of Town Lake, recreation components will be added to both Indian Bend Wash and the Salt River. Along Indian Bend Wash, no recreation features will be included in the low flow channel area north of Curry Road. South of Curry Road, proposed recreation elements include multi-use trails with wayfinding signage, ramadas, interpretive/environmental education features, a comfort station, picnic tables, grassed open space, and a parking lot. The trails will serve as circum-navigational routes around Town Lake and will connect to regional and inter-city trail networks. Trail placement will be located to provide the greatest opportunities for exploration of environmental restoration features. These trails will service the many visitors to the commercial businesses which will soon be located on the south bank of Town Lake, and will also serve as throughways for recreationalists wanting to traverse the developed Salt River from Mesa to Phoenix. Environmental education features will include interpretive information and displays about the benefits of recreation development in the reach, the relationship of the Tempe IBW to recreation development within the City of Scottsdale, restoration activities associated with the Tempe IBW reach and the purpose and techniques for control of storm flows in the Tempe IBW.

Upstream of Town Lake along the Salt River, recreation elements will consist primarily of multi-use trails with signage, environmental education features and a grassed outdoor seating area. This seating area will overlook the confluence of the IBW and Salt River, providing scenic viewing opportunities. Opportunities for wildlife viewing will also be provided because of the restoration project.

Downstream of Town Lake along the Salt River, primary recreation features will include a complete trail system to provide opportunities for scenic viewing of the downstream restoration area and to provide for passive activities such as picnicking and bird watching. Trails will be located along the south bank levee. A pedestrian bridge spanning the downstream end of Town Lake will also be provided. The bridge and trail system will provide unrestricted views of the restoration area. Two ramadas and a comfort station are also included for this area.

Projected Visitation

Visitation to the Tempe recreation areas is expected to be derived from: 1) those living in the market area and driving to the site; 2) local residents within walking distance; and 3) those staying at nearby hotels and conference centers.

Visitation at the resource for those driving to the site will be limited based upon the available parking in the area. Tempe has estimated that there are approximately 1,700 parking spaces available within walking distance of the proposed recreation sites. Visitation data maintained by the City for other recreation sites indicates an average number of visitors per vehicle of 3.0. Thus, the instantaneous resource capacity is estimated at 5,100 visitors. With a daily turnover rate of 3 times per parking space, total daily capacity equals 15,300 visitors.

Annual visitation for those driving to the resource 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:

Winter Peak Days	64 days	979,200 visitors	(at 100% capacity)
Winter Non-Prime Time	180 days	688,500 visitors	(at 25% capacity)
June/September	60 days	137,700 visitors	(at 15% capacity)
July/August	61 days	46,700 visitors	(at 5% capacity)
Total		1,852,100 visitors (annual)	

An additional 150,900 annual visits are projected from businesses, residences, and Arizona State University which are located within walking distance of the site. Total vehicular and non-vehicular visitation is therefore estimated at 2.003 million, annually.

Significant hotel and conference center development has and will continue to take place in the Town Lake area. This will provide an additional visitation source. These users are predominantly travelers and are addressed separately from the local MSA population. Tempe's analysis indicates that approximately 547,500 visits can be expected from these travelers. Total visitation, including those from vehicular, non-vehicular, and hotel sources, is estimated at 2.55 million, annually.

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 141,000. Excluding transfers, annual visitation is estimated at 2.41 million.

The Phoenix MSA and Tempe have experienced annual compound population growth rates of 0.4% and 2.7%, respectively. Due to resource capacity, availability of local parking, etc., visitation is expected to grow at a conservative 0.4% annual rate. This growth will be experienced primarily during non-peak days and summer months. Average annual visitation is estimated at 2.532 million (excluding transfers).

Recreation Value

A panel of City of Tempe recreation experts 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	27
Availability of Opportunity	0-18	14
Carrying Capacity	0-14	13
Accessibility	0-18	18
Environmental	0-20	17
Total	0-100	89

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 89 is approximately $7.07. Applying this dollar value to the annual visitation estimate of 2,532,000 yields a total annual recreation value of $17,901,000 (rounded).

Phoenix Recreation Plan

Recreation Project Features

The City of Phoenix has developed a preliminary Recreation Plan for the Phoenix Reach. A copy of the analysis conducted by the City is included in the Recreation Appendix of the F4 Package. 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 for the Phoenix Reach while developing an awareness, knowledge and understanding of desert riparian habitats and its interrelatedness to the environment as a whole. Major project features three parking lots, information kiosks, a visitor center, overlooks, shade structures, bridges, trails, demonstration gardens and outdoor classrooms, 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. Outdoor classrooms will provide education opportunities for students from the grade school through graduate school level.

Projected Visitation

Visitation at the resource will be limited based upon the available parking in the area. Phoenix's design includes three parking lots with a total of 250 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 0.25 visitors arrive to the site by an alternative mode of transportation, e.g., bicycle, foot traffic and public transportation. Thus, the instantaneous resource capacity is estimated at 750 visitors.

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:

Winter Prime Time	70 days	157,500 visitors
Winter Non-Prime Time	170 days	255,000 visitors
Summer Prime Time	28 days	42,000 visitors
Summer Non-Prime Time	92 days	69,000 visitors
Total		523,500 visitors (annual)

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 12,500. Excluding transfers, annual visitation is estimated at 511,000.

Visitation is assumed to be at capacity during winter prime time. However, increases in summer and non-prime time use are expected to result in an overall increase in visitation of 100,000 over the next 20 years. This represents an average annual compound growth rate of less than one percent. Visitation for project years 21-50 is projected to grow by an average annual compound growth rate of 0.5 percent. Average annual visitation is estimated at 566,600 (excluding transfers).

Recreation Value

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	16
Carrying Capacity	0-14	14
Accessibility	0-18	18
Environmental	0-20	17
Total	0-100	94

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 not any 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 outdoor classrooms, 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 94 is approximately $7.28. Applying this dollar value to the annual visitation estimate of 566,600 yields a total annual recreation value of $4,125,000 (rounded).

Costs

The cities of Phoenix and Tempe have prepared cost estimates for their respective recreation plans (see table which follows).

Table 15
Recreation Analysis
Estimated Costs

	Tempe Reach	Phoenix Reach	Total
First Cost	$4,413,000	$5,000,000	$9,413,000
Interest During Construction*	$160,000	$181,000	$341,000
Gross Investment	$4,573,000	$5,181,000	$9,754,000
Annual Cost**	$347,200	$393,300	$740,500
O&M***	$1,323,900	$1,500,000	$2,823,900
Total Annual Cost	$1,671,100	$1,893,300	$3,564,400

** One year construction period assumed*
*** 7 3/8%, 50 Years*
**** Tempe O&M cost estimate based upon Phoenix O&M/Total First Cost percentage*

It is important to note that the total first cost of construction of $9.4 million exceeds ten percent of the combined cost of the recommended plans for the Phoenix and Tempe reaches, which totals about $82 million. Corps guidance limits total recreation expenditures to 10% of total project costs. Recreation plans were developed by the cities of Tempe and Phoenix prior to having knowledge of what the recommended restoration plans and their respective costs were going to be.

Benefit/Cost Analysis

Table 16 displays the benefit/cost analysis for the Tempe and Phoenix Reaches.

Table 16
Recreation Analysis
Benefit/Cost Analysis

	Tempe Reach	Phoenix Reach	Total
Annual Benefit	$17,901,000	$4,125,000	$22,026,000
Annual Cost	$1,671,100	$1,893,000	$3,564,400
Net Benefits	$16,229,900	$2,232,000	$18,461,900
B/C Ratio	10.71	2.18	6.18

ADDENDUM

PURPOSE

This addendum presents a summary of some of the currently utilized analytical methods to quantify environmental outputs in monetary terms. In addition, some of the implementation difficulties associated with these methods are discussed. A list of references follows.

BACKGROUND

Through Reconnaissance and Feasibility Studies, the U.S. Army Corps of Engineers ("Corps") devotes considerable time and effort to determine whether to expend federal dollars on water resources projects. The primary methodology utilized in these studies to determine whether or not a project is "justified" is through a comparison of the quantified monetary benefits of the proposed project relative to its costs.

The Corps has developed techniques to quantify many types of benefits realized from water resources projects. For example, flood control project benefits can be quantified as the difference between inundation damages to structures within the floodplain under with and without project conditions. Additional methods are available to quantify benefits resulting from navigation, shore protection, hydroelectric power, water supply and recreational projects or project components. However, although many Corps projects provide significant environmental enhancement benefits, there are no currently established Corps guidelines on how to monetize such benefits.

Increasing importance is being placed upon the restoration, preservation and enhancement of the nation's environment. The Corps is an active participant in this endeavor, with an increasing number of projects in which environmental enhancement is either the primary purpose or a key component. Corps economic analysis of environmental enhancement projects currently consists of comparing the project's benefits in such non-monetary terms as increases in "habitat units" to the costs of providing the given level of benefits. However, since environmental outputs are not quantified in monetary terms, a direct dollar comparison between costs and benefits is not possible. For example, there is no way to determine the project alternative which has the highest level of net benefits or which has the highest benefit/cost ratio.

In the absence of such guidelines, the Corps focus has been on providing an "incremental cost analysis". In such analyses, the marginal cost of providing additional environmental outputs is determined. All combinations of alternatives are analyzed to determine the least costly way to provide a spectrum of environmental outputs. This provides a useful tool for determining those projects or project components which are cost efficient. However, it does not indicate which alternative provides the greatest National Economic Development benefits.

THE PROBLEM

Considerable efforts have been made by various government agencies and academic institutions to develop methods to monetize benefits associated with increasing environmental outputs. However, there are several key difficulties which must be overcome. *Economic and Environmental Considerations for Incremental Cost Analysis in Mitigation Planning*, published by the U.S. Army Corps of Engineers' Water Resources Support Center (March 1991) summarizes some of these problems:

> *Economic values include commercial, recreational, option, existence and bequest values, of which only a part can be satisfactorily described in monetary terms and even less is valued in an operating market. The much larger set includes non-market values, such as: (1) option value, which refers to an individual's willingness to pay to maintain habitat, such as wildlife recreation opportunities, (2) existence value, which refers to the economic benefit from knowing that natural resources exist, and (3) bequest value, which is the willingness to pay for preserving natural and unique resources for future generations ... The difference between market and non-market values is a source of confusion for some individuals, especially for managers who trade resources in the market place, such as coal and lumber. In addition, others doubt that economic values such as option, existence and bequest can be accurately measured. (p. 8)*
>
> *The net benefit optimization problem clearly cannot be solved if the benefits cannot be estimated. (The difficulties attendant to optimizing the level of mitigation become rather obvious when the functions and arguments of in a benefit relationship are considered. First, the values of mitigation outputs are normally non-market goods that cannot be easily estimated. In addition to measurement problems, there are conceptual difficulties as well. Recent work in the area of non-market valuation of environmental resources indicate that value may include option, existence and bequest values as well as value in use. Theory and estimation techniques are still developing in these areas. Second, as noted above, the quantification of the outputs is currently an extremely ticklish problem. It is even more difficult to link these outputs convincingly to the input factors, X, that planners can control. Even if these difficulties can be overcome estimating the costs, R, of some of the input factors remains a formidable problem). Thus though economic efficiency theory clearly applies to determining the appropriate and justified level of mitigation, it cannot yet be routinely used. As a result, there is no objective way to determine the optimum level of mitigation. (p. 15)*

OVERVIEW OF METHODOLOGIES

Various monetary valuation techniques for environmental resources have been developed. These techniques can be categorized as follows: 1) market techniques; 2) surrogate market techniques; and 3) non-market techniques. The following overview of these techniques was obtained from IWR Report 95-R-2, *Review of Monetary and Nonmonetary Valuation of Environmental Investments* (February 1995).

Market Based Techniques

Changes in Factors of Production. The monetary value of environmental resources which have value as inputs in a productive process can be easily calculated. This technique is limited to those resources that can be used as inputs, and the inferred value of that resource may understate its true worth to society. An example of such a situation might be the change in water treatment costs associated with a manufacturing process that requires clean water as an input.

Weak Complementary Goods. If the enjoyment of consuming a market-measurable service is enhanced by a non-market environmental service, the demand for the market service should increase with an increase in the complementary environmental service. When the enjoyment of the environmental service requires purchase of this market good or if the service can be considered as a characteristic of a market good, it is possible to measure the value of a change in the environmental service that is based on the demand for the market good.

Defensive Expenditures. Defensive expenditures are made either to prevent or counteract the adverse effects of pollution. In effect, it is spending on a good that is a substitute for increased environmental outputs. Conversely, an increase in the environmental outputs should reduce defensive expenditure. The marginal change in defensive expenditures represents a willingness to pay for the incremental change in the environmental outputs.

Next Best Alternatives. When environmental resources have private goods that are viable substitutes, the value of these resources can be inferred from the market value of the substitute. Two shortcomings of this market-based technique are that few environmental resources have such substitutes, and a market value may not reflect the true value to society.

Surrogate-Market Techniques

Travel Cost Method. The travel cost method is a well established technique for valuing the recreation value of environmental resources. The travel cost in time and money is considered representative of the willingness of the user to pay for access to that resource. The limitation of these surrogate-market techniques are that it only gauges the recreational value and does not consider other values of environmental resources to society, nor does it allow for nonuse valuation.

Hedonic Prices. The concept of hedonic prices is that the prices and quantities of private goods purchased in the marketplace often reflect the value of associated public goods. Hedonic prices have been developed for environmental resources through property prices, travel costs and wages. However, the challenge for valuation of environmental resources is the inability of consumers to select their most preferred bundle of characteristics of the specific private goods.

Non-market Techniques

Contingent Valuation Method. The contingent valuation method is the most accepted non-market monetary valuation technique. It is based on a survey of individuals to directly build a demand curve for the subject good or service and discern the value of the service based upon the public's willingness to pay. In this method, individuals are asked directly what they would be willing to pay for a change in environmental resources. The answers are hypothetical in the sense that the response does not result in an actual payment being made. The primary difficulty with this approach is ensuring that there are not any biases which cause individuals to overstate or understate their true preferences. Since there is no actual market, there is no way to verify the correctness of the responses. However, despite its limitations, the contingent valuation method is the only monetary valuation method available for estimating non-use values such as option values and existence values.

Additional discussion regarding the above techniques, as well as other environmental resource valuation issues, can be found in numerous publications. A list of some of these references follows.

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RIO SALADO, SALT RIVER
ARIZONA

APPENDIX D

ENVIRONMENTAL/EIS

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT
SOUTH PACIFIC DIVISION
MAY 1997

Habitat Valuation Analysis
For Environmental Restoration
Rio Salado Project

I. INTRODUCTION AND PURPOSE

The purpose of this Appendix is to provide information supporting the plan recommended in the Main Report and the Environmental Impact Statement for the Rio Salado Feasibility Study.

The Corps' guidance for ecosystem restoration in the Civil Works Program is provided in Engineer Circular (EC) 1005-2-210. The purpose of the guidance is to assure that civil work investments in ecosystem restoration have the intended beneficial effects, are consistent with Administration policy, and will be conducted in the most cost effective manner.

This guidance (EC 1105-2-210:13.b.(1) and (20)) requires that the ecosystem outputs of proposed alternatives of a feasibility study be subjected to a detailed cost effectiveness and incremental cost analysis. The primary purpose being to allow explicit comparison of the additional cost and additional outputs associated with the alternatives. To perform this type of analysis, it is necessary that the environmental outputs be based on some quantifiable unit (e.g., Habitat Units, fisherman-days, visitor use days). This allows determination of the most cost-effective restoration option or combination of options that best meet the restoration goals.

The following analysis uses a habitat-based method to quantitatively characterize biological values of fish and wildlife habitat in the study area.

II. EXISTING ENVIRONMENTAL DEGRADATION AND RESTORATION OPPORTUNITIES

A. Habitat degradation.

Destruction of riparian habitat in the southwest has been widely reported (see Bahre 1991; Busch and Smith 1995; Rea 1983). A historical perspective of the Salt River appears in Haughley (1994) and Ohmart (1979). These reports and studies are incorporated by reference as per 40 CFR 1502.21.

Dam construction throughout the Salt River's upper watershed in the early 1900's changed the original character of the river and by the 1940's the river ceased to flow. The Salt River in the Feasibility Study Area (i.e., in the urbanized areas of Tempe and Phoenix) is essentially an expansive dry river bed dominated by large expanses of cobble and rubble and devoid of riparian vegetation.

Recent channelization projects by the Arizona Department of Transportation and the new Priest Drive bridge constructed by Maricopa County have physically altered the natural character of the western portion of the river.

B. Restoration goals. As stated in the "Planning Objectives" of the Plan Formulation of this Study, one objective is to restore the study area to a more natural condition by supplying water to the channel and revegetating with native plant species. As such, the HEP team reached a consensus that the goal of this restoration effort should be to restore the channel to conditions that are as close to natural as possible. It was agreed that a natural channel would meander and naturally be dominated with freshwater aquatic strand-type vegetation (see Minckley and Brown [1982:265]). The first terrace or bench (i.e., the immediate floodplain) would naturally be dominated by willows and cottonwoods; the upper terraces or "secondary'" floodplain is, under natural conditions, dominated by the mesquite "*bosque*" (or woodland) (see Minckley and Brown [1982:269]) and Minckley and Brown [1982:249]).

III. EVALUATION METHOD USED

A. Background. A reconnaissance field survey was conducted for the Reconnaissance Study to determine habitat values in the Rio Salado area (see USACOE 1995: Appendix A, pg. 53). A total of 29 sites along the Salt River were visited and evaluated using a modified Habitat Evaluations Procedure (HEP) (hereafter called a HEP-like analysis). This analysis was conducted to quantitatively assess the value of existing habitat and the potential value of restored habitat (i.e., under future with Project Conditions) on the Salt River.

(Note that HEP is a habitat-based evaluation procedure; it is used to give a quantitative, numerical value to biological

resources of concern. HEP, developed by the USFWS [USFWS 1980], is a formal process whereby tested habitat suitability models for certain species are used which directs the measurement of certain habitat variables for the selected species (e.g., percent of canopy cover, number of snag trees, stream temperature, percent ground cover, etc.) to obtain a Habitat Suitability Index (HSI). This is then used to obtain a numerical rating of habitat units for the selected species.

In the Reconnissance Study and in this evaluation, a numerical rating or value between 0.0 and 1.0 was assigned to the habitat as its value (i.e., Habitat Value [HV]). The HV was then multiplied by the area of the habitat to obtain the Habitat Units (HUs) for each habitat type.)

For the Reconnaissance Study an average habitat value was determined for each of the 29 sites by averaging rating criteria that were agreed on by a consensus of HEP team members (see USACOE 1995; Appendix A, pgs. 55-57).

(Note that the values generated for the rating criteria were based on actual field-collected data. Rating criteria used were: the presence of threatened or endangered species, presence of permanent water, the amount of existing disturbance and a determination of the "Anderson-Ohmart" value [from Anderson and Ohmart 1993] [also see USACE 1995, Appendix A:55].)

A future with project conditions evaluations was also conducted for the Reconnaissance Study. This analysis predicted what habitat units might be achieved through environmental restoration.

B. Habitat Evaluation.

The habitat evaluation used in the Reconnaissance Study formed the basis for the habitat valuation of the Feasibility Study. Personnel from USFWS and Arizona Game and Fish Department (AG&FD) who were involved in the Reconnaissance Study HEP-like analysis provided input into the determination of habitat value for this HEP-like analysis.

Since there is essentially no existing habitat (or habitat value) in the Feasibility Study Area (i.e., no habitat value for without project conditions), this HEP-like analysis for the Feasibility

Study was essentially a future with project analysis. As such actual collection of field data was necessary.

Habitat Values for each habitat type under the various proposed restoration alternatives (see section V below) were determined primarily by a consensus of the best professional judgement of resource agency biologist that performed the HEP-like analysis for the Reconnaissance Study. The team's collective background knowledge of riparian habitat in the project area and their participation in the Reconnaissance Study HEP-like analysis allowed for the an objective assessment of the potential habitat value of restoration alternatives.

IV. RESTORATION ALTERNATIVES

Section 2 of the F4 submittal provides a detailed description of the restoration alternatives being considered. As mentioned in Section 2, restoration alternatives involve the "Phoenix Reach" and the "Tempe Reach".

The 8 alternatives (excluding the no action alternative) being considered for the Phoenix reach range from a low-water use alternatives to high water use alternatives (see Section 2.3 of the F4 submittal).

Five alternatives (excluding the no action alternative) are being considered for the Tempe Reach. They also involve a range of alternatives from low water usage to high water usage (see Section 2.3 of the F4 submittal for a detailed description of the alternatives).

V. HABITAT VALUE COMPARISON OF RESTORATION ALTERNATIVES

Tables 1 and 2 summarized the Habitat Units determined for each alternative for the Phoenix and Tempe reaches. As mentioned in Section III.B., habitat values were determined by a consensus of HEP team members. The consensus determination of Habitat Values for habitat types were largely influenced by the amount of water available for vegetation and the proximity of the habitat to areas of human disturbance.

<u>Phoenix Reach.</u> A simple comparison of the total Habitat Units (HUs) associated with alternatives shows that the most HUs are

derived from the alternative that provides for the most water and most acreage devoted to wildlife habitat. As would be expected, the alternative that provides for a perennial stream, more wetland associated plants, and vegetating existing gravel pits in the study area yields the most HUs. As would be expected, the low water alternatives have the least HUs.

It should be noted, however, that a simple comparison of the total habitat units may mask the restoration goal of trying to restore the river to a more "natural" condition (i.e., providing for the various habitat types typical of a desert river).

Tempe Reach. As would be expected, the same relationship exist for the Tempe Reach. The alternative that provides for the most available water and most acreage for restoration yields the highest HUs.

Table 1. Habitat Units for each habitat type for the restoration alternatives proposed for the "Phoenix Reach". (A detailed description of the Alternatives appears in Section 2.1 and 2.3 of the F4 submittal.)

Alternatives	Habitat Units (HUs) for each Habitat Type[1]					Total HUs
	Mesquite	Cottonwood/ Willow	Wetland Marsh	Aquatic Strand	Open Space	
High Water (w/Stream & Gravel Pits):						
Low-Flow Channel	n/a[2]	n/a	n/a	(130)(.6) = 12	n/a	
Bench	(30)(.5) = 15	(160)(.7) = 112	(100)(.7) = 70	n/a	n/a	
Bank	(5)(.5) = 2.5	(40)(.7) = 28	n/a	n/a	n/a	
Overbank	(25)(.5) = 12.5	(20)(.7) = 14	n/a	n/a	(25)(.3) = 7.5	
Park/Gateway	n/a	n/a	n/a	n/a	(50)(.3) = 15	
Gravel Pits	n/a	(10)(.7) = 7	n/a	n/a	n/a	
Sub-total	30	161	70	78	22.5	309
Low Water (w/Stream & Gravel Pits):						
Low-Flow Channel	n/a	n/a	n/a	(130)(.5)= 65	n/a	
Bench	(50)(.5) = 25	(80)(.6) = 48	(40)(.6) = 24	n/a	(120)(.25) = 30.0	
Bank	n/a	n/a	n/a	n/a	(45)(.25) = 11.25	
Overbank	(45)(.5) = 22.5	n/a	n/a	n/a	(35)(.25) = 8.75	
Park/Gateway	n/a	n/a	n/a	n/a	(50)(.25) = 12.5	
Gravel Pits	n/a	(10)(.7) = 7	n/a	n/a	n/a	
Sub-total	47.5	55	24	65	62.5	256.5
High Water (w/Stream & no Gravel Pits):						
Low-Flow Channel	n/a	n/a	n/a	(130)(.6) = 78	n/a	
Bench	n/a	(160)(.7) = 112	(100)(.7) = 70	n/a	n/a	
Bank	n/a	(5)(.7) = 3.5	n/a	n/a	(30)(.3) = 9	
Overbank	(10)(.5) = 5	(20)(.7) = 14	n/a	n/a	(10)(.3) = 3	
Park/Gateway	n/a	n/a	n/a	n/a	(50)(.3) = 15	
Sub-total	5	129.5	70	78	27	301.5

[1]Habitat Units are determined by multiplying (acres) x (habitat value).
[2]N/A means that no acreage is proposed for this habitat type.

Table 1 (Continued). Habitat Units for each habitat type for the restoration alternatives proposed for the "Phoenix Reach". (A detailed description of the Alternatives appears in Section 2.1 and 2.3 of the F4 submittal.)

Alternatives	Habitat Units (HUs) for each Habitat Type[1]					Total HUs
	Mesquite	Cottonwood/ Willow	Wetland Marsh	Aquatic Strand	Open Space	
High Water (no stream & no Gravel pits):						
Low-Flow Channel	n/a[2]	n/a	n/a	n/a	(130)(.25) = 32.5	
Bench	n/a	(160)(.6) = 96	(100)(.6) = 60	n/a	n/a	
Bank	n/a	(5)(.6) = 3	n/a	n/a	(30)(.25) = 7.5	
Overbank	(10)(.5) = 5	(20)(.6) = 12	n/a	n/a	(10)(.25) = 2.5	
Park/Gateway	n/a	n/a	n/a	n/a	(50)(.25) = 12.5	
Sub-total	5	111	60	0	55	231
Low Water (w/Stream & no Gravel Pits):						
Low-Flow Channel	n/a	n/a	n/a	(130)(.5) = 65	n/a	
Bench	(20)(.5) = 10	(80)(.6) = 48	(40)(.6) = 24	n/a	(120)(.25) = 30.0	
Bank	n/a	n/a	n/a	n/a	(35)(.25) = 8.75	
Overbank	(30)(.5) = 15	n/a	n/a	n/a	(20)(.25) = 5	
Park/Gateway	n/a	n/a	n/a	n/a	(50)(.25) = 12.5	
Sub-total	25	48	24	65	56.3	218.3
Low Water (no Stream & no Gravel Pits):						
Low-Flow Channel	n/a	n/a	n/a	n/a	(130)(.2) = 26	
Bench	(20)(.5) = 10	(80)(.5) = 40	(40)(.6) = 24	n/a	(120)(.2) = 24	
Bank	n/a	n/a	n/a	n/a	(35)(.2) = 7	
Overbank	(30)(.5) = 15	n/a	n/a	n/a	(20)(.2) = 4	
Park/Gateway	n/a	n/a	n/a	n/a	(50)(.2) = 10	
Sub-total	25	40	24	0	71	160

[1]Habitat Units are determined by multiplying (acres) x (habitat value).
[2]N/A means that no acreage is proposed for this habitat type.

Table 1 (Continued). Habitat Units for each habitat type for the restoration alternatives proposed for the "Phoenix Reach". (A detailed description of the Alternatives appears in Section 2.1 and 2.3 of the F4 submittal.)

Alternatives	Habitat Units (HUs) for each Habitat Type[1]					Total HUs
	Mesquite	Cottonwood/ Willow	Wetland Marsh	Aquatic Strand	Open Space	
High Water (no stream & w/Gravel pits):						
Low-Flow Channel	n/a[2]	n/a	n/a	n/a	(130)(.25) = 32.5	
Bench	(30)(.5) = 15	(160)(.6) = 96	(100)(.6) = 60	n/a	n/a	
Bank	(5)(.5) = 2.5	(40)(.6) = 24	n/a	n/a	(5)(.25) = 1.25	
Overbank	(25)(.5) = 12.5	(20)(.6) = 12	n/a	n/a	(25)(.25) = 6.25	
Park/Gateway	n/a	n/a	n/a	n/a	(50)(.25) = 12.5	
Gravel Pits	n/a	(10)(.6) = 6	n/a	n/a	n/a	
Sub-total	30	138	60	0	52.5	280.5
Low Water (no Stream & w/Gravel Pits):						
Low-Flow Channel	n/a	n/a	n/a	n/a	(130)(.2) = 26	
Bench	(50)(.5) = 25	(80)(.5) = 40	(40)(.6) = 24	n/a	(120)(.2) = 24	
Bank	n/a	n/a	n/a	n/a	(35)(.2) = 7	
Overbank	(30)(.5) = 15	n/a	n/a	n/a	(20)(.2) = 4	
Park/Gateway	n/a	n/a	n/a	n/a	(50)(.2) = 10	
Gravel Pits	n/a	(10)(.7) = 7	n/a	n/a	n/a	
Sub-total	40	47	24	0	71	182

[1]Habitat Units are determined by multiplying (acres) x (habitat value).
[2]N/A means that no acreage is proposed for this habitat type.

Table 2. Habitat Units for each habitat type for the restoration alternatives proposed for the "Tempe Reach". (A detailed description of the Alternatives appears in Section 2.1 and 2.4 of the F4 submittal.)

Alternatives	Habitat Units (HUs) for each Habitat Type[1]					Total HUs
	Mesquite	Cottonwood/ Willow	Wetland Marsh	Aquatic Strand	Open Space	
High Water:						
Indian Bend Wash	(20)(.6) = 12	n/a[2]	n/a	(50)(.58) = 29	(10)(.2) = 2	
Salt River (upstream)	n/a	(10)(.6) = 6	(8)(.7) = 5.6	n/a	(12)(.2) = 2.4	
Salt River (downstream)	n/a	(10)(.6) = 6	(8)(.7) = 5.6	n/a	(12)(.2) = 2.4	71.0
Low Water:						
Indian Bend Wash	(20)(.6) = 12	n/a	n/a	n/a	(10)(.2) = 2	
Salt River (upstream)	(5)(.4) = 2	n/a	n/a	n/a	(25)(.2) = 5	
Salt River (downstream)	(5)(.5) = 2.5	n/a	n/a	n/a	(25)(.2) = 5	28.5
High Water:						
Indian Bend Wash	(20)(.6) = 12	n/a	n/a	(50)(.58) = 29	(10)(.2) = 2	
Salt River (downstream)	n/a	(10)(.6) = 6	(8)(.7) = 5.6	n/a	(12)(.2) = 2.4	57.0
Low Water:						
Indian Bend Wash	(20)(.6) = 12	n/a	n/a	n/a	(10)(.2) = 2	14.0
High Water:						
Salt River (downstream)	n/a	(10)(.6) = 6	(8)(.7) = 5.6	n/a	(12)(.2) = 2.4	14.0

[1]Habitat Units are determined by multiplying (acres) x (habitat value).
[2]N/A means that no acreage is proposed for this habitat type.

VI. RECOMMENDED RESTORATION PLAN

{{To be prepared after the F4 submittal.}}

VII. LITERATURE CITED

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SECTION 2. ALTERNATIVES CONSIDERED, INCLUDING PROPOSED ACTION

Section 2 of this Environmental Impact Statement (EIS) provides a description of the project as proposed by the U.S. Army Corps of Engineers (USACE), referred to as the Proposed Action (see Section 2.1). Based on the requirements of the National Environmental Policy Act (NEPA), this EIS also considers reasonable alternatives to the Proposed Action, including the No Action Alternative (see Sections 2.2, 2.3, and 2.4). Section 2.5 presents the scenario used for analysis of cumulative impacts. In presenting this scenario, the various other projects likely to have impacts in combination with the Proposed Action and/or Project Alternatives are identified and described. A comparison of the alternatives to the Proposed Action is presented in Section 2.6.

Please note that Section 1 of this EIS addresses the purpose and need for the Proposed Action, agency use of this document, and public concerns and involvement.

2.1 PROPOSED ACTION

2.1.1 OVERVIEW OF THE PROPOSED ACTION

The USACE in conjunction with two local sponsors, the Cities of Phoenix and Tempe, proposes to undertake the environmental restoration of two sites along the Salt River in the State of Arizona (see Figures 2-1 and 2-2). The first site, hereafter referred to as the 'Phoenix Reach', consists of a 5-mile portion of the Salt River in the City of Phoenix. The second site, referred to as the 'Tempe Reach', is located in the City of Tempe on portions of the Salt River and Indian Bend Wash (a tributary to the Salt River). The specific locations of the two sites are shown in Figures 2-3 and 2-4.

In the context of this project, environmental restoration refers to the re-introduction of water flows in the river channel and the restoration of natural habitats historically associated with the Salt River flood plain. The habitat types proposed to be established in the river channel are described in Section 2.1.2. The proposed environmental restoration project involves various areas in the bottom and along the sides of the river, and terms describing these various components of the river channel are used throughout this document. The term *low-flow channel* refers to an incised channel in the river bottom designed to convey low-level flows, and *benches* refer to the portions of the river bed on either side of the low-flow channel. The river *banks* are the sloping sides of the river channel and the *overbanks* are the areas above the banks on each side of the river. In addition, the proposed restoration of the Phoenix Reach incorporates three existing *gravel pits* along the edges of the river channel into the restoration scheme. A typical cross-section of the river channel is shown in Figure 2-5.

Figure 2-1: Regional Location Map

Figure 2-2: Project Site Locations

Figure 2-3: Phoenix Reach Area Map

Figure 2-4: Tempe Reach Area Map

Figure 2-5: Typically River Channel Cross Section

Phoenix Reach

The Phoenix Reach is a 5-mile portion of the Salt River which runs through the City of Phoenix. The upstream limit of the Phoenix Reach is the Interstate-10 bridge and the downstream limit is the 19th Avenue bridge. Currently, much of the Phoenix Reach is occupied by old landfills and active sand/gravel mining operations along the banks of the river. The proposed restoration of the Phoenix Reach would involve the construction of a 200-foot wide low-flow channel in the river bottom, the establishment of riparian habitat in the river bottom and along the edges of three gravel pits, and the establishment of mesquite habitat on the benches and overbanks of the river channel. The project would also include the construction of recreational trails in the river bottom and on the banks and overbanks of the river. Three park areas are planned for construction on the overbanks of the channel to serve as public gateways to the river.

Restoration of the Phoenix Reach includes the creation of a perennially flowing stream in the low-flow channel in the river bottom. This stream would be about 10-20 feet wide and would flow at a rate of about 5-10 cubic feet per second (cfs).

The Phoenix Reach includes the restoration of a total of approximately 880 acres. This includes about 550 acres in the Salt River channel and 330 acres at three separate gravel pits along the channel. The acreages of habitats and other areas planned for the Phoenix Reach are displayed in Table 2-1, below.

Table 2-1 Phoenix Reach

Area	Acreage						Total Acres
	Mesquite Upland	Cottonwood Willow	Wetland Marsh	Aquatic Strand	Open Space	Other	
Low-Flow Channel	-	-	-	130	-	-	130
Bench	30	160	100	-	-	10	300
Bank	5	40	-	-	-	5	50
Overbank	25	20	-	-	25	40	110
Park/Gateway Areas	-	-	-	-	50	-	50
Gravel Pits	-	10	-	-	-	230	240
Totals	**60**	**230**	**100**	**130**	**75**	**285**	**880**

Tempe Reach

The Tempe Reach consists of portions of the Salt River and Indian Bend Wash immediately adjacent to Town Lake. Town Lake is an artificial body of water which the City of Tempe plans to construct within the Salt River channel at the confluence of the Salt River and Indian Bend Wash. The lake will be

constructed by installing inflatable dams across the river and filling the area between the dams with water. The lake will be approximately 200 acres in size and will contain about 3,500 acre-feet of water. Construction is anticipated to begin in summer 1997 (S. Neilsen, City of Tempe).

The Tempe Reach includes three areas which would be restored. The first area is located in Indian Bend Wash between the McKellips Road bridge and the confluence with the Salt River, a distance of 1.3 miles. A municipal golf course now occupies the land in the wash between McKellips and Curry Roads and, therefore, the restoration will be limited to the low-flow channel in this section of the wash. Between Curry Road and the Salt River, restoration efforts will include the entire area between the banks which define the wash, including both the low-flow channel and the benches on either side of the channel. The second area included in the Tempe Reach, referred to as *upstream* Salt River, is an 1,800-foot length of the Salt River between the upstream dam of Town Lake and the grade control structure located 200 feet downstream from the McClintock Road bridge. The third area, referred to as *downstream* Salt River, is approximately a 2,000-foot segment of the Salt River immediately below the downstream dam of Town Lake.

In the Tempe Reach, there are a total of approximately 140 acres to be restored. This includes about 50 acres in the low-flow channel of the Indian Bend Wash, 30 acres in the bench of the wash, 30 acres in the Salt River bottom upstream of Town Lake, and 30 acres in the Salt River bottom downstream of Town Lake. The acreages of habitats and other areas planned for the Tempe Reach are displayed below in Table 2-2.

Table 2-2 Tempe Reach

Area	Acreage						Total Acres
	Mesquite Upland	Cottonwood Willow	Wetland Marsh	Aquatic Strand	Open Space	Other	
Indian Bend Wash	20	-	-	50	10	-	80
Upstream Salt River	-	10	8	-	12	-	30
Downstream Salt River	-	10	8	-	12	-	30
Totals	**20**	**20**	**16**	**50**	**34**	**0**	**140**

2.1.2 PROJECT COMPONENTS

The primary purpose of the Rio Salado environmental restoration project is to restore natural habitat within portions of the Salt River and Indian Bend Wash in the Cities of Phoenix and Tempe. Incidental to this objective is the creation of passive recreational opportunities associated with the restored habitat areas—trails for walking and biking, and areas for observing wildlife and learning about the natural history

of the river. Critical to both the environmental restoration and recreation components of the project is the availability of adequate water supplies to support the restored habitat areas. In addition, the river channel must continue to function as a regional flood control facility.

Habitat Restoration

The Proposed Action would include the establishment of several habitat types within both the Phoenix and Tempe Reaches, including mesquite upland, cottonwood/willow riparian forest, wetland marsh, and riparian strand and scrubland. Mesquite upland habitat is dominated by honey mesquite trees and is normally found on the upper terraces of the flood plain, above the active flood channel. Cottonwood/willow riparian forest habitat is dominated by a combination of cottonwood and willow trees. This plant community is typically found along the edge of active stream beds and can extend outward to the edge of the two-year flood boundary. Wetland marsh habitat consists primarily of cattails, bulrushes, and water cress. This habitat is found along active watercourses, backwater areas, shallow ponds, and in areas of heavily saturated soils. Riparian strand habitat is found within the flood channels of rivers and streams and contains short-lived, successional plant species adapted to periodic flooding, scouring, and soil deposition. Riparian scrubland is also located along the drainages of rivers and streams, but in areas less frequently subject to flooding. These areas are more densely vegetated than riparian strands, consisting primarily of low to medium height trees and shrubs in scrub form. All of these habitats are associated with Sonoran Desert riparian corridors and each historically existed in the Salt River flood plain. In addition, the project would include some open space and urban park areas which do not have high habitat value but are utilized by some wildlife species on an opportunistic basis.

Water Supply

Water is an essential element to the restoration of both the Phoenix and Tempe Reaches. Because of the emphasis on riparian habitat, a relatively large amount of water would be required to support the proposed restoration project. For the Phoenix Reach, it is estimated that [amount] of water would be needed to support the planned habitats and maintain a perennial stream in the low-flow channel. It is estimated that [amount] of water would be needed to support the proposed restoration of the Tempe Reach.

The Cities of Phoenix and Tempe will each be responsible for the provision of the water needed to support the habitats within their respective portions of the river. Each city is considering two basic options for the supply of water—water from underground aquifers or water from the Central Arizona Project (CAP).

Well water would be drawn from near-surface aquifers. Because of contamination from industrial uses, agriculture and waste disposal, the water from these wells would need to be treated before being released into the environmental restoration areas. For the Phoenix Reach, water would be supplied by a series of wells located on the overbanks of the river. For the Tempe Reach, water would be supplied by an existing well located just west of Indian Bend Wash, on the south side of McKellips Road.

CAP water would be delivered to either the Phoenix or Tempe Reaches via the Salt River Project canal system. No treatment of this water would be needed prior to release into the environmental restoration areas.

Within the Phoenix Reach, water (from either wells or the SRP system) would be conveyed along the overbank of the river through either pipes or open ditches. The water would then flow down the river banks into the bottom of the river channel. A portion of the water would be released into the low-flow channel to create a perennial stream and the remainder would be conveyed by ditches to the wetland areas to be constructed on the benches in the river channel. After flowing through one or more wetland areas, this water would be released into the low-flow channel, joining the perennial stream in the channel.

To supply the Tempe Reach, water would be released into the low-flow channel of Indian Bend Wash south of the McKellips Road bridge. It would then flow downstream to where Indian Bend Wash meets Town Lake. The flows will not be allowed to enter Town Lake and instead will be collected and carried by gravity flow through a pipe to the upstream segment of Salt River. These flows will be released into the Salt River channel at a point just above Town Lake's upstream dam. The accumulated flow will support a wetland area adjacent to the dam. As the flows trapped upstream of the dam become excessive, a pumping system will remove the overflows, which will be directed by pipe to the downstream segment of Town Lake. This water will flow through the downstream segment of the Salt River, eventually seeping down into the cobbles of the river channel in the vicinity of Priest Drive.

Recreation

In order to provide recreational opportunities for the public, the project will include a system of trails within the river corridor. It is anticipated that these trails will be 10-12 feet wide and paved with asphaltic concrete. The trails will serve dual purposes -- as recreational paths for pedestrians and bicyclists and as service roads providing access to the habitats and facilities within the river corridor. The trails will be located in the river bottom on either side of the low-flow channel and on the banks and overbanks of the river. Interpretive signs will installed along the trail system for visitors wishing to learn about the habitats and natural history associated with the river channel.

Along the Phoenix Reach, public access points will be constructed at three locations -- the south side of the river at 16th Street, the north side of the river at Central Avenue, and the south side of the river at 7th Avenue. These public access points will include parking areas, interpretive displays, turf areas, and ramadas, as well as access to the trail system.

Flood Control

Flows in the Salt River are controlled by six major upstream dams which impound water for hydroelectric power generation, water supply, and flood control purposes. During most years, all upstream flows are diverted by these dams, preventing these flows from reaching the project area. On average, it is estimated that water will spill over the nearest dam (Granite Reef Dam, a minor agricultural water diversion structure 14 miles east of Tempe -- not one of the six major dams discussed above) once every three years, resulting in sustained flow through the project area during some portions of those years. Depending on the size and duration of flows, sustained flows through the project area could damage the restored habitat in the river channel. While the scouring effects of large volume flows could displace much of the restored vegetation in the river channel, smaller flood events could damage or destroy habitat by submerging vegetation for extended periods of time. It is estimated that cottonwoods can survive inundation for periods of up to 30 days and willows can survive for even longer periods. Mesquite and other upland plants are less tolerant of inundation.

Along the Phoenix Reach, a low-flow channel will be constructed in the river bottom to convey low-level flows and thereby minimize potential damage to the restored habitat areas. The low-flow channel will be 200 feet wide and approximately 10 feet in depth, and the sides of channel will be reinforced with soil cement. The design capacity of the low-flow channel is 12,200 cubic feet per second (cfs). A channel of this size will not prevent periodic inundation of the habitat areas, but should be sufficient to substantially reduce the likelihood that restored river habitats will be flooded for durations of more than 30 days.

Along the Tempe Reach, a low-flow channel currently exists in the middle of Indian Bend Wash. This channel be will maintained at its current width of 150 feet. Low-flow channels will not be constructed in the Salt River segments of the Tempe Reach.

Currently, the flows from a 100-year flood event would be contained within the existing river channel (with some overflow into adjacent gravel pits). USACE regulations require that the ability of the river to convey flood flows must not be comprised by restoration projects. Therefore, the flood capacity of the river will be maintained with the proposed project.

2.1.3 PROJECT CONSTRUCTION

Construction of the proposed restoration project would proceed in distinct stages. The first stage of construction would involve grading of the river bed and banks to create the planned configuration of channels, benches, and levees within the river channel. This would include: 1) the excavation of a low-flow channel in the river bottom, 2) the creation of benches on either side of the low-flow channel, 3) the lowering of the levees which separate the gravel pits from the river channel, 4) reducing the slope angle along the banks of the gravel pits, and 5) various re-configuration of the river banks. Exotic vegetation in the river channel (such as salt cedar) would also be removed during this initial stage of construction.

Following grading and landform modification, various improvements associated with habitat restoration and flood control would be constructed or installed. In the Phoenix Reach, the sides of the low-flow channel would be lined with soil cement in order to stabilize the channel banks. Also along the Phoenix Reach, the banks of the river channel may be reinforced with soil cement adjacent to the landfills along the river's edge in order to prevent river flows from eroding the banks at these locations and infiltrating the landfills (the river bank adjacent to the19th Avenue Landfill is already reinforced). Other improvements would include the installation of wells and water treatment equipment, and the construction of conveyance systems to bring water from the overbanks to the habitat areas in the river bottom. These water conveyance systems will consist of a combination of underground pipes and open ditches or canals. In the overbank areas, the open ditches will probably be lined with concrete or soil cement.

In the Tempe Reach, a drain pipe will be installed to carry flows from the downstream end of Indian Bend Wash to the upstream portion of the Salt River. A pump and pipe system will also be installed at the upstream dam of Town Lake to convey accumulated water around the lake, from the upstream to the downstream portion of the Salt River. In both the Phoenix and Tempe Reaches, paved maintenance roads, which would also serve as recreational trails, would be constructed on the overbanks of the river channel, on the banks of the gravel pits, and in the river bottom.

The next stage of construction would involve soil preparation and planting to create habitat areas on the benches and banks of the river channel. The bottoms of the planned wetland marsh areas will be covered with an impermeable soil liner to prevent water in the marshes from seeping into the loose gravel and cobbles of the river bed. Soil may also be imported and spread over the other habitat areas in order to provide more suitable conditions for the establishment of plants. Following soil preparation, the various habitat areas will be planted with native vegetation. Above-ground irrigation systems will be installed to provide water to the plantings until they are adequately established.

In order to create each of the planned habitat types, the dominant vegetation characteristic of each habitat will be planted. To create the mesquite upland habitat, mesquite trees (*Prosopis* sp.) will be planted at a density of 100 plantings per acre. Understory plants which may be planted in the mesquite upland include elderberry (*Sambucus mexicana*), greythorn (*Zizyphus obtusifolia* var. *canescens*), and wolfberry (*Lyceum fremontii*). For the cottonwood/willow riparian habitat, Fremont cottonwood trees (*Populus fremontii*) will be planted at a density of 150 plantings/acre and Goodding willow trees (*Salix gooddingii*) will be planted at a density of 400 plantings/acre. Other plants which may be planted in the cottonwood/willow habitat include common reed (*Phragmites communis*), desert broom (*Baccharis sarothroides*), and elderberry (*Sambucus mexicana*). The wetland marsh habitat would consist of plantings of cattail (*Typha* sp.) and giant bulrush (*Scirpus californicus*). Riparian strand and scrubland habitats will not be planted, but are expected to become established on their own in the low-flow channel. Various other native species will also become established on their own where conditions are favorable. The selected planting densities assume that a small percentage (perhaps 10%) of the original plantings will not survive.

2.1.4 Operation and Maintenance

Various operation and maintenance activities will be required after the initial construction of the planned habitat areas, as well as on an ongoing and recurring basis. It is estimated that full habitat establishment will take approximately __ years for the wetland marsh areas, __ years for the cottonwood/willow areas, and __ years for the mesquite areas. Until each habitat area is fully established, maintenance activities will include irrigation of the new plantings, replacement of dead or diseased plants, removal of invasive exotic plants, and, perhaps, some pruning of the plantings. Until various types of plants grow to sufficient size, some form of protection from herbivore (plant-eating) animals may be required.

Ongoing maintenance activities will include removal of invasive plants, and debris removal and habitat repair after storm flows. Periodically, large storm flows will wash away riparian vegetation (especially aquatic strand/scrub in the low-flow channel) and inundate the various habitat areas within the river channel. It is estimated that plants in the cottonwood/willow habitat will be able to survive inundations of up to 30 days, and that mesquite will survive inundation periods of 1-2 days. Especially large floods could cause substantial damage to the habitats in the river. After periods of heavy flows and inundation within the river channel, plants will need to be replaced and a period of habitat re-establishment will ensue. The amount of replacement required will depend on the size of the flows through the river and period of inundation for the various habitat areas. Therefore, a recurring cycle of habitat repair and re-establishment is anticipated throughout the life of the project.

2.2 NO ACTION ALTERNATIVE

One of the most important aspects of the environmental review process is the identification and assessment of reasonable alternatives that have the potential for avoiding or minimizing the impacts of a proposed project. In addition to mandating consideration of the No Action or No Project Alternative, NEPA Regulations (Section 1502.14) emphasize the selection of a reasonable range of technically feasible alternatives and adequate assessment of these alternatives to allow for a comparative analysis for consideration by decision makers. Further, NEPA regulations [Section 1502.14(c)] provide for the inclusion of reasonable alternatives not within the jurisdiction of the lead agency. This section discusses the No Action Alternative and Sections 2.3 and 2.4 describe other alternatives to the Proposed Action.

The **No Action Alternative** required for consideration under NEPA regulations would mean that existing conditions within the Tempe and Phoenix Reaches of the Salt River would continue into the future. The 550 acres of the Salt River bed in Phoenix from the Interstate-10 bridge to 19th Avenue would remain primarily barren cobbles and the gravel pits along this portion of the river would remain in their current condition. Similarly, Indian Bend Wash in the Tempe Reach between Curry Road and the confluence with the Salt River would remain as bare earth and cobbles and the low-flow channel between McKellips and Curry Roads would remain its present condition with bermuda grasses invading from the adjacent golf course. The upstream Salt River portion of the Tempe Reach would remain as barren cobbles. Except for riparian habitat associated with overspill from Town Lake, the downstream portion of the Salt River would also remain as barren cobbles. An evaluation of the environmental impacts of the No Action Alternative is provided within each environmental issue area in Sections 4.1 through 4.12 of this EIS. A comparison of this alternative to the Proposed Action is provided in Section 2.6.

2.3 PHOENIX REACH ALTERNATIVES

Alternatives for the environmental restoration of the Phoenix Reach of the Salt River were presented in the interim feasibility study completed by the USACE, entitled Rio Salado, Salt River, Arizona, General Investigations, F3 Package (January 1997). The USACE has since narrowed the range of alternatives to include only those alternatives which include a 200-foot wide low-flow channel (see Section 2.5 for an explanation of the rationale for eliminating other alternatives). The alternatives identified by the USACE are described below. The No Action Alternative is discussed in Section 2.2, above.

2.3.1 PHOENIX REACH LOW-WATER ALTERNATIVE (WITH PERENNIAL STREAM AND GRAVEL PITS)

The components of this alternative are essentially the same as those of the Proposed Action, but the sizes of the various habitat types are altered so that less water is required to support the habitats to be established in the river channel. In order to reduce the water demands of the planned habitats, this alternative includes more mesquite upland habitat and less of the water-consumptive, riparian habitat (freshwater marsh and cottonwood/willow riparian forest). Although this alternative has an altered habitat mix, the total amount of habitat established in the river channel (880 acres) is the same as that of the Proposed Action. It is estimated that [amount] of water would be required to support this alternative. Other than the difference in habitat mix, this alternative includes all the same components as the Proposed Action, including a 200-foot wide low-flow channel with a perennial stream, three public gateways to the river, recreational trails on the river bottom and banks, and restoration of the gravel pits along the edges of the river channel (see Table 2-3).

Table 2-3 Phoenix Reach Low-Water Alternative (with Perennial Stream and Gravel Pits)

Area	Acreage						Total Acres
	Mesquite Upland	Cottonwood Willow	Wetland Marsh	Aquatic Strand	Open Space	Other	
Low-Flow Channel	-	-	-	130	-	-	130
Bench	50	80	40	-	120	10	300
Bank	-	-	-	-	45	5	50
Overbank	45	-	-	-	35	30	110
Park/Gateway Areas	-	-	-	-	50	-	50
Gravel Pits	-	10	-	-	-	230	240
Totals	**95**	**90**	**40**	**130**	**250**	**275**	**880**

2.3.2 PHOENIX REACH HIGH-WATER ALTERNATIVE (WITHOUT GRAVEL PITS)

This alternative for the Phoenix Reach is similar to the Proposed Action but does not incorporate the gravel pits along the edges of the river channel. As a result, the total amount of area to be restored within the Phoenix Reach is reduced from 880 acres to 550 acres under this alternative. Similar to the Proposed Action, this alternative emphasizes riparian habitat and, therefore, is considered a high water consumption alternative. It is estimated that [amount] of water would be required to support this alternative. Other than the exclusion of the gravel pits, this alternative is identical to the Proposed Action and would still include a 200-foot wide low-flow channel with a perennial stream, three public gateways to the river, and recreational trails on the river bottom and banks (see Table 2-4).

Table 2-4 Phoenix Reach High-Water Alternative (without Gravel Pits)

Area	Acreage						Total Acres
	Mesquite Upland	Cottonwood Willow	Wetland Marsh	Aquatic Strand	Open Space	Other	
Low-Flow Channel	-	-	-	130	-	-	130
Bench	-	160	100	-	-	10	270
Bank	-	5	-	-	30	5	40
Overbank	10	20	-	-	10	20	60
Park/Gateway Areas	-	-	-	-	50	-	50
Gravel Pits	-	-	-	-	-	-	0
Totals	**10**	**185**	**100**	**130**	**90**	**35**	**550**

2.3.3 PHOENIX REACH HIGH-WATER ALTERNATIVE (WITHOUT PERENNIAL STREAM AND GRAVEL PITS)

This alternative for the Phoenix Reach does not include either a perennial stream in the low-flow channel or the restoration of the gravel pits along the river's edge. Due to the exclusion of the gravel pits, the total area to be restored within the Phoenix Reach is only 550 acres under this alternative. Similar to the Proposed Action, this alternative emphasizes riparian habitat and, therefore, is considered a high water consumption alternative. It is estimated that [amount] of water would be required to support this alternative. This alternative would still include a 200-foot wide low-flow channel, three public gateways to the river, and recreational trails on the river bottom and banks (see Table 2-5).

Table 2-5 Phoenix Reach High-Water Alternative (without Perennial Stream and Gravel Pits)

Area	Acreage						Total Acres
	Mesquite Upland	Cottonwood Willow	Wetland Marsh	Aquatic Strand	Open Space	Other	
Low-Flow Channel	-	-	-	-	130	-	130
Bench	-	160	100	-		10	270
Bank	-	5	-	-	30	5	40
Overbank	10	20	-	-	10	20	60
Park/Gateway Areas	-	-	-	-	50	-	50
Gravel Pits	-	-	-	-	-	-	0
Totals	**10**	**185**	**100**	**0**	**220**	**35**	**550**

2.3.4 PHOENIX REACH LOW-WATER ALTERNATIVE (WITHOUT GRAVEL PITS)

Under this Phoenix Reach alternative, the sizes of the various habitat types are altered so that less water is required to support the restoration of the river channel. In order to reduce the water demands of the

planned habitats, this alternative includes more mesquite upland habitat and less of the water-consumptive, riparian habitat (freshwater marsh and cottonwood/willow riparian forest). It is estimated that [amount] of water would be required to support this alternative. This alternative also does not include the restoration of the gravel pits along the river's edge. This alternative would still include a 200-foot wide low-flow channel with a perennial stream, three public gateways to the river, and recreational trails on the river bottom and banks (see Table 2-6).

Table 2-6 Phoenix Reach Low-Water Alternative (without Gravel Pits)

Area	Acreage						Total Acres
	Mesquite Upland	Cottonwood Willow	Wetland Marsh	Aquatic Strand	Open Space	Other	
Low-Flow Channel	-	-	-	130	-	-	130
Bench	20	80	40	-	120	10	270
Bank	-	-	-	-	35	5	40
Overbank	30	-	-	-	20	10	60
Park/Gateway Areas	-	-	-	-	50	-	50
Gravel Pits	-	-	-	-	-	-	0
Totals	**50**	**80**	**40**	**130**	**225**	**25**	**550**

2.3.5 PHOENIX REACH LOW-WATER ALTERNATIVE (WITHOUT PERENNIAL STREAM AND GRAVEL PITS)

This alternative for the Phoenix Reach does not include either a perennial stream in the low-flow channel or the restoration of the gravel pits along the river's edge. Due to the exclusion of the gravel pits, the total area to be restored within the Phoenix Reach is only 550 acres under this alternative. The sizes of the various habitat types are altered under this alternative in order to reduce the amount of water required to support the restoration of the river channel. Therefore, this alternative includes more mesquite upland habitat and less of the water-consumptive, riparian habitat (freshwater marsh and cottonwood/willow riparian forest). It is estimated that [amount] of water would be required to support this alternative. This alternative would still include a 200-foot wide low-flow channel, three public gateways to the river, and recreational trails on the river bottom and banks (see Table 2-7).

Table 2-7 Phoenix Reach Low-Water Alternative (without Perennial Stream and Gravel Pits)

Area	Acreage						Total Acres
	Mesquite Upland	Cottonwood Willow	Wetland Marsh	Aquatic Strand	Open Space	Other	
Low-Flow Channel	-	-	-	-	130	-	130
Bench	20	80	40	-	120	10	270
Bank	-	-	-	-	35	5	40
Overbank	30	-	-	-	20	10	60
Park/Gateway Areas	-	-	-	-	50	-	50
Gravel Pits	-	-	-	-	-	-	0
Totals	**50**	**80**	**40**	**0**	**355**	**25**	**550**

2.3.6 PHOENIX REACH HIGH-WATER ALTERNATIVE (WITHOUT PERENNIAL STREAM)

This Phoenix Reach alternative differs only from the Proposed Action in that it does not include a perennial stream in the low-flow channel. The total amount of habitat to be established under this alternative (880 acres) is the same as that of the Proposed Action. Similar to the Proposed Action, this alternative emphasizes riparian habitat and, therefore, is considered a high water consumption alternative. It is estimated that [amount] of water would be required to support this alternative. Other than the elimination of the perennial stream, this alternative is identical to the Proposed Action and would still include a 200-foot wide low-flow channel, three public gateways to the river, recreational trails on the river bottom and banks, and restoration of the gravel pits along the edges on the river channel.

Table 2-8 Phoenix Reach High-Water Alternative (without Perennial Stream)

Area	Acreage						Total Acres
	Mesquite Upland	Cottonwood Willow	Wetland Marsh	Aquatic Strand	Open Space	Other	
Low-Flow Channel	-	-	-	-	130	-	130
Bench	30	160	100	-	-	10	300
Bank	5	40	-	-	5	-	50
Overbank	25	20	-	-	25	40	110
Park/Gateway Areas	-	-	-	-	50	-	50
Gravel Pits	-	10	-	-	-	230	240
Totals	**60**	**230**	**100**	**0**	**210**	**280**	**880**

2.3.7 PHOENIX REACH LOW-WATER ALTERNATIVE (WITHOUT PERENNIAL STREAM)

Under this Phoenix Reach alternative, the sizes of the various habitat types are altered so that less water is required to support the restoration of the river channel. In order to reduce the water demands of the

planned habitats, this alternative includes more mesquite upland habitat and less of the water-consumptive, riparian habitat (freshwater marsh and cottonwood/willow riparian forest). It is estimated that [amount] of water would be required to support this alternative. This alternative also does not include a perennial stream in the low-flow channel. This alternative would include a 200-foot wide low-flow channel, three public gateways to the river, recreational trails on the river bottom and banks, and the incorporation of the gravel pits along the river's edge into the restoration effort (see Table 2-9).

Table 2-9 Phoenix Reach Low-Water Alternative (without Perennial Stream)

Area	Acreage						Total Acres
	Mesquite Upland	Cottonwood Willow	Wetland Marsh	Aquatic Strand	Open Space	Other	
Low-Flow Channel	-	-	-	-	130	-	130
Bench	50	80	40	-	120	10	300
Bank	-	-	-	-	45	5	50
Overbank	45	-	-	-	35	30	110
Park/Gateway Areas	-	-	-	-	50	-	50
Gravel Pits	-	10	-	-	-	230	240
Totals	**95**	**90**	**40**	**0**	**380**	**275**	**880**

2.4 TEMPE REACH ALTERNATIVES

Alternatives for the environmental restoration of the Tempe Reach were presented in the interim feasibility study completed by the USACE, entitled Rio Salado, Salt River, Arizona, General Investigations, F3 Package (January 1997). The USACE has since added a new site to the Tempe Reach -- the Salt River segment immediately downstream of Town Lake. Therefore, the alternatives for the restoration of the Tempe Reach presented in the interim feasibility study have been modified to include this new segment of the Salt River.

The Proposed Action includes the restoration of all three segments of the Tempe Reach under a high water consumption scenario. The alternatives for the Tempe Reach include a low water consumption alternative, as well as alternatives which would involve the restoration of only one or two of the three Tempe Reach segments.

2.4.1 TEMPE REACH LOW-WATER ALTERNATIVE (INDIAN BEND WASH, UPSTREAM SALT RIVER, DOWNSTREAM SALT RIVER)

This alternative includes the restoration of all three segments of the Tempe Reach (Indian Bend Wash, upstream Salt River, and downstream Salt River) utilizing a habitat mix which would be less water consumptive than the Proposed Action. It is estimated that [amount] of water would be required to support this alternative (see Table 2-10).

Table 2-10 Tempe Reach Low-Water Alternative (Indian Bend Wash, Upstream Salt River, Downstream Salt River)

Area	Acreage						Total Acres
	Mesquite Upland	Cottonwood Willow	Wetland Marsh	Aquatic Strand	Open Space	Other	
Indian Bend Wash	20	-	-	-	10	50	80
Upstream Salt River	5	-	-	-	25	-	30
Downstream Salt River	5	-	-	-	25	-	30
Totals	**30**	**0**	**0**	**0**	**60**	**50**	**140**

2.4.2 TEMPE REACH HIGH-WATER ALTERNATIVE (INDIAN BEND WASH, DOWNSTREAM SALT RIVER)

This alternative includes the restoration of Indian Bend Wash and the Salt River channel immediately downstream of Town Lake. For this alternative, water from the Indian Bend Wash portion of the area would be piped by gravity flow along the north bank of Town Lake and discharged immediately below the downstream dam of Town Lake. The third segment of the Tempe Reach (Salt River upstream of Town Lake) would remain in its present condition. Similar to the Proposed Action, this alternative emphasizes riparian habitat and, therefore, is considered a high water consumption alternative. It is estimated that [amount] of water would be required to support this alternative (see Table 2-11).

Table 2-11: Tempe Reach High-Water Alternative (Indian Bend Wash, Downstream Salt River)

Area	Acreage						Total Acres
	Mesquite Upland	Cottonwood Willow	Wetland Marsh	Aquatic Strand	Open Space	Other	
Indian Bend Wash	20	-	-	50	10	-	80
Upstream Salt River	-	-	-	-	-	30	30
Downstream Salt River	-	10	8	-	12	-	30
Totals	**20**	**10**	**8**	**50**	**22**	**30**	**140**

2.4.3 TEMPE REACH LOW-WATER ALTERNATIVE (INDIAN BEND WASH ONLY)

This alternative includes only the restoration of Indian Bend Wash. The Salt River segments of the Tempe Reach (upstream and downstream of Town Lake) would remain in their present condition. This alternative utilizes a habitat mix which would be less water consumptive than the Proposed Action. It is estimated that [amount] of water would be required to support this alternative (see Table 2-12).

Table 2-12 Tempe Reach Low-Water Alternative (Indian Bend Wash only)

Area	Acreage						Total Acres
	Mesquite Upland	Cottonwood Willow	Wetland Marsh	Aquatic Strand	Open Space	Other	
Indian Bend Wash	20	-	-	-	10	50	80
Upstream Salt River	-	-	-	-	-	30	30
Downstream Salt River	-	-	-	-	-	-	0
Totals	**20**	**0**	**0**	**0**	**10**	**80**	**110**

2.4.4 TEMPE REACH HIGH-WATER ALTERNATIVE (DOWNSTREAM SALT RIVER ONLY)

This alternative includes only the restoration of the Salt River segment downstream of Town Lake. The water source would be comprised of overflow from Town Lake, supplemented by other sources to be identified by the City of Tempe. The other two segments of the Tempe Reach (Indian Bend Wash and Salt River upstream of Town Lake) would remain in their present condition. Similar to the Proposed Action, this alternative emphasizes riparian habitat and, therefore, is considered a high water consumption alternative. It is estimated that [amount] of water would be required to support this alternative (see Table 2-13).

Table 2-13: Tempe Reach High-Water Alternative (Downstream Salt River only)

Area	Acreage						Total Acres
	Mesquite Upland	Cottonwood Willow	Wetland Marsh	Aquatic Strand	Open Space	Other	
Indian Bend Wash	-	-	-	-	-	-	0
Upstream Salt River	-	-	-	-	-	-	0
Downstream Salt River	-	10	8	-	12	-	30
Totals	**0**	**10**	**8**	**0**	**12**	**0**	**30**

2.5 ALTERNATIVES CONSIDERED AND REJECTED

A wide range of alternatives for the environmental restoration of both the Phoenix and Tempe Reaches of the Salt River were presented in the interim feasibility study completed by the USACE, entitled Rio Salado, Salt River, Arizona, General Investigations, F3 Package (January 1997). A number of the alternatives presented in the interim feasibility study have been eliminated from further consideration by the USACE and, therefore, are not considered viable alternatives for the purposes of this EIS.

For the Phoenix Reach, the alternatives which have been eliminated are the alternatives which either did not include a low-flow channel in the river bottom or included a low-flow channel greater than 200' in width. The alternatives which did not include a low-flow channel were eliminated because hydraulic analysis indicated that the restored habitats in the river bottom would be subject to frequent damage unless a channel was constructed to contain low-level flows. Although they would be able to convey larger flows, the wider channel configurations were eliminated as alternatives because these larger channels would consume a significant portion of the area available in the river bottom for the creation of habitat. Also, because it was determined that a 200'-wide channel would be sufficient to reduce the risks of prolonged inundation of the restored habitat areas, the wider channel configurations were considered unnecessary. In summary, the Phoenix Reach alternatives eliminated from further consideration include:

- Low water, no low-flow channel
- Low water, 350' low-flow channel
- Low water, 500' low-flow channel
- High water, no low-flow channel
- High water, 350' low-flow channel
- High water, no low-flow channel (with perennial stream)
- High water, 350' low-flow channel (with perennial stream)
- Low water, no low-flow channel (with gravel pits)
- Low water, 350' low-flow channel (with gravel pits)
- Low water, 500' low-flow channel (with gravel pits)
- High water, no low-flow channel (with gravel pits)
- High water, 350' low-flow channel (with gravel pits)
- High water, no low-flow channel (with perennial stream)
- High water, 350' low-flow channel (with perennial stream and gravel pits).

For the Tempe Reach, the low- and high-water alternatives which included Indian Bend Wash and upstream Salt River were eliminated in favor of low- and high-water alternatives which included Indian Bend Wash

and the Salt River segments both upstream *and* downstream of Town Lake. The high-water alternative which included only Indian Bend Wash was eliminated because of the difficulties involved in removing the flows which would accumulate adjacent to Town Lake (in high-water alternatives which include a Salt River segment, accumulated Indian Bend Wash flows could be diverted to the Salt River). In summary, the Tempe Reach alternatives eliminated from further consideration include:

- Low-water, Indian Bend Wash and Salt River upstream of Town Lake
- High-water, Indian Bend Wash only
- High-water, Indian Bend Wash and Salt River upstream of Town Lake.

2.6 CUMULATIVE PROJECTS CONSIDERED

The cumulative scenario consists of projects that are reasonably foreseeable (i.e., planned or projected) during the life of the Proposed Action. This section provides a listing of various projects comprising the cumulative scenario, that when considered together with the Proposed Action, may compound or increase environmental impacts. Table 2-14 presents the cumulative projects considered for this study. Cumulative projects are mapped on Figure 2-6, showing their approximate location within the study area. These projects are listed as cumulative projects to the Proposed Action based on discussions with the community development departments of the Cities of Phoenix and Tempe.

[Insert Table 2-14 -- Cumulative Projects]

Cumulative projects do not include existing projects that are completed or in operation (with the exception of existing projects that would have increased activities over the baseline assumptions). These existing projects are included in the environmental setting for individual issue areas in Section 3 (Affected Environment).

2.7 COMPARISON OF ALTERNATIVES

Table 2-15 summarizes the relative feasibility and impacts of the alternatives considered in comparison to the Proposed Action. These alternatives are described in Sections 2.2, 2.3, and 2.4, and their impacts are presented by issue area in Sections 4.1 through 4.12.

[Insert Table 2-15 -- Alternatives Comparison]

2.8 REFERENCES

USACE (U.S. Army Corps of Engineers). 1997. Los Angeles District, South Pacific Division, *Rio Salado, Salt River, Arizona, General Investigations, F3 Package*. January.

Placeholder for Figure 2-6 Cumulative Projects Map

RIO SALADO, SALT RIVER
ARIZONA

APPENDIX E

REAL ESTATE

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT
SOUTH PACIFIC DIVISION
MAY 1997

RIO SALADO ENVIRONMENTAL RESTORATION PROJECT

REAL ESTATE APPENDIX

REAL ESTATE ACQUISITION PLAN

FEASIBILITY STUDY F4 STAGE

Revised March 24, 1997

Real Estate Plan and Appendix
Rio Salado
Environmental Restoration Project

Introduction:

This project is primarily aimed at environmental restoration through wetland and riparian habitat development through an urbanized and highly developed section of the Salt River (Rio Salado) flowing through Phoenix. There are two main reaches of the river included in this plan; one at the eastern end near Tempe, Arizona and the Phoenix reach running between the I-10 bridge and the I-17 overpass/bridge. The City of Tempe and the City of Phoenix will be the project sponsors. Land ownership maps are provided. Accompanying each ownership map is a land use map. The geography, land use, and history of this area have a significant bearing on the real estate crediting and valuation factors to be addressed within this report. It is important to note that real estate take lines have not yet been definitely established for this project. The premise we have been given is that the habitat restoration measures will be confined within the bed and banks of the river. This zone would coincide with the river's established floodplain and floodway. Without established project take lines, this real estate plan and appendix is necessarily limited to a general discussion of the real estate aspects which are known at this time of project formulation.

Authority:

The authority for this project study is provided under the Corps of Engineer's General Investigations Authority for civil works projects. Funding for the study was appropriated in the Water Resources Development Act of 1994. After the feasibility report, project authorization and funding for implementation will be obtained as a separately authorized civil works project within the next Water Resources Development Act.

Purpose:

This stage of the real estate plan supports the "F4" phase of the feasibility study, The final feasibility report will be used as the basis for authority and funding to commence project implementation. Previous reports on this project include an approved Reconnaissance Report. In the early 1980's the Corps also studied several civil works projects for improvement of water resources issues along the Rio Salado corridor and some of these studies contained ingredients similar to the environmental or recreational benefits envisioned by this project.

Description of Lands.

The project is conveniently divided into two areas. At the City of Tempe reach of the river the project has been named *Tempe Cienega*. At the Phoenix reach the name, *Rio de Vida,* has been given, which means "River of Life".

Tempe Cienega

Within this reach of the river the planned habitat restoration measures are located within the meander lines of the river. This land is owned by the City of Tempe, the Maricopa County Flood Control District (MCFCD) and the U.S. Bureau of Land Management (BLM) The MCFCD area was acquired for the Indian Bend Wash civil works project. It has been previously used and credited and policy prevents it being credited for another civil works project The BLM area is all within the riparian zone within the ordinary high water marks of the river which was never patented, claimed or purchased. These are sometimes referred to as "omitted lands". This area within the bed and banks of the river and wash has no economic value. For project purposes the sponsor can obtain no cost permits from the public agencies to operate and maintain the habitat plantings within the bed of the river. A permit is a sufficient interest in real property on the BLM omitted lands and MCFCD right-of-way. These types of permits can be obtained without costs with the possible exception of an administrative processing fee.

Phoenix; Rio de Vida

The City of Phoenix also owns some of the land within the river banks and is pursuing current acquisitions to place the area within the banks of the river in public ownership. The Project Cooperation Agreement will allow the sponsor to receive credit for any lands it has acquired within 5 years preceding the signing of the agreement.

There are a number of private owners including commercial sand and gravel operations. The largest concerns are Calmat and United Metro The project will reclaim the riverbed so vegetation and wildlife habitat can recover. The sponsor will be required to show that is owns fee simple title to all areas within the river where habitat restoration work will be implemented.

At one specific area, (River mile 215.2, joining the Calmat property), a crossing area will be reserved to the owners. This is a working sand and gravel operation which continues to extract materials on both sides of the river. The reservation of a 60 foot wide travel corridor for movement of equipment and machinery and transportation of material would preclude a sizable severance damage on this ownership.

Additional areas outside the ordinary high water lines of the river may be needed for recreational features including public access and gateways. However at the date of this writing (March 1997) the locations for these plans have not been defined.

<u>Crediting for LERRD's and Special Issues:</u>

Tempe Cienega

The land within the banks of the Salt River will continue to be used as public open space and no restrictions or changes will be placed on the land that did not exist prior to the project. The area within Indian Bend Wash has already been utilized for a Federal cost shared project. Since the habitat work will be constrained within the river, there is no need to acquire any additional interests in real estate. The recommended instrument for the BLM and the Flood Control District lands is a no cost permit or agreement. This

agreement will allow the sponsor to develop landscaping and plantings inside the river. Therefore, there are no real estate costs or credits for this section of the project.

Phoenix: Rio de Vida

Note: This section will be more detailed when more detailed plan formulation data is available . An unanswered question at present is size, nature, location of recreation improvements. Another question is what areas formerly used a gravel extraction areas might be incorporated into the project, if any. Permanent improvements located outside the banks and floodplain such as public facilities, entrances areas, ADA access, parking lots will require fee interests. At this F4 stage, some preliminary information on the real estate and crediting issues is presented. The lands chosen for the project are of limited utility due their location within the banks of the Salt River. Environmental restrictions and past uses of the property are also discussed. All together, these considerations indicate that the crediting for the real estate on this project lands will not be a significant percentage of the total project costs.

The Local Sponsor would obtain credit for lands acquired within the past 5 years preceding the signing of a Project Cooperation Agreement. The credit will be based on the appraised fair market value as of the date the land or interest is made available for the project.

It must be noted that the lands within the bed and banks of the river and near or adjacent to elevated highways and bridges are limited in their potential and the appraised value applied for crediting purposes will take this fully into account.

For the city-owned lands (owned more than 5 years prior to a signed PCA), there is no greater interest or limitation on use being imposed on these lands specifically as a result of the project. The city-owned areas include street and bridge rights-of way and former city landfills. The project is aimed at restoring these lands. The project is not a "taking" of any kind on the city-owned property and does not restrict or encumber the property in any way. The project will not cause any diminution in the utility of this land or any loss of value. The project is actually a positive benefit to these reclaimed and restored public areas. Accordingly, there is no interest to credit for the city-owned lands.

Standard Estates

All estates used in the project implementation will be used verbatim from ER 405-1-12. At this juncture of the study, there are no non-standard estates submitted for approval. In general, the estate needed for the project is fee simple.

Federal Lands, Interests or Reservations.

There is one portion of BLM "omitted lands" in the Tempe section of the project as discussed above. A permit is the recommended real estate instrument. No Federal lands will be withdrawn for the project. Some of the project areas are within the meander lines or high water marks of the river and the valuation or crediting for lands will consider the effect of Federal, state or local governmental rights or powers.

Induced Flooding Potential Addressed:

There will be no construction induced flooding.

Hazardous Waste and Previous Land Uses.

The City of Phoenix has operated a former landfill which was closed under a Consent Decree issued through he regulatory enforcement powers of the Arizona Department of Environmental Quality (ADEQ) This site is on the EPA's National Priority List, commonly known as a Superfund Site. ADEQ now monitors the clean-up and remediation program over this site. ADEQ has ordered the City of Phoenix to undertake an extensive monitoring and data collection program to track emissions or releases which could potentially affect air and water quality. This regulatory listing affects the future utility and value not only of the former City property but the adjacent property as well. This is a negative market influence or stigma which would tend to further depress the economic potential and value of these lands.

Cost Estimate.

As of the date of this writing in March 1997 there is still insufficient project information and data to give any cost estimates for lands and damages. The gross appraisal will not be performed until sufficient planning information is decided and the planned extent and nature of the taking areas are known. A gross appraisal cannot be accomplished until real estate take lines have been established. However, based on the limited information being formulated at the present time, it is possible that that appraisals may only be necessary for recreation features on the Phoenix portion of the project situated above and outside of the designated floodplain and floodway. The question of former gravel pits and their valuation is addressed latter in this report.

As mentioned above, there are no creditable real estate interests being delivered to the project at the Tempe Cienega Reach. Since there will be no real estate costs applicable directly to the Tempe Cienega reach and project purposes, there will be no gross appraisal for this reach.

Concerning the Phoenix reach, at present the formulated plan is limited to the width of the river. This cross sectional area of the Salt River carries normal discharges and flood flows. It is within the designated and regulated floodplain which precludes most developmental use. This Phoenix reach is directly adjacent to former city landfills and some abandoned gravel pits. At the 19th Avenue and I-10 area the channel is crossed by an elevated interstate highway and its approaches. Given these restrictions and limitations, it would be hard to imagine a prospective economic use or development potential. Thus, the area within the river can only be attributed a very nominal value for crediting purposes. A per acre unit value for the land within the river will be formulated in a subsequent phase of this study. The estimated cost for LERRD's on this project is not expected to comprise a very significant contribution toward the sponsor's cost share.

Relocation Assistance (URA Relocations)

There are no residential relocations presently anticipated. Further the project is being formulated to avoid any displacements of any commercial businesses.

Mineral Activity _ Sand and Gravel Operations and Pits

Due to the formulation of the project, there will be no direct project costs associated with mineral activity. A further treatment of this subject is needed and is presented in the following two subparts: 1) the river floodplain, and 2) the former gravel pits lying outside that designated area.

1. Riverbed and Designated Floodplain:

There is some sand and gravel extraction being done in close proximity to the Phoenix reach, Rio De Vida. The project is being formulated to avoid any involuntary or forced takings. The City of Phoenix will attempt to work with some of the private owners of sand and gravel operations to acquire the land within the bed and banks of the Salt River for the habitat restoration measures. The extraction of river material within the ordinary high water lines of the river is regulated through the Section 404 permitting program and other Federal and State environmental regulations. Some of the sand and gravel operations have pending permit applications on file. The valuation of their property within the banks of the river will have to consider the permit status as of the date of acquisition for the project. To be considered for an appraised valuation, any use must be "legally permissible".

2. Gravel Pits Outside Floodplain.

It has not yet been determined which areas, if any, located outside the riverbanks and floodplain will be incorporated into the project. It has been suggested that an alternative be explored to use some abandoned gravel pits as surface water features (In Progress Review Conference, February 19, 1997). Actively used sand and gravel pits will not be considered for acquisition by the local sponsor. The local sponsor has already determined that these active operations cannot be economically acquired. The present heavy construction boom in metropolitan Phoenix creates a steady demand for this material. Thus any producing sources are being fully utilized for their economic return.

The use of abandoned or uneconomical sand and gravel pits will present some interesting appraisal aspects in the gross appraisal when it is prepared. This is only a preliminary discussion of some of the valuation factors that are present.

It is only economical to consider acquiring and using the pits which are already exhausted. Such former gravel pits may present an owner with liability rather than an asset. Contributing to the valuation of such abandoned sites, an appraisal would consider public liability for safety and attractive nuisances, environmental exposure and liability to Federal and state regulatory mandates, and the cost to cure by filling and compacting to render the site suitable for some alternative use. The pits are excavated below groundwater level. The infill of such sources may now require a Section 404 permit to convert a water feature or wetland considered under the regulatory jurisdiction

of the Section 404 permit program. A conversion of use would have to be cleared through the permitting process and may not be considered if a reasonable alternative is available. Further compacted fill sites are often precluded for use for several years to attenuate or monitor any environmental conditions. Often it will take a length of years before such sites can be used to support a building for example.

The valuation problem for such a site for a future would first have to consider the significant cost to cure. The present worth would also be discounted over the period required before the site is deemed safe and usable. Given these considerations, the abandoned or formerly utilized gravel pits may have no intrinsic market value.

The valuation of the sites will be taken up more specifically when it known which sites will be included and which sites the sponsor will be asking to receive credit should any such properties be included in this project. At this early stage of project formulation, the real estate plan is merely pointing out that any credit may be nominal at best and will be based on the appraised fair market value at the time the property is made available.

Other Matters.

The sponsor is not using any zoning ordinances in lieu of acquisitions of lands or easements within the project take areas. The project design does not require any relocation of third party utilities or rights-of-way.

Use Of Eminent Domain

The local sponsors would like to secure the real estate interests on a voluntary and cooperative basis and not have to resort to condemnation except as a last resort. Also condemnation might be needed as a tool to cure a legal matter or title encumbrance even though the parties can agree to terms. Both the City of Phoenix and the City of Tempe are legally chartered municipal corporations in the State of Arizona with full powers of eminent domain, which they may use if necessary to acquire real property for public purposes.

Schedule and Acquisition Plan:

There are only few uncomplicated acquisitions for the local sponsor to undertake and most of these are routine. There are no known obstacles or issues for the sponsor to complete and have all LERRD's certified prior to implementation. The project is being formulated such that the City of Tempe and the City of Phoenix will have acquired all lands and real estate needed for the planned project features in advance of the signing of a Project Cooperation Agreement for construction and implementation. The City Of Phoenix is working on potential acquisitions independently and in advance. They have been fully informed and notified of all of their risks and potential liabilities of performing such advance acquisition work according to the regulations. Since the City of Phoenix is only working on administrative items using their own staff and they are only pursuing possible donations, there appears to be little risks enjoined by the sponsor by working in advance.

REAL ESTATE EXHIBIT 1

OWNERSHIP MAPS WITH LAND USE MAPS

Phoenix Reach

Tempe Reach

REAL ESTATE EXHIBIT 2

PROPERTY OWNERSHIP WITHIN STUDY AREA

Potentially affected property owners at Tempe Cienega from McKellips to Curry Roads

Ownership	Assessor Parcel Number	Parcel Size	Take Acreage	Use(s)
MCFCD	132-07-002F	0.03+/-	N/C	Indian Bend Wash & Golf Course
MCFCD	132-07-003E	11.00+/-	N/C	Indian Bend Wash & Golf Course
MCFCD	132-07-003F	0.12+/-	N/C	Indian Bend Wash & Golf Course
MCFCD	132-08-001W	11.89+/-	N/C	Indian Bend Wash & Golf Course
MCFCD	132-08-012	1.10+/-	N/C	Indian Bend Wash & Golf Course
MCFCD	132-09-001B	23.89+/-	N/C	Indian Bend Wash & Golf Course
MCFCD	132-09-002	0.05+/-	N/C	Indian Bend Wash & Golf Course
MCFCD	132-14-002E	9.65+/-	N/C	Indian Bend Wash & Golf Course
MCFCD	132-14-002K	4.63+/-	N/C	Indian Bend Wash & Golf Course
MCFCD	132-14-002J	0.23+/-	N/C	Indian Bend Wash & Golf Course
MCFCD	132-14-003L	0.66+/-	N/C	Indian Bend Wash & Golf Course
MCFCD	132-14-003U	3.30+/-	N/C	Indian Bend Wash & Golf Course
MCFCD	132-14-004A	4.94+/-	N/C	Indian Bend Wash & Golf Course
City of Tempe	132-07-002C	0.07+/-	N/C	Indian Bend Wash
City of Tempe	132-07-002D	0.02+/-	N/C	Indian Bend Wash
U.S. BLM	132-14-006	0.44+/-	N/C	Indian Bend Wash

Potentially affected property owners at Tempe Cienega from Curry Road to Salt River

Ownership	Assessor Parcel Number	Parcel Size	Take Acreage	Use(s)
MCFCD	132-17-001C	1.87+/-	N/C	Indian Bend Wash
MCFCD	132-17-002G	14.00+/-	N/C	Indian Bend Wash
MCFCD	132-17-003A	1.51+/-	N/C	Indian Bend Wash
MCFCD	132-17-005E	2.68+/-	N/C	Indian Bend Wash
MCFCD	132-17-006A	1.36+/-	N/C	Indian Bend Wash
MCFCD	132-17-006B	0.48+/-	N/C	Indian Bend Wash
MCFCD	132-17-007C	1.37+/-	N/C	Indian Bend Wash
MCFCD	132-17-007F	0.35+/-	N/C	Indian Bend Wash

Potentially affected property owners from McClintock Road to Indian Bend Wash

Ownership	Assessor Parcel Number	Parcel Size	Take Acreage	Use(s)
Arizona Board of Regents	132-32-003D	13.77+/-	N/C	Vacant
City of Tempe	132-32-004B	19.51+/-	N/C	Vacant
City of Tempe	132-32-004D	25.48+/-	N/C	Vacant
U.S. BLM	132-31-000	unknown	N/C	Salt River Channel
U.S. BLM	132-32-000	unknown	N/C	Salt River Channel
MCFCD	132-31-003B	1.6+/-	N/C	Salt River Channel

Listing of potentially affected property owners along 19th Avenue to 7th Avenue

Ownership	Assessor Parcel Number	Parcel Size	Take Acreage	Use(s)
City of Phoenix	105-38-009B	74.2+/-	N/C	Superfund Site
City of Phoenix	105-38-010	17.1+/-	N/C	Superfund Site
City of Phoenix	105-38-008A	67.9+/-	N/C	River Channel & Superfund Site
City of Phoenix	105-38-008B	1.1+/-	N/C	River Channel
City of Phoenix	105-53-013A	1.9+/-	N/C	River Channel
City of Phoenix	105-53-013C	32.0+/-	N/C	River Channel & Superfund Site
City of Phoenix	105-53-014	3.3+/-	N/C	Superfund Site
City of Phoenix	105-53-016A	24.4+/-	N/C	River Channel & Superfund Site
City of Phoenix	105-53-018A	8.2+/-	N/C	Superfund Site
City of Phoenix	105-53-033D	4.8+/-	N/C	River Channel
City of Phoenix	105-53-033F	2.3+/-	N/C	Vacant
City of Phoenix	105-53-033H	0.9+/-	N/C	Vacant
City of Phoenix	105-54-001C	2.4+/-	N/C	River Channel
Robert Peters	105-53-025C	4.4+/-	N/C	Vacant
Robert Peters	105-53-027B	0.3+/-	N/C	Vacant
Robert Peters	105-53-033J	16.5+/-	N/C	Vacant & River Channel
Western Block	105-53-015H	1.8+/-	N/C	Manufacturing
Western Block	105-53-027A	2.4+/-	N/C	Manufacturing
Western Block	105-53-033G	1.7+/-	N/C	Manufacturing
Robert Linsenmeyer	105-36-029	14.5+/-	N/C	Gravel Pit
McDonald & Wilhelm	105-38-001A	78.1+/-	N/C	Gravel Pit & River Channel
McDonald & Wilhelm	105-38-002B	31.8+/-	N/C	Gravel Pit & River Channel
McDonald & Wilhelm	105-38-003	2.6+/-	N/C	Gravel Pit
City of Phoenix	105-38-001B	1.6+/-	N/C	River Channel
City of Phoenix	105-38-004	14.6+/-	N/C	Vacant & River Channel
United Metro Materials	105-54-001B	27.9+/-	N/C	Gravel Pit & vacant
United Metro Materials	105-54-001D	33.3+/-	N/C	Gravel Pit
United Metro Materials	105-54-002B	38.2+/-	N/C	Gravel Pit
United Metro Materials	105-38-005	1.8+/-	N/C	Landfill
United Metro Materials	105-38-006C	2.8+/-	N/C	Landfill
United Metro Materials	105-38-007	21.7+/-	N/C	Landfill

Listing of potentially affected property owners along 7th Avenue to Central Avenue

Ownership	Assessor Parcel Number	Parcel Size	Take Acreage	Use(s)
City of Phoenix	113-01-001B	4.8+/-	N/C	Vacant & River Channel
City of Phoenix	113-01-001C	26.2+/-	N/C	Vacant & River Channel
United Metro Materials	113-01-001D	6.7+/-	N/C	Gravel Pit
United Metro Materials	113-01-004A	18.1+/-	N/C	Gravel Pit & Quarry Facility
United Metro Materials	113-01-005	0.8+/-	N/C	Quarry Facility
United Metro Materials	113-01-003A	8.2+/-	N/C	Quarry Facility
United Metro Materials	113-01-006A	9.9+/-	N/C	River Channel & Quarry
United Metro Materials	113-01-002	1.0+/-	N/C	River Channel
United Metro Materials	113-01-008B	15.1+/-	N/C	Gravel Pit & Quarry Facility
United Metro Materials	113-01-008A	18.1+/-	N/C	Gravel Pit
United Metro Materials	113-01-007	11.6+/-	N/C	Vacant
United Metro Materials	112-45-004	unknown	N/C	Vacant
United Metro Materials	112-45-011	unknown	N/C	Vacant
United Metro Materials	112-45-012	unknown	N/C	Vacant
United Metro Materials	112-45-014	unknown	N/C	Vacant
United Metro Materials	112-45-016D	unknown	N/C	Vacant
United Metro Materials	112-46-004A	unknown	N/C	Landfill
United Metro Materials	112-46-005A	unknown	N/C	Landfill
United Metro Materials	112-46-013D	unknown	N/C	Landfill
United Metro Materials	112-46-013E	unknown	N/C	Landfill
United Metro Materials	112-46-014A	unknown	N/C	Landfill
United Metro Materials	112-46-024	unknown	N/C	Landfill

Listing of potentially affected property owners along Central Avenue to 7th Street

City of Phoenix	112-47-002D	unknown	N/C	River Channel
City of Phoenix	113-08-002B	1.3+/-	N/C	Landfill & River channel
City of Phoenix	113-08-002D	6.0+/-	N/C	Landfill
CalMat Properties	112-47-002E	16.4+/-	N/C	River Channel
CalMat Properties	113-08-002C	14.1+/-	N/C	River Channel
CalMat Properties	113-08-003A	17.4+/-	N/C	River Channel
CalMat Properties	113-08-001D	10.1+/-	N/C	Landfill
CalMat Properties	113-08-001E	1.8+/-	N/C	Landfill
CalMat Properties	113-08-001F	4.1+/-	N/C	Landfill
CalMat Properties	113-08-004C	11.2+/-	N/C	Landfill
CalMat Properties	113-08-004D	7.3+/-	N/C	Vacant
City of Phoenix	113-08-003B	0.7+/-	N/C	River Channel
City of Phoenix	113-08-003C	0.7+/-	N/C	River Channel

Listing of potentially affected property owners along 7th Street to 16th Street

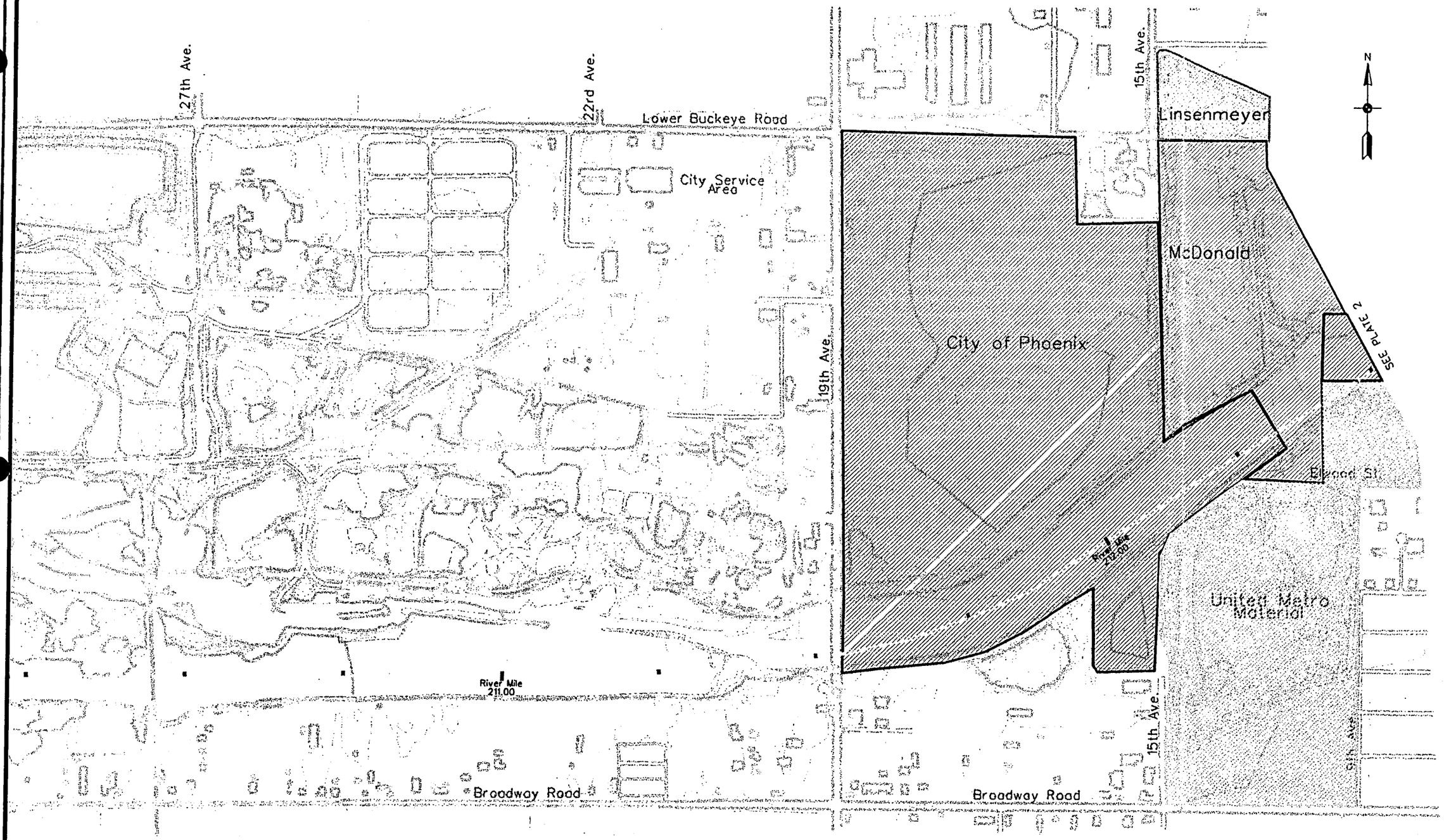
Ownership	Assessor Parcel Number	Parcel Size	Take Acreage	Use(s)
City of Phoenix	115-49-002F	0.6+/-	N/C	River Channel
City of Phoenix	115-49-002H	0.8+/-	N/C	River Channel
City of Phoenix	113-15-001P	1.4+/-	N/C	River Channel
CalMat Properties	113-15-001R	5.1+/-	N/C	Vacant
CalMat Properties	113-15-001D	6.8+/-	N/C	Vacant
CalMat Properties	113-15-001Q	0.3+/-	N/C	Vacant
City of Phoenix	113-15-001K	0.5+/-	N/C	Vacant
City of Phoenix	113-15-001M	1.6+/-	N/C	Vacant
City of Phoenix	113-15-001T	72.5+/-	N/C	Old Landfill with Park
City of Phoenix	113-15-001S	0.3+/-	N/C	Old Landfill with Park
City of Phoenix	113-17-005	10.6+/-	N/C	Old Landfill with Park
City of Phoenix	113-17-002	1.5+/-	N/C	Old Landfill with Park
City of Phoenix	113-17-001	1.5+/-	N/C	Old Landfill with Park
City of Phoenix	113-17-008	0.8+/-	N/C	Old Landfill with Park
City of Phoenix	113-22-003C	8.6+/-	N/C	Old Landfill with Park
City of Phoenix	113-22-004E	65.7+/-	N/C	Old Landfill with Park
City of Phoenix	113-22-007	0.4+/-	N/C	Old Landfill with Park
City of Phoenix	113-22-001H	10.3+/-	N/C	River Channel
CalMat Properties	115-49-002J	2.7+/-	N/C	River Channel
CalMat Properties	115-50-002G	0.9+/-	N/C	River Channel
CalMat Properties	113-15-001W	0.7+/-	N/C	River Channel
CalMat Properties	113-15-001X	0.3+/-	N/C	River Channel
CalMat Properties	113-22-001J	21.7+/-	N/C	Vacant
CalMat Properties	113-22-002A	1.5+/	N/C	River Channel
CalMat Properties	113-22-003D	23.4+/-	N/C	River Channel
CalMat Properties	113-22-001K	1.6+/-	N/C	River Channel

Listing of potentially affected property owners along 16th Street to 24th Street

Ownership	Assessor Parcel Number	Parcel Size	Take Acreage	Use(s)
City of Phoenix	122-29-002D	5.0+/-	N/C	River channel
City of Phoenix	122-29-003B	3.3+/-	N/C	River channel
City of Phoenix	122-29-005C	9.6+/-	N/C	River channel
Jewell Porterie	122-29-004A	6.6+/-	N/C	River channel
CalMat Properties	122-29-005K	48.7+/-	N/C	Vacant
CalMat Properties	122-26-003C	33.5+/-	N/C	Landfill
CalMat Properties	122-26-001B	32.8+/-	N/C	Landfill
CalMat Properties	122-29-002E	2.1+/-	N/C	River Channel
CalMat Properties	122-29-003A	25.1+/-	N/C	Gravel Pit
CalMat Properties	122-29-005J	13.3+/-	N/C	River Channel
CalMat Properties	122-29-007	29.3+/-	N/C	Gravel Pit
CalMat Properties	122-32-121	10.7+/-	N/C	Vacant
CalMat Properties	122-29-004A	78.7+/-	N/C	Gravel Pit & River Channel
CalMat Properties	122-34-002	4.3+/-	N/C	Gravel Pit
CalMat Properties	122-34-001C	30.9+/-	N/C	Gravel Pit
CalMat Properties	122-30-083B	3.3+/-	N/C	Vacant
CalMat Properties	122-30-084	3.2+/-	N/C	Vacant
City of Phoenix	122-26-002A	3.8+/-	N/C	River Channel & Vacant

Listing of potentially affected property owners along 24th Street to I-10 Bridge

Ownership	Assessor Parcel Number	Parcel Size	Take Acreage	Use(s)
City of Phoenix	122-25-002M	4.7+/-	N/C	River Channel & Vacant
City of Phoenix	122-25-003A	0.5+/-	N/C	River Channel
Robert McIntyre	122-25-003B	7.9+/-	N/C	Salvage Yard
CalMat Properties	122-25-002L	69.9+/-	N/C	River Channel & Vacant
CalMat Properties	122-25-004G	48.8+/-	N/C	Gravel Pit
CalMat Properties	122-25-001	1.0+/-	N/C	River Channel
CalMat Properties	122-24-002G	2.1+/-	N/C	Gravel Pit
CalMat Properties	122-24-003G	4.7+/-	N/C	Vacant
State of Arizona - ADOT	122-25-004F	9.1+/-	N/C	River Channel & Gravel Pit
State of Arizona - ADOT	122-25-002G	0.9+/-	N/C	River Channel
State of Arizona - ADOT	122-24-002D	6.1+/-	N/C	River Channel
State of Arizona - ADOT	122-24-003F	20.3+/-	N/C	River Channel & Vacant
State of Arizona - ADOT	122-24-002K	18.2+/-	N/C	River Channel & Vacant



Contour Interval - 20 feet

Scale - 1 : 800

SYMBOL	DESCRIPTIONS	DATE	APPROVAL

REVISIONS

RIO SALADO, ARIZONA
FEASIBILITY REPORT

RIVER MILE 211.00 TO 212.51

LAND OWNERSHIP

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

DESIGNED BY:
DRAWN BY:
CHECKED BY:

SUBMITTED BY:

CHIEF, PLANNING BRANCH

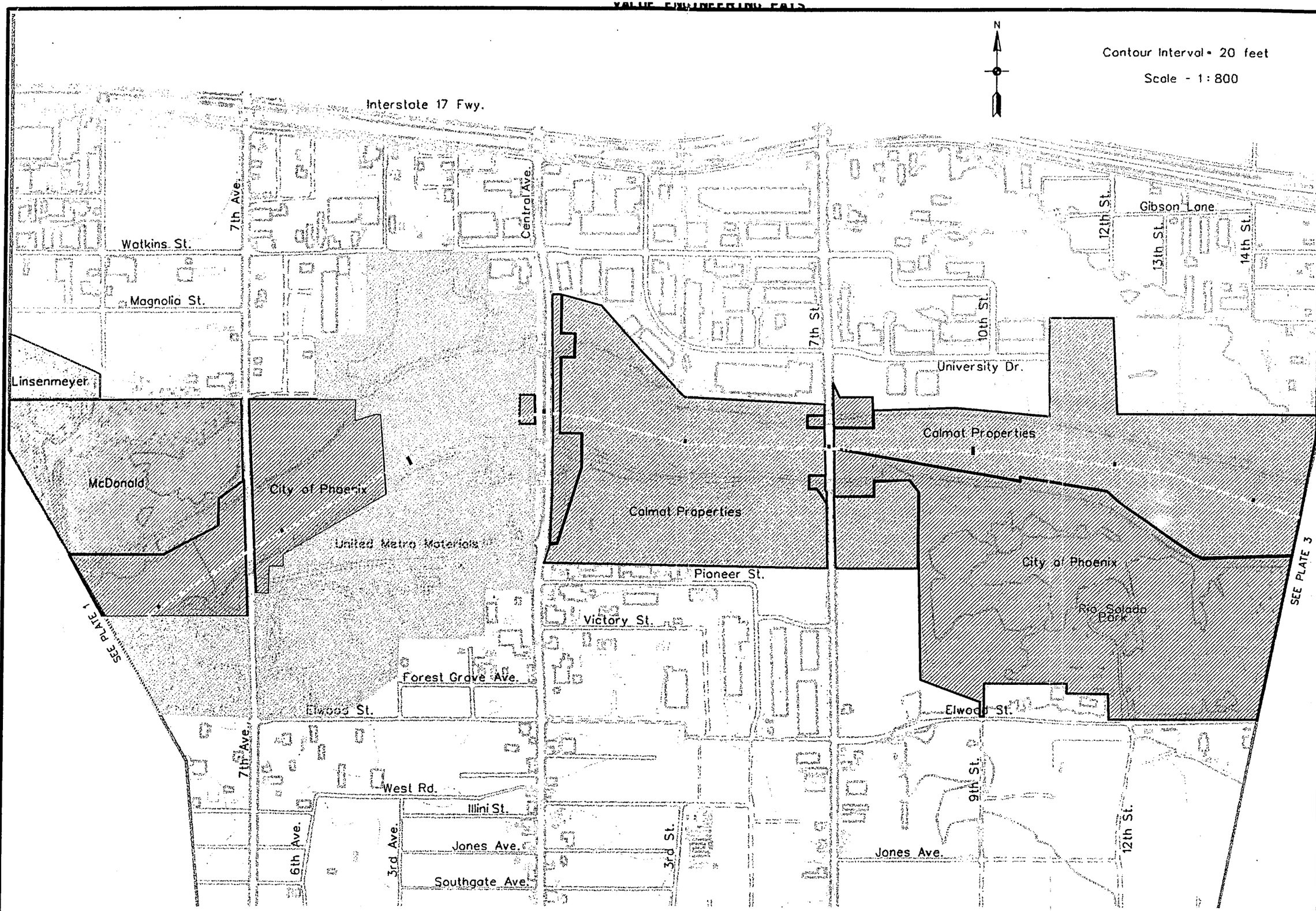
DISTRICT FILE NO.

SPEC. NO.

CADD FILE NAME

PLATE 1B

SAFETY PAYS



SYMBOL	DESCRIPTIONS	DATE	APPROVAL
	REVISIONS		

RIO SALADO, ARIZONA
FEASIBILITY REPORT

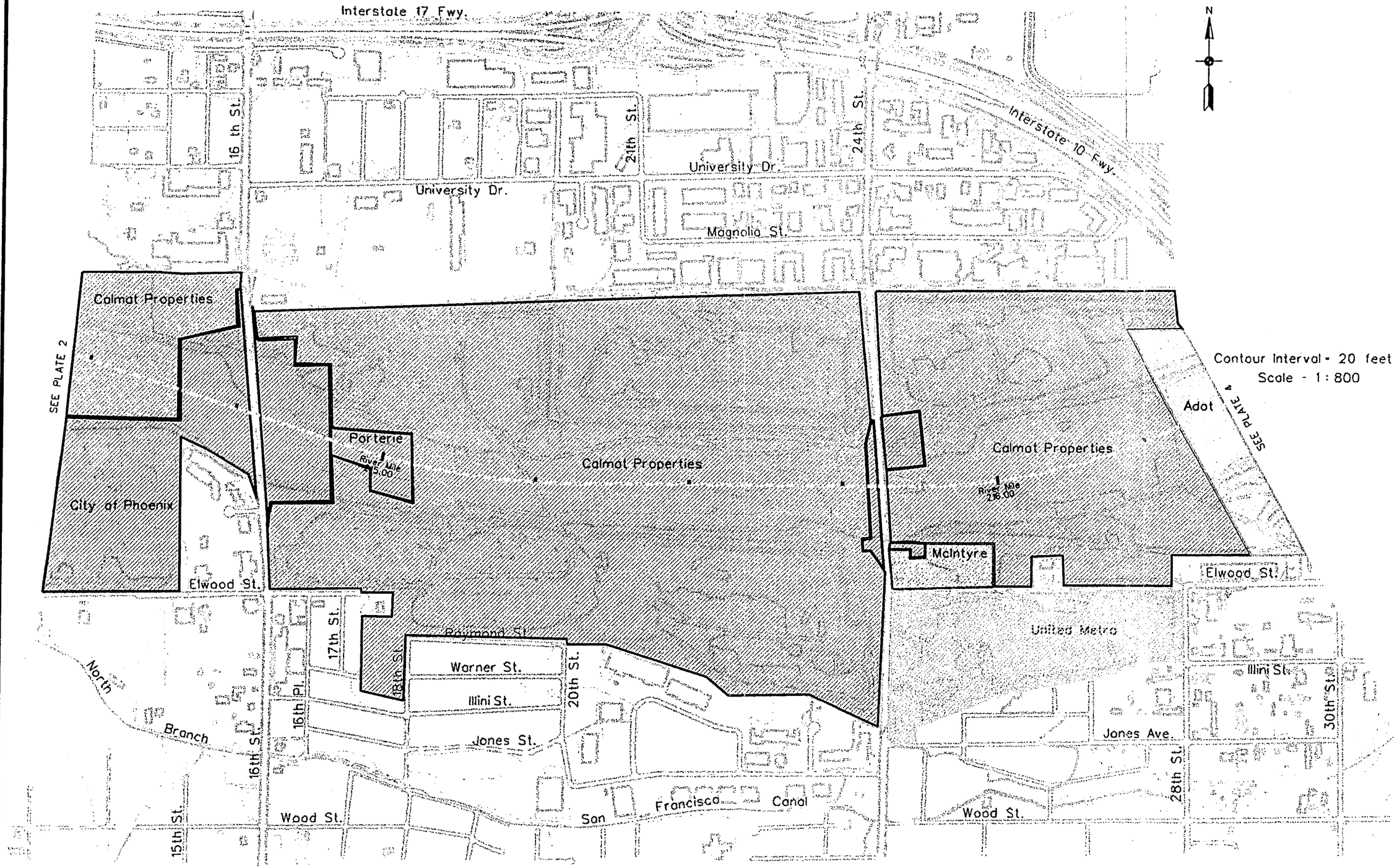
RIVER MILE 212.40 TO 214.58

LAND OWNERSHIP

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

DESIGNED BY:
DRAWN BY:
CHECKED BY:
CADD FILE NAME:
SUBMITTED BY:
CHIEF, XXX BRANCH
DISTRICT FILE NO.
SPEC. NO.

PLATE 2B



Contour Interval - 20 feet
Scale - 1 : 800

SYMBOL	DESCRIPTIONS	DATE	APPROVAL
	REVISIONS		

RIO SALADO, ARIZONA
FEASIBILITY REPORT
RIVER MILE 214.49 TO 216.40
LAND OWNERSHIP

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

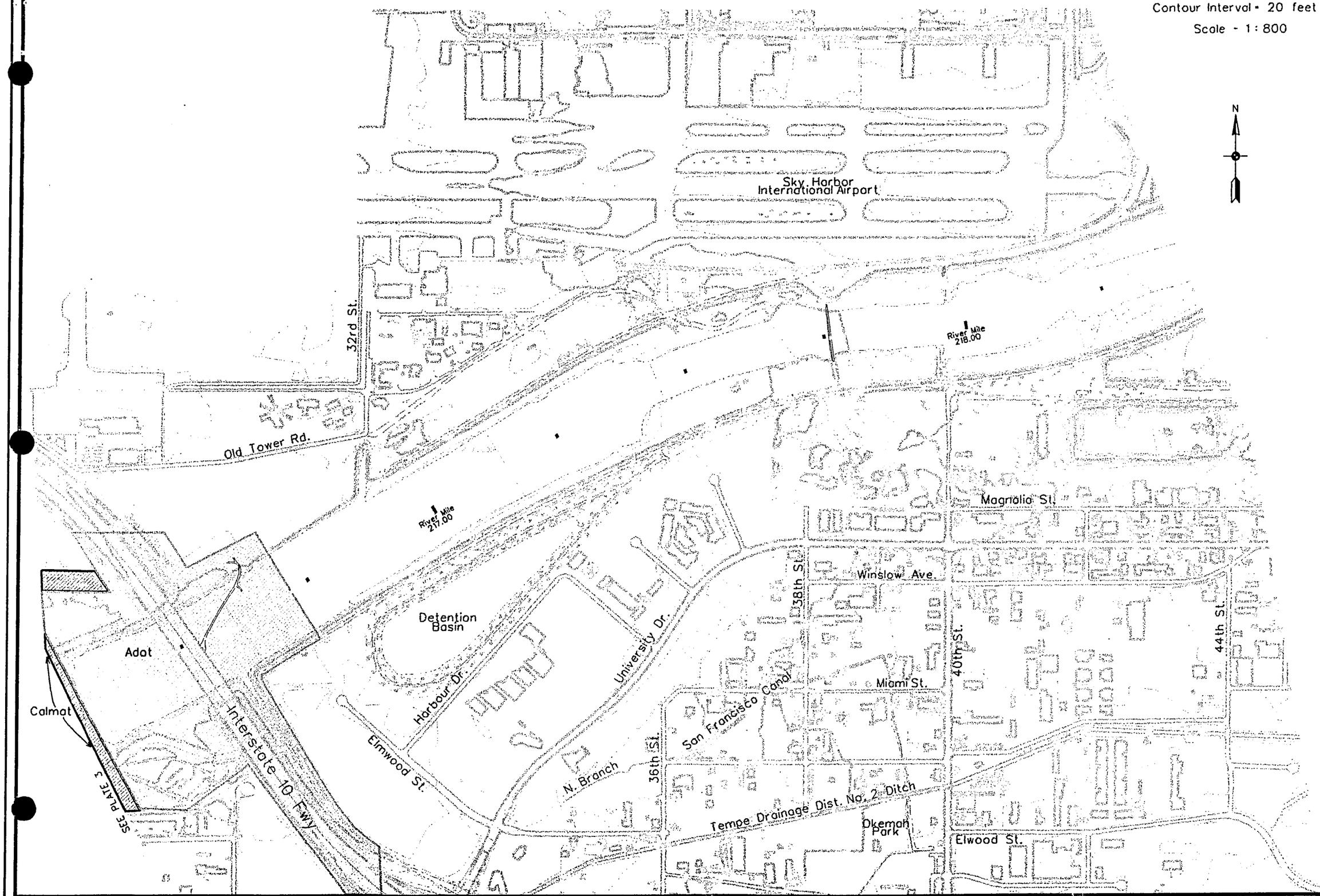
DESIGNED BY:
DRAWN BY:
CHECKED BY:
SUBMITTED BY:
XXX
CHIEF, XXX BRANCH
CADD FILE NAME:
DISTRICT FILE NO.
SPEC. NO.

PLATE 3B

SAFETY PAYS

Contour Interval - 20 feet

Scale - 1:800



SYMBOL	DESCRIPTIONS	DATE	APPROVAL
	REVISIONS		

RIO SALADO, ARIZONA
FEASIBILITY REPORT

RIVER MILE 216.29 TO 217.00

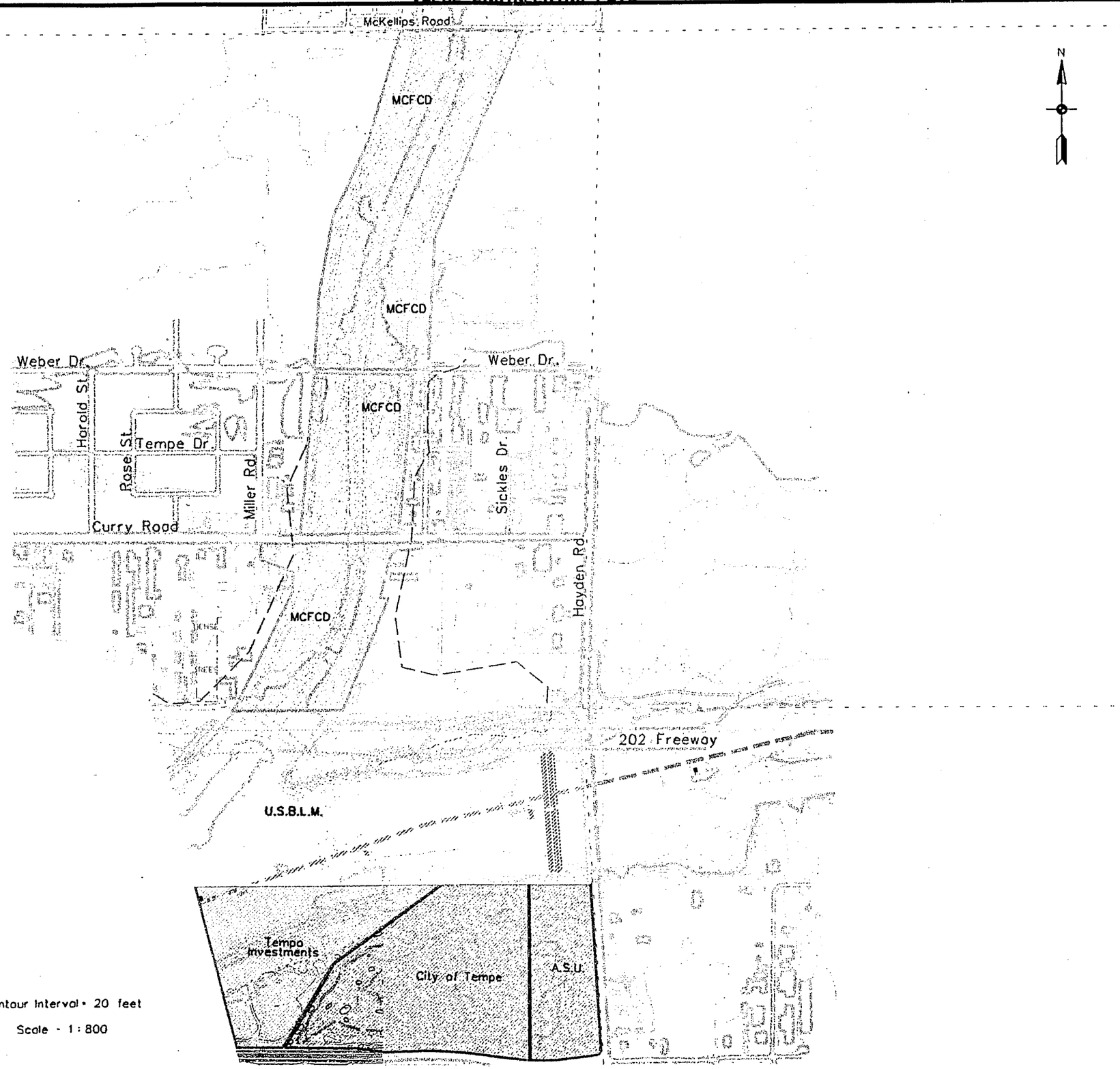
LAND OWNERSHIP

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

DESIGNED BY:
DRAWN BY:
CHECKED BY:
SUBMITTED BY:
CHIEF, XXX BRANCH
CADD FILE NAME:
DISTRICT FILE NO.
SPEC. NO.

PLATE 4B

VALUE ENGINEERING PAYS



Contour Interval = 20 feet

Scale - 1 : 800

SYMBOL	DESCRIPTIONS	DATE	APPROVAL
	REVISIONS		

RIO SALADO, ARIZONA
FEASIBILITY REPORT

TEMPE REACH

LAND OWNERSHIP

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES
CORPS OF ENGINEERS

DESIGNED BY:
DRAWN BY:
CHECKED BY:

SUBMITTED BY:

XXX
CHIEF, XXX BRANCH

DISTRICT FILE NO. 2920/ SPEC. NO. DACW09-96-B-0007 CADD FILE NAME:

PLATE 5B

SALLY TO BIVS

RIO SALADO, SALT RIVER
ARIZONA

APPENDIX F

GEOTECHNICAL/HTRW

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT
SOUTH PACIFIC DIVISION
MAY 1997

Rio Salado

Geotechnical Appendix

Existing Conditions

Regional Geology

The project area is in the Phoenix basin of the Salt River Valley. Metropolitan Phoenix is located geomorphically 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 northwest to southeast trending, rugged mountains (ranges). During late Miocene time (Tertiary period), the mountain ranges were extensively dissected uplifted and down dropped by northwest to southwest and east to west trending sub-parallel normal faults (Reynolds 1988). An extensive amount of volcanic eruptions and activity accompanied the faulting. After late Miocene time and until the late Tertiary period, the ranges deeply eroded and filled their down dropped areas (basins) with sediments, which were later consolidated into sedimentary rocks. After the late Tertiary and until recent (Holocene) time, the basins, including the Salt River Valley, filled with unconsolidated and occasional semi-consolidated sediment eroded from the ranges. The thickest accumulations of Valley alluvium formed during the early to middle Quaternary period.

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

The mountain ranges that border the project area consist mostly of Tertiary age sedimentary and volcanic rocks that lie unconformably upon an ancient Precambrian igneous and metamorphic basement complex (AGS 1986). The complex is composed predominantly of igneous granite and diorite, metamorphosed schist, gneiss and volcanic rock. The Tertiary rocks are made up of volcanic basalt, andesite, rhyolite and sedimentary sandstone, siltstone and conglomerate.

The Phoenix basin consists of Quaternary sediments that constitute the valley fill. They consist mostly of poorly to well consolidated (cemented) and unconsolidated gravel, sand, silt, and clay, representing several environments and ages of deposition. The total thickness of the alluvial materials range from near zero meters along the mountain fronts to 3,000 meters under the valley interior.

Geology of the Project Area

The Rio Salado project extends a total of approximately 10.6 km east and west along the Salt River, which flows west into the Phoenix Basin from the Superstition and Goldfield mountain ranges. The width of the Salt River floodplain is approximately 1.5 km within the gentle, flat slopes of the Basin, but is restricted to less than ½ km near Tempe Butte, west of Tempe. Here, the river alluvium is confined to the north by Papago Buttes and to the south by Tempe Butte.

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

Quaternary sediments consist of: 1) <u>Salt River Valley alluvium and terraces</u> - approximately 83-1,425 meters of unconsolidated to well-cemented gravel and boulders, interbedded with irregular silt, sand and gravel lenses; and 2) <u>Colluvium</u>- approximately 1.5-75 meters of loose to well-cemented silt, sand, clay and gravel.

The Salt River alluvium thickens towards the east and west of Tempe Butte gap, in the city of Tempe (figure 1). At the gap, streambed deposits average less than 75 meters thick and in some places bedrock is exposed. A significant exposure of Precambrian age granite occurs in patches at the streambed surface along a 2.5 km length of the channel just west of the gap.

Salt River Valley terrace deposits lie exposed 1.5-117 meters

above the Salt River channel, mostly beyond the project boundaries (near the perimeters of the Salt River flood plain) (AGS 1978). The terraces consist of thick well-cemented to non-cemented sand and gravel and are considered older than the alluvium within the confines of the Salt River. However, contacts between the two types of deposits are gradational at depth, which means they are undifferentiated and remain both of Quaternary age. The terrace and alluvial deposits in turn overlie thick Tertiary sedimentary and volcanic rocks beneath the basin and interface with Tertiary rocks along mountain ranges and inselbergs. The very thick Precambrian basement complex underlies basin terrace and alluvium at maximum depths of greater than 1,000 meters or greater.

Faults

Faults in central Arizona are generally short, discontinuous, normal faults, some of which have been interpreted to displace Quaternary formations. Most fall within the Jerome-Wasatch Structural Zone, a 75 km wide band which extends from Utah into Mexico. In Utah, the zone is associated with current earthquake activity and displays evidence of abundant Quaternary faulting. In Arizona, the zone includes the Main Street Fault in the northwest corner of the state and the Verde Fault located approximately 90 km north of the Rio Salado. Both faults are considered to be potentially active.

Within the study area, a zone (approximately 400 meters wide) of exposed, Tertiary age inactive normal faults, exists just north of Tempe Butte gap. The zone trends northwest to southeast and is located approximately 333 meters north-northwest of the edge of the Salt River and extends northwestward where it ends at a distance of approximately 4,400 meters from here. An east to west trending (approximately 1,760 meter long) Tertiary age fault lies concealed below the alluvium, in the middle of the Salt river, at Tempe Butte Gap.

Seismicity

An evaluation of the geologic and seismic conditions within a 162-km radius of the project area indicates that 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 162-km radius of the project area from 1870 through 1980. 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 162-km radius.

The historical 1887 7.2M Sonora, Mexico earthquake was located more than 411 km from Tempe, AZ, and expressed 50 kilometers of surface rupture with 3 meters of normal displacement, causing rockfalls in the project area. The most recent (1974) events, located about 24 km northeast of the project area, had recorded Richter magnitudes of only 2.5 and 3.0.

Ground Water

The project area overlies portions of the principal aquifer within the Phoenix Basin that consists of Quaternary and late Tertiary alluvium and late Tertiary bedrock.

The Basin groundwater flow moves generally east to west, from the Salt River toward a major cone of depression near Luke Air Force Base, approximately 24 km (15 mi) west of Phoenix (USGS 1952). To a lesser extent, groundwater also flows in a northwestward direction toward a second cone of depression in the Deer Valley area.

Recharge to the groundwater basin is derived from seepage of irrigation waters, Salt river flows, rainfall, and underflow of groundwater. Recharge from streamflow and rainfall is minor, and the amount of recharge from irrigation seepage and underflow has not been high enough to offset progressive lowering of the water table.

Long-term groundwater withdrawal, since the 1940's, has resulted in a general decline in water levels from 67-100 meters (200-300 ft) throughout the Phoenix Basin. However, water-level declines have usually been less than 16.5 meters (50 ft) near the Salt River. The overall trend indicates a progressive decline in water levels westward from the project area toward Luke Air Force Base and northwestward toward Deer Valley.

Hydrogeology

Ground water at the Rio Salado project site occurs within three major and one minor hydrogeological units that are bounded below by impermeable Tertiary and Precambrian basement rocks (USEPA 1991). A north looking conceptual regional hydrogeologic cross section (profile) of the Upper Alluvial Unit (UAU), Middle Alluvial Unit (MAU) and Lower Alluvial Unit (LAU), less the Red Unit, is seen in figure 1 (ADWR 1993). An eastward looking local hydrogeologic profile showing the three alluvial units and the Red unit is seen in figure 2 (USEPA 1993). 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):

UAU (Upper Alluvial Unit)

The base of this unit occurs atop the Middle Alluvial Unit (MAU) at approximately 37 to 57 meters below ground surface at Tempe and approximately 117 meters below ground surface at Phoenix (figure 2). The unit was formed during the final stages of alluvial development of the Phoenix Basin, approximately late Pleistocene to recent (Holocene) time. Unit lithology 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 and exhibits the following aquifer characteristics (USEPA 1990):

Hydraulic Conductivity (K) - The K within this unit at Tempe is approximately 10 to 125 meters/day, higher than the 70 meters/day at Phoenix. K measured within this unit throughout the Phoenix basin is approximately 8 to 85 meters/day.

Aquifer Thickness - The thickness of this unit is approximately 37 to 57 meters at Tempe and approximately 117 meters at Phoenix.

UAU (Upper Alluvial Unit)

Water Level (measured from approximately 1990 to 1993) - The water levels in this unit measure approximately 17 to 40 meters below ground surface at Tempe and approximately 7 to 13 meters below ground surface at Phoenix. Ground water levels have risen as much as 15 meters within this unit at Tempe, Arizona in response to recharge events (USEPA 1993). Ground water levels at Phoenix fluctuate between 7 to 10 meters during both discharge and recharge events, but rise 0.23 to 0.43 meters per day during recharge from flood events (Dames & Moore 1991). Overall, the ground water levels within the unit across the project decline approximately 12 meters per year in response to discharge events (Dames & Moore 1991).

Aquifer Production - Approximately 25% of the ground water pumpage in the Phoenix basin is directed towards this unit. A very large portion of the ground water is used for agriculture. Little or none of the water is used for drinking water purposes (Wilson 1991).

MAU (Middle Alluvial Unit)

This unit underlies the UAU and is in contact with the Lower Alluvial Unit (LAU) at approximately 83 to 267 meters below ground surface at Tempe and 200 to 317 meters below ground surface at Phoenix (figure 2). This unit 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 that exhibits the following aquifer characteristics (USEPA 1993):

Hydraulic Conductivity (K) - The K within this unit at Tempe is approximately 0.85 to 25 meters/day and approximately 1 to 10 meters/day within the Phoenix Basin.

Aquifer Thickness - The thickness of this unit is approximately 47 to 210 meters at Tempe and approximately 83 to 200 meters at Phoenix.

Semi-Confining Layer - This unit is generally comprised of more than several discontinuous semi-confining layers that consist predominantly of silt and clay.

MAU (Middle Alluvial Unit)

Water Level (measured from approximately 1990 to 1993) - The water levels in this unit measure approximately 52 to 67 meters below ground surface at Tempe.

Aquifer Production - Approximately 50% of the ground water pumpage in the Phoenix basin is directed towards this unit. A large portion of the ground water is used for agriculture. A smaller portion of the ground water is used for drinking water purposes (Wilson 1991).

LAU (Lower Alluvial Unit)

This unit underlies the MAU and is in direct or fault contact with the Red Unit at an unknown depth within the project area. 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 that exhibits the following aquifer characteristics (USEPA 1993):

Hydraulic Conductivity (K) - The K within this unit is higher than the MAU and averages approximately 4.8 (9 feet/day) to 95 meters/day (450 feet/day) at Tempe and approximately 1 (5 feet/day) to 25 meters/day (60 feet/day) within the Phoenix Basin.

Aquifer Thickness - The thickness of this unit is unknown.

Semi-Confining Layer - This unit is generally comprised of more than several discontinuous semi-confining layers that consist predominantly of clay and mudstone.

Water Level (measured from approximately 1990 to 1993) - The water levels in this unit measure approximately 55 to 71 meters below ground surface at Tempe.

Aquifer Production - Approximately 25% of the ground water pumpage in the Phoenix basin is directed towards this unit. A large portion of the ground water is used for agriculture. A smaller portion of the ground water is used for drinking water purposes (Wilson 1991).

Red Unit

The Red Unit underlies the LAU and overlies Tertiary and Precambrian basement rocks at unknown depths within the project area. The Red Unit 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 ground water likely originates from within faults and fracture zones within bedrock (ADWR 1993).

Ground water movement and connection within all three of the upper alluvial units is mostly lateral and somewhat vertical. Vertical ground water 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, but is more prevalent in Tempe, where a steeper vertical ground water gradient exists. The vertical and lateral ground water movement between the Red Unit and the LAU is unknown.

Ground Water Contamination

At present, all of the HTW contamination to the ground water within or near the project has been attributed to Volatile Organic Carbons (VOCs) leaching into the ground water. VOC leaching has occurred from either mismanaged storage, pumping into ground water and/or improper dumping of VOC and related chemical compounds at Superfund sites located within or near the project boundaries. VOCs have been detected within the UAU and MAU, but not the LAU or Red Unit. There is no direct evidence that surface water recharge from the Salt River has contaminated the three alluvial aquifers with Hazardous and Toxic Waste (HTW) unless such recharge has been associated with the Superfund sites.

Subsidence

Available information suggests that subsidence in the project area has not occurred. Ground failure in the form of (pumping) subsidence and earth-fissures has occurred in other areas of the Phoenix Basin. The closest ground failure occurrences to the project area are near Luke Air Force Base, approximately 24 km from the site, where .3 to 1 meters of subsidence has been measured and exhibits the shape of a 3.2 km (2 mi) diameter "bowl" depression.

Earth-fissures and subsidence are both produced by groundwater (pumping) withdrawal, whereby ground (soil) compresses (subsides) because it has lost the support of water within its pores. Earth-fissures develop when the soil subsides differentially and pulls apart.

The Phoenix area will continue to be affected by subsidence because of groundwater overdraft, principally where ground water withdrawal is most severe.

Previous Explorations

Limits of the project area were explored by the Corps in 1957 by drilling 5 power-auger soil holes with 45.7 cm (18-inch) diameters. The exploratory borings ranged in depth from 5 to 7 meters (15 to 21 ft). Soil was also examined by logging 4 vertical sections in 4 gravel pits. The thickness of these sections ranged from 4.5- 15 meters (13.5 to 45 ft). The materials encountered during the exploration were predominantly granular.

Stone Sources

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 Rio Salado project. The two stone quarries are less than 16 km (10 mi) from the site and 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 listed as:

Sunstate Rock and Materials and
-located 20th St. and E. McKellips
Beardsley Rd, Phx, AZ.
-passed rock 1990 quality tests.
-passed 1994 visual inspection.
-produces granite.

Salt River Sand & Rock
-located at Dobson & Rds, Phx, AZ.
-passed 1994 rock quality tests.
-passed 1994 visual inspection.
-produces green schist.

CONCRETE MATERIALS

Aggregates for Construction

Concrete aggregate sources investigated in previous studies are described below. Each general source is identified by the stream from which materials are taken. Future studies would require re-evaluation of these sources in accordance with SPD policy. On-site sources will be investigated and evaluated for production of aggregates for use in construction.

SALT RIVER

Sands and gravels from the Salt River are historically the oldest producing sources of aggregates for the Phoenix area. Coarse aggregates and cobbles are generally present in sizes to 300 mm. In some cases material as large as 600 mm is available. Some deposits have run out of sizes larger than gravels. The percentage of sand in these sources is adequate for economical concrete construction.

CAVE CREEK

The Cave Creek sources have cobbles to 600 mm. A sufficient quantity of coarse aggregates is available. Some of the plants are importing sand from the Agua Fria River.

AGUA FRIA RIVER

The Agua Fria sources are the youngest sources being mined in the Phoenix area at this time. The maximum size of material generally varies between 300 to 450 mm, with a larger proportion of sand than other sources. The Agua Fria sources should have sufficient material to satisfy all construction needs.

Cement

There are two major producers of cement in the state of Arizona who are presently producing cements which are pre-qualified by the Waterways Experiment Station for use in Corps of Engineer's projects. These plants are the Phoenix Portland Cement Corporation at Clarkdale, approximately 130 kilometers north of the project site; and the Arizona Portland Cement Company at Rillito approximately 210 kilometers southeast of the project site. Additional cements would be available from the California

Portland Cement Company, at Colton, California, approximately 580 kilometers west of the project site. Recently cements produced in Mexico have been imported to the United States and have been used in the Tucson area.

There are two cement plants producing Type III cement which conforms to ASTM Specification C 150. These are the Genstar Cement Co. plant at Stockton, California approximately 1000 kilometers northwest of the project site and the Calaveras Cement Co at San Andreas, California approximately 1250 kilometers northwest of the project site.

Pozzolan

In accordance with current Federal Regulations the option to use flyash, a pozzolanic admixture, as a substitute for Portland Cement will be allowed in the production of concrete for the North Scottsdale Study. Concrete generally produced in the area at the present time uses pozzolan to offset reactivities between the cement and silicates in the aggregate and to reduce the heat of hydration. Flyash, proven to be suitable in the past, would be available from a plant near Page, Arizona, approximately 650 kilometers north of the project site, and from a plant at Cochise, Arizona, approximately 300 kilometers southeast of the project site.

Admixtures

Two types of admixtures are used extensively by concrete producers in the Phoenix area. These are air-entraining admixtures and water reducing admixtures. Some high range water reducing admixtures have been used. It is anticipated that all classes of admixtures will be used in construction of the North Scottsdale Projects.

Water

Sufficient water suitable for concrete construction would be available at existing concrete plants. It the Contractor elects to erect an onsite batch plant, water most likely could be obtained from local municipalities.

Potential for Soil-Cement Construction

Soil-cement has been used extensively in the Southwest, particularly in Arizona as stream-bank protection. There are several examples of this type of construction along the Salt River in the nearby area which have exploited the use of soil-cement. Some of these projects were protection for the 19th Ave Landfill, protection for ADOT structures through the Tempe area and a soil-cement levee at Sky-Harbor International Airport.

Additionally, the Corps of Engineers constructed soil-cement lined levees along the Agua Fria River in the middle 1980's.

The Salt River has historically been the source of the majority of aggregates used in concrete construction in the Phoenix area. No detailed surveys of potential borrow sources for soil-cement aggregates have been completed. Based on previously available information and the performance of the above cited projects it is likely that suitable materials would be available from excavation in the stream-bed. One of the possibilities which could increase the cost of the soil-cement is the lack of sufficient fine grained materials. Excavated materials from some of the sources being exploited, in the Salt River, are primarily gravels and cobbles.

Additional Studies

The Reconnaissance report indicated approximately 155,000 cubic yards (118,500 cubic meters) of soil cement would be needed. There was no specified amount of structural concrete included in the report. Some of the design alternatives selected included concrete foundations for rubber dams which could also be constructed of RCC or soil-cement. These are additional alternatives worth investigating in more detail later during the planned Geotechnical Explorations.

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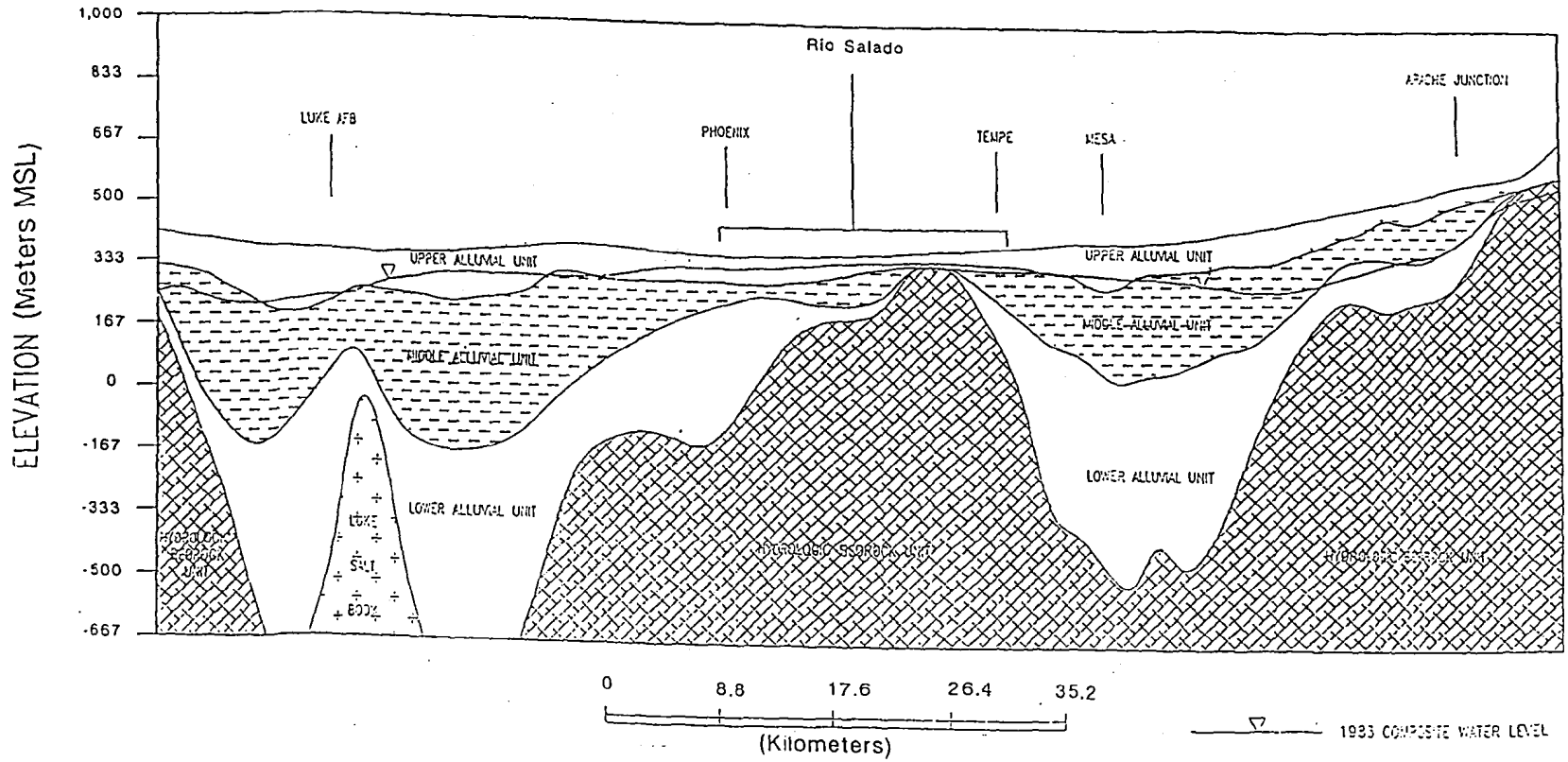
SALT RIVER VALLEY
GENERALIZED HYDROGEOLOGIC CROSS-SECTION

"Looking North"

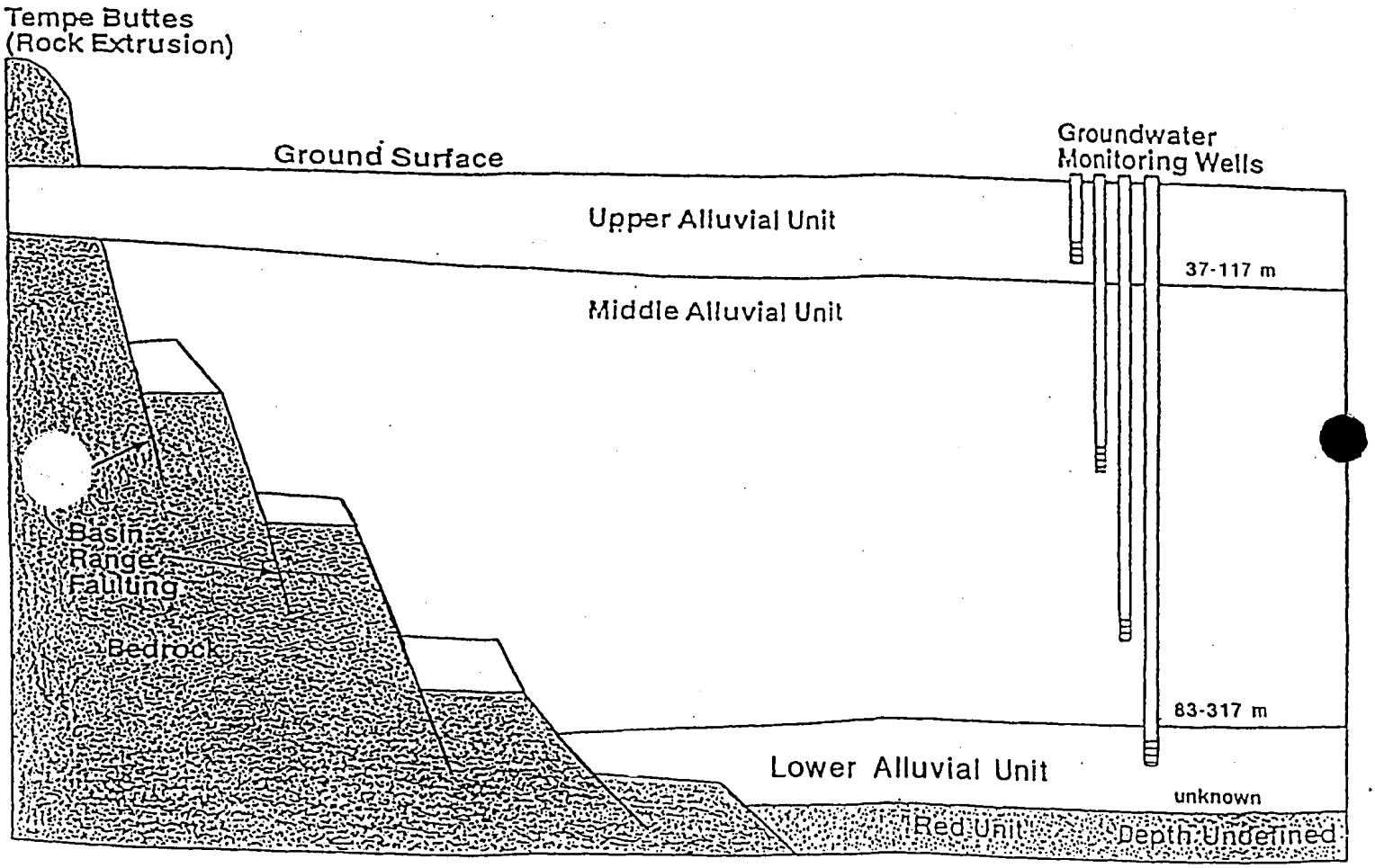


VERTICAL EXAGGERATION = 30 X

Figure 1

Rio Salado

Hydrogeologic Cross Section



"Looking East"

(not to scale)

Figure 2

US ARMY CORPS OF ENGINEERS
3636 North Central Avenue, Suite 740
Phoenix, Arizona 85012-1936
(602) 640-2003 (office)
(602) 640-5383 (fax)

LETTER OF TRANSMITTAL

DATE: 15 April 1997

TO: Steve Neilsen
City of Tempe
Economic Development/Rio Salado
PO Box 5002
Tempe, Arizona 85280

FROM: Mike Ternak, P.E. MT

SUBJECT: Rio Salado Feasibility Study

ITEMS TRANSMITTED:

Comments from our Geotechnical Branch on the Salt River Environmental Survey performed by Geotechnical and Environmental Consultants, Inc.

COMMENTS:

The survey was submitted by the City as an in-kind service for HTRW assessments. The review comments indicate that additional information and conclusions are required in order to help establish the potential HTRW impacts on the feasibility of the project. If you, City staff, or the consultant have any questions, please feel free to contact me or you may directly contact Jeffry Devine of our Geotechnical Branch at (213) 452-3578.

cf: CESPL-ED-GG (Devine)

US ARMY CORPS OF ENGINEERS
3636 North Central Avenue, Suite 740
Phoenix, Arizona 85012-1936
(602) 640-2003 (office)
(602) 640-5383 (fax)

LETTER OF TRANSMITTAL

DATE: 15 April 1997

TO: Peter Atonna
City of Phoenix
200 West Washington, 6th Floor
Phoenix, Arizona 85003

FROM: Mike Ternak, P.E. MT

SUBJECT: Rio Salado Feasibility Study

ITEMS TRANSMITTED:

Comments from our Geotechnical Branch on the Salt River Environmental Survey performed byMalcolm Pirnie, Inc.

COMMENTS:

The survey was submitted by the City as an in-kind service for HTRW assessments. The review comments indicate that additional information and conclusions are required in order to help establish the potential HTRW impacts on the feasibility of the project. If you, City staff, or the consultant have any questions, please feel free to contact me or you may directly contact Jeffry Devine of our Geotechnical Branch at (213) 452-3578.

cf: CESPL-ED-GG (Devine)

To : Mike Ternak@PDP@SPL
From : Jeffrey D Devine@ED@SPL
Subject :
Date : Monday, April 14, 1997 at 7:49:00 am PDT
Attachment : (none)
Certify : N

Mike:

I assume you have received my LAN message of last week and the attachments?

The HTRW appendices need to be prepared according to the Memorandum I sent you, dated last year. Basically, both cities have prepared Phase I site assessment packages for their respective portions of the study. These assessments contain all of the information we are looking for, except for conclusions based from the information contained in them, we need to have locations on a plan view map of the soil and ground water plumes, concentration levels of the plumes and status, names of regulators, etc. involved in oversight of HTRW sitesm within 1/4 mile of the study boundaries. This information needs to be pulled out of the existing assessment documents and conclusions drawn by the cities. Thanks.

The following comments are from Mr. Jeffrey Devine, the District HTRW geologist for the Corps of Engineers, Geotechnical Branch, Los Angeles District. The comments cover the appendix H, HTRW portion of the study for both the **city of Phoenix and the city of Tempe**:

1. **Phoenix portion of the study, figure 2...** The boundaries of the TCE contours need to be indicated as to whether they are approximate or exact and this needs to written in the map legend, also the reference source of the information for the contours needs to be explained in the report or written within the legend. Also, are the TCE contours for ground water or soil, which?, determine this and state it within the report.

2. **Phoenix portion of study, figure 2...** Are the TCE contours the only contours found to exist for a ground water plume in this part of the Rio Salado project? Where was the information for the TCE contours found? Search for additional information on ground water and soil plumes, similar to that found in developing the TCE contours and use this to develop other soil and ground water contours for the Phoenix part of the Rio Salado project. There must be other plumes that have been identified for this area by others, ADEQ, etc., if so, draw them on the map as indicated for the TCE contours and include the information as mentioned in comment 1. If such information does not exist, then state it in the appendix and explain why it does not exist?

3. **Plumes pertaining to both portions of the study...** The ADEQ says it will provide more information on ground water plumes in the project area to the Corps project manager on or about March 31, 1997, both the City of Phoenix and the City of Tempe should work closely with ADEQ and others, such as the EPA, etc., to determine the existing whereabouts of ground water and soil plumes that may impact the Rio Salado project. It is necessary that the existing conditions include showing all of the ground water and soil plumes, within 1/4 mile of the banks of the entire study area to satisfy ADEQ and the EPA and the Corps requirements for the existing conditions part of this project, (*see ADEQ comments regarding concerns of ground water plumes near the project, a copy of these comments can be found with the project manager, Mr. John Drake, Planning Division of the U.S. Army Corps of Engineers, Phoenix project office, Phone# (602) 640-2003).

4. **ADEQ comments...** As a reminder, most of the comments from ADEQ inquire as to the impact the Rio Salado project will have on HTRW ground water and/or soil plumes and Superfund, WQARF and ADEQ HTRW sites. This step in the project study involves the existing conditions, the future project impact to HTRW sites is unknown at this time and shall not be part of the discussion within appendix H. Discuss only the current conditions and whereabouts of plumes and HTRW sites, etc., <u>do not</u> discuss potential of the project on existing contamination found within the study area, but <u>do</u> mention that this will be discussed in the F4 step of the Feasibility study process..

5. **Phoenix portion of the study...** The Phase I Site Assessment is adequate for this level of study, but the information contained within it's tables and figures is unusable, unless it is analyzed and summarized into one discussion regarding the existing HTRW conditions at the Phoenix portion of the study. Please summarize the database into one discussion covering these aspects. For example, investigate only those HTRW sites that are undergoing remediation

(cleanup) or investigation, because of violations in the state and federal environmental law with regard to contaminated soils and ground water and air. The generators and storers of hazardous waste generators do not need to be discussed, identified or shown on figures as hazardous waste sites of concern, have their ground water and soil plumes drawn, etc, if they are not in current violation of state laws regarding discovery of contaminated soil and ground water and/or air. Identify only the sites that have been discovered as having caused or in indirectly cause contamination to the soil, air or ground water within the 1/4 mile limit of the project. This will eliminate most of the USTs, dry wells, spills and hazardous waste generators. Choose only those sites, such as leaking USTs, hazardous waste sites, landfills, etc., that have been identified in the database as having contaminated soil, ground water and/or air and identify the soil and or ground water plumes associated with these sites, if they exist. If not enough data, in the form of plumes, etc., exists for these sites, then state why and what type of information is lacking or simply state the progress of cleanup or monitoring or investigation and/or the typical site's current status with regards to ADEQ or EPA. Do not discuss or indicate contamination associated with a site in violation, in which the site does not seem to be within reasonable distance to the 1/4 mile boundaries, and would not seem to have an obvious impact to the uses of the Rio Salado project site.

6. **Tempe portion of the study...** Before preparing their HTRW portion of appendix H, the city of Tempe study should also follow the guidelines outlined in comment 5.

CESPL-ED-GG (1110) 2 October 1996

MEMORANDUM FOR Rio Salado Project Files

SUBJECT: Rio Salado Feasibility Study, HTRW Assessment.

1. Purpose. At the request of Mr. Kelly Ryan, Study Manager, Planning Section C, a visual inspection was performed on 10 September 1996 of the existing HTRW without-project conditions within the Phoenix Lago De Vida and Tempe Rio Salado portions of the Rio Salado study area. In addition, meetings were held on the 10th and 25th of September 1996 with various representatives of the City of Phoenix and Tempe to discuss Corps requirements and recommendations for the subtask of: summarization and evaluation of existing HTRW data and main task of: writing the HTRW portion of the feasibility study. The following Corps personnel were present during the site visit and at the meetings:

Jeffrey Devine, Geologist, Geotechnical Branch, Engineering Division.

Kelly Ryan, PE, Study Manager, Planning Section C, Planning Division.

2. Objective. To promote a final subtask report that is concise, well organized and focuses discussion around a central series of map presentations and tables of HTRW data.

3. Observations. The entire project study area was examined in cursory detail for HTRW remediation activities and HTRW impacts to soil, ground water and surface water from the following possible man made pollutant sources and/or activities: abandoned and active landfills/waste disposal sites, storm water/sewer treatment discharge sites, abandoned and active well sites, sand & gravel operations, industrial sites and superfund sites. In conjunction with the field visit a fair amount of information on the locations and types of HTRW contamination within the study area was discovered during review of various Phase I Assessments, EPA superfund reports (RODs = Records of Decisions) and miscellaneous environmental assessment documents obtained from city personnel.

The presence of HTRW contaminants within the immediate study area boundaries was not readily apparent, except for the following: 1. The appearance of black to grey (possible

hydrocarbon/asphalt) stained soil berms built via sand and gravel dumping operations. These berms encroach the Phoenix Lago De Vida project boundaries and are located along the south side of the Salt river, near 7th Avenue, along the perimeter of an active sand and gravel operation.

The on going construction of the City of Phoenix 19th Avenue landfill cap and berm was observed during the site inspection.

4. Summary.

a. Only one site, the sand & gravel operation near 7th Avenue, showed visual indications of HTRW contaminants. The entire project study area could not be inspected in detail due to access and time constraints, however, further discussions with City of Tempe and Phoenix personnel and familiarization of the entire project study area indicate that most of the HTRW contamination in the study area has been reported or remains known and unseen within ground water and soil associated with landfills, past industrial practices, USTs, etc. Much of the HTRW contamination associated with storm water is also unseen since it occurs only during storms or discharge.

b. A good amount of background (archival and recent) HTRW data and literature exists within the City, local, federal, state and private database. HTRW background data and literature can be categorized into two types: 1. Prominent HTRW information that is thoroughly to well documented and usually covers EPA listed Superfund sites, Water Quality Assurance Revolving Fund (WQARF) *sites* or Arizona Department of Environmental Quality (ADEQ) listed sites. 2. Less prominent HTRW information that is detailed to semi-detailed and usually covers listed or unlisted Underground Storage Tank (UST), listed or unlisted and abandoned or active landfill, small industrial, miscellaneous sites. Prominent informational packages include EPA RODs, site assessments and site investigation reports, feasibility studies and miscellaneous data, etc. Less prominent informational packages include site assessment, environmental assessment and site investigation reports, feasibility studies, storm water quality reports and miscellaneous data, etc.

c. Prominent HTRW areas contain well documented information of the following type: a. In situ soil and ground water contaminant levels and their reference to Applicable or Relevant and Appropriate Regulations (ARARs). b. Resource Conservation

and Recovery Act (RCRA) and Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) cleanup criteria for soil and ground water and their reference to ARARs. c. Plan and profile views of ground water and soil plumes, sources of contamination, ground water monitoring and water wells (abandoned and active). d. Discussion of remediation methods and technologies. E. Background history, current status of Superfund sites and explanation of the cleanup process, including list of regulators.

d. Less prominent HTRW areas are dispersed, less extensively studied, documented as separate contaminant sites and therefore are more likely to contain occasional, scattered information of the thorough type found in prominent sites.

e. Examples of three prominent (Superfund locations) sites within the study area are: The 19th Avenue landfill site, North and South Indian Bend Wash Superfund areas. Examples of less prominent HTRW sites, such as the abandoned Central Avenue landfill, located between 7th Street and Central Avenue in Phoenix and the abandoned landfill near highway 202 in Tempe and other UST, storm water collection, industrial and miscellaneous areas are abundant within and near the study area.

5. Recommendations.

1. The local sponsors should prepare and complete the subtask of documenting and discussing the existing HTRW conditions at the project. Draft and final drafts of the HTRW existing conditions shall be provided to the Los Angeles District Corps of Engineers. The Los Angeles District task is to review both the draft and finals.

The following are Los Angeles District perspectives and guidelines that may assist in the preparation of a subtask report and also in completion of the main task:

<u>Prominent</u> site data should be reviewed for a more thorough discussion and definition of ARARs, cleanup levels, regulator responsibilities and remediation processes. <u>Less</u> prominent site data should be reviewed and information flagged that conforms to that outlined in prominent data.

A review and research of <u>less</u> prominent and <u>prominent</u> data should be conducted throughout the following study

limits: For the Tempe Reach, Indian Bend Wash from McKellips Road to confluence with the Salt River, and the Salt River from McClintock Road to Rural Road at a minimum of 1/4 mile outward from the banks. For the Phoenix Reach, the Salt River from I-10 to 19th Avenue at a minimum of 1/4 mile outward from the banks.

HTRW information shall be discussed in writing and presented onto a plan view maps of appropriate scales, 1:25,000 and/or 1:24,000 scale, no greater than 1:50,000 scale

The following types of HTRW information, if available, should be indicated on the map in greater detail than previously shown on maps and figures within the Reconnaissance report: 1. HTRW ground water, soil and storm water plumes shown to their most recent extent. 2. Direction of plume flow. 3. Areas reported as sites of illegal HTRW dumping, etc. 4. HTRW contaminated well sites. 5. Storm water discharge sites. 6. Areas within sand & gravel operations that are HTRW contaminated or suspected of such. 7. Regulated and unregulated, abandoned or active landfills and/or other HTRW sites not mentioned here or pertinent to the project. The above information should be supplemented with labels and/or discussions of the most recent in-situ contaminant levels and type of HTRW contamination present and/or any combination thereof.

The following type of HTRW information should be discussed in writing and an explanation given if not available: 1. The types of HTRW contaminants present at each site and their contaminant levels present in-situ. Contaminant levels may be also be included on maps as labels and/or any combination thereof, etc., as explained above. 2. Whether or not the contaminant levels are associated with ARARs and if not, why? 2. Listing of regulators or agencies responsible for monitoring and/or cleanup of HTRW contaminants. 3. Status of cleanup efforts, levels and discussion of cleanup technologies employed at regulated/listed sites. 4. Cleanup, monitoring and current status of unregulated or abandoned sites. Discuss whether such sites are regulated and if so why? and under what ARARs and if not, why? 5. Listing of ARARs, Statues and laws associated with all the types of HTRW contaminants and sites found at the project. 6. Estimation of thickness of HTRW contaminants within ground water and soil found in

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SALT RIVER ENVIRONMENTAL SURVEY

SALT RIVER BANK STUDY AREA
From Salt River Bank to 1/4 Mile of Bank
From 1/4 Mile to 1/2 Mile of Salt River Bank

CITY OF PHOENIX
OFFICE OF ENVIRONMENTAL PROGRAMS
PHOENIX, ARIZONA

December 1996

MALCOLM PIRNIE, INC.
432 North 44th Street
Suite 400
Phoenix, AZ 85008

MALCOLM PIRNIE

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TABLE 1
SUMMARY OF IDENTIFIED SITES
Salt River Study Area

TYPE OF SITE	SITES WITHIN 1/4 MILE OF RIVER BANK	SITES FROM 1/4 MILE TO 1/2 MILE OF RIVER BANK	TOTAL SITES WITHIN STUDY AREA
Sites Within WQARF Sites	98	105	203
Federal Superfund (NPL)	1	0	1
ZIP ACIDS List	10	13	23
State Landfills	1	0	1
CERCLA Sites	1	1	2
Spill Incidents	22	19	41
UST Sites	43	57	100
LUST Sites	20	28	48
Dry Wells	20	24	44
RCRA-TSD	0	1	1
RCRA-LQG	2	6	8
RCRA-SQG	44	33	77

CITY OF PHOENIX
SALT RIVER ENVIRONMENTAL SURVEY

TABLE 2
NPL SITES and STATE LANDFILL SITES
Survey From Salt River Bank to 1/4 Mile of Bank

MAP I.D. NO.	EDR I.D. NO.	ADDRESS	NAME
0	1000223728	19TH AVE	NINETEENTH AVENUE LANDFILL
203	S100240613	1 MI S OF I 10 E ON 19 TH AVE ON E	19TH AVE LANDFILL

CITY OF PHOENIX
SALT RIVER ENVIRONMENTAL SURVEY

TABLE 4A
SITES WITHIN WQARF SITES - WEST VAN BUREN (WVB)
Survey From Salt River Bank to 1/4 Mile of Bank

MAP I.D. NO.	ADDRESS	NAME
169	2454 S 7TH AVE	HOLIDAY RECYCLING
193	7TH AVE & LOWER BUCKEYE RD	7TH AVE LDFL
211	3640 S 19TH AVE	TANNER COMPANIES PLANT 1
211	3640 S 19TH AVE	UNITED METRO
211	3640 S 19TH AVE	TANNER CO THE
240	4021 S 19TH AVE	WESTERN BLOCK COMPANY
240	4021 S 19TH AVE	WESTERN BLOCK CO INC
240	4021 S 19 AVE. E. OF 19 SR BANK	WESTERN BLOCK CO.

CITY OF PHOENIX
SALT RIVER ENVIRONMENTAL SURVEY

TABLE 4B
SITES WITHIN WQARF SITES - EAST WASHINGTON (EW)
Survey From Salt River Bank to 1/4 Mile of Bank

MAP I.D. NO.	ADDRESS	NAME
142	450 E WATKINS	BUSINESS SYSTEMS OF AZ INC
142	405 E WATKINS ST	MILWAUKEE ELECTRIC TOOL CORP
143	17 W WATKINS ST	SAV ON PLATING INC OF ARIZONA
143	CENTRAL AVE & WATKINS ST	CENTRAL AVE LDFL
143	23 W WATKINS	MKB CONST INC
143	23 W WATKINS	MKB CONSTRUCTION INC
143	135 WATKINS ST	SEWELL PLASTICS INC
143	135 E WATKINS ST	SEWELL PLASTICS, INC.
143	2202 S CENTRAL	I 10 INTERNATIONAL TRUCK INC
143	2202 S CENTRAL AVE	I10 INTERNATIONAL TRUCKS INC
143	2202 S CENTRAL AVE	I-10 INTERNATIONAL TRUCK INC
144	215 E WATKINS ST	PENZOIL RECYLERS
144	245 E WATKINS ST	CBS INC FOOD BROKERS
144	261 E UNIVERSITY	TRENDWOOD INC
144	261 E UNIVERSITY ST	TRENDWOOD WAREHOUSE
144	302 E UNIVERSITY DR	LEPRINO FOODS
145	401 W WATKINS	AIMCO PRECISION INC
145	508 W WATKINS	SPECIAL PROCESSES OF AZ INC
145	447 W WATKINS ST	COMMERCIAL BUILDING
145	438 W WATKINS ST	MACHINCO, INC.
145	420 W WATKINS ST	ST VINCENT DE PAUL SOCIETY
145	503 W WATKINS ST	WAREHOUSE
146	310 W. WATKINS ST.	B & A TRAILER REPAIR
146	310 W WATKINS ST	B & A TRAILER REPAIR
146	308 W. WATKINS	MICOR ELECTRIC
151	218 W WATKINS ST	CHH PARTNERSHIP
151	151 W WATKINS ST	UNION ROCK & MATERIALS CORP
163	810 E HAMMOND LN	ARIZONA TESTING LABS
163	810 E HAMMOND LA	ARIZONA TESTING LABORATORIES
163	834 E HAMMOND LANE	MARLAM INDUSTRIES INC
165	1405 E. HAMMOND LN.	'GIL"S RECYCLING OPERATION'
166	2432 S 6TH ST	BANK ONE ARIZONA FLEET SRVS
166	2432 S 6TH STREET	PHOENIX DISTRIBUTING
166	2453 S 6TH ST	FIREBIRD FUEL CO 7TH ST CARDLOCK
170	510 E UNIVERSITY DR	BELL ATLANTIC SYSTEMS LEASING INTL INC
174	1696 E UNIVERSITY DRIVE	LAKESHORE EQUIPMENT
174	1705 E UNIVERSITY DR	INDUSTRIAL ASPHALT PHX LOC#58
174	1705 S. UNIVERSITY	
174	1705 EAST UNIVERSITY DRIVE	ARIZONA SAND & ROCK
174	1705 E UNIVERSITY DR	PHOENIX TANK TERMINAL LOC #2
174	1705 E UNIVERSITY	INDUSTRIAL ASPHALT DIV GULF OI
175	2020 E UNIVERSITY DR	ARIZONA WHOLESALE SUPPLY CO
175	2642 S 20TH PL	SUNDT CORP EQUIPMENT SERVICE YARD
176	1646 E UNIVERSITY	SENATRO EQUIP AND TRUCK SERVICE
177	1801 E UNIVERSITY DRIVE	CALMAT CO OF ARIZONA
177	1801 E UNIVERSITY DR	CALMAT COMPANIES THE
177	1801 E UNIVERSITY DR	ARIZONA SAND & ROCK

CITY OF PHOENIX
SALT RIVER ENVIRONMENTAL SURVEY

TABLE 4B
SITES WITHIN WQARF SITES - EAST WASHINGTON (EW)
Survey From Salt River Bank to 1/4 Mile of Bank

MAP I.D. NO.	ADDRESS	NAME
178	1835 E UNIVERSITY DRIVE	PRE STRESS BUILDING
179	1919 E UNIVERSITY DR	MATERIALS RECOVERY FACILITY
183	813 E UNIVERSITY	L & M LAMINATES
183	825 E UNIVERSITY DR	TIME SYSTEMS
184	2610 S 16TH STREET	ARIZONA DEPT OF PUBLIC SAFETY
184	2610 S 16TH AVE	AZ DEPT OF PUBLIC SAFETY
184	2610 S 16TH ST	DPS
184	2626 S 16TH ST	D.P.S.
184	2652 S 16TH ST	MISSION INDUSTRIES
184	2652 S 16TH ST	MISSION UNIFORM AND LINEN SERVICE
185	1002 E UNIVERSITY DR	ARIZONA TRANE
185	1007 E UNIVERSITY DR	CELWAVE
188	2629 S 21ST ST	INTL DIATOMS IND INC
191	2626 S 7TH ST	'SMITTY"S SUPER VALU INC'
192	520 W LOWER BUCKEYE RD	PHOENIX, CITY OF
194	2121 E MAGNOLIA ST	SAMARITAN HEALTH SERVICES
194	2121 E MAGNOLIA	HEALTH SERVICES ADMINISTRATION
195	2229 E MAGNOLIA ST	AIRBORNE FREIGHT
195	2216 E MAGNOLIA	SCOTT ENGINEERING CO
195	2218 E MAGNOLIA	COL PRESS INC
195	2229 E MAGNOLIA	H J H INSULATION CHEM INC
196	2326 E MAGNOLIA ST	MAGNOLIA BUILDING
196	2302 E MAGNOLIA ST	BOB WALLACE CARS INC
196	2326 E MAGNOLIA	AMERICAN CHEM TECH INC
197	2501 E MAGNOLIA ST	THOMPSON INDUSTRIES
197	2525 E. MAGNOLIA ST.	STAR CONTAINER CO.
197	2525 E. MAGNOLIA ST.	STAR CONTAINER CORP.
197	2501 E. MAGNOLIA	AZ FREEPORT WAREHOUSE, INC.
197	2501 E. MAGNOLIA ST.	SCOTT CONTAINER CORP.
197	2501 E. MAGNOLIA ST.	SCOTT CONTAINER GROUP
197	2512 E MAGNOLIA ST	MCLANE FOODS, INC.
197	2512 E MAGNOLIA ST	MCLANE FOODS, INC.
198	2635 E. MAGNOLIA ST.	BROWN TIRE COMPANY WAREHOUSE
198	2635 E MAGNOLIA ST	MULTI-TENANT OFFICE/WAREHOUSE
198	2635 E. MAGNOLIA ST.	BROWN TIRE CO.
198	2655 E MAGNOLIA	AZ DEPT OF MAGNOLIA SUITE 2
198	2655 E MAGNOLIA ST	CC&F BUILDING IC-23
198	2655 E. MAGNOLIA	DHL WORLDWIDE EXPRESS
198	2655 E. MAGNOLIA	DHL WORLDWIDE EXPRESS
199	2601 E MAGNOLIA ST	PHOENIX ADMINISTRATION SERVICES
202	2800 S CENTRAL AVE	UNITED METRO MATERIALS PLANT 1
202	2800 S CENTRAL AVE	UNION ROCK & MATERIALS PLANT 1
202	2800 S CENTRAL AVE	UNION ROCK & MTRL CORP

CITY OF PHOENIX
SALT RIVER ENVIRONMENTAL SURVEY

TABLE 4C
SITES WITHIN WQARF SITES - SKY HARBOR (SH)
Survey From Salt River Bank to 1/4 Mile of Bank

MAP I.D. NO.	ADDRESS	NAME
None		

CITY OF PHOENIX
SALT RIVER ENVIRONMENTAL SURVEY

TABLE 5
CERCLA SITES
Survey From Salt River Bank to 1/4 Mile of Bank

MAP I.D. NO.	ADDRESS	NAME	COMMENTS
0	19TH AVE	NINETEENTH AVENUE LANDFILL	This site is currently under investigation by the government to assess the extent of further action.

CITY OF PHOENIX
SALT RIVER ENVIRONMENTAL SURVEY

TABLE 6A
RCRA DATABASE - SMALL QUANTITY GENERATORS
Survey From Salt River Bank to 1/4 Mile of Bank

MAP I.D. NO.	ADDRESS	NAME
142	450 E WATKINS	BUSINESS SYSTEMS OF AZ INC
142	405 E WATKINS ST	MILWAUKEE ELECTRIC TOOL CORP
143	17 W WATKINS ST	SAV ON PLATING INC OF ARIZONA
143	23 W WATKINS	MKB CONSTRUCTION INC
143	2202 S CENTRAL AVE	I10 INTERNATIONAL TRUCKS INC
144	261 E UNIVERSITY ST	TRENDWOOD WAREHOUSE
145	401 W WATKINS	AIMCO PRECISION INC
145	508 W WATKINS	SPECIAL PROCESSES OF AZ INC
163	810 E HAMMOND LA	ARIZONA TESTING LABORATORIES
163	834 E HAMMOND LANE	MARLAM INDUSTRIES INC
166	2432 S 6TH ST	BANK ONE ARIZONA FLEET SRVS
169	2454 S 7TH AVE	HOLIDAY RECYCLING
170	510 E UNIVERSITY DR	BELL ATLANTIC SYSTEMS LEASING INTL INC
176	1646 E UNIVERSITY	SENATRO EQUIP AND TRUCK SERVICE
177	1801 E UNIVERSITY DR	CALMAT COMPANIES THE
183	825 E UNIVERSITY DR	TIME SYSTEMS
184	2610 S 16TH AVE	AZ DEPT OF PUBLIC SAFETY
184	2652 S 16TH ST	MISSION UNIFORM AND LINEN SERVICE
185	1002 E UNIVERSITY DR	ARIZONA TRANE
194	2121 E MAGNOLIA	HEALTH SERVICES ADMINISTRATION
195	2216 E MAGNOLIA	SCOTT ENGINEERING CO
195	2218 E MAGNOLIA	COL PRESS INC
196	2302 E MAGNOLIA ST	BOB WALLACE CARS INC
196	2326 E MAGNOLIA	AMERICAN CHEM TECH INC
198	2655 E MAGNOLIA	AZ DEPT OF MAGNOLIA SUITE 2
202	2800 S CENTRAL AVE	UNION ROCK & MATERIALS PLANT 1
205	3050 S 35TH ST	DELUXE CHECK PRINTERS
207	40 E PIONEER	BF GOODRICH WHEEL AND BRAKE RPR STAT
209	3405 S 5TH ST	PHOENIX POLICE PROP CITY OF
209	3414 S 5TH ST	BF GOODRICH AIRCRAFT EVAC SYS
209	3445 S 5TH STREET	ADVO SYSTEMS INC
210	1545 E VICTORY	SPECIAL PROCESSES OF AZ INC
210	1522 E VICTORY ST STE 2	LIGHTING RESOURCES INC
211	3640 S 19TH AVE	TANNER CO THE
213	3420 S 7TH ST STE 5	STANFAST STANDARD REGISTER CO
228	895 W ELWOOD	ACE ASPHALT
231	1475 E ELWOOD	GILBERT PUMP AND EQUIPMENT CO
232	1580 E ELWOOD	BROWNING FERRIS INDUSTRIES
232	3602 S 16TH PL	GRIGGS PAINT OF DOMCOM ENT INC
232	3550 S 16TH ST	RELIANCE ELECTRIC CO
235	3745 S 7TH AVE	CEM TEC CORPORATION
237	2818 E ILLINI	TIERNAY CASTINGS INC
246	788 W ILLINI	BRYANT INDUSTRIES
246	888 W ILLINI ST	DISPOSAL CONTROL SERVICE INC

CITY OF PHOENIX
SALT RIVER ENVIRONMENTAL SURVEY

TABLE 6B
RCRA DATABASE - LARGE QUANTITY GENERATORS
Survey From Salt River Bank to 1/4 Mile of Bank

MAP I.D. NO.	ADDRESS	NAME
143	135 WATKINS ST	SEWELL PLASTICS INC
220	2920 E ELWOOD ST	TIMES FIBER COMMUNICATIONS INC

CITY OF PHOENIX
SALT RIVER ENVIRONMENTAL SURVEY

TABLE 6C
RCRA DATABASE - TREATMENT/STORAGE/DISPOSAL
Survey From Salt River Bank to 1/4 Mile of Bank

MAP I.D. NO.	ADDRESS	NAME
None		

TABLE 7
UNDERGROUND STORAGE TANKS
Survey From Salt River Bank to 1/4 Mile of Bank

MAP I.D. NO	FACILITY I.D. NO.	ADDRESS	NAME	COMMENTS
143	0-002555	2202 S CENTRAL AVE	I-10 INTERNATIONAL TRUCK INC	1 REMOVED TANK 1 ACTIVE TANK
144	0-006031	245 E WATKINS ST	CBS INC FOOD BROKERS	1 CLOSED TANK
144	0-002951	302 E UNIVERSITY DR	LEPRINO FOODS	1 REMOVED TANK
145	0-004271	420 W WATKINS ST	ST VINCENT DE PAUL SOCIETY	4 REMOVED TANKS
145	0-005531	503 W WATKINS ST	WAREHOUSE	1 REMOVED TANK
151	0-007469	218 W WATKINS ST	CHH PARTNERSHIP	2 REMOVED TANKS
151	0-005310	151 W WATKINS ST	UNION ROCK & MATERIALS CORP	3 REMOVED TANKS
166	0-000004	2432 S 6TH STREET	PHOENIX DISTRIBUTING	2 REMOVED TANKS
166	0-008111	2453 S 6TH ST	FIREBIRD FUEL CO 7TH ST CARDLOCK	5 ACTIVE TANKS
174	0-000844	1696 E UNIVERSITY DR	LAKESHORE EQUIPMENT	3 REMOVED TANKS
174	0-002564	1705 E UNIVERSITY DR	INDUSTRIAL ASPHALT PHX LOC#58	2 REMOVED TANKS
174	0-002562	1705 E UNIVERSITY DR	PHOENIX TANK TERMINAL LOC #2	2 REMOVED TANKS
175	0-000454	2020 E UNIVERSITY DR	ARIZONA WHOLESALE SUPPLY CO	3 REMOVED TANKS
175	0-004780	2642 S 20TH PL	SUNDT CORP EQUIPMENT SERVICE YARD	3 REMOVED TANKS
177	0-000847	1801 E UNIVERSITY DR	CALMAT CO OF ARIZONA	5 REMOVED TANKS 2 ACTIVE TANKS
178	0-000841	1835 E UNIVERSITY DR	PRE STRESS BUILDING	2 REMOVED TANKS
183	0-008461	813 E UNIVERSITY	L & M LAMINATES	1 ACTIVE TANK
184	0-000200	2610 S 16TH STREET	ARIZONA DEPT OF PUBLIC SAFETY	1 REMOVED TANK 1 ACTIVE TANK
191	0-004566	2626 S 7TH ST	'SMITTY"S SUPER VALU INC'	3 REMOVED TANKS
194	0-004328	2121 E MAGNOLIA ST	SAMARITAN HEALTH SERVICES	1 REMOVED TANK
195	0-007905	2229 E MAGNOLIA ST	AIRBORNE FREIGHT	2 REMOVED TANKS
196	0-003586	2326 E MAGNOLIA ST	MAGNOLIA BUILDING	1 REMOVED TANK
197	0-005691	2501 E MAGNOLIA ST	THOMPSON INDUSTRIES	2 REMOVED TANKS
202	0-005323	2800 S CENTRAL AVE	UNITED METRO MATERIALS PLANT 1	1 CLOSED TANK 2 REMOVED TANKS
207	0-001795	40 E PIONEER ST	B F GOODRICH CO	1 REMOVED TANK
209	0-008564	315 E PIONEER ST	FORMER UNIVERSAL HYDRAULICS	1 REMOVED TANK
211	0-004836	3640 S 19TH AVE	TANNER COMPANIES PLANT 1	6 REMOVED TANKS 1 CLOSED TANK 4 ACTIVE TANKS
213	0-008612	3420 S 7TH ST	VACANT PROPERTY SOUTHWEST STORAGE SYSTE	1 REMOVED TANK
221	0-005203	3622 S 30TH ST	TURF IRRIGATION & WATER WRKS	1 REMOVED TANK
224	0-007400	3615 S 28TH ST	KLEVEN CONSTRUCTION INC	3 ACTIVE TANKS
228	0-006129	895 W ELWOOD ST	ACE ASPHALT OF ARIZONA INC	1 REMOVED TANK 3 ACTIVE TANKS 1 TEMPORARY TANK
231	0-006530	1475 E ELWOOD ST	GILBERT PUMP & EQUIPMENT CO	3 ACTIVE TANKS
232	0-004422	1509 E ELWOOD ST	MCGUCKIN DRILLING INC	4 ACTIVE TANKS
232	0-000781	1580 E ELWOOD	BROWNING & FERRIS INDUSTRIES	8 REMOVED TANKS 6 ACTIVE TANKS
232	0-004406	3635 S 16TH ST	SEALY MATTRESS MANUFACTURING CO	2 REMOVED TANKS
240	0-005611	4021 S 19TH AVE	WESTERN BLOCK COMPANY	4 REMOVED TANKS
268	0-000778	4300 S 15TH AVE	BROWN TANK & STEEL	2 REMOVED TANKS
269	0-001534	4305 S 19TH AVE	CIRCLE K # 1968	3 ACTIVE TANKS

CITY OF PHOENIX
SALT RIVER ENVIRONMENTAL SURVEY

TABLE 7
UNDERGROUND STORAGE TANKS
Survey From Salt River Bank to 1/4 Mile of Bank

MAP I.D. NO	FACILITY I.D. NO.	ADDRESS	NAME	COMMENTS
273	0-002113	1930 W BROADWAY R	COOLEY WHOLESALE LUMBER CO	2 REMOVED TANKS
282	0-004162	4300 S 17TH AVE	ROAD JAMMERS MACHINERY	3 REMOVED TANKS
283	0-008097	1820 W BROADWAY R	ARIZONA TEAMSTERS APPRENTICESHIP	2 REMOVED TANKS
283	0-005058	1824 W BROADWAY R	C S W CONTRACTORS INC	2 REMOVED TANKS
291	0-001283	4422 S 19TH AVE	CIRCLE K # 670	3 REMOVED TANKS

TABLE 8
LEAKING UNDERGROUND STORAGE TANK SITES
Survey From Salt River Bank to 1/4 Mile of Bank

MAP I.D. NO.	FACILITY I.D. NO.	LEAK I.D.	ADDRESS	NAME	CASE CLOSED (1)
143	0-002555	2372.01	2202 S CENTRAL AVE	I-10 INTERNATIONAL TRUCK INC	Not Reported
		1455.01			Not Reported
144	0-002951	2990.01	302 E UNIVERSITY DR	LEPRINO FOODS	Not Reported
145	0-004271	1124.01	420 W WATKINS ST	ST VINCENT DE PAUL SOCIETY	Not Reported
166	0-000004	2472.01	2432 S 6TH STREET	PHOENIX DISTRIBUTING	YES
174	0-002562	1022.01	1705 E UNIVERSITY DR	PHOENIX TANK TERMINAL LOC #2	Not Reported
175	0-004780	4144.01	2642 S 20TH PL	SUNDT CORP EQUIPMENT SERVICE YARD	YES
177	0-000847	0871.01	1801 E UNIVERSITY DRIVE	CALMAT CO OF ARIZONA	YES
		0771.01			Not Reported
		0771.03			Not Reported
		0771.02			YES
178	0-000841	0201.01	1835 E UNIVERSITY DRIVE	PRE STRESS BUILDING	YES
184	0-000200	2292.01	2610 S 16TH STREET	ARIZONA DEPT OF PUBLIC SAFETY	YES
191	0-004566	2718.03	2626 S 7TH ST	'SMITTY"S SUPER VALU INC'	YES
		2718.04			YES
		2718.01			YES
		2718.02			YES
202	0-005323	0775.01	2800 S CENTRAL AVE	UNITED METRO MATERIALS PLANT 1	Not Reported
207	0-001795	3699.01	40 E PIONEER ST	B F GOODRICH CO	YES
209	0-008564	4101.01	315 E PIONEER ST	FORMER UNIVERSAL HYDRAULICS	YES
211	0-004836	0476.01	3640 S 19TH AVE	TANNER COMPANIES PLANT 1	Not Reported
232	0-000781	2458.01	1580 E ELWOOD	BROWNING & FERRIS INDUSTRIES	Not Reported
		2311.01			Not Reported
		0438.01			YES
240	0-005611	1128.01	4021 S 19TH AVE	WESTERN BLOCK COMPANY	Not Reported
273	0-002113	2842.01	1930 W BROADWAY RD	COOLEY WHOLESALE LUMBER CO	Not Reported
282	0-004162	2381.01	4300 S 17TH AVE	ROAD JAMMERS MACHINERY	YES
283	0-008097	2705.01	1820 W BROADWAY RD	ARIZONA TEAMSTERS APPRENTICESHIP	Not Reported
291	0-001283	3357.01	4422 S 19TH AVE	CIRCLE K # 670	Not Reported

Notes:
1. Not Reported - Indicates no additional information was available at the time of the EDR study.

TABLE 9
DRY WELLS
Survey From Salt River Bank to 1/4 Mile of Bank

MAP I.D. NO.	ADDRESS	NAME
145	447 W WATKINS ST	COMMERCIAL BUILDING
145	438 W WATKINS ST	MACHINCO, INC.
163	810 E HAMMOND LN	ARIZONA TESTING LABS
179	1919 E UNIVERSITY DR	MATERIALS RECOVERY FACILITY
184	2626 S 16TH ST	D.P.S.
184	2652 S 16TH ST	MISSION INDUSTRIES
185	1007 E UNIVERSITY DR	CELWAVE
198	2635 E MAGNOLIA ST	MULTI-TENANT OFFICE/WAREHOUSE
198	2655 E MAGNOLIA ST	CC&F BUILDING IC-23
199	2601 E MAGNOLIA ST	PHOENIX ADMINISTRATION SERVICES
208	109 E PIONEER ST	HEIL ROTOMOLD INC
209	3414 S 5TH ST	BFGOODRICH ARROSPACE - AIRCRAFT
209	3445 S 5TH ST	S. VALLEY INDUSTRIAL PARK, BLDG S-3
213	3420 S 7TH ST	SOUTH VALLEY INDUSTRIAL PARK
213	3446 S 7TH ST	CC&F BUILDING S-4
231	1475 E ELWOOD ST	GILBERT PUMP & MAINTENANCE BUILDING
232	1509 E ELWOOD ST	MCGUCKIN DRILLING, INC.
232	1580 E ELWOOD ST	BROWNING-FERRIS INDUSTRIES OF AZ
232	3602 S 16TH ST	A-1 IMPORTS ONLY
237	3820 S 28TH ST	ARIZONA INDUSTRIAL CATERING

TABLE 10
ARIZONA SPILLS LIST
Survey From Salt River Bank to 1/4 Mile of Bank

MAP I.D. NO.	FACILITY I.D. NO.	ADDRESS	NAME	CHEMICAL	AMOUNT SPILLED (1)	SAMPLES COLLECTED	CLEAN-UP (1)
144	91090C	215 E WATKINS ST	PENZOIL RECYLERS	FUEL(PROPANE)	250 LBS	0	YES
146	89199	308 W. WATKINS	MICOR ELECTRIC	FRIABLE ASBESTOS	10 LBS	0	NO
165	89260	1405 E. HAMMOND LN.	'GIL"S RECYCLING OPERATION'	TCE	7-8 DRUMS	0	NO
184	93-031-B	2610 S 16TH ST	DPS	EXPLOSIVE C	Not Reported	0	Not Reported
192	94-049-A	520 W LOWER BUCKEYE RD	PHOENIX, CITY OF	TRASH/GARBAGE	Not Reported	0	Not Reported
197	88298	2501 E. MAGNOLIA	AZ FREEPORT WAREHOUSE, INC.	NALCO 2548 OXY.SCAVENGER	30-35 GAL	1	YES
197	94005F	2512 E MAGNOLIA ST	MCLANE FOODS, INC.	AMMONIA	Not Reported	0	Not Reported
197	94-005-F	2512 E MAGNOLIA ST	MCLANE FOODS, INC.	AMMONIA	Not Reported	0	Not Reported
198	89189	2655 E. MAGNOLIA	DHL WORLDWIDE EXPRESS	SEALING COMPOUND	3,1-PT CANS	0	YES
198	89264	2655 E. MAGNOLIA	DHL WORLDWIDE EXPRESS	CHLORPYRITOS	< 1 PINT	0	YES
211	95-025-G	3640 S 19TH AVE	UNITED METRO	DIESEL	Not Reported	0	Not Reported
212	94008F	3445 S 24TH ST	MCINTYRE AUTO PARTS	GASOLINE	Not Reported	0	Not Reported
212	94-008-F	3445 S 24TH ST	MCINTYRE AUTO PARTS	GASOLINE	Not Reported	0	Not Reported
214	87046	3403 SO. 1ST AVE.	CUSTOM BOLT MFG.	ZINC CHROMATE	UNKNOWN	0	NO
216	87253	3424 SO. 3RD AVE.	ALCOR METALS	CYANIDE WASTE	21 DRUMS	0	NO
228	88133	895 W. ELWOOD	ACE ASPHALT	UNKNOWN	UNKNOWN	0	NO
235	96-020-G	3736 S 7TH AVE	PYRAMID INDUSTRIES	ACETONE	Not Reported	0	Not Reported
235	88100	3745 SO. 7TH AVE.	CEM-TEC	PAINTS, THINNERS	1500 GAL	0	YES
237	87101	2818 E. ILLINI	TIERNEY CASTINGS	TETRACHLOROETHYLENE	55 GAL	0	YES
240	95-037-A	4021 S 19 AVE. E. OF 19 SR B	WESTERN BLOCK CO.	CONCRETE ADDITIVE	Not Reported	0	Not Reported
245	95-021-A	3827 S 26TH ST	UNKNOWN	OIL, WASTE	Not Reported	0	Not Reported
286	94-078-A	2000 W BROADWAY RD	AAA BROADWAY AUTO PARTS	RED PHOSPHORUS & LAB CHEM	Not Reported	0	Not Reported

Notes:
1. Not Reported - Indicates no additional information was available at the time of the EDR study.

CITY OF PHOENIX
SALT RIVER ENVIRONMENTAL SURVEY

TABLE 11
NPL SITES and STATE LANDFILL SITES
Survey From 1/4 Mile to 1/2 Mile of Salt River Bank

MAP I.D. NO.	EDR I.D. NO.	ADDRESS	NAME
None			

CITY OF PHOENIX
SALT RIVER ENVIRONMENTAL SURVEY

TABLE 12
ZIPACIDS ARIZONA STATE HAZARDOUS WASTE SITES
Survey From 1/4 Mile to 1/2 Mile of Salt River Bank

MAP I.D. NO.	ADDRESS	NAME
117	1831 S CENTRAL	QUALITY PRINTED CIRCUITS CORP
134	2001 S 32ND ST	161ST AREFG AIR NATL GUARD
134	2001 S 32ND ST	SKY HARBOR ARIZ AIR NATL GUARD BASE
136	2325 S 7TH ST	AMERON PIPE DIV SOUTHWEST
141	2424 S 24TH ST	CUSTOM CIRCUITS
152	1120 W WATKINS ST	1120 WEST WATKINS SITE
152	1120 W WATKINS ST	CHEM RESEARCH #3
162	2635 SOUTH 24TH STREET	GARRETT GENERAL AVIATION SERVICES D
189	2625 S 19TH AVE	KENWORTH MOTOR TRUCK DISTRIBUTOR
223	1223 E ELWOOD ST	PETROLEUM RECYCLING PRODUCTS, INC.
230	1309 E. ELWOOD ST.	CASTING TOWER PRODUCTS
261	1504 E. ENCINAS LANE	STATEWIDE RKW TRUCKING CO.
274	1500 LOWER BUCKEYE	LOWER BUCKEYE SITE

CITY OF PHOENIX
SALT RIVER ENVIRONMENTAL SURVEY

TABLE 13A
SITES WITHIN WQARF SITES - WEST VAN BUREN (WVB)
Survey From 1/4 Mile to 1/2 Mile of Salt River Bank

MAP I.D. NO.	ADDRESS	NAME
125	2120 S 7TH ST	UNOCAL 6091
147	747 W WATKINS ST	RIO SALADO WAREHOUSE
148	951 W WATKINS	BAYER IND INC
148	951 W WATKINS ST	ACROLOC
148	951 W WATKINS ST	FORMER BAYER UST FACILITY
150	1202 W WATKINS ST	ABLE-CARDON
152	1141 W WATKINS RD	AUTOMATED PATHOLOGY SERV
152	1120 W WATKINS	CHEMRESEARCH PAINT DIV
152	1120 W WATKINS ST	1120 WEST WATKINS SITE
152	1120 W WATKINS ST	CHEM RESEARCH #3
152	1120 W WATKINS ST	METWEST OF ARIZONA
152	1120 WEST WATKINS	CHEM RESEARCH #3
153	1301 W WATKINS ST	MCATEE EQUIPMENT COMPANY
153	1310 W WATKINS RD	WHITE CHEM CO
168	1001 W MAGNOLIA ST	RICKETTS TRUCKING INC
171	14TH & MAGNOLIA STS	14TH ST LDFL
173	2530 S 16TH AVE	MP ENVIRONMENTAL
182	2655 S 11TH AVE	THERMO FLUIDS INC PHOENIX
189	2602 S 19TH AVE	NEILS DETROIT DIESEL INC
189	2602 S 19TH AVE	WILLIAMS DETROIT DIESEL ALLISON
189	2625 S 19TH AVE	BLUE CIRCLE WEST LEASING
189	2625 S 19TH AVE	KENWORTH OF ARIZONA
189	2625 S 19TH AVE	KENWORTH OF AZ
189	2625 S 19TH AVE	KENWORTH MOTOR TRUCK DISTRIBUTOR
190	2575 S 16TH AVE	GREENFIELD ENVIRONMENTAL
190	2575 S 16TH AVE	GREENFIELD ENVIRONMENTAL OF AZ
200	2602 S 15TH AVE	PHOENIX TALLOW
201	2010 W LOWER BUCKEYE	EMPIRE WASTE AND RECYCLING
201	2010 W LOWER BUCKEYE ROAD	EMPIRE METALS INC
204	3000 S 19TH AVE	WASTE MANAGEMENT OF PHX-SOUTH
204	3000 S 19TH AVE	UNIVERSAL WASTE CONTROL
204	3000 S 19TH AVE	WASTE MANAGEMENT OF PHX SOUTH
204	3020 S 19TH AVE	LINCOLN AUTO
204	3050 S 19TH AVE	ASPHALT PRODUCTS TRANSPORT CO
204	3050 SO. 19TH AVE.	CHEVRON, PHX ASPHALT PLANT
204	3050 SO. 19TH AVE.	CHEVRON
204	3050 S 19TH AVE	CHEVRON USA INC PHOENIX ASPHAL
204	3052 S 19TH AVE	TANNER CO INC TPAC DIV
206	3210 S 19TH AVE	PHOENIX METAL RECYCLING

CITY OF PHOENIX
SALT RIVER ENVIRONMENTAL SURVEY

TABLE 13B
SITES WITHIN WQARF SITES - EAST WASHINGTON (EW)
Survey From 1/4 Mile to 1/2 Mile of Salt River Bank

MAP I.D. NO.	ADDRESS	NAME
108	101 W MOHAVE	SPECTRO CHEM
108	1712 S 1ST AVE	THORSON SUPPLY COMPANY INC
115	368 W APACHE ST	FIRE STATION # 6
116	1841 S 5TH AVE	HOSPODKA, MARIAN
117	123 E DURANGO ST	WACO SCAFFOLDING
117	1802 SO. CENTRAL	WESTERN STATE PETROLEUM
117	1802 SO. CENTRAL	HAMPTON PETROLEUM CO.
117	1802 SO. CENTRAL	CARDLOCK INC.
117	1802 S CENTRAL AVE	CORY CARDLOCK # 16
117	1829 S CENTRAL AVE	QUALITY PRINTED CIRCUITS
117	1831 S CENTRAL	QUALITY PRINTED CIRCUITS CORP
120	102 W MARICOPA FWY	SHANKA BOATS
122		2045 S. 7TH AVENUE I-10
123	2102 S 3RD DRIVE	ABC MOVING & STORAGE CO INC
124	1007 E MARICOPA FWY	BRIAN HYNDMAN
124	1033 E MARICOPA FWY	AIR CARGO TRANSIT INC
125	2107 S 7TH AVE	TEXACO 60-349-0300
127	111 E MARICOPA FWY	JEPSEN SOUTHWEST INC
128	2118 S 5TH AVE	KLEEN PRO INC
129	330 E MARICOPA FWY	ARIZONA TRUCK & EQUIPMENT REPAIR
129	330 E MARICOPA FREEWAY	ARIZONA TRUCK AND EQUIPMENT RPR
130	2148 S 6TH AVE	PETES CUSTOM POLISHING PLATING
136	2250 S 7TH ST	KEEBLER COMPANY
136	2325 S 7TH ST	AMERON PIPE DIV SOUTHWEST
137	1717 E MARICOPA FREEWAY	HORIZON MOVING SYS
140	1315 E GIBSON	SENATRO EQUIPTMENT & TRUCK
140	1315 E GIBSON LANE	GIBSON PROPERTY
140	1325 E GIBSON LANE	PPG/SALAGLAS
140	1325 E GIBSON LN	PPG/SALAGLAS
141	2424 S 24TH ST	CUSTOM CIRCUITS
154	2400 S 14TH ST	WESTERN TRUCK EQUIPMENT CO INC
155	2229 S 16TH ST	ACTION EQUIP & SCAFFOLD CO INC
156	1850 E WATKINS	GREAT WESTERN PUBLISHING
156	1850 E WATKINS ST	HEWSON & WATKINS
157	2241 SO 15TH PLACE	FX ENVIRONMENTAL PRODUCTS CORP
157	2241 S 15TH PL	AZTEC SPECIALTY CHEMICAL
157	2321 S 15TH STREET	CAPRICORN STEEL
158	1941 E WATKINS	SUNDSTRAND AVIATION OPERATION
158	2410 S 19TH PL	COLEMAN PLUMBING
159	2025 E WATKINS ST	RECORD MASTERS
159	2025 E WATKINS ST	RECORD MASTERS
162	2635 S 24TH ST	GARRETT GENERAL/ALLIED SIGNAL
162	2635 SOUTH 24TH STREET	GARRETT GENERAL AVIATION SERVICES D
162	2635 S 24TH ST	GARRETT GENERAL AVIATION SERVICE
164	2430 S 20TH ST	CRANE BUILDING
167	2413 S 21ST ST	J C PENNEY UNIT 9517-4

CITY OF PHOENIX
SALT RIVER ENVIRONMENTAL SURVEY

TABLE 13B
SITES WITHIN WQARF SITES - EAST WASHINGTON (EW)
Survey From 1/4 Mile to 1/2 Mile of Salt River Bank

MAP I.D. NO.	ADDRESS	NAME
172	2635 SOUTH 24TH STREET	GARRET GENERAL AVIATION SERVICES DIV
172	2324 E UNIVERSITY DR	APS INC
172	2345 E UNIVERSITY DR	CASTILLO COMPANY, INC. OFFICE BLDG.
180	2202 E UNIVERSITY DR	HOMEDCO
180	2229 E UNIVERSITY	AIRO GRAPHICS
180	2236 E UNIVERSITY	TOP SEAL CORP
181	2423 E UNIVERSITY DR	AMERICAN FINE FOOD INC
181	2810 S 24TH ST	FILTERCOLD CORP
181	2810 S 24TH ST STE 117	TRM COPY CTRS CORP
186	2555 E UNIVERSITY	PHOENIX INST OF TECHNOLOGY
187	2625 E UNIVERSITY DR	CADILLAC PLASTIC
187	2625 E UNIVERSITY DR	CADILLAC PLASTIC

CITY OF PHOENIX
SALT RIVER ENVIRONMENTAL SURVEY

TABLE 13C
SITES WITHIN WQARF SITES - SKY HARBOR (SH)
Survey From 1/4 Mile to 1/2 Mile of Salt River Bank

MAP I.D. NO.	ADDRESS	NAME
134	2001 S 32ND ST	161ST AREFG AIR NATL GUARD
134	2001 SO. 32 ST.	ARVEY PAPAER & SUPPLIES
134	2001 S 32ND ST	SKY HARBOR ARIZ AIR NATL GUARD BASE
134	2001 S 32ND STREET	AIR NATIONAL GUARD 161ST AIR REFUELING
134	2001 S 32ND ST	USANG AZ 161ST AREFG
134	2001 S 32ND ST	SKY HARBOR ANG BASE
139	29TH ST N OF GIBSON LANE	SURFACE IMPOUNDMENT @ SKY HARBOR
141	2401 S 24TH ST	KNOELL HOMES INC

TABLE 14
CERCLA SITES
Survey From 1/4 Mile to 1/2 Mile of Salt River Bank

MAP I.D. NO.	ADDRESS	NAME	COMMENTS
172	2635 SOUTH 24TH STREET	GARRET GENERAL AVIATION SERVICES DIV	This site is currently under investigation by the government to assess the extent of further action. NOT ON NPL.

CITY OF PHOENIX
SALT RIVER ENVIRONMENTAL SURVEY

TABLE 15A
RCRA DATABASE - SMALL QUANTITY GENERATORS
Survey From 1/4 Mile to 1/2 Mile of Salt River Bank

MAP I.D. NO.	ADDRESS	NAME
108	101 W MOHAVE	SPECTRO CHEM
117	1831 S CENTRAL	QUALITY PRINTED CIRCUITS CORP
128	2118 S 5TH AVE	KLEEN PRO INC
129	330 E MARICOPA FREEWAY	ARIZONA TRUCK AND EQUIPMENT RPR
134	2001 S 32ND ST	USANG AZ 161ST AREFG
136	2325 S 7TH ST	AMERON PIPE DIV SOUTHWEST
140	1315 E GIBSON	SENATRO EQUIPTMENT & TRUCK
156	1850 E WATKINS	GREAT WESTERN PUBLISHING
162	2635 S 24TH ST	GARRETT GENERAL/ALLIED SIGNAL
172	2324 E UNIVERSITY DR	APS INC
180	2229 E UNIVERSITY	AIRO GRAPHICS
180	2236 E UNIVERSITY	TOP SEAL CORP
181	2810 S 24TH ST STE 117	TRM COPY CTRS CORP
182	2655 S 11TH AVE	THERMO FLUIDS INC PHOENIX
186	2555 E UNIVERSITY	PHOENIX INST OF TECHNOLOGY
189	2602 S 19TH AVE	WILLIAMS DETROIT DIESEL ALLISON
189	2625 S 19TH AVE	BLUE CIRCLE WEST LEASING
189	2625 S 19TH AVE	KENWORTH OF AZ
201	2010 W LOWER BUCKEYE	EMPIRE WASTE AND RECYCLING
204	3000 S 19TH AVE	UNIVERSAL WASTE CONTROL
204	3000 S 19TH AVE	WASTE MANAGEMENT OF PHX SOUTH
204	3050 S 19TH AVE	CHEVRON USA INC PHOENIX ASPHAL
204	3052 S 19TH AVE	TANNER CO INC TPAC DIV
206	3210 S 19TH AVE	PHOENIX METAL RECYCLING
215	3443 S CENTRAL	PHOENIX SOUTHERN COMD CITY OF
218	147 W FOREST GROVE	SOUTH SIDE METALS
225	144 W ELWOOD	ROJO RECYCLING
229	1223 E ELWOOD ST	DOMINO ROAD COATINGS INC
233	3615 S CENTRAL AVE	MERCURY TOOL AND MFG INC
243	3807 S 7TH ST	ALLIED TOOL & DIE CO
258	2133 E JONES AVE	SHERWIN-WILLIAMS CO
260	2327 E JONES AVE	QUALITY INKS INC
274	1521 W BROADWAY	TURNERS MACHINE SHOP

CITY OF PHOENIX
SALT RIVER ENVIRONMENTAL SURVEY

TABLE 15B
RCRA DATABASE - LARGE QUANTITY GENERATORS
Survey From 1/4 Mile to 1/2 Mile of Salt River Bank

MAP I.D. NO.	ADDRESS	NAME
130	2148 S 6TH AVE	PETES CUSTOM POLISHING PLATING
141	2424 S 24TH ST	CUSTOM CIRCUITS
148	951 W WATKINS	BAYER IND INC
152	1120 W WATKINS	CHEMRESEARCH PAINT DIV
158	1941 E WATKINS	SUNDSTRAND AVIATION OPERATION
190	2575 S 16TH AVE	GREENFIELD ENVIRONMENTAL OF AZ

TABLE 16
UNDERGROUND STORAGE TANKS
Survey From 1/4 Mile to 1/2 Mile of Salt River Bank

MAP I.D. NO.	FACILITY I.D. NO.	ADDRESS	NAME	COMMENTS
108	0-008418	1712 S 1ST AVE	THORSON SUPPLY COMPANY INC	1 REMOVED TANK
115	0-003804	368 W APACHE ST	FIRE STATION # 6	1 REMOVED TANK
117	0-007793	123 E DURANGO ST	WACO SCAFFOLDING	3 REMOVED TANKS
117	0-001963	1802 S CENTRAL AVE	CORY CARDLOCK # 16	3 ACTIVE TANKS
123	0-000005	2102 S 3RD DRIVE	ABC MOVING & STORAGE CO INC	1 REMOVED TANK
124	0-007156	1007 E MARICOPA FWY	BRIAN HYNDMAN	3 REMOVED TANKS
124	0-007330	1033 E MARICOPA FWY	AIR CARGO TRANSIT INC	1 ACTIVE TANK
125	0-000915	2107 S 7TH AVE	TEXACO 60-349-0300	4 REMOVED TANKS
125	0-005314	2120 S 7TH ST	UNOCAL 6091	3 REMOVED TANKS
127	0-002720	111 E MARICOPA FWY	JEPSEN SOUTHWEST INC	2 ACTIVE TANKS
134	0-000092	2001 S 32ND STREET	AIR NATIONAL GUARD 161ST AIR REFUELING	3 REMOVED TANKS 16 ACTIVE TANKS
136	0-002396	2250 S 7TH ST	KEEBLER COMPANY	1 REMOVED TANK
136	0-000130	2325 S 7TH ST	AMERON PIPE DIV SOUTHWEST	7 REMOVED TANKS
137	0-002530	1717 E MARICOPA FREEWAY	HORIZON MOVING SYS	3 ACTIVE TANKS
140	0-000638	1315 E GIBSON LANE	GIBSON PROPERTY	2 PERM TANKS
140	8-007544	1325 E GIBSON LANE	PPG/SALAGLAS	1 REMOVED TANK
141	0-006166	2401 S 24TH ST	KNOELL HOMES INC	4 REMOVED TANKS
148	0-007823	951 W WATKINS ST	FORMER BAYER UST FACILITY	2 TEMPORARY TANKS
150	0-007177	1202 W WATKINS ST	ABLE-CARDON	1 REMOVED TANK
152	0-006100	1120 W WATKINS ST	METWEST OF ARIZONA	1 REMOVED TANK
154	0-007355	2400 S 14TH ST	WESTERN TRUCK EQUIPMENT CO INC	1 REMOVED TANK
155	0-006017	2229 S 16TH ST	ACTION EQUIP & SCAFFOLD CO INC	2 REMOVED TANKS
157	0-000704	2321 S 15TH STREET	CAPRICORN STEEL	1 REMOVED TANK
158	0-007592	2410 S 19TH PL	COLEMAN PLUMBING	1 REMOVED TANK
162	0-002223	2635 S 24TH ST	GARRETT GENERAL AVIATION SERVICE	1 REMOVED TANK
167	0-003661	2413 S 21ST ST	J C PENNEY UNIT 9517-4	2 REMOVED TANKS
168	0-002662	1001 W MAGNOLIA ST	RICKETTS TRUCKING INC	1 REMOVED TANK
181	0-002626	2423 E UNIVERSITY DR	AMERICAN FINE FOOD INC	3 REMOVED TANKS
189	0-006541	2602 S 19TH AVE	NEILS DETROIT DIESEL INC	3 REMOVED TANKS
189	0-002185	2625 S 19TH AVE	KENWORTH OF ARIZONA	6 REMOVED TANKS
200	0-000624	2602 S 15TH AVE	PHOENIX TALLOW	6 REMOVED TANKS
201	0-001930	2010 W LOWER BUCKEYE ROAD	EMPIRE METALS INC	2 REMOVED TANKS 2 ACTIVE TANKS

CITY OF PHOENIX
SALT RIVER ENVIRONMENTAL SURVEY

TABLE 15C
RCRA DATABASE - TREATMENT/STORAGE/DISPOSAL
Survey From 1/4 Mile to 1/2 Mile of Salt River Bank

MAP I.D. NO.	ADDRESS	NAME
190	2575 S 16TH AVE	GREENFIELD ENVIRONMENTAL OF AZ

TABLE 16
UNDERGROUND STORAGE TANKS
Survey From 1/4 Mile to 1/2 Mile of Salt River Bank

MAP I.D. NO.	FACILITY I.D. NO.	ADDRESS	NAME	COMMENTS
204	0-004798	3000 S 19TH AVE	WASTE MANAGEMENT OF PHX-SOUTH	2 REMOVED TANKS 3 ACTIVE TANKS
204	0-002668	3020 S 19TH AVE	LINCOLN AUTO	2 REMOVED TANKS
204	0-000482	3050 S 19TH AVE	ASPHALT PRODUCTS TRANSPORT CO	2 REMOVED TANKS
215	0-004505	3443 S CENTRAL AVE	SOUTHERN COMMAND	4 REMOVED TANKS 5 ACTIVE TANKS
218	0-006957	126 W FOREST GROVE AVE	'FRANK"S TRANSFER INC'	2 CLOSED TANKS
222	0-007947	950 E ELWOOD ST	LOCAL UNION 75 IRON WORKERS UNION	3 REMOVED TANKS
226	0-000327	335 W ELWOOD ST	SOUTHPARK I	2 REMOVED TANKS
236	0-000669	3801 S 30TH STREET	BARRICADE & LIGHT RENTAL INC	1 REMOVED TANK
238	0-001950	2902 E ILLINI	ENVIRONMENTAL CARE INC	5 ACTIVE TANKS
239	0-007640	3401 E ILLINI ST	S & S PAVING	1 REMOVED TANK
241	0-006075	516 W WEST RD	SUN STATE STEEL INC	1 REMOVED TANK
242	0-000219	310 W WEST ROAD	SOUTHPARK 1	2 REMOVED TANKS
243	0-005629	3839 S 7TH ST	FUELCO #107	2 REMOVED TANKS 5 ACTIVE TANKS
247	0-000824	3800 S 16TH STREET	C & W CHEMICALS CO INC	9 REMOVED TANKS
248	0-000686	3951 S 30TH STREET	BENTLEY-DILLE GRADALL RENTALS IN	11 REMOVED TANKS
252	0-005799	2902 E JONES AVE	JOHNNY A AVECHUCO MASONERY CONST	2 REMOVED TANKS
252	0-000071	2916 E JONES AVE	BARRICADE & LIGHT PENSION PLAN	2 REMOVED TANKS
252	0-000685	2950 E JONES	R AND J BENTLEY CORP PROFIT SHAR	2 REMOVED TANKS
253	0-008627	2850 E JONES AVE	ROAD MAINTENANCE SUPPLY	1 REMOVED TANK
253	0-007516	2833 E JONES AVE	ECONOMY BEDDING	1 REMOVED TANK
263	0-006176	4129 S 30TH ST	BEECROFT TRENCHING INC	2 REMOVED TANKS
267	0-002085	2946 E WOOD ST	FTS CONSTRUCTION INC	1 REMOVED TANK
274	0-003977	1501 W BROADWAY RD	PROGESSIVE ROOFING	1 REMOVED TANK
274	0-006074	1502 W BROADWAY RD	SANDVICK EQUIPMENT & SUPPLY CO	1 REMOVED TANK
279	0-006997	1311 W BROADWAY	BROADWAY CARDLOCK #23	3 ACTIVE TANKS

TABLE 17
LEAKING UNDERGROUND STORAGE TANK SITES
Survey From 1/4 Mile to 1/2 Mile of Salt River Bank

MAP I.D. NO.	FACILITY I.D. NO.	LEAK I.D.	ADDRESS	NAME	CASE CLOSED (1)
226	0-000327	0696.01	335 W ELWOOD ST	SOUTHPARK I	Not Reported
243	0-005629	0562.01	3839 S 7TH ST	FUELCO #107	YES
253	0-007516	1921.01	2833 E JONES AVE	ECONOMY BEDDING	YES
		1921.01			YES
263	0-006176	1733.01	4129 S 30TH ST	BEECROFT TRENCHING INC	YES
		1652.01			Not Reported
267	0-002085	3529.01	2946 E WOOD ST	FTS CONSTRUCTION INC	YES

Notes:
1. Not Reported - Indicates no additional information was available at the time of the EDR study.

TABLE 18
DRY WELLS
Survey From 1/4 Mile to 1/2 Mile of Salt River Bank

MAP I.D. NO.	ADDRESS	NAME
120	102 W MARICOPA FWY	SHANKA BOATS
124	1033 E MARICOPA FWY	AIR CARGO TRANSIT INC
129	330 E MARICOPA FWY	ARIZONA TRUCK & EQUIPMENT REPAIR
136	2250 S 7TH ST	KEEBLER COMPANY
140	1325 E GIBSON LN	PPG/SALAGLAS
147	747 W WATKINS ST	RIO SALADO WAREHOUSE
148	951 W WATKINS ST	ACROLOC
153	1301 W WATKINS ST	MCATEE EQUIPMENT COMPANY
156	1850 E WATKINS ST	HEWSON & WATKINS
164	2430 S 20TH ST	CRANE BUILDING
172	2345 E UNIVERSITY DR	CASTILLO COMPANY, INC. OFFICE BLDG.
180	2202 E UNIVERSITY DR	HOMEDCO
187	2625 E UNIVERSITY DR	CADILLAC PLASTIC
215	3443 S CENTRAL AVE	C.O.P. POLICE SOUTH RESOURCES BLDG.
219	3137 E ELWOOD ST	RYAN AT SOUTHBANK
227	100 E ELWOOD ST	C.O.P. POLICE PROPERTY MANAGEMENT
234	3643 S 7TH ST	3643 SOUTH 7TH STREET
236	3015 E ILLINI ST	BARRICADE & LIGHT RENTAL CO.
243	3807 S 7TH ST	ALLIED TOOL & DIE CO
251	4006 S 23RD ST	RIVERVIEW COMMERCE CENTER
255	4022 S 20TH ST	MULTI-TENANT OFFICE/WAREHOUSE
257	2101 E JONES AVE	MICHAEL LEWIS COMPANY
259	2231 EAST JONES AVENUE	COURIER TRANSPORTATION COMPANY
260	2320 E JONES AVE	SOUTHWEST AIRLINES RESERVATION CENT

TABLE 19
ARIZONA SPILLS LIST
Survey From 1/4 Mile to 1/2 Mile of Salt River Bank

MAP I.D. NO.	FACILITY I.D. NO.	ADDRESS	NAME	CHEMICAL	AMOUNT SPILLED (1)	SAMPLES COLLECTED	CLEAN-UP (1)
116	95-057-G	1841 S 5TH AVE	HOSPODKA, MARIAN	ACIDS/SOLVENTS	Not Reported	0	Not Reported
117	87081	1802 SO. CENTRAL	WESTERN STATE PETROLEUM	DIESEL, OIL & GAS	40-50 GAL	0	YES
117	90178C	1802 SO. CENTRAL	HAMPTON PETROLEUM CO.	TRANS-MIX OIL	360 GAL	0	YES
117	86124	1802 SO. CENTRAL	CARDLOCK INC.	GASOLINE (UNLEADED)	250 GAL	0	NO
117	91083C	1829 S CENTRAL AVE	QUALITY PRINTED CIRCUITS	UNKNOWN WHITE POWDER	25 LBS	0	NO
134	87181	2001 SO. 32 ST.	ARVEY PAPAER & SUPPLIES	AMMONIA SULFATE, ETC	UNKNOWN	0	YES
157	91112C	2241 S 15TH PL	AZTEC SPECIALTY CHEMICAL	TRIPHENYL METHANE DYE	50 GAL	2	YES
159	94016F	2025 E WATKINS ST	RECORD MASTERS	FORMALDEHYDE	Not Reported	0	Not Reported
159	94-016-F	2025 E WATKINS ST	RECORD MASTERS	FORMALDEHYDE	Not Reported	0	Not Reported
173	94-055-C	2530 S 16TH AVE	MP ENVIRONMENTAL	VANADIUM PENTOXIDE	Not Reported	0	Not Reported
187	94018G	2625 E UNIVERSITY DR	CADILLAC PLASTIC	UNKNOWN	Not Reported	0	Not Reported
187	94-018-G	2625 E UNIVERSITY DR	CADILLAC PLASTIC	UNKNOWN	Not Reported	0	Not Reported
204	84001	3050 SO. 19TH AVE.	CHEVRON, PHX ASPHALT PLANT	ASPHALT OSH	2200 GAL	0	YES
204	91131C	3050 SO. 19TH AVE.	CHEVRON	HYDROCHLORIC ACID	NONE	0	NO
217	93-053-B	3424 S 3RD PL	WYNNE, VIRGEL	PLATING WASTE	Not Reported	0	Not Reported
230	94-011-G	1309 E ELWOOD ST	PHOENIX COOLING TOWERS	SOLVENTS (MEK,TOLUENE..)	Not Reported	0	Not Reported
230	94011G	1309 E ELWOOD ST	PHOENIX COOLING TOWERS	SOLVENTS (MEK,TOLUENE..)	Not Reported	0	Not Reported
243	94026F	3822 S 7TH ST	ARY BROTHERS TRUCKING	DIESEL FUEL	Not Reported	0	Not Reported
254	95-039-C	2700 E JONES AVE	COP - UNKNOWN	OIL (USED)	Not Reported	0	Not Reported

Notes:

1. Not Reported - Indicates no additional information was available at the time of the EDR study.

CITY OF PHOENIX
SALT RIVER ENVIRONMENTAL SURVEY

AREA DESCRIPTIONS [1]

AREA I.D.	LOCATION		OWNERSHIP
	East-West Boundaries	North-South Boundaries	
SITES IDENTIFIED BY AERIAL PHOTO INTERPRETATION			
3	16th Street - 12th Street	North Bank of Salt River	Arizona Sand & Rock Co. Arizona Bank
4	12st Street - 11th Street	North Bank of Salt River	Ameron, Inc.
5	16th Street - 7th Street	South Bank of Salt River - Elwood	City of Phoenix Arizona Sand & Rock Co. Ralph Feffer & Sons Development Co. Del Rio Land David & Rosellen Paton
6	7th Street - Central Avenue	South Bank of Salt River	Arizona Sand & Rock Co.
7	2nd Avenue - Central Avenue	North Bank of Salt River	Central Avnue Landfill Co. Union Sand & Rock Co.
8	10th Avenue - 7th Avenue	North Bank of Salt River	City of Phoenix Union Rock & Material Co. Wilma Tressia Etal Pike
9 (North)	19th Avenue to 15th Avenue	Lower Buckey Road - North Bank of Salt River	City of Phoenix Pasqualetti Properties, Inc.
9 (South)	17th Avenue to 15th Avenue	South Bank of Salt River	Superior Co. Robert Peters
21	36th Street - 32nd Street	North Bank of Salt River	City of Phoenix
[illegible]	36th Street - 34th Street	South Bank of Salt River	Tanner Land Co., Inc.
[illegible]	34th Street - 32nd Street	South Bank of Salt River	Tanner Land Co., Inc.
24	32nd Street - 30th Street	North Bank of Salt River	Arizona Sand & Rock Co. City of Phoenix
25	25th Street - 24th Street	North Bank of Salt River	Arizona Sand & Rock Co.
26	25th Street - 24th Street	South Bank of Salt River	Union Rock & Material Co.
27	24th Street - 23rd Street	South Bank of Salt River	A.G. Cobis & Hillview, Ltd. Arizona Sand & Rock Co.
28	20th Street - 18th Place	South Bank of Salt River	Arizona Sand & Rock Co.
29	18th Street - 16th Street	South Bank of Salt River	Arizona Sand & Rock Co.
30	16th Street - 14th Street	University Drive - North Bank of Salt River	Arizona Sand & Rock Co. Arizona Bank
31	11th Street - 9th Street	Westbount Frontage Road - Gibson Lane	Arizona Sand & Rock Co. Multiple Owners
32	2nd Avenue - 7th Avenue	Watkins Road - North Bank of Salt River	City of Phoenix Union Sand & Rock Co. Union Rock & Material Co.
33	7th Avenue - 8th Avenue	South Bank of Salt River - North of Elwood	
34	18th Avenue - 19th Avenue	1 Block North of Broadway Road	Tiffany Properties Virginia Jan Tiffany Western Block Co. Multiple Owners
35	20st Avenue - 21th Avenue	1 Block North of Broadway Road - South Bank of Salt River	Tanner Land Co., Inc. John Ewing Tom Ewing Lavelle H. Schmidt N.S. Shumway Lester O. Smith, Jr. Multiple Owners

1. Salt River Landfill Advisory Committee, Final Report, January 29, 1986.

CITY OF PHOENIX
SALT RIVER ENVIRONMENTAL SURVEY

AREA DESCRIPTIONS [1]

AREA	LOCATION	OWNERSHIP
SURFACE IMPOUNDMENTS IDENTIFIED BY AERIAL PHOTO INTERPRETATION		
B	SE Corner of Sky Harbor South Runway	Private
C	24th Street and North Bank of Salt River (NE)	Private
D	19th Street and South Bank of Salt River (SE)	Private
E	6th Street, South of Elwood	Private
F	South of No. 6 Above	Private
G	16th Avenue and Lower Buckeye Road	Private
H	19th Avenue, 1 Block North of Broadway	Private

1. Salt River Landfill Advisory Committee, Final Report, January 29, 1986.

ENVIRONMENTAL RESEARCH
SALT RIVER BETWEEN MCCLINTOCK ROAD AND RURAL ROAD
AND
INDIAN BEND WASH BETWEEN THE SALT RIVER AND
MCKELLIPS ROAD
TEMPE, ARIZONA

Prepared for:

City of Tempe
Attention: Ms. Carol Martsch
Public Works Department
31 East Fifth Street
Tempe, Arizona

Project Number: 97-0029.R01

Geotechnical and Environmental Consultants, Inc.

2447 West 12th Street, Suite 4, • Tempe, Arizona 85281 • (602) 966-8631 • FAX (602) 966-8821
1300 South Milton Road, Suite 209 • Flagstaff, Arizona 86001 • (520) 779-9965 • FAX (520) 779-7123

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Roger A. Brewer, P.E. Donald J. Spadola, P.E. Chet L. Pearson, P.E.
Christopher L. Jacquemin, P.E. Charles E. O'Bannon, Ph.D.,P.E.

April 4, 1997

City of Tempe
Public Works Department
31 East Fifth Street
Tempe, Arizona

Attention: Ms. Carol Martsch

Reference: Environmental Research
Salt River between McClintock Road and Rural Road and
Indian Bend Wash between the Salt River and McKellips Road
Tempe, Arizona

Dear Ms. Martsch:

Geotechnical and Environmental Consultants, Inc. (GEC) is pleased to provide this letter presenting the environmental research of the referenced site. We conducted this work in accordance with our proposal to the City of Tempe (GEC Proposal No. 97-0093, dated March 10, 1997). GEC subcontracted Environmental Data Resources (EDR), an environmental research company to review reasonably available lists and databases of facilities within a one-quarter mile radius of the site, between a one-quarter and one-half mile radius of the site, and prepare a map showing these locations. Lists and databases reviewed by EDR included Federal and State "Superfund" study areas, State Hazardous Waste sites, solid waste facilities and landfills, CERCLIS sites, underground storage tanks (USTs), leaking underground storage tanks (LUSTs), drywells and RCRA-regulated facilities.

GEC summarized EDR findings as presented in Tables 1 through 16. Table 1 presents a summary of the findings for both search distances and all of the lists/databases reviewed. Tables 2 through 9 present summaries of the findings for lists/databases reviewed within a one-quarter mile radius of the site. Tables 10 through 16 present summaries for the findings for lists/databases reviewed between a one-quarter and one-half mile radius of the site. The "Map I.D. No." column in Tables 2 through 16 corresponds to a location presented on the attached maps.

EDR's report of the study area within a one-quarter mile radius of the site is presented in Appendix A. EDR's report of the study area between one-quarter and one-half mile of the

site is presented in Appendix B. EDR's report presented in Appendix B includes an orphan summary. The orphan summary presents facilities that appear on the environmental lists/databases but are not included on the map for a variety of reasons. Some of the listings represent only a billing address and some are published on non-existent address ranges of streets or roadways. Since some of the facilities may represent a billing or business office GEC did not attempt to include these facilities on the maps prepared for this report.

We hope this information is helpful in assisting the City of Tempe with preparing the HTRW Assessment for the site. If we can be of further assistance, or if you have any questions please call us at 966-8631. Thank you for your business.

Sincerely,

GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS, INC.

4.4.97

Donald J. Spadola, P.E.

Copies to: Addressee (6)

TABLES

CITY OF TEMPE
ENVIRONMENTAL RESEARCH

TABLE 1
SUMMARY OF IDENTIFIED SITES
Salt River/Indian Bend Wash

Type of Site	Sites within 1/4 mile of River Bank	Sites from 1/4 mile to 1/2 mile of River Bank	Total Sites within Study Area
Federal Superfund (NPL)	1	1	1
State Hazardous Waste Sites	4	10	14
State Solid Waste Facilities/Landfills	1	0	1
CERCLIS Sites	1	2	2
Spill Incidents/Emergency Response	5	0	5
UST Files	10	14	24
LUST Files	6	10	16
Dry Wells	7	3	10
RCRA-LQG	2	2	4
RCRA-SQG	10	8	18

CITY OF TEMPE
ENVIRONMENTAL RESEARCH

TABLE 2
NPL SITES AND STATE HAZARDOUS WASTE SITES
Salt River/Indian Bend Wash to 1/4 mile of Bank

Map I.D. No.	EDR I.D. No.	Address	Name
Shading	1000245609	McDowell Rd. & Hayden Rd.	Indian Bend Wash Area
2	1000366270	7811 E. Pierce St.	Marro Plating
5	S101570555	350 N. Hayden Rd.	Comtech Data
23	1000482878	T1N R4E NE¼ SEC14	Hayden Road Landfill

CITY OF TEMPE
ENVIRONMENTAL RESEARCH

TABLE 3
CERCLIS SITES/STATE SOLID WASTE FACILITIES
Salt River/Indian Bend Wash to 1/4 mile of Bank

Map I.D. No.	EDR I.D. No.	Address	Name
Shading		McDowell and Hayden Rd.	Indian Bend Wash
28	S100250235	1.3 mi. N. of Apache Blvd. on Hayden Rd.	ARCA Landfill

CITY OF TEMPE
ENVIRONMENTAL RESEARCH

TABLE 4
ARIZONA SPILLS LIST
Salt River/Indian Bend Wash to 1/4 mile of Bank

Map I.D. No.	Facility I.D. No.	Address	Name	Chemical	Amount Spilled (1)	Samples Collected	Clean-Up (1)
2	S100887165	7800 E. Pierce St.	GI Trucking	Potassium Cyanide	27 lbs.	1	Yes
4	S100886319	7616 E. Polk St.	DEA	Drug Lab Chemicals	None	0	No
11	S101315113	Miller Rd./Weber Dr.	SRP	Acrolein	Not reported	0	Not reported
19	S100888305	1450 E. Curry Rd.	Tony's Detail and Body Shop	Unknown	Unknown	0	No
22	S101315120	800 N. Miller Rd.	Earl's Fiberglass	Acetone/MEK	Not reported	0	Not reported

CITY OF TEMPE
ENVIRONMENTAL RESEARCH

TABLE 5
UNDERGROUND STORAGE TANKS
Salt River/Indian Bend Wash to 1/4 mile of Bank

Map I.D. No.	Facility ID No.	Address	Name
5	U003051566	302 N. Hayden Rd.	Fast Gas #111
5	U003050852	304 N. Hayden Rd.	AM-PM Arco
5	U003050442	401 N. Hayden Rd.	Green Acres Mortuary & Cemetary
6	U001625466	7602 E. McKellips	Circle K #1797
6	U001626955	1327 E. McKellips	City of Scottsdale
15	U001627674	1005 N. Stadem	Truly Nolen Exterminating
16	U000016613	1229 E. Curry Rd.	Landscape & Maintenance of Arizona
20	U001156554	1717 E. Curry Rd.	Trench Safety Equipment Corporation
24	U001628223	1150 E. Gilbert Dr.	Pueblo Lumber
25	U001628343	1050 E. Gilbert Dr.	KW Shahan Trucking

CITY OF TEMPE
ENVIRONMENTAL RESEARCH

TABLE 6
LEAKING UNDERGROUND STORAGE TANK SITES
Salt River/Indian Bend Wash to 1/4 mile of Bank

Map I.D. No.	Facility I.D. No.	Leak I.D.	Address	Name	Case Closed
6	U001625466	3725.01	7602 East McKellips	Circle K #1797	No
15	U001627674	0742.01	1005 North Stadem Dr.	Truly Nolen Exterminating	No
16	U000016613	2314.01	1229 East Curry Rd.	Landscape and Maintenance	No
20	U001156554	0479.01	1717 East Curry Rd.	Trench Safety Equipment Corp.	No
24	U001628223	2270.01	1150 East Gilbert Dr.	Pueblo Lumber	No
25	U001628343	1285.01	1050 East Gilbert Dr.	K W Shahan Trucking	No

CITY OF TEMPE
ENVIRONMENTAL RESEARCH

TABLE 7
DRY WELLS
Salt River/Indian Bend Wash to 1/4 mile of Bank

Map I.D. No.	Facility I.D. No.	Address	Name
3	S101599051	7901 E. Pierce St.	Xtant Technologies
7	S101598597	1445 E. McKellips Rd.	Tri City Storage
13	S102263863	1220 North Stadem Dr.	1200 North Stadem Drive
14	S101598555	1111 North Miller Rd.	Kirby Business Center
15	S102264255	1014 North Stadem Dr.	Dalzell Inc.
15	S101598582	1022 North Stadem Dr.	Stadem Property
19	S102049391	1450 East Currry Rd.	Gold Tech Industries

CITY OF TEMPE
ENVIRONMENTAL RESEARCH

TABLE 8
RCRA DATABASE - LARGE QUANTITY GENERATORS
Salt River/Indian Bend Wash to 1/4 mile of Bank

Map I.D. No.	Facility I.D. No.	Address	Name
2	1000366270	7811 E. Pierce St.	Marro Plating
13	1000366873	1214 N. Stadem Dr.	Microelectronics Exchange Corporation

CITY OF TEMPE
ENVIRONMENTAL RESEARCH

TABLE 9
RCRA DATABASE - SMALL QUANTITY GENERATORS
Salt River/Indian Bend Wash to 1/4 mile of Bank

Map I.D. No.	Facility I.D. No.	Address	Name
5	1000398152	350 N. Hayden Rd.	Fairchild Data Corporation
6	U001626955	1323 E. McKellips	City of Scottsdale
14	1000472709	1111 N. Miller Rd.	Scottsdale Acura
15	100013373	950 N. Stadem Dr.	Ron Thompson's Auto Body
15	1000110115	1030 N. Stadem Dr.	E F Data
15	1000184103	1043 N. Stadem Dr.	Gold Tech Industries
16	1000370309	1245 E. Curry Dr.	Sports Car Service Center
19	1000354461	1450 E. Curry Dr.	Gold Tech Industries
20	1000589401	1717 E. Curry Rd.	ACM Equipment

CITY OF TEMPE
ENVIRONMENTAL RESEARCH

TABLE 10
NPL SITES AND STATE HAZARDOUS WASTE SITES
1/4 mile to 1/2 mile of Banks of Salt River/Indian Bend Wash

Map I.D. No.	EDR I.D. No.	Address	Name
Shading	1000245609	McDowell Rd. & Hayden Rd.	Indian Bend Wash Area
29	1000241627	1976 East Pima St.	Kachina Redi-Mix
29	1000725154	1976 East Pima St.	Phoenix Ready Mix
30	S102421856	36 North Perry Lane	Great Western Mining Development
30	S102421856	115 North Perry Lane	Arizona Castings
30	1000665931	North of 1st St., South of Pima Rd.	Angela Berglund
30	1000420258	209 North Perry Lane	Whitronics
30	S101570613	259 North Perry Lane	First Street Landfill
32	1000482888	Pima and 1st St.	Maricopa County Landfill
35	1000181968	119 S Industrial Dr.	Circuit Technology

CITY OF TEMPE
ENVIRONMENTAL RESEARCH

TABLE 11
CERCLIS SITES
1/4 mile to 1/2 mile of Banks of Salt River/Indian Bend Wash

Map I.D. No.	EDR I.D. No.	Address	Name
shade		McDowell Road and Hayden Rd.	Indian Bend Wash Area
30	1000665931	North of 1st St., South of Pima Rd.	Angela Berglund

CITY OF TEMPE
ENVIRONMENTAL RESEARCH

TABLE 12
UNDERGROUND STORAGE TANKS
1/4 to 1/2 mile of Banks of Salt River/Indian Bend Wash

Map I.D. No.	Facility ID No.	Address	Name
1	U003051372	800 N. Hayden Rd.	University U-Haul #723-56
8	U003051472	1900 N. Hayden Rd.	Hayden Auto Plaza
9	U001156535	1616 N. Hayden Rd.	Malibu Grand Prix
10	U001001900	1500 N. McClintock Dr.	Island of Big Surf
18	U001626006	1045 E. Curry Rd.	Princess Property Management
26	U000737862	929 E. Gilbert Dr.	John Hartman
26	U001156533	711 N. Scottsdale Rd.	Ken Darcangelo
29	1000241627	1976 E. Pima St.	Kachina Redi-Mix
30	U003051334	117 S. Perry Ln.	Tempe Crane, Inc.
30	U003051478	106 S. Perry Ln.	Firebird Fuel Co.
30	U000016577	210 N. Perry Ln.	Earl Clark Roofing
31	U003051211	145 N. McClintock	Alto Automotive Enterprises
31	U003051425	203 N. McClintock	Tri-City Transmission
33	U001625827	1831 E. First St.	Frito-Lay Distribution

CITY OF TEMPE
ENVIRONMENTAL RESEARCH

TABLE 13
LEAKING UNDERGROUND STORAGE TANK SITES
1/4 to 1/2 mile of Banks of Salt River/Indian Bend Wash

Map I.D. No.	Facility I.D. No.	Leak I.D.	Address	Name	Case Closed
8	U003051472	4078.01	1900 N. Hayden Rd.	Hayden Auto Plaza	Yes 12/21/95
9	S10233393	4543.01	1616 N. Hayden Rd.	Tempe MGPC, Inc. #521	No
10	U001001900	2006.01	1500 N. McClintock Dr.	Island of Big Surf	Yes 5/4/93
26	U000737862	1334.01	929 E. Gilbert Dr.	John Hartman	No
29	1000241627	1072.01	1976 E. Pima St.	Kachina Redi-Mix	Yes 8/14/91
30	U003051334	3469.01	117 S. Perry Ln.	Tempe Crane, Inc.	No
30	U000016577	4394.01	210 N. Perry Ln.	Earl Clark Roofing	Yes 7/18/96
31	U003051211	4507.01	145 N. McClintock St.	Alto Automotive	No
31	U003051425	3331.01	203 N. McClintock St.	Tri-City Transmission Service	No
33	U001625827	0367.01	1831 E. 1st Street	Frito Lay Distribution Center	Yes 3/14/88

CITY OF TEMPE
ENVIRONMENTAL RESEARCH

TABLE 14
DRY WELLS
1/4 mile to 1/2 mile of Banks of Salt River/Indian Bend Wash

Map I.D. No.	Facility I.D. No.	Address	Name
12	S101598584	1322 N. McClintock Rd.	Surfside Marine
21	S102263976	910 N. Scottsdale Rd.	Automotive Service Facility
27	S101598556	610 E. Gilbert Dr.	La Mirage

CITY OF TEMPE
ENVIRONMENTAL RESEARCH

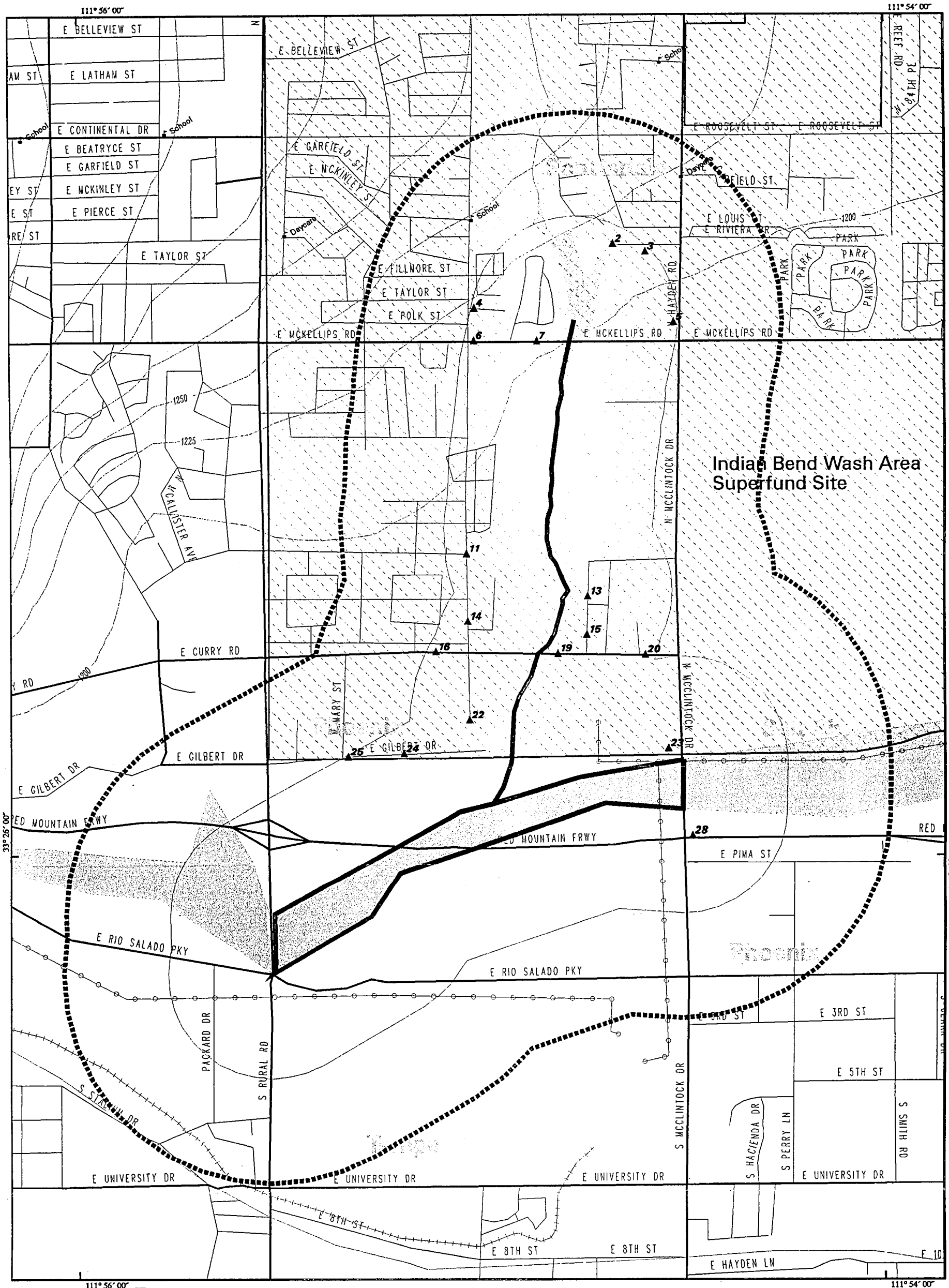
TABLE 15
RCRA DATABASE - LARGE QUANTITY GENERATORS
1/4 to 1/2 mile of Banks of Salt River/Indian Bend Wash

Map I.D. No.	Facility I.D. No.	Address	Name
17	1000181968	1123 E.Curry Rd.	Family Auto Painting and Body
35	10002548527	119 S. Industrial Dr.	Circuit Technology

TABLE 16
RCRA DATABASE - SMALL QUANTITY GENERATORS
1/4 to 1/2 mile of Banks of Salt River/Indian Bend Wash

Map I.D. No.	Facility I.D. No.	Address	Name
17	1000317841	1123 E. Curry Rd.	Econo Auto Painting of Az
29	1000136381	1976 E. Pima St.	Sun West Disposal
30	1000817990	109 S. Perry Ln.	Allisons Stripping
30	1000817815	106 N. Perry Ln.	Gold Circuit Inc.
34	1000402915	101 S. Hayden Rd.	Western States Tire and Auto
35	1000174686	108 S. Industrial Dr.	Genco
36	1000340688	215 S. Industrial Dr.	Motor Trend Specialties
37	1000472691	634 S. Rural Rd.	Joyces Magic Touch

FIGURES



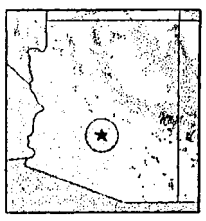
edr

Phone: 800-352-0050

Study Area For

Salt River Study

< 1/4 Search



Phoenix, AZ

Legend

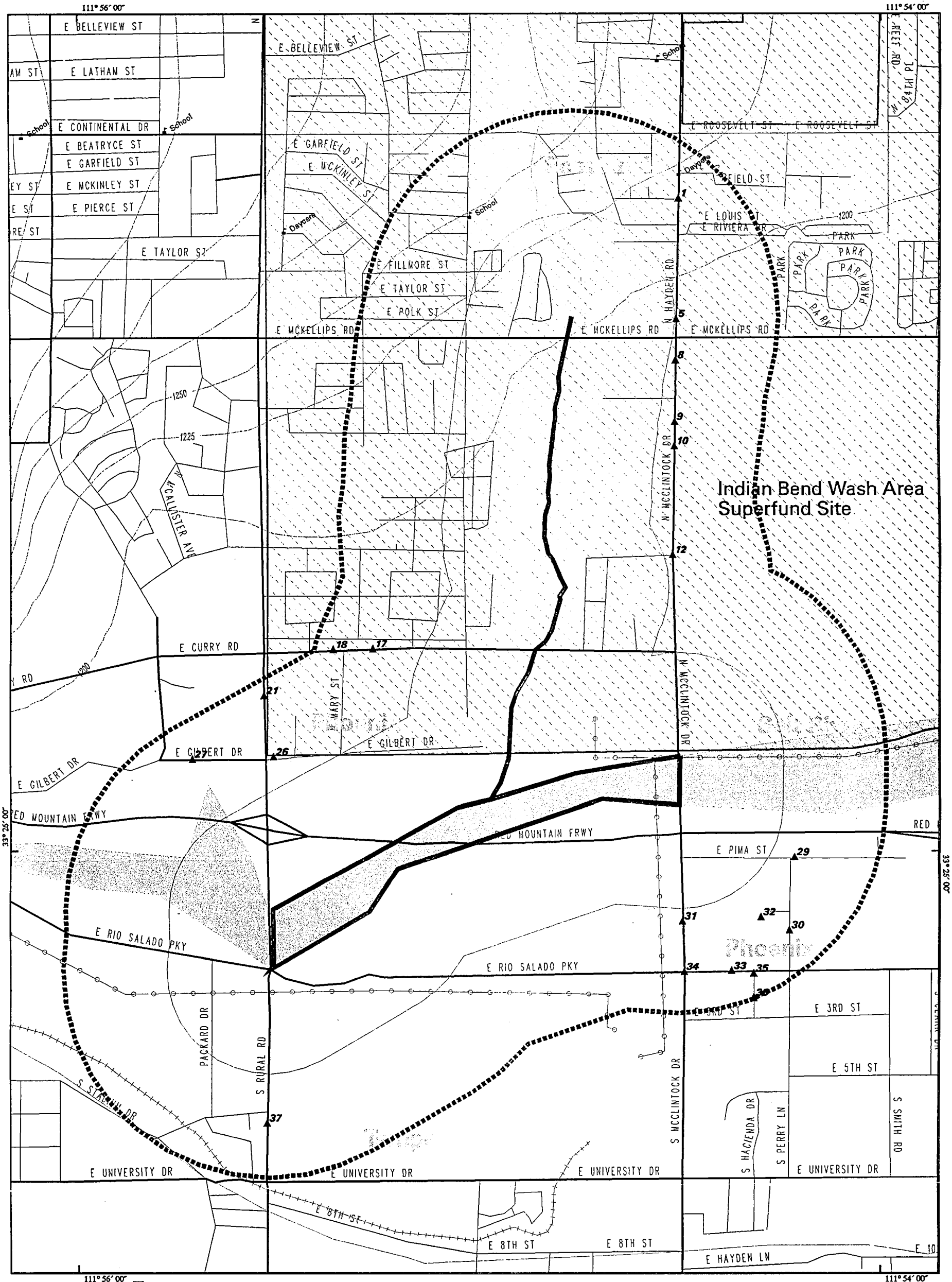
- Listed Sites
- Earthquake Epicenters (Richter 5 or greater)
- Study Area Boundary
- Roads
- Major Roads
- Waterways
- Railroads
- Contour Lines
- Pipelines
- Powerlines
- Fault Lines
- Water
- Superfund Sites

N

0 1/8 1/4

Scale in Miles

164569.1s - 28 Mar 97



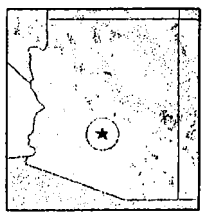
edr

Phone: 800-352-0050

Study Area For

1/4 - 1/2 Search

Salt River Study



Phoenix, AZ

Legend

- Listed Sites
- Earthquake Epicenters (Richter 5 or greater)
- Study Area Boundary
- Roads
- Major Roads
- Waterways
- Railroads
- Contour Lines
- Pipelines
- Powerlines
- Fault Lines
- Water
- Superfund Sites

N

0 1/8 1/4

Scale in Miles

164569.1s - 28 Mar 97

APPENDIX A

The EDR Corridor Study Report

Study Area
Salt River Study
Phoenix, AZ 85257
< 1/4 Search

March 27, 1997

Inquiry number 164569.1s

Environmental Data Resources, Inc.

Creators of Toxicheck/®

The Source For Environmental Risk Management Data

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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 RECORDS:

CERCLIS: Comprehensive Environmental Response, Compensation, and Liability Information System
Source: EPA/NTIS
Telephone: 703-603-8904
CERCLIS: 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: 12/31/96
Date Made Active at EDR: 03/03/97
Database Release Frequency: Monthly
Date of Data Arrival at EDR: 01/16/97
Elapsed ASTM days: 46
Date of Last EDR Contact: 03/03/97

ERNS: Emergency Response Notification System
Source: EPA/NTIS
Telephone: 202-260-2342
ERNS: Emergency Response Notification System. ERNS records and stores information on reported releases of oil and hazardous substances.

Date of Government Version: 12/31/96
Date Made Active at EDR: 03/18/97
Database Release Frequency: Quarterly
Date of Data Arrival at EDR: 02/05/97
Elapsed ASTM days: 41
Date of Last EDR Contact: 01/27/97

NPL: National Priority List
Source: EPA
Telephone: 703-603-8852
NPL: 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).

Date of Government Version: 12/01/96
Date Made Active at EDR: 03/03/97
Database Release Frequency: Semi-Annually
Date of Data Arrival at EDR: 01/08/97
Elapsed ASTM days: 54
Date of Last EDR Contact: 12/23/96

RCRIS: Resource Conservation and Recovery Information System
Source: EPA/NTIS
Telephone: 703-308-7907
RCRIS: 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: 10/31/96
Date Made Active at EDR: 03/03/97
Database Release Frequency: Semi-Annually
Date of Data Arrival at EDR: 01/09/97
Elapsed ASTM days: 53
Date of Last EDR Contact: 02/27/97

FEDERAL NON-ASTM RECORDS:

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: Varies
Database Release Frequency: Varies
Date of Last EDR Contact: Varies
Date of Next Scheduled EDR Contact: 09/01/95

CORRACTS: Corrective Action Report
Source: EPA
Telephone: 703-308-7907
CORRACTS: CORRACTS identifies hazardous waste handlers with RCRA corrective action activity.

Date of Government Version: 12/01/96
Database Release Frequency: Semi-Annually
Date of Last EDR Contact: 12/18/96
Date of Next Scheduled EDR Contact: 03/17/97

FINDS: Facility Index System
Source: EPA/NTIS
Telephone: 703-908-2493
FINDS: 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: 09/30/95
Database Release Frequency: Quarterly
Date of Last EDR Contact: 12/30/96
Date of Next Scheduled EDR Contact: 04/07/97

HMIRS: Hazardous Materials Information Reporting System
Source: U.S. Department of Transportation
Telephone: 202-366-4555
HMIRS: Hazardous Materials Incident Report System. HMIRS contains hazardous material spill incidents reported to DOT.

Date of Government Version: 12/31/95
Database Release Frequency: Annually
Date of Last EDR Contact: 01/27/97
Date of Next Scheduled EDR Contact: 04/28/97

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: 02/13/96
Database Release Frequency: Quarterly
Date of Last EDR Contact: 01/14/97
Date of Next Scheduled EDR Contact: 04/14/97

NPL LIENS: Federal Superfund Liens
Source: EPA
Telephone: 205-564-4267
NPL LIENS: 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: 03/03/97
Date of Next Scheduled EDR Contact: 05/26/97

PADS: PCB Activity Database System
Source: EPA
Telephone: 202-260-3992
PADS: 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: 08/26/96
Database Release Frequency: Semi-Annually
Date of Last EDR Contact: 01/02/97
Date of Next Scheduled EDR Contact: 05/19/97

RAATS: RCRA Administrative Action Tracking System
Source: EPA
Telephone: 202-564-4104
RAATS: 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.

Date of Government Version: 04/17/95
Database Release Frequency: N/A
Date of Last EDR Contact: 12/16/96
Date of Next Scheduled EDR Contact: 03/17/97

ROD: Records Of Decision
Source: NTIS
Telephone: 703-416-0703
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: 03/31/95
Database Release Frequency: Annually
Date of Last EDR Contact: 03/05/97
Date of Next Scheduled EDR Contact: 06/02/97

TRIS: Toxic Chemical Release Inventory System
Source: EPA/NTIS
Telephone: 202-260-2320
TRIS: 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: 12/31/92
Database Release Frequency: Annually
Date of Last EDR Contact: 03/04/97
Date of Next Scheduled EDR Contact: 03/31/97

TSCA: Toxic Substances Control Act
Source: EPA/NTIS
Telephone: 202-260-1444
TSCA: 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. USEPA has no current plan to update and/or re-issue this database.

Date of Government Version: 01/31/95
Database Release Frequency: Annually
Date of Last EDR Contact: 12/18/96
Date of Next Scheduled EDR Contact: 03/17/97

STATE OF ARIZONA ASTM RECORDS:

LUST: Leaking Tank Listing
Source: Department of Environmental Quality
Telephone: 602-207-4345
LUST: 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: 10/07/96
Date Made Active at EDR: 12/13/96
Database Release Frequency: Semi-Annually
Date of Data Arrival at EDR: 11/12/96
Elapsed ASTM days: 31
Date of Last EDR Contact: 01/27/97

SHWS: ZipAcids
Source: Department of Environmental Quality
Telephone: 602-207-2202
ACIDS: 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.

Date of Government Version: 12/13/96
Date Made Active at EDR: 03/14/97
Database Release Frequency: Semi-Annually
Date of Data Arrival at EDR: 02/10/97
Elapsed ASTM days: 32
Date of Last EDR Contact: 01/27/97

SWF/LF: Directory of Solid Waste Facilities
Source: Department of Environmental Quality
Telephone: 602-207-4132
SWF/LF: 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: 10/08/96
Date Made Active at EDR: 11/21/96
Database Release Frequency: Annually
Date of Data Arrival at EDR: 10/25/96
Elapsed ASTM days: 27
Date of Last EDR Contact: 01/06/97

UST: Arizona UST - DMS Facility and Tank Data Listing By City
Source: Department of Environmental Quality
Telephone: 602-207-4345
UST: 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: 02/07/96
Date Made Active at EDR: 05/20/96
Database Release Frequency: Semi-Annually
Date of Data Arrival at EDR: 04/22/96
Elapsed ASTM days: 28
Date of Last EDR Contact: 02/12/97

WQARF: Water Quality Assurance Revolving Fund
Source: Department of Environmnetal Quality
Telephone: 602-207-2202
WQARF: The State of Arizona has established a program under A.R.S. 49-282 to remedy sites which may have an actual or potential impact upon waters of the State, caused by hazardous substances. In the WQARF program, the state takes actions to identify the extent and impact of the contamination and to identify the parties responsible for remediation of the site. The WQARF program provides matching funds to political subdivisions and other state agencies for clean-up activities.

Date of Government Version: 10/01/96
Date Made Active at EDR: 01/07/97
Database Release Frequency: Annually
Date of Data Arrival at EDR: 12/23/96
Elapsed ASTM days: 15
Date of Last EDR Contact: 01/06/97

STATE OF ARIZONA NON-ASTM RECORDS:

AQUIFER: Waste Water Treatment Facilities
Source: Department of Environmental Quality
Telephone: 602-207-4688
AQUIFER: Waste Water Treatment Facilities with APP (Aquifer Protection Permits.)

Date of Government Version: 02/09/96
Database Release Frequency: Semi-Annually
Date of Last EDR Contact: 02/13/97
Date of Next Scheduled EDR Contact: 05/05/97

DRY WELLS: Drywell Registration
Source: Department of Environmental Quality
Telephone: 602-207-2202
DRY WELLS: Arizona Dry Well List. Constructed solely for the disposal of storm water, more than 3,400 dry wells have been registered with the state under A.R.S. 49-331 through 336.

Date of Government Version: 07/18/96
Database Release Frequency: Semi-Annually
Date of Last EDR Contact: 11/18/96
Date of Next Scheduled EDR Contact: 06/16/97

DOD: Department of Defense Sites
Source: Department of Environmental Quality
Telephone: 602-207-2202
DOD: In addition to the NPL and WQARF Priority List sites, the Arizona Department of Environmental Quality (ADEQ) Remedial Projects program also manages ten non-priority list Department of Defense sites. These DOD sites are funded by the U.S. Department of Defense for cleanup.

Date of Government Version: 10/01/96
Database Release Frequency: Annually
Date of Last EDR Contact: 01/06/97
Date of Next Scheduled EDR Contact: 04/07/97

SPILLS: Hazardous Material Logbook
Source: Department of Environmental Quality
Telephone: 602-207-2202
SPILLS: 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: 06/30/96
Database Release Frequency: Semi-Annually
Date of Last EDR Contact: 02/10/97
Date of Next Scheduled EDR Contact: 04/07/97

WWFAC: Waste Water Treatment Facilities
Source: Department of Environmental Quality
Telephone: 602-207-4623
WWFAC: Statewide list of waste water treatment facilities.

Date of Government Version: 12/03/96
Database Release Frequency: Semi-Annually
Date of Last EDR Contact: 03/05/97
Date of Next Scheduled EDR Contact: 06/02/97

Historical and 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.

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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The information contained in this report has predominantly been obtained from publicly available sources produced by entities other than Real Property Scan. While reasonable steps have been taken to insure the accuracy of this report, Real Property Scan does not guarantee the accuracy of this report. Any liability on the part of Real Property Scan is strictly limited to a refund of the amount paid. No claim is made for the actual existence of toxins at any site. This report does not constitute a legal opinion.

DELISTED NPL: Delisted NPL Sites
Source: EPA
Telephone: 703-603-8769
DELISTED NPL: 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.

NFRAP: No Further Remedial Action Planned
Source: EPA/NTIS
Telephone: 703-416-0702
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.

FRDS: Federal Reporting Data System
Source: EPA/Office of Drinking Water
Telephone: 202-260-2805
FRDS provides information regarding public water supplies and their compliance with monitoring requirements, maximum contaminant levels (MCL's), and other requirements of the Safe Drinking Water Act of 1986.

Area Radon Information: The National Radon Database has been developed by the U.S. Environmental Protection Agency (USEPA) and is a compilation of the EPA/State Residential Radon Survey and the National Residential Radon Survey. The study covers the years 1986 - 1992. Where necessary data has been supplemented by information collected at private sources such as universities and research institutions.

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 who, due to their fragile immune systems, are deemed to be especially sensitive to environmental discharges. These typically include the elderly, the sick, and children. While the exact location of these sensitive receptors cannot be determined, EDR indicates those facilities, such as schools, hospitals, day care centers, and nursing homes, where sensitive receptors are likely to be located.

USGS Water Wells: In November 1971 the United States Geological Survey (USGS) implemented a national water resource information tracking system. This database contains descriptive information on sites where the USGS collects or has collected data on surface water and/or groundwater. The groundwater data includes information on more than 900,000 wells, springs, and other sources of groundwater.

Flood Zone Data: This data, available in select counties across the country, was obtained by EDR in 1994 from the Federal Emergency Management Agency (FEMA). Data depicts 100-year and 500-year flood zones as defined by FEMA.

Epicenters: World earthquake epicenters, Richter 5 or greater
Source: Department of Commerce, National Oceanic and Atmospheric Administration

Water Dams: National Inventory of Dams
Source: Federal Emergency Management Agency
Telephone: 202-646-2801
WATER DAMS: National computer database of more than 74,000 dams maintained by the Federal Emergency Management Agency.

Well Registration Database
Source: Department of Water Resources
Telephone: 602-542-1586
Contains information provided to ADWR's Operations Division by well drillers and/or owners.

EXECUTIVE SUMMARY

A search of available environmental records was conducted by Environmental Data Resources, Inc. (EDR). The search met the specific requirements of ASTM Standard Practice for Environmental Site Assessments, E 1527-94, or custom distances requested by the user.

The address of the subject property for which the search was intended is:

SALT RIVER STUDY
PHOENIX, AZ 85257

No mapped sites were found in EDR's search of available ("reasonably ascertainable ") government records either on the subject property or within the ASTM E 1527-94 search radius around the subject property for the following Databases:

RCRIS-TSD:..... Resource Conservation and Recovery Information System
Az Wqarf:..... Water Quality Assurance Revolving Fund

Unmapped (orphan) sites are not considered in the foregoing analysis.

Search Results:

Search results for the subject property and the search radius, are listed below:

Subject Property:

The subject property was not listed in any of the databases searched by EDR.

Surrounding Properties:

Page numbers refer to the EDR Radius Map report where detailed data on individual sites be reviewed.

Sites listed in ***bold italics*** are in multiple databases.

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 12/01/1996 has revealed that there is 1 NPL site within approximately 0.5 Miles of the subject property.

Site	Address	Map ID	Page
INDIAN BEND WASH AREA	***MCDOWELL RD & HAYDEN***	***0***	***2***

SHWS: The State Hazardous Waste Sites records are the states' equivalent to CERCLIS. These sites may or may not already by 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 comes from the Department of Environmental Quality's ZipAcids database.

A review of the SHWS list, as provided by EDR, and dated 12/13/1996 has revealed that there are 4 SHWS sites within approximately 0.5 Miles of the subject property.

Site	Address	Map ID	Page
INDIAN BEND WASH AREA	***MCDOWELL RD & HAYDEN***	***0***	***2***
MARRO PLATING	***7811 E PIERCE ST***	***2***	***4***
COMTECH DATA	350 N HAYDEN RD	5	7
HAYDEN ROAD LANDFILL	***T1N R4E NE/4 OF SECTION 14***	***23***	***18***

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, persuant 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 12/31/1996 has revealed that there is 1 CERCLIS site within approximately 0.5 Miles of the subject property.

Site	Address	Map ID	Page
INDIAN BEND WASH AREA	***MCDOWELL RD & HAYDEN***	***0***	***2***

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 comes 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, and dated 10/08/1996 has revealed that there is 1 SWF/LF site within approximately 0.5 Miles of the subject property.

Site	Address	Map ID	Page
ARCA LANDFILL	1.3 MI N OF APACHE BLVD ON HAY	28	20

LUST: The Leaking Underground Storage Tank Incident Reports contain an inventory of reported leaking underground storage tank incidents. The data comes 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 10/07/1996 has revealed that there are 6 LUST sites within approximately 0.5 Miles of the subject property.

Site	Address	Map ID	Page
CIRCLE K # 1797	*7602 E MCKELLIPS*	*6*	*9*
TRULY NOLEN EXTERMINATING	*1005 N STADEM DR*	*15*	*12*
LANDSCAPE & MAINTENANCE OF AZ	*1229 E CURRY RD*	*16*	*14*
TRENCH SAFETY EQUIPMENT CORP	*1717 E CURRY ROAD*	*20*	*16*
PUEBLO LUMBER	*1150 E GILBERT DR*	*24*	*18*
K W SHAHAN TRUCKING	*1050 E GILBERT DR*	*25*	*19*

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 comes 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 02/07/1996 has revealed that there are 10 UST sites within approximately 0.5 Miles of the subject property.

Site	Address	Map ID	Page
FAST GAS #111	302 N HAYDEN ROAD	5	5
AM-PM ARCO	304 N HAYDEN RD	5	6
GREEN ACRES MORTUARIES & CEMET	401 N HAYDEN RD	5	8
CIRCLE K # 1797	*7602 E MCKELLIPS*	*6*	*9*
CITY OF SCOTTSDALE	1327 E MCKELLIPS	6	9
TRULY NOLEN EXTERMINATING	*1005 N STADEM DR*	*15*	*12*
LANDSCAPE & MAINTENANCE OF AZ	*1229 E CURRY RD*	*16*	*14*
TRENCH SAFETY EQUIPMENT CORP	*1717 E CURRY ROAD*	*20*	*16*
PUEBLO LUMBER	*1150 E GILBERT DR*	*24*	*18*
K W SHAHAN TRUCKING	*1050 E GILBERT DR*	*25*	*19*

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 10/31/1996 has revealed that there are 10 RCRIS-SQG sites within approximately 0.5 Miles of the subject property.

Site	Address	Map ID	Page
FAIRCHILD DATA CORPORATION	350 N HAYDEN ROAD	5	6

Site	Address	Map ID	Page
FAIRCHILD DATA CORP	*350 N HAYDEN*	*5*	*7*
SCOTTSDALE CITY OF	1323 E MCKELLIPS	6	8
SCOTTSDALE ACURA BODY SHOP	*1111 N MILLER RD*	*14*	*11*
RON THOMPSON'S AUTO BODY	*950 N STADEM DR*	*15*	*12*
E F DATA	*1030 N STADEM DR*	*15*	*13*
GOLD TECH INDUSTRIES	*1043 N STADEM DR*	*15*	*13*
SPORTS CAR SVC CTR	*1245 E CURRY DR*	*16*	*14*
GOLD TECH INDUSTRIES	1450 E CURRY RD	19	15
A C M EQUIPMENT RENTAL	*1717 E CURRY RD*	*20*	*17*

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 10/31/1996 has revealed that there are 2 RCRIS-LQG sites within approximately 0.5 Miles of the subject property.

Site	Address	Map ID	Page
MARRO PLATING	*7811 E PIERCE ST*	*2*	*4*
MICROELECTRONICS EXCHANGE CORP	*1214 N STADEM DR*	*13*	*11*

Drywells: Constructed solely for the disposal of storm water, more than 3,400 drywells have been registered with the state under A.R.S. 49-331 through 336. The source is the Department of Environmental Quality's Drywell Registration database.

A review of the Dry Well list, as provided by EDR, and dated 07/18/1996 has revealed that there are 7 Dry Well sites within approximately 0.5 Miles of the subject property.

Site	Address	Map ID	Page
XTANT TECHNOLOGIES, INC.	7901 EAST PIERCE STREET	3	4
TRI CITY STORAGE SOLUTIONS	1445 EAST MCKELLIPS ROAD	7	10
1200 NORTH STADEM DRIVE	1200 NORTH STADEM DRIVE	13	11
KIRBY BUSINESS CENTER	1111 NORTH MILLER ROAD	14	12
DALZELL INC.	1014 NORTH STADEM DRIVE	15	14
STADEM PROPERTY	1022 NORTH STADEM DRIVE	15	14
GOLD TECH INDUSTRIES	1450 EAST CURRY ROAD	19	16

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, and dated 06/30/1996 has revealed that there are 5 AZ Spills sites within approximately 0.25 Miles of the subject property.

Site	Address	Map ID	Page
GI TRUCKING CO.	7800 E. PIERCE ST.	2	3

EXECUTIVE SUMMARY

Site	Address	Map ID	Page
DEA	7616 E POLK ST	4	5
SRP	MILLER RD. / WEBER	11	10
TONY'S DETAIL & BODY SHOP	1450 E CURRY RD	19	15
EARL'S FIBERGLASS	800 N MILLER RD	22	18

MAP FINDINGS SUMMARY

Database	Target Property	Search Distance (Miles)	< 1/4
NPL		0.250	1
RCRIS-TSD		0.250	0
State Haz. Waste		0.250	4
CERCLIS		0.250	1
State Landfill		0.250	1
Az Wqarf		0.250	0
LUST		0.250	6
UST		0.250	10
RCRIS Sm. Quan. Gen.		0.250	10
RCRIS Lg. Quan. Gen.		0.250	2
Az. Dry Well		0.250	7
AZ Spills		0.250	5

TP = Target Property

NR = Not Requested at this Search Distance

* Sites may be listed in more than one database

Map ID Latitude Longitude Distance	Site	Database(s)	EDR ID Number EPA ID Number

Coal Gas Site Search: No site was found in a search of Real Property Scan's ENVIROHAZ database.

NPL **Region**	**INDIAN BEND WASH AREA** **MCDOWELL RD & HAYDEN** **SCOTTSDALE, AZ 85253**	**CERCLIS** **FINDS** **NPL** **CONSENT** **ROD** **SHWS**	**1000245609** **AZD980695969**

CERCLIS Classification Data:

Site Incident Category:	WELLS	Federal Facility:	NO
Ownership Status:	PRIVATE	NPL Status:	CURRENTLY ON THE FINAL NPL
EPA Notes:	INDIAN BEND WASH IS APPROX 12 SQ MI IN SCOTTSDALE AND TEMPE,AZ. DRINKING WATER FOR 350,000+ PEOPLE IS CONTAMINATED WITH CHLORINATED SOLVENTS. 6 MUNICIPAL WELLS HAVE BEEN SHUT DOWN,BLENDED, OR CONVERTED TO OTHER USES.		

CERCLIS Assessment History:

Assessment:	DISCOVERY	Completed:	12/01/1979
Assessment:	PRELIMINARY ASSESSMENT	Completed:	06/01/1980
Assessment:	SCREENING SITE INSPECTION	Completed:	12/01/1982
Assessment:	HAZARD RANKING DETERMINED	Completed:	12/01/1982
Assessment:	PROPOSAL TO NPL	Completed:	12/30/1982
Assessment:	FINAL LISTING ON NPL	Completed:	09/08/1983
Assessment:	RMVL INVESTIGATION AT NPL	Completed:	09/06/1990
Assessment:	RMVL INVESTIGATION AT NPL	Completed:	02/26/1991
Assessment:	REMOVAL COMMUNITY RELATIONS	Completed:	Not reported
Assessment:	REMOVAL ACTION	Completed:	06/15/1994
Assessment:	COMBINED RI/FS	Completed:	09/12/1991
Assessment:	MANAGEMENT ASSISTANCE	Completed:	Not reported
Assessment:	REMEDIAL COMMUNITY RELATIONS	Completed:	Not reported
Assessment:	RECORD OF DECISION	Completed:	09/12/1991
Assessment:	ADMINISTRATIVE RECORD	Completed:	Not reported
Assessment:	FEASIBILITY STUDY	Completed:	09/12/1991
Assessment:	REMEDIAL INVESTIGATION	Completed:	09/12/1991
Assessment:	RECORD OF DECISION	Completed:	09/21/1988
Assessment:	COMBINED RI/FS	Completed:	09/21/1988
Assessment:	REMEDIAL COMMUNITY RELATIONS	Completed:	Not reported
Assessment:	MANAGEMENT ASSISTANCE	Completed:	Not reported
Assessment:	ADMINISTRATIVE RECORD	Completed:	Not reported
Assessment:	REMEDIAL DESIGN	Completed:	07/27/1989
Assessment:	COMBINED RI/FS	Completed:	Not reported
Assessment:	RECORD OF DECISION	Completed:	Not reported
Assessment:	REMEDIAL DESIGN	Completed:	Not reported
Assessment:	REMEDIAL COMMUNITY RELATIONS	Completed:	Not reported
Assessment:	REMEDIAL ACTION	Completed:	Not reported
Assessment:	BASELINE RISK ASSESSMENT	Completed:	Not reported
Assessment:	REMEDIAL INVESTIGATION	Completed:	Not reported
Assessment:	COMBINED RI/FS	Completed:	09/12/1991
Assessment:	RECORD OF DECISION	Completed:	09/12/1991
Assessment:	COMBINED RI/FS	Completed:	09/12/1991
Assessment:	RECORD OF DECISION	Completed:	09/12/1991
Assessment:	COMBINED RI/FS	Completed:	09/12/1991
Assessment:	RECORD OF DECISION	Completed:	09/12/1991
Assessment:	REMEDIAL DESIGN	Completed:	05/19/1995
Assessment:	REMEDIAL ACTION	Completed:	Not reported
Assessment:	RECORD OF DECISION	Completed:	09/27/1993

INDIAN BEND WASH AREA (Continued) 1000245609

Assessment:	FEASIBILITY STUDY	Completed:	09/27/1993
Assessment:	REMEDIAL INVESTIGATION	Completed:	Not reported
Assessment:	REMEDIAL ACTION	Completed:	Not reported
Assessment:	REMEDIAL ACTION	Completed:	Not reported
Assessment:	REMEDIAL DESIGN	Completed:	Not reported
Assessment:	REMEDIAL ACTION	Completed:	Not reported
Assessment:	REMEDIAL ACTION	Completed:	Not reported
Assessment:	REMEDIAL ACTION	Completed:	Not reported
Assessment:	REMEDIAL DESIGN	Completed:	Not reported
Assessment:	REMEDIAL DESIGN	Completed:	Not reported

CERCLIS Site Status:
This site is currently under investigation by the government to assess the extent of further action

NPL:

ID:	09AZ001
Date Listed:	9/08/83 (FINAL)
EPA/ID:	AZD980695969
Haz. Rank Score:	42.24
Status:	LISTED ON NPL
Rank:	430
Group:	9
Ownership:	Municipal
Permit:	None
Site Activities:	Ground Water Plume
Site Condition:	Contam. Ground Water
Waste Type:	Metals
Waste Type:	Solvents
Waste Form:	Not reported

Contaminant:	Media Affected:
1,1,2-TRICHLOROETHYLENE (TCE)	Ground Water
CHROMIUM AND COMPOUNDS, NOS (CR)	Not reported

Distance to nearest Population:	Not reported
Population within a 1 Mile Radius:	Not reported
Population within a 2 Mile Radius:	Not reported
Population within a 4 Mile Radius:	Not reported
Vertical Distance to Aquifer:	Not reported
Ground Water Use:	Used as Drinking Water, Alternative Source not Available
Distance to nearest Surface Water:	Not reported

ROD:
Full-text of USEPA Record of Decision(s) is available from EDR.

CONSENT:
Full-text of a consent decree on this site issued by a United States District Court is available from EDR.

SHWS:

Facility ID:	161	EPA ID:	AZD980695969
Program:	PA/SI	WAQRF Area:	Not reported

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2 WNW <1/4 1039.186 — **GI TRUCKING CO.**, **7800 E. PIERCE ST.**, **PHX, AZ 85000** — **AZ Spills** — **S100887165**, **N/A**

Map ID / Latitude / Longitude / Distance	Site	Database(s)	EDR ID Number / EPA ID Number

GI TRUCKING CO. (Continued) — S100887165

Az Spills:

Facility ID:	89124	Incident Date:	05/05/1989
Chemicals:	POTASSIUM CYANIDE		
Response Date:	Not reported	Report / Assist:	Not reported
Type:	Not reported	No of Samples:	1
Referred to:	Not reported	Referral Date:	Not reported
Structure:	Not reported	Quantity:	27 LBS.
ERU Response:	YES	Cleanup:	YES
Referral:	NO	Threat/Spill:	SPILL
RQ (Exceeded):	YES/10 LBS.	Property Mngmt:	Not reported
Source:	Not reported		
Release Factor:	Not reported		

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2 WNW <1/4 1017.760

MARRO PLATING
7811 E PIERCE ST
SCOTTSDALE, AZ 85257

FINDS 1000366270
RCRIS-LQG AZD055646921
CERC-NFRAP
SHWS

CERCLIS-NFRAP Classification Data:

Site Incident Category:	Not reported	Federal Facility:	NO
Ownership Status:	UNKNOWN	NPL Status:	NOT ON NPL
EPA Notes:	Not reported		

CERCLIS-NFRAP Assessment History:

Assessment:	SCREENING SITE INSPECTION	Completed:	12/01/82
Assessment:	DISCOVERY	Completed:	06/01/82
Assessment:	PRELIMINARY ASSESSMENT	Completed:	12/01/82

RCRIS:

Owner: NOT REQUIRED
(415) 555-1212

Contact: ENVIRONMENTAL MANAGER
(602) 945-0781

Classification: Large Quantity Generator

Waste	Quantity	Waste	Quantity
F001	0.000 (N)	F006	0.000 (N)

(P) = Pounds , (K) = Kilograms , (M) = Metric Tons , (T) = Tons , (N) = Not Reported

Used Oil Recyc: No

Violation Status: Violations exist

There are 1 compliance/violation record(s) reported at this site:

Evaluation	Area of Violation	Date of Compliance
Compliance Evaluation Inspection (CEI)	Generator-All Requirements	08/11/1989

SHWS:

Facility ID:	212	EPA ID:	AZD055646921
Program:	PA/SI	WAQRF Area:	Not reported

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3 WNW <1/4 1277.957

XTANT TECHNOLOGIES, INC.
7901 EAST PIERCE STREET
SCOTTSDALE, AZ 85257

Dry Well S101599051
N/A

Map ID / Latitude / Longitude / Distance	Site	Database(s)	EDR ID Number / EPA ID Number
	XTANT TECHNOLOGIES, INC. (Continued)		S101599051

DRY WELLS:
Region: 10162 Num of Wells: 2

Map ID / Latitude / Longitude / Distance	Site	Database(s)	EDR ID Number / EPA ID Number
4 WNW <1/4 1212.820	**DEA** **7616 E POLK ST** **SCOTTSDALE, AZ 85257**	**AZ Spills**	S100886319 N/A

Az Spills:

Facility ID:	91087B	Incident Date:	08/20/1991
Chemicals:	DRUG LAB CHEMICALS		
Response Date:	Not reported	Report / Assist:	Not reported
Type:	Not reported	No of Samples:	0
Referred to:	Not reported	Referral Date:	Not reported
Structure:	Not reported	Quantity:	NONE
ERU Response:	YES	Cleanup:	NO
Referral:	NO	Threat/Spill:	Not reported
RQ (Exceeded):	Not reported	Property Mngmt:	PRIVATE
Source:	Not reported		
Release Factor:	No Release		

Map ID / Latitude / Longitude / Distance	Site	Database(s)	EDR ID Number / EPA ID Number
5 WNW <1/4 1285.941	**FAST GAS #111** **302 N HAYDEN ROAD** **SCOTTSDALE, AZ 85257**	**UST**	U003051566 N/A

UST:

Facility ID:	0-000919	Tank ID:	1
Product:	Gasoline	Tank Status:	Remv
Capacity:	10,000	Construction Mat:	Bare Steel
Age:	26	Piping Mat:	Galvanized Steel
Piping Type:	Not Marked		
Tank Remed Design:	Not reported		
Piping Remed Design:	Not reported		
Owner:	CARDON CORP		
Owner Address:	1819 E SOUTHERN MESA, AZ 85204		

Facility ID:	0-000919	Tank ID:	2
Product:	Gasoline	Tank Status:	Remv
Capacity:	10,000	Construction Mat:	Bare Steel
Age:	26	Piping Mat:	Galvanized Steel
Piping Type:	Not Marked		
Tank Remed Design:	Not reported		
Piping Remed Design:	Not reported		
Owner:	CARDON CORP		
Owner Address:	1819 E SOUTHERN MESA, AZ 85204		

Map ID / Latitude / Longitude / Distance	Site	Database(s)	EDR ID Number / EPA ID Number
	FAST GAS #111 (Continued)		U003051566

Facility ID: 0-000919
Product: Gasoline
Capacity: 10,000
Age: 26
Piping Type: Not Marked
Tank Remed Design: Not reported
Piping Remed Design: Not reported
Owner: CARDON CORP
Owner Address: 1819 E SOUTHERN
MESA, AZ 85204

Tank ID: 3
Tank Status: Remv
Construction Mat: Bare Steel
Piping Mat: Galvanized Steel

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5 WNW <1/4 1284.635	**AM-PM ARCO** **304 N HAYDEN RD** **SCOTTSDALE, AZ 85257**	UST	U003050852 N/A

UST:

Facility ID: 0-008156
Product: Gasoline
Capacity: 12,000
Age: 7
Piping Type: Pressure
Tank Remed Design: Tightness Testing
Piping Remed Design: Leak Detector
Owner: A P C HOLDING CORP
Owner Address: 111 PACIFICA #250
IRVINE, CA 92718

Tank ID: 1
Tank Status: Curr
Construction Mat: Fiberglass
Piping Mat: Fiberglass

Facility ID: 0-008156
Product: Gasoline
Capacity: 12,000
Age: 7
Piping Type: Pressure
Tank Remed Design: Tightness Testing
Piping Remed Design: Leak Detector
Owner: A P C HOLDING CORP
Owner Address: 111 PACIFICA #250
IRVINE, CA 92718

Tank ID: 2
Tank Status: Curr
Construction Mat: Fiberglass
Piping Mat: Fiberglass

Facility ID: 0-008156
Product: Gasoline
Capacity: 12,000
Age: 7
Piping Type: Pressure
Tank Remed Design: Tightness Testing
Piping Remed Design: Leak Detector
Owner: A P C HOLDING CORP
Owner Address: 111 PACIFICA #250
IRVINE, CA 92718

Tank ID: 3
Tank Status: Curr
Construction Mat: Fiberglass
Piping Mat: Fiberglass

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5 WNW <1/4 1266.997	**FAIRCHILD DATA CORPORATION** **350 N HAYDEN ROAD** **SCOTTSDALE, AZ 85257**	RCRIS-SQG	1000354461 AZD980895346

Map ID / Latitude / Longitude / Distance	Site	Database(s)	EDR ID Number / EPA ID Number

FAIRCHILD DATA CORPORATION (Continued) — **1000354461**

RCRIS:
Owner: LD HANCOCK COMPANY
(415) 555-1212

Contact: ENVIRONMENTAL MANAGER
(602) 949-1155

Classification: Conditionally Exempt Small Quantity Generator

Waste	Quantity	Waste	Quantity
D001	0.000 (N)	D002	0.000 (N)

(P) = Pounds , (K) = Kilograms , (M) = Metric Tons , (T) = Tons , (N) = Not Reported

Used Oil Recyc: No

Violation Status: No violations found

---

5 WNW <1/4 1266.997 — **COMTECH DATA**, **350 N HAYDEN RD**, **SCOTTSDALE, AZ 85257** — **SHWS** — **S101570555**, **N/A**

SHWS:
Facility ID: 39 — EPA ID: AZD068391564
Program: PA/SI — WAQRF Area: Not reported

---

5 WNW <1/4 1266.997 — **FAIRCHILD DATA CORP**, **350 N HAYDEN**, **SCOTTSDALE, AZ 85257** — **RCRIS-SQG**, **FINDS**, **CERC-NFRAP** — **1000398152**, **AZD068391564**

CERCLIS-NFRAP Classification Data:
Site Incident Category: Not reported — Federal Facility: NO
Ownership Status: UNKNOWN — NPL Status: NOT ON NPL
EPA Notes: Not reported

CERCLIS-NFRAP Assessment History:

Assessment:	SCREENING SITE INSPECTION	Completed:	03/01/83
Assessment:	DISCOVERY	Completed:	08/01/80
Assessment:	PRELIMINARY ASSESSMENT	Completed:	03/01/83
Assessment:	SCREENING SITE INSPECTION	Completed:	03/28/90

CERCLIS-NFRAP Alias Name(s):
BECKMAN INSTRUMENTS
SPERRY INFORMATION DISPLAY DIV

RCRIS:
Owner: FAIRCHILD INDUSTRIES
(415) 555-1212

Contact: ENVIRONMENTAL MANAGER
(602) 949-1155

Classification: Conditionally Exempt Small Quantity Generator

Waste	Quantity	Waste	Quantity
D000	0.000 (N)	D001	0.000 (N)
F001	0.000 (N)	F002	0.000 (N)

(P) = Pounds , (K) = Kilograms , (M) = Metric Tons , (T) = Tons , (N) = Not Reported

Map ID Latitude Longitude Distance	Site	Database(s)	EDR ID Number EPA ID Number
	FAIRCHILD DATA CORP (Continued)		**1000398152**

Used Oil Recyc: No

Violation Status: No violations found

---

5 WNW <1/4 1277.024	**GREEN ACRES MORTUARIES & CEMETER 401 N HAYDEN RD SCOTTSDALE, AZ 85257**	**UST**	**U003050442 N/A**

UST:

Facility ID:	0-005982	Tank ID:	1
Product:	Gasoline	Tank Status:	Remv
Capacity:	5,000	Construction Mat:	Bare Steel
Age:	27	Piping Mat:	Galvanized Steel
Piping Type:	Not reported		
Tank Remed Design:	Not reported		
Piping Remed Design:	Not reported		
Owner:	GREEN ACRES MORTUARIES & CEMETER		
Owner Address:	PO BOX 1147 SCOTTSDALE, AZ 85252		

Facility ID:	0-005982	Tank ID:	2
Product:	Diesel	Tank Status:	Remv
Capacity:	800	Construction Mat:	Bare Steel
Age:	17	Piping Mat:	Galvanized Steel
Piping Type:	Not reported		
Tank Remed Design:	Not reported		
Piping Remed Design:	Not reported		
Owner:	GREEN ACRES MORTUARIES & CEMETER		
Owner Address:	PO BOX 1147 SCOTTSDALE, AZ 85252		

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6 WNW <1/4 1090.413	**SCOTTSDALE CITY OF 1323 E MCKELLIPS SCOTTSDALE, AZ 85281**	**RCRIS-SQG**	**1000422092 AZD981675564**

RCRIS:

Owner:	CITY OF SCOTTSDALE (415) 555-1212
Contact:	ENVIRONMENTAL MANAGER (602) 994-7735
Classification:	Small Quantity Generator

Waste	Quantity	Waste	Quantity
D000	0.000 (N)	D001	0.000 (N)
F002	0.000 (N)		

(P) = Pounds , (K) = Kilograms , (M) = Metric Tons , (T) = Tons , (N) = Not Reported

Map ID Latitude Longitude Distance	Site	Database(s)	EDR ID Number EPA ID Number
	SCOTTSDALE CITY OF (Continued)		**1000422092**

Used Oil Recyc: No

Violation Status: No violations found

---

6 WNW <1/4 1192.127	**CIRCLE K # 1797 7602 E MCKELLIPS SCOTTSDALE, AZ 85257**	**UST LUST**	**U001625466 N/A**

LUST:

Facility ID:	0-001489	Leak ID:	3725.01
Date Reported:	09/20/1994	Date Closed:	Not reported
Owner ID:	787		
Owner:	CIRCLE K CORPORATION		
Address:	3003 N CENTRAL AVE 18TH FLOOR PHOENIX, AZ 85012		

UST:

Facility ID:	0-001489	Tank ID:	1
Product:	Gasoline	Tank Status:	Curr
Capacity:	10,000	Construction Mat:	Fiberglass
Age:	10	Piping Mat:	Fiberglass
Piping Type:	Pressure		
Tank Remed Design:	Tightness Testing		
Piping Remed Design:	Leak Detector		
Owner:	CIRCLE K CORPORATION		
Owner Address:	3003 N CENTRAL AVE 18TH FLOOR PHOENIX, AZ 85012		

Facility ID:	0-001489	Tank ID:	2
Product:	Gasoline	Tank Status:	Curr
Capacity:	10,000	Construction Mat:	Fiberglass
Age:	10	Piping Mat:	Fiberglass
Piping Type:	Pressure		
Tank Remed Design:	Tightness Testing		
Piping Remed Design:	Leak Detector		
Owner:	CIRCLE K CORPORATION		
Owner Address:	3003 N CENTRAL AVE 18TH FLOOR PHOENIX, AZ 85012		

Facility ID:	0-001489	Tank ID:	3
Product:	Gasoline	Tank Status:	Curr
Capacity:	10,000	Construction Mat:	Fiberglass
Age:	10	Piping Mat:	Fiberglass
Piping Type:	Pressure		
Tank Remed Design:	Tightness Testing		
Piping Remed Design:	Leak Detector		
Owner:	CIRCLE K CORPORATION		
Owner Address:	3003 N CENTRAL AVE 18TH FLOOR PHOENIX, AZ 85012		

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6 WNW <1/4 1074.268	**CITY OF SCOTTSDALE 1327 E MCKELLIPS SCOTTSDALE, AZ 85251**	**UST**	**U001626955 N/A**

Map ID / Latitude / Longitude / Distance	Site	Database(s)	EDR ID Number / EPA ID Number

CITY OF SCOTTSDALE (Continued) — U001626955

UST:

Facility ID: 0-004391
Product: Gasoline
Capacity: 10,000
Age: 20
Piping Type: Not reported
Tank Remed Design: Not reported
Piping Remed Design: Not reported
Owner: CITY OF SCOTTSDALE
Owner Address: 9191 E SAN SALVADOR DR
SCOTTSDALE, AZ 85258

Tank ID: 1
Tank Status: Remv
Construction Mat: Bare Steel
Piping Mat: Unknown

Facility ID: 0-004391
Product: Diesel
Capacity: 10,000
Age: 20
Piping Type: Not reported
Tank Remed Design: Not reported
Piping Remed Design: Not reported
Owner: CITY OF SCOTTSDALE
Owner Address: 9191 E SAN SALVADOR DR
SCOTTSDALE, AZ 85258

Tank ID: 2
Tank Status: Remv
Construction Mat: Bare Steel
Piping Mat: Unknown

Facility ID: 0-004391
Product: Diesel
Capacity: 10,000
Age: 15
Piping Type: Not reported
Tank Remed Design: Not reported
Piping Remed Design: Not reported
Owner: CITY OF SCOTTSDALE
Owner Address: 9191 E SAN SALVADOR DR
SCOTTSDALE, AZ 85258

Tank ID: 3
Tank Status: Remv
Construction Mat: Bare Steel
Piping Mat: Unknown

Facility ID: 0-004391
Product: Diesel
Capacity: 10,000
Age: 15
Piping Type: Not reported
Tank Remed Design: Not reported
Piping Remed Design: Not reported
Owner: CITY OF SCOTTSDALE
Owner Address: 9191 E SAN SALVADOR DR
SCOTTSDALE, AZ 85258

Tank ID: 4
Tank Status: Remv
Construction Mat: Bare Steel
Piping Mat: Unknown

---

7 WNW < 1/4 388.196 — **TRI CITY STORAGE SOLUTIONS**, **1445 EAST MCKELLIPS ROAD**, **TEMPE, AZ 85281** — Dry Well — S101598597, N/A

DRY WELLS:
Region: 9898
Num of Wells: 1

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11 WNW <1/4 990.368 — **SRP**, **MILLER RD. / WEBER**, **TEMPE, AZ** — AZ Spills — S101315113, N/A

Map ID / Latitude / Longitude / Distance	Site	Database(s)	EDR ID Number / EPA ID Number
	SRP (Continued)		**S101315113**

Az Spills:

Facility ID:	94-026-G	Incident Date:	07/14/94
Chemicals:	ACROLEIN		
Response Date:	N/A	Report / Assist:	REPORT
Type:	RELEASE	No of Samples:	0
Referred to:	N/A	Referral Date:	N/A
Structure:	CYLINDER	Quantity:	Not reported
ERU Response:	Not reported	Cleanup:	Not reported
Referral:	Not reported	Threat/Spill:	Not reported
RQ (Exceeded):	Not reported	Property Mngmt:	PRIVATE
Source:	Not reported		
Release Factor:	Not reported		

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13 WNW < 1/4 239.304	**MICROELECTRONICS EXCHANGE CORP 1214 N STADEM DR TEMPE, AZ 85281**	**FINDS RCRIS-LQG**	**1000366873 AZD980893176**

RCRIS:

Owner: NOT REQUIRED
(415) 555-1212

Contact: ENVIRONMENTAL MANAGER
(602) 829-0422

Classification: Large Quantity Generator, Hazardous Waste Transporter

Waste	Quantity	Waste	Quantity
F007	0.000 (N)	F009	0.000 (N)

(P) = Pounds , (K) = Kilograms , (M) = Metric Tons , (T) = Tons , (N) = Not Reported

Used Oil Recyc: No

Violation Status: Violations exist

There are 2 compliance/violation record(s) reported at this site:

Evaluation	Area of Violation	Date of Compliance
Compliance Evaluation Inspection (CEI)	Generator-All Requirements	11/29/1991
	Generator-All Requirements	11/29/1991
Compliance Evaluation Inspection (CEI)	Generator-All Requirements	03/06/1989
	Transporter-All Requirements	03/06/1989

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13 WNW < 1/4 248.889	**1200 NORTH STADEM DRIVE 1200 NORTH STADEM DRIVE TEMPE, AZ 85281**	**Dry Well**	**S102263863 N/A**

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14 WNW <1/4 930.550	**SCOTTSDALE ACURA BODY SHOP 1111 N MILLER RD TEMPE, AZ 85281**	**RCRIS-SQG FINDS**	**1000472709 AZD982444663**

Map ID / Latitude / Longitude / Distance	Site	Database(s)	EDR ID Number / EPA ID Number

SCOTTSDALE ACURA BODY SHOP (Continued) — 1000472709

RCRIS:

Owner: SCOTTSDALE AUTOMOTIVE GROUP
(415) 555-1212

Contact: ENVIRONMENTAL MANAGER
(602) 966-7500

Classification: Small Quantity Generator

Waste	Quantity	Waste	Quantity
D001	0.000 (N)	D006	0.000 (N)
D007	0.000 (N)	D008	0.000 (N)
F005	0.000 (N)		

(P) = Pounds , (K) = Kilograms , (M) = Metric Tons , (T) = Tons , (N) = Not Reported

Used Oil Recyc: No

Violation Status: No violations found

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14 WNW <1/4 930.550

KIRBY BUSINESS CENTER
1111 NORTH MILLER ROAD
TEMPE, AZ 85281

Dry Well — S101598555 / N/A

DRY WELLS:

Region: 3293 Num of Wells: 1

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15 WNW < 1/4 412.690

RON THOMPSON'S AUTO BODY
950 N STADEM DR
TEMPE, AZ 85281

RCRIS-SQG, FINDS — 1000133737 / AZD982506370

RCRIS:

Owner: RON THOMPSON
(415) 555-1212

Contact: ENVIRONMENTAL MANAGER
(602) 968-9363

Classification: Small Quantity Generator

Waste	Quantity
D001	0.000 (N)

(P) = Pounds , (K) = Kilograms , (M) = Metric Tons , (T) = Tons , (N) = Not Reported

Used Oil Recyc: No

Violation Status: No violations found

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15 WNW < 1/4 380.713

TRULY NOLEN EXTERMINATING
1005 N STADEM DR
TEMPE, AZ 85281

UST, LUST — U001627674 / N/A

Map ID Latitude Longitude Distance	Site	Database(s)	EDR ID Number EPA ID Number
	TRULY NOLEN EXTERMINATING (Continued)		**U001627674**

LUST:

Facility ID:	0-005772	Leak ID:	0742.01
Date Reported:	05/24/1989	Date Closed:	Not reported
Owner ID:	3569		
Owner:	TRULY NOLEN OF AMERICA INC		
Address:	3620 E SPEEDWAY BLVD TUCSON, AZ 85716		

UST:

Facility ID:	0-005772	Tank ID:	1
Product:	Gasoline	Tank Status:	Remv
Capacity:	10,000	Construction Mat:	Bare Steel
Age:	11	Piping Mat:	Galvanized Steel
Piping Type:	Not reported		
Tank Remed Design:	Not reported		
Piping Remed Design:	Not reported		
Owner:	TRULY NOLEN OF AMERICA INC		
Owner Address:	3620 E SPEEDWAY BLVD TUCSON, AZ 85716		

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15 WNW < 1/4 366.680	**E F DATA 1030 N STADEM DR TEMPE, AZ 85281**	**RCRIS-SQG FINDS**	**1000110115 AZD982401747**

RCRIS:

Owner: CALIFORNIA MICROWAVE
(415) 555-1212

Contact: ENVIRONMENTAL MANAGER
(602) 968-0447

Classification: Small Quantity Generator

Waste	Quantity
D000	0.000 (N)

(P) = Pounds , (K) = Kilograms , (M) = Metric Tons , (T) = Tons , (N) = Not Reported

Used Oil Recyc: No

Violation Status: No violations found

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15 WNW < 1/4 359.252	**GOLD TECH INDUSTRIES 1043 N STADEM DR TEMPE, AZ 85281**	**RCRIS-SQG FINDS**	**1000184103 AZD982509945**

Map ID / Latitude / Longitude / Distance	Site	Database(s)	EDR ID Number / EPA ID Number
	GOLD TECH INDUSTRIES (Continued)		1000184103

RCRIS:
Owner: LARRY OR KAREN YOUNG
(415) 555-1212
Contact: ENVIRONMENTAL MANAGER
(602) 968-1930
Classification: Small Quantity Generator

Waste	Quantity	Waste	Quantity
D000	0.000 (N)	D002	0.000 (N)

(P) = Pounds , (K) = Kilograms , (M) = Metric Tons , (T) = Tons , (N) = Not Reported

Used Oil Recyc: No

Violation Status: No violations found

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15 WNW < 1/4 374.661	**DALZELL INC.** **1014 NORTH STADEM DRIVE** **TEMPE, AZ 85281**	**Dry Well**	**S102264255** **N/A**

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15 WNW < 1/4 371.632	**STADEM PROPERTY** **1022 NORTH STADEM DRIVE** **TEMPE, AZ 85281**	**Dry Well**	**S101598582** **N/A**

DRY WELLS:
Region: 8784 Num of Wells: 1

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16 WNW <1/4 1090.432	**SPORTS CAR SVC CTR** **1245 E CURRY DR** **TEMPE, AZ 85281**	**RCRIS-SQG** **FINDS**	**1000370309** **AZD982503682**

RCRIS:
Owner: TONY RITZ
(415) 555-1212
Contact: ENVIRONMENTAL MANAGER
(602) 966-6061
Classification: Conditionally Exempt Small Quantity Generator

Waste	Quantity	Waste	Quantity
D001	0.000 (N)	F002	0.000 (N)

(P) = Pounds , (K) = Kilograms , (M) = Metric Tons , (T) = Tons , (N) = Not Reported

Used Oil Recyc: No

Violation Status: No violations found

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16 WNW <1/4 1189.821	**LANDSCAPE & MAINTENANCE OF AZ** **1229 E CURRY RD** **TEMPE, AZ 85281**	**UST** **LUST**	**U000016613** **N/A**

Map ID / Latitude / Longitude / Distance	Site	Database(s)	EDR ID Number / EPA ID Number

LANDSCAPE & MAINTENANCE OF AZ (Continued) — U000016613

LUST:

Facility ID:	0-002921	Leak ID:	2314.01
Date Reported:	05/18/1992	Date Closed:	Not reported
Owner ID:	2070		
Owner:	LANDSCAPE & MAINTENANCE OF AZ		
Address:	1229 E CURRY ROAD TEMPE, AZ 85281		

UST:

Facility ID:	0-002921	Tank ID:	1
Product:	Gasoline	Tank Status:	Remv
Capacity:	8,000	Construction Mat:	Bare Steel
Age:	27	Piping Mat:	Bare Steel
Piping Type:	Suction -- No Valve		
Tank Remed Design:	Tightness Testing		
Piping Remed Design:	Line Tightness		
Owner:	LANDSCAPE & MAINTENANCE OF AZ		
Owner Address:	1229 E CURRY ROAD TEMPE, AZ 85281		

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19 WNW < 1/4 159.071 — **TONY'S DETAIL & BODY SHOP, 1450 E CURRY RD, TEMPE, AZ** — AZ Spills — S100888305, N/A

Az Spills:

Facility ID:	86191	Incident Date:	12/31/1986
Chemicals:	UNKNOWN CLEANING SOLVENTS		
Response Date:	Not reported	Report / Assist:	Not reported
Type:	Not reported	No of Samples:	0
Referred to:	Not reported	Referral Date:	Not reported
Structure:	Not reported	Quantity:	UNKNOWN
ERU Response:	NO	Cleanup:	NO
Referral:	YES	Threat/Spill:	SPILL
RQ (Exceeded):	Not reported	Property Mngmt:	Not reported
Source:	Not reported		
Release Factor:	Not reported		

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19 WNW < 1/4 159.071 — **GOLD TECH INDUSTRIES, 1450 E CURRY RD, TEMPE, AZ 85281** — RCRIS-SQG — 1000886062, AZD981669989

RCRIS:

Owner: TS INDUSTRIES INC DBA GOLD TECH IND
(602) 968-1930

Contact: KIRK YOUNG
(602) 894-0434

Classification: Small Quantity Generator

Waste	Quantity	Waste	Quantity
D000	0.000 (N)	D002	0.000 (N)
D007	0.000 (N)	D008	0.000 (N)
F006	0.000 (N)	F019	0.000 (N)
P073	0.000 (N)	P115	0.000 (N)

Map ID / Latitude / Longitude / Distance	Site	Database(s)	EDR ID Number / EPA ID Number

GOLD TECH INDUSTRIES (Continued) — 1000886062

U103	0.000 (N)	U145	0.000 (N)
U217	0.000 (N)	U249	0.000 (N)

(P) = Pounds , (K) = Kilograms , (M) = Metric Tons , (T) = Tons , (N) = Not Reported

Used Oil Recyc: No

Violation Status: No violations found

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19 WNW < 1/4 159.071 — **GOLD TECH INDUSTRIES, 1450 EAST CURRY ROAD, TEMPE, AZ 85281** — Dry Well — S102049391, N/A

DRY WELLS:
Region: 11468 — Num of Wells: 1

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20 WNW <1/4 1132.366 — **TRENCH SAFETY EQUIPMENT CORP, 1717 E CURRY ROAD, TEMPE, AZ 85281** — UST, LUST — U001156554, N/A

LUST:
Facility ID: 0-001799
Date Reported: 09/20/1990
Owner ID: 4347
Owner: BOB JONES
Address: 1002 TENNANT WAY
LONGVIEW, WA 98632
Leak ID: 0479.01
Date Closed: Not reported

UST:
Facility ID: 0-001799
Product: Diesel
Capacity: 8,000
Age: 26
Piping Type: Not Marked
Tank Remed Design: Not reported
Piping Remed Design: Not reported
Owner: BOB JONES
Owner Address: 1002 TENNANT WAY
LONGVIEW, WA 98632
Tank ID: 1
Tank Status: Remv
Construction Mat: Bare Steel
Piping Mat: Galvanized Steel

Facility ID: 0-001799
Product: Gasoline
Capacity: 6,000
Age: 26
Piping Type: Not reported
Tank Remed Design: Not reported
Piping Remed Design: Not reported
Owner: BOB JONES
Owner Address: 1002 TENNANT WAY
LONGVIEW, WA 98632
Tank ID: 2
Tank Status: Remv
Construction Mat: Bare Steel
Piping Mat: Galvanized Steel

Map ID / Latitude / Longitude / Distance	Site	Database(s)	EDR ID Number / EPA ID Number
	TRENCH SAFETY EQUIPMENT CORP (Continued)		U001156554

Facility ID: 0-001799
Product: Used Oil
Capacity: 2,000
Age: 26
Piping Type: Not reported
Tank Remed Design: Not reported
Piping Remed Design: Not reported
Owner: BOB JONES
Owner Address: 1002 TENNANT WAY
LONGVIEW, WA 98632

Tank ID: 3
Tank Status: Remv
Construction Mat: Bare Steel
Piping Mat: Galvanized Steel

Facility ID: 0-001799
Product: Diesel
Capacity: 2,000
Age: 19
Piping Type: Suction -- Valve
Tank Remed Design: Manual Gauging
Piping Remed Design: Line Tightness
Owner: BOB JONES
Owner Address: 1002 TENNANT WAY
LONGVIEW, WA 98632

Tank ID: 4
Tank Status: Remv
Construction Mat: Bare Steel
Piping Mat: Fiberglass

Facility ID: 0-001799
Product: Gasoline
Capacity: 1,000
Age: 19
Piping Type: Suction -- Valve
Tank Remed Design: Manual Gauging
Piping Remed Design: Line Tightness
Owner: BOB JONES
Owner Address: 1002 TENNANT WAY
LONGVIEW, WA 98632

Tank ID: 5
Tank Status: Remv
Construction Mat: Bare Steel
Piping Mat: Fiberglass

Facility ID: 0-001799
Product: Used Oil
Capacity: 500
Age: 20
Piping Type: Gravity Fed
Tank Remed Design: Manual Gauging
Piping Remed Design: Not reported
Owner: BOB JONES
Owner Address: 1002 TENNANT WAY
LONGVIEW, WA 98632

Tank ID: 6
Tank Status: Remv
Construction Mat: Bare Steel
Piping Mat: Not reported

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20 WNW <1/4 1132.366	**A C M EQUIPMENT RENTAL** **1717 E CURRY RD** **TEMPE, AZ 85281**	**RCRIS-SQG** **FINDS**	**1000589401** **AZD983471269**

Map ID / Latitude / Longitude / Distance	Site	Database(s)	EDR ID Number / EPA ID Number
	A C M EQUIPMENT RENTAL (Continued)		1000589401

RCRIS:
Owner: WATTS INVESTMENT
(602) 275-2398

Contact: T GLADE WILLIAMS
(801) 974-0511

Classification: Small Quantity Generator

Waste	Quantity	Waste	Quantity
D000	0.000 (N)	D001	0.000 (N)
D006	0.000 (N)	D007	0.000 (N)
D008	0.000 (N)	D018	0.000 (N)
D027	0.000 (N)	D039	0.000 (N)
D040	0.000 (N)		

(P) = Pounds , (K) = Kilograms , (M) = Metric Tons , (T) = Tons , (N) = Not Reported

Used Oil Recyc: No

Violation Status: No violations found

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22 WNW < 1/4 530.0212	**EARL'S FIBERGLASS** **800 N MILLER RD** **TEMPE, AZ 85281**	**AZ Spills**	**S101315120** **N/A**

Az Spills:

Facility ID:	94-068-A	Incident Date:	11/11/94
Chemicals:	ACETONE/MEKP		
Response Date:	N/A	Report / Assist:	REPORT
Type:	THREAT	No of Samples:	0
Referred to:	N/A	Referral Date:	N/A
Structure:	CONTAINERS	Quantity:	Not reported
ERU Response:	Not reported	Cleanup:	Not reported
Referral:	Not reported	Threat/Spill:	Not reported
RQ (Exceeded):	Not reported	Property Mngmt:	PRIVATE
Source:	Not reported		
Release Factor:	Not reported		

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23 WNW < 1/4 162.7043	**HAYDEN ROAD LANDFILL** **T1N R4E NE/4 OF SECTION 14** **TEMPE, AZ 85281**	**FINDS** **SHWS**	**1000482878** **AZD983466285**

SHWS:

Facility ID:	1010	EPA ID:	AZD983466285
Program:	PA/SI	WAQRF Area:	Not reported

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24 WNW <1/4 934.1513	**PUEBLO LUMBER** **1150 E GILBERT DR** **TEMPE, AZ 85281**	**UST** **LUST**	**U001628223** **N/A**

Map ID / Latitude / Longitude / Distance	Site	Database(s)	EDR ID Number / EPA ID Number
	PUEBLO LUMBER (Continued)		**U001628223**

LUST:

Facility ID:	0-006867	Leak ID:	2270.01
Date Reported:	04/16/1992	Date Closed:	Not reported
Owner ID:	4574		
Owner:	LARRY MCCRERY		
Address:	9391 E CALLE DE LAS BRISAS SCOTTSDALE, AZ 85255		

UST:

Facility ID:	0-006867	Tank ID:	1
Product:	Gasoline	Tank Status:	Remv
Capacity:	4,000	Construction Mat:	Bare Steel
Age:	12	Piping Mat:	Bare Steel
Piping Type:	Not reported		
Tank Remed Design:	Not reported		
Piping Remed Design:	Not reported		
Owner:	LARRY MCCRERY		
Owner Address:	9391 E CALLE DE LAS BRISAS SCOTTSDALE, AZ 85255		

Facility ID:	0-006867	Tank ID:	2
Product:	Diesel	Tank Status:	Remv
Capacity:	4,000	Construction Mat:	Bare Steel
Age:	12	Piping Mat:	Bare Steel
Piping Type:	Not reported		
Tank Remed Design:	Not reported		
Piping Remed Design:	Not reported		
Owner:	LARRY MCCRERY		
Owner Address:	9391 E CALLE DE LAS BRISAS SCOTTSDALE, AZ 85255		

Facility ID:	0-006867	Tank ID:	3
Product:	FORM OIL	Tank Status:	Remv
Capacity:	1,000	Construction Mat:	Bare Steel
Age:	12	Piping Mat:	Bare Steel
Piping Type:	Not reported		
Tank Remed Design:	Not reported		
Piping Remed Design:	Not reported		
Owner:	LARRY MCCRERY		
Owner Address:	9391 E CALLE DE LAS BRISAS SCOTTSDALE, AZ 85255		

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25 **WNW** **<1/4** **1224.512**	**K W SHAHAN TRUCKING** **1050 E GILBERT DR** **TEMPE, AZ 85281**	**UST** **LUST**	**U001628343** **N/A**

LUST:

Facility ID:	0-007168	Leak ID:	1285.01
Date Reported:	05/25/1990	Date Closed:	Not reported
Owner ID:	227		
Owner:	K W SHAHAN TRUCKING		
Address:	1050 E GILBERT DRIVE TEMPE, AZ 85281		

Map ID Latitude Longitude Distance	Site	Database(s)	EDR ID Number EPA ID Number
	K W SHAHAN TRUCKING (Continued)		**U001628343**

UST:

Facility ID:	0-007168	Tank ID:	1
Product:	Diesel	Tank Status:	Perm
Capacity:	Unknown	Construction Mat:	Bare Steel
Age:	10	Piping Mat:	Unknown
Piping Type:	Suction -- No Valve		
Tank Remed Design:	Not reported		
Piping Remed Design:	Not reported		
Owner:	K W SHAHAN TRUCKING		
Owner Address:	1050 E GILBERT DRIVE TEMPE, AZ 85281		

28 **WNW** **< 1/4** **335.6432**	**ARCA LANDFILL** **1.3 MI N OF APACHE BLVD ON HAYDEN R** **TEMPE, AZ**	**SWF/LF**	**S100250235** **N/A**

EPA Waste Codes Addendum

Code	Description
D000	NOT DEFINED
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.
D006	CADMIUM
D007	CHROMIUM
D008	LEAD
D018	BENZENE
D027	1,4-DICHLOROBENZENE
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.
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

EPA Waste Codes Addendum

Code	Description
	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 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.
P073	NICKEL CARBONYL
P073	NICKEL CARBONYL NI(CO)4, (T-4)-
P115	SULFURIC ACID, DITHALLIUM(1+) SALT
P115	THALLIUM(L) SULFATE
U103	DIMETHYL SULFATE
U103	SULFURIC ACID, DIMETHYL ESTER
U145	LEAD PHOSPHATE
U145	PHOSPHORIC ACID, LEAD(2+) SALT (2:3)
U217	NITRIC ACID, THALLIUM(1+) SALT
U217	THALLIUM(I) NITRATE
U249	ZINC PHOSPHIDE ZN3P2, WHEN PRESENT AT CONCENTRATIONS OF 10% OR LESS

Thank you for your business.
Please contact EDR at 1-800-352-0050
with any questions or comments.

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APPENDIX B

The EDR Corridor Study Report

Study Area
Salt River Study
Phoenix, AZ 85257
1/4 - 1/2 Search

March 27, 1997

Inquiry number 164569.1s

Environmental Data Resources, Inc.

Creators of Toxicheck/®

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

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 RECORDS:

CERCLIS: Comprehensive Environmental Response, Compensation, and Liability Information System
Source: EPA/NTIS
Telephone: 703-603-8904
CERCLIS: 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: 12/31/96
Date Made Active at EDR: 03/03/97
Database Release Frequency: Monthly
Date of Data Arrival at EDR: 01/16/97
Elapsed ASTM days: 46
Date of Last EDR Contact: 03/03/97

ERNS: Emergency Response Notification System
Source: EPA/NTIS
Telephone: 202-260-2342
ERNS: Emergency Response Notification System. ERNS records and stores information on reported releases of oil and hazardous substances.

Date of Government Version: 12/31/96
Date Made Active at EDR: 03/18/97
Database Release Frequency: Quarterly
Date of Data Arrival at EDR: 02/05/97
Elapsed ASTM days: 41
Date of Last EDR Contact: 01/27/97

NPL: National Priority List
Source: EPA
Telephone: 703-603-8852
NPL: 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).

Date of Government Version: 12/01/96
Date Made Active at EDR: 03/03/97
Database Release Frequency: Semi-Annually
Date of Data Arrival at EDR: 01/08/97
Elapsed ASTM days: 54
Date of Last EDR Contact: 12/23/96

RCRIS: Resource Conservation and Recovery Information System
Source: EPA/NTIS
Telephone: 703-308-7907
RCRIS: 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: 10/31/96
Date Made Active at EDR: 03/03/97
Database Release Frequency: Semi-Annually
Date of Data Arrival at EDR: 01/09/97
Elapsed ASTM days: 53
Date of Last EDR Contact: 02/27/97

FEDERAL NON-ASTM RECORDS:

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: Varies
Database Release Frequency: Varies
Date of Last EDR Contact: Varies
Date of Next Scheduled EDR Contact: 09/01/95

CORRACTS: Corrective Action Report
Source: EPA
Telephone: 703-308-7907
CORRACTS: CORRACTS identifies hazardous waste handlers with RCRA corrective action activity.

Date of Government Version: 12/01/96
Database Release Frequency: Semi-Annually
Date of Last EDR Contact: 12/18/96
Date of Next Scheduled EDR Contact: 03/17/97

FINDS: Facility Index System
Source: EPA/NTIS
Telephone: 703-908-2493
FINDS: 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: 09/30/95
Database Release Frequency: Quarterly
Date of Last EDR Contact: 12/30/96
Date of Next Scheduled EDR Contact: 04/07/97

HMIRS: Hazardous Materials Information Reporting System
Source: U.S. Department of Transportation
Telephone: 202-366-4555
HMIRS: Hazardous Materials Incident Report System. HMIRS contains hazardous material spill incidents reported to DOT.

Date of Government Version: 12/31/95
Database Release Frequency: Annually
Date of Last EDR Contact: 01/27/97
Date of Next Scheduled EDR Contact: 04/28/97

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: 02/13/96
Database Release Frequency: Quarterly
Date of Last EDR Contact: 01/14/97
Date of Next Scheduled EDR Contact: 04/14/97

NPL LIENS: Federal Superfund Liens
Source: EPA
Telephone: 205-564-4267
NPL LIENS: 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: 03/03/97
Date of Next Scheduled EDR Contact: 05/26/97

PADS: PCB Activity Database System
Source: EPA
Telephone: 202-260-3992
PADS: 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: 08/26/96
Database Release Frequency: Semi-Annually
Date of Last EDR Contact: 01/02/97
Date of Next Scheduled EDR Contact: 05/19/97

RAATS: RCRA Administrative Action Tracking System
Source: EPA
Telephone: 202-564-4104
RAATS: 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.

Date of Government Version: 04/17/95
Database Release Frequency: N/A
Date of Last EDR Contact: 12/16/96
Date of Next Scheduled EDR Contact: 03/17/97

ROD: Records Of Decision
Source: NTIS
Telephone: 703-416-0703
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: 03/31/95
Database Release Frequency: Annually
Date of Last EDR Contact: 03/05/97
Date of Next Scheduled EDR Contact: 06/02/97

TRIS: Toxic Chemical Release Inventory System
Source: EPA/NTIS
Telephone: 202-260-2320
TRIS: 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: 12/31/92
Database Release Frequency: Annually
Date of Last EDR Contact: 03/04/97
Date of Next Scheduled EDR Contact: 03/31/97

TSCA: Toxic Substances Control Act
Source: EPA/NTIS
Telephone: 202-260-1444
TSCA: 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. USEPA has no current plan to update and/or re-issue this database.

Date of Government Version: 01/31/95
Database Release Frequency: Annually
Date of Last EDR Contact: 12/18/96
Date of Next Scheduled EDR Contact: 03/17/97

STATE OF ARIZONA ASTM RECORDS:

LUST: Leaking Tank Listing
Source: Department of Environmental Quality
Telephone: 602-207-4345
LUST: 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: 10/07/96
Date Made Active at EDR: 12/13/96
Database Release Frequency: Semi-Annually
Date of Data Arrival at EDR: 11/12/96
Elapsed ASTM days: 31
Date of Last EDR Contact: 01/27/97

SHWS: ZipAcids
Source: Department of Environmental Quality
Telephone: 602-207-2202
ACIDS: 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.

Date of Government Version: 12/13/96
Date Made Active at EDR: 03/14/97
Database Release Frequency: Semi-Annually
Date of Data Arrival at EDR: 02/10/97
Elapsed ASTM days: 32
Date of Last EDR Contact: 01/27/97

SWF/LF: Directory of Solid Waste Facilities
Source: Department of Environmental Quality
Telephone: 602-207-4132
SWF/LF: 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: 10/08/96
Date Made Active at EDR: 11/21/96
Database Release Frequency: Annually
Date of Data Arrival at EDR: 10/25/96
Elapsed ASTM days: 27
Date of Last EDR Contact: 01/06/97

UST: Arizona UST - DMS Facility and Tank Data Listing By City
Source: Department of Environmental Quality
Telephone: 602-207-4345
UST: 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: 02/07/96
Date Made Active at EDR: 05/20/96
Database Release Frequency: Semi-Annually
Date of Data Arrival at EDR: 04/22/96
Elapsed ASTM days: 28
Date of Last EDR Contact: 02/12/97

WQARF: Water Quality Assurance Revolving Fund
Source: Department of Environmnetal Quality
Telephone: 602-207-2202
WQARF: The State of Arizona has established a program under A.R.S. 49-282 to remedy sites which may have an actual or potential impact upon waters of the State, caused by hazardous substances. In the WQARF program, the state takes actions to identify the extent and impact of the contamination and to identify the parties responsible for remediation of the site. The WQARF program provides matching funds to political subdivisions and other state agencies for clean-up activities.

Date of Government Version: 10/01/96
Date Made Active at EDR: 01/07/97
Database Release Frequency: Annually
Date of Data Arrival at EDR: 12/23/96
Elapsed ASTM days: 15
Date of Last EDR Contact: 01/06/97

STATE OF ARIZONA NON-ASTM RECORDS:

AQUIFER: Waste Water Treatment Facilities
Source: Department of Environmental Quality
Telephone: 602-207-4688
AQUIFER: Waste Water Treatment Facilities with APP (Aquifer Protection Permits.)

Date of Government Version: 02/09/96
Database Release Frequency: Semi-Annually
Date of Last EDR Contact: 02/13/97
Date of Next Scheduled EDR Contact: 05/05/97

DRY WELLS: Drywell Registration
Source: Department of Environmental Quality
Telephone: 602-207-2202
DRY WELLS: Arizona Dry Well List. Constructed solely for the disposal of storm water, more than 3,400 dry wells have been registered with the state under A.R.S. 49-331 through 336.

Date of Government Version: 07/18/96
Database Release Frequency: Semi-Annually
Date of Last EDR Contact: 11/18/96
Date of Next Scheduled EDR Contact: 06/16/97

DOD: Department of Defense Sites
Source: Department of Environmental Quality
Telephone: 602-207-2202
DOD: In addition to the NPL and WQARF Priority List sites, the Arizona Department of Environmental Quality (ADEQ) Remedial Projects program also manages ten non-priority list Department of Defense sites. These DOD sites are funded by the U.S. Department of Defense for cleanup.

Date of Government Version: 10/01/96
Database Release Frequency: Annually
Date of Last EDR Contact: 01/06/97
Date of Next Scheduled EDR Contact: 04/07/97

SPILLS: Hazardous Material Logbook
Source: Department of Environmental Quality
Telephone: 602-207-2202
SPILLS: 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: 06/30/96
Database Release Frequency: Semi-Annually
Date of Last EDR Contact: 02/10/97
Date of Next Scheduled EDR Contact: 04/07/97

WWFAC: Waste Water Treatment Facilities
Source: Department of Environmental Quality
Telephone: 602-207-4623
WWFAC: Statewide list of waste water treatment facilities.

Date of Government Version: 12/03/96
Database Release Frequency: Semi-Annually
Date of Last EDR Contact: 03/05/97
Date of Next Scheduled EDR Contact: 06/02/97

Historical and 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.

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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The information contained in this report has predominantly been obtained from publicly available sources produced by entities other than Real Property Scan. While reasonable steps have been taken to insure the accuracy of this report, Real Property Scan does not guarantee the accuracy of this report. Any liability on the part of Real Property Scan is strictly limited to a refund of the amount paid. No claim is made for the actual existence of toxins at any site. This report does not constitute a legal opinion.

DELISTED NPL: Delisted NPL Sites
Source: EPA
Telephone: 703-603-8769
DELISTED NPL: 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.

NFRAP: No Further Remedial Action Planned
Source: EPA/NTIS
Telephone: 703-416-0702
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.

FRDS: Federal Reporting Data System
Source: EPA/Office of Drinking Water
Telephone: 202-260-2805
FRDS provides information regarding public water supplies and their compliance with monitoring requirements, maximum contaminant levels (MCL's), and other requirements of the Safe Drinking Water Act of 1986.

Area Radon Information: The National Radon Database has been developed by the U.S. Environmental Protection Agency (USEPA) and is a compilation of the EPA/State Residential Radon Survey and the National Residential Radon Survey. The study covers the years 1986 - 1992. Where necessary data has been supplemented by information collected at private sources such as universities and research institutions.

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 who, due to their fragile immune systems, are deemed to be especially sensitive to environmental discharges. These typically include the elderly, the sick, and children. While the exact location of these sensitive receptors cannot be determined, EDR indicates those facilities, such as schools, hospitals, day care centers, and nursing homes, where sensitive receptors are likely to be located.

USGS Water Wells: In November 1971 the United States Geological Survey (USGS) implemented a national water resource information tracking system. This database contains descriptive information on sites where the USGS collects or has collected data on surface water and/or groundwater. The groundwater data includes information on more than 900,000 wells, springs, and other sources of groundwater.

Flood Zone Data: This data, available in select counties across the country, was obtained by EDR in 1994 from the Federal Emergency Management Agency (FEMA). Data depicts 100-year and 500-year flood zones as defined by FEMA.

Epicenters: World earthquake epicenters, Richter 5 or greater
Source: Department of Commerce, National Oceanic and Atmospheric Administration

Water Dams: National Inventory of Dams
Source: Federal Emergency Management Agency
Telephone: 202-646-2801
WATER DAMS: National computer database of more than 74,000 dams maintained by the Federal Emergency Management Agency.

Well Registration Database
Source: Department of Water Resources
Telephone: 602-542-1586
Contains information provided to ADWR's Operations Division by well drillers and/or owners.

EXECUTIVE SUMMARY

A search of available environmental records was conducted by Environmental Data Resources, Inc. (EDR). The search met the specific requirements of ASTM Standard Practice for Environmental Site Assessments, E 1527-94, or custom distances requested by the user.

The address of the subject property for which the search was intended is:

SALT RIVER STUDY
PHOENIX, AZ 85257

No mapped sites were found in EDR's search of available ("reasonably ascertainable ") government records either on the subject property or within the ASTM E 1527-94 search radius around the subject property for the following Databases:

RCRIS-TSD:..... Resource Conservation and Recovery Information System
SWF/LF:..... Directory of Solid Waste Facilities
Az Wqarf:..... Water Quality Assurance Revolving Fund
AZ Spills:..... Hazardous Material Logbook

Unmapped (orphan) sites are not considered in the foregoing analysis.

Search Results:

Search results for the subject property and the search radius, are listed below:

Subject Property:

The subject property was not listed in any of the databases searched by EDR.

Surrounding Properties:

Page numbers refer to the EDR Radius Map report where detailed data on individual sites be reviewed.

Sites listed in ***bold italics*** are in multiple databases.

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 12/01/1996 has revealed that there is 1 NPL site within approximately 0.5 Miles of the subject property.

Site	Address	Map ID	Page
INDIAN BEND WASH AREA	***MCDOWELL RD & HAYDEN***	***0***	***2***

SHWS: The State Hazardous Waste Sites records are the states' equivalent to CERCLIS. These sites may or may not already by 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 comes from the Department of Environmental Quality's ZipAcids database.

A review of the SHWS list, as provided by EDR, and dated 12/13/1996 has revealed that there are 10 SHWS sites within approximately 0.5 Miles of the subject property.

Site	Address	Map ID	Page
INDIAN BEND WASH AREA	***MCDOWELL RD & HAYDEN***	***0***	***2***
KACHINA REDI-MIX	***1976 E PIMA ST***	***29***	***9***
PHOENIX READY MIX	***1976 E PIMA ST***	***29***	***10***
GREAT WESTERN MINING DEVELOPME	36 N PERRY LN	30	12
ARIZONA CASTING	***115 N PERRY LN***	***30***	***12***
ANGELA BERGLUND	***N OF 1ST ST, S OF PIMA RD, E O***	***30***	***13***
WHITRONICS	***209 N PERRY LN***	***30***	***13***
FIRST STREET LANDFILL	259 N PERRY LN	30	14
MARICOPA COUNTY LANDFILL	***PIMA & 1ST ST. WEST OF PERRY L***	***32***	***15***
CIRCUIT TECHNOLOGY	***119 S INDUSTRIAL DR***	***35***	***16***

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, persuant 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 12/31/1996 has revealed that there are 2 CERCLIS sites within approximately 0.5 Miles of the subject property.

Site	Address	Map ID	Page
INDIAN BEND WASH AREA	***MCDOWELL RD & HAYDEN***	***0***	***2***
ANGELA BERGLUND	***N OF 1ST ST, S OF PIMA RD, E O***	***30***	***13***

EXECUTIVE SUMMARY

LUST: The Leaking Underground Storage Tank Incident Reports contain an inventory of reported leaking underground storage tank incidents. The data comes 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 10/07/1996 has revealed that there are 10 LUST sites within approximately 0.5 Miles of the subject property.

Site	Address	Map ID	Page
HAYDEN AUTO PLAZA	***1900 N HAYDEN RD***	***8***	***4***
TEMPE MGPC, INC #521	1616 N HAYDEN ROAD	9	5
ISLAND OF BIG SURF/DAVID BUSCH	***1500 N MCCLINTOCK DR***	***10***	***6***
JOHN HARTMAN	***929 E GILBERT DR***	***26***	***8***
KACHINA REDI-MIX	***1976 E PIMA ST***	***29***	***9***
TEMPE CRANE INC	***117 S PERRY LN***	***30***	***10***
EARL CLARK ROOFING	***210 N PERRY LN***	***30***	***13***
ALTO AUTOMOTIVE ENTERPRISES	***145 N MCCLINTOCK DR***	***31***	***14***
TRI-CITY TRANSMISSION SERVICE	***203 N MCCLINTOCK DR***	***31***	***15***
FRITO-LAY DISTRIBUTION CTR	***1831 E 1ST STREET***	***33***	***16***

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 comes 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 02/07/1996 has revealed that there are 14 UST sites within approximately 0.5 Miles of the subject property.

Site	Address	Map ID	Page
UNIVERSITY U-HAUL #723-56	800 N HAYDEN RD	1	3
HAYDEN AUTO PLAZA	***1900 N HAYDEN RD***	***8***	***4***
MALIBU GRAND PRIX	1616 N HAYDEN ROAD	9	5
ISLAND OF BIG SURF/DAVID BUSCH	***1500 N MCCLINTOCK DR***	***10***	***6***
PRINCESS PROPERTY MANAGEMENT	1045 E CURRY RD	18	7
JOHN HARTMAN	***929 E GILBERT DR***	***26***	***8***
KEN DARCANGELO	711 N SCOTTSDALE RD	26	8
KACHINA REDI-MIX	***1976 E PIMA ST***	***29***	***9***
TEMPE CRANE INC	***117 S PERRY LN***	***30***	***10***
FIREBIRD FUEL COMPANY	106 S PERRY LN	30	11
EARL CLARK ROOFING	***210 N PERRY LN***	***30***	***13***
ALTO AUTOMOTIVE ENTERPRISES	***145 N MCCLINTOCK DR***	***31***	***14***
TRI-CITY TRANSMISSION SERVICE	***203 N MCCLINTOCK DR***	***31***	***15***
FRITO-LAY DISTRIBUTION CTR	***1831 E 1ST STREET***	***33***	***16***

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 10/31/1996 has revealed that there are 8 RCRIS-SQG sites within approximately 0.5 Miles of the subject property.

Site	Address	Map ID	Page
ECONO AUTO PAINTING OF AZ INC	***1123 E CURRY RD***	***17***	***6***
SUN WEST DISPOSAL INC	1976 E PIMA ST	29	10

Site	Address	Map ID	Page
ALLISONS STRIPPING	*109 S PERRY LN*	*30*	*11*
GOLD CIRCUIT INC	*106 N PERRY LN*	*30*	*12*
WESTERN STATES TIRE & AUTO SER	*101 S HAYDEN*	*34*	*16*
GENCO	*108 S INDUSTRIAL DR*	*35*	*17*
MOTOR TREND SPECIALTY ES	*215 S INDUSTRIAL DR #3*	*36*	*17*
JOYCES MAGIC TOUCH	*634 S RURAL RD #119*	*37*	*18*

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 10/31/1996 has revealed that there are 2 RCRIS-LQG sites within approximately 0.5 Miles of the subject property.

Site	Address	Map ID	Page
FAMILY AUTO PAINTING & BODY WO	1123 E CURRY RD	17	7
CIRCUIT TECHNOLOGY	*119 S INDUSTRIAL DR*	*35*	*16*

Drywells: Constructed solely for the disposal of storm water, more than 3,400 drywells have been registered with the state under A.R.S. 49-331 through 336. The source is the Department of Environmental Quality's Drywell Registration database.

A review of the Dry Well list, as provided by EDR, and dated 07/18/1996 has revealed that there are 3 Dry Well sites within approximately 0.5 Miles of the subject property.

Site	Address	Map ID	Page
SURFSIDE MARINE	1322 NORTH MCCLINTOCK	12	6
AUTOMOTIVE SERVICE FACILITY	910 NORTH SCOTTSDALE ROAD	21	8
LA MIRAGE	610 EAST GILBERT DRIVE	27	9

MAP FINDINGS SUMMARY

Database	Target Property	Search Distance (Miles)	1/4 - 1/2
NPL		0.500	0
RCRIS-TSD		0.500	0
State Haz. Waste		0.500	10
CERCLIS		0.500	2
State Landfill		0.500	0
Az Wqarf		0.500	0
LUST		0.500	10
UST		0.500	14
RCRIS Sm. Quan. Gen.		0.500	8
RCRIS Lg. Quan. Gen.		0.500	2
Az. Dry Well		0.500	3
AZ Spills		0.250	NR

TP = Target Property

NR = Not Requested at this Search Distance

* Sites may be listed in more than one database

Map ID Latitude Longitude Distance	Site	Database(s)	EDR ID Number EPA ID Number

Coal Gas Site Search: No site was found in a search of Real Property Scan's ENVIROHAZ database.

NPL **Region**	**INDIAN BEND WASH AREA** **MCDOWELL RD & HAYDEN** **SCOTTSDALE, AZ 85253**	**CERCLIS** **FINDS** **NPL** **CONSENT** **ROD** **SHWS**	**1000245609** **AZD980695969**

CERCLIS Classification Data:

Site Incident Category: WELLS — Federal Facility: NO

Ownership Status: PRIVATE — NPL Status: CURRENTLY ON THE FINAL NPL

EPA Notes: INDIAN BEND WASH IS APPROX 12 SQ MI IN SCOTTSDALE AND TEMPE,AZ. DRINKING WATER FOR 350,000+ PEOPLE IS CONTAMINATED WITH CHLORINATED SOLVENTS. 6 MUNICIPAL WELLS HAVE BEEN SHUT DOWN,BLENDED, OR CONVERTED TO OTHER USES.

CERCLIS Assessment History:

Assessment:	DISCOVERY	Completed:	12/01/1979
Assessment:	PRELIMINARY ASSESSMENT	Completed:	06/01/1980
Assessment:	SCREENING SITE INSPECTION	Completed:	12/01/1982
Assessment:	HAZARD RANKING DETERMINED	Completed:	12/01/1982
Assessment:	PROPOSAL TO NPL	Completed:	12/30/1982
Assessment:	FINAL LISTING ON NPL	Completed:	09/08/1983
Assessment:	RMVL INVESTIGATION AT NPL	Completed:	09/06/1990
Assessment:	RMVL INVESTIGATION AT NPL	Completed:	02/26/1991
Assessment:	REMOVAL COMMUNITY RELATIONS	Completed:	Not reported
Assessment:	REMOVAL ACTION	Completed:	06/15/1994
Assessment:	COMBINED RI/FS	Completed:	09/12/1991
Assessment:	MANAGEMENT ASSISTANCE	Completed:	Not reported
Assessment:	REMEDIAL COMMUNITY RELATIONS	Completed:	Not reported
Assessment:	RECORD OF DECISION	Completed:	09/12/1991
Assessment:	ADMINISTRATIVE RECORD	Completed:	Not reported
Assessment:	FEASIBILITY STUDY	Completed:	09/12/1991
Assessment:	REMEDIAL INVESTIGATION	Completed:	09/12/1991
Assessment:	RECORD OF DECISION	Completed:	09/21/1988
Assessment:	COMBINED RI/FS	Completed:	09/21/1988
Assessment:	REMEDIAL COMMUNITY RELATIONS	Completed:	Not reported
Assessment:	MANAGEMENT ASSISTANCE	Completed:	Not reported
Assessment:	ADMINISTRATIVE RECORD	Completed:	Not reported
Assessment:	REMEDIAL DESIGN	Completed:	07/27/1989
Assessment:	COMBINED RI/FS	Completed:	Not reported
Assessment:	RECORD OF DECISION	Completed:	Not reported
Assessment:	REMEDIAL DESIGN	Completed:	Not reported
Assessment:	REMEDIAL COMMUNITY RELATIONS	Completed:	Not reported
Assessment:	REMEDIAL ACTION	Completed:	Not reported
Assessment:	BASELINE RISK ASSESSMENT	Completed:	Not reported
Assessment:	REMEDIAL INVESTIGATION	Completed:	Not reported
Assessment:	COMBINED RI/FS	Completed:	09/12/1991
Assessment:	RECORD OF DECISION	Completed:	09/12/1991
Assessment:	COMBINED RI/FS	Completed:	09/12/1991
Assessment:	RECORD OF DECISION	Completed:	09/12/1991
Assessment:	COMBINED RI/FS	Completed:	09/12/1991
Assessment:	RECORD OF DECISION	Completed:	09/12/1991
Assessment:	REMEDIAL DESIGN	Completed:	05/19/1995
Assessment:	REMEDIAL ACTION	Completed:	Not reported
Assessment:	RECORD OF DECISION	Completed:	09/27/1993

Map ID / Latitude / Longitude / Distance	Site	Database(s)	EDR ID Number / EPA ID Number

INDIAN BEND WASH AREA (Continued) — 1000245609

Assessment:	FEASIBILITY STUDY	Completed:	09/27/1993
Assessment:	REMEDIAL INVESTIGATION	Completed:	Not reported
Assessment:	REMEDIAL ACTION	Completed:	Not reported
Assessment:	REMEDIAL ACTION	Completed:	Not reported
Assessment:	REMEDIAL DESIGN	Completed:	Not reported
Assessment:	REMEDIAL ACTION	Completed:	Not reported
Assessment:	REMEDIAL ACTION	Completed:	Not reported
Assessment:	REMEDIAL ACTION	Completed:	Not reported
Assessment:	REMEDIAL DESIGN	Completed:	Not reported
Assessment:	REMEDIAL DESIGN	Completed:	Not reported

CERCLIS Site Status:
This site is currently under investigation by the government to assess the extent of further action

NPL:

ID:	09AZ001
Date Listed:	9/08/83 (FINAL)
EPA/ID:	AZD980695969
Haz. Rank Score:	42.24
Status:	LISTED ON NPL
Rank:	430
Group:	9
Ownership:	Municipal
Permit:	None
Site Activities:	Ground Water Plume
Site Condition:	Contam. Ground Water
Waste Type:	Metals
Waste Type:	Solvents
Waste Form:	Not reported

Contaminant:	Media Affected:
1,1,2-TRICHLOROETHYLENE (TCE)	Ground Water
CHROMIUM AND COMPOUNDS, NOS (CR)	Not reported

Distance to nearest Population:	Not reported
Population within a 1 Mile Radius:	Not reported
Population within a 2 Mile Radius:	Not reported
Population within a 4 Mile Radius:	Not reported
Vertical Distance to Aquifer:	Not reported
Ground Water Use:	Used as Drinking Water, Alternative Source not Available
Distance to nearest Surface Water:	Not reported

ROD:
Full-text of USEPA Record of Decision(s) is available from EDR.

CONSENT:
Full-text of a consent decree on this site issued by a United States District Court is available from EDR.

SHWS:

Facility ID:	161	EPA ID:	AZD980695969
Program:	PA/SI	WAQRF Area:	Not reported

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1 WNW 1/4-1/2 1925.768 — **UNIVERSITY U-HAUL #723-56**, **800 N HAYDEN RD**, **TEMPE, AZ 85281** — **UST** — **U003051372**, **N/A**

Map ID / Latitude / Longitude / Distance	Site	Database(s)	EDR ID Number / EPA ID Number
	UNIVERSITY U-HAUL #723-56 (Continued)		U003051372

UST:

Facility ID: 0-005926
Product: Gasoline
Capacity: 12,000
Age: 16
Piping Type: Pressure
Tank Remed Design: Manual Gauging
Piping Remed Design: Leak Detector
Owner: U-HAUL REAL ESTATE COMPANY
Owner Address: 1325 AIRMOTIVE WAY STE 100
RENO, NV 89502

Tank ID: 1
Tank Status: Remv
Construction Mat: Bare Steel
Piping Mat: Galvanized Steel

Facility ID: 0-005926
Product: Gasoline
Capacity: 10,000
Age: 12
Piping Type: Pressure
Tank Remed Design: Manual Gauging
Piping Remed Design: Leak Detector
Owner: U-HAUL REAL ESTATE COMPANY
Owner Address: 1325 AIRMOTIVE WAY STE 100
RENO, NV 89502

Tank ID: 2
Tank Status: Remv
Construction Mat: Fiberglass
Piping Mat: Galvanized Steel

Facility ID: 0-005926
Product: Diesel
Capacity: 10,000
Age: 12
Piping Type: Pressure
Tank Remed Design: Manual Gauging
Piping Remed Design: Leak Detector
Owner: U-HAUL REAL ESTATE COMPANY
Owner Address: 1325 AIRMOTIVE WAY STE 100
RENO, NV 89502

Tank ID: 3
Tank Status: Remv
Construction Mat: Fiberglass
Piping Mat: Galvanized Steel

Map ID / Latitude / Longitude / Distance	Site	Database(s)	EDR ID Number / EPA ID Number
8 WNW 1/4-1/2 1341.121	**HAYDEN AUTO PLAZA** **1900 N HAYDEN RD** **TEMPE, AZ 85281**	UST LUST	U003051472 N/A

LUST:

Facility ID: 0-008622
Date Reported: 05/19/1995
Owner ID: 5313
Owner: CK CENTERS INC
Address: 1930 S ALMA SCHOOL RD #A115
MESA, AZ 85210

Leak ID: 4078.01
Date Closed: 12/21/1995

Map ID Latitude Longitude Distance	Site	Database(s)	EDR ID Number EPA ID Number
	HAYDEN AUTO PLAZA (Continued)		**U003051472**

UST:

Facility ID:	0-008622	Tank ID:	1
Product:	NEW OIL	Tank Status:	Remv
Capacity:	2,000	Construction Mat:	Bare Steel
Age:	11	Piping Mat:	Bare Steel
Piping Type:	Suction -- Valve		
Tank Remed Design:	Not reported		
Piping Remed Design:	Not reported		
Owner:	CK CENTERS INC		
Owner Address:	1930 S ALMA SCHOOL RD #A115 MESA, AZ 85210		

Facility ID:	0-008622	Tank ID:	2
Product:	Used Oil	Tank Status:	Remv
Capacity:	3,000	Construction Mat:	Bare Steel
Age:	11	Piping Mat:	Bare Steel
Piping Type:	Gravity Fed		
Tank Remed Design:	Not reported		
Piping Remed Design:	Not reported		
Owner:	CK CENTERS INC		
Owner Address:	1930 S ALMA SCHOOL RD #A115 MESA, AZ 85210		

Facility ID:	0-008622	Tank ID:	3
Product:	NEW OIL	Tank Status:	Remv
Capacity:	2,000	Construction Mat:	Bare Steel
Age:	11	Piping Mat:	Bare Steel
Piping Type:	Suction -- Valve		
Tank Remed Design:	Not reported		
Piping Remed Design:	Not reported		
Owner:	CK CENTERS INC		
Owner Address:	1930 S ALMA SCHOOL RD #A115 MESA, AZ 85210		

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9 **WNW** **1/4-1/2** **1446.309**	**MALIBU GRAND PRIX** **1616 N HAYDEN ROAD** **TEMPE, AZ 85281**	**UST**	**U001156535** **N/A**

UST:

Facility ID:	0-006529	Tank ID:	1
Product:	Gasoline	Tank Status:	Curr
Capacity:	1,500	Construction Mat:	Epoxy Steel
Age:	22	Piping Mat:	Galvanized Steel
Piping Type:	Suction -- Valve		
Tank Remed Design:	Manual Gauging		
Piping Remed Design:	Leak Detector		
Owner:	MALIBU GRAND PRIX		
Owner Address:	1616 N HAYDEN TEMPE, AZ 85281		

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9 **WNW** **1/4-1/2** **1445.283**	**TEMPE MGPC, INC #521** **1616 N HAYDEN ROAD** **TEMPE, AZ 85281**	**LUST**	**S102331393** **N/A**

Map ID / Latitude / Longitude / Distance	Site	Database(s)	EDR ID Number / EPA ID Number
	TEMPE MGPC, INC #521 (Continued)		**S102331393**

LUST:

Facility ID:	0-006529	Leak ID:	4543.01
Date Reported:	08/02/1996	Date Closed:	Not reported
Owner ID:	2198		
Owner:	MALIBU GRAND PRIX		
Address:	1616 N HAYDEN TEMPE, AZ 85281		

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10 WNW 1/4-1/2 1474.988	**ISLAND OF BIG SURF/DAVID BUSCH 1500 N MCCLINTOCK DR TEMPE, AZ 85281**	**UST LUST**	**U001001900 N/A**

LUST:

Facility ID:	0-007495	Leak ID:	2006.01
Date Reported:	10/18/1991	Date Closed:	05/04/1993
Owner ID:	3335		
Owner:	ISLAND OF BIG SURF/DAVID BUSCH		
Address:	1500 N MCCLINTOCK TEMPE, AZ 85281		

UST:

Facility ID:	0-007495	Tank ID:	1
Product:	Gasoline	Tank Status:	Remv
Capacity:	1,000	Construction Mat:	Bare Steel
Age:	17	Piping Mat:	Unknown
Piping Type:	Suction -- No Valve		
Tank Remed Design:	Not reported		
Piping Remed Design:	Not reported		
Owner:	ISLAND OF BIG SURF/DAVID BUSCH		
Owner Address:	1500 N MCCLINTOCK TEMPE, AZ 85281		

Facility ID:	0-007495	Tank ID:	2
Product:	Diesel	Tank Status:	Remv
Capacity:	350	Construction Mat:	Bare Steel
Age:	27	Piping Mat:	Unknown
Piping Type:	Suction -- No Valve		
Tank Remed Design:	Not reported		
Piping Remed Design:	Not reported		
Owner:	ISLAND OF BIG SURF/DAVID BUSCH		
Owner Address:	1500 N MCCLINTOCK TEMPE, AZ 85281		

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12 WNW 1/4-1/2 1354.905	**SURFSIDE MARINE 1322 NORTH MCCLINTOCK TEMPE, AZ 85281**	**Dry Well**	**S101598584 N/A**

DRY WELLS:

Region:	6553	Num of Wells:	1

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17 WNW 1/4-1/2 1819.598	**ECONO AUTO PAINTING OF AZ INC 1123 E CURRY RD TEMPE, AZ 85281**	**RCRIS-SQG FINDS**	**1000317841 AZD981447568**

Map ID / Latitude / Longitude / Distance	Site	Database(s)	EDR ID Number / EPA ID Number
	ECONO AUTO PAINTING OF AZ INC (Continued)		**1000317841**

RCRIS:
Owner: EDWIN WATSON
(415) 555-1212
Contact: ENVIRONMENTAL MANAGER
(813) 933-7657
Classification: Small Quantity Generator

Waste	Quantity
D001	0.000 (N)

(P) = Pounds , (K) = Kilograms , (M) = Metric Tons , (T) = Tons , (N) = Not Reported

Used Oil Recyc: No

Violation Status: No violations found

Map ID / Latitude / Longitude / Distance	Site	Database(s)	EDR ID Number / EPA ID Number
17 WNW 1/4-1/2 1819.598	**FAMILY AUTO PAINTING & BODY WORKS 1123 E CURRY RD TEMPE, AZ 85281**	**RCRIS-LQG**	**1000254857 AZD982481806**

RCRIS:
Owner: BOB CUMPSTONE JR
(415) 555-1212
Contact: ENVIRONMENTAL MANAGER
(602) 968-4992
Classification: Large Quantity Generator

Waste	Quantity
NONE	0.000 (N)

(P) = Pounds , (K) = Kilograms , (M) = Metric Tons , (T) = Tons , (N) = Not Reported

Used Oil Recyc: No

Violation Status: No violations found

Map ID / Latitude / Longitude / Distance	Site	Database(s)	EDR ID Number / EPA ID Number
18 WNW 1/4-1/2 2271.333	**PRINCESS PROPERTY MANAGEMENT 1045 E CURRY RD TEMPE, AZ 85281**	**UST**	**U001626006 N/A**

UST:

Facility ID:	0-002532	Tank ID:	1
Product:	Diesel	Tank Status:	Remv
Capacity:	1,000	Construction Mat:	Bare Steel
Age:	23	Piping Mat:	Galvanized Steel
Piping Type:	Suction -- No Valve		
Tank Remed Design:	Not reported		
Piping Remed Design:	Not reported		
Owner:	PAUL PRISTO		
Owner Address:	1045 E CURRY ROAD TEMPE, AZ 85281		

Map ID Latitude Longitude Distance	Site	Database(s)	EDR ID Number EPA ID Number
	PRINCESS PROPERTY MANAGEMENT (Continued)		**U001626006**

Facility ID: 0-002532
Product: Diesel
Capacity: 1,000
Age: 23
Piping Type: Suction -- No Valve
Tank Remed Design: Not reported
Piping Remed Design: Not reported
Owner: PAUL PRISTO
Owner Address: 1045 E CURRY ROAD
TEMPE, AZ 85281

Tank ID: 2
Tank Status: Remv
Construction Mat: Bare Steel
Piping Mat: Galvanized Steel

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21 **WNW** **1/4-1/2** **2313.564**	**AUTOMOTIVE SERVICE FACILITY** **910 NORTH SCOTTSDALE ROAD** **TEMPE, AZ 85281**	**Dry Well**	**S102263976** **N/A**

---

26 **WNW** **1/4-1/2** **1548.835**	**JOHN HARTMAN** **929 E GILBERT DR** **TEMPE, AZ 85281**	**UST** **LUST**	**U000737862** **N/A**

LUST:
Facility ID: 0-006872
Date Reported: 06/28/1990
Owner ID: 4068
Owner: AZ DEPT OF TRANSPORTATION
Address: 205 S 17TH AVE
PHOENIX, AZ 85007

Leak ID: 1334.01
Date Closed: Not reported

UST:
Facility ID: 0-006872
Product: Gasoline
Capacity: 4,000
Age: Unk
Piping Type: Suction -- Valve
Tank Remed Design: Not reported
Piping Remed Design: Not reported
Owner: AZ DEPT OF TRANSPORTATION
Owner Address: 205 S 17TH AVE
PHOENIX, AZ 85007

Tank ID: 1
Tank Status: Remv
Construction Mat: Bare Steel
Piping Mat: Bare Steel

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26 **WNW** **1/4-1/2** **1661.380**	**KEN DARCANGELO** **711 N SCOTTSDALE RD** **TEMPE, AZ 85281**	**UST**	**U001156533** **N/A**

Map ID / Latitude / Longitude / Distance	Site	Database(s)	EDR ID Number / EPA ID Number

KEN DARCANGELO (Continued) — U001156533

UST:

Facility ID: 0-002671 — Tank ID: 1
Product: UNKNOWN — Tank Status: Remv
Capacity: Unknown — Construction Mat: Bare Steel
Age: 16 — Piping Mat: Galvanized Steel
Piping Type: Not reported
Tank Remed Design: Not reported
Piping Remed Design: Not reported
Owner: KEN DARCANGELO
Owner Address: 10050 E MOUNTAIN VIEW LAKE DR124
SCOTTSDALE, AZ 85258

Facility ID: 0-002671 — Tank ID: 2
Product: UNKNOWN — Tank Status: Remv
Capacity: Unknown — Construction Mat: Bare Steel
Age: 16 — Piping Mat: Galvanized Steel
Piping Type: Not reported
Tank Remed Design: Not reported
Piping Remed Design: Not reported
Owner: KEN DARCANGELO
Owner Address: 10050 E MOUNTAIN VIEW LAKE DR124
SCOTTSDALE, AZ 85258

Facility ID: 0-002671 — Tank ID: 3
Product: UNKNOWN — Tank Status: Remv
Capacity: Unknown — Construction Mat: Bare Steel
Age: 16 — Piping Mat: Galvanized Steel
Piping Type: Not reported
Tank Remed Design: Not reported
Piping Remed Design: Not reported
Owner: KEN DARCANGELO
Owner Address: 10050 E MOUNTAIN VIEW LAKE DR124
SCOTTSDALE, AZ 85258

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27 WNW 1/4-1/2 2054.900

LA MIRAGE
610 EAST GILBERT DRIVE
TEMPE, AZ 85281

Dry Well — S101598556 / N/A

DRY WELLS:
Region: 368 — Num of Wells: 4

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29 WNW 1/4-1/2 1530.761

KACHINA REDI-MIX
1976 E PIMA ST
TEMPE, AZ 85281

CERC-NFRAP 1000241627
UST AZD980813570
LUST
SHWS

CERCLIS-NFRAP Classification Data:
Site Incident Category: Not reported — Federal Facility: NO
Ownership Status: UNKNOWN — NPL Status: NOT ON NPL
EPA Notes: Not reported

CERCLIS-NFRAP Assessment History:

Assessment:	Completed:
DISCOVERY	02/01/83
PRELIMINARY ASSESSMENT	01/01/85
PRELIMINARY ASSESSMENT	11/01/88
PRELIMINARY ASSESSMENT	05/16/90

CERCLIS-NFRAP Alias Name(s):
RESOURCE RECLAMATION CORP

Map ID Latitude Longitude Distance	Site	Database(s)	EDR ID Number EPA ID Number
	KACHINA REDI-MIX (Continued)		**1000241627**

SHWS:

Facility ID:	229	EPA ID:	AZD980813570
Program:	PA/SI	WAQRF Area:	Not reported
Facility ID:	1066	EPA ID:	AZD982491664
Program:	PA/SI	WAQRF Area:	Not reported

LUST:

Facility ID:	0-002765	Leak ID:	1072.01
Date Reported:	01/08/1990	Date Closed:	08/14/1991
Owner ID:	1507		
Owner:	PHOENIX REDI-MIX CO		
Address:	3635 S 43RD AVE PHOENIX, AZ 85009		

UST:

Facility ID:	0-002765	Tank ID:	1
Product:	Diesel	Tank Status:	Remv
Capacity:	10,000	Construction Mat:	Bare Steel
Age:	14	Piping Mat:	Galvanized Steel
Piping Type:	Not reported		
Tank Remed Design:	Not reported		
Piping Remed Design:	Not reported		
Owner:	PHOENIX REDI-MIX CO		
Owner Address:	3635 S 43RD AVE PHOENIX, AZ 85009		

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29 WNW 1/4-1/2 1530.761	**PHOENIX READY MIX 1976 E PIMA ST TEMPE, AZ 85034**	**FINDS SHWS**	**1000725154 AZD980813570**

SHWS:

Facility ID:	1055	EPA ID:	AZD983474099
Program:	PA/SI	WAQRF Area:	Not reported

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29 WNW 1/4-1/2 1535.178	**SUN WEST DISPOSAL INC 1976 E PIMA ST TEMPE, AZ 85281**	**RCRIS-SQG**	**1000136381 AZD982491664**

Used Oil Recyc: No

Violation Status: No violations found

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30 WNW 1/4-1/2 2444.165	**TEMPE CRANE INC 117 S PERRY LN TEMPE, AZ 85281**	**UST LUST**	**U003051334 N/A**

LUST:

Facility ID:	0-004883	Leak ID:	3469.01
Date Reported:	04/12/1994	Date Closed:	Not reported
Owner ID:	3430		
Owner:	TEMPE CRANE INC		
Address:	117 S PERRY LANE TEMPE, AZ 85281		

Map ID / Latitude / Longitude / Distance	Site	Database(s)	EDR ID Number / EPA ID Number
	TEMPE CRANE INC (Continued)		U003051334

UST:

Facility ID:	0-004883	Tank ID:	1
Product:	Diesel	Tank Status:	Remv
Capacity:	6,000	Construction Mat:	Bare Steel
Age:	19	Piping Mat:	Bare Steel
Piping Type:	Not Marked		
Tank Remed Design:	Not reported		
Piping Remed Design:	Not reported		
Owner:	TEMPE CRANE INC		
Owner Address:	117 S PERRY LANE TEMPE, AZ 85281		

Map ID / Latitude / Longitude / Distance	Site	Database(s)	EDR ID Number / EPA ID Number
30 WNW 1/4-1/2 2424.959	**ALLISONS STRIPPING** **109 S PERRY LN** **TEMPE, AZ 85281**	RCRIS-SQG FINDS	1000817990 AZD983481078

RCRIS:

Owner: EDWARD ALLISON
(602) 961-4507

Contact: THOMAS ALLISON
(602) 966-3281

Classification: Small Quantity Generator

Waste	Quantity	Waste	Quantity
D000	0.000 (N)	D008	0.000 (N)
F002	0.000 (N)	F003	0.000 (N)

(P) = Pounds , (K) = Kilograms , (M) = Metric Tons , (T) = Tons , (N) = Not Reported

Used Oil Recyc: No

Violation Status: No violations found

Map ID / Latitude / Longitude / Distance	Site	Database(s)	EDR ID Number / EPA ID Number
30 WNW 1/4-1/2 2419.407	**FIREBIRD FUEL COMPANY** **106 S PERRY LN** **TEMPE, AZ 85281**	UST	U003051478 N/A

UST:

Facility ID:	0-008680	Tank ID:	1
Product:	Gasoline	Tank Status:	Curr
Capacity:	6,000	Construction Mat:	Composite
Age:	0	Piping Mat:	Fiberglass
Piping Type:	Pressure		
Tank Remed Design:	Auto. Gauging		
Piping Remed Design:	Sec. Containmen		
Owner:	PHOENIX FUEL CO		
Owner Address:	PO BOX 6176 PHOENIX, AZ 85005		

Map ID / Latitude / Longitude / Distance	Site	Database(s)	EDR ID Number / EPA ID Number
	FIREBIRD FUEL COMPANY (Continued)		**U003051478**

Facility ID: 0-008680
Product: Gasoline
Capacity: 10,000
Age: 0
Piping Type: Pressure
Tank Remed Design: Manual Gauging
Piping Remed Design: Sec. Containmen
Owner: PHOENIX FUEL CO
Owner Address: PO BOX 6176
PHOENIX, AZ 85005

Tank ID: 2
Tank Status: Curr
Construction Mat: Composite
Piping Mat: Fiberglass

Facility ID: 0-008680
Product: Diesel
Capacity: 12,000
Age: 0
Piping Type: Pressure
Tank Remed Design: Auto. Gauging
Piping Remed Design: Sec. Containmen
Owner: PHOENIX FUEL CO
Owner Address: PO BOX 6176
PHOENIX, AZ 85005

Tank ID: 3
Tank Status: Curr
Construction Mat: Composite
Piping Mat: Fiberglass

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30 WNW 1/4-1/2 2307.926	**GREAT WESTERN MINING DEVELOPMENT 36 N PERRY LN TEMPE, AZ 85281**	**SHWS**	**S102421856 N/A**

SHWS:
Facility ID: 1007
Program: PA/SI

EPA ID: AZD983466277
WAQRF Area: Not reported

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30 WNW 1/4-1/2 2113.209	**GOLD CIRCUIT INC 106 N PERRY LN TEMPE, AZ 85281**	**RCRIS-SQG FINDS**	**1000817815 AZD983478124**

RCRIS:
Owner: GREENBERG JAMES
(602) 829-0404

Contact: JAMES GREENBERG
(602) 829-0404

Classification: Conditionally Exempt Small Quantity Generator

Waste	Quantity	Waste	Quantity
D003	0.000 (N)	F007	0.000 (N)

(P) = Pounds , (K) = Kilograms , (M) = Metric Tons , (T) = Tons , (N) = Not Reported

Used Oil Recyc: No

Violation Status: No violations found

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30 WNW 1/4-1/2 2086.258	**ARIZONA CASTING 115 N PERRY LN TEMPE, AZ 85281**	**FINDS SHWS**	**1000443530 AZD070254008**

Map ID Latitude Longitude Distance	Site	Database(s)	EDR ID Number EPA ID Number
	ARIZONA CASTING (Continued)		**1000443530**

SHWS:
Facility ID: 2 EPA ID: AZD070254008
Program: SIBW WAQRF Area: Not reported

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30 WNW 1/4-1/2 1870.267	**ANGELA BERGLUND N OF 1ST ST, S OF PIMA RD, E OF PERRY LN TEMPE, AZ 85281**	**CERCLIS FINDS SHWS**	**1000665931 AZD983476698**

CERCLIS Classification Data:
Site Incident Category: Not reported Federal Facility: NO
Ownership Status: PRIVATE NPL Status: NOT ON NPL
EPA Notes: Not reported
CERCLIS Assessment History:
Assessment: DISCOVERY Completed: 04/23/1992
CERCLIS Site Status:
This site is currently under investigation by the government to assess the extent of further action

SHWS:
Facility ID: 963 EPA ID: AZD983476698
Program: PA/SI WAQRF Area: Not reported

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30 WNW 1/4-1/2 1852.437	**WHITRONICS 209 N PERRY LN TEMPE, AZ 85281**	**FINDS SHWS**	**1000420258 AZD120317730**

SHWS:
Facility ID: 51 EPA ID: AZD120317730
Program: PA/SI WAQRF Area: Not reported

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30 WNW 1/4-1/2 1852.437	**EARL CLARK ROOFING 210 N PERRY LN TEMPE, AZ 85281**	**UST LUST**	**U000016577 N/A**

LUST:
Facility ID: 0-002650 Leak ID: 4394.01
Date Reported: 03/29/1996 Date Closed: 07/18/1996
Owner ID: 4090
Owner: EARL CLARK ROOFING
Address: 210 N PERRY LANE
TEMPE, AZ 85281

UST:
Facility ID: 0-002650 Tank ID: 1
Product: Gasoline Tank Status: Perm
Capacity: 1,000 Construction Mat: Unknown
Age: 18 Piping Mat: Unknown
Piping Type: Not reported
Tank Remed Design: Not reported
Piping Remed Design: Not reported
Owner: EARL CLARK ROOFING
Owner Address: 210 N PERRY LANE
TEMPE, AZ 85281

Map ID Latitude Longitude Distance	Site	Database(s)	EDR ID Number EPA ID Number
30 WNW 1/4-1/2 1739.573	**FIRST STREET LANDFILL** **259 N PERRY LN** **TEMPE, AZ 85281**	**SHWS**	**S101570613** **N/A**

SHWS:

Facility ID:	997	EPA ID:	AZD983466269
Program:	PA/SI	WAQRF Area:	Not reported
Facility ID:	1023	EPA ID:	AZD983466301
Program:	PA/SI	WAQRF Area:	Not reported

31 WNW 1/4-1/2 1523.117	**ALTO AUTOMOTIVE ENTERPRISES** **145 N MCCLINTOCK DR** **TEMPE, AZ 85281**	**UST** **LUST**	**U003051211** **N/A**

LUST:

Facility ID:	0-002493	Leak ID:	4507.01
Date Reported:	06/28/1996	Date Closed:	Not reported
Owner ID:	1715		
Owner:	ATCO AUTOMOTIVE LTD		
Address:	145/153 N MCCLINTOCK DRIVE TEMPE, AZ 85281		

UST:

Facility ID:	0-002493	Tank ID:	1
Product:	Gasoline	Tank Status:	Temp
Capacity:	10,000	Construction Mat:	Bare Steel
Age:	27	Piping Mat:	Galvanized Steel
Piping Type:	Pressure		
Tank Remed Design:	Not reported		
Piping Remed Design:	Not reported		
Owner:	ATCO AUTOMOTIVE LTD		
Owner Address:	145/153 N MCCLINTOCK DRIVE TEMPE, AZ 85281		

Facility ID:	0-002493	Tank ID:	2
Product:	Gasoline	Tank Status:	Temp
Capacity:	10,000	Construction Mat:	Bare Steel
Age:	27	Piping Mat:	Galvanized Steel
Piping Type:	Pressure		
Tank Remed Design:	Not reported		
Piping Remed Design:	Not reported		
Owner:	ATCO AUTOMOTIVE LTD		
Owner Address:	145/153 N MCCLINTOCK DRIVE TEMPE, AZ 85281		

Facility ID:	0-002493	Tank ID:	3
Product:	Gasoline	Tank Status:	Temp
Capacity:	7,500	Construction Mat:	Bare Steel
Age:	27	Piping Mat:	Galvanized Steel
Piping Type:	Pressure		
Tank Remed Design:	Not reported		
Piping Remed Design:	Not reported		
Owner:	ATCO AUTOMOTIVE LTD		
Owner Address:	145/153 N MCCLINTOCK DRIVE TEMPE, AZ 85281		

Map ID / Latitude / Longitude / Distance	Site	Database(s)	EDR ID Number / EPA ID Number
	ALTO AUTOMOTIVE ENTERPRISES (Continued)		**U003051211**

Facility ID: 0-002493 — Tank ID: 4
Product: Gasoline — Tank Status: Temp
Capacity: 7,500 — Construction Mat: Bare Steel
Age: 24 — Piping Mat: Galvanized Steel
Piping Type: Suction -- No Valve
Tank Remed Design: Not reported
Piping Remed Design: Not reported
Owner: ATCO AUTOMOTIVE LTD
Owner Address: 145/153 N MCCLINTOCK DRIVE
TEMPE, AZ 85281

Facility ID: 0-002493 — Tank ID: 5
Product: Gasoline — Tank Status: Temp
Capacity: 7,500 — Construction Mat: Bare Steel
Age: 24 — Piping Mat: Galvanized Steel
Piping Type: Not Marked
Tank Remed Design: Not reported
Piping Remed Design: Not reported
Owner: ATCO AUTOMOTIVE LTD
Owner Address: 145/153 N MCCLINTOCK DRIVE
TEMPE, AZ 85281

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31 WNW 1/4-1/2 1323.965	**TRI-CITY TRANSMISSION SERVICE 203 N MCCLINTOCK DR TEMPE, AZ 85281**	**UST LUST**	**U003051425 N/A**

LUST:
Facility ID: 0-007385 — Leak ID: 3331.01
Date Reported: 01/26/1994 — Date Closed: Not reported
Owner ID: 897
Owner: TRI CITY TRANSMISSION SERVICE
Address: 203 N MCCLINTOCK DRIVE
TEMPE, AZ 85281

UST:
Facility ID: 0-007385 — Tank ID: 1
Product: ATF — Tank Status: Remv
Capacity: 500 — Construction Mat: Bare Steel
Age: 11 — Piping Mat: Galvanized Steel
Piping Type: Gravity Fed
Tank Remed Design: Manual Gauging
Piping Remed Design: Not reported
Owner: TRI CITY TRANSMISSION SERVICE
Owner Address: 203 N MCCLINTOCK DRIVE
TEMPE, AZ 85281

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32 WNW 1/4-1/2 1682.968	**MARICOPA COUNTY LANDFILL PIMA & 1ST ST. WEST OF PERRY LANE TEMPE, AZ 85281**	**FINDS SHWS**	**1000482888 AZD983466681**

SHWS:
Facility ID: 1028 — EPA ID: AZD983466681
Program: PA/SI — WAQRF Area: Not reported

Map ID / Latitude / Longitude / Distance	Site	Database(s)	EDR ID Number / EPA ID Number
33 WNW 1/4-1/2 2107.148	FRITO-LAY DISTRIBUTION CTR 1831 E 1ST STREET TEMPE, AZ 85281	UST LUST	U001625827 N/A

LUST:

Facility ID:	0-002189	Leak ID:	0367.01
Date Reported:	11/20/1987	Date Closed:	03/14/1988
Owner ID:	1459		
Owner:	FRITO-LAY INC		
Address:	1450 W MARICOPA HIGHWAY CASA GRANDE, AZ 85222		

UST:

Facility ID:	0-002189	Tank ID:	1
Product:	Gasoline	Tank Status:	Remv
Capacity:	10,000	Construction Mat:	Unknown
Age:	21	Piping Mat:	Galvanized Steel
Piping Type:	Not reported		
Tank Remed Design:	Not reported		
Piping Remed Design:	Not reported		
Owner:	FRITO-LAY INC		
Owner Address:	1450 W MARICOPA HIGHWAY CASA GRANDE, AZ 85222		

34 WNW 1/4-1/2 2019.313	WESTERN STATES TIRE & AUTO SER 101 S HAYDEN TEMPE, AZ 85281	RCRIS-SQG FINDS	1000402915 AZD982502965

RCRIS:

Owner: WESTERN STATES TRUST
(415) 555-1212

Contact: ENVIRONMENTAL MANAGER
(602) 272-4555

Classification: Small Quantity Generator

Waste	Quantity	Waste	Quantity
D001	0.000 (N)	F001	0.000 (N)
U002	0.000 (N)	U052	0.000 (N)
U070	0.000 (N)	U080	0.000 (N)
U220	0.000 (N)	U223	0.000 (N)
U226	0.000 (N)	U239	0.000 (N)

(P) = Pounds , (K) = Kilograms , (M) = Metric Tons , (T) = Tons , (N) = Not Reported

Used Oil Recyc: No

Violation Status: No violations found

35 WNW 1/4-1/2 2245.112	CIRCUIT TECHNOLOGY 119 S INDUSTRIAL DR TEMPE, AZ 85281	FINDS RCRIS-LQG SHWS	1000181968 AZD068402643

Map ID / Latitude / Longitude / Distance	Site	Database(s)	EDR ID Number / EPA ID Number
	CIRCUIT TECHNOLOGY (Continued)		**1000181968**

RCRIS:

Owner: HERBERT D PERKINS
(415) 555-1212

Contact: ENVIRONMENTAL MANAGER
(602) 966-7295

Classification: Large Quantity Generator

Waste	Quantity	Waste	Quantity
D001	0.000 (N)	D002	0.000 (N)
D003	0.000 (N)	D004	0.000 (N)
F003	0.000 (N)	F006	0.000 (N)
F007	0.000 (N)	F008	0.000 (N)
F009	0.000 (N)	F010	0.000 (N)
P030	0.000 (N)	P076	0.000 (N)
U031	0.000 (N)	U122	0.000 (N)
U154	0.000 (N)	U209	0.000 (N)

(P) = Pounds , (K) = Kilograms , (M) = Metric Tons , (T) = Tons , (N) = Not Reported

Used Oil Recyc: No

Violation Status: Violations exist, high priority violator

There are 1 compliance/violation record(s) reported at this site:

Evaluation	Area of Violation	Date of Compliance
Compliance Evaluation Inspection (CEI)	Generator-All Requirements	06/01/1990

SHWS:

Facility ID: 7
Program: PA/SI
EPA ID: AZD068402643
WAQRF Area: Not reported

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35 WNW 1/4-1/2 2219.520

GENCO
108 S INDUSTRIAL DR
TEMPE, AZ 85281

RCRIS-SQG 1000174686
FINDS AZD982466518

RCRIS:

Owner: HEALION MIKE
(415) 555-1212

Contact: ENVIRONMENTAL MANAGER
(602) 894-1341

Classification: Small Quantity Generator

Waste	Quantity	Waste	Quantity
D000	0.000 (N)	D001	0.000 (N)

(P) = Pounds , (K) = Kilograms , (M) = Metric Tons , (T) = Tons , (N) = Not Reported

Used Oil Recyc: No

Violation Status: No violations found

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36 WNW 1/4-1/2 2499.212

MOTOR TREND SPECIALTY ES
215 S INDUSTRIAL DR #3
TEMPE, AZ 85281

RCRIS-SQG 1000340688
FINDS AZD982512220

Map ID Latitude Longitude Distance	Site	Database(s)	EDR ID Number EPA ID Number

MOTOR TREND SPECIALTY ES (Continued) 1000340688

RCRIS:

Owner: SWANSON TODD
(415) 555-1212

Contact: ENVIRONMENTAL MANAGER
(602) 968-5848

Classification: Small Quantity Generator

Waste	Quantity
D001	0.000 (N)

(P) = Pounds , (K) = Kilograms , (M) = Metric Tons , (T) = Tons , (N) = Not Reported

Used Oil Recyc: No

Violation Status: No violations found

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37 WNW 1/4-1/2 1852.793	**JOYCES MAGIC TOUCH** **634 S RURAL RD #119** **TEMPE, AZ 85283**	**RCRIS-SQG** **FINDS**	**1000472691** **AZD982438301**

RCRIS:

Owner: JOYCE BOSACKI
(415) 555-1212

Contact: ENVIRONMENTAL MANAGER
(602) 820-7800

Classification: Conditionally Exempt Small Quantity Generator

Waste	Quantity
F002	0.000 (N)

(P) = Pounds , (K) = Kilograms , (M) = Metric Tons , (T) = Tons , (N) = Not Reported

Used Oil Recyc: No

Violation Status: No violations found

ORPHAN SUMMARY

City	EDR ID	Site Name	Site Address	Zip	Database(s)	Facility ID
MARICOPA COUNTY	S102286805	SALT RIVER MSWLF: BILLING ACCT FOR			SWF/LF	
MARICOPA COUNTY	S102286816	TRI CITY: BILLING ACCT FOR SCOTTSDA			SWF/LF	
MARICOPA COUNTY	S102286817	TRI-CITY: BILLING ACCT FOR GILBERT			SWF/LF	
MARICOPA COUNTY	S102286825	WICKENBURG: BILLING ACCT-MARICOPA C			SWF/LF	
MARICOPA COUNTY	S102286914	PHOENIX, CITY OF-22ND AVENUE CSWLF	22ND AVENUE / LOWER BUCKEYE RD NE		SWF/LF	
MARICOPA COUNTY	S102286774	GLENN WEINBERGER CDLF	3 BLOCKS S OF LOWER BUCKEYE RD ON 3		SWF/LF	
MARICOPA COUNTY	S102286963	USAF WILLIAMS AFB MSWLF	SW CORNER OF WILLIAMS AIR FORCE BAS		SWF/LF	
MARICOPA COUNTY	S100293349	CHANDLER	NORTHWEST CORNER OF OCOTILLO / MC		SWF/LF	
MARICOPA COUNTY	S102286754	CHANDLER, CITY OF-MCQUEEN MSWLF	NW CORNER OF OCOTILLO / MCQUEEN R		SWF/LF	
MARICOPA COUNTY	S102286795	PHOENIX, CITY OF-27TH AVENUE MSWLF	SW CORNER OF 27TH AVE. / LOWER BU		SWF/LF	
MARICOPA COUNTY	S102286808	SANIFILL-LONE CACTUS RLF	NW CORNER OF 7TH ST / BEARDSLEY R		SWF/LF	
MARICOPA COUNTY	S102286873	KACHINA READY MIX-FIRST STREET CRLF	NE CORNER OF FIRST STREET / CLARK		SWF/LF	
MARICOPA COUNTY	S102286885	MESA, CITY OF-MESA CSWLF	NORTHWEST CORNER OF CENTER STREET A		SWF/LF	
MARICOPA COUNTY	S102286909	ORANGEWOOD CSWOD	NORTHEAST CORNER OF ORANGEWOOD /		SWF/LF	
MARICOPA COUNTY	S102286916	PHOENIX, CITY OF-DEER VALLEY CSWLF	SOUTHEAST CORNER OF 19TH AVE / GR		SWF/LF	
MARICOPA COUNTY	S102286787	MARICOPA COUNTY-CAVE CREEK MSWLF	8.3 MI E OF I-17 ON THE SOUTH SIDE		SWF/LF	
MARICOPA COUNTY	S102286865	GENERAL MOTORS (GM) PROVING GROUND	ELLIOT ROAD EAST TO SOSSMAN ROAD, S		SWF/LF	
MARICOPA COUNTY	S102286792	MARICOPA COUNTY-QUEEN CREEK MSWLF	.5 MI S OF CHANDLER HEIGHTS RD. ON		SWF/LF	
MARICOPA COUNTY	S100293359	TRI-CITY	1 MILE N OF MCDOWELL ON THE BEELINE		SWF/LF	
MARICOPA COUNTY	S102286882	MARICOPA COUNTY-MORRISTOWN CSWLF	1 MILE SOUTH OF U.S. 60 OFF MORRIST		SWF/LF	
MARICOPA COUNTY	S102286912	PHOENIX, CITY OF-16TH ST (DEL RIO)	1 MILE SOUTH OF I-10 ON 16TH STREET		SWF/LF	
MARICOPA COUNTY	S102286913	PHOENIX, CITY OF-19TH AVENUE CSWLF	1 MILE SOUTH OF I-10 ON EAST SIDE O		SWF/LF	
MARICOPA COUNTY	S100293347	BUTTERFIELD STATION	1 MILE N. OF 238 ON 99TH AVE, MOBIL		SWF/LF	
MARICOPA COUNTY	S100293346	APS	6 MILES SO. OF I-10 ON WINTERSBERG		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	S100293358	SKUNK CREEK	1 MILES W OF I-17 ON HAPPY VALLEY R		SWF/LF	
MARICOPA COUNTY	S100293360	WEINBERGER	.5 MILES SOUTH OF LOWER BUCKEYE ROA		SWF/LF	
MARICOPA COUNTY	S102286962	UNION ROCK-CENTRAL AVENUE CRLF	.25 MILES SOUTH OF I-17 ON CENTRAL		SWF/LF	
MARICOPA COUNTY	S102286759	CONTINENTAL WASTE-GILA BEND REGIONA	5 MILES WEST OF GILA BEND		SWF/LF	
MARICOPA COUNTY	S102286790	MARICOPA COUNTY-NEW RIVER MSWLF	4.3 MILES W OF I-17 ON E. LAKE PLES		SWF/LF	
MARICOPA COUNTY	S102286880	MARICOPA COUNTY-AGUILA CSWLF	3.1 MILES WEST OF AQUILA ON THE SOU		SWF/LF	
MARICOPA COUNTY	S102286884	MARICOPA COUNTY-RAINBOW VALLEY CSWL	5.5 MILES FROM AZ 85 W TO AIRPORT R		SWF/LF	
MARICOPA COUNTY	S100293355	NEW RIVER	4.3 MILES W OF I-17 ON THE E SIDE O		SWF/LF	
MARICOPA COUNTY	S102286788	MARICOPA COUNTY-GILA BEND MSWLF	3.4 MI N OF AZ. 85 ON WEST SIDE OF		SWF/LF	
MARICOPA COUNTY	S102286806	SALT RIVER-PIMA TRIBE-TRI CITY MSWL	1 MI N OF MCDOWELL ON THE BEELINE H		SWF/LF	
MARICOPA COUNTY	S102286826	WMI-BUTTERFIELD STATION MSWLF	1 MI N OF 238 ON 99TH AVE; MOBILE A		SWF/LF	
MARICOPA COUNTY	S102286752	CALMAT-LITCHFIELD/AVONDALE RLF	NEAR INTERSECTION EL MIRAGE / IND S		SWF/LF	
MARICOPA COUNTY	S100240624	ALLIED	SOUTH OF INDIAN SCHOOL RD, WEST SID		SWF/LF	
MARICOPA COUNTY	S102286734	AETS (CHEM WASTE MGMT.)	SW PORTION OF THE CITY OF PHX NEAR		SWF/LF	
MARICOPA COUNTY	S102286835	7TH STREET CSWOD	PROMISCUOUS DUMP @ 7TH STREET / S		SWF/LF	

City	EDR ID	Site Name	Site Address	Zip	Database(s)	Facility ID
MARICOPA COUNTY	S102286845	CHANDLER, CITY OF-CSWLF	RAY RD. -2 MILES EAST OF GILBERT RO		SWF/LF	
MARICOPA COUNTY	S102286738	APS-PALO VERDE NGS PSWLF	6 MI S OF I-10 ON WINTERSBERG RD. (		SWF/LF	
MARICOPA COUNTY	S102286815	TERRA QUEST CDLF	1.5 MI S BASELINE;E SIDE PRIEST/AVE		SWF/LF	
MARICOPA COUNTY	S100293353	HASSAYAMPA	SALOME RD W TO THE JUNCTION OF WICK		SWF/LF	
MARICOPA COUNTY	S102286789	MARICOPA COUNTY-HASSAYAMPA MSWLF	SALOME RD. WEST TO JUNC. OF WICKENB		SWF/LF	
MARICOPA COUNTY	S100293345	40TH STREET LANDFILL	NO. SIDE OF MAGNOLIA, .25 MLS. EAST		SWF/LF	
MARICOPA COUNTY	S100293352	GLENDALE	N SIDE OF GLENDALE AVE E OF THE AGU		SWF/LF	
MARICOPA COUNTY	S102286773	GLENDALE, CITY OF-GLENDALE MSWLF	N SIDE OF GLENDALE AVE. E OF THE AG		SWF/LF	
MARICOPA COUNTY	S102286844	CHANDLER INT. #2 CSWLF	S SIDE OF QUEEN CREEK RD 1 MILE E O		SWF/LF	
MARICOPA COUNTY	S102286863	EL MIRAGE CRLF	SOUTH SIDE OF AZ 93 / AGUA FRIA R		SWF/LF	
MARICOPA COUNTY	S102286881	MARICOPA COUNTY-AVONDALE CSWLF	N. SIDE OF INTERSECTIO OF U.S. 80 A		SWF/LF	
MARICOPA COUNTY	S102286915	PHOENIX, CITY OF-91ST AVENUE CSWLF	WEST SIDE OF 91SR AVE, OPPOSITE 91S		SWF/LF	
MARICOPA COUNTY	S102286917	PHOENIX, CITY OF-ESTES CSWLF	EAST SIDE OF 40TH STREET SOUTH OF S		SWF/LF	
MARICOPA COUNTY	S102286941	TEMPE, CITY OF-TEMPE #1 CSWLF	SOUTH SIDE OF SALT RIVER ON HAYDEN		SWF/LF	
MARICOPA COUNTY	S102286940	TEMPE DISPOSAL FEES TO BUTTERFIELD	TEMPE PAID DISPOSAL FEES IN ERROR?		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	
MARICOPA COUNTY	S102286791	MARICOPA COUNTY-NORTHWEST REGIONAL	3.5 MI W OF U.S. 89 ON DEER VALLEY		SWF/LF	
MARICOPA COUNTY	S102286796	PHOENIX, CITY OF-SKUNK CREEK MSWLF	1/4 MI W OFF I-17 ON HAPPY VALLEY R		SWF/LF	
MARICOPA COUNTY	S102286824	WICKENBURG, TOWN OF-WICKENBURG MSWL	4.6 MI W OF INTERSEC. OF US 60 /		SWF/LF	
MARICOPA COUNTY	S102286883	MARICOPA COUNTY-PERRYVILLE CSWLF	YUMA ROAD EAST OF LUKE AIR FORCE AU		SWF/LF	
MESA	1000725166	MESA AREA GROUND WATER COMPANY	T1N R5E	85281	FINDS	
PHOENIX	S101570009	LUKE AIR FORCE AUXILIARY FIELD #1			SHWS	701
PHOENIX	S101860986	UNITED INDUSTRIAL CONTRACTORS			SHWS	1380
PHOENIX	U003052252	3RD AVE/ROOSEVELT RIGHT-OF-WAY	3RD AVE/ROOSEVELT RIGHT-OF-WAY		UST	0-008613
PHOENIX	S101570618	MECH TRONICS (NEW)	BROADWAY / 16TH STREET	85281	SHWS	875
PHOENIX	S100885713	APS	4606 W HADLEY ST		AZ Spills, SHWS	1297
PHOENIX	S102264309	EAST THUNDERBIRD SQUARE	NWC SCOTTSDALE ROAD / THUNDERBIRD R		Dry Well	
PHOENIX	S100885481	AMERICAN AIRLINES	SKY HARBOR AIRPORT		AZ Spills, SHWS	372
SCOTTSDALE	S102049972	SCOTTSDALE COMMERCE CENTER	1405 / 1495 NORTH HAYDEN ROAD	85257	Dry Well	
SCOTTSDALE	S102049110	CITY OF SCOTTSDALE - CORPORATION YA	SE CORNER OF MILLER / MCKELLIPS	85257	Dry Well	
SCOTTSDALE	S102049322	FIRE STATION #10	SE CORNER OF MILLER / THOMAS ROAD	85257	Dry Well	
SCOTTSDALE	S102049350	FOUNTAIN PLAZA	NE CORNER OF 77TH STREET / MCDOWELL	85257	Dry Well	
SCOTTSDALE	U001628271	OLD CORPORATION YARD	1323 E MCKELLIPS	85257	UST, LUST	0-006965
SCOTTSDALE	1000904647	TMC RADIOLOGY	1402 N MILLER RD UNIT 15	85257	RCRIS-SQG	
SCOTTSDALE	S101178109	LOS ARCOS CROSSING SHOPPING CENTER	SW-C MILLER ROAD / MCDOWELL ROAD	85257	Dry Well	
TEMPE	S101312267	NORTHWEST TEMPE		85281	Az Wqarf, SHWS	940
TEMPE	S101177347	ARIZONA BIKE	1656 EAST 6TH STREET	85281	Dry Well	
TEMPE	1000350254	CAMPUS BODY SALON LTD	1139 E CURRY RD STE 21	85281	RCRIS-SQG, FINDS	
TEMPE	U003051288	SAGUARO GUNITE INC	851 S DORSEY LN	85281	UST, LUST	0-004246
TEMPE	1000482872	RURAL METRO CORP.	2004 E. FIRST STREET	85281	FINDS, SHWS	1070
TEMPE	1000482873	TEMPE INDUSTRIAL PARTNERSHIP	1920 E. FIRST STREET	85281	FINDS, SHWS	1085
TEMPE	1000482875	ARIZONA MOTORCYCLE SALVAGE, INC.	1812 E. FIRST STREET	85281	FINDS, SHWS	852
TEMPE	1000482887	SALT RIVER MARINE	1826 E. FIRST ST	85281	FINDS, SHWS	1072
TEMPE	1000486232	FIREWORKS PRODUCTION INTERNATIONAL	1924 E FIRST ST	85281	FINDS, SHWS	996
TEMPE	1000175205	MAACO AUTO PAINTING + BODYWORKS	525 S HAYDEN RD STE J	85281	RCRIS-SQG, FINDS	

ORPHAN SUMMARY

City	EDR ID	Site Name	Site Address	Zip	Database(s)	Facility ID
TEMPE	1001022922	GIA CORPORATION DBA PLATUM ENT	104 S INDUSTRIAL DR STE A	85281	RCRIS-SQG	
TEMPE	S101598560	MARICOPA COUNTY TEMPE AUTO LICENSE	1703 EAST LARKSPUR DRIVE	85281	Dry Well	
TEMPE	S102264460	HAYDEN BUSINESS PARK	415-425 SOUTH MCCLINTOCK / 402-420	85281	Dry Well	
TEMPE	S101177805	EAST PAPAGO	NE-C TAYLOR STREET / 52ND STREET	85281	Dry Well	
TEMPE	S102050038	SONORA RESIDENCE HALL	SW OF MAIN / RURAL ROAD	85287	Dry Well	
TEMPE	1000666020	DOWNEY CONSTRUCTION	S OF PIMA ST / E OF PERRY LANE	85281	SHWS	990
TEMPE	1000978022	GIA CORP	420 S PERRY LN STE 4	85281	RCRIS-SQG, FINDS	
TEMPE	1000977978	CURTIS MACHINE	1318 E PRINCESS DR	85281	RCRIS-SQG	
TEMPE	S102421858	INDIANHEAD MFG CO- TEMPE	1318 E PRINCESS DR	85281	SHWS	163
TEMPE	S101598756	PACKARD STADIUM BATTING CAGES	RIO SALADO BLVD / SCOTTSDALE RD	85287	Dry Well	
TEMPE	U003051254	NEW CONTRUCTION INC	1992 E RIO SALADO PKWY	85281	UST, LUST	0-003513
TEMPE	S101092194	SONORA RESIDENCE HALL	SOUTH RURAL ROAD / RR TRACKS	85287	Dry Well	
TEMPE	1000224590	TUNEUP MASTERS 613	808 S RURAL RD	85281	RCRIS-SQG, FINDS, UST	0-006795
TEMPE	1000589374	TOSCO NORTHWEST CO #01877	809 S RURAL RD AND UNIVERSITY	85281	RCRIS-SQG, FINDS	
TEMPE	S101430644	CORNERSTONE SHOPPING CENTER	705-725 SOUTH RURAL ROAD/920-970 EA	85281	Dry Well	
TEMPE	S101598533	FAIRLANES BOWL	4407 SOUTH RURAL	85281	Dry Well	
TEMPE	S101598554	JUAN'S CANTINA	855 SOUTH RURAL ROAD	85281	Dry Well	
TEMPE	S101598594	THE CORNERSTONE SHOPPING CENTER	725 SOUTH RURAL ROAD SUITE C201	85281	Dry Well	
TEMPE	U003051186	RAS # 70877	809 S RURAL ROAD	85281	UST	0-001864
TEMPE	S100985183	EXXON RAS #70877	809 S RURAL RD	85281	LUST	0-001864
TEMPE	U003052355	OWNERSHIP UNKNOWN	1213-1215 N SCOTTSDALE RD	85281	UST	0-008557
TEMPE	S102421854	CRAVEN MARTIN DESIGNS	326 S SIESTA LN # 5	85281	SHWS	984
TEMPE	S102421855	ELECTRONIC TECHNICAL SALES, INC.	1403 WAST 10TH PLACE, SUITE B-110	85281	SHWS	1128

DETAILED ORPHAN LISTING

Site	Database(s)	EDR ID Number EPA ID Number

SALT RIVER MSWLF: BILLING ACCT FOR — SWF/LF — S102286805, N/A

MARICOPA COUNTY, AZ

LF:

Facility ID:	18	Facility Type:	Municipal
Facility Status:	ACTIVE	Closure Date:	Not reported
Permit Status:	N/A	Permit Date:	Not reported
Operator:	CITY OF MESA	Operator Phone:	Not reported
Invoice Name:	CITY OF MESA SANITATION DEPARTMENT		
Open To Public:	Not reported		
Waste Type[s]:	Not reported		

TRI CITY: BILLING ACCT FOR SCOTTSDA — SWF/LF — S102286816, N/A

MARICOPA COUNTY, AZ

LF:

Facility ID:	31	Facility Type:	Municipal
Facility Status:	ACTIVE	Closure Date:	Not reported
Permit Status:	N/A	Permit Date:	Not reported
Operator:	CITY OF SCOTTSDALE	Operator Phone:	Not reported
Invoice Name:	CITY OF SCOTTSDALE SANITATION DIV		
Open To Public:	Not reported		
Waste Type[s]:	Not reported		

TRI-CITY: BILLING ACCT FOR GILBERT — SWF/LF — S102286817, N/A

MARICOPA COUNTY, AZ

LF:

Facility ID:	29	Facility Type:	Municipal
Facility Status:	ACTIVE	Closure Date:	Not reported
Permit Status:	N/A	Permit Date:	Not reported
Operator:	TOWN OF GILBERT	Operator Phone:	Not reported
Invoice Name:	TOWN OF GILBERT		
Open To Public:	Not reported		
Waste Type[s]:	Not reported		

WICKENBURG: BILLING ACCT-MARICOPA C — SWF/LF — S102286825, N/A

MARICOPA COUNTY, AZ

LF:

Facility ID:	7	Facility Type:	Municipal
Facility Status:	ACTIVE	Closure Date:	Not reported
Permit Status:	N/A	Permit Date:	Not reported
Operator:	MARICOPA COUNTY SOLID WAS	Operator Phone:	Not reported
Invoice Name:	MARICOPA COUNTY SOLID WASTE DEPT		
Open To Public:	Not reported		
Waste Type[s]:	Not reported		

Site	Database(s)	EDR ID Number EPA ID Number
PHOENIX, CITY OF-22ND AVENUE CSWLF **22ND AVENUE / LOWER BUCKEYE RD NE** **MARICOPA COUNTY, AZ**	**SWF/LF**	**S102286914** **N/A**

LF:

Facility ID:	0	Facility Type:	Municipal
Facility Status:	CLOSED	Closure Date:	Not reported
Permit Status:	Not reported	Permit Date:	Not reported
Operator:	CITY OF PHOENIX	Operator Phone:	Not reported
Invoice Name:	Not reported		
Open To Public:	Not reported		
Waste Type[s]:	Agricultural, Construction, Green, Mixed Municipal, Wood		

GLENN WEINBERGER CDLF **3 BLOCKS S OF LOWER BUCKEYE RD ON 3** **MARICOPA COUNTY, AZ**	**SWF/LF**	**S102286774** **N/A**

LF:

Facility ID:	3	Facility Type:	Construction Debris
Facility Status:	ACTIVE	Closure Date:	Not reported
Permit Status:	Not reported	Permit Date:	08/01/80
Operator:	G WEINBERGER TOPSOIL INC	Operator Phone:	(602) 278-9155
Invoice Name:	GLENN WEINBERGER		
Open To Public:	Yes		
Waste Type[s]:	Construction		

USAF WILLIAMS AFB MSWLF **SW CORNER OF WILLIAMS AIR FORCE BAS** **MARICOPA COUNTY, AZ**	**SWF/LF**	**S102286963** **N/A**

LF:

Facility ID:	136	Facility Type:	Municipal
Facility Status:	CLOSED	Closure Date:	Not reported
Permit Status:	Not reported	Permit Date:	Not reported
Operator:	US AIR FORCE	Operator Phone:	Not reported
Invoice Name:	Not reported		
Open To Public:	No		
Waste Type[s]:	Not reported		

CHANDLER **NORTHWEST CORNER OF OCOTILLO / MC** **MARICOPA COUNTY, AZ**	**SWF/LF**	**S100293349** **N/A**

CHANDLER, CITY OF-MCQUEEN MSWLF **NW CORNER OF OCOTILLO / MCQUEEN R** **MARICOPA COUNTY, AZ**	**SWF/LF**	**S102286754** **N/A**

LF:

Facility ID:	20	Facility Type:	Municipal
Facility Status:	ACTIVE	Closure Date:	06/01/98
Permit Status:	Not reported	Permit Date:	11/15/82
Operator:	CITY OF CHANDLER	Operator Phone:	(602) 786-2897
Invoice Name:	CHANDLER CITY OF / PUBLIC WORKS DEPT		
Open To Public:	Yes		
Waste Type[s]:	Construction, Green, Mixed Municipal, Sludge, Wood		

Site	Database(s)	EDR ID Number EPA ID Number
PHOENIX, CITY OF-27TH AVENUE MSWLF **SW CORNER OF 27TH AVE. / LOWER BU** **MARICOPA COUNTY, AZ**	**SWF/LF**	**S102286795** **N/A**

LF:

Facility ID:	1	Facility Type:	Municipal
Facility Status:	INACTIVE	Closure Date:	Not reported
Permit Status:	Not reported	Permit Date:	Not reported
Operator:	CITY OF PHOENIX	Operator Phone:	(602) 256-3307
Invoice Name:	CITY OF PHOENIX PUBLIC WORKS DEPT		
Open To Public:	Not reported		
Waste Type[s]:	Construction, Green, Mixed Municipal, Wood		

SANIFILL-LONE CACTUS RLF **NW CORNER OF 7TH ST / BEARDSLEY R** **MARICOPA COUNTY, AZ**	**SWF/LF**	**S102286808** **N/A**

LF:

Facility ID:	11	Facility Type:	Construction Debris
Facility Status:	ACTIVE	Closure Date:	Not reported
Permit Status:	Not reported	Permit Date:	02/18/93
Operator:	SANIFILL OF ARIZONA	Operator Phone:	(602) 242-5143
Invoice Name:	SANFILL OF ARIZONA		
Open To Public:	Yes		
Waste Type[s]:	Construction, Green, Wood		

KACHINA READY MIX-FIRST STREET CRLF **NE CORNER OF FIRST STREET / CLARK** **MARICOPA COUNTY, AZ**	**SWF/LF**	**S102286873** **N/A**

LF:

Facility ID:	0	Facility Type:	Construction Debris
Facility Status:	CLOSED	Closure Date:	Not reported
Permit Status:	Not reported	Permit Date:	Not reported
Operator:	KACHINA READY-MIX	Operator Phone:	Not reported
Invoice Name:	Not reported		
Open To Public:	Not reported		
Waste Type[s]:	Agricultural, Construction, Green, Wood		

MESA, CITY OF-MESA CSWLF **NORTHWEST CORNER OF CENTER STREET A** **MARICOPA COUNTY, AZ**	**SWF/LF**	**S102286885** **N/A**

LF:

Facility ID:	0	Facility Type:	Municipal
Facility Status:	CLOSED	Closure Date:	Not reported
Permit Status:	Not reported	Permit Date:	Not reported
Operator:	CITY OF MESA	Operator Phone:	Not reported
Invoice Name:	Not reported		
Open To Public:	Not reported		
Waste Type[s]:	Not reported		

Site	Database(s)	EDR ID Number EPA ID Number
ORANGEWOOD CSWOD **NORTHEAST CORNER OF ORANGEWOOD /** **MARICOPA COUNTY, AZ**	**SWF/LF**	**S102286909** **N/A**

LF:

Facility ID:	0	Facility Type:	Municipal
Facility Status:	CLOSED	Closure Date:	Not reported
Permit Status:	Not reported	Permit Date:	Not reported
Operator:	Not reported	Operator Phone:	Not reported
Invoice Name:	Not reported		
Open To Public:	Not reported		
Waste Type[s]:	Not reported		

PHOENIX, CITY OF-DEER VALLEY CSWLF **SOUTHEAST CORNER OF 19TH AVE / GR** **MARICOPA COUNTY, AZ**	**SWF/LF**	**S102286916** **N/A**

LF:

Facility ID:	0	Facility Type:	Municipal
Facility Status:	CLOSED	Closure Date:	Not reported
Permit Status:	Not reported	Permit Date:	Not reported
Operator:	CITY OF PHOENIX	Operator Phone:	Not reported
Invoice Name:	Not reported		
Open To Public:	Not reported		
Waste Type[s]:	Agricultural, Construction, Green, Mixed Municipal, Wood		

MARICOPA COUNTY-CAVE CREEK MSWLF **8.3 MI E OF I-17 ON THE SOUTH SIDE** **MARICOPA COUNTY, AZ**	**SWF/LF**	**S102286787** **N/A**

LF:

Facility ID:	4	Facility Type:	Municipal
Facility Status:	ACTIVE	Closure Date:	Not reported
Permit Status:	N.O.D.	Permit Date:	Not reported
Operator:	MARICOPA COUNTY	Operator Phone:	(602) 506-8726
Invoice Name:	MARICOPA COUNTY SOLID WASTE DEPT		
Open To Public:	Not reported		
Waste Type[s]:	Construction, Green, Mixed Municipal, Wood		

GENERAL MOTORS (GM) PROVING GROUND **ELLIOT ROAD EAST TO SOSSMAN ROAD, S** **MARICOPA COUNTY, AZ**	**SWF/LF**	**S102286865** **N/A**

LF:

Facility ID:	0	Facility Type:	Private Solid Waste Landfill
Facility Status:	CLOSED	Closure Date:	01/01/88
Permit Status:	Not reported	Permit Date:	01/01/82
Operator:	GENERAL MOTORS	Operator Phone:	(602) 827-5239
Invoice Name:	Not reported		
Open To Public:	No		
Waste Type[s]:	Agricultural, Construction, Green, Mixed Municipal, Wood		

Site	Database(s)	EDR ID Number EPA ID Number
MARICOPA COUNTY-QUEEN CREEK MSWLF **.5 MI S OF CHANDLER HEIGHTS RD. ON** **MARICOPA COUNTY, AZ**	**SWF/LF**	**S102286792** **N/A**

LF:

Facility ID:	2	Facility Type:	Municipal
Facility Status:	ACTIVE	Closure Date:	Not reported
Permit Status:	N.O.D.	Permit Date:	Not reported
Operator:	MARICOPA COUNTY	Operator Phone:	(602) 506-8726
Invoice Name:	MARICOPA COUNTY SOLID WASTE DEPT		
Open To Public:	Yes		
Waste Type[s]:	Construction, Green, Mixed Municipal, Wood		

TRI-CITY **1 MILE N OF MCDOWELL ON THE BEELINE** **MARICOPA COUNTY, AZ**	**SWF/LF**	**S100293359** **N/A**
MARICOPA COUNTY-MORRISTOWN CSWLF **1 MILE SOUTH OF U.S. 60 OFF MORRIST** **MARICOPA COUNTY, AZ**	**SWF/LF**	**S102286882** **N/A**

LF:

Facility ID:	0	Facility Type:	Municipal
Facility Status:	CLOSED	Closure Date:	Not reported
Permit Status:	Not reported	Permit Date:	Not reported
Operator:	MARICOPA COUNTY	Operator Phone:	Not reported
Invoice Name:	Not reported		
Open To Public:	Not reported		
Waste Type[s]:	Agricultural, Construction, Green, Mixed Municipal, Wood		

PHOENIX, CITY OF-16TH ST (DEL RIO) **1 MILE SOUTH OF I-10 ON 16TH STREET** **MARICOPA COUNTY, AZ**	**SWF/LF**	**S102286912** **N/A**

LF:

Facility ID:	0	Facility Type:	Municipal
Facility Status:	CLOSED	Closure Date:	Not reported
Permit Status:	Not reported	Permit Date:	Not reported
Operator:	CITY OF PHOENIX	Operator Phone:	Not reported
Invoice Name:	Not reported		
Open To Public:	Not reported		
Waste Type[s]:	Agricultural, Construction, Green, Mixed Municipal, Wood		

PHOENIX, CITY OF-19TH AVENUE CSWLF **1 MILE SOUTH OF I-10 ON EAST SIDE O** **MARICOPA COUNTY, AZ**	**SWF/LF**	**S102286913** **N/A**

LF:

Facility ID:	0	Facility Type:	Municipal
Facility Status:	CLOSED	Closure Date:	Not reported
Permit Status:	Not reported	Permit Date:	Not reported
Operator:	CITY OF PHOENIX	Operator Phone:	Not reported
Invoice Name:	Not reported		
Open To Public:	Not reported		
Waste Type[s]:	Agricultural, Construction, Green, Liquids, Mixed Municipal, Sludge, Wood		

Site	Database(s)	EDR ID Number EPA ID Number
BUTTERFIELD STATION **1 MILE N. OF 238 ON 99TH AVE, MOBIL** **MARICOPA COUNTY, AZ**	**SWF/LF**	**S100293347** **N/A**
APS **6 MILES SO. OF I-10 ON WINTERSBERG** **MARICOPA COUNTY, AZ**	**SWF/LF**	**S100293346** **N/A**
CAVE CREEK **8.3 MILES EAST OF I-17 ON THE SOUTH** **MARICOPA COUNTY, AZ**	**SWF/LF**	**S100293348** **N/A**
GILA BEND **3.4 MILES N OF AZ. 85 ON WEST SIDE** **MARICOPA COUNTY, AZ**	**SWF/LF**	**S100293351** **N/A**
NORTHWEST REGIONAL **3.5 MILES WEST OF U.S. 89 ON DEER V** **MARICOPA COUNTY, AZ**	**SWF/LF**	**S100293356** **N/A**
QUEEN CREEK **.5 MILES S OF CHANDLER HEIGHTS ROAD** **MARICOPA COUNTY, AZ**	**SWF/LF**	**S100293357** **N/A**
SKUNK CREEK **1 MILES W OF I-17 ON HAPPY VALLEY R** **MARICOPA COUNTY, AZ**	**SWF/LF**	**S100293358** **N/A**
WEINBERGER **.5 MILES SOUTH OF LOWER BUCKEYE ROA** **MARICOPA COUNTY, AZ**	**SWF/LF**	**S100293360** **N/A**
UNION ROCK-CENTRAL AVENUE CRLF **.25 MILES SOUTH OF I-17 ON CENTRAL** **MARICOPA COUNTY, AZ**	**SWF/LF**	**S102286962** **N/A**

LF:

Facility ID:	0	Facility Type:	Construction Debris
Facility Status:	CLOSED	Closure Date:	Not reported
Permit Status:	Not reported	Permit Date:	Not reported
Operator:	UNION ROCK & MATERIALS	Operator Phone:	Not reported
Invoice Name:	Not reported		
Open To Public:	Not reported		
Waste Type[s]:	Agricultural, Construction, Green, Wood		

Site	Database(s)	EDR ID Number EPA ID Number
CONTINENTAL WASTE-GILA BEND REGIONA **5 MILES WEST OF GILA BEND** **MARICOPA COUNTY, AZ**	**SWF/LF**	**S102286759** **N/A**

LF:

Facility ID:	0	Facility Type:	Municipal
Facility Status:	ACTIVE	Closure Date:	01/01/27
Permit Status:	PENDING	Permit Date:	01/01/97
Operator:	CONTINENTAL WASTE IND	Operator Phone:	(602) 257-5200
Invoice Name:	Not reported		
Open To Public:	Yes		
Waste Type[s]:	Not reported		

MARICOPA COUNTY-NEW RIVER MSWLF **4.3 MILES W OF I-17 ON E. LAKE PLES** **MARICOPA COUNTY, AZ**	**SWF/LF**	**S102286790** **N/A**

LF:

Facility ID:	5	Facility Type:	Municipal
Facility Status:	ACTIVE	Closure Date:	Not reported
Permit Status:	N.O.D.	Permit Date:	Not reported
Operator:	MARICOPA COUNTY	Operator Phone:	(602) 506-8726
Invoice Name:	MARICOPA COUNTY SOLID WASTE DEPT		
Open To Public:	Not reported		
Waste Type[s]:	Liquids, Mixed Municipal		

MARICOPA COUNTY-AGUILA CSWLF **3.1 MILES WEST OF AQUILA ON THE SOU** **MARICOPA COUNTY, AZ**	**SWF/LF**	**S102286880** **N/A**

LF:

Facility ID:	0	Facility Type:	Municipal
Facility Status:	CLOSED	Closure Date:	Not reported
Permit Status:	Not reported	Permit Date:	Not reported
Operator:	MARICOPA COUNTY	Operator Phone:	Not reported
Invoice Name:	Not reported		
Open To Public:	Not reported		
Waste Type[s]:	Agricultural, Construction, Green, Mixed Municipal, Wood		

MARICOPA COUNTY-RAINBOW VALLEY CSWL **5.5 MILES FROM AZ 85 W TO AIRPORT R** **MARICOPA COUNTY, AZ**	**SWF/LF**	**S102286884** **N/A**

LF:

Facility ID:	0	Facility Type:	Municipal
Facility Status:	CLOSED	Closure Date:	Not reported
Permit Status:	Not reported	Permit Date:	Not reported
Operator:	MARICOPA COUNTY	Operator Phone:	Not reported
Invoice Name:	Not reported		
Open To Public:	Not reported		
Waste Type[s]:	Agricultural, Construction, Green, Mixed Municipal, Wood		

Site	Database(s)	EDR ID Number EPA ID Number
NEW RIVER **4.3 MILES W OF I-17 ON THE E SIDE O** **MARICOPA COUNTY, AZ**	**SWF/LF**	**S100293355** **N/A**

MARICOPA COUNTY-GILA BEND MSWLF — **SWF/LF** — **S102286788**
3.4 MI N OF AZ. 85 ON WEST SIDE OF — **N/A**
MARICOPA COUNTY, AZ

LF:

Facility ID:	6	Facility Type:	Municipal
Facility Status:	INACTIVE	Closure Date:	06/26/96
Permit Status:	N.O.D.	Permit Date:	Not reported
Operator:	MARICOPA COUNTY	Operator Phone:	(602) 506-8726
Invoice Name:	MARICOPA COUNTY SOLID WASTE DEPT		
Open To Public:	Yes		
Waste Type[s]:	Mixed Municipal		

SALT RIVER-PIMA TRIBE-TRI CITY MSWL — **SWF/LF** — **S102286806**
1 MI N OF MCDOWELL ON THE BEELINE H — **N/A**
MARICOPA COUNTY, AZ

LF:

Facility ID:	0	Facility Type:	Municipal
Facility Status:	ACTIVE	Closure Date:	Not reported
Permit Status:	Not reported	Permit Date:	Not reported
Operator:	SALT RIVER-PIMA TRIB	Operator Phone:	Not reported
Invoice Name:	SALT RIVER-PIMA INDIAN TRIBE		
Open To Public:	Not reported		
Waste Type[s]:	Not reported		

WMI-BUTTERFIELD STATION MSWLF — **SWF/LF** — **S102286826**
1 MI N OF 238 ON 99TH AVE; MOBILE A — **N/A**
MARICOPA COUNTY, AZ

LF:

Facility ID:	10	Facility Type:	Municipal
Facility Status:	ACTIVE	Closure Date:	Not reported
Permit Status:	APP	Permit Date:	08/24/93
Operator:	WASTE MGMT INC	Operator Phone:	(602) 256-0630
Invoice Name:	WASTE MANAGEMENT OF AZ SKY HARBOR		
Open To Public:	Yes		
Waste Type[s]:	Construction, Green, Industrial, Mixed Municipal, Petroleum Contaminated Soil, Sludge, Wood, Asbestos, Dead Animals		

CALMAT-LITCHFIELD/AVONDALE RLF — **SWF/LF** — **S102286752**
NEAR INTERSECTION EL MIRAGE / IND S — **N/A**
MARICOPA COUNTY, AZ

LF:

Facility ID:	12	Facility Type:	Construction Debris
Facility Status:	ACTIVE	Closure Date:	Not reported
Permit Status:	CURRENT	Permit Date:	01/28/92
Operator:	THE CALMAT PROPERTIES	Operator Phone:	(602) 258-8818
Invoice Name:	THE CALMAT PROPERTIES COMPANIES		
Open To Public:	Yes		
Waste Type[s]:	Construction, Green, Wood		

Site	Database(s)	EDR ID Number EPA ID Number
ALLIED **SOUTH OF INDIAN SCHOOL RD, WEST SID** **MARICOPA COUNTY, AZ**	**SWF/LF**	**S100240624** **N/A**

AETS (CHEM WASTE MGMT.) — **SWF/LF** — **S102286734** / **N/A**
SW PORTION OF THE CITY OF PHX NEAR
MARICOPA COUNTY, AZ

LF:

Facility ID:	0	Facility Type:	Treatment/Storage
Facility Status:	ACTIVE	Closure Date:	Not reported
Permit Status:	Not reported	Permit Date:	Not reported
Operator:	CHEMICAL WASTE MGMT.	Operator Phone:	(602) 243-6154
Invoice Name:	Not reported		
Open To Public:	Yes		
Waste Type[s]:	Not reported		

7TH STREET CSWOD — **SWF/LF** — **S102286835** / **N/A**
PROMISCUOUS DUMP @ 7TH STREET / S
MARICOPA COUNTY, AZ

LF:

Facility ID:	0	Facility Type:	Municipal
Facility Status:	CLOSED	Closure Date:	Not reported
Permit Status:	Not reported	Permit Date:	Not reported
Operator:	Not reported	Operator Phone:	Not reported
Invoice Name:	Not reported		
Open To Public:	Not reported		
Waste Type[s]:	Not reported		

CHANDLER, CITY OF-CSWLF — **SWF/LF** — **S102286845** / **N/A**
RAY RD. -2 MILES EAST OF GILBERT RO
MARICOPA COUNTY, AZ

LF:

Facility ID:	0	Facility Type:	Municipal
Facility Status:	CLOSED	Closure Date:	Not reported
Permit Status:	Not reported	Permit Date:	Not reported
Operator:	Not reported	Operator Phone:	Not reported
Invoice Name:	Not reported		
Open To Public:	Not reported		
Waste Type[s]:	Not reported		

APS-PALO VERDE NGS PSWLF — **SWF/LF** — **S102286738** / **N/A**
6 MI S OF I-10 ON WINTERSBERG RD. (
MARICOPA COUNTY, AZ

LF:

Facility ID:	15	Facility Type:	Private Solid Waste Landfill
Facility Status:	ACTIVE	Closure Date:	Not reported
Permit Status:	Not reported	Permit Date:	Not reported
Operator:	ARIZONA PUBLIC SERVICE	Operator Phone:	(520) 393-5000
Invoice Name:	ARIZONA PUBLIC SERVICE		
Open To Public:	No		
Waste Type[s]:	Not reported		

Site	Database(s)	EDR ID Number EPA ID Number
TERRA QUEST CDLF **1.5 MI S BASELINE;E SIDE PRIEST/AVE** **MARICOPA COUNTY, AZ**	**SWF/LF**	**S102286815** **N/A**

LF:

Facility ID:	109	Facility Type:	Construction Debris
Facility Status:	INACTIVE	Closure Date:	Not reported
Permit Status:	Not reported	Permit Date:	Not reported
Operator:	TERRA QUEST LTD	Operator Phone:	(602) 831-6618
Invoice Name:	TERRA QUEST LTD		
Open To Public:	Not reported		
Waste Type[s]:	Construction		

HASSAYAMPA **SALOME RD W TO THE JUNCTION OF WICK** **MARICOPA COUNTY, AZ**	**SWF/LF**	**S100293353** **N/A**

MARICOPA COUNTY-HASSAYAMPA MSWLF **SALOME RD. WEST TO JUNC. OF WICKENB** **MARICOPA COUNTY, AZ**	**SWF/LF**	**S102286789** **N/A**

LF:

Facility ID:	8	Facility Type:	Municipal
Facility Status:	ACTIVE	Closure Date:	Not reported
Permit Status:	N.O.D.	Permit Date:	Not reported
Operator:	MARICOPA COUNTY	Operator Phone:	(602) 506-8726
Invoice Name:	MARICOPA COUNTY SOLID WASTE DEPT		
Open To Public:	Not reported		
Waste Type[s]:	Mixed Municipal, Asbestos		

40TH STREET LANDFILL **NO. SIDE OF MAGNOLIA, .25 MLS. EAST** **MARICOPA COUNTY, AZ**	**SWF/LF**	**S100293345** **N/A**

GLENDALE **N SIDE OF GLENDALE AVE E OF THE AGU** **MARICOPA COUNTY, AZ**	**SWF/LF**	**S100293352** **N/A**

GLENDALE, CITY OF-GLENDALE MSWLF **N SIDE OF GLENDALE AVE. E OF THE AG** **MARICOPA COUNTY, AZ**	**SWF/LF**	**S102286773** **N/A**

LF:

Facility ID:	34	Facility Type:	Municipal
Facility Status:	ACTIVE	Closure Date:	Not reported
Permit Status:	NOD	Permit Date:	06/05/85
Operator:	CITY OF GLENDALE	Operator Phone:	(602) 930-2661
Invoice Name:	CITY OF GLENDALE		
Open To Public:	Yes		
Waste Type[s]:	Construction, Green, Mixed Municipal, Wood, Dead Animals		

Site	Database(s)	EDR ID Number EPA ID Number
CHANDLER INT. #2 CSWLF **S SIDE OF QUEEN CREEK RD 1 MILE E O** **MARICOPA COUNTY, AZ**	**SWF/LF**	**S102286844** **N/A**

LF:

Facility ID:	0	Facility Type:	Municipal
Facility Status:	CLOSED	Closure Date:	Not reported
Permit Status:	Not reported	Permit Date:	Not reported
Operator:	Not reported	Operator Phone:	Not reported
Invoice Name:	Not reported		
Open To Public:	Not reported		
Waste Type[s]:	Not reported		

EL MIRAGE CRLF **SOUTH SIDE OF AZ 93 / AGUA FRIA R** **MARICOPA COUNTY, AZ**	**SWF/LF**	**S102286863** **N/A**

LF:

Facility ID:	0	Facility Type:	Construction Debris
Facility Status:	CLOSED	Closure Date:	Not reported
Permit Status:	Not reported	Permit Date:	Not reported
Operator:	KEN BOYCE	Operator Phone:	Not reported
Invoice Name:	Not reported		
Open To Public:	Not reported		
Waste Type[s]:	Not reported		

MARICOPA COUNTY-AVONDALE CSWLF **N. SIDE OF INTERSECTIO OF U.S. 80 A** **MARICOPA COUNTY, AZ**	**SWF/LF**	**S102286881** **N/A**

LF:

Facility ID:	0	Facility Type:	Municipal
Facility Status:	CLOSED	Closure Date:	Not reported
Permit Status:	Not reported	Permit Date:	Not reported
Operator:	MARICOPA COUNTY	Operator Phone:	Not reported
Invoice Name:	Not reported		
Open To Public:	Not reported		
Waste Type[s]:	Agricultural, Construction, Green, Mixed Municipal, Wood		

PHOENIX, CITY OF-91ST AVENUE CSWLF **WEST SIDE OF 91SR AVE, OPPOSITE 91S** **MARICOPA COUNTY, AZ**	**SWF/LF**	**S102286915** **N/A**

LF:

Facility ID:	0	Facility Type:	Municipal
Facility Status:	CLOSED	Closure Date:	Not reported
Permit Status:	Not reported	Permit Date:	Not reported
Operator:	CITY OF PHOENIX	Operator Phone:	Not reported
Invoice Name:	Not reported		
Open To Public:	Not reported		
Waste Type[s]:	Agricultural, Construction, Green, Mixed Municipal, Wood		

Site	Database(s)	EDR ID Number EPA ID Number
PHOENIX, CITY OF-ESTES CSWLF **EAST SIDE OF 40TH STREET SOUTH OF S** **MARICOPA COUNTY, AZ**	**SWF/LF**	**S102286917** **N/A**

LF:

Facility ID:	0	Facility Type:	Municipal
Facility Status:	CLOSED	Closure Date:	Not reported
Permit Status:	Not reported	Permit Date:	Not reported
Operator:	CITY OF PHOENIX	Operator Phone:	Not reported
Invoice Name:	Not reported		
Open To Public:	Not reported		
Waste Type[s]:	Agricultural, Construction, Green, Mixed Municipal, Wood		

TEMPE, CITY OF-TEMPE #1 CSWLF **SOUTH SIDE OF SALT RIVER ON HAYDEN** **MARICOPA COUNTY, AZ**	**SWF/LF**	**S102286941** **N/A**

LF:

Facility ID:	0	Facility Type:	Municipal
Facility Status:	CLOSED	Closure Date:	Not reported
Permit Status:	Not reported	Permit Date:	Not reported
Operator:	CITY OF TEMPE	Operator Phone:	Not reported
Invoice Name:	Not reported		
Open To Public:	Not reported		
Waste Type[s]:	Not reported		

TEMPE DISPOSAL FEES TO BUTTERFIELD **TEMPE PAID DISPOSAL FEES IN ERROR?** **MARICOPA COUNTY, AZ**	**SWF/LF**	**S102286940** **N/A**

LF:

Facility ID:	33	Facility Type:	Municipal
Facility Status:	CLOSED	Closure Date:	Not reported
Permit Status:	Not reported	Permit Date:	Not reported
Operator:	TEMPE CITY OF PUBLIC WKS	Operator Phone:	Not reported
Invoice Name:	CITY OF TEMPE PUBLIC WORKS DEPT		
Open To Public:	Not reported		
Waste Type[s]:	Not reported		

27TH AVENUE **THE SOUTHWEST CORNER OF 27TH AVE AN** **MARICOPA COUNTY, AZ**	**SWF/LF**	**S100293344** **N/A**

DEER VALLEY LANDFILL **THE SOUTHWEST CORNER OF 16TH STREET** **MARICOPA COUNTY, AZ**	**SWF/LF**	**S100293350** **N/A**

LONE CACTUS LANDFILL **ON THE N WEST CORNER OF 7TH ST /** **MARICOPA COUNTY, AZ**	**SWF/LF**	**S100293354** **N/A**

Site	Database(s)	EDR ID Number EPA ID Number
MARICOPA COUNTY-NORTHWEST REGIONAL **3.5 MI W OF U.S. 89 ON DEER VALLEY** **MARICOPA COUNTY, AZ**	**SWF/LF**	**S102286791** **N/A**

LF:

Facility ID:	9	Facility Type:	Municipal
Facility Status:	ACTIVE	Closure Date:	Not reported
Permit Status:	N.O.D.	Permit Date:	Not reported
Operator:	MARICOPA COUNTY	Operator Phone:	(602) 506-8726
Invoice Name:	MARICOPA COUNTY SOLID WASTE DEPT		
Open To Public:	Not reported		
Waste Type[s]:	Mixed Municipal, Dead Animals		

PHOENIX, CITY OF-SKUNK CREEK MSWLF **1/4 MI W OFF I-17 ON HAPPY VALLEY R** **MARICOPA COUNTY, AZ**	**SWF/LF**	**S102286796** **N/A**

LF:

Facility ID:	118	Facility Type:	Municipal
Facility Status:	ACTIVE	Closure Date:	Not reported
Permit Status:	Not reported	Permit Date:	Not reported
Operator:	CITY OF PHOENIX	Operator Phone:	(602) 256-3309
Invoice Name:	CITY OF PHOENIX PUBLIC WORKS DEPT		
Open To Public:	Not reported		
Waste Type[s]:	Construction, Green, Mixed Municipal, Wood		

WICKENBURG, TOWN OF-WICKENBURG MSWL **4.6 MI W OF INTERSEC. OF US 60 /** **MARICOPA COUNTY, AZ**	**SWF/LF**	**S102286824** **N/A**

LF:

Facility ID:	38	Facility Type:	Municipal
Facility Status:	ACTIVE	Closure Date:	Not reported
Permit Status:	Not reported	Permit Date:	Not reported
Operator:	TOWN OF WICKENBURG	Operator Phone:	(520) 684-2761
Invoice Name:	TOWN OF WICKENBERG PUBLIC WORKS DEPT		
Open To Public:	Not reported		
Waste Type[s]:	Construction, Green, Mixed Municipal, Wood		

MARICOPA COUNTY-PERRYVILLE CSWLF **YUMA ROAD EAST OF LUKE AIR FORCE AU** **MARICOPA COUNTY, AZ**	**SWF/LF**	**S102286883** **N/A**

LF:

Facility ID:	0	Facility Type:	Municipal
Facility Status:	CLOSED	Closure Date:	Not reported
Permit Status:	Not reported	Permit Date:	Not reported
Operator:	MARICOPA COUNTY	Operator Phone:	Not reported
Invoice Name:	Not reported		
Open To Public:	Not reported		
Waste Type[s]:	Not reported		

Site	Database(s)	EDR ID Number EPA ID Number
MESA AREA GROUND WATER COMPANY **T1N R5E** **MESA, AZ 85281**	**FINDS**	**1000725166** **AZD980886287**

LUKE AIR FORCE AUXILIARY FIELD #1
PHOENIX, AZ
SHWS — **S101570009** / **N/A**

SHWS:
Facility ID: 701
Program: "J" SITE
EPA ID: Not reported
WAQRF Area: Not reported

UNITED INDUSTRIAL CONTRACTORS
PHOENIX, AZ
SHWS — **S101860986** / **N/A**

SHWS:
Facility ID: 1380
Program: SEE WEST OSBORNE
EPA ID: Not reported
WAQRF Area: Not reported

3RD AVE/ROOSEVELT RIGHT-OF-WAY
3RD AVE/ROOSEVELT RIGHT-OF-WAY
PHOENIX, AZ
UST — **U003052252** / **N/A**

UST:
Facility ID: 0-008613
Product: UNKNOWN
Capacity: 500
Age: Unk
Piping Type: Not reported
Tank Remed Design: Not reported
Piping Remed Design: Not reported
Owner: CITY OF PHOENIX POSSESSION
Owner Address: 200 W WASHINGTON ST 14TH FLOOR OEP
PHOENIX, AZ 85003
Tank ID: 1
Tank Status: Perm
Construction Mat: Bare Steel
Piping Mat: Bare Steel

MECH TRONICS (NEW)
BROADWAY / 16TH STREET
PHOENIX, AZ 85281
SHWS — **S101570618** / **N/A**

SHWS:
Facility ID: 875
Program: PA/SI
EPA ID: AZD983473158
WAQRF Area: Not reported

APS
4606 W HADLEY ST
PHOENIX, AZ
AZ Spills
SHWS — **S100885713** / **N/A**

SHWS:
Facility ID: 1297
Program: UNKNOWN
EPA ID: Not reported
WAQRF Area: WVB

Site	Database(s)	EDR ID Number EPA ID Number

APS (Continued) — S100885713

Az Spills:

Facility ID:	92015C	Incident Date:	01-29-92
Chemicals:	SOLVENT/PAINT/THINNER MIX		
Response Date:	Not reported	Report / Assist:	REPORT
Type:	RELEASE	No of Samples:	0
Referred to:	N/A	Referral Date:	N/A
Structure:	PIPE	Quantity:	Not reported
ERU Response:	Not reported	Cleanup:	Not reported
Referral:	Not reported	Threat/Spill:	Not reported
RQ (Exceeded):	Not reported	Property Mngmt:	PRIVATE
Source:	Not reported		
Release Factor:	Not reported		

EAST THUNDERBIRD SQUARE
NWC SCOTTSDALE ROAD / THUNDERBIRD R
PHOENIX, AZ

Dry Well — S102264309 / N/A

AMERICAN AIRLINES
SKY HARBOR AIRPORT
PHOENIX, AZ

AZ Spills, SHWS — S100885481 / N/A

SHWS:

Facility ID:	372	EPA ID:	Not reported
Program:	WQARF	WAQRF Area:	EW

Az Spills:

Facility ID:	93-052-B	Incident Date:	10/25/93
Chemicals:	SULFURIC ACID		
Response Date:	10/25/93	Report / Assist:	ASSIST
Type:	RELEASE	No of Samples:	0
Referred to:	FBI/FAA	Referral Date:	10/25/93
Structure:	BOTTLE	Quantity:	Not reported
ERU Response:	Not reported	Cleanup:	Not reported
Referral:	Not reported	Threat/Spill:	Not reported
RQ (Exceeded):	Not reported	Property Mngmt:	CITY
Source:	Not reported		
Release Factor:	Not reported		

SCOTTSDALE COMMERCE CENTER
1405 / 1495 NORTH HAYDEN ROAD
SCOTTSDALE, AZ 85257

Dry Well — S102049972 / N/A

DRY WELLS:

Region:	996	Num of Wells:	2

CITY OF SCOTTSDALE - CORPORATION YA
SE CORNER OF MILLER / MCKELLIPS
SCOTTSDALE, AZ 85257

Dry Well — S102049110 / N/A

DRY WELLS:

Region:	11708	Num of Wells:	1

Site	Database(s)	EDR ID Number EPA ID Number
FIRE STATION #10 **SE CORNER OF MILLER / THOMAS ROAD** **SCOTTSDALE, AZ 85257**	**Dry Well**	**S102049322** **N/A**

DRY WELLS:
Region: 11957 Num of Wells: 1

FOUNTAIN PLAZA **NE CORNER OF 77TH STREET / MCDOWELL** **SCOTTSDALE, AZ 85257**	**Dry Well**	**S102049350** **N/A**

DRY WELLS:
Region: 9487 Num of Wells: 3

OLD CORPORATION YARD **1323 E MCKELLIPS** **SCOTTSDALE, AZ 85257**	**UST** **LUST**	**U001628271** **N/A**

LUST:
Facility ID: 0-006965
Date Reported: 06/08/1990
Owner ID: 915
Owner: CITY OF SCOTTSDALE
Address: 9191 E SAN SALVADOR DR
SCOTTSDALE, AZ 85258
Leak ID: 1298.01
Date Closed: Not reported

UST:
Facility ID: 0-006965
Product: Gasoline
Capacity: 10,000
Age: Unk
Piping Type: Pressure
Tank Remed Design: Not reported
Piping Remed Design: Not reported
Owner: CITY OF SCOTTSDALE
Owner Address: 9191 E SAN SALVADOR DR
SCOTTSDALE, AZ 85258
Tank ID: 1
Tank Status: Remv
Construction Mat: Bare Steel
Piping Mat: Bare Steel

Facility ID: 0-006965
Product: Diesel
Capacity: 10,000
Age: Unk
Piping Type: Pressure
Tank Remed Design: Not reported
Piping Remed Design: Not reported
Owner: CITY OF SCOTTSDALE
Owner Address: 9191 E SAN SALVADOR DR
SCOTTSDALE, AZ 85258
Tank ID: 2
Tank Status: Remv
Construction Mat: Bare Steel
Piping Mat: Bare Steel

Site	Database(s)	EDR ID Number EPA ID Number
OLD CORPORATION YARD (Continued)		U001628271

Facility ID: 0-006965
Product: Diesel
Capacity: 10,000
Age: Unk
Piping Type: Pressure
Tank Remed Design: Not reported
Piping Remed Design: Not reported
Owner: CITY OF SCOTTSDALE
Owner Address: 9191 E SAN SALVADOR DR
SCOTTSDALE, AZ 85258

Tank ID: 3
Tank Status: Remv
Construction Mat: Bare Steel
Piping Mat: Bare Steel

Facility ID: 0-006965
Product: Used Oil
Capacity: 500
Age: Unk
Piping Type: Gravity Fed
Tank Remed Design: Not reported
Piping Remed Design: Not reported
Owner: CITY OF SCOTTSDALE
Owner Address: 9191 E SAN SALVADOR DR
SCOTTSDALE, AZ 85258

Tank ID: 4
Tank Status: Remv
Construction Mat: Bare Steel
Piping Mat: Bare Steel

Facility ID: 0-006965
Product: Used Oil
Capacity: 250
Age: Unk
Piping Type: Gravity Fed
Tank Remed Design: Not reported
Piping Remed Design: Not reported
Owner: CITY OF SCOTTSDALE
Owner Address: 9191 E SAN SALVADOR DR
SCOTTSDALE, AZ 85258

Tank ID: 5
Tank Status: Remv
Construction Mat: ALUM
Piping Mat: ALUM

TMC RADIOLOGY
1402 N MILLER RD UNIT 15
SCOTTSDALE, AZ 85257

RCRIS-SQG **1000904647**
AZD983482985

RCRIS:

Owner: DVI TMC RADIOLOGY LTD
(602) 820-2021

Contact: KRISTAL GEIS
(602) 820-2021

Classification: Small Quantity Generator

Waste	Quantity	Waste	Quantity
D000	0.000 (N)	D002	0.000 (N)
D011	0.000 (N)		

(P) = Pounds , (K) = Kilograms , (M) = Metric Tons , (T) = Tons , (N) = Not Reported

Site	Database(s)	EDR ID Number EPA ID Number
TMC RADIOLOGY (Continued)		1000904647

Used Oil Recyc: No

Violation Status: No violations found

LOS ARCOS CROSSING SHOPPING CENTER SW-C MILLER ROAD / MCDOWELL ROAD SCOTTSDALE, AZ 85257	**Dry Well**	**S101178109 N/A**

DRY WELLS:

Region:	1676	Num of Wells:	1

NORTHWEST TEMPE TEMPE, AZ 85281	**Az Wqarf SHWS**	**S101312267 N/A**

SHWS:

Facility ID:	940	EPA ID:	Not reported
Program:	WQARF	WAQRF Area:	NW

ARIZONA BIKE 1656 EAST 6TH STREET TEMPE, AZ 85281	**Dry Well**	**S101177347 N/A**

DRY WELLS:

Region:	2092	Num of Wells:	2

CAMPUS BODY SALON LTD 1139 E CURRY RD STE 21 TEMPE, AZ 85281	**RCRIS-SQG FINDS**	**1000350254 AZD981690480**

RCRIS:

Owner: VAL ANDY
(415) 555-1212

Contact: ENVIRONMENTAL MANAGER
(602) 967-4976

Classification: Small Quantity Generator

Waste	Quantity
D001	0.000 (N)

(P) = Pounds , (K) = Kilograms , (M) = Metric Tons , (T) = Tons , (N) = Not Reported

Used Oil Recyc: No

Violation Status: No violations found

SAGUARO GUNITE INC 851 S DORSEY LN TEMPE, AZ 85281	**UST LUST**	**U003051288 N/A**

Site	Database(s)	EDR ID Number EPA ID Number

SAGUARO GUNITE INC (Continued) — U003051288

LUST:

Facility ID:	0-004246	Leak ID:	3923.01
Date Reported:	02/02/1995	Date Closed:	Not reported
Owner ID:	3006		
Owner:	SAGUARO GUNITE INC		
Address:	8424 E CAMBRIDGE SCOTTSDALE, AZ 85257		

UST:

Facility ID:	0-004246	Tank ID:	1
Product:	Diesel	Tank Status:	Curr
Capacity:	10,000	Construction Mat:	Bare Steel
Age:	15	Piping Mat:	Galvanized Steel
Piping Type:	Not reported		
Tank Remed Design:	Not reported		
Piping Remed Design:	Not reported		
Owner:	SAGUARO GUNITE INC		
Owner Address:	8424 E CAMBRIDGE SCOTTSDALE, AZ 85257		

Facility ID:	0-004246	Tank ID:	2
Product:	Gasoline	Tank Status:	Curr
Capacity:	10,000	Construction Mat:	Bare Steel
Age:	15	Piping Mat:	Galvanized Steel
Piping Type:	Not reported		
Tank Remed Design:	Not reported		
Piping Remed Design:	Not reported		
Owner:	SAGUARO GUNITE INC		
Owner Address:	8424 E CAMBRIDGE SCOTTSDALE, AZ 85257		

RURAL METRO CORP. — FINDS 1000482872
2004 E. FIRST STREET — SHWS AZD983466210
TEMPE, AZ 85281

SHWS:

Facility ID:	1070	EPA ID:	AZD983466210
Program:	PA/SI	WAQRF Area:	Not reported

TEMPE INDUSTRIAL PARTNERSHIP — FINDS 1000482873
1920 E. FIRST STREET — SHWS AZD983466236
TEMPE, AZ 85281

SHWS:

Facility ID:	1085	EPA ID:	AZD983466236
Program:	PA/SI	WAQRF Area:	Not reported

ARIZONA MOTORCYCLE SALVAGE, INC. — FINDS 1000482875
1812 E. FIRST STREET — SHWS AZD983466251
TEMPE, AZ 85281

SHWS:

Facility ID:	852	EPA ID:	AZD983466251
Program:	PA/SI	WAQRF Area:	Not reported

Site	Database(s)	EDR ID Number EPA ID Number
SALT RIVER MARINE **1826 E. FIRST ST** **TEMPE, AZ 85281**	**FINDS** **SHWS**	**1000482887** **AZD983466434**

SHWS:

Facility ID:	1072	EPA ID:	AZD983466434
Program:	PA/SI	WAQRF Area:	Not reported

FIREWORKS PRODUCTION INTERNATIONAL **1924 E FIRST ST** **TEMPE, AZ 85281**	**FINDS** **SHWS**	**1000486232** **AZD983473943**

SHWS:

Facility ID:	996	EPA ID:	AZD983473943
Program:	PA/SI	WAQRF Area:	Not reported

MAACO AUTO PAINTING + BODYWORKS **525 S HAYDEN RD STE J** **TEMPE, AZ 85281**	**RCRIS-SQG** **FINDS**	**1000175205** **AZD980892657**

RCRIS:

Owner: GERALD ABBOTT
(415) 555-1212

Contact: ENVIRONMENTAL MANAGER
(602) 829-6874

Classification: Small Quantity Generator

Waste	Quantity
F005	0.000 (N)

(P) = Pounds , (K) = Kilograms , (M) = Metric Tons , (T) = Tons , (N) = Not Reported

Used Oil Recyc: No

Violation Status: No violations found

GIA CORPORATION DBA PLATUM ENT **104 S INDUSTRIAL DR STE A** **TEMPE, AZ 85281**	**RCRIS-SQG**	**1001022922** **AZR000001537**

RCRIS:

Owner: EUGENE C CHAMBERLAIN
(602) 985-4300

Contact: PAUL CHAMBERLAIN
(602) 967-3690

Classification: Small Quantity Generator

Waste	Quantity	Waste	Quantity
D000	0.000 (N)	D002	0.000 (N)
D007	0.000 (N)	D008	0.000 (N)
D011	0.000 (N)	F006	0.000 (N)
F007	0.000 (N)	F008	0.000 (N)
F019	0.000 (N)		

(P) = Pounds , (K) = Kilograms , (M) = Metric Tons , (T) = Tons , (N) = Not Reported

Site	Database(s)	EDR ID Number EPA ID Number
GIA CORPORATION DBA PLATUM ENT (Continued)		1001022922

Used Oil Recyc: No

Violation Status: No violations found

MARICOPA COUNTY TEMPE AUTO LICENSE
1703 EAST LARKSPUR DRIVE
TEMPE, AZ 85281

Dry Well — S101598560 / N/A

DRY WELLS:
Region: 2863 — Num of Wells: 2

HAYDEN BUSINESS PARK
415-425 SOUTH MCCLINTOCK / 402-420
TEMPE, AZ 85281

Dry Well — S102264460 / N/A

EAST PAPAGO
NE-C TAYLOR STREET / 52ND STREET
TEMPE, AZ 85281

Dry Well — S101177805 / N/A

DRY WELLS:
Region: 4753 — Num of Wells: 3

SONORA RESIDENCE HALL
SW OF MAIN / RURAL ROAD
TEMPE, AZ 85287

Dry Well — S102050038 / N/A

DRY WELLS:
Region: 10872 — Num of Wells: 1

DOWNEY CONSTRUCTION
S OF PIMA ST / E OF PERRY LANE
TEMPE, AZ 85281

SHWS — 1000666020 / N/A

SHWS:
Facility ID: 990 — EPA ID: AZD983473935
Program: PA/SI — WAQRF Area: Not reported

GIA CORP
420 S PERRY LN STE 4
TEMPE, AZ 85281

RCRIS-SQG, FINDS — 1000978022 / AZ0000943910

RCRIS:
Owner: BARBARA PETERSON
(602) 807-2467

Contact: PAUL CHAMBERLAIN
(602) 967-3690

Classification: Small Quantity Generator

Waste	Quantity	Waste	Quantity
D000	0.000 (N)	D002	0.000 (N)
D007	0.000 (N)	D008	0.000 (N)

Site	Database(s)	EDR ID Number EPA ID Number

GIA CORP (Continued) 1000978022

D011	0.000 (N)	F006	0.000 (N)
F007	0.000 (N)	F008	0.000 (N)
F019	0.000 (N)		

(P) = Pounds , (K) = Kilograms , (M) = Metric Tons , (T) = Tons , (N) = Not Reported

Used Oil Recyc: No

Violation Status: No violations found

CURTIS MACHINE
1318 E PRINCESS DR
TEMPE, AZ 85281

RCRIS-SQG **1000977978**
AZD009020009

RCRIS:

Owner: CURTIS NED
(602) 968-2400

Contact: NED CURTIS
(602) 968-2400

Classification: Conditionally Exempt Small Quantity Generator

Waste	Quantity
D001	0.000 (N)

(P) = Pounds , (K) = Kilograms , (M) = Metric Tons , (T) = Tons , (N) = Not Reported

Used Oil Recyc: No

Violation Status: Violations exist, high priority violator

There are 1 compliance/violation record(s) reported at this site:

Evaluation	Area of Violation	Date of Compliance
Compliance Evaluation Inspection (CEI)	Generator-All Requirements	12/08/1992

INDIANHEAD MFG CO- TEMPE
1318 E PRINCESS DR
TEMPE, AZ 85281

SHWS **S102421858**
N/A

SHWS:

Facility ID: 163
Program: PA/SI

EPA ID: AZD009020009
WAQRF Area: Not reported

PACKARD STADIUM BATTING CAGES
RIO SALADO BLVD / SCOTTSDALE RD
TEMPE, AZ 85287

Dry Well **S101598756**
N/A

DRY WELLS:

Region: 7506

Num of Wells: 1

Site	Database(s)	EDR ID Number EPA ID Number
NEW CONTRUCTION INC **1992 E RIO SALADO PKWY** **TEMPE, AZ 85281**	**UST** **LUST**	**U003051254** **N/A**

LUST:

Facility ID: 0-003513
Date Reported: 08/18/1993
Owner ID: 2470
Owner: NEW CONTRUCTION INC
Address: 1992 E RIO SALADO PARKWAY
TEMPE, AZ 85281

Leak ID: 2999.01
Date Closed: Not reported

UST:

Facility ID: 0-003513
Product: Diesel
Capacity: 4,000
Age: 19
Piping Type: Suction -- No Valve
Tank Remed Design: Not reported
Piping Remed Design: Not reported
Owner: NEW CONTRUCTION INC
Owner Address: 1992 E RIO SALADO PARKWAY
TEMPE, AZ 85281

Tank ID: 1
Tank Status: Remv
Construction Mat: Bare Steel
Piping Mat: Bare Steel

Facility ID: 0-003513
Product: Gasoline
Capacity: 3,000
Age: 19
Piping Type: Suction -- No Valve
Tank Remed Design: Not reported
Piping Remed Design: Not reported
Owner: NEW CONTRUCTION INC
Owner Address: 1992 E RIO SALADO PARKWAY
TEMPE, AZ 85281

Tank ID: 2
Tank Status: Remv
Construction Mat: Bare Steel
Piping Mat: Bare Steel

Facility ID: 0-003513
Product: Diesel
Capacity: 1,000
Age: 19
Piping Type: Suction -- No Valve
Tank Remed Design: Not reported
Piping Remed Design: Not reported
Owner: NEW CONTRUCTION INC
Owner Address: 1992 E RIO SALADO PARKWAY
TEMPE, AZ 85281

Tank ID: 3
Tank Status: Remv
Construction Mat: Bare Steel
Piping Mat: Bare Steel

SONORA RESIDENCE HALL **SOUTH RURAL ROAD / RR TRACKS** **TEMPE, AZ 85287**	**Dry Well**	**S101092194** **N/A**

DRY WELLS:

Region: 8977

Num of Wells: 1

Site	Database(s)	EDR ID Number EPA ID Number
TUNEUP MASTERS 613 **808 S RURAL RD** **TEMPE, AZ 85281**	**RCRIS-SQG** **FINDS** **UST**	**1000224590** **AZD982524167**

RCRIS:

Owner: TUNEUP MASTERS INC
(415) 555-1212

Contact: ENVIRONMENTAL MANAGER
(805) 375-1100

Classification: Conditionally Exempt Small Quantity Generator

Waste	Quantity	Waste	Quantity
D001	0.000 (N)	F002	0.000 (N)
F004	0.000 (N)	F005	0.000 (N)

(P) = Pounds , (K) = Kilograms , (M) = Metric Tons , (T) = Tons , (N) = Not Reported

Used Oil Recyc: No

Violation Status: No violations found

UST:

Facility ID:	0-006795	Tank ID:	1
Product:	Used Oil	Tank Status:	Remv
Capacity:	550	Construction Mat:	Unknown
Age:	Unk	Piping Mat:	Unknown
Piping Type:	Not reported		
Tank Remed Design:	Tightness Testing		
Piping Remed Design:	Not reported		
Owner:	TUNEUP MASTERS INC		
Owner Address:	2001 CORPORATE CENTER DR NEWBURY PARK, CA 91320		

TOSCO NORTHWEST CO #01877 **809 S RURAL RD AND UNIVERSITY** **TEMPE, AZ 85281**	**RCRIS-SQG** **FINDS**	**1000589374** **AZD983470824**

RCRIS:

Owner: TOSCO NORTHWEST COMPANY
(206) 442-7000

Contact: LYNN CHUN
(206) 442-7193

Classification: Small Quantity Generator

Waste	Quantity	Waste	Quantity
D000	0.000 (N)	D001	0.000 (N)
D018	0.000 (N)		

(P) = Pounds , (K) = Kilograms , (M) = Metric Tons , (T) = Tons , (N) = Not Reported

Used Oil Recyc: No

Violation Status: No violations found

Site	Database(s)	EDR ID Number EPA ID Number
CORNERSTONE SHOPPING CENTER **705-725 SOUTH RURAL ROAD/920-970 EA** **TEMPE, AZ 85281**	**Dry Well**	**S101430644** **N/A**

DRY WELLS:
Region: 10018 Num of Wells: 2

FAIRLANES BOWL **4407 SOUTH RURAL** **TEMPE, AZ 85281**	**Dry Well**	**S101598533** **N/A**

DRY WELLS:
Region: 7647 Num of Wells: 2

JUAN'S CANTINA **855 SOUTH RURAL ROAD** **TEMPE, AZ 85281**	**Dry Well**	**S101598554** **N/A**

DRY WELLS:
Region: 3746 Num of Wells: 1

THE CORNERSTONE SHOPPING CENTER **725 SOUTH RURAL ROAD SUITE C201** **TEMPE, AZ 85281**	**Dry Well**	**S101598594** **N/A**

DRY WELLS:
Region: 8893 Num of Wells: 1

RAS # 70877 **809 S RURAL ROAD** **TEMPE, AZ 85281**	**UST**	**U003051186** **N/A**

UST:

Facility ID: 0-001864
Product: Gasoline
Capacity: 6,000
Age: 22
Piping Type: Not reported
Tank Remed Design: Not reported
Piping Remed Design: Not reported
Owner: TOSCO REFINING & MKTG CO
Owner Address: 601 UNION STREET, SUITE #2500
SEATTLE, WA 98101

Tank ID: 1
Tank Status: Remv
Construction Mat: Bare Steel
Piping Mat: Bare Steel

Facility ID: 0-001864
Product: Gasoline
Capacity: 8,000
Age: 22
Piping Type: Not reported
Tank Remed Design: Not reported
Piping Remed Design: Not reported
Owner: TOSCO REFINING & MKTG CO
Owner Address: 601 UNION STREET, SUITE #2500
SEATTLE, WA 98101

Tank ID: 2
Tank Status: Remv
Construction Mat: Bare Steel
Piping Mat: Bare Steel

Site	Database(s)	EDR ID Number EPA ID Number

RAS # 70877 (Continued) — U003051186

Facility ID: 0-001864
Product: Gasoline
Capacity: 10,000
Age: 22
Piping Type: Not reported
Tank Remed Design: Not reported
Piping Remed Design: Not reported
Owner: TOSCO REFINING & MKTG CO
Owner Address: 601 UNION STREET, SUITE #2500
SEATTLE, WA 98101

Tank ID: 3
Tank Status: Remv
Construction Mat: Bare Steel
Piping Mat: Bare Steel

Facility ID: 0-001864
Product: Gasoline
Capacity: 12,000
Age: 8
Piping Type: Pressure
Tank Remed Design: Tightness Testing
Piping Remed Design: Leak Detector
Owner: TOSCO REFINING & MKTG CO
Owner Address: 601 UNION STREET, SUITE #2500
SEATTLE, WA 98101

Tank ID: 4
Tank Status: Curr
Construction Mat: Fiberglass
Piping Mat: Fiberglass

Facility ID: 0-001864
Product: Gasoline
Capacity: 10,000
Age: 8
Piping Type: Pressure
Tank Remed Design: Tightness Testing
Piping Remed Design: Leak Detector
Owner: TOSCO REFINING & MKTG CO
Owner Address: 601 UNION STREET, SUITE #2500
SEATTLE, WA 98101

Tank ID: 5
Tank Status: Curr
Construction Mat: Fiberglass
Piping Mat: Fiberglass

Facility ID: 0-001864
Product: Gasoline
Capacity: 10,000
Age: 8
Piping Type: Pressure
Tank Remed Design: Tightness Testing
Piping Remed Design: Leak Detector
Owner: TOSCO REFINING & MKTG CO
Owner Address: 601 UNION STREET, SUITE #2500
SEATTLE, WA 98101

Tank ID: 6
Tank Status: Curr
Construction Mat: Fiberglass
Piping Mat: Fiberglass

EXXON RAS #70877
809 S RURAL RD
TEMPE, AZ 85281

LUST — **S100985183**
N/A

LUST:
Facility ID: 0-001864
Date Reported: 11/23/1993
Owner ID: 5212
Owner: TOSCO REFINING & MKTG CO
Address: 601 UNION STREET, SUITE #2500
SEATTLE, WA 98101

Leak ID: 3206.01
Date Closed: Not reported

Site	Database(s)	EDR ID Number EPA ID Number

EXXON RAS #70877 (Continued) — S100985183

Facility ID: 0-001864
Date Reported: 11/23/1993
Owner ID: 5212
Owner: TOSCO REFINING & MKTG CO
Address: 601 UNION STREET, SUITE #2500
SEATTLE, WA 98101
Leak ID: 3206.03
Date Closed: Not reported

Facility ID: 0-001864
Date Reported: 11/23/1993
Owner ID: 5212
Owner: TOSCO REFINING & MKTG CO
Address: 601 UNION STREET, SUITE #2500
SEATTLE, WA 98101
Leak ID: 3206.04
Date Closed: Not reported

Facility ID: 0-001864
Date Reported: 11/23/1993
Owner ID: 5212
Owner: TOSCO REFINING & MKTG CO
Address: 601 UNION STREET, SUITE #2500
SEATTLE, WA 98101
Leak ID: 3206.02
Date Closed: Not reported

OWNERSHIP UNKNOWN
1213-1215 N SCOTTSDALE RD
TEMPE, AZ 85281
UST — **U003052355**, **N/A**

UST:
Facility ID: 0-008557
Product: UNK
Capacity: Unknown
Age: Unk
Piping Type: Not Marked
Tank Remed Design: Not reported
Piping Remed Design: Not reported
Owner: OWNERSHIP UNKNOWN
Owner Address: 1213-1215 N SCOTTSDALE RD
TEMPE, AZ 85281
Tank ID: 1
Tank Status: Temp
Construction Mat: Not Marked
Piping Mat: Not Marked

CRAVEN MARTIN DESIGNS
326 S SIESTA LN # 5
TEMPE, AZ 85281
SHWS — **S102421854**, **N/A**

SHWS:
Facility ID: 984
Program: PA/SI
EPA ID: AZD980883391
WAQRF Area: Not reported

ELECTRONIC TECHNICAL SALES, INC.
1403 WAST 10TH PLACE, SUITE B-110
TEMPE, AZ 85281
SHWS — **S102421855**, **N/A**

SHWS:
Facility ID: 1128
Program: PA/SI
EPA ID: AZD983479775
WAQRF Area: Not reported

EPA Waste Codes Addendum

Code	Description
D000	NOT DEFINED
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
D007	CHROMIUM
D008	LEAD
D011	SILVER
D018	BENZENE
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

EPA Waste Codes Addendum

Code	Description
	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 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
F008	PLATING BATH RESIDUES FROM THE BOTTOM OF PLATING BATHS FROM ELECTROPLATING OPERATIONS WHERE CYANIDES ARE USED IN THE PROCESS.
F009	SPENT STRIPPING AND CLEANING BATH SOLUTIONS FROM ELECTROPLATING OPERATIONS WHERE CYANIDES ARE USED IN THE PROCESS.
F010	QUENCHING BATH RESIDUES FROM OIL BATHS FROM METAL HEAT TREATING 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.
NONE	NONE
P030	CYANIDES (SOLUBLE CYANIDE SALTS), NOT OTHERWISE SPECIFIED
P076	NITRIC OXIDE
P076	NITROGEN OXIDE NO
U002	ACETONE (I)

EPA Waste Codes Addendum

Code	Description
U002	2-PROPANONE (I)
U031	1-BUTANOL (I)
U031	N-BUTYL ALCOHOL (I)
U052	CRESOL (CRESYLIC ACID)
U052	PHENOL, METHYL-
U070	BENZENE, 1,2-DICHLORO-
U070	O-DICHLOROBENZENE
U080	METHANE, DICHLORO-
U080	METHYLENE CHLORIDE
U122	FORMALDEHYDE
U154	METHANOL (I)
U154	METHYL ALCOHOL (I)
U209	ETHANE, 1,1,2,2-TETRACHLORO-
U209	1,1,2,2-TETRACHLOROETHANE
U220	BENZENE, METHYL-
U220	TOLUENE
U223	BENZENE, 1,3-DIISOCYANATOMETHYL- (R,T)
U223	TOLUENE DIISOCYANATE (R,T)
U226	ETHANE, 1,1,1-TRICHLORO-
U226	METHYL CHLOROFORM
U239	BENZENE, DIMETHYL- (I,T)
U239	XYLENE (I)

Thank you for your business.
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EPA Waste Codes Addendum

Code	Description
D000	NOT DEFINED
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
D008	LEAD
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

EPA Waste Codes Addendum

Code	Description
	F005, AND STILL BOTTOMS FROM THE RECOVERY OF THESE SPENT SOLVENTS AND SPENT SOLVENT MIXTURES.
F006	WASTEWATER TREATMENT SLUDGES FROM ELECTROPLATING OPERATIONS EXCEPT FROM THE 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
F008	PLATING BATH RESIDUES FROM THE BOTTOM OF PLATING BATHS FROM ELECTROPLATING OPERATIONS WHERE CYANIDES ARE USED IN THE PROCESS.
F009	SPENT STRIPPING AND CLEANING BATH SOLUTIONS FROM ELECTROPLATING OPERATIONS WHERE CYANIDES ARE USED IN THE PROCESS.
F010	QUENCHING BATH RESIDUES FROM OIL BATHS FROM METAL HEAT TREATING OPERATIONS WHERE CYANIDES ARE USED IN THE PROCESS.
NONE	NONE
P030	CYANIDES (SOLUBLE CYANIDE SALTS), NOT OTHERWISE SPECIFIED
P076	NITRIC OXIDE
P076	NITROGEN OXIDE NO
U002	ACETONE (I)
U002	2-PROPANONE (I)
U031	1-BUTANOL (I)
U031	N-BUTYL ALCOHOL (I)
U052	CRESOL (CRESYLIC ACID)
U052	PHENOL, METHYL-
U070	BENZENE, 1,2-DICHLORO-
U070	O-DICHLOROBENZENE
U080	METHANE, DICHLORO-
U080	METHYLENE CHLORIDE
U122	FORMALDEHYDE
U154	METHANOL (I)
U154	METHYL ALCOHOL (I)

EPA Waste Codes Addendum

Code	Description
U209	ETHANE, 1,1,2,2-TETRACHLORO-
U209	1,1,2,2-TETRACHLOROETHANE
U220	BENZENE, METHYL-
U220	TOLUENE
U223	BENZENE, 1,3-DIISOCYANATOMETHYL- (R,T)
U223	TOLUENE DIISOCYANATE (R,T)
U226	ETHANE, 1,1,1-TRICHLORO-
U226	METHYL CHLOROFORM
U239	BENZENE, DIMETHYL- (I,T)
U239	XYLENE (I)

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RIO SALADO, SALT RIVER
ARIZONA

APPENDIX G

DESIGN & COST

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT
SOUTH PACIFIC DIVISION
MAY 1997

Feasibility Study of Rio Salado Project at Phoenix and Tempe, Arizona.

Item No.	Description	Quantity	UOM	Unit Cost	Sub-Total	Conting.(%	Conting. Amt.	Total
1	Phoenix Reach (SR/LW)							
a)	Mesque Bosque/Upland	50	ACR	$11,000	$550,000	20%	$110,000	$660,000
b)	Cottonwood/Willow	80	ACR	$62,150	$4,972,000	20%	$994,400	$5,966,000
c)	Wetland Marsh	40	ACR	$14,170	$566,800	20%	$113,360	$680,000
d)	Water (shallow grndwtr, 2 MGD)	1	EA	$3,340,000	$3,340,000	20%	$668,000	$4,008,000
e)	Low Flow Channel w/ 5 Drop Structures	1	EA	$22,000,000	$22,000,000	20%	$4,400,000	$26,400,000
	Sub-Total				$31,428,800		$6,285,760	$37,714,000
	Planning, Engineering, & Design (PE&D)					5%		$1,886,000
	Sub-Total							$39,600,000
	Supervision & Administration					6.50%		$2,574,000
	Total First Cost							$42,174,000
	Annual OMRR&R (Water Supply)	1	EA	$310,000	$310,000	20%	$62,000	$372,000
	Annual OMRR&R (Habitat)	1	EA	$708,750	$708,750	20%	$141,750	$851,000
2	Phoenix Reach (SR/HW)							
a)	Mesque Bosque/Upland	10	ACR	$11,000	$110,000	20%	$22,000	$132,000
b)	Cottonwood/Willow	185	ACR	$62,150	$11,497,750	20%	$2,299,550	$13,797,000
c)	Wetland Marsh	100	ACR	$14,170	$1,417,000	20%	$283,400	$1,700,000
d)	Water (shallow grndwtr, 5 MGD)	1	EA	$7,800,000	$7,800,000	20%	$1,560,000	$9,360,000
e)	Low Flow Channel w/ 5 Drop Structures	1	EA	$22,000,000	$22,000,000	20%	$4,400,000	$26,400,000
	Sub-Total				$42,824,750		$8,564,950	$51,389,000
	Planning, Engineering, & Design (PE&D)					5%		$2,569,000
	Sub-Total							$53,958,000
	Supervision & Administration					6.50%		$3,507,000
	Total First Cost							$57,465,000
	Annual OMRR&R (Water Supply)	1	EA	$710,000	$710,000	20%	$142,000	$852,000
	Annual OMRR&R (Habitat)	1	EA	$1,516,650	$1,516,650	20%	$303,330	$1,820,000

3	Phoenix Reach (SR/HW+S)							
a)	Low Flow Channel w/ 5 Drop Structures	1	EA	$22,000,000	$22,000,000	20%	$4,400,000	$26,400,000
b)	Mesque Bosque/Upland	10	ACR	$11,000	$110,000	20%	$22,000	$132,000
c)	Cottonwood/Willow	185	ACR	$62,150	$11,497,750	20%	$2,299,550	$13,797,000
d)	Wetland Marsh	100	ACR	$14,170	$1,417,000	20%	$283,400	$1,700,000
e)	Water (shallow grndwtr, 12 MGD)	1	EA	$19,240,000	$19,240,000	20%	$3,848,000	$23,088,000
	Sub-Total				$54,264,750		$10,852,950	$65,118,000
	Planning, Engineering, & Design (PE&D)					5%		$3,256,000
	Sub-Total							$68,374,000
	Supervision & Administration					6.50%		$9,000
	Total First Cost							$68,383,000
	Annual OMRR&R (Water Supply)	1	EA	$1,830,000	$1,830,000	20%	$366,000	$2,196,000
	Annual OMRR&R (Habitat)	1	EA	$1,517,000	$1,517,000	20%	$303,400	$1,820,000
4	Phoenix Reach (SR/LW+S)							
a)	Mesque Bosque/Upland	50	ACR	$11,000	$550,000	20%	$110,000	$660,000
b)	Cottonwood/Willow	80	ACR	$62,150	$4,972,000	20%	$994,400	$5,966,000
c)	Wetland Marsh	40	ACR	$14,170	$566,800	20%	$113,360	$680,000
d)	Water (shallow grndwtr, 9.11 MGD)	1	EA	$15,500,000	$15,500,000	20%	$3,100,000	$18,600,000
e)	Low Flow Channel w/ 5 Drop Structures	1	EA	$22,000,000	$22,000,000	20%	$4,400,000	$26,400,000
	Sub-Total				$43,588,800		$8,717,760	$52,306,000
	Planning, Engineering, & Design (PE&D)					5%		$2,615,000
	Sub-Total							$54,921,000
	Supervision & Administration					6.50%		$3,570,000
	Total First Cost							$58,491,000
	Annual OMRR&R (Water Supply)	1	EA	$1,420,000	$1,420,000	20%	$284,000	$1,704,000
	Annual OMRR&R (Habitat)	1	EA	$708,750	$708,750	20%	$141,750	$851,000

5	Phoenix Reach (SR+G/LW)							
a)	Mesque Bosque/Upland	95	ACR	$11,000	$1,045,000	20%	$209,000	$1,254,000
b)	Cottonwood/Willow	90	ACR	$62,150	$5,593,500	20%	$1,118,700	$6,712,000
c)	Wetland Marsh	40	ACR	$14,170	$566,800	20%	$113,360	$680,000
d)	Water (shallow grndwtr, 2 MGD)	1	EA	$3,320,000	$3,320,000	20%	$664,000	$3,984,000
e)	Low Flow Channel w/ 5 Drop Structures	1	EA	$22,000,000	$22,000,000	20%	$4,400,000	$26,400,000
	Sub-Total				$32,525,300		$6,505,060	$39,030,000
	Planning, Engineering, & Design (PE&D)					5%		$1,952,000
	Sub-Total							$40,982,000
	Supervision & Administration					6.50%		$2,664,000
	Total First Cost							$43,646,000
	Annual OMRR&R (Water Supply)	1	EA	$300,000	$300,000	20%	$60,000	$360,000
	Annual OMRR&R (Habitat)	1	EA	$838,500	$838,500	20%	$167,700	$1,006,000
6	Phoenix Reach (SR+G/HW)							
a)	Mesque Bosque/Upland	60	ACR	$11,000	$660,000	20%	$132,000	$792,000
b)	Cottonwood/Willow	230	ACR	$62,150	$14,294,500	20%	$2,858,900	$17,153,000
c)	Wetland Marsh	100	ACR	$14,170	$1,417,000	20%	$283,400	$1,700,000
d)	Water (shallow grndwtr, 5 MGD)	1	EA	$8,500,000	$8,500,000	20%	$1,700,000	$10,200,000
e)	Low Flow Channel w/ 5 Drop Structures	1	EA	$22,000,000	$22,000,000	20%	$4,400,000	$26,400,000
	Sub-Total				$46,871,500		$9,374,300	$56,245,000
	Planning, Engineering, & Design (PE&D)					5%		$2,812,000
	Sub-Total							$59,057,000
	Supervision & Administration					6.50%		$3,839,000
	Total First Cost							$62,896,000
	Annual OMRR&R (Water Supply)	1	EA	$780,000	$780,000	20%	$156,000	$936,000
	Annual OMRR&R (Habitat)	1	EA	$1,906,200	$1,906,200	20%	$381,240	$2,287,000

7	Phoenix Reach (SR+G/LW+S)							
a)	Mesque Bosque/Upland	95	ACR	$11,000	$1,045,000	20%	$209,000	$1,254,000
b)	Cottonwood/Willow	90	ACR	$62,150	$5,593,500	20%	$1,118,700	$6,712,000
c)	Wetland Marsh	40	ACR	$14,170	$566,800	20%	$113,360	$680,000
d)	Water (shallow grndwtr, 9.22 MGD)	1	EA	$15,710,000	$15,710,000	20%	$3,142,000	$18,852,000
e)	Low Flow Channel w/ 5 Drop Structures	1	EA	$22,000,000	$22,000,000	20%	$4,400,000	$26,400,000
	Sub-Total				$44,915,300		$8,983,060	$53,898,000
	Planning, Engineering, & Design (PE&D)					5%		$2,695,000
	Sub-Total							$56,593,000
	Supervision & Administration					6.50%		$3,679,000
	Total First Cost							$60,272,000
	Annual OMRR&R (Water Supply)	1	EA	$1,440,000	$1,440,000	20%	$288,000	$1,728,000
	Annual OMRR&R (Habitat)	1	EA	$838,500	$838,500	20%	$167,700	$1,006,000
8	Phoenix Reach (SR+G/HW+S)							
a)	Mesque Bosque/Upland	60	ACR	$11,000	$660,000	20%	$132,000	$792,000
b)	Cottonwood/Willow	220	ACR	$62,150	$13,673,000	20%	$2,734,600	$16,408,000
c)	Wetland Marsh	100	ACR	$14,170	$1,417,000	20%	$283,400	$1,700,000
d)	Water (shallow grndwtr, 12.14 MGD)	1	EA	$19,770,000	$19,770,000	20%	$3,954,000	$23,724,000
e)	Low Flow Channel w/ 5 Drop Structures	1	EA	$22,000,000	$22,000,000	20%	$4,400,000	$26,400,000
	Sub-Total				$57,520,000		$11,504,000	$69,024,000
	Planning, Engineering, & Design (PE&D)					5%		$3,451,000
	Sub-Total							$72,475,000
	Supervision & Administration					6.50%		$4,711,000
	Total First Cost							$77,186,000
	Annual OMRR&R (Water Supply)	1	EA	$1,890,000	$1,890,000	20%	$378,000	$2,268,000
	Annual OMRR&R (Habitat)	1	EA	$1,906,125	$1,906,125	20%	$381,225	$2,287,000

9	Tempe Reach (IBW/LW)							
a)	Mesque Bosque/Upland	20	ACR	$11,000	$220,000	20%	$44,000	$264,000
b)	Cottonwood/Willow	0	ACR	$62,150	$0	20%	$0	$0
c)	Wetland Marsh	0	ACR	$14,170	$0	20%	$0	$0
d)	Water (shallow grndwtr, 0.15 MGD)	1	EA	$703,000	$703,000	20%	$140,600	$844,000
	Sub-Total				$923,000		$184,600	$1,108,000
	Planning, Engineering, & Design (PE&D)					5%		$55,000
	Sub-Total							$1,163,000
	Supervision & Administration					6.50%		$76,000
	Total First Cost							$1,239,000
	Annual OMRR&R (Water Supply)	1	EA	$28,000	$28,000	20%	$5,600	$34,000
	Annual OMRR&R (Habitat)	1	EA	$25,500	$25,500	20%	$5,100	$31,000
10	Tempe Reach (IBW+SR(US + DS)/LW)							
a)	Mesque Bosque/Upland	30	ACR	$11,000	$330,000	20%	$66,000	$396,000
b)	Cottonwood/Willow	0	ACR	$62,150	$0	20%	$0	$0
c)	Wetland Marsh	0	ACR	$14,170	$0	20%	$0	$0
d)	Water (shallow grndwtr, 0.23 MGD)	1	EA	$703,000	$703,000	20%	$140,600	$844,000
	Sub-Total				$1,033,000		$206,600	$1,240,000
	Planning, Engineering, & Design (PE&D)					5%		$62,000
	Sub-Total							$1,302,000
	Supervision & Administration					6.50%		$85,000
	Total First Cost							$1,387,000
	Annual OMRR&R (Water Supply)	1	EA	$32,000	$32,000	20%	$6,400	$38,000
	Annual OMRR&R (Habitat)	1	EA	$38,250	$38,250	20%	$7,650	$46,000

11	Tempe Reach (IBW+SR(DS)/HW)							
a)	Mesque Bosque/Upland	20	ACR	$11,000	$220,000	20%	$44,000	$264,000
b)	Cottonwood/Willow	10	ACR	$62,150	$621,500	20%	$124,300	$746,000
c)	Wetland Marsh	8	ACR	$14,170	$113,360	20%	$22,672	$136,000
d)	Water (shallow grndwtr, 2.50 MGD)	1	EA	$703,000	$703,000	20%	$140,600	$844,000
e)	24" RCP Gravity Drain	3900	LF	$95	$370,500	20%	$74,100	$445,000
	Sub-Total				$2,028,360		$405,672	$2,435,000
	Planning, Engineering, & Design (PE&D)					5%		$122,000
	Sub-Total							$2,557,000
	Supervision & Administration					6.50%		$166,000
	Total First Cost							$2,723,000
	Annual OMRR&R (Water Supply)	1	EA	$152,000	$152,000	20%	$30,400	$182,000
	Annual OMRR&R (Habitat)	1	EA	$111,150	$111,150	20%	$22,230	$133,000
12	Tempe Reach (IBW+SR(US +DS)/HW)							
a)	Mesque Bosque/Upland	20	ACR	$11,000	$220,000	20%	$44,000	$264,000
b)	Cottonwood/Willow	20	ACR	$62,150	$1,243,000	20%	$248,600	$1,492,000
c)	Wetland Marsh	16	ACR	$14,170	$226,720	20%	$45,344	$272,000
d)	Water (shallow grndwtr, 2.85 MGD)	1	EA	$703,000	$703,000	20%	$140,600	$844,000
e)	Pump Station and Pump	1	LS	$400,000	$400,000	20%	$80,000	$480,000
f)	36" Conveyance Pipe Line	3900	LF	$162	$631,800	20%	$126,360	$758,000
g)	24" RCP Gravity Drain	1250	LF	$95	$118,750	20%	$23,750	$143,000
	Sub-Total				$3,543,270		$708,654	$4,253,000
	Planning, Engineering, & Design (PE&D)					5%		$213,000
	Sub-Total							$4,466,000
	Supervision & Administration					6.50%		$290,000
	Total First Cost							$4,756,000
	Annual OMRR&R (Water Supply)	1	EA	$170,000	$170,000	20%	$34,000	$204,000
	Annual OMRR&R (Habitat)	1	EA	$196,650	$196,650	20%	$39,330	$236,000

13	Tempe Reach (SR(DS)/HW)							
a)	Mesque Bosque/Upland							
b)	Cottonwood/Willow	10	ACR	$62,150	$621,500	20%	$124,300	$746,000
c)	Wetland Marsh	8	ACR	$14,170	$113,360	20%	$22,672	$136,000
d)	Water (shallow grndwtr, 0.35 MGD)	1	EA	$703,000	$703,000	20%	$140,600	$844,000
	Sub-Total				$1,437,860		$287,572	$1,726,000
	Planning, Engineering, & Design (PE&D)					5%		$86,000
	Sub-Total							$1,812,000
	Supervision & Administration					6.50%		$118,000
	Total First Cost							$1,930,000
	Annual OMRR&R (Water Supply)	1	EA	$38,000	$38,000	20%	$7,600	$46,000
	Annual OMRR&R (Habitat)	1	EA	$85,650	$85,650	20%	$17,130	$103,000

QUANTITY TAKE-OFF				ESTIMATE	
Location & FY Program RIO SALADO LOW FLOW CHANNEL				Job No.	
Directive Job No.		Computed By John Karakawa		Prepared By	
Line Item No.		Checked By		Checked By	
Description SOIL CEMENT LINED LOW FLOW CHANNEL WITH 5 DROP STRUCTURES		Date 24 APRIL 1997		Date	
Item No.	Description	Estimated Quantity	Unit	Unit Cost	Total Cost
1.	Excavation	2,000,000	CY		
2.	Soil Cement	300,000	CY		
3	Concrete For Drop Structures	11,000	CY		
4	Reinforcement	545	Tons		
	Contingencies				
	Preconstruction Engin. and Design				
	Construction Management				
	Environmental Mitigation				
	Real Estate				

RIO SALADO, SALT RIVER
ARIZONA

APPENDIX H

WATER SUPPLY ANALYSIS & COST

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT
SOUTH PACIFIC DIVISION
MAY 1997

City of Phoenix

RIO SALADO
WATER SUPPLY AND O&M COSTS

dollars in millions

	Design Capacity, MGD		
	10	20	40
1. Surface Water Supply			
Capital construction costs; water supply acquisition & distribution system	14.42	24.04	39.65
O&M costs, annual	0.01	0.02	0.04
Water Resources development fees, annual	0.79	1.59	3.15
2. Groundwater, Shallow Wells			
Capital costs; well construction, distribution system	3.04	5.32	10.64
Capital costs; wellhead environmental treatment costs	14.00	24.50	49.00
O&M costs; annual pumping and fees	0.31	0.62	1.24
O&M costs; environmental treatment, annual	0.46	0.92	1.84
Water resource development fees, annual	0.79	1.58	3.16
3. Groundwater, Deep Wells			
Capital costs: well construction, distribution system	6.92	12.11	24.22
O&M costs, annual pumping and fees	0.87	1.94	3.88
Water resourse development fees, annual	0.79	1.58	3.16

Notes:

1) Capital costs would be a part of initial construction costs and be a part of the locally matched Federal cost of the project. Other costs would be a part of the annual operating costs of the project.

2) Wellhead environmental costs, construction and O&M, would apply only if well water treatment is required and if treatment through constructed wetlands in the project is not acceptable

City of Phoenix

3) Water resource development fees are required only if it is determined that offsetting water purchases to be used for recharge credits must be made to match the quantity of water used in the project

4) Well design costs are based on a peak demand which is assumed to be twice the average daily usage. Water and pumpage costs are based on the average daily usage.

SUMMARY

The following tables summarize water supply costs on a minimum and a maximum basis. The minimum costs assume that any water treatment can be accomplished as part of the project's wetlands design and that no water resource development costs will apply. The maximum costs assume that both water treatment and water resource development fees will be required.

Minimum Costs

1. Surface Water Supply			
Capital costs	14.42	24.04	39.65
O&M costs	0.80	1.61	3.19
2. Groundwater, Shallow Wells			
Capital costs	3.04	5.32	10.64
O&M costs	0.31	0.62	1.24
3. Groundwater, Deep Wells			
Capital costs	6.92	12.11	24.22
O&M costs	0.87	1.94	3.88

Maximum Costs

1. Surface Water Supply			
Capital costs	14.42	24.04	39.65
O&M costs	0.80	1.61	3.19
2. Groundwater, Shallow Wells			
Capital costs	17.04	29.82	59.64
O&M costs	1.56	3.12	6.24
3. Groundwater, Deep Wells			
Capital costs	6.92	12.11	24.22
O&M costs	1.66	3.52	7.04

City of Phoenix
WATER SERVICES DEPARTMENT
WATER ENGINEERING DIVISION

Winner of the Carl Bertelsmann Prize

To: Peter Attona
Deputy Planning Director

Date: April 30, 1997

Thru: Mario Saldamando, P.E. MS
Assistant Water Services Director for Technical Services

From: Keith Larson KRL
Water Resources Planner

Subject: COST ESTIMATES FOR WATER SUPPLY OPTIONS FOR RIO SALADO PROJECT

This memorandum summarizes an analysis done to estimate and compare the annualized capital and operation and maintenance costs and total capital costs associated with three water supply alternatives for the proposed Rio Salado Project.

The alternatives evaluated include: 1) Shallow Groundwater Wells distributed throughout the project area that are assumed to require wellhead treatment facilities, 2) Deep wells in the area that are assumed not to require advanced treatment, and 3) Surface water wheeled through the SRP canal system and delivered through new pipelines to the project in three locations.

Three different water demand levels were evaluated: 1) Average day demand 5 million gallons per day (MGD) with a peak-day demand of 10 MGD; 2) average demand of 10 MGD with peak demand of 20 MGD; and 3) average demand of 20 MGD with peak demand of 40 MGD.

The cost estimates are summarized in the table below. Detailed cost spreadsheets and cost assumptions are attached.

Annualized Capital and O&M Cost $/Acre-Foot
Total Capital Cost in Parenthesis

	Peak-day Demand		
	10 MGD	20 MGD	40 MGD
Surface Water	356 ($12 M)	384 ($22 M)	393 ($38 M)
Groundwater (Deep Wells)	419 ($7 M)	404 ($12M)	404 ($24M)
Groundwater (Shallow Wells)	532 ($17 M)	544 ($30 M)	544 ($60 M)

Discussion

The above cost estimates should be viewed as rough numbers for planning purposes only. There are significant questions regarding the degree of water treatment that will be required for groundwater from either of the well options.

Shallow well option costs could decrease significantly if all wells do not require treatment, and deep well option costs could increase significantly if treatment is required for either naturally occurring substances or industrial or agricultural-related contaminants. Alternative treatment technologies (i.e., constructed wetlands) if approved by regulatory agencies, could reduce treatment costs significantly while providing habitat amenities. Groundwater options assume the water recharged to accrue credits comes from the City's existing surplus CAP allocations during the early years of the project and from surplus reclaimed water at the 23rd Avenue Water Reclamation Plant. No costs are included for acquisition of additional water rights.

Surface water delivery costs include back-up wells for use during canal maintenance periods on SRP's south side system. Consideration of the surface water option assumes that replacement water supplies are available and can be secured. The City's Water Resources Plan indicates additional water supplies will be needed for projected population growth beyond the year 2020. Use of surface water for Rio Salado that is now planned for domestic use would move up in time the need for additional supplies.

All options will require further study to determine feasibility and more accurate costs if the project progresses. To fully evaluate the groundwater options, test wells would need to be drilled and water quality samples taken. Discussions with SRP would be needed to further determine feasibility and operating constraints, especially with the higher water use alternatives.

We look forward to discussing these options further with you.

KL/dkt

Attachments

c: Bill Chase
Donn Stolzfus

kl2pa29.apr

Rio Salado Water Supply Cost Analysis Assumptions

Groundwater Options

1) Well Produce Average of 2500 gpm (3.57 MGD) each..

2) Wells are 20" diameter, 200 ft. In depth for shallow well option, 1700 ft. Deep for deep well option.

3) Shallow wells will require treatment systems for both Volatile Organics (VOCs) and metals. VOC treatment will be accomplished through air stripping and granular activated carbon (GAC). Metals will be removed using ion exchange processes.

4) Deep wells would withdraw water from the lower aquifer unit only and would not require the treatment required for the shallow wells.

5) Costs for acquiring groundwater pumping credits were included in order to place the groundwater and surface water options on an equal footing for cost comparisons. Cost was based on annual CAP water purchase costs and costs to recharge in the Granite Reef Underground Storage Project (GRUSP).

6) Costs for treatment systems for each well were based on units cost figures for systems having a 1 MGD capacity. This cost was multiplied by only 2.0 instead of 3.6 (3.6 MGD per well) to allow for savings related to economies of scale.

7) A peak-day to average day demand ratio of 2.0 was assumed.

8) The number of wells required for each capacity option was rounded to the nearest whole number, and an additional well was included for backup use in the event of a well outage.

9) A time period of 20-years and a 7.5 percent interest rate was assumed for amortization purposes.

Surface Water Supply Option

1) The cost associated with acquiring a water supply to replace existing supplies was included. The cost basis used was $1,200 per AF, which is the cost paid by municipalities in recent Indian water rights settlements.

2) The supply is assumed to be wheeled from the CAP system through the CAP/SRP interconnect to the Western Canal on the south side of the Salt River. This is the closest canal to the project site with sufficient capacity to move the

required peak-day flow of 40 MGD for the high-end water demand scenario.

3) Delivery of the water was assumed to occur through three gravity flow pipe connections to the Western Canal to provide for even distribution of water through the project area.

4) A slope of 0.0035 was assumed in the pipe capacity analysis.

5) Pipe cost figures were based on recent facility cost study done for the Water Services Department by Black and Veatch.

Unknown Factors and Constraints

1) The quality of groundwater and the level of treatment required for both the shallow and deep well options is uncertain. This will have to be verified by drilling and pumping of test wells. Therefore, actual costs for the groundwater options could vary considerably from the assumptions presented here.

2) Capacity available in the SRP canal system during peak summer periods has not been investigated. At a peak demand of 40 MGD, over 25 percent of the capacity of SRP's Western Canal would be required. The capacity constraints in the Western Canal and at points upstream in the SRP system will have to be researched with SRP.

Rios 5

Rio Salado Water Supply Cost Estimates **Surface Water Option - 5 MGD Ann Av**
10 MGD Peak

Capital Cost	**Total Cap. ($mill.)**	**Amortized Cost ($/AF)**
3 -16" pipelines, 2.2 miles each @ $86/ft.	2.99	53.39
6 - Turnout /auto control structures	0.6	10.71
Acquisition of replacement water supply @ $1,200 per AF x 5,600 AF	6.72	120.00
1 Backup Well (Deep)	**1.6**	28.57
Total Capital Cost	11.91	212.68
Operation and Maintenance Costs		
O&M for Gate and Control Structures		2.00
Annual Water Resource Costs		
CAP Capital and O&M Charges		121.00
Interconnect and Wheeling Through SRP System.		20.00
Total Water Resource Cost		141.00
Total Estimated Capital and O&M Cost		355.68 $/AF

Rio Salado Water Supply Cost Estimates **Surface Water Option - 10 MGD Avg. 20 MGD Peak**

Capital Cost	**Total Cap. ($mill.)**	**Amortized Cost ($/AF)**
3 -24" pipelines, 2.2 miles each @ $133/ft.	4.63	82.68
6 - Turnout /auto control structures	0.6	10.71
Acquisition of replacement water supply @ $1,200 per AF x 11,200 AF	13.44	120.00
2 Backup Wells	3.2	28.57
Total Capital Cost	21.87	241.96
Operation and Maintenance Costs		
O&M for Gate and Control Structures		1.00
Annual Water Resource Costs		
CAP Capital and O&M Charges		121.00
Interconnect and Wheeling Through SRP System.		20.00
Total Water Resource Cost		141.00
Total Estimated Capital and O&M Cost		383.96 $/AF

Rio SE

Rio Salado Water Supply Cost Estimates **Surface Water Option - 20 MGD Avg. 40 MGD Peak**

Capital Cost	**Total Cap. ($mill.)**	**Amortized Cost ($/AF)**
3 -27" pipelines, 2.2 miles each @ $160/ft.	5.58	99.64
6 - Turnout /auto control structures	0.6	10.71
Acquisition of replacement water supply @ $1,200 per AF x 22,400 AF	26.88	120.00
1 3 backup Wells (Deep)	4.8	21.43
Total Capital Cost	37.86	251.79
Operation and Maintenance Costs		
O&M for Gate and Control Structures		0.50
Annual Water Resource Costs		
CAP Capital and O&M Charges		121.00
Interconnect and Wheeling Through SRP System.		20.00
Total Water Resource Cost		141.00
Total Estimated Capital and O&M Cost		393.29 $/AF

Rio Salado Water Supply Cost Estimates

Groundwater Option: 5 MGD Ann. Avg.
10 MGD Peak

Capital Cost	**$/Well ($mill.)**	**# Wells**	**Total Cap. ($mill.)**	**Amortized Cost ($/AF)**
Well Construction	0.63	4	2.52	45.00
Well Piping	0.13	4	0.52	9.29
VOC Treatment (Packed Col. w/GAC)	2.5	4	10	178.57
Metals Treatment (Ion Exchange)	1	4	4	71.43
Total Well Capital	4.26	4	17.04	304.29
Operation and Maintenance Costs				
Pumping and Fees				55.00
Treatment O&M				
Air Stripping w/GAC				56.00
Ion Exchange				26.00
Total O&M Cost				137.00
Water Resource Costs				
Acquist. & Recharge				
CAP Water in GRUSP				
Capital and O&M CAP				121.00
Interconnect. and Recharge Cost.				20.00
Total Water Resource Cost				141.00
Total Estimated Capital and O&M Cost				582.29

Rio Salado Water Supply Cost Estimates

Groundwater Option: 10 MGD Ann. Avg.
20 MGD Peak

Capital Cost	**$/Well ($mill.)**	**# Wells**	**Total Cap. ($mill.)**	**Amortized Cost ($/AF)**
Well Construction	0.63	7	4.41	39.38
Well Piping	0.13	7	0.91	8.13
VOC Treatment (Packed Col. w/GAC)	2.5	7	17.5	156.25
Metals Treatment (Ion Exchange)	1	7	7	62.50
Total Well Capital	4.26	7	29.82	266.25
Operation and Maintenance Costs				
Pumping and Fees				55.00
Treatment O&M				
Air Stripping w/GAC				56.00
Ion Exchange				26.00
Total O&M Cost				137.00
Water Resource Costs				
Acquist. & Recharge				
CAP Water in GRUSP				
Capital and O&M CAP				121.00
Interconnect. and Recharge Cost.				20.00
Total Water Resource Cost				141.00
Total Estimated Capital and O&M Cost				544.25 $/AF

Rio Salado Water Supply Cost Estimates

Groundwater Option: 20 MGD Ann. Avg.
40 MGD Peak

Capital Cost	**$/Well ($mill.)**	**# Wells**	**Total Cap. ($mill.)**	**Amortized Cost ($/AF)**
Well Construction	0.63	14	8.82	39.38
Well Piping	0.13	14	1.82	8.13
VOC Treatment (Packed Col. w/GAC)	2.5	14	35	156.25
Metals Treatment (Ion Exchange)	1	14	14	62.50
Total Well Capital	4.26	14	59.64	266.25
Operation and Maintenance Costs				
Pumping and Fees				55.00
Treatment O&M				
Air Stripping w/GAC				56.00
Ion Exchange				26.00
Total O&M Cost				137.00
Water Resource Costs				
Acquist. & Recharge				
CAP Water in GRUSP				
Capital and O&M CAP				121.00
Interconnect. and Recharge Cost.				20.00
Total Water Resource Cost				141.00
Total Estimated Capital and O&M Cost				544.25 $/AF

Rio510

Rio Salado Water Supply Cost Estimates

Groundwater Option: 5 MGD Ann. Avg.
Deep Wells 10 MGD Peak

Capital Cost	$/Well ($mill.)	# Wells	Total Cap. ($mill.)	Amortized Cost ($/AF)
Well Construction	1.6	4	6.4	114.29
Well Piping	0.13	4	0.52	9.29
VOC Treatment (Packed Col. w/GAC)	0	4	0	0.00
Metals Treatment (Ion Exchange)	0	4	0	0.00
Total Well Capital	1.73	4	6.92	123.57
Operation and Maintenance Costs				
Pumping and Fees				155.00
Treatment O&M				
Air Stripping w/GAC				0.00
Ion Exchange				0.00
Total O&M Cost				155.00
Water Resource Costs				
Acquist. & Recharge				
CAP Water in GRUSP				
Capital and O&M CAP				121.00
Interconnect. and Recharge Cost.				20.00
Total Water Resource Cost				141.00
Total Estimated Capital and O&M Cost				419.57

R10512

Rio Salado Water Supply Cost Estimates

Groundwater Option: 10 MGD Ann. Avg.
Deep Wells 20 MGD Peak

Capital Cost	$/Well ($mill.)	# Wells	Total Cap. ($mill.)	Amortized Cost ($/AF)
Well Construction	1.6	7	11.2	100.00
Well Piping	0.13	7	0.91	8.13
VOC Treatment (Packed Col. w/GAC)	0	7	0	0.00
Metals Treatment (Ion Exchange)	0	7	0	0.00
Total Well Capital	1.73	7	12.11	108.13
Operation and Maintenance Costs				
Pumping and Fees				155.00
Treatment O&M				
Air Stripping w/GAC				0.00
Ion Exchange				0.00
Total O&M Cost				155.00
Water Resource Costs				
Acquist. & Recharge				
CAP Water in GRUSP				
Capital and O&M CAP				121.00
Interconnect. and Recharge Cost.				20.00
Total Water Resource Cost				141.00
Total Estimated Capital and O&M Cost				404.13 $/AF

Rio Salado Water Supply Cost Estimates

Groundwater Option: 20 MGD Ann. Avg.
Deep Wells 40 MGD Peak

Capital Cost	$/Well ($mill.)	# Wells	Total Cap. ($mill.)	Amortized Cost ($/AF)
Well Construction	1.6	14	22.4	100.00
Well Piping	0.13	14	1.82	8.13
VOC Treatment (Packed Col. w/GAC)	0	14	0	0.00
Metals Treatment (Ion Exchange)	0	14	0	0.00
Total Well Capital	1.73	14	24.22	108.13
Operation and Maintenance Costs				
Pumping and Fees				155.00
Treatment O&M				
Air Stripping w/GAC				0.00
Ion Exchange				0.00
Total O&M Cost				155.00
Water Resource Costs				
Acquist. & Recharge				
CAP Water in GRUSP				
Capital and O&M CAP				121.00
Interconnect. and Recharge Cost.				20.00
Total Water Resource Cost				141.00
Total Estimated Capital and O&M Cost				404.13 $/AF

Rio Salado Habitat Restoration Project
Tempe Cienega

Preliminary Water Source Study

Prepared by City of Tempe, Public Works - Water Management Division

May 13, 1997

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Background

The City of Tempe's Water Management Division (WMD) was asked to provide recommendations for a source of water supply to restore wetlands and habitat to historic condition along three reaches of the Salt River within Tempe. The three reaches are: 1) within the Indian Bend Wash (IBW) between McKellips Road and the IBW drop structure into the Salt River (IBW reach), 2) within the Salt River directly upstream of the planned Rio Salado Town Lake upstream rubber dam (SRU reach), and 3) within the Salt River downstream of the planned Rio Salado Town Lake downstream rubber dam (SRD reach). The relative sizes of these areas are approximately 25-30 acres in the IBW site, approximately 60 acres in the upstream Salt River site, and approximately 80 acres in the downstream Salt River site. The water allocation required to sustain these proposed improvements is estimated to be approximately 750 acre-feet per year (equivalent to a continuous flow of about 465 gpm).

Water Sources

WMD staff considered several potential sources of water supply for this remediation project. Each of those sources is briefly discussed in the following paragraphs

Rio Salado Golf Course Well

The Rio Salado Golf Course is located near the IBW between McKellips and Curry Roads, and is directly upstream of the IBW reach. The golf course has a well with a capacity of 500 gpm (800 acre-feet per year). The well pumps into an on-site pond which is then used to pressure irrigate the golf course. The golf course has an annual groundwater allotment of approximately 217 acre-feet. Historically they have used their total allotment to irrigate the golf course. Under current ADWR regulation no additional groundwater can be withdrawn from this well.

City of Tempe Well #6

Well #6 is located on SRP non-member lands west and nearly adjacent to the IBW just south of McKellips Road. It is piped to allow discharge to the SRP Indian Bend Pump Ditch, or directly into the IBW via a storm drain. The well has a pumping capacity of approximately 2400 gpm (3800 acre-feet per year) but pumps from an aquifer contaminated with volatile organic compounds (VOC's) throughout it's total depth. This well is located within a plume of VOC contamination (predominantly trichloroethylene, or TCE) in the North Indian Bend Wash Super Fund Site (NIBW SFS). Use of this well as a water source for the habitat remediation project would require clean-up of the VOC contamination in the well discharge to meet drinking water standards. The groundwater discharge from the well currently contains TCE levels above Arizona Aquifer Water Quality Standards (AAWQS for TCE = 5 ug/l, current wellhead discharge TCE concentration = 10-20 ug/l). Total Dissolved Solids (TDS) levels in Well #6 are in the 400 to 700 ug/l range. There may also be USEPA permitting issues due to the possibility of impacting ongoing remedial actions at the NIBW SFS by increased pumping at Well #6.

The following table lists the ranges of specific groundwater quality parameters from recent sampling at COT Well #6.

<u>COT Well #6 - Groundwater Chemistry</u> (in *mg/l, unless otherwise noted; ND = Non-detect*)

Total Dissolved Solids (TDS): 620 - 780
pH: 7.4 to 7.9
T. Alkalinity: 148 - 182
U. Hardness: 246 -276
CA++ Hardness: 56 - 109
Conductivity: 1200 - 1325 us/cm
Fluoride: 0.40 -0.46
Chloride: 181 - 269
Nitrate - N: 3.2 - 4.0
Sulfate: 81 - 101
Trichloroethylene (TCE): 7 - 26 ug/L
Tetrachloroethylene (PCE): ND - 0.8 ug/L
Chloroform: ND - 0.7 ug/L

If water from COT Well #6 is delivered to the IBW wetland site via the IBW channel, additional water will need to be scheduled for delivery to make up for transmission losses, unless some infiltration reduction measures are incorporated into the IBW channel. Use of the SRP Indian Bend Pump Ditch pipeline system to convey water to the IBW wetlands site may be possible, except during peak irrigation season on the SRP system. This SRP pipeline has a capacity of approximately 25 cfs. Deliveries to the wetland through this pipeline would only require flows of 1 to 2 cfs. Use of the SRP Indian Bend Pump Ditch pipeline system would eliminate most of the conveyance losses that would occur in the IBW reach between McKellips Road and Curry Road if the water were delivered to the wetland reach below Curry Road through the IBW channel.

Any groundwater withdrawn from COT Well #6 for this project will have to be credited as a recovery of underground storage credits unless the groundwater is considered to be a poor quality water source or part of the remedial action at the NIBW SFS. The current WQARF legislation provides exemptions for pumping of poor quality groundwater or groundwater extracted in remedial actions. It is likely that any increased level of pumping at COT Well #6 for this project will be subject to review or approval by the EPA and ADEQ due to potential impacts to the NIBW remedial action plan.

Scottsdale Indian Bend Wash Lakes/Well Supply from NIBW Remedial Actions

Scottsdale has a series of lakes in the IBW north of McKellips Road. These lakes are fed by Scottsdale and SRP wells to create a linear park with many recreational opportunities. Additional well pumping by Scottsdale and SRP could be used to provide water for the proposed habitat. However, some of the wells are located in the NIBW SFS and would require well head treatment of the water to drinking water standards. Any pumping from SRP wells would have to be "paid back" because of use on non-member lands. Any additional pumping from City of Scottsdale wells already utilized for

IBW lake supply would also require payback with other water supplies or a payment for water delivered.

If water from the Scottsdale IBW Lakes were to be delivered to the IBW wetland site via the IBW channel, additional water will need to be scheduled for delivery to make up for transmission losses. Similar to the option for delivery of water from COT Well #6, use of the SRP Indian Bend Pump Ditch pipeline system to convey water to the IBW wetland site may be possible, except during peak irrigation season on the SRP system, reducing conveyance losses to the IBW wetland site.

Additional water supplies may become available in the future from remedial groundwater pumping and treatment in the NIBW area. These supplies could be delivered to the IBW reach via overflow from the Scottsdale IBW lakes or through the SRP Indian Bend Pump Ditch. These water supplies may be subject to the SRP member/non-member land use limitations or payback requirements.

City of Scottsdale Well 69 - Scottsdale Metering Station Well

The City of Scottsdale (COS) has an unused, or underutilized well at a location favorable to provide a water supply for this proposed project. COS Well #69, also known as the COS Metering Station Well, is located near the IBW, south of Curry Road and north of the Salt River near the COS Fire Training Facility. Recent NIBW data indicates that this well is not currently being used. No discussions with COS officials have taken place with regard to the potential use of this well.

SRP Replacement Water

SRP water could be used to as a source of supply for the habitat remediation. However, use of the water on non-member lands would require pay back. The source for pay back water would most likely be high-cost CAP water if any were available.

Salt River Pima Maricopa Indian Community

These Indian reservation lands have ample water supply. In addition, the close proximity of some of these lands to the Rio Salado project suggest that significant development may occur in the future. The opportunity exists for potential exchanges of water supplies with the Community in the future. It is possible that negotiations with the SRPMIC could result in sources of water to use in the habitat remediation project. However, no discussions have taken place and the time frame for any negotiated water exchange is probably 5 to 10 years, after development is underway in the Rio Salado Project and the surrounding area.

South Indian Bend Wash Super Fund Site (SIBW SFS)

The USEPA has a potential groundwater remediation project in the SIBWSFS which could supply water for the habitat. Again, the time frame for this project is long term ... probably 5 to 10 years. This water will be part of a groundwater remediation action for the SIBW SFS and will not need to be credited a s a recovery of underground storage credits. If the SIBW remediation wells are located on SRP member lands, there are

potential SRP payback issues for use of this water at the wetlands habitat sites, all of which are SRP non-member land.

Papago Backwash Discharge

The Papago Water Treatment Plant (PWTP) discharges decanted filter backwash water through a riparian area near the Arizona Historical Museum, through Papago Park at College Avenue and Curry Road, and ultimately into SRP's Indian Bend Pump Ditch. The flow is estimated to be approximately 250 acre-feet per year. This water source could possibly be combined with, or exchanged for, other sources to supply water to the potential habitat sites.

APS Cooling Tower Blowdown

The APS Ocotillo Power Plant is located at the northwest corner of McClintock Drive and University Drive. The plant uses groundwater to provide cooling water for the steam generation process. The water is typically cycled through the cooling towers several times concentrating the TDS and creating salty wastewater. APS currently disposes of this waste flow through municipal sewers. The flow could be routed to the SRU reach with minimal capital expenditure. At this time the flows are unknown. A fatal flaw may be the TDS levels in the water ... it may be too salty to sustain plant life.

Ranking of Potential Water Sources

The attached spreadsheet/matrix (Figure 1) outlines estimated costs for each of the alternatives discussed. Each alternative has been assigned a Water Source Probability based on the WMD's staff knowledge of current political forces and water availability.

There are two potential water sources that can be assigned a HIGH probability as a supply for the proposed habitat project. These are City of Tempe Well #6 and SRP Replacement Water.

COT Well #6

This well is a known commodity, it will produce plenty of water but the quality is such that wellhead treatment would be required. Wellhead treatment means substantial up-front capital costs and annual O&M costs in addition to normal pumping costs. An advantage of Well #6 is it's location, on non-member land, so SRP pay back issues are irrelevant. The well also has enough capacity to provide water for all three habitat sites with plenty left over to be used by the CoT WMD to pay back SRP for other non-member land uses throughout the City. This alternative has estimated capital costs of $703,000 for wellhead treatment, annual O&M costs (for wellhead treatment) of $20,000 and an estimated water cost of $47 per acre-foot. The uncertainty about Well #6 is related to the location of the well in proximity to the groundwater remediation already underway.

SRP Replacement Water

It is possible to arrange deliveries of SRP water to the habitat sites. However, because these sites are on non-member land the water would have to be paid back to SRP. Purchased CAP water is the most likely source of supply for the pay back water. There are no estimated capital or O&M costs associated with this alternative but the water cost is estimated to be $175 per acre-foot. This cost could also rise if CAP water prices rise.

Conclusions & Recommendations

Well #6 provides the best opportunity for a water source solution for the proposed habitat restoration project. There is adequate water available, there are no SRP pay back or accounting issues to deal with, if the groundwater withdrawal can be classified as a remediation project no charges will be made against current banked groundwater sources, and the source provides opportunities for the CoT WMD to pay back other non-member land uses in the City ... a Win-Win project.

Alternative Water Sources fo orps/Rio Salado Wetlands

				Infrastructure Costs			Water Related Costs										
Alt.	Water Source	Available Flow (GPM)	Water Source Probability	Estimated Capital Cost	Estimated Annual O&M Cost	WMD Acquisition Cost ($/AF)	Estimated 1997 Replacement Cost ($/AF)	+	Recovery Cost ($/AF)	+	Transport Cost ($/AF)	=	Cost to WMD ($/AF)	+	Admin Cost ($/AF)	=	Cost to Project ($/AF)
1	Rio Salado Golf Course Well	None	None	N/A	N/A	N/A	N/A		N/A		N/A		N/A		N/A		N/A
2	City of Tempe Well #6	2400	High	703,000	20,000	0	0		32		10		42		5		47
3	Scottsdale Indian Bend Wash Lakes/Wells	?	Low	703,000	20,000	117	117		32		10		159		16		175
4	City of Scottsdale Well #69	?	Medium	*	*	117	117		32		10		159		16		175
5	SRP Replacement Water	Adequate	High	0	0	117	117		32		10		159		16		175
6	Salt River Pima Maricopa Indian Community	?	Low	?	?	117	117		32		10		159		16		175
7	South Indian Bend Wash Superfund Site	?	Low	?	?	?	?		?		?		?		?		?
8	Papago Backwash Discharge	255	Medium	50,000	0	10	117		0		10		127		13		140
9	APS Cooling Tower Discharge **	?	Low	?	?	?	?		?		?		?		?		?

* Unknown water quality ... may require wellhead treatment with associated annual O&M costs

** Water quality may be fatal flaw ... TDS too high

Figure 1

RIO SALADO, SALT RIVER
ARIZONA

APPENDIX I

RECREATION

U.S. ARMY CORPS OF ENGINEERS
LOS ANGELES DISTRICT
SOUTH PACIFIC DIVISION
MAY 1997

RIO SALADO HABITAT RESTORATION PROJECT - Recreation Component

Prepared for
United States Army Corps of Engineers

by
City of Phoenix Parks, Recreation and Library Department
Phoenix, Arizona

May 12, 1997

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1

NARRATIVE DESCRIPTION OF RECREATION FEATURES

The *Rio Salado Habitat Restoration Project*, in the heart of the City of Phoenix, provides a unique opportunity for resource-based recreation and environmental education. The restoration of the dry Salt River bed will bring a riparian open space feature to the downtown area spanning 5 miles and over 500 acres. A desert riparian habitat in the center of an urban area is unlike any other resource within the City, and like the Mountain Preserve will provide for unique recreational opportunities to residents and out of town visitors alike.

Drawing on a valley population base of two million, it is estimated that visitation to the Rio Salado project could top one half million annually. Primary use times for this unique resource would coincide with the "visitor season" typically between October and May when temperatures are moderate. Recognizing our diverse society, the Rio Salado will have design components which reflect this ranging from areas for adaptive or special needs to multi-lingual signage.

The goal of the recreation component is to provide opportunities for visitors of all ages and from varied backgrounds to enjoy this unique resource while developing an awareness, knowledge and understanding of desert riparian habitats and its interrelatedness to the environment as a whole. Additionally, it is an opportunity to share the role of the Rio Salado through the history of the Valley including pre history. Visitors to this day use area will have the opportunity to participate in a wide variety of recreation pursuits ranging from enjoying scenic views, picnicking with the family, learning about the habitat or exploring the resource on foot, by bicycle or horseback.

For planning purposes the recreation component has been divided into three primary areas:
The Bank; The Terrace; and The Riverbed. Each of these areas provides a different venue for recreational opportunities ranging from *Active, Moderate and Passive* which coincide with learning opportunities allowing participants to learn; see; and experience the resource first hand.

The Bank provides experiences including hiking, biking, and horseback riding to scenic overlooks and leisure walking, in a restored desert riparian habitat.

The Terrace is the area where the habitat has the most direct access to a permanent water source to create a self sustaining eco system. This area will create a balance between trails and interpretive experiences for man and preservation of native desert fauna and flora in their own habitat.

The Riverbed represents an area unaltered by man, and will change in response to seasonal 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 which define and shape desert rivers.

The Bank Experience

The Rio Salado experience will vary for users, ranging from individuals who may just enjoy the scenic vistas as they travel through the area, to families who may plan for a day visit to the resource. Typically visitors to the Rio Salado will be able to arrive by private vehicle, or alternate mode of transportation including public transit or bicycle. Users would enter at one of three primary access points along *The Bank* at 7th Avenue, Central Avenue or 16th Street. Each access point will provide appropriate signage and an orientation kiosk or visitor centers which will give visitors an overview of the myriad of activities and experiences available at the Rio Salado. Additionally, it will orient users to the sensitivity of the area and appropriate uses and expectations. Amenities at each access point will vary, but may include; parking, restroom facilities, water fountains, shade structures, site furniture and appropriate lighting. 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 trails will allow visitors to explore the Rio Salado Bank on foot, horseback, bicycle, or roller blades. Exercise or Par courses can be included. The hard pack service/access road, will accommodate a variety of cycling activities allowing for travel along the entire project. Natural surface trails will traverse the bank leading foot traffic, horseback and mountain bicycles to scenic overlooks, or loops throughout the area. Additionally, an accessible trail will be provided for users with limited mobility. Interpretive trails will allow for self-guided tours of the area.

Scenic Overlooks:
Accessible locations along the roadways or by trail will allow for family picnicking, informal play and scenic vistas of the entire project. More secluded areas will provide for informal seating and meditation gardens.

Interpretive Opportunities:
Kiosks, signed trails, and multimedia displays will give visitors information regarding the resource including the restoration of the habitat, the hydro cycle, a historical perspective of the Salt River and flora and fauna within the project area.

Outdoor Terraced Seating with stage:
A terraced grass seating area will be provided for groups of 50-75 to attend lectures and special interest speakers.

Outdoor Classrooms:
Areas will be designed for groups and classes of 50 to 75 to gather and prepare for a learning experiences at the Rio Salado.

The Terrace Experience

The Terrace will provide for more moderate recreation including interpretive trails, outdoor classrooms and study areas. *The Terrace* will be accessible by trail from select locations along *The Bank*. 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. Due to the sensitive nature of *The Terrace*, no pets or bicycles will be allowed. *The Terrace* will provide opportunities for environmental education and developing an understanding of how the habitat has been restored. Some areas of *The Terrace* will be designated as "sensitive" habitat, and may be protected from public impacts.

Opportunities available at *The Terrace* will include:

Trails:
Trails will transition visitors from *The Bank* to the more sensitive *Terrace Habitat* and will be available for hikers and horseback rides. An accessible interpretive trail will be provided for visitors with limited mobility along with signage regarding the Habitat Restoration Project.

Scenic Overlooks:
Locations along *The Terrace* will allow for family picnicking, interpretive opportunities and provide scenic vistas of the river bed below. More secluded areas will provide for informal seating and meditation gardens.

Habitat Views:
Special areas will provide wildlife blinds allowing visitors an opportunity to observe wildlife in their natural habitat. Signage about the particular Habitat will be provided.

Demonstration Gardens:
Gardens along *The Terrace* will provide visitors insight into the inner workings of a habitat restoration project and its role in balancing the fragile ecosystem. Special "wetlands" walks, or trails to ponding areas featuring aquatic vegetation will be provided.

Study Areas:
These unique areas will allow opportunities for educational institutions to conduct long range or one day study of the unique workings of the Rio Salado including water conservation, riparian areas and habitat restoration as well as vegetation and wildlife.

Birding:
These unique areas will allow opportunities for novice and experienced birders to view and learn about the variety of water foul, birds of prey, migratory and song birds that will find sanctuary within the Rio Salado habitat.

Urban Fishing:
Ponds providing habitat for fish will allow anglers opportunities to fish in an urban setting.

Outdoor Classrooms:
Areas will be designed for groups and classes of 50 to 75 to gather and prepare for a learning experiences at the Rio Salado.

The Riverbed Experience

The Riverbed is the true sensitive habitat of the Rio Salado, and will provide visitors unique opportunities to view, enjoy and experience a restored desert riparian habitat. This area allows one to explore an unaltered riparian zone supported only by limited stream flows and surface runoff. Some areas within *The Riverbed* will be designated as sanctuary or conservation areas, restricted to public use, allowing for the protection of biologically sensitive animals and plant life. No pets and limited mechanized means of travel will be allowed in *The Riverbed*. Natural surface trails will lead visitors to *The Riverbed* from *The Terrace*, and allow for a crossing of the stream bed expanding opportunities to loop and explore the river habitat. Visitors to the area will leave with a heightened awareness of the fragile relationship between water availability and habitat in the desert.

2

EXPECTED FUTURE VISITATION

Annual Visitation

The Rio Salado Recreation Component is designed to provide for high quality experiences in a unique riparian area. Overall capacity of the parking facilities will be designed for not more than 250 vehicles. 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 vehicle. Additionally, it is estimated that .25 visitors arrive to the site by an alternate mode of transportation including bicycle, foot traffic and public transportation.

In the Valley of the Sun, visitation to recreational sites coincides with temperature. Phoenix is sunny, experiencing 7.5 inches of annual rainfall. Visitation is looked at 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, as well as numerous "winter residents". Summer months bring hot sunny days, and occasional afternoon thunderstorms. Temperatures average 102 degrees, making the early mornings and evenings the best time for recreational pursuits.

Anticipated visitation at the Rio Salado is based on use projections during PRIME TIME and NON-PRIME TIME throughout the year. PRIME TIME consists of high visitation days, and includes weekends and holidays. NON-PRIME TIME are weekdays. The unique design of the resource, balances recreational experiences and preservation. A visit to Rio Salado is expended to span 3 hours at the resource, although many visits will be longer, and some much shorter. Turnover refers to the number of times it is anticipated a parking space will be filled daily.

Below is a breakdown of anticipated visitation during WINTER and SUMMER for both PRIME TIME and NON-PRIME TIME.

WINTER 79% of annual use			**412,500 visitors**
PRIME TIME	70 days	3 turnovers	157,500 visitors
NON-PRIME TIME	170 days	2 turnovers	255,000 visitors
SUMMER 21 % of annual use			**111,000 visitors**
PRIME TIME	28 days	2 turnovers	42,000 visitors
NON-PRIME TIME	92 days	1 turnover	69,000 visitors

TOTAL ANNUAL VISITATION 523,500

Future Visitation Growth

As the valley population grows, and the Rio Salado matures, visitation to the resource is anticipated to increase. It is anticipated that WINTER PRIME TIME visitation will be at facility capacity. The growth during this time will be with those visiting the resource through alternative means such as improved trail linkages. Growth in this time period will increase by 5% over 20 years, for a total increase of 20,625 visitors.

The greatest increase in growth 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 the Rio Salado. It is anticipated that visitation during the summer will increase by 72% over 20 years for a total increase of 80,500 visitors.

Overall visitation increase for the resource over 20 years is projected to be approximately 100,000.

3

POINT VALUE ASSESSMENT

Point Value Estimates

(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: 16***

None 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 the Rio Salado are 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. The Rio Salado is located within a metropolitan area with access to the interstate highway system, major public transportation routes, major traffic thoroughfares, and neighborhood and 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 urban blight. Most notable of this is the federal governments distinction of the surrounding area being designated an Empowerment Zone / Economic Community.

TOTAL POSSIBLE POINTS: 100 **TOTAL SCORED POINTS: 94**

Assessment Panel Members

A panel of Phoenix Parks, Recreation and Library Department employees from a variety of recreation, design, and resource management backgrounds reviewed and scored the factor justification utilizing Table 6-29 to determine point values for the Rio Salado Recreation Component:

René Vera	Recreation Supervisor
Sarah Hall	Park Manager
Walt Kinsler	Landscape Architect II
Veronica Zendejas	Recreation Coordinator II
Randy Singh	Park Manager

4

TRANSFERS OF RECREATION FROM OTHER SITES

Narrative

It is estimated that the Rio Salado will have little to no impact on visitation at other resource based facilities in the area, resulting in minimal "transfer".

The Rio Salado will provide a unique riparian area unlike any other resource in the metropolitan area. This fact, coupled with the ever growing demand for resource based recreation sites makes "transfer of use" minimal. Existing resource based sites have a primary use of hikers and mountain bikers seeking varied trails with significant elevation gains of 500 to 1,000 feet. This is not available at Rio Salado.

Within a 25 mile radius of Rio Salado, it is envisioned that the use groups which may transfer from other sites include:

- educational field trips
- bird watchers
- passive nature watchers
- canal joggers
- recreational cyclists

These groups account for approximately 5% or 250,000 of the total annual visitation at an existing resource based facility with visitation of approximately one million. Five percent will account for an approximate transfer of 12,500 visitors.

5

PRELIMINARY COST ESTIMATES

Attachment

Preliminary Cost Estimates

24TH STREET TO 19TH AVENUE

DESCRIPTION	QUANTITY	UNIT COST	TOTAL
PARKING LOTS			
A	130 spcs.	$1,000/spc.	$130,000
B	60 spcs.	$1,000/spc.	$60,000
C	60 spcs.	$1,000/spc.	$60,000
STRUCTURES			
Information Kiosk			
Large	3	$15,000/ea.	$45,000
Medium	5	$7,500/ea.	$37,500
Small	9	$3,000/ea.	$27,000
Visitor Center/ Interpretive Center	5,000sf.	$110/sf	$550,000
Overlooks w/ railing			
Large (1225 sf.)	2	$40,000/ea.	$80,000
Medium (625 sf.)	5	$20,000/ea.	$100,000
Small (225 sf.)	9	$10,000/ea.	$90,000
Shade Structures			
Large	3	$60,000/ea	$180,000
Medium	5	$30,000/ea.	$150,000
Small	9	$10,000/ea.	$90,000
Bridges			
Large (50' span)	2	$50,000/ea.	$100,000
Medium (30' span)	2	$30,000/ea.	$60,000
Small (15' span)	5	$15,000/ea.	$75,000
Restroom Facility	2	$150,000/ea	$300,000
TRAILS			
Paved Interpretive	84,480 sf.	$3.00/sf.	$253,440
Stabililized D. G.	126,720 sf.	$.90/sf.	$114,050
Graded Earthen	464,640 sf.	$.10/sf.	$46,500
Ramps	35,000 sf.	$2.50/sf.	$87,500
RETAINING WALLS			
C.I.P.	2,000 Lf.	$150/Lf.	$300,000
Gabions	2,000 Lf.	$80/Lf.	$160,000
Boulders	4,000 Lf.	$50/Lf.	$200,000

DEMONSTRATION GARDENS	4	$125,000/ea.	$500,000
OUTDOOR CLASSROOMS			
Large Formal (30-70 people)	1	$75,000	$75,000
Medium Formal (20-40 people)	1	$40,000	$40,000
Small Informal (5-15 people)	2	$20,000/ea.	$40,000
INTERPRETIVE SIGNAGE/DISPLAYS	250	$300/ea	$75,000
LANDSCAPE MATERIAL			
Willow			
36" box	50	$800/ea.	$40,000
24" box	110	$200/ea.	$22,000
15 gallon	250	$70/ea.	$17,500
5 gallon	400	$30/ea.	$12,000
Mesquite			
36" box	50	$800/ea.	$40,000
24" box	110	$200/ea.	$22,000
15 gallon	250	$70/ea	$17,500
5 gallon	400	$30/ea.	$12,000
Riparian Seed Mix	100,000 sf.	$.10/sf.	$10,000
IRRIGATION SYSTEM	L.S.		$538,010
MISCELLANEOUS			
Drinking Fountains	10	$5,000/ea.	$50,000
Benches			
custom	20	$1,500/ea	$30,000
recycled	60	$800/ea.	$48,000
ELECTRICAL			
Service	L.S.		$75,000
Area Lights	10	$4,000/ea.	$40,000
TOTAL			**$5,000,000**

OPERATION AND MAINTENANCE

The development of the Rio Salado Habitat Restoration Project is anticipated to take approximately 4 years. Once construction is complete, and the resource is open for public day use, Operation and Maintenance will begin. The projected Operation and Maintenance costs for the Rio Salado Recreation Component are estimated to be 1.5 million annually. This breaks down to an cost off approximately $2,727 per acre for the 550 acre site. This cost should remain constant except for annual inflation.

The Rio Salado will be a day use area open 365 days a year. Daily operation and maintenance will be consistent with the generally approved standards for the City of Phoenix Parks, Recreation and Library Department which includes a preventative maintenance program.

A further breakdown of the projected cost is shown below.

Personnel **$1,069,000.**

Daily operation including litter control, tree and shrub maintenance, irrigation system operation and maintenance, trail maintenance and repair, trash receptacle emptying and maintenance, erosion control, sign maintenance, safety inspections, site and visitor security, restroom cleaning, interpretive programming.

Commodities **$ 171,000.**

Equipment and supplies for daily operations

Contractual **$ 260,000.**

Refuse collection, water, sewer, fleet maintenance, electrical and mechanical.

Annual Maintenance Cost **$1,500,000**

First Time Cost **$ 500,000**

Furniture, fixtures, vehicles, radios

First Year and Annual Maintenance Cost **$2,000,000**

Rio Salado Habitat Restoration Project
Tempe Cienega

Preliminary Recreation Plan

Prepared by City of Tempe, Economic Development and Community Services with
Logan Simpson & Dye

May 13, 1997

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Introduction

The vision for the Tempe Rio Salado originated at Arizona State University nearly 30 years ago. Once the dream of the many citizens, the project is ready to move forward and turn the dream into reality. The Rio Salado Project will provide a recreational and commercial experience while re-capturing the historical character of the Salt River. The restoration of the river will bring water-based open space back to the City of Tempe. Ultimately there will be a transformation into a desert oasis featuring a multitude of public recreational opportunities integrated with commercial and residential projects.

A primary component will include the *Rio Salado Habitat Restoration Project.* In the heart of metropolitan Phoenix, this project will provide a unique opportunity for recreation and environmental education. The project proposes to re-establish a desert riparian habitat, providing a unique resource and a regional attraction for the entire metropolitan Phoenix area. Situated in the heart of downtown Tempe, the project will benefit from the current popularity of the area as well as the proposed future growth associated with the Rio Salado project. Surrounding east valley communities and out-of-town visitors have easy access to this recreational attraction.

Currently, the US Army Corps of Engineers is conducting a feasibility study for the Salt River Restoration Project and will be responsible for planning and designing the Project features. As part of the City of Tempe's in-kind services to be provided to the Corps, various design ideas and clarifications are being prepared through reports such as this one. This report will describe the restoration and recreation elements proposed for the Project areas upstream and downstream of the Tempe Town Lake. The restoration portion is included to justify some of the recreational elements. The methods used to assess recreational effects complies with the National Economic Development (NED) benefit calculation procedures outlined in Engineer Regulation (ER) 1105-2-100 (U.S. Army Corps of Engineers, 1990), specifically those described in Chapter 6, Section VIII - NED Benefit Evaluation Procedure: Recreation. The assessment will include and estimation for visitor use days for a fifty year period, 1998 - 2048.

Upstream Recreation Plan

This portion of the Project, comprised of approximately 71 acres, is separated into two units called the Indian Bend Wash Unit and the Upstream Salt River Unit. These areas are defined by separate inflow channels into the Project which merge at the confluence of the wash and river to form the upstream limits of the Town Lake. Generally, Indian Bend Wash carries storm flows for a local watershed, encompassing the City of Scottsdale and Maricopa County areas farther north. The Salt River is part of a State-wide system that conveys run-off from central Arizona to the Gulf of California and the Pacific Ocean. Because of the different watersheds with which these units are associated, they have different flow characteristics.

Indian Bend Wash (IBW) Unit

The IBW Unit is subdivided by physiographic differences within its length. North of Curry Road, a low flow channel (approximately 150' wide) bisects the private Rio Salado Golf Course. The course layout is oriented in a north/south arrangement on either side of the low-flow channel between Curry Road and McKellips Road. The channel was established in this location in the 1970's, and storm flows onto the course are rare. No formal attempts have been made to re-vegetate the channel; vegetation has established naturally. The existing vegetation is sparse and of poor quality. Invasive exotics and opportunistic species are found in this reach of the channel.

The proposed restoration activities in this reach include the planting of mesquite trees along the transition area between the golf course and the channel. The trees will be placed to take advantage of the runoff from daily watering at the course which naturally flows toward the channel. In order to improve the poor quality of habitat in the area, the plan introduces tree species which previously existed along the IBW. Within the channel bottom, wetland/marsh habitat will be constructed to provide a high quality habitat. It is anticipated that water fowl such as ducks, herons and terrestrial animals will benefit from the wetland habitat establishment.

The City does not wish to encourage recreational use in the low-flow channel, due to the existing golf course, therefore, no activities are proposed in this portion of the project area. Restoration of the existing channel for habitat enhancements the only intended use of the wash. However, citizens will benefit from the occasional animal sightings and bird watching opportunities which are not currently available.

South of Curry Road, the existing landscape is composed of bare earth with negligible habitat value. Remnants of a former City of Tempe park (including sections of concrete sidewalk, turf and security lighting) exist within 300 feet south of Curry Road. Between the park remnants and the Indian Bend Drop Structure to the south, the landscape is mostly barren, with little vegetative cover. The low flow channel in this reach becomes indistinguishable as it approaches the Indian Bend Drop Structure.

The proposed restoration treatment calls for the establishment of mesquite groves along the low flow channel to replicate historic conditions along the IBW. Storm flows in this section fan out over the terraces and cover almost all portions of the channel: turf, irrigated with an automatic system, is proposed to provide erosion control and open space park. Wetland/marsh habitat is recommended within the limits of the low flow channel and will provide supplemental wildlife values in the IBW. The wetlands will be constructed using organic compounds mixed with in-situ soil to create the reservoir lining. A unique feature of this restoration activity is the installation of a diverter pipe system from the IBW wetland/marsh habitat to the Salt River restoration area. This pipe will allow water levels in the IBW wetland to be controlled and maintained without damage to the installed improvements.

South of Curry Road, recreation elements such as multi-use trails with wayfinding signage, ramadas, interpretive/environmental education features, a comfort station, picnic tables, grassed open space and a parking lot. The multi-use trails are the primary access for security patrols, the Flood Control District and maintenance of the restoration project. The trails will serve as a circumnavigational pedestrian routes around the Town Lake and will connect to regional and inter-City recreation trail networks. The trail's placement has been located to provide the greatest opportunities for exploration of the Project features. All trails will be accessible to limited mobility individuals, as permitted by grades and access. While the trails will service the many visitors to the commercial businesses planned on the south bank of the Town Lake, they will also serve as throughways for recreationalists wanting to traverse the developed Salt River from Mesa to Phoenix. At appropriate locations along the trails, wayfinding signage is proposed to inform the users of directional information and additional recreational opportunities on each trail. A sign package is being developed for the entire reach of the City of Tempe Rio Salado project.

Environmental education features and displays are proposed along each of the two major north-south trails along the IBW. These features will provide interpretive information and displays about the benefits of recreation development in the reach, the relationship of the Tempe IBW to recreation development within the City of Scottsdale, restoration activities associated with the Tempe IBW reach, and the purpose and techniques for control of storm flows in the Tempe IBW.

Near the intersection of Curry and Miller Roads, a small parking lot of 55 cars is proposed. This is the only City of Tempe lot dedicated for recreation users of the IBW/Town Lake because of the predominance of commercial use of land around the Lake. It is anticipated that recreationalists will use the IBW lot in association with the nearby amenities for picnicking, wildlife viewing, hiking, and general recreation.

Upstream Salt River Unit

The native habitat of the Salt River has been lost due to flood control management and irrigation demand for runoff water impounded at upstream dams. In addition, channelization of the Salt River in 1992 eliminated remaining vegetation within the area. What exists within the river bottom at this time is a combination of self-established exotic and native species. The primary vegetation is thin grasses. Minor vegetation is associated with municipal drainage outfalls entering the river. The habitat values of the area are negligible.

The proposed restoration will entail seeding native grasses and desert scrub species over the majority of the river bottom. This desert scrub will provide erosion protection and will offer wildlife enhanced foraging and cover opportunities. The introduced species are anticipated to thrive near the municipal outfalls. Wetland/marsh habitat types are proposed for a section of the river bottom adjacent to the upstream dam of the Town Lake. This habitat will be supplied by stream flows in the Salt River and diversions from the IBW and from municipal outfalls. The habitat can be dewatered (to control the amount of water) through a by pass system around the

Lake (south bank). The wetlands will be constructed using organic compounds mixed with in-situ soil to create the reservoir lining. Aquatic organisms will flourish in the warm temperature of the wetlands. Fish will not be introduced into the wetlands, it is expected that opportunists will occasionally deposit native and exotic species into the system.

Adjacent to the wetlands/marsh habitat, Cottonwood/willow and other aquatic-dependent species will be installed. A 15-25 foot wide strip of habitat will replicate the native riparian habitat lost over the last 50 years due to degradation of the river system. The Cottonwood/willow environment is a valued habitat in the Sonoran Desert, providing cover, nesting and foraging locations for numerous species. Moving away from the Cottonwood/willow habitat, an Aquatic Strand of vegetation is proposed to transition from the water dependent species to the desert scrub vegetation covering the river bottom. Within this vegetative type, the density of plants will be reduced from the Cottonwood/willow densities, but they will be higher in numbers than the desert scrub. The width of the strand will vary from 10-35 feet.

Within this unit, recreation elements will consist primarily of multi-use maintenance path with wayfinding signage, environmental education features, and an grassed, outdoor seating area. The irrigated turf seating area will overlook the confluence of the IBW and the Salt River. From this site, recreationalists will have scenic viewing opportunities of a lake unequaled in the City of Tempe and the Phoenix Metropolitan area. Views over the Town Lake and the Upstream Dam/Restoration Area will also be afforded to visitors of this location. Much of the dry river bottom will be restored under the proposed project; visitors will be able to view the restoration process first-hand. Additionally, opportunities for wildlife viewing will greatly increase because of the restoration project. Environmental education displays are proposed at the confluence and seating area, on both sides of the channel upstream of the Dam and on both sides of the channel near the existing grade control structure.

Downstream Recreation Plan

The downstream area currently contains native grasses like the upstream area plus numerous Salt Cedar (*Tamarisk sp.*) less than 10 feet high scattered over the river bottom. The emerging trees are rapidly establishing in this environment (covering approximately 30% of the river bottom) and will dominate the habitat within a few years.

Restoration of the downstream Salt River area is very similar to the restoration of the upstream area of the Salt River. In fact, the concepts and proposed habitat types are exactly the same. However, Salt Cedar will be removed from the river bottom as necessary to promote higher quality habitat. All proposed wetland/marsh habitat is located outside the 10,000 foot FAA restricted zone.

The primary purpose of the proposed recreation facilities at this location is to complete the trail system, to provide opportunities for scenic viewing of the downstream restoration area and to provide a location for passive activities such as picnicking and bird watching. As with the upstream trail system, the downstream trail system will be the primary access for security patrols, the Flood Control District and for maintenance of the restoration project. No recreation activities are anticipated within the Salt River channel.

The most dramatic feature of this area will be the pedestrian bridge over the Dam; the capacity to construct this feature has already been built into the Dam design. From the unique vantage point over the Dam, pedestrians will have opportunities to view upstream onto the Town Lake and downstream over the wetland/marsh habitat to be constructed with the Project. No comparable scenic viewing experience exists in the Phoenix Metropolitan area.

A vegetated strand of mesquites along the south bank will provide shade for recreationalists; encouraging picnicking and bird watching. To support scenic viewing and bird watching, a trail will be constructed on the top of the south bank levee. The trail will offer unrestricted views of the restoration area and the mesquite habitat while providing a variety of experiences not found on other proposed recreation features. The mesquite strand will separate the walkers on this trail from interference from bickers and joggers using the multi-use trail. Two ramadas and a comfort station will be provided for all recreationalists' use.

Wayfinding signage will be installed at appropriate locations along the trails. Environmental education displays are proposed at each of the ramadas and at several points on the pedestrian bridge.

Recreation Activity Estimate

A *Design Day-Load* is used to estimate the capacity and annual visitation for a site. As the habitat areas are sub-elements of a larger recreation development project, those who will actually use the recreational amenities of the habitat are a sub-element of the larger recreation project visitation. The larger Rio Salado Project as a whole is classified as a regional destination park using the classification system developed by NRPA (Recreation, Park and Open Space Standards and Guidelines, 1987)

The majority of recreational activity will be realized by those living within the prescribed one hour driving time as identified by NRPA for criteria for determining impact and use for a regional park. For the purposes of this study, the population for the Phoenix MSA will be used as the base population within the one hour driving time radius. The base population for the Phoenix-Mesa MSA for 1995 was reported at 2,563,582.

The habitat areas are capable of being accessed via several modes of transportation. As downtown Tempe has become a major destination for many in the metropolitan Phoenix area, it is expected that the Rio Salado area and the habitats in particular will become attractive destinations as well. Available parking, convenient access, and many other factors will effect carrying capacities of the habitat areas.

For the local population from the Phoenix MSA, it is estimated that the primary mode of conveyance to access the habitats will be personal vehicle. Access to the habitats can be made from pay and free public parking areas in and around downtown Tempe. However, these parking spaces must be shared with other customers who use the parking amenities to attend classes at ASU, employees in the downtown, etc. Currently, there are over 17,000 parking spaces either currently available in proposed within walking distance of access points of the habitat trails. For this report, it will be assumed that 10%, or 1,700 spaces will be available for recreational users during peak season. Peak recreational season is from October through May (non-peak June through September). During peak season, use is expected to be higher on weekends than weekdays, although weekday usage should remain high with the proximity to the university and schools. During non-peak season, usage is expected to be minimal due to the physical constraints of the weather.

Of the 1,700 spaces it will be assumed that they have a turn over of three times daily, with three passengers per vehicle. Using these assumptions, it is estimated that the peak design day-load is 15,300 visits. It is estimated that there will be 64 days of 100% capacity, primarily on weekends, 160 days of 25% capacity, weekdays during peak season, and 60 days of non-peak season at 15% usage, summer months June and September and 61 days at 5% usage, July and August. During non-peak, day and weekend use is not anticipated to vary do to temperature extremes.

From vehicular traffic it is estimated that day load capabilities of the site will be 1,775,565. In addition to the vehicular traffic it is anticipated a high level of pedestrian access to the site due to the proximity of residents, businesses and the university. Using demographic data from the area, population within walking distance of the habitats is 12,578. It is assumed that each resident will make at least one trip a month to or through the habitat area for an additional 150,864 visits. Total visits from vehicular and non-vehicular are estimated to be 1,926,429.

In the Rio Salado development area, there will be an addition of hotels and conference centers. These developments are destination oriented in themselves, however, it is anticipated that a percentage of the destination population will use the habitats for the recreational experience. These users are predominately travelers and are addressed separately from the local MSA population.

Estimates indicate that these areas will generate in excess of 15,000 visits daily regardless of time of year. Although Phoenix in general has a higher room occupancy rate from January-April, it is estimated that Tempe's occupancy rate should remain relatively even throughout the year. For the purposes of *Design Day-Load* from the tourist component it is estimated 10% or 547,500 visits can be anticipated annually.

Total visitation to the habitat area is expected to be approximately 2,473,429 annually.

The City of Tempe has experienced a 1.4% population growth over the past 5 years. At the same time, the MSA has experienced a 6%+ annual growth rate. It is anticipated that the growth rate for Tempe will slow as Tempe reaches build out. As a majority of the visitation will come from Tempe residents and tourists staying in Tempe, a conservative growth rate of 0.4% per annum will be used to predict increased visitation over the next 50 years.

Table 1 - Fifty year Visitation Projection
using 0.4% annual visitation increase

2,473,429 - Year 1	2,647,114 - Year 18	2,832,994 - Year 35
2,483,323	2,657,702	2,844,326
2,493,256	2,668,333	2,855,703
2,503,229	2,679,006	2,867,126
2,513,242	2,689,722	2,878,595
2,523,295	2,700,481	2,890,109
2,533,388	2,711,283	2,901,670
2,543,522	2,722,128	2,913,276
2,553,696	2,733,017	2,924,929
2,563,911	2,743,949	2,936,629
2,574,166	2,754,924	2,948,376
2,584,463	2,765,944	2,960,169
2,594,801	2,777,008	2,972,010
2,605,180	2,788,116	2,983,898
2,615,601	2,799,268	2,995,833
2,626,063	2,810,465	3,007,817 - Year 50
2,636,567	2,821,707	

Visitation Transfers to New Site

As Tempe has only one regional park within it's current park system, it is anticipated that minimal transfers of visitation from other parks will be experienced within Tempe. Overall usage of neighborhood parks should remain stable. Larger parks within the park system should expect a 10% or greater transfer of visitation to the Rio Salado area for a total of approximately 750,000 user visits annually. Using the same 10% figure with Rio Salado for Habitat visitation, it is expected that 75,000 visits will be transferred to from local parks to the habitat.

As a majority of park usage is by local resident and destination visits, it is anticipated that minimal transfer visits will occur from other jurisdictions. Agencies that develop similar facilities as those being proposed by Tempe, should receive the smallest transfer in visitation. Estimated visitation transfers are as follows:

1-5 Mile radius of project area - 10%,	approximately 15,000 visits lost annually from other parks
6-10 Mile radius of project area - 5-7%	approximately 28,000 visits lost annually from other parks
10-20 Mile radius of project area - 3-5%	approximately 33,000 visits lost annually from other parks
20+ Mile radius or project area - 0-3%	approximately 65,000 visits lost annually from other parks

Estimated Economic Value of Recreational Activity

Total point value estimated as follows:

Recreation Experience . . . . . 27 points

Habitat restoration provides mesquite bosque and riparian resource areas for outdoor classrooms; flora and fauna sanctuary and conservation; water conservation; bird watching; plant identification and education; interpretive opportunities; scenic overlooks; jogging; hiking; horseback riding; cycling; picnicking; photography.

Availability . . . . . 14 points

The nearest natural riparian habitat is over an hour away; the Salt River Recreation Area and the Verde River Recreation Area in the Tonto National Forest. As the valley continues to grow, the availability of such natural resources will become even more critical.

Carrying Capacity . . . . . 13 points

In an effort to minimize impact on the natural habitat, this project utilizes a shared facility concept. The proximity of these habitat to adjacent public uses enables shared restroom and respite facilities for public health and safety. The implementation of multi-use trails for both recreational use, maintenance and security reduces trail impact to habitat. Utilize ramada and natural shade canopies in key viewing areas to provide interpretive signage and educational elements. This plan would be designed and managed to provide a high quality recreational experience within a protected natural environment by enhancing and preserving the resources.

Accessibility . . . . . 18 points

This project is ideally situated in a metropolitan area accessible to over five cities. It has excellent access to the freeway and public transit systems. This site has easy access for bikes, pedestrians, automobiles, and buses; opening the experience to low-income and minority groups who might otherwise not have this opportunity. Large groups from the local university, highschools and elementary schools have easy access. This project is closer to more neighborhoods than any other existing or proposed riparian habitat. People with physical challenges will have access to this unique natural environment.

Environmental . . . . . 17 points

This plan provides a unique opportunity to experience the natural riparian and bosque environments in an ideal location. Historical and cultural references surround the sites, referencing the interaction of man and nature from as early as the Hohokams in 400 ad. The educational and recreational components of the plan and the location work with surrounding land features addressing the importance of plants, animals, minerals and water in the desert. Significant natural aesthetic elements include views of Papago and Hayden Buttes and surrounding mountains and access to diverse plant material. There are no industrial businesses, sand & gravel mining, operating landfills or other conflicting land uses near this project. The freeway system has been enhanced through this area to blend with natural elements. Adjacent public park areas will provide natural transition from habitat to the built community. Existing geology, topography, and water resources will be enhanced by the addition of vegetation and wildlife.

Total . . . . . 89 points

Cost Estimates

Cost estimates are given for each different area of the restoration project and a total of the three. See the attached pages.

Tempe Restoration Project
Indian Bend Wash (IBW) Unit
Preliminary Opinion of Probable Cost

May 15, 1997

Prepared By: Logan Simpson & Dye

Item #	Item Description	Qty.	Units	Unit Price	Subtotal
1	Mobilization	1	LS	$15,000.00	$15,000
2	Excavation/Grading	35,000	SY	$2.50	$87,500
3	Concrete Ramp	0	EA	$75,000.00	$0
4	Parking Lot	55	CARS	$1,000.00	$55,000
5	Multi-use Trail (12') (Concrete)	70,560	SF	$3.50	$246,960
6	Multi-use Trail (12') (Decomposed Granite)	0	SF	$1.00	$0
7	Pedestrian Bridge over Downstream Dam	0	EA	$1,700,000.00	$0
8	Ramada	9	EA	$25,000.00	$225,000
9	Comfort Station (including utilities)	1	EA	$125,000.00	$125,000
10	Miscellaneous (Railings, Metals, Walls)	1	LS	$20,000.00	$20,000
11	Foot Bridge	3	EA	$35,000.00	$105,000
12	Miscellaneous (Drinking Fountains, Picnic Tables, etc.)	1	LS	$20,000.00	$20,000
13	Interpretive Signs	4	EA	$350.00	$1,400
14	Environmental Education Displays	2	EA	$750.00	$1,500

Subtototal	$902,36[illegible]
Contingency (15%)	$135,354
Preliminary Opinion of Probable Total Cost	**$1,037,714**

Tempe Restoration Project
Upstream Salt River Unit
Preliminary Opinion of Probable Cost

May 15, 1997

Prepared By: Logan Simpson & Dye

Item #	Item Description	Qty.	Units	Unit Price	Subtotal
1	Mobilization	1	LS	$10,000.00	$10,000
2	Excavation/Grading	37,500	SY	$2.50	$93,750
3	Concrete Ramp	3	EA	$75,000.00	$225,000
4	Parking Lot	0	CARS	$1,000.00	$0
5	Multi-use Trail (12') (Concrete)	72,000	SF	$3.50	$252,000
6	Multi-use Trail (12') (Decomposed Granite)	0	SF	$1.00	$0
7	Pedestrian Bridge over Downstream Dam	0	EA	$1,700,000.00	$0
8	Ramada	0	EA	$25,000.00	$0
9	Comfort Station (including utilities)	0	EA	$125,000.00	$0
10	Miscellaneous (Railings, Metals, Walls)	1	LS	$25,000.00	$25,000
11	Foot Bridge	1	EA	$35,000.00	$35,000
12	Miscellaneous (Drinking Fountains, Picnic Tables, etc.)	1	LS	$10,000.00	$10,000
13	Interpretive Signs	3	EA	$350.00	$1,050
14	Environmental Education Displays	5	EA	$750.00	$3,750

Subtototal	$655,550
Contingency (15%)	$98,333
Preliminary Opinion of Probable Total Cost	**$753,883**

Tempe Restoration Project
Downstream Salt River Unit
Preliminary Opinion of Probable Cost

May 15, 1997

Prepared By: Logan Simpson & Dye

Item #	Item Description	Qty.	Units	Unit Price	Subtotal
1	Mobilization	1	LS	$25,000.00	$25,000
2	Excavation/Grading	66,000	SY	$2.50	$165,000
3	Concrete Ramp	0	EA	$75,000.00	$0
4	Parking Lot	0	CARS	$1,000.00	$0
5	Multi-use Trail (12') (Concrete)	48,000	SF	$3.50	$168,000
6	Multi-use Trail (12') (Decomposed Granite)	3,600	SF	$1.00	$3,600
7	Pedestrian Bridge over Downstream Dam	1	EA	$1,700,000.00	$1,700,000
8	Ramada	2	EA	$25,000.00	$50,000
9	Comfort Station (including utilities)	1	EA	$125,000.00	$125,000
10	Miscellaneous (Railings, Metals, Walls)	1	LS	$25,000.00	$25,000
11	Foot Bridge	0	EA	$35,000.00	$0
12	Miscellaneous (Drinking Fountains, Picnic Tables, etc.)	1	LS	$15,000.00	$15,000
13	Interpretive Signs	5	EA	$350.00	$1,750
14	Environmental Education Displays	2	EA	$750.00	$1,500

Subtototal	$2,279,85[illegible]
Contingency (15%)	$341,9[illegible]
Preliminary Opinion of Probable Total Cost	**$2,621,828**

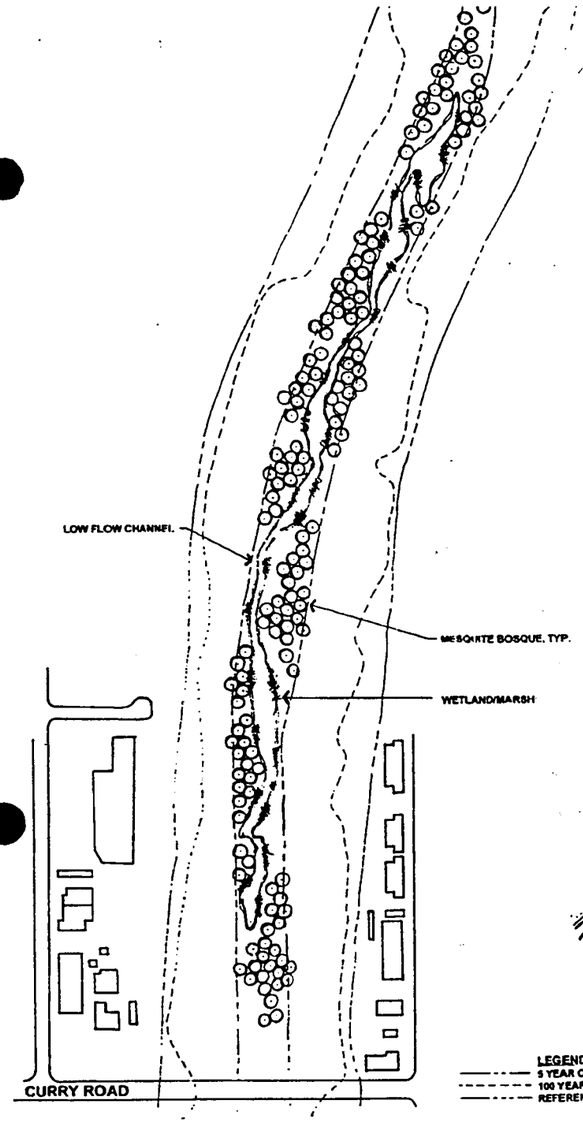
Tempe Restoration Project
Summary of
Preliminary Opinion of Probable Cost

May 15, 1997

Prepared By: Logan Simpson & Dye

Item #	Item Description	Qty.	Units	Unit Price	Subtotal
1	Mobilization	3	LS	N/A	$50,000
2	Excavation/Grading	138,500	SY	$2.50	$346,250
3	Concrete Ramp	3	EA	$75,000.00	$225,000
4	Parking Lot	55	CARS	$1,000.00	$55,000
5	Multi-use Trail (12') (Concrete)	190,560	SF	$3.50	$666,960
6	Multi-use Trail (12') (Decomposed Granite)	3,600	SF	$1.00	$3,600
7	Pedestrian Bridge over Downstream Dam	1	EA	$1,700,000.00	$1,700,000
8	Ramada	11	EA	$25,000.00	$275,000
9	Comfort Station (including utilities)	2	EA	$125,000.00	$250,000
10	Miscellaneous (Railings, Metals, Walls)	3	LS	N/A	$70,000
11	Foot Bridge	4	EA	$35,000.00	$140,000
12	Miscellaneous (Drinking Fountains, Picnic Tables, etc.)	3	LS	N/A	$45,000
13	Interpretive Signs	12	EA	$350.00	$4,200
14	Environmental Education Displays	9	EA	$750.00	$6,750

Subtototal	$3,837,760
Contingency (15%)	$575,664
Preliminary Opinion of Probable Total Cost	**$4,413,424**



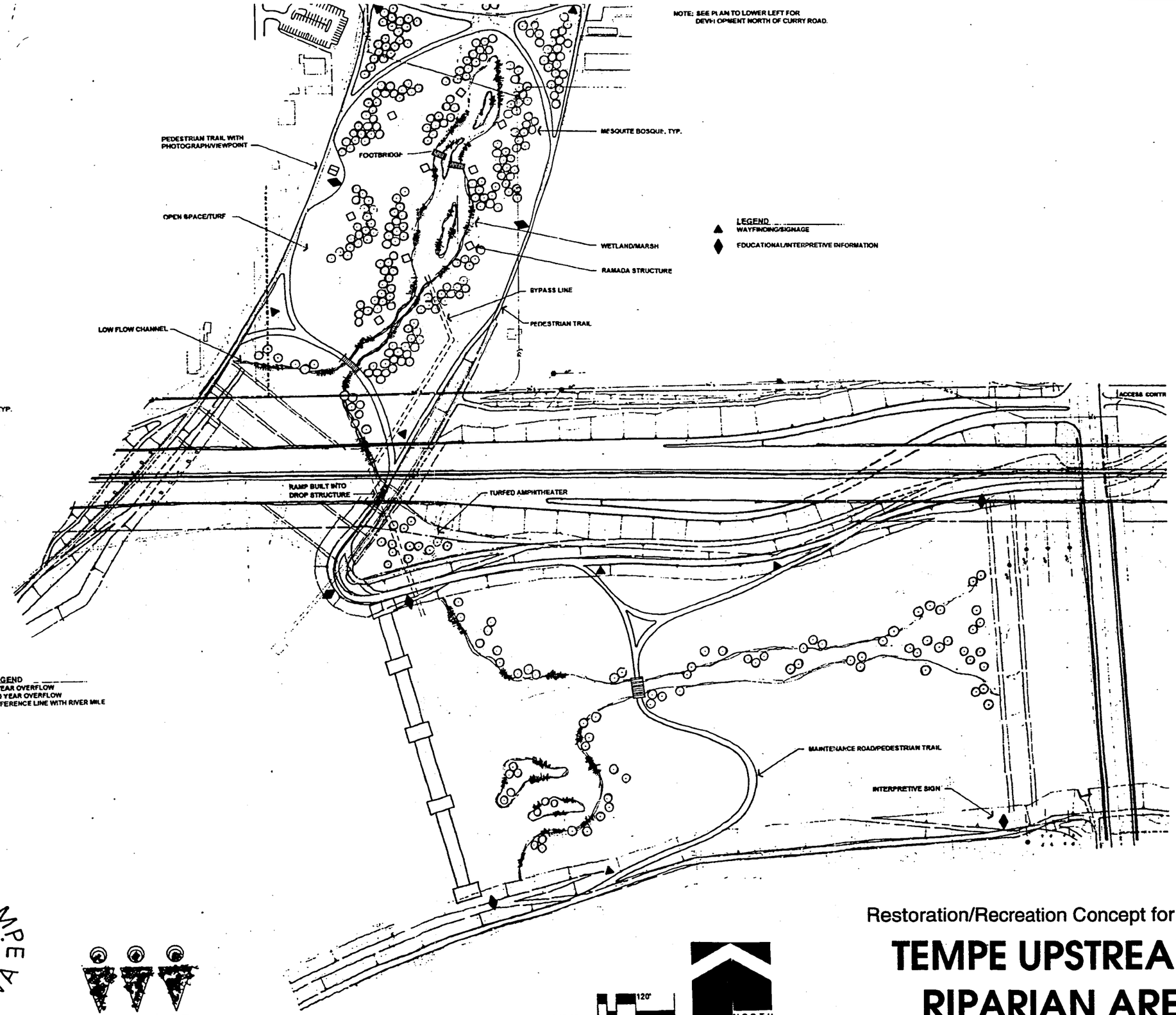
NOTE: SEE PLAN AT UPPER RIGHT FOR DEVELOPMENT SOUTH OF CURRY ROAD.

LEGEND
- 5 YEAR OVERFLOW
- 100 YEAR OVERFLOW
- REFERENCE LINE WITH RIVER MILE

200'

(NORTH OF CURRY ROAD ONLY)

NOTE: SEE PLAN TO LOWER LEFT FOR DEVELOPMENT NORTH OF CURRY ROAD.



LEGEND
- WAYFINDING/SIGNAGE
- EDUCATIONAL/INTERPRETIVE INFORMATION

120'

NORTH

05/13/97

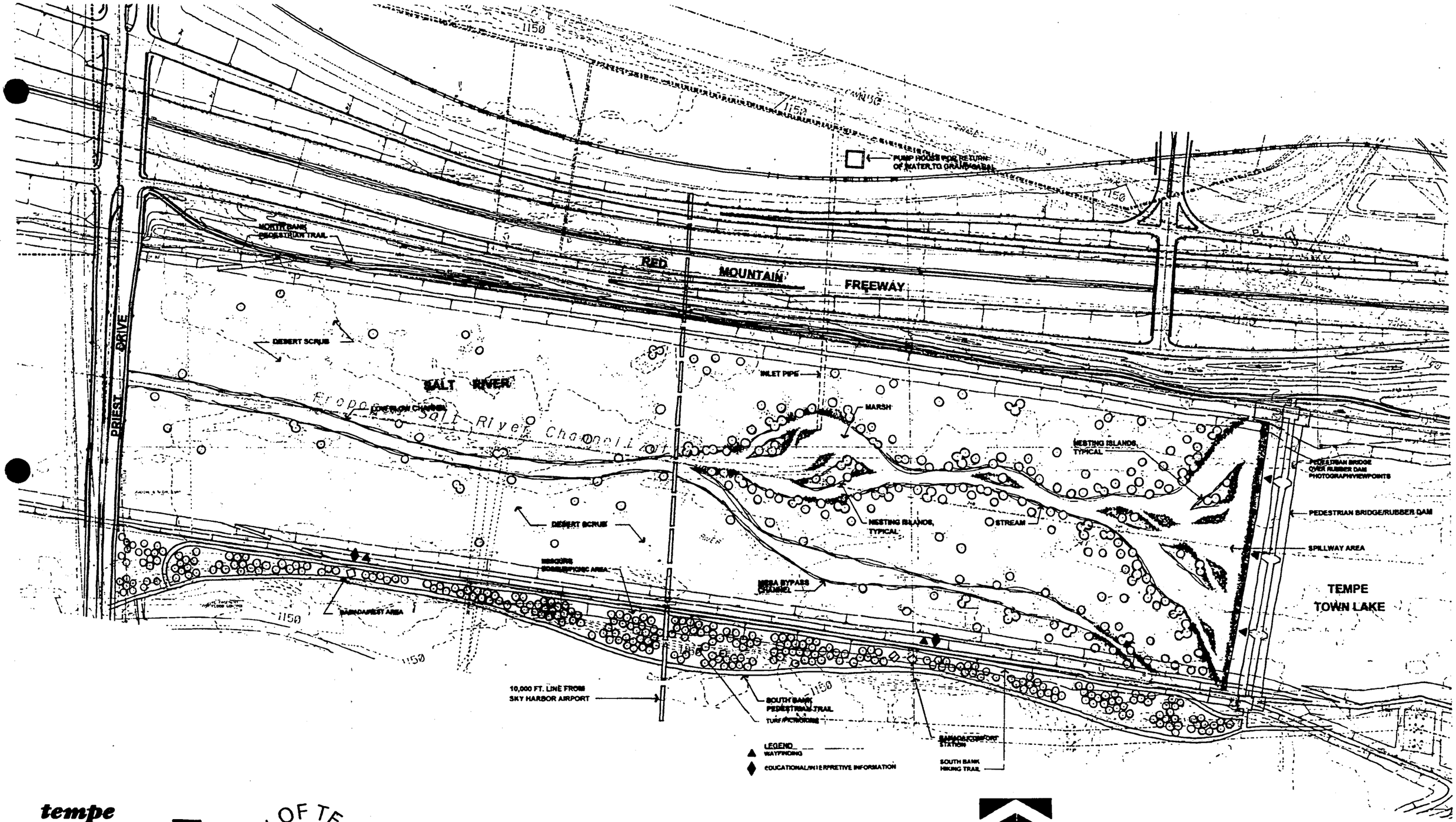
tempe rio salado

CITY OF TEMPE ARIZONA
Community Development Department

Logan Simpson & Dye

Restoration/Recreation Concept for the

TEMPE UPSTREAM RIPARIAN AREA



tempe rio salado

CITY OF TEMPE ARIZONA
Community Development Department

Logan Simpson & Dye

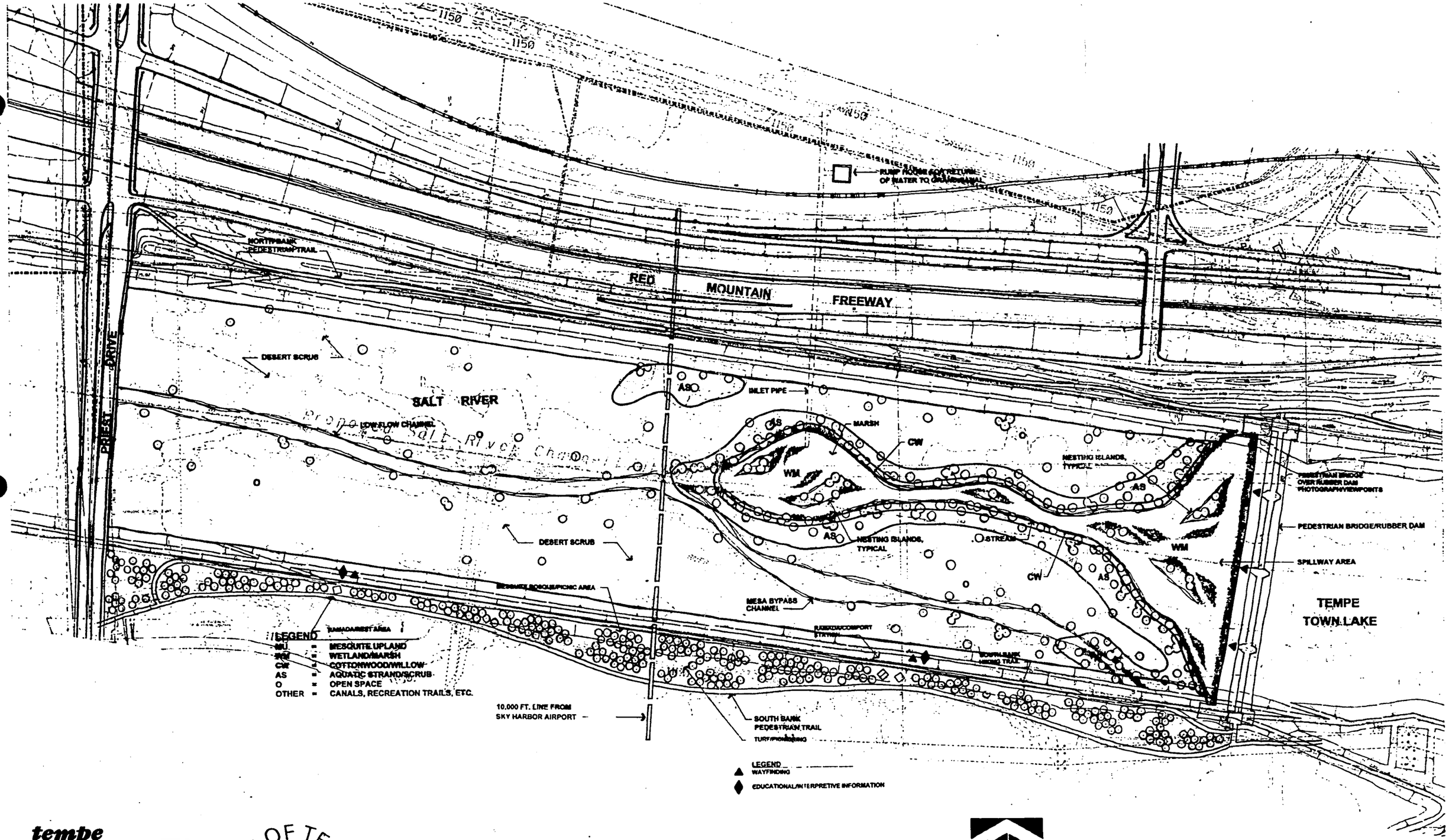
NORTH

120'

06/13/97

Restoration/Recreation Concept for the

TEMPE DOWNSTREAM RIPARIAN AREA



tempe rio salado

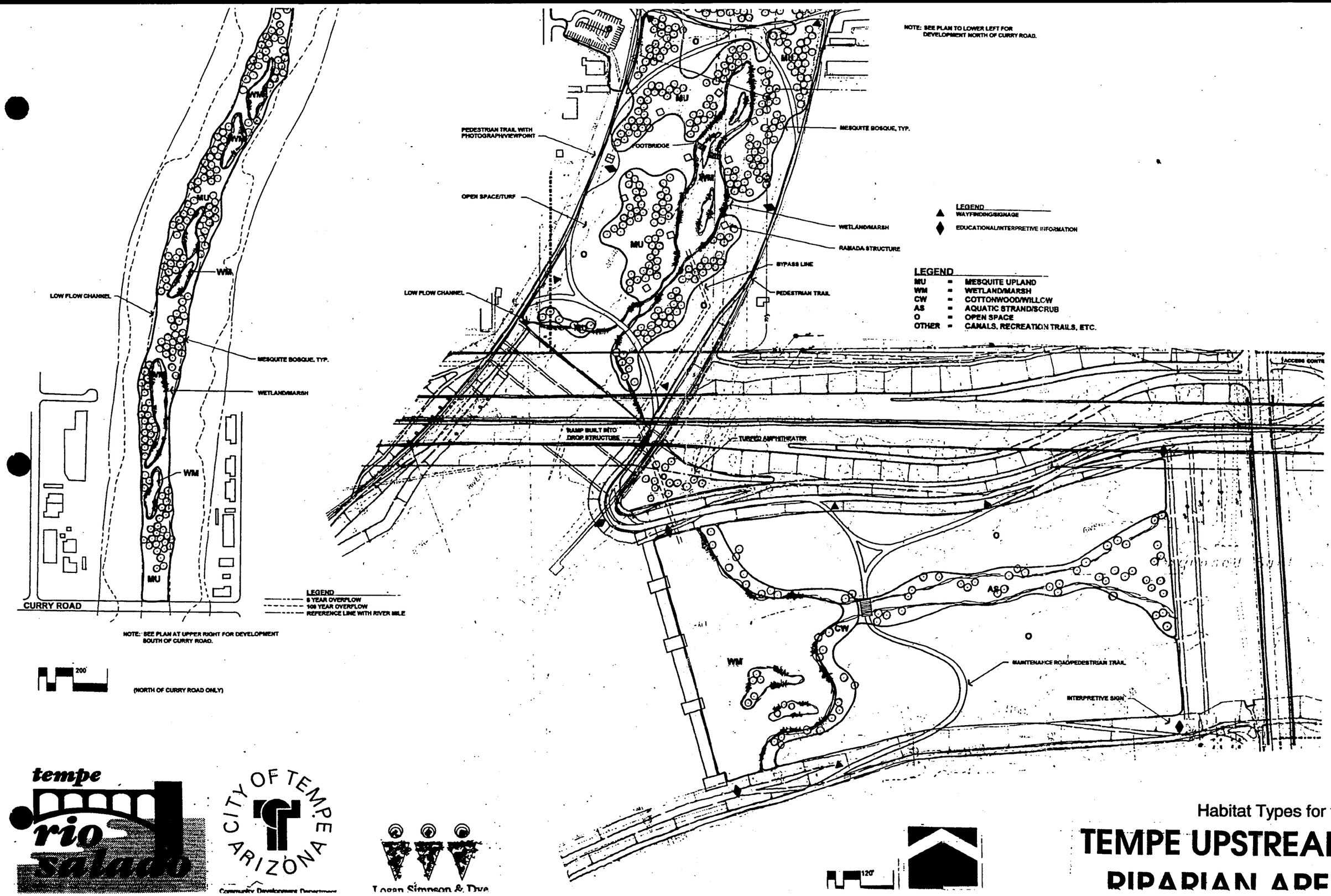
CITY OF TEMPE ARIZONA
Community Development Department

Logan Simpson & Dye

05/13/97

Habitat Types for the

TEMPE DOWNSTREAM RIPARIAN AREA



Habitat Types for the

TEMPE UPSTREAM RIPARIAN AREA