Arizona Stream Navigability Study for the

Gila River: Colorado River Confluence to the Town of Safford

Draft Final Report

Prepared for the

Arizona State Land Department

Date of Original Report: October 1994
Revised: September, 1996

Original Report Prepared by
Arizona State Land Department
Arizona Geological Survey
SWCA Environmental Consultants

June 2003 Revision by:

JE Fuller/Hydrology & Geomorphology, Inc.

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HYDROLOGY & GEOMORPHOLOGY, INC.

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Preface

This report was prepared by the Arizona State Land Department (ASLD) Drainage and Engineering Section. The report summarizes information relating to the navigability or non-navigability of the Gila River as of the time of statehood on February 14, 1912. This report documents information relating to the Gila River from the Colorado River confluence near Yuma to the head of the Safford Valley at Solomon, Arizona. The information presented in this report is intended to provide data and evidence to the Arizona Navigable Stream Adjudication Commission (ANSAC) which will make a determination as to the navigability or non-navigability of the Gila River. This report does not make a recommendation or conclusion regarding title navigability of the Gila River.

The report consists of several related sections. First, an archaeological overview of the Gila River relating to river uses is presented to set the long-term context of river conditions. Second, a historical study of the periods prior to and including statehood is presented that focuses on river uses, modes of transportation, and river conditions. Third, limited oral history for the river is presented. Fourth, historical and modern hydrologic data are summarized to illustrate past and potential flow conditions in the river. Fifth, a review of geologic influences on stream flow and river conditions is presented. Sixth, land use and land ownership information are described and presented in a GIS format.

The Upper Salt River Navigability Study was originally performed by the ASLD Drainage and Engineering Section, in cooperation with SWCA Environmental Consultants, Inc. (SWCA) and the Arizona Geological Survey (AZGS). The study was completed as directed by Arizona Revised Statutes 37-1124. Project staff included Clyde Anderson, ASLD, Project Manager; Dennis Gilpin and Dawn Greenwald, SWCA, historian/archaeologist; Gary Huckleberry, AZGS, geomorphologist; Cameron Hanye, ASLD, GIS specialist; Greg Keller, ASLD, land planner; and Terry Arce and Roz Sedillo, ASLD, land title specialists. The original study was revised in 2003 by JEF under ASLD contract #AD000150-010 to reflect changes in Arizona navigability legislation. Use of this document is governed by ASLD and ANSAC.

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CHAPTER I

Introduction

Purpose of Study

House Bill 2594, codified as A.R.S. §37-1101 to -1156, was enacted by the Arizona State Legislature and signed by the Governor on July 7, 1992. This Bill provided for the establishment of an administrative procedure to gather information and determine the extent of the State of Arizona's ownership of the beds of watercourses within Arizona. To this end, the Bill established the Arizona Navigable Stream Adjudication Commission (ANSAC) through July 1, 2000, consisting of five members appointed by the Governor. At the same time, the Bill charged the Arizona State Land Department with the task of performing studies to identify, catalogue, gather and evaluate existing available information to aid ANSAC in making its determinations.

The purpose of this study is to identify, catalogue, gather and evaluate existing available information relating to the Gila River. This report presents archaeological, historical, hydrologic, hydraulic, geomorphologic and land use information identified and gathered during the study and consists of resources such as books, maps, artifacts, magazines, photographs, land records, survey notes, flood insurance studies, floodplain maps, stream gage records, geologic maps, soil maps, vegetation maps, contour and topographic maps, etc. A listing of the resources is included in the appendix.

Project Background

In 1984, Valley Concrete and Materials Company was mining sand and gravel in the Verde River near Deadhorse Ranch State Park. In its efforts to curtail Valley's mining operations the State Attorney General's office invoked the State's implicit ownership of the beds of navigable watercourses under the Equal Footing Doctrine. Under that Doctrine, all states entered the Union with the same rights and privileges as the original 13 states - on an "equal footing". One of those rights was the ownership of the beds of navigable watercourses and tidal waters under the Public Trust Doctrine which dates back to the Roman European and, more recently, the British crown which held those lands and others in trust for use by the public for fishing, recreation, commerce and general navigation. The State eventually settled out of court with Valley Concrete, but the question of the State's interest in navigable watercourses remained unsettled.

In 1986 the State Legislature attempted to resolve the question of ownership by passing Senate Bill 1308. That Bill was vetoed by Governor Babbitt. In 1987 the State Legislature again attempted to resolve the question of ownership by enacting

House Bill 2017[1] which declared the Colorado River navigable (by previous actions), indicated that the Gila, Salt and Verde Rivers might be navigable, and that all other watercourses in the State were non-navigable. That Act was signed April 27, 1987 by Governor Mecham. The Act further permitted the release of Gila, Salt and Verde River lands to the public by means of filing a quit claim for a nominal fee. Within three months the Center for Law in the Public Interest was in court, challenging the Act as an unconstitutional gift of public lands and claiming there was no rational basis for declaring watercourses navigable or non-navigable. Eventually the Arizona Court of Appeals agreed with the Center and in 1991 invalidated the Act as unconstitutional.[2]

The question of title ownership remained clouded, however, and in July 1992 the State Legislature enacted House Bill 2594.[3] That Act established the Arizona Navigable Stream Adjudication Commission, ANSAC, and created an administrative process for gathering available information and making a determination relating to navigability or non-navigability. In addition, the State Land Department was charged with the task of gathering information to aid ANSAC in its review and determinations. Since 1992, the State' s navigability legislation has been modified twice, once by House Bill 2589 which was found to have unconstitutional presumptions of non-navigability, and the second time by Senate Bill 1275, which restored the so-called federal test of navigability as the standard by which ANSAC would make determinations of navigability.

Definition of Navigability

Navigability is defined within Title 37, Chapter 7, Arizona Revised Statutes to guide the Commission in its determinations. Specifically, A.R.S. §37-1101(6) states:

> "'Navigable' or 'navigable watercourse' means a watercourse, or a portion or reach of a watercourse, that was in existence on February 14, 1912, and that was used or was susceptible to being used, in its ordinary and natural condition, as a highway for commerce, over which trade and travel were or could have been conducted in the customary modes of trade and travel on water."

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[1] HB 2017, State of Arizona, 38th Legislature, First Regular Session, introduced January 12, 1987.

[2] Appeal from the Superior Court of Maricopa County, Case No. CV 87-20506, in the Court of Appeals, State of Arizona, Division One, filed September 10, 1991.

[3] HB 2594, State of Arizona, 40th Legislature, Second Regular Session, introduced February 27, 1992.

Scope of Study

1. Study Limit

This study includes the Gila River, which is located generally in the southern half of Arizona as it runs from its confluence with the Colorado River northeast of Yuma, Township 8 South, Range 23 West, G.S.R.B.M., to the Gila Box northeast of Safford, Township 7 South, Rand 27 East, G.S.R.B.M. (See General Location Map, Appendix A)

For the purposes of this study, areas which lie within the 100-year floodplain as defined by the latest Flood Insurance Rate Map (F.I.R.M.) community panels published by the Federal Emergency Management Agency (F.E.M.A.) prior to July 1, 1993, were evaluated. These specified limits generally lie outside of the "ordinary high water mark" and were chosen to insure that parcels lying partially or wholly within the "ordinary high water mark" would be identified. It will thus be possible to notify the owners or lessees of parcels which will be affected by the Commission's determination of navigability or non-navigability. The study area includes lands owned or leased by private individuals or companies, and city, county, state and federal agencies. Also, the Gila crosses portions of three separate Indian Reservations, in existence since before Statehood.

2. Project Team

The Project Team for the original ASLD study includes the following individuals. Without their efforts this study would not have been possible.

Clyde Anderson, Drainage and Engineering Section
Terry Arce, Title and Contracts Section
Cameron Hanye, Drainage and Engineering Section
W. Dempsey Helms, Drainage and Engineering Section
Greg Keller, Urban Planning Section
James Latham, Drainage and Engineering Section
V. Ottozawa-Chatupron, Drainage and Engineering Section
Rozanna Sedillo, Title and Contracts Section
Donna Smith, Drainage and Engineering Section
Dennis Gilpin, Archaeologist, SWCA Associates
Gary Huckleberry, Geomorphologist, AZ Geological Society

Also, additional staff from various sections provided support for this study at critical times.

3. Project Tasks

a. Historical Literature Search

A.R.S. § 37-1124 required a literature search be performed to identify historical reference materials. This literature search was performed by Mr. Clyde Anderson, Mr. W. Dempsey Helms, Mr. James Latham and Mr. V. Ottozawa-Chatupron of the Arizona State Land Department (ASLD) Drainage and Engineering Section. This search was based on visits to various persons, museums and libraries in the state.

The ASLD library assembled for this project served as a beginning point and a source to identify other materials. The literature search included an interview with Ms. Mary Lu Moore, historian, assigned to the Civil Division, Arizona Attorney General's office. Also, searches were conducted at the Arizona State Capitol Library, Phoenix Public Library, Yuma Public Library, Arizona State University Library, University of Arizona Library, Safford Public Library, and other public libraries in towns located near the Gila River. Historical societies and museums were also visited. These included Yuma Crossing Quartermaster Depot Historic Site, Yuma Art Center, Quechan Indian Museum, Arizona Historical Society Museum Colorado River Division, Wellton-Mohawk Fine Arts & Historical Museum, Gila Bend Museum, Buckeye Valley Historical & Archaeological Museum, Casa Grande Valley Historical Society Museum, Gila River Arts & Crafts Center and Heritage Park, Graham County Historical Society Museum, Arizona State Capitol Museum, Heard Museum, Phoenix Museum of History, Tempe Historical Museum, Arizona Republic/Phoenix Gazette newspaper morgues, McCormick Railroad Exhibit, and Arizona State University - Museum of Geology. This literature search identified maps, books, newspaper articles, journals, magazines and overall histories which provided historical information related to historical uses of the river for navigation and types of business which were located near the river.

This historical literature search was based on areas identified on base maps provided by the ASLD Drainage and Engineering Section.

b. Archaeological Literature Search

A.R.S. § 37-1124 and Part Two, Paragraph 2.1.1 of the Request For Proposal required a literature search be performed to identify historical and archaeological reference materials. This literature search was performed by Mr. Dennis Gilpin of SWCA Environmental Consultants. This search was based on visits to various persons, museums and libraries in the state.

The ASLD library assembled for this project served as a beginning point and as a source to identify other materials. The literature search included an interview with

Ms. Mary Lu Moore, historian, assigned to the Civil Division, Arizona Attorney General's office. Also, searches were conducted at the Arizona State Capitol Library, Phoenix Public Library, Yuma Public Library, Arizona State University Library, University of Arizona Library, Safford Public Library, and other public libraries in towns located near the Gila River. Historical societies and museums were also visited. These included Yuma Crossing Quartermaster Depot Historic Site, Yuma Art Center, Quechan Indian Museum, Arizona Historical Society Museum Colorado River Division, Wellton-Mohawk Fine Arts & Historical Museum, Gila Bend Museum, Buckeye Valley Historical & Archaeological Museum, Casa Grande Valley Historical Society Museum, Gila River Arts & Crafts Center and Heritage Park, Graham County Historical Society Museum, Arizona State Capitol Museum, Heard Museum, Phoenix Museum of History, Tempe Historical Museum, Arizona Republic/Phoenix Gazette newspaper morgues, McCormick Railroad Exhibit, and Arizona State University - Museum of Geology. Visits to these locations suggested additional sources, which were added to the list. This literature search identified maps, books, newspaper articles, journals, magazines, advertisements, and directories which provided historical and archaeological information related to historical uses of the river for navigation and types of business which were located near the river, such as warehouses, transportation and shipping.

This archaeological literature search was based on areas identified on base maps provided by the ASLD Drainage and Engineering Section. A catalogue of the literature and artifacts identified during this search was prepared and submitted to the Project Manager. The catalogue identifies the river reach, the location of the resource and the title of the resource.

c. Hydrologic & Hydraulic Literature Search

A.R.S. § 37-1124 required a literature search be performed to identify hydrologic and hydraulic reference materials. This literature search was performed by Mr. Clyde Anderson and Ms. Donna Smith of the Arizona State Land Department (ASLD) Drainage and Engineering Section. This search was based on visits to various persons, city, county, state and federal agencies.

The ASLD library assembled for this project served as a beginning point and a source to identify other materials. This research identified and catalogued aerial photographs, maps, books, technical journals, newspaper articles, magazine articles, stream gage records, survey data, and flood insurance studies which provided information related to stream flow, flood events, changes in the river's course and character. Searches were conducted at various locations, including Arizona Department of Water Resources, Arizona Game and Fish Department, Arizona Department of Transportation, Corps of Engineers, City of Phoenix Floodplain Management Section, Flood Control Districts (Yuma County, Maricopa County, Pinal

County, Gila County, Graham County), State Capitol Library, Phoenix Public Library, Yuma Public Library, Arizona State University Library, Arizona State University Engineering Library, University of Arizona Library, University of Arizona Engineering Library, and Bureau of Land Management.

This hydrologic and hydraulic literature search was based on areas identified on base maps provided by the ASLD Drainage and Engineering Section.

d. Geomorphological Literature Search

A.R.S. § 37-1124 required a literature search be performed to identify geomorphologic reference materials. This literature search was performed by Mr. Gary Huckleberry of Arizona Geological Survey. This search was based on visits to various persons, city, county, state and federal agencies.

The ASLD library assembled for this project served as a beginning point and as a source by which to identify other materials. This research identified and catalogued aerial photographs, maps, books, technical journals, newspaper articles, magazine articles, stream gage records, soils maps, geologic maps, geologic event records, survey data and flood insurance studies which provided information related to stream flow, flood events, and changes in the river's course and character. Searches were conducted at various locations. These included but were not limited to Arizona Department of Water Resources, Arizona Game and Fish Department, Arizona Department of Transportation, Corps of Engineers, City of Phoenix Floodplain Management Section, Flood Control Districts (Yuma County, Maricopa County, Pinal County, Gila County, Graham County), State Capitol Library, Phoenix Public Library, Yuma Public Library, Arizona State University Library, Arizona State University Engineering Library, University of Arizona Library, University of Arizona Engineering Library, and Bureau of Land Management.

This geomorphological literature search was based on areas identified on base maps provided by the ASLD Drainage and Engineering Section.

e. Historical Literature Review

A.R.S. § 37-1124 required that historical reference materials be reviewed to identify and evaluate evidence of historic uses of the study reach. This review and evaluation was performed by Mr. Clyde Anderson, Mr. W. Dempsey Helms, Mr. James Latham and Mr. V. Ottozawa-Chatupron of the Arizona State Land Department (ASLD) Drainage and Engineering Section.

This review evaluated evidence contained in the documents identified during the literature search, and sought to identify attempted uses of the river or the

surrounding communities for activities such as the transportation of persons or goods or other commercial activity upon or across the study reach; recreational activity (such as boating) which has occurred upon the study reach; human or social developments which occurred upon or along the banks of the study reach; irrigation systems related to the study reach; and other activities that occurred which may provide evidence of the navigability of the river at the time of Statehood. Oral histories of long-time residents over the age of 75 were identified and interviewed to incorporate their memories of river flow and tales of river use passed on to them by their parents, grandparents, and other friends and acquaintances. This literature review and evaluation was based on materials and persons identified during the literature search, and included field trips to population centers along the river.

f. Archaeological Literature Review

A.R.S. § 37-1124 required that archaeological reference materials be reviewed to identify and evaluate evidence of historic uses of the study reach. This review and evaluation was performed by Ms. Dawn M. Greenwald and Mr. Dennis Gilpin of SWCA, Inc.

This review evaluated evidence contained in the documents identified during the literature search, and sought to identify uses of the river or the surrounding communities for activities such as the transportation of persons or goods or other commercial activity upon or across the study reach; recreational activity (such as boating) which has occurred upon the study reach; human or social developments which occurred upon or along the banks of the study reach; irrigation systems related to the study reach; and other activities that occurred which provided evidence of the navigability of the river at the time of Statehood. Wherever possible, long-term residents over the age of 75 were identified and interviewed to incorporate their memories of river flow and tales of river use passed on to them by their parents, grandparents, and other friends and acquaintances.

This archaeological literature review and evaluation was based on materials and persons identified during the archaeological literature search, and included field trips to population centers along the river.

A catalogue of the literature and artifacts utilized during this review was prepared and included in the report. The catalogue identified the river reach in the resource to the highest degree possible, the location of the resource, and the title of the resource. A report was prepared which identified historical uses of specific river reaches.

g. Hydrologic & Hydraulic Literature Review

A.R.S. § 37-1124 required that hydrologic and hydraulic reference materials be reviewed to identify and evaluate evidence of normal stream flow events, changes in alignment, and other characteristics of the study reach. This review and evaluation was performed by Mr. Clyde Anderson of the Arizona State Land Department (ASLD) Drainage and Engineering Section (see Chapter 7, "Geomorphology").

This review evaluated existing available evidence contained in the documents identified during the literature search pertaining to the discharge of the river. Items reviewed during this evaluation included stream gage records; FIS studies and FIRM maps associated performed by FEMA; USGS topographic maps; BLM records; hydrologic or hydraulic studies performed by the Corps of Engineers; County Flood Control Districts; Arizona Department Of Transportation; Arizona Department of Water Rights; Arizona Department of Environmental Quality; Salt River Project; city and county engineering departments; other public agencies and private consultants; geomorphological studies and reports; city, county and state topographic maps; and accounts of unusual hydrologic, hydraulic, geomorphologic events which occurred along the river. Based on the existing available information, the stream discharge, slope, velocity, normal flow, depth, width, and roughness for the annual, 2-year, and 5-year runoff events were identified. Based on the existing available information, the location of the river and the ordinary high-water mark at the time of Statehood were identified. This literature review and evaluation were based on these materials identified during the hydrologic and hydraulic literature search.

h. Geomorphological Literature Review

A.R.S. § 37-1124 required that geomorphologic reference materials be reviewed to identify and evaluate evidence of normal stream flow events, changes in alignment, and other characteristics of the study reach. This review and evaluation was performed by Mr. Gary Huckleberry of the Arizona Geological Survey.

This review evaluated existing available evidence contained in the documents identified during the geomorphological literature search pertaining to the discharge of the river. Items reviewed during this evaluation included stream gage records; FIS studies and FIRM maps associated performed by FEMA; USGS topographic maps; BLM records; hydrologic or hydraulic studies performed by the Corps of Engineers; County Flood Control Districts; Arizona Department Of Transportation; Arizona Department of Water Rights; Arizona Department of Environmental Quality; Salt River Project; city and county engineering departments; other public agencies and private consultants; geomorphological studies and reports; city, county and state topographic maps; and accounts of unusual hydrologic, hydraulic, geomorphologic events which occurred along the river. Based on the existing available information, the stream

discharge, slope, velocity, normal flow, depth, width, and roughness for the annual, 2-year, and 5-year runoff events were identified. Based on the existing available information, the location of the river and the ordinary high-water mark at the time of Statehood were identified. Geologic materials were reviewed to identify changes in the alignment of the river. The current and historic soil condition within and along the river were reviewed to identify degradation and aggradation, which may have occurred before or since the time of before Statehood. This geomorphological literature review and evaluation was based on materials identified during the geomorphological literature search.

i. Ownership Identification

A.R.S. § 37-1124(D) required that the current title ownership of the underlying land be identified. Ownership was determined by Ms. Terry Arce and Ms. Rozanna Sedillo of the Arizona State Land Department (ASLD) Title and Contracts Section. This research was based on those areas identified on base maps provided by the ASLD Drainage and Engineering Section. State land ownership and current lessees were identified by reviewing ASLD records (CLASS). City, county, state and private ownership and lessees were identified by reviewing County Assessor and County Recorder maps and records. Federal ownership and lessees were identified by reviewing Bureau of Land Management maps and records. Parcels and parcel numbers were identified on, or referenced to, the base maps. Information collected and recorded includes the name of the current owner (lessee if public land), the recorded acreage legal description, and a general sketch of the parcel boundary. This review required contacts with the various county seats. Sources of information, in addition to those provided by the Drainage and Engineering Section, were catalogued and provided to the Project Manager. The information contained in the report was stored in an INFO database. A report was prepared which includes the information collected and was keyed to the base map.

j. Land Use Information

A.R.S. § 37-1124 (D) required that the use of underlying lands be identified from existing available information. Land use was identified by Mr. Greg Keller of the Arizona State Land Department (ASLD) Urban Planning Section.

A cursory overview of land use and condition was performed by reviewing the most recent aerial photographs from Flood Control Districts, USGS, BLM, ADOT, ADWR, ADEQ and/or ASLD files. City, county and/or ASLD planning records were reviewed to confirm current and proposed land use. Site reconnaissance (field) visits were performed to review those areas where aerial photographs and public records were either non-existent or out-of-date.

Environmentally oriented site reconnaissance visits were performed simultaneously with land use site visits. This reconnaissance was to identify apparent environmental concerns, and public trust values associated with the site, such as well sites, drainage facilities, parks, waste treatment facilities and landfills, riparian systems, wildlife, vegetation, recreational uses, etc.

This office and site review was based on a listing of preliminary aerial photographic resources, and areas identified on base maps provided by the ASLD Drainage and Engineering Section. A report was prepared and submitted to the Project Manager based on the review and keyed to the base map. The report will identify the river reach, land use patterns, apparent environmental concerns and associated public trust values. An index of the public trust values was prepared and presented in matrix form, based on discussions with ASLD personnel (Natural Resources, Urban Planning, Appraisals, etc.).

k. Geographic Information Systems

Mr. Cameron Hanye of the Arizona State Land Department (ASLD), Drainage and Engineering Section performed a search to identify existing available Geographic Information System (GIS) coverage which was utilized and/or modified for use in base maps for this study. The Arizona Land Resource Information System (ALRIS) library located within ASLD served as a beginning point and a source to identify other materials. This search identified and catalogued land ownership, township-range-section, cities, counties, hydrology, slope, USGS quadrangle, soils, vegetation, and other existing available GIS coverage. Searches were conducted at city, county, state and federal agencies such as the Arizona Department of Water Resources, the Arizona Department of Transportation, Floodplain Managers and Flood Control Districts, Assessors, Recorders, the Arizona Department of Environmental Quality, the Arizona Game and Fish Department, the Arizona Parks Department, the Bureau of Land Management, and the Bureau of Reclamation. Information gathered during the performance of other tasks was entered into new GIS covers as needed.

All materials utilized during this search and a catalogue which identifies the materials, the type of resource, the title of the resource, the location of the resource and the river reach was submitted to the State Land Department upon completion of the study. Maps and exhibits have been prepared to present the information contained in the GIS files, and have been stored in ALRIS directories. A hardcopy version of land use and ownership maps are on file at the Drainage and Engineering Section, ASLD. A summary report was prepared which briefly identifies the sources of information, the types of information acquired, and how the information was utilized and presented.

CHAPTER II

Methodology

Procedures

1. Initial Contact

Initial contact for data collection was made by means of a telephone call to identify the address and an initial contact/addressee. A letter and questionnaire (see Appendix B) were then sent to public agencies to identify existing available resources. The letter briefly explained the intent of the Streambed Program and the State Land Department's charge to gather information. The letter requested the addressee to review the questionnaire which was attached to the letter, and to return it to the State Land Department.

Nearly 80 agencies were contacted by mail (see mailing list in Appendix C). Forty-three responses were received either in the form of the questionnaire or a letter, some including information or photos. Agencies which did not respond to the initial mailing were contacted by telephone and their responses were taken in that manner. Agencies which were contacted include: libraries, museums, historical societies, county engineers, county assessors and recorders, county planning departments, state agencies and federal agencies. Ms. Mary Lu Moore of the Arizona State Attorney General's Office was contacted and was of great assistance in identifying potential resources.

2. Follow-up Contact

Follow-up contact consisted of either a follow-up telephone conversation to confirm the response, or a site visit to identify and gather materials pertaining to the study. Visits to libraries and museums provided access to books, maps, photographs, oral histories, journals, and streamflow records. A bibliography of these materials is located in the Appendix. Recent aerial photographs of the river were obtained to assist in identifying features.

3. Agency Identification

Through the means of a 'brainstorming' session, numerous agencies were identified that might be repositories for pertinent information. Agencies identified were: Federal, State, County and City agencies including libraries, engineers, historical societies, etc.

4. **Initial telephone call**

The initial contact with an agency consisted of a telephone conversation, either with the head of the agency, or whoever happened to answer the telephone. During that conversation, an 'initial contact' was identified and the address of the agency was confirmed. The respondent was informed that a letter request would be in the mail within a few days, and that the Department would appreciate a timely response to their request.

5. **Follow-up with a letter request**

After identifying the 'initial point of contact', a formal letter was submitted to the contacted agency requesting their assistance in identifying and gathering pertinent information. In order to facilitate the agency's response, a self-addressed, postmarked envelope was included with the request for information. A copy of a survey questionnaire was also included with the letter, and the contacted agency was asked to search within their agency to identify pertinent information.

6. **Follow-up phone call or personal visit**

When the agency responded with either the questionnaire or a letter (a number of agencies responded with both the questionnaire and resource materials), either a follow-up telephone call was placed to review the response, or a personal visit was arranged.

7. **Second letter request**

After the follow-up telephone call or personal visit, a second set of request letters was mailed to the agencies. In the case of those agencies which had not responded to the initial request, a second request was mailed. In the case of agencies which had responded to the initial request, a second request was made to the agency to take a second look and attempt to identify any material which may have been overlooked at the time of the original request.

8. **Combination and comparison of results if more than one visitor or telephone interview occurred.**

Documentation

Resources have been identified by title, author, publisher information, date, location, nature of resource whenever possible. Photocopies of documents have been obtained for closer scrutiny and to facilitate documentation. In cases where a

hardcopy version of the original or transcribed materials was not available for photocopying, hand written notes were taken. If the material was available on microfiché, either copies were made from the microfiché, or the microfiché was duplicated. Resource materials not included within this report are available for review at the State Land Department.

CHAPTER III

Archaeology

ARCHAEOLOGICAL OVERVIEW OF THE GILA RIVER VALLEY

Dawn M. Greenwald and Dennis Gilpin

The Gila River has a long record of prehistoric use and occupation. The river spans southern Arizona from the New Mexico border to the Colorado River, and prehistoric occupation along its banks reflects a multitude of cultural influences. For management purposes, discussion of archaeology along the river has been organized by river segments. The lower Gila includes the segment from the Colorado River to just west of the Gila's confluence with the Agua Fria River (Figure 1); the middle Gila is the segment from just west of the Agua Fria River to just east of the town of Florence (Figure 2); and the upper Gila flows from east of Florence to the New Mexico border (Figure 3). The middle Gila is the segment best known archaeologically, although the other segments contain more cultural diversity. Only a few historic archaeological projects have been conducted along the river, and these are summarized in the final section. The prehistoric archaeology sections were written by Dawn Greenwald, and the historic archaeology section was authored by Dennis Gilpin.

ARCHAEOLOGICAL PROJECTS

Lower Gila

Early explorers and travelers, such as William H. Emory and Newton Chittenden, documented a few archaeological sites along the Gila River prior to systematic inquiries. In 1846, Emory (1848:89-91) described and illustrated the glyphs at the site of Painted Rocks (Figure 1). Chittenden visited the Fortified Hill site in 1888 or 1889, and later published an article about the site, including a map (Chittendon 1905; McGuire and Schiffer 1982). Others who commented on archaeological manifestations in these early years were Bancroft (1883), Lumholtz (1912), McGee (1895, 1896), and Huntington (1912, 1914).

The first archaeological surveys that were conducted were broad overviews of the region. They usually were biased toward larger sites, such as villages, and concentrated on reporting manifestations of the Hohokam, the prehistoric culture that was centered in the Salt and Gila Basins. Gila Pueblo (Gladwin and Gladwin 1929, 1930), a privately owned archaeological research foundation, conducted reconnaissance surveys to determine the boundaries of the red-on-buff culture (Hohokam) and determined that southwestern Arizona was peripheral to it. The Gila

Bend area was surveyed by Simmons (n.d.) for cerros de trincheras, hills terraced with dry-laid stone walls, and in the 1960s Wasley (1965) and Vivian (1965) surveyed most of the lower Gila in sections (Table 1).

The Painted Rocks Reservoir area was surveyed by Schroeder, Ezell, and others, with sites excavated in the same area between 1958 and 1961 (Wasley and Johnson 1965), including Fortified Hill, Citrus, and Rock Ball Court (Figure 1), all typical Hohokam village sites. Canals near Gila Bend were sectioned by Woodbury (1961), who also tested another canal that served the Gatlin site. Based on these investigations, Woodbury estimated that there were over 10 miles of prehistoric canals in the Gila Bend area. In the 1970s, the Museum of Northern Arizona conducted numerous archaeological studies for the Liberty to Gila Bend transmission line. Six archaeological sites were located within the centerline right-of-way, which was 45 miles long; five additional sites were found during survey of 2 linear miles of access roads. All these sites except one, a prehistoric and historic canal system, were surficial and small. The Bureau of Land Management (BLM) sponsored a large survey (12,800 acres) near Buckeye Hills within their Greenbelt Planning Unit for administrative purposes. Sites were predominantly Hohokam and consisted of a variety of types (Rodgers 1976).

Overviews of the lower Gila River area have been produced by the BLM. Doelle (1975a) prepared an overview of BLM's Greenbelt Planning Unit, and McGuire and Schiffer (1982) published an overview for the BLM of the prehistory of southwest Arizona, concentrating on the area of the Sonoran Desert south of the Gila River.

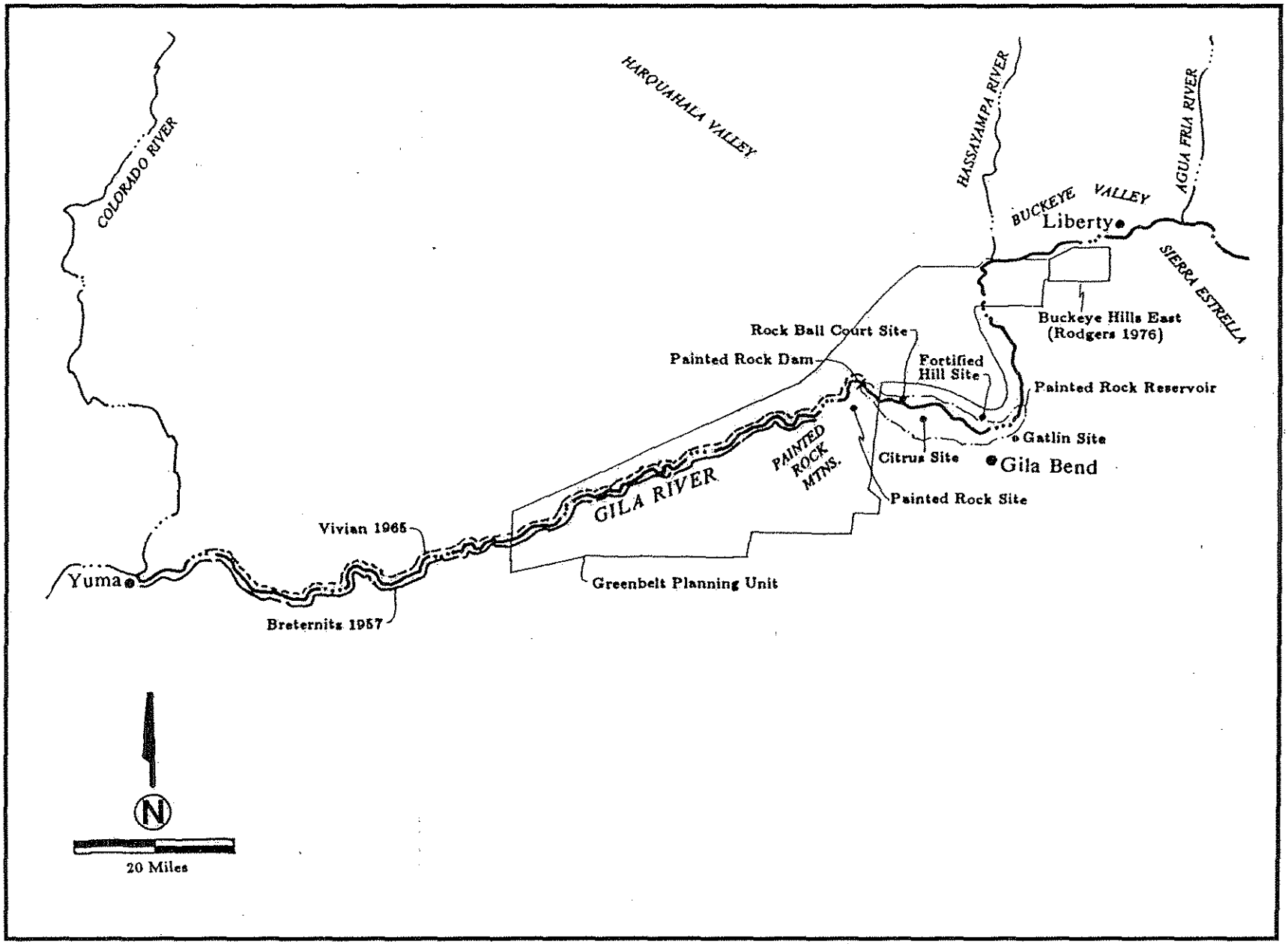

Figure 1. Major archaeological sites and project areas along the lower Gila River.

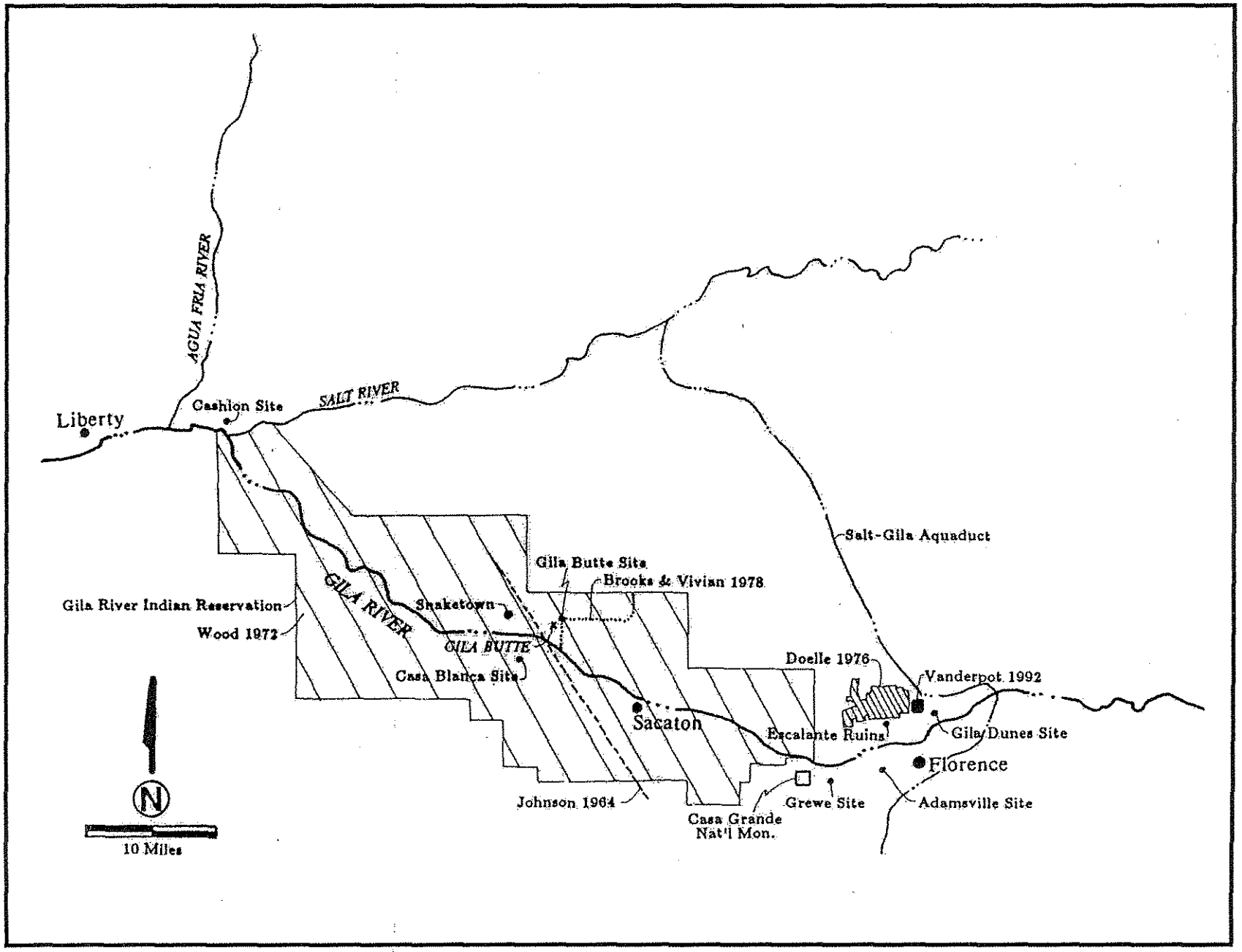

Figure 2. Major archaeological sites and project areas along the middle Gila River.

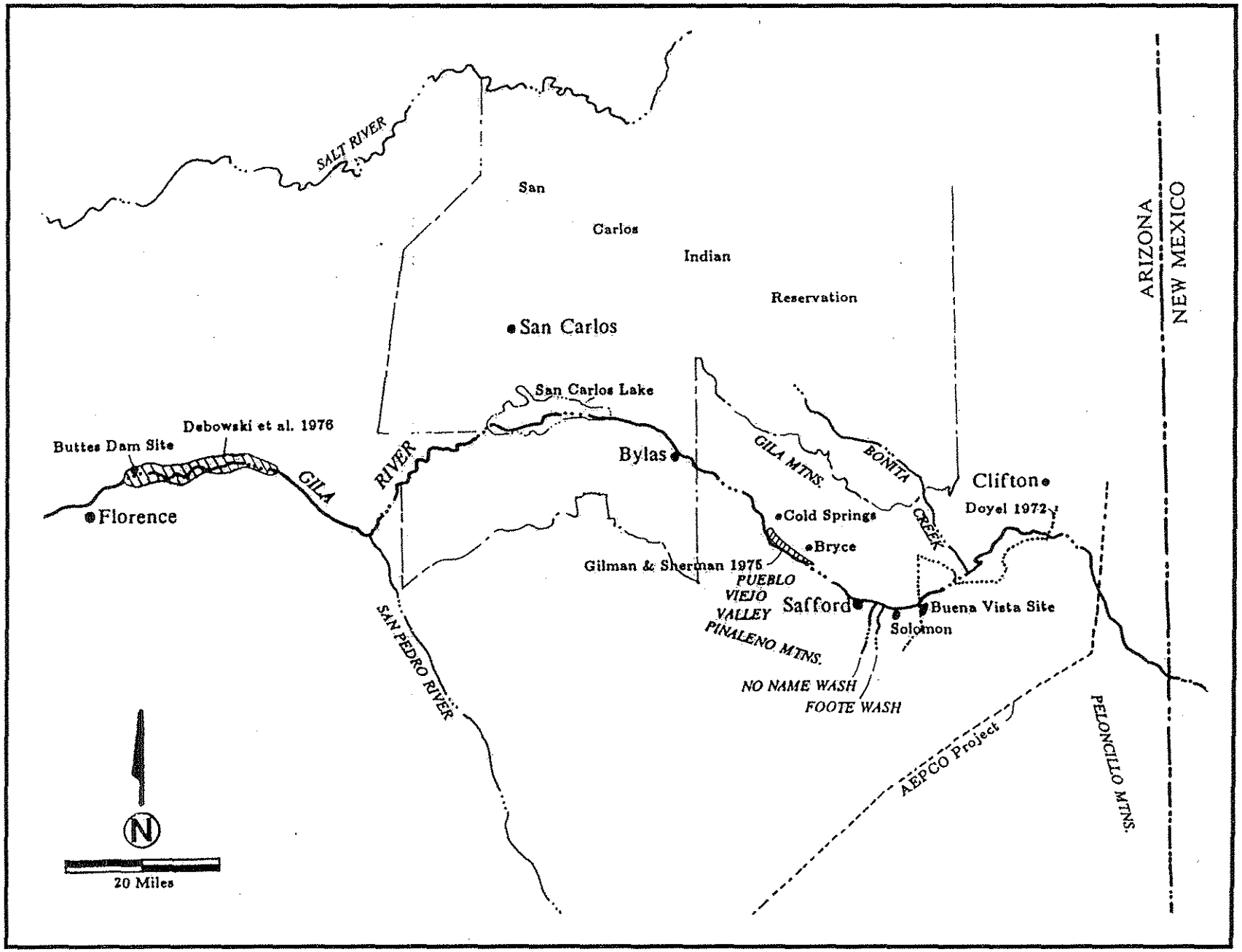

Figure 3. Major archaeological sites and project areas along the upper Gila River.

Table 1. Major Archaeological Projects Along the Gila River

Sponsor	Type of Project	Area Extent	Number of Sites	Reference
National Park Service	Survey	Gila River from Gillespie Dam to confluence with the Salt River (approx. 40 miles)	?	Walsey 1965
National Park Service	Survey	Blaisdell to Painted Rock Dam (120 miles)	85	Vivian 1965
National Park Service	Painted Rocks Reservoir Survey	Painted Rocks Reservoir	28	Schroeder and Ezell, cited in Wasley & Johnson 1965
National Park Service	Painted Rocks Reservoir Excavation	Excavation & Survey	26 (survey) 18 (excavation)	Wasley & Johnson 1965
Rockefeller Foundation of New York	Excavation	Excavation	canals	Woodberry 1961
Arizona Public Service Company	Liberty-to-Gila Bend Transmission Line Survey	45 linear miles	43	Brook et al. 1977
Arizona Public Service Company	Liberty-to-Gila Bend Transmission Line Survey	184.5 linear miles	18	Brook & Davidson 1975; Simmons 1976; Stein 1977
Archaeological Institute of America	Reconnaissance	Southwest U.S. & Mexico	?	Bandelier 1884, 1892
Smithsonian Institution	Reconnaissance	Gila River & its tributaries	?	Fewkes 1909
Various	Mapping canals	Buckeye Valley & Casa Grande	canals	Midvale 1965, 1974
Mrs. W.B. Thompson American Museum of Natural History	Thompson Expedition (Excavation)	"Lower Gila Region"	?	Schmidt 1927
Gila Pueblo	Excavation	Casa Grande and Adamsville sites	2	Gladwin 1928
Gila Pueblo	Reconnaissance	Gila River from Florence to Estrella Mountains	178	Gladwin and Gladwin 1929
Gila Pueblo	Reconnaissance	Gila River between Gila Bend and Yuma	15	Gladwin and Gladwin 1930
Gila Pueblo	Reconnaissance	?	?	Gladwin and Gladwin 1935
Gila Pueblo	Excavation	Snaketown site	1	Gladwin et al. 1937
Van Bergen/ Los Angeles Museum	Excavation	Grewe site	1	Hayden 1931; Woodward 1931
Southwestern Monuments Association	Excavation (testing)	Casa Grande National Monument	1	Ambler 1961; Hastings 1934
Maricopa County Parks and	Survey	Estrella Mountain Regional Park	12	Johnson 1963

Sponsor	Type of Project	Area Extent	Number of Sites	Reference
Recreation Department				
Arizona State Highway Department	Excavation (testing)	Excavation	8	Johnson 1964
Arizona State Highway Department	Excavation	Snaketown site	1	Haury 1965, 1976
Bureau of Reclamation	Central Arizona Project Survey (Salt-Gila Aqueduct)	58 miles long (Apache Junction to near Picacho, Arizona)	75	Dittert, Fish, and Simonis 1969; Grady et al. 1973; Stein 1979
Bureau of Reclamation	Central Arizona Project Excavations	Excavation	45	Teague and Crown 1983, 1984
Continental Oil Company	Excavation	Excavation	6	Doyel 1974
Continental Oil Company	Survey	7860 acres	9	Doelle 1976b
National Park Service	Roosevelt Water Conservation District Floodway Project Survey and Testing	approximately 1181 acres	29 (survey) 14 (excavation)	Brooks and Vivian 1976; Greenleaf and Vivian 1971; Rice 1977, 1979; Rice et al. 1979; Wilcox 1979
Bureau of American Ethnology	Reconnaissance	Pueblo Viejo area	>15	Fewkes 1904; Hough 1907
University of California	Reconnaissance	Southeast Arizona	?	Sauer and Brand 1930
National Park Service	Excavation	Buttes Dam Site	1	Wasley and Benham 1968
National Park Service	Excavation	Excavation	2	Johnson and Wasley 1966
National Park Service	Survey	Gila River channel between Safford and the Buttes Dam Site (approximately 110 miles)	>39	Tuohy 1960
Bureau of Reclamation	Buttes Reservoir Survey	approximately 9700 acres	272	Debowski et al. 1976
Tucson Gas and Electric Company	San Juan to Vail Transmission Line Survey	approximately 120 miles long	3	Doyel 1972
Graham-Curtis Canal Company	Survey	North side of Gila River between Bryce and Cold Springs	4	Gilman and Sherman 1975
Arizona Electric Power Cooperative	Survey	approximately 123 km long	89	Simpson and Westfall 1978
Arizona Electric Power Cooperative	Excavation	Excavation	11	Westfall et al. 1979
Gila River Indian Community	Reconnaissance	Gila River Indian Reservation (95,000 acres)	366	Ayres 1975; Wood 1972
U.S. Army Corps of Engineers	Survey and Testing	150 acres near Florence	16 (survey) 1 (testing)	Vanderpot 1992
Bureau of Land Management	Survey	Buckeye Hills East (12,800 acres)	20	Rodgers 1976

Middle Gila

Many early explorers, visitors, missionaries, and American government representatives noted archaeological ruins along the middle Gila. The early chroniclers were particularly impressed by Casa Grande, a large Classic period Hohokam site that contains a Great House, a large, multistoried adobe structure. Some of these early commentaries came from Father Kino, a Jesuit missionary who first visited the area in 1694; Manje and Bernal, Spanish soldiers; and Emory, Johnson, and Bartlett, American government personnel. Bandelier (1884, 1892) also wrote about Casa Grande while conducting ethnographic, archaeological, and archival research for the Archaeological Institute of America in the southwest United States and Mexico. In two separate accounts he interpreted the structure differently, once as a residence and then as a fortress. Bandelier made other observations along the Gila, noting that major ruins on the south bank of the river were located between 3 and 6 miles apart within a 2-mile-wide strip and that there were large concentrations of sites between Sacaton and Florence (Bandelier 1892:447, 458). The Hemenway Expedition, led by Cushing in 1886, visited several sites, including Casa Grande, and in 1891 the Smithsonian Institution sponsored Fewkes's work of documenting the extent of vandalism at Casa Grande. Cosmos Mindeleff (1896, 1897) produced records of the site before and after stabilization/restoration occurred at the site, providing detailed descriptions of the architecture. He believed that Casa Grande was built and occupied by ancestors of the Pima. Fewkes continued the work of repairing and protecting the site from the elements from 1906 to 1908 so that it could serve as an "exhibition ruin" for the American public (Wilcox 1977:36).

Following his Casa Grande work, Fewkes (1909) conducted a reconnaissance survey along the Gila and its tributaries to describe major ruins and their condition. During his survey he noted extensive canal systems associated with the sites. In 1927, Cummings studied prehistoric canals around Casa Grande on both sides of the river, and Frank Midvale (1965, 1974) mapped canal systems from approximately 10 miles west and 15 miles east of Casa Grande, as well as canals around eastern Buckeye Valley (Figure 4).

In 1925, Schmidt (1927) led the Thompson Expedition excavations at sites along the Gila and Salt rivers. The goal of the expedition was to establish chronological relationships among sites. Gladwin (1928) conducted test excavations to establish a ceramic and cultural sequence at the Casa Grande and Adamsville sites.

The Gila Pueblo survey began in 1928 (Gladwin and Gladwin 1929), with the area along the Gila River covered from Florence west to the Sierra Estrella Mountains. The survey was specifically oriented to defining the range of the red-on-buff pottery that is the trademark of the Hohokam prehistoric culture. Between 1934 and 1935 Gila Pueblo excavated the large Hohokam village site of Snaketown (Gladwin et al. 1937). This work was a milestone in Hohokam archaeology, providing expanded and systematized knowledge on Hohokam material culture. Architecture, ball courts, and

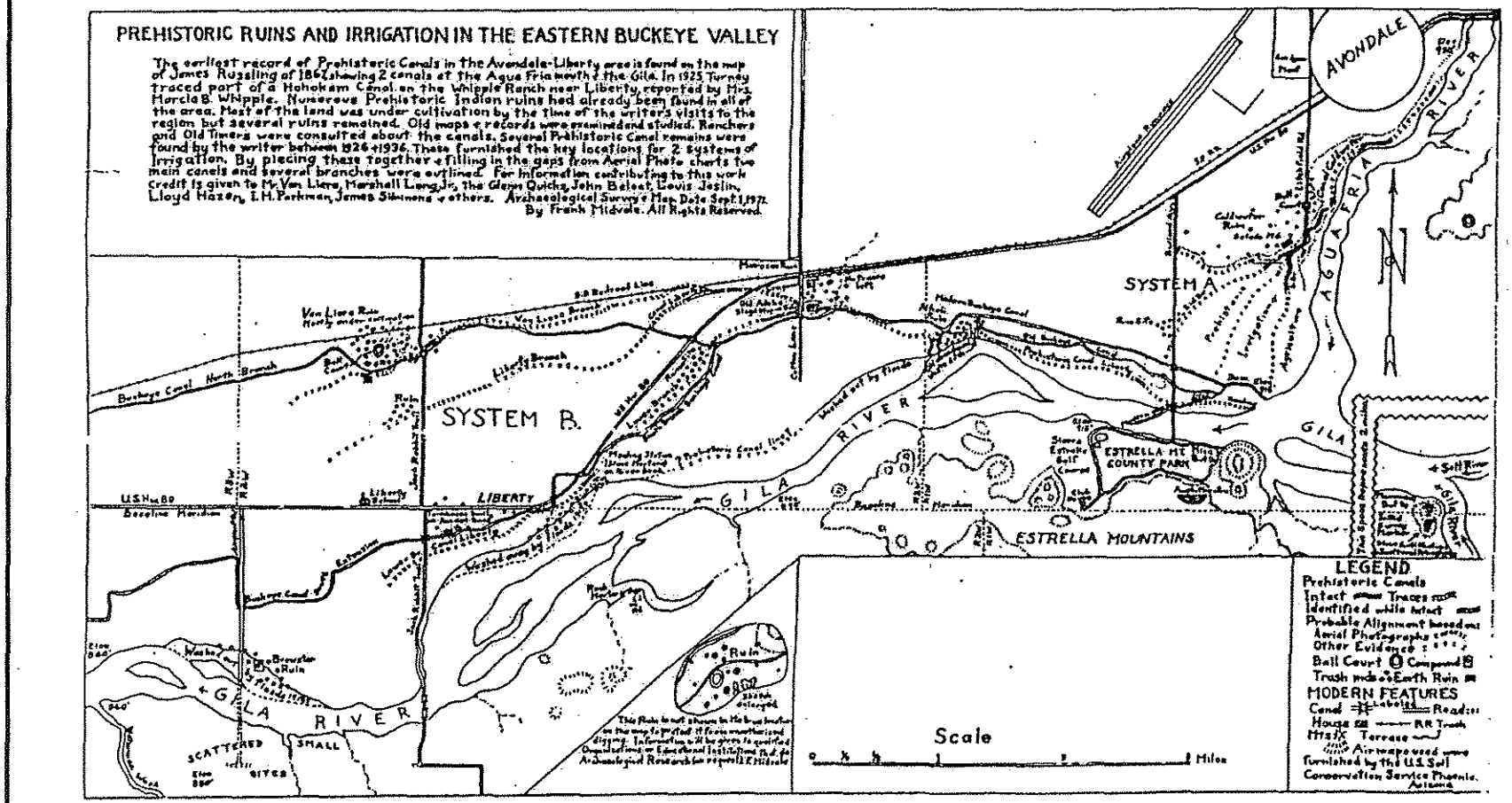

Figure 4. Midvale's map (1974) of the eastern Buckeye Valley.

canals were investigated, and the chronological sequence that was developed was the basis for the chronology used today (Table 2). Other sites that were excavated during the early 1930s include the Grewe site, about 1 mile east of Casa Grande National Monument (Hayden 1931; Woodward 1931), and Casa Grande (Ambler 1961; Hastings 1934).

Table 2. Chronology for the Prehistory of the Gila River Valley, Hohokam Region

Southwestern	Post-Classic	Polvorón	A.D. 1350-1450
Southwestern	Classic	Civano	A.D. 1250-1350
Southwestern		Soho	A.D. 1100-1250
Southwestern	Sedentary	Sacaton	A.D. 900-1100
Southwestern	Colonial	Santa Cruz	A.D. 750-900
Southwestern		Gila Butte	A.D. 650-750
Southwestern	Pioneer	Snaketown	A.D. 550-650
Southwestern		Sweetwater	A.D. 450-550
Southwestern		Estrella	A.D. 350-450
Southwestern		Vahki	A.D. 250-350
Archaic			8000 B.C - A.D. 1
Paleoindian			10,000 - 8000 B.C.

The 1960s saw an increase in archaeological work along the middle Gila. In 1963, the Maricopa County Parks and Recreation Department sponsored a survey of five regional parks, including the Sierra Estrella Mountains (Johnson 1963), where 12 sites were recorded. Construction of Interstate 10 promoted archaeological work near Gila Butte on the Gila River Indian Reservation (Johnson 1964). Eight sites were investigated, including numerous burials. Between 1964 and 1965 the site of Snaketown was re-examined by Haury (1965, 1976). A total of 181 houses were excavated and 29 mounds were tested to collect information on chronology, possible Mesoamerican influences, and the history of irrigation agriculture. Beginning in 1969, a series of projects were undertaken in conjunction with the Central Arizona Project (CAP), a large, multiple-year project sponsored by the Bureau of Reclamation to construct an aqueduct that would supply water from the Colorado River to central and southern Arizona (Table 1). Surveys were conducted along the Granite Reef, Salt-Gila, and Tucson portions of the aqueduct, and these were followed by testing and data recovery efforts in the 1970s and 1980s. An intensive site survey of the Gila River Indian Reservation conducted in 1970 (Wood 1972) located over 300 prehistoric Hohokam and historic Pima sites. The purpose of the survey was for better management of reservation land.

Beginning in 1971, a number of survey and excavation projects were conducted by Continental Oil Company to mitigate the impacts of a drilling project on the north side of the Gila River near Florence. A preliminary survey and salvage excavations were undertaken in

1971 and 1972 (Ayres 1971; Windmiller 1972), with excavations in 1973 at Escalante Ruin, a large Hohokam site reported in detail in Doyel's 1974 dissertation. In 1974, 7860 acres were surveyed north of Escalante Ruin as part of the same project, locating nine sites. A statistical sample of the surveyed area was also subjected to further investigation, with the emphasis on reconstructing patterns of prehistoric upland exploitation (Doelle 1976b). At about the same time, the Roosevelt Water Conservation District Floodway Project to widen and extend the existing floodway to the Gila River was initiated; in 1971, survey and test excavations (Brooks and Vivian 1976; Greenleaf and Vivian 1971) included work at the Gila Butte Site. The Arizona State Museum (ASM) continued the work in 1974 (Brooks and Vivian 1976), and a 1977 management report (Rice 1977) assessed the project's impact on 29 sites and site complexes in the Gila Butte-Santan area (Berry and Marmaduke 1982:90). The report was followed by testing of 22 sites (Rice 1979; Rice et al. 1979; Wilcox 1979).

Upper Gila

Less archaeological work has been done along the upper Gila River than along the middle Gila. Early explorations and expeditions, including those sponsored by the Bureau of American Ethnology, were in the form of descriptions and brief reconnaissance surveys. Lieutenant Emory described ruins along the Gila River and provided the first description of the Buena Vista site, near Safford (Emory 1848). Bandelier (1892), Russell, Fewkes (1904), and Hough (1907) conducted surveys that passed through the area. During their survey, Fewkes and Hough visited the Buena Vista and Solomonville sites in the Safford region, noting that agriculture had almost destroyed the site of Solomonville. Gila Pueblo's survey of the area (Gladwin and Gladwin 1935) focused on identifying the range of Hohokam red-on-buff pottery. In 1929, Sauer and Brand (1930) conducted a survey that covered the Gila River from approximately San Carlos to the Arizona/New Mexico border. Their goal was to locate the maximum number of archaeological sites in the time allotted and to collect a representative sample of artifacts. The number of sites located is not reported in the text. Tatman (Brown 1973) conducted brief excavations at the Buena Vista site, although they were never completed.

In 1963, Vivian surveyed the proposed Buttes Reservoir area for the National Park Service (NPS), locating five sites. In 1966, ASM excavated one of the sites, the Buttes Dam site, a large Hohokam village on a terrace on the north side of the river (Wasley and Benham 1968). Two other sites were excavated for the NPS on the San Carlos Indian Reservation in 1963 (Johnson and Wasley 1966), but they represented a local variation of a mixture of cultural manifestations (Bronitsky and Merritt 1986). The original survey for the project (Gila River Channel Rectification Project) recorded 18 sites (Tuohy 1960) in 1959, 10 on the north bank and 8 on the south bank of the Gila River, near Bylas.

In the 1970s, a number of surveys and other archaeological work were undertaken in conjunction with utility and water control projects. In 1972, a survey was conducted for Tucson Gas and Electric from Clifton to Tucson (Doyel 1972). In 1974 a survey was done for the Graham-Curtis Canal Company for the proposed construction of five flood control dams

and their associated features (Gilman and Sherman 1975). This survey area was approximately 10 miles northwest of Safford, with four prehistoric sites recorded between the floodplain and the second terrace of the river. Dam site areas near Safford also were surveyed for the Coronado Resource Conservation and Development Project in 1975 (Kinkade 1975). Twenty-one sites were found along Foote Wash and No Name Wash, which empty into the Gila River Valley. Most of the sites represented small temporary camps. A series of surveys were conducted for Arizona Electric Power Cooperative (AEPCO) in 1977 from their Greelee Substation to their Cochise Power Plant south of Willcox. A total of 103 sites were recorded (Simpson and Westfall 1978), and 11 sites subsequently were excavated (Westfall et al. 1979). Survey of the proposed Buttes Reservoir area in the 1970s located 250 prehistoric sites or site components, most of which were associated with Hohokam occupation (Debowski et al. 1976).

Other, smaller projects also took place during this time period. In 1973, survey and limited excavations in the Pueblo Viejo area, near Safford, examined the origins of Salado cultural influence seen there (Bown 1973). Two Salado sites also were excavated by students from Eastern Arizona College in 1975 and 1976 (Bronitsky and Merritt 1986:65).

Overviews for the area around the upper Gila River have been produced to date for the Bureau of Land Management (BLM). Separate overviews were compiled for the Middle Gila Planning Unit (Debowski and Fritz 1974), Winkelman and Black Hills Planning Units (Teague 1974), Geronimo Planning Unit (Doelle 1975b), and for Southeast Arizona in general (Bronitsky and Merritt 1986). The earlier overviews do not always include maps, providing only descriptions of planning units in the text.

PREHISTORIC CULTURAL HISTORY

Lower Gila

Evidence of Paleoindian occupation (approximately 10,000 to 8000 B.C.) of the lower Gila occurs only in the western portion. Between Yuma and Painted Rock Mountains, Breternitz (1957:1) noted a trail site that may have been associated with the Malpais phase (Rogers 1939:6-8). The trail is located on desert pavement and is a cultural feature typical of the San Dieguito Industry, a long-lived and widespread stone artifact industry in the southwest desert, that may date to pre-9000 B.C., although there is controversy regarding the temporal placement of this phase.

Archaic period (8000 B.C.- A.D. 1) sites have not been identified along the lower Gila River, although areas to the north and south of the river have Archaic period occupations. Ventana Cave (Haury 1950), approximately 45 miles to the south, had stratified Archaic deposits, and the Harquahala Valley (Bostwick et al. 1988), approximately 35 miles to the north, contained a number of Archaic sites. Sites that consist only of stone artifacts have been found by Breternitz (1957) and Vivian (1965), and these may represent either occupations by Archaic period hunters and gatherers or use by later ceramic-using groups as

temporary camps.

The introduction of ceramics into the prehistoric Southwest was a transition away from the Archaic period lifestyle of mobile hunting and gathering to a more sedentary way of life that was accompanied by farming, food storage, and a settlement shift toward major rivers and streams (Wilcox 1979). Following the Archaic period, two ceramic traditions were prevalent along the lower Gila, the Patayan and the Hohokam cultures. Patayan sites are less well known than Hohokam sites, generally because they are smaller and fewer in number. In addition, little or no archaeological work, recording or excavation, has been done on Patayan sites, so that little information is available. During the pre-Classic periods (A.D. 300-1100), Patayan influence generally extended west of Gila Bend; during the Classic period (A.D. 1100-1450) it spread east to the Buckeye Hills area. Lower Colorado Buff Ware ceramics are dominant on Patayan sites and were the type found most often during Breternitz's 1955 survey. He recorded 11 sites that contained pottery; most of them were campsites located on sand dunes, in the mesquite flats of the river floodplain, or away from the river (Breternitz 1957:2). Rogers (n.d., cited in Stone 1986:68) described Patayan sites as temporary camping and resource exploitation remains near desert trails that linked reaches of the Colorado and Gila rivers. In the Buckeye Hills area, Patayan occupation is inferred by the presence of Lower Colorado Buff Ware that generally was recovered from upland areas. Use of the area appears to have been associated with seasonal exploitation and is represented by artifact scatters and rock rings as temporary sleeping circles. Along the lower terrace, these remains are usually mixed with Hohokam artifacts (Rodgers 1976:70).

The Hohokam culture occupied the easternmost section of the lower Gila, from the area around Gila Bend to its eastern boundary with the middle Gila River. The Hohokam along the Gila were sedentary agriculturalists who produced a distinctive red-on-buff pottery and expanded their sphere of influence to many parts of the Southwest, evident by architectural and other material traits. Hohokam culture history has been divided into phases within periods (Table 2), separated by changes in ceramic and other material traits, and includes the Pioneer, Colonial, Sedentary, Classic, and post-Classic periods. The Hohokam occupied the lower Gila beginning in the Pioneer period, but ceramics from this period are always mixed with those from later occupations (Doelle 1975a:7). During the Colonial period (A.D. 650-900), however, habitation sites are definable and settlement pattern can be reconstructed. Large permanent habitation sites are concentrated around the Painted Rocks Reservoir and Gila Bend area and are represented by the Rock Ball Court and the Gatlin sites. The Rock Ball Court site (Figure 1) is situated on a terrace overlooking the Gila River from the north. Five structures were excavated at the site, as well as a ball court, two cremations, a pit oven, trash mounds, and borrow pits. The structures and ball court showed some variation from typical Hohokam characteristics. Three of the structures were pithouses, described as houses built completely within pits (Wasley and Johnson 1965:6-17), but they were unusually large, deep, and irregularly shaped (Wasley and Johnson 1965:17). Two of the structures were oval rock-lined surface structures, not typical Hohokam types, that may have been used for storage. In addition, the ball court (26.0 x 14.5 m) was shallower than usual and was surrounded by a caliche apron. These unusual patterns were thought to represent a local development of Hohokam-style architecture. The pithouses had an average floor area of 16.5

m^2, and the surface structures had areas of 29.8 m^2 and 15.0 m^2 each. Based on the Painted Rocks Reservoir excavations, Wasley and Johnson (1965:80) determined that by the Colonial period in the Gila Bend area, Hohokam villages were located on the first and second terraces above the river. Although no canals were found associated with this time period, site locations suggest their use for farming.

The Sedentary period (A.D. 900-1100) was the most elaborate stage of Hohokam culture in the Painted Rocks Reservoir project area (Wasley and Johnson 1965:18). Sites dating to this period include the Gatlin and Citrus sites (Figure 1). The Sedentary component of the Gatlin site that was excavated incorporates a platform mound, 22 trash mounds, 2 ball courts, a crematorium, a pithouse, and an irrigation canal. The platform mound had a flat top and sloping sides with rounded corners and was irregularly subrectangular (Wasley and Johnson 1965:18). It was built and added on to in successive stages; at its final and largest stage, it was about 12 ft above the surface of the plaza and measured 95 x 70 ft. The trash mounds were an average of 15 m in diameter and 1 m in height. Both ball courts consisted of shallow depressions with semicircular ridges of earth bordering the court along both long sides. One of the ball courts measured 33.0 × 11.2 m; the pithouse had a floor area of 11.7 m^2. The canal had a U-shaped profile, with a channel width of approximately 3 m and a depth of 1.3-1.8 m, and its head was located about 5 miles northeast of the site (Wasley and Johnson 1965:24).

The Citrus site was another Hohokam village located about 15 miles west of the Gatlin site. The northern section of the site had been destroyed by agricultural activities. This site included not only 2 ball courts and 11 structures (pithouses), but a caliche-floored plaza as well. Most of the houses were situated around the edges of the plaza, which was approximately rectangular and measured 35 × 20 m (Wasley and Johnson 1965:37). Three other Sedentary period sites were excavated, revealing the presence of more ball courts, trash mounds, and pithouses. Platform mounds and ball courts imply social organization and complexity among the residents of these sites and that they participated within the same type of sociopolitical structure that was in place to the east, in the heart of Hohokam country. Irrigation agriculture was practiced, and canals were maintained.

After A.D. 1100, following the transition from the Sedentary to the Classic period, there was a settlement pattern shift in the Painted Rocks Reservoir area. Villages changed location from the first and second terraces above the river to the floodplain or first terrace. Five Hohokam Classic period sites were excavated within the Painted Rocks Reservoir (Wasley and Johnson 1965:69), and one, the Fortified Hill site, was described. The Fortified Hill site is located on a butte with a sheer cliff on the north side; it comprises approximately 40 masonry structures within fortification walls. This defensive type of site is more characteristic of areas to the south of the Gila, where fortified sites were common. Only one structure from the Classic period sites was excavated. It was a rectangular surface masonry structure, typical for this time period, with a large floor area (74.4 m^2). Sites contained both inhumation and cremation burial features. The combination of such features is usual during the Classic period, although the appearance of inhumations in the Hohokam area is usually attributed to Salado cultural influences, other traits of which are not apparent in the Gila Bend

area.

No post-Classic remains have been reported along the lower Gila. Because so little archaeological work has been done, no conclusions regarding this time period are possible.

Middle Gila

Some archaeological remains of the Paleoindian and Archaic traditions have been recorded along this segment of the Gila River. Evidence of the Paleoindian tradition has been found in the form of a few isolated projectile points in the area around Florence (Agenbroad 1967:116; Huckell 1982) and north of Coolidge (Agenbroad 1967:114). Archaic evidence also occurs as isolated projectile points, as well as a camp site near Florence (Vanderpot 1992:11). The Gila Dunes site was used during the Archaic period as a camp for the seasonal exploitation of resources that were found along and adjacent to the river (Fish n.d.;Vanderpot 1992).

Prehistoric cultural history along the middle Gila is dominated by the Hohokam, with a chronological sequence following that in Table 2. The transition from the Archaic to the Hohokam tradition is generally not well documented along the Gila River. This may be due to inundation of sites by the river so that they are not visible from the surface; transition period sites have been discovered along floodplains of minor tributaries and washes south of the Gila, representing early attempts at floodwater farming prior to the introduction of irrigation agriculture. Hallmarks of the Hohokam culture include canal irrigation, cremations, ball courts, platform mounds, polished redwares and brownware pottery, and other artifacts. Primary sites that have been investigated along the middle Gila include large villages, such as Casa Grande and Snaketown. From intensive study of these large sites, information such as site-specific data and settlement structure through time has been compiled. Haury's (1978) detailed descriptions of excavations at Snaketown have contributed to our knowledge of pre-Classic site architecture and artifact types. Investigations along the Salt-Gila Aqueduct for the Central Arizona Project (Teague and Crown 1984) added to information on Classic period sites. Wilcox (1979) later conducted an analysis of settlement patterns along the middle Gila based on data from university site files, published reports, and his personal observations. His analysis produced a site-size classification based on acreage and changes in site location relative to the river and other sites (Table 3). According to Wilcox's classification, sites were organized as Class A (0.025-35 acres), Class B (50-165 acres), Class C (180-550 acres), or Class D (over 1000 acres). Only the Cashion site, located near the confluence of the Salt and Gila rivers, was categorized as Class D. The discussion that follows draws most heavily on these studies in assimilating current archaeological knowledge of the area.

Table 3. Selected Data on Sites along the Middle Gila River

Temporal Period	House Floor Area[1] (m^2)	Average Distance[2] Between Sites (km)	Average Distance[2] of Sites from River (km)
Early Pioneer	51	NA	1.8
Late Pioneer	23	4.4	2.1
Colonial	20	3.3	2.2
Sedentary	20-25	NA	2.4
Classic	17.1	2.3	2.1

[1]Pre-Classic statistics are taken from Haury 1978, and the Classic period statistics are derived from Teague and Crown 1983.
[2]Statistics are taken from Wilcox 1979.
NA = not available

The Pioneer period, the earliest in the Hohokam sequence, is represented by the Gila Butte and Snaketown sites (Figure 2). During this period, sites were dispersed in no particular pattern along the river at the edge of the floodplain and on the second terrace (Wilcox 1979:101). They consisted of small autonomous villages, each with its own canal system. Early Pioneer period sites were found on the north of the river, while later Pioneer villages were located on both sides of the river. The average distance from the river was 2.1 km, and there was an average distance of 4.4 km between sites (Table 3).

The earliest houses, during the Vahki phase of the Pioneer period (Table 2) were large (average floor area = 51 m^2) and square, becoming progressively smaller (average floor area = 23 m^2) and sometimes rectangular during later Pioneer period phases. The earlier, larger houses are inferred to have been used by large extended families (Haury 1978:68).

Average distance between sites narrowed to 3.3 km during the Gila Butte phase of the Colonial period due to an increase in the number of sites as well as an increase in site size. Ball courts appear on sites located along canal systems. The later Colonial period, or Santa Cruz phase, was a relatively stable time with few new sites and modest increases in village size. Casa Grande, Gila Butte, and the Grewe sites were founded during this period. Settlement pattern along the river continued to be dispersed, with sites averaging a slightly greater distance (2.2 km) from the river than the previous period. Houses had a smaller floor area (average = 10-15 m^2) and developed rounded corners at the end of the Colonial period.

Sedentary period sites in general increased in size; Snaketown doubled in size (Wilcox 1979:105). Few new sites emerged during this time, and the new sites were smaller than previously established villages, possibly representing a hierarchical settlement pattern similar to a chiefdom-level society (Rafferty 1982:83). Agriculture intensified near the villages, and the average distance from the river increased to 2.4 km. Dry farming techniques were employed in the bajada, or lower mountain slope, zone in the form of linear and grid borders,

check dams, and rock piles. Rock piles were placed around a plant to conserve moisture and trap nutrients.

Houses were variable in both size (20-25 m^2 in floor area) and shape, occurring as either square or rectangular with rounded corners, or elliptical. Sometimes houses were grouped around a small open area, with their doorways facing the same area. Caliche-capped mounds appeared, notably Mound 16 at Snaketown, with ball courts increasing in number and in the distance between them, which averaged 6.8-8 km (Wilcox 1979:106).

The Classic period saw changes to the Hohokam system. Although new sites emerged, many were abandoned, including Snaketown. Sites associated with this period are Casa Grande, Adamsville, and the Escalante Ruin. Contiguous adobe surface rooms, compound walls enclosing the dwelling structures within a relatively small area, monumental architecture such as platform mounds and "big houses" (Casa Grande), and polychrome ceramics make their appearance during this time. Platform mounds are irregularly distributed, and the average distance of sites from the river decreases to 2.1 km (early Classic period) (Wilcox 1979:106). Several canal systems were consolidated into single systems as agriculture further intensified and sociopolitical organization became even more complex. An elite segment of the population, administering separate polities and with special access to exotic or long distance trade materials may have occupied the platform mounds.

Post-Classic sites have not been identified in the area, although they are known along the Salt River. However, these later occupations have only recently been described and defined, and future archaeological work may discover such later occupations along the middle Gila. During this time, population decreased and settlement pattern reverted to a dispersed rather than nucleated pattern. Pithouses replaced the adobe architecture of the previous period, and no more platform mounds were constructed. No new canals were built, and most Hohokam sites were abandoned.

Upper Gila

Remains of the Paleoindian big-game-hunting tradition in the Southwest (10,000-8000 B.C.) have not been found along the upper Gila River. Possible Archaic (8000 B.C.-1 A.D.) sites have been found (Kinkade 1975) south of the river east of Safford. Securely dated Archaic sites are not known, but the Gila Valley is thought to be the northern boundary of the local Archaic occupation, the Cochise culture, in southeastern Arizona (Sayles 1945).

Following the Archaic period, the Gila River Valley (Figure 3) was settled and influenced by different culture groups. The western most portion of the upper Gila segment, in the area of the proposed Buttes Reservoir, was occupied primarily by the Hohokam; the Safford Valley and Clifton areas were occupied primarily by the Mogollon; and by approximately A.D. 1200, all of these areas were influenced by Salado cultural manifestations. Hohokam occupation, as noted above for the other Gila River segments, was centered around the Salt-Gila Basin along the middle Gila River. The Mogollon culture was originally defined as a population inhabiting

mountain and mountain-lowland transition zones of east-central Arizona and western New Mexico (Wheat 1955). The Salado occupation, first identified by a series of pottery types such as Pinto, Gila, and Tonto Polychrome, is represented by a complex of characteristics that was centered around the Tonto-Globe area beginning about A.D. 1100-1500. Most archaeological investigations along the upper Gila River have been surveys; thus, little detail is available. Also, most have taken place around the Safford Valley, where many prehistoric remains have been lost because of historic and modern farming. However, based on surveys for the Graham-Curtis Project, Gilman and Sherman (1975) concluded that there were formerly villages of 50-200 rooms along the entire length of the Safford Valley and along the Pinaleño Mountain foothills (Gilman and Sherman 1975:5-6). Sites with agricultural features, such as gridded gardens, terraces, and canals, are found along the river floodplain and terraces, and Pinaleño Mountain foothills. Sites in the Gila Mountains were much smaller and included both open sites and rock shelters. Kinkade's (1975) survey southwest of Safford along two washes found numerous limited-activity sites that represented temporary camps associated with lithic manufacture and exploitation and possible check dams associated with water control.

Hohokam populations occupied the western portion of the upper Gila, and these sites are best represented by an archaeological survey associated with the proposed Buttes Reservoir. Two hundred fifty sites were recorded: 61 habitation sites, 36 prehistoric agricultural components, 22 rock shelters and caves, 91 temporary hunting or gathering sites, and 40 lithic procurement and tool production sites. Most of the prehistoric occupation of the area was during the late Colonial and Sedentary periods (Table 2) and was most intensive along the portion of the Gila River where the floodplain is widest (Debowski et al. 1976:104). General trends in Hohokam characteristics and culture history in this area follow those of the middle Gila, except that no canals were noted. This may be due to the absence of subsurface excavations in the area or because, as Debowski et al. (1976:91) indicate, "...the area is not amenable to canal irrigation due to the velocity of the Gila River." Most of the agricultural features, including check dams, diversion dams, terraces, and rock piles, were found on the north side of the river in areas that were least dissected and which were gently sloping, the most ideal conditions for farming in the area.

The earliest habitation site in the Buttes Reservoir area was occupied from the late Pioneer period to the Colonial period. A ball court and trash mounds were noted at the site. Colonial through Sedentary period occupations were represented by rectangular, subrectangular, and oval pithouses, ball courts, and trash mounds. Classic period sites exhibited evidence of Salado influence, with cobble structures and compound walls. Limited activity sites, such as plant-gathering sites, were usually found further away from the river, on the first and second geological terraces and in the upper bajadas, where the paloverde-saguaro community is common. Hunting sites usually were situated on high locations such as ridges, spurs, and knolls (Debowski et al. 1976:94). Rockshelters and caves were occupied from the Colonial through the Classic periods and were used for temporary or extended habitation and for limited activities (Debowski et al. 1976:99).

The rest of the upper Gila was occupied, for the most part, by the Mogollon (Table 4).

Until approximately A.D. 1000, Mogollon populations lived in pithouse villages located in easily defensible positions (Teague 1974:8) in a dispersed pattern. Brown's research focused on early pithouses at five sites, including Buena Vista, in the Safford area. He found comparisons of Salado traits among these sites and other sites from both the Point of Pines-Reserve and the Tonto Basin areas. He called the Salado manifestations in the Safford area the Pueblo Viejo Salado. Sites investigated by Brown (1974) were pueblos with multiple (4 to 170), contiguous rooms and plazas, some of which were partially or fully enclosed by walls. He determined that they were occupied anywhere from post-A.D. 1250 to the early fourteenth century.

Table 4. Chronology for the Prehistory of the Gila River Valley, Mogollon Region

Tradition	Phase	Dates
Southwestern	Encinas	A.D. 950-1200
Southwestern	Cerros	A.D. 850-950
Southwestern	Galiuro	A.D. 650-850
Southwestern	Pinaleño	A.D. 400-650
Southwestern	Dos Cabezas	A.D. 100-400
Southwestern	Peñasco	300 B.C. - A.D. 100
Archaic		8000-300 B.C.
Paleoindian		10,000-8000 B.C.

From approximately A.D. 100 on, contact with other cultural groups increased, and by A.D. 950-1200 many Hohokam traits were present (Simpson and Westfall 1978:24). In the Safford Valley, prior to the introduction of Salado polychromes, culture contact was oriented in a north-south direction, stretching from the White Mountains in the north to Casas Grandes, across the modern international border, in the south. With the introduction of Salado traits, interaction expanded to include contact west of the Safford Valley. The appearance of the Salado complex added traits such as polychrome and other ceramic types, puebloan architecture of coursed masonry or solid adobe, cliff dwellings, compounds or defense walls, and inhumation burials. According to Brown,

> *Salado polychromes have been found on terraces above the Gila River, mainly on sites downstream from Safford. Salado in the Safford area differs from Tonto Basin Salado by the presence of Point of Pines-Reserve ceramic types, the absence of compound architecture, and the absence of late northern tradewares [Brown 1974, cited in Simpson and Westfall 1978:26]*

PREHISTORIC USE OF THE GILA RIVER

During the period of prehistoric occupation, the entire length of the Gila River played a major role in human settlement patterns and occupational success. As discussed above, most prehistoric habitations along the river were situated close to the river. In fact, along the lower Gila where Patayan populations settled, occupation was confined to the river valley (Breternitz 1957:1). Along the middle Gila, communities were able to settle about 2 km from the river floodplain because of the extensive canal systems that furnished irrigation water. In all segments of the river, site density dramatically decreased with distance from the river.

The river served as a focus for subsistence and cultural diversity. A variety of culture groups occupied the Gila Valley, and a mixture of traits among these groups attests to the communication link between populations, fostered by the river's course. Evidence of one of these linkage systems is the formalized network of ball courts. "The large Hohokam communities in the Gila Bend area, for example, are linked with those in the Phoenix Basin by a continuous string of settlements along the Gila River in which ballcourts appear to occur about every 3-5 km... (Wilcox, McGuire, and Sternberg 1981:201)." Other networks, such as trade or exchange, were set up to foster interaction with areas outside of the Gila Valley as well. Examples include the Salado influence and trails that connected populations along the lower Gila to those along the Colorado River and south to the Papagueria (Breternitz 1957:12). Diversification within culture groups also was fostered by the river. Characteristics of riverine versus non-riverine populations have been noted for both the Patayan (Schroeder 1957:177) and the Hohokam (Haury 1950). Diversity was produced by differences in subsistence strategies and diet, promoted by living either next to the river or in the desert without the benefit of the river as a permanent water source.

Prehistorically, the Gila River provided a wide variety of dietary and other subsistence resources. The river itself provided a permanent water source and fish as a source of protein (Miller 1955). Cobbles along the river bed were used extensively as raw material for tools and for Classic period structures. In addition, the river promoted great diversity in floral and faunal resources along its banks. Riparian vegetation was more lush than it is today. Excavations at Escalante Ruin determined that a saltbush-mesquite community was prevalent around Casa Grande and Escalante during the prehistoric occupation (Doyel 1974:16). Today, only dead mesquite trees and creosote bush are visible. In the past, mesquite bosques were common along the river, and the water table was relatively high. In fact, Haury (1978:9) describes a prehistoric well at the site of Snaketown no more than 3 m deep "...that tapped a reservoir fed by Queen Creek (Berry and Marmaduke 1982:20)." There was a significant riparian community historically as well.

> *Along the formerly great Gila River (the now dry bed of which stretches across the Sonoran Desert of western Arizona) there were extensive marshes, swamps, and flood plains with cattail (Typha domingensis), bullrush (Scirpus olneyi), giant reed (Arundo donax), common reed (Phragmites communis), arrowweed (Pluchea sericea), and many trees. The dense vegetation of these well-developed riparian communities often stood 10 to 15 feet high and supported a tremendous quantity of wildlife [Lowe 1964:30].*

The riverine environment supported a wide variety of animal species, particularly rodents, small mammals, birds, and fish. When Father Kino visited the Pima of the Gila Valley, he noted that "...all its inhabitants are fishermen, and have many nets and other tackle with which they fish all year" (cited in Berry and Marmaduke 1982:27). Fish remains (*Acipenser*) were also identified from prehistoric contexts at the site of Snaketown (Miller 1955:132).

Agriculture was a primary use of the river. Irrigation, dry farming, and floodwater farming were evident along most of the river, from the Gila Bend area to beyond the Safford Valley from the pre-Classic to the Classic period. Arable land and water availability were primary factors in settlement location, and the type of agriculture that was practiced was based on the character of the river at any given point as well as the character of the landscape and distance from the river. According to Debowski et al. (1976:90), the area around the proposed Buttes Reservoir did not have canals because the velocity of the river was not suited to canal irrigation; instead, water control features such as diversion dams, contoured terraces, rock alignments, and rock piles were used to capture rainfall or runoff for agricultural fields. These techniques maximized potentially arable land and expanded alternatives of procuring water for fields beyond the available irrigation canal zone. The inhabitants thus decreased the likelihood of failure by not relying on one system alone. This would have been important for an expanding Hohokam population that probably needed surplus to feed political and economic specialists. Moreover, river flooding would have washed out intakes and damaged canals, necessitating a backup system for crop production. Floodwater farming was practiced by Patayan inhabitants along the lower Gila (Schroeder 1957:177) and by Hohokam farmers. Canal irrigation was practiced by the Hohokam from the area around Gila Bend (Woodbury 1961) to the Pinaleño Mountain foothills (Doelle 1975b:12). Canals are known archaeologically from the Gatlin site (Wasley and Johnson 65:24), Casa Grande (Cummings 1927:9-10), and the surrounding area (Brooks and Vivian 1976:29-33; Midvale 1965), Snaketown (Haury 1978; Woodbury 1961), and other sites along the middle Gila (Berry and Marmaduke 1982:50; Fewkes 1909; Wilcox 1979:115), the Fortified Hill Site (McGuire and Schiffer 1982:106), the Gila Butte site (Greenleaf and Vivian 1971), the eastern Buckeye Valley (Midvale 1974), and near Gila Bend (McGuire and Schiffer 1982:133; Woodbury 1961).

ENVIRONMENTAL RECONSTRUCTIONS

Within recent years, enormous strides have been taken in understanding of the prehistoric natural environment. Reconstructions have included paleo-climatic and hydrological conditions in the lower Colorado Plateau that are applicable to southern Arizona in general (Dean et al. 1985; Euler et al. 1979) and paleo-botanical and paleo-faunal types native to the Gila River Valley used by the prehistoric inhabitants.

Euler et al. (1979) produced a paleo-environmental record for the American Southwest by plotting geo-climatic and bio-climatic indicators for the Colorado Plateau. Indicators consisted

of data from tree-rings, pollen records, and alluvial sediments. These data were analyzed within a temporal framework, and fluctuations through time were noted (Table 5). Dean et al. (1985) used similar data to produce a model of interaction between the cultural system (prehistoric populations) and the natural system (environment), and identified periods of stress. In general, low water tables and channel entrenchment, or degradation, would have an adverse effect on agriculture; on the other hand, high effective moisture and aggradation, or surface stability, would be favorable to the development of irrigation systems, as well as other agricultural technologies. Variability in the dendroclimatic record might have produced some short-term responses prehistorically to accommodate unusually high or low precipitation, such as relocation of agricultural fields or the expansion of irrigation systems (Dean et al. 1985:542-543).

Prehistorically, the floodplain and terraces of the Gila River contained a wide variety of plant and animal species. Desertification and reduction in this habitat (Crosswhite 1981:67; Hastings and Turner 1965; Rea 1983) in recent times have decreased species diversity and changed some of the flora and fauna that characterize the Sonoran Desert landscape. Man's influence over only the past 100 years has created changes along the river in the amount of groundwater, erosion, and depletion of native vegetation. The riparian forest is mostly gone or replaced by feral salt cedar, and weedy species proliferate. The water table, previously a few feet below the surface, now averages hundreds of feet underground (Rea 1983:3). The archaeological and historic records document the change in riparian and desert scrub communities from historic to modern times. Yet the natural resources used prehistorically by the Hohokam remained relatively constant. Archaeological data, such as pollen, macro-botanical, and faunal remains, indicate that there were no radical changes in the natural environment, and thus the climate, prehistorically.

Table 5. Environmental Reconstructions Applicable to the Gila River Valley

A.D.	Effective Moisture*	Depositional and Erosional Cycles*	Dendroclimatic Variability*	Salt River Geomorphic Processes**
1500		Degradation	Frequent Oscillations	
1400				Marked lateral erosion and channel widening (A.D. 1356-1370)
				Stable Conditions; trend toward island-braided channel (infrequent high-magnitude flows); some channel avulsion probable; deepening of channel (A.D. 1197-1355)
1300	Low	Aggradation		
1200		Degradation	Infrequent Oscillations	
				Trend toward bar-braided channel (infrequent high-magnitude flows); some channel avulsion possible (A.D. 1052-1196)
1100				
				Trend away from bar-braided channel toward island-braided conditions; channel narrowing (A.D. 900-1051)
1000	High	Aggradation		
900				
			Frequent Oscillations	Establishment of bar-braided channel; channel widening and bank erosion (A.D. 798-899)
800	Low	Degradation		
				Channel Stabilization (A.D. 740-797)
700	High	Aggradation	Infrequent Oscillations	
600				

* From Masse 1991, after Dean et al. 1985 and Euler et al. 1979.

** From Gregory 1991, after Nials, Gregory, and Graybill 1989.

HISTORICAL ARCHAEOLOGY

Only a limited amount of archaeological research has been conducted on sites dating to the historic period along the Gila River. Two extensive surveys, one at the Barry M. Goldwater Gunnery Range east of Yuma and south of the Gila River, the other at the Florence Military Reservation, recorded historic sites. The survey of the Goldwater Range was conducted by Statistical Research, Inc. and resulted in the recording of one historic road, three historic homesteads, and one historic mining camp (Bruder et al. 1988). The survey of the Florence Military Reservation, also conducted by Statistical Research, resulted in documentation of the 1879-1881 mill and smelter town of Reymert (DeNoon Camp) and a site associated with the World War II Prisoner of War Camp at Florence. Most of the historic sites recorded during this survey, though, were associated with cutting ironwood for conversion to charcoal, which was then used in mining smelters. The archaeologists believed that the entire area was clearcut for charcoal production (Ayres 1992:33-34). More intensive archaeological investigations have occurred at Yuma, the Gila Bend Stage Station, and Alicia Station (north of the Gila River between Sacaton and Casa Blanca).

Historic sites in the Yuma area have been extensively investigated. Redondo Ruins, a late nineteenth-century ranch site where irrigation agriculture was practiced, was excavated by Janus Associates, Inc. in 1983 (Ayres 1983). In 1984, Janus Associates conducted test excavations at the downtown mall in Yuma and identified foundations of commercial buildings constructed between 1890 and 1930 and used by "grocers, tailors, cobblers, barbers, dry cleaners, and a Chinese laundry" (Ayres 1984:34). In 1988, areas around the Southern Pacific Railroad Station and Hotel were excavated by Archaeological Research Services, Inc. (Ayres 1988:34). Several historical archaeological studies have been conducted at the Yuma Quartermaster Depot (Stone 1980, 1983; Swanson and Altschul 1991). Swanson and Altschul (1991) summarize these studies and discuss the history of Yuma, presenting new data from archaeological and archival studies.

In their historical overview, Swanson and Altschul (1991:23-94) discuss Spanish exploration and missionization of the Gila-Colorado River transportation route, establishment of the Gila Trail by trappers from the United States, military use of the Gila Trail during the Mexican War in 1846, and conversion of the Gila Trail to the Southern Overland Trail to California by the forty-niners. Ferry service across the Colorado, a military post, and civilian settlement at Yuma Crossing all date to 1849. Leach's Federal Wagon Road and the Butterfield Overland Stage Route were established through Yuma in 1858. The use of steamboats on the Colorado began in the 1850s. The Quartermaster Depot was established in 1867 and was supplied by steamboat. With the construction of the Southern Pacific Railroad to Yuma in 1877, the use of steamboats declined, but some were still in use during the first part of the

twentieth century. The coming of the railroad also limited the need for the Quartermaster Depot, which was officially closed in 1883. Swanson and Altschul mention in passing that "the Gila, much smaller than the Colorado, has always been rather marginal for navigation" (Swanson and Altschul 1991:17), and that "The Gila was less attractive as a navigation artery, but it too was explored with the discovery of placer gold around Gila City in the early 1860s (Doyle et al. 1984:64)" (Swanson and Altschul 1991:38).

Irrigation agriculture began in the 1870s, and in 1902, the Reclamation Service began studies for the Yuma Project, a major irrigation project. Archaeological investigations of the Quartermaster Depot resulted in the identification of a trash deposit associated with steamboat-captain Isaac Polhamus's house, the depot guardhouse, a trash deposit associated with the final years of the depot, late nineteenth-century adobe structures, an early twentieth-century pumphouse and associated canals, and a 1909 corral (Swanson and Altschul 1991:ii).

The Gila Bend Stage Station, in use from 1858 to 1880, was excavated by the Arizona State Museum in 1960 (Berge 1968). The excavations were among the first historical archaeology projects in Arizona. The site consisted of five adobe structures. Two "structures" were actually two blocks of rooms under a single roof, separated by a hall, and probably functioned as guest rooms for travelers. The third structure was a kitchen and dining area, the fourth was a forge, and the fifth was a stable. The original stage station, called Gila Ranch, was built by the Butterfield Overland Stage Company in 1858 and then rebuilt in 1860 after it was destroyed by Indians. The stage station was used by a number of stage lines until the railroad arrived in 1880, and the town of Gila Bend was moved away from the Gila River and next to the railroad. The old stage station was heavily damaged by a flood in 1891.

Arizona State University conducted excavations at Alicia Station, located on the Maricopa, Phoenix, and Salt River Railroad. This site contained extensive historic Pima materials, which provided information on Anglo-Pima acculturation (DaCosta and Ditzler 1977; Upham n.d.).

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CHAPTER IV

History

A. Historical Overview/River Chronology

The history of human activity along the Gila River has been recorded in numerous books, journals, newspaper accounts, magazine articles, and U.S.G.S. Water Supply Papers (WSP). From the pre-historic Indian bands (some nomadic) who used it for its life-giving waters, to the Spanish *conquistadors* who followed it in their search for golden cities, to the more modern "Forty-Niners" who traveled along it on their way to the California gold fields, to turn-of-the-century Territorial Arizonans who occasionally plied it with various types of water craft, the river has been used as an silent guide and a source of life giving water. The following series of extracts is but a brief compilation of written materials which chronicle those activities.

1697 A party passing through the Gila River basin reported the following in November, 1697: "On the 18th we continued west over an extensive plain, sterile and without pasture; and at the end of five miles, we discovered, on the other side of the river (the Gila), other houses and edifices. The sergeant, Juan Bautista de Escalante, swam over with two companions to examine them; and they said that the walls were two yards in thickness, like those of a fort; and that there were other ruins about, but all of ancient date." ("Excavations at Snaketown", Harold S. Gladwin, et. al., p. 3, Tucson, University of Arizona Press, 1965).

1748 Fr. Kino visited Agua Caliente, named the site "Santa Maria del Agua Caliente"; considered locating a mission ("Arizona Place Names," p. 11).

1775 A Spanish expedition of about 180 persons, led by Don Juan Bautista de Anza, traveled from Horcasitas, Mexico to San Francisco. The party traveled the Gila from the Casa Grande Ruin to the Colorado River. Father Pedro Font's diary reports Indian agriculture, irrigation systems and describes various reaches as "dry," "half way up his legs," "reaching to the shoulder-blades of the horses," and "very deep and ran very slowly." The Gila River portion of the trek lasted from October 30 to November 28, 1775, covering 77 leagues (231 miles), according to Font ("Anza's California Expeditions - Volume IV, Font's Complete Diary of the Second Anza Expedition").

1824-7 A party of five, including James O. Pattie, trapped beaver and travelled the entirety of the Gila River ("The Personal Narrative of James O. Pattie of Kentucky," p. 90).

1846 Kearny's "Army of the West" performed what was probably the first systematic exploration of the Gila River, traveling from Silver City, New Mexico to the Colorado River junction department around October 20, 1846, and arriving November 23, 1846 ("The Gila: River of the Southwest," p. 140).

1846-1847 A United States Army expedition, including surveyors and geologists, explored along the Gila River on orders from the United States Congress to identify "practicable and economic" routes for a railroad from the Mississippi River to the Pacific Ocean (Extract from Report of a Military Reconnaissance, made in 1846 and 1847 by Lieut. Col. W.H. Emory," pp. 5-15).

1846-7 Captain Philip St. George Cooke and the Mormon Battalion made a one-way patrol from Santa Fe to San Diego during the Mexican War, reaching the Pima villages around December 22, 1846 after raising the American flag in Tucson on December 17, 1846. After taking the cutoff to Gila Bend, Cooke placed Lt. George Stoneman in charge of a detail to float supplies down the Gila from Gila Bend to Yuma. Stoneman's "raft" consisted of two wagon beds lashed together, went aground on numerous occasions and Stoneman was forced to jettison a portion of the cargo. Stoneman rejoined Cooke at the mouth of the Gila on January 8, 1847 ("The Gila: River of the Southwest," pp. 151-4).

1849 A party of 33, including John L. Chamberlin departed Lewisburg, Pennsylvania in February 1849, arrived in Santa Fe, New Mexico on July 7, 1849, reached the Gila River on July 9, 1849, and arrived in Yuma on August 9, 1849. The party followed Kearny's Gila Trail, also known as the "Devil's Turnpike" to the travelers. They encountered the Knickerbocker party on July 12, 1849. An estimated 600 men traveled the Gila Trail en route to California for the Gold Rush ("Traveling the 'Devil's Turnpike: The Heyday of the Upper Gila Trail, 1846-1849," pp. 8-12).

1849 The Edward Howard party constructed a boat and floated the Gila from approximately Gila Bend to Yuma; a child was born enroute ("The Gila: River of the Southwest," pp. 175-6).

1849 Camp Calhoun established, September ("Arizona Place Names," p. 498).

1849 An unnamed party of Forty-Niners, including Stanislaus Laselle, traveled from Fort Smith, Arkansas to vicinity of Los Angeles along the Gila Trail, departing Fort Smith on March 25, 1849, arriving at the Gila River on July 3, 1849, and arriving at the Colorado River on August 6, 1849 ("The 1849 Diary of Stanislaus Lasselle," Overland Journal, pp. 21-4).

1849 A wagon train of Forty-Niners, identified as the "Peoria Train" and including Charles Edward Pancoast, traveled from Fort Leavenworth, Kansas to Los Angeles along the Gila Trail, departing April 29, 1849 and arriving January 1, 1850 ("A Quaker Forty-Niner," pp. 242-54). (See map end of Section A.)

1849 A wagon train of Forty-Niners, identified as the "Little Rock Company" and including Robert Brownlee, traveled from Fort Smith, Arkansas to Yuma along the Gila Trail, departing in the late months of 1849 and arriving in early 1850 ("An American Odyssey: The Autobiography of a 19th Century Scotsman, Robert Brownlee," pp. 67-8).

1849-1850 John W. Audobon (son of naturalist John James Audobon) and a party traveled from near Brownsville, Texas to Georgetown, California along the "Southern Route" passing through Tucson and the Pima Villages (September 24, 1849), apparently crossed the Gila just north of Gila Bend after taking the forty-mile shortcut and crossed the Colorado River downstream of the mouth of the Gila (October 14, 1849) ("Audobon's Western Journal: 1849-1850," pp. 154-63).

1850 Camp Calhoun renamed Camp Independence, November 27 ("Arizona Place Names," p. 498).

1850 An unsigned letter from a traveler at 'Camp Salvation' reported in part that the "expedient of lightening down teams by building small boats on the Gila" had been tried and succeeded and that many Gila Trail travelers had thus reached the Colorado River. (*New York Daily Tribune*, February 18, 1850).

1851 Camp Independence renamed Camp Yuma, March ("Arizona Place Names," p. 498).

1852 Camp Yuma reestablished as Fort Yuma, February 22 ("Arizona Place Names," p. 499).

1853-1854 A United States Army expedition, including surveyors and geologists, explored along the Gila River on orders from the United States Congress to identify "practicable and economic" routes for a railroad from the Mississippi to the Pacific. Vol. VII: Reported the Gila was _ to ½ miles wide and up to 12 feet deep, had wide bottoms and lagoons, and that the Pimas were irrigating field crops in a 6 to 8 mile wide river bottom. Vol. II: Reported that the river bed location had changed in a few locations and dry in mid-February. Vol. I: Reported that water was not available during certain seasons, that logs could probably be delivered from the Mogoyon mountains down the Gila, and that the river was approximately 9 feet deep for 35 miles up from the mouth during low

water period ("Reports on Explorations and Surveys, . . . Route for a Railroad from the Mississippi River to the Pacific Ocean," 33C2S Senate Ex. Doc. No. 78 and 33C3S House Ex. Doc. No. 91).

1854 Town of Yuma surveyed and filed in San Diego as "Colorado City", the "Arizona City", the "Yuma City" ("Arizona Place Names," p. 499).

1854 Fort Yuma abandoned as military post and turned over to Interior Department, January ("Arizona Place Names," p. 498).

1857 A United States Army expedition, including surveyors, explored southern Arizona Territory to identify the Mexican-American boundary, including travels along the Gila River. Vol. I: Reported that near and below Florence the river was about 40 yards wide and an average 2 feet deep, with a 'sinuous course, with a swift current and turbid waters ("Report on the United States and Mexican Boundary Survey, . . . by W. H. Emory," 34C1S Senate Ex. Doc. No. 108).

1857-1858 An expedition of 18 officers, including John C. Reid, plus a number of others, travelled for ten months through Texas, New Mexico, Arizona, Sonora and California at the direction of Congress. Tucson to Sacaton to Yuma ("Reid's Tramp," pp. 227-31).

1858 Butterfield Southern Overland Mail Company established "early in 1858 from St. Louis to San Francisco, 2759 miles" ("Arizona Place Names," p. 69).

1858 Yuma (New Mexico) Post Office established, March 17, as Colorado City ("Arizona Place Names," p. 499).

1858 Colorado City (Yuma) Post Master appointed, March 17 ("Arizona Place Names," p. 499).

1858 Gila City Post Office established, December 24 ("Arizona Place Names," p. 177).

1858 Gila City stage station established about 24 miles east of Yuma, near modern-day town of Dome ("Arizona Place Names," p. 177).

1859 Act of Congress approved February 28, 1859 (II Stat., 401) established Gila River Indian Reservation. ("Indian Affairs - Laws and Treaties," Vol., III (Laws), Charles J. Kappler, ed., p. 804, Washington, GPO, 1904).

1866 Towns of Florence and Adamsville were established ("Arizona Place Names," p. 10).

1866 Early (first) house in Florence constructed by Charles G. Mason ("Arizona Place Names," p. 164).

1866 Yuma (Arizona) Post Office established, October 16 as Yuma ("Arizona Place Names," p. 499).

1867 Agua Caliente Post Office established, March 12 ("Arizona Place Names," p. 12).

1867 Henry Morgan operated Morgan's Ferry near Maricopa Wells for approximately 25 years, beginning in 1867. (Arizona Magazine (Arizona Republic newspaper), December 9, 1984

1869 Phoenix Post Office established, June 15 ("Arizona Place Names," p. 327).

1869 Chase and Brady Irrigation Ditch constructed at Florence.

1869 The Stewart Party, including Harriet Bunyard, departed Collin County, Texas (near Dallas) on May 1, 1869 and headed for California along the Southern Trail through Tucson and the Pima Villages. The party reached the Gila on August 26, 1869 and reached Yuma on September 22, 1869 (Ho for California, pp. 239-47).

1870 The Shrode Party, including Mrs. Maria Shrode, departed Sulphur Bluff, Texas on or about May 10, 1870 and headed for California along the Southern Trail, reaching the Pima Villages on November 1, 1870 and arrived in Yuma around December 11, 1870 (Ho for California, pp. 288-93).

1871 San Carlos Indian Reservation, then known variously as the White Mountain or Camp Apache Reservation, established under Executive Order by President U.S. Grant, dated November 9, 1871 ("Indian Affairs - Laws and Treaties, Vol. I (laws)", Charles J. Kappler, ed., Washington, GPO, 1904).

1871 Gila Bend Post Office established, May 1 ("Arizona Place Names," p. 176).

1872 San Carlos military post office established October 12, later Town of San Carlos ("Arizona Place Names," p. 382).

1873 Solomonville (Solomon) Post Office established, April 10 ("Arizona Place Names," p. 415).

1873 Arizona City renamed Yuma by Territorial Legislature, February 2 ("Arizona Place Names," p. 499).

1873 Yuma (Arizona Territory Post Office established, October 16. ("Arizona Place Names," p. 499).

1875 Safford Post Office established, March 5 ("Arizona Place Names," p. 373).

1876 Gila River Reservation established under executive Order by President U.S. Grant dated August 31, 1876 ("Indian Affairs - Laws and Treaties, Vol. I (laws)", Charles J. Kappler, ed., p. 806, Washington, GPO, 1904).

1876 Sacaton Post Office established, January 3 ("Arizona Place Names," p. 372).

1877 Report of a pioneer party travelling west which occasionally encounters the Gila River; locations are somewhat vague. "Thursday, August 2nd: [near Safford] . . . terribly warm and dusty, grass burned up but plenty of water in the river. Vegetables look fine as they are irrigated from large ditches . . . Saturday, August 18th: [location unspecified] . . . we were follow the river for a mile and then leave it and it will be fifteen miles to water which we'll have to buy. What a blessing it is to have good water." (Craig, Helen Baldock. Within Adobe Walls, 1877-1973. Phoenix, Arizona: Art-Press Printers, 1975. pp. 25 & 31).

1877 Mohawk stage station established ("Arizona Place Names," p. 283).

1879 Gila River Reservation boundaries revised under Executive Order by President Rutherford B. Hayes dated January 10, 1879 ("Indian Affairs - Laws and Treaties, Vol. I (laws)", Charles J. Kappler, ed., p. 806, Washington, GPO, 1904).

1879 Gila River Reservation boundaries revised under Executive Order by President Rutherford B. Hayes, dated June 14, 1879 and canceling Executive Order by President Rutherford B. Hayes, dated January 10, 1879 ("Indian Affairs - Laws and Treaties, Vol. I (laws)", Charles J. Kappler, ed., p. 806-807, Washington, GPO, 1904).

1880 Glenbar first located by Joseph Mathews, December 1880 ("Arizona Place Names," p. 179).

1880 Pima Post Office established, August 23; Mormon settlement in 1879 or 1880 ("Arizona Place Names," p. 331).

1881 Dome identified as "Castle Dome". Dome Post Office established April 24, 1900 ("Arizona Place Names," p. 132).

1881 Hassayampa Post Office established, March 28 ("Arizona Place Names," p. 200).

1881 Three men including William "Buckey" O'Neill, departed Phoenix for Yuma in a 20 feet long, 5 feet wide boat christened "Yuma or Bust", and that they were "wading in water up to their knees". (*Phoenix Gazette*, November 30, 1881).

1881 The O'Neill party returned to Phoenix claiming to have successfully negotiated the river to Yuma in six days. The Gazette's editor, however, disputed that claim and reported that the party had been "compelled to wade in the water the greater part of the time, while pushing their craft ahead of them." (*Phoenix Gazette*, December 3, 1881).

1881 "Messrs. Cotton and Bingham will leave tomorrow for Yuma by way of the Salt and Gila Rivers. They have constructed for the trip, and 18-foot skiff, flat-bottom, which will draw very little water . . ." (*Arizona Gazette*, February 17, 1881).

1882 Town of San Carlos Post Office established, October 12; later submerged by San Carlos Reservoir ("Arizona Place Names," p. 382).

1882 Gila Bend Indian Reservation established under Executive Order by President Chester A. Arthur dated December 12, 1882 ("Indian Affairs - Laws and Treaties, Vol. I (laws)", Charles J. Kappler, ed., p. 804, Washington, GPO, 1904).

1883 Central settled ("Arizona Place Names," p. 86).

1884 "Mr. A.J. McDonald is building a large ferry boat for the Gila and Salt River Ferry Company to be put on the Salt River below town. It will be of the same dimensions as the one sent to the Gila, viz: 16 by 18 feet. It will be worked on an inch and a quarter steel cable and be a permanent arrangement." (*Phoenix Herald*, April 8, 1884).

1886 Central Post Office established, January 11 ("Arizona Place Names," p. 86).

1888 Thatcher Post Office established, March 10 ("Arizona Place Names", p. 441).

1888 Buckeye Post Office established, March 10 ("Arizona Place Names," p. 65).

1889 The United States Geological Survey reported forty-nine irrigation canals were taking water from the Gila River to serve at least 221440 acres of land (Twelfth Annual Report of the U.S.G.S.).

1889 United States Geological Survey stream gauging station established at the Buttes (Section 11, Township 4 South, Range 11 East).

1890 Mohawk Post Office established, June 25 ("Arizona Place Names," p. 283).

1891 "R.M. Straus of Aztec, senior partner in the house of Straus, Dallman & Co., made the SENTINEL a call yesterday. They have their new ferry-boat ready and at work crossing the Gila River. It is large enough to carry a loaded 6-horse team in safety." (*Arizona Sentinel*, March 28, 1891).

1892 Eden Post Office established, May 23 ("Arizona Place Names," p. 141).

1895 "Editor Arizona Sentinel: . . . to make an extended trip down the Gila River to its junction with the Colorado . . . I obtained 90 days vacation . . . built a boat 3½x 18 feet of the flat bottomed type . . . the Graham (Gila?) Valley was reached, 35 miles from our starting point . . . and enjoys an unlimited supply of water for irrigating purposes . . . Fort Thomas on January 23rd . . . we left (San Carlos Post) January 28th . . . disembarking all of our camp equipage, we safely ran our sturdy little house boat through the rapids (of 'Bugaboo Canyon') . . . below us sounded the deafening roar of falls and waters which we had yet to pass . . . our little house boat was lowered through the (second) rapids and between boulders in a torturous route, by means of our long (200') rope . . . (which) suddenly slackened and I . . . plunged into the icy water and partly swam and was partly carried by the strong current downstream . . . the boat appearing much the worse for wear after its plunge down the rapids, one end being entirely submerged . . . my companion was bailing out the water from the stern . . . I swam to the boat . . . we repaired the boat in a couple of hours and continued our voyage . . . our boat was hauled on a train from Sacaton to Tempe. We spent two days visiting Phoenix and . . . a start was made for Yuma. Since arriving here . . . I would not engage to make the trip down (the Gila's) hazardous waters again." ("Four Hundred Miles Down the Gila River--Incidents of the Trip," J.W. Evans, *Arizona Sentinel*, March 9, 1895).

1895 "Yesterday morning Amos Adams and G.W. Evans arrived in Phoenix having come all the way from Clifton to Sacaton in a boat. These gentlemen enjoy the proud distinction of being the first men to pass through the box canyon of the Gila by water. They left Clifton on January second and launched their boat which had been especially constructed for the purpose on the San Francisco River, they journeyed down that stream to the Gila which they entered fourteen miles below Clifton. From that point they remained on the Gila, until they reached Sacaton, travelling by that stream about three hundred miles. There they disembarked and hauled their boat to Phoenix and after laying on provisions, etc., they will leave tomorrow on the Salt River, to the Gila, thence to the Colorado and by that stream to the Gulf." (*Phoenix Herald*, February 18, 1895).

1895 Congress enacted the Indian Appropriation Act of March 2, 1895 and allotted $3500 to investigate the Gila River Indian Reservation's water problem. The study concluded that turning flows back to the Reservation at the expense of upstream users would be inefficient and not recommended. ("The Campaign for Water in Central Arizona," *Arizona and the West*, pp. 132-133, Summer 1981).

1895 "The following letter was received this morning from Mr. Amos Adams...who passed through the Salt River Valley about a week ago. 'Gila Bend, February 23, Editor Herald--In terms of my promise to write I wish to say that we found nothing unusual on our voyage down the Salt and Gila Rivers except that ducks were plentiful..." (*Phoenix Herald*, February 25, 1895).

1896 Geronimo Post Office established, April 30 ("Arizona Place Names," p. 175).

1898 Congress appropriated $20,000 for the USGS to investigate two dam sites on the Gila River. The Buttes and Queen Creek sites were initially investigated but discounted due to bedrock and limited flow problems, respectively. San Carlos was discovered when the USGS went further upstream. ("The Campaign for Water in Central Arizona," *Arizona and the West*, pp. 134-135, Summer 1981).

1898 Drought illustrated need for water storage facilities in Central Arizona. ("The Campaign for Water in Central Arizona," *Arizona and the West*, p. 139, Summer 1981).

1899 "(Near San Carlos Indian agency) (t)he right bank is high, but the left is low and liable to overflow. The bed of the (Gila River) is sandy and shifting." (WSP No. 38, p. 314).

1899 "The channel of the (Gila) river at the Buttes is composed of quicksand and likely to change daily with any considerable amount of water in the river." (WSP No. 38, p. 317).

1899 United States Geological Survey paper by J.B. Lippincott recognized water supply problems related to Gila River Indian Reservation and diversions upstream of San Carlos. Recommended construction of San Carlos dam and reservoir to alleviate the problem (WSP No. 33, 1900).

1899 Arlington Post Office established, November 23 ("Arizona Place Names," p. 28).

1899 United States Geological Survey abandoned stream gauging station at the Buttes (WSP No. 38, p. 319).

1899 United States Geological Survey stream gauging station established at San Carlos, ½ mile south of Indian agency at San Carlos and below mouth of San Carlos Creek (river) (WSP No. 38, pp. 313-314).

1899 First reclamation appropriations legislation introduced; would have appropriated $1,000,000 for work at San Carlos site. Bill was for foundation work, plans preparation, bedrock investigations. Defeated. ("The Campaign for Water in Central Arizona," *Arizona and the West*, p. 138, Summer 1981).

1900 Mohawk S.P.R.R. railroad station established ("Arizona Place Names," p. 283).

1900 Dome Post Office established, April 24 ("Arizona Place Names," p. 132).

1900 Kelvin Post Office established, April 25 ("Arizona Place Names," p. 231).

1900 Kofa Post Office established, June 5 ("Arizona Place Names," p. 236).

1901 Liberty Post Office established, February 15 ("Arizona Place Names," p. 246).

1901 Representative Francis G. Newlands (Nevada) proposed federally managed funds for irrigation projects. Defeated in 1901, reintroduced and enacted as Reclamation Act in 1902. ("The Campaign for Water in Central Arizona," *Arizona and the West*, p. 139, Summer 1981).

1901 "It is the general impression among our people that the construction of the San Carlos reservoir by the government will make it easier for us to obtain federal aid in the building of the Tonto dam; that it will be an entering wedge, so to speak, and about all we will have to do is put our fingers in the slot and pull out an appropriation large enough to suit the most ambitious. The *Republican* thinks differently. If Congress appropriates money for the building of the San Carlos Dam we will be told by congressmen from other sections that we have enough. That Arizona is not the only duck in the puddle - there are others. It is probable that the San Carlos dam will be constructed and we hope it will be...But with its completion we believe our hopes for federal aid vanish for the present." (*Arizona Republican*, January 1, 1901).

1901 "Col. Walter Graves, of Washington, D.C., arrived at Sacaton Tuesday, ordered there, it is said, to investigate the underflow of the Gila River with the view of furnishing water for irrigation to supply the Indians on the reservation...the fact is that during the dry season there is not enough water in the river to dampen the sand at bedrock." (*Florence Tribune*, November 2, 1901).

1901 "The Gila River is still up and dangerous to ford. At Kelvin a wire rope is stretched across the river on which runs a cage for carrying passengers and freight. On Thursday a cart was carried over and an attempt was made to lead a horse across." (*Florence Tribune*, February 16, 1901).

1902 Reclamation Act enacted, including irrigation of privately held lands; opened up potential of Salt River Project. ("The Campaign for Water in Central Arizona," *Arizona and the West*, p. 140, Summer 1981).

1903 On October 12, 1903, Secretary of Interior E.A. Hitchcock designated the Salt River Project as the first federal reclamation project. ("The Campaign for Water in Central Arizona," *Arizona and the West*, p. 48, Summer 1981).

1903 United States Geological Survey stream gauging station established at Dome (WSP No. 100, p. 26, WSP No. 133, p. 204).

1904 Wellton Post Office established, August 4 ("Arizona Place Names," p. 479).

1904 Gila City name changed to Gila, March 3 ("Arizona Place Names," p. 177).

1904 United States Geological Survey stream gauging station established near Cliff, New Mexico, ½ mile below the mouth of the Mangos (Mancos) River, 40 miles from Silver City, New Mexico (WSP No. 133, p. 198).

1904 "The channel is straight for 400 feet above and 300 feet below the (Cliff, New Mexico) stations. The current is swift. Both banks are about 6 feet high, clean, and subject to overflow during extreme high water. The bed of the stream is composed of sand and gravel, free from vegetation, and shifting. There is but one channel at high and low stages." (WSP No. 133, p. 198).

1904 "The channel is straight for 100 feet above and 900 feet below the (Gila City) station. Velocity is swift. The right bank is low and not subject to overflow. The left bank is above high water. The bed of the stream is composed of silt and sand and is subject to continual change." (WSP No. 133, p. 204).

1905 "The point of gaging (at Dome, formerly Gila City) first established was one-fourth mile north of the depot at Dome. The river now flows in a channel fully 1 mile north of the original channel. The Gila carries an enormous amount of mud and sand. At times the waves of sand traveling along the bed of the stream are so large, the current is so swift, and the stream to (so?) shallow, that the water is broken into a uniform succession of waves 2 feet high and over...At every flood the channel shifts. The valley at its narrowest is half a mile wide and the waters may occupy any part or all of it." (WSP No. 175, p. 164).

1905 Christmas Post Office established, June 17 ("Arizona Place Names," pp. 93-4).

1905 United States Geological Survey stream gauging station at Cliff, New Mexico temporarily abandoned, February 17. Station reestablished, May 22 (WSP No. 175, p. 159).

1905 Jack Henness of Florence was employing a suspended cable-and-cage arrangement to transport passengers and cargo ~~over~~ the river. The article also reports that Henness smiled down on "the crew of the *Gila Queen* (ferry boat) as he passes over their heads." (*Arizona Blade Tribune*, March 4, 1905).

1905 The Gila was "that raging stream." The article also indicated that in at least one instance Henness had transported burros and prospecting equipment. (*Arizona Blade Tribune*, March 11, 1905).

1905 Two new boats had entered the thriving ferry boat business, the *Mayflower* and the *Rey del Gila*. The *Tribune* also indicated that a hand-driven side propeller boat was unable to negotiate the river. (*Arizona Blade Tribune*, March 18, 1905).

1905 A new ferry boat, the *Gila King*, had entered the ferry business. The boat was 20 feet long, 6 feet wide and capable of carrying a 3000 pound load. (*Arizona Blade Tribune*, April 1, 1905).

1905 A man named Jack Shibely launched from Phoenix enroute downriver. The boat capsized once, losing much of its cargo, but was uprighted and eventually reached Gila Bend. (*The Arizona Republican*, April 3, 1905).

1905 An attempt was made to cross the Gila in an 18 feet long, 5 feet wide, 3½ feet deep boat while the Maricopa and Phoenix railway bridge (vicinity Township 3 South, Range 3 East) was washed out. The attempt to even launch failed, however, because "the current was too swift." (*Phoenix Enterprise*, December 9, 1905).

1905 Heavy flows in Gila River washed away portions of bridge at Florence, "the one public road improvement in which the whole people of the territory have a common interest." Local interests recommended that the bridge be relocated "up the river about 300 yards," where "the channel of the river has never changed...within the memory of the oldest Pima Indian not living." (*Arizona Blade-Tribune*, February 11, 1905).

1905 A new model boat, with "hand-driven, side-propellers" failed to cross the Gila. It was speculated that "nothing short of a ten horse power engine" was required. River flow "cut away the head of the canal" near the Arthur ranch. (*Arizona Blade-Tribune*, March 18, 1905).

1907 United States Geological Survey stream gauging station at Cliff, New Mexico abandoned, December 31 (WSP No. 249, p. 176).

1908 "Except for fringe ice along the edges of the stream, ice conditions (near Bedrock, New Mexico) do not interfere with the accuracy of the (gauging) results...Because of...the constantly shifting channel..." (WSP No. 175, p. 165).

1908 United States Geological Survey stream gauging station established near Redrock, New Mexico, about 2 miles east of Redrock post office and about 300 yards above the Middle Box Canyon of the Gila, May 14 (WSP No. 249, p. 176).

1908 "It has been impossible to cross it without the use of boats..." (*Arizona Blade-Tribune*, August 1, 1908).

1909 Bilas (Bylas) appeared on G.L.O. mapping ("Arizona Place Names," p. 70).

1909 United States Geological Survey relocated stream gauging station near Redrock, New Mexico to about 1/8 mile upstream of original location, July 16 (eastern edge, Township 18 South, Range 18 West) (WSP No. 269, p. 219).

1909 Gila Bend Indian Reservation boundaries revised under Executive Order No. 1090 by President William H. Taft, dated June 17, 1909. ("Indian Affairs - Laws and Treaties," Vol. III (Laws), Charles J. Kappler, ed., p. 669, Washington, GPO, 1913).

1909 Price Post Office established, March 18 ("Arizona Place Names," p. 348).

1910 "The channel is straight for some distance above and below the (Guthrie, Arizona) station. The right bank is high and rocky; the left bank is lower, is covered with brush, and is subject to overflow at extreme high water. The bed of the stream is composed of shifting sand and silt. High-stage measurements are made from a car and cable 50 feet below the gage. At lower stages measurements are made by wading above the gage, as the current at cable section is very sluggish." (WSP No. 289, p. 203).

1910 "The channel has a slight curve above the station, but is straight for 1,500 feet below (San Carlos). Both banks are high and not subject to overflow. The bed of the stream is wide and composed of shifting sand. Discharge measurements are made from the railroad bridge, except at low water, when they are made by wading." (WSP No. 289, p. 204).

1910 United States Geological Survey stream gauging station established near Guthrie, Arizona, in Section 3, Township 6 South, Range 30 East, November 6 (WSP No. 289, p. 202).

1910 United States Geological Survey relocated stream gauging station at San Carlos to about 1 mile upstream of original location, August 17 (WSP No. 289, p. 203).

1910 "Work on the territorial road bridge is progressing rapidly..." and should be "...completed in time for...the Territorial fair." (*Arizona Blade-Tribune*, September 17, 1910).

1910 "Water is increasing in volume at the head of the Casa Grande Valley canal...probably due to the decrease in evaporation..." (*Arizona Blade-Tribune*, October 29, 1910).

1910 "Seventeen automobiles enroute from Tucson to Phoenix with fair visitors...balked at the river but all got across safely...the river was carrying...about 20 percent silt..." (*Arizona Blade-Tribune*, November 12, 1910).

1910 Act of Congress approved June 25, 1910 (36 stat., 847) provided Executive Branch with additional authority related to Indian affairs. ("Indian Affairs - Laws and Treaties," Vol. III (Laws), Charles J. Kappler, ed., p. 668, Washington, GPO, 1913).

1911 United States Geological Survey stream gauging station near Redrock, New Mexico washed away by flood, July 23. Station reestablished, October 3; operative, December 1. Temporary gage for interim period (WSP No. 309, p. 228).

1911 United States Geological Survey stream gauging station established near Silver City, New Mexico about 45 miles northeast of Silver City and 500 feet below the confluence of the East and West Fork of the Gila River (Northwest corner, Township 13 South, Range 13 West), June 20 (WSP No. 329, p. 202).

1911 United States Geological Survey stream gauging station established at Kelvin, ½ mile below mouth of Mineral Creek, 1 mile below Kelvin, operative, January 26 (WSP No. 309, p. 231).

1911 Gila River Indian Reservation boundaries revised under Executive Order No. 1387 by President William H. Taft, dated July 31, 1911 ("Indian Affairs - Laws and Treaties," Vol. III (Laws), Charles J. Kappler, ed., p. 668, Washington, GPO, 1913).

1911 Gila River Indian Reservation boundaries revised under Executive Order No. 1447 by President William H. Taft, dated December 16, 1911. ("Indian Affairs - Laws and Treaties," Vol. III (Laws), Charles J. Kappler, ed., p. 669, Washington, GPO, 1913).

1911 "Terry Branaman commenced running his big four-horse bus over the new bridge Wednesday morning...the old ford being uncomfortably deep...impassable by Wednesday evening." (*Arizona Blade-Tribune*, January 14, 1911).

1911 "Don't forget to explain [to inquirers] that the natural flow of the Gila River at Florence is sufficient to amply irrigate 25,000 acres of land...last year [was] a drought year..." (*Arizona Blade-Tribune*, March 18, 1911).

1911 "Heavy rains east of Florence...sent a volume of water down the Gila and the ranchers under the O.T. canal got an irrigation." (*Arizona Blade-Tribune*, June 17, 1911).

1911 "Copious rainfalls...sent a good volume of water...into the Gila and the local canals are all full of water." (*Arizona Blade-Tribune*, September 2, 1911).

1911 "Rains...have caused a large volume of water to pass down the Gila..." (*Arizona Blade-Tribune*, September 9, 1911).

1911 The Gila River, "when properly husbanded, carries sufficient water to irrigate nearly a half-million acres of land...the right to the [catchment basin] site, however, is disputed by the Southern Pacific railroad...[the Tucson] Chamber of Commerce adopted resolutions endorsing the proposed [San Carlos] reservoir as against the claims of the railroad...[Phoenicians] petitioned the Secretary of the Interior to grant the railroad the right of way to the exclusion of the proposed reservoir...with nearly 500,000 acres of irrigable land open for homestead and occupation..." (*Arizona Blade-Tribune*, March 18, 1911).

1911 "It will take two or three weeks to get ready for a barbecue and by that time the order reserving the San Carlos reservoir site for the use and benefit of this valley, will have been issued by the Secretary of the Interior, we believe..." (*Arizona Blade-Tribune*, March 4, 1911).

1912 "The volume of water in the river...is smaller now than it was ever before known to be at this time of the year...[probably due to] low temperatures...[which] prevented the snow from melting." (*Arizona Blade-Tribune*, February 3, 1912).

1912 "Drought was broken...good supply of water in the river..." (*Arizona Blade-Tribune*, March 9, 1912).

1912 "...8½feet of water in the Gila River...In 1883-4 we had no rainfall here between September and March. But early in March it began to rain...at short intervals, up to August. The Gila River ran bank full for 90 consecutive days and Wm. Eaton, with a boat 4x14 feet in size, cleared $1500..." (*Arizona Blade-Tribune*, March 16, 1912).

1912 "...still a large volume of water going down the river...river was dry at this point long before this date last year..." (*Arizona Blade-Tribune*, May 4, 1912).

1912 "The normal flow of the Gila River, at Florence, is sufficient...to grow [crops] on at least 25,000 acres of land...never been, during the 32 years we have resided in Florence, a single year in which said normal flow was not sufficient for that purpose." (*Arizona Blade-Tribune*, July 27, 1912).

1913 Hayden Junction Post Office established, November 8 ("Arizona Place Names," p. 202).

1913 United States Geological Survey stream gauging station established near Sentinel, Arizona in Section 10, Township 5 South, Range 9 West, July 1 (WSP No. 359, p. 221).

1913 "It is only 12 feet to (underground) water" below Gila Bend. (*Arizona Blade-Tribune*, August 2, 1913).

1913 "...in the vicinity of Kelvin...the stream was swollen..." (*Arizona Blade-Tribune*, December 13, 1913).

1914 United States Geological Survey stream gauging station near Silver City, New Mexico was abandoned, December 31 (WSP No. 389, p. 148).

1914 United States Geological Survey stream gauging station established near Gila, New Mexico, April 8. Station abandoned, December 17 (WSP No. 389, p. 150).

1914 United States Geological Survey stream gauging station near Redrock, New Mexico was abandoned, December 31 (WSP No. 389, p. 152).

1914 United States Geological Survey stream gauging station established near Duncan, Arizona in Section 21, Township 19 South, Range 20 West (New Mexico), about 15 miles above Duncan, May 10 (WSP No. 389, p. 154).

1914 United States Geological Survey stream gauging station established near Solomonville (Solomon), Arizona in Section 31, Township 6 South, Range 28 East, about 10 miles above Solomonville, April 21 (WSP No. 389, p. 156).

1914 United States Geological Survey stream gauging station briefly established near Florence, Arizona about 1 mile above Indian reservation line and 7 miles below Florence, July 7, abandoned, September 26 (WSP No. 389, p. 160).

1914 Suit was filed on December 9, 1913 (Geo. Lobb vs. Pete Avenente and others) which asserted, in part: "That the Gila River is an unnavigable stream of water...That plaintiffs said lands are...supplied with water diverted from said Gila River and carried there to by irrigation canals...That in the year 1868, the then owner...diverted and cause(d) to be diverted from the said Gila River...have ever since said year 1868, continuously diverted or caused to be diverted...from said river" (*Arizona Blade-Tribune*, January 31, 1914).

1914 Newspaper published article which included a standardized form for claiming water rights. The standard form, created by the O.T. Canal Company included a line which asserted "...the Gila River is an unnavigable stream..." (*Arizona Blade-Tribune*, February 14, 1914).

1914 "...heavy flow of water was in the river..." (*Arizona Blade-Tribune*, June 27, 1914).

1914 "...a good supply of water in the Gila River...farmers are taking advantage of the opportunity to make an irrigation." (*Arizona Blade-Tribune*, July 18, 1914).

1914 "...more water in the Gila River...than during the past two years." (*Arizona Blade-Tribune*, July 25, 1914).

1914 United States Geological Survey stream gauging station near San Carlos, Arizona washed away by flood, December 18. Station reestablished, September 11, 1915(WSP No. 409, p. 156).

1914 "...the Gila River (that is normally dry) is a raging torrent...since last Sunday...when the river...was ten and one-half feet deep at the bridge...the river was higher than at any time since the big flood of January 1905...it is estimated that 100,000 acre feet of water...every twenty-four hours." (*Arizona Blade-Tribune*, December 26, 1914).

1915 Komatke Post Office established, December 22 ("Arizona Place Names," p. 237).

1915 "...the Florence-Casa Grande canal has been damaged to the extent of from $8000 to $10,000..." principally "...at the head gate, where fully a mile and a half of the canal has been entirely obliterated." (*Arizona Blade-Tribune*, January 2, 1915).

1915 "From the heavy rain of last Friday and the melting snows the river had risen to the four-foot mark and a whirlpool formed..." (*Arizona Blade-Tribune*, February 27, 1915).

1915 "For the third time this season...the bridge across the Gila River went out again..." (*Arizona Blade-Tribune*, April 3, 1915).

1915 "A rise in the river Thursday caused a change in the channel...cutting out the south bank of the river..." (*Arizona Blade-Tribune*, April 10, 1915).

1915 United States Geological Survey stream gauging station near Duncan, Arizona was abandoned, September 30 (WSP No. 409, p. 151).

1916 An automobile had slipped off a ferry boat into five feet of water in the Gila River. (*Arizona Blade-Tribune*, February 9, 1916).

1916 Ashurst-Hayden diversion works authorized by Act of Congress on May 18, 1916 creating Florence-Casa Grande Irrigation Project.

1916 A photo depicted members of the Third Battalion, 14th Infantry fording the river in their army vehicles. (*Arizona Blade Tribune*, September 30, 1916.

1917 United States Geological Survey stream gauging station near Sentinel, Arizona was abandoned, March 2 (WSP No. 459, p. 154).

1917 United States Geological Survey stream gauging station established at Winkelman, Arizona in Section 24, Township 5 South, Range 15 East, September 10 (WSP No. 479, p. 149).

1917 Bylas Post Office, September 13 ("Arizona Place Names," p. 70).

1918 United States Geological Survey stream gauging station at Winkelman, Arizona was abandoned, June 27 (WSP No. 479, p. 149).

1918 United States Geological Survey stream gauging station near Guthrie, Arizona was abandoned, July 11 (WSP No. 479, p. 144).

1920 United States Geological Survey stream gauging station established near Ashurst, Arizona in Section 30, Township 5 South, Range 24 East about 1½ miles east of Ashurst, Graham County, December 24 (WSP No. 549, p. 119).

1921 Calva appeared on GLO map, originally named Dewey ("Arizona Place Names," p. 72).

1921 Gillespie Dam constructed by Gila Water Company ("Arizona Place Names," p. 179).

1921 United States Geological Survey stream gauging station established at Gillespie Dam, Arizona in Section 28, Township 2 South, Range 5 West, August 4 (WSP No. 589, p. 106).

1921 Gillespie Dam completed, stream flow was recorded beginning August 4, 1921. Water-stage recorder was relocated July 28, 1924 (WSP No. 589, p. 106).

1923 United States Geological Survey stream gauging station established at York, Arizona in Section 19, Township 6 South, Range 31 East, May 15 (WSP No. 589, p. 98).

1923 United States Geological Survey stream gauging station established at Ashurst-Hayden Dam near Florence, Arizona in Section 8, Township 4 South, Range 11 East, July 1 (WSP No. 569, p. 112).

1925 Gillespie Dam Post Office established, August 24 ("Arizona Place Names," p. 179).

1926 Roll Post Office established, November 3 ("Arizona Place Names," p. 367).

1927 Olberg Post Office established, June 2 ("Arizona Place Names," p. 307).

1928 Construction of Coolidge Dam was completed. Flow through the dam regulated since November 15, 1928 (WSP No. 689, p. 70).

1928 Coolidge Dam Post Office established, May 7 ("Arizona Place Names," p. 109).

1941 Extracts from Thesis by Ava S. Baldwin: "One of the first ditches was the Chase and Brady Ditch, which was four or five miles in length and used for running the flour mill of Peter R. Brady, built in 1869 ... Patrick Holland from Ireland was the first white man to have the idea of damming the river; he built the Holland ditches ... Another worry to the people of Florence was the diversion of water along the upper Gila ... The upper Gila River had a comparatively consistent flow near the New Mexico line, but not infrequently the river near Florence was dry for several months at a time. There was one fight after another over water. Many of these were legal battles. The people of Graham County and

especially the Mormons around Thatcher diverted great quantities of water ... " ("The History of Florence, Arizona, 1866-1940," by Ava S. Baldwin, A Thesis submitted to the faculty of the Department of History, University of Arizona, 1941).

1959 Three men had entered the Gila River in the vicinity of Duncan with the intention of traveling to Yuma. A later account of the trip was reported on February 29, 1959 in the *Yuma Courier.* (*Arizona Sentinel*, February 8, 1959).

1959 United States Geological Survey Stream gauging station established at Painted Rock Dam, Arizona in Section 18, Township 4 South, Range 7 West, October 1 (WSP No. 1926, p. 505).

1964 ...in Bancroft's 'Annals of Arizona'...the footnote (p. 487) first referring to the boat, reads: E.H. Howard, in the San Francisco Bulletin, July 8, 1885, gives the most complete record. He says the boat, 16 ft. long by 5 ft. 6 in. wide, was built for the trip, and first launched on Lake Michigan, being mounted on wheels for land service but used to cross rivers on the way. The writer sailed in her later in San Diego Bay and he says '...the *boy* born on the Gila is still living in Lake Co., Cal.' ("Gift of a Boy," Roscoe G. Willson, *Arizona Republic* ("Sunday Magazine"), August 2, 1964).

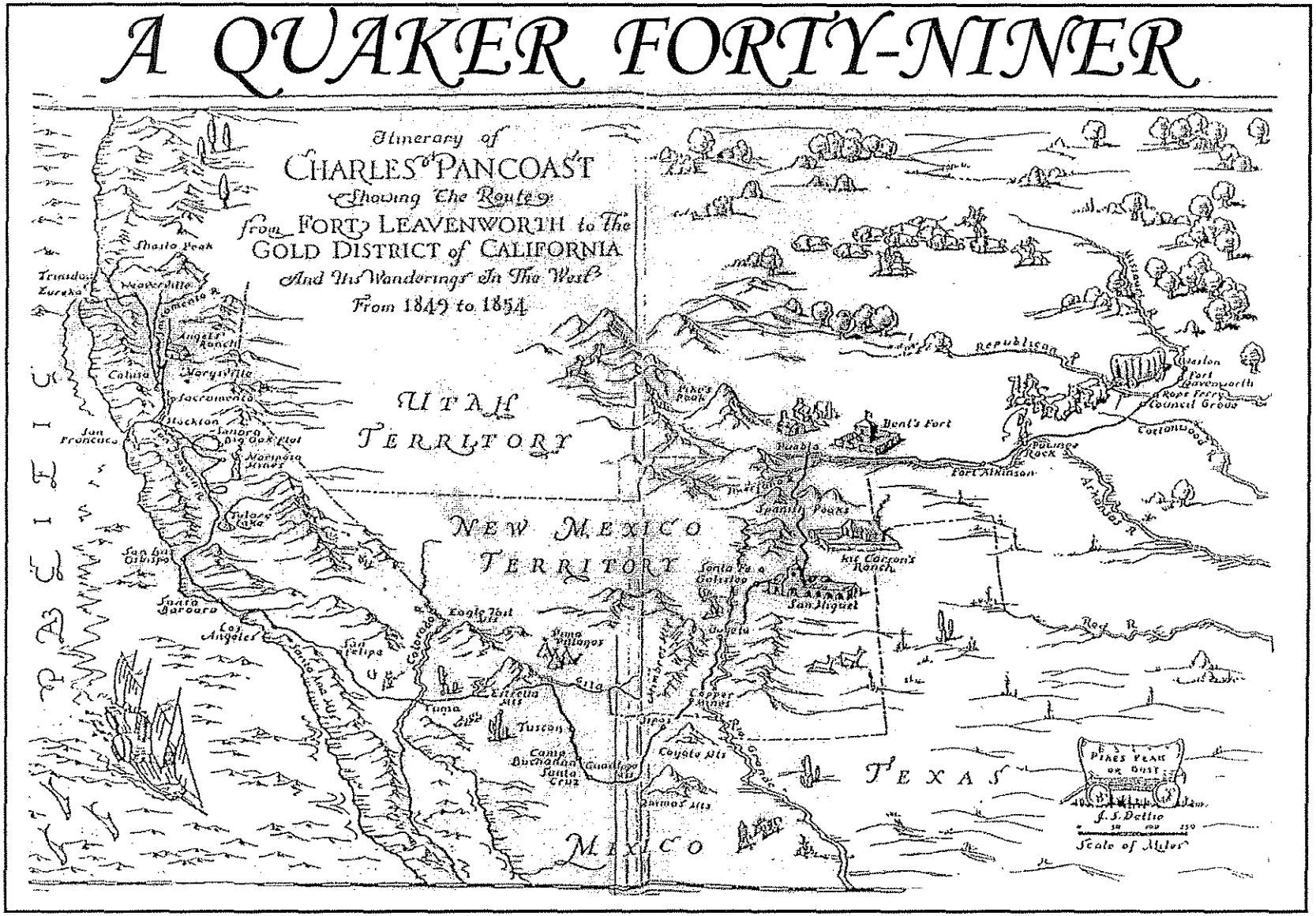

FIGURE 5. A Quaker Forty-Niner Map

B. Historic Descriptions of the River

River location

In addition to the incidental descriptions included within published reports such as newspapers, books and journals, the Gila River has been surveyed and described periodically by the Bureau of Land Management and its predecessor agencies since 1867 and continuing to the present day. An index of the BLM's survey field notes, as well as copies of the field notes and accompanying survey plats created from those notes are located at the Arizona State Land Department. A review of the survey plats indicates that the Gila has moved periodically, considerably in some locations and negligibly in other locations. Selected extracts of the survey notes follow.

In 1875 the Gila River intersected the California border in Section 22, Township 8 south, Range 23 West, Gila and Salt River Base and Meridian (G&SRB&M), as displayed on BLM map 3921. In 1993 the river's mouth was located in Section 30, Township 8 South, Range 22 West, G&SRB&M (Yuma East Quadrangle, U.S.G.S. 7.5 minute series, 1979; and Federal Insurance Rate Map Panel 04009 0715C, revised November 15, 1985).

Book, Date, Township/Range, Page, Remarks

Book 1624, 12/1890, T8S/R1W

p.20 "The high water in the Gila River having flooded the bottom land east of this point, I am obliged to run on an offset line to avoid it.

p.23 East between Sections 1 and 2, @ 71.00 chains, "Left bank of Gila River, runs N.W. Bank of river is now about 10 ft above surface of river."

p.28 North between Sections 1 (R21W) and 6 (R20W), @ 3.91 chains, "As the cor. would come in the river 2.00 chs. from Left bank the distance of the meander corner on right bank is 3.91 chains," (2.00 + 3.91 chs) * 66 ft = 390 ft
@ 4.00 chains, "having lost some of our tools in crossing the *swollen stream*"

Book 1214, 12/1890, T8S/R21W

pp.73-82 "Meanders of the Left bank of the Gila River, downstream"
"I commence at the Meander Corner to fractional Secs. 12 and 7 on the East boundary of the Township ... thence I run with meanders in Sec. 12 ... "Bank 4 ft high"

p.74 @ 10.20 chains, "Land along river bank level. Soil rich loam. No timber but a few young cottonwoods, and thick willows brush 7.00 chs. Thence in Sec. 1"

p.74 @ 6.00 chains, "bank 8 ft high"

p.74 @ 23.00 chains, "bank 8 ft high"

p.75 "dense brush of willows and mesquite 130.00 chs, 10.00 chs sand & mud"

p.75 @ 32.00 chains, "bank 4 ft high"

p.76 "no timber, except scattering cottonwoods and some mesquite, dense brush 58.00 chs. Thence in Sec. 3."

p.76 @ 48.00 chains, "Banks 4 ft high at 6.00 chs, enter brush ... Land level and subject to overflow 10 ft deep"

p.76 "to meander cor. to frac'l Sec. 3 & 4. Land level and subject to overflow 10 ft deep. No timber except a scattering of cottonwoods. Dense brush 90.00 chs. Thence in Sec. 4."

p.77 "to meander cor. to frac'l Secs. 4 & 9. Land level, subject to overflow 10 to 12 ft deep as shown by drift on trees. Dense brush of small cottonwoods and willows and screw bean 59.00 chs. Thence in Sec. 9"

p.78 "No timber except a few scattered cottonwoods. Dense willow & mesquite brush 74.20 chs. Thence in Sec. 8"

p.79 "to meander cor, to frac'l Secs. 8 & 17. No timber, but dense brush 71.10 chs. Subject to overflow from 10 to 15 feet depth. Thence in Sec. 17."

p.80 "In thick willows & mesquite to meander cor... to frac'l secs. 17 & 18. No timber except a few cottonwoods and mesquites. Dense brush 23.70 chs. Thence in Sec. 18"

p.81 "to meander cor. on W. boundary of T8S, R21W. Dense brush 103.60 chs. The entire line of left bank except a very few chains is subject to overflow. Entire length of meander lines on left bank is 8 mi, 44.90 chs of which 7 mi, 79.80 chs are in dense brush. Thence in Sec. 19, in thick brush."

p.82 "to meander cor to frac'l secs. 18 & 19. No timber. Dense brush 23.10 chs."

pp. 83-90 "Meanders on right bank of Gila River, upstream."

p.83 "to meander cor. to frac'l Secs. 17 & 18. No timber, except a few cottonwoods. Dense brush 123.10 chs. Thence in Sec. 19."

p.84 "to flag and meander cor. to frac'l Secs. 18 & 19. Heavy brush 4.70 chs. Thence in Sec. 17"

p.85 "No timber, but a few cottonwoods. Dense brush 16.00 chs."

p.85 "No timber except scattering cottonwoods. Dense brush 79.80 chs."

p.86 "No timber, except some cottonwood. Dense brush 61.20 chs."

p.87 "No timber, except a few cottonwoods. Dense brush of willows and thorns 66.90 chs."

p.87 "Land level & subject to overflow 5 ft deep. No timber except a few cottonwoods. Dense brush 94.50 chs."

p.88 "No timber except scattering cottonwoods. Dense brush 85.00 chs."

p.89 "No timber except a few scattering cottonwoods. Dense brush 136.00 chs. Total length of meanders on right bank = 8 mi. 45.10 chs of which 8 mi. 27.20 chs are in brush."

p.91 General Description. "The bottoms are generally good land, alkaline in places, and generally covered with heavy growth of mesquite, arrowood and willow brush which is very dense in the bottoms along the river ... The only water in the township is that in the Gila River, which is sometimes dry for three months in summer but at the date of this survey and during all summer a large stream has constantly flowed into the Colorado near Yuma."

Book 1213, 9/1890, T5S/R21W

p.18 North between Sections 8 & 9 @ 24.10 chains, "Left bank of Gila River runs S.W."

p.34 North between Sections 18 and 19, @ 28.00 chains, "Descend 8 ft. to lower bottoms, and enter dense brush".
@ 37.40 chains, "Left bank of Gila River runs S.W. Bank about 4 ft. above surface of water ... Distance across river 7.50 chs."
@ 44.90 chains, "To meander point & flag on Right bank ... **my party cannot cross the river, except by swimming**" (Emphasis added.)

p.39 Between Sections 17 and 18, "marked ... 'T8S, S17' on E. and 'R21W, S18' on W. faces ... **I then cause 2 men to swim the river and set a post**" (Emphasis added.)

p.41 North between Sections 1 and 2, @ 16.46 chains, "Gila River runs nearly west"

p.44 North between Sections 2 and 3, "**I cross my flag in a boat to the right bank**" (Emphasis added.)

Book 1159, 2/1877, T5S/R11W

p.1C North between Sections 35 and 36, @ 1.10 chains, "Enter lower land"
@ 28.38 chains, "Intersect left bank Gila River, brs. S. of W....set flag on line, on opposite bank of river, and measure off base 100 lks E. to point whence flag brs. N6°16'W, making distance across stream, on line, 9.10 chs"
@ 37.48 chains, "Right bank of river, on line"

Book 4082, 2/1934, T5S/R11W

p.9 South between Sections 26 and 35, @ 24.00 chains, "Main channel of Gila R., 300 lks. wide, SW. Dry"
@ 67.20 chains, "N. bank of the Gila River bottom, 10 ft. high, bears NE. and SW."

Book 4081, 1/1934, T5S/R10W

p.6 near Agua Caliente, North between Sections 13 and 14, @ 70.00 chains, "Enter Gila River bottom land, bears, E. and W."
@ 78.00 chains, "Gila River channel, 100 lks. wide, course W. Dry."
@ 80.48 chains, "Set...cor. of secs. 11, 12, 13 and 14"

p.7 North between Sections 11 and 12, @ 17.50 chains, "High N. bank of the Gila River, bears E. and W.,"
17.50 + (80.48-70) = 27.98 chains wide

p.44 General Description. "The Gila River runs a steady stream of water only after heavy rains. Most of the year the channel is dry, but in some places the water rises and flows a short distance and then sinks in the sands, indicating an underground flow."

Book 1158, 1/1877, T5S/R10W

p.46 North between Sections 29 and 32, @ 70.65 chains, "The left bank Gila River, brs. SW....I now set flag on line on opposite bank of river, and measure

off a base 100 lks. S. to a point whence flag brs N81°23'W, making distance across 6.6 chs."
@ 77.25 chains, "Right bank of river, on line."

p.48 North between Sections 29 and 30, @ 9.70 chains, "Old bank of river, brs. S. of W."

p.50 West between Sections 19 and 30, @ 67.80 chains, "Irrigating ditch runs S.W."

Book 4080, 3/1934, T5S/R9W

p.18 West between Sections 10 and 15, @ 1.00 chains, "Descend 92 ft. over NW. slope through scattering undergrowth:
@ 5.00 chains, "Thence over sandy river bed."
@ 21.00 chains, "Enter Gila River channel, course NW."
@ 30.00 chains, "Leave river channel, course NW.; asc. 132 ft. over NE. slope."

p.34 West between Sections 7 and 18, @ 64.00 chains, "Main channel of the Gila River, 200 lks. wide, course SW."

p.34 North between Sections 7 and 8, @ 58.00 chains, "Thence over sandy river bed."
@ 62.00 chains, "Main channel of the Gila River, 3 chs. wide, course W."
@ 75.00 chains, "Right bank of Gila River, bears E. and W."

p.35 West between Sections 5 and 8, @ 3.50 chains, "Enter Gila River channel, course NW., small stream of water."
@ 4.50 chains, "Left bank of channel; thence over dry sandy river bed."
@ 15.00 chains, "Right bank of river channel; thence along sandy river bar."
at 56.00 chains, "Leave river bottom; ascend 23 ft over SE. slope."

p.36 General Description. "...The general elevation is about 550 ft. above sea level, excepting along the Gila River bottom, where it is about 100 ft. lower...The Gila River enters the township near the northeast cor. of sec. 12, flows in a general westerly direction, and leaves near the northwest cor. of sec. 18. The river channel is seldom more than three chains wide. At times of high water, much of the bottom land is overflowed and the river frequently changes its channel. The river bottoms vary in width from twenty to eighty chains . . . The cottonwood trees and arrow weeds are found only along the river bottom...Along the cliff walls on the south side of the Gila River, about 25 chains west and 10 chains south of the ¼section corner of sections 7 and 18, extending for a distance of a quarter of a mile, are numerous well preserved Indian hieroglyphics."

Book 3824, 12/1926, T5S/R9W

p.6 North between Sections 1 and 2, "Over level sandy river bottom land, thru scattering undergrowth."
@ 10.00 chains, "Intersect left shore of the Gila River, bears, N80°E. and S80°W. Distance across river by triangulation, 10.63 chs.
@ 20.63 chains, "Intersect right bank of Gila River, 3 ft. high, bears E. and W. Thence over level sandy bottom land, thru dense undergrowth."

@ 36.00 chains, "Leave low river bottom land. Ascend 13 ft.
@ 36.43 chains, "Top of old river bank, bears N80°W and S80°E."

p.7 North between Sections 10 and 11, @ 9.44 chains, "Intersect left shore of the Gila River, bearing 70°E. and S70°W."
@ 24.00 chains, "Intersect right shore of Gila River, bears N70°E. and S70°W. Thence over level sandy bottom land, thru dense undergrowth."

p.8 East between Sections 2 and 11, @ 62.00 chains, "Foot of bluff and right bank of Gila River, 3 ft. high, bearing N.10°E. and S.10°W. Distance across Gila River by triangulation, 4.94 chs.(x66' = 326')"
@ 66.94 chains, "Left shore of Gila River, bears N.10°E. and S.10°W. Thence over level sandy bottom land."

Book 1157, 1/1877, T5S/R9W

p.9 North between Sections 11 and 12, @ 50.15 chains, "Old river bank, brs. W."
@ 76.11 chains, "Intersect the left bank of the Gila River, brs, S. of W....I now set a flag on line, on opposite bank of river and measure off a base 100 lks. W. to point whence flag brs. N.11.5°E. which gives distance across, 4.91 chs, or at"
@ 81.02 chains, "On line on opposite bank."

p.10 West between Sections 1 and 12, @ 61.00 chains, "Gila river bank."

p.20 North between Sections 10 and 11, @ 4.00 chains, "Bluff and descend."
@ 6.30 chains, "Enter lower bottom."
@ 53.08 chains, "Intersect left bank Gila River...set a flag on opposite bank, on line, and measure off a base 200 lks. E. to point whence flag brs. N.21.5°W. making distance across, 5.08 chs, or at"
@ 58.16 chains, "Opposite or right bank of river."
@ 72.38 chains, "Ascend to table land."

p.30 West between Sections 10 and 15, @ 15.10 chains, "Intersect left bank of Gila River, brs. S.W."

p.31 North between Sections 9 and 10, @ 30.00 chains, "Enter bottom"
@ 53.25 chains, "Left bank Gila River, brs. N. of W....I now set flag on line on right bank of river, and measure off a base 100 lks. W. to point whence flag brs. N.14°E. making distance across 4.01 chs, or at"
@ 57.26 chains, "On line on right bank of river."

p.42 North between Sections 8 and 9, @ 41.20 chains, "Enter bottom"
@ 75.00 chains, "Left bank Gila River, brs. S. of W....I now set flag on line on right bank of river, and measure off a base 100 lks. W. to point whence flag brs. N.11.25°E. making distance across 4.95 chs, or at"
@ 79.95 chains, "Right bank of Gila River."

p.54 North between Sections 17 and 18, @ 61.00 chains, "Bluff and descend."
@ 67.85 chains, "Left bank Gila River, brs. S.W....I now set flag on line on right bank of river, and measure off a base 100 lks. W. to point whence flag brs. N.14°31'E. making distance across 3.86 chs, or at"
@ 71.71 chains, "Right bank of Gila River."

p.55 East between Sections 8 and 17, @ 69.50 chains, "The left bank Gila River, brs. S.W.... distance across river 4.50 chs."
@ 74.00 chains, "Right bank of river."

p.56 East between Sections 7 and 18, @ 11.30 chains, "The left bank Gila River, brs. N.W. ... distance across river 10.39 chs."
@ 21.69 chains, "Right bank of river."

p.61 General Description. "This township ... contains some good bottom land which can be irrigated from the river. The river contains an abundance of water not yet utilized."

Book 2233, 12/15/1910, T5S/R8W

p.74 North between Sections 5 and 6, @ 21.30 chains, "Right bank of Gila River and over dry bed of river through dense arrow and water mote brush"
@ 31.00 chains, "Cross small stream of running water 12 lks. wide 6 ins. deep, course SW"
@ 39.60 chains, "Left bank of Gila River and over level land through dense mesquite and chico brush."

p.6 General Description. "The Gila River runs through secs. 5 and 6, a small stream of water which sinks in the sand and rises again all along its course through these secs. The water is very brackish and not good for domestic purposes."

Book 4479, 2/1955, T5S/R8W, nothing apparent in the notes

Book 4707, 10/1964, T5S/R8W, nothing apparent in the notes

Book 2817, 7/10/1914, T4S/R8W

p.3 North between Sections 11 and 12, @ 9.00 chains, "Enter main channel of Gila River, course SW"
@ 49.00 chains, "N. bank of Gila R., 20 ft high, brs ENE. & WSW., asc"

p.3 West between Sections 12 and 13, @ 37.00 chains, "Bank of river, W. end of island, old bed runs to WSW., and S., present bed runs to NNE. & NE. around point of island, enter Gila River, lower bottom, subject to overflow, leave cottonwood and palo verde."

p.6 North between Sections 14 and 15, @ 29.00 chains, "N. bank of Gila River, brs. WSW. & ENE., asc. abruptly 15 ft. Thence over fine level land."

p.6 West between Sections 11 and 14, @ 5.00 chains, "Enter main river bed, course SW"
@ 29.00 chains, "W. bank of Gila River, brs. SW & NE, asc. abruptly" 10 ft. (near Rocky Point)

Book 2232, 8/1910, T4S/R8W

p.5 North between Sections 26 and 27, @ 51.62 chains, "Left bank of Gila River and over dry bed of river through dense arrow and water mote brush."
@ 80.00 chains, "Point for cor. of secs. 22, 23, 26 and 27 falls in bed of river where cor. cannot be permanently established."

p.5 West between Sections 23 and 26, @ 62.64 chains, "Left bank of Gila River and over dry bed of river through dense arrow and water mote brush."

p.7 South between Sections 27 and 28, @ 35.74 chains, "Left bank of Gila River and over dry bed of river through dense arrow and water mote brush."
@ 37.80 chains, "Cross small stream of water 15 lks. wide, 6 ins. deep, course S.W."
@ 80.00 chains, "Point for cor. of secs. 21, 22, 27 and 28 falls in bed of Gila River, and **as either bank of the river is more that 40.00 chs dist from the true point for this sec.** I am unable to establish a witness cor." (Emphasis added.)

p.7 East between Sections 22 and 27, @ 34.16 chains, "Cross small stream of water 13 lks. wide, course S.W., 6 ins. deep."
@ 40.01 chains, "Point for ¼sec. cor falls in bed of Gila River where first high water would wash it away, ...nearest point on the bank of the river is S. of point for ~~cow~~ cor. . . . 30 chains."

Book 1163, 3/1871, T1S/R7W

p.1C North between Sections 35 and 36, @ 62.00 chains, "Intersect the left bank of the Gila River; runs west. Bluff bank 20 feet high & set a meander post ... Cross river on line, **water 16 inches deep & lively current.**" (Emphasis added.)
@ 64.70 chains, "Low sand bars between channels
@ 70.50 chains, "The north channel of same river."

p.9 East between Sections 26 and 35, @ 9.00 chains, "Intersect the left bank of the Gila River... Bluff bank 20 feet high, & bears N.W."
@ 15.40 chains, "Sand bars 1½ft. above low water."
@ 32.00 chains, "North channel of river runs N.W."
@ 35.10 chains, "Dry sand bar."
@ 60.00 chains, "Same channel, runs S.W. 3 chains wide & water 12 inches deep."
at 71.00 chains, "Same channel, runs N.W. and 3 chains wide."

p.24 North between Sections 28 and 29, @ 14.00 chains, "Enter level bottom land, bears N.W. & S.E."
@ 43.00 chains, "Intersect the left bank of the Gila River, runs west. Bluff bank, 15 feet high.(Cross on line)"
@ 46.30 chains, "Right bank of River 20 feet high & set a meander post"
46.30-43.00 = 3.30 chains = 217.8 ft

Book 1743, 4/1892, T4S/R6W

p.2 "With three assistants, team and wagon, I proceed up the Gila River, five miles to the ferry, but find it impossible to convey a wagon across; and learn also, there is a deep channel still north of the visable (sic) bank, which prevents reaching the ferry with a team on the north side. Therefore, I return to cor, to sec. 34-35-2-3, where I find an old mesquite post (thence East bet. secs. 35 & 2)"
@ 56.00 chains, "Left bank of River."
@ 73.73 chains, "Mesquite stub ... near edge of water. Left bank"

p.4 North between Sections 34 and 35, @ 38.44 chains, "Left bank of river"
p.11 North between Sections 31 and 32, "North to left bank of river. To all appearances the bank of river is several chains further south - here also - than before the flood of two years ago."
p.14 North on range line, Range 6W and 7W, "Thence to river bank, which from present land marks must be some 8 or 10 chains further south than before the flood of two years ago."
p.17 West on south boundary of Section 36, @ 25.50 chains, "Right bank of old river bed."
@ 75.02 chains, "Edge of water, main channel of river."
p.23 South between Sections 35 and 34, @ 6.85 chains, "Right bank of river; course N86°W. I find on this line, a middle ground to the south covered with dense growth of cottonwood and willow, with a deep and swift channel on each side. Therefore connection with line on south side of river at marked cottonwood tree cannot be made without jeopardizing life."
p.38 Diagram showing lines surveyed (of sections and Gila River alignment) dated June 2, 1890

Book 1153, 6/1890, T4S/R6W
p.46 "Meanders of the left bank of the Gila River"
p.46 "Low, sandy bed of old river"
p.47 "bank 4 ft high ... bank 6 ft high ... bank 10 ft high ... bank 15 ft high"
p.48 "Along low bed of river"
p.48 "Along bank 10 ft high ... leave high bank ... follow low bed of river"
p.49 "Along old bed of river ... bank 16 ft high"
p.50 "Along high banks ... leave high bank"
p.51 "on N side of Gila River... 8.90 chains to the South bank"
p.53 "Right bank of the Gila River, upstream ... bank 6 ft high"
p.56 "bank 8 ft high... leave high bank... along old bed of river"
p.57 "low bed of river... bank 12 ft high... leave high bank, along old bed of river"
p.57 "bank 10 ft high ... old bed of river ... bank 10 ft high"
p.60 General Description. "Driftwood ... lies in the branches of cottonwood trees 14 ft above the level of the water ... The township is well watered by the Gila River which runs through the Southern portion of it"

Book 1616, 7/1890, T4S/R6W, Nothing apparent in the notes

Book 1743, 4/1892, T5S/R6W

p.15 North between Section 1, R6W and Section 6, R5W, @ 14.12 chains, "left bank of River... proceed up the river... **cross by ferry to opposite side**" (Emphasis added.)

Book 1156, 3/1871, T5S/R6W
p.63 General Description. "There is an abundance of mesquite timber for fuel and some other purposes."

Book 1164, 3/1871, T5S/R5W

p.64 General Description. "The Gila is at times subject to very high freshets - and at all times even at a low stage of water as at present runs a volume of water equal to about 100000 inches. It has a fall of about 20 feet to the mile in this township and flows over a sandy bottom and is fordable at nearly all points **except in time of high water, when it becomes almost impassible for boats, which precludes men from (unintelligible) lying on both side of the river - hence the necessity for meandering the stream. The lands in this township... can mostly be irrigated from the river by a system of canals. A company is also organized to construct a (unintelligible) canal, beginning 20 miles above here and leading the water down and parallel to the river to a point some 12 miles below this township.**" (Emphasis added.)

Book 1634, 3/1871, T5S/R4W

p.11 West between Sections 5 and 32, @ 4.50 chains, "Descend bank & enter low bottom subject to overflow & brs. N. & S."
@ 33.00 chains, "Left bank of Gila River bears South."
@ 35.50 chains, "Right bank of River & set a post."

p.13 General Description. "The lands in this township...can be irrigated by **a system of ditches** which will probably soon be constructed..." (Emphasis added.)

Book 1165, 3/1871, T5S/R4W

p.64 **Meanders.** (Emphasis added.) Nothing apparent in the notes.

p.65 General Description. "the left bank...is from 15 to 20 feet high while the right bank is not (unintelligible) than 5 feet and the narrow bottom lands on the right bank are soon pinched..."

Book 1152, 6/1892, T4S/R4W

p.4 North between Sections 7 and 8, @ 38.00 chains, "Left bank of Gila River."
@ 51.00 chains, "Right bank of Gila River."

Book 1635, 3/1871, T4S/R4W

p.23 General Description. "The Gila River flows along the East base of a high rocky mountain & has a wide sandy bed. Current smooth and lively, having a fall of six feet to the mile."

Book 1161, 3/1871, T4S/R4W

p.54 West between Sections 5 and 8, @ 15.00 chains, "Enter low land brs. N. & S."
@ 25.60 chains, "Intersect the left bank of Gila River 6 feet high."

p.55 West between Sections 5 and 8, @ 28.00 chains, "West bank of East channel of river, low sand bed."
@ 50.20 chains, "West channel of river runs S."
@ 53.00 chains, "The right bank of Gila River 18 feet high."

p.58 Meanders. Nothing apparent in the notes.

Book 1161, 3/1871, T3S/R4W

p.45 East between Sections 29 and 32, @ 54.00 chains, "Right bank of Gila River, 20 feet high, river runs S."
@ 57.00 chains, "Dry sand bed 2 feet above water."
@ 67.00 chains, "Middle channel of river runs S."
@ 77.40 chains, "East channel of river runs S."

p.45 West between Sections 29 and 32, @ 26.00 chains, "Right bank of river."

p.47 East between Sections 20 and 29, @ 48.00 chains, "Right bank of Gila River. Cross W. channel 3 chains wide runs South."
@ 67.00 chains, "Middle channel 2 chains wide runs S."
@ 74.60 chains, "East channel of river 240 links wide runs S."
@ 77.00 chains, "Left bank of river. 20 ft high, brs. N. & S."

p.47 West between Sections 20 and 29, @ 3.00 chains, "Left bank of river."

p.48 West between Sections 20 and 29, @ 32.00 chains, "Right bank of Gila River."

p.49 West between Sections 17 and 20, @ 19.40 chains, "Intersect the left bank of Gila River 8 feet high... East channel 3 chains wide, thin sand."

p.49 West between Sections 17 and 20, @ 40.50 chains, "West channel of river 2 chains wide runs S."
@ 43.00 chains, "Right bank of Gila River."

p.51 West between Sections 8 and 17, @ 11.00 chains, "Intersect the left bank of the Gila River. Bluff bank 20 feet high."
@ 14.00 West bank of East channel low sand, river runs S."
@ 33.00 Middle channel. 2 chains wide runs S."

p.52 West between Sections 8 and 17, @ 46.00 chains, "West channel of river 3 chains wide runs S."
@ 49.00 chains, "Right bank of Gila River, 20 feet high."

p.54 West between Sections 5 and 8, @ 25.60 chains, "Intersect the left bank of Gila River, 6 feet high."

p.55 West between Sections 5 and 8, @ 28.00 chains, "West bank of East channel of river, low sand bed."
@ 50.20 chains, "West channel of river runs S."
@ 53.00 chains, "Right bank of Gila River, 18 feet high."

p108 North between Sections 31 and 32, @ 29.70 chains, "Right bank of Gila River 15 feet high & runs S.E."

p109 East between Sections 29 and 32, @ 17.00 chains, "East channel of Gila River 3.20 links wide runs S."
@ 20.20 chains, "Left bank of Gila River 18 ft high & runs South."

p110 West between Sections 29 and 32, @ 59.80 chains, "Left bank of Gila River...Bluff bank 18 feet high. Cross East channel on line 320 links wide runs South."

p111 West between Sections 30 and 31, @ 22.00 chains, "West channel of Gila River runs South."
@ 24.70 chains, "Right bank of Gila River."

p113 West between Sections 20 and 29, @ 72.50 chains, "Left bank of Gila River...Bluff bank 20 feet high, brs. N & S. Cross East channel on the line."
@ 74.75 chains, "Dry sand bed."

p115 East between Sections 19 and 30, @ 41.20 chains, "Right bank of Gila River 20 feet high, runs S."
@ 44.00 chains, "Dry sand bed on East side of West channel of river, runs S."
@ 63.00 chains, " Middle channel of river 2 chains wide runs S."

p117 North between Sections 19 and 20, @ 11.00 chains, "East channel of Gila River brs S.E."
@ 14.20 chains, "Left bank of Gila River 20 feet high."

p119 West between Sections 18 and 19, @ 19.00 chains, "Right bank of Gila River runs S. - 20 feet high."
@ 45.00 chains, "East channel of Gila River 3.80 chains wide runs S."
@ 48.80 chains, "Left bank of Gila River 20 feet high."

p123 West between Sections 7 and 18, @ 43.50 chains, "Left bank of Gila River 12 feet high runs South & 3 chains wide to sand bed."
@ 59.00 chains, "Middle channel 2 chains wide."
@ 70.00 chains, "West channel. 2 chains wide & runs South."
@ 75.00 chains, "Right bank of Gila River 18 feet high."

p124 West between Sections 7 and 18, @ 3.60 chains, "Right bank of Gila River."
@ 35.10 chains, "Left bank of Gila River."

p131 General Description. "The Gila River flows through the S.W. corner of the township & has a lively current."

Book 1151, T3S/R5W

p.17 East between Sections 12 and 13, @ 41.20 chains, "Enter low bottom"
@ 66.25 chains, "Right bank of river brs. S20°E, measure across"
@ 70.60 chains, "Left bank of river, low banks and deep water"

p.58 General Description. "There is an abundance of water in the river for irrigating."

Book 1162, 2/21/1883, T2S/R5W

p.40 North between Sections 33 and 34, @ 61.00 chains, "enter low bottom"
@ 76.00 chains, "right bank of Gila River"

p.42 East between Sections 27 and 34, @ 3.38 chains, "Left bank of River, deep water, low banks"
@ 20.00 chains, "Leave low bottom, enter mesquite and greasewood"

p.59 East between Sections 28 and 33, @ 27.5 chains, "Enter river bottom"
@ 78.84 chains, "Right bank of Gila River, low banks brs. S10°E" 78.84-27.5 = 51.34 chains = 3388.44 ft

p.70 East between Sections 9 and 16, @ 68.00 chains, "Right bank of Gila River"

p.71 @ 71.15 chains, "Left bank of Gila River, low banks & low bottom land"
@ 78.00 chains, "...leave bottom enter high land"

p.75 East between Sections 4 and 9, @ 68.10 chains, "Enter low bottom"
@ 74.00 chains, "Right bank of Gila River brs N & S30°W from this point, measure across".
@ 77.40 chains, "Left bank of River, low banks, deep water" 77.40-74.00 = 3.40 chains = 224.4 ft

p.79 East between Sections 29 and 32, @ 53.00 chains, "Dry wash, 30 ft. deep, 60 lks wide, course N60°E"

p100 General Description. "there is ... an abundance of water in the River".

Book 1161, 3/1871, T2S/R5W

p137 North between Sections 34 and 35, @ 47.50 chains, "Right bank of Gila River runs S.E."
@ 57.00 chains, "Dry sand bed, 1 foot above water."
@ 74.50 chains, "N. channel of Gila 3 chains wide and runs S.E."

p139 West between Sections 26 and 35, @ 71.80 chains, "Left bank of Gila River 20 feet high."

p141 West along 1/4 Section line, Section 27, @ 48.30 chains, "Left bank of the Gila River...Gila River about 4 chains wide here, deep water".

Book 1635, 3/1871, T3S/R4W

p.45 General Description. "The Gila River has a smooth lively current and at low water has about 150,000 inches [miner's inches?] of water all of which can be diverted to the use of irrigation."

Book 1635, 3/1871, T3S/R4W

p.52 General description. "A portion of the lands in Sections 25, 26, 27, 35 and 36 are of good quality."

Book 2874, 3/1915, T1S/R5W, Nothing apparent in the notes.

Book 1169, 12/1882, T1S/R5W

p102 General Description. "There is enough timber for all purposes, and **water for irrigation in abundance.**" (Emphasis added.)

Book 1168, 1/1883, T1S/R4W

p.96 General Description. "There is a dense under growth of all kinds of bushes in the bottom land while the hills produce greasewood, catclaw and arrowbrush. **There is plenty of water for irrigation in the Gila River.**" (Emphasis added.)

Book 1167, 1/1883, T1S/R3W

p.97 West between Sections 7 and 18, @ 9.00 chains, "Left bank of Gila River course S31°W, low bank, measure across."
@ 17.30 chains, "Right bank of Gila River, brs. S31°W, high bank."

p.99 North between Sections 7 and 8, @ 2.87 chains, "Left bank of river, brs. E. & W., measure across."
@ 6.54 chains, "Right bank of Gila River brs. E. & W. **Deep water**, low banks on south." (Emphasis added.)
p107 General Description. "The land... can be irrigated from the Gila River and than it will produce most any thing."

Book 1632, 12/1882, T1S/R2W, Nothing apparent in the notes

Book 3930, 3/1931, T1S/R2W
p.65 North between Sections 4 and 5, @ 47.25 chains, "Left bank of Gila River channel, 6 ft. high, bears NE. and SW."
@ 49.75 chains, "Center of channel of Gila River, water 5 ft. deep, course SW."
@ 54.25 chains, "Right bank of Gila River, 40 ft. high, bears NE. and SW. thence over cultivated farm lands."
@ 69.75 chains, "Irrigation canal, 12 ft. wide, course SW."
p.81 General Description. "Along the Gila River bottom there is a dense growth of will and desert tamarack brush and cottonwood timber... The Gila River leaves the township near the ¼sec. cor. on the W. boundary of sec. 7 and north of it in secs. 4, 5, 6, 7 and 8 there is an extended area of irrigated land now being intensively cultivated... Except the Gila River there are no springs nor live streams in the township."

Book 1166, 1/1883, T1S/R2W
p.97 General Description. "**There is plenty of water in the Gila River for irrigation.**" (Emphasis added.)

Book 2056, 6/1907, T1N/R2W, Nothing apparent in the notes.

Book 2055, 6/1907, T1N/R2W
p133 General Description. "The soil is generally adobe, and... if supplied with water would raise abundant crops. There is no timber in the township excepting a scattering growth of cottonwoods along the Gila River. The Gila River runs across the southeastern cor. of the township."

Book 1006, 2/1882, T1N/R2W
p.92 General Description. "...if the waters of the Gila River, would be conducted in a ditch to the land for irrigation (which could be done with some expense) the land could be made very valuable and productive."

Book 2980, 4/1915, T1N/R1W
p.31 General Description. "The township is watered by the Gila and Agua Fria rivers, and canal systems already constructed over the major part of the township."

Book 1, 2/29/1868, T1N/R1W

p423 **The Gila River** runs west through the Tp at the northern base of these mountains. It **is a fine stream of water about 10.00 chains wide.** The right bank and bed are sandy and has a rapid current generally... **The Agua Fria Creek** enters the Tp in Sec 2 and runs southerly through it and empties in the Gila River. It **is a wide but shallow water course**, and sandy banks and bed and dry except during times of great freshets." (Emphasis added.)

Book 2647, 1/1913, T1S/R1W, Nothing apparent in the notes.

Book 2, 3/12/1868(?), T1N/R1E, Nothing apparent in the notes.

Book 3457, 1/1912, T1N/R1E, Nothing apparent in the notes.

Book 3457, 1/1912, T1S/R1E

p193 General Description. "The southeastern portion (of the township) is inhabited by the Pima Cooperative Company of Indians who formed an association to build a canal and irrigation system... These Indians farm about twenty acres each, and are very prosperous. **The Gila River traverses the township in a Northwesterly direction and contains water at all seasons of the year."** (Emphasis added.)

Book 609, 2/1868, T1S/R1E

p.31 General Description. "The Gila River enters the Tp on the East boundary of sec. 36 and flows in a NW direction through it leaving it at the NW cor. of sec. 6."

Book 3959, 1/1933, T4S/R8E

p.4 South along West boundary of Section 30, @ 36.24 chains, "The right bank of the Gila River, vertical, 5 ft. high, bears NW. and SE."

p.5 South on North-South centerline of Section 30, @ 49.80 chains, "Descend bank, 4 ft. high, bears NW. and SE. Thence over level bottom land, through scattering cottonwood".

@ 52.40 chains, "Descend bank, 2 ft. high, bears NW. and SE. Leave fence, bears NW."

@ 53.50 chains, "Bank, 3 ft. high, bears NW. and SE. Thence over low sandy bottom land".

@ 63.87 chains, "The right bank of the Gila River, sloping, 2 ft. high, bears NW. and SE."

p.6 South on the West 1/16 section line of Section 30, @ 18.20 chains, "Record distance for old meander cor. No trace found ... Descend bank 3 ft. high and enter bottom, bears E. and W. ... Set an iron post, 3 ft. long, 1 in. diam., 30 ins. in the ground, for special meander cor., with brass cap mkd. ... Descend bank 3 ft. high and enter bottom, bears E. and W."

@ 42.50 chains, "Descend bank, 2 ft. high, bears NW. and SE."

@ 47.60 chains, "Descend vertical bank, 5 ft. high, bears E. and W. Enter low

sandy bottom."
@ 49.33 chains, "The right bank of the Gila River, vertical, 4 ft. high, bears NW. and SE."

p.7 West on East-West midline of Section 30, @ 6.00 chains, "Descend bank, 5 ft. high, bears NW. and SE. Enter bottom land and cottonwood"
@ 21.10 chains, "Descend sloping bank, 2 ft. high, bears NW. and SE."
@ 35.36 chains, "The right bank of the Gila River, vertical, 5 ft. high, bears NW. and SE."

p.8 In Sec. 30, Meanders; "bank, 2 ft. high ... Bank 3 ft. high ... Bank 5 ft high".

Book 3477, 10/1919, T5S/R8E

p.27 Meanders.

Book 631, 6/1869, T5S/R9E

p.24 North between Sections 4 and 5, @ 47.00 chains, "To bed of Gila River in ordinary stage of water. At present it is dry."
@ 57.00 chains, "channel of River bearing S 80° W & N 45° E."

p.32 West between Sections 6 and 7, @ 65.00 chains, "Gila River bearing S 75° W & N 45° E"
@ 70.00 chains, "Cross the same and run parallel" $5\sin 15° = 1.294$ chains

p.34 "A great portion of (the land in this township) would produce good crops is if water could be brought upon it. This is almost an impossibility. There is barely enough in the Gila River for the use of the Settlements as they are."

Book 3836, 7/1929, T5S/R9E

p.56 General Description. "There is no surface water, save in the two canals ... The Gila River carries a shallow flow of water thru the winter and early spring months, only".

Book 1471, 4/1869, T5S/R9E

p.20 East between Sections 4 (R5S) and 33 (R4S), @ 5.50 chains, "To bank of Gila River which bears N45°E & S45°W".
@ 12.50 chains, "Cross the same into low bottom with dense undergrowth..."
@ 50.00 chains, "To low overflowed bottom".

p.20 East between Sections 3 (R5S) and 34 (R4S), @ 1.60 chains, "Cross irrigation ditch bearing N & S.

Book 1471, 4/1869, T4S/R9E

p.24 North on the east boundary of Section 25, @ 15.50 chains, "To Gila River running S45°W & N45°E".
@ 18.00 chains, "Cross the same to low sandy bottom".
@ 60.00 chains, "To table land".

Book 1471, 4/1869, T4S/R10E

p.42 North on the east boundary of Section 12, @ 47.12 chains, "To a willow 6 in. dia. on bank of Gila River, which bears S45°W".
@ 60.00 chains, "Cross Gila River to 3rd rate sandy bottom".

Book 624, 5/1869, T4S/R9E

p.39 nothing apparent in the notes

Book 3838, 7/1929, T4S/R9E

p.42 "Water in the Gila River is underground except at intermittent points and in stormy periods".

Book 625, 2/1869, T4S/R10E

p.7 East between Sections 12 and 13, @ 12.50 chains, "To Gila River running N45°W & S45°E".
@ 16.00 chains, "Cross the same to low overflow bottom".
@ 27.50 chains, "To River bearing S45°W & N45°E".
@ 30.50 chains, "Cross the same to 2nd rate bottom".

p.8 North between Sections 11 and 12, @ 2.00 chains, "bank of the Gila River".

p.46 "The land in this township is of no value except that in the Gila bottom".

Book 643, 6/1892, T4S/R11E

p102 "wash 2.00 chains"

p.93 Meanders.

p106 "There are two excellent dam sites in Sec. 11 between the North and South Buttes".

p105 "The Gila River flows through this township in a westerly direction".

Book 3695, 3/1926, T4S/R12E

p.51 South of township line, @ 54.46 chains, "Right bank of Gila River, brs E. and W".
@ 54.86 chains, "Center of channel of Gila River, 2.00 chains wide, course W."
@ 56.64 chains, "Left bank of Gila River, brs. E. and W.; a spring...and the Gila River running westerly...offer the only water supply".

Book 3603, 5/1924, T4S/R13E

p.32 West between Sections 1 and 12, @ 66.05 chains, "Right edge of bed of Gila River, brs. N50°W and S50°E, across dry sandy bed of Gila River".
@ 74.00 chains, "Right edge of *water* in Gila River brs. NW and SE, across *water* flowing NW".
@ 77.00 chains, "Left edge of *water* in Gila River brs. NW and SE. Leave Gila River."

p.33 North between Sections 1 and 12, @ 70.55 chains, "Right edge of bed of Gila River, brs. NW and SE, across dry sandy bed of Gila River".
@ 75.00 chains, "Right edge of *water* in Gila River brs. NW and SE, across

water flowing NW".
@ 77.75 chains, "Left edge of *water* in Gila River".

p.39 North between Sections 10 and 11, @ 66.40 chains, "Left bank of Gila River, brs. E. and W., across river bed".
@ 66.90 chains, "Left edge of water, brs. E.and W. ... across water, flowing W."
@ 68.90 chains, "Right edge of water, brs. E.and W. ... across river bed".
@ 72.00 chains, "Right bank of Gila River, brs. E. and W. Leave Gila River".

p.40 West between Sections 2 and 11, @ 16.35 chains, "Left bank of Gila River, brs. NE. and SW. Thence across river bed."
@ 19.40 chains, "Left edge of water, brs. N.32°E. & S.32°W. Thence across water flowing SW."
@ 21.35 chains, "Right edge of water, brs. N.32°E. and S.32°W. Leave water. Thence across river bed."
@ 23.10 chains, "Right bank of Gila river, brs. N.32°E. and S.32°W. Leave Gila river."

p.70 General Description. "The Gila river affords water all thru the year."

Book 626, T4S/R14E

p.35 West between Sections 6 and 7, @ 35.20 chains, "Gila River 100 lks. wide, flows N.W."

p.38 "narrow valley extending N.W. along the Gila River, with deep rich soil and abundance of water for irrigation purposes".

Book 632, T4S/R15E

p.61 General Description. "There is rich bottom land along the river"

Book 633, 2/1878, T5S/R15E

p.54 "There is an abundance of water for irrigating purposes ... The Gila River where it passes through this township is not an 'impassable' object".

Book 634, 1/1878, T5S/R16E

p.60 North between Sections 5 and 6, 2.00 chains, "Intersect the left bank of the Gila River ... The river runs S. of W. and is 80 lks. wide".

p.61 Meanders

p.67 General Description. "This township lies in the junction of the Gila and San Pedro Rivers. There is agricultural land along the rivers and water to irrigate it".

Book 1961, T4S/R16E

p.61 General Description. "The Gila River runs diagonally nearly through the center of this township. Along the river is rich bottom land from a mile to two miles in width, which will produce heavy crops".

Book 1563, T4S/R16E

p.5 North between Township 5, Ranges 23 & 24 East, between Sections 7 and 12, @ 72.35 chains, "Intersect left bank of Gila River ... distance across the river, 2.40 chains".
@ 74.75 chains, "Right bank of Gila River".

p.27 _ between Townships 4 and 5 South, Range 23 East,
@ 75.41 chains, "Intersect right bank of Gila River ... distance across river 1.08 chains".
@ 75.49 chains, "Left bank of river".

p.37 North between Township 4 South, Ranges 22 and 23 East, between Sections 7 and 12.

Book 1961, Meanders.

Book 635, 1/1876, T5S/R23E

p.61 General Description. "This township covers mostly grazing land. The N.E. corner lies along the Gila River and contains some very rich bottom land".

Book 676, T5S/R24E

p.61 General Description. "The Gila River runs through the S.W. portion of this township, and along its bottom there is much rich land that can be brought under cultivation".

Book 674, 2/1875, T6S/R24E

p.61 Meanders

p.66 General Description. "The Gila River runs through the N.E. part of the township. Along this on either side for a width of from one to two miles the land is rich bottom which can be easily irrigated from the river".

Book 675, 2/1875, T6S/R25E

p.1D North between Sections 35 and 36, @ 19.95 chains, "Intersect the left bank of the Gila River ... distance of 2.05 chains across".
@ 22.00 chains, "To right bank".

p.62 Meanders.

p.71 General Description. "The Gila River runs diagonally through this township. Along the river on both sides is a wide bottom of rich land".

Book 690, 3/1875, T7S/R25E

p.61 Meanders.

p.62 General Description. "The Gila River runs through the extreme N. Eastern part of the township. Along the valley is rich bottom land".

Book 692, 2/1875, T7S/R26E

p.56 Meanders.

p.63 General Description. "This township includes the bottom land on both sides of the Gila, more than two miles in width in places on the south side".

Book 693, T7S/R27E
p.55 Meanders.
p.61 General Description. "This township lies along the river and on both sides of it. The bottom averages about a mile in width on either side of the river".

Book 662, 2/1896, T6S/R27E
p106 Meanders.
p108 Meanders.
p110 General Description. "Secs. 35 & 36 ... are well watered and irrigated by ditches taking water out of the Gila River which runs along their respective south boundaries ... Some cottonwood and willow along the Gila River".

Book 1591, xx/yyyy, T6S/R28E
p.66 North between Sections 1 (R28E) and 6 (R29E), @ 19.90 chains, "Enter Gila bottom".
@ 23.85 chains, "Center of Gila River, 120 lks.wide flows, S.W."
@ 24.50 chains, "Begin ascent".
@ 25.75 chains, "Top, bears E & W, descend".
@ 27.00 chains, "Enter Gila bottom, bears, E & W".
@ 28.00 chains, "Center of Gila River, 100 lks. wide, flows S.E."
@ 40.00 chains, "Point for ¼sec. ~~cow.~~ cor. in bed of Gila River, subject to overflow".
@ 42.12 chains, "Center of Gila River, 110 lks. wide, flows S.W."
@ 42.85 chains, "Ascend from Gila River, and E. slope of ridge."

There are also accounts describing the Gila River included in U.S.G.S. Annual Reports and Papers in the late 19th century. Following are a number of those accounts.

Tenth Annual Report, 1888-89

"Self-recording instruments are not practicable at any place thus far found to be available for gauging, owing to the shallowness of the streams and the unstable character of their channels. Mr. Farish, however, with rare energy and devotion has done much in grappling with these difficulties. Three stations have been established by him: on the Gila about 14 miles above Florence, on the Salt a little above the junction of the Verde, and on the Verde near the latter locality. Continuous records have been maintained and repeated gaugings made. About forty rain-gauges have been placed in various localities in Arizona whence observations are specially desired and needed. An evaporation station has been located at Tempe, where the correlated meteorologic observations are maintained." [p. 87]

Eleventh Annual Report, 1889-90

"In place of the regularly recurring annual floods of spring and early summer, so strongly marked on the discharge diagrams of other basins, these rivers show conditions almost the reverse, being at that season at their very lowest stages - even dry - and rising in sudden floods at the beginning of and during the winter. These floods are of the most destructive and violent character; the rate at which the water rises and increases in amount is astonishingly rapid, although the volume is not always very great. For instance, in an ordinary flood the Salt River, the principal tributary of the Gila, has risen in about three hours from 500 second-feet to 30,000 second-feet, falling again almost as rapidly, so that the average for the day or for two or three days would not be more than 10,000 or perhaps 5,000 second-feet. From this it will be recognized that the onset of such a flood is terrific. Coming without warning, it catches up logs and bowlders [sic] in the bed, undermines the banks, and, tearing out trees and cutting sand-bars, is loaded with this mass of sand, gravel, and driftwood - most formidable weapons for destruction ... Along the headwaters of the river are several open valleys, and in those of southeastern Arizona agriculture is steadily increasing by the use of water from the river or from side streams. On the extreme eastern edge of the territory, near the town of Duncan, some 2,000 acres have been reclaimed, and in the valley from Solomonville westward for 20 miles down the river fifteen irrigating ditches, covering in the aggregate 45,000 acres, have been constructed. There are in addition several other irrigated areas near the mouth of the San Pedro. The principal tributaries are the San Pedro and Santa Cruz Rivers, on the south side, and the Salt, Aqua [sic] Fria, and Hassayampa Rivers, on the north side. The floods of the upper Gila and its tributaries are usually short and violent, the highest water occurring during the months of January and February. During a freshet the river rises from 8 to 12 feet and increases in width from 3000 feet to a mile and a half. It is sometimes impassable for weeks, and in places has the appearance of a vast sea of muddy water. The season of low water occurs during the months of June and July, the river bed being then dry in places for miles." [pp. 58-9]

Twelfth Annual Report, 1890-91

"The spring of 1891 was characterized by the greatest flood of which a record has been kept. This came, as have most of those of February and March, from the Gila Basin, where a large amount of damage was done by the extraordinary rains ... The Gila Basin (Pl. LXXV), the most southerly portion of the great Colorado drainage basin, includes the greater part of Arizona, as well as a portion of New Mexico and of Sonora, in the Republic of Mexico. In all this area of 66,020 square miles the success of agriculture depends upon the artificial application of water to the crops. This water is derived from the Gila River and its tributaries by means of canals and ditches, which distribute it to the fields of each farmer. These streams fluctuate greatly, being at times subject to sudden floods, especially during summer rains, when they often sweep out bridges, dams, and canal head works, while at other times they

may diminish until the water almost disappears. In floods there is, of course, far more water than can be used, although at this season as much as possible is put upon the crops, especially the forage plants, and great quantities are turned upon the fields in order to saturate the ground; but, on the other hand, during the ordinary low stages of the streams, the acreage of crops is limited to that which can be watered by the diminished flow. On Pl LXXV is given a map of the basin on a scale of 40 miles to the inch, with contour interval of 1,000 feet. This is taken from the U.S. Geological Survey map of 1891 and shows in a general way, as is necessary on this scale, the elevations in this basin. It has been derived from all material accessible and gives at a glance the present condition of our knowledge of this important region ... Assuming that this map (Pl. LXXV) of the drainage basin is approximately correct, sufficiently so for general purposes, computations have been made of the area of land lying at different elevations, the result being as follows: The total area of the basin is 66,020 square miles. Of this area - 9 per cent is under 1,000 feet; 19 per cent is between 1,000 and 2,000 feet; 16 per cent is between 2,000 and 3,000 feet; 14 per cent is between 3,000 and 4,000 feet; 15 per cent is between 4,000 and 5,000 feet; 12 per cent is between 5,000 and 6,000 feet; 8 per cent is between 6,000 and 7,000 feet; 7 per cent is over 7,000 feet. The greater portion of the land lying at an elevation of less than 3,000 feet, may be classed as sandy plains, in large part agricultural if water could be supplied; in other words, about 44 per cent of the entire area of the basin would fall into this class. The lands over 5,000 feet in elevation may be considered as mountainous catchment areas. These aggregate 27 per cent of the entire basin, and it is from this 27 per cent, or a portion thereof at least, that all of the water comes. The greater part, if not all, of the grazing and mining regions are included within this 27 per cent, as well as all the timber. The land from 3,000 to 5,000 feet above the sea is partly plain and partly foothill. A small part is agricultural, especially at the headwaters of the Verde and those of the Upper Gila, but in the main it is broken country, of little value even for grazing. ... The Gila basin includes, besides the greater part of southern Arizona, a small portion of the Territory of New Mexico, and the State of Sonora, in the Republic of Mexico. In the case of this latter country, the rim of the basin has been arbitrarily assumed, as there are no available maps which define it, and on the southwestern edge the boundary between the United States and Mexico is taken as the limit of the basin. This area, by countries, is shown in the following table:

	Square miles
Socorro County, New Mexico	3,893
Sierra County, New Mexico	156
Grant County, New Mexico	2,818
	6,867
Republic of Mexico	1,168
Apache County, Arizona	2,550
Graham County, Arizona	6,152
Cochise County, Arizona	3,212
Gila County, Arizona	5,300
Pinal County, Arizona	10,596
Pima County, Arizona	9,685
Yavapai County, Arizona	9,815
Maricopa County, Arizona	4,671
Yuma County, Arizona	57,985
TOTAL:	**66,020**

"Nearly 88 per cent of the entire area is in Arizona, a little over 10 per cent in New Mexico, and nearly 2 per cent in Mexico ... Its total length from the source in New Mexico [sic] to the junction with the Colorado River, not including its many windings, is fully 500 miles ... The floods of the Gila are usually short and violent, the highest water occurring during the months of January and February. During a freshet the river rises in some places from 8 to 12 feet, and increases in width from 300 feet to a mile and a half. It is sometimes impassable for weeks, and has the appearance in places of a sea of muddy water. The season of low water occurs during the months of June and July, the river bed being then dry in places ... Eliminating the floods, it has been found, for example, by the hydrographers of the Geological Survey that about 200 second-feet passed through the buttes above Florence during the year in which, as ascertained by the census, there were about 6,600 acres of crops successfully irrigated ... In this basin a number of excellent sites are know to exist; two in particular have been so often discussed that it is sufficient merely to refer to them. The first is in Pinal County, 15 miles above Florence, where the Gila flows between two 'buttes,' forming a canyon 200 feet or more in width, with perpendicular walls on each side. In this canyon a dam of sufficient magnitude would impound, from various estimates, enough water to irrigate a large part of the plains below. The second is at Oatman Flats, in the western part of Maricopa County. The Gila at this point flows between bluffs of limestone from 111 to 126 feet high, and at a distance of

1,195 feet from each other. There is a large storage basin above, in which, by means of a suitable dam, sufficient water could be stored during the storm floods to serve the Lower Gila Valley during the dry season ... As a general thing, it may be said that in this basin, owing to the diversity of topography in the high lands, the rainfall increases with the altitude, and therefore the greater part of the precipitation occurs along the northeastern edge of the basin, while out on the great plains through which the Gila flows, and where the best agricultural land is situated, there is the least moisture, the average at Yuma being less than 3 inches, at Texas Hill, 4 inches; at Maricopa, 5 inches; and at Casa Grande, a little over 4 inches; while, on the other hand, near and among the mountains, or rather the slopes of the edge of the great plateau, the rainfall increases to 10, 15, or even 20 inches and over ... The year 1884 was an unusually rainy one throughout this basin, as well as throughout a great part of the West, as previously noted, while 1885 was a year of minimum precipitation. since those years, the average rainfall has been nearly constant, and perhaps diminishing slightly through 1888 and 1889 ... The Upper Gila district or headwaters of the main Gila may be considered as including that part of the basin from the highest catchment down to the buttes above Florence, excluding, however, the San Pedro ... The Gila in this portion of its course flows throughout the year, and is subject to sudden and violent floods, especially during the summer season ... The middle Gila district is a trunk river division, and depends for its water supply upon the amount which comes from the two districts above mentioned, namely, the upper Gila and the San Pedro. The limits of this district are somewhat arbitrary, the district being considered as extending from the Buttes above Florence to the junction of the Gila with the Salt, and including on both sides of the river that portion of the great plain which can be irrigated from the Gila River ... In the latter part of June the bed of the river is often dry, its water being diverted by the numerous canals of this district. Floods are liable to occur with great violence in July and August, as well as in January, February, and March. There is usually sufficient water to mature one crop, but it reported that the second crop has been lost repeatedly. According to the statements of the irrigators, the year 1890 was one of the dryest (sic) known, while during 1889 the supply may be considered as about at an average ... The amount of water available for this basin was accurately determined by the Geological Survey during about one year; but their work was stopped at the end of this time by lack of further appropriation ... The Lower Gila District may be said to include the arable land from Gila Bend to Yuma, where the Gila River empties into the Colorado. This is a main-trunk district, receiving the waters which escape from the Middle Gila District and from the Lower Salt ... There were only 555 acres on which crops were reported raised by irrigation in 1889, but a far greater acreage has been brought under ditch. There are a large number of extensive canals and ditch systems projected or under construction in this district, but whose success must apparently be a matter of some doubt. The land of the Lower Gila District is of great fertility and is adapted to the cultivation of many fruits of the semitropic zone, as, for example, oranges, lemons, and other citrus fruits.

It is thus known as the citrus belt of Arizona, and promises to become of great importance in these productions. Besides the fruit, alfalfa, barley, and wheat are reported to be cultivated, and vineyards have been successfully planted." [pp. 291-5, 299, 301, 305-6 & 314]

Sixteenth Annual Report, 1894-95

"A considerable number of canals and ditches have been constructed, taking water from the Salt and Verde, as well as from the Gila itself; and the ordinary summer flow is needed for the lands now under cultivation. There is, however, an enormous amount of water going to waste at various times of the year, following the sudden storms or 'cloud-bursts' in the mountains, but these floods occur at such irregular intervals and come with such violence that it is impracticable to attempt to save much of the water ... With the exception of the great Colorado River, which, however, flows in stupendous canyons or gorges thousands of feet below the arable lands, the streams of the Territory are small, and usually intermittent." [p. 505]

Eighteenth Annual Report, 1896-97

A Key Map of the proposed "Buttes Reservoir Site On Gila River, Arizona" is displayed on Pl. XX [following p. 292]

Twentieth Annual Report, 1898-99

"On Pl. XLIII are shown two of the localities where the river enters a narrow gorge. Above both of these gorges the river valley widens, being comparatively flat, so that, except for the depth to bed rock at the dam sites, the conditions are highly favorable for the construction of storage reservoirs." [p. 405]

Twenty-First Annual Report, 1899-1900

"[Gila River] passes alternately through narrow canyons and out upon valleys, where its waters are diverted for irrigation ... About 10 miles before Gila River reaches the Arizona line the canyon broadens into a valley of considerable width, known as Duncan Valley ... March 22, 1899, [the Gila River in Duncan Valley] was carrying in the canyon above the head of all ditches 160 second-feet." [p. 334-5]

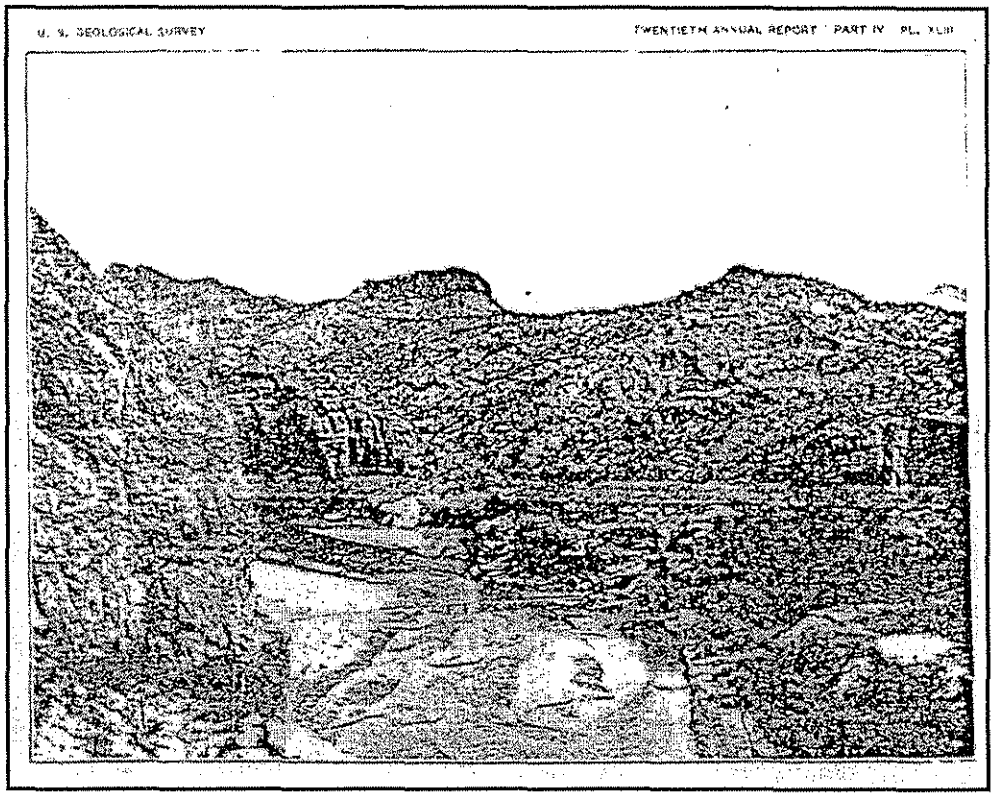

FIGURE 6. DAM SITE AT BUTTES, ARIZONA, LOOKING DOWNSTREAM

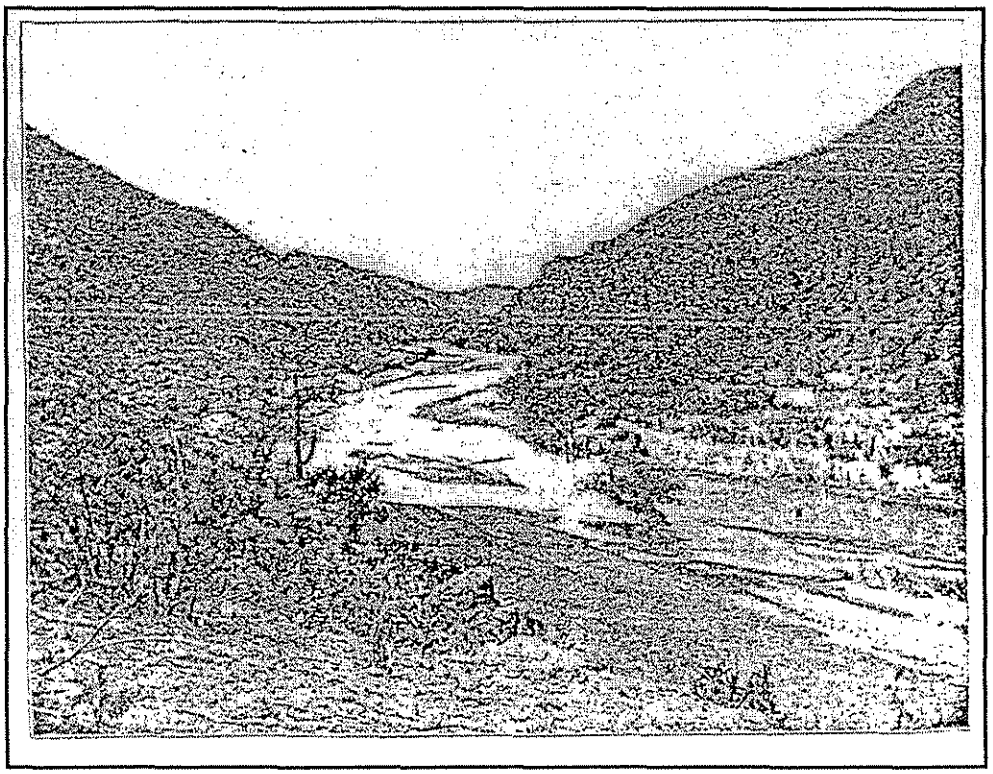

FIGURE 7. DAM SITE BELOW RIVERSIDE, ARIZONA, LOOKING DOWNSTREAM

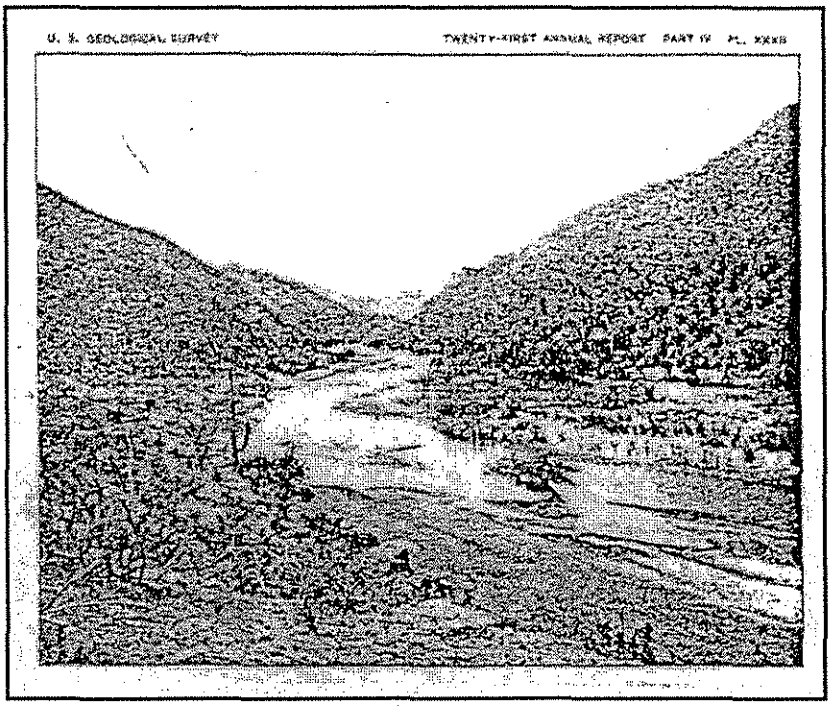

FIGURE 8. RIVERSIDE DAM SITE, ARIZONA, LOOKING DOWNSTREAM

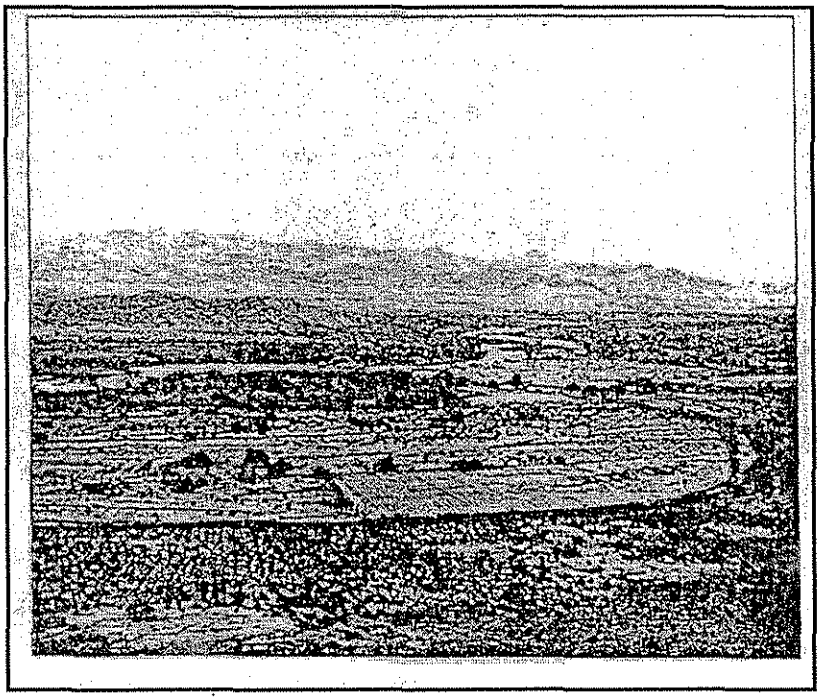

FIGURE 9. RIVERSIDE RESERVOIR SITE

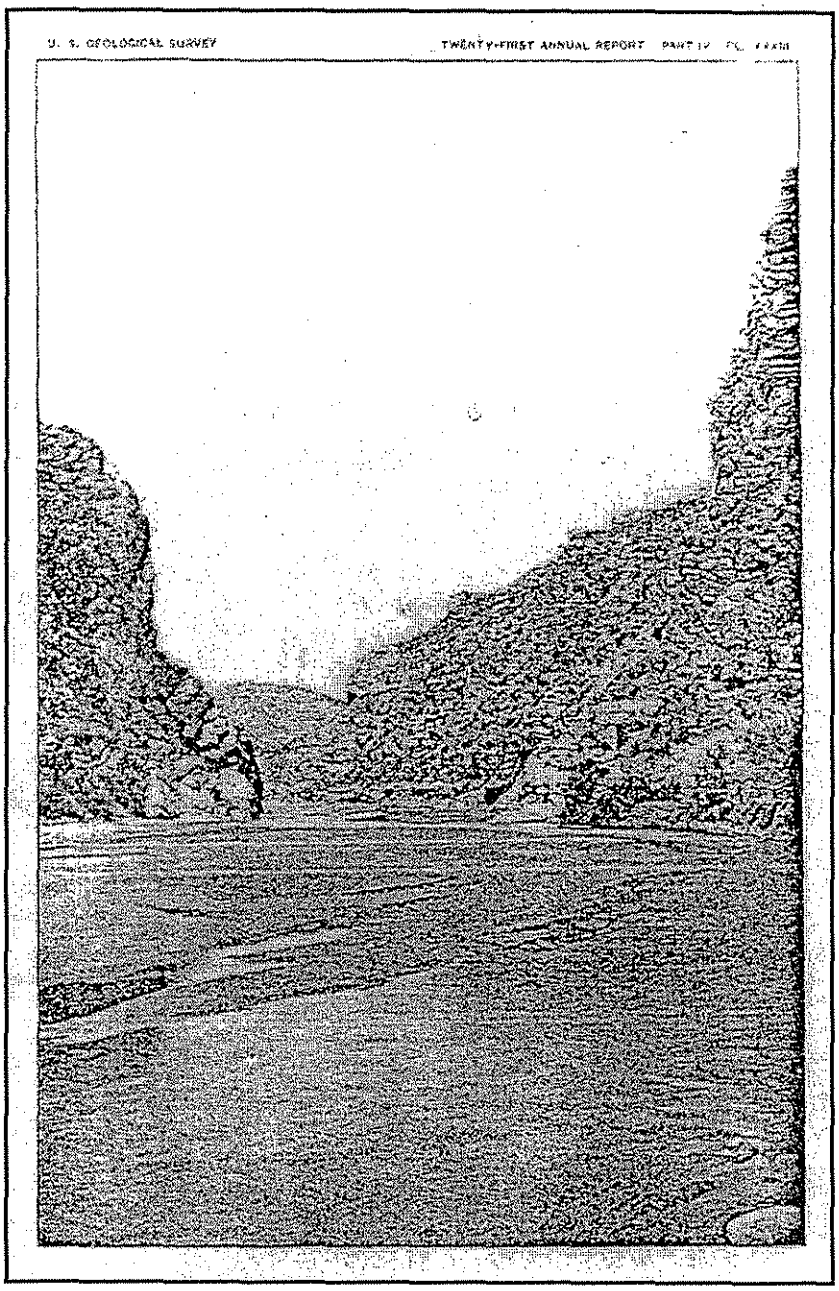

FIGURE 10. SAN CARLOS DAM SITE, ARIZONA, LOOKING UPSTREAM

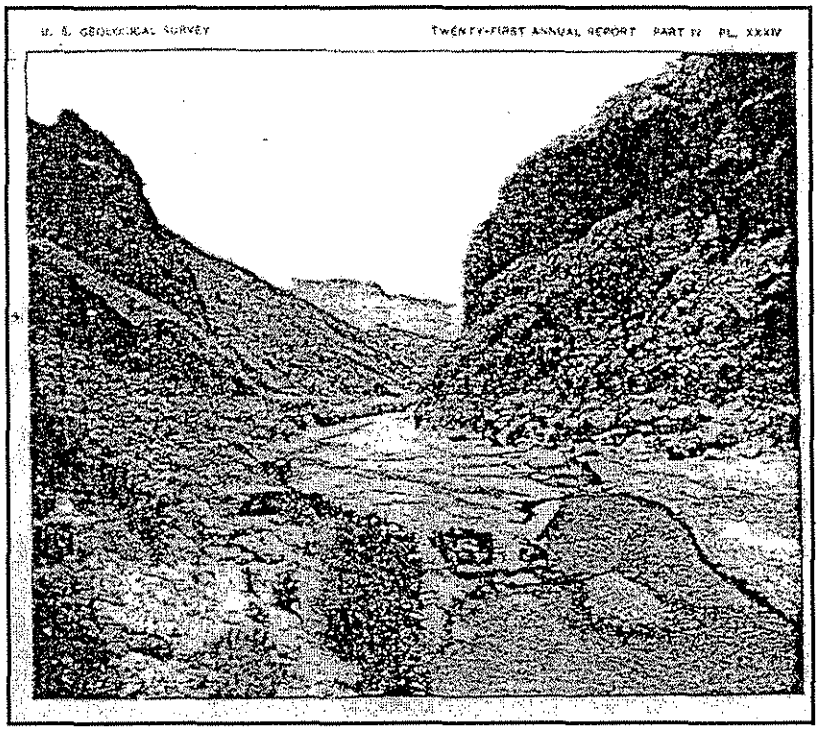

FIGURE 11. SAN CARLOS DAM SITE, ARIZONA, LOOKING DOWNSTREAM.

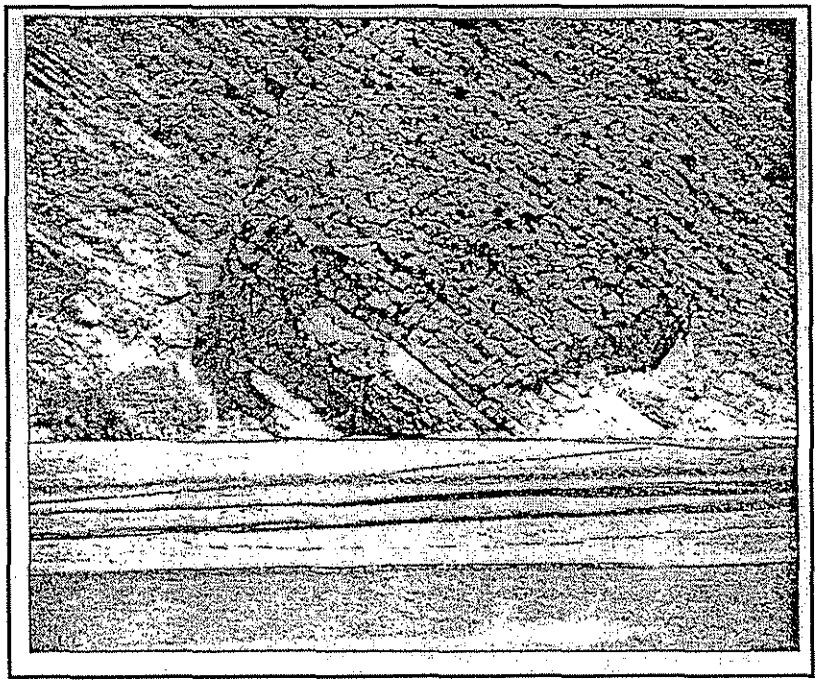

FIGURE 12. LEFT ABUTMENT OF SAN CARLOS DAM SITE.

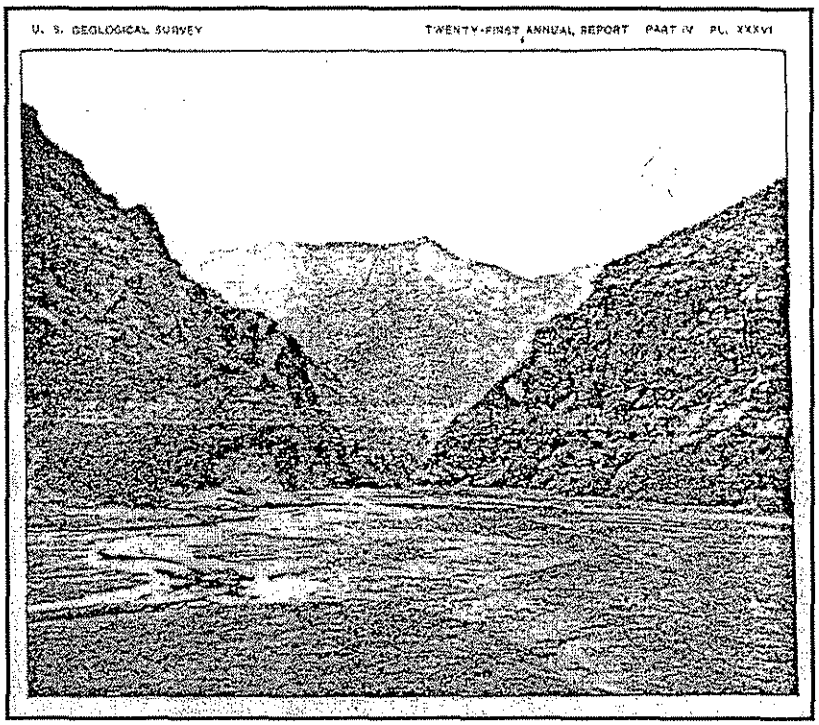

FIGURE 13. GILA RIVER CANYON, 15 MILES BELOW SAN CARLOS DAM SITE.

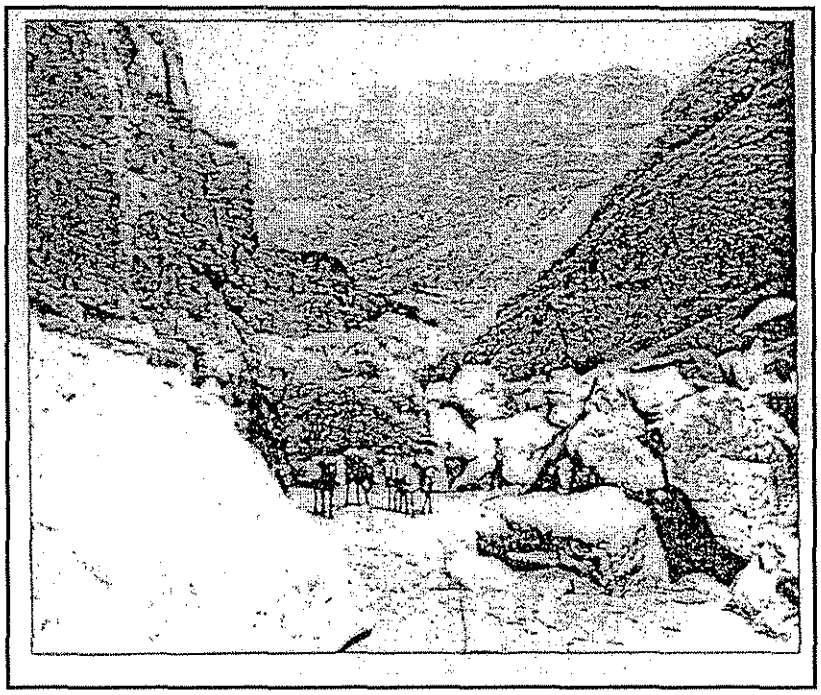

FIGURE 14. GILA RIVER CANYON, 8 MILES BELOW SAN CARLOS DAM SITE.

C. Historical Uses of the River

2. Irrigation

Canals: Pre-Statehood Activity

In the early 1890's the Gila River Basin was defined by the United States Geological Survey as containing three reaches or "districts" with a number of tributary districts (San Pedro, Verde, Upper Salt, Lower Salt, Agua Fria, Hassayampa, and Santa Cruz). Numerous diversions for irrigation occurred in these districts (see table below). The total area of the Gila Basin was estimated at 66,020 square miles, or approximately 42,252,800 acres, and includes the greater portion of southern Arizona, a small portion of the western New Mexico and a portion of Sonora, Mexico. The river flows through a number of Arizona's agricultural irrigated areas including Duncan Valley near Duncan; Safford Valley from San Jose to Fort Thomas; farming areas around Florence and Coolidge; the Gila River Indian Reservation; Buckeye Valley west of Phoenix to Arlington; Dendora Valley just downstream of Painted Rock Dam; Hyder Valley; and Mohawk Valley east of Yuma.

The Upper Gila district was defined as being a "headwater basin" of the Gila from the highest catchment down to the Buttes above Florence, excluding the San Pedro River. The Gila was perennial in this reach and provided waters to irrigate 14.3 square miles, or 9,137 acres.[1]

The Middle Gila district was defined as a "trunk river division" which reached from the Buttes area above Florence to the confluence of the Gila with the Salt. The district drew its flows wholly from waters in the Gila River (Upper Gila and San Pedro districts). The Gila was often dry during the early summer in this reach, at least in part due diversions by the "numerous canals" upstream and within the district, but was able to irrigate 6,619 acres in 1890. The periodic "violent" floods of late winter and late summer provided sufficient flows to mature one crop but were frequently too erratic to support the second crop.[2]

The Lower Gila district was defined as a "main-trunk district, receiving the waters which escape from the Middle Gila District and from the Lower Salt," depending largely on diversion activities in the upstream districts. Approximately 4,000 acres were irrigated in 1889, but it was felt that this area was capable of greater things, and to that end the Gila Bend Irrigating Company was in the process of building an ambitious, 75 mile long canal to irrigate the valley all the way to the Yuma county line.[3]

The San Pedro district was defined as a "headwater basin" of the Gila and was somewhat undefined in the late 1800's owing largely to limited mapping. The San Pedro rises in Sonora, Mexico and flows north through Cochise, Pima and Pinal Counties. No storage occurred on the San Pedro at this time, although the Director of the Geological Service recommended that consideration be given to developing such facilities; irrigation diversions for more than 5,800 acres were taking place in the upper

and lower portions of the San Pedro Valley.[4]

The Verde district was considered a "headwater basin" of the Gila and encompassed approximately 6,000 square miles. The Verde and its tributaries rise in Yavapai County, Arizona and flows south into Maricopa County. Approximately 1,948 acres of crops were identified as being irrigated by diversions from the Verde and its tributaries in 1889-90. No storage facilities existed on the Verde at this time, but the problems associated with crop irrigation were related to canal damage or turnout difficulties.[5]

The Upper Salt district was considered a "headwater basin" of the Gila and encompassed approximately 6,260 square miles. The Upper Salt and its tributaries rise in Yavapai, Apache, Gila, Graham and Pinal Counties and flow west to the mouth of the Verde. Only 815 acres of crops were being irrigated in the district in 1889-90, largely due to the mountainous nature of the terrain.[6]

The Lower Salt district was considered a "trunk river division" of the Gila. The district received flows only from the Salt River and stretched from the mouth of the Verde to the Salt River mouth at its confluence with the Gila southwest of Phoenix. A reported 29,171 acres of crops were irrigated in the district in 1889-90 and it was estimated that number could be doubled with strategically located storage facilities to impound the periodic flood flows.[7]

The Agua Fria district was considered a "lost river basin" in 1890 due to the small supply of water conveyed in the river and the relatively large amount of arable land it was diverted to irrigate. The estimated area of the basin was 1,420 square miles at Gillete, near the confluence of the Agua Fria and New River. Most years, no flows reached the Salt River of which it is a tributary and lost crops were not uncommon.[8]

The Hassayampa district was considered a "lost river basin" due to the small supply of water in the river and the large amount of arable land it was diverted to irrigate. The district comprised 1,810 square miles, almost evenly split between Yavapai County (source of its headwaters) and Maricopa County. Most years the river sinks into its bed before reaching the Salt.[9]

The Santa Cruz district was considered a "lost river basin" due to the small supply of water in the river and the large amount of arable land it was diverted to irrigate. The river rises in the Canelo Hills east of Patagonia, flows south past Lochiel into northern Sonora, Republic of Mexico. There are approximately 3,500 square miles in the district. It was reported that 2,672 acres of crops were irrigated in the district in 1889. Most times the river sinks into its bed before reaching the Gila.

Canals which existed, along with reported estimated lengths and acreage irrigated on the Gila and its tributary rivers, are identified in the "Canals reported as taking water from the Gila River in 1889" table at the end of Section C.[10]

Canals: Since Statehood to Present Day

On June 29, 1935 the Gila River Decree, Globe Equity No. 59 was entered in the United States District Court (Arizona District) as a result of *The United States of America v. Gila Valley Irrigation District, et. al.* The Gila River Water Commissioner was created by the Decree and assumed his duties on January 1, 1936. The Decree set out water rights priorities for water users along the Gila River from New Mexico to the Salt-Gila River confluence. Senior priority was for 35,000 acres of land in the Gila River Indian Reservation, followed by 1,000 acres of land in the San Carlos Indian Reservation, and a number of priorities for other lands along the river including 100,546 acres of land in the San Carlos Project.[11]

At the present time, numerous irrigation canals and other diversions withdraw water from the Gila River and its tributaries for irrigation, industrial and municipal uses. Diversions from the Gila for irrigation of about 500 acres occur above Gila, New Mexico (river miles 572.5); 5,000 acres above Redrock, New Mexico (river miles 539.2); 6,200 acres above Blue Creek, near Virden, New Mexico and above Duncan Valley diversions; 14,300 acres above San Francisco River, near Clifton and below Duncan Valley diversions; 17,500 acres plus mining and municipal use above the head of Safford Valley; 69,000 acres plus mining and municipal use above Calva, San Carlos Reservoir and Winkelman; 82,000 acres plus mining and municipal use above Kelvin; up to an additional 100,000 acres for the San Carlos Project diverted at Ashurst-Hayden Dam approximately 7¼miles upstream of Florence; and "large," untabulated diversions above Laveen, Gillespie Dam, Painted Rock Dam and Dome owing to irrigation on the Gila River Indian Reservation and tributary rivers. On the San Carlos River, about 600 acres are irrigated above Peridot. Under the San Carlos Project up to 100,000 acres are irrigated annually. On the San Pedro River, about 10,800 acres were irrigated in Arizona in 1978. On the Santa Cruz River, about 26,000 acres are irrigated above Tucson, while more than 240,000 acres (not including the San Carlos Project) are irrigated above Laveen. On the Salt River system, approximately 3,100 acres are irrigated above Lake Roosevelt on the Salt and its tributaries, while another 12,500 acres are irrigated above Horseshoe Dam on the Verde River; all flows reaching Stewart Mountain Dam (Saguaro Lake) are diverted at Granite Reef Dam either for irrigation in the Salt River Valley or municipal use by the City of Phoenix except in periods of high flood flow. As of 1988, since the dam began regulating flow in 1911, the average discharge for the Salt River below Roosevelt Dam has been 896 cfs. Since 1934, the average discharge below Stewart Mountain Dam to Granite Reef Dam has been 978 cfs, which does not include flow in the Verde River. Since 1961, the average discharge on the Verde River below Bartlett Dam and near the confluence with the Salt River has been 645 cfs. Combined average flow to Granite Reef Dam has been over 1500 cfs since 1961, all diverted for irrigation or municipal use except in cases of high flood flows.[12] On the Agua Fria River, about 600 acres are irrigated above Mayer, while flows impounded in Lake Pleasant behind Waddell Dam are diverted to Beardsley via the Beardsley Canal (approximately 20,000 acre-feet in 1989). There are only small diversions reported on the Hassayampa River. At Gillespie Dam on the Gila River, there are regular diversions into the Enterprise and Gila Bend canals.

The following canals have removed water from the Gila River since U.S.G.S. records have been maintained[13]:

in Duncan Valley, NM-AZ:
- Sunset Canal (diverts flow in New Mexico)
- Cooper-Windham Canal
- Moddle Canal (diverts flow in New Mexico)
- New Model (diverts flow in New Mexico)
- (New Model Canal formerly known as Moddle Canal)
- Shriver Canal (diverts flow in New Mexico)
- (Shriver was combined with Moddle Canal, January 1, 1948)
- Valley Canal (diverts flow in New Mexico)
- Duncan Canal
- Black & McClesky Canal
- Colmenero Canal
- Sexton
- York
- R. Sexton

in Safford Valley, AZ:
- Brown Canal, Solomon, AZ
- Tidwell Canal, Solomon, AZ
- Fourness Canal, Solomon
- Sunset Canal
- San Jose Canal, Solomon
- Montezuma
- Union
- Graham Canal, Safford
- Oregon Canal, Thatcher
- Smithville Canal, Thatcher
- Dodge-Nevada
- Curtis
- Fort Thomas Canal, Ashurst
- Colvin-Jones
- T.D. Burton

near Florence:
- Florence-Casa Grande Canal
- Florence Canal, Florence
- O.T. Canal, Florence
- Pierson-Nicholas Canal, Florence

above Gillespie Dam:
- Gila Bend Canal, Gillespie Dam
- Enterprise Canal, Gillespie Dam

The following canals removed water from the Gila River (or were reported as under construction) prior to Arizona's Statehood:

Upper Gila District (above Florence):

#Cooper(Casper)-Windham Canal (diverts flow in New Mexico)
#Moddle(Model) Canal (diverts flow in New Mexico)
#Shriver(Schriver) Canal (diverts flow in New Mexico)
#Johnson (diverts flow in New Mexico)
#Martin (diverts flow in New Mexico)
#Wilson (diverts flow in New Mexico)
#Hill (diverts flow in New Mexico)
#Rucker (diverts flow in New Mexico)
#Telles (diverts flow in New Mexico)
#Hughes (diverts flow in New Mexico)
#Valley Canal (diverts flow in New Mexico)
#Franklin (diverts flow in New Mexico)
#Waters
#Owen
#Duncan Canal
#Black & McClesky (McCloskey) Canal
#Ward & Courtney
#Day
#Brown Canal
*#San Jose Canal
*#Montezuma
*#Union
#Graham Canal
*#Oregon Canal
*#Smithville Canal
*#Nevada
#Curtis
#Fort Thomas Canal
*#Central Canal
*#Sunflower Canal
*#Gonzales
*#Mejia
*#Maxey
*#Darby
*#Michelana
#Saline
#Mexican
#Lower Thompson
#Upper Thompson
#Reid
#Vogel
#Kempton

#Mathewsville
#Brice
#Dodge
#Union Branch
#Lee
#Old San Jose
#Sanchez
#Enterprise
#Shields
#Winkleman
#Brannaman

Middle Gila District (Florence to Salt mouth):

*Florence Canal
*Moore's
*McClelland
*Sharp
*Stiles
*Swiss
*Brash
*Montezuma
*Pat Holland
*Alamo Amarillo
*Brady
*Adamsville
*White
*Walker & Dempsey

Middle Gila District (on Gila River Indian Reservation):

#Blackwater
#Sacaton Flats, or Hassankoek
#Cottonwoods, or S'oufpack
#Santan
#Lower Santan, or Hirlchirlechirk
#S'totonnick
#Wakey
#Babechirl
#South Sho-otk
#North Sho-otk
#Railroad Crossing, or South Shonnick
#Highland, or North Shonnick

Lower Gila District (below Salt mouth):

*Gila Bend Canal Company
*Enterprise Canal, Gillespie Dam
*Buckeye
*Gila River
*Gould Bros
*Palmer

*Citrus
*Monarch
*Gila River Irrigating Co

Sources:

* Twelfth Annual Report of the United States Geological Survey, 1890-91, pp. 303, 306, 314

Twenty-First Annual Report of the United States Geological Survey, 1899-1900, pp. 335-6, 340-1, 356-7

The following canals currently exist to divert flow from the Gila River (not all canals are active at this time):

(The Gila Water Commissioner was first appointed by the United States District Court for Arizona effective January 1, 1936, following the *Gila River Decree*, which affirmed diversion priorities.)

in Duncan Valley, NM-AZ:

*Sunset Canal (diverts flow in New Mexico)
*New Model (diverts flow in New Mexico)
*Valley Canal (diverts flow in New Mexico)
*Duncan Canal
*Black & McClesky Canal
*Colmenero Canal
*Albert
*Sexton
*York
*R. Sexton

in Safford Valley, AZ:

*Consolidated Brown Canal (formerly Brown Canal)
*Tidwell Canal (formerly Michelana Canal)
(combined with Brown Canal after March 1, 1976)
*Fourness Canal
*San Jose Canal
*Montezuma
*Union
*Graham Canal
*Smithville Canal
*Dodge-Nevada
*Curtis
*Fort Thomas Canal
*Colvin-Jones
*T.D. Burton

near Florence:

*Florence-Casa Grande Canal

above Gillespie Dam:

*Gila Bend Canal, Gillespie Dam
*Enterprise Canal, Gillespie Dam

Source:

* USGS Water-Resources Data for Arizona, AZ-80-1

The average annual diversions for reaches along the Gila River are as follows:

Location	Acre-feet diverted	Average cfs diverted
in Duncan Valley (above Clifton)	25529	35.3
in Safford Valley (above Solomon)	3309	4.6
in Safford Valley (above Calva)	109272	150.9
@ Ashurst-Hayden Dam (above Florence)	230088	317.8
above Gillespie Dam	46205	63.8

The cumulative average annual diversions for reaches along the Gila River are as follows:

Location	Acre-feet diverted	Average cfs diverted
in Duncan Valley (above Clifton)	25529	35.3
in Safford Valley (above Solomon)	28838	39.9
in Safford Valley (above Calva)	138110	190.8
@ Ashurst-Hayden Dam (above Florence)	368198	508.6
above Gillespie Dam	414403	572.4

Sources:

USGS Water Supply Papers Number 1313
USGS Water Supply Papers Number 1733
USGS Water Supply Papers Number 1926
USGS Water Supply Papers Number 2126
USGS Water Resources Data for Arizona, AZ-71-1
USGS Water Resources Data for Arizona, AZ-72-1
USGS Water Resources Data for Arizona, AZ-73-1
USGS Water Resources Data for Arizona, AZ-74-1
USGS Water Resources Data for Arizona, AZ-75-1
USGS Water Resources Data for Arizona, AZ-76-1
USGS Water Resources Data for Arizona, AZ-77-1
USGS Water Resources Data for Arizona, AZ-78-1
USGS Water Resources Data for Arizona, AZ-79-1
USGS Water Resources Data for Arizona, AZ-80-1

The following canals have existed to divert flow from the Gila River since Statehood (not all canals are active at this time):

in Duncan Valley, NM-AZ [1]:

*Sunset Canal (diverts flow in New Mexico)
*New Model (diverts flow in New Mexico)
*Shriver (combined with Moddle Canal January 1, 1948)
*Valley Canal (diverts flow in New Mexico)
*Duncan Canal
*Black & McClesky Canal
*Colmenero Canal
@Albert
*Sexton
*York
*R. Sexton

in Safford Valley, AZ [1]:

*Brown Canal (Consolidated Brown Canal after March 1, 1976)
*Tidwell Canal (formerly Michelana Canal; combined with Brown Canal after March 1, 1976)
*Fourness Canal
*San Jose Canal
*Montezuma
*Union
*Graham Canal
*Smithville Canal
*Dodge-Nevada
*Curtis
*Fort Thomas Canal
*Colvin-Jones
#T.D. Burton

near Florence:

*Florence-Casa Grande Canal
*Florence Canal
*O.T. Canal
*Pierson-Nicholas Canal

above Gillespie Dam:

*Gila Bend Canal, Gillespie Dam
*Enterprise Canal, Gillespie Dam

[1] USGS WSP 1049, p. 173 and *The United States of America v. Gila Valley Irrigation District, et.al.*, June 29, 1935; The Gila Water Commissioner was first appointed by the United States District Court for Arizona effective January 1, 1936, following the *Gila River Decree*, which affirmed diversion priorities.

Sources:

* USGS Water Supply Paper 1313
# USGS Water Supply Paper 1926
@ USGS Water Resources Data for Arizona AZ-73-1

Dams

Dams and irrigation diversions located on the Gila River and other rivers have affected flow within the Gila River since before the turn of the century.

At this time there are four major dams operating along the Gila River within the limits of the study area. These are Coolidge Dam, Ashurst-Hayden Dam, Gillespie Dam and Painted Rock Dam. Also on the river, but just upstream of the study area, is San Jose Canal diversion dam.

Coolidge Dam and San Carlos Reservoir are located in the SW¼Section 17, Township 3 South, Range 18 East, latitude 33°-10'-10", longitude 110°-31'-50" and approximately 18 miles northeast of Winkelman, Gila County. The dam was completed October 25, 1928, and has regulated flow since November 15, 1928. Coolidge Dam impounds Gila River flows in San Carlos Reservoir. The Gila River has an estimated drainage area of 12,886 square miles at this location. The current estimated usable capacity of the reservoir is 866,600 to 1,073,600 acre-feet between elevations of 2382.63 feet (the sill of the lowest outlet gate) and 2510.4 feet (the revised crest of the spillway). The maximum recorded storage of the reservoir is 1,090,000 acre-feet, which occurred from February 26 to March 6, 1980. Due to sediment, which has accumulated since the dam's completion in 1928, there is no dead storage behind the dam at this time. The reservoir stores water for irrigation of approximately 100,000 acres of crop lands in the San Carlos Project, and is also used for power development dependent on irrigation demands. In the late 1970's, the Bureau of Reclamation performed a safety evaluation of Coolidge Dam at the request of the Bureau of Indian Affairs, which owns and operates the dam. The evaluation revealed safety deficiencies related to the dam's inability to pass a Probable Maximum Flood (PMF), and a deterioration of the dam's outlet works and penstocks. Another Reclamation report in mid-1989 identified a "significant failure potential" related to a PMF due to overloaded spillways and dam overtopping. The Bureau of Reclamation indicates that repair construction is approximately six months to one year behind schedule due to delays related to the excessive runoff of late 1992 and early 1993.[14]

Ashurst-Hayden Dam is located in the SW¼NW¼Section 8, Township 4 South, Range 11 East, latitude 33°-06'-00", longitude 111°-14'-50" and approximately 9 miles east of Florence, Pinal County. The dam has been operational since July 1923. The Gila River has an estimated drainage area of 18,305 square miles at this location. There is a diversion for the Florence-Casa Grande irrigation canal at the dam, with four sluice gates in the dam with top of opening at 6.5 feet below the crest of the

dam. The crest of the dam is at elevation of 1583.0 (mean sea level). Flow to the dam is partly regulated by storage in San Carlos Reservoir.

Gillespie Dam[1] is located in the SE¼NE¼Section 28, Township 2 South, Range 5 West, latitude 36°-13'-45", longitude 112°-46'-00" and approximately 6 miles south of Arlington, Maricopa County and 8 miles downstream from the Hassayampa River. The Gila River has an estimated drainage area of 49,650 square miles at this location. There are diversions for the Enterprise and Gila Bend irrigation canals at Gillespie Dam. The dam has been operational since August 1921. The maximum recorded discharge at this location was 178,000 cfs, recorded February 16, 1980; the maximum ~~estimated~~ discharge (outside of period of record), at this location was 250,000 cfs, which occurred during February 1891. The average discharge of the river above diversions at the dam for the 56 year period of record is 391 cfs.

Painted Rock Dam and Reservoir are located in the SE¼Section 18, Township 4 South, Range 7 West, latitude 33°-04'-30", longitude 113°-00'-50" and approximately 19 miles northeast of Sentinel, Maricopa County. The Gila River has an estimated drainage area of 50,910 square miles at this location. The dam has been operational since October 1959. There are no diversions for irrigation at this location, although there are many diversions above the dam for irrigation. Flow above dam is regulated by many reservoirs, including: Painted Rock, San Carlos, Bartlett and Horseshoe on the Verde River; Lake Pleasant on the Agua Fria River and Saguaro; Canyon, Apache and Theodore Roosevelt Lakes on the Salt River. The largest of these is Painted Rock Reservoir, which has an estimated capacity of 2,492,000 acre-feet for control of flood runoff. The maximum recorded discharge at this location was 9,190 cfs, which occurred on May 3, 1983.

On the Salt River, the combined capacity of Saguaro Lake, Canyon Lake, Apache Lake and Theodore Roosevelt Lake reservoirs is an estimated 1,755,000 acre-feet, on the Verde River, the combined capacity of Bartlett Lake and Horseshoe Lake reservoirs is an estimated 317,700 acre-feet, and on the Agua Fria River, the capacity of Lake Pleasant is estimated at 157,600 acre-feet.

United States Geological Survey records report that local farmers have been removing water from the Gila since at least 1889. At that time nearly 450 miles of ditches delivered water for irrigation to over 220,000 acres along the Gila.[13] A list of these ditches is attached at the end of this section. Over 20 canals remove water from the Gila at this time, serving over 100,000 acres of crop land.[15]

Upstream of the study area is San Jose Canal diversion dam, which is located in the SE¼Section 36, Township 6 South, Range 27 East, latitude 32°-51'-40", longitude 109°-32'-30" and about 5 miles northeast of Solomon.

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[1] Gillespie Dam breached in the 1993 flood and has not yet been repaired.

NOTES ON SOURCES:

Information related to irrigation canal flows and dams along the Gila River has been primarily obtained from the Twelfth Annual Report of the United States Geological Survey, 1890-91; United States Geological Survey Water Supply Papers Number 1313, 1733, 1926 and 2126, and United States Geological States Water-Resources Data Reports AZ-71-1 through AZ-80-1 (in cooperation with Arizona Department of Water Resources).

1 Twelfth Annual Report of the United States Geological Survey, 1890-91, Part II -- Irrigation, p. 302
2 ibid., p. 305
3 ibid., p. 314
4 ibid., pp. 302-3
5 ibid., pp. 309-10
6 ibid., pp. 310-1
7 ibid., pp. 311-3
8 ibid., p. 315
9 ibid., p. 315
10 ibid., pp. 315-6
11 "Water Service Organizations in Arizona," p. 124, Arizona Department of Water Resources, April 1991, Phoenix
12 U.S.G.S. Water-Data Report AZ-89-1, pp. 135-267
13 U.S.G.S. Water Supply Paper Number 1313, p. 595
14 "Coolidge Dam Rehabilitation Fact Sheet," Bureau of Reclamation, undated
15 Twelfth Annual Report of the United States Geological Survey, 1890-1891, Part II -- Irrigation, pp. 302-3, 305-9, 314

D. Regional Transportation

1. Railroads

Southern Pacific Railroad Company entered the State from the west through Yuma. During the summer of 1877 work gangs constructed the first bridge across the Colorado River, spanning 667 feet. On September 29, 1877 construction was halted based on orders by the Secretary of War. Until the proper paperwork was completed and authorization was granted, the railroad was not to lay its rails and bridge the Colorado, a federal stream. Work was halted under the watchful eye of the Fort Yuma garrison. Before midnight the railroad began laying track across the bridge and around sunrise work was complete and the first locomotive rolled into Yuma. By May 19, 1879 work had progressed to Casa Grande. Following a temporary suspension, construction resumed, reaching Tucson by March 1880.

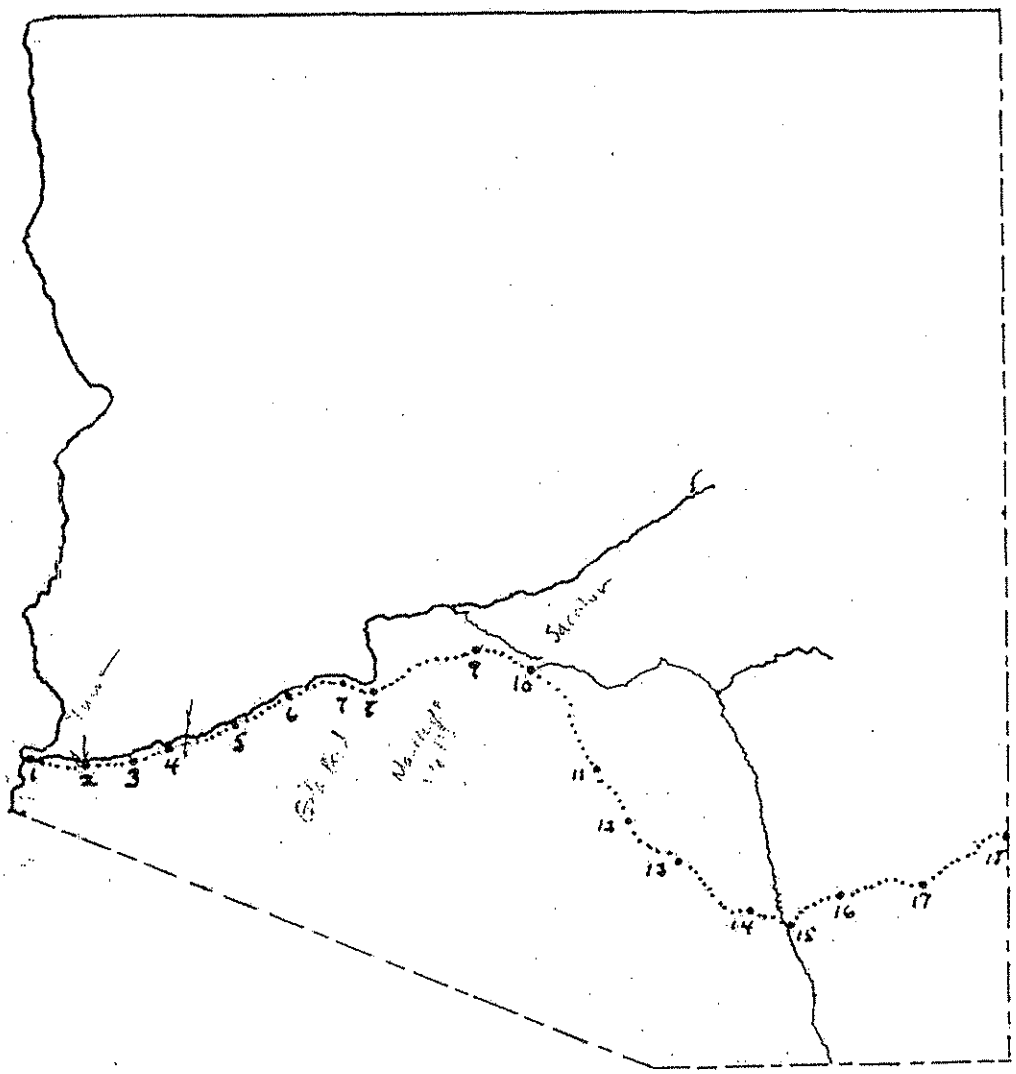
2. Stage Lines

The San Antonio and San Diego Mail Line (or Mail Route 8076) was established by James Birch in 1857 in response to a need for reliable mail delivery to the Pacific Coast which would not be routed on a turn-around through Saint Joseph, Missouri. The Arizona portion of the route included legs through Tucson, the Pima Villages (near Sacaton) and Yuma. The route was authorized to commence July 1, 1857 on a semi-monthly basis. The contract was amended on September 10, 1858 when it conflicted with the Butterfield Overland Mail.

The Butterfield Overland Mail (Route 12587) was established on September 16, 1857 and commenced one year later. The route was semi-weekly and replaced the portion of the San Antonio-San Diego Mail lying between El Paso and Yuma. The service was suitable for transporting passengers. This service was discontinued in March 1861. The attached map at the end of Section D displays the route and stations within Arizona. The Mileage Table following the map indicates the approximate distance from station to station as reported to the Postmaster General. From March 1861 through 1865 (1866?), no mail service other than courier or individual existed in Arizona. The Civil War was the apparent cause.

In 1867, service was re-established along the old Butterfield route by an unnamed company. The Texas and California State Company commenced operation in 1875. By 1879 several local stage lines operated within the Arizona Territory.

(Source: Overland Butterfield Mail Across Arizona, Arizona Pioneers' Historical Society Tract)



EASTBOUND BUTTERFIELD OVERLAND MAIL ROUTE
ACROSS ARIZONA

	Miles		*Miles*
1—Yuma		10—Sacaton	22
2—Swiveller's Ranch	20	11—Picacho Pass	37
3—Filibuster Camp	18	12—Point of Mountain	22
4—Peterman's	19	13—Tucson	18
5—Stanwix		14—Cienega	35
6—Oatman Flat	47	15—San Pedro River (Benson)	24
7—Murderer's Grave	20	16—Dragoon Springs	23
8—Gila Ranch (Gila Bend)	17	17—Apache Pass	40
		18—Stein's Pass	35
Total across Arizona			437

FIGURE 15. MAIL ROUTE

MILEAGE TABLE ACROSS ARIZONA OF THE FIRST EASTBOUND BUTTERFIELD STAGE FROM SAN FRANCISCO

Bailey — Special agent

Report to Hon. A. V. Brown, postmaster general, accompanied first Overland Mail to east.

Fort Yuma to:

Swiveller's Ranch	20	miles
*Filibuster Camp	18	"
Peterman's	19	"
Griswell's	12	"
Flap-jack Ranch	15	"
Oatman Flat	20	"
Murderers' Grave	20	"
Gila Ranch	17	"
Maricopa Wells	40	"
Sacaton	22	"
Picacho del Tucson	37	"
Pointer Mountain (Charcos de los Pimos)	22	"
Tucson	18	"
Total	280	miles

Tucson to:

Cienega de los Pimas	35	miles
San Pedro River	24	"
Dragoon Springs	23	"
Apache Pass (Puerto del Dado)	40	"
Stein's Pass	35	"

(No water except at stations)

Total	157	miles
Across Arizona	437	miles

Approximate distance

St. Louis to San Francisco	2800	miles
Contract time	25	days

Average speed approximately .....5 miles per hour
Left San Francisco, 12:10 a.m., September 14, 1858
In Tucson .....September 25,1858
Arrived Tipton, Mo., 9:05 a.m., October 9, 1858

*(*Crabb's Filibustering Expedition into Sonora*, 1857, started from here).

From the

DECENNIAL CENSUS 1860

Territory of New Mexico, County of Arizona

Aggregate population 6,482

Names with probable connection with Overland Mail, Arizona City, Territory of New Mexico and Ft. Yuma, Colorado Township, California.

Name	*Age*	*Sex*	*Occupation*	*Property Value*	*Place of Birth*
Andrews, George	26	M	Mail Conductor		New York
Baker, Andrew	32	M	Stage Driver		" "
Brewer, Louis	35	M	Mail Conductor		Maryland
Doran, Hugh	28	M	Mail Conductor		New York
Doten, James	42	M	Coach Maker		Sonora, Mex.
Doten, Rose	25	F		1,000	Massachusetts
Doten, Adele	2	F			California
Doten, Mary	4/12	F			"
Hosmer, Newell	30	M	Stage Driver		New York
Jacobs, George W.	38	M	Overland Mail Agent		
Lloyd, John	37	M	Mail Conductor		" "
McTurk, John	35	M	Mail Conductor		" "
Parks, Oliver M.	40	M	Stage Driver		" "
Stafford, Henry	33	M	Stage Driver		Pennsylvania
Stevens, Edward C.	32	M	Overland Mail Agent	7,200	New York
Tyler, Smith	32	M	Mail Conductor		New York
Weld, Benjamin G.	24	M	Driver	10,000	Maine
GILA CITY (Ft. Yuma)					
Baine, Josiah	33	M	Stage Driver		Maine
Neeley, Sam	30	M	Stage Driver		Tennessee
Great Overland Mail Stations between Pima Villages and Gila City (Post Office, Gila City)					
Safford, Henry	26	M	Stage Driver	2,000	Pennsylvania
40 names, mostly farmers, hostlers, teamsters, machinists, one lawyer, 2 sailors, miners					
Frame, Geo. Craton	34	M	Owned Station, Gila Bend		Ohio
Great Overland Mail Stations between Tucson and the Pima Villages (Post Office, Tucson)					
Hooker, Van	26	M	Stage Driver		Virginia
33 names, several hostlers and teamsters.					
PIMA VILLAGES					
25 names — blacksmiths, hostlers, teamsters.					
TUCSON					
Bartlett, P. M.	28	M	Stage Driver		Tennessee
Hitchings, Jepe	30	M	" "		New York
Lyon, King	24	M	" "		" "
Quin, John	24	M	" "		" "
Smith, James	25	M	" "		" "
Wallace, James F.	32	M	" "		Massachusetts

CHAPTER V

Oral Histories and Interviews

A. Sources

Oral histories and Interviews were discovered in the Arizona State University Library (Arizona Collection), Yuma (Arizona Historical Society) and various locations along the river. Complete copies of the histories and interviews are included in Appendix D.

B. Discussion

Following are excerpts of those oral histories and interviews which have to date been discovered during research along the Gila River. It is not felt that this is a complete index of existing oral histories or possible interviews, nor is this presented as such.

Donald Clyde Pace (interviewed by Kristina Minister, May 6, 1982, Arizona Oral History Project):

(pp.17-8) M: "Can you tell us what the occupations of most of these people (near Solomonville, Safford and Thatcher) was?"

P: "Well, all right, the people came in from Utah and other places, Alabama and one place or another. They settled in Pima first, then came up to Central and then they settled across the river ... I remember one of them telling me that they got down to the Gila River, and it was flooding, and they couldn't get across ..."
(pp.77-9)

M: "Were there speeches that were made, plays?"

P: "Yes, and ... I remember taking the team and wagon and going out to the reservoir to go swimming for Easter ... We rode the flume. The flume ran from the sawmill down to the foot of the mountain. They would saw the timber on the mountain and then put it in this flume ..."

Ralph W. Bilby, Sr. (interviewed by Kristina Minister, March 17, 1982, Arizona Oral History Project)

(pp.4-5) B: "... We went right down the Blue River into Clifton. We must have crossed that river a hundred times. It was not a big stream. It'd be knee deep for the horses ... I remember we got down to Solomonville -- or right near Solomonville where the Gila River comes into the Gila Valley there -- on the first day of June, 1890 ..."

Laura Killman (interviewed by Carol Brooks, March 1, 1990, Wellton Library District records), occurrences in the vicinity of Dome

(pp.1-2) B: "Laura, tell us about where you were born and when, and about your family."

K: "... my Dad went to Camp Verde ... which was in 1916 ... It's a little hill across the river from Wellton ... and they loaded Grandpa in there and they headed for Wellton and crossed the river ... it was probably, oh ---- three, four hundred yards down to the river bank, and down at the river bank, then, where the main Gila River hit, it came in and hit the side of this little mountain and it kept, there was a big hole of water there all the time, because there was no dams up the river and the water, the river ran all the time. We had to cross the ferry at Dome to get out here ..."

(p.6) B: "How long did it take you to get into town?"

K: "... The road was rough --- deep ruts, and we crossed the ferry at Dome --- a little Mexican by the name of Juan Nunez poled the ferry across --- he had one arm off right here, and he would put the pole under his arm and then pole the ferry back and forth across, and my Daddy said the first year that we were out here, it cost him $250.00 in ferry crossing. Every time we crossed, it was $2.50. And we had to ship our feed out on the car --- box car, to Dome ..."

(p.8) B: "How did people find out about the Springs."

K: "Just word of mouth ... There was one old --- two Frenchmen ... they met this old Indian some place and he told them that, if they would come to Yuma and come up the river from Yuma, he didn't know how many miles ..."

(p.10) B: "What kind of problems did people out here face as they started growing crops?"

K: "Well, when they commenced puttin' in the dams up above, then they dried us up completely."

(p.11) B: "When did they start that (the Mohawk Municipal Water Conservation District)?"

K: "Oh, it must have been in the middle twenties because by that time the railroad was coming through ... as the river dried up, the dams up above dried the river up ..."

(p.14) B: "You said you watched them building the bridge. Which bridge was that?"

K: "The Antelope bridge, I mean, the railroad bridge ... And the river still ran a couple of times enough that it would --- they had a little spur line across down, just below the big bridge that they was workin' on and they would haul some of their equipment

across it, and the river washed it down one time --- washed it out and they had to rebuild it and all that stuff, but that must have been in --- they began working on that in '24, I think is when they started workin' on that railroad bridge."

Daniel Wilford Colvin (statement September 6, 1993)

"As a child of eight years of age before Statehood in 1911 until I was grown, I spent many hours swimming and playing in the Gila River which was located about one half mile from my home in Eden, Arizona ... As a boy, I would float down the river on a log when there was enough water in the river to do so ... As a boy, I saw no commercial use of the Gila River between San Jose and Sunnyside. The bigest [sic] reason was the diversion dams. The second bigest [sic] reason was the lack of water. During the dry months of the year, the river would dry up and leave only sand and gravel in the river bed just as it does today. The only boat that I ever saw on the river was the hand made boat of David Colvin's. He used the boat one year during a flood to ford the river. He had to haul the boat up the river whenever he wanted to cross ... During a flood, people on the North side of the river would cross either by swimming or on horse back, but they did not do it very often. It wasn't until 1915 that the first bridge was built in Bryce. It made the crossing much easier ... In my 90 years of living in Eden, I have seen a lot of things but the use of the Gila River for navigation was not one of them. Commercial fishing for Razorback Sucker fish was another thing that did not happen in the area where I grew up ..."

LaVena Coffen (interviewed by Carol Brooks, June 11, 1987)

(p.2) C: "When did they (your parents) first come to Yuma?"

L: "In 1906. Down at the old depot. That I can remember because I wanted my little red hat so bad in the morning so I could see the bridge open, when the boats would start out in the morning and they never did and I always regretted that..."

(pp.2-4) C: "Which block of Main Street?"

L: "... Well, that's where it was. Right there. The old school was there and then the theater. The theater must have been built in 1910, 1911 or 1912. They had that in the paper wrong because they said it was 1915 or 1916 but I think it's because it went down in the 1916 flood and then redone ... When we left Main Street, was when the land open out at Dome. That open up in 1914. Papa never would stay at anyone's farm long enough to ... I guess he was used to going along with the railroad from pillar to post, but anyway, he went out there to sell land, like McCune did, but the first year, they had a big flood and water was from mountain to mountain out there ... Evidently, the river bed had been up there at one time and oh! that water was high! I think it was Christmas Day and that water was coming down there in torrents, with trees and everything and papa built a boat. And he told my mother, "Etta, when the water gets up to our door sill, we're getting out of here!" With a boat that he had just built, I don't think we'd ever have made it ... But darned if that water didn't come up to our door sill and start to recede. So, we got through that. Then, we moved across

the river and papa built up high, next to the railroad track. That was in 1915. Then, we had another flood with the water up the mountain ..."

Mrs. Hazel Shepard, Florence (interviewed by James Latham, September 16, 1993)
Summary: Mrs. Shepard lived with her family in Phoenix and her father worked as a carpenter in Florence. During the flood of 1915, it was necessary for her father to be transported across the Gila River by boat. The boat landing was about ½mile upstream of Florence, the boats were put in the river, would catch the current and cross to the other side. These boats were used to carry not only passengers, but lumber and other supplies. The boats were small wooden, flat bottomed, rowed by two men. Mrs. Shepard recalls seeing Indians crossing the Gila River in boats in the area of Ashurst-Hayden dam in the 1920s.

Mr. Juan Gutierrez, Florence (interviewed by James Latham, September 16, 1993)
Juan Gutierrez, 89 years old, has lived in Florence since the age of 13. He states that his father worked on the boats ferrying passengers and supplies across the Gila river in 1917. The boats were small rowboats, a fee was charged to cross and the boat landing was at the extension of Main Street in Florence.

Ms. Violet White, Florence (telephone interview by James Latham, September 16, 1993)

Ms. White recalls small boats being used to transport passengers and supplies for a fee across the Gila River at Florence around 1916-1917.

CHAPTER VI

Hydrology

A. Introduction

Since the late nineteenth century two distinct actions have combined to change the nature of flow in the Gila River: 1) Indian populations initially (and apparently well before the 19th century) and subsequently Anglo-European settlers withdrew water from the Gila to irrigate crops at various locations; and, 2) water conservation and flood control dams have been constructed to regulate flow. Numerous pioneer accounts have related the fact that Indian cultures had been, apparently, withdrawing water from the Gila, most notably the Pimas near modern day Sacaton.

A paper written by Joseph Barlow Lippincott for the United States Geologic Survey (U.S.G.S.), and published in 1900, took note of the Pima's irrigation history and cautioned that construction of proposed diversion structures near and upstream of Safford would put the Pima's agriculture at risk. This would only serve to aggravate a shortage which commenced around 1886 following the construction of a diversion dam (Ashurst-Hayden) and irrigation canal (Florence Canal) by the Florence Canal Company, approximately 15 miles upstream of the Gila River Indian Reservation.[1]

Since that time additional diversion and storage dams have been constructed and, as U.S.G.S. Water Supply Papers indicate, irrigation canals were constructed near Safford, Arizona as early as water year 1914; near Virden, NM, Duncan, AZ, Thatcher, AZ, and Ashurst, AZ, as early as water year 1915; and at Gillespie Dam as early as water year 1935.[2] Additionally, Gillespie Dam was completed in 1924, Coolidge Dam was completed in 1928, and Painted Rock Dam was completed in 1959. Irrigation ditches, however, were pulling water out of the Gila near Safford, Florence, Buckeye, Gillespie Dam and Gila Bend as early as 1890.[3]

The total area of the Gila Basin is estimated at 66,020 square miles. It includes the greater portion of southern Arizona, a small portion of western New Mexico and a portion of Sonora, Mexico. The Gila River rises in southwestern New Mexico and has a general southwesterly direction until it enters Arizona about 3½ miles southeast of Duncan, where it turns northwest. Its principal sources of supply are from the Black Range on the east, and from a number of ranges on the west, including Little Range, Mogollon Range, and Diablo Range. The average elevation of these mountain peaks is from 9,000 to 10,000 feet. The general character of the country is a high and rolling plateau, with the river flowing through it in a deep canyon, and with practically no agricultural lands within its area. The river emerges from its upper canyon about 10 miles before it reaches the Arizona line, and then flows northwest through the Duncan Valley, until just before it receives the waters of the San Francisco River. Duncan Valley contains a number of canals which divert water for irrigation purposes.

The Gila River then flows southwest in canyon for about 20 miles below the mouth of the San Francisco, or to within 10 miles of Solomon. At this point the hills separate, forming a large valley, Safford Valley, which is extensively populated and is one of the finest irrigated portions of the State. This valley extends northwest from a point 10 miles above Solomon to a point about six miles below the mouth of San Carlos River on the San Carlos Indian Reservation. At this latter place the mountains suddenly close in again, and the river enters a box canyon with a width of 100 feet. Coolidge Dam is located at this point.[4]

The river remains in a southwesterly canyon from a short distance just below the Coolidge Dam, to about one mile above the mouth of the San Pedro River at Winkelman/Hayden. The country then broadens into an unnamed valley of considerable size, extending northwest for a distance of about 20 miles from Hayden, past Kearny, to below the mouth of Mineral Creek. From the mouth of Mineral Creek the river flows west in canyon again until North and South Buttes are reached, a distance of about 15 miles, where the river opens onto the plains region of south-central Arizona.[5] It then winds northwest for about 75 miles before receiving the waters of the Salt River southwest of Phoenix. From there, the Gila turns west, receives the waters of the Agua Fria River about three miles downstream of the Salt, and continues west through the Buckeye Valley for about 25 miles before reaching the Arlington Valley, where it receives the waters of the Hassayampa River. From here the river flows south through an unnamed valley for about 25 miles to Gila Bend and enters the Citrus Valley. The river passes through the Gila Bend Indian Reservation and Painted Rock Reservoir and flows northwest to the Painted Rock Dam at the mouth of the Gila River Canyon which lies between the Gila Bend Mountains and Painted Rock Mountains. The river then opens into Dendora Valley and flows southwest for about 10 miles before reaching the Oatman Flat and briefly contracting. It then enters Hyder Valley on the Sentinel Plain and winds southwest for about 25 miles to the San Cristobal Valley near Horn, continues southwest for about 10 miles and enters the Mohawk Valley at Texas Hill. The river continues west-southwest for about 30 miles through the Mohawk Valley past Wellton, turns northwest into Dome Valley for about 15 miles, and enters a brief contraction between the Dome Mountains and the Laguna Mountains before opening onto the North Gila Valley about 10 miles east of Yuma. The river then flows west to its confluence with the Colorado River about four miles east of Yuma.

The principal tributaries of the Gila are the San Francisco, Salt, Agua Fria and Hassayampa rivers from the north, and the San Pedro and Santa Cruz rivers from the south.

The San Francisco River, the principal tributary of the upper Gila River, rises in the southeastern part of Apache County, near the town of Alpine and passes into the southwestern part of Socorro County, New Mexico within a distance of about 15 miles. In this reach the river drains about 75 square miles in Arizona. Its course through New Mexico is southerly, with the river returning to Arizona near latitude 33°

North into Graham County. The river courses through a succession of canyons alternating with short valley openings, with an average fall of about 35 to 40 feet per mile.[6] The San Francisco River joins with the Gila about six miles southwest of Clifton.[7] The basin comprises approximately 2800 square miles, of which 1800 square miles are in New Mexico and 1,000 in Arizona.[8]

The San Pedro River rises in the northern part of the State of Sonora, Mexico, flows northward for more than 100 miles, and empties into the Gila below the town of Hayden, 45 miles above Florence. Rising in a country of very light snowfall, the river depends for the greater part of its water supply on the frequent showers of the rainy seasons. It flows over a sandy bed between high, steep banks, and during the dry season, it shrinks to an insignificant stream of clear water, which rises and sinks in the sand with the varying depth of bed rock.[9]

The Salt River, though considered a tributary of the Gila, is in fact larger both in catchment area and in discharge. It receives the drainage from central Arizona, and its principal tributary, the Verde, flows southeasterly and south from the mountains and table-lands south of the Colorado River. The Verde Valley is situated in Yavapai County, on the headwaters of the stream, and extends from a canyon above Camp Verde to a point about 10 miles below. About a mile above the junction of the Verde and 30 miles above Phoenix, the Salt enters the plains of the Salt River Valley.[10]

The floods of the upper Gila and its tributaries are usually short and violent, occurring during the months of January and February, although prolonged above-average flows often occur late winter and spring. The season of low water occurs in June and July. The average annual precipitation over the greater part of the tributary drainage area of Gila and San Francisco rivers in New Mexico is between 10 and 15 inches and in the high mountains of the headwater region it rises above 20 inches. The winters are mild except in the mountainous sections, and very little ice forms on the rivers.[11]

The drainage basin of the Gila includes 7,000 square miles of timberland, 11,000 square miles of woodland, 45,000 square miles of land upon which there is no timber, 1,300 square miles of scattered timber, and 300 square miles of open land.[11]

Irrigation in New Mexico is confined chiefly to the bottom lands along the main streams and their tributaries, and the total area irrigated comprises only a few thousand acres.[11] Irrigation in Arizona occurs in the Duncan Valley, the Safford Valley, on the plains west of Hayden to Phoenix, in the Buckeye Valley west of Phoenix, south of Gillespie Dam to Gila Bend, in Dendora Valley west of Gila Bend, and in the Wellton-Mohawk Valley east of Yuma, although the Wellton-Mohawk area is now irrigated by waters from the Colorado River. Irrigation also occurs on many of the Gila tributaries, including the San Francisco River (many diversions above Clifton), the San Pedro River (at its mouth at Winkelman and many small diversions upstream), the Santa Cruz River (many small diversions above Laveen upstream to above Nogales), the Verde River (near Fort McDowell and many small diversions above Bartlett Reservoir), the Salt River (at Granite Reef Dam), the Agua Fria River

(above Lake Pleasant and many small diversions upstream) and the Hassayampa River (many small diversions above Morristown).[12]

Additionally, irrigation occurs on both the San Carlos and Gila River Indian Reservations. Irrigated lands on the Gila River in Arizona total between 100,000 and 200,000 acres of privately held lands, and up to 100,000 acres of Indian Reservation lands.

B. Streamflow Records

The best apparent source of information relating to stream flow is the gauge records maintained by the U.S.G.S. The U.S.G.S. has been in existence since approximately 1879, and a review of the U.S.G.S. Annual Reports and Water Supply Papers indicates the U.S.G.S. has been studying the Gila River drainage basin since 1888 when the Survey began establishing gauging stations on numerous rivers around the country including the Gila, Salt and Verde Rivers in Arizona. The first Gila River gauge was established in 1889 approximately 14 miles upstream of Florence at a location referred to as 'The Buttes,' and was driven directly into the river bed.[13] This gauge proved to be unworkable and was replaced. Record flows for the current gauge stations (following statehood) are reported in U.S. Geological Survey Water Date Report AZ-91-1 (see Appendix E).

B.1. Pre-1912

A. The gauging station at Dome was initially established by the United States Geological Survey in 1903, and is located at latitude 32° 45' 39" north, longitude 114° 25' 11" west in the SW1/4 Section 4, Township 8 South, Range 21 West. This station is identified as number 09520500 by the Geological Survey. The current stream gauge is a water-stage recorder and records at the station are considered poor by the Geological Survey, in part due to the many diversions above the station for irrigation.

Early Geological Survey gauge records at this station consist of gauge height, rating curve and sporadic discharge records. The initial daily average, monthly average and peak discharge records were recorded and reported in January, 1903. During the period prior to Statehood the average monthly flow was 1,277 cfs and the maximum recorded flow was 95,000 cfs which occurred on March 20, 1905 and on November 29, 1905 (U.S.G.S. Water Supply Paper 1683, Appendix E).

B. The gauging station at the Buttes dam site was initially established by the United States Geological Survey in 1889 and is located at latitude 33° 05' 30" north, longitude 111° 11' 30" west in the SW1/4 Section 11, Township 4 South, Range 11 East. The station was discontinued in 1899. Up to that time the Buttes site had been under consideration as a reservoir, but it was superseded by the San Carlos site.

Early Geological Survey gauge records at this station consist of gauge height, rating curve and sporadic discharge records. The initial daily average, monthly average and peak discharge records were recorded and reported in August, 1889. During the period prior to Statehood, the average monthly flow was 630.2 cfs and the maximum recorded flow was 102,000 cfs which occurred on February 22, 1891.

C. The gauging station at Kelvin was initially established by the United States Geological Survey in 1911 and is located at latitude 33° 06' 10" north, longitude 111° 58' 33" west in the NE1/4 NW1/4 Section 12, Township 4 South, Range 13 East. The station is identified as number 09474000 by the Geological Survey. The current stream gauge is a water-state recorder-type gauge and records at the station are considered good by the Geological Survey. [WSP 1683]

Early Geological Survey gauge records at this station consist of gauge height, rating curve and sporadic discharge records. The initial daily average, monthly average and peak discharge records were recorded and reported in January, 1911. During the period prior to Statehood the average monthly flow was 739.4 cfs, and the maximum estimated flow was 190,000 cfs, which occurred on November 28, 1905 (see U.S.G.S. Water Supply Pater 1683, Appendix E).

D. The gauging station at San Carlos/Coolidge Dam was initially established by the United States Geological Survey in 1899, and is located at latitude 33° 10'" north, longitude 110° 31' 50" west in the SW1/4 Section 17, Township 3 South, Range 18 East. The station was relocated approximately one mile upstream in 1910. The station is identified as number 09469500 by the Geological Survey. The current stream gauge is a water-stage recorder-type gauge and records at the station are considered excellent for flows above 5 cfs, which are considered fair by the Geological Survey.

Early Geological Survey gauge records at this station consist of gauge height, rating curve and sporadic discharge records. The initial daily average, monthly average and peak discharge records were recorded and reported in 1899. During the period prior to Statehood, the average monthly flow was 272 cfs and the maximum estimated flow was 150,000 cfs, which occurred on November 28, 1905 (see U.S.G.S. Water Supply Paper 1683, Appendix E).

B.2. Following Statehood (February 14, 1912)

A. The gauging station at Dome was initially established by the United States Geological Survey in 1903 and is located at latitude 32° 45' 39" north, longitude 114° 25' 11" west in the SW1/4 Section 4, Township 8 South, Range 21 West. The station is identified as number 09520500 by the Geological Survey. The current stream gauge is a water-stage recorder-type gauge and records at the station are considered poor by the Geological Survey, in part due to the many diversions above the station for irrigation.

Geological Survey gauge records at this station consist of gauge height, rating curve, daily mean, monthly mean and instantaneous peak discharge records. Daily average, monthly average and peak discharge records were recorded and reported for the period 1903 to 1991, with a break in the record for the years 1917 to 1928. During the record period the average monthly flow was 455 cfs, and the maximum estimated flow was 200,000 cfs which occurred on January 22, 1916.

B. The gauging station near Sentinel was first established by the United States Geological Survey on December 17, 1912 and was located in Section 10, Township 8 South, Range 9 West above the diversion dam of the Southwestern Fruit & Irrigation Company. The gauge was destroyed June 2, 1913 due to a break in the dam. The gauge was re-established June 3, 1913 downstream of the dam, with the first gauge heights reported July 1, 1913. The station was discontinued March 2, 1917, apparently due to the shifting character of the river's sandy bed. The gauge was a vertical staff in the left bank. A rating curve was never developed and daily discharges were reported only for the months of November and December, 1913, January through May, 1914 and July through December, 1914. A peak flow of 120,000 cubic feet per second was estimated for January 31, 1915.

C. The gauging station at Painted Rock Dam was initially established by the United States Geological Survey in October, 1959, and is located at latitude 33° 04' 30" north, longitude 113° 00' 50" west in the SE1/4 Section 18, Township 4 South, Range 7 West. The station is identified as number 09519800 by the Geological Survey. The current stream gauge is a water-stage recorder-type gauge and records at the station are considered fair by the Geological Survey, since diversions occur above the station for irrigation.

Geological Survey gauge records at this station consist of gauge height, rating curve, daily mean, monthly mean and instantaneous peak discharge records. Daily average, monthly average and peak discharge records were recorded and reported for the period October, 1959 to 1991, with no breaks in the record. During the record period the average monthly flow was 344.6 cfs and the maximum recorded flow was 5060 cfs which occurred on September 17, 1980.

D. The gauging station below Gillespie Dam was initially established by the United States Geological Survey in 1921 and is located at latitude 33° 13' 45" north, longitude 112° 46' 00" west in the SE1/4 NE1/4 Section 28, Township 2 South, Range 5 West. The station is identified as number 09519500 by the Geological Survey. The current stream gauge is a water-stage recorder-type gauge and records at the station are considered fair by the Geological Survey.

Geological Survey gauge records at this station consist of gauge height, rating curve, daily mean, monthly mean, and instantaneous peak discharge records. Daily average, monthly average, and peak discharge records have been recorded and reported since August, 1921 to the present, with no breaks in the record. During the record period, the average monthly flow was 393.4 cfs. The maximum observed flow of 178,000 cfs occurred on February 16, 1980. Prior to the period of record, the estimated maximum flow was 250,000 cfs which occurred in February, 1891.

E. The gauging station at Laveen was initially established by the United States Geological Survey in January, 1940 and is located at latitude 33° 15' 25" north, longitude 112° 09' 59" west in the SW1/4 NW1/4 Section 16, Township 2 South, Range 2 East. The station is identified as number 09479500 by the Geological Survey. The current stream gauge is a water-stage recorder-type gauge and records at the station are considered fair by the Geological Survey.

Geological Survey gauge records at this station consist of gauge height, rating curve, daily mean, monthly mean and instantaneous peak discharge records. Daily average, monthly average and peak discharge records were recorded and reported for the period of January, 1940 to the present, with a break in the record for the period of October, 1946 to November, 1947. During the record period the average monthly flow was 31.64 cfs and the maximum recorded flow was 35,000 cfs which occurred on October 4, 1983.

F. The gauging station at Kelvin was initially established by the United States Geological Survey in 1911 and is located at latitude 33° 06' 10" north, longitude 111° 58' 33" west in the NE1/4 NW1/4 Section 12, Township 4 South, Range 13 East. The station is identified as number 09474000 by the Geological Survey. The current stream gauge is a water-stage recorder-type gauge and records at the station are considered good by the Geological Survey. [AZ-91-1]

Geological Survey gauge records at this station consist of gauge height, rating curve, daily mean, monthly mean and instantaneous peak discharge records. Daily average, monthly average and peak discharge records were recorded and reported for the period of January, 1911 to the present, with no breaks in the record. During the record period the average monthly flow was 491 cfs and the maximum recorded flow was 132,000 cfs which occurred on January 20, 1916.

G. The gauging station at Winkelman was initially established by the United States Geological Survey in 1917 and is located at latitude 33° 00' 21" north,

longitude 110° 45' 21" west in the SW1/4 SW1/4 Section 13, Township 5 South, Range 15 East. The station is identified as number 09470000 by the Geological Survey. The current stream gauge is a water-stage recorder-type gauge and records at the station are considered good to fair by the Geological Survey.

Geological Survey gauge records at this station consist of gauge height, rating curve, daily mean, monthly mean and instantaneous peak discharge records. Daily average, monthly average and peak discharge records were recorded and reported for the period 1917 to present, with occasional breaks in the record for the years 1918 to 1941 and 1981 to 1984. During the record period the average monthly flow was 332.1 cfs and the maximum recorded flow was 55000 cfs which occurred on August 9, 1944. This station was discontinued after September, 1991.

H. The gauging station at Coolidge Dam/San Carlos Reservoir was initially established by the United States Geological Survey in 1899 and is located at latitude 33° 10' 10" north, longitude 110° 31' 50" west in the SW¼Section 17, Township 3 South, Range 18 East. The station is identified as number 09469500 by the Geological Survey. The current stream gauge is a water-stage recorder-type gauge and records at the station are considered excellent by the Geological Survey. [AZ-91-1]

Geological Survey gauge records at this station consist of gauge height, rating curve, daily mean, monthly mean and instantaneous peak discharge records. Daily average, monthly average and peak discharge records were recorded and reported for the period 1899 to 1991, with occasional breaks in the record for the years 1906 to 1909, and 1911 to 1913. During the record period the average monthly flow was 379.4 cfs and the maximum recorded flow was 130,000 cfs which occurred on January 20, 1916.

I. The gauging station at Calva was initially established by the United States Geological Survey in 1929 and is located at latitude 33° 11' 08" north, longitude 110° 13' 10" west in the SW1/4 Section 8, Township 3 South, Range 21 East. The station is identified as number 09466500 by the Geological Survey. The current stream gauge is a water-stage recorder-type gauge and records at the station are considered good by the Geological Survey.

Geological Survey gauge records at this station consist of gauge height, rating curve, daily mean, monthly mean and instantaneous peak discharge records. Daily average, monthly average and peak discharge records were recorded and reported for the period 1929 to the present, with no breaks in the record. The peak flow for January 20, 1916 has been estimated in excess of 100,000 cfs. During the record period the average monthly flow was 334 cfs and the maximum recorded flow was 150,000 cfs which occurred on October 3, 1983.

J. The gauging station at Solomon was initially established by the United States Geological Survey in 1914 and is located at latitude 32° 52' 06" north, longitude 109° 30' 38" west in the SE1/4 NE1/4 Section 31, Township 6 South, Range 28

East. The station is identified as number 09448500 by the Geological Survey. The current stream gauge is a water-stage recorder-type gauge and records at the station are considered good by the Geological Survey.

Geological Survey gauge records at this station consist of gauge height, rating curve, daily mean, monthly mean and instantaneous peak discharge records. Daily average, monthly average and peak discharge records were recorded and reported for the period 1914 to the present, with no breaks in the record. During the record period the average monthly flow was 480.9 cfs and the maximum recorded flow was 132,000 cfs which occurred on October 2, 1983.

B.3. Influence of Dams and Reservoirs

There are two major reservoirs located along the Gila River which regulate its daily flow. The first is the San Carlos Reservoir, located in Township 3 South/Ranges 18 and 19 East, impounded by Coolidge Dam, and has a usable capacity of 935,000 acre-feet. The dam was completed October 25, 1928 and flow was first regulated after November 15, 1928. The reservoir regulates flow for irrigation projects downstream to Gillespie Dam, south of Arlington, west of Phoenix.

The second reservoir is the Painted Rock Reservoir, located in Township 4 South/Ranges 4, 5, 6 and 7 West and Township 5 South/Ranges 4, 5, 6 and 7 West, impounded by Painted Rock Dam, and has a usable capacity of 2,492,000 acre-feet. The dam was completed in 1959, and flow was first regulated after 1960. The reservoir mitigates flood flow for areas downstream to the Colorado River confluence east of Yuma.

C. Flow Frequency and Rating Curves

After assembling available stream flow data for the various gauging stations it was necessary to determine the anticipated flow rates for various return periods. To do this a generally accepted statistical method referred to as log-Pierson Type III was employed. These analyses are presented in Appendix G and the results of these analyses are summarized in the table at the end of Section C.

For this investigation, flows on the Gila fall into three time periods: (1) prior to 1912, when the Roosevelt Dam was completed on the Salt, and flow records for stations below the Salt-Gila confluence are affected; (2) prior to 1928, when Coolidge Dam was completed and flow records for stations above the Salt-Gila confluence and below Coolidge Dam are affected; and (3) the total period of record for those stations above Coolidge Dam, which have flow regulated only to the extent that water is diverted for irrigation purposes.

Event flows on the Gila fall into five alternative conditions:

(1) Unregulated flow. This applies to Gila River stations upstream of Coolidge Dam which are unregulated within Arizona. Conversations with the New Mexico Public Lands Commissioner and the Bureau of Reclamation indicated that there are no conservation or flood-control structures on the Gila within New Mexico;

(2) Regulated flow following completion of Coolidge Dam. This applies to stations downstream of Coolidge Dam and upstream of the Salt River confluence;

(3) Regulated flow following completion of Roosevelt Dam and prior to completion of Coolidge Dam. This applies to stations downstream of the Salt River confluence.

(4) Unregulated flow following completion of Roosevelt Dam and following completion of Coolidge Dam. This applies to stations downstream of the Salt River confluence.

(5) Unregulated flow prior to construction of Roosevelt Dam. This applies to all stations downstream of Coolidge Dam, which are now regulated.

Obviously, not all of these conditions apply to every station on the Gila. Also, not all Gila stations existed prior to completion of Roosevelt Dam, while some have only been maintained since completion of Coolidge Dam.

Typical stream flow characteristics (flow rate, normal depth, average velocity and hydraulic radius) were identified for various flow events by developing a rating curve for the river at either the gauging station or a more typical cross section nearby. The rating curve data and assumed cross sections are presented in Appendix F.

D. Climatic Variation

In gathering data and making assumptions it was necessary to identify the potential for changes in local climate and its possible effects on rainfall within the Gila River basin and runoff within the river. In identifying a rational basis for determining flood flow frequency the materials repeatedly referred to the United States Water Resources Council's "Guidelines for Determining Flood Flow Frequency," Bulletin 17A. A review of the assumptions discussed in the document revealed the following:

> "A. Climatic Trends
>
> There is much speculation about climatic changes. Available evidence indicates that major changes occur in time scales involving thousands of years. In hydrologic analysis it is conventional to assume flood flows are not affected by climatic trends or cycles. Climatic time invariance was assumed when developing this guide."[14]

In 1978, Daniel M. Johnson of the Department of Geography, Portland State

University asserted that existing climatic records have "deceived" researchers and that the period of 1905-1930 was a "persistently wet period" throughout much of the American West. As a result of this 'deception' water appropriations have exceeded naturally occurring water supplies which in turn resulted in costly legal actions to resolve disputes.[15]

Climatological data for selected stations along the Gila River were acquired from the Office of Climatology at Arizona State University, Tempe. Mean monthly maximum temperature, mean monthly minimum temperature, and total precipitation data for United States Weather Bureau stations at Buckeye, Clifton, Florence, Gila Bend, Sacaton, and Yuma Citrus Station were collected and reviewed. The data for these stations was averaged and presented in Appendix H. Annual mean maximum temperatures, annual mean minimum temperatures and annual total precipitation values were averaged for those years with complete records. Monthly mean maximum temperature, monthly mean minimum temperature, and monthly total precipitation values were averaged for all available data.

Annual mean maximum temperatures and annual mean minimum temperatures were computed as weighted values, e.g., the mean value for January was multiplied by 31 days, the February mean value was multiplied by 28 days (29 for leap year), etc. The products for all months were summed, divided by 365 days (366 for leap year) and displayed as the 'Annual Average.' The 'Mean Annual average' was similarly computed, using the mean monthly values. Annual total precipitation is a simple sum of the monthly precipitation for years with complete records, while mean annual total precipitation is the sum of mean monthly precipitation. In those instances where either temperature or precipitation data are incomplete or not recorded, no value is displayed and mean values are unaffected. Where either no rainfall was recorded, or no more than a 'Trace' amount was recorded, "0.00" is displayed in the table.

Annual average mean maximum temperatures, annual average mean minimum temperatures, and annual total precipitation are displayed graphically in relation to the respective mean annual values. Discontinuities in the graphs reflect gaps in the data sets.

Data sets for Weather Bureau stations at Safford Experimental Farm, Winkelman 6S, and Yuma Valley were collected, but these data are relatively recent (no earlier than 1930) and were not analyzed. Mean temperature data were also collected, but were not analyzed. Temperature and precipitation data are displayed in Appendix H.

A comparison of the mean and extreme values suggests that fluctuations of extrema have been minor. Mathematical analyses suggests that variations have, indeed been negligible. It is therefore recommended that the USWRC assumption of climatic time invariance be accepted for this study.

[1] "Storage of Water on Gila River, Arizona," U.S.G.S. Water Supply Paper Number 33, pp. 10-12

[2] Compilation of Records of Surface Waters of the United States through September 1950, Part 9. Colorado River Basin, USGS Water Supply Paper Number 1313

[3] Twelfth Annual Report of the United States Geological Survey to the Secretary of the Interior, 1890-91, Part II - Irrigation, pp. 302-314

[4] U.S.G.S. Water Supply Paper Number 38, p. 313

[5] ibid., pp. 316-7

[6] Twenty-First Annual Report of the U.S.G.S. to the Secretary of the Interior, 1899-1900, p. 338-9

[7] U.S.G.S. Water Supply Paper Number 269, p. 217

[8] U.S.G.S. Water Resources Data for Arizona, Water Year 1971, AZ-71-1, p. 94

[9] WSP 269, pp. 217-8

[10] U.S.G.S. Water Supply Paper Number 211, p. 121

[11] WSP 269, p. 218

[12] WSP 929, pp. 263, 286, 294, 297, 300, 306

[13] Tenth Annual Report of the United States Geological Survey to the Secretary of the Interior, 1888-89, Part II - Irrigation, pg. 87.

[14] "Guidelines for Determining Flood Flow Frequency," United States Water Resources Council, Bulletin #17A of the Hydrology Committee, p. 6, revised June 1977.

[15] "Our Changing Climate – Its Impact on the Availability of Water," by Daniel M. Johnson, Department of Geography, Portland State University, Climatological Publications, Scientific Papers No. 4, 1978.

Summary of estimated peak flows, various return periods, log-Pierson III method 09/03/96
Gila River Navigability Study

Location	2-year event	5-year event	10-year event	25-year event	50-year event	100-year event	num. of records	period of record
Buttes	9195	27651	57509	142399	274715	521562	6	total record
Calva	6466	18650	34744	71376	117079	186670	63	total record
Clifton	6171	12546	17486	24237	29514	34876	69	total record
Coolidge Dam	763	1571	2111	2965	21699	173769	63	post-Coolidge Dam
Coolidge Dam	1216	4476	10742	31933	70547	153039	82	total record
Coolidge Dam	9303	27442	52668	113088	192505	318911	24	pre-statehood
Dome	2348	14987	37858	98809	180580	306862	89	total record
Dome	17619	56260	101357	187552	277011	391115	18	post-Roosevelt Dam, pre-Coolidge Dam
Dome	27398	82818	133443	206692	263605	322883	9	pre-Roosevelt
Dome	894	3330	6013	10541	14619	19173	64	post-Coolidge Dam
Gillespie Dam	3532	21952	58520	169490	339895	640936	72	total record
Gillespie Dam	29470	72848	126439	242568	382718	590743	10	pre-Coolidge Dam
Gillespie Dam	26152	49632	70490	125350	133958	169411	9	post-Roosevelt Dam, pre-Coolidge Dam
Gillespie Dam	2342	14182	38853	119756	255347	513707	63	post-Coolidge Dam
Kelvin	8738	22383	39520	77056	122741	190993	83	total record
Kelvin	21494	56368	96005	173318	257043	396332	21	pre-Coolidge Dam
Kelvin	6830	14636	23086	39284	56791	80518	62	post-Coolidge Dam
Laveen	911	4678	10214	22268	35785	53704	53	total record
Laveen	834	3527	6693	12241	17349	23119	50	post-Coolidge Dam
Painted Rock Dam	377	1812	3930	8670	14202	21833	32	total record
Solomon	9471	23142	38115	66538	96760	136695	78	total record
Winkelman	3514	8825	15498	30178	48154	75167	47	total record

flowsums.wk3

HISTORICAL GEOMORPHOLOGY OF THE GILA RIVER

by

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A Report Submitted to the CH2MHill as part of
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CHAPTER VII

HISTORICAL GEOMORPHOLOGY OF THE GILA RIVER

Introduction

Integral to ascertaining the navigability of the Gila River at time of statehood is an understanding of the river's geomorphology. The Gila River has been the topic of several geomorphic studies that have focused on changes in channel position and form through time (e.g., Burkham, 1972; Graf, 1981; Huckleberry, 1993b; Stevens and others, 1975). Although detailed historical descriptions of the Gila River only extend approximately 120 years, within that short interval of time the river has changed between narrow, meandering and wide, braided conditions (see Leopold and Wolman, 1957 for common channel patterns). Channel changes on the Gila River are driven primarily by changes in the frequency of large floods (Burkham, 1972, Huckleberry, 1993b), however, one cannot ignore the effects of human disturbances (Bahre, 1991). Irrigation diversions, dams, exotic vegetation, and channelization have also undoubtedly affected the hydraulics and hydrology of the channel.

Historical channel changes on the Gila River are not the same along all reaches of the river. Alluvial reaches, i.e., segments not confined by bedrock, are prone to greater changes in channel position and form. Furthermore, because of physiographic variability and a climatic gradient across the Gila River watershed, different reaches have unique hydrologic characteristics (Hirschboek, 1985), and thus as one might expect, channel transformations along separate reaches are not synchronous or uniform. In addition, dams and irrigation diversions have altered different reaches of the Gila River.

In this study, the historical channel changes were reviewed for three primary alluvial reaches of the Gila River (Figure A). The upper Gila River includes two reaches: a larger reach located in the Safford Valley and a smaller reach located between Winkelman and Kelvin. The middle Gila River is an alluvial reach extending from Florence to its confluence with the Salt River. The lower Gila River is a largely alluvial reach extending from the mouth of the Salt River to Yuma (excluding Painted Rock Reservoir). These divisions of the Gila River are partly arbitrary and partly based on hydrologic and physiographic boundaries. The upper Gila River is located within the mountainous Central Highland zone and receives considerable baseflow from snowmelt. In contrast, the middle Gila River is located within the Basin and Range physiographic province and is supplied by lower elevation watersheds such as the San Pedro and Santa Cruz river catchment areas. The lower Gila River is also in the Basin and Range province, but its flow is supplemented by the Salt River which supplies a greater volume of water than the middle and upper Gila River watersheds.

Historical channel positions were plotted for the study reaches onto U.S. Geological Survey 7.5' quadrangles. Archival sources include 1) General Land Office cadastral survey notes and plat maps, 2) historical maps produced by the U.S. Geological Survey, Bureau of Reclamation, and Indian Irrigation Service, 3) historical aerial photography, and 4) U.S. Geological Survey 7.5' orthophotoquads. All photographs and maps were adjusted to 1:24,000 scale and plotted on the quadrangles with a zoom transfer scope. Previous channel reconstructions by Burkham (1972) and Huckleberry (1993b) were utilized to describe historical channel changes. It is clear from this investigation that all three study reaches were experiencing changes in channel form in 1912, and that these changes were driven by a shift from a period of drought to one of the wettest decades in 500 years (Meko and Graybill, 1993).

Evolution of the Gila River

The Gila River is the primary drainage for southern Arizona with a drainage area of approximately 150,000 km^2 (60,000 mi^2) that extends into western New Mexico and northern Sonora. As a major water source in the Sonoran Desert, it has been the locus of cultural activity for at least 2,000 years, but the origin of this river extends back several million years. The ancestral Gila River originated after the landscape of southern and central Arizona had been radically altered into a series of linear mountain ranges and basins approximately 8 to 15 million years ago (Damon and others, 1984). Initially drainage was closed within individual basins, however, the basins eventually filled, and regional drainage became integrated sometime between 3 and 6 million years ago (Menges and Pearthree, 1989; Morrison, 1985; Shafiquallah and others, 1980). As drainage became integrated, the Gila River and its tributaries began to incise into basin deposits forming several strath terraces in the Central Highland zone. In the more tectonically stable Basin and Range province, the Gila River primarily deposited sediment. Here there are few terraces except along the margins of the Phoenix Basin (Huckleberry, 1993a; Péwé, 1978). Radiometric dates from basalt flows intercalated with Gila River gravels indicate that the oldest Gila River landforms in the Basin and Range province are at least 3.0 million years old (Shafiquallah and others, 1980).

The modern geologic flood plain of the Gila River is incised into early Pleistocene surfaces and contains channel and overbank alluvial deposits. The channel deposits consist primarily of sands, gravels, and cobbles and are latest Pleistocene and Holocene in age based primarily on faunal evidence (Huckleberry, 1993b). The overbank deposits consist primarily of sand, silt, and clay and are generally within 3 m (9 ft) of the surface and date to the middle and late Holocene. Although a firm Holocene chronology of climatic variability has yet to be defined, it is clear that secular changes in climate characterized by changes in the intensity and seasonality of precipitation resulted in different periods of flood frequency and magnitude (Ely, 1992; Meko and Graybill, 1993; Nials and others, 1989). This undoubtedly resulted in alternating periods of channel stability and instability, and specifically, changes in channel form (e.g., braided vs. meandering) during the Holocene. Periods of increased large flood frequency are more likely to be associated with wide, braided channel conditions on the Gila River (Burkham, 1972; Huckleberry, 1993b).

Upper Gila River

The upper Gila River study reach is located in the mountainous region of east-central Arizona and divided into two study reaches: a larger reach in the Safford Valley, a northwest trending basin bounded by the Pinaleños and Gila Mountains, and a smaller reach located in a smaller, unnamed valley located between the Dripping Springs and Tortilla Mountains. This latter reach is herein referred to as the Kearny reach. The segment between the Safford Valley and Kearny reaches is covered by San Carlos Reservoir or confined by bedrock and is not addressed in this study. The study reaches are characterized by a flood plain of variable width inset into basin fill. The upper Gila River flood plain is widest in the upper part of the Safford Valley where it is approximately 5 km (3 mi) wide; in the lower part of the Safford Valley and in the Kearny reach, the flood plain is approximately 3 km (2 mi) wide. In general, upper Gila River flood-plain alluvium is 7-10 m thick (Culler and others, 1970).

The upper Gila River watershed extends into the Mogollon Highlands of eastern Arizona and western New Mexico; drainage basin area at the mouth of the Safford Valley is approximately 29,800 km^2 (11,500 mi^2). There are no major dams upstream from the Safford Valley, but streamflow on the Kearny reach is partially controlled by Coolidge Dam which was completed in 1928. Mean annual precipitation within the watershed ranges 20-100 cm (8-40 in) and averages

approximately 36 cm (14 in). There are two periods of peak flow that are directly linked to two rainy seasons (Sellers and Hill, 1974). Summer peak flow occurs between July and October and is predominantly linked to monsoonal, convective storms. Winter peak flow occurs November through June and is supplied largely by frontal storms, snowmelt, and groundwater storage (Burkham, 1970). Segments of the upper Gila River are frequently dry in June and July (Turner, 1974).

Gaged streamflow records on the upper Gila River extend only to 1911 and provide a limited timeframe for analyzing long-term streamflow patterns. However, a recent dendrohydrological study by Meko and Graybill (1993) reconstructs mean annual streamflow for the upper Gila River for the period A.D. 1663-1985 based on statistical relationships between tree-ring width and gaged annual streamflow. The reconstructions are characterized by a series of irregularly spaced, multidecadal peaks and troughs of high and low annual streamflow. Interestingly, the 20th century contains the wettest decade (1906-1915) and the driest decade (1947-1956) within the 322 year reconstruction. Decadal scale changes in climate appear to be stochastic and related to shifts in large-scale ocean-atmospheric circulation patterns. Much of the temporal variability in annual streamflow on the upper Gila River may be linked to El Niño - Southern Oscillation climatic phenomena (Betancourt and Webb, 1992; D'Arrigo and Jacoby, 1991).

Of geomorphic significance is that as the volume of streamflow changes in response to secular climatic variability so does river channel geometry as it adjusts to accommodate changing flow regimes. Alluvial rivers adjust their hydraulic parameters (e.g., width, depth, sinuosity, hydraulic roughness, and slope) in response to changing discharge and sediment load (Leopold and Maddock, 1955). Although dryland rivers do not adjust to gradual changes in flow regime as rapidly as rivers in wetter climates (Wolman and Gerson, 1978), dryland streams do respond to low frequency, high magnitude flow events that may accompany secular climatic change (Baker, 1977, Graf, 1988). If changes in annual stream flow correspond with changes in large flood frequency, then one can expect the upper Gila River to have a channel geometry subject to dramatic changes through time at decadal time scales.

A classic study of historical channel changes on the upper Gila River was performed by Burkham (1972) as part of the U.S. Geological Survey's Phreatophyte Study near San Carlos Reservoir (Culler and others, 1970). Burkham utilized historical descriptions, survey notes, maps, and photographs to reconstruct channel width and sinuosity for a segment of the upper Gila River from 1846-1970 (Table A). To summarize, Burkham divides the chronology into three periods. From 1846 to 1904, the upper Gila River contained a relatively deep, narrow, and sinuous channel; from 1905-1917, the channel increased its width over 600 percent and became straighter, whereas from 1918-1970 the channel narrowed and increased its sinuosity (Figure B). These channel changes are clearly correlated to changing flood frequency. Large floods and above average streamflow between 1905 and 1917 resulted in the destruction of large cottonwood groves and the formation of a wide, braided channel (Olmstead, 1919). The largest floods occurred in 1891, 1905, 1906, and 1916. Of all of the hydraulic parameters sensitive to changing hydrologic conditions, channel width seems to have been most responsive to changing flow regimes (Figure B). The period 1918-1970 was a relatively dry period [culminating in the decade of 1947-1956 (Meko and Graybill, 1993)] and one with few large floods. During this period, vegetation returned to the flood plain and facilitated sedimentation (Turner, 1974). It took 50 years for the flood plain to return to conditions resembling those before 1905, although introduced exotics like tamarisk (*Tamarix* sp) precluded the return to identical pre-1905 conditions (Graf, 1988b).

No systematic study of historical channel changes exists for the Kearny reach. Cursory inspection of the General Land Office plats (Table C) indicates that the river contained a single, slightly sinuous channel in the 1870's. Photographs of the channel near Riverside reveal a relatively wide

sandy channel (Lippincott, 1900: Plate 17). That there was little vegetation in the channel during this period is also suggested by the Florence (1:125,000) quadrangle surveyed in 1900 which shows a road following the course of the river downstream from Kelvin. The Ray (1:62,500) quadrangle was surveyed in 1907-08 after the 1905 floods, and it shows a wide sandy flood plain with several branching channels similar to that described for the Safford Valley reach after 1905. A large flood in September, 1926 on the San Pedro River (see Hereford and Betancourt, 1993) may have helped to maintain wide-braided conditions on this reach until 1930. However, the subsequent period of low flood frequency plus the effect of Coolidge Dam halting large floods from the upper watershed have contributed to a heavily vegetated flood plain with a single, narrow, low flow channel.

Burkham's (1972) detailed study provides a good indication of channel conditions on the upper Gila River at time of statehood, 1912. The transformation from a single-meandering channel to a wide-braided channel began in earnest in 1905 and was largely completed by 1916 (Table A). Channel characteristics presented by Burkham for the year 1914 are a good representation of channel characteristics in 1912. Moreover, the channel boundaries presented by Olmstead (1919) and reproduced by Burkham (1972: Plate 1) for the upper Gila River in 1914-15 can be considered a close approximation of 1912 channel boundaries. The 1914-15 channel boundaries may be a little wider than those of 1912, however, since there were large floods in December, 1914 and January, 1915 that resulted in bank cutting (Olmstead, 1919). It is hypothesized that wide-braided channel conditions also characterized the Kearny reach in 1912 based on historical records of widespread erosion along the upper Gila River and San Pedro River (Burkham, 1972; Hereford and Betancourt, 1993, Olmstead, 1919; Turner, 1974).

Middle Gila River

As the Gila River splits the gap between North and South Butte east of Florence, it enters the southern margins of the Phoenix Basin (Péwé, 1978) where it begins to flow over deep alluvium and lose much of its flow to infiltration. The middle Gila River study reach extends from the Ashurst-Hayden Diversion Dam to the Salt River (Figure A); most of this reach is located within the Gila River Indian Community. Due to upstream diversions for irrigation agriculture, the middle Gila River flows only during infrequent floods. An exception occurs in the lower part of this reach near the Sierra Estrella Mountains where effluent from irrigation supports a sluggish, narrow stream (Rea, 1983). Of the 150,000 km^2 (60,0000 mi^2) comprising the Gila River drainage basin, 47,400 km^2 (18,960 mi^2) lies above the Ashurst-Hayden Diversion Dam with 33,390 km^2 (13,360 mi^2) located above Coolidge Dam and most of the remaining 14,010 km^2 (5,600 mi^2) located within the San Pedro River system. There are no pristine records of annual streamflow for the middle Gila River; by the time gaging stations were established, water was already being diverted for irrigation.

Middle Gila River climate is arid and warm. July maximum temperatures at Sacaton average 41° C; January minimum temperatures at Sacaton average 1° C (Sellers and Hill, 1974). There is a slight moisture gradient from west to east; mean annual rainfall ranges from 19 cm at Maricopa to 21 cm at Sacaton and 24 cm at Florence.

Historical descriptions of the Gila River extend back to 1697 when Padre Kino and Captain Juan Manje described a channel with large cottonwoods supporting irrigation agriculture at the Pima Villages (Figure C). Subsequent European visitors passing through the area also described a stable, narrow and relatively deep channel with dense riparian galleries (Huckleberry, 1993b; Rea, 1983). Before Anglo settlement in the 1860's, the middle Gila River would periodically run dry near the Pima Villages during May and June (Rea, 1983). The early cadastral surveys (Table C) also characterize the middle Gila as having a single, narrow channel up until 1891. In 1891, the

middle Gila River experienced a large flood that resulted in some channel widening. Beginning in the 1890's, streamflow on the middle Gila River was greatly reduced due to Anglo irrigation diversion, but the river was still susceptible to large flood flows. Beginning in 1905, a series of large floods struck the middle Gila River coinciding with a radical transformation in channel planform and geometry (Figure D). Similar to the upper Gila River (Burkham, 1972), the middle Gila River contained a wide, braided channel between 1905 and 1920 correlating to a period of high large flood frequency with the largest floods occuring in 1905, 1914, and 1916 (Figure C).

After construction of Coolidge Dam in 1928, the middle Gila River became somewhat hydrologically disconnected from the upper Gila River. The middle Gila River above Pima Butte seldom contained streamflow except during rare floods, and most of the floods that did pass through this reach were generated in the San Pedro River watershed (an exception is the flood of January, 1993). Below Pima Butte, effluent from irrigation and naturally shallow water tables have helped to maintain a small stream. Throughout the middle Gila River a low flow channel formed within the former wide braided channel during the 1930's, 40's and 50's forming a compound channel planform (Graf, 1988a). Only recently has the channel changed its geometry when the sustained flow of the floods of January, 1993 converted the compound channel above Pima Butte into a single, wide, braided channel.

It is clear that the upper and middle Gila Rivers share similar histories (Figure B), but there are some differences. The middle Gila River experienced two catastrophic floods in 1833 and 1868, and anecdotal evidence (see Huckleberry, 1993b) suggests that the magnitude of the 1833 and 1868 floods on the middle Gila River was greater than that of the 1905 flood, the flood responsible for dramatic channel changes on the upper and middle Gila River. Burkham (1972) mentioned no floods on the Upper Gila River during these years, and he assumed that none occurred given stable channel conditions throughout most of the 19th century. That the middle Gila River remained stable despite these large floods is contrary to disequilibrium models of arid stream behavior (Graf, 1981; Stevens and others, 1975). Applying the concept of critical discharge for sediment entrainment, catastrophic floods should result in dramatic channel changes (Graf, 1983). However, as recent floods attest, it is not the peak discharge that is as critical in channel transformations as the duration of those floods. Although the October, 1983 flood had a peak discharge of 2,800 m^3/s (100,000 ft^3/s; measured at Kelvin gage), it did not produce any long lasting changes to channel planform. In contrast, the January, 1993 flood with a peak discharge of 2,080 m^3/s (74,290 ft^3/s) resulted in the most dramatic changes in channel planform since 1905. If flood duration is a more important variable than peak discharge in channel changes, then there is a stronger basis for reconstructing prehistoric channel behavior for the Gila River based on dendrohydrological data than for other streams like the Salt River (Nials and others, 1989).

In 1912, the middle Gila River above Pima Butte contained a wide, shallow, braided, sandy channel. This is supported by several maps drafted during the period 1900-1914 by the U.S. Reclamation Service, Geological Survey, and Indian Irrigation Service (Table C), and terrestial photographs of the river (e.g., Haury, 1976: Figure 8.47). Downstream from Pima Butte, there is less domumentation pertaining to channel geometry, although resurveys of townships T. 1 S., R. 1 E., T. 1 S., R. 2 E., T. 2 S., R. 2 E., T. 2 S., R. 3 E., and T. 3 S., R. 3 E. performed 1910-12 reveal a much wider channel than that surveyed in the 1860's and 1870's.

Lower Gila River

From the confluence of the Salt River near Phoenix, the lower Gila River flows southwestward towards the Colorado River near Yuma (Figure A). Like the middle Gila River, this stretch of the Gila flows mostly over deep alluvium within the Basin and Range physiographic province. In a few places the river is confined by bedrock (e.g., near Arlington and below Painted Rock Dam), but elsewhere the river contains a wide, unconfined flood plain (generally > 3 km (2 mi)). All

tributaries along this reach are ephemeral and seldom flow. The climate is arid and hot. Daily maximum temperatures average 31° C (88° F) at both Yuma and Buckeye whereas mean annual precipitation at Yuma and Buckeye is 7 cm (2.8 in) and 18 cm (7.1 in), respectively (Sellers and Hill, 1974).

Before Anglo settlement in the Phoenix Basin, streamflow on the Salt River was greater than that on the middle Gila River. Reinvigorated by the Salt River watershed (38,850 km^2 (6,600 mi^2) in area), most of the lower Gila River was perennial reaching all the way to the Colorado River (Ross, 1923). Spanish explorers during the 1700's described the native peoples living along the lower Gila River as fishermen, and large galleries of cottonwood trees lined the banks as recently as the late 1800's. Also, there were a few successful journeys by boat down the lower Gila River during the 1800's (Ross, 1923; McCroskey, 1988). However, expansion of irrigation systems within the upper watershed during the late 19th century and subsequent construction of large dams during the early 20th century greatly reduced the amount of streamflow reaching the lower Gila River. As a result, there are no pristine records of gaged streamflow for the lower Gila River. Eventually the upstream diversions combined with local groundwater pumping for agriculture converted the lower Gila River into an intermittent stream by 1920 (Brown and others, 1981; Bryan, 1923; Ross, 1923). Except for a segment near Buckeye fed by irrigation and waste water effluent from Phoenix, the lower Gila River flows only after rare, heavy rains.

Unlike the upper and middle Gila River segments, there have been no systematic measures of historic channel width, although Graf (1981) measured changes in low flow channel sinuosity for the reach upstream from Gila Bend. Historical descriptions of the lower Gila River vary somewhat which may reflect not only changes in channel configuration through time but also spatial variability in channel geometry at any one time due to local hydrological conditions. In general, the lower Gila River channel appears to have been braided in historical times. Lieutenant William Emory of the Kearny Expedition in 1846 described the lower Gila River as "about 100 yards wide and flowing gently along a sandy bottom..." However, a rancher described the river near Powers Butte (between Buckeye and Gillespie Dam) in 1889 as having a well-defined channel with hard, sloping banks lined with cottonwood and bushes. The water was clear, was 5 or 6 feet deep, and contained many fish." (Ross, 1923:66). The former description implies a braided, sandy stream, whereas the latter suggests a relatively, narrow, deep channel, however, the latter description may be of the main flow channel within an overall braided channel. Discrepancies in descriptions may also be enhanced by observers describing the same reach during different times of the year under different streamflow conditions.

Given that the lower Gila River flood plain is comprised mostly of sand and silt (Ross, 1923), the bank material can be easily mobilized by floods of significant magnitude and duration. This results in spatially dynamic low flow channels that shift after large floods (Graf, 1981). Early cadastral surveys plats and U.S. Geological Survey maps reveal considerable shifts in channel position near Yuma and Agua Caliente during the late 1800's and early 1900's. In a detailed study of the lower Gila River between the Salt River and Gila Bend, Graf (1981, 1988b,c) documented shifts in the low flow channel and demonstrated the effects of not only floods but also vegetation in processes of sedimentation and channel avulsion. Reaches that showed the greatest spatial instability included those behind Gillespie Dam (an area of heavy sedimentation) and other areas of dense tamarisk growth.

Given the similar chronologies of channel changes on the upper and middle Gila Rivers (Burkham, 1972; Huckleberry, 1993b), one has to ask whether or not the lower Gila River experienced similar changes. Graf's (1981, 1988b,c) study of the lower Gila River suggests that this reach did not experience dramatic changes in channel configuration near the turn of the century: "Between 1868 and 1929 the channel was braided, and the 1905 flood had no particular geomorphic significance." (Graf, 1988b:233). This stands in contrast to statements made by Ross

(1923:64) who noted that the Gila River has "changed materially since it was first seen by white men". Of course, Ross was referring to the entire lower Gila River rather than the reach studied by Graf, but nonetheless there are distinct geomorphological differences in channel descriptions for the entire lower Gila River before and after 1890.

Before 1890, the lower Gila River had a distinct main flow channel within a larger braided, flood-flow channel. Every winter and spring, flow would exceed channel capacity of the main flow channel and extend into the adjacent flood channels. Dramatic changes appear to have occurred during two large floods in 1890 and 1891. A flood in February, 1890 damaged settlements and eroded terraces along the lower Gila River. Erosion was probably enhanced by a large surge in flow that entered the lower Gila River through the Hassayampa River due to the Walnut Grove Dam failure (Dobyns, 1981). The following year, another large flood passed down the lower Gila River. This flood generated the largest estimated peak discharge on the Salt River (8,400 m3/s (300,000 ft3/s)). Ross (1923:67) noted that "The disastrous floods of 1890 and 1891 did much to break down the river's confining banks, partly filled the channel with sediment, and in general interfered with the equilibrium that had been established." Although Dobyns (1981) believes that erosion on the lower Gila River began as early as 1867, it appears that major changes did not occur until after 1890 and that the floods of 1890 and 1891 were the driving force behind the change in channel configuration. During the next 25 years, a braided, sandy flood plain was probably maintained by the flux of sediment and water generated from the upper and middle Gila Rivers during the abnormally wet decade of 1905 to 1915.

The best descriptions of the lower Gila River channel near the time of statehood are offered by Ross (1923) who systematically described several segments from Buckeye to Yuma. By 1920, the segment in Buckeye Valley wandered "over a sandy flood plain between cut banks 5 to 15 feet high. The flood plain varies in width but is a mile or more in most places. The water meanders in shifting channels and does not cover more than a small part of its flood plain exept during unusually great floods." (Ross, 1923:68). (Contrast this with the rancher's 1889 description presented above.) Ross characterized the segment in the Arlington Valley as similar to that in the Buckeye Valley. Between Gillespie Dam and Gila Bend, the channel had higher banks but still maintained its wide form. At Gila Bend, a cross-section reveals a wide channel composed of silt and sand. Ross did not describe the reach from Gila Bend to Painted Rock Mountains, however where the river cuts through the Sentinel volcanic field, he described the channel as 10 to 30+ m (30 to 100+ ft) wide between low banks. Between Agua Caliente and Palomas, the channel contained banks over 10 m (30 ft) high and had shifted its position almost a mile. From Palomas to Yuma, Ross (1923:75) described the lower Gila River flood plain as "a desolate expanse of silt and sand dotted with thickets of mesquite..." and the channel as having banks 1 to 3 m (3 to 10 ft) high. These descriptions are probably applicable to channel conditions in 1912 except that at the time of statehood there was probably more water within the braided channel.

Plotting Channel Boundaries

Mapping historical channel positions is a challenging endeavor given the often arbitrary nature of channel boundaries. Whereas channel boundaries are easily defined in bedrock reaches of rivers or in entrenched or channelized alluvial rivers, they are less absolute in braided reaches where channel position frequently varies in space and time. Also, rivers in humid regions usually have easily discernable boundaries where a single channel conveys most of the flow throughout the year. However, dryland rivers are different in that the annual peak flow is considerably larger than the mean annual flow (Graf, 1988a), and thus there are commonly low and high flow channels. This latter situation certainly applies to the Gila River, especially the middle and lower reaches. Borrowing from Burkham (1972) and Minckley and Clark (1984), in this study "channel" is defined as that part of the fluvial system that conveys channelized flow and is scoured of perennial vegetation by flooding.

The earliest scaled maps that show the location of channel boundaries in Arizona are the General Land Office (now the Bureau of Land Management) plat maps. These maps were constructed when the townships were originally surveyed. The first townships along the Gila River were mapped in 1868; most others were mapped by 1900. Many of these townships were resurveyed after 1912. Because the position of the channel is only measured where it crosses township and section boundaries; the channel is sketched between section lines, and thus their mapped position is of questionable accuracy. For example, in several places the channel is plotted outside the flood plain. Subsequent maps by the U.S. Geological Survey are more accurate although lacking the detail of the larger scale General Land Office plats. Aerial photographic coverage of the river begins in the middle and late 1930's; the negatives for these photographs are housed at the National Archives in Washington D.C. In this study, 1930's aerial photography for only the upper and middle reaches of the Gila River was accessed (Tables A and C). The most recent channel boundaries presented in this study are based on orthophotoquads from 1971-72. Comments regarding the plotting of channel positions from each reach are presented below.

Upper Gila River

All of the townships crossed by the study reaches of the upper Gila River were surveyed in the 1870's (Table A) except those located within the San Carlos Apache Indian Reservation. The accuracy of the channel position on the plats is greatest in townships T. 6 S., R. 24 E., T. 6 S., R. 25 E., and T. 7 S., R. 26 E. where sections are subdivided into 1/8 units; elsewhere, channel position is estimated between section lines. During this period, the upper Gila River contained a single flow channel with more definite boundaries.

The upper Gila River was subsequently mapped by Olmstead (1919) and resurveyed by the General Land Office. After 1905, the upper Gila River consisted of a wide braided channel with several smaller branching channels. Channel boundaries mapped during this period include the entire scoured channel formed after the large floods of 1905, 1914-15, and 1916. The earliest systematic aerial photography was flown in 1934 and 1935 by the Soil Conservation Service. By 1934, mesquite and tamarisk had colonized the flood plain (Turner, 1974), and a main flow channel had become discontinuously re-established. The latter defines the channel boundaries plotted in this study.

By 1972, agricultural fields had encroached onto the margins of the former 1914-15 flood channel mapped by Olmstead (1919). Furthermore, several reaches are confined by artificial levees resulted in rectilinear channel boundaries. Several of the photographs were taken after the flood of October, 1972 and show several freshly scoured areas. However, by and large the channel is relatively narrow and comparable to that described by Burkham (1972).

Middle Gila River

All of the original township surveys and associated plats (1868, 1869, and 1876) that cover the middle Gila River include section boundaries except townships T. 3 S., R. 4 E., T. 3 E., R. 5 E., T. 4 S., R. 5 E., T. 4 S., R. 6 E. (Table C). Thus there is good control of channel position along section lines, but inbetween section lines the accuracy is questionable. For example, the segments of the channel are plotted outside the flood plain in townships T. 1 S, R. 1 E., and T. 4 S., R. 10 E. Accurate mapping of the middle Gila River channel begins in 1904 with the U.S. Reclamation Service maps of the Gila River Indian Community (these were incorporated into the U.S. Geological Survey 15' quadrangles of the area). The 1904 maps generally show a single main flow channel with distinct banks although branching channels occur locally.

Channel boundaries on maps produced after 1905 cover a wider portion of the flood plain when

the middle Gila River converted to a wide, braided channel. Maps produced in 1914 and 1928 demarcate the channel by steep banks that contained the large floods of 1905, 1914, and 1916. Hence these channel boundaries contrast from earlier boundaries in that they define the limits of flow during infrequent floods. Between these boundaries, a much smaller, low flow channel shifted laterally across the larger flood channel. Aerial photography flown in March, 1936 by the Soil Conservation Service reveals a more stable low flow channel established along most segments. Adjacent bars and islands within the flood plain became covered with phreatophytic vegetation like tamarisk and mesquite (*Prosopsis* sp) and are clearly outside the main channel. The photography shows that much of the middle Gila River is dry except for segments near Blackwater and below Pima Butte.

By 1972, a distinct compound channel configuration is established where a single, narrow low flow channel is inset into a larger flood plain with several overflow channels. Near Florence, the low flow channel was mechanically channelized. Also, many of the phreatophytes formerly present in the flood plain were absent due to groundwater withdrawal and subsequent lowered water tables (Rea, 1983). Because the low flow channel along most reaches is too small to support unregulated streamflow, it is not suitable for defining the middle Gila River channel. However, the overflow channels are difficult to distinguish on the orthophotoquads since they consist of several small distributary channels and lack vegetation along their banks. Consequently, banks on the larger flood channel are used to define the 1972 channel boundary resulting in a relatively wide channel. Locally, the 1936 and 1972 channel boundaries are identical.

Lower Gila River

Most of the first General Land Office plats that include the lower Gila River were surveyed between 1868 and 1890 except for T. 4 S., R. 8 W. (1910), T. 5 S., R. 10 W. (1914), T. 8 S., R. 19 W. (1912), and T. 8 S., R. 20 W. (1916) (Table E). Channel positions before 1890 are sketched between section lines in all of the townships except T. 8 S., R. 21 W. and T. 8 S., R. 22 W. where sections are subdivided into 1/8 units. All subsequent surveys subdivide the sections and provide better accuracy on channel position. The lower Gila River is plotted as a single channel on most of the early plats, although the channel is shown to branch along a few reaches. Plats produced after 1910 tend to show a wider flood channel with a single thread, low flow channel. Fifteen and 30 minute U.S. Geological Survey maps of the lower reach below Agua Caliente are based on surveys made in 1901-02 and 1926-27. These maps are more accurate for plotting channel position but provide little information as to channel configuration. By 1920, streamflow is largely intermittent and most of the alluvial reaches are dry (Ross, 1923).

By the time the lower Gila River is systematically photographed from the air, it is an intermittent stream and most reaches are dry (Ross, 1923). Photography for the orthophotoquads was flown in 1971 and 1972. The orthophotoquads show a distinct break in channel configuration above and below Gillespie Dam. Above the dam, the channel is characterized by a sinuous low flow channel lined with tamarisk within a larger braided flood channel (Graf, 1981, 1988b,c). Similar to the lower reach of the middle Gila River, the outer banks of the braided flood channel are used to define the channel boundaries. In many places, artificial levees encroach upon this boundary. Below Gillespie Dam, there is considerably less flood plain vegetation, and the low flow channel is also braided but contains a slightly sinuous course. This compound form extends to Wellton, but from Wellton to Yuma, the channel is largely channelized by a series of artificial levees.

Summary

The Gila River is a classic example of a dryland river that seldom seeks an equilibrium form (Graf, 1988a; Knighton, 1984; Stevens and others, 1975). Unlike rivers in humid regions that have more stable channels adjusted for more continuous streamflow with less variance in discharge,

the dryland rivers are inherently more unstable and more prone to changes in channel configuration. In such unstable fluvial systems, channel configuration depends much upon the history of previous flood events. Periods of high flood frequency are likely to correlate to periods of increased channel instability. In 1912, Arizona was experiencing one of its wettest decades in several centuries (Meko and Graybill, 1993). This was also a period of increased large flood frequency (Ely, 1992), and not surprisingly, many streams within the Gila River watershed were experincing channel changes (Bahre, 1991). Beginning in 1905 on the upper and middle segments of the Gila River, the channel was experiencing tremendous channel widening due to bank cutting during periods of sustained flood flow (Burkham, 1972; Huckleberry, 1993b). In 1912, vegetation had not yet colonized the scoured flood channel, and most alluvial reaches were wide, sandy, and braided. Interestingly, the floods of January, 1993 have resulted in similar channel changes on at least the middle reach of the Gila River.

The chronology of channel dynamics on the lower Gila River are less certain, however it appears that dramatic channel transformations occurred in 1890 and 1891, approximately 15 years earlier than that for the upper and middle reaches. It appears again that two catastrophic floods were instrumental in the destruction of flood plain vegetation and causing dramatic bank erosion (Ross, 1923). Although construction of Roosevelt Dam on the Salt River limited the magnitude of flood flow reaching the lower Gila River after 1911, the lower Gila River was still experiencing excess sediment and water generated from the upper and middle Gila River reaches and possibly other tributaries during the time of statehood. Consequently, channel planform and geometry of the lower Gila River in 1912 can also be characterized as mostly shallow and braided.

Although system instability is believed to have been climatically driven on the Gila River, one cannot ignore anthropogenic mechanisms as well. At the turn of the century, the Gila River watershed was experiencing considerable vegetation change due to cattle grazing and removal of flood-plain vegetation for agricultural purposes (Bahre, 1991). Removal of grass from hillslopes accelerates runoff leading to larger peak discharges in main trunk streams, and removal of flood plain vegetation exposes banks to greater erosion. Because a rare climatic event corresponded in time to considerable landscape degradation near the turn of the century, it is not possible to separate the natural and anthropogenic causes of the channel changes on the Gila River. Obviously both processes play a role. However, a basic premise of this study is that the Gila River responds to secular climatic variability by radical changes in channel configuration, and that periods of increased, large flood frequency correlate with unstable, braided channel conditions.

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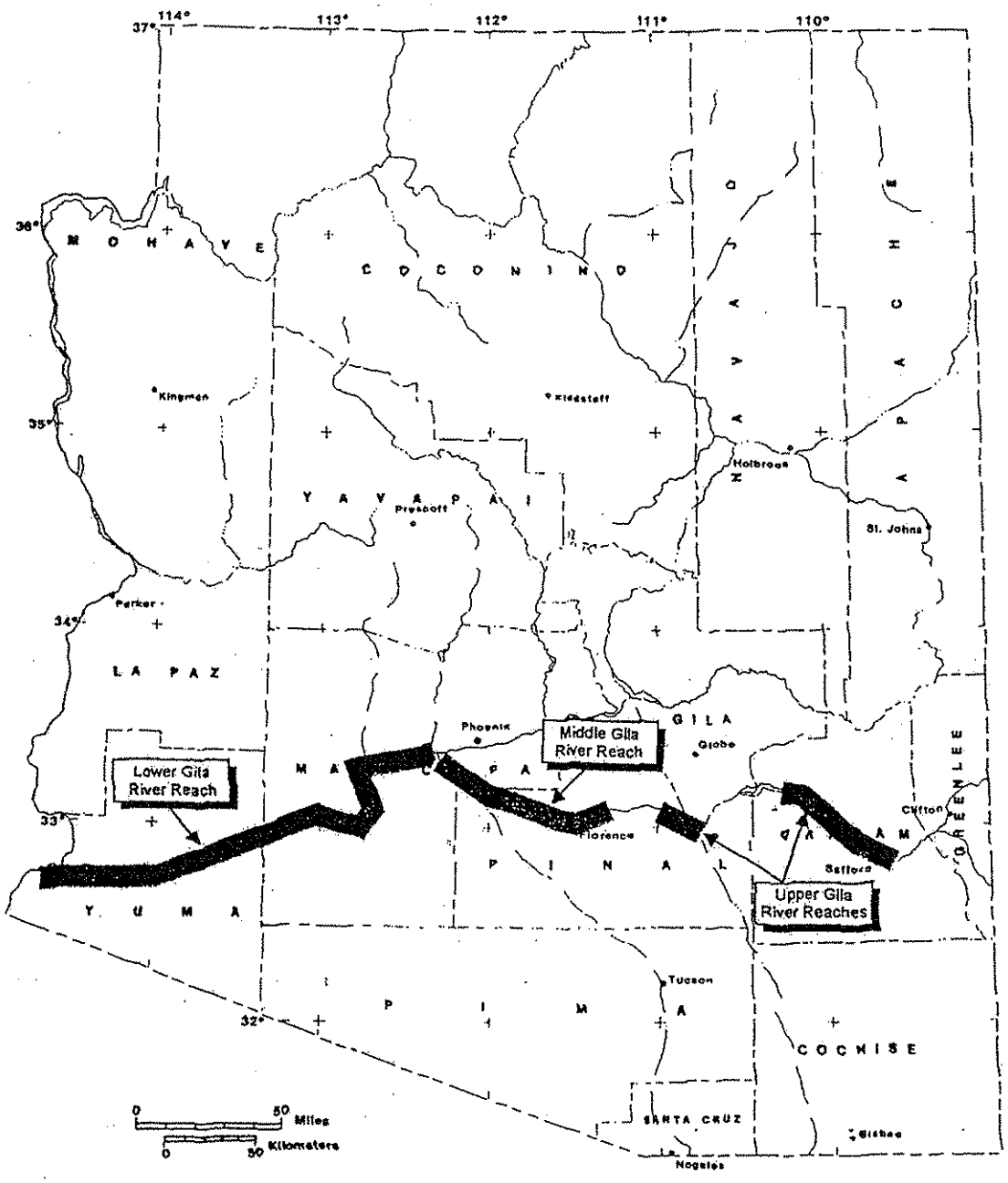
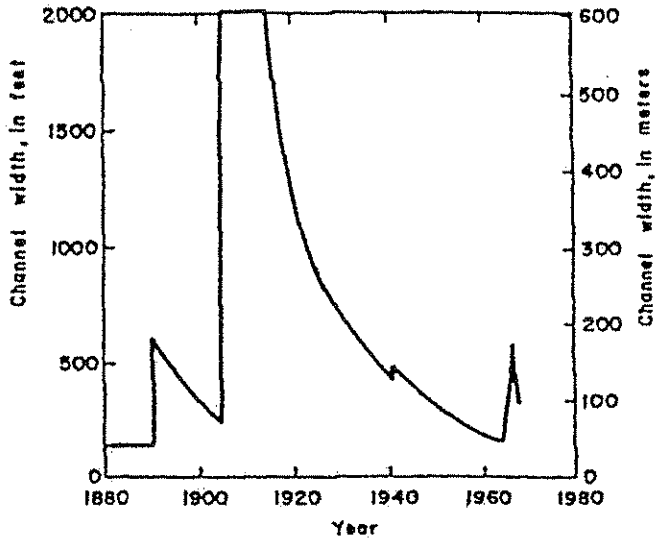


FIGURE 16. STUDY REACHES OF THE GILA RIVER



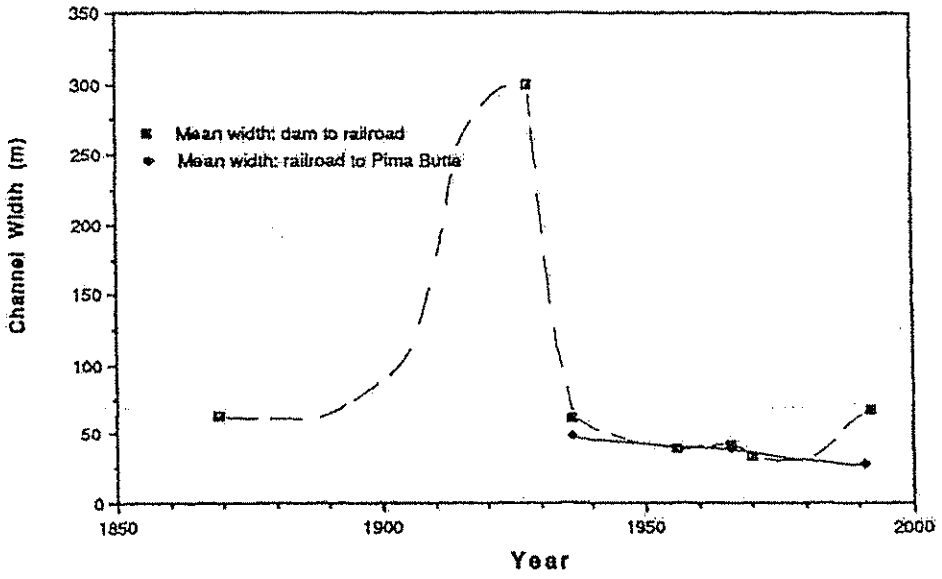


FIGURE 17. Changes in channel width for the upper (top) and middle (below segments of the Gila River. Data for upper Gila River from Burkham (1972: Plate 3). Data for Middle Gila River from Huckleberry, (1993: Figure 19).

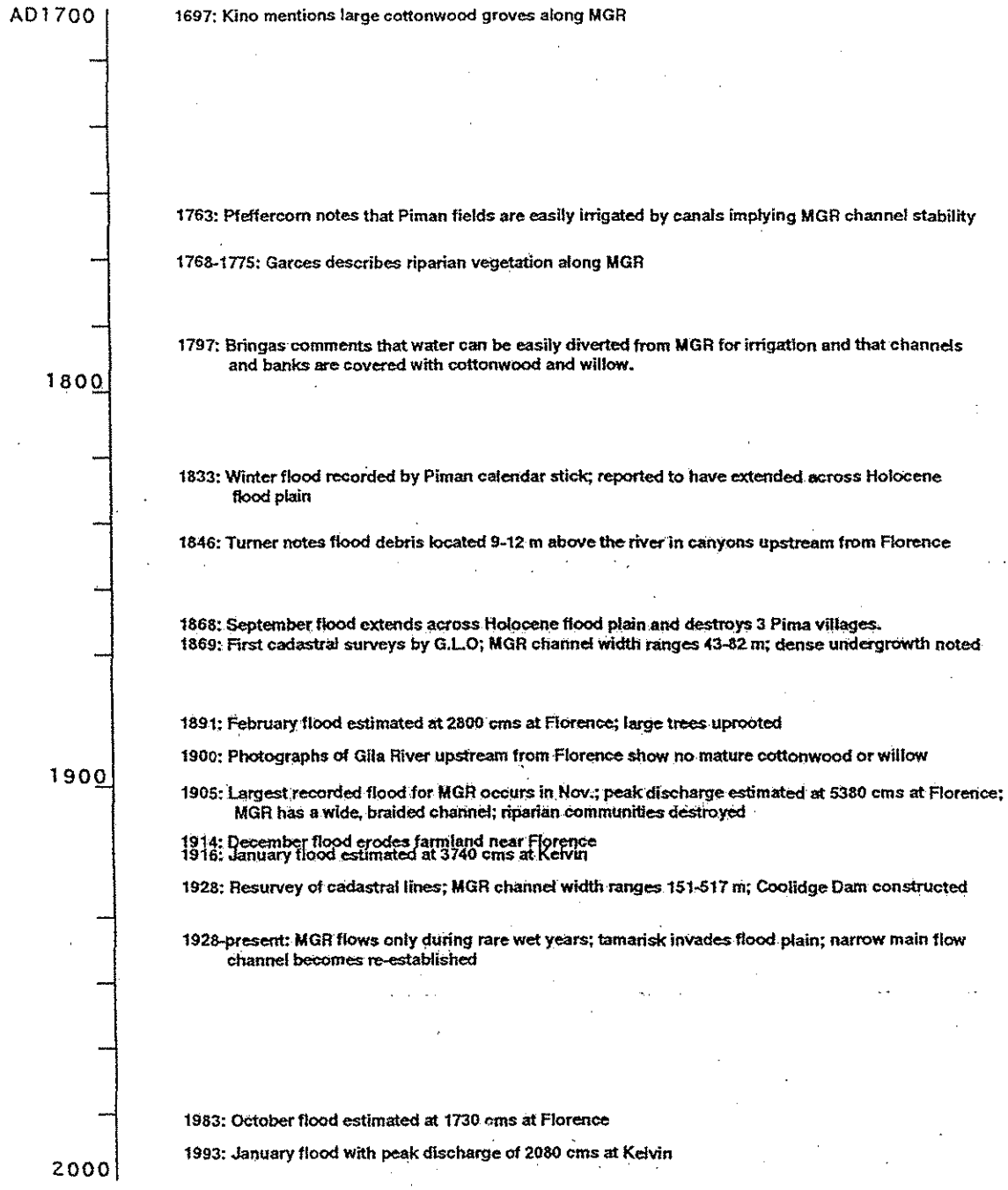


FIGURE 18. Historical descriptions of the middle Gila River (Huckleberry, 1993: Figure 18)

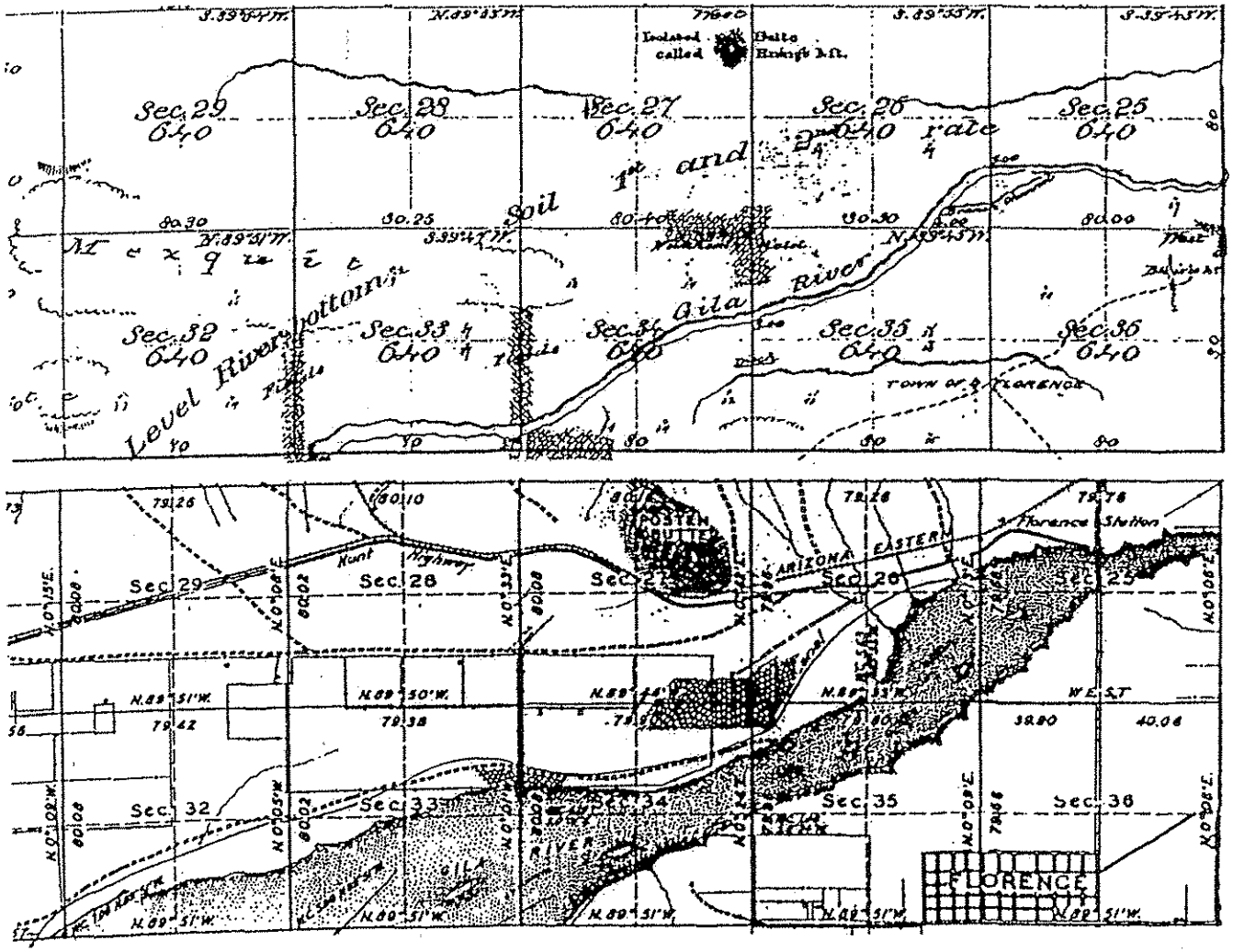


FIGURE 19. General Land Office plats of township T. 4 S., R. 9 E. surveyed in 1869 (above) and 1928 (below). Note change in the width of the Gila River channel.

Table A. Maps and Aerial Photographs Utilized in Plotting Upper Gila River Channel.

USGS 7.5' Quadrangles (year of photography)	Orthophotoquads (year of photography)	Aerial Photography[1] (year)	Other Historical Maps[2] (year)	Cadastral Surveys (year and township)
Kearny (1962)	Kearny (1972)	1934		1879 (T4S, R14E)
Hayden (1962)	Hayden (1972)	1934		1877 (T5S, R14E) 1877 (T5S, R15E)
Winkelman (1947)	Winkelman (1972)	1934		1877 (T5S, R15E)
Dewey Flat (1959)	San Carlos Reservoir NE (1972)			
Calva (1957)	Bylas NW (1972)		1914-1915	
Bylas (1957)	Bylas NE (1972)	1935	1914-1915	
Geronimo (1957)	Bylas SE (1972)	1935, 1952	1914-1915	1875 (T4S, R23E)
Fort Thomas (1957)	Fort Thomas SW (1972)	1935, 1952	1914-1915	1875 (T4S, R23E) 1875 (T5S, R23E) 1875 (T5S, R24E)
Eden (1957)	Thatcher NW (1972)	1935, 1952	1914-1915	1875 (T5S, R24E) 1875, 1916 (T6S, R24E)
Pima (1957)	Thatcher NE (1972)	1935, 1952	1914-1915	1875, 1916 (T6S, R24E) 1875 (T6S, R25E)
Thatcher (1957)	Thatcher SE (1972)	1935, 1952	1914-1915	1875 (T6S, R25E)
Safford (1957)	Safford SW (1972)	1935, 1952	1914-1915	1875 (T6S, R25E) 1875 (T7S, R25E) 1875 (T7S, R26E)

[1] 1934 SCS photography on file at the Arizona Geological Survey; 1935 SCS photography on file at the Bureau of Land Managment, Safford; (1952 SCS photography in Gelderman, 1970)

[2] 1914-1915 channel position in Burkham, 1972:Plate 1, originally from Olmstead, 1919.

Table B. Upper Gila River Channel Characteristics (Adapted from Burkham, 1972: Table 1).

Year	Total Area ha (acres)	Length km (miles)	Average Width m (ft)	Sinuosity m/m
Subreach A: Near Solomon to Pima Bridge (See Burkham 1972: Plate 1)				
1875	116 (290)	24.54 (15.34)	48 (160)	1.20
1903	176 (441)	22.88 (14.30)	75 (250)	1.12
1914	1,192 (2,980)	20.38 (12.74)	579 (1,930)	1.00
1935	334 (836)	22.11 (13.82)	150 (500)	1.08
1957	224 (560)	23.07 (14.42)	96 (320)	1.13
1966	428 (1,070)	20.54 (12.84)	207 (690)	1.01
1967	464 (1,160)	20.64 (12.90)	222 (740)	1.01
1968	332 (830)	20.48 (12.80)	159 (530)	1.01
Subreach B: Pima Bridge to Near Geronimo (See Burkham 1972: Plate 1)				
1875	152 (380)	36.64 (22.90) [1]	41 (137)	---
1894	180 (450) [2]	11.90 (7.44) [2]	150 (500) [2]	1.12
1903	179 (448) [2]	22.2 (13.9) [2]	81 (270) [2]	1.16
1914	360 (900)	32.3 (20.2)	600 (2,000)	1.00
1935	580 (1,450)	36.1 (22.6)	159 (530)	1.12
1942	516 (1,290)	36.9 (23.1)	138 (460)	1.14
1957	236 (590)	38.5 (24.1)	60 (200)	1.19
1966	324 (810)	36.6 (22.9)	87 (290)	1.13
1967	632 (1,580)	36.8 (23.0)	171 (570)	1.13
1968	360 (900)	36.4 (22.8)	99 (330)	1.13
Subreach D: Near Bylas to Near Calva (See Burkham 1972: Plate 1)				
1914	201 (503)	9.74 (6.09)	272 (907)	1.09
1935	128 (320)	10.06 (6.29)	126 (420)	1.12
1942	90 (225)	10.50 (6.56)	84 (280)	1.17
1947	28 (70)	11.06 (6.91)	24 (80)	1.24
1954	24 (59)	11.28 (7.05)	21 (70)	1.26
1964	28 (70)	11.71 (7.32)	24 (80)	1.31
1967	49 (122)	10.88 (6.80)	45 (150)	1.22
1968	95 (238)	10.88 (6.80)	87 (290)	1.22

[1] Stream length was not measured in 1875; the length was "sketched in" by the field party.

[2] Map covered only part of reach.

Table C. Maps and Photography Utilized in Plotting the Middle Gila River Channel Positions.

USGS 7.5' Quadrangles (year of photography[1])	USGS 15' Quadrangles (year of photography or survey)	Orthophotoquads (year of photography)	Aerial Photography (year)[2]	Other Historical Maps[3] (year)	Historical Cadastral Surveys (year and township)
Florence SE (1963)		Florence SE (1972)	1936	1914	1869, 1928 (T4S, R10E)
Florence (1963, *1978*)		Florence (1972)	1936	1914	1869, 1928 (T4S, R9E) 1869, 1928 (T5S, R9E) 1869, 1928 (T5S, R8E)
Blackwater (1963, *1978*)	Sacaton (1904-1906)	Blackwater (1971)	1936	1914	1869, 1928 (T5S, R8E) 1876 (T4S, R8E) 1876 (T4S, R7E)
Sacaton (1963, *1978*)	Sacaton (1904-1906)	Sacaton (1971)	1936		1876 (T4S, R7E)
Gila Butte SE (1951, *1978*)	Gila Butte (1903-1904)	Gila Butte SE (1971)	1936		
Gila Butte (1951, *1978*)	Gila Butte (1903-1904)	Gila Butte (1971)	1936		
Gila Butte NW (1951, *1978*)	Gila Butte (1903-1904)	Gila Butte NW (1971)	1936		
Pima Butte (1951, *1967*)	Maricopa (1903-1904)	Pima Butte (1971)	1936		1876 (T3S, R3E) 1876 (T2S, R3E) 1868 (T2S, R2E)
Montezuma Peak (1951, *1967*)	Maricopa (1903-1904)	Montezuma Peak (1971)	1936		1868 (T2S, R2E)
Laveen (1951, *1973*)	Phoenix (1903-1904)	Laveen (1971)	1936		1868 (T2S, R2E) 1868 (T1S, R2E) 1868 (T1S, R1E)
Avondale SE (1954, *1971*)		Avondale SE (1971)	1936		1868 (T1S, R1E)

[1] Year of revision photography in intalics.

[2] Soil Conservation Photography on file at the Cartographic Division, National Archives, Washington D.C.

[3] Map of Florence District, U.S. Indian Irrigation Service, on file at the Bureau of Indian Affairs, Phoenix.

Table Da. Channel widths (meters) of selected cross-sections in upper reach of middle Gila River.

Township		Surveyed	Year							
& Range	Sections	Cross-section	1869	1892	1928	1936	1954-57	1966	1969-70	1992
T4S, R10E	11&12	1	70		275	85	-	61	-	-
T4S, R10E	10&11	2	70		-	73	-	61	-	70
T4S, R10E	15&16	3	50		269	58	30	41	36	
T4S, R10E	20&21	4	57		220	43	40	45	31	30
T4S, R10E	19&30		50	140	340	-	-	-	-	-
T4S, R9E	25&30		-		151	58	34	-	-	-
T4S, R9E	25&26		60		-	58	40	31	44	
T4S, R9E	26&35	5	57		225	57	-	31		30
T4S, R9E	34&35	6	43		339	58	48	41	29	-
T4S, R9E	33&34		53		278	65	-	-	-	-
T5S, R9E	5&4	7	-		383	50	54	66	36	85
T5S, R9E	6&7		71		-	-	-	-	-	-
T5S, R9E	12&7	8	82		424	65	26	15	26	60
T5S, R8E	11&12	9	81		172	58	23	41	31	105
T5S, R8E	10&11	10	70		517	72	55	36	36	95
average			62.6		299.4	61.5	38.9	42.6	33.6	67.9
standard deviation			12.3		106.7	10.7	11.7	15.2	5.6	29.8
median			62.5		334.0	64.0	39.0	40.5	35.0	67.5

1869, 1892, and 1928 values are determined from survey notes.
1936, 1954-1957, and 1969-1970 values measured from aerial photographs.
1966 values measured from Florence SE and Florence quadrangles (1:24,000).
1992 values measured with electronic station; low flow channel.

Table Db. Channel widths (meters) of selected cross-sections in lower reach of middle Gila River.

Township & Range	Sections	Surveyed Cross-Section	Year 1876	1903	1914	1928	1936	1966	1991
T5S, R8E	3&4	11				247	36	40	56
T4S, R8E	31&32	12	20				28	40	35
T4S, R8E	22&27	13					69	38	29
T4S, R6,7E	7&12	14					57	34	41
T4S, R6E	9	15					56	48	36
T4S, R6E	6	16					63		23
T3S, R5E	21	17			92		49		16
T3S, R5E	18&19	18			145		56		20
T3S, R4E	14	19		65			35		17
T3S, R4E	19&20	20		49			42		10
						average	49.1	40.0	28.3
						standard deviation	13.4	5.10	14.0
						median	48.5	43.0	33.0

Notes:
1. 1876 and 1928 values determined from survey notes.
2. 1903 values measured from U.S. Indian Service Map (1:32,000).
3. 1914 values measured from U.S. Indian Service Map (1:12,000).
4. 1936 values measured from aerial photography.
5. 1966 values measured from Blackwater and Sacaton quadrangles (1:24,000).
6. 1991 values measured with electronic station; low flow channel.

Table E. Maps and Photography Utilized in Plotting Lower Gila River Channel Position.

USGS 7.5' Quadrangles (year of photography[1])	USGS 15' Quadrangles (year of photography or survey)	Orthophotoquads (year of photography)	Aerial Photography[2] (year)	Historical Cadastral Surveys (year and township)
Tolleson (1954, *1978*)		Tolleson (1971)		1868 (T1N, R1W)
Perryville (1954, *1978*)		Perryville (1971)		1868 (T1N, R1W) 1883 (T1N, R2W)
Avondale SW (1957, *1971*)		Avondale SW (1971)		1883 (T1S, R2W)
Buckeye (1958, *1971*)		Buckeye (1972)		1883 (T1S, R3W)
Hassayampa (1958, *1971*)		Hassayampa (1972)		1883 (T1S, R4W) 1882 (T1S, R5W)
Arlington (1960, *1981*)		Arlington SE (1972)		1882 (T1S, R5W) 1882 (T2S, R5W)
Spring Mt. (1972)		Spring Mt (1972)		1882 (T2S, R5W)
Cotton Center NW (1972)		Cotton Center NW (1972)		1882 (T3S, R5W) 1871 (T3S, R4W)
Cotton Center (1972)		Cotton Center SW (1972)		1871 (T4S, R4W) 1871 (T5S, R4W)
Gila Bend (1972)		Gila Bend NW (1972)		
Dendora Valley (1979)		Dendora Valley SE (1972)		1910 (T4S, R8W) 1914 (T5S, R8W)
Oatman Mt. (1979)		Dendora Valley SW (1972)	1953	1877 (T5S, R9W) 1877 (T5S, R10W)
Sentinel Peak (1979)		Sentinel Peak (1972)	1953	1877 (T5S, R10W)
Hyder SE (1963, *1980*)	Hyder (1927)	Hyder SE (1972)	1953	
Agua Caliente (1962, *1982*)	Aztec (1926-27)	Agua Caliente (1972)	1953	1877 (T5S, R10W) 1877 (T5S, R11W)
Aztec NW (1963, *1980*)	Aztec (1926-27)	Aztec NW (1972)		1877 (T6S, R11W) 1877 (T6S, R12W)
Horn (1962-63)	Stoval (1927)	Horn (1972)		1877 (T6S, R12W) 1877 (T6S, R13W)
Dateland (1962-62; *1980*)	Stoval (1927)	Dateland (1972)		1877 (T6S, R13W) 1877 (T7S, R13W)
Texas Hill (1963, *1980*)	Stoval (1927)	Texas Hill (1972)	1953	1877 (T6S, R13W) 1877 (T7S, R14W)
Growler (1953, *1980*)	Norton (1926)	Growler (1972)	1953	1877 (T7S, R15W) 1878 (T7S, R16W)
Roll (1953, *1980*)	Norton (1926)	Roll (1972)	1953	1878 (T7S, R16W) 1878 (T8S, R16W)
Tacna (1962, *1980*)	Mohawk (1926)	Tacna (1972)		1878 (T8S, R16W) 1878 (T8S, R17W)
Wellton Mesa (1962)	Wellton (1926)	Wellton Mesa (1972)		1878 (T8S, R17W) 1878 (T8S, R18W)

USGS 7.5' Quadrangles (year of photography[1])	USGS 15' Quadrangles (year of photography or survey)	Orthophotoquads (year of photography)	Aerial Photography[2] (year)	Historical Cadastral Surveys (year and township)
Wellton (1962)	Wellton (1926)	Wellton (1972)		1878 (T8S, R18W) 1912 (T8S, R19W)
Ligurta (1962)	Fortuna (1902-03; 1925-26)	Ligurta (1972)		1916 (T8S, R20W)
Dome (1953, *1985*)	Laguna (1902-03; 1925-26)	Dome (1972)		1890 (T8S, R21W)
Laguna Dam (1953, *1976*)	Laguna (1902-03; 1925-26)	Laguna Dam (1972)		1890 (T8S, R21W)
Fortuna (1962-62, *1976*)	Fortuna (1902-03; 1925-26)	Fortuna (1972)		1890 (T8S, R21W) 1874 (T8S, R22W)
Yuma East (1948, *1976*)	Yuma (1902-03)	Yuma East (1973)		1874 (T8S, R22W)

[1] Year of revision photography in intalics.
[2] 1953 photography on file at the Arizona Geological Survey

CHAPTER VIII

Land Use Along the Gila River

Part 1

(General overview and summary of existing land uses along the Gila River from Safford to Yuma, Arizona.)

For the purposes of this study, the 300-mile study area encompassing the Gila River and its 100-year floodplain has been divided into segments that reflect the predominant land use on uses within each segment of the reach. The land uses are shown parcel by parcel on the Gila River Base Map and include:

- Agricultural/Undeveloped
- Residential - Single Family/Mobile Homes
- Commercial
- Mineral/Mining
- Municipal Water/Wastewater Plants & Landfills
- Parks/Recreation/Open Space

The data presented in this chapter was not updated for the 2003 report revision.

1. Background

The Gila River runs almost the entire east-to-west length of Arizona. The reach for this study starts in Safford and ends at the confluence of the Gila and Colorado Rivers just east of Yuma. After studying the land uses within the reach and during several field trips, it was found that modern settlement patterns along the Gila River have been more a result of the railroad rather than of the river itself, although the river and its water supply played a key role.

Starting in Safford, other major communities along the Gila include Thatcher, Winkelman, Kearny, Florence, Coolidge, Gila Bend, Wellton and Yuma. The settlement of these communities, with the exception of Yuma, corresponded directly to the construction of the railroad in the late 1870's, rather then to the presence of the Gila River. Over time, these communities became centers for agriculture as irrigation facilities were developed. This agricultural orientation still predominantly exists today.

2. Land Use Summary

For the purposes of this summary, the Gila River from Safford to Yuma has been divided into eight segments based on the predominant land use in each segment.

These segments include the following:

1. Gila Box to eastern San Carlos Indian Reservation boundary
2. Western San Carlos Indian Reservation Boundary to Winkleman
3. Winkleman to Kelvin
4. Kelvin to Ashurst-Hayden Dam
5. Ashurst-Hayden Dam to eastern Gila River Indian Reservation boundary
6. Western Gila River Indian Reservation boundary to easter Painted Rock State Park boundary
7. Eastern Painted Rock State Park boundary to western Painted Rock State Park boundary
8. Western Painted Rock State Park boundary to Yuma

1. Gila Box to eastern San Carlos Indian Reservation Boundary

Agriculture/undeveloped is the predominant land use in this Gila River segment. Appurtenant to this agricultural land use pattern is an abundance of irrigation well sites, an extensive network of irrigation canals and some agricultural buildings and facilities.

Intermittent residential land uses also exist in this segment, such as two trailer parks just to the west of Solomon, and individual residential dwelling units in or near the villages of Solomon, Pima, Bryce, Geronimo and Fort Thomas.

While there are no park/recreation areas located within this segment, approximately 23 miles of the Gila River within the Gila Box is considered suitable for inclusion in the Wild and Scenic River System in conjunction with the Arizona Desert Wilderness Act approved by the U.S. Congress in 1990.

2. Western San Carlos Indian Reservation to Winkleman

This segment of the Gila River forms the boundary between fee land to the north and the San Carlos Indian Reservation to the south and is totally undeveloped. With a terrain characterized by steep mountain cliffs and sandy vegetated river bottom land, this segment of the Gila River possesses a high degree of riparian and wildlife habitat value. A 7.5 mile portion of this segment is considered to be partially suitable for inclusion in the Wild and Scenic River System.

3. Winkleman to Kelvin

Several small communities dot this segment of the Gila River which depend on the mining industry for their livelihoods. Winkleman Flats, located in the eastern portion of the town of Winkleman lies within the 100-year flood plain and experienced extensive damage by the flooding of the Gila River in the spring of 1993.

There are, however, individual residential dwelling units situated within the flood plain

between Winkleman and Hayden, in Kearney, and in the small unincorporated area of Riverside.

Between the towns of Winkleman and Hayden and within the 100-year flood plain is a large tailings pond associated with the ASARCO pit and deep copper mining operation. While located within the flood plain, the high dirt walls surrounding the pond are intended to prevent any pollutants from entering the Gila River.

Other uses located within the flood plain in this segment of the Gila River include the Hayden Golf Club in Winkleman, an underground gas transmission line in the vicinity of the confluence of the San Pedro and Gila Rivers, and a sewage disposal pond in Kearney.

Finally, according to ADEQ, there is a closed landfill located at the southeastern edge of the Hayden Country Club that was once operated by the Town of Hayden. This closed landfill is situated within the Gila River's 100-year flood plain.

4. Kelvin to Ashurst-Hayden Dam

For the most part inaccessible except by rail, this Gila River segment is very similar to segment 2 in that the streambed is almost totally undeveloped. The only development along this segment is the A-Diamond Ranch with two barns and the settlement of Cochran, with two individual dwelling units, both within the 100-year floodplain.

This lack of development, coupled with steep mountain slopes and dense native and salt cedar vegetation, make this segment very valuable as a riparian and wildlife habitat.

5. Ashurst-Hayden Dam to eastern Gila River Indian Reservation boundary

This segment of the Gila River widens to as much as one mile at some points downstream of the Ashurst-Hayden Dam, which was constructed for irrigation water diversion. The Florence-Casa Grande Canal carries these irrigation waters to the many agricultural fields that lie both within and just outside of the 100-year flood plain. Because of their proximity to the Florence State prison, some of these fields lie within State Prison Ranches No. 1 and 2.

Other land uses within this segment include individual residential units to the north and west of the City of Florence, a sewage disposal pond northwest of Florence, and two gravel pits, one east of Florence and one to the northwest of the village of Adamsville. There are also two closed landfills that are located within the river's 100-year flood plain, both of which were operated by the City of Coolidge.

6. Western Gila River Indian Reservation Boundary to eastern Gila Bend Indian Reservation Boundary

Beginning at the confluence with the Salt River, this Gila River segment is predominantly agricultural with its antecedents of well sites and irrigation canals. In fact, one water impoundment structure, Gillespie Dam, was constructed not for flood control but for the purpose of diverting water into the Arlington and Gila Bend Canals that provide irrigation water to the numerous ranches in the area, most notable the Poloma Ranch. Because of this heavy emphasis on farming, there appear to be many agricultural structures such as barns and outbuildings that lie within the 100-year floodplain, primarily in the area south of Buckeye.

In the area of the confluence of the Gila, Salt and Agua Fria Rivers, just south of the City of Avondale, possibly as many as one hundred agricultural buildings lie within the 100-year floodplain. These buildings are situated in the vicinity of 115th Avenue and Southern Avenue. Other concentrations of residential dwelling units in the floodplain exist south of Buckeye in the village of Allenville and in the Arlington Valley. Adjacent to these residential units is the Arlington School, also situated within the 100-year floodplain.

Other land uses in this segment, that lie within the flood plain, include portions of the Phoenix International Raceway parking lot; the Estrella Mountain Regional Park and Sierra Estrella Golf Course; wastewater treatment plants and sewage disposal ponds west of Buckeye and north of Gila Bend; several gravel pits; two landing strips west of Gila Bend; four natural gas pipelines (three in vicinity of Gillespie Dam); and the Liberty Cemetery of Tuthill and Lower River Roads.

In addition, there is a closed landfill once operated by the Town of Buckeye located within the river's 100-year floodplain at Miller Road and the Gila River.

7. Eastern Painted Rock State Park boundary to western Painted Rock State Park boundary

The boundaries of this segment encompass Painted Rock Reservoir and approximately 2,500 acres below Painted Rock Dam that was once leased by Arizona State Parks. Owned by the U.S. Bureau of Land Management, the primary land use within this segment has been recreational in nature. With Arizona State Parks providing facilities for fishing, boating and other passive recreation opportunities. However, the recreational value of this segment is currently questionable due to the DDT infiltration into the watercourse from surrounding agricultural uses. At the time of this study in 1993, the park was closed and Arizona State Parks had not renewed its lease due to this environmental problem.

8. Western Painted Rock State Park boundary to Yuma

Beginning in the area known as Dendora Valley and ending at the confluence of the Gila River with the Colorado River at Yuma, the predominant land use in this segment

is agricultural or undeveloped. Another land use characteristic of this segment, because of its agricultural orientation, are the great number of roadways and canals that were constructed to access and to serve the many fields under cultivation that lie within the floodplain. This land use pattern is extremely defined in the area administered by the Mohawk-Wellton Irrigation and Drainage District.

Also prevalent within the flood plain throughout this segment, are scattered residential units and agricultural buildings, specifically, north of Dateland, near Texas Hill, near the Colfred Floodway, north of Tacna, Roll and Wellton, and east of Yuma. In addition, three other uses that lie within the floodplain in this segment are a landing strip near Tacna, the Mohawk Valley School near the village of Roll, and a closed landfill located 2.8 miles north of Wellton.

Part 2

(Discussion of land uses, ownership, acreages and environmental concerns with appendix and table references.)

Land ownership, land use and environmental concerns along the study reach of the Gila River between Safford and the confluence with the Colorado River at Yuma will be discussed in this part of the chapter. Information gathered for reference and study include:

- Land Ownership
- Land Use and Existing Improvements
- Vegetation and Wildlife
- Environmental Concerns

The discussion in the second part of this chapter is limited to current land ownership, existing land uses and improvements and environmental concerns within the floodplain boundaries along the study reach. Some reference, however, is made of the Gila River before and after the time of Statehood (February 14, 1912) for historical perspective in summarizing vegetation and wildlife.

1. Information Sources

The sources of information for the land ownership were the county assessor records at the Maricopa County Assessor's Office (Maricopa County), the county assessor records at the Arizona Department of Revenue (Yuma, Gila and Graham Counties), the Pinal County Assessor's Office (for Pinal County), the State Land Department leasing database and the Bureau of Land Management's land ownership records. Sources for land use information were the County Flood Control Offices in Yuma, Maricopa, Pinal and Graham Counties (to identify existing sand and gravel operations on the study reach), U.S. Department of the Interior, Fish and Wildlife Service, Arizona Game and Fish Department, Arizona Parks Department, Arizona Department

of Environmental Quality and the Arizona State Mine Inspector for other land use information.

2. Methodology

Data was obtained from Maricopa and Pinal County Assessors records, Arizona Department of Revenue assessors records, for Yuma, Gila and Graham Counties, the State Land Department and Bureau of Land Management records, to ascertain land ownership; local, State and Federal agencies were contacted to obtain land use data. This data was used to construct a Geographical Information System (GIS) for the Gila River study reach. The GIS can be used to assign information, such as land use, land ownership, vegetation, wildlife and geologic/hydrologic characteristics and other information to specific land parcels or reaches of a river. The Gila River GIS developed for this study was partially adopted from the Flood Control District of Maricopa County (FCDMC) GIS, and combined with the data described above.

A portion of land ownership information for the Gila River GIS was received from FCDMC as ARC/INFO export files, and was converted into a GIS coverage after removing parcel polygons for Salt River areas. Land Use information was also obtained from local, State and Federal agencies (described above). Land use codes in the GIS were based on standard state of Arizona property use codes obtained from the Arizona Department of Revenue, and were recorded and entered with ownership information using ARC/INFO file.

Plots of GIS information for the Gila River, including land owned by Arizona Game and Fish, U.S. Bureau of Land Management, Indian Reservations, Arizona State Trust Land, privately held lands and other (unspecified) owners are provided in Appendix I. These GIS plots also include:

- Land Ownership
- Land Use
- Main Channel Alignment
- Floodplain Limits

3. Land Use and Ownership

Land Ownership was obtained from the Arizona Department of Revenue assessor records (for Yuma, Gila and Graham Counties), Maricopa County assessor records, Pinal County assessor records, State Land Department leasing records, Bureau of Land Management ownership records and from FCDMC Metroscan file for that portion of the Gila River from the Salt River confluence to Gillespie Dam. A summary of Gila River land ownership and land use information based on these data sources are shown in the following tables. The largest percentage of land held, between the confluence of the Gila and Colorado Rivers and Safford is private, followed by the Bureau of Land Management, three indian reservations (San Carlos, Gila and the tiny Gila Bend Indian Reservation north of the Town of Gila Bend), Arizona Department of

Game and Fish and State Trust lands managed by the Arizona State Land Department.

Gila River Land Ownership	
Owner	**Acres**
Private	243,772
Bureau of Land Management	105,480
Gila River Indian Reservation	5,289
San Carlos Indian Reservation	7,358
Gila Bend Indian Reservation	9,694
Game and Fish Department	1,898
Arizona State Trust Lands	30,135
Other	151,365
Total	**554,992**

Gila River Land Use	
Land Use	**Acres**
Vacant Land	80,577
Residential-single family	1,830
Residential-multiple family	20
Hotel-motel-resorts	0
Condominiums	0
Commercial property	1,096
Industrial Property	149
Farm/ranch property	149,665
Public utilities	168
Natural resources	1,270
Special use property	5,657
General service use	170,182
Other	144,378
Total	**554,992**

4. Agriculture

Agriculture is the primary land use along the Gila River from the confluence at the Colorado River, through three Indian Reservations; the Gila Bend Indian Reservation, north of the Town of Gila Bend, the Gila Indian Reservation, south of Phoenix and the San Carlos Indian Reservation, northeast of Hayden (see General Location Map in Appendix A) to the terminus of the study reach at Solomon. Examples of crops to be found along the study reach include: cotton and lettuce, alfalfa hay, winter grains (such as wheat and barley), milo/sorghum and assorted vegetable crops (such as beets, broccoli, onions and cabbage). In the Safford area, Graham County, cotton, wheat and feed grains are found. Cotton, wheat and barley, and feed grains/alfalfa may be found on the San Carlos Indian Reservation, in the Florence area, and on the Gila Indian Reservation. West of Phoenix, along the Gila River to the Gillespie Dam, cotton, milo, alfalfa, winter grains (wheat and barley), and some vegetable crops are grown. Along the lower Gila River from Gillespie Dam to the Yuma area, cotton, wheat, alfalfa, a variety of vegetables (especially lettuce) and citrus are found. Plots of agricultural use are provided on the land use maps in Appendix J.

5. Wildlife Habitat

The Arizona Game and Fish Department (AGFD) own 1,898 acres of land on the lower reach of the Gila River (from the Salt River confluence to Roll, Arizona). The biggest percentage lies along the study reach between the Salt River confluence and Gillespie Dam. The balance is dotted along the study reach from Gillespie Dam to an area near Roll (see land ownership maps in Appendix I. AGFD use their land for wildlife habitat, waterfowl, sand and gravel leasing, flood control and right of way leasing. At the time of this study, AGFD was in the draft stage of preparing management plans for their properties. AGFD recently acquired "Quigley Pond" downstream from Texas Hill. AGFD had six (6) parcels in the vicinity of Texas Hill; three (3) were exchanged with the Bureau of Land Management for "Quigley Pond". Another plan for 1991-1995 is the Robbins Butte wildlife area near Robbins Butte, NE¼ Section 28, T1S, R4W (Dove nesting, waterfowl, wildlife habitat) Reference Robbins Butte Wildlife Area Management Plan 1991-1995, Federal Aid Project W-85-17-30, November 1990 (see land use maps in Appendix J). Additional information on wildlife habitat planning by AGFD will be provided to the State Land Department in the near future.

Contacts with the United States Department of Interior, Fish and Wildlife Service, revealed that they have no wildlife refuges along the Gila River study reach.

6. Recreation

No specific sites have been identified along the Gila River study reach (except at San Carlos Reservoir) as recreational areas to accommodate activities such as boating, fishing and swimming; although, throughout the years people have individually engaged in these activities whenever conditions on the river have been favorable to do so. Even so, the State of Arizona recognizes that its water courses are a potential valuable resource for outdoor recreation. To this end, the state developed a comprehensive plan to assure the protection, enhancement, and enjoyment of the state's native resources -- The Statewide Outdoor Comprehensive Recreation Plan (SCORP). SCORP was prepared by Arizona State Parks and financed in part through a comprehensive planning assistance grant from the United States Department of Interior, National Park Service, under the provisions of the Land and Water Conservation Fund Act of 1965 (LWCF; Public Law 88-578)[1].

The Arizona State Parks Board (ASPB) is responsible for administering the LWCF program in Arizona and preparing its Statewide Comprehensive Outdoor Recreation Plan[2].

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[1] Arizona Statewide Comprehensive Outdoor Recreation Plan, Rose Mofford, Governor, Arizona State Parks, 1989

[2] Arizona Statewide Comprehensive Outdoor Recreation Plan, Rose Mofford, Governor, Arizona State Parks, 1989

Arizona's waterways are becoming increasingly important as recreational resources. Arizonans and visitors alike have come to view these waters as refreshing and revitalizing contrasts to urban and desert landscapes. In ever-growing numbers, people are pursuing water-related activities such as boating, tubing, hunting, fishing, hiking and swimming. Rivers and streams also provide desirable opportunities for more passive pursuits including picnicking, nature study, and general sightseeing[3].

In response to growing and changing demands in the state, the Arizona State parks Board initiated a major update of the Arizona State Comprehensive Outdoor Recreation Plan in 1987. Recognizing the importance of waterways to the state's overall outdoor recreation program, State Parks elected to focus a substantial portion of its efforts on a recreational and environmental evaluation of streams and wetlands. The Arizona rivers, Streams and Wetlands Study is the result of this initiative[4].

The study's fundamental conclusion is that Arizona's rivers, streams and wetlands can provide a wide variety of high quality outdoor recreation experiences for both residents and visitors[5]. The Gila River is mentioned in this report, along with the Salt, Verde and Little Colorado Rivers, for its growing popularity in whitewater boating, though no specific reach is identified. Notation was made that "in its native condition, Arizona's landscape was not as parched as what we experience today. Little more than a century ago, rivers and streams flowed year round in nearly every area of the state. The Santa Cruz River in Tucson, the Salt River in Phoenix, and the Gila River in Safford were, at one time, all perennial streams."[6]

It is estimated that only five to ten percent of Arizona's original native riparian habitat remains today. As a result, riparian communities now comprise only a very small portion of the total southwestern landscape, between 0.1 and 0.5 percent. Riparian areas are now Arizona's most threatened natural communities[7]. Fishing and hunting are not the only recreational activities to suffer from degradation of stream resources. Without adequate flow, boating is impossible; without healthy vegetation, campers lose shade and scenic quality suffers. Clearly, there is a relationship between environmental quality and diversity of recreational opportunities; a relationship that

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[3] Arizona Rivers, Streams and Wetlands Study, Chapter 2, pages 82-84; Arizona Statewide Comprehensive Outdoor Recreation Plan, Rose Mofford, Governor, Arizona State Parks, 1989

[4] Arizona Rivers, Streams and Wetlands Study, Chapter 2, pages 32-84; Arizona Statewide Comprehensive Outdoor Recreation Plan, Rose Mofford, Governor, Arizona State Parks, 1989

[5] Arizona Rivers, Streams and Wetlands Study, Chapter 2, pages 82-84; Arizona Statewide Comprehensive Outdoor Recreation Plan, Rose Mofford, Governor, Arizona State Parks, 1989

[6] Arizona Rivers, Streams and Wetlands Study, Chapter 2, pages 82-84; Arizona Statewide Comprehensive Outdoor Recreation Plan, Rose Mofford, Governor, Arizona State Parks, 1989

[7] Arizona Rivers, Streams and Wetlands Study, Chapter 2, pages 82-84; Arizona Statewide Comprehensive Outdoor Plan, Rose Mofford, Governor, Arizona State Parks, 1989

must be taken into account in planning for future stream and wetland recreation[8].

7. Other Uses

Numerous other activities and uses are currently present on the Gila River study reach. These include dam and flood control structures, flood control and drainage districts, commercial activities such as sand and gravel mining, roads, bridges and railroads. A summary of these uses follows:

Dam structures:

Four dam structures have identified along the study reach:

1. Coolidge Dam: located in the SW¼Section 17, T3S, R18E; latitude 33°-10'-10", longitude 110°-31'-50"; drainage area 12886 square miles; completed October 25, 1928, regulating flow since November 15, 1928; current estimated usable capacity is 866,600 to 1,073,600 acre-feet between elevations 2382.63 ft. (sill of lowest outlet gate) and 2510.4 ft. (revised, crest of spillway); maximum recorded storage 1,090,000 acre-feet, 26 February to 6 March 1980; no dead storage; stores water for irrigation of 100,000 acre San Carlos Project and for power development dependent on irrigation demands.

2. Ashurst-Hayden Dam: located in the SW¼NW¼Section 8, T4S, R11E; latitude 33°-14'-50"; drainage area 18,305 square miles; operational since July 1923; 10 miles northeast of Florence, Pinal County; diversions for Florence-Casa Grande irrigation canal; flow partially regulated by storage in San Carlos Reservoir; four sluice gates in dam with tip of opening 6.5 feet below crest of dam.

3. Gillespie Dam: located in the SE¼NE¼Section 28, T2S, R5W; latitude 36°-13'-45", longitude 112°-46'-00"; eight (8) miles downstream from Hassayampa River, approximately six (6) miles south of Arlington, Maricopa County; drainage area 49,650 square miles; diversions for Gila Bend Canal and Enterprise Canal; operational since August 1921; maximum recorded discharge, this location, 178,000 cfs, 16 February 1980; maximum estimated discharge for this location (outside of period of record) was 250,000 cfs, February 1891; average discharge of river above diversions at dam for 56 year period of record, 391 cfs.

4. Painted Rock Dam: located in the SE¼Section 18, T4S, R7W; latitude 33°-

[8] Arizona Rivers, Streams and Wetlands Study, Chapter 2, pages 82-84; Arizona Statewide Comprehensive Outdoor Recreation Plan, Rose Mofford, Governor, 1989

04'-30", longitude 113°-00'-50"; 19 miles northeast of Sentinel, Maricopa County; drainage area 50,910 square miles; operational since October 1959; no diversions for irrigation at this location; many diversions above station for irrigation; flow above dam regulated by many reservoirs, the largest of which is Painted Rock Reservoir, estimated capacity 2,492,000 acre-feet; maximum recorded discharge, this location, 9,190 cfs, 3 May 1983.

Major reservoirs on tributaries to the Gila River that have impacts on flow include:

Salt River: combined capacity of reservoirs is estimated at 1,755,000 acre-feet.

Verde River: combined capacity of Bartlett and Horseshoe Reservoirs is estimated at 317,700 acre-feet.

Agua Fria River: capacity of Lake Pleasant is estimated at 157,600 acre-feet.

See the land use maps in Appendix J for approximate locations of these features.

Irrigation/Flood Control Districts

Irrigation and drainage districts, flood control districts and agriculture water companies identified along the study reach between the confluence of the Gila and Colorado Rivers at Yuma and Safford include:

- Yuma Irrigation District - Yuma County
- Wellton-Mohawk Irrigation and Drainage District - Yuma County
- Arlington Canal Company - Maricopa County
- Woolsey Flood Protection District - Maricopa County
- Buckeye Water Conservation and Drainage District - Maricopa County
- Florence Flood Control District - Pinal County
- San Carlos Irrigation and Drainage District - Pinal County
- Gila Valley Irrigation District - Graham County
- Safford Valley Consolidated Canal System - Graham County

Commercial Activities

The land use maps in Appendix J show locations for commercial or industrial uses. Contacts with the floodplain offices of the counties where the Gila River was studied indicates that there are fifteen (15) sand and gravel mining operations presently operating under permit on the Gila River. These are shown in the table below.

Gila River Study Reach Active Sand and Gravel Operations Maricopa County				
OPERATOR	PERMIT STATUS	SEC	TWP	RNG
Edward Kelton Const	Approved	5	1S	2W
George Bell/Mesa Materials	Approved	1	1S	1W
Joseph Urban Family Trust	Approved	34	1N	1W
Randy Harper	Approved	36	1N	1W
Pioneer Landscaping Materials	Approved	7	1S	2W
Sanner Contracting	Approved	34	1N	1W
Andrew Jackson	Approved	15	1S	3W
Gravel Resources	Approved	15	1S	3W
Andrew Jackson	Approved	19	1S	3W
Gravel Resources	Approved	24	1S	4W
Andrew Jackson	Approved	14	1S	3W
Gravel Resources	Approved	14	1S	3W
Western Rock and Sand	Approved	Gila Bend		
Harper Sand and Rock	Approved	36	1N	1E
Pinal County				
Tanner Sand and Gravel Co	Approved	Maricopa Road		

Contact with the Arizona Department of Environmental Quality revealed that there are no operational landfills along the study reach of the Gila River. Five closed landfills have been identified and are listed in the table below.

Landfills along the Gila River Study Reach (closed)								
FACILITY	TYPE	COUNTY	TYPES ACCEPTED	OPERATOR'S NAME	DIRECTION	SEC	TWP	RNG
Wellton	CSWLF	Yuma	Rubbish ? Asbestos ? Septage ? MSW ? LW ?	Yuma County 2703 Ave B Yuma 85364	2.8 miles north of Wellton on Ave B	19 SENENE	8S	18W
Buckeye	CSWLF	Maricopa	Rubbish Y Asbestos N Septage N MSW Y LW N	Tn of Buckeye 715 Monroe Buckeye 85326	at Miller Rd and the Gila River	?	1S	3W
Coolidge #1	CSWLF	Pinal	Rubbish Y Asbestos N Septage N MSW Y LW N	Cty of Coolidge PO Box 398 Coolidge 85228	.6 miles north of AZ 287 on Nafiger Rd	12 NWNWSW	5S	8E
Coolidge #2	CSWLF	Pinal	Rubbish Y Asbestos N Septage N MSW Y LW N	Cty of Coolidge PO Box 398 Coolidge 85228	1 mile north of AZ 287 on Christenson Rd	12 SWNWNW	5S	8E
Hayden #2	CSWLF	Gila	Rubbish Y Asbestos ? Septage ? MSW Y LW ?	Tn of Hayden 520 Velasco Ave Hayden 85235	adjacent to the southeast edge of Country Club	23	5S	15E

Municipal and residential land use locations along the Gila River study reach, identified in county assessor records, are provided on the land use maps in Appendix J. During the storm events from January to early March 1993, some residential homes in Winkleman were inundated by flood waters of the Gila River. Since that event, FEMA has settled with the homeowners who lost their homes. These people have relocated and the Winkleman Flats area is closed to residential use.

Environmental

Biotic Communities[9] (vegetation and wildlife)

Historically, the Gila River has supported a variety of riparian ecosystems that continue to change over time. These changes have occurred, and will continue to occur as a result of land uses that locate along the river from Safford to Yuma.

Prior to Arizona Statehood in 1912, native Americans utilized floodplain lands along the Gila River for inundation agriculture and eventually small scale irrigation agriculture, primarily around the communities of Safford and Thatcher. This combined inundation/irrigation farming practice was continued by Anglo settlers that entered the region in the late 19th and early 20th centuries.

This ever expanding agricultural land use trend along the Gila River's entire reach began having profound effects on the river's diverse biotic communities. As agricultural use expanded, the native mesquite vegetation that lived along the river were removed in favor of agriculture. Cattle ranching also had a negative impact on biotic communities, as river banks were cleared so that cattle could directly access the river. These agricultural/cattle grazing activities led to an increase in erosion and sediment run-off.

Perhaps no other action changed the river's biotic communities as much as the introduction of the salt cedar in approximately 1915 in the Safford area. Once the salt cedar was established, native plants were almost completed excluded. The salt cedar's ecological adaptiveness has led to its proliferation not only along the Gila River, but in other riparian areas throughout the southwestern United States.

Finally, the River's biotic communities were further impacted by the construction of irrigation impoundment dams over a span of some 40 years. These dams include Gillespie Dam (1921), Coolidge and Ashurst-Hayden Dams (1928) and the Painted Rock Dam (1959). The construction of these dams has artificially changed the river's ecosystems in areas that became flooded after the dam was built, and in areas downstream of the dams that receive less than the historical flows prior to dam construction.

Based on this historical perspective, the following narrative will discuss, very generally, the current state of the Gila River's biotic communities. The purpose, the Gila River has been divided into the Upper Gila River from Safford to Avondale, and the Lower Gila River from Avondale to Yuma.

As mentioned previously, the vegetation in both the Upper Gila and the Lower Gila

[9] Ohmart, Robert D., 1979, Past and Present Biotic Communities of the Lower Colorado River Mainstem and Selected Tributaries, Volume V.

regions consisted largely of cottonwoods and willows until land clearing at the introduction of the salt cedar. Today, while some concentrations of cottonwoods and willows still exist, the predominant land cover is salt cedar. There also exists various species of mesquite, as well as other more desert oriented vegetation such as saguaro cacti, dessert broom and brittlebush. In the more riparian areas at the river's edge and within the streambed itself, there are a variety of cattails and both native and non-native grasses.

Changes in wildlife populations are much more difficult to gauge because quantitative data on changing wildlife patterns are almost nonexistent. Since generating this quantitative data is beyond the scope of this study, what can be detailed is what wildlife populations do exist in both the upper and lower Gila River reaches.

Bird populations in both the upper and lower Gila River regions include songbirds (wrens, swallows, warblers, tanagers, finches and sparrows), game-birds (dove, Gambel quail), resident birds (owls, sandpipers, killdeers and roadrunners), as well as migratory birds (sandhill cranes and bald eagles). Currently, 14 species of migratory, or resident, birds in the Gila River region have been placed on the Federal endangered species list, including the bald eagle, the peregrine falcon and the Yuma clapper rail.

Mammal populations of the Gila River region include a variety of bats, squirrels, chipmunks and jackrabbit. Also present within the river's reach are porcupines, coyotes, badgers, skunks, foxes and gophers. Threatened and endangered mammals include the Yuma Mountain Lion, Sonoran Pronghorn and the Desert Bighorn Sheep.

Also inhabiting the Gila River study area are a number of amphibians and reptiles which include several species of rattlesnakes, such as the sidewinder and Mohave rattlesnakes, in addition to many varieties of non-poisonous snakes. Amphibians include frogs, lizards and toads, all of which seek out the river for its riparian habitat. Threatened and endangered reptiles that may inhabit the study area include the desert tortoise and the gila monster.

Environmental Concerns[10]

As mentioned previously in the land use summary of this report, approximately five closed landfills exist within the Gila River study area. These landfills are historic in nature and were predominantly localized in use. They can present both groundwater and air quality problems and, depending on the type of refuse in each landfill and its relative location to the floodplain, each of these closed landfill sites should be the subject of further study prior to converting these sites to public lands.

Water quality, both surface and subsurface, is another environmental concern for the Gila River. To address this concern, ADEQ utilizes a number of Fixed Station

[10] Arizona Department of Environmental Quality, 1992, Arizona Water Quality Assessment.

Network (FSN) monitoring stations along the Gila River between Safford and Yuma. These stations, which were established by the United States Geologic Service (USGS) for monitoring river levels and quantities of flows, are used by ADEQ and a variety of other public/private entities to monitor water quality of the river. The results of this monitoring has revealed that certain segments of the river have a variety of pollution problems that are directly related to nearby or adjacent land uses. These pollutants are generated by forming activities, mining operations and other municipal/industrial uses located along the Gila River and its many tributaries.

One of the most notable surface water pollution situations along the Gila River has been the high levels of DDT in the area of the Painted Rock Dam. Arizona State Parks leased approximately 2,600 acres of land bellow Painted Rock Dam for many years as a state park; however, due to the DDT problem, gave up that lease in 1990. Signs have been erected warning that fish taken from the Gila River in this area should not be consumed. This serious situation still exists at the time of this study.

With respect to groundwater quality, ADEQ also monitors groundwater contamination on a statewide basis. Similar to surface water contamination, groundwater contamination is closely related to land use. In the Gila River study area, underground aquifer tests have revealed a higher than normal amount of total dissolved solids (TDS), so much higher in fact that water pumped from many wells along the river contain TDS in the range of 3,000-10,000 mg/L of water. This level, according to ADEQ, can have a detrimental effect on irrigated crops. Agriculture and mining are both major contributors to high levels of TDS.

Various flood control projects have been proposed and some implemented over the years to reduce flooding along the Gila River study reach. Already mentioned in the Land Use and Ownership Section of this chapter, the Florence Flood Control District located northeast of Florence along the Gila River provides flood protection to district members; the Woolsey Flood Protection District, the boundaries of which extend from Gillespie Dam along the Gila River to Gila Bend and east from the river approximately 13 miles at its widest, provides flood protection to farms, crop land, State Trust land and federal land (BLM). Flood protection work to control flooding within the Wellton-Mohawk Irrigation and Drainage District was implemented in the eighties. Much of this work has had an impact on the river environment. The Final Environmental Impact Statement for Clearing of Phreatophytic Vegetation from the Salt and Gila Rivers from Ninety-first Avenue to Gillespie Dam, Maricopa County, Arizona, Department of the Interior, U.S. Fish and Wildlife Service, Region 2, November 1981, prepared by Flood Control District of Maricopa County discusses the impact of such a proposed action to reduce flooding along the rivers. Examples of these impacts cited include; soil erosion, increased capacity of the channel, removal of mature salt cedar, habitat loss, temporary degradation of existing fisheries; existing prehistoric sites would require clearing and existing land use along the reach identified for construction would be impacted by land exchanges with the federal government or other compensation or temporary loss of use; air quality degradation (temporary) could also occur. Recommended mitigation measures

include the following actions:

- Confine open burning activities to periods when the wind is from the east - with respect to activities on the reach of the Salt and Gila Rivers cited above.
- Implement dust control measures during construction activities near populated areas.
- Develop wildlife habitats within AGFD lands to replace loss of habitat.
- Consult with the Arizona State Historic Preservation Officer and the Arizona Advisory Council on Historic Preservation to ascertain future requirements for addressing cultural resources that may be affected.

On any reach of the Gila River that the Arizona Navigable Streams Adjudication Commission determines to be navigable the environmental issues impacting that reach at the time of determining the public trust values have to be taken into account in accordance with A.R.S. § 37-1123.

DATA SOURCES / LAND USE AND ENVIRONMENTAL SUMMARY

- U.S.G.S. 7.5 min topographic maps
- TRW Assessor Records/Maps (ownership/land use)
- field surveys
- Arizona Division of Emergency Management (aerials)
- Arizona State Parks
- Arizona Game and Fish Department
- Arizona Rock Products Association (Roy Steigol 254-8465)
- Arizona Department of Environmental Quality
- Arizona State Land Department, GIS

Published Data Sources

Arizona Department of Environmental Quality, Arizona Water Quality Assessment, 1992

Arizona Department of Environmental Quality, Directory of Arizona Municipal Solid Waste Landfills (MSWLF), Rubbish Landfills (RLF) and Private Solid Waste Landfills (PSWLF), March 1993

Ohmout, Robert D., Past and Present Biotic Communities of the Lower Colorado River Mainstem and Selected Tributaries, Vol. V, 1979

Trimble, Marshall, Arizona: A Cavalcade of History, 1989

U.S. Bureau of Land Management, Lower Gila South Resource Management Plan and Environmental Impact Statement, Phoenix District, Arizona, 1985

U.S. Bureau of Land Management, Wild and Scenic River Suitability Assessments, Arizona, 1993

U.S. Fish and Wildlife Service, Final Environmental Impact Statement: Clearing of Phreatophytic Vegetation from the Salt and Gila Rivers: 91st Avenue to Gillespie Dam, Maricopa County, Arizona, 1981

CHAPTER IX

Technical Report: GIS for Gila River

March 9, 1995

A. Land Ownership and Use

The land ownership GIS for the Gila River was digitized from assessor maps using the ALRIS AZTRS coverage as the base map (see Section C). The percentage of private land within the 100-year floodplain (based on Table 1) is 44.0%.

The 100-year floodplain was chosen as the study area limits. All parcels entirely or partially within this floodplain limit were digitized and coded.

The land ownership GIS also contains the land use data for all private parcels and some public parcels within the floodplain. The values used were based on State of Arizona property use codes, and the classifications created, are shown in Appendix B of this chapter.

B. 100-Year Floodplain

The 100-year floodplain was digitized from lines drafted onto USGS 7.5' topographic quadrangle maps. These maps were used as a guide to determine which parcels were to be digitized into the land ownership/use GIS. The 100-year floodplain used, was copied from FEMA flood insurance rate maps.

TABLE 1: Ownership and Land Use Summary for Land within 100-Year Floodplain of the Gila River.

Breakdown by Land Owner

Owner	Acres
Private	243,772
State	30,135
Bureau of Land Management	105,480
Gila Bend Indian Reservation	9,694
Gila River Indian Reservation	5,289
San Carlos Indian Reservation	7,358
Arizona Game and Fish Department	1,898
Other	151,365
Total	**554,992**

Breakdown by Land Use

Land Use	Acres
Vacant Land	80,577
Residential - Single Family	1,830
Residential - Multiple Family	20
Hotel - Motel – Resorts	0
Condominiums	0
Commercial Property	1,096
Industrial Property	149
Farm/Ranch Property	149,665
Public Utilities	168
Natural Resources	1,270
Special Use Property	5,657
General Service Use	170,182
Other	144,378
Total	**554,992**

C. Methodology

1. Land Ownership

Pertinent tiles from ALRIS's AZTRS coverage were copied and appended to create the base for the parcels coverage. Four new items -- BOOK, MAP, PARCEL, and OWN_CODE -- were added (see Appendix A of this chapter).

Registration tics for digitizing were created by adding and snapping a tic to the coordinates of each section corner stored in the AZTRS coverage. Tics for half-section, quarter-section, or smaller maps, were created by manually digitizing them from the section maps. For detail maps lacking sufficient reference points, tics were placed at strategic points corresponding to the outline of the mapped area.

Arcs for parcel polygons were digitized from assessor plats. Parcels which fell entirely or partially within the floodplain as delineated on the FEMA map sheets were digitized.

A parcel dataset for the portion of the Gila River, from the confluence with the Salt River downstream to Gillespie Dam, was received from Maricopa County Flood Control District. This dataset was not used because it was found to be incompatible with the ALRIS coordinates existing in the other datasets. Since the total number of parcels involved in this area was relatively small, it was decided simply to digitize them from the assessor maps.

In most cases, assessor maps were considered the final authority in matters of boundary and ownership, although ASLD ownership maps were also consulted in cases of agency administered lands (ASLD & BLM).

Once all the arcs were digitized, the topology was built and the parcel boundaries were rechecked against the original maps. Polygon labels were then created and attributes assigned and checked for consistency.

The ownership relate file was created in INFO, by entering owner data from "TRW" microfiche copies of county assessor ownership records, obtained from the Appraisal Section of ASLD.

Once the ownership relate file was completed, parcel polygons were checked to make sure that each parcel was coded and could relate to a record in the ownership relate file. See Appendix C of this chapter for the list of ownership codes.

2. Land Use

Assessor land use codes (State of Arizona Property Use Codes) were recorded and entered at the same time as name and address of owners. Appendix B of the chapter, lists these land use codes and shows how they are divided into general land use categories.

3. 100-Year Floodplain

Tic marks for digitizing were the 7.5 minute quadrangle map corner tics copied from the QUADS coverage. Then the floodplain boundary lines were digitized, edgematched, and the topology was built. Polygon labels were then created and attributes assigned and checked. All source maps are stored in the Drainage and Engineering Section of ASLD.

4. Date Storage

All data (see Appendix D of this chapter) is available from, and stored on, the SUN computer system at ASLD. All this data is in the form of Arc/Info coverages or related INFO files. Copies of all original sources, including assessor maps and field notes, are also stored in the Drainage and Engineering Section of ASLD.

Appendix A: Data Formats

PARCELS COVER PAT FILE

PARCELS.PAT ITEMS

AREA	12	F
PERIMETER	12	F
PARCELS#	5	B
PARCELS-ID	5	B
TOWNSHIP	4	C
RANGE	4	C
SECTION	2	C
COUNTY	2	I
BOOK	3	C
MAP	3	C
PARCEL	4	C
** REDEFINED ITEMS **		
TR	8	C
TRS	10	C
OWN_CODE	12	C

NOTES: Items AREA through SECTION are identical to the corresponding items in ALRIS's AZTRS coverage.

OWN_CODE = COUNTY+BOOK+MAP+PARCEL

OWNERSHIP/LAND USE DATA RELATE FILE

OWNDATA ITEMS

PROP_ADD	78	C	
OWNER	2	I	
OWN_NAME	40	C	
ADDRESS1	40	C	
ADDRESS2	40	C	
ADDRESS3	40	C	
ADDRESS4	40	C	
STATUS_DAT	10	D	
LC#	2	C	
IC#	2	C	
LCIC_DESC	30	C	
ACRES	9	N	
IMP_VAL	9	I	
LAND_VAL	9	I	
TOT_VAL	11	I	
LEGAL1	78	C	
LEGAL2	78	C	
LEGAL3	78	C	
LEGAL4	78	C	
LEGAL5	78	C	
OTH_CODE	80	C	
OTH_USE	80	C	
COUNTY	2	I	
BOOK	3	C	
MAP	3	C	
PARCEL	4	C	
** REDEFINED ITEMS **			
OWN_CODE	12	C	
LCIC#	4	C	[State landuse code]
PARCEL-N	4	I	
BOOK-N	3	I	
MAP-N	3	I	
OWN_ADD	200	C	

Appendix B: Land Use Categories and Codes (continued)

FARM/RANCH PROPERTY

4000 Plant Nurseries, Greenhouses, Hydroponic Greenhouses
4100 Field Crops - Hay, Cotton, Grain, etc.
4200 Vineyards
4300 Other Crop Trees - Mature Trees
4400 Citurs Crop Trees - Mature Trees
4500 High Density Agricultural
4600 Immature Crops - Vineyards, Trees, Not-Trees, etc.
4700 Grazing - Ranch Property
4800 Pasture Land
4900 Fallow Land

UTILITY PROPERTY

5000 NOT USED
5100 Railroad Operating Machinery
5200 Telephone and Telegraph Operating Property
5300 Pipeline Operating Property
5400 Gas and Electric Utility Operating Property
5500 Water Utility Operating Property
5600 Microwave Service
5700 Municipal Utilities - Electric, Water
5800 Airline Flight Property
5900 Private Car Companies

NATURAL RESOURCES

6000 NOT USED
6100 Producing Mines
6200 Railroad Property
6300 Oil and Gas Geothermal Resource Interests
6400 Electric and Gas Companies Environmental Protection Facilities
6500 Electric and Gas - Under Construction
6600 Non-Producing Mine Property
6700 NOT USED
6800 Mineral Rights Only
6900 Standing Timber
7000 NOT USED
7100 NOT USED
7200 NOT USED
7300 NOT USED
7400 NOT USED
7500 NOT USED
7600 NOT USED
7700 NOT USED
7800 NOT USED
7900 NOT USED
8000 NOT USED
8100 NOT USED
8200 NOT USED
8300 NOT USED
8400 NOT USED

Appendix B: Land Use Categories and Codes

VACANT PROPERTY

0000 Vacant Land

RESIDENTIAL PROPERTY

0100 Single Family
0200 NOT USED
0300 Multiple Residential
0400 Hotel
0500 Motel
0600 Resorts
0700 Condominiums
0800 Mobile Home
0900 Miscellaneous and Salvage

COMMERCIAL PROPERTY

1000 Miscellaneous Commercial
1100 Store, Grocery
1200 Store, with Office or Apartment
1300 Department Store
1400 Shopping Center
1500 Office Building
1600 Bank/Credit Union
1700 Service Station
1800 Automotive Sales and Service
1900 Nursing Homes etc.
2000 Restaurant and/or Bar
2100 Hospital, Medical Buildings
2200 Race Tracks, Private Airstrips
2300 Cemeteries and Mortuaries
2400 Golf Courses
2500 Amusement Facilities, Theaters, Bowling Alleys, Skating Rinks
2600 Parking Garages
2700 Club, Lodge or Fraternal Organization
2800 Partial Complete Structures - Under Construction
2900 Private School or Day Care Center

INDUSTRIAL PROPERTY

3000 Industrial Park
3100 Manufacturing of Durable and Non-Durable Products except foods
3200 Manufacturing of Food and Kindled Products
3300 NOT USED
3400 Lumbering, Saw Mills and Planning Mills
3500 Cotton Gins and Compresses
3600 Mining, Quarring and Processing
3700 Warehousing, Storage, and Truck Terminals
3800 NOT USED
3900 NOT USED

Appendix B: Land Use Categories and Codes (continued)

SPECIAL USE PROPERTY

8500 NOT USED
8600 Miscellaneous Commercial or Industrial Improvements
on subdivided or unsubdivided acreage
8700 Improved Residential Site on more than 5 acres of land
8800 Limited Use (Well Sites, Tower Sites, Private Roads, etc.)
8900 NOT USED

GENERAL SERVICE USE PROPERTY

9000 NOT USED
9100 NOT USED
9200 Religious and Charitable
9300 NOT USED
9400 Federal Government
9500 State Government
9600 County Government
9700 Municipal Government
9800 Indian Lands
9900 NOT USED

END OF CODES

Appendix C: Land Ownership Codes

01	Private Owners
02	State Land
03	Bureau of Land Management
04 - 17	NOT USED - Other
18 ----	Gila River Indian Reservation
19 - 28	NOT USED - Other
29	San Carlos Indian Reservation
30 - 33	NOT USED - Other
34	Gila Bend Indian Reservation
35 - 70	NOT USED - Other
71	Arizona Game & Fish Department
72 - 99	NOT USED - Other

Appendix D: Data Inventory

Land Ownership/Use GIS (names correspond to ALRIS LAND tiles):

YUMAW, YUMAE, DATEW, DATEE, LHORNE,
GILAW, PHXSW, PHXSE, MESAW, MESAE,
CASAW, CASAE, GLOBEW, GLOBEE, MAMW,
CLIFW, SAFFW

Relate File: OWNDATA

One Hundred Year Floodplain: FLOOD

Chapter X

Summary

The Gila River has been a reliable source of water for a large portion of central Arizona for more than a millenium. Documented uses of the river include water supply for irrigation, recreational and commercial boating, fishing and recreation. At times it has served as a barrier to transportation from north to south. This report has documented continuous use of the Gila River from the time of the Hohokam, through the period around statehood and up to the modern era.

The Gila River has a long record of prehistoric use and occupation. The native American Hohokam civilization in central Arizona was dependent on water diverted from the Gila River to support their agricultural economy (A.D. 550-1450); the Mogollon civilization occupied the upper Gila reaches (A.D. 100-1200); and the Patayan civilization occupied portions of the Gila from west of Gila Bend to east of the Buckeye Hills (A.D. 300-1450). Primary uses of the river were for water for agriculture and fish for protein; river cobbles were a source of tools and building materials. Types of agriculture which were practiced included irrigation, floodwater and dry farming.

Geologic and hydrologic data provide specific evidence of the natural condition of the Gila River only since the mid-1800's, although portions of the river were described as consisting of a stable, narrow and relatively deep channel as early as the late 1600's by Father Kino and others. This type of channel was probably typical prior to construction of the Roosevelt and San Carlos dams in the early 1900's; the river has become broader and shallower since construction of the dams. Prior to construction of Roosevelt and San Carlos dams the river was apparently perennial to the confluence with the Colorado River. Due to changes in climate characterized by changes in intensity and seasonality of precipitation, the Gila has likely alternated between periods of channel stability and instability and specifically in form (e.g., braided vs. meandering). Periods of high seasonal flow probably occurred during late summer and mid-to-late winter, with low flows occurring during May and June. U.S.G.S. records indicate that annual flood discharges in excess of 20,000 cfs were not uncommon from Safford to Yuma, with maximum recorded or estimated discharges of 150,000 to 200,000.

Early explorers of the Gila River probably found the river in much the same condition as the earlier Patayan, Hohokam and Mogollon residents. The stream's flow was perennial though variable with the seasons and included fish populations, beaver and other small game in a well developed riparian habitat. Early Anglo residents floated boats, canoes, logs, rafts and ferries through the study area, and although use of the river was largely dependent on higher seasonal flows, boats were apparently on the river at all times of the year. Boat traffic apparently occurred as recently as 1908 and ferries were on the river around Phoenix as late as 1905. Travel seems to have

been down-river or across the river, but not up-river. Travel on the river was frequently interrupted due to hazards such as sand bars or snags. Use of the river's water for irrigation seems to have had a higher priority than use as a means of transportation, with numerous canals constructed beginning in the late 1800's from above Safford to Gila Bend. Residents along the river used the river for recreation and fishing, although to lessening degrees with the passage of time and the construction of the upstream dams.

By Statehood, an extensive series of irrigation diversions in combination with the construction of Salt River reservoirs had largely reduced flows in the Gila downstream of the Salt River confluence. In 1929, San Carlos reservoir on the Gila above the town of Winkelman further reduced flows in the river, with modern day flows largely dependent on local runoff or large storm events which are not fully contained by the reservoirs. Flows upstream of San Carlos reservoir continue to be perennial. Recreational boating continues upstream of San Carlos on a regular basis, while downstream recreational boating opportunities are largely dependent on response of the river to transient flows. Since 1912, the Gila River has been characterized by a normally dry channel downstream of San Carlos reservoir except during periods of sustained high flows in excess of reservoir and diversion capacities.

The Gila River could have and did support some types of boating during the period prior to statehood. By 1912, use of boats on the river had declined but was still possible in some reaches during portions of some years, especially upstream of the San Carlos reservoir; a condition which persists today. Finally, at the confluence of the Gila River with the Colorado River at Yuma the Colorado River and, therefore the Gila River, is navigable for an undetermined length of the Gila River upstream of the confluence due to backwater effects with the Colorado River. The extent of this navigable backwater must be determined at a future time.

CHAPTER XI

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Appendix A

General Location Map on file with the Arizona State Land Department, Drainage and Engineering Section.

Appendix B

Contact Letter/Information Request on file with the Arizona State Land Department, Drainage and Engineering Section.

Appendix C

Contact/Mailing List on file with the Arizona State Land Department, Drainage and Engineering Section.

Appendix D

Oral Histories on file with the Arizona State Land Department, Drainage and Engineering Section.

Appendix E

Extract of U.S.G.S. Water Supply Papers and Water-Data Reports on file with the Arizona State Land Department, Drainage and Engineering Section.

Appendix F

Rating Curves are on file with the Arizona State Land Department, Drainage and Engineering Section.

Appendix G

Flood Frequency Analyses on file with the Arizona State Land Department, Drainage and Engineering Section.

Appendix H

Summary of Temperature and Precipitation Records on file with the Arizona State Land Department, Drainage and Engineering Section.

Appendix I

Land Ownership Maps on file with the Arizona State Land Department, Drainage and Engineering Section.

Appendix J

Land Use Maps on file with the Arizona State Land Department, Drainage and Engineering Section.

Appendix K

Present-day Gila River Photographs on file with the Arizona State Land Department, Drainage and Engineering Section.