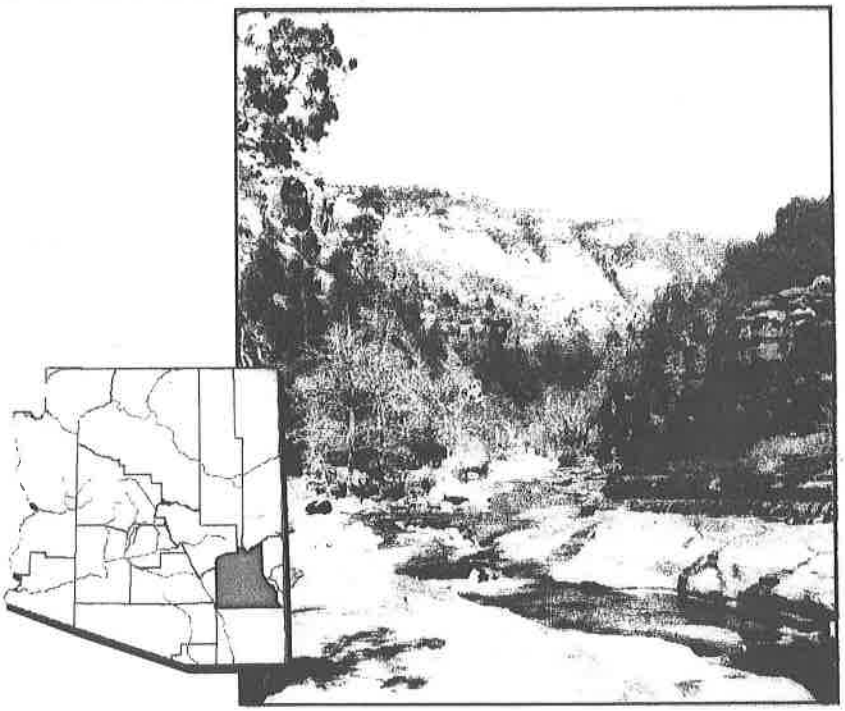
Final Report
SMALL & MINOR WATERCOURSES ANALYSIS for Graham County, Arizona

Contract No. AD 990205



ARIZONA STATE LAND DEPARTMENT

April 2001

Stantec Consulting Inc.
In Association with
JE Fuller/Hydrology & Geomorphology, Inc.

Stantec

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Contract No. AD 990205

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April 2001

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FOR GRAHAM COUNTY
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Executive Summary

The small and minor watercourses in Graham County were evaluated using the three-level evaluation process that was previously developed by the project team (Stantec, 1998 & 1999b). This evaluation process analyzes the watercourses at increasing levels of detail to assess susceptibility and evidence of stream navigability.

The results of the Level 1 analysis for the 3,226 watercourses in Graham County indicated 3,080 watercourses (see Table A-1A, Appendix A) failed every diagnostic attribute that was used in the screening process. These diagnostic attributes include *stream type, dam information, historical and modern boating accounts, the existence of fish,* and *any special watercourse status designation*. One hundred and forty six (146) watercourses passed the Level 1 analysis to proceed to Level 2 analysis (see Table A-1B, Appendix A).

For watercourses reaching Level 2, the information from the Level 1 analysis is validated and weighted. The watercourses passing a pre-established minimum rating are passed on to Level 3. For Level 2 analysis, there were One hundred and forty one (141) watercourses that failed the sorting process and were dropped from further study and investigation (see Table A-2A, Appendix A). Five (5) watercourses namely Bonita Creek, Eagle Creek, San Carlos River, Black River and Aravaipa Creek survived the Level 2 screening process (see Table A-2B, Appendix A) and were forwarded for Level 3 analysis.

Level 3 analysis consists of hydrologic (quantity of flow expected in the watercourse), hydraulic (expected flow depths, velocities and widths), and geomorphic (land form/characteristics of the watercourse valley) assessments as they relate to navigability. Watercourses passing Level 3 analysis are eligible for a "detailed" study that specifically looks at the nine non-navigability criteria established by ARS Section 37-1128.

Of the five watercourses studied at Level 3, only one watercourse, Eagle Creek, was forwarded for a detailed study.

1.0 Introduction

1.1 STUDY BACKGROUND

The State of Arizona is currently adjudicating navigability with regard to ownership interest in streambeds throughout Arizona. Claims of streambed ownership depend on whether or not a given stream was navigable or susceptible to navigation at the time of statehood in 1912. The reader is referred to the Project Background section of the report titled, "*Criteria for Assessing Characteristics of Navigability for Small Watercourses in Arizona*" (Stantec, 1998) for a complete discussion of the history of the navigability issue in Arizona.

The Arizona Navigable Stream Adjudication Commission (ANSAC) is legislatively mandated to establish administrative procedures, hold public hearings, and make recommendations to the Arizona Legislature as to which watercourses were navigable or non-navigable at the time of statehood. To date there have been 14 major river systems that have been adjudicated by the State of Arizona.

ANSAC is required to complete their legislatively mandated tasks by June 30, 2002. There are over 39,039 documented watercourses in Arizona, the vast majority of which are minor or small watercourses. In consideration of these two factors, ANSAC determined that the small watercourses should be considered separately from the major rivers in order to expedite the evaluation process to meet the target date for completion in the year 2002. ANSAC contracted with Stantec in 1997 to: (1) establish minimum technical and historical criteria for small watercourses in accordance with the legislative definition of navigability; (2) develop an evaluation system to assess watercourses utilizing the criteria; and (3) catalog in a database all documented watercourses in the state. That work was completed in 1998 and the results are summarized in *Criteria for Assessing Characteristics of Navigability for Small Watercourses in Arizona* (Stantec, 1998).

In May 1999, ANSAC authorized the Stantec project team to proceed with a Pilot Study to further test the evaluation system and apply the small watercourse criteria to a limited sample of small watercourses in selected locations. The scope of work for the Pilot Study covered Level 1 analysis for the entire State of Arizona, Level 2 analysis for Mohave, La Paz, and Yuma counties, and Level 3 analysis for three watercourses identified to represent the diverse physiographic conditions in Arizona. The project team is currently under contract with the Arizona State Land Department (ASLD) to continue

this work by applying the evaluation system to all remaining small watercourses throughout the state that were not addressed in the Pilot Study. That work is scheduled for completion in June 2001.

The reporting of project results is categorized by county so that ANSAC can conduct hearings within each county for the purpose of determining stream navigability and settling streambed ownership. This report documents the navigability results for Graham County.

1.2 COUNTY DESCRIPTION

Graham County is located in the southeastern section of the State and is comprised of about 4,649 mi.^{2} land area. It borders the counties of Navajo, and Apache to the north, Gila to the northwest, Greenlee to the east, Cochise to the south, Pinal to the west, and Pima to the southwest. (see Figure 1). The county lies within the following Latitude and Longitude ranges: *32°25'45"N to 33°39'30"N and 109°11'00"W to 110°27'00"W.* There are 3,226 documented small and minor watercourses in Graham County of which 3,069 are unnamed. These watercourses, both named and unnamed, were the subject of the evaluation process involving the three levels of analysis developed by the project team (and a detailed study if any watercourse(s) passed the Level 3 analysis).

1.3 REPORT OBJECTIVES

The work plan for the small and minor watercourses project was to analyze, summarize and present the results of the three-level classification analysis comprised of the following main work tasks and activities:

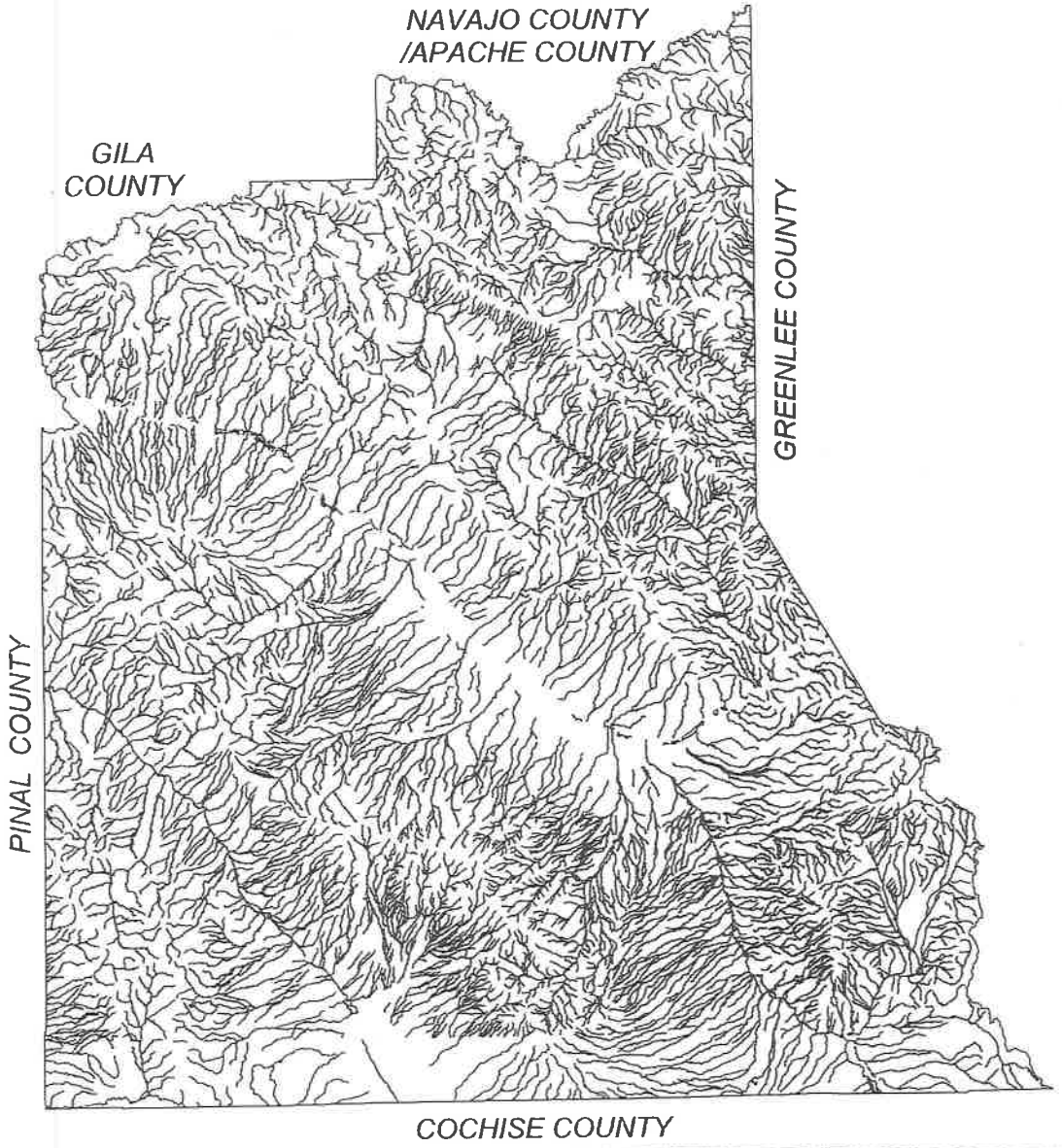
Task 1 – *Summarize and present the results of Level 1 Analysis*

This task identifies two data sets as the result of the Level 1 Analysis. They are:

(1) NRL1 data set – This data set comprises all watercourses that have at least one affirmative hit from six key stream attributes: *perennial classification, with fish, dam-impacted, with modern boating and historical boating records*, and *with special status*. This data set proceeds to the Level 2 analysis.

(2) RL1 data set – This data set comprises those watercourses that do not have any affirmative hit from the six key stream attributes. This data set is dropped from further analysis and evaluation.

FIGURE 1
Small and Minor Watercourses in Graham County



Arizona Map

LEGEND:

Watercourses

Graham County

N
W
E
S

10 0 10 20 30 Miles

Task 2 – *Summarize and present results from Level 2 analysis.*

Similar to Level 1 analysis, this task identifies two data sets as the result of the Level 2 analysis. They are:

(1) NRL2 data set – This data set is comprised of the watercourses that have potential susceptibility to navigation according to the qualitative evaluation procedure used in Level 2. This data set proceeds to Level 3 analysis.

(2) RL2 data set – This data set is comprised of those watercourses that have no evidence of susceptibility to navigation based on the qualitative analysis performed in Level 2. This data set is dropped from further analysis and evaluation.

Task 3 – *Summarize and present results from Level 3 analysis.*

Similar to Level 1 and Level 2 analyses, this task identifies two data sets as the result of the Level 3 analysis. They are:

(1) NRL3 data set – This data set is comprised of the watercourses that have characteristics of susceptibility to navigation upon evaluation of the geomorphologic, hydrologic, and hydraulic conditions of the watercourses and validation of these conditions with established boating criteria. This data set is recommended for a detailed study.

(2) RL3 data set – This data set is comprised of those watercourses that fail to meet the criteria for susceptibility to navigation.

Task 4 – *Detailed Studies*

Detailed study for Level 3 survivors (NRL3 watercourses) is beyond the scope of the current project. NRL3 watercourses would be investigated in a separate contract with Arizona State Land Department. Though they are not part of the existing project contract, a section is allocated in this report for their integration as their study documentation becomes available.

2.0 Data Requirements

2.1 BASELINE DATA

The watercourse database operates in a Geographic Information System (GIS) environment. This allows the user to analyze the spatial characteristics of the studied watercourses in a graphical or tabular format. The project team selected ArcView GIS, a GIS analysis and thematic map software, for its ease of use and its operational capabilities. In addition, ArcView GIS supports many of the hydrologic assessment activities that have been conducted by state, federal and local agencies. The viability of this data must meet the following criteria to be considered applicable to this project:

- Data are already in or can be readily converted to a GIS format
- Data are readily accessible, technically sound and historically accurate
- Data can be easily sorted by category or criteria.

The primary data source in the development of the master database was obtained from the Arizona Land Resource Information System (ALRIS). The surface water data sets were originally derived from baseline Digital Line Graph (DLG) maps compiled by the US Geological Survey (USGS), which were further enhanced by the US Environmental Protection Agency (EPA) in several versions called the River Reach Files. The latest version, commonly called RF3, is a federal standard for identifying and cataloging water bodies. The RF3 file was converted to a GIS ARC format by ALRIS and has been distributed and used by various public and private agencies working on water management issues.

The base GIS layer used in the master watercourse database is an ALRIS-converted RF3 data set called STREAMS. It is a line coverage of hydrography (streams) within Arizona and contains 87,735 separate watercourse segments. The STREAMS file includes several fields that were relevant in the development of the master watercourse database. They include the Hydrologic Unit Code (HUC), segment number, mileage, watercourse type, and watercourse name. A binary (yes/no) field for each criterion and a county field were added to aid in the Level 1 sorting process. All manmade water features (canals, aqueducts, flumes, etc.) were removed from the master watercourse database. The major rivers previously assessed by the ASLD for characteristics of navigability or susceptibility to navigation and subsequently adjudicated by the ANSAC were also removed. The resulting master watercourse database contains 76,166 records or stream segments (typically many stream segments comprise one watercourse).

Additional ALRIS Data Sets were used in conjunction with the STREAMS layer to allow for detailed resolution of the physical location of each watercourse. These data sets are listed in Table 1.

Table 1
ALRIS Data Sets

Name of Data Set	Data Type / Format	Description
AZSPRINGS	Vector: Point Format: ArcInfo	This coverage consists of spring locations in Arizona. Incorporates information extracted from both the USGS Geonames database and the USGS Digital Line Graphs (DLG).
AZTRS	Vector: Polygon Format: ArcInfo	This statewide coverage consists of the Township, Range and Section grid lines.
County	Vector: Polygon Format: ArcInfo	This polygonal Data Set consists of individual county and an appended statewide coverage.
Lakes	Vector: Polygon Format: ArcInfo	This polygon cover consists of all the lakes in Arizona.
HUCS	Vector: Polygon Format: ArcInfo	This data set consists of Hydrologic Unit Code areas (drainage basins) in Arizona.
DAMS	Vector: Point Format: ArcInfo	This data set consists of jurisdictional dams maintained by ADWR.
GAGES	Vector: Point Format: ArcInfo	This data set consists of streamflow gaging stations maintained and operated by USGS.

2.2 DATA CONVERSIONS

The processing of data during query and search operations was slow due to the large file sizes of the data sets being used. To allow for ease of data storage and manipulation, a method of reducing the file size was undertaken which would not impact the outcome of the analysis.

The largest challenge was identifying a method to combine multiple stream segments into a single watercourse. Approximately 73% (55,387 segments) of the records in the original STREAMS Data Set are without names. In addition, there are a large number of separate watercourses with the same names; (e.g., Sycamore Wash). To resolve this, the project team assigned a unique nomenclature to all unnamed and same-named watercourses. For unnamed watercourses, nomenclature was assigned by combining the HUC ID with the Segment number (e.g. H34-2300). Same-named watercourses were assigned new nomenclature by combining the name with the county

within which the majority of the watercourse was located. If there were more than one same-named watercourse within the same county, an additional numerical ID was added to the name (e.g., Sycamore Creek, Yavapai 1). This naming convention enabled reliable query and display and reduced the watercourse records to 39,039.

The project team assigned township, range, and section (TRS) location attributes to the mouth of each watercourse. The project team was not successful in linking the watercourse database to latitude/longitude GIS coverages, but this was not essential as the database is linked to the TRS system for location referencing.

2.3 DEVELOPMENT OF SATELLITE DATABASES

Six satellite databases were developed for each of the criterion comprising the Level 1 evaluation screening process. These satellite databases were populated with both diagnostic data fields used for the binary queries in the ANSAC master watercourse database, and also informational fields to provide additional information relative to the Level 1 criteria where readily available. The watercourses that tested affirmatively were converted to new satellite databases (themes) based on the criterion queried and were linked to the master database by a unique watercourse name or assigned watercourse ID. Each satellite database can be layered graphically in any selected combination to facilitate watercourse evaluation and to create meaningful reports. Listed below are the six satellite databases (with thematic displays) that were created along with the source documentation associated with each database.

Perennial - Only watercourses that have been classified by both the Arizona State Parks (1995) and ALRIS (1988) as perennial are so identified in the database. The approach used in identifying these watercourses in case of classification conflict was presented and described in detail in an earlier ANSAC report by Stantec (1998). Since the original stream database (comprised of 76,166 stream segments) was recently converted into a watercourse database (comprised of 39,039 records), assignment of perennial stream type to watercourses was made for those washes and streams with at least one perennial segment.

Conflicts in the classification of watercourses beyond the two sources named above are addressed in the Level 2 analysis, which employs a qualitative approach in the evaluation procedure. The project team acquired a GIS coverage developed by the Arizona Game and Fish Department entitled Perennial Waters of Arizona (AG&F, 1995,1997). The perennial streams, originally compiled and mapped by Brown et al (1977, 1978, and 1981), are the foundation of the GIS coverage of perennial streams developed by Arizona Game and Fish Department (1995, 1997). These data are used

extensively by both federal and state agencies and were used by the project team to supplement the original perennial streams classified by Arizona State Parks (1995) and ALRIS (1988). Brown's perennial streams data were not integrated into the Level 1 analysis, but were used for the qualitative assessment in Level 2 for NRL1 watercourses located in Graham County.

Dams - The Arizona Department of Water Resources (ADWR) developed the GIS coverage in point features indicating the location of all the jurisdictional dams[1] in Arizona. The coverage contains data fields describing essential attributes of those dams important to the agency in matters of dam safety, management and ownership. However, essential data important to the pilot study are not completely populated such as township, range, and section, county, date constructed, dam types, wash location, purpose, and other important physical attributes. The missing information plus the resolution of the dam coverage made the task of identifying dam-impacted streams very difficult. The resolution problem associated with the dam GIS coverage was largely due to inconsistent development standards of different state agencies. Most of the GIS coverages used in the project were developed by ALRIS, while the dam coverage was developed by ADWR.

There are other sources of data for dam structures built in the state of Arizona besides that provided by ADWR. The US Geological Survey (USGS) and the Federal Emergency Management Agency (FEMA) maintain a listing of dams for the entire United States. Inconsistency in the use of names for the dams and data attributes between these various sources resulted in the sole utilization of the ADWR dam database for the study. Originally, the dam coverage from ADWR was comprised of 397 records. After the deletion of dams that are used for mining tailings and those that are located off-stream (a total of 26 records), the final record count was reduced to 371 dams.

Fish - A report published by the USDA Forest Service titled *Run Wild* (Silvey et al, 1984) was used to identify the occurrence of fish species and their habitats in Arizona. Several sources validate the findings listed in the *Run Wild* document. A total of 292 watercourses were identified as having one or more species of fish. Efforts to acquire existing fish GIS database information from Arizona State University (ASU) was not successful. Instead, information gathered from a number of reliable federal and state agency sources was used. These sources are listed in the references.

Historical and Modern Boating – Published accounts of modern boating were obtained from the Greenlee County Historical Society, Yavapai Historical Society, Mormon Archives, Apache County Historical Society,

[1] Dams or artificial barriers are considered jurisdictional if they exhibit the following height and storage characteristics:

1. Greater than 25 feet in height and greater than 15 acre-feet storage.
2. Greater than six feet in height and greater than 50 acre-feet storage.

Arizona State Parks, Central Arizona Paddlers Club, Arizona Game and Fish Department and professional river rafting companies. One watercourse has a documented account of historical boating while 10 others have modern boating accounts.

Special Status – The Special Status category includes water-related characteristics that make a watercourse of particular interest or concern to various organizations and/or governmental agencies. Watercourses identified as having the following designations were included in the Special Status database: In-stream Flow Application and/or Permit, Unique Waters, Wild and Scenic, Riparian, and Preserve area. Agencies issuing the Special Status designation were contacted to identify watercourses meeting the criterion.

3.0 Analytical Procedure

A three-level evaluation system shown in Figure 2 was developed by the project team under the previous phase of this project (Stantec, 1998) and adopted for use in the follow-up Pilot Study (Stantec, 1999). The approach involves a multi-level screening process of increasing refinement designed to identify watercourses least likely to meet the statutory and legal definitions of navigability. The evaluation process consists of three levels as follows:

3.1 LEVEL 1 ANALYSIS

The goal of Level 1 of the watercourse evaluation procedure is to perform an initial screening of the entire catalog of small and minor watercourses. The purpose is to eliminate the watercourses most likely to be non-susceptible to navigation and which exhibit no evidence of actual navigation in fact.

The Level 1 analysis is a binary, quantitative sorting process utilizing the data queries programmed into the database catalog. Those queries are the digital expression of the technical and historical criteria considered diagnostic for evaluating watercourses for susceptibility to navigation and for navigation in fact, respectively. The minimum criteria include *stream type, dam information, historical and modern boating accounts, the existence of fish,* and *any special watercourse status designation (see* Figure 3).

The Level 1 screening process is applied to all small watercourses in the database catalog using available information from existing databases compiled by various agencies. Only those watercourses that test negatively to all six criteria are rejected at Level 1 as most likely to be non-susceptible to navigation. All watercourses, which test affirmatively to one or more of the criteria comprising the data queries, require further evaluation at Level 2.

Figure 2
THREE-LEVEL WATERCOURSE
EVALUATION PROCEDURE

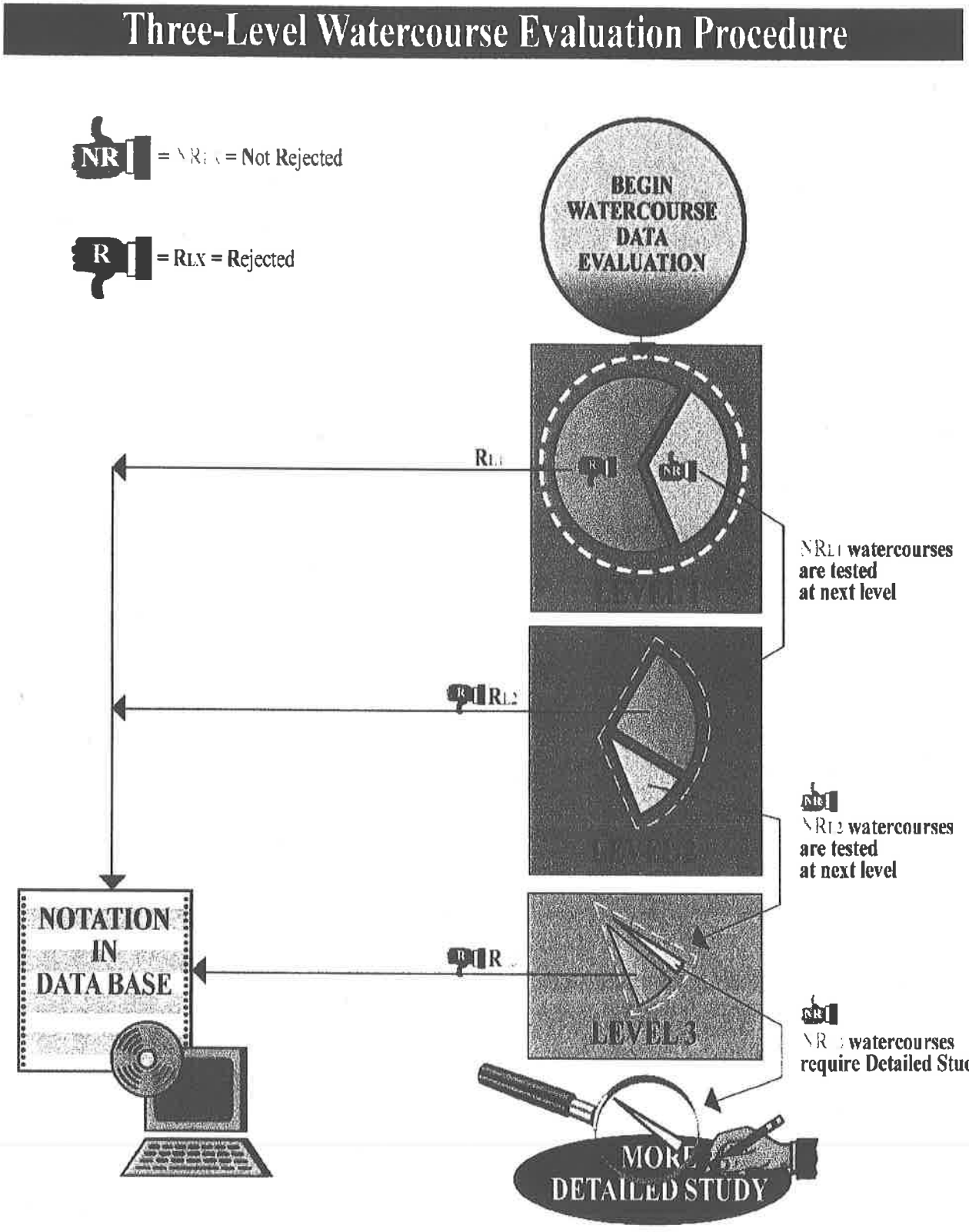
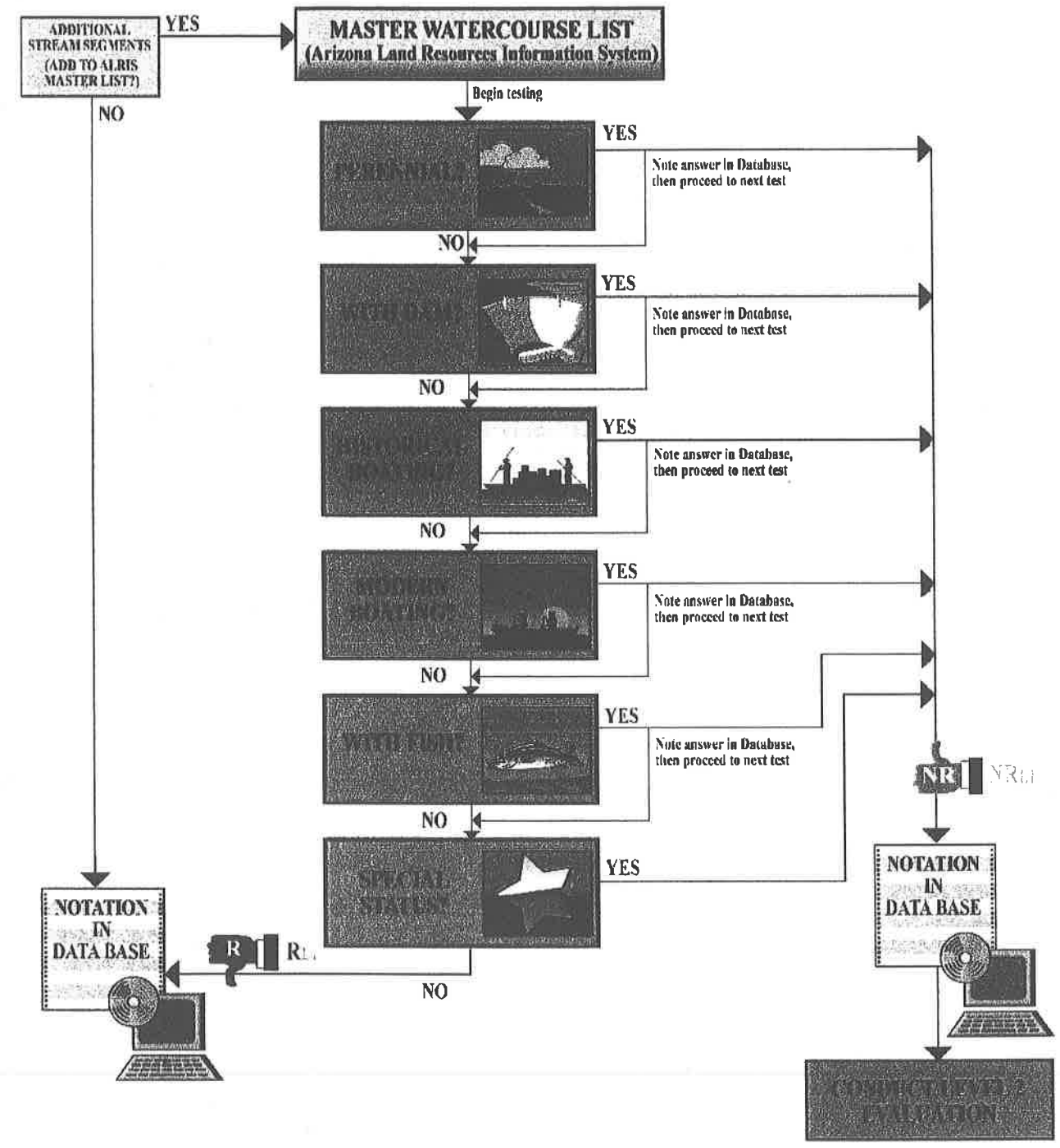


Figure 3
LEVEL 1 SCREENING PROCEDURE



3.2 LEVEL 2 ANALYSIS

The goal of the Level 2 watercourse evaluation procedure is to perform a refined screening to eliminate the watercourses unlikely to be susceptible to navigation. Contiguous watercourse segments were combined to form study reaches to be evaluated in Level 2.

The Level 2 method of approach is more qualitative than the binary data queries employed at Level 1. Level 2 assessment involves the qualitative review of watercourse location, typical watershed characteristics, and typical watercourse characteristics, among other features, for verification and interpretation of the reason(s), which caused them to advance from Level 1.

3.2.1 TWO-STAGE FILTERING PROCESS

The recommended Level 2 methodology involves the further assessment of those watercourse characteristics that tested positively at Level 1 in two parts as shown in Figure 4 and described below:

1. The first-cut filter individually analyzes each criterion that caused a particular watercourse to advance to Level 2 – referred to herein as "affirmative responses" – for information salient to the navigability question as shown in Figure 5. Those watercourses are categorized into three groups as follows:

   Category A – Potentially Susceptible to Navigation

   Category B – Not Likely Susceptible to Navigation

   Category C – Not Susceptible to Navigation

   All watercourses with documented boating accounts - historical and/or modern - will automatically advance to *Category A* comprised of watercourses potentially susceptible to navigation. These watercourses are forwarded for Level 3 analysis.

   The streams classified as *Category C,* which comprised of watercourses not susceptible to navigation, are rejected at Level 2 and will not be investigated further.

2. The second-cut filter analyzes *Category B* watercourses with multiple affirmative hits on multiple segments for diagnostic hit combinations that are evidence of navigation in fact or are indicative of susceptibility to navigation as shown in Figure 6. In addition, a refined approach of applying a rating system is considered to rank the Level 2 watercourses and identify those watercourses that merit further evaluation at Level 3.

Figure 4
Level 2 Screening Concept

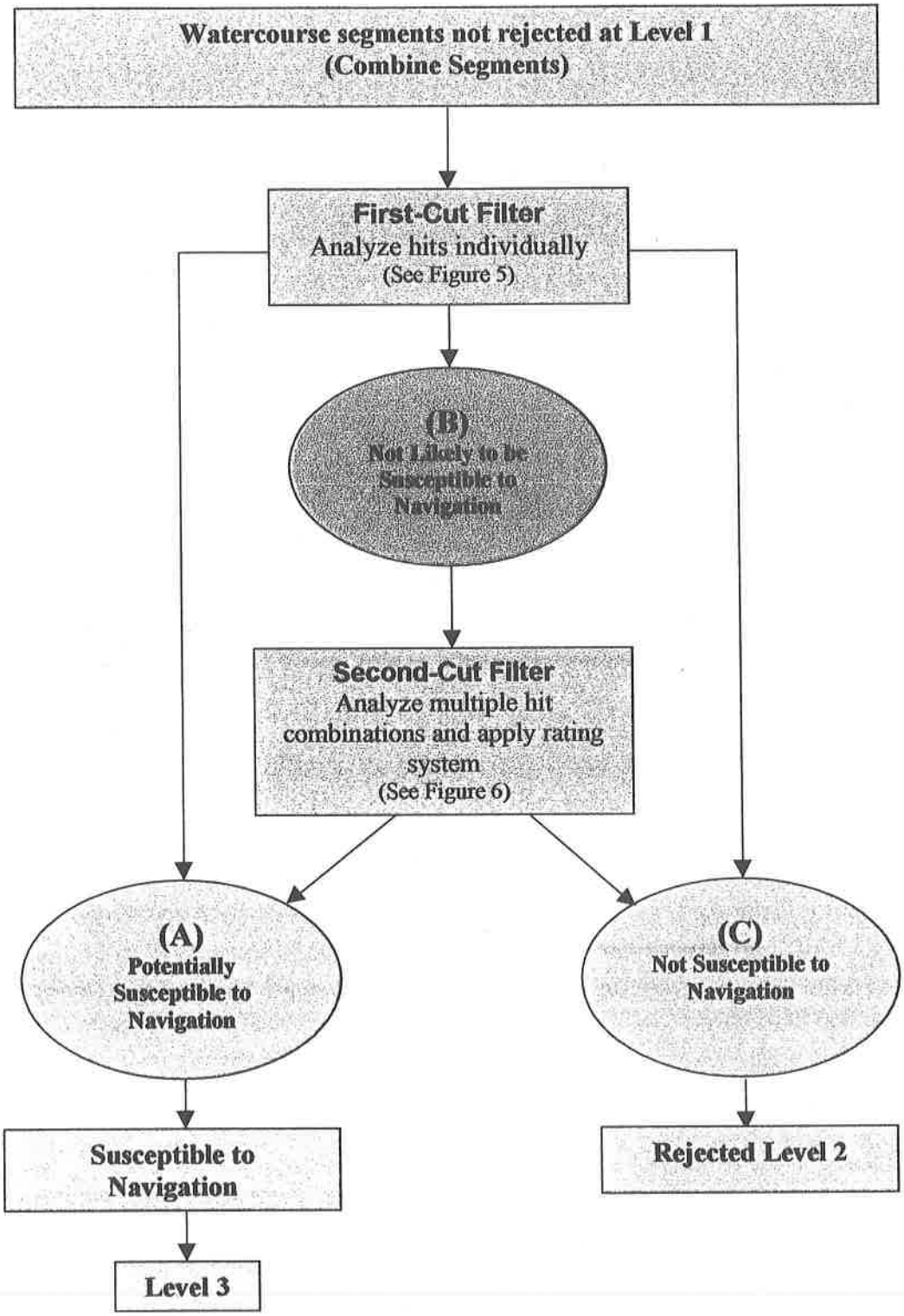


Figure 5
Level 2 Watercourse Screening
First-Cut Filter

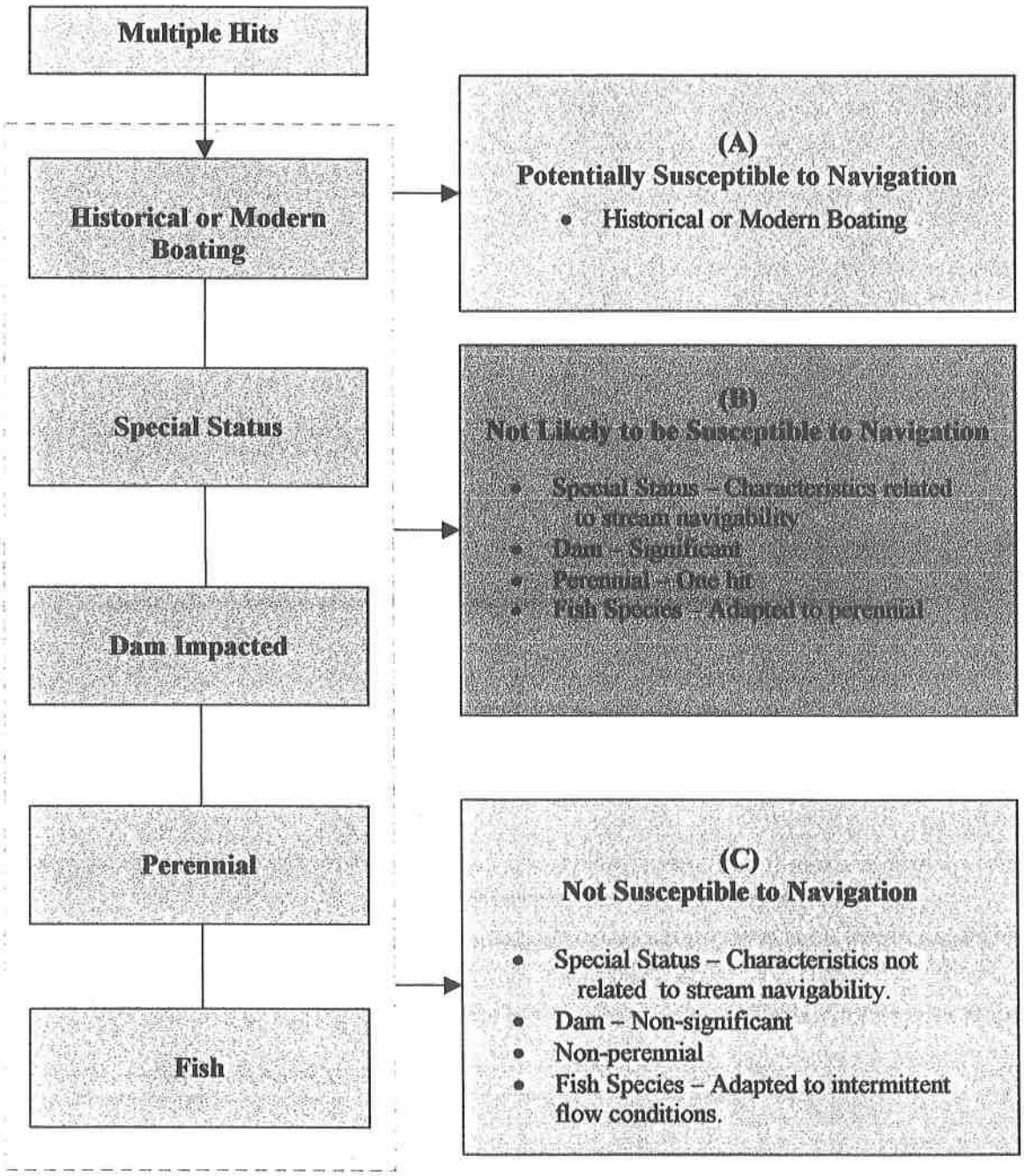
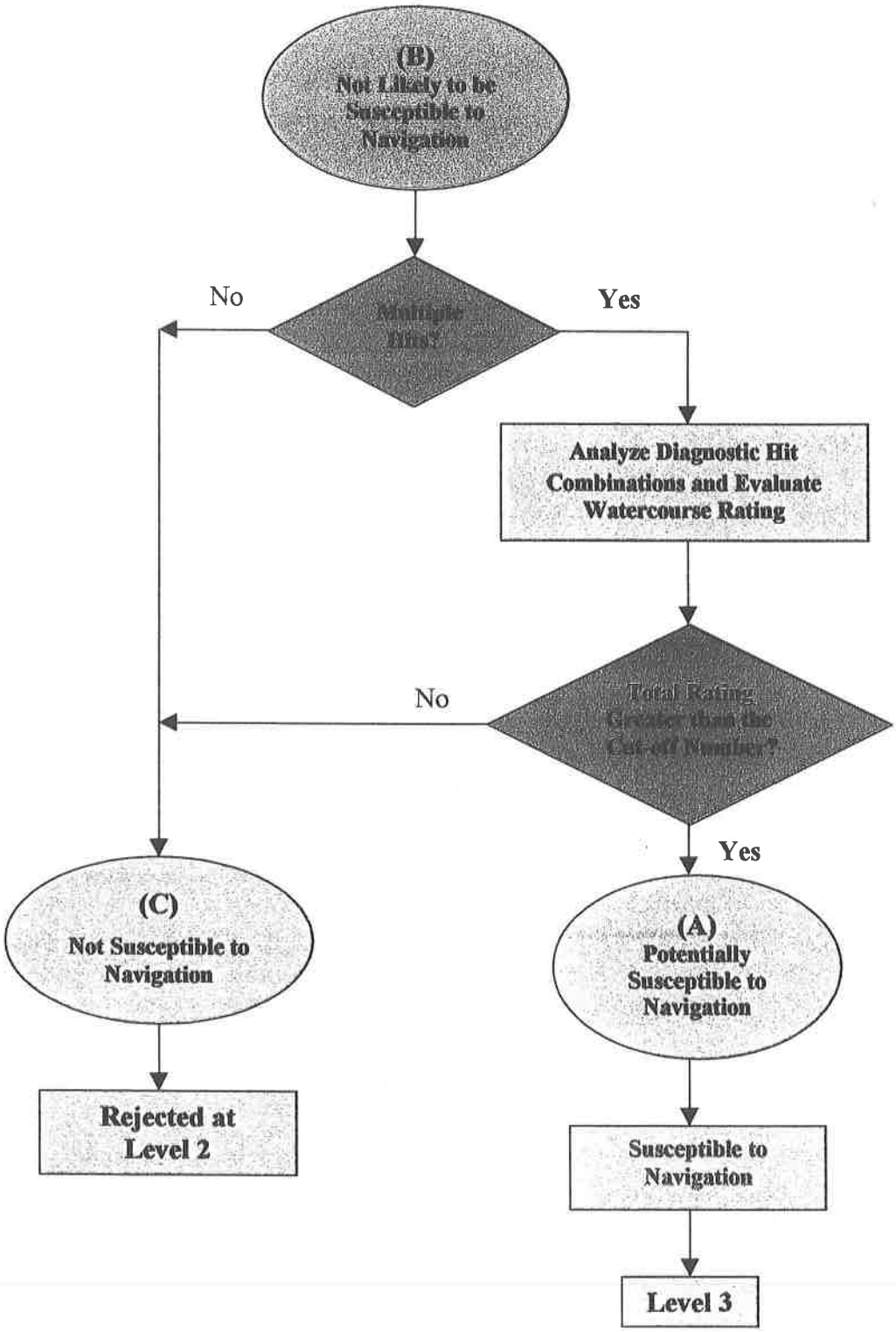


Figure 6
Level 2 Watercourse Screening
Second Cut Filter



The application of the rating system is based on the premise that the six criteria used in the classification analysis of the small and minor watercourses do not carry equal weights as far as establishing potential susceptibility of any given watercourse to navigation.

Ultimately, the second-cut filter classifies the watercourses into two categories (i.e., *Category A* and *Category C*) based on their likelihood of being susceptible to navigation. Watercourses with multiple hits indicative of susceptibility on contiguous segments and with evaluated total ratings of more than 11.0 are classified under *Category A. Category A* watercourses, which merit quantitative engineering analysis, are potentially susceptible to navigation and thus, forwarded for Level 3 analysis.

Watercourses, which are determined upon visual and/or manual inspection to exhibit physical characteristics incompatible with successful navigation (such as high elevations or steep slopes), and which received total ratings of 11.0 and below, are classified under *Category C. Category C* watercourses are rejected at Level 2 and are eliminated from further consideration in the study.

3.2.2 RELATIVE WEIGHTS USED FOR VARIOUS DATA (*Second Cut Filter, Tier 1 Data Weighting)*

For the second cut filter, this study utilized a two tier data rating process. The first tier looked at the data for a particular criterion or category. Here, there were considerations used by the project team to put relative weights on the various data used characterizing the relative importance of the information provided. By way of example, there were two data sources to describe the perennial watercourse data set. If one data source was known to have better information due to more extensive research and effort in acquiring the information, that data was assigned a greater weight in the analysis. The first tier rating process looked at the data for the criteria that had multiple sources to assess consistency between the data sources and the relativity of the data to susceptibility of navigation.

For the six criteria (or data categories) used in the classification analysis, only the *perennial, fish,* and *special status* data were evaluated due to multiple data sources. Evaluation of relative weights for *historical boating, modern boating,* and *dam-impacted* data was not necessary because only one data source was available for each.

Perennial - The information on perennial watercourses was taken from two data sources (ALRIS, 1999; ASP, 1995; and AGFD, 1988). Since the two sources were considered to be equally credible and reliable, equal weights of

0.50 were given to each. When the two data sources declare the same stream or watercourse to be perennial, a total weight of 1.0 is assigned for that particular stream. If conflicting stream classifications are provided on a given watercourse (i.e., one data source declares the stream to be perennial while the other data source declares it otherwise), the stream in question is given a total weight of 0.50.

Fish - Two general categories of fish species were considered for the study as indicators of water conditions in a particular stream. The presence of native fish species in the watercourse indicates that water might be present all-year round, otherwise this type of fish species would not survive. The presence of a non-native fish species indicates that water might not be present all the time which explains why this type of fish species must be seasonally introduced into the stream. Relative weights of 0.75 and 0.25 were assigned by the project team to the native and non-native fish species due to the association of these fish species with stream classification and conditions (i.e., perennial and non-perennial). If the two fish species were present in a particular watercourse, a total weight of 1.0 was assigned to the watercourse for the *fish* criterion.

Special Status - Five (5) special status designations were considered for the small and minor watercourses study. These designations indicate that a selected number of streams are under various programs sponsored, overseen, or monitored by federal or state agencies. These special status designations include *instream flow, riparian, wild and scenic, preserve,* and *unique waters.* The project team developed an arbitrary weighting system to reflect the importance of each of the special status designations relative to navigability.

From these five special status designations, only *instream flow* provides a quantitative information on the streamflow condition of the stream, which is one of the characteristics applicable to navigability. The other four designations are indicative of environmental protection and for land and habitat preservation. The information they provide on water-related issues, particularly on water quantities, are not a program requirement. *The instream flow* information for any given stream indicates whether a permit has already been granted or an application is being processed. Watercourses with *instream flow permits* indicate that streamflows are significant while watercourses with *instream flow applications* indicate that some streamflows are available. Therefore, watercourses with *instream flow applications* cannot be assigned the same weight as those with *instream flow permits*.

In summary, considering the relative importance of these special status classifications and their direct bearing on water quantity and streamflow, numerical scores were provided to estimate the relative weights of these five special status designations. Numerical scores assigned were as follows:

	Special Status Designation	Score
(a)	Instream Flow (Permit/Application)	3.00/1.50
(b)	Wild and Scenic	0.25
(c)	Preserve	0.25
(d)	Riparian	0.25
(e)	Unique Waters	0.25

The numerical scores above were use to establish the relative weights of the five special status designations as follows:

	Special Status Designation	Relative Weight
(a)	Instream Flow (Permit/Application)	0.750/0.375
(b)	Wild and Scenic	0.0625
(c)	Preserve	0.0625
(d)	Riparian	0.0625
(e)	Unique Waters	0.0625

For a watercourse with all the five special status designations (i.e., Instream Flow (Permit), Wild and Scenic, Preserve, Riparian, and Unique Waters), the total weight would be 1.0.

3.2.3 DETERMINATION OF NUMERICAL WEIGHTS (*Second Cut Filter, Tier 2 Data Weighting)*

The problem of not using a rating system for the watercourses is the assumption that the six criteria for the classification analysis carry the same weight as far as assessing their role to the stream navigability question. For example, historical boating, which is perceived to have the greatest bearing to stream navigability from among the six criteria, should carry the greatest weight possible.

Assigning associated weights to each of the six criteria based on their relevance to stream navigability aids in establishing a ranking system for the watercourses. The ranking system for the watercourses prioritizes the streams as follows: (1) those watercourses that show evidence of potential susceptibility to navigation which are forwarded to Level 3; and (2) those watercourses that show limited or weak susceptibility to navigation which are rejected at Level 2.

In order to assign numerical weights to the six criteria, a rating system was adopted with the goal of ranking the 1025 watercourses statewide to be evaluated in Level 2. The rating system was created by applying the criteria scoring matrix used for value engineering evaluation as shown in Figure B-1 (see Appendix B).

The procedure involves the identification of all the criteria to be used in the analysis. For the current study, the criteria are: *(a) historical boating, (b) modern boating, (c) perennial, (d) dam-impacted, (e) special status,* and *(f) fish.* Each criterion is compared with the rest of the criteria by assigning relative numerical values based on the preference scale provided below.

Value	**Degree of Preference**
4	*Major Preference*
3	*Medium Preference*
2	*Minor Preference*
1	*No Preference*
	(Each criterion scores one point).

For example, if three criteria (say *X, Y,* and *Z*) are being compared for the purpose of assigning numerical weights to them, each criterion must be individually compared to each of the other criteria (say *X vs. Y, X vs. Z, and Y vs. Z*). In each comparison there are only two possible choices, i.e., either one criterion is superior or preferred over the other criterion, or both criteria are on par - that is, no criterion is superior or preferred. For the first choice (where one criterion is superior or preferred), alphanumeric ratings similar to the examples below could be used:

X4 - indicates that criterion *X* is a *major preference* over criterion *Y* or criterion *Z*, whichever criterion *X* is being compared against.

Z3 - indicates that criterion *Z* is a *medium preference* over criterion *X* or criterion *Y*, whichever criterion *Z* is being compared against.

Y2 - indicates that criterion *Y* is a *minor preference* over criterion *X* or criterion *Z*, whichever criterion *Y* is being compared against.

For the second choice (where no criterion is superior or preferred), alphanumeric ratings similar to the examples below could be used:

X,Y1 - indicates that criterion *X* and criterion *Y* are on par (no preference) assigning one point for each criterion.

Y,Z1 - indicates that criterion *Y* and criterion *Z* are on par (no preference) assigning one point for each criterion.

When all possible comparison scenarios are exhausted, the assigned numerical values are summed up for each criterion. The criterion that receives the highest total raw score should carry the highest numerical weight. Ranking all the criteria based on the raw scores evaluated, numerical

weights from 0 to 10 are assigned accordingly. A numerical weight of 10 should be assigned to the criterion with the largest raw score, 9 or a lower rating to the second largest raw score, and so on.

3.2.4 CUT-OFF NUMBER FOR THE RATING SYSTEM

As part of the Level 2 analysis, the selection of the cut-off number used to identify the watercourses for Level 3 analysis (NRL2 data set) is based on a combination of positive responses on the six criteria. The scenarios presented below were considered to select the cut-off number for the study. It is important to note that the criteria weights presented in Table B-1 (Appendix B) were used for these scenarios. The evaluated weights are: historical boating = 10, modern boating = 8, perennial = 7, dam-impacted = 4, fish = 4, and special status = 2. The use of 11.0 as the cut-off number is justified as follows:

1. Watercourses with historical boating and modern boating accounts are automatically forwarded for Level 3 analysis. These watercourses are most likely to be perennial to have such boating accounts. Here, a minimum total rating of 15.0 is achieved.

2. Watercourses must be perennial, dam-impacted, and with fish to be forwarded for Level 3 analysis. Here, a maximum total rating of 15.0 is achieved.

3. Watercourses must be at least perennial, with fish, and with special status to be forwarded for Level 3 analysis. Considering the weights established for the six criteria, the total rating for this combination of responses is 13.0.

4. Watercourses must be at least perennial, dam-impacted, and with special status to be forwarded for Level 3 analysis. Here, a maximum total rating of 13.0 is possible.

5. Watercourses with fish, dam-impacted and with special status designations do not score high enough to be considered for Level 3 analysis. The total rating for this combination is 10.0.

6. Watercourses that are perennial and with fish or dam-impacted do not score high enough to be considered for Level 3 analysis. The same is true for watercourses that are perennial and dam-impacted. The total ratings for these two scenarios are 11.0.

The scenarios presented above are the combinations that clarify the significance of the cut-off number. The scenario for a watercourse that is perennial and with fish (item 6 above) does not indicate that the watercourse is not navigable. It is only saying that the watercourse does not have the

characteristics strong enough to be forwarded for Level 3 analysis. The purpose of the ranking system was to prioritize the 1025 watercourses that survived the Level 1 analysis relative to the strongest evidence or characteristics of susceptibility to navigation. The bottom-ranked is the least likely to exhibit characteristics or evidence of susceptibility to navigation. The cut-off number of 11.0, which is the rating for a perennial watercourse that is either with fish or dam-impacted (item 6), defines a scenario involving stream characteristics that do not score high enough to be further investigated.

In summary, streams forwarded to Level 3 analysis must be perennial and with at least two other positive responses in categories that indicate potential reliable flow conditions.

As shown in Figure 7, the total ratings evaluated from two rating systems for the 1025 watercourses are plotted. The red line represents the total ratings evaluated from the refined Level 2 approach that applied numerical weights for the six criteria. The blue line represents the total ratings without the numerical weights. Using the total rating plot of the refined Level 2 approach, two break points were identified. Associated with these break points are the total number of watercourses potentially studied for Level 3 analysis. A total rating equal to or greater than 14.0 involves 35 watercourses. A total rating more than 11.0, on the other hand, would involve 56 watercourses to be studied (This number excludes those that were already studied).

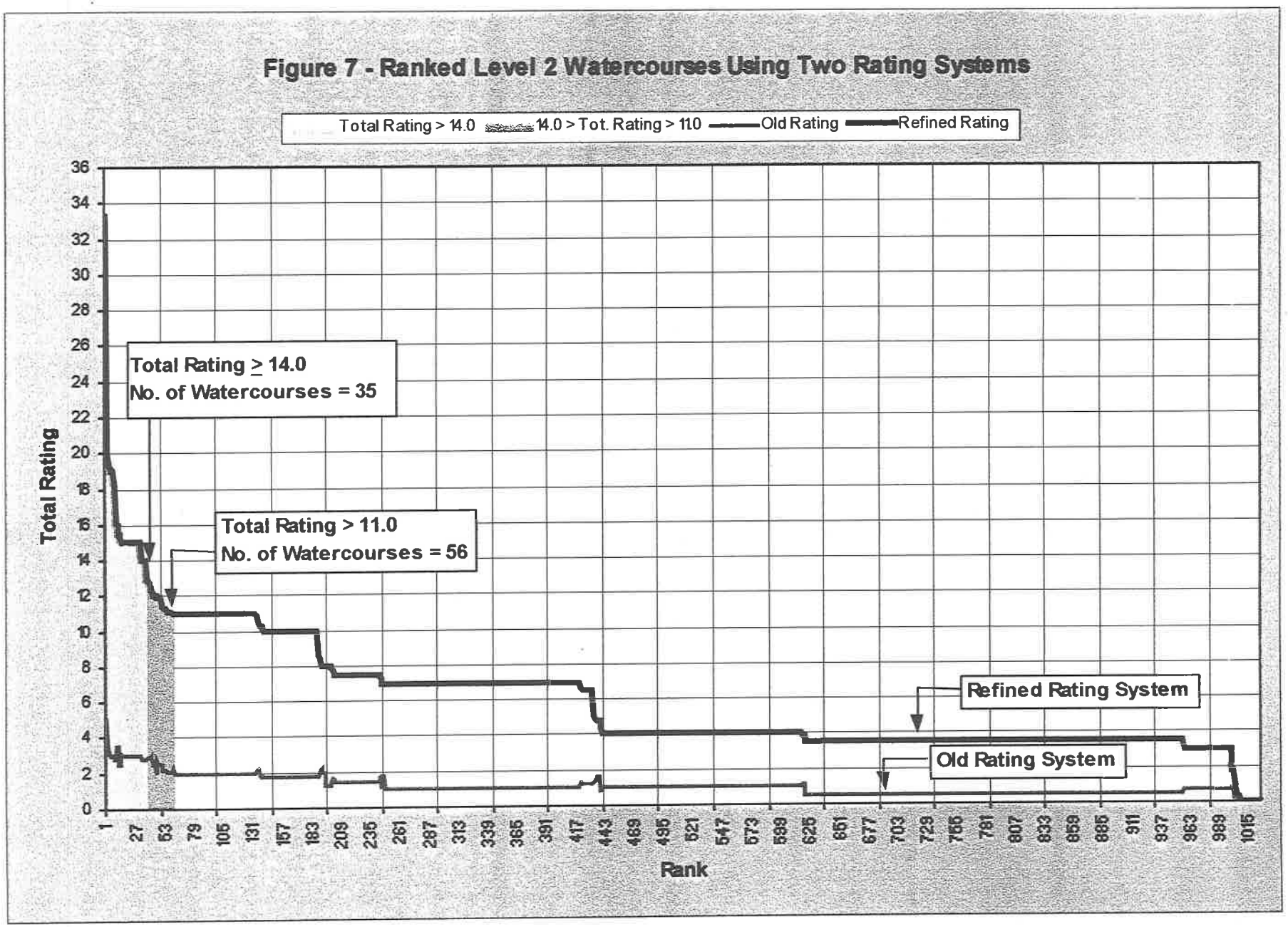
The selection of 11.0 as the cut-off number is based on the fact that a good number of the watercourses that are in the total rating range of 11.0 to 14.0 are identified as significant streams with high public interest. The list includes Cibecue Creek, Canyon Creek, Sycamore Creek, Seven Springs Wash, Pinto Creek, and Paria River. The use of 11.0 as the cut-off number requires 56 watercourses to be studied at Level 3. These are the watercourses that score high in the rating system and thus, are the best candidates for Level 3 analysis.

3.3 LEVEL 3 ANALYSIS

The goal of the Level 3 sorting process is to eliminate watercourses that are non-susceptible to navigation utilizing quantitative engineering methodologies. The primary objective of the Level 3 engineering methodologies is to provide technically sound data from which typical channel characteristics and flow rates for each watercourse can be estimated and used to determine susceptibility to navigation. Additionally, any physical obstacles to successful navigation along a watercourse will be identified and assessed at Level 3.

The recommended methodologies for the Level 3 screening process involve application of quantitative hydrologic and hydraulic analyses that require a significant level of effort to meet the requirements of the adjudication process.

Figure 7 - Ranked Level 2 Watercourses Using Two Rating Systems



The availability of streamgage data significantly impacts the level of effort required to quantify discharge rate and hydraulic geometry for evaluation of watercourse susceptibility to navigation. The recommended methodologies include:

1. Quantitative analysis of US Geological Survey (USGS) streamflow records or USGS regression-type methodologies based on streamflow records or extrapolation of gage data to adjacent watersheds to estimate discharge in the subject watercourse; and

2. Use of USGS rating curves or Manning's ratings to estimate flow characteristics such as depth, width and velocity in the subject watercourse.

The Level 3 screening process is applied only to those watercourses not rejected at Level 2 (NRL2 data set). The watercourses with no evidence of actual navigation in fact and determined to be not susceptible to navigation are rejected at Level 3. All remaining watercourses merit detailed study comparable to that performed for the major river studies and advance to the final level of the watercourse evaluation system.

3.4 LEVEL 3 – DETAILED STUDY SIMULTANEOUS ANALYSIS

Figure 8 shows the schematics of the procedure adopted to evaluate the small and minor watercourses that have passed the Level 2 analysis. This approach was used by the project team to meet the accelerated schedule set by ANSAC for public hearings. It was not possible to meet the ANSAC schedule and wait for the outcome of the Level 3 screening prior to knowing which watercourse would proceed to detailed studies. Since the Level 3 analysis takes significant effort (and time) to complete, and detailed studies take an even greater effort, the completion dates of the detailed studies would extend beyond the scheduled ANSAC hearings. Therefore, the need to complete all analyses for every watercourse prior to the hearing dates requires that the Level 3 analysis and the detailed studies be conducted simultaneously or in parallel track (see Figure 8). This, however, does not require every NRL2 watercourse to be studied in detail but only those that had the highest ratings in the ranking system.

Although this approach effectively eliminates the scheduling problem presented above, this entails some extra cost for the engineering and analysis. It is most likely that some of the watercourses that have been studied in detail would turn up in the RL3 (rejected data set in Level 3) list after the Level 3 analysis. This RL3 data set comprises those watercourses that merit no further evaluation and study after Level 3.

The extra cost, however, is insignificant compared to the importance of meeting the goal of completing the task within the allotted time frame. It is critical that the cases of all the small and minor watercourses in the fifteen counties of Arizona are heard and fully adjudicated before the Commission sunset date of June 30, 2002.

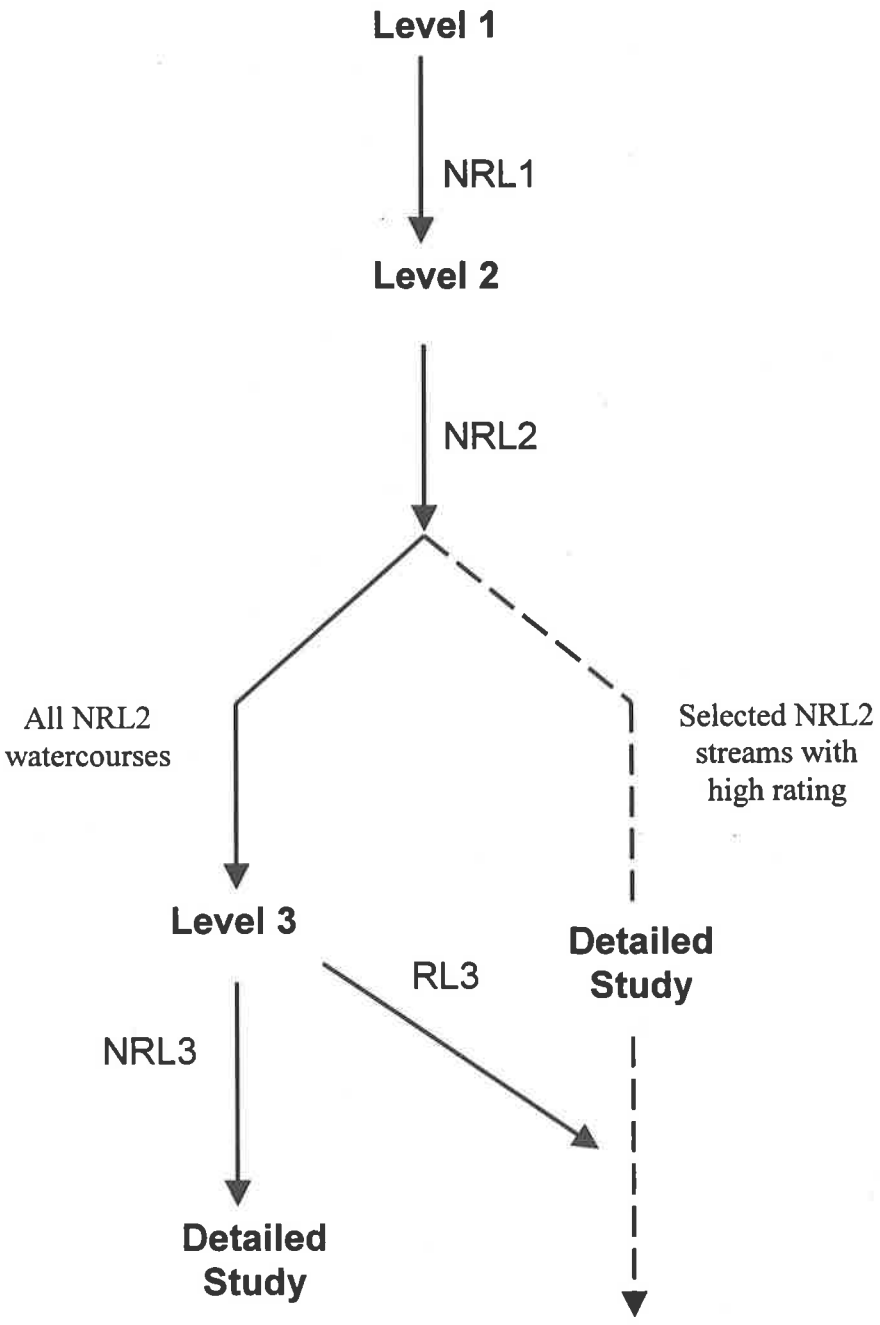


Figure 8
Schematics showing simultaneous analysis of
selected NRL2 watercourses in Level 3 and Detailed Study

4.0 Results

4.1 LEVEL 1 ANALYSIS

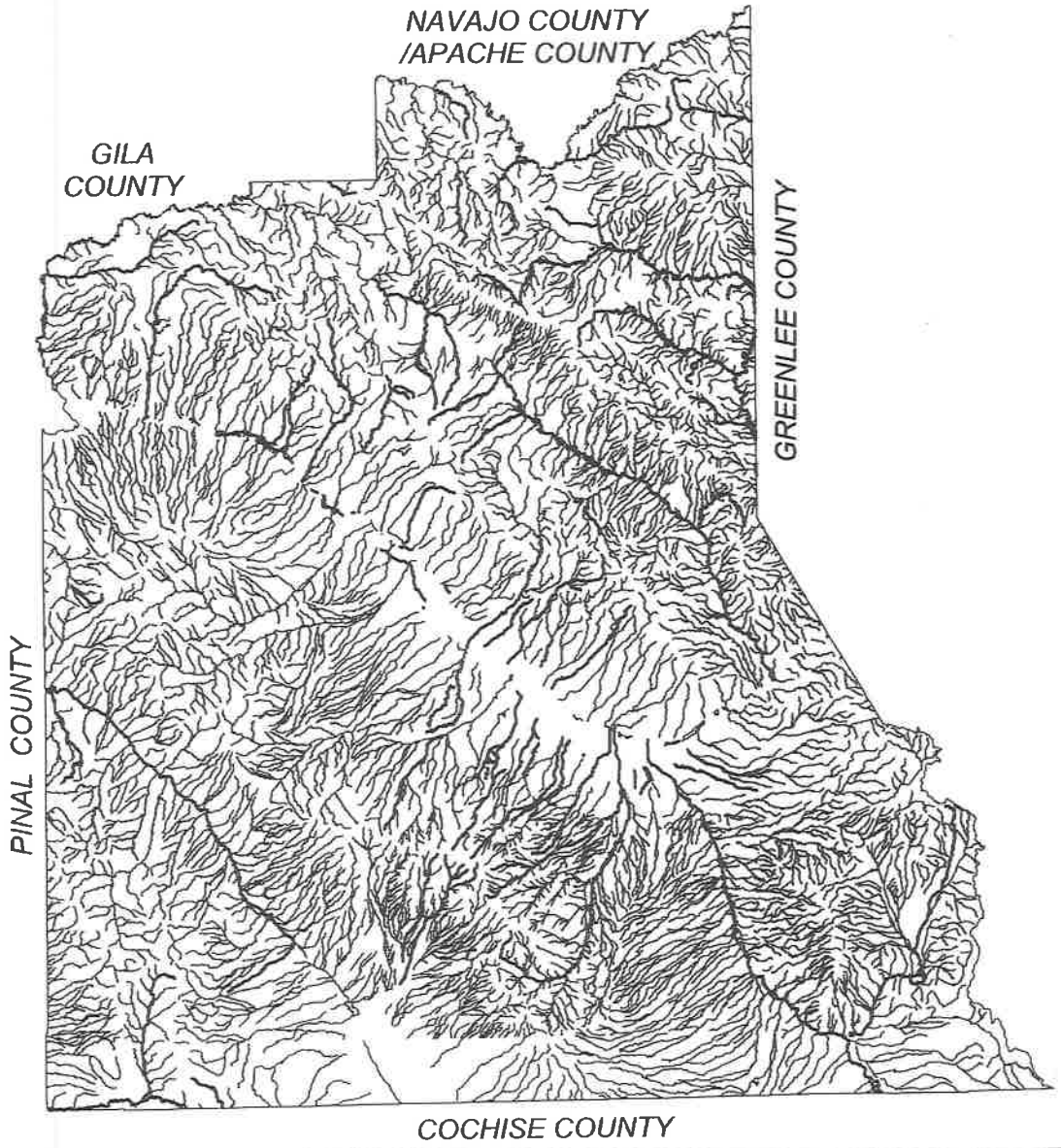
The application of the Level 1 sorting procedure to all small and minor watercourses in Graham County resulted into two data sets. The RL1 data set is comprised of all watercourses that test negatively for each criterion used in the Level 1 database query. This indicates that no characteristics of stream susceptibility to navigation are exhibited based upon known records and information. Level 1 analysis results indicate a significant percentage of the watercourses (95.5% or 3,080 records out of 3,226 total) test negatively to all Level 1 criteria and, therefore, do not justify further evaluation at Level 2.

The NLR1 data set is comprised of those watercourses that exhibit some characteristics of susceptibility to navigation based upon at least one affirmative response (hit) to the six criteria used in the Level 1 evaluation. Results of the analysis indicate that there are 146 watercourses (approximately 4.5%) in Graham County, which justify analysis at Level 2.

The summary listings for RL1 and NRL1 data sets are presented in Tables A-1A and A-1B in Appendix A. One hundred and twenty eight (128) of the NRL1 watercourses are one-hitters and eighteen (18) watercourses tested affirmatively to more than one of the Level 1 criteria used in the database query.

The maps of RL1 and NRL1 data sets determined from the Level 1 sort are shown in Figure 9.

FIGURE 9
NRL1 and RL1 Data Sets from Level 1 Analysis for Graham County



Arizona Map

LEGEND:

NRL1 Data Set

RL1 Data Set

Graham County

N

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10 0 10 20 30 Miles

4.2 LEVEL 2 ANALYSIS

The NRL1 data set resulting from Level 1 analysis contains 146 watercourses. Results from the application of the Level 2 approach to the 146 watercourses are presented and discussed in the sections that follow. Employing the first-cut screening process shown in Figure 5 for the NRL1 data set leads to the classification of the watercourses as follows:

A. Stream *Category A* – potentially susceptible to navigation

1. Black River
2. Eagle Creek

B. Stream *Category B* – navigation possible, not likely

1. Aravaipa Creek
2. Ash Creek 1 - Graham
3. Bear Wallow Creek
4. Bonita Creek - Graham
5. Frye Creek
6. Redfield Canyon
7. San Carlos River
8. Swamp Springs Canyon
9. Bass Canyon
10. Grant Creek - Graham
11. Marijilda Wash
12. Markham Creek
13. Point of Pines Creek
14. Stockton Wash
15. Turkey Creek 2 - Graham
16. 1 Unnamed Wash

C. Stream Category C – navigation unlikely.

1. Bigler Wash
2. Billingsley Creek
3. Bobcat Creek
4. Brushy Creek - Graham
5. Burton Wash
6. Cienega Creek - Graham
7. Dry Prong Creek
8. Elwood Canyon Creek
9. Freezeout Creek
10. Gibson Creek - Graham
11. Goudy Canyon Wash

12. Hackberry Creek - Graham
13. Hot Well Draw
14. Long Creek
15. Midnight Creek
16. Moonshine Creek
17. Natural Corral Creek
18. Ninemile Creek
19. Paymaster Wash
20. Peck Wash
21. Post Creek
22. Salt Creek - Graham
23. San Simon River
24. Sevenmile Creek
25. Soldier Creek - Graham
26. South Fork Ask Creek 2
27. Squaw Creek 1 - Graham
28. Watson Wash
29. Willow Creek 1
30. 99 Unnamed Washes

Employing the second-cut filter screening process shown in Figure 6 and the criteria scoring matrix presented in Figure B-1 (see Appendix B) to establish a ranking system for the watercourses leads to the identification of those watercourses rejected at Level 2 and those that are forwarded for Level 3 analysis. All watercourses with total ratings equal to or lesser than the cut-off number of 11.0 are classified under *Category C.* These watercourses comprise the RL2 data set, which are not forwarded for Level 3 analysis. On the other hand, the watercourses with total ratings more than the cut-off number of 11.0 are classified under *Category A.* These watercourses comprise those that are potentially susceptible to navigation and hence, are forwarded for Level 3 analysis.

To illustrate the use of the numerical weights for the refined approach, the case of Black River in Apache, Navajo, Gila, Greenlee and Graham Counties is considered (see Table A-2C, Appendix A). From the database, Black River exhibits the information shown in Table 2 [column (3)] on the six criteria. The rating of 1.0 for perennial is evaluated from the fact that Black River is perennial according to ALRIS (1999) and Brown et al. (1981).

The rating of 1.0 for fish is evaluated from the fact that both native and non-native fish species are documented for Black River. Weights given to fish species are: 0.75 for native fish and 0.25 for non-native species. A total weight of 1.0 for fish is evaluated from the sum of these two weights. The special status rating of 0.13 is evaluated from two special status designations described as riparian and wild & scenic.

Weights given to special status classifications are: 3.00 for instream flow (permit), 1.50 for instream flow (application), and 0.25 each for riparian, preserve, wild and scenic, and unique waters. A total weight of 4.0 is evaluated for any watercourse that has all these special status designations. The weighted average rating for any watercourse with special status is determined by dividing the total weight by 4.0.

In the case of Black River, the weighted average rating of 0.13 is evaluated from dividing 0.50 (i.e., 0.25 + 0.25) by 4.0.

From the analysis performed in Table 2, the total rating evaluated for Black River is 19.26, which is greater than the cut-off number of 11.0. This indicates that Black River is forwarded for Level 3 analysis.

Table 2 - Evaluation of Total Rating

Criterion	Weights	Rating	Refined Rating	Notes/ Remarks
(1)	(2)	(3)	(4) = (2)x(3)	(5)
Perennial	7	1.0	7.00	Stream is perennial according to ALRIS (1999) and Brown et al (1981).
Historical Boating	10	0.00	0.00	No historical boating.
Modern Boating	8	1.00	8.00	With modern boating.
Dam-Impacted	4	0.00	0.00	Not dam-impacted.
Fish	4	1.00	4.00	Native and non-native fish species are present.
Special Status	2	0.13	0.26	Special status designations are instream flow (application), riparian, and preserve.
Total Rating		3.13	19.26	Greater than 11.00.

The listing of watercourses classified under stream *Category A* and *Category C* for the second cut filter screening process are provided as follows:

D. Stream *Category A* – potentially susceptible to navigation.

1. San Carlos River
2. Aravaipa Creek
3. Bonita Creek – Graham

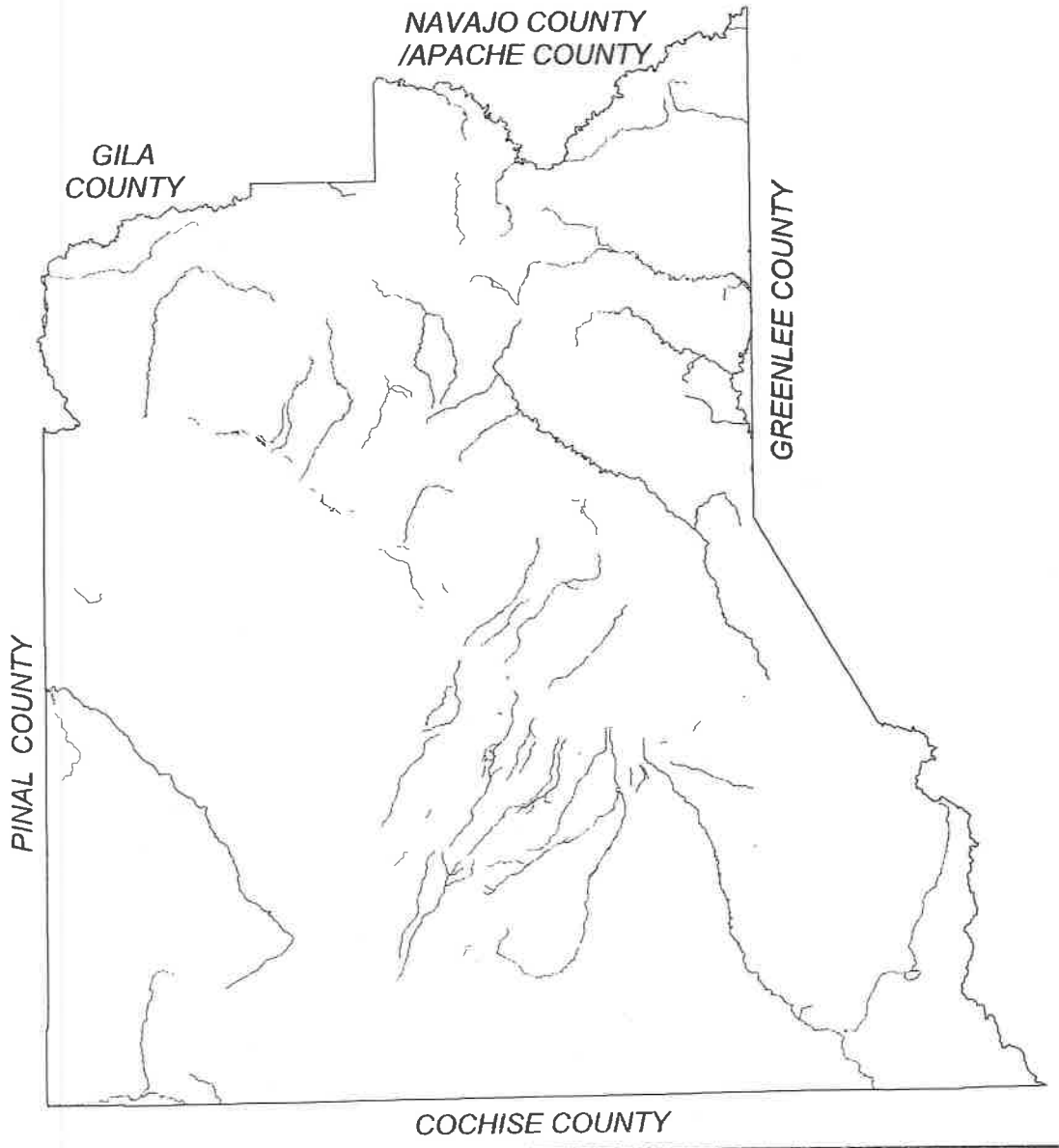
D. Stream Category C – navigation unlikely.

1. Ash Creek 1 - Graham
2. Bear Wallow Creek
3. Frye Creek
4. Redfield Canyon
5. Swamp Springs Canyon
6. Bass Canyon
7. Grant Creek - Graham
8. Marijilda Wash
9. Markham Creek
10. Point of Pines Creek
11. Stockton Wash
12. Turkey Creek 2 - Graham
13. 1 Unnamed Wash

A summary listing of the RL2 data set is presented in Tables A-2A (see Appendix A). The map associated with the RL2 data set evaluated from Level 2 is shown in Figure 10.

The numerical weights assigned to the six criteria were based on the average values evaluated from the use of the criteria scoring matrix. This numerical weights are used as multipliers for the six criteria in calculating the total rating associated with each watercourse. The summary table listing the numerical weights assigned to the six criteria from a pool of seven participants is shown in Table B-1 (see Appendix B - Criteria Weight Evaluation).

FIGURE 10
NRL2 and RL2 Data Sets from Level 2 Analysis for Graham County



Arizona Map

LEGEND:

NRL2 Data Set

RL2 Data Set

Graham County

N
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10 0 10 20 30 Miles

4.3 LEVEL 3 ANALYSIS

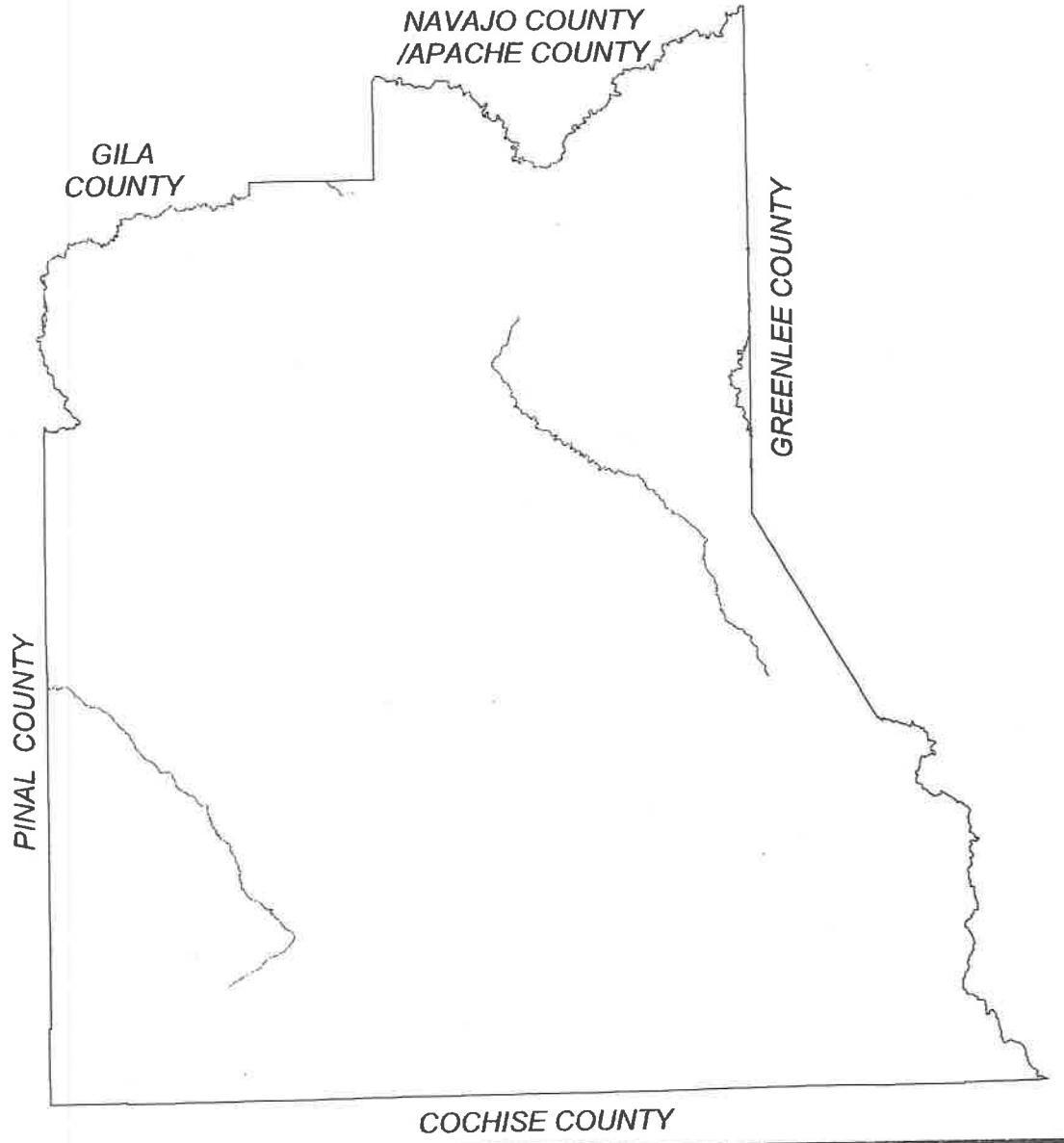
The five (5) watercourses in Graham County that survived the Level 2 analysis (represented by NRL2 data set) were further evaluated at Level 3. These watercourses are identified below and details of the Level 3 analysis results are provided in the sections that follow. Each section comprises an individual, *'stand alone'* Level 3 study.

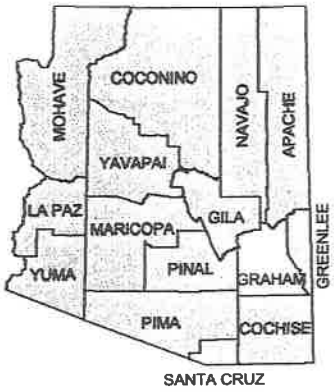
1. Black River
2. Aravaipa Creek
3. Bonita Creek [1]
4. Eagle Creek
5. San Carlos River

The map associated with RL3 and NRL3 data sets evaluated from Level 3 analysis are shown in Figure 11.

[1] Referred to as Bonita Creek - Graham in the project database.

FIGURE 11
NRL3 and RL3 Data Sets from Level 3 Analysis for Graham County





Map of Arizona

LEGEND:

NRL3 Data Set

RL3 Data Set

Graham County

N
W E
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10 0 10 20 30 Miles

4.3.1 Level 3 Analysis for the Black River Counties: Apache/Gila/Graham/Greenlee/Navajo

Introduction

The following information summarizes the Level 3 analysis of the Black River in Apache, Gila, Graham, Greenlee and Navajo Counties in Arizona (Hydrologic Unit: 15060101). The purpose of the Level 3 analysis is to provide basic technical data regarding stream characteristics from which the Arizona Navigable Stream Adjudication Commission (ANSAC) can make a recommendation of navigability or non-navigability to the Arizona legislature.

The Black River had four affirmative responses in the Level 1 analysis: *modern boating, fish, special status,* and *perennial stream classification*. According to Level 2 criteria, the watercourse is classified under stream Category *A (Potentially Susceptible to Navigation)* thus justifying forwarding the watercourse to Level 3 analysis. The total rating evaluated for the Black River using the refined approach at Level 2 was 19.26.

Stream Geomorphology

The Black River trends its way to the west from headwaters in Williams Valley and Big Lake to its confluence with the Salt River approximately 13.0 miles west-southwest of Whiteriver, Arizona. The total drainage area of the Black River at the mouth is about 1,252 square miles. The upper drainage area is south of Springerville, AZ. Elevations along the watercourse range from a maximum of about 7,840 feet at the headwaters to about 4,230 feet at the Salt River confluence.

The Black River is about 113.4 miles long and can be divided into three stream reaches:

(1) The upper reach is about 13.1 miles long and extends from the headwaters to the confluence with Reservation Creek. The reach has a relatively steep average channel slope of about 69.4 ft/mi or 0.0131 ft/ft.

(2) The middle reach is about 44 miles long and extends from the confluence with Reservation Creek to a point about 6 miles downstream of Gage No. 09489500. The slope flattens a little in this reach to about 51.1 ft/mi or 0.0097 ft/ft.

(3) The lower reach is about 56.3 miles long and extends from a point about 6 miles downstream of Gage No. 09489500 to the confluence with the Salt River. The channel slope flattens considerably along the lower reach with the average channel slope being about 36.2 ft/mi or 0.0069 ft/ft.

Field photographs of the Black River are provided in Appendix A. Cited photographs of the Black River published mostly in Arizona Highways Magazine are listed and described in Appendix B.

Hydrology

Hydrologic data for the Black River is available from three USGS stream gages:

(a) Black River Near Maverick, AZ (Gage Station No. 09489100, SW1/4 S30, T4N, R28E);
(b) Black River Below Pumping Plant, Near Point of Pines, AZ (Gage Station No. 09489500, W1/2 S32, T2N, R25E); and
(c) Black River Near Fort Apache, AZ (Gage Station No. 09490500, NW1/4 S12, T4N, R20E).

Gage Station No. 09489100 is located on the right bank 1.0 miles downstream from Fish Creek, 1.1 miles upstream from Conklin Creek, and 6 miles southeast of Maverick. The elevation of the gage is approximately 6,850 feet above sea level. The contributing drainage area at the gage is 315 $mi.^2$. Gage Station No. 09489500 is located on the left bank 0.9 miles downstream from Phelps Dodge Corp. pumping plant, 1.3 miles downstream from Freezeout Creek, 8 miles northwest of Point of Pines, and 63 miles upstream from confluence with White River. The elevation of the gage is approximately 5,725 feet above sea level. Gage Station No. 09490500 is located on downstream side of first pier from right bank on highway bridge, 5 miles upstream from confluence with the White River and 14 miles west of Fort Apache. The elevation of the gage is approximately 4,345 feet above sea level. The contributing drainage area to the gage is 1,232 $mi.^2$.

Flow data for the Black River at the three USGS gaging stations are summarized in Table 1 and shown in Figures 1, 2, 3 & 4. The 2-year peak discharges of 1,620 cfs, 2,230 and 7,460 cfs should not be assumed to be representative of typical flows. The 2-year peak discharge represents that event that is exceeded less than about 0.50% of the time. Ordinary flows are those events that are exceeded 10% to 90% of the time.

Table 1
Streamflow Data from USGS Gaging Stations Along the Black River
(Source: Pope et al., 1998)

Flow Data	Gage 09489100 Discharge (cfs)	Gage 09489500 Discharge (cfs)	Gage 09490500 Discharge (cfs)
(1)	(2)	(3)	(4)
Mean Annual Flow	141	221	438
90% Flow Duration	20	23	39
50% Flow Duration	40	61	109
10% Flow Duration	354	596	1,230
2-Year Flood Peak	1,620	2,230	7,460

Figure 1
Black River - Flow Duration Curves
[Data Source: Pope et al. (1998)]

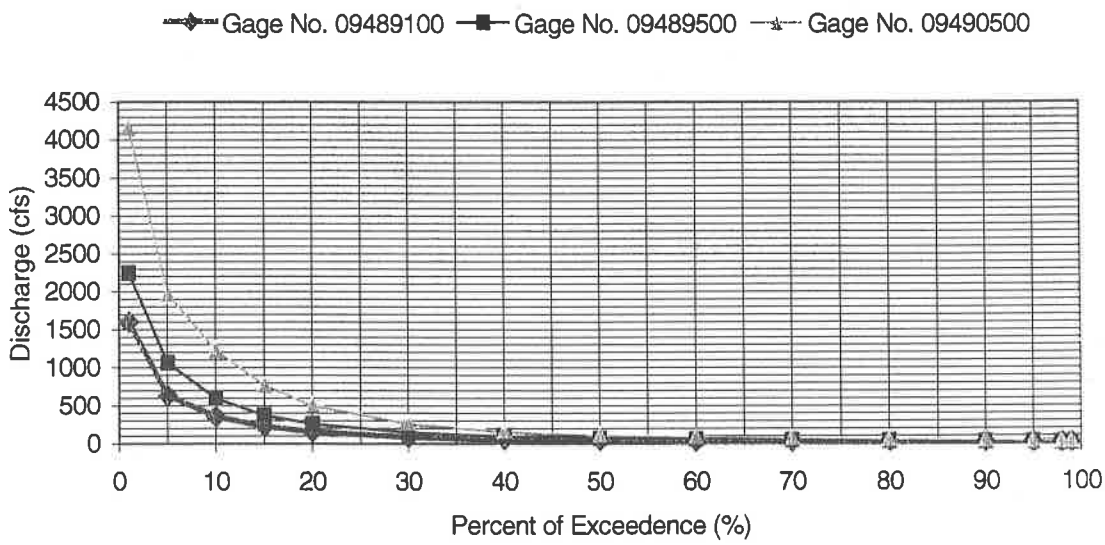


Figure 2
Black River Near Maverick, AZ (Gage No. 09489100)
Average Monthly Flow Rate (cfs)

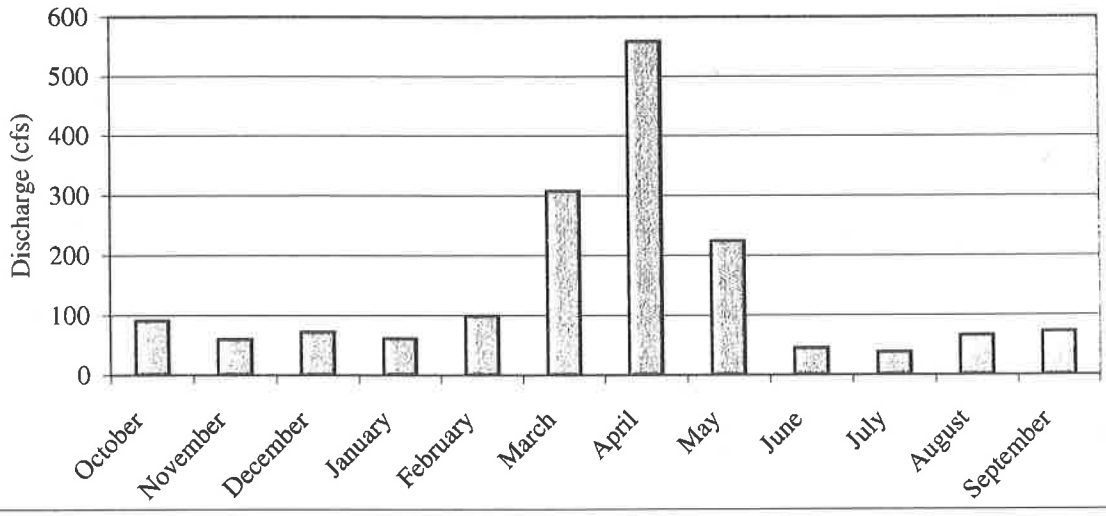


Figure 3
Black River Below Pumping Plant, Near Point of Pines, AZ
(Gage No. 09489500)
Average Monthly Flow Rate (cfs)

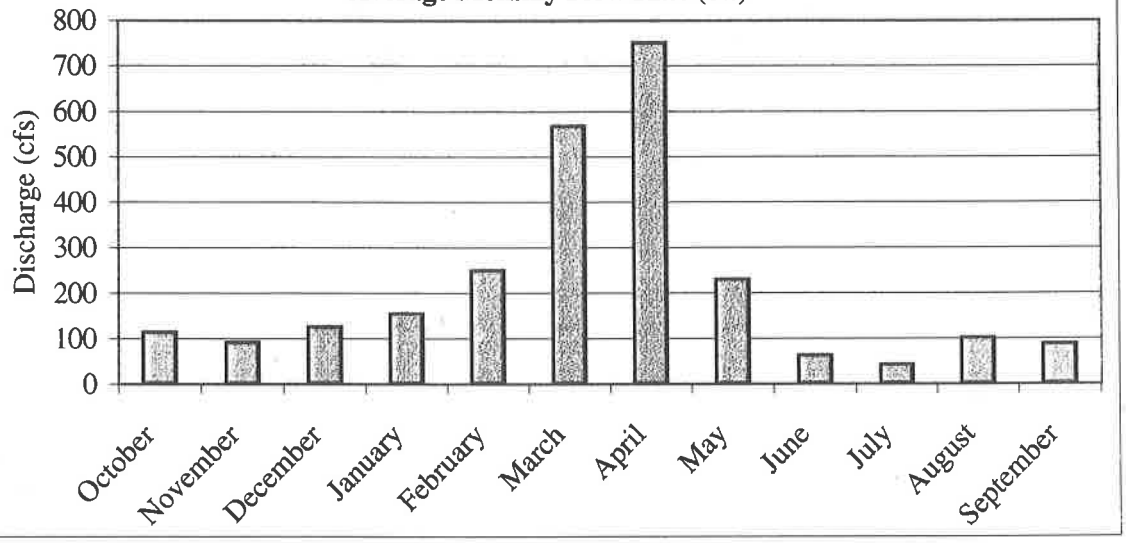
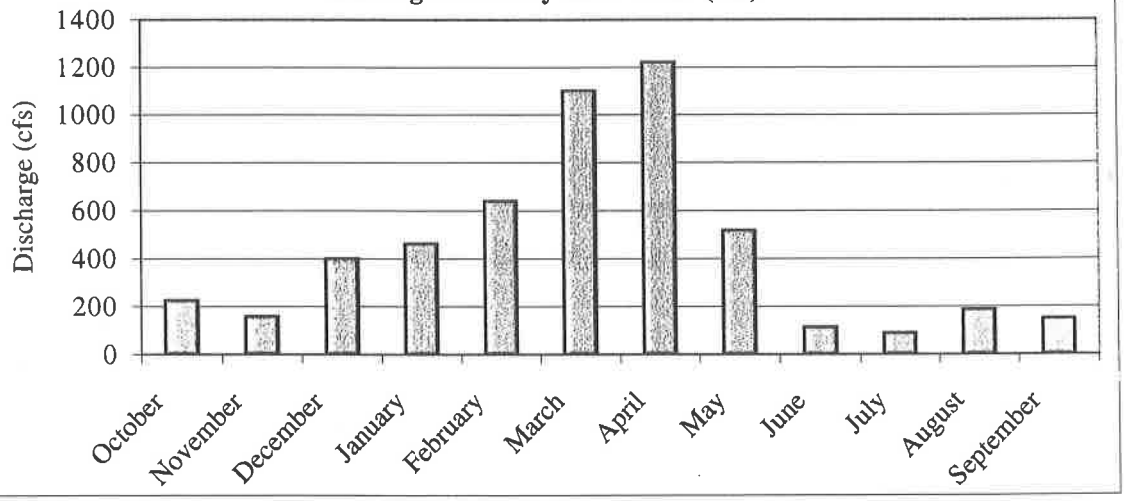


Figure 4
Black River Near Fort Apache, AZ
(Gage No. 09490500)
Average Monthly Flow Rate (cfs)



The flow data summarized above indicates that the Black River is perennial at all the gages. The average monthly flow rates (see Figures 2, 3 and 4) are all above zero. The typical flow rate downstream is around 100 to 200 cfs, with exceptional flows occurring during the winter months and the beginning of spring (January through April).

Hydraulics

Rating data was obtained for Gage Station Nos. 09489500 and 09490500 from the U.S. Geological Survey (USGS, 2000a & 2000b). No rating data was available for Gage Station No. 09489100 because data collection has been discontinued. Values reported in Table 2 (columns 3 and 5) were determined using Manning's equation for a rectangular channel (values in column 4 were estimated based on field investigation). Values reported in Tables 3 and 4 (columns 4 and 5) were determined using Manning's equation for a rectangular channel. Data used for the hydraulic analysis were based on information obtained during field investigation and from topographic maps.

Table 2
Rating Data at Gage Station No. 09489100
Black River Near Maverick, Arizona

Data	Discharge [1] (cfs)	Depth [2] (ft)	Width [2] (ft)	Velocity [2] (ft)
(1)	(2)	(3)	(4)	(5)
Mean Annual Flow	141	1.13 – 1.61	15 – 25	5.0 – 5.9
90% Flow Duration	20	0.72 – 0.88	6 – 8	3.5 – 3.8
50% Flow Duration	40	0.95 – 1.12	8 – 10	4.2 – 4.5
10% Flow Duration	354	1.61 – 2.02	25 – 35	6.3 – 7.0
2-Year Flood Peak	1,620	3.08 – 4.22	35 – 55	9.6 – 11.0

[1] Data Source: Pope et al (1998).
[2] Data Source: Evaluated from hydraulic analysis using n = 0.035, slope = 0.0131 ft/ft and a rectangular channel.

Table 3
Rating Data at Gage Station No. 09489500
Black River Below Pumping Plant Near Point Of Pines, Arizona

Item	Discharge [1] (cfs)	Depth [2] (ft)	Width [3] (ft)	Velocity [3] (ft)
(1)	(2)	(3)	(4)	(5)
Mean Annual Flow	221	1.61	25.8	5.31
90% Flow Duration	23	0.90	7.6	3.38
50% Flow Duration	61	1.16	12.7	4.13
10% Flow Duration	596	2.23	40.2	6.65
2-Year Flood Peak	2,230	4.19	53.9	9.87

[1] Data Source: Pope et al (1998).
[2] Data Source: USGS (2000a)
[3] Data Source: Evaluated from hydraulic analysis using n = 0.035, slope = 0.0097 ft/ft and a rectangular channel.

Table 4
Hydraulic Analysis at Gage Station No. 09490500
Black River Near Fort Apache, Arizona

Item	Discharge [1] (cfs)	Depth [2] (ft)	Width [3] (ft)	Velocity [4] (ft)
(1)	(2)	(3)	(4)	(5)
Mean Annual Flow	438	3.29	20.5	6.48
90% Flow Duration	39	1.61	6.5	3.71
50% Flow Duration	109	2.11	11.0	4.68
10% Flow Duration	1,230	4.75	31.0	8.34
2-Year Flood Peak	7,460	10.80	50.8	13.60

[1] Data Source: Pope et al (1998).
[2] Data Source: USGS (2000b).
[3] Data Source: Evaluated from hydraulic analysis using n = 0.035, slope = 0.0069 ft/ft and a rectangular channel.

Boating Criteria

The boating criteria cited below were reported in previous detailed navigability studies prepared for the Arizona State Land Department (1996, 1997). The following tables summarize navigability criteria information from the above mentioned studies and reports. Note that these estimates refer to recreational boating and not commercial boating.

Table 5
Minimum Required Stream Width and Depth for Recreation Craft
(Source: Cooperative Instream Flow Service Group, 1978)

Type of Craft	Depth (ft.)	Width (ft.)
(1)	(2)	(3)
Canoe, Kayak	0.5	4.0
Raft, Drift Boat, Row Boat	1.0	6.0
Tube	1.0	4.0
Power Boat	3.0	6.0

Table 6
Minimum and Maximum Conditions for Recreational Water Boating
(Source: Cortell and Associates, Inc., 1977)

Type of Boat	Minimum Condition			Maximum Condition		
	Width	Depth	Velocity	Width	Depth	Velocity
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Canoe, Kayak	25 ft.	3-6 in.	5 fps	-	-	15 fps
Raft, Drift Boat	50 ft.	1 ft.	5 fps	-	-	15 fps
Low Power Boating	25 ft.	1 ft.	-	-	-	10 fps
Tube	25 ft.	1 ft.	1 fps	-	-	10 fps

Table 7
Flow Requirements for Pre-1940 Canoeing
(Source: Slingluff, J., 1987)

Boat Type	Depth
(1)	(2)
Flat Bottomed (Wood or Canvas)	4 in.
Round Bottomed (Wood or Canvas)	6 in.

Summary and Conclusion

Comparison of the boating criteria above with the hydraulic conditions estimated for the Black River indicates that the lower reach (Gage No. 09490500) could possibly allow recreational watercrafts access about 90 percent of the time. For the middle reach (Gage No. 09489500), hydraulic conditions could possibly allow canoe or kayak access 90 percent of the time, access to the other types of non-motorized crafts 50 percent of the time and access to motorized craft (powerboat) 10 percent of the time. For the upper reach (Gage No. 09489100), hydraulic conditions could possibly allow canoe and kayak access 90 percent of the time, other non-motorized crafts access 50 percent of the time and motorized crafts (powerboat) access 10 percent of the time.

Due to obstructions along the reach such as overgrowth and rock outcrop, shallow flow depths, and steep slopes in the upper reach (see photograph descriptions in Appendix B), continuous access would be nearly impossible and other than localized recreational use would most likely not be conducive for regular transport. A detailed study is not recommended for the Black River.

Limitations

This evaluation is based on readily available information that reflects the level of detail and funding authorized for the Small and Minor Watercourses Analysis by Arizona State Land Department (ASLD). The following limitations apply to the results presented above:

(a) The hydraulic rating sections, located near the three gage sites, may or may not apply to the entire study reaches.

(b) Hydrologic data for a given stream varies with location along the reach and with time in response to climatic conditions. The study reach considered is quite long and care should be exercised in reviewing and applying the flow hydraulics. The hydrologic information provided is the best data readily available for the stream.

(c) Stream conditions are assumed to represent conditions at the time of Arizona statehood. Unless stated otherwise, no conditions were identified during the Level 3 analysis that indicated substantial changes in stream morphology with respect to navigability criteria.

References

(1) Arizona Department of Transportation, (1994), Highway Drainage Design Manual, Hydrology, *Research Project No. HPR-PL-1-43 (281)*, prepared by NBS/Lowry Engineers and Planners, Inc., and George V. Sabol Consulting Engineers, Inc., March 1993 (Revised: April, 1994).

(2) Arizona Game and Fish Department (1998), Perennial Stream Map, adapted from "Drainage Map of Arizona Showing Some Important Wetlands" (D.E. Brown, N. B. Carmony, and R.M. Turner, 1982) and the "Statewide Riparian Inventory and Mapping" (Arizona Game and Fish Department, 1994), produced by the Habitat Branch, May 1998.

(3) Arizona Game and Fish Department (1999), Geospatial Data Set: Perennial Streams of Arizona, digital files provided to Stantec Consulting, Inc., Phoenix, Arizona, in July 9, 1999.

(4) Arizona Navigable Stream Adjudication Commission, (1999), Small and Minor Watercourses Pilot Study, prepared by Stantec Consulting, Inc., JE Fuller/Hydrology & Geomorphology, Inc., and Water Resources Research Center, University of Arizona, Contract No. A7-0109-001, Phoenix, Arizona, October 1999.

(5) Arizona State Land Department, (1996), Arizona Stream Navigability Study for the Upper Salt River (Granite Reef Dam to the Headwaters), *Preliminary Report*, prepared by SFC Engineering Company, George V. Sabol Consulting Engineers, Inc., JE Fuller/Hydrology and Geomorphology, Inc., and SWCA, Inc. Environmental Consultants, November 1996.

(6) Arizona State Land Department, (1997), Arizona Stream Navigability Study for the Little Colorado River (Sunrise to the Headwaters) and Puerco River (Little Colorado River Confluence to the State Boundary), *Final Report*, prepared by SFC Engineering Company, George V. Sabol Consulting Engineers, Inc., JE Fuller/Hydrology and Geomorphology, Inc., and SWCA, Inc. Environmental Consultants, June 1997.

(7) Arizona Land Resources Information System, Geospatial Data Set: Streams, digital data files provided to Stantec Consulting, Inc., Phoenix, Arizona, in July 13, 1999.

(8) Cooperative Instream Flow Service Group, (1978). Methods of assessing instream flows for recreation. *Instream Flow Information Paper No. 6.* FWS/OBS-78/34. Report prepared by U.S. Fish and Wildlife Service, U.S. Environmental Protection Agency, Heritage Conservation and Recreation Service, and Bureau of Reclamation, June, 1978.

(9) Cortell and Associates, Inc. (1977). Recreation and instream flow, Vol. 1: Flow Requirements, Analysis of Benefits, Legal & Institutional Constraints. Report submitted to U.S. Department of the Interior and Bureau of Outdoor Recreation #BOR D6429, July, 1977.

(10) Holmes, W. F., Pyper, G. E., Gates, J. S., Schaefer, D. H., and Waddell, K. M., 1997, Hydrology and water quality of the Beaver Dam Wash area, Washington County, Utah, Lincoln County, Nevada, and Mohave County, Arizona, Water-Resources Investigations Report 97-4193, Prepared in cooperation with the Utah Department of Natural Resources, Division of Water Resources; Nevada Department of Conservation and Natural Resources; Arizona Department of Water Resources; and Bureau of Land Management, published by the U.S. Geological Survey, Salt Lake City, Utah.

(11) Langbein, Walter B., (1962). Hydraulics of river channels as related to navigability. *U.S. Geological Survey Water-Supply Paper 1539-W.*

(12) Pope, G.L., Rigas, P.D., and Smith, C. F., (1998), Statistical Summaries of Streamflow Data and Characteristics of Drainage Basins for Selected Streamflow-Gaging Stations in Arizona Through Water Year 1996, *Water Resources Investigations Report 98-4225*, prepared in cooperation with Arizona Department of Water Resources, Bureau of Reclamation, Pima County Board of Supervisors, Flood Control District of Maricopa County, and Salt River Project, U.S. Geological Survey, Tucson, Arizona.

(13) Slingluff, J. (1987). Deposition of Jim Slingluff for No. C 569870, Maricopa County, et al and Arizona Center for Law in the Public Interest, et al., and Calmat Co. of Arizona, et al, v. State of Arizona, Arizona State Land Department, M. Jean Hassel, and Milo J. Hassel, et al. November 23, 1987.

(14) U.S. Geological Survey, (2000a), Expanded Rating Table for Black River Below Pumping Plant Near Point Of Pines, Arizona (Gage No. 09489500) data provided by USGS Water Resources Division, Flagstaff, Arizona on July 19, 2000.

(15) U.S. Geological Survey, (2000b), Expanded Rating Table for Black River Near Fort Apache, Arizona (Gage No. 09490500) data provided by USGS Water Resources Division, Flagstaff, Arizona on July 19, 2000.

Supplementary References:

(16) Arizona Highways. June, 1980 issue. Cover photograph of the Black River.

(17) Arizona Highways. March, 1982 issue. Photograph of the Black River. p. 29.

(18) Arizona Highways. December, 1982 issue. Photograph of the Black River. p. 21.

(19) Arizona Highways. April, 1991 issue. , Photograph of the Black River. p. 7.

(20) Arizona Highways. July, 1992 issue. Photograph of the Black River. p. 47.

(21) Arizona Highways. July, 1999 issue. Photograph of the Black River. p. 52.

(22) Arizona Rivers: Lifeblood of the Desert. March 1991. Photograph of the Black River. p. 14.

APPENDIX A– Photographs of the Black River

Photograph No. 1 – Black River (Headwaters)
Black River looking upstream at the confluence of the East Fork and West Fork. (Photo Date: September 17, 2000).

Photograph No. 2 – Black River (Headwaters)
Black River looking downstream at the confluence of the East Fork and West Fork. (Photo Taken: September 17, 2000).

APPENDIX B
Photograph Descriptions of Black River from Magazine Publications

1. Arizona Highways. March 1982. p.29 – photo by Sam Lowe. Flow is about 10 to 15 feet wide and 0.5 to 1.0 feet deep; channel is very rocky and obstructed, probably fairly steep slope; this section is in the upper reach.

2. Arizona Highways. April 1991. p.7 – photo by Richard Maack. Flow is about 20 to 25 feet wide and 0.5 to 1.0 feet deep (man standing and fishing in middle of river) running through a grassy meadow; slow flow with a somewhat mild slope - this section probably located within the upper reach.

3. Arizona Highways. December 1982. p.21 – photo by Dick Dietrich. Flow is about 15 to 20 feet wide, grassy side slopes and a water depth of approximately 1.5 feet; this section located probably in the mid to upper reach.

4. Arizona Highways. June 1980. cover – photo by Robert Whitaker. Flow is about 15 to 20 feet wide and 1.0 to 2.0 feet deep; big boulders occupy the sides of and are scattered within the channel (man standing on boulder fishing); flow characterized by rapids; side slopes are covered with trees; the channel at this location probably has a fairly moderate to steep slope characterizing the upper or middle reach.

5. Arizona Highways. July 1992. p.47 – photo by Edward McCain. Flow is about 20 to 25 feet wide and possibly as much as 2.0 or more deep; banks are fairly moderately sloped and grassy; a section of rock outcropping with turbulent flow is visible at the upstream end of the reach in the picture; channel probably has a moderate slope characterizing the middle reach.

6. Arizona Rivers: Lifeblood of the Desert. March 1991. p.14 – Photo by Congressman Jon Kyl. Flow is about 25 to 35 feet wide and probably at least 2.0 to 3.0 feet deep; side slopes are steep and rocky with many trees; the channel seems to have a somewhat mild to moderate slope; turbulent water is evident with some rocks exposed; this picture was most likely taken in the lower reach.

7. Arizona Highways. July 1999. p.52 – photo by Edward McCain. Flow is about 15 to 25 feet wide (low flow) and 1.0 to 1.5 feet deep but the channel bottom itself at this section looks to be probably 50 to 75 feet wide at higher flows; channel has a evenly rocky bottom (river rock) with shallow side slopes covered by scattered bushes and dry desert grass with some big cottonwoods near the banks; this section located in the lower reach.

NOTE: An attempt was made to list these pictures in order by location from upstream to downstream.

4.3.2 Level 3 Analysis for Aravaipa Creek
Counties: Graham/Pinal

Introduction

The following summarizes our preliminary information for the Level 3 analysis of Aravaipa Creek (Hydrologic Unit: 15050203). The purpose of the Level 3 analysis is to provide basic technical data regarding stream characteristics from which the ANSAC can make a recommendation of navigability or non-navigability.

Stream Geomorphology

Aravaipa Creek, a tributary to the San Pedro River, is located in Pinal and Graham Counties in southeastern Arizona. The 541 square mile watershed drains the Galiuro, Pinaleno, and Santa Teresa Mountains, as well as the intervening alluvial fill valleys. Elevations in the watershed range from about 8,400 feet in the Pinaleno Moutains to 2,160 feet at the San Pedro River confluence, although the maximum elevation along Aravaipa Creek itself is only about 4200 feet.

Aravaipa Creek can be divided into the following three stream reaches:

- Upper Reach – Aravaipa Valley above BLM Wilderness Area
- Middle Reach – BLM Wilderness Area & Canyon
- Lower Reach – Downstream of BLM Wilderness Area to San Pedro River

The upper reach flows through the Aravaipa Valley, an agricultural region located mostly upstream of the town of Klondyke. The upper reach is ephemeral or intermittent, and consists of wide, braided channels which are normally dry. The upper reach is about 55 miles long and has a slope of about 0.9 percent. The middle reach extends through the Aravaipa Canyon Wilderness Area managed by the Bureau of Land Management, with portions owned by The Nature Conservancy. The middle reach is perennial, and consists of sand- and gravel-bedded stream segments flowing in the bottom of deep, vertical-walled bedrock canyons. The middle reach is about 11.5 miles long and is slightly steeper than the adjacent reaches with a slope of about 2.5 percent. The lower reach extends from the downstream end of the Aravaipa Canyon Wilderness Area to the San Pedro River confluence. Most of the lower reach is perennial, with the flow becoming less reliable in the downstream direction. The lower reach is approximately 6 miles long, consists of wide, shallow, slightly braided channels, and has an average slope of about 0.9 percent.

Photographs of Aravaipa Creek are provided in the Appendix.

Hydrology

Hydrologic data are available from the USGS stream gage "Aravaipa Creek Near Mammoth, AZ" (Station #09473000), which is located in the Lower Reach of Aravaipa Creek, as described above. Other gaging information is also available from the US Fish & Wildlife Service, the Bureau of Land Management, the Nature

Conservancy, and some private parties living along the wash. For this analysis, only the USGS data were considered due to the high quality of USGS sampling and reporting procedures, the length of record at the USGS station (1919-1921, 1931-1941, 1965-1999), and the availability of the USGS data. The USGS gage data are most applicable to the middle and lower reaches of the study area.

Flow data for Aravaipa Creek reported by the USGS (Pope et. al, 1999) are summarized in Table 1 and Figures 1 and 2.

Table 1. Flow Data
Aravaipa Creek @ USGS Station 09473000

Period	Discharge (cfs)
Mean Annual Flow	36
90% Flow Duration	6.2
50% Flow Duration	17
10% Flow Duration	48
2-Year Flood Peak	3,980

Figure 1. Aravaipa Creek Flow Duration Data

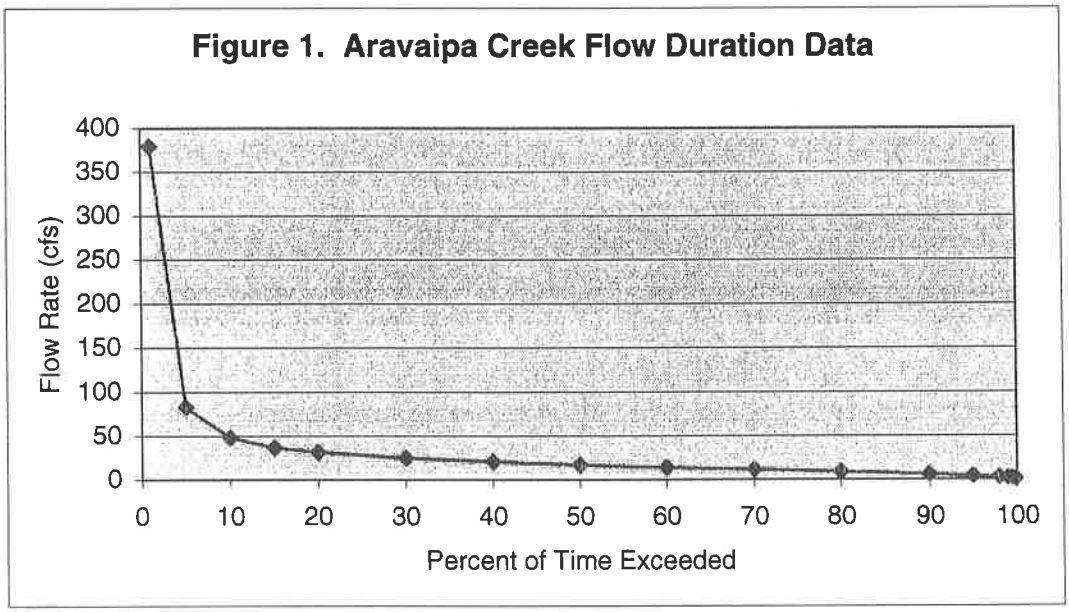
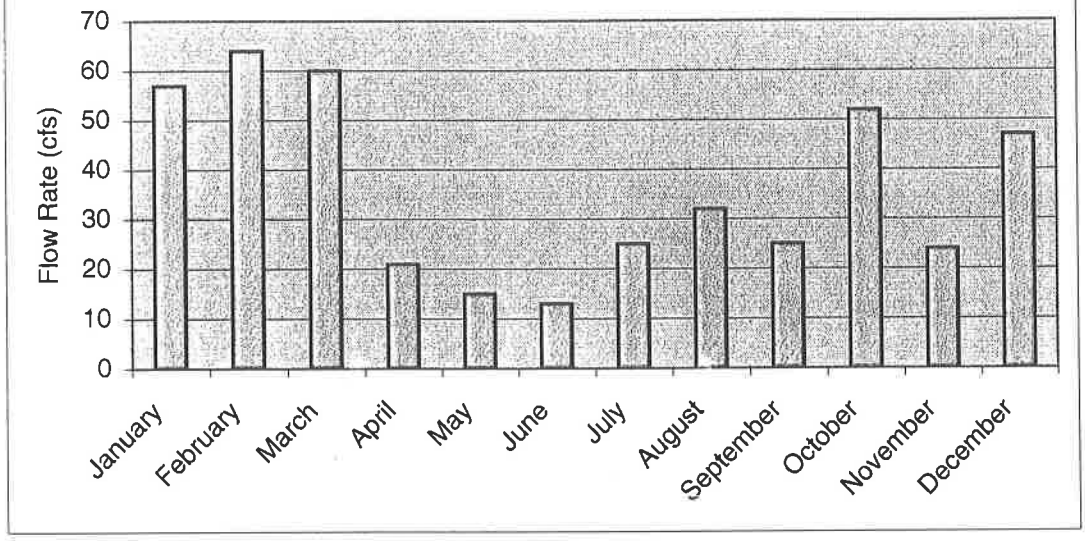


Figure 2. Aravaipa Creek Monthly Flow Data



The flow data summarized above confirm that Aravaipa Creek is perennial, and that flow rates average 50-60 cfs between January and March each year. The average annual flow rate is 36 cfs, although the median flow rate (50% duration) is only 17 cfs. The flow data reported above generally applies to the lower and middle reaches of Aravaipa Creek. These data do not apply to the upper reach, which is not perennial and typically has a dry streambed.

Hydraulics

Rating curves were obtained from USGS records and from field-surveyed cross sections. Field sections were hand gaged at discharges ranging from 12 cfs to 17 cfs. Hydraulic data reported for the field sections at the 50 percent flow duration are actual measurements of depth, width and velocity at 17 cfs. Hydraulic data reported for other frequencies were obtained from rating curves developed using Manning's equation. The hydraulic data from the USGS gage are from actual field measurements by USGS staff.

Table 2. ANSAC Pilot Study Level 3 Analysis
Aravaipa Creek @ USGS Gage

Discharge Data	Discharge (cfs)	Depth (ft)	Width (ft)	Velocity (fps)
Mean Annual Flow	36	1.6	32	2.2
90% Flow Duration	6.2	1.2	18	0.5
50% Flow Duration	17	1.4	30	1.3
10% Flow Duration	48	1.7	32	2.3
2-Year Flood Peak	3,980	6.1	No info.	No info.

Table 3. ANSAC Pilot Study Level 3 Analysis Aravaipa Creek in BLM Wilderness (Canyon Reach, Field Surveyed Sections)							
	Discharge (cfs)	Depth (ft)		Width (ft)		Velocity (fps)	
		Xn #1	Xn #2	Xn #1	Xn #2	Xn #1	Xn #2
Mean Annual Flow	36	1.6	0.7	12	23	4.0	3.1
90% Flow Duration	6.2	0.8	0.3	5	19	2.9	1.8
50% Flow Duration	17	1.2	0.5	7	21	3.6	2.5
10% Flow Duration	48	1.8	0.8	15	24	4.3	3.2
2-Year Flood Peak	3,980	14.9	8.6	31	40	12.8	13.5

Notes:
1. Section #1 (Xn#1) is located immediately downstream of the Painted Cave Creek confluence.
2. Section #2 (Xn#2) is located immediately upstream of the Turkey Creek confluence.

Boating Criteria

The boating criteria cited below were reported in previous detailed navigability studies prepared for the Arizona State Land Department, and are based on the following references:

1. Cooperative Instream Flow Service Group, 1978. Methods of Assessing Instream Flows for Recreation. Instream Flow Information Paper: No. 6. FWS/OBS-78/34. June. Report prepared by U.S. Fish and Wildlife Service, U.S. Environmental Protection Agency, Heritage Conservation and Recreation Service, and Bureau of Reclamation.
2. Jason M. Cortell and Associates, Inc., 1977, Recreation and Instream Flow, Vol. 1: Flow Requirements, Analysis of Benefits, Legal & Institutional Constraints. Report submitted to U.S. Department of the Interior, Bureau of Outdoor Recreation #BOR D6429. July.
3. Walter B. Langbein, 1962. Hydraulics of River Channels as Related to Navigability. U.S. Geological Survey Water-Supply Paper 1539-W.
4. Jim Slingluff, 1987. Deposition of Jim Slingluff for No. C 569870, Maricopa County, et al and Arizona Center for Law in the Public Interest, et al., and Calmat Co. of Arizona, et al, v. State of Arizona, Arizona State Land Department, M. Jean Hassel, and Milo J. Hassel, et al. November 23, 1987.

The following tables summarize navigability criteria information from references 1 to 4. Note that these data reference recreational boating, not necessarily commercial boating.

Table 4. Minimum Required Stream Width and Depth for Recreation Craft[1]		
Type of Craft	Depth (ft.)	Width (ft.)
Canoe, Kayak	0.5	4
Raft, Drift Boat, Row Boat	1.0	6
Tube	1.0	4
Power Boat	3.0	6
[1] After reference #1		

Table 5. Minimum and Maximum Conditions for Recreational Water Boating[1]						
Type of Boat	Minimum Condition			Maximum Condition		
	Width	Depth	Velocity	Width	Depth	Velocity
Canoe, Kayak	25 ft.	3-6 in.	5 fps	-	-	15 fps
Raft, Drift Boat	50 ft.	1 ft.	5 fps	-	-	15 fps
Low Power Boating	25 ft.	1 ft.	-	-	-	10 fps
Tube	25 ft.	1 ft.	1 fps	-	-	10 fps
[1] After reference 2.						

Table 6. Flow Requirements for Pre-1940 Canoe Boating[1]	
Boat Type	Depth
Flat Bottomed (Wood or Canvas)	4 in.
Round Bottomed (Wood or Canvas)	6 in.
[1] After reference 4.	

Summary

Comparison of the boating criteria and hydraulic data for Aravaipa Creek shown above indicate that the lower and middle reaches could be boated by low draft canoes or kayaks slightly more than half the time, but that boating by larger commercial craft would be unlikely. Expected velocities during the 2-year flood approach the maximum rates for recreational boating, and would seriously hinder upstream travel. Field data collected by the author indicates that such recreational boating would be moderately difficult due to numerous shallow riffles and overhanging vegetation. No modern or historical accounts of any type of boating in Aravaipa Creek were obtained during the course of the Small Watercourse Study. A Level 4 study is not recommended for Aravaipa Creek.

Limitations

This evaluation is based on readily available information that reflects the level of detail and funding authorized for the ANSAC Small Watercourses Navigability Study. The following limitations apply to the results presented above:

- The hydraulic rating sections may or may not apply to the entire study reach. However, the rating section results probably represent better than order-of-magnitude accuracy for estimates of width, depth, and velocity at any given point within the study reach.

- Hydrologic data for any stream varies with location within a reach, and with time in response to climatic conditions. The hydrologic information provided is best readily available data for the stream.

- Stream conditions were assumed to represent conditions as of the time of Arizona statehood. Unless stated otherwise, no data were identified during the Level 3 analysis that indicated substantive changes in stream morphology with respect to navigability criteria.

Photographs of Aravaipa Creek

Photograph #1. Aravaipa Creek above Turkey Creek (Canyon Reach) at approximately 17 cfs on July 2, 1999.

Photograph #2. Aravaipa Creek below Painted Cave Creek (Canyon Reach) at approximately 17 cfs on July 5, 1999.

4.3.3 Level 3 Analysis for Bonita Creek
County: Graham

Introduction

The following summarizes the Level 3 navigability analysis for Bonita Creek (Hydrologic Unit: 15040005). The purpose of the Level 3 analysis is to provide basic technical data regarding stream characteristics from which the ANSAC can make a recommendation of navigability or non-navigability.

Bonita Creek, named for the beauty attributed to the riparian area along the creek, is located in Graham County (Figure 1). The rating for Bonita Creek using the Level 2 refined approach was 12.12.

Stream Geomorphology

The 315 square mile Bonita Creek watershed drains a portion of the Gila Mountains before flowing into the Gila River within the Gila Box-Riparian National Conservation Area. The watershed elevation ranges from over 6,626 feet at Gila Peak to 3,130 feet at the Gila River/Bonita Creek confluence (Figure 2). Vegetation within the watershed varies from Arizona Upland desert scrub in the lower elevations, to various desert grasses and juniper in the upper elevations. Vegetation along Bonita Creek includes oak-walnut riparian forests at some locations, as well as desert grasses and reeds, and sycamore. Table 1 provides a number of watershed characteristics for Bonita Creek as measured at the U.S. Geological Survey (USGS) stream gauge near Morenci, Arizona (#09447800).

For the purposes of this study, Bonita Creek was divided into two stream reaches, although the river changes gradually in the downstream direction without a clear reach division point. In the heart of the Gila Box-Riparian Conservation area, the creek is located within a deep canyon, and is confined by steep bedrock canyon walls. The main channel in this lower reach has a sand and cobble bed, and ranges from 8 to 15 feet wide. The lower reach generally has a wide cross section and a main channel which frequently splits and rejoins. In general, the lower reach lacks a defined floodplain, and flow tends to inundate the entire area between the canyon walls.

The Lower Reach is predominately perennial, with the main flow source from Bonita Spring. Bank conditions suggest that Bonita Creek frequently changes channel position and geometry in response to small floods. In most places in the Lower Reach, mid-channel bars are covered with cobbles and small boulders.

The bed of the main channel in the upper reach of Bonita Creek consists of a single channel filled with sands and pebbles. The channel is located in a wide flatland among gently rolling plains covered with desert grasses. Woody riparian vegetation in the Upper Reach is limited or nonexistent. In most places, floodplains greater than 100 feet wide extend along both sides of the

channel. Field evidence suggests that flows rarely overflow the banks. The upper reaches of Bonita Creek are ephemeral.

Figure 1. Bonita Creek Location Map

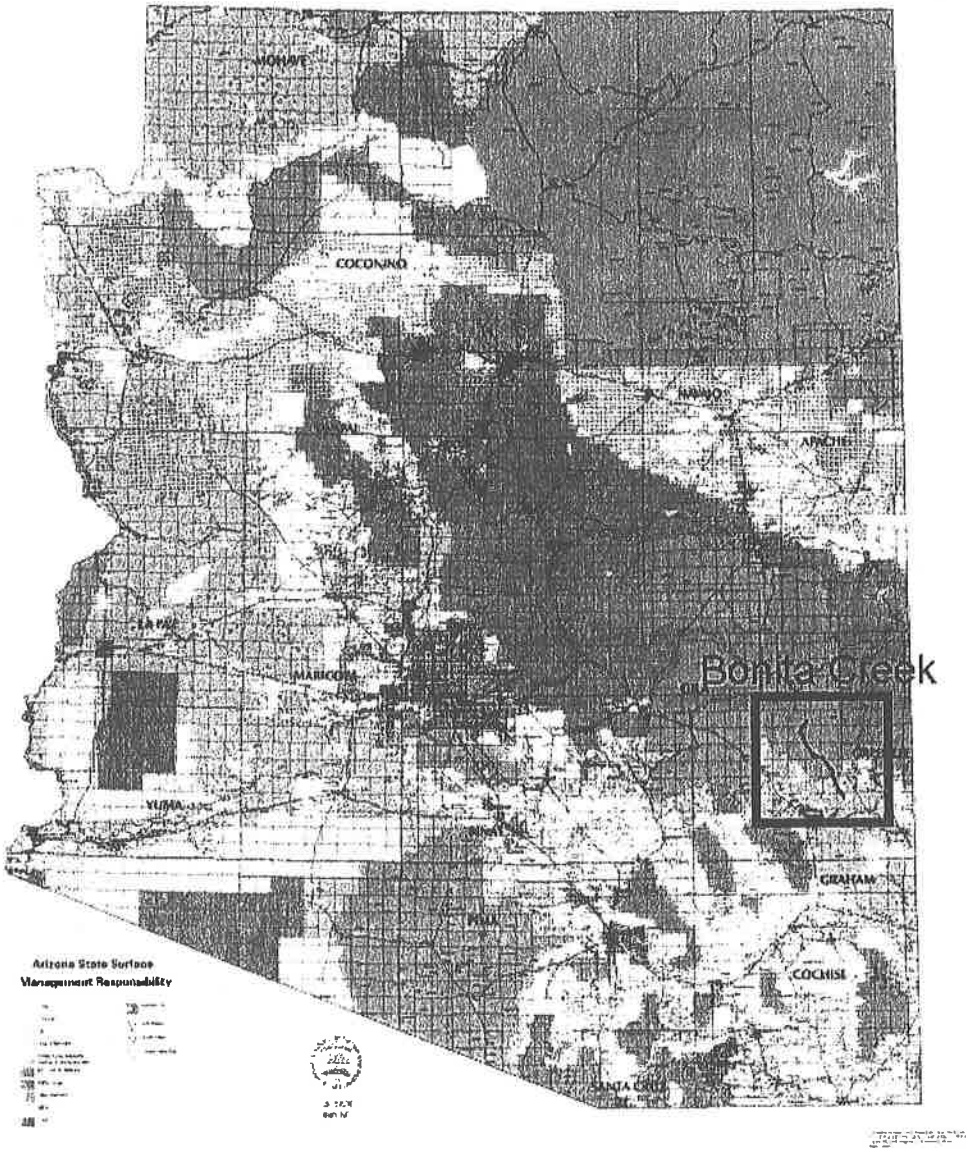
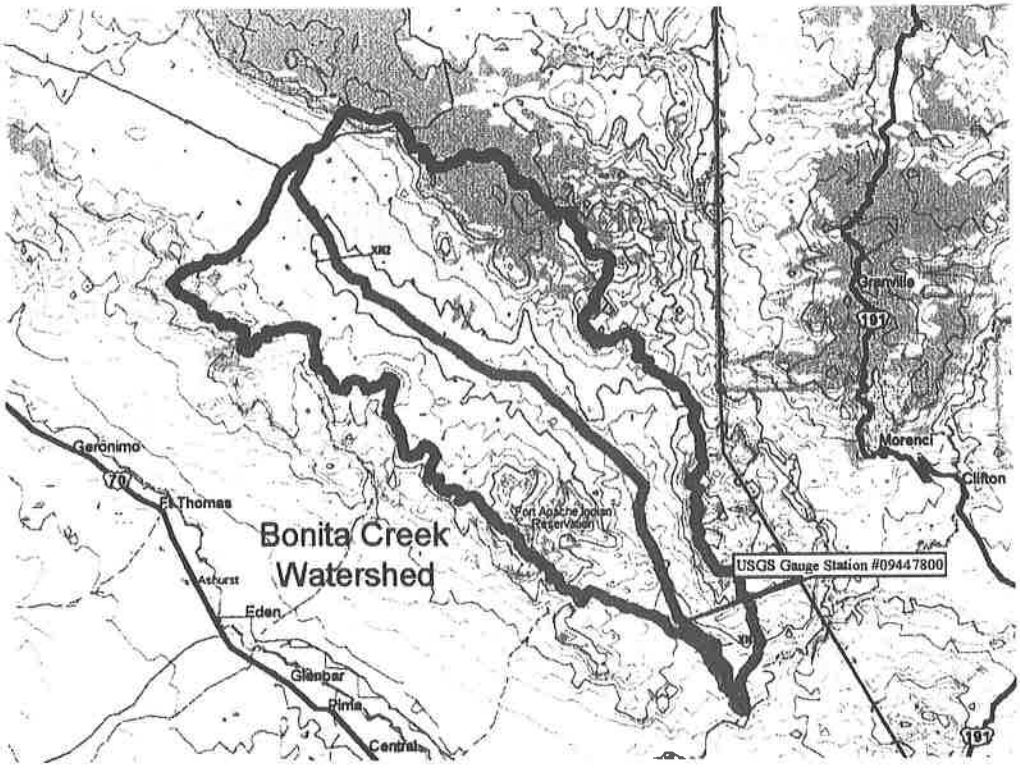
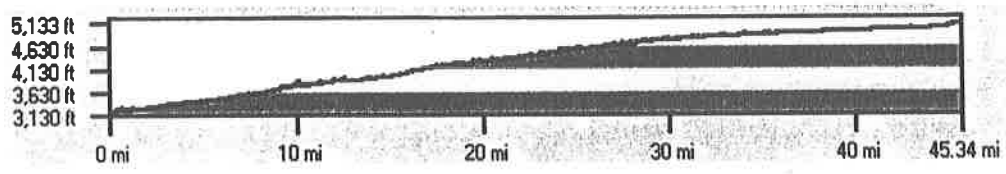


Figure 2. Bonita Creek Watershed Location Map



The average slope of the entire stream reach is about 0.8 percent (0.008 ft./ft., Figure 3). No evidence was identified for this study that the plan form or location of the stream corridor has varied significantly since the time of statehood. Photographs of Bonita Creek are provided at the end of this report.

Figure 3. Longitudinal Profile of Bonita Creek



Hydrology

The USGS stream gauge provides a systematic record of flow for Bonita Creek. Tables 2 to 4 and Figures 4 to 6 provide a summary of stream flow data and flood frequency predictions based on the USGS records (Pope et. al., 1998). The period of record for the USGS gauge is 1981-1999.

Table 1 provides a summary of watershed and stream characteristics (Pope et. al., 1998). Table 2 lists average monthly and average annual flow rates. Table 3 summarizes stream flow statistics and significant floods recorded at

the USGS gauge. Table 4 shows the peak discharges for floods of various recurrence intervals. Figures 4 to 6 provide graphical depictions of discharge data for the USGS gauge.

Table 1. Bonita Creek Navigability Study
Stream Characteristics Bonita Creek near Morenci (#09447800)

Watershed Characteristic	Value
Stream length	19.58 mi.
Main channel slope	44.4 ft./mi.
Mean basin elevation	5174 ft.
Mean annual precipitation	16 in.
Drainage area	302 $mi.^2$
Period of record	1981-1999

Table 2. Bonita Creek Navigability Study
Mean Monthly Streamflow Data for Bonita Creek near Morenci (#09447800)

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean	61	31	15	5.4	4.1	3.3	7.7	8.3	8.4	14	6.2	11
Max	769	165	54	8.3	6.3	5.9	14	14	29	176	22	30
Min	5.2	4.2	3.5	2.0	2.1	1.3	2.3	4.3	2.5	1.5	1.9	5.0

Period of Record: 1981-1999

Table 3. Bonita Creek Navigability Study
Streamflow Statistics for Bonita Creek near Morenci (#09447800)

Flow Characteristic	Flow Rate (cfs)
Annual Mean Flow	14
Maximum Annual Mean	84
Minimum Annual Mean	4.2
Lowest Daily Mean (Aug. 31, 1988)	0.66
Highest Daily Mean (Jan. 19, 1993)	10,200
Max. Instantaneous Peak Flow (Jan. 18, 1993)	19,500
Flow value exceeded 10% of the time	10
Flow value exceeded 50% of the time	4.8
Flow value exceeded 90% of the time	2.5

Table 4. Bonita Creek Navigability Study
Peak Discharges for Bonita Creek near Morenci (#09447800)

2-year	5-year	10-year	25-year	50-year	100-year
2,320	5,680	9,070	15,000	20,600	27,600

Figure 4. Flow Duration Curve for Bonita Creek (Graham Co.)

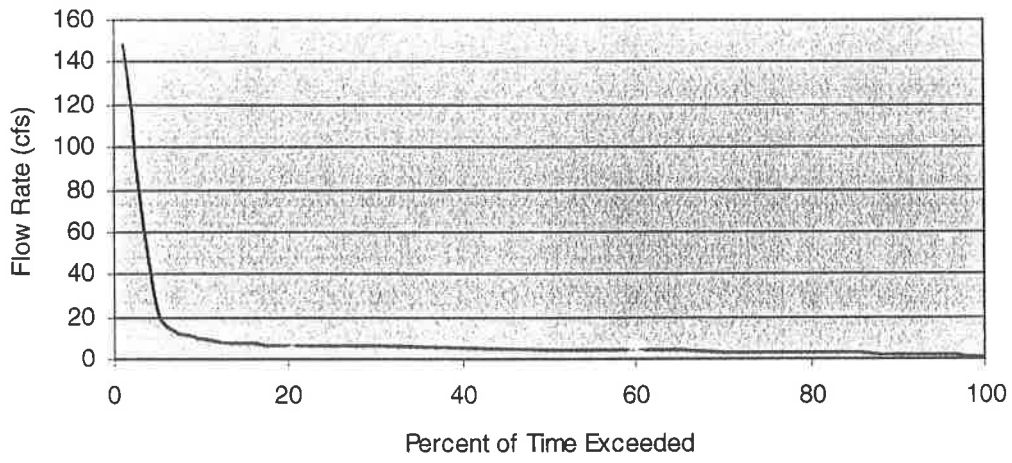


Figure 5. Monthly Average Flow for Bonita Creek (Graham Co.)

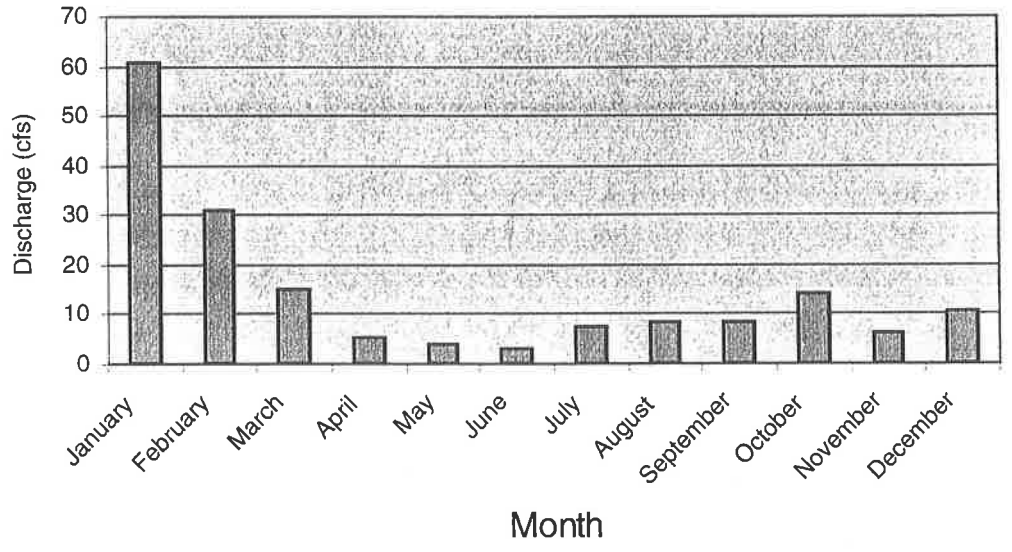
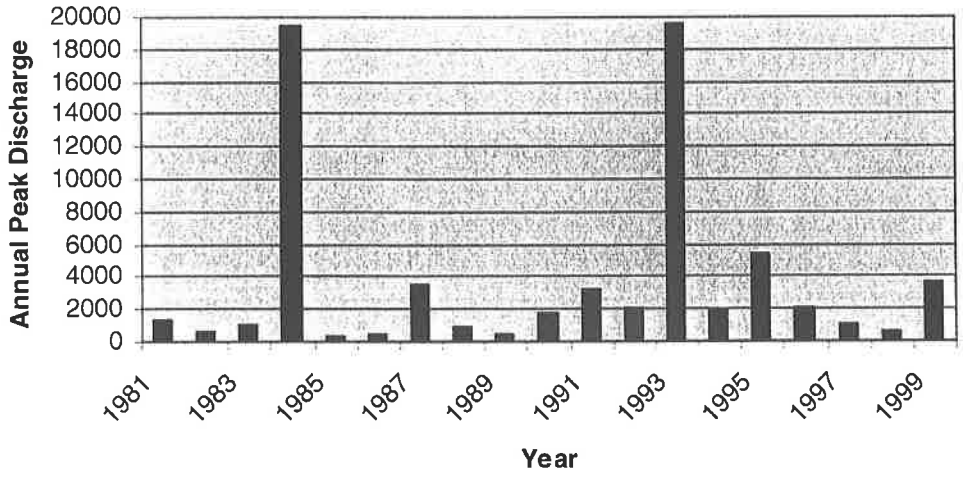


Figure 6. Annual Peak Discharges for Bonita Creek (Graham Co.)



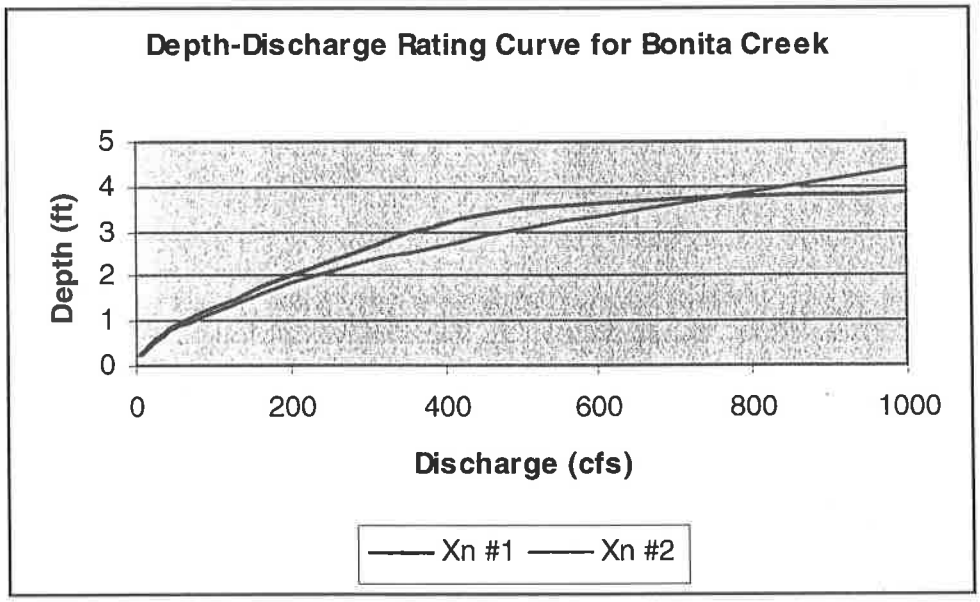
The USGS gauge data indicate that the stream is perennial. Both monthly average flows and minimum average flows exceed zero throughout the year, indicating that flow is reliably present in the stream. Field visits conducted on December 13, 2000 and January 5, 2001 indicate that Bonita Creek is perennial downstream of Bonita Spring. The highest average monthly flow rates occur during January through March, due to snowmelt, winter storms, and reduced evapotranspiration.

Hydraulics

Estimated hydraulic characteristics were developed based on observed stream conditions and historic stream flow records available from the USGS gauges. Table 5 summarizes a range of probable values for stream depth and width at various flow rates. Note that the hydraulic parameters shown below are based on flow data at the USGS gauge sites, and average cross sections for the study reach. The estimates probably represent no better than order-of-magnitude estimates of flow conditions at any specific location within the study reach. A rating curve for an assumed cross section developed from field observations is shown in Figure 7.

Table 5. Bonita Creek Navigability Study Estimated Range of Hydraulic Characteristics							
Flow Duration	Discharge (cfs)	Depth (ft)		Width (ft)		Average Velocity (fps)	
		Xn #1	Xn #2	Xn #1	Xn #2	Xn #1	Xn #2
10%	10	0.33	0.31	16.5	16.3	1.8	2.0
50%	4.8	0.21	0.20	16.3	15.8	1.4	1.5
90%	2.5	0.14	0.13	16.2	15.6	1.1	1.2
Mean Annual	16	0.45	0.42	16.7	16.8	2.2	2.4
2-Year Flood	2,320	5.22	6.72	142	43.2	5.7	11.9

Notes:
1. Section #1 (Xn#1) is located about one mile upstream of Gila River confluence.
2. Section #2 (Xn#2) is located at the crossing of Indian Route 8.



Boating Criteria

The boating criteria cited below were reported in previous detailed navigability studies prepared for the Arizona State Land Department, and are based on the following references:

1. Cooperative Instream Flow Service Group, 1978. Methods of Assessing Instream Flows for Recreation. Instream Flow Information Paper: No. 6. FWS/OBS-78/34. June. Report prepared by U.S. Fish and Wildlife Service, U.S. Environmental Protection Agency, Heritage Conservation and Recreation Service, and Bureau of Reclamation.
2. Jason M. Cortell and Associates, Inc., 1977, Recreation and Instream Flow, Vol. 1: Flow Requirements, Analysis of Benefits, Legal & Institutional Constraints. Report submitted to U.S. Department of the Interior, Bureau of Outdoor Recreation #BOR D6429. July.

3. Walter B. Langbein, 1962. Hydraulics of River Channels as Related to Navigability. U.S. Geological Survey Water-Supply Paper 1539-W.
4. Jim Slingluff, 1987. Deposition of Jim Slingluff for No. C 569870, Maricopa County, et. al. and Arizona Center for Law in the Public Interest, et. al., and Calmat Co. of Arizona, et. al., v. State of Arizona, Arizona State Land Department, M. Jean Hassel, and Milo J. Hassel, et. al. November 23, 1987.

The following tables summarize navigability criteria information from references 1 to 4. Note that these data reference recreational boating, not necessarily commercial boating.

Table 6. Minimum Required Stream Width and Depth for Recreation Craft[1]

Type of Craft	Depth (ft.)	Width (ft.)
Canoe, Kayak	0.5	4
Raft, Drift Boat, Row Boat	1.0	6
Tube	1.0	4
Power Boat	3.0	6

[1] After reference #1

Table 7. Minimum and Maximum Conditions for Recreational Water Boating[1]

Type of Boat	Minimum Condition			Maximum Condition		
	Width	Depth	Velocity	Width	Depth	Velocity
Canoe, Kayak	25 ft.	3-6 in.	5 fps	-	-	15 fps
Raft, Drift Boat	50 ft.	1 ft.	5 fps	-	-	15 fps
Low Power Boating	25 ft.	1 ft.	-	-	-	10 fps
Tube	25 ft.	1 ft.	1 fps	-	-	10 fps

[1] After reference 2.

Table 8. Flow Requirements for Pre-1940 Canoe Boating[1]

Boat Type	Depth
Flat Bottomed (Wood or Canvas)	4 in.
Round Bottomed (Wood or Canvas)	6 in.

[1] After reference 4.

Summary

Comparison of the boating criteria and hydraulic data for Bonita Creek above indicate that flow depths rarely are sufficient to support even recreational boating by canoes or kayaks. Only during floods do flow depths exceed the minimum required depths. However, boating during floods would be hazardous due to steep slopes, high velocities, and overhanging vegetation. Boating by larger commercial craft would be even more unlikely and hazardous. Field evidence supports the conclusion that the upper reaches are generally too narrow or lack flow, and the lower reaches do not have depths that would allow most types of boating. No modern or historical account of any type of boating in Bonita Creek was identified for this study. A detailed study is not recommended for Bonita Creek.

Limitations

This evaluation is based on readily available information that reflects the level of detail authorized for the ANSAC Small Watercourses Navigability Study. The following limitations apply to the results presented above:

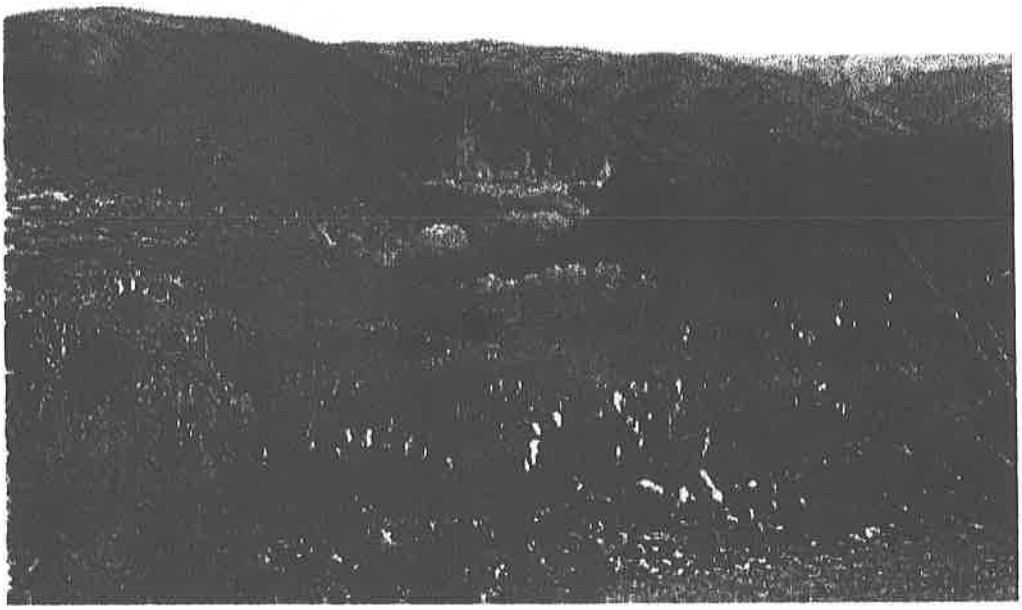
- The hydraulic rating sections may or may not apply to the entire study reach. However, the rating section results probably represent no better than order-of-magnitude accuracy for estimates of width, depth, and velocity at any given point within the study reach.

- Hydrologic data for any stream varies with location within a reach, and with time in response to climatic conditions. The hydrologic information provided is the best readily available data for the stream.

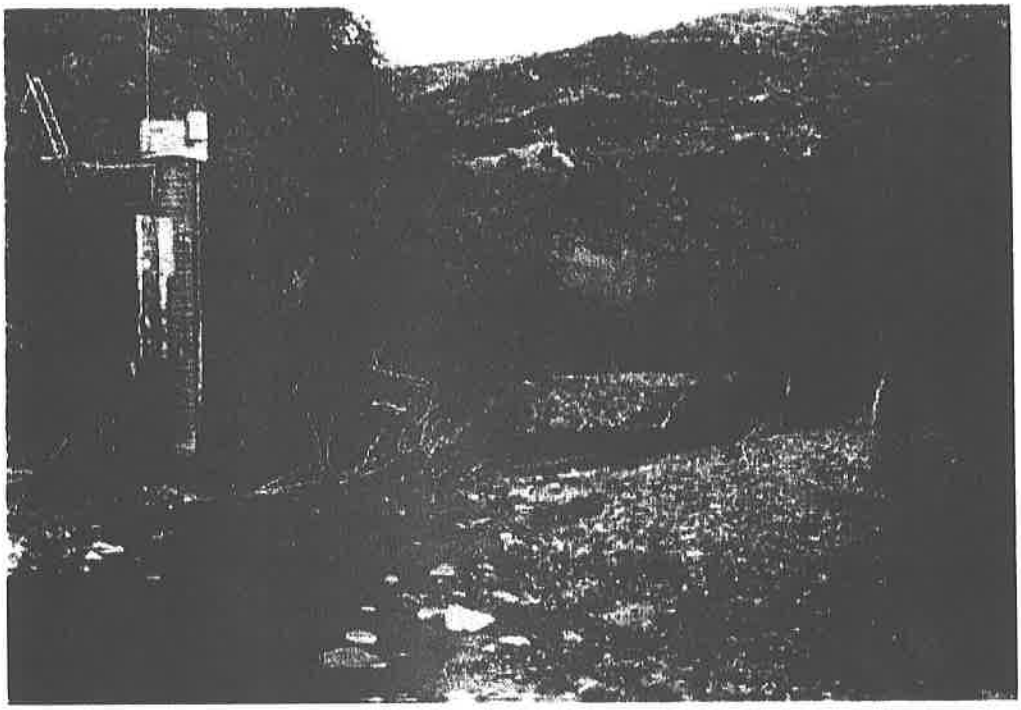
Stream conditions were assumed to represent conditions as of the time of Arizona statehood. Unless stated otherwise, no data were identified during the Level 3 analysis that indicated substantive changes in stream morphology with respect to navigability criteria.

Photographs of Bonita Creek

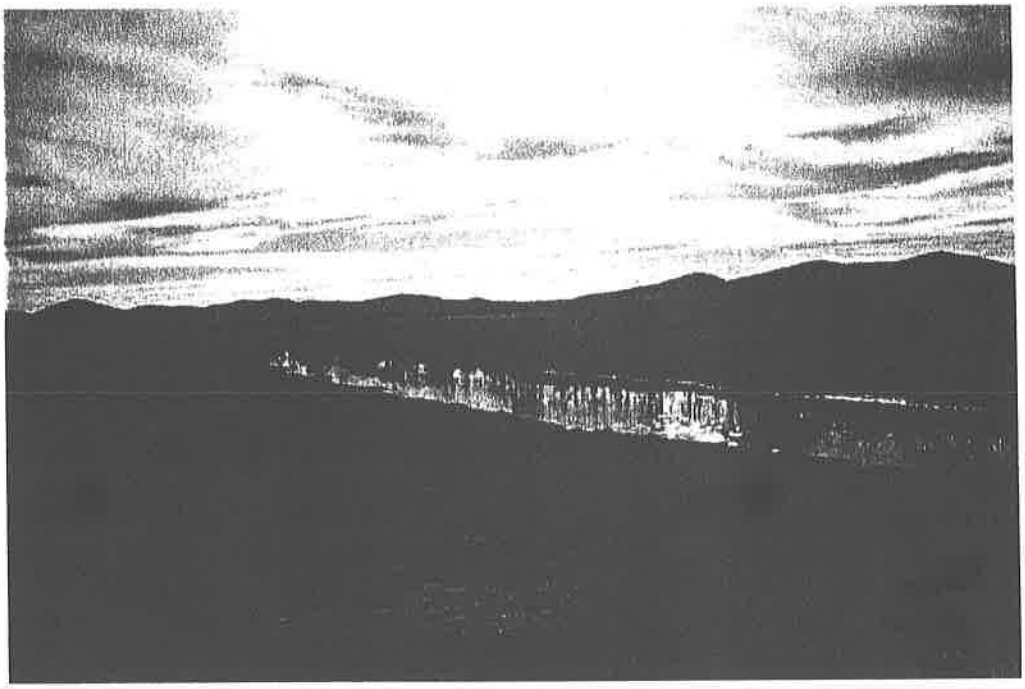
Photograph 1. Looking downstream at the Gila/Bonita confluence. 12/13/2000.



Photograph 2. Looking downstream at Gila/Bonita confluence. 12/13/2000.



Photograph 3. Looking downstream at USGS gauge near Morenci. 12/13/2000.



Photograph 4. Looking upstream at I.R. 8 crossing near headwaters. 01/05/2001

4.3.4 Level 3 Analysis for Eagle Creek
Counties: Graham/Greenlee

Introduction

The following summarizes the Level 3 navigability analysis for Eagle Creek (Hydrologic Unit: 15040005), which is located in Graham and Greenlee Counties near the Town of Clifton (Figure 1). The purpose of the Level 3 analysis is to provide basic technical data regarding stream characteristics from which ANSAC can make a recommendation of navigability or non-navigability.

Eagle Creek was named for the eagles that were once found along its river valley. The total rating evaluated for Eagle Creek using the refined approach at Level 2 is 19.12.

Stream Geomorphology

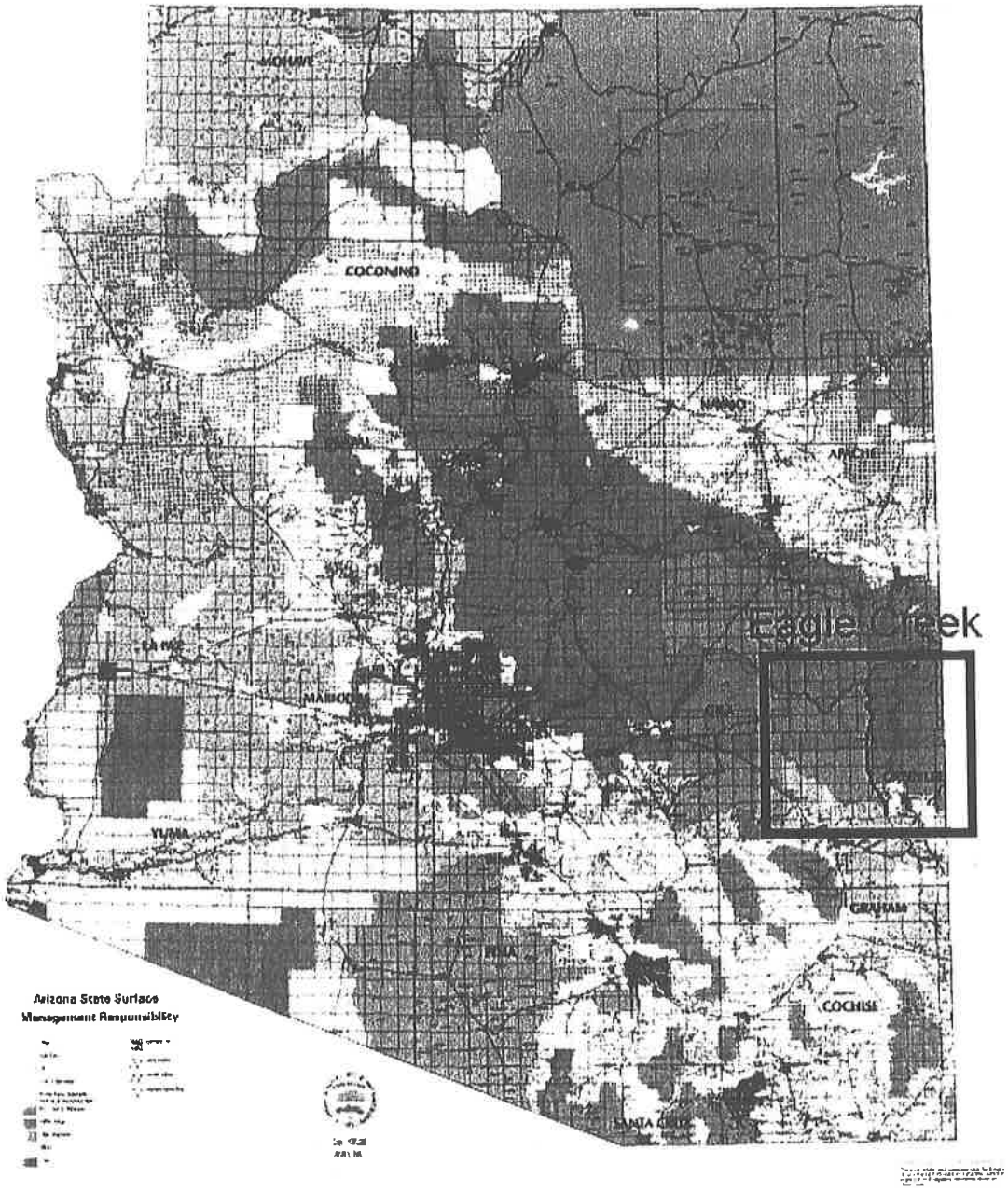
The Eagle Creek watershed is located in eastern Arizona in what is widely regarded as the transition zone between the Basin and Range and Colorado Plateau physiographic provinces of Arizona. The watershed extends from the Gila River confluence, at a point about nine miles southwest of the Clifton-Morenci area, to the Mogollon Rim near Alpine (Figure 2). The Eagle Creek watershed is bounded by the Mogollon Rim to the north, U.S. Highway 191 to the east, and the Natanes Mountains on the San Carlos Apache Reservation to the west. Elevations within the basin range from 3,300 at the Gila River confluence to approximately 8,500 feet along the Mogollon Rim. Table 1 shows watershed characteristics for Eagle Creek measured at the USGS stream gauge near Morenci.

Table 1. Eagle Creek Navigability Study Stream Characteristics

Watershed Characteristic	At USGS Stream gauge #09447000 near Morenci
Stream length	52.5 mi.
Main channel slope	60.9 ft./mi.
Mean basin elevation	6,060 ft. msl
Mean annual precipitation	19.2 in.
Forested area	64 %
Drainage area	622 $mi.^2$

Eagle Creek has an average slope of about 1.2 % (0.012 ft./ft.), and consists of a cobble-bedded channel with low banks lined by riparian vegetation or grassland. The main channel has a straight to slightly sinuous single channel with occasional braided reaches. The geometry of the channel and floodplain is fairly consistent along the entire

Figure 1. Eagle Creek Location Map



study reach. The main channel has a bottom width of about 10 feet, a top width of about 50 feet, and a depth of about 4 feet. The stream has a classic pool-and-riffle pattern in most reaches. The floodplain along the channel varies from 100 to 400 feet in width in the more well-defined canyon reaches, which comprise most of the study reach. The exception to the canyon cross section is a three mile reach upstream of the Double Circle Ranch, where the floodplain widens to about 3,000 feet. No evidence was identified in the record to suggest that the location or alignment of the stream corridor has varied significantly since the time of statehood.

Figure 2. Eagle Creek Watershed Location Map

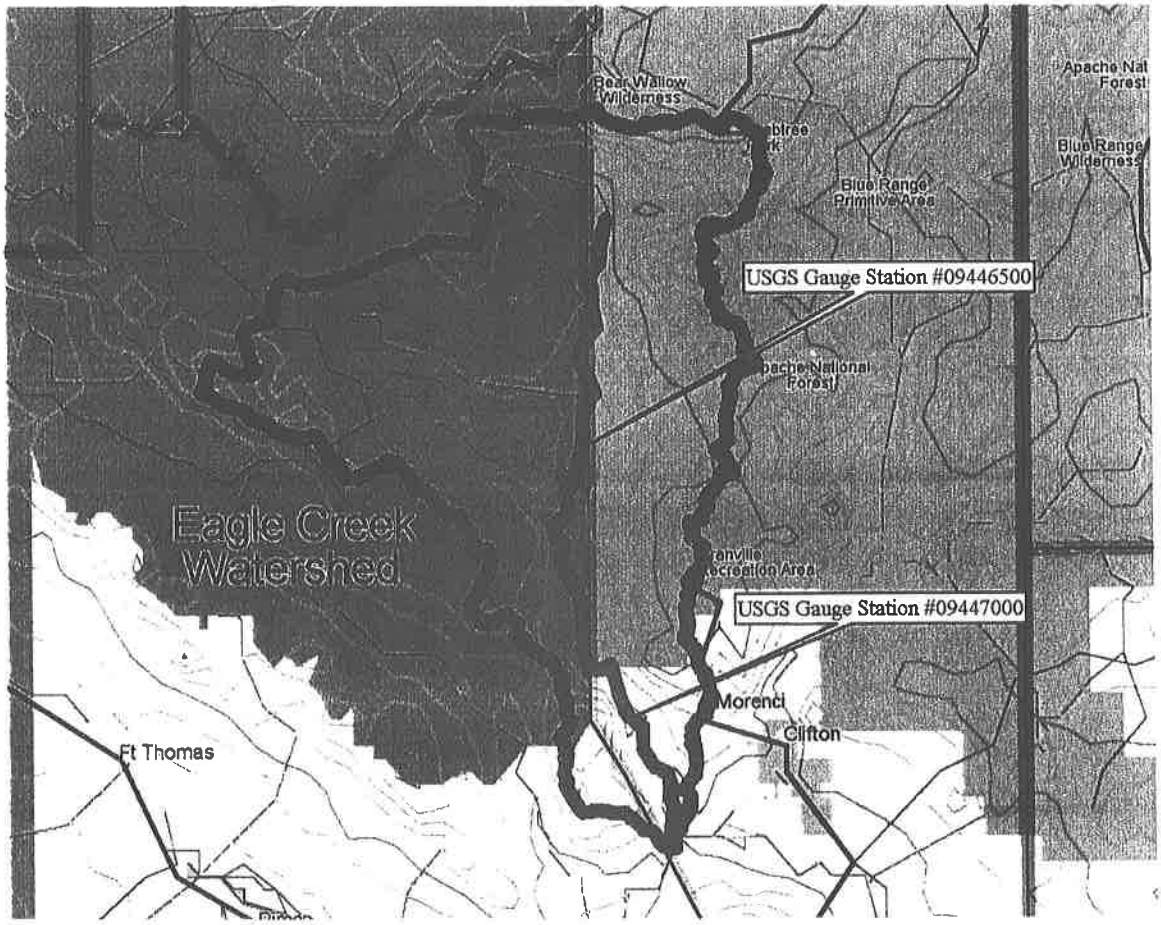
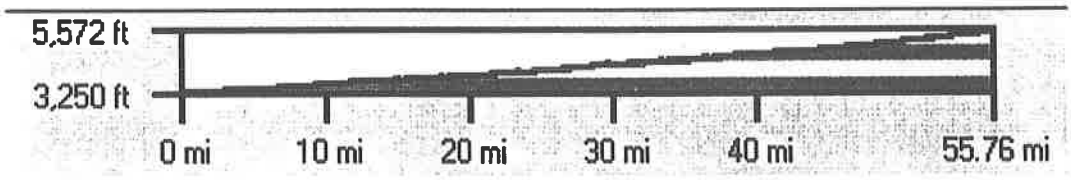


Figure 3. Longitudinal Profile of Eagle Creek



Representative photographs of Eagle Creek are provided at the end of this report.

Hydrology

The USGS stream gauges provide the primary record of stream flow on Eagle Creek. The locations of the two gauges within the study area are shown on Figure 2. Tables 2 through 4 provide summaries of streamflow data and flood frequency predictions based on the USGS gauge records (Pope et. al., 1998). Figure 4 shows the flow duration curves at the USGS gauges. Figures 5 and 6 provide graphical depictions of monthly averages and peak discharge values for the gauges.

In addition to the USGS stream gauge data, information was obtained from the Phelps Dodge Corporation regarding flow imported into Eagle Creek from the Black River and Eagle Creek well fields and diversions made to the Phelps Dodge mining operations at the pumping station near Morenci, which is located approximately 2 miles downstream of USGS gauge #09447000. Flow diversions at the Morenci Pump Station began in about 1898. Import of flow into the Eagle River basin from Black River began in 1945. Pumping of flow into Eagle Creek from well fields located near Double Circle Ranch began in 1959. Table 6 provides a summary of the flow import and diversion information.

The USGS gauge data indicate that Eagle Creek is perennial along much of its length. At gauge #09447000 the minimum average monthly flow and the 90 percent flow duration rates are both greater than the mean annual import flow value shown in Table 5. At gauge #09446500 the mean monthly flow rates are greater than the mean annual import flow rate (14 cfs) for eleven of the twelve months of the year. The highest average flows typically occur in the winter months due to snow melt and winter cyclonic precipitation. Comparison of the 50% flow duration (median flow rate) and the average annual flow rate indicates that the average annual flow rate is skewed upward by flood peaks. That is, much of the annual flow volume is provided by floods rather than during low flows

Table 2. Eagle Creek Navigability Study
Mean Monthly Streamflow Data for gauges on Eagle Creek

Near Double Circle Ranch, Near Morenci (#09446500)												
Month	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Mean	41	22	41	27	18	16	21	38	20	18	13	46
Max	310	101	213	89	25	25	36	93	42	33	22	502
Min	4.7	4.1	5.9	4.3	5.3	3.7	13	13	11	5.7	5.2	4.7
Period of Record: 1945-1967												
Above Pumping Plant, Near Morenci (#09447000)												
Month	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Mean	184	135	109	53	33	25	37	55	35	60	35	87
Max	4,440	1,760	709	214	84	49	98	203	114	1,170	228	884
Min	11	11	14	11	9.2	5.3	16	19	13	13	10	11
Period of Record: 1945-1996												

Table 3. Eagle Creek Navigability Study
Streamflow Statistics for gauges on Eagle Creek

Flow Characteristic	**Value**	
	Near Double Circle Ranch (#09446500)	**Above Pumping Plant (#09447000)**
Annual Mean Flow	26 (cfs)	71 (cfs)
Maximum Annual Mean	81 (cfs)	568 (cfs)
Minimum Annual Mean	11 (cfs)	17 (cfs)
Lowest Daily Mean	1.9 (cfs)	3.2 (cfs)
Highest Daily Mean	6,350 (cfs)	29,000 (cfs)
Max. Instantaneous Peak Flow	30,000 (cfs)	36,800 (cfs)
Annual Mean Runoff	18,824 (acre-feet)	51,402 (acre-feet)
Flow value exceeded 10% of the time	38 (cfs)	88 (cfs)
Flow value exceeded 50% of the time	16 (cfs)	30 (cfs)
Flow value exceeded 90% of the time	5.6 (cfs)	15 (cfs)

Table 4. Eagle Creek Navigability Study Peak Discharges for Eagle Creek					
Near Double Circle Ranch (#09446500)					
2-year	**5-year**	**10-year**	**25-year**	**50-year**	**100-year**
2,510	5,690	8,760	13,900	18,800	24,600
Above Pumping Plant (#09447000)					
2-year	**5-year**	**10-year**	**25-year**	**50-year**	**100-year**
2,730	8,300	14,400	24,900	35,000	47,000

Figure 4. Flow Duration Curve for Eagle Creek

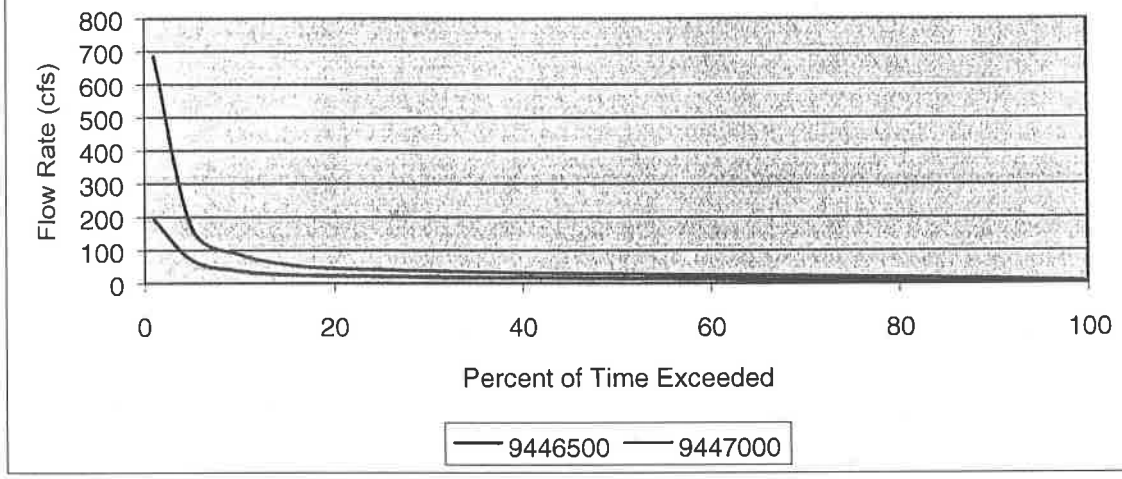


Figure 5. Monthly Average Flow for Eagle Creek

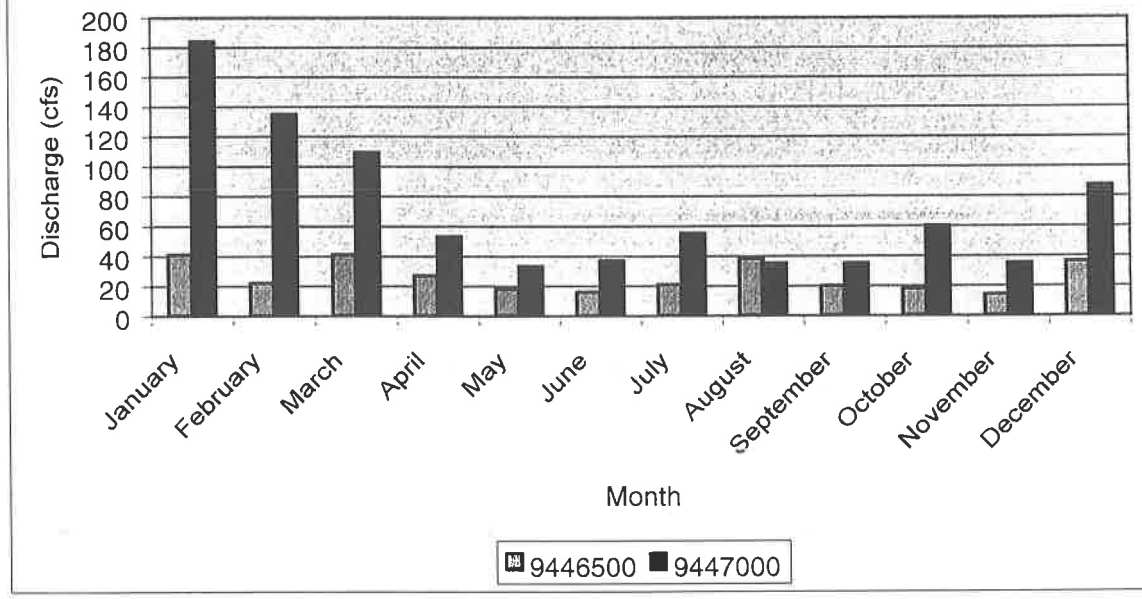


Figure 6. Annual Peak Discharges for Eagle Creek

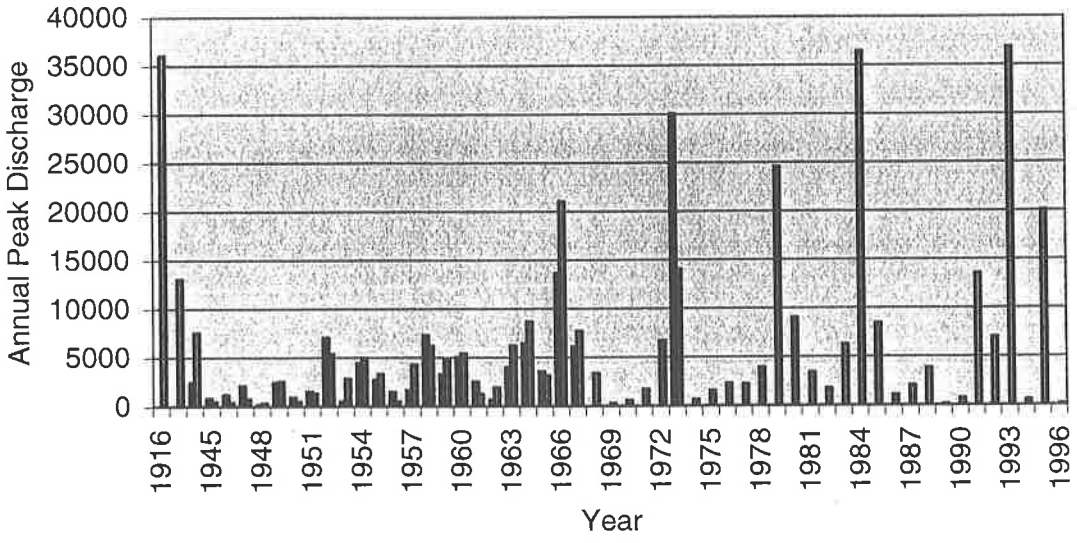


Table 5. Summary of Flow Imports and Diversions for Eagle Creek		
	Volume	**Mean Flow Rate**
Mean Annual Flow at USGS gauge 09447000	51,402 ac-ft	71 cfs
Mean Annual Import from Black River	7,336 ac-ft	10 cfs
Mean Annual Import from Upper Eagle Creek Well Fields (1959-1996)	3,521 ac-ft	4.9 cfs
Mean Annual Import from Black River & Well Fields	10,256 ac-ft	14 cfs
Net Annual Base Flow at USGS gauge 09447000 (i.e., without imported flow)	41,146 ac-ft	57 cfs
Percent of Annual Flow at USGS gauge 09447000 which is imported	20%	
Mean Annual Diversion at Pumping Station	12,935 ac-ft	18 cfs
Percent of Annual Flow at USGS gauge 09447000 which is diverted at pumping station	25%	
Period of Record 1945-1996 except where noted		

Hydraulics

Measured data for hydraulic flow characteristics at the time of statehood were not available. Therefore, estimated hydraulic characteristics were developed based on observed stream conditions and historic streamflow data available from the USGS stream gauges. Tables 7 and 8 provide summaries of the resulting range of values for estimated stream depth, width, and velocity. It should be noted that the hydraulic parameters shown below are not specific to any one location along the stream and assume that the streamflow characteristics for the referenced gauges would be

applicable at all locations within the study reach. A rating curve for an assumed cross section developed from field observations is shown in Figure 7.

Table 6. Eagle Creek Navigability Study
Estimated Average Hydraulic Characteristics for Streamflow at gauge #09446500

Flow Duration	Discharge (cfs)	Average Channel Flow Depth (ft)	Average Channel Velocity (ft/s)	Average Channel Flow Width (ft)
10 %	24	0.4	2.6	20
50 %	2	0.14	1.2	12
90 %	--	--	--	--
Average Annual	12	0.3	2.6	17
2-Year Flood	2,496	3.5	11.1	50

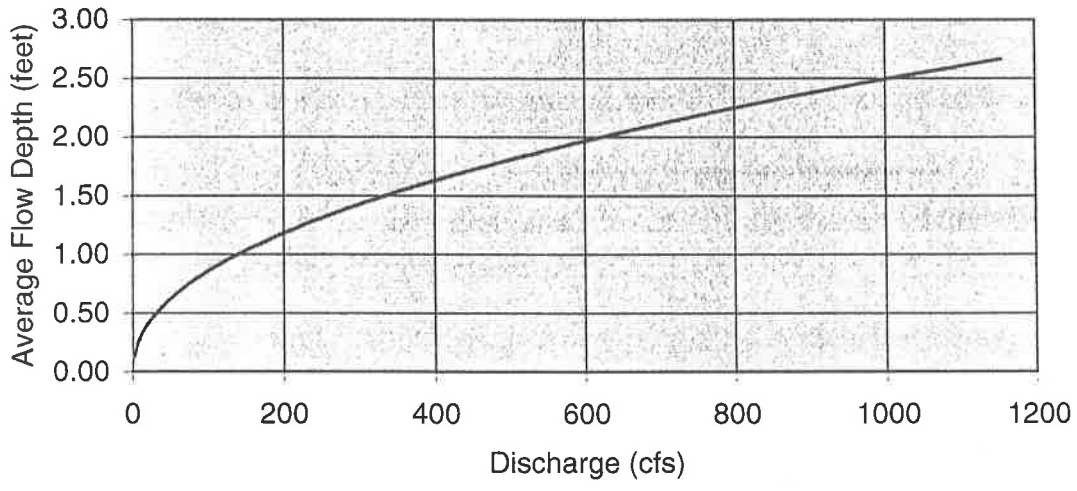
* Adjusted downward to account for average import flow of 14 cfs which did not exist prior to 1945 (see Table 5)

Table 7. Eagle Creek Navigability Study
Estimated Average Hydraulic Characteristics for Streamflow at gauge #09447000

Flow Duration	Discharge (cfs)	Average Channel Flow Depth (ft)	Average Channel Velocity (ft/s)	Average Channel Flow Width (ft)
10 %	74	0.8	3.7	26
50 %	16	0.4	2.3	19
90 %	1	0.1	1.0	10
Average Annual	57	0.7	3.5	25
2-Year Flood	2,716	3.7	11.3	50

* Adjusted downward to account for average import flow of 14 cfs which did not exist prior to 1945 (see Table 5)

Figure 7. Depth-Discharge Curve for Eagle Creek



Boating Criteria

The boating criteria cited below were reported in previous detailed navigability studies prepared for the Arizona State Land Department, and are based on the following references:

1. Cooperative Instream Flow Service Group, 1978. Methods of Assessing Instream Flows for Recreation. Instream Flow Information Paper: No. 6. FWS/OBS-78/34. June. Report prepared by U.S. Fish and Wildlife Service, U.S. Environmental Protection Agency, Heritage Conservation and Recreation Service, and Bureau of Reclamation.
2. Jason M. Cortell and Associates, Inc., 1977, Recreation and Instream Flow, Vol. 1: Flow Requirements, Analysis of Benefits, Legal & Institutional Constraints. Report submitted to U.S. Department of the Interior, Bureau of Outdoor Recreation #BOR D6429. July.
3. Walter B. Langbein, 1962. Hydraulics of River Channels as Related to Navigability. U.S. Geological Survey Water-Supply Paper 1539-W.
4. Jim Slingluff, 1987. Deposition of Jim Slingluff for No. C 569870, Maricopa County, et al and Arizona Center for Law in the Public Interest, et al., and Calmat Co. of Arizona, et al, v. State of Arizona, Arizona State Land Department, M. Jean Hassel, and Milo J. Hassel, et al. November 23, 1987.

The following tables summarize navigability criteria information from references 1 to 4. Note that these data reference recreational boating, not necessarily commercial boating.

Table 8. Minimum Required Stream Width and Depth for Recreation Craft[1]

Type of Craft	Depth (ft.)	Width (ft.)
Canoe, Kayak	0.5	4
Raft, Drift Boat, Row Boat	1.0	6
Tube	1.0	4
Power Boat	3.0	6

[1] After reference #1

Table 9. Minimum and Maximum Conditions for Recreational Water Boating[1]

Type of Boat	Minimum Condition			Maximum Condition		
	Width	Depth	Velocity	Width	Depth	Velocity
Canoe, Kayak	25 ft.	3-6 in.	5 fps	-	-	15 fps
Raft, Drift Boat	50 ft.	1 ft.	5 fps	-	-	15 fps
Low Power Boating	25 ft.	1 ft.	-	-	-	10 fps
Tube	25 ft.	1 ft.	1 fps	-	-	10 fps

[1] After reference 2.

Table 10. Flow Requirements for Pre-1940 Canoe Boating[1]

Boat Type	Depth
Flat Bottomed (Wood or Canvas)	4 in.
Round Bottomed (Wood or Canvas)	6 in.

[1] After reference 4.

Summary

Eagle Creek is a perennial stream. Field investigation in December 2000 indicated that flow depths are generally less than one foot and often less than six inches with flow widths varying from ten to thirty feet. Comparison of estimated flow characteristics for Eagle Creek with federal boating criteria indicates that acceptable recreational boating conditions exist less than 10 percent of the time. Boating during floods, when higher flow depths would be present, would be difficult and hazardous due to high velocities, overhanging vegetation, rapids and waterfalls. However, the Arizona State Parks Department lists Eagle Creek as a modern recreational boating stream. Due the record of modern boating and the presence of perennial flow, a detailed study is recommended for Eagle Creek.

Limitations

This evaluation is based on readily available information that reflects the level of detail authorized for the ANSAC Small Watercourses Navigability Study. The following limitations apply to the results presented above:

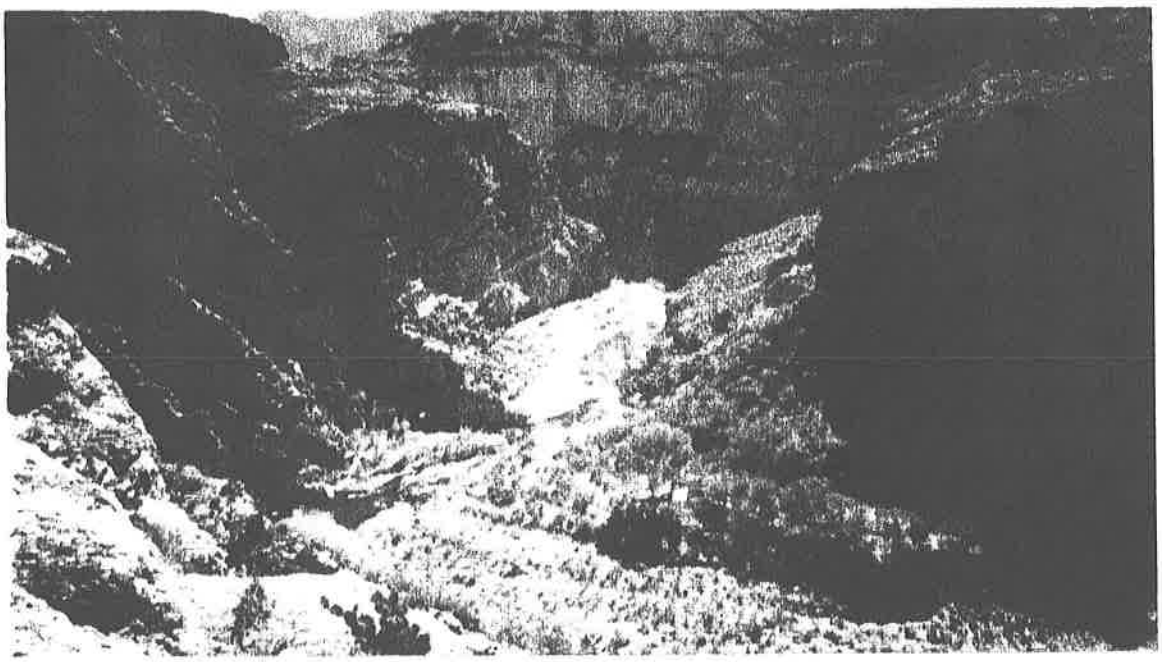
- The hydraulic rating sections may or may not apply to the entire study reach. However, the rating section results probably represent no better than order-of-magnitude accuracy for estimates of width, depth, and velocity at any given point within the study reach.

- Hydrologic data for any stream varies with location within a reach, and with time in response to climatic conditions. The hydrologic information provided is the best readily available data for the stream.

- Stream conditions were assumed to represent conditions as of the time of Arizona statehood. Unless stated otherwise, no data were identified during the Level 3 analysis that indicated substantive changes in stream morphology with respect to navigability criteria.

Photographs of Eagle Creek

Looking downstream from Eagle Creek School crossing (upstream end of study reach).



Looking downstream from the pump station near Morenci (downstream end of study reach).

4.3.5 Level 3 Analysis for San Carlos River
Counties: Graham/Gila

Introduction

The following summarizes the Level 3 navigability analysis for the San Carlos River (Hydrologic Unit: 15040007). The purpose of the Level 3 analysis is to provide basic technical data regarding stream characteristics from which the ANSAC can make a recommendation of navigability or non-navigability.

The San Carlos River, named for the town through which it flows, is located in Graham County in southeastern Arizona (Figure 1). The rating for the San Carlos River using the Level 2 refined approach was 15.00.

Stream Geomorphology

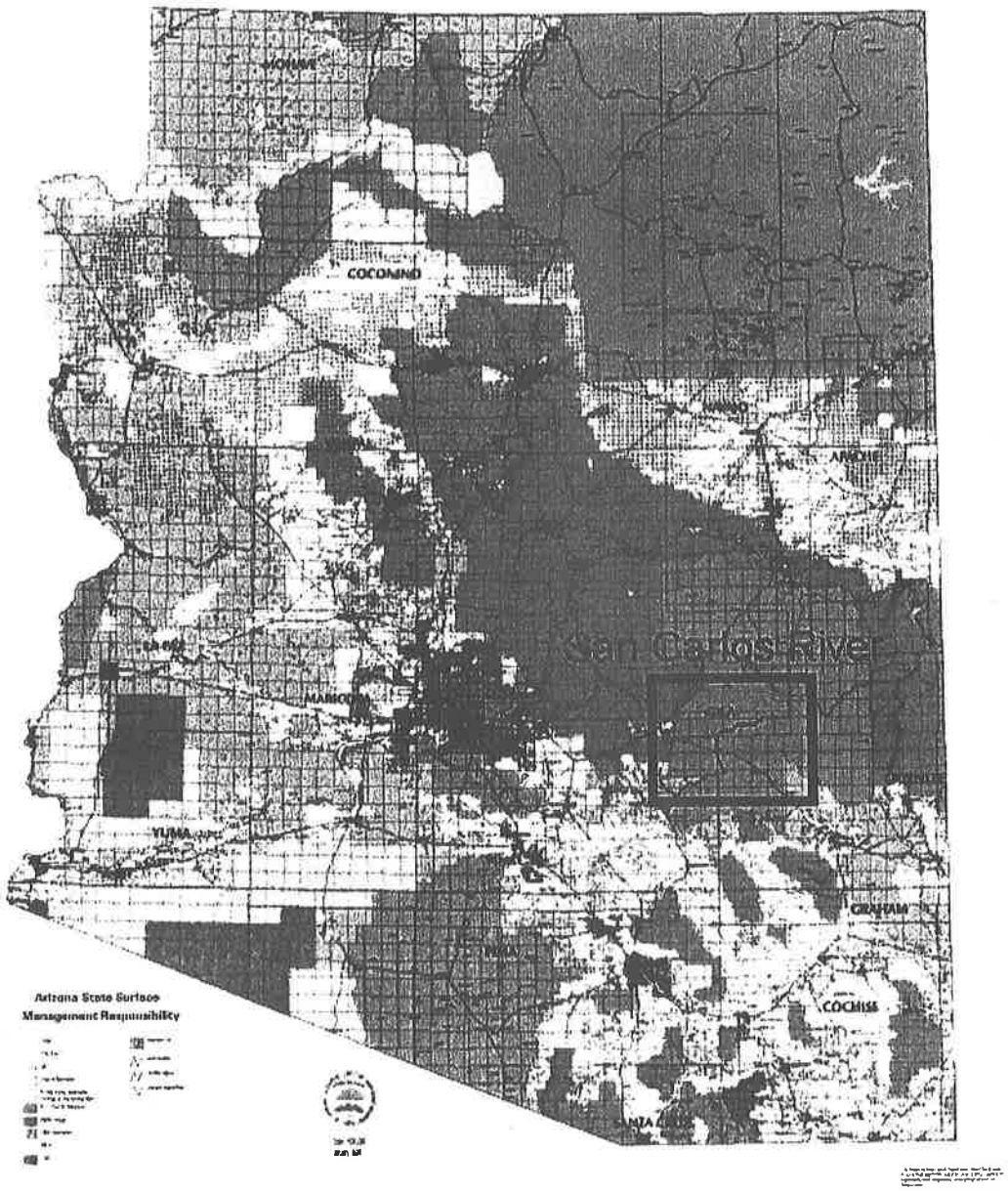
The 1061 square mile San Carlos River watershed drains a portion of the San Carlos Indian Reservation and flows into San Carlos Reservoir. The watershed ranges from over 6,940 feet at the Apache Peaks to 2,552 feet where the San Carlos River meets the high water mark of the San Carlos Lake (Figure 2). Vegetation within the watershed varies from Arizona Upland desert scrub in the lower elevations, to oak-woodland and pinyon-juniper in the upper elevations. Vegetation along the San Carlos River includes cottonwood-willow and walnut riparian forests at some locations, as well as desert grasses and reeds. Table 1 provides a number of watershed characteristics for the San Carlos River as measured at the U.S. Geological Survey (USGS) stream gauge near Peridot, AZ (#09468500). The USGS gauge is located upstream of where State Route 70 crosses the San Carlos River (Figure 2).

For the purposes of this study, the San Carlos River was divided into the following three reaches:

- Mountain Canyon Reach – headwaters to Blue River confluence
- Valley Reach –Blue River confluence to San Carlos Reservoir
- Reservoir Reach – area below San Carlos Reservoir high water point

In the Mountain Reach, the main channel contains small boulders and cobbles and has a pool-riffle pattern. The channel is located in the bottom of a "V" shaped deep canyon, with a small to non-existent floodplain, and a narrow corridor of riparian vegetation. The Mountain Reach is perennial.

Figure 1. San Carlos River Location Map



The main channel in the Valley Reach is a braided, sand and cobble bed channel approximately 75 feet wide. The stream valley generally has a wide, shallow cross section with multiple channels, with the widths of individual braids varying from as low as 3 feet to as much as 35 feet. The Valley Reach is intermittent.

Coolidge Dam, constructed on the Gila River in 1928 by the Bureau of Indian Affairs (BIA), inundates a portion of the San Carlos River near the Gila River confluence. The maximum water surface elevation of San Carlos Lake is

2,552 feet, which is higher than the elevation of the pre-dam San Carlos River/Gila River confluence. The 2,552 high water elevation corresponds to a point about 8 miles above the Gila River, and about one mile downstream of the US 70 road crossing (Figure 2). However, because the Coolidge Dam was not constructed until after Arizona statehood, stream conditions in the Reservoir Reach were probably similar to the conditions described for the Valley Reach.

The average slope of the entire study reach is about 0.9 percent (0.009 ft./ft., Figure 3). No evidence was identified for this study that the plan form or location of the stream corridor varied significantly since the time of statehood. Photographs of the San Carlos River are provided at the end of this report.

Figure 2. San Carlos River Watershed Location Map

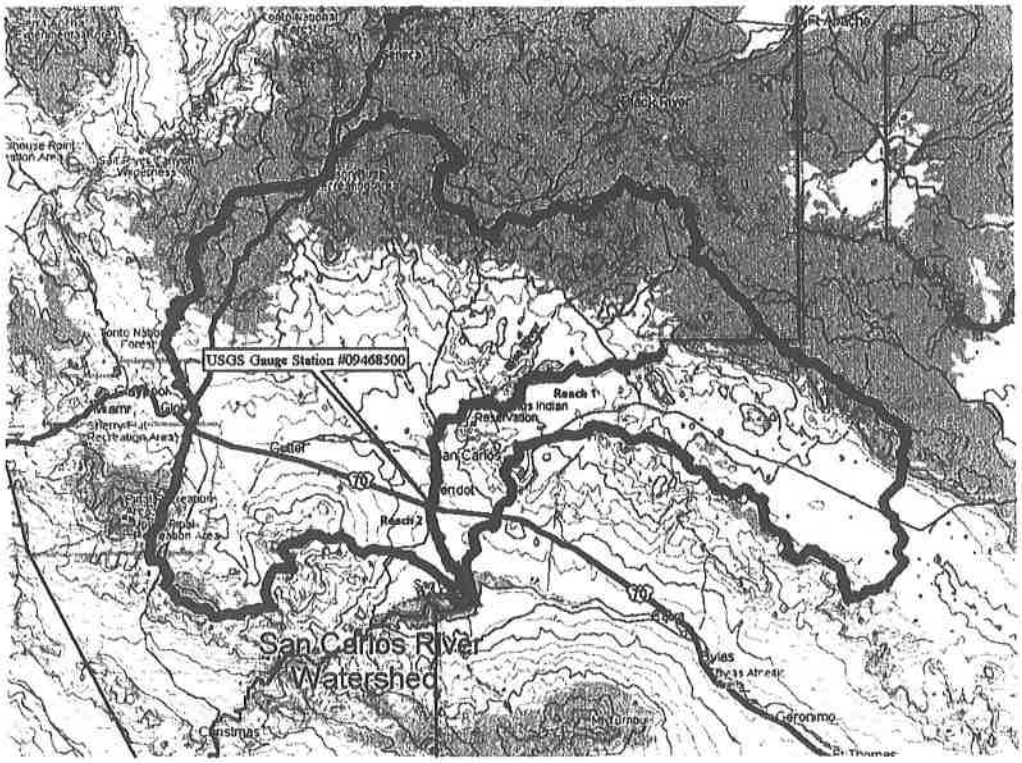
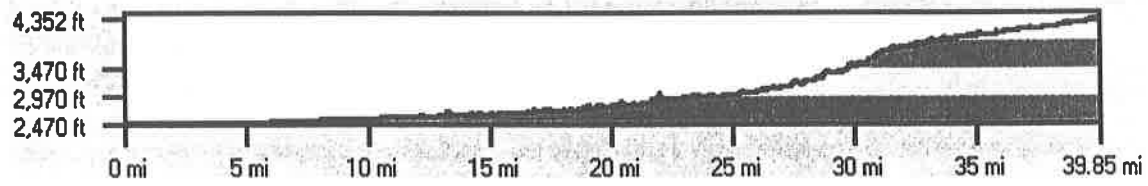


Figure 3. Longitudinal Profile of the San Carlos River



Hydrology

The USGS stream gauge provides a systematic record of flow for the San Carlos River. Tables 2 to 4 and Figures 4 to 6 provide a summary of stream flow data and flood frequency predictions based on the USGS records (Pope et. al., 1998). Coolidge Dam does not alter the hydrology above the high water mark, or affect gauge statistics recorded at the USGS gauge near Peridot (#09468500). San Carlos Lake is located approximately 1 mile downstream of the USGS gauging station. The period of record for the USGS gauge is 1930-1996.

Table 1 provides a summary of watershed and stream characteristics (Pope et. al., 1998). Table 2 lists average monthly and average annual flow rates. Table 3 summarizes stream flow statistics and significant floods recorded at the USGS gauge. Table 4 shows the peak discharges for floods of various recurrence intervals. Figures 4 to 6 provide graphical depictions of discharge data for the USGS gauge.

Table 1. San Carlos River Navigability Study
Stream Characteristics for San Carlos River near Peridot (#09468500)

Watershed Characteristic	Value
Stream length	56.7 mi.
Main channel slope	29.4 ft./mi.
Mean basin elevation	4,480 ft.
Mean annual precipitation	17.2 in.
Drainage area	1,026 $mi.^2$
Period of record	1930-1996

Table 2. San Carlos River Navigability Study
Mean Monthly Streamflow Data for San Carlos River near Peridot (#09468500)

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mean	151	170	149	24	7.8	3.6	19	55	25	30	19	111
Max	3,210	1,500	1,260	170	42	20	85	320	166	519	178	1,580
Min	5.8	7.0	4.8	2.2	0.03	0.0	0.0	1.6	0.0	0.20	2.7	5.1

Period of Record: 1930-1996

Table 3. San Carlos River Navigability Study
Streamflow Statistics for San Carlos River near Peridot (#09468500)

Flow Characteristic	Flow Rate (cfs)
Annual Mean Flow	63
Maximum Annual Mean	426
Minimum Annual Mean	8.2
Lowest Daily Mean (many dates)	0.0
Highest Daily Mean (Jan. 8, 1993)	20,000
Max. Instantaneous Peak Flow (Jan. 8, 1993)	54,800
Flow value exceeded 10% of the time	69
Flow value exceeded 50% of the time	10
Flow value exceeded 90% of the time	1.1

Table 4. San Carlos River Navigability Study Peak Discharges for San Carlos River near Peridot (#09468500)					
2-year	5-year	10-year	25-year	50-year	100-year
7,460	15,800	23,500	36,200	48,000	62,100

Figure 4. Flow Duration Curve for San Carlos River

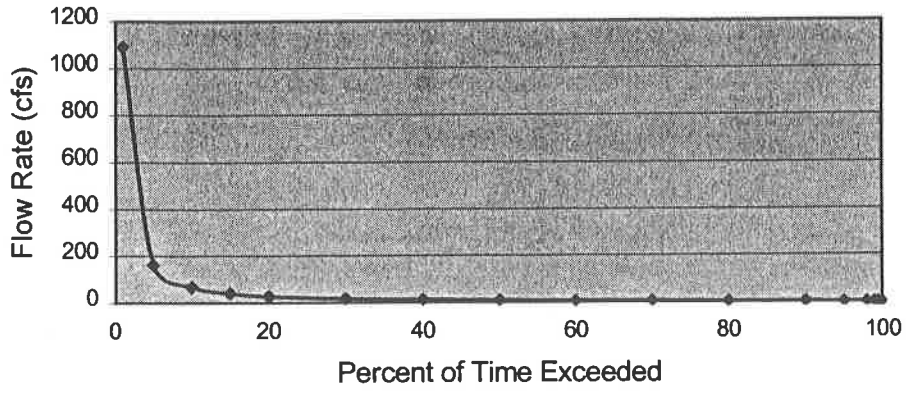
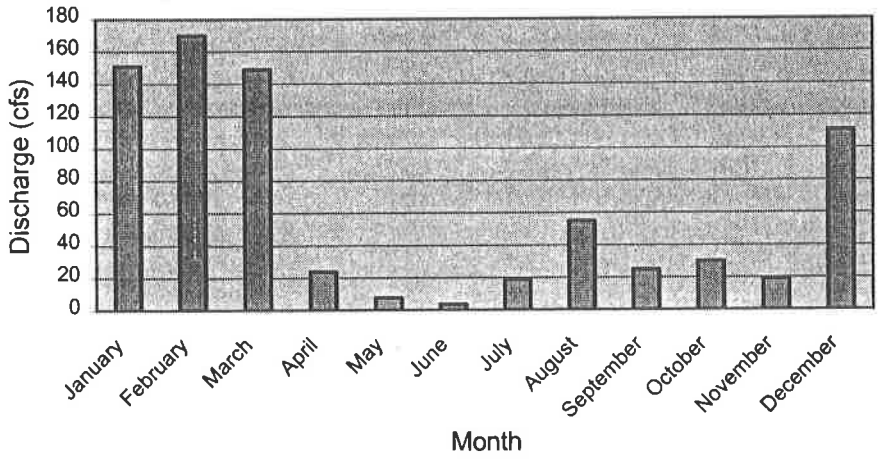
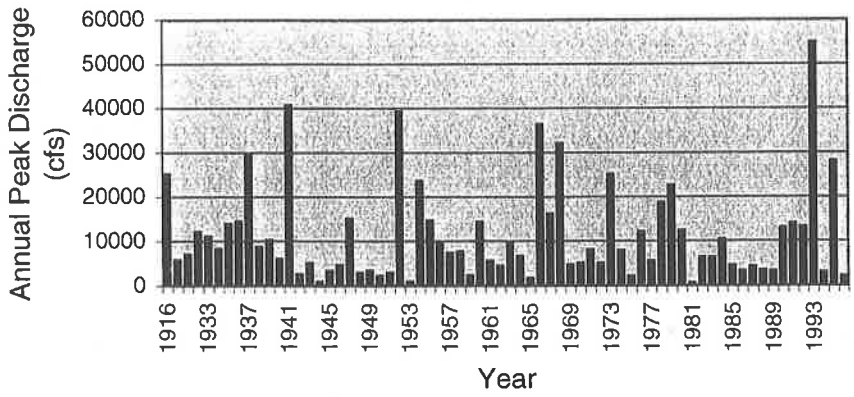


Figure 5. Monthly Average Flow for San Carlos River



The USGS gauge data indicate that the stream is perennial during average years. While the average monthly flow rates are all greater than zero, the minimum average monthly flow is zero for the months of June, July, and September, indicating that the river can dry up completely at times. The highest average flows occur during the winter storm months of January and February, with above average flow rates throughout the winter.

Figure 6. Annual Peak Discharges for San Carlos River



Hydraulics

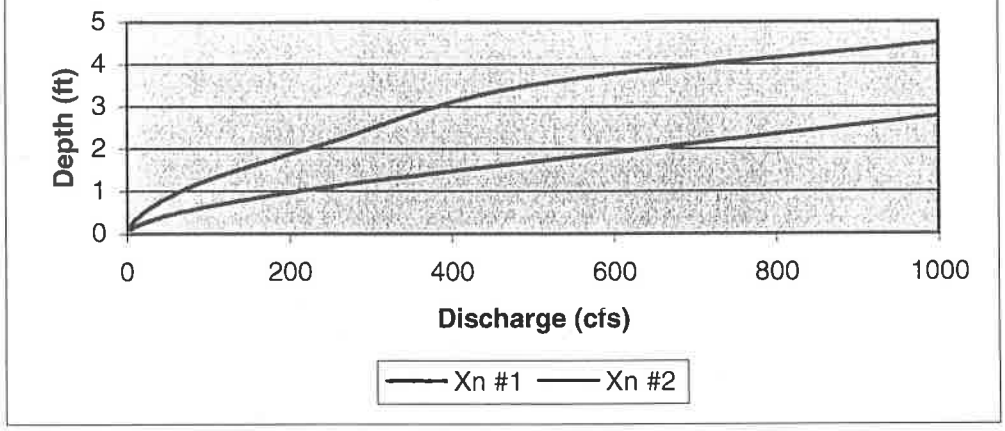
Estimated hydraulic characteristics were developed based on observed stream conditions and historic stream flow records available from the USGS gauge. Table 5 summarizes a range of probable values for stream depth and width at various flow rates. Note that the hydraulic parameters shown below are based on flow data at the USGS gauge site, and an average cross section for the study reach. The estimates probably represent no better than order-of-magnitude estimates of flow conditions at any specific location within the study reach. A rating curve for an assumed cross section developed from field observations is shown in Figure 7.

Table 5. San Carlos River Navigability Study
Estimated Range of Hydraulic Characteristics

Flow Duration	Discharge (cfs)	Depth (ft)		Width (ft)		Average Velocity (ft)	
		Xn #1	Xn #2	Xn #1	Xn #2	Xn #1	Xn #2
10%	69	1.0	0.5	37	60	2.0	2.3
50%	10	0.3	0.2	32	60	1.0	1.1
90%	1.1	0.1	0.3	31	60	0.4	0.4
Mean Annual	63	1.0	0.5	36	60	2.0	2.2
2-Year Flood	7,480	8.0	9.4	290	73	5.3	11.5

Notes:
1. Section #1 (Xn#1) is located at the railroad crossing downstream of US 60.
2. Section #2 (Xn#2) is located at the crossing Indian Route 5.

Figure 7. Depth-Discharge Rating Curves for the San Carlos River



Boating Criteria

The boating criteria cited below were reported in previous detailed navigability studies prepared for the Arizona State Land Department, and are based on the following references:

1. Cooperative Instream Flow Service Group, 1978. Methods of Assessing Instream Flows for Recreation. Instream Flow Information Paper: No. 6. FWS/OBS-78/34. June. Report prepared by U.S. Fish and Wildlife Service, U.S. Environmental Protection Agency, Heritage Conservation and Recreation Service, and Bureau of Reclamation.
2. Jason M. Cortell and Associates, Inc., 1977, Recreation and Instream Flow, Vol. 1: Flow Requirements, Analysis of Benefits, Legal & Institutional Constraints. Report submitted to U.S. Department of the Interior, Bureau of Outdoor Recreation #BOR D6429. July.
3. Walter B. Langbein, 1962. Hydraulics of River Channels as Related to Navigability. U.S. Geological Survey Water-Supply Paper 1539-W.
4. Jim Slingluff, 1987. Deposition of Jim Slingluff for No. C 569870, Maricopa County, et al and Arizona Center for Law in the Public Interest, et al., and Calmat Co. of Arizona, et al, v. State of Arizona, Arizona State Land Department, M. Jean Hassel, and Milo J. Hassel, et al. November 23, 1987.

The following tables summarize navigability criteria information from references 1 to 4. Note that these data reference recreational boating, not necessarily commercial boating.

Table 6. Minimum Required Stream Width and Depth for Recreation Craft[1]		
Type of Craft	**Depth (ft.)**	**Width (ft.)**
Canoe, Kayak	0.5	4
Raft, Drift Boat, Row Boat	1.0	6
Tube	1.0	4
Power Boat	3.0	6
[1] After reference #1		

Table 7. Minimum and Maximum Conditions for Recreational Water Boating[1]						
Type of Boat	**Minimum Condition**			**Maximum Condition**		
	Width	**Depth**	**Velocity**	**Width**	**Depth**	**Velocity**
Canoe, Kayak	25 ft.	3-6 in.	5 fps	-	-	15 fps
Raft, Drift Boat	50 ft.	1 ft.	5 fps	-	-	15 fps
Low Power Boating	25 ft.	1 ft.	-	-	-	10 fps
Tube	25 ft.	1 ft.	1 fps	-	-	10 fps
[1] After reference 2.						

Table 8. Flow Requirements for Pre-1940 Canoe Boating[1]	
Boat Type	**Depth**
Flat Bottomed (Wood or Canvas)	4 in.
Round Bottomed (Wood or Canvas)	6 in.
[1] After reference 4.	

Summary

Comparison of the boating criteria and hydraulic data for the San Carlos River shown above indicate that the stream could be boated less than 10 percent of the time, even by canoes or kayaks. In the Mountain Reach, where flow is confined to a relatively narrow corridor, recreational boating would be limited by the shallow flow. Boating during floods, which would have greater depths, would be dangerous or difficult due to high velocities, floating debris, overhanging vegetation and steep slopes. Boating by large commercial craft would be even more unlikely and hazardous. No modern or historical account of any type of boating in the San Carlos River was identified for this study. A detailed study is not recommended for the San Carlos River.

Limitations

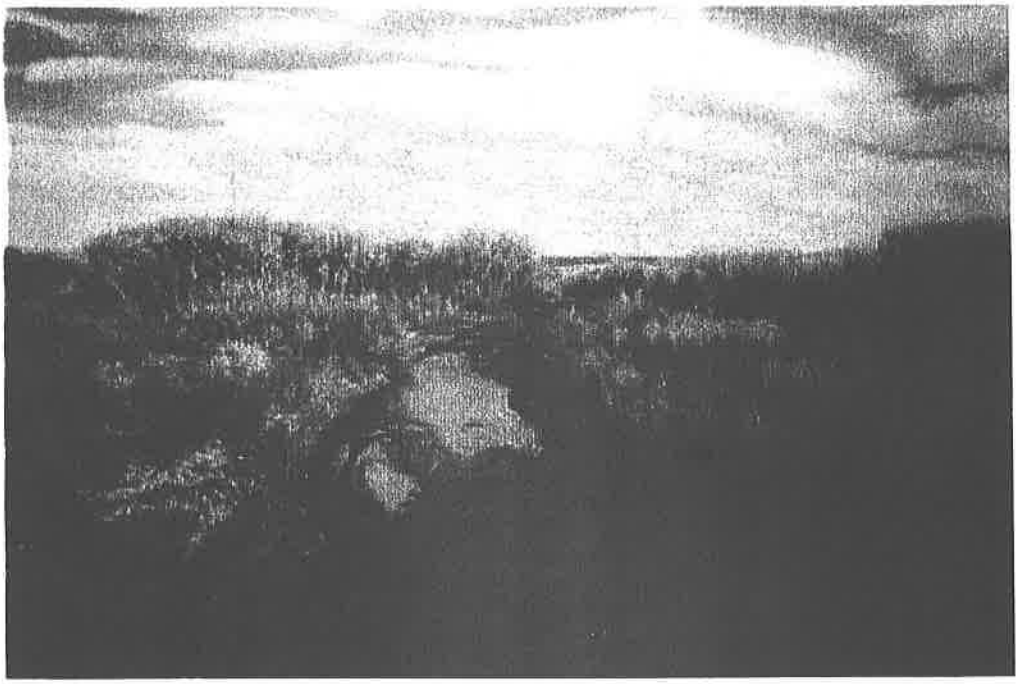
This evaluation is based on readily available information that reflects the level of detail authorized for the ANSAC Small Watercourses Navigability Study. The following limitations apply to the results presented above:

- The hydraulic rating sections may or may not apply to the entire study reach. The rating section results probably represent better than order-of-magnitude accuracy for estimates of width, depth, and velocity at any given point within the study reach.

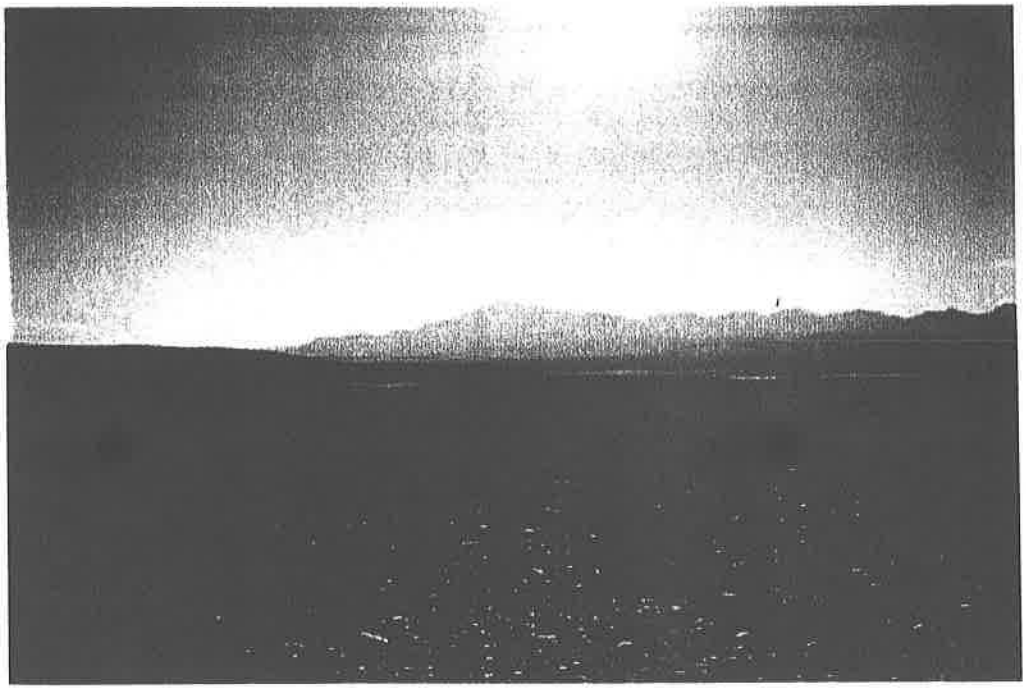
- Hydrologic data for any stream varies with location within a reach, and with time in response to climatic conditions. The hydrologic information provided is the best readily available data for the stream.

Stream conditions were assumed to represent conditions as of the time of Arizona statehood. Unless stated otherwise, no data were identified during the Level 3 analysis that indicated substantive changes in stream morphology with respect to navigability criteria.

Photographs of the San Carlos River

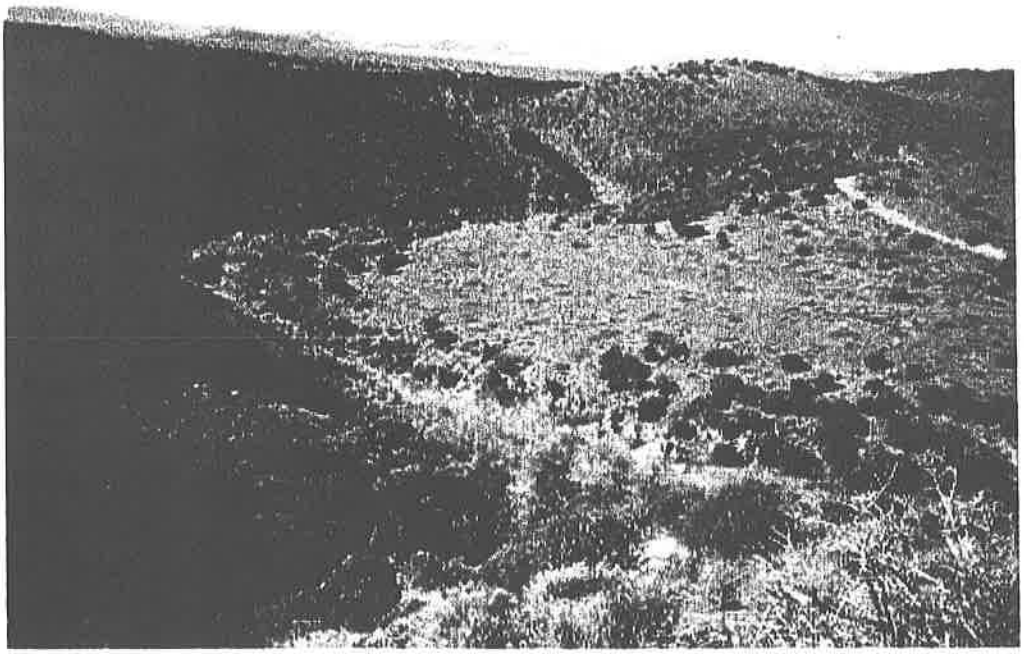


Photograph 1. Looking upstream at railroad crossing downstream of U.S. 60 (Xn #1). 01/05/2001.



Photograph 2. Looking downstream from distance at San Carlos/Gila confluence. Dam just downstream on Gila River creates San Carlos Lake, which creates ponding in the lowest San Carlos River. 01/05/2001

Photograph 3. Looking upstream at crossing of I.R. 5 (Xn #2). 01/05/2001



Photograph 4. Overview of upper San Carlos River, on I.R. 5 near Xn #2. 01/05/2001

4.4 DETAILED STUDY

Of the five (5) watercourses evaluated at Level 3, only Eagle Creek survived the engineering analysis to be forwarded for detailed navigability studies. Results of the detailed studies for Eagle Creek are provided in Appendix C.

5.0 Conclusions

The methodology used in the analysis of small and minor watercourses employed a three-tier process. Level 1 analysis screens the database of all watercourses in the county for stream type, dam information, historical and modern accounts of boating, the existence of fish, and any special status designation. Level 2 analysis research into the watercourses that have positive responses to validate the Level 1 analysis along with the application of a weighting system to rank the surviving watercourses. The watercourses passing a threshold rating are assessed for navigability relative to flow duration, width, depth, and velocity along with landform impediments (Level 3). The essence of the Level 1-3 analysis applies to ARS Section 37-1128 in that watercourses failing any of these levels would be found to meet one or more of the non-navigability criteria to a high degree of certainty. Watercourses passing Level 3 analysis would be found eligible for a detailed study to further assess navigability.

The analysis undertaken for the small and minor watercourses in Graham County found the following:

- Of the total 3,226 watercourses evaluated, 3,080 did not survive the Level 1 screening process while 146 watercourses were forwarded to the Level 2 analysis. At Level 2, one hundred and forty one (141) watercourses failed the screening process while five (5) watercourses survived and were forwarded for the Level 3 analysis.
- The five (5) watercourses in Graham County that were studied at Level 3 were Bonita Creek, Eagle Creek, San Carlos River, Aravaipa Creek and Black River.
- Based on the engineering analyses performed on the five watercourses at Level 3, four watercourses examined had failed to exhibit evidence of susceptibility to navigation as that term is defined in ARS Section 37-1128.
- In summary, only one watercourse in Graham County, Eagle Creek, survived the three-level screening process to be forwarded for a detailed study.

6.0 References

Arizona Department of Water Resources (ADWR), Geospatial Data set: Dams, a digital file submitted to Stantec Consulting, Inc. dated March 12, 1999.

Arizona Game and Fish Department, Geospatial Data set: Perennial Waters of Arizona, a digital file submitted to Stantec Consulting, Inc. dated July 9, 1999.

Arizona State Land Department, Arizona Land Resources Information System (ALRIS), Geospatial Data set: Streams, a digital file submitted to Stantec Consulting, Inc. dated July 13, 1999.

Arizona State Land Department, Arizona Land Resources Information System (ALRIS), Geospatial Data set: County, a digital file submitted to Stantec Consulting, Inc. dated July 13, 1999.

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Stantec Consulting, Inc., (1999a), Small and Minor Watercourses Analysis, a proposal submitted to Arizona State Land Department, Phoenix, Arizona on June 1999.

Stantec Consulting, Inc., (1999b), Small and Minor Watercourses Pilot Study, *Final Report*, submitted to Arizona Navigable Stream Adjudication Commission (ANSAC), on October 1999.

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Stantec Consulting, Inc., (1999d), Small and Minor Watercourses Analysis for Mohave County, Arizona, *Final Report*, submitted to Arizona State Land Department, Phoenix, Arizona on December 31, 1999.

Stantec Consulting, Inc., (1999e), Small and Minor Watercourses Analysis for Yuma County, Arizona, *Final Report*, submitted to Arizona State Land Department, Phoenix, Arizona on December 31, 1999.

Stantec Consulting, Inc., (2000a), Small and Minor Watercourses Analysis for Santa Cruz County, Arizona, *Final Report*, submitted to Arizona State Land Department, Phoenix, Arizona on August 1, 2000.

Stantec Consulting, Inc., (2000b), Small and Minor Watercourses Analysis for Pima County, Arizona, *Final Report*, submitted to Arizona State Land Department, Phoenix, Arizona on August 1, 2000.

Stantec Consulting, Inc., (2000c), Small and Minor Watercourses Analysis for Cochise County, Arizona, *Final Report*, submitted to Arizona State Land Department, Phoenix, Arizona on August 1, 2000.

Stantec Consulting, Inc., (2000d), Small and Minor Watercourses Analysis for Coconino County, Arizona, *Final Report*, submitted to Arizona State Land Department, Phoenix, Arizona on September 2000.

Stantec Consulting, Inc., (2000e), Small and Minor Watercourses Analysis for Yavapai County, Arizona, *Final Report*, submitted to Arizona State Land Department, Phoenix, Arizona on September 2000.

Stantec Consulting, Inc., (2000f), Small and Minor Watercourses Analysis for Pinal County, Arizona, *Final Report*, submitted to Arizona State Land Department, Phoenix, Arizona on September 2000.

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Appendix A – List of Watercourses

Table A-1A
Watercourses in Graham County Rejected at Level 1

No. (1)	W_ID (2)	W_NAME (3)	SEGCOUNT (4)	W_COUNTIES (5)	W_MILES (6)	W_ADDRESS (7)	W_PER (8)	W_MBOAT (9)	W_HBOAT (10)	W_FISH (11)	W_SSTATUS (12)	W_DIMP (13)	HITS (14)
1	59	Apache Wash - Graham	4	Graham	4.612	T2.0S,R19.0E,S27	No	No	No	No	No	No	0
2	84	Ash Creek 2 - Graham	20	Graham	16.013	T1.0N,R21.0E,S08	No	No	No	No	No	No	0
3	89	Ash Creek 3 - Graham	10	Graham	25.397	T10.0S,R22.0E,S36	No	No	No	No	No	No	0
4	127	Bar-X Wash	9	Graham	9.650	T11.0S,R24.0E,S04	No	No	No	No	No	No	0
5	178	Big Creek	4	Graham	8.664	T10.0S,R23.0E,S01	No	No	No	No	No	No	0
6	229	Black Rock Wash - Graham	34	Graham	26.521	T5.0S,R23.0E,S02	No	No	No	No	No	No	0
7	263	Bollen Wash	12	Graham/Pima	13.046	T11.0S,R18.0E,S13	No	No	No	No	No	No	0
8	269	Booger Canyon St	5	Graham/Pinal	6.746	T6.0S,R18.0E,S10	No	No	No	No	No	No	0
9	286	Box Spring Creek	4	Cochise/Graham	13.703	T11.0S,R22.0E,S18	No	No	No	No	No	No	0
10	384	Carland Wash	3	Graham	7.812	T4.0S,R23.0E,S07	No	No	No	No	No	No	0
11	481	Clark Wash	20	Graham/Pinal	12.744	T9.0S,R17.0E,S23	No	No	No	No	No	No	0
12	491	Clover Creek - Graham	12	Graham	12.742	T2.0N,R24.0E,S31	No	No	No	No	No	No	0
13	525	Copper Creek	17	Graham/Pinal	15.870	T8.0S,R17.0E,S34	No	No	No	No	No	No	0
14	581	Coyote Wash - Graham	17	Graham	20.235	T6.0S,R25.0E,S21	No	No	No	No	No	No	0
15	595	Crazy Horse Creek	1	Graham	2.143	T9.0S,R25.0E,S06	No	No	No	No	No	No	0
16	596	Crazy Horse Wash	2	Graham	4.737	T8.0S,R21.0E,S07	No	No	No	No	No	No	0
17	622	Day Mine Wash	8	Graham	10.732	T4.0S,R23.0E,S21	No	No	No	No	No	No	0
18	638	Deer Creek - Pinal	26	Graham/Pinal	21.583	T4.0S,R16.0E,S33	No	No	No	No	No	No	0
19	641	Deer Creek 1 - Graham	2	Graham	7.152	T8.0S,R21.0E,S28	No	No	No	No	No	No	0
20	642	Deer Creek 1 - Graham/Pinal	13	Graham/Pinal	15.647	T6.0S,R18.0E,S14	No	No	No	No	No	No	0
21	658	Dial Wash	3	Cochise/Graham	16.347	T11.0S,R28.0E,S31	No	No	No	No	No	No	0
22	689	Dry Creek - Graham	2	Graham	6.820	T5.0S,R27.0E,S26	No	No	No	No	No	No	0
23	761	Fine Wash	10	Graham	7.777	T4.0S,R23.0E,S28	No	No	No	No	No	No	0
24	765	Fish Creek	1	Graham/Navajo	0.172	T3.0N,R23.0E,S26	No	No	No	No	No	No	0
25	772	Fivemile Wash - Graham	8	Graham	9.857	T3.0S,R21.0E,S10	No	No	No	No	No	No	0
26	790	Fourmile Creek	19	Graham	13.374	T7.0S,R20.0E,S07	No	No	No	No	No	No	0
27	802	Fresnal Wash - Graham	5	Graham	7.150	T8.0S,R21.0E,S27	No	No	No	No	No	No	0
28	814	Garden Creek	20	Graham/Pinal	22.481	T4.0S,R19.0E,S32	No	No	No	No	No	No	0
29	818	Gardner Creek	2	Graham	6.920	T9.0S,R20.0E,S13	No	No	No	No	No	No	0
30	827	Gillespie Wash	12	Graham	4.285	T10.0S,R25.0E,S14	No	No	No	No	No	No	0
31	831	Gold Gulch	25	Cochise/Graham	32.283	T10.0S,R28.0E,S33	No	No	No	No	No	No	0
32	836	Goodwin Wash	28	Graham	25.496	T4.0S,R23.0E,S17	No	No	No	No	No	No	0
33	852	Grapevine Canyon - Graham	5	Graham	4.243	T10.0S,R24.0E,S06	No	No	No	No	No	No	0
34	37657	High Creek	19	Graham	22.140	T10.0S,R22.0E,S14	No	No	No	No	No	No	0
35	37664	Hog Canyon Wash	8	Graham	9.960	T10.0S,R24.0E,S11	No	No	No	No	No	No	0
36	37689	Horton Creek - Graham	4	Graham	5.053	T11.0S,R22.0E,S01	No	No	No	No	No	No	0
37	37693	Hot Springs Wash	3	Graham	8.191	T5.0S,R24.0E,S20	No	No	No	No	No	No	0
38	37747	Jacobson Creek	23	Graham	11.558	T8.0S,R26.0E,S09	No	No	No	No	No	No	0
39	37752	Jesus Canyon Wash	5	Graham	8.472	T9.0S,R23.0E,S21	No	No	No	No	No	No	0
40	37759	Johnny Creek	11	Graham	7.508	T5.0S,R27.0E,S10	No	No	No	No	No	No	0
41	37786	Kelly Gulch	14	Graham	14.591	T3.0S,R19.0E,S09	No	No	No	No	No	No	0
42	37787	Kennedy Falls Wash	5	Graham	5.824	T8.0S,R21.0E,S20	No	No	No	No	No	No	0
43	37794	Klondyke Wash	3	Graham	6.696	T6.0S,R20.0E,S34	No	No	No	No	No	No	0
44	37824	Left Branch Long	1	Graham	2.924	T7.0S,R20.0E,S30	No	No	No	No	No	No	0
45	37825	Left Fork Markha	12	Graham	12.493	T3.0S,R24.0E,S36	No	No	No	No	No	No	0

NOTES: The column headings are defined as follows:

W_ID: Unique ID number given to the watercourse
W_NAME: Name of the watercourse.
SEGCOUNT: Number of segments merged together to comprise the waterco
W_COUNTIES: County(ies) where the watercourse is located.
W_MILES: Length of the watercourse in miles.
W_ADDRESS: Township, Range and Section of the mouth of the watercourse
W_PER: Stream classification-perennial or not.
W_MBOAT: With modern boating or not.
W_HBOAT: With historical boating or not.
W_FISH: With fish or not.
W_DIMP: Impacted by dam or not.
W_SSTATUS: With special status designations or not.
HITS: Number of affirmative hits based on the six attribute data.

Table A-1A
Watercourses in Graham County Rejected at Level 1

No. (1)	W_ID (2)	W_NAME (3)	SEGCOUNT (4)	W_COUNTIES (5)	W_MILES (6)	W_ADDRESS (7)	W_PER (8)	W_MBOAT (9)	W_HBOAT (10)	W_FISH (11)	W_SSTATUS (12)	W_DIMP (13)	HITS (14)
46	37864	Little Rocky Creek	7	Graham	5.645	T1.0S,R23.0E,S02	No	No	No	No	No	No	0
47	37882	Lone Star Wash	6	Graham	9.000	T7.0S,R26.0E,S08	No	No	No	No	No	No	0
48	37888	Long Hollow	4	Graham	4.993	T7.0S,R20.0E,S29	No	No	No	No	No	No	0
49	37903	Low Creek	6	Graham	9.277	T9.0S,R21.0E,S36	No	No	No	No	No	No	0
50	37917	Malay Creek	5	Graham/Greenlee	3.649	T3.0N,R27.0E,S10	No	No	No	No	No	No	0
51	37931	Martin Wash	5	Graham	9.298	T10.0S,R24.0E,S21	No	No	No	No	No	No	0
52	37932	Martinez Wash - Graham	10	Graham	8.383	T4.0S,R27.0E,S27	No	No	No	No	No	No	0
53	37972	Middle Prong Creek	11	Graham/Greenlee	10.211	T1.0N,R28.0E,S07	No	No	No	No	No	No	0
54	38035	Mud Spring Wash	2	Cochise/Graham	8.078	T11.0S,R22.0E,S14	No	No	No	No	No	No	0
55	38072	Noon Creek	5	Graham	3.821	T9.0S,R25.0E,S09	No	No	No	No	No	No	0
56	38081	North Fork Ash Creek	12	Graham	10.672	T1.0S,R23.0E,S08	No	No	No	No	No	No	0
57	38096	North Oak Creek	4	Graham	7.041	T10.0S,R20.0E,S25	No	No	No	No	No	No	0
58	38115	Oak Creek 1 - Graham	9	Graham	11.623	T8.0S,R21.0E,S07	No	No	No	No	No	No	0
59	38117	Oak Creek 2 - Graham	4	Graham	8.050	T10.0S,R22.0E,S14	No	No	No	No	No	No	0
60	38119	Oak Creek 3 - Graham	2	Graham	1.883	T4.0S,R27.0E,S29	No	No	No	No	No	No	0
61	38120	Oak Draw	25	Graham	18.029	T9.0S,R27.0E,S02	No	No	No	No	No	No	0
62	38138	Owl Wash	5	Graham	16.515	T10.0S,R28.0E,S18	No	No	No	No	No	No	0
63	38148	Paddys River	7	Graham	11.149	T8.0S,R21.0E,S33	No	No	No	No	No	No	0
64	38152	Paisano Canyon Spring	1	Graham/Pinal	5.524	T6.0S,R18.0E,S14	No	No	No	No	No	No	0
65	38172	Park Creek - Graham	28	Graham	15.452	T3.0S,R26.0E,S35	No	No	No	No	No	No	0
66	38181	Patterson Wash	2	Graham	3.776	T6.0S,R24.0E,S15	No	No	No	No	No	No	0
67	38197	Peters Wash	2	Graham/Pinal	7.132	T10.0S,R18.0E,S33	No	No	No	No	No	No	0
68	38240	Pistol Creek	9	Graham	5.012	T3.0S,R28.0E,S32	No	No	No	No	No	No	0
69	38242	Pitchfork Canyon	8	Graham	8.347	T10.0S,R23.0E,S01	No	No	No	No	No	No	0
70	38311	Rattlesnake Creek	18	Graham	21.094	T7.0S,R20.0E,S27	No	No	No	No	No	No	0
71	38334	Reiley Creek	2	Cochise/Graham	7.731	T11.0S,R23.0E,S32	No	No	No	No	No	No	0
72	38341	Right Branch Lon	1	Graham	1.365	T7.0S,R19.0E,S25	No	No	No	No	No	No	0
73	38343	Right Fork Markh	5	Graham	4.848	T4.0S,R25.0E,S28	No	No	No	No	No	No	0
74	38390	Sacaton Wash	2	Cochise/Graham	6.320	T12.0S,R25.0E,S09	No	No	No	No	No	No	0
75	38427	Sand Wash - Graham	4	Graham	5.507	T6.0S,R19.0E,S27	No	No	No	No	No	No	0
76	38446	Sawmill Creek	13	Graham	15.759	T3.0N,R23.0E,S28	No	No	No	No	No	No	0
77	38448	Scanlon Wash	12	Graham/Pinal	10.139	T9.0S,R18.0E,S06	No	No	No	No	No	No	0
78	38472	Sheep Camp Wash	1	Graham	4.087	T11.0S,R19.0E,S10	No	No	No	No	No	No	0
79	38480	Sheep Wash - Greenlee	21	Graham/Greenlee	16.900	T2.0S,R28.0E,S03	No	No	No	No	No	No	0
80	38481	Sheep Wash 1 - Graham	3	Graham	5.556	T4.0S,R26.0E,S12	No	No	No	No	No	No	0
81	38482	Sheep Wash 2 - Graham	10	Graham	6.463	T8.0S,R21.0E,S12	No	No	No	No	No	No	0
82	38488	Shoat Tank Wash	3	Graham	3.627	T7.0S,R30.0E,S20	No	No	No	No	No	No	0
83	38521	Slick Rock Wash	22	Graham	23.371	T8.0S,R28.0E,S22	No	No	No	No	No	No	0
84	38543	Soldier Hole Creek	7	Graham	8.104	T1.0S,R23.0E,S13	No	No	No	No	No	No	0
85	38553	South Cienega Creek	5	Graham	5.845	T2.0S,R27.0E,S29	No	No	No	No	No	No	0
86	38555	South Fork Ash Creek 1	6	Graham	6.896	T11.0S,R21.0E,S03	No	No	No	No	No	No	0
87	38561	South Fork Clark	4	Graham/Pinal	2.647	T8.0S,R18.0E,S35	No	No	No	No	No	No	0
88	38578	South Oak Creek	4	Graham	5.622	T10.0S,R21.0E,S28	No	No	No	No	No	No	0
89	38580	South Taylor Wash	14	Graham	14.181	T8.0S,R23.0E,S29	No	No	No	No	No	No	0
90	38604	Squaw Creek 2 - Graham	7	Graham	7.534	T7.0S,R20.0E,S21	No	No	No	No	No	No	0

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W_PER: Stream classification-perennial or not.
W_MBOAT: With modern boating or not.
W_HBOAT: With historical boating or not.
W_FISH: With fish or not.
W_DIMP: Impacted by dam or not.
W_SSTATUS: With special status designations or not.
HITS: Number of affirmative hits based on the six attribute data.

Table A-1A
Watercourses in Graham County Rejected at Level 1

No. (1)	W_ID (2)	W_NAME (3)	SEGCOUNT (4)	W_COUNTIES (5)	W_MILES (6)	W_ADDRESS (7)	W_PER (8)	W_MBOAT (9)	W_HBOAT (10)	W_FISH (11)	W_SSTATUS (12)	W_DIMP (13)	HITS (14)
91	38606	Squaw Creek 3 - Graham	2	Graham	3.392	T5.0S,R20.0E,S12	No	No	No	No	No	No	0
92	38622	Stockton Pass Wash	1	Graham	0.991	T10.0S,R24.0E,S12	No	No	No	No	No	No	0
93	38649	Sycamore Creek - Graham	3	Graham	3.794	T8.0S,R20.0E,S31	No	No	No	No	No	No	0
94	38683	Telegraph Wash 1	13	Graham	9.242	T5.0S,R22.0E,S27	No	No	No	No	No	No	0
95	38684	Telegraph Wash 2	6	Graham	4.660	T5.0S,R19.0E,S29	No	No	No	No	No	No	0
96	38703	Tidwell Wash	3	Graham	7.105	T7.0S,R26.0E,S12	No	No	No	No	No	No	0
97	38719	Tollgate Wash	11	Graham/Greenlee	11.861	T7.0S,R28.0E,S10	No	No	No	No	No	No	0
98	38742	Triplet Wash 1	5	Graham	9.407	T2.0S,R19.0E,S11	No	No	No	No	No	No	0
99	38743	Triplet Wash 2	4	Graham	6.835	T1.0S,R19.0E,S30	No	No	No	No	No	No	0
100	38762	Tule Creek	3	Graham/Greenlee	6.773	T3.0S,R28.0E,S08	No	No	No	No	No	No	0
101	38777	Turkey Creek 1 - Graham	9	Graham	10.449	T1.0N,R25.0E,S29	No	No	No	No	No	No	0
102	38773	Turkey Creek 3 - Graham	4	Graham	6.517	T15.0S,R18.0E,S01	No	No	No	No	No	No	0
103	38792	Twilight Creek	2	Graham	2.351	T9.0S,R25.0E,S17	No	No	No	No	No	No	0
104	38795	Two E Wash	8	Graham	9.594	T9.0S,R21.0E,S03	No	No	No	No	No	No	0
105	38800	Underwood Wash	21	Graham	24.492	T7.0S,R22.0E,S30	No	No	No	No	No	No	0
106	38819	WA Wash	7	Graham	13.827	T10.0S,R27.0E,S01	No	No	No	No	No	No	0
107	38872	West Prong Creek	11	Graham/Greenlee	7.488	T1.0N,R27.0E,S02	No	No	No	No	No	No	0
108	38901	Whitlock Wash	14	Graham	11.715	T10.0S,R30.0E,S17	No	No	No	No	No	No	0
109	38920	Willow Creek - Graham	7	Graham	3.240	T8.0S,R20.0E,S29	No	No	No	No	No	No	0
110	38930	Willow Spring Wash - Graham	10	Graham	16.487	T10.0S,R28.0E,S18	No	No	No	No	No	No	0
111	38968	Yuma Wash - Graham	5	Graham	10.463	T7.0S,R28.0E,S01	No	No	No	No	No	No	0
112	-	2969 Unnamed Washes	-	-	-	-	No	No	No	No	No	No	0

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W_HBOAT: With historical boating or not.
W_FISH: With fish or not.
W_DIMP: Impacted by dam or not.
W_SSTATUS: With special status designations or not.
HITS: Number of affirmative hits based on the six attribute data.

Table A-1B
Watercourses in Graham County Not Rejected at Level 1

No. (1)	W_ID (2)	W_NAME (3)	SEGCOUNT (4)	W_COUNTIES (5)	W_MILES (6)	W_ADDRESS (7)	W_PER (8)	W_MBOAT (9)	W_HBOAT (10)	W_FISH (11)	W_SSTATUS (12)	W_DIMP (13)	HITS (14)
1	226	Black River	97	Apache/Gila/Graham/Greenlee/Navajo	121.77	T3.0N,R23.0E,S28	Yes	Yes	No	Yes	Yes	No	4
2	706	Eagle Creek	159	Graham/Greenlee	63.99	T1.0N,R28.0E,S31	Yes	Yes	No	Yes	Yes	No	4
3	62	Aravaipa Creek	90	Graham/Pinal	62.50	T7.0S,R16.0E,S09	Yes	No	No	Yes	Yes	No	3
4	78	Ash Creek 1 - Graham	16	Graham	19.34	T7.0S,R24.0E,S13	Yes	No	No	Yes	Yes	No	3
5	151	Bear Wallow Creek	5	Graham/Greenlee	5.90	T3.0N,R27.0E,S03	Yes	No	No	Yes	Yes	No	3
6	267	Bonita Creek - Graham	100	Graham	52.85	T6.0S,R28.0E,S21	Yes	No	No	Yes	Yes	No	3
7	807	Frye Creek	8	Graham	15.73	T8.0S,R24.0E,S13	Yes	No	No	Yes	No	Yes	3
8	38326	Redfield Canyon	22	Cochise/Graham/Pima	24.30	T12.0S,R18.0E,S02	Yes	No	No	Yes	Yes	No	3
9	38409	San Carlos River	56	Gila/Graham	49.15	T1.0N,R21.0E,S08	Yes	No	No	Yes	No	Yes	3
10	38642	Swamp Springs Canyon	4	Cochise/Graham	5.70	T11.0S,R20.0E,S32	Yes	No	No	Yes	Yes	No	3
11	132	Bass Canyon	1	Cochise/Graham	6.18	T12.0S,R21.0E,S08	No	No	No	Yes	Yes	No	2
12	849	Grant Creek - Graham	16	Graham	12.75	T9.0S,R24.0E,S19	Yes	No	No	Yes	No	No	2
13	19016	H43_1999	2	Graham	1.31	T7.0S,R24.0E,S23	Yes	No	No	No	No	Yes	2
14	37925	Marijilda Wash	22	Graham	14.96	T7.0S,R26.0E,S34	Yes	No	No	Yes	No	No	2
15	37926	Markham Creek	8	Graham	11.75	T6.0S,R24.0E,S04	No	No	No	Yes	No	Yes	2
16	38251	Point of Pines Creek	32	Graham	21.42	T1.0N,R25.0E,S36	Yes	No	No	No	No	Yes	2
17	38623	Stockton Wash	47	Graham	32.69	T7.0S,R26.0E,S09	Yes	No	No	No	No	Yes	2
18	38781	Turkey Creek 2 - Graham	5	Graham	9.70	T6.0S,R19.0E,S19	Yes	No	No	No	Yes	No	2
19	196	Bigler Wash	4	Graham	8.33	T6.0S,R24.0E,S09	Yes	No	No	No	No	No	1
20	199	Billingsley Creek	2	Graham	6.18	T6.0S,R24.0E,S02	No	No	No	No	No	Yes	1
21	257	Bobcat Creek	13	Graham	8.94	T2.0N,R24.0E,S34	Yes	No	No	No	No	No	1
22	305	Brushy Creek - Graham	9	Graham	6.93	T3.0S,R28.0E,S08	Yes	No	No	No	No	No	1
23	341	Burton Wash	2	Graham	7.87	T4.0S,R23.0E,S26	Yes	No	No	No	No	No	1
24	468	Cienega Creek - Graham	37	Graham	22.06	T2.0S,R27.0E,S24	Yes	No	No	No	No	No	1
25	696	Dry Prong Creek	18	Graham/Greenlee	14.38	T2.0N,R27.0E,S14	No	No	No	Yes	No	No	1
26	744	Elwood Canyon Creek	6	Graham	6.64	T3.0N,R23.0E,S35	Yes	No	No	No	No	No	1
27	799	Freezeout Creek	19	Graham	12.44	T2.0N,R25.0E,S27	Yes	No	No	No	No	No	1
28	825	Gibson Creek - Graham	4	Graham	3.77	T8.0S,R25.0E,S32	No	No	No	Yes	No	No	1
29	840	Goudy Canyon Wash	8	Graham	9.62	T9.0S,R23.0E,S34	Yes	No	No	No	No	No	1
30	15653	H39_0481	1	Gila/Graham	1.10	T1.0S,R19.0E,S07	Yes	No	No	No	No	No	1
31	15798	H39_0628	1	Gila/Graham	0.88	T1.0S,R19.0E,S19	Yes	No	No	No	No	No	1
32	15801	H39_0631	3	Graham	1.24	T1.0S,R19.0E,S31	Yes	No	No	No	No	No	1
33	17456	H43_0127	1	Graham/Greenlee	0.36	T1.0S,R28.0E,S05	Yes	No	No	No	No	No	1
34	17476	H43_0160	1	Graham	0.13	T2.0S,R28.0E,S05	Yes	No	No	No	No	No	1
35	17479	H43_0164	1	Graham	0.48	T2.0S,R28.0E,S08	Yes	No	No	No	No	No	1
36	17533	H43_0273	1	Graham	0.09	T3.0S,R21.0E,S13	Yes	No	No	No	No	No	1
37	17544	H43_0303	1	Graham	0.05	T4.0S,R22.0E,S11	Yes	No	No	No	No	No	1
38	17545	H43_0304	1	Graham	0.21	T4.0S,R22.0E,S11	Yes	No	No	No	No	No	1
39	17550	H43_0312	1	Graham	0.04	T4.0S,R23.0E,S21	Yes	No	No	No	No	No	1
40	17559	H43_0328	1	Graham	0.85	T4.0S,R23.0E,S29	Yes	No	No	No	No	No	1
41	17563	H43_0333	1	Graham	1.90	T5.0S,R23.0E,S02	Yes	No	No	No	No	No	1
42	17568	H43_0341	2	Graham	0.94	T5.0S,R24.0E,S07	Yes	No	No	No	No	No	1
43	17581	H43_0359	1	Graham	0.04	T5.0S,R23.0E,S24	Yes	No	No	No	No	No	1
44	17582	H43_0361	1	Graham	0.17	T5.0S,R23.0E,S24	Yes	No	No	No	No	No	1
45	17616	H43_0418	1	Graham	0.75	T6.0S,R24.0E,S21	Yes	No	No	No	No	No	1

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W_HBOAT: With historical boating or not.
W_FISH: With fish or not.
W_DIMP: Impacted by dam or not.
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Table A-1B
Watercourses in Graham County Not Rejected at Level 1

No. (1)	W_ID (2)	W_NAME (3)	SEGCOUNT (4)	W_COUNTIES (5)	W_MILES (6)	W_ADDRESS (7)	W_PER (8)	W_MBOAT (9)	W_HBOAT (10)	W_FISH (11)	W_SSTATUS (12)	W_DIMP (13)	HITS (14)
46	17623	H43_0431	1	Graham	0.16	T6.0S,R28.0E,S30	Yes	No	No	No	No	No	1
47	17631	H43_0448	1	Graham	0.13	T6.0S,R24.0E,S36	No	No	No	No	No	Yes	1
48	17641	H43_0468	1	Graham	0.22	T7.0S,R23.0E,S01	Yes	No	No	No	No	No	1
49	17642	H43_0469	2	Graham	0.25	T7.0S,R23.0E,S01	Yes	No	No	No	No	No	1
50	17643	H43_0470	2	Graham	3.64	T6.0S,R24.0E,S29	Yes	No	No	No	No	No	1
51	17687	H43_0551	1	Graham	1.30	T7.0S,R26.0E,S26	No	No	No	No	No	Yes	1
52	17689	H43_0554	1	Graham	1.46	T7.0S,R26.0E,S27	No	No	No	No	No	Yes	1
53	17692	H43_0557	1	Graham	7.44	T7.0S,R27.0E,S20	No	No	No	No	No	Yes	1
54	17693	H43_0559	1	Graham	2.53	T7.0S,R26.0E,S26	No	No	No	No	No	Yes	1
55	17777	H43_0703	1	Graham	0.36	T6.0S,R24.0E,S36	No	No	No	No	No	Yes	1
56	17843	H43_0796	1	Graham	0.61	T3.0S,R21.0E,S14	Yes	No	No	No	No	No	1
57	17844	H43_0797	1	Graham	0.53	T3.0S,R21.0E,S14	Yes	No	No	No	No	No	1
58	17855	H43_0808	2	Graham	1.10	T4.0S,R22.0E,S03	Yes	No	No	No	No	No	1
59	17856	H43_0809	2	Graham	0.39	T4.0S,R22.0E,S10	Yes	No	No	No	No	No	1
60	17858	H43_0811	1	Graham	0.19	T4.0S,R22.0E,S03	Yes	No	No	No	No	No	1
61	17918	H43_0874	1	Graham	0.19	T4.0S,R23.0E,S27	Yes	No	No	No	No	No	1
62	17919	H43_0875	1	Graham	0.03	T4.0S,R23.0E,S27	Yes	No	No	No	No	No	1
63	17995	H43_0954	2	Graham	1.13	T5.0S,R25.0E,S11	No	No	No	No	No	Yes	1
64	18020	H43_0979	11	Graham	13.03	T7.0S,R26.0E,S08	No	No	No	No	No	Yes	1
65	18030	H43_0989	1	Graham	7.96	T7.0S,R25.0E,S14	No	No	No	No	No	Yes	1
66	18031	H43_0990	1	Graham	0.32	T7.0S,R25.0E,S24	No	No	No	No	No	Yes	1
67	18033	H43_0992	1	Graham	0.80	T8.0S,R25.0E,S03	Yes	No	No	No	No	No	1
68	18034	H43_0993	1	Graham	0.65	T8.0S,R25.0E,S03	Yes	No	No	No	No	No	1
69	18048	H43_1007	1	Graham	0.12	T8.0S,R25.0E,S19	Yes	No	No	No	No	No	1
70	18049	H43_1008	1	Graham	0.03	T8.0S,R25.0E,S17	Yes	No	No	No	No	No	1
71	18065	H43_1024	1	Graham	0.62	T8.0S,R25.0E,S23	Yes	No	No	No	No	No	1
72	18078	H43_1039	2	Graham	1.15	T9.0S,R24.0E,S12	Yes	No	No	No	No	No	1
73	18205	H43_1170	2	Graham	0.28	T7.0S,R27.0E,S18	Yes	No	No	No	No	No	1
74	18206	H43_1171	1	Graham	0.37	T7.0S,R27.0E,S18	Yes	No	No	No	No	No	1
75	18207	H43_1172	1	Graham	0.12	T7.0S,R27.0E,S18	Yes	No	No	No	No	No	1
76	18488	H43_1461	1	Graham	0.08	T1.0N,R25.0E,S23	Yes	No	No	No	No	No	1
77	18489	H43_1462	1	Graham	0.06	T1.0N,R25.0E,S25	Yes	No	No	No	No	No	1
78	18553	H43_1532	2	Graham	0.48	T1.0S,R28.0E,S19	Yes	No	No	No	No	No	1
79	18554	H43_1533	2	Graham	3.52	T1.0S,R28.0E,S19	Yes	No	No	No	No	No	1
80	18615	H43_1595	3	Graham	1.75	T2.0S,R27.0E,S15	Yes	No	No	No	No	No	1
81	18616	H43_1596	2	Graham	2.49	T2.0S,R27.0E,S16	Yes	No	No	No	No	No	1
82	18629	H43_1609	1	Graham	0.07	T3.0S,R28.0E,S17	Yes	No	No	No	No	No	1
83	18889	H43_1871	2	Graham	1.01	T4.0S,R25.0E,S12	No	No	No	No	No	Yes	1
84	18891	H43_1873	2	Graham	1.72	T4.0S,R25.0E,S13	No	No	No	No	No	Yes	1
85	18892	H43_1874	1	Graham	2.75	T4.0S,R25.0E,S13	No	No	No	No	No	Yes	1
86	18966	H43_1949	2	Graham	1.16	T7.0S,R27.0E,S09	Yes	No	No	No	No	No	1
87	18968	H43_1951	1	Graham	0.32	T7.0S,R26.0E,S09	Yes	No	No	No	No	No	1
88	18971	H43_1954	1	Graham	0.08	T7.0S,R24.0E,S03	Yes	No	No	No	No	No	1
89	18972	H43_1955	9	Graham	9.56	T7.0S,R24.0E,S08	Yes	No	No	No	No	No	1
90	19004	H43_1987	2	Graham	0.82	T8.0S,R24.0E,S07	Yes	No	No	No	No	No	1

NOTES: The column headings are defined as follows:

W_ID: Unique ID number given to the watercourse
W_NAME: Name of the watercourse.
SEGCOUNT: Number of segments merged together to comprise the watercourse.
W_COUNTIES: County(ies) where the watercourse is located.
W_MILES: Length of the watercourse in miles.
W_ADDRESS: Township, Range and Section of the mouth of the watercourse. [S88 - No designated Township, Range, and Section]
W_PER: Stream classification-perennial or not.
W_MBOAT: With modern boating or not.
W_HBOAT: With historical boating or not.
W_FISH: With fish or not.
W_DIMP: Impacted by dam or not.
W_SSTATUS: With special status designations or not.
HITS: Number of affirmative hits based on the six attribute data.

Table A-1B
Watercourses in Graham County Not Rejected at Level 1

No. (1)	W_ID (2)	W_NAME (3)	SEGCOUNT (4)	W_COUNTIES (5)	W_MILES (6)	W_ADDRESS (7)	W_PER (8)	W_MBOAT (9)	W_HBOAT (10)	W_FISH (11)	W_SSTATUS (12)	W_DIMP (13)	HITS (14)
91	19020	H43_2003	1	Graham	1.58	T7.0S,R24.0E,S35	Yes	No	No	No	No	No	1
92	19021	H43_2004	2	Graham	0.56	T7.0S,R24.0E,S24	Yes	No	No	No	No	No	1
93	19022	H43_2005	1	Graham	0.19	T7.0S,R24.0E,S24	Yes	No	No	No	No	No	1
94	19023	H43_2006	1	Graham	0.08	T7.0S,R24.0E,S14	Yes	No	No	No	No	No	1
95	19024	H43_2008	2	Graham	5.85	T7.0S,R25.0E,S04	No	No	No	No	No	Yes	1
96	19025	H43_2009	2	Graham	4.00	T7.0S,R25.0E,S04	No	No	No	No	No	Yes	1
97	19035	H43_2020	1	Graham	0.26	T6.0S,R24.0E,S09	Yes	No	No	No	No	No	1
98	19105	H43_2091	3	Graham	3.38	T5.0S,R23.0E,S02	Yes	No	No	No	No	No	1
99	19113	H43_2100	1	Graham	0.40	T4.0S,R22.0E,S12	Yes	No	No	No	No	No	1
100	19114	H43_2101	4	Graham	1.07	T4.0S,R22.0E,S11	Yes	No	No	No	No	No	1
101	19116	H43_2103	1	Graham	0.22	T4.0S,R22.0E,S11	Yes	No	No	No	No	No	1
102	19117	H43_2104	1	Graham	0.23	T4.0S,R22.0E,S11	Yes	No	No	No	No	No	1
103	19122	H43_2109	4	Graham	7.51	T3.0S,R23.0E,S19	Yes	No	No	No	No	No	1
104	19126	H43_2113	2	Graham	1.76	T2.0S,R23.0E,S28	Yes	No	No	No	No	No	1
105	19127	H43_2114	2	Graham	2.23	T2.0S,R23.0E,S27	Yes	No	No	No	No	No	1
106	19129	H43_2116	3	Graham	0.44	T4.0S,R22.0E,S11	Yes	No	No	No	No	No	1
107	19131	H43_2118	1	Graham	0.68	T3.0S,R22.0E,S33	Yes	No	No	No	No	No	1
108	19146	H43_2136	2	Graham	0.88	T3.0S,R22.0E,S19	Yes	No	No	No	No	No	1
109	19148	H43_2138	1	Graham	0.33	T3.0S,R21.0E,S13	Yes	No	No	No	No	No	1
110	19149	H43_2139	2	Graham	0.41	T3.0S,R21.0E,S13	Yes	No	No	No	No	No	1
111	19150	H43_2140	1	Graham	0.37	T3.0S,R21.0E,S13	Yes	No	No	No	No	No	1
112	19151	H43_2141	6	Graham	4.99	T3.0S,R21.0E,S11	Yes	No	No	No	No	No	1
113	19152	H43_2142	1	Graham	0.18	T3.0S,R21.0E,S12	Yes	No	No	No	No	No	1
114	19155	H43_2146	1	Graham	0.13	T3.0S,R22.0E,S20	Yes	No	No	No	No	No	1
115	19168	H43_2160	1	Graham	0.26	T3.0S,R21.0E,S10	Yes	No	No	No	No	No	1
116	19175	H43_2167	2	Graham	0.33	T3.0S,R21.0E,S09	Yes	No	No	No	No	No	1
117	19176	H43_2168	2	Graham	0.79	T3.0S,R21.0E,S09	Yes	No	No	No	No	No	1
118	19177	H43_2169	5	Graham	1.60	T3.0S,R21.0E,S09	Yes	No	No	No	No	No	1
119	19178	H43_2170	1	Graham	0.07	T3.0S,R21.0E,S10	Yes	No	No	No	No	No	1
120	19180	H43_2172	2	Graham	1.03	T3.0S,R21.0E,S08	Yes	No	No	No	No	No	1
121	19196	H43_2188	1	Graham	0.17	T3.0S,R20.0E,S01	Yes	No	No	No	No	No	1
122	19201	H43_2193	1	Graham	0.63	T3.0S,R20.0E,S01	Yes	No	No	No	No	No	1
123	19353	H43_2346	1	Graham	0.32	T4.0S,R23.0E,S27	Yes	No	No	No	No	No	1
124	20168	H46_0623	1	Graham	1.83	T11.0S,R28.0E,S01	Yes	No	No	No	No	No	1
125	33347	H77_1461	1	Graham	3.33	T5.0S,R19.0E,S09	No	No	No	No	No	Yes	1
126	35523	H81_0014	2	Graham	1.82	T8.0S,R23.0E,S34	No	No	No	No	No	Yes	1
127	35588	H81_0091	1	Graham	0.80	T10.0S,R24.0E,S04	Yes	No	No	No	No	No	1
128	35596	H81_0099	1	Graham	0.65	T10.0S,R24.0E,S04	Yes	No	No	No	No	No	1
129	37605	Hackberry Creek - Graham	19	Graham	15.32	T1.0S,R19.0E,S07	Yes	No	No	No	No	No	1
130	37694	Hot Well Draw	38	Graham	27.88	T11.0S,R29.0E,S09	Yes	No	No	No	No	No	1
131	37887	Long Creek	9	Graham	10.66	T3.0S,R21.0E,S24	Yes	No	No	No	No	No	1
132	37977	Midnight Creek	16	Graham	9.63	T4.0S,R27.0E,S10	Yes	No	No	No	No	No	1
133	38019	Moonshine Creek	1	Graham	1.36	T9.0S,R24.0E,S05	No	No	No	Yes	No	No	1
134	38055	Natural Corral Creek	6	Gila/Graham	7.74	T1.0N,R18.0E,S25	No	No	No	Yes	No	No	1
135	38065	Ninemile Creek	11	Graham	10.15	T2.0S,R23.0E,S01	Yes	No	No	No	No	No	1

NOTES: **The column headings are defined as follows:**

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W_NAME: Name of the watercourse.
SEGCOUNT: Number of segments merged together to comprise the watercourse.
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W_MILES: Length of the watercourse in miles.
W_ADDRESS: Township, Range and Section of the mouth of the watercourse. [S88 - No designated Township, Range, and Section].
W_PER: Stream classification-perennial or not.
W_MBOAT: With modern boating or not.
W_HBOAT: With historical boating or not.
W_FISH: With fish or not.
W_DIMP: Impacted by dam or not.
W_SSTATUS: With special status designations or not.
HITS: Number of affirmative hits based on the six attribute data.

Table A-1B
Watercourses in Graham County Not Rejected at Level 1

No. (1)	W_ID (2)	W_NAME (3)	SEGCOUNT (4)	W_COUNTIES (5)	W_MILES (6)	W_ADDRESS (7)	W_PER (8)	W_MBOAT (9)	W_HBOAT (10)	W_FISH (11)	W_SSTATUS (12)	W_DIMP (13)	HITS (14)
136	38183	Paymaster Wash	8	Graham	7.70	T3.0S,R25.0E,S05	Yes	No	No	No	No	No	1
137	38189	Peck Wash	13	Graham	13.78	T6.0S,R25.0E,S07	No	No	No	No	No	Yes	1
138	38267	Post Creek	3	Graham	2.63	T9.0S,R24.0E,S05	No	No	No	Yes	No	No	1
139	38399	Salt Creek - Graham	28	Graham	42.45	T3.0S,R20.0E,S05	No	No	No	Yes	No	No	1
140	38417	San Simon River	100	Cochise/Graham	78.23	T13.0S,R31.0E,S32	No	No	No	No	No	Yes	1
141	38465	Sevenmile Creek	11	Graham	8.21	T2.0S,R24.0E,S26	Yes	No	No	No	No	No	1
142	38542	Soldier Creek - Graham	2	Graham	2.03	T8.0S,R24.0E,S32	No	No	No	Yes	No	No	1
143	38556	South Fork Ask Creek 2	17	Graham	15.70	T2.0S,R24.0E,S21	Yes	No	No	No	No	No	1
144	38602	Squaw Creek 1 - Graham	11	Graham	7.64	T2.0N,R24.0E,S31	Yes	No	No	No	No	No	1
145	38844	Watson Wash	3	Graham	10.04	T6.0S,R25.0E,S27	Yes	No	No	No	No	Yes	1
146	38923	Willow Creek 1	72	Graham/Greenlee	29.56	T1.0S,R28.0E,S18	Yes	No	No	No	No	No	1

NOTES: **The column headings are defined as follows:**

W_ID: Unique ID number given to the watercourse.
W_NAME: Name of the watercourse.
SEGCOUNT: Number of segments merged together to comprise the watercourse.
W_COUNTIES: County(ies) where the watercourse is located.
W_MILES: Length of the watercourse in miles.
W_ADDRESS: Township, Range and Section of the mouth of the watercourse. [S88 - No designated Township, Range, and Section].
W_PER: Stream classification-perennial or not.
W_MBOAT: With modern boating or not.
W_HBOAT: With historical boating or not.
W_FISH: With fish or not.
W_DIMP: Impacted by dam or not.
W_SSTATUS: With special status designations or not.
HITS: Number of affirmative hits based on the six attribute data.

Table A-2A
Watercourses in Graham County Rejected at Level 2

NO (1)	W_ID (2)	W_NAME (3)	SEGCOUNT (4)	W_COUNTIES (5)	W_MILES (6)	W_ADDRESS (7)	L1_PER (8)	L2_PER (9)	L2_MBOAT (10)	L2_HBOAT (11)	L2_DIMP (12)	L2_FISH (13)	L2_SSTATUS (14)	NEW_RAT (15)
1	78	Ash Creek 1 - Graham	16	Graham	19.34	T7.0S,R24.0E,S13	Yes	Yes	No	No	No	Yes	No	11.00
2	849	Grant Creek - Graham	16	Graham	12.75	T9.0S,R24.0E,S19	Yes	Yes	No	No	No	Yes	No	11.00
3	37925	Marijilda Wash	22	Graham	14.96	T7.0S,R26.0E,S34	Yes	Yes	No	No	No	Yes	No	11.00
4	38326	Redfield Canyon	22	ochise/Graham/Pima	24.30	T12.0S,R18.0E,S02	Yes	Yes	No	No	No	Yes	Yes	10.88
5	38642	Swamp Springs Canyon	4	Cochise/Graham	5.70	T11.0S,R20.0E,S32	Yes	Yes	No	No	No	Yes	Yes	10.88
6	807	Frye Creek	8	Graham	15.73	T8.0S,R24.0E,S13	Yes	Yes	No	No	Yes	Yes	No	10.50
7	19016	H43_1999	2	Graham	1.31	T7.0S,R24.0E,S23	Yes	Yes	No	No	Yes	No	No	7.50
8	38019	Moonshine Creek	1	Graham	1.36	T9.0S,R24.0E,S05	No	M	No	No	No	Yes	No	7.50
9	38251	Point of Pines Creek	32	Graham	21.42	T1.0N,R25.0E,S36	Yes	Yes	No	No	Yes	No	No	7.50
10	38267	Post Creek	3	Graham	2.63	T9.0S,R24.0E,S05	No	M	No	No	No	Yes	No	7.50
11	38623	Stockton Wash	47	Graham	32.69	T7.0S,R26.0E,S09	Yes	Yes	No	No	Yes	No	No	7.50
12	38844	Watson Wash	3	Graham	10.04	T6.0S,R25.0E,S27	Yes	Yes	No	No	Yes	No	No	7.50
13	18553	H43_1532	2	Graham	0.48	T1.0S,R28.0E,S19	Yes	Yes	No	No	No	No	No	7.00
14	37926	Markham Creek	8	Graham	11.75	T6.0S,R24.0E,S04	No	No	No	No	Yes	Yes	No	7.00
15	151	Bear Wallow Creek	5	Graham/Greenlee	5.90	T3.0N,R27.0E,S03	Yes	Yes	No	No	No	Yes	No	6.50
16	38542	Soldier Creek - Graham	2	Graham	2.03	T8.0S,R24.0E,S32	No	Yes	No	No	No	Yes	No	6.50
17	132	Bass Canyon	1	Cochise/Graham	6.18	T12.0S,R21.0E,S08	No	No	No	No	No	Yes	Yes	4.76
18	199	Billingsley Creek	2	Graham	6.18	T6.0S,R24.0E,S02	No	No	No	No	Yes	No	No	4.00
19	17631	H43_0448	1	Graham	0.13	T6.0S,R24.0E,S36	No	No	No	No	Yes	No	No	4.00
20	17687	H43_0551	1	Graham	1.30	T7.0S,R26.0E,S26	No	No	No	No	Yes	No	No	4.00
21	17689	H43_0554	1	Graham	1.46	T7.0S,R26.0E,S27	No	No	No	No	Yes	No	No	4.00
22	17692	H43_0557	1	Graham	7.44	T7.0S,R27.0E,S20	No	No	No	No	Yes	No	No	4.00
23	17693	H43_0559	1	Graham	2.53	T7.0S,R26.0E,S26	No	No	No	No	Yes	No	No	4.00
24	17777	H43_0703	1	Graham	0.36	T6.0S,R24.0E,S36	No	No	No	No	Yes	No	No	4.00
25	17995	H43_0954	2	Graham	1.13	T5.0S,R25.0E,S11	No	No	No	No	Yes	No	No	4.00
26	18020	H43_0979	11	Graham	13.03	T7.0S,R26.0E,S08	No	No	No	No	Yes	No	No	4.00
27	18030	H43_0989	1	Graham	7.96	T7.0S,R25.0E,S14	No	No	No	No	Yes	No	No	4.00
28	18031	H43_0990	1	Graham	0.32	T7.0S,R25.0E,S24	No	No	No	No	Yes	No	No	4.00
29	18889	H43_1871	2	Graham	1.01	T4.0S,R25.0E,S12	No	No	No	No	Yes	No	No	4.00
30	18891	H43_1873	2	Graham	1.72	T4.0S,R25.0E,S13	No	No	No	No	Yes	No	No	4.00
31	18892	H43_1874	1	Graham	2.75	T4.0S,R25.0E,S13	No	No	No	No	Yes	No	No	4.00
32	19024	H43_2008	2	Graham	5.85	T7.0S,R25.0E,S04	No	No	No	No	Yes	No	No	4.00
33	19025	H43_2009	2	Graham	4.00	T7.0S,R25.0E,S04	No	No	No	No	Yes	No	No	4.00
34	35523	H81_0014	2	Graham	1.82	T8.0S,R23.0E,S34	No	No	No	No	Yes	No	No	4.00
35	38055	Natural Corral Creek	6	Gila/Graham	7.74	T1.0N,R18.0E,S25	No	No	No	No	No	Yes	No	4.00
36	38189	Peck Wash	13	Graham	13.78	T6.0S,R25.0E,S07	No	No	No	No	Yes	No	No	4.00
37	38417	San Simon River	100	Cochise/Graham	78.23	T13.0S,R31.0E,S32	No	No	No	No	Yes	No	No	4.00
38	196	Bigler Wash	4	Graham	8.33	T6.0S,R24.0E,S09	Yes	Yes	No	No	No	No	No	3.50
39	257	Bobcat Creek	13	Graham	8.94	T2.0N,R24.0E,S34	Yes	Yes	No	No	No	No	No	3.50
40	305	Brushy Creek - Graham	9	Graham	6.93	T3.0S,R28.0E,S08	Yes	Yes	No	No	No	No	No	3.50
41	341	Burton Wash	2	Graham	7.87	T4.0S,R23.0E,S26	Yes	Yes	No	No	No	No	No	3.50
42	468	Cienega Creek - Graham	37	Graham	22.06	T2.0S,R27.0E,S24	Yes	Yes	No	No	No	No	No	3.50
43	744	Elwood Canyon Creek	6	Graham	6.64	T3.0N,R23.0E,S35	Yes	Yes	No	No	No	No	No	3.50
44	799	Freezeout Creek	19	Graham	12.44	T2.0N,R25.0E,S27	Yes	Yes	No	No	No	No	No	3.50
45	840	Goudy Canyon Wash	8	Graham	9.62	T9.0S,R23.0E,S34	Yes	Yes	No	No	No	No	No	3.50

NOTES: The column headings are identified as follows:

W_ID: Unique ID number given to the watercourse.
W_NAME: Name of the watercourse.
SEGCOUNT: Number of segments merged together to comprise the watercouse.
W_COUNTIES: County(ies) where the watercourse is located.
W_MILES: Length of the watercourse in miles.
W_ADDRESS: Township, Range and Section of the mouth of the watercourse.
L1_PER: Level 1 stream classification - perennial or not. The classification is provided by ALRIS (1999) and Arizona State Parks (1995).
L2_PER: Level 2 stream classification; M designation means that the stream is classified as perennial and non-perennial by the two data sources.
L2_MBOAT: With or without modern boating account.
L2_HBOAT: With or without historical boating account.
L2_DIMP: Dam-impacted or not.
L2_FISH: With fish or not.
L2_SSTATUS: With special status designations or not.
NEW_RAT Computed total rating of the watercourse based on the evaluated weights.

Table A-2A
Watercourses in Graham County Rejected at Level 2

NO (1)	W_ID (2)	W_NAME (3)	SEGCOUNT (4)	W_COUNTIES (5)	W_MILES (6)	W_ADDRESS (7)	L1_PER (8)	L2_PER (9)	L2_MBOAT (10)	L2_HBOAT (11)	L2_DIMP (12)	L2_FISH (13)	L2_SSTATUS (14)	NEW_RAT (15)
46	15653	H39_0481	1	Gila/Graham	1.10	T1.0S,R19.0E,S07	Yes	Yes	No	No	No	No	No	3.50
47	15798	H39_0628	1	Gila/Graham	0.88	T1.0S,R19.0E,S19	Yes	Yes	No	No	No	No	No	3.50
48	15801	H39_0631	3	Graham	1.24	T1.0S,R19.0E,S31	Yes	Yes	No	No	No	No	No	3.50
49	17456	H43_0127	1	Graham/Greenlee	0.36	T1.0S,R28.0E,S05	Yes	Yes	No	No	No	No	No	3.50
50	17476	H43_0160	1	Graham	0.13	T2.0S,R28.0E,S05	Yes	Yes	No	No	No	No	No	3.50
51	17479	H43_0164	1	Graham	0.48	T2.0S,R28.0E,S08	Yes	Yes	No	No	No	No	No	3.50
52	17533	H43_0273	1	Graham	0.09	T3.0S,R21.0E,S13	Yes	Yes	No	No	No	No	No	3.50
53	17544	H43_0303	1	Graham	0.05	T4.0S,R22.0E,S11	Yes	Yes	No	No	No	No	No	3.50
54	17545	H43_0304	1	Graham	0.21	T4.0S,R22.0E,S11	Yes	Yes	No	No	No	No	No	3.50
55	17550	H43_0312	1	Graham	0.04	T4.0S,R23.0E,S21	Yes	Yes	No	No	No	No	No	3.50
56	17559	H43_0328	1	Graham	0.85	T4.0S,R23.0E,S29	Yes	Yes	No	No	No	No	No	3.50
57	17563	H43_0333	1	Graham	1.90	T5.0S,R23.0E,S02	Yes	Yes	No	No	No	No	No	3.50
58	17568	H43_0341	2	Graham	0.94	T5.0S,R24.0E,S07	Yes	Yes	No	No	No	No	No	3.50
59	17581	H43_0359	1	Graham	0.04	T5.0S,R23.0E,S24	Yes	Yes	No	No	No	No	No	3.50
60	17582	H43_0361	1	Graham	0.17	T5.0S,R23.0E,S24	Yes	Yes	No	No	No	No	No	3.50
61	17616	H43_0418	1	Graham	0.75	T6.0S,R24.0E,S21	Yes	Yes	No	No	No	No	No	3.50
62	17623	H43_0431	1	Graham	0.16	T6.0S,R28.0E,S30	Yes	Yes	No	No	No	No	No	3.50
63	17641	H43_0468	1	Graham	0.22	T7.0S,R23.0E,S01	Yes	Yes	No	No	No	No	No	3.50
64	17642	H43_0469	2	Graham	0.25	T7.0S,R23.0E,S01	Yes	Yes	No	No	No	No	No	3.50
65	17643	H43_0470	2	Graham	3.64	T6.0S,R24.0E,S29	Yes	Yes	No	No	No	No	No	3.50
66	17843	H43_0796	1	Graham	0.61	T3.0S,R21.0E,S14	Yes	Yes	No	No	No	No	No	3.50
67	17844	H43_0797	1	Graham	0.53	T3.0S,R21.0E,S14	Yes	Yes	No	No	No	No	No	3.50
68	17855	H43_0808	2	Graham	1.10	T4.0S,R22.0E,S03	Yes	Yes	No	No	No	No	No	3.50
69	17856	H43_0809	2	Graham	0.39	T4.0S,R22.0E,S10	Yes	Yes	No	No	No	No	No	3.50
70	17858	H43_0811	1	Graham	0.19	T4.0S,R22.0E,S03	Yes	Yes	No	No	No	No	No	3.50
71	17918	H43_0874	1	Graham	0.19	T4.0S,R23.0E,S27	Yes	Yes	No	No	No	No	No	3.50
72	17919	H43_0875	1	Graham	0.03	T4.0S,R23.0E,S27	Yes	Yes	No	No	No	No	No	3.50
73	18033	H43_0992	1	Graham	0.80	T8.0S,R25.0E,S03	Yes	Yes	No	No	No	No	No	3.50
74	18034	H43_0993	1	Graham	0.65	T8.0S,R25.0E,S03	Yes	Yes	No	No	No	No	No	3.50
75	18048	H43_1007	1	Graham	0.12	T8.0S,R25.0E,S19	Yes	Yes	No	No	No	No	No	3.50
76	18049	H43_1008	1	Graham	0.03	T8.0S,R25.0E,S17	Yes	Yes	No	No	No	No	No	3.50
77	18065	H43_1024	1	Graham	0.62	T8.0S,R25.0E,S23	Yes	Yes	No	No	No	No	No	3.50
78	18078	H43_1039	2	Graham	1.15	T9.0S,R24.0E,S12	Yes	Yes	No	No	No	No	No	3.50
79	18205	H43_1170	2	Graham	0.28	T7.0S,R27.0E,S18	Yes	Yes	No	No	No	No	No	3.50
80	18206	H43_1171	1	Graham	0.37	T7.0S,R27.0E,S18	Yes	Yes	No	No	No	No	No	3.50
81	18207	H43_1172	1	Graham	0.12	T7.0S,R27.0E,S18	Yes	Yes	No	No	No	No	No	3.50
82	18488	H43_1461	1	Graham	0.08	T1.0N,R25.0E,S23	Yes	M	No	No	No	No	No	3.50
83	18489	H43_1462	1	Graham	0.06	T1.0N,R25.0E,S25	Yes	Yes	No	No	No	No	No	3.50
84	18554	H43_1533	2	Graham	3.52	T1.0S,R28.0E,S19	Yes	M	No	No	No	No	No	3.50
85	18615	H43_1595	3	Graham	1.75	T2.0S,R27.0E,S15	Yes	Yes	No	No	No	No	No	3.50
86	18616	H43_1596	2	Graham	2.49	T2.0S,R27.0E,S16	Yes	Yes	No	No	No	No	No	3.50
87	18629	H43_1609	1	Graham	0.07	T3.0S,R28.0E,S17	Yes	Yes	No	No	No	No	No	3.50
88	18966	H43_1949	2	Graham	1.16	T7.0S,R27.0E,S09	Yes	Yes	No	No	No	No	No	3.50
89	18968	H43_1951	1	Graham	0.32	T7.0S,R26.0E,S09	Yes	Yes	No	No	No	No	No	3.50
90	18971	H43_1954	1	Graham	0.08	T7.0S,R24.0E,S03	Yes	Yes	No	No	No	No	No	3.50

NOTES: The column headings are identified as follows:

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SEGCOUNT: Number of segments merged together to comprise the watercourse.
W_COUNTIES: County(ies) where the watercourse is located.
W_MILES: Length of the watercourse in miles.
W_ADDRESS: Township, Range and Section of the mouth of the watercourse.
L1_PER: Level 1 stream classification - perennial or not. The classification is provided by ALRIS (1999) and Arizona State Parks (1995).
L2_PER: Level 2 stream classification; M designation means that the stream is classified as perennial and non-perennial by the two data sources.
L2_MBOAT: With or without modern boating account.
L2_HBOAT: With or without historical boating account.
L2_DIMP: Dam-impacted or not.
L2_FISH: With fish or not.
L2_SSTATUS: With special status designations or not.
NEW_RAT Computed total rating of the watercourse based on the evaluated weights.

Table A-2A
Watercourses in Graham County Rejected at Level 2

NO	W_ID	W_NAME	SEGCOUNT	W_COUNTIES	W_MILES	W_ADDRESS	L1_PER	L2_PER	L2_MBOAT	L2_HBOAT	L2_DIMP	L2_FISH	L2_SSTATUS	NEW_RAT
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
91	18972	H43_1955	9	Graham	9.56	T7.0S,R24.0E,S08	Yes	M	No	No	No	No	No	3.50
92	19004	H43_1987	2	Graham	0.82	T8.0S,R24.0E,S07	Yes	Yes	No	No	No	No	No	3.50
93	19020	H43_2003	1	Graham	1.58	T7.0S,R24.0E,S35	Yes	Yes	No	No	No	No	No	3.50
94	19021	H43_2004	2	Graham	0.56	T7.0S,R24.0E,S24	Yes	Yes	No	No	No	No	No	3.50
95	19022	H43_2005	1	Graham	0.19	T7.0S,R24.0E,S24	Yes	Yes	No	No	No	No	No	3.50
96	19023	H43_2006	1	Graham	0.08	T7.0S,R24.0E,S14	Yes	Yes	No	No	No	No	No	3.50
97	19035	H43_2020	1	Graham	0.26	T6.0S,R24.0E,S09	Yes	Yes	No	No	No	No	No	3.50
98	19105	H43_2091	3	Graham	3.38	T5.0S,R23.0E,S02	Yes	Yes	No	No	No	No	No	3.50
99	19113	H43_2100	1	Graham	0.40	T4.0S,R22.0E,S12	Yes	Yes	No	No	No	No	No	3.50
100	19114	H43_2101	4	Graham	1.07	T4.0S,R22.0E,S11	Yes	Yes	No	No	No	No	No	3.50
101	19116	H43_2103	1	Graham	0.22	T4.0S,R22.0E,S11	Yes	Yes	No	No	No	No	No	3.50
102	19117	H43_2104	1	Graham	0.23	T4.0S,R22.0E,S11	Yes	Yes	No	No	No	No	No	3.50
103	19122	H43_2109	4	Graham	7.51	T3.0S,R23.0E,S19	Yes	Yes	No	No	No	No	No	3.50
104	19126	H43_2113	2	Graham	1.76	T2.0S,R23.0E,S28	Yes	Yes	No	No	No	No	No	3.50
105	19127	H43_2114	2	Graham	2.23	T2.0S,R23.0E,S27	Yes	Yes	No	No	No	No	No	3.50
106	19129	H43_2116	3	Graham	0.44	T4.0S,R22.0E,S11	Yes	Yes	No	No	No	No	No	3.50
107	19131	H43_2118	1	Graham	0.68	T3.0S,R22.0E,S33	Yes	Yes	No	No	No	No	No	3.50
108	19146	H43_2136	2	Graham	0.88	T3.0S,R22.0E,S19	Yes	Yes	No	No	No	No	No	3.50
109	19148	H43_2138	1	Graham	0.33	T3.0S,R21.0E,S13	Yes	Yes	No	No	No	No	No	3.50
110	19149	H43_2139	2	Graham	0.41	T3.0S,R21.0E,S13	Yes	Yes	No	No	No	No	No	3.50
111	19150	H43_2140	1	Graham	0.37	T3.0S,R21.0E,S13	Yes	Yes	No	No	No	No	No	3.50
112	19151	H43_2141	6	Graham	4.99	T3.0S,R21.0E,S11	Yes	Yes	No	No	No	No	No	3.50
113	19152	H43_2142	1	Graham	0.18	T3.0S,R21.0E,S12	Yes	Yes	No	No	No	No	No	3.50
114	19155	H43_2146	1	Graham	0.13	T3.0S,R22.0E,S20	Yes	Yes	No	No	No	No	No	3.50
115	19168	H43_2160	1	Graham	0.26	T3.0S,R21.0E,S10	Yes	Yes	No	No	No	No	No	3.50
116	19175	H43_2167	2	Graham	0.33	T3.0S,R21.0E,S09	Yes	Yes	No	No	No	No	No	3.50
117	19176	H43_2168	2	Graham	0.79	T3.0S,R21.0E,S09	Yes	Yes	No	No	No	No	No	3.50
118	19177	H43_2169	5	Graham	1.60	T3.0S,R21.0E,S09	Yes	Yes	No	No	No	No	No	3.50
119	19178	H43_2170	1	Graham	0.07	T3.0S,R21.0E,S10	Yes	Yes	No	No	No	No	No	3.50
120	19180	H43_2172	2	Graham	1.03	T3.0S,R21.0E,S08	Yes	Yes	No	No	No	No	No	3.50
121	19196	H43_2188	1	Graham	0.17	T3.0S,R20.0E,S01	Yes	Yes	No	No	No	No	No	3.50
122	19201	H43_2193	1	Graham	0.63	T3.0S,R20.0E,S01	Yes	Yes	No	No	No	No	No	3.50
123	19353	H43_2346	1	Graham	0.32	T4.0S,R23.0E,S27	Yes	Yes	No	No	No	No	No	3.50
124	20168	H46_0623	1	Graham	1.83	T11.0S,R28.0E,S01	Yes	Yes	No	No	No	No	No	3.50
125	35588	H81_0091	1	Graham	0.80	T10.0S,R24.0E,S04	Yes	Yes	No	No	No	No	No	3.50
126	35596	H81_0099	1	Graham	0.65	T10.0S,R24.0E,S04	Yes	Yes	No	No	No	No	No	3.50
127	37605	Hackberry Creek - Graham	19	Graham	15.32	T1.0S,R19.0E,S07	Yes	Yes	No	No	No	No	No	3.50
128	37694	Hot Well Draw	38	Graham	27.88	T11.0S,R29.0E,S09	Yes	Yes	No	No	No	No	No	3.50
129	37887	Long Creek	9	Graham	10.66	T3.0S,R21.0E,S24	Yes	Yes	No	No	No	No	No	3.50
130	37977	Midnight Creek	16	Graham	9.63	T4.0S,R27.0E,S10	Yes	Yes	No	No	No	No	No	3.50
131	38065	Ninemile Creek	11	Graham	10.15	T2.0S,R23.0E,S01	Yes	Yes	No	No	No	No	No	3.50
132	38183	Paymaster Wash	8	Graham	7.70	T3.0S,R25.0E,S05	Yes	Yes	No	No	No	No	No	3.50
133	38465	Sevenmile Creek	11	Graham	8.21	T2.0S,R24.0E,S26	Yes	Yes	No	No	No	No	No	3.50
134	38556	South Fork Ask Creek 2	17	Graham	15.70	T2.0S,R24.0E,S21	Yes	Yes	No	No	No	No	No	3.50
135	38602	Squaw Creek 1 - Graham	11	Graham	7.64	T2.0N,R24.0E,S31	Yes	Yes	No	No	No	No	No	3.50

NOTES: The column headings are identified as follows:

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W_NAME: Name of the watercourse.
SEGCOUNT: Number of segments merged together to comprise the watercouse.
W_COUNTIES: County(ies) where the watercourse is located.
W_MILES: Length of the watercourse in miles.
W_ADDRESS: Township, Range and Section of the mouth of the watercourse.
L1_PER: Level 1 stream classification - perennial or not. The classification is provided by ALRIS (1999) and Arizona State Parks (1995).
L2_PER: Level 2 stream classification; M designation means that the stream is classified as perennial and non-perennial by the two data sources.
L2_MBOAT: With or without modern boating account.
L2_HBOAT: With or without historical boating account.
L2_DIMP: Dam-impacted or not.
L2_FISH: With fish or not.
L2_SSTATUS: With special status designations or not.
NEW_RAT Computed total rating of the watercourse based on the evaluated weights.

Table A-2A
Watercourses in Graham County Rejected at Level 2

NO (1)	W_ID (2)	W_NAME (3)	SEGCOUNT (4)	W_COUNTIES (5)	W_MILES (6)	W_ADDRESS (7)	L1_PER (8)	L2_PER (9)	L2_MBOAT (10)	L2_HBOAT (11)	L2_DIMP (12)	L2_FISH (13)	L2_SSTATUS (14)	NEW_RAT (15)
136	38602	Squaw Creek 1 - Graham	11	Graham	7.64	T2.0N,R24.0E,S31	Yes	Yes	No	No	No	No	No	3.50
137	38781	Turkey Creek 2 - Graham	5	Graham	9.70	T6.0S,R19.0E,S19	Yes	Yes	No	No	No	No	No	3.50
138	696	Dry Prong Creek	18	Graham/Greenlee	14.38	T2.0N,R27.0E,S14	No	No	No	No	No	Yes	No	3.00
139	825	Gibson Creek - Graham	4	Graham	3.77	T8.0S,R25.0E,S32	No	No	No	No	No	Yes	No	3.00
140	38399	Salt Creek - Graham	28	Graham	42.45	T3.0S,R20.0E,S05	No	No	No	No	No	Yes	No	3.00
141	33347	H77_1461	1	Graham	3.33	T5.0S,R19.0E,S09	No	No	No	No	No	No	No	0.00

NOTES: The column headings are identified as follows:

W_ID: Unique ID number given to the watercourse.
W_NAME: Name of the watercourse.
SEGCOUNT: Number of segments merged together to comprise the watercouse.
W_COUNTIES: County(ies) where the watercourse is located.
W_MILES: Length of the watercourse in miles.
W_ADDRESS: Township, Range and Section of the mouth of the watercourse.
L1_PER: Level 1 stream classification - perennial or not. The classification is provided by ALRIS (1999) and Arizona State Parks (1995).
L2_PER: Level 2 stream classification; M designation means that the stream is classified as perennial and non-perennial by the two data sources.
L2_MBOAT: With or without modern boating account.
L2_HBOAT: With or without historical boating account.
L2_DIMP: Dam-impacted or not.
L2_FISH: With fish or not.
L2_SSTATUS: With special status designations or not.
NEW_RAT Computed total rating of the watercourse based on the evaluated weighls.

Table A-2B
Watercourses in Graham County Not Rejected at Level 2

NO. (1)	W_ID (2)	W_NAME (3)	SEGCOUNT (4)	W_COUNTIES (5)	W_MILES (6)	W_ADDRESS (7)	L1_PER (8)	L2_PER (9)	L2_MBOAT (10)	L2_HBOAT (11)	L2_DIMP (12)	L2_FISH (13)	L2_SSTATUS (14)	NEW_RAT (15)
1	226	Black River	97	Apache/Gila/Graham/Greenlee/Navajo	122	T3.0N,R23.0E,S28	Yes	Yes	Yes	No	No	Yes	Yes	19.26
2	706	Eagle Creek	159	Graham/Greenlee	64	T1.0N,R28.0E,S31	Yes	Yes	Yes	No	No	Yes	Yes	19.12
3	38409	San Carlos River	56	Gila/Graham	49	T1.0N,R21.0E,S08	Yes	Yes	No	No	Yes	Yes	No	15.00
4	61	Aravaipa Creek	90	Graham/Pinal	63	T6.0S,R19.0E,S19	Yes	Yes	No	No	No	Yes	Yes	12.88
5	267	Bonita Creek - Graham	100	Graham	53	T6.0S,R28.0E,S21	Yes	Yes	No	No	No	Yes	Yes	12.12

NOTES: The column headings are identified as follows:

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W_NAME: Name of the watercourse.
SEGCOUNT: Number of segments merged together to comprise the watercouse.
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W_MILES: Length of the watercourse in miles.
W_ADDRESS: Township, Range and Section of the mouth of the watercourse.
L1_PER: Level 1 stream classification - perennial or not. The classification is provided by ALRIS (1999) and Arizona State Parks (1995).
L2_PER: Level 2 stream classification; M designation means that the stream is classified as perennial and non-perennial by the two data sources.
L2_MBOAT: With or without modern boating account.
L2_HBOAT: With or without historical boating account.
L2_DIMP: Dam-impacted or not.
L2_FISH: With fish or not.
L2_SSTATUS: With special status designations or not.
NEW_RAT Computed total rating of the watercourse based on the evaluated weights.

Table A-2C
Watercourses in Gila County with Evaluated Ratings at Level 2

No.	W_ID	W_NAME	SEGCOUNT	W_COUNTIES	W_MILES	PER_RAT	HBOAT_RAT	MBOAT_RAT	DIMP_RAT	FISH_RAT	SS_RAT	TOT_RAT	REF_RAT
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
1	226	Black River	97	Apache/Gila/Graham/Greenlee/Navajo	121.77	1.0	0.0	1.0	0.0	1.00	0.130	3.13	19.26
2	706	Eagle Creek	159	Graham/Greenlee	63.99	1.0	0.0	1.0	0.0	1.00	0.060	3.06	19.12
3	38409	San Carlos River	56	Gila/Graham	49.15	1.0	0.0	0.0	1.0	1.00	0.000	3.00	15.00
4	61	Aravaipa Creek	90	Graham/Pinal	62.50	1.0	0.0	0.0	0.0	1.00	0.940	2.94	12.88
5	267	Bonita Creek - Graham	100	Graham	52.85	1.0	0.0	0.0	0.0	1.00	0.560	2.56	12.12
6	78	Ash Creek 1 - Graham	16	Graham	19.34	1.0	0.0	0.0	0.0	1.00	0.000	2.00	11.00
7	849	Grant Creek - Graham	16	Graham	12.75	1.0	0.0	0.0	0.0	1.00	0.000	2.00	11.00
8	37925	Marijilda Wash	22	Graham	14.96	1.0	0.0	0.0	0.0	1.00	0.000	2.00	11.00
9	38326	Redfield Canyon	22	Cochise/Graham/Pima	24.30	1.0	0.0	0.0	0.0	0.75	0.440	2.19	10.88
10	38642	Swamp Springs Canyon	4	Cochise/Graham	5.70	1.0	0.0	0.0	0.0	0.75	0.440	2.19	10.88
11	807	Frye Creek	8	Graham	15.73	0.5	0.0	0.0	1.0	0.75	0.000	2.25	10.50
12	19016	H43_1999	2	Graham	1.31	0.5	0.0	0.0	1.0	0.00	0.000	1.50	7.50
13	38019	Moonshine Creek	1	Graham	1.36	0.5	0.0	0.0	0.0	1.00	0.000	1.50	7.50
14	38251	Point of Pines Creek	32	Graham	21.42	0.5	0.0	0.0	1.0	0.00	0.000	1.50	7.50
15	38267	Post Creek	3	Graham	2.63	0.5	0.0	0.0	0.0	1.00	0.000	1.50	7.50
16	38623	Stockton Wash	47	Graham	32.69	0.5	0.0	0.0	1.0	0.00	0.000	1.50	7.50
17	38844	Watson Wash	3	Graham	10.04	0.5	0.0	0.0	1.0	0.00	0.000	1.50	7.50
18	37926	Markham Creek	8	Graham	11.75	0.0	0.0	0.0	1.0	0.75	0.000	1.75	7.00
19	151	Bear Wallow Creek	5	Graham/Greenlee	5.90	0.5	0.0	0.0	0.0	0.75	0.000	1.25	6.50
20	38542	Soldier Creek - Graham	2	Graham	2.03	0.5	0.0	0.0	0.0	0.75	0.000	1.25	6.50
21	132	Bass Canyon	1	Cochise/Graham	6.18	0.0	0.0	0.0	0.0	0.75	0.880	1.63	4.76
22	199	Billingsley Creek	2	Graham	6.18	0.0	0.0	0.0	1.0	0.00	0.000	1.00	4.00
23	17631	H43_0448	1	Graham	0.13	0.0	0.0	0.0	1.0	0.00	0.000	1.00	4.00
24	17687	H43_0551	1	Graham	1.30	0.0	0.0	0.0	1.0	0.00	0.000	1.00	4.00
25	17689	H43_0554	1	Graham	1.46	0.0	0.0	0.0	1.0	0.00	0.000	1.00	4.00
26	17692	H43_0557	1	Graham	7.44	0.0	0.0	0.0	1.0	0.00	0.000	1.00	4.00
27	17693	H43_0559	1	Graham	2.53	0.0	0.0	0.0	1.0	0.00	0.000	1.00	4.00
28	17777	H43_0703	1	Graham	0.36	0.0	0.0	0.0	1.0	0.00	0.000	1.00	4.00
29	17995	H43_0954	2	Graham	1.13	0.0	0.0	0.0	1.0	0.00	0.000	1.00	4.00
30	18020	H43_0979	11	Graham	13.03	0.0	0.0	0.0	1.0	0.00	0.000	1.00	4.00
31	18030	H43_0989	1	Graham	7.96	0.0	0.0	0.0	1.0	0.00	0.000	1.00	4.00
32	18031	H43_0990	1	Graham	0.32	0.0	0.0	0.0	1.0	0.00	0.000	1.00	4.00
33	18889	H43_1871	2	Graham	1.01	0.0	0.0	0.0	1.0	0.00	0.000	1.00	4.00
34	18891	H43_1873	2	Graham	1.72	0.0	0.0	0.0	1.0	0.00	0.000	1.00	4.00
35	18892	H43_1874	1	Graham	2.75	0.0	0.0	0.0	1.0	0.00	0.000	1.00	4.00
36	19024	H43_2008	2	Graham	5.85	0.0	0.0	0.0	1.0	0.00	0.000	1.00	4.00
37	19025	H43_2009	2	Graham	4.00	0.0	0.0	0.0	1.0	0.00	0.000	1.00	4.00
38	35523	H81_0014	2	Graham	1.82	0.0	0.0	0.0	1.0	0.00	0.000	1.00	4.00
39	38055	Natural Corral Creek	6	Gila/Graham	7.74	0.0	0.0	0.0	0.0	1.00	0.000	1.00	4.00
40	38189	Peck Wash	13	Graham	13.78	0.0	0.0	0.0	1.0	0.00	0.000	1.00	4.00
41	38417	San Simon River	100	Cochise/Graham	78.23	0.0	0.0	0.0	1.0	0.00	0.000	1.00	4.00
42	196	Bigler Wash	4	Graham	8.33	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50
43	257	Bobcat Creek	13	Graham	8.94	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50
44	305	Brushy Creek - Graham	9	Graham	6.93	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50
45	341	Burton Wash	2	Graham	7.87	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50

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FISH_RAT: Fish rating evaluated for the watercourse.
SS_RAT: Special status rating evaluated for the watercourse.
TOT_RAT: Total rating evaluated for the watercourse which is the sum of the six ratings.
REF_RAT: Refined total rating evaluated for the watercourse considering the numerical weights assigned to the six criteria.

Table A-2C
Watercourses in Gila County with Evaluated Ratings at Level 2

No.	W_ID	W_NAME	SEGCOUNT	W_COUNTIES	W_MILES	PER_RAT	HBOAT_RAT	MBOAT_RAT	DIMP_RAT	FISH_RAT	SS_RAT	TOT_RAT	REF_RAT
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
46	468	Cienega Creek - Graham	37	Graham	22.06	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50
47	744	Elwood Canyon Creek	6	Graham	6.64	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50
48	799	Freezeout Creek	19	Graham	12.44	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50
49	840	Goudy Canyon Wash	8	Graham	9.62	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50
50	15653	H39_0481	1	Gila/Graham	1.10	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50
51	15798	H39_0628	1	Gila/Graham	0.88	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50
52	15801	H39_0631	3	Graham	1.24	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50
53	17456	H43_0127	1	Graham/Greenlee	0.36	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50
54	17476	H43_0160	1	Graham	0.13	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50
55	17479	H43_0164	1	Graham	0.48	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50
56	17533	H43_0273	1	Graham	0.09	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50
57	17544	H43_0303	1	Graham	0.05	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50
58	17545	H43_0304	1	Graham	0.21	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50
59	17550	H43_0312	1	Graham	0.04	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50
60	17559	H43_0328	1	Graham	0.85	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50
61	17563	H43_0333	1	Graham	1.90	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50
62	17568	H43_0341	2	Graham	0.94	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50
63	17581	H43_0359	1	Graham	0.04	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50
64	17582	H43_0361	1	Graham	0.17	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50
65	17616	H43_0418	1	Graham	0.75	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50
66	17623	H43_0431	1	Graham	0.16	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50
67	17641	H43_0468	1	Graham	0.22	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50
68	17642	H43_0469	2	Graham	0.25	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50
69	17643	H43_0470	2	Graham	3.64	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50
70	17843	H43_0796	1	Graham	0.61	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50
71	17844	H43_0797	1	Graham	0.53	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50
72	17855	H43_0808	2	Graham	1.10	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50
73	17856	H43_0809	2	Graham	0.39	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50
74	17858	H43_0811	1	Graham	0.19	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50
75	17918	H43_0874	1	Graham	0.19	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50
76	17919	H43_0875	1	Graham	0.03	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50
77	18033	H43_0992	1	Graham	0.80	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50
78	18034	H43_0993	1	Graham	0.65	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50
79	18048	H43_1007	1	Graham	0.12	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50
80	18049	H43_1008	1	Graham	0.03	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50
81	18065	H43_1024	1	Graham	0.62	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50
82	18078	H43_1039	2	Graham	1.15	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50
83	18205	H43_1170	2	Graham	0.28	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50
84	18206	H43_1171	1	Graham	0.37	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50
85	18207	H43_1172	1	Graham	0.12	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50
86	18488	H43_1461	1	Graham	0.08	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50
87	18489	H43_1462	1	Graham	0.06	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50
88	18553	H43_1532	2	Graham	0.48	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50
89	18554	H43_1533	2	Graham	3.52	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50
90	18615	H43_1595	3	Graham	1.75	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50

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Table A-2C
Watercourses in Gila County with Evaluated Ratings at Level 2

No.	W_ID	W_NAME	SEGCOUNT	W_COUNTIES	W_MILES	PER_RAT	HBOAT_RAT	MBOAT_RAT	DIMP_RAT	FISH_RAT	SS_RAT	TOT_RAT	REF_RAT
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
91	18616	H43_1596	2	Graham	2.49	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50
92	18629	H43_1609	1	Graham	0.07	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50
93	18966	H43_1949	2	Graham	1.16	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50
94	18968	H43_1951	1	Graham	0.32	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50
95	18971	H43_1954	1	Graham	0.08	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50
96	18972	H43_1955	9	Graham	9.56	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50
97	19004	H43_1987	2	Graham	0.62	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50
98	19020	H43_2003	1	Graham	1.58	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50
99	19021	H43_2004	2	Graham	0.56	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50
100	19022	H43_2005	1	Graham	0.19	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50
101	19023	H43_2006	1	Graham	0.08	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50
102	19035	H43_2020	1	Graham	0.26	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50
103	19105	H43_2091	3	Graham	3.38	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50
104	19113	H43_2100	1	Graham	0.40	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50
105	19114	H43_2101	4	Graham	1.07	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50
106	19116	H43_2103	1	Graham	0.22	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50
107	19117	H43_2104	1	Graham	0.23	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50
108	19122	H43_2109	4	Graham	7.51	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50
109	19126	H43_2113	2	Graham	1.76	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50
110	19127	H43_2114	2	Graham	2.23	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50
111	19129	H43_2116	3	Graham	0.44	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50
112	19131	H43_2118	1	Graham	0.68	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50
113	19146	H43_2136	2	Graham	0.88	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50
114	19148	H43_2138	1	Graham	0.33	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50
115	19149	H43_2139	2	Graham	0.41	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50
116	19150	H43_2140	1	Graham	0.37	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50
117	19151	H43_2141	6	Graham	4.99	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50
118	19152	H43_2142	1	Graham	0.18	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50
119	19155	H43_2146	1	Graham	0.13	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50
120	19168	H43_2160	1	Graham	0.26	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50
121	19175	H43_2167	2	Graham	0.33	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50
122	19176	H43_2168	2	Graham	0.79	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50
123	19177	H43_2169	5	Graham	1.60	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50
124	19178	H43_2170	1	Graham	0.07	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50
125	19180	H43_2172	2	Graham	1.03	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50
126	19196	H43_2188	1	Graham	0.17	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50
127	19201	H43_2193	1	Graham	0.63	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50
128	19353	H43_2346	1	Graham	0.32	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50
129	20168	H46_0623	1	Graham	1.83	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50
130	35588	H81_0091	1	Graham	0.80	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50
131	35596	H81_0099	1	Graham	0.65	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50
132	37605	Hackberry Creek - Graham	19	Graham	15.32	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50
133	37694	Hot Well Draw	38	Graham	27.88	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50
134	37887	Long Creek	9	Graham	10.66	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50
135	37977	Midnight Creek	16	Graham	9.63	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50

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Table A-2C
Watercourses in Gila County with Evaluated Ratings at Level 2

No.	W_ID	W_NAME	SEGCOUNT	W_COUNTIES	W_MILES	PER_RAT	HBOAT_RAT	MBOAT_RAT	DIMP_RAT	FISH_RAT	SS_RAT	TOT_RAT	REF_RAT
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
136	38065	Ninemile Creek	11	Graham	10.15	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50
137	38183	Paymaster Wash	8	Graham	7.70	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50
138	38465	Sevenmile Creek	11	Graham	8.21	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50
139	38556	South Fork Ask Creek 2	17	Graham	15.70	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50
140	38602	Squaw Creek 1 - Graham	11	Graham	7.64	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50
141	38781	Turkey Creek 2 - Graham	5	Graham	9.70	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50
142	38923	Willow Creek 1	72	Graham/Greenlee	29.56	0.5	0.0	0.0	0.0	0.00	0.000	0.50	3.50
143	696	Dry Prong Creek	18	Graham/Greenlee	14.38	0.0	0.0	0.0	0.0	0.75	0.000	0.75	3.00
144	825	Gibson Creek - Graham	4	Graham	3.77	0.0	0.0	0.0	0.0	0.75	0.000	0.75	3.00
145	38399	Salt Creek - Graham	28	Graham	42.45	0.0	0.0	0.0	0.0	0.75	0.000	0.75	3.00
146	33347	H77_1461	1	Graham	3.33	0.0	0.0	0.0	0.0	0.00	0.000	0.00	0.00

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Table A-3
List of Small and Minor Watercourses in Graham County

Apache Wash - Graham
Aravaipa Creek
Ash Creek 1 - Graham
Ash Creek 2 - Graham
Ash Creek 3 - Graham
Bar-X Wash
Bass Canyon
Bear Wallow Creek
Big Creek
Bigler Wash
Billingsley Creek
Black River
Black Rock Wash - Graham
Bobcat Creek
Bollen Wash
Bonita Creek - Graham
Booger Canyon St
Box Spring Creek
Brushy Creek - Graham
Burton Wash
Carland Wash
Cienega Creek - Graham
Clark Wash
Clover Creek - Graham
Copper Creek
Coyote Wash - Graham
Crazy Horse Creek
Crazy Horse Wash
Day Mine Wash
Deer Creek - Pinal
Deer Creek 1 - Graham
Deer Creek 1 - Graham/Pinal
Dial Wash
Dry Creek - Graham
Dry Prong Creek
Eagle Creek
Elwood Canyon Creek
Fine Wash
Fish Creek
Fivemile Wash - Graham
Fourmile Creek
Freezeout Creek
Fresnal Wash - Graham
Frye Creek
Garden Creek
Gardner Creek
Gibson Creek - Graham
Gillespie Wash
Gold Gulch
Goodwin Wash
Goudy Canyon Wash
Grant Creek - Graham
Grapevine Canyon - Graham
Hackberry Creek - Graham
High Creek
Hog Canyon Wash
Horton Creek - Graham
Hot Springs Wash
Hot Well Draw
Jacobson Creek
Jesus Canyon Wash
Johnny Creek
Kelly Gulch
Kennedy Falls Wash
Klondyke Wash
Left Branch Long
Left Fork Markha
Little Rocky Creek
Lone Star Wash
Long Creek
Long Hollow
Low Creek
Malay Creek
Marijilda Wash
Markham Creek
Martin Wash
Martinez Wash - Graham
Middle Prong Creek
Midnight Creek
Moonshine Creek
Mud Spring Wash
Natural Corral Creek
Ninemile Creek
Noon Creek
North Fork Ash Creek
North Oak Creek
Oak Creek 1 - Graham
Oak Creek 2 - Graham
Oak Creek 3 - Graham
Oak Draw
Owl Wash
Paddys River
Paisano Canyon Spring
Park Creek - Graham
Patterson Wash
Paymaster Wash
Peck Wash
Peters Wash
Pistol Creek
Pitchfork Canyon
Point of Pines Creek
Post Creek
Rattlesnake Creek
Redfield Canyon
Reiley Creek
Right Branch Lon

Table A-3
List of Small and Minor Watercourses in Graham County

Right Fork Markh
Sacaton Wash
Salt Creek - Graham
San Carlos River
San Simon River
Sand Wash - Graham
Sawmill Creek
Scanlon Wash
Sevenmile Creek
Sheep Camp Wash
Sheep Wash - Greenlee
Sheep Wash 1 - Graham
Sheep Wash 2 - Graham
Shoat Tank Wash
Slick Rock Wash
Soldier Creek - Graham
Soldier Hole Creek
South Cienega Creek
South Fork Ash Creek 1
South Fork Ask Creek 2
South Fork Clark
South Oak Creek
South Taylor Wash
Squaw Creek 1 - Graham
Squaw Creek 2 - Graham
Squaw Creek 3 - Graham
Stockton Pass Wash
Stockton Wash
Swamp Springs Canyon
Sycamore Creek - Graham
Telegraph Wash 1
Telegraph Wash 2
Tidwell Wash
Tollgate Wash
Triplet Wash 1
Triplet Wash 2
Tule Creek
Turkey Creek 3 - Graham
Turkey Creek 1 - Graham
Turkey Creek 2 - Graham
Twilight Creek
Two E Wash
Underwood Wash
WA Wash
Watson Wash
West Prong Creek
Whitlock Wash
Willow Creek - Graham
Willow Creek 1
Willow Spring Wash - Graham
Yuma Wash - Graham
Zulu Wash
3,069 Unnamed Washes

Appendix B - Criteria Weight Evaluation

Figure B-1
Criteria Scoring Matrix

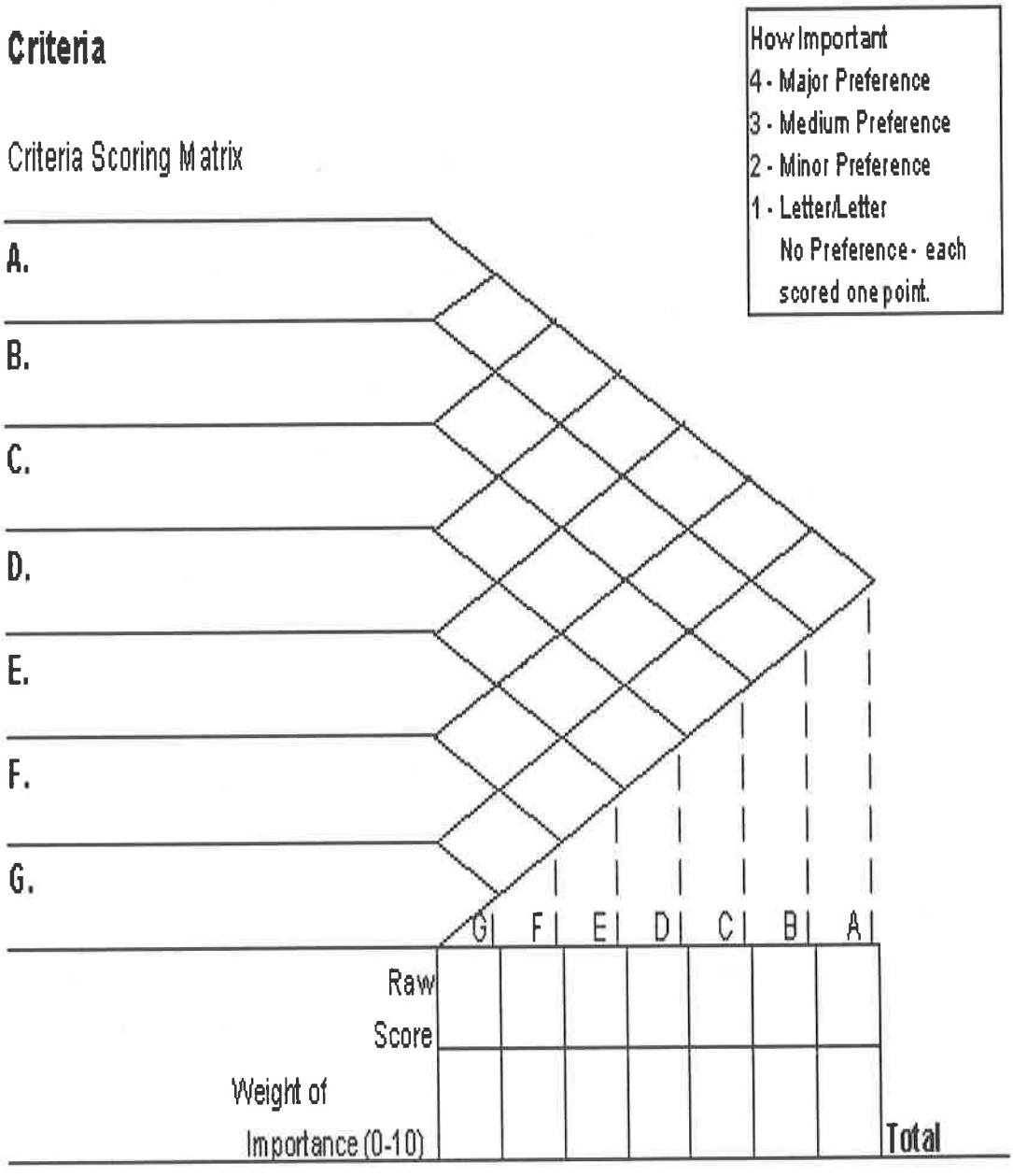


Table B-1
Evaluation of Numerical Weights for the Six Criteria

Item No.	Description of Criterion	Participant No.							Average Weight	Recommended Weight
		1	2	3	4	5	6	7		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
1	Historical Boating	9	10	10	10	10	10	10	9.9	10
2	Modern Boating	3	7	10	9	7	10	7	7.6	8
3	Perennial	8	5	8	6	6	7	6	6.6	7
4	Dam-Impacted	7	2	4	2	4	5	3	3.9	4
5	Special Status	2	3	2	2	2	2	2	2.1	2
6	Fish	4	3	6	3	3	3	5	3.9	4

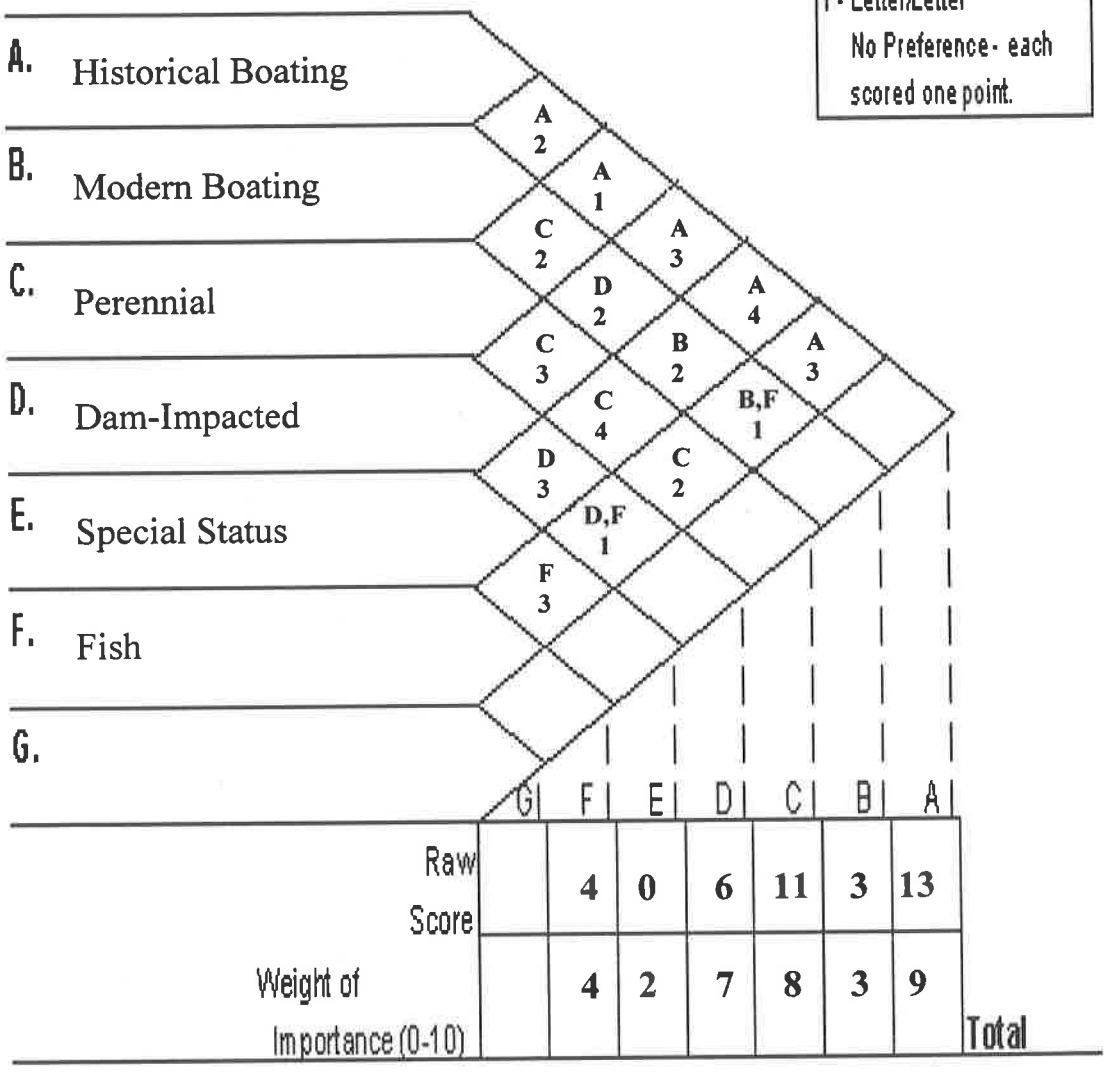
Note: For the list of participants involved in the determination of the criteria weights for the rating system, please refer to Table B-2 of this Appendix.

Participant No. 1

Criteria

How Important
4 - Major Preference
3 - Medium Preference
2 - Minor Preference
1 - Letter/Letter
No Preference - each scored one point.

Criteria Scoring Matrix

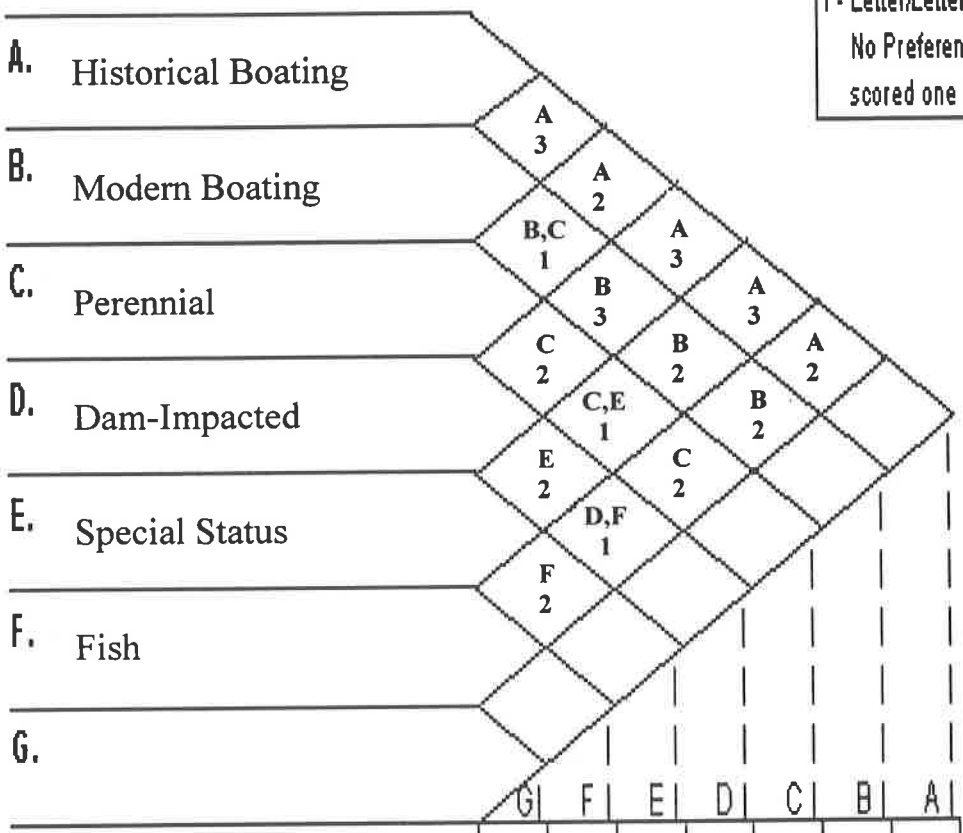


Participant No. 2

Criteria

How Important
4 - Major Preference
3 - Medium Preference
2 - Minor Preference
1 - Letter/Letter
No Preference - each scored one point.

Criteria Scoring Matrix



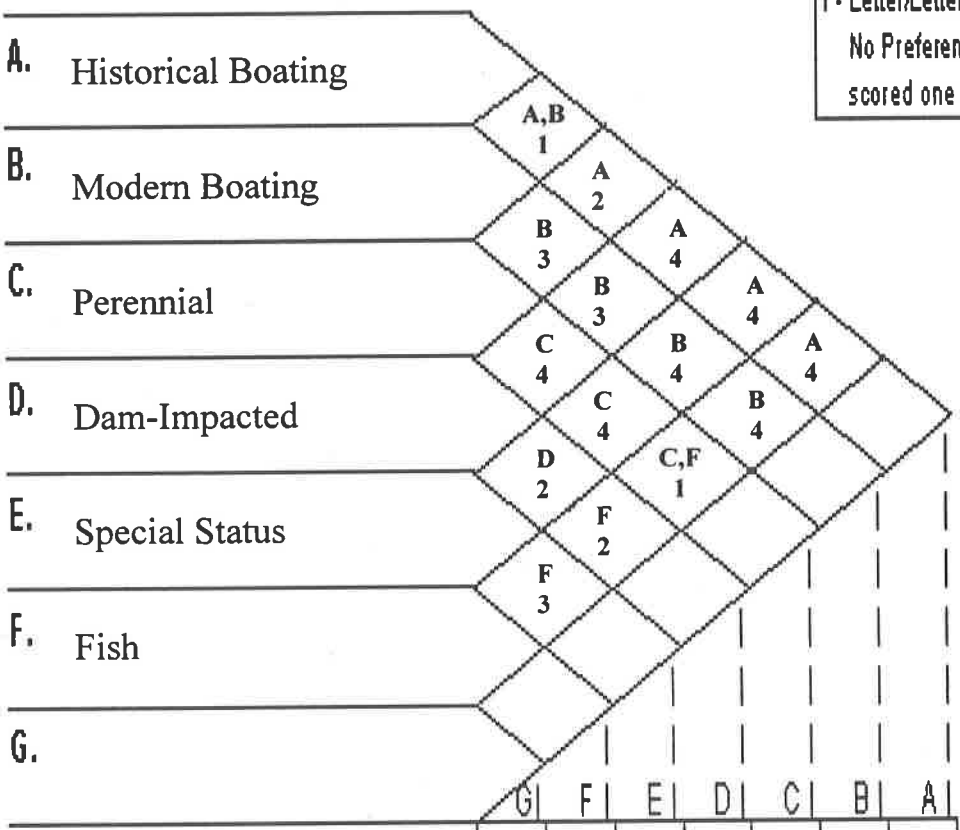
	G	F	E	D	C	B	A	
Raw Score		3	3	1	6	8	13	
Weight of Importance (0-10)		3	3	2	5	7	10	Total

Participant No. 3

Criteria

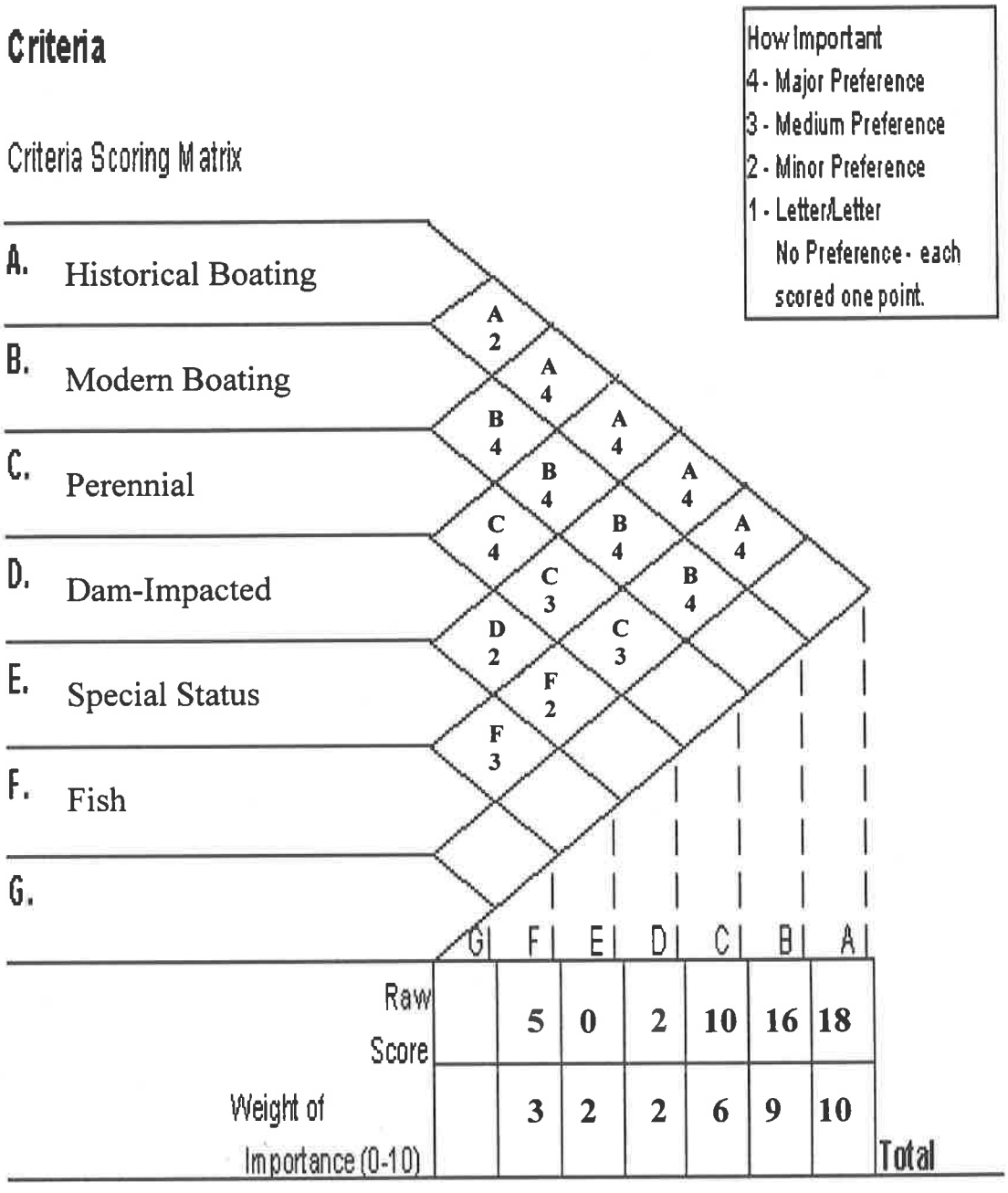
How Important
4 - Major Preference
3 - Medium Preference
2 - Minor Preference
1 - Letter/Letter
No Preference - each scored one point.

Criteria Scoring Matrix



	G	F	E	D	C	B	A	
Raw Score		6	0	2	9	15	15	
Weight of Importance (0-10)		6	2	4	8	10	10	Total

Participant No. 4

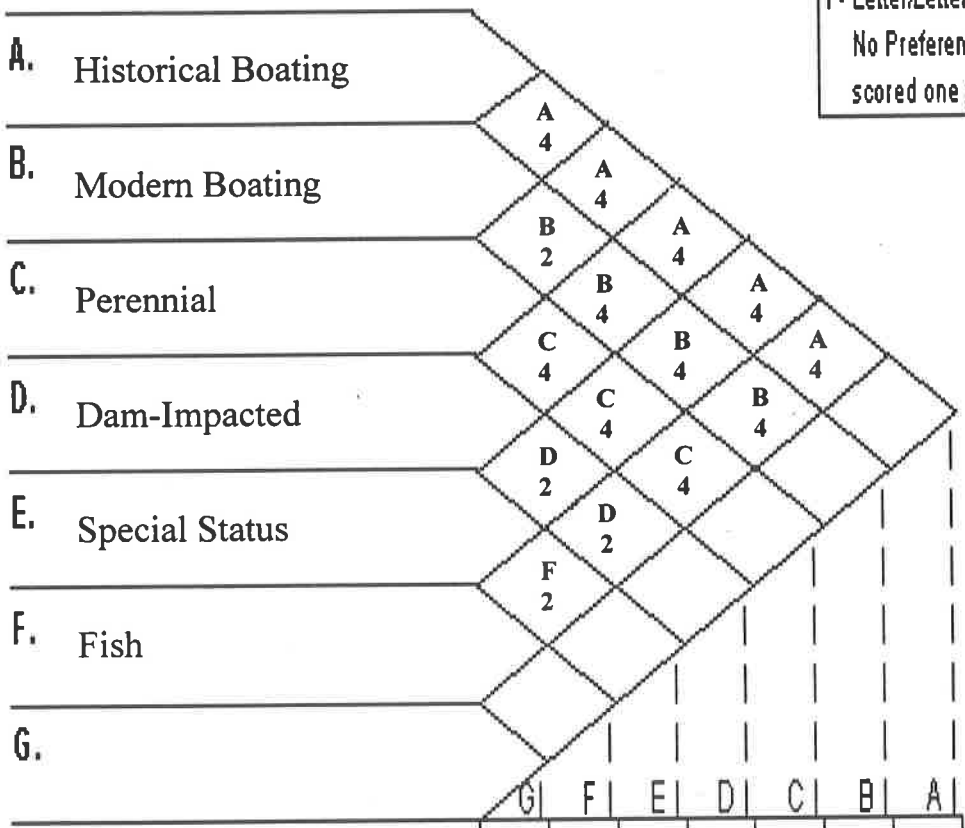


Participant No. 5

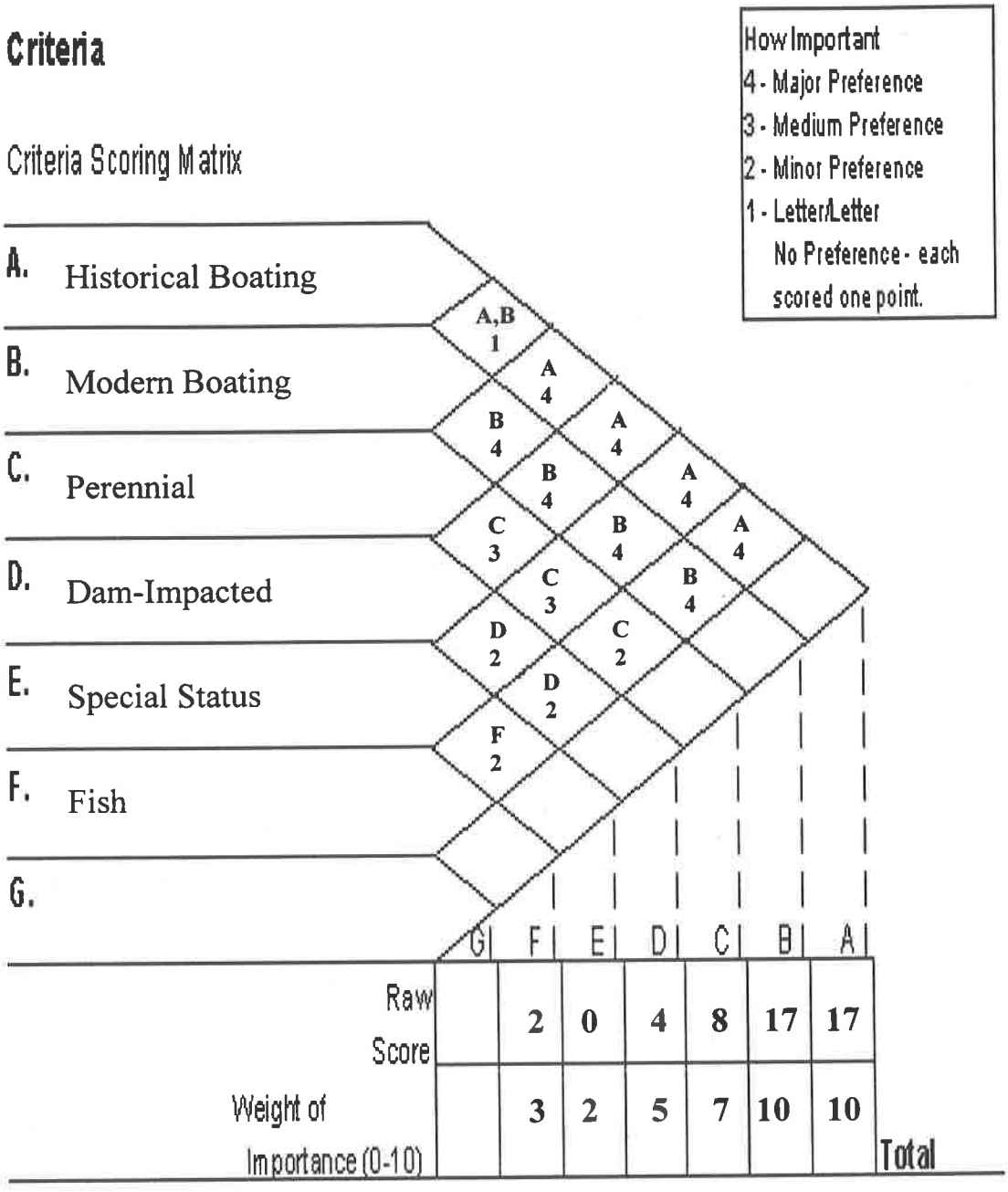
Criteria

Criteria Scoring Matrix

How Important
4 - Major Preference
3 - Medium Preference
2 - Minor Preference
1 - Letter/Letter
No Preference - each scored one point.



Participant No. 6



Participant No. 7

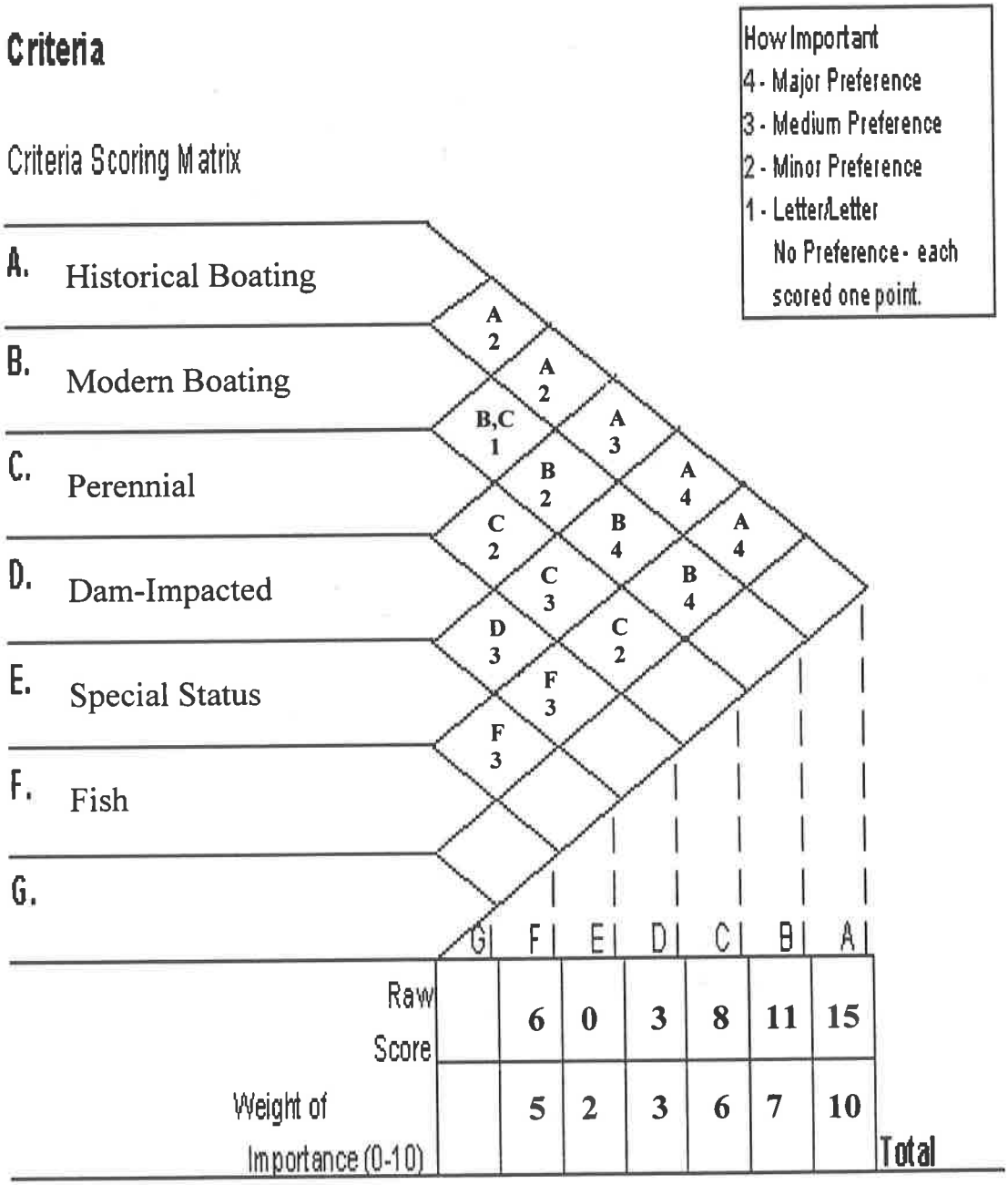


Table B-2

List of Participants Involved in the Determination of Criteria Weights
(in Alphabetal Order)

Name	Project Involvement	Official Position	Agency/ Company
(2)	(3)	(4)	(5)
Carlos C. Carriaga, P.E., Ph.D.	Project Manager (Stantec)	Water Resources Engineer	Stantec
V. Ottozawa Chatupron, P.E., Ph.D.	Project Supervisor (ASLD)	Manager, Engineering Section	ASLD
Patricia Q. Deschamps, P.E., R.L.S.	Former Project Manager (Stantec)	Senior Engineer	Navigant
Cheryl Doyle	Project Manager (ASLD)	Project Manager	ASLD
Jonathan E. Fuller, P.E., P.H.	Project Manager (JEF)	President	JEF
George V. Sabol, P.E., Ph.D.	Principal	Senior Associate	Stantec
Scot S. Schlund, P.E.	Principal	Division Manager, Water Resources	Stantec

Notes: Stantec – Stantec Consulting, Inc.
JEF – JE Fuller / Hydrology and Geomorphology, Inc.
ASLD – Arizona State Land Department
Navigant – Navigant Consulting, Inc.

Appendix C
Stream Navigability Study for Eagle Creek

Stream Navigability Study

For

Eagle Creek

From: the Headwaters
To: The Gila River

Prepared for:

Arizona State Land Department
1616 West Adams Street
Phoenix, Arizona 85007
(602) 542-4621

January 2001

Prepared by:

JE FULLER
HYDROLOGY & GEOMORPHOLOGY, INC.

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PREFACE

This report was prepared under contract to the Arizona State Land Department (ASLD). This report summarizes information gathered relating to the navigability of Eagle Creek in eastern Arizona. Information presented in this report is intended to provide data for the Arizona Navigable Stream Adjudication Commission (ANSAC) from which ANSAC can make a recommendation to the Arizona Legislature regarding the navigability of the stream. This report does not make a recommendation or draw any conclusions regarding title navigability.

The report consists of the following parts:

- Historical information from periods prior to and including the time of statehood is discussed with respect to river uses, modes of transportation, and river conditions.
- Hydrologic and geomorphic information is presented to document both past and present stream conditions as they relate to navigability.
- Land ownership information is presented in GIS format to identify the location of public vs. private land boundaries.

This study was performed by JE Fuller/ Hydrology & Geomorphology, Inc. (JEF). The study was completed under State Contract #A8-0049 Purchase Order #LDA-01-0895 for the ASLD. Project staff included: V. Ottosawa-Chatupron/ASLD, Project Manager; J. Fuller/JEF, Project Manager; J. Wallace/JEF, Project Engineer; and T. Lehman/JEF, GIS Task Leader. Data summarized in this study were obtained from numerous agencies, libraries, and collections named within the report. Use of this document is governed by ASLD.

EXECUTIVE SUMMARY

JE Fuller/ Hydrology & Geomorphology, Inc. (JEF) was retained by the Arizona State Land Department (ASLD) to prepare a report summarizing information related to the navigability of Eagle Creek. The study reach extends from the Gila River confluence, located about nine miles southwest of the Clifton-Morenci area, to the headwaters near State Route 191 (Figure ES-1). Table ES-1 below shows the latitude and longitude of the Eagle Creek study limits.

Table ES-1. Eagle Creek Navigability Study Reach Limits

Location along Eagle Creek	Latitude	Longitude
Gila River Confluence	32°57.6'N	109°24.4'W
Headwaters divide	33°34.6'N	109°20.3'W

The basic approach to this study was to develop a database of information to be used by ANSAC in making recommendations concerning navigability. Because the State's definition of navigability includes both actual navigation and susceptibility to navigation, the data collection effort was directed at the following two areas:

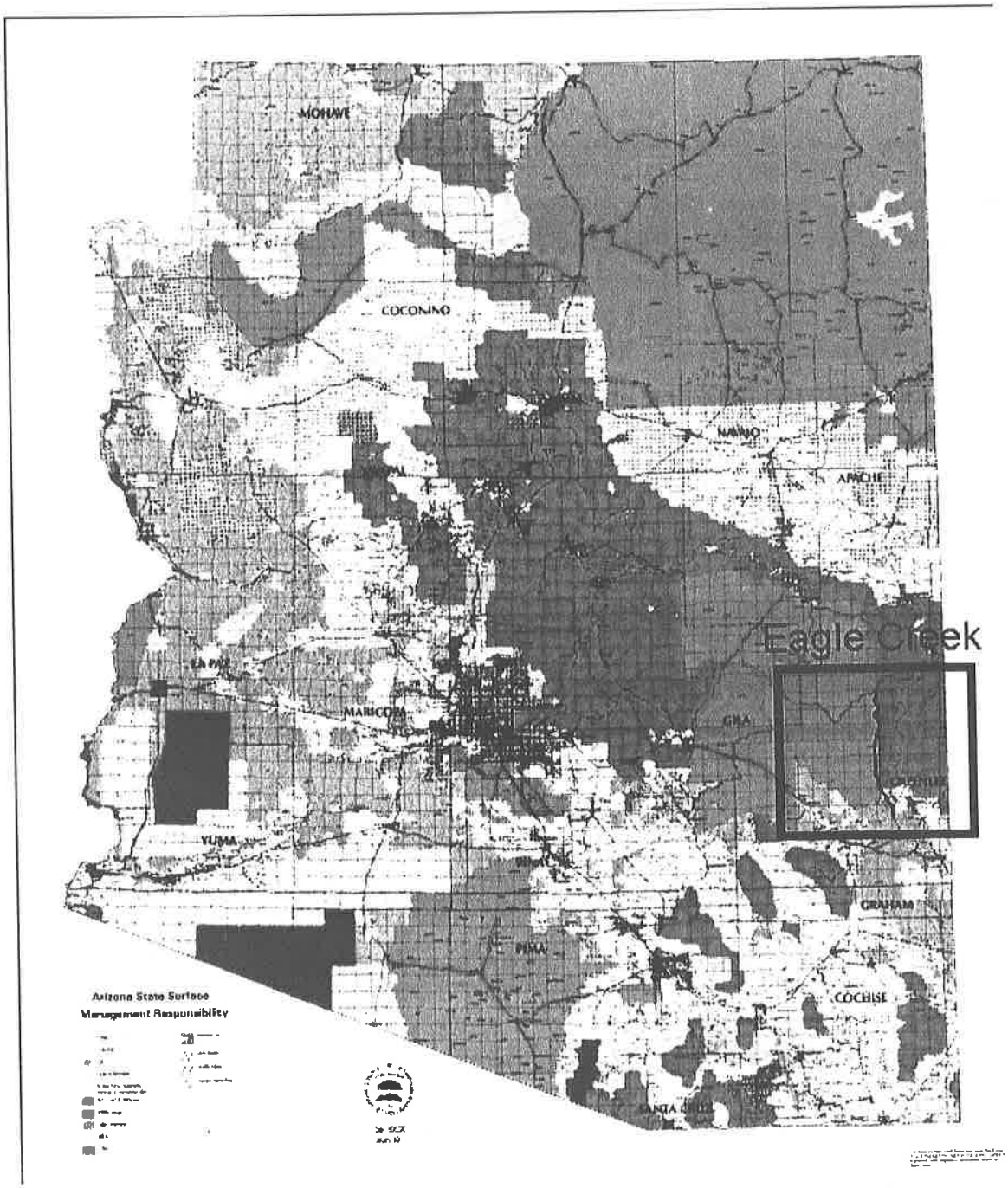
- Historical Uses of the Creek. Data describing actual uses of the stream as of the time of statehood were collected to help answer the question, "Was the stream used for navigation?"

- Potential Uses of the Creek. Data describing stream conditions as of the time of statehood were collected to help answer the question, "Could the stream have been used for navigation?"

Specific tasks for the study included agency contact, a literature search, summary of data collected from agencies and the literature, and preparation of a final report. The objectives of the agency contact task were to inform community officials of the study, to obtain information on historical and potential stream uses, and to obtain access to data collected by agency personnel for the stream. For the latter task, public officials from agencies having jurisdiction along the stream segments were contacted. The objective of the literature search was to obtain published and unpublished documentation of historical stream uses and stream conditions. Information collected from agency contacts was supplemented by published information from public and private collections.

The literature search focused on the following three subject areas: (1) history, (2) hydrology and geomorphology and (3) land ownership. Historical data provide information not only on actual uses of the stream as of the time of statehood, but also on whether stream conditions would have supported navigation. This document summarizes uses of the stream and the adjacent river valley in historic times, with special emphasis on the establishment, growth, and development of towns, irrigation systems, and commercial activities where applicable.

Figure ES-1: Eagle Creek Location Map



Hydrologic/hydraulic data are the primary sources of information regarding susceptibility to navigation. These data include estimates of flow depth, width, velocity, and average flow conditions as of the time of statehood, based on the available modern records for natural stream conditions as of the time of statehood, as well as for existing stream conditions. Existing state land ownership data were compiled into a GIS database

that identified the location of public vs. private land along the stream. The results of the data collection are summarized in the following paragraphs.

History

Eagle Creek has a history of human occupation dates back to about 300 B.C. and extends to the present. Spanish exploration of the area began in the 1500's, but it was not until the late 1800's that the first influx of Anglo-American settlers reached the area. During the late 1800's and early 1900's the creek valley was home to a number of homestead families. Transportation in the area as of the time of statehood was typically by foot, horse, wagon or rail. No historical record in the literature was found for this study of boating or other use of Eagle Creek to run passenger craft or the types commercial craft listed in the State's navigability criteria, such as keelboats, steamboats or powered barges. However, water from the creek has been pumped to mining operations in Morenci since 1898.

Hydrology & Geomorphology

Eagle Creek drains a watershed of roughly 677 square miles located in eastern Arizona in what is widely regarded as the transition zone between the Basin and Range and Colorado Plateau physiographic provinces of Arizona. Eagle Creek has an average slope of about 1.2 % (0.012 ft./ft.), and consists primarily of a cobble-bedded channel with low banks lined by riparian vegetation or grassland.

Eagle Creek is a perennial stream along most of its length. No evidence was identified for this study that suggests that the location or alignment of the stream corridor has varied significantly over time. GLO survey records from 1913-1914 provide stream descriptions at section line crossings indicating flow depths varying from 3 to 24 inches, and flow widths varying from 13 to 80 feet. During a field investigation in December 2000 observed flow depths were generally less than one foot and often less than six inches with flow widths varying from ten to thirty feet. Comparison of estimated flow characteristics for Eagle Creek with federal boating criteria indicates that acceptable recreational boating conditions exist less than 10 percent of the time.

Boating

Flow depths are generally not sufficient to support commercial boating, boating by the types of commercial vessels typically used as of the time of statehood, or upstream boating except during floods. Boating during floods would be difficult and hazardous due to high velocities, overhanging vegetation, rapids and waterfalls. There is no evidence in the record to suggest that Eagle Creek was used for commercial boating of any kind in the past, and no evidence was identified in this study that suggests that flow conditions as of the time of statehood would have made the stream more susceptible to boating than its existing condition. Eagle Creek is listed by the Arizona State Parks Department as a seasonal recreational kayak and canoe stream.

Land Ownership

A Geographic Information System (GIS) mapping product was developed depicting the spatial relationship between the studied stream and land ownership. Mapping of the study area was performed utilizing ESRI ArcView 3.2 GIS software. The base layers for the GIS were obtained from the Arizona Land Resources Information System (ALRIS) maintained by the Arizona State Land Department (ASLD) as modified by Stantec Consulting Inc. for the ANSAC Small Watercourse and Minor Watercourse Pilot Study. In addition, floodplain data from the Federal Emergency Management Agency (FEMA) National Flood Insurance Program (NFIP) Q3 Flood Data were processed for presentation with the Stantec data. Finally, the U.S. Geological Survey (USGS) 250,000 series digital raster graphic (DRG) maps were used as supplemental background for these maps.

Navigability Criteria

A.R.S. Section 37-1128 mandates a presumption of non-navigability if certain criteria apply to the stream reach as of February 14, 1912. Data for Eagle Creek developed as a part of this study are summarized below for each of the criteria established by A.R.S. Section 37-1128. Each numbered item lists the criteria in italics followed by the corresponding result of the study.

1. *The stream flowed only in direct response to precipitation and was dry at all other times.* Most reaches of Eagle Creek appear to be perennial, flowing all or most of the time in response to discharge from springs, tributary inflows, geologic controls, and snowmelt, as well as in response to precipitation.

2. *No sustained trade and travel occurred both upstream and downstream in the watercourse.* No evidence was found during the course of this study to indicate that sustained trade or travel occurred in boats in either the upstream or downstream direction on Eagle Creek.

3. *No profitable commercial enterprise was conducted by using the watercourse for trade and travel.* No evidence was found to indicate that commercial enterprise of any kind was conducted using the watercourse for trade or travel in boats.

4. *Vessels customarily used for commerce on navigable watercourses in 1912, such as keelboats, steamboats or powered barges, were not used on the watercourse.* No evidence was found to suggest that any of the above types of commercial vessels were ever used on Eagle Creek.

5. *Diversions were made from the watercourse to irrigate and reclaim land by persons who made entries under the Desert Land Act of 1877.* No evidence was found that entries under the Desert Land Act of 1877 were made for diversion of flow from Eagle Creek. Flow from Eagle Creek has been diverted near Morenci since 1898 for use in mining operations in Morenci.

6. *Any boating or fishing was for recreational and not commercial purposes.* No evidence was found of boating or commercial fishing on Eagle Creek as of the time of statehood. Eagle Creek is used for recreational fishing and boating. Recreational boating consists of seasonal kayaking and whitewater canoeing.

7. *Any flotation of logs or other material that occurred or was possible on the watercourse was not and could not have been regularly conducted for commercial purposes.* No record of use of Eagle Creek for flotation of logs or other material was found in historical documents. Flotation of logs is possible during seasonal high flows and during floods.

8. *There were bridges, fords, dikes, manmade water conveyance systems or other structures constructed in or across the watercourse that would have been inconsistent with or impediments to navigation.* At least one diversion structure existed on Eagle Creek at the time of statehood at the current location of the pump station diversion near Morenci. It is likely that there were numerous fords or other crossings existing along the study reach. Some of these structures may have been impediments to some types of navigation.

9. *Transportation in proximity to the watercourse was customarily accomplished by methods other than by boat.* Based on the evidence collected, transportation in proximity to Eagle Creek was customarily accomplished by foot, horse, or wagon as of the time of statehood.

10. *The United States did not regulate the watercourse under the Rivers and Harbors Act of 1899.* No evidence was found in the research to indicate that Eagle Creek was regulated under this code as of the time of statehood.

INTRODUCTION

Information presented in this report is intended to provide data for the Arizona Navigable Stream Adjudication Commission (ANSAC) from which ANSAC can make a recommendation to the Arizona Legislature regarding the navigability of Eagle Creek. This report does not make a recommendation or draw any conclusions regarding title navigability. The report consists of the following parts:

- History
- Hydrology & Geomorphology
- Land Ownership

Eagle Creek is located in Greenlee and Graham Counties in eastern Arizona and drains south from the White Mountains into the Gila River upstream of Safford, Arizona. The Eagle Creek watershed is bounded by the Mogollon Rim to the north, U.S. Highway 191 to the east, and the Natanes Mountains on the San Carlos Apache Reservation to the west (Figure 1). The watershed is located entirely within the San Carlos Apache Indian Reservation and the Apache-Sitgreaves National Forest.

HISTORY

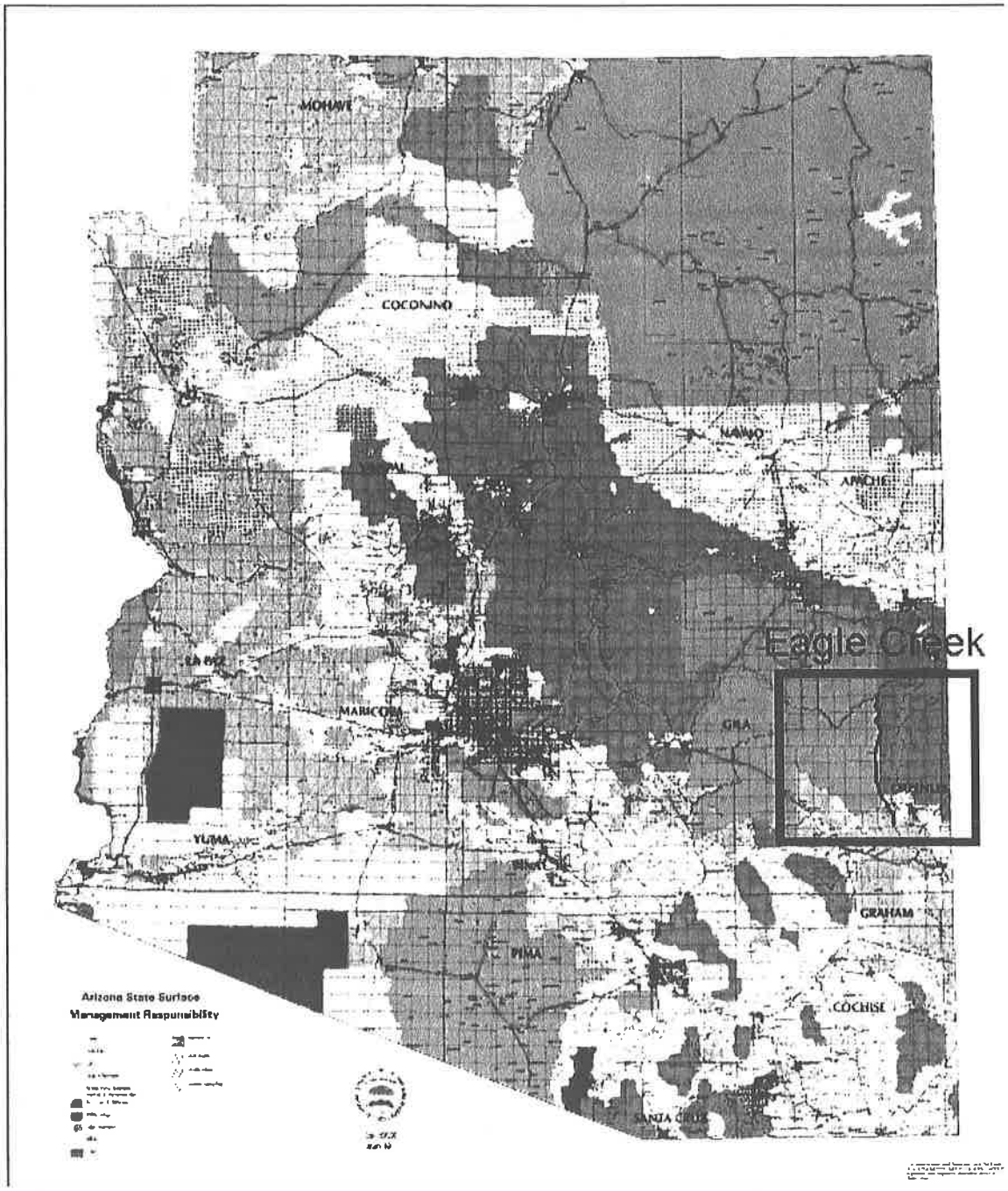
Exploration and Settlement

Eagle Creek lies within the eastern portion of the Mogollon Rim/White Mountains geographical area. This area was inhabited by the Mogollon culture from about 300 B.C. until the thirteenth century A.D. (Comeaux, 1981). In 1540, the expedition of Francisco Vasquez de Coronado passed through this region on its way to conquer what were believed to be rich cities to the north. The Coronado Expedition marked the first excursion of Europeans through the region. During the 17th century A.D., Apache Indians entered the region from the east (Walker and Bufkin, 1979). In 1880, Eagle Creek was the site of an Apache encampment in 1880 that consisted of approximately 40 to 50 families, including both White Mountain and Chiricahua Apaches, who planted corn along the creek (Collins, 1994).

The California Gold Rush of 1849 brought the first influx of American travelers and settlers through the area from the east. Hunters and trappers began working in the region as well. Gold was discovered in Eagle Creek in 1861 and it became a destination for many prospectors. During this time conflicts between the Anglos and Apaches were quite common. At about this same time Mormon expansion worked its way south from Utah, up the Little Colorado River valley, through the area surrounding Eagle Creek and into the Gila River Valley to the south. During the late 1800's and early 1900's homesteaders settled in the area as well. Beginning in 1898, water was pumped from Eagle Creek up to mining operations in Morenci. This practice was expanded in the 1940's to include pumping of water from Black River (a tributary to the Salt River) into the Eagle Creek watershed to augment the supply of water being pumped to Morenci. In

1926, the Coronado Trail Highway (then U.S. Highway 666, now U.S. Highway 191) was constructed to provide access between the Clifton-Morenci area and the Springerville-Alpine area. The Coronado Trail Highway marks the eastern edge of the Eagle Creek Valley.

Figure 1: Eagle Creek Location Map



Vegetation and Wildlife

Eagle Creek is located within an area that consists primarily of Montane Conifer forests in the upper watershed along the Mogollon Rim with Juniper-Pinyon Woodland and Oak-Pine Woodland in the lower watershed (Hendricks, 1985). The Montane Conifer forest areas consist of extensive Ponderosa Pine forests which were heavily logged during the latter part of the 1800's and throughout the 1900's. The region was host to a wide variety of wildlife at the beginning of the period of Anglo settlement. Aldo Leopold wrote that he had seen "everything from 12-point bucks, 30-pound gobblers, to Mexican Pigeons and Wild Geese," (Flader, 1974) while other reports listed buffalo, bear, lion, deer, wolf and coyote (undated/unsigned correspondence obtained from U.S. Forest Service). Others report that the area was home to elk, turkey, mountain lions, and bears (Shumway, 1998). The area is currently the site of reintroduction of the Mexican Gray Wolf which was eliminated by hunting in the early part of the 1900's.

Transportation

The literature review indicates that transportation along Eagle Creek as of the time of statehood was by foot, horseback or horse-drawn wagon. No railroad segments were ever constructed along Eagle Creek. No record of commercial boating of any type on Eagle Creek was identified during the course of this study.

Other Uses of Eagle Creek

In 1898, the Morenci Water Company constructed a log dam on Eagle Creek and pumped water from the creek through a four inch pipeline to the town of Morenci, five miles away, for municipal and mining use. The use of Eagle Creek for water supply was expanded in the 1940's when the Phelps-Dodge Company constructed a pumping station on the Black River to pump water into the Eagle Creek to augment the supply of water already being diverted to Morenci. Then in the late 1950's a well field was developed on Eagle Creek some distance upstream of the Morenci take-out point to provide additional supply to Eagle Creek for diversion to Morenci. The diversions from Black River and pumping of water from Eagle Creek to Morenci continue to this day. Pumping from Eagle Creek to Morenci averaged 10,808 acre-feet per year (15 cfs) during the 54 year period from 1945 to 1999.

Summary

Eagle Creek has a history of human occupation dates back to about 300 B.C. and extends to the present. Spanish exploration of the area began in the 1500's, but it was not until the late 1800's that first influx of Anglo-American settlers reached the area. During the late 1800's and early 1900's the creek valley was home to a number of homestead families. Settlement in the area was probably related to the presence of reliable water from Eagle Creek, but not for use of the stream corridor as a corridor for transportation in boats. Transportation in the area was by foot, horse, wagon or rail. There is no record in the literature of boating or other use of Eagle Creek to run passenger craft or commercial

craft such as keelboats, steamboats or powered barges. However, water from the creek has been pumped to mining operations in Morenci since 1898, and has been used for water supply to local residents and pioneers.

Figure 2. Eagle Creek circa 1900, about ten miles above Morenci

HYDROLOGY

Geographic and Hydrologic Setting

The Eagle Creek watershed is located in eastern Arizona in what is widely regarded as the transition zone between the Basin and Range and Colorado Plateau physiographic provinces of Arizona. The watershed extends from the Gila River confluence, at a point about nine miles southwest of the Clifton-Morenci area, to the Mogollon Rim near Alpine (Figure 3). The Eagle Creek watershed is bounded by the Mogollon Rim to the north, U.S. Highway 191 to the east, and the Natanes Mountains on the San Carlos Apache Reservation to the west. Elevations within the basin range from 3,300 at the Gila River confluence to approximately 8,500 feet along the Mogollon Rim. The table below provides a number of watershed characteristics for Eagle Creek as measured at the USGS stream gauge located approximately 12 miles upstream from the Gila River confluence (see Figure 3).

Table 1. Eagle Creek Navigability Study
Stream Characteristics

Watershed Characteristic	At USGS Stream gauge #09447000
Stream length	52.5 mi.
Main channel slope	60.9 ft./mi.
Mean basin elevation	6,060 ft. msl
Mean annual precipitation	19.2 in.
Forested area	64 %
Drainage area	622 $mi.^2$

Data Sources

Hydrologic data for Eagle Creek are available from USGS gauge numbers 09446500 and 09447000 (see Figure 3 for gauge locations). Additional hydrologic data regarding diversions into and out of the creek were obtained from the Phelps-Dodge Corporation.

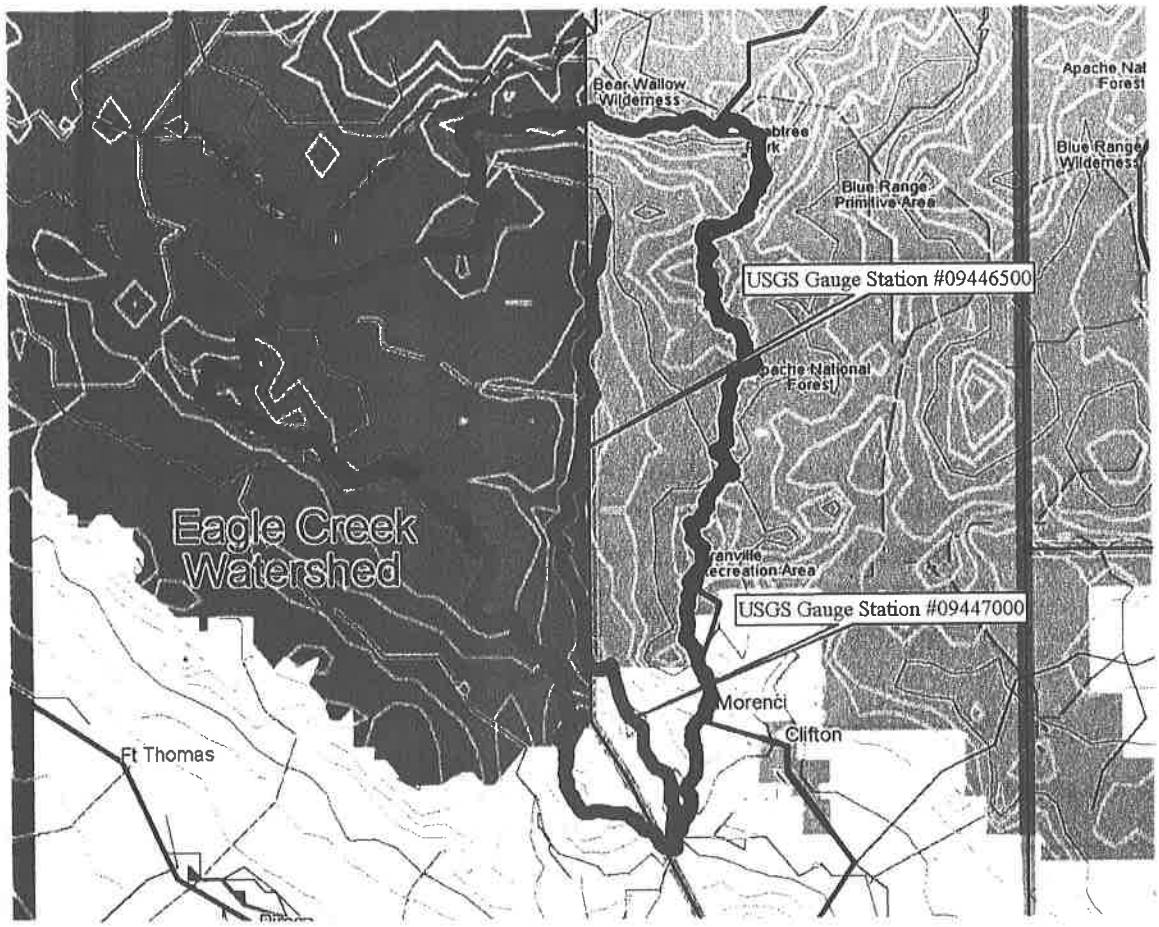
Statehood Hydrology

No hydrologic records from the year of statehood (February 14, 1912) were found during the course of this study. Hydrologic data recorded close to this time period are limited to the survey notes of the Government Land Office (GLO) surveyors on file at the Bureau of Land Management Records office in Phoenix. GLO surveys in the area adjacent to Eagle Creek were conducted in 1913 and 1914, and notations on the condition of the creek were recorded.

Eagle Creek runs through Townships 1, 2, 3 & 4 South and Townships 1 & 2 North all of Range 28 East and portions of the White Mountain Indian Reservation (see Appendix A Land Use Maps for Township-Range locations). Useful stream descriptions are recorded in the section line surveys of Township 1,2 & 4 South and 1 North of Range 28 East. No survey was done in Township 2 North, Range 28 East or within the interior

of the reservation in the vicinity of Eagle Creek. A survey of the eastern border of the reservation does include information on the condition of Eagle Creek.

Figure 3: Eagle Creek Watershed Location Map



The surveys that recorded the condition of Eagle Creek were completed from November 1913 to April 1914. During the time of the survey Eagle Creek was flowing. At some locations depth of water was recorded as 2 feet deep. In other locations the flow was as shallow as 3 inches deep. Widths ranged from 13 feet to 80 feet, suggesting that stream conditions as of the time of statehood were similar to current conditions along the creek, at least with respect to navigability criteria.

Post-Statehood Hydrology

The USGS stream gauges provide the primary record of stream flow on Eagle Creek. The locations of the two gauges within the study area are shown on Figure 3. Tables 2 through 4 provide summaries of streamflow data and flood frequency predictions based on the USGS gauge records (Pope et. al., 1998). Figure 4 shows the flow duration curves at the USGS gauges. Figures 5 and 6 provide graphical depictions of monthly averages and peak discharge values for the gauges.

In addition to the USGS stream gauge data, information was obtained from the Phelps Dodge Corporation regarding flow imported into Eagle Creek from the Black

River and Eagle Creek well fields and diversions made to the Phelps Dodge mining operations at the pumping station near Morenci, which is located approximately 2 miles downstream of USGS gauge #09447000. Flow diversions at the Morenci Pump Station began in about 1898. Import of flow into the Eagle River basin from Black River began in 1945. Pumping of flow into Eagle Creek from well fields located near Double Circle Ranch began in 1959. Table 6 provides a summary of the flow import and diversion information.

Table 2. Eagle Creek Navigability Study
Mean Monthly Streamflow Data for gauges on Eagle Creek

Near Double Circle Ranch, Near Morenci (#09446500)												
Month	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Mean	41	22	41	27	18	16	21	38	20	18	13	46
Max	310	101	213	89	25	25	36	93	42	33	22	502
Min	4.7	4.1	5.9	4.3	5.3	3.7	13	13	11	5.7	5.2	4.7
Period of Record: 1945-1967												
Above Pumping Plant, Near Morenci (#09447000)												
Month	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Mean	184	135	109	53	33	25	37	55	35	60	35	87
Max	4,440	1,760	709	214	84	49	98	203	114	1,170	228	884
Min	11	11	14	11	9.2	5.3	16	19	13	13	10	11
Period of Record: 1945-1996												

Table 3. Eagle Creek Navigability Study
Streamflow Statistics for gauges on Eagle Creek

Flow Characteristic	**Value**	
	Near Double Circle Ranch (#09446500)	**Above Pumping Plant (#09447000)**
Annual Mean Flow	26 (cfs)	71 (cfs)
Maximum Annual Mean	81 (cfs)	568 (cfs)
Minimum Annual Mean	11 (cfs)	17 (cfs)
Lowest Daily Mean	1.9 (cfs)	3.2 (cfs)
Highest Daily Mean	6,350 (cfs)	29,000 (cfs)
Max. Instantaneous Peak Flow	30,000 (cfs)	36,800 (cfs)
Annual Mean Runoff	18,824 (acre-feet)	51,402 (acre-feet)
Flow value exceeded 10% of the time	38 (cfs)	88 (cfs)
Flow value exceeded 50% of the time	16 (cfs)	30 (cfs)
Flow value exceeded 90% of the time	5.6 (cfs)	15 (cfs)

Table 4. Eagle Creek Navigability Study
Peak Discharges for Eagle Creek

Near Double Circle Ranch (#09446500)					
2-year	**5-year**	**10-year**	**25-year**	**50-year**	**100-year**
2,510	5,690	8,760	13,900	18,800	24,600
Above Pumping Plant (#09447000)					
2-year	**5-year**	**10-year**	**25-year**	**50-year**	**100-year**
2,730	8,300	14,400	24,900	35,000	47,000

Figure 4. Flow Duration Curve for Eagle Creek

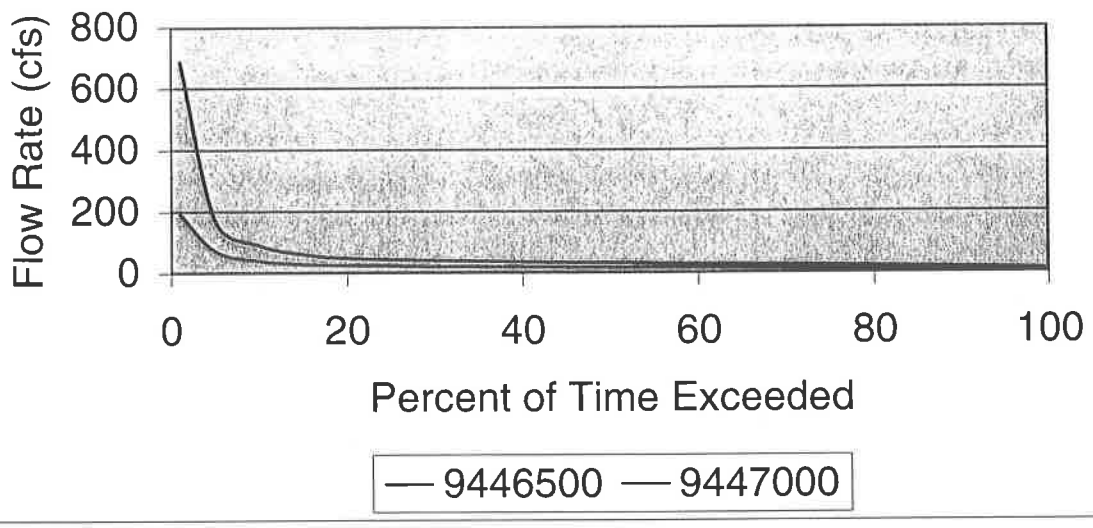


Figure 5. Monthly Average Flow for Eagle Creek

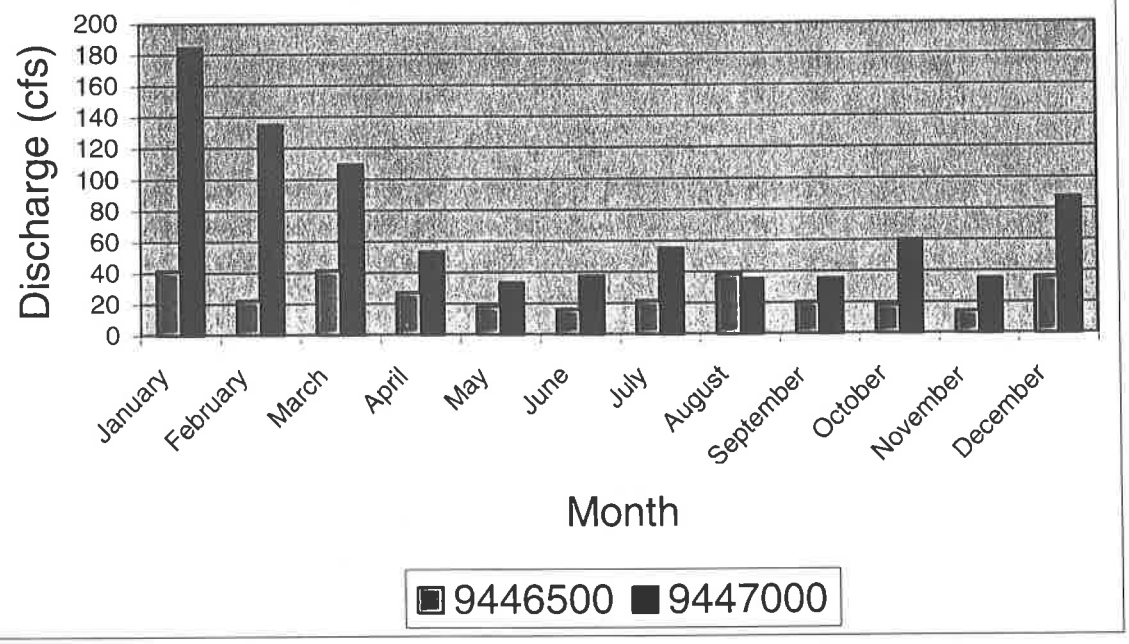


Figure 6. Annual Peak Discharges for Eagle Creek

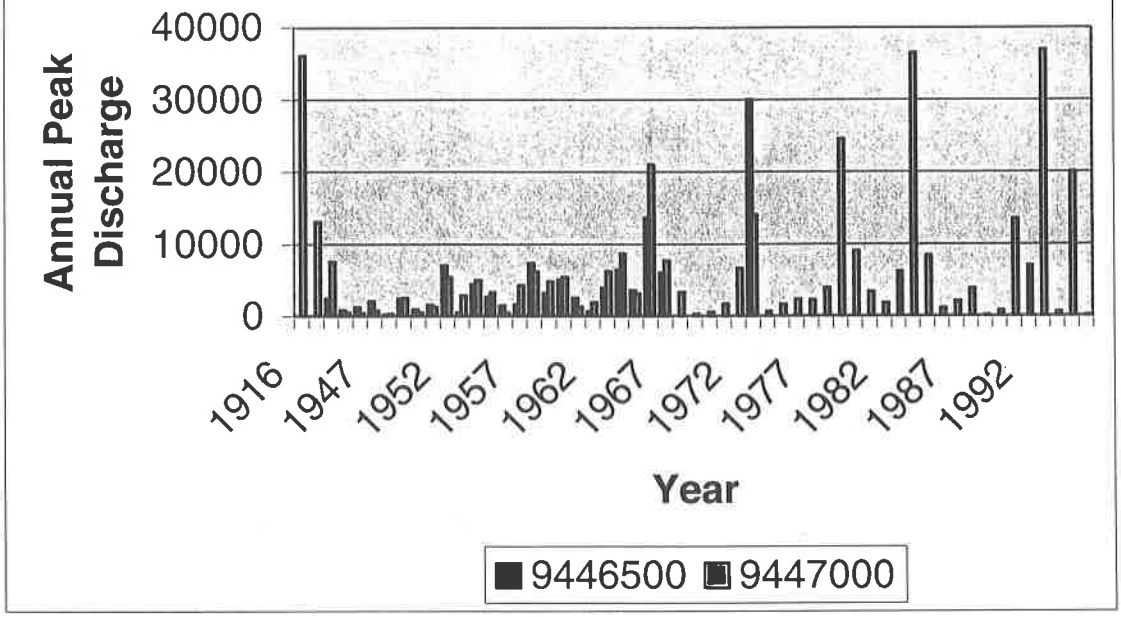


Table 5. Summary of Flow Imports and Diversions for Eagle Creek		
	Volume	**Mean Flow Rate**
Mean Annual Flow at USGS gauge 09447000	51,402 ac-ft	71 cfs
Mean Annual Import from Black River	7,336 ac-ft	10 cfs
Mean Annual Import from Upper Eagle Creek Well Fields (1959-1996)	3,521 ac-ft	4.9 cfs
Mean Annual Import from Black River & Well Fields	10,256 ac-ft	14 cfs
Net Annual Base Flow at USGS gauge 09447000 (i.e., without imported flow)	41,146 ac-ft	57 cfs
Percent of Annual Flow at USGS gauge 09447000 which is imported	20%	
Mean Annual Diversion at Pumping Station	12,935 ac-ft	18 cfs
Percent of Annual Flow at USGS gauge 09447000 which is diverted at pumping station	25%	
* Period of Record 1945-1996 except where noted		

The USGS gauge data indicate that Eagle Creek is perennial along much of its length. At gauge #09447000 the minimum average monthly flow and the 90 percent flow duration rates are both greater than the mean annual import flow value shown in Table 5. At gauge #09446500 the mean monthly flow rates are greater than the mean annual import flow rate (14 cfs) for eleven of the twelve months of the year. The highest average flows typically occur in the winter months due to snow melt and winter cyclonic

precipitation. Comparison of the 50% flow duration (median flow rate) and the average annual flow rate indicates that the average annual flow rate is skewed upward by flood peaks. That is, much of the annual flow volume is provided by floods rather than during low flows

Floods

Historic information on the occurrence of floods along Eagle Creek was limited. Information for the USGS gauging station upstream of the Morenci pumping station (gauge #09447000) indicates a flood of 36,000 cfs on January 18, 1916, which was approximately a 50-year flood, based on the gauge data at this location. Even small floods, such as the 2-year storm, are significantly larger than average flow conditions, and result in large increases in depth and velocity, making boating during floods difficult and hazardous.

Climatic Variation

Research from previous navigability studies (CH2M Hill, 1993) indicates that Arizona's climate at statehood was not drastically different from existing or pre-statehood conditions. However, the period around the year 1912 was probably subject to higher than average stream flow, indicating that streams may have been more likely to have been navigable at statehood, than during other, less "wet" periods of Arizona history.[1] It is noted that some of Arizona's largest floods, in terms of both volume and peak flow rate, occurred in the twenty years prior to statehood.

Geomorphology

Eagle Creek has an average slope of about 1.15 % (0.0115 ft./ft.), and consists primarily of a cobble-bedded channel with low, well-vegetated banks. Bank vegetation includes both woody riparian species and grasses. The main channel is straight to slightly sinuous, and consists primarily of a single channel with occasional braided reaches. The geometry of the channel and floodplain is fairly consistent along the entire stream reach. The main channel has a bottom width of about 10 feet, a top width of about 50 feet, and a bank height of about 4 feet in most locations. The stream exhibits classical pool-and-riffle patterns throughout most of the study area. The floodplain along the channel varies from 100 to 400 feet wide in the more well-defined canyon reaches which dominate the stream. The exception to this plan form is an approximately three mile reach upstream of the Double Circle Ranch where the floodplain widens to approximately 3,000 feet in width. No evidence was identified in the record to suggest that the location or alignment of the stream corridor has varied significantly over time.

---

[1] Human impacts such as irrigation diversions, etc., have tended to lessen average stream discharge rates, obscuring climatic effects on some Arizona streams.

Figure 7. Longitudinal Profile of Eagle Creek

Hydraulic Characteristics

Measured data for hydraulic flow characteristics for the year of statehood were not available. Therefore, hydraulic characteristics were estimated from observed stream conditions and historic streamflow data available from the USGS stream gauges. Table 6 provides a summary of the resulting range of values for estimated stream depth, width, and velocity. Note that the hydraulic parameters shown below are not specific to any one location along the stream and assume that the streamflow characteristics for the referenced gauge would be relevant at all locations within the study area. A rating curve for an assumed cross section developed from field observations is shown in Figure 7.

Table 6. Eagle Creek Navigability Study
Estimated Average Hydraulic Characteristics for Streamflow at gauge #09446500

Flow Duration	Discharge* (cfs)	Average Channel Flow Depth (ft)	Average Channel Velocity (ft/s)	Average Channel Flow Width (ft)
10 %	24	0.4	2.6	20
50 %	2	0.14	1.2	12
90 %	--	--	--	--
Average Annual	12	0.3	2.6	17
2-Year Flood	2,496	3.5	11.1	50

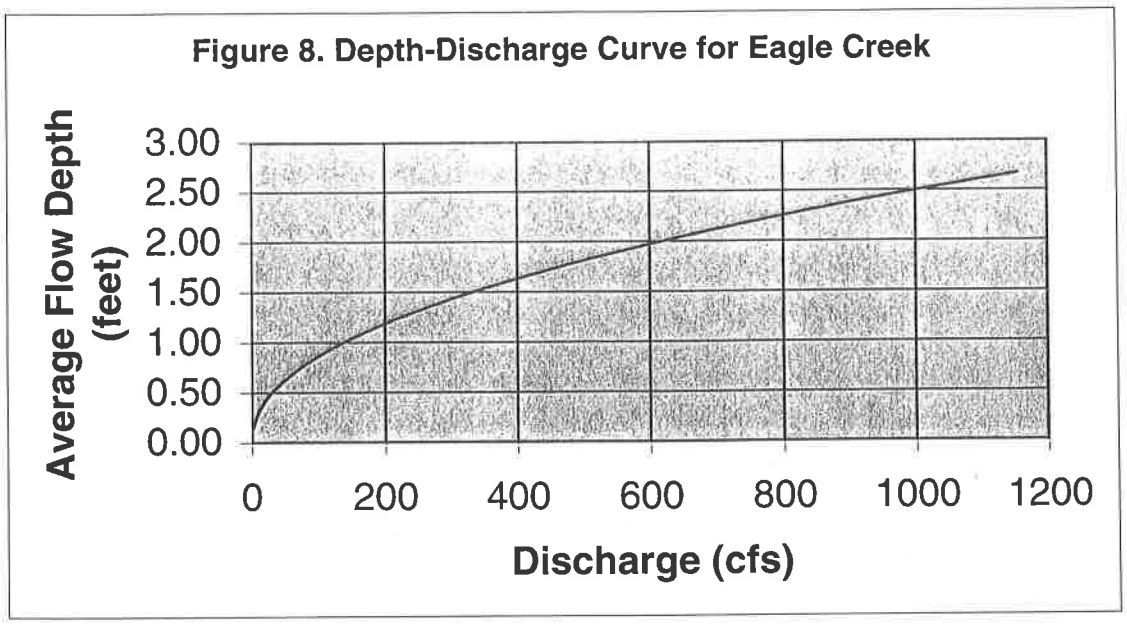
* NOTE: Flow rates are adjusted downward to account for average import flow of 14 cfs which did not exist prior to 1945 (See Table 5).

Table 7. Eagle Creek Navigability Study
Estimated Average Hydraulic Characteristics for Streamflow at gauge #09447000

Flow Duration	Discharge* (cfs)	Average Channel Flow Depth (ft)	Average Channel Velocity (ft/s)	Average Channel Flow Width (ft)
10 %	74	0.8	3.7	26
50 %	16	0.4	2.3	19
90 %	1	0.1	1.0	10
Average Annual	57	0.7	3.5	25
2-Year Flood	2,716	3.7	11.3	50

* NOTE: Flow rates are adjusted downward to account for average import flow of 14 cfs which did not exist prior to 1945 (See Table 5).

To better reflect likely flow rates as of the time of statehood, the flow rates used in Tables 6 and 7 to estimate typical flow depths, widths, and velocities were adjusted downward to account for increased flow due to diversions into the Eagle Creek watershed. That is, the existing flow rates in Eagle Creek upstream of the Morenci diversion are somewhat higher than the natural (non-diversion) flow rates that existed prior to the 1800's.



Field Observations

As a part of this study, a field study was conducted on December 28-29, 2000 to observe and document the condition of the stream at various locations within the study area. Some of the photographs taken at various locations along Eagle Creek are shown in Figures 8 through 11. The field photographs support the historical descriptions of stream flow conditions, and confirm the variability of flow conditions within the study area.

Figure 9. Photograph of Eagle Creek

Looking downstream from Honeymoon Campground.

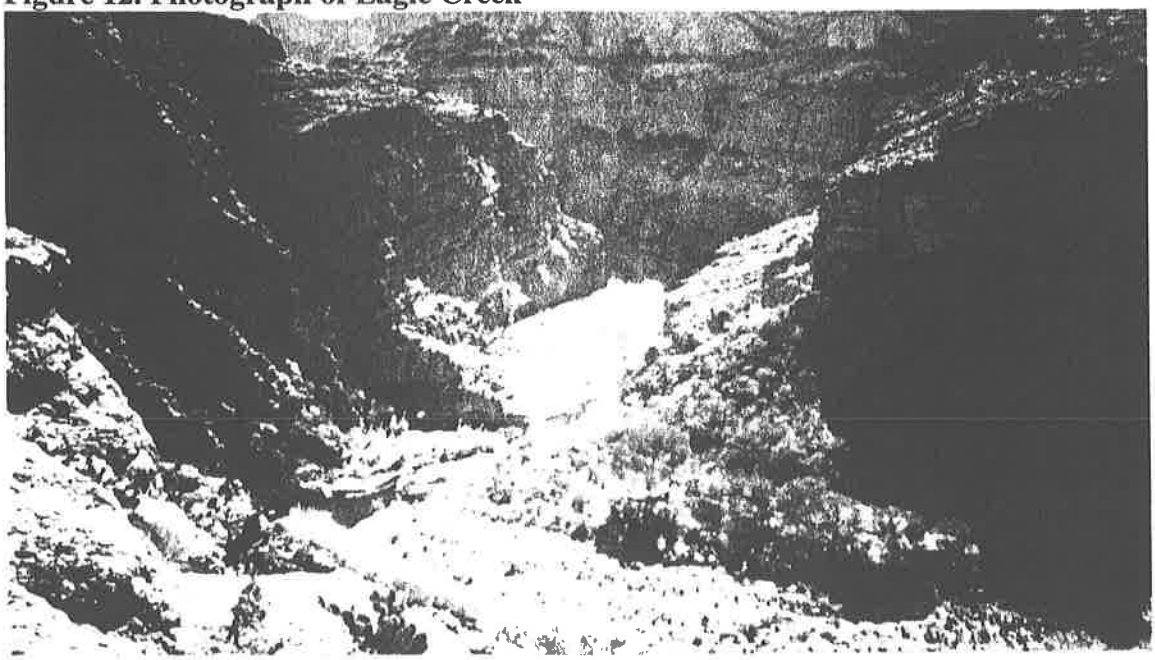
Figure 10. Photograph of Eagle Creek

Looking downstream from a point approximately 5 miles north of Double Circle Ranch.

Figure 11. Photograph of Eagle Creek

Looking downstream from Eagle Creek School crossing near Double Circle Ranch.

Figure 12. Photograph of Eagle Creek



Looking downstream from the Morenci Pumping Station.

Susceptibility to Navigation

The boating criteria cited below were reported in previous detailed navigability studies prepared for the Arizona State Land Department, and are based on the following references:

1. Cooperative Instream Flow Service Group, 1978. Methods of Assessing Instream Flows for Recreation. Instream Flow Information Paper: No. 6. FWS/OBS-78/34. June. Report prepared by U.S. Fish and Wildlife Service, U.S. Environmental Protection Agency, Heritage Conservation and Recreation Service, and Bureau of Reclamation.
2. Jason M. Cortell and Associates, Inc., 1977, Recreation and Instream Flow, Vol. 1: Flow Requirements, Analysis of Benefits, Legal & Institutional Constraints. Report submitted to U.S. Department of the Interior, Bureau of Outdoor Recreation #BOR D6429. July.
3. Walter B. Langbein, 1962. Hydraulics of River Channels as Related to Navigability. U.S. Geological Survey Water-Supply Paper 1539-W.
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The following tables summarize navigability criteria information from references 1 to 4. Note that these data reference recreational boating, not necessarily commercial boating.

Table 8. Minimum Required Stream Width and Depth for Recreation Craft[1]

Type of Craft	Depth (ft.)	Width (ft.)
Canoe, Kayak	0.5	4
Raft, Drift Boat, Row Boat	1.0	6
Tube	1.0	4
Power Boat	3.0	6

[1] After reference #1

Table 9. Minimum and Maximum Conditions for Recreational Water Boating[1]

Type of Boat	Minimum Condition			Maximum Condition		
	Width	Depth	Velocity	Width	Depth	Velocity
Canoe, Kayak	25 ft.	3-6 in.	5 fps	-	-	15 fps
Raft, Drift Boat	50 ft.	1 ft.	5 fps	-	-	15 fps
Low Power Boating	25 ft.	1 ft.	-	-	-	10 fps
Tube	25 ft.	1 ft.	1 fps	-	-	10 fps

[1] After reference 2.

Table 10. Flow Requirements for Pre-1940 Canoe Boating[1]

Boat Type	Depth
Flat Bottomed (Wood or Canvas)	4 in.
Round Bottomed (Wood or Canvas)	6 in.

[1] After reference 4.

Most Arizona boaters surveyed as a part of previous navigability studies did not agree with the minimum velocity and width criteria given in Table 9. They argue that since boats can be used on lakes and ponds which have no measurable (zero) velocity, no real minimum velocity exists, except perhaps for tubing. Minimum velocities in Table 9 are probably intended to indicate what stream conditions are most typically considered "fun."

Comparison of the boating criteria and hydraulic data for Eagle Creek shown above indicate that the stream could be boated by canoes, kayaks and tubes, but only at flow rates above the 10 percent flow duration. Note that some of the flow rates above the 10 percent flow duration rate include floods. Any type of boating during floods is difficult or hazardous due to high velocities, floating debris, overhanging vegetation, and natural obstructions. Boating by powerboats or larger commercial craft would be even more unlikely and hazardous.

The hydraulic rating curves also indicate that some types of logs could be floated on Eagle Creek during seasonal high flow periods and floods. Even though Eagle Creek may be susceptible to floating logs periodically, no historical record of such activity was found for this study.

Boating

Eagle Creek was listed as modern recreational boating stream in only one of the sources consulted for this study. Those sources included the following documents:

- *Arizona Rivers and Streams Guide* – Arizona State Parks, 1989
- *Arizona Rivers, Streams, and Wetlands Study* – Arizona State Parks, 1989
- *Boating Survey of Arizona Rivers* – Central Arizona Paddlers' Club, 1992
- *Rivers of the Southwest: A Boaters' Guide to the Rivers of Colorado, New Mexico, Utah, and Arizona* - Anderson and Hopkinson 1987

Eagle Creek is listed a seasonal kayak and whitewater canoe stream in the Arizona State Parks Department *Arizona Rivers, Streams, and Wetlands Study.* That study reported that, although water was cold, was subject to low flows, and had fences that created obstructions, the reach parallel to Forest Service Road 217 was commonly boated during March and April. However, Eagle Creek was not listed by the Central Arizona Paddlers' Club (CAPD), in Anderson and Hopkinson's boating guide, or in another 1989 river guide by Arizona State Parks. Based on the field conditions observed during the course of this study, it was concluded that the Eagle Creek study reach could be used for recreational boating during seasonal high flow conditions.

No references to commercial boating on Eagle Creek were identified during this study. No commercial recreational outfitters advertise any operations or excursions on Eagle Creek.

Summary

Eagle Creek drains a watershed of roughly 677 square miles located in eastern Arizona in what is widely regarded as the transition zone between the Basin and Range and Colorado Plateau physiographic provinces of Arizona. Eagle Creek has an average slope of about 1.15 % (0.0115 ft./ft.), and consists primarily of a cobble-bedded channel and low banks lined by riparian vegetation or grassland.

Eagle Creek is a perennial stream along most of its length. There is no evidence in the record to suggest that the location or alignment of the stream has varied significantly over time. GLO survey records from 1913-1914 provide stream descriptions at section line crossings indicating flow depths varying from 3 to 24 inches, and flow widths varying from 13 to 80 feet. Field investigation in December 2000 indicated flow depths generally less than one foot and often less than six inches with flow widths varying from ten to thirty feet. Comparison of estimated flow characteristics for Eagle Creek with federal boating criteria indicates that acceptable recreational boating conditions exist less than 10 percent of the time. Flow depths are generally not sufficient to support commercial boating, boating by the types of commercial vessels typically used as of the time of statehood, or upstream boating except during floods. Boating during floods would be difficult and hazardous due to high velocities, overhanging vegetation, rapids and waterfalls. Hydraulic rating curve data indicate that floatation of some types of logs is possible during seasonal high flows or during floods. There is no evidence in the record to suggest that Eagle Creek was used for commercial boating of any kind in the past, and no evidence was identified in this study that suggests that flow conditions as of the time of statehood would have made the stream slightly more susceptible to boating than its existing condition.

LAND OWNERSHIP

A Geographic Information System (GIS) mapping product was developed depicting the spatial relationship between the studied stream and land ownership. Mapping of the study area was performed utilizing ESRI ArcView 3.2 GIS software. The base layers for the GIS were obtained from the Arizona Land Resources Information System (ALRIS) maintained by the Arizona State Land Department (ASLD) as modified by Stantec Consulting Inc. for the ANSAC Small Watercourse and Minor Watercourse Pilot Study. In addition, floodplain data from the Federal Emergency Management Agency (FEMA) National Flood Insurance Program (NFIP) Q3 Flood Data were processed for presentation with the Stantec data. Finally, the U.S. Geological Survey (USGS) 250,000 series digital raster graphic (DRG) maps were used as supplemental background for these maps. Land use maps are provided in Appendix B.

Table 11. Eagle Creek Navigability Study Base and Reference Layers from ALRIS	
Name	**Contents**
STREAMS	Hydrography consisting of linear features, i.e., streams
SPRINGS	This data set consists of spring locations in Arizona.
TRANS123	Statewide transportation data. Linear data representing roads and streets, classes 1, 2, and 3 from the ALRIS database.
LAND	This data set contains a group of integrated data layers. These layers consist of Public Land Survey system data (Township, Ranges and Section), land ownership and county boundaries.
AZTRS	This statewide coverage consists of the Township, Range and Section grid lines. This dataset was created by processing the LAND coverage. See the LAND documentation.
HUC	Hydrologic Unit Code areas (drainage basins) in Arizona.
Projection	NAD 27, UTM Zone 12

Ownership Categories

Private
State of Arizona (State Trust)
U.S. Forest Service (Coronado National Forest)
Bureau of Land Management (BLM)
Parks and Recreation

FEMA Floodplains

NFIP Q3 data for Greenlee County. ARC/INFO coverages from FEMA converted to ArcView shapefiles and projected to fit with the Stantec data by JEF.

USGS Digital Raster Graphics (DRG)

250,000 scale series DRGs used as additional background map. Includes topography and numerous place names for helpful reference and orientation.

CONTACTS

Agency/Affiliation	Name	Address	Phone
Greenlee County Historical Museum	Mr. Don Lund and Ms. Laura Washington	317 Chase Creek Clifton, AZ 85533	520-865-3115
Apache-Sitgreaves National Forest Service	Mr. Mel Schweikert Mapping	P.O. Box 640 Springerville, AZ 85938	520-333-6264
U.S. Geological Survey	Mr. Greg Pope	520 N. Park Ave. Suite 221 Tucson, AZ 85719	520-670-6671
BLM Public Records Section	Mr. Jim Hutchison	3707 N. 7th Street Phoenix, AZ 85014	602-650-0511
Greenlee County Chamber of Commerce	NA	100 N Coronado Blvd Clifton, AZ 85533	(520) 865-3313

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Anderson and Hopkinson, 1987, Rivers of the Southwest: A Boaters' Guide to the Rivers of Colorado, New Mexico, Utah, and Arizona, 2nd Ed., Pruett, Boulder, Colorado.

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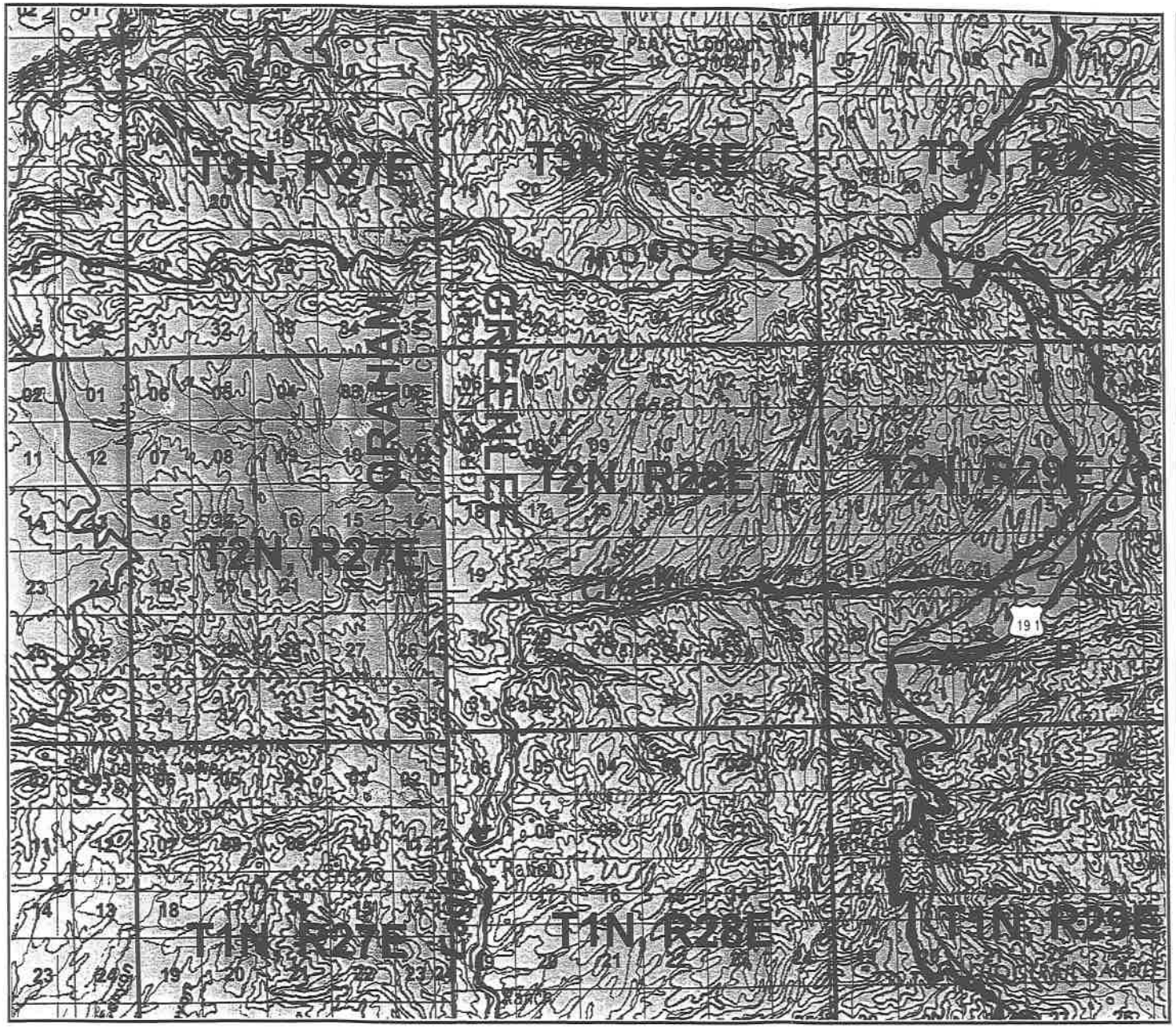
APPENDIX C.1

LAND OWNERSHIP MAPS



LEGEND

- Eagle Creek
- County Line
- FEMA Floodplains*
- USGS HUCS
- Section Lines
- Streams
- Springs

* Floodplains for Graham County not available

Land Ownership

- BLM
- NATIONAL FOREST
- PRIVATE
- STATE TRUST
- INDIAN RESERVATION

Transportation

- Interstate
- State Hwy
- Improved Road

Background map is the USGS 250,000 series DRG.

N W E S

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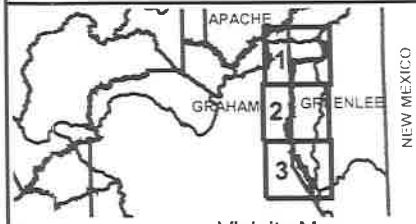


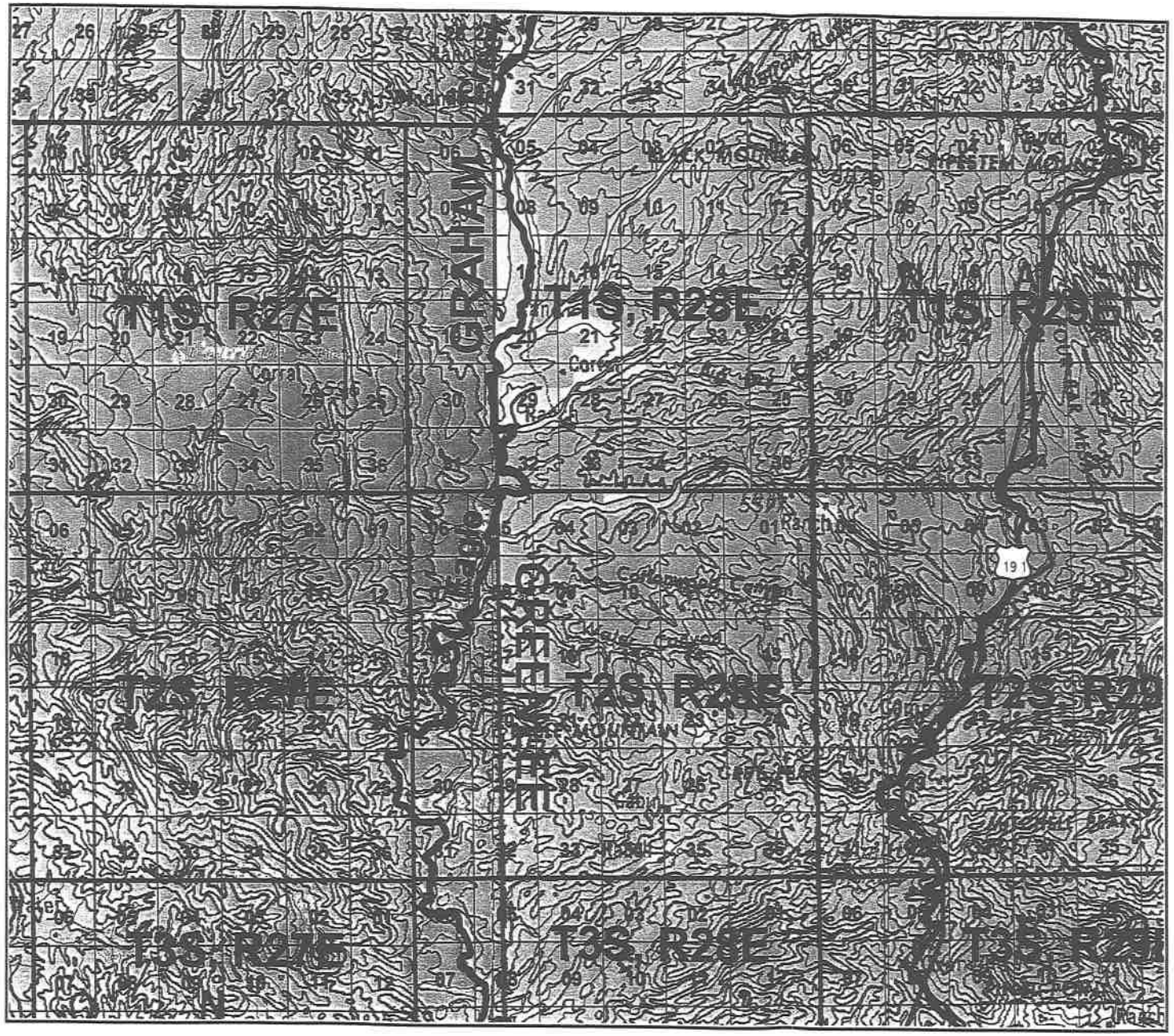
Vicinity Map

EAGLE CREEK NAVIGABILITY STUDY
Land Ownership Map

Prepared for: Arizona State Land Department

By: JE FULLER HYDROLOGY & GEOMORPHOLOGY, INC

January 2001



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Background map is the USGS 250,000 series DRG.

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1 0 1 2 3 Miles

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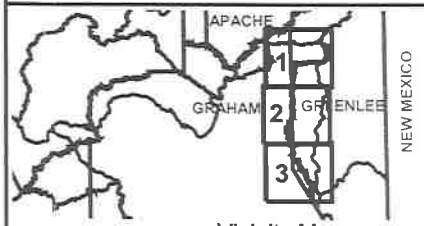


Vicinity Map

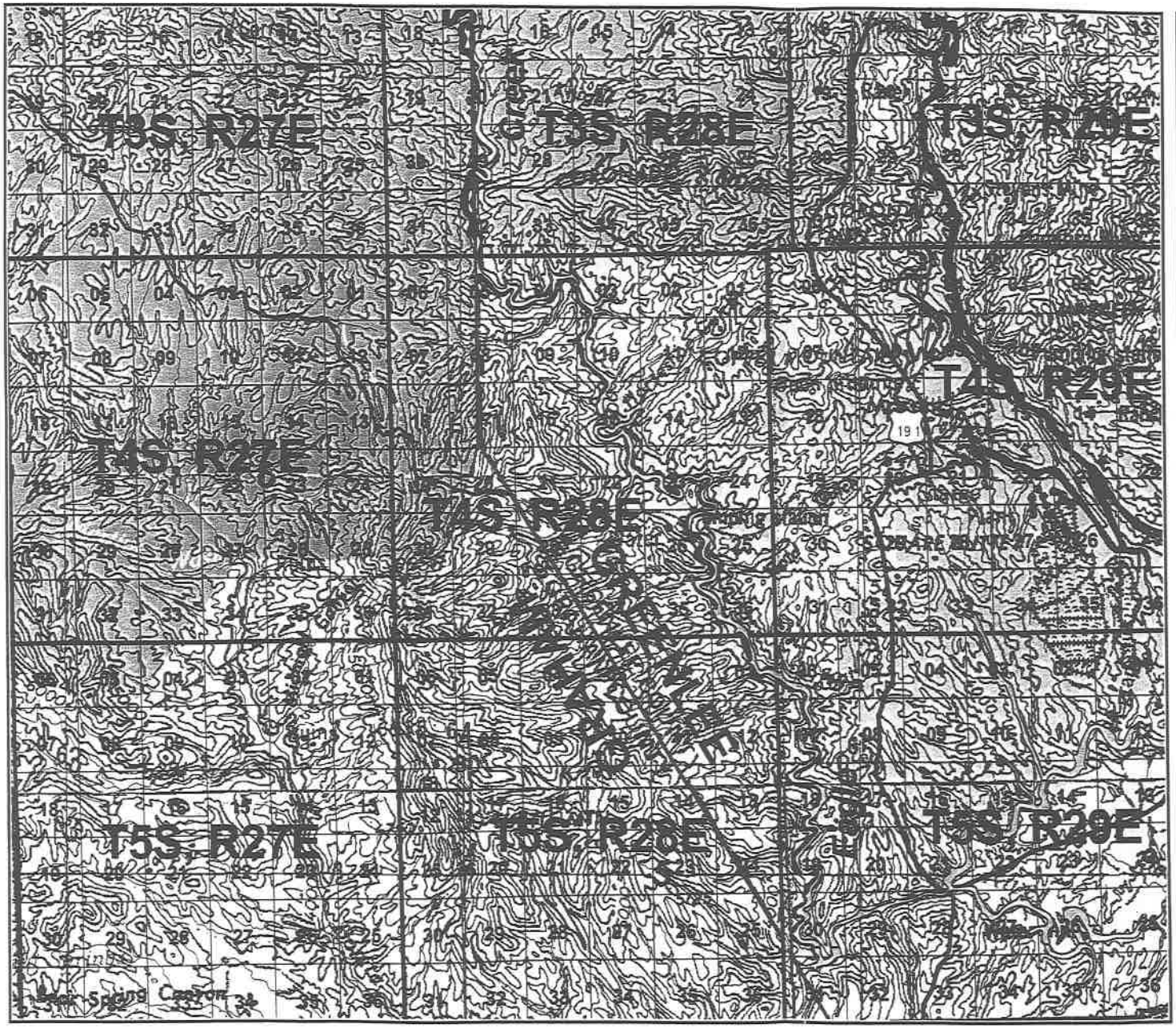
EAGLE CREEK NAVIGABILITY STUDY
Land Ownership Map

Prepared for: Arizona State Land Department

By: JE FULLER HYDROLOGY & GEOMORPHOLOGY, INC

January 2001

Sheet 2 of 3



LEGEND

- Eagle Creek
- County Line
- FEMA Floodplains*
- USGS HUCS
- Section Lines
- Streams
- Springs

* Floodplains for Graham County not available

Land Ownership

- BLM
- NATIONAL FOREST
- PRIVATE
- STATE TRUST
- INDIAN RESERVATION

Transportation

- Interstate
- State Hwy
- Improved Road

Background map is the USGS 250,000 series DRG.

N W E S

1 0 1 2 3 Miles

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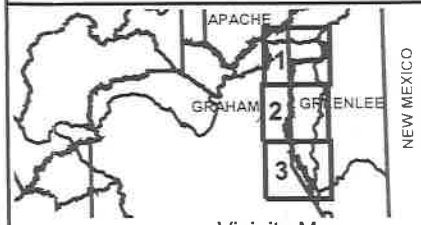


Vicinity Map

EAGLE CREEK NAVIGABILITY STUDY
Land Ownership Map

Prepared for: Arizona State Land Department

By: JE FULLER HYDROLOGY & GEOMORPHOLOGY, INC.

January 2001

Sheet 3 of 3

APPENDIX C.2

USGS STREAMFLOW DATA

09446500 EAGLE CREEK NEAR DOUBLE CIRCLE RANCH, NEAR MORENCI, AZ

LOCATION.--Lat 33°18'00", long 109°29'30", in SW$^1/_4$ sec.32, T.1 S., R.28 E., Graham County, Hydrologic Unit 15040005, (unsurveyed), on left bank 0.5 mi upstream from head of Box Canyon, 2.75 mi downstream from Willow Creek, 3.25 mi downstream from Double Circle Ranch, and 17 mi northwest of Morenci.

DRAINAGE AREA.--377 mi^2.

Annual peak discharges

Water year	Date	Annual peak discharge (ft^3/s)	Discharge codes	Water year	Date	Annual peak discharge (ft^3/s)	Discharge codes
1944	09-11-44	2,400		1957	08-01-57	1,610	
1945	08-06-45	798		1958	09-10-58	7,270	
1946	07-10-46	1,160		1959	08-01-59	3,200	
1947	08-25-47	2,070		1960	01-12-60	4,990	
1948	08-21-48	135		1961	09-11-61	2,470	
1949	01-13-49	2,400		1962	01-25-62	612	
1950	07-28-50	874		1963	08-21-63	3,920	
1951	08-28-51	1,470		1964	09-10-64	6,390	
1952	01-13-52	7,000		1965	08-01-65	3,510	
1953	08-01-53	456		1966	12-30-65	13,600	
1954	08-24-54	4,380		1967	08-11-67	6,000	
1955	08-21-55	2,680		1973	10-20-72	[1]30,000	HP
1956	07-31-56	1,410					

[1]Highest since 1944.

Basin characteristics

Main channel slope (ft/mi)	Stream length (mi)	Mean basin elevation (ft)	Forested area (percent)	Soil index	Mean annual precipitation (in)	Rainfall intensity, 24-hour 2-year (in)	Rainfall intensity, 24-hour 50-year (in)
100	29.2	6,410	75.0	3.0	20.0	2.0	3.9

09446500 EAGLE CREEK NEAR DOUBLE CIRCLE RANCH, NEAR MORENCI, AZ—Continued

MEAN MONTHLY AND ANNUAL DISCHARGES 1945-67

MONTH	MAXIMUM (FT3/S)	MINIMUM (FT3/S)	MEAN (FT3/S)	STANDARD DEVIATION (FT3/S)	COEFFICIENT OF VARIATION	PERCENT OF ANNUAL RUNOFF
OCTOBER	33	5.7	18	5.9	0.33	5.7
NOVEMBER	22	6.2	14	5.3	0.38	4.5
DECEMBER	502	4.7	36	103	2.9	11.6
JANUARY	310	4.7	41	76	1.8	13.3
FEBRUARY	101	4.1	22	27	1.2	7.1
MARCH	213	5.9	41	48	1.2	13.1
APRIL	69	4.3	27	18	0.64	8.9
MAY	25	5.3	18	4.3	0.24	5.7
JUNE	25	3.7	16	4.6	0.30	5.0
JULY	36	13	21	6.3	0.30	6.7
AUGUST	93	13	38	25	0.66	12.1
SEPTEMBER	42	11	20	8.8	0.45	6.4
ANNUAL	81	11	26	16	0.62	100

MAGNITUDE AND PROBABILITY OF ANNUAL LOW FLOW BASED ON PERIOD OF RECORD 1946-67

PERIOD (CONSECUTIVE DAYS)	DISCHARGE, IN FT3/S, FOR INDICATED RECURRENCE INTERVAL, IN YEARS, AND NON-EXCEEDANCE PROBABILITY, IN PERCENT					
	2	5	10	20	50	100
	50%	20%	10%	5%	2%	1%
1	4.1	3.1	2.7	2.3	2.0	1.9
3	4.2	3.1	2.7	2.4	2.1	1.9
7	4.4	3.3	2.9	2.6	2.3	2.2
14	5.1	3.9	3.4	3.1	2.8	2.7
30	5.8	4.5	4.0	3.8	3.5	3.4
60	6.8	5.0	4.4	3.9	3.6	3.3
90	7.5	5.4	4.6	4.1	3.6	3.4
120	9.1	6.6	5.6	5.0	4.3	3.9
183	12	9.4	8.2	7.3	6.5	6.0

MAGNITUDE AND PROBABILITY OF INSTANTANEOUS PEAK FLOW BASED ON PERIOD OF RECORD 1944-67, 1973

DISCHARGE, IN FT3/S, FOR INDICATED RECURRENCE INTERVAL IN YEARS, AND EXCEEDANCE PROBABILITY, IN PERCENT					
2	5	10	25	50	100
50%	20%	10%	4%	2%	1%
2,510	5,690	8,760	13,900	18,800	24,600

WEIGHTED SKEW (LOGS)= 0.03
MEAN (LOGS)= 3.40
STANDARD DEV. (LOGS)= 0.42

MAGNITUDE AND PROBABILITY OF ANNUAL HIGH FLOW BASED ON PERIOD OF RECORD 1945-67

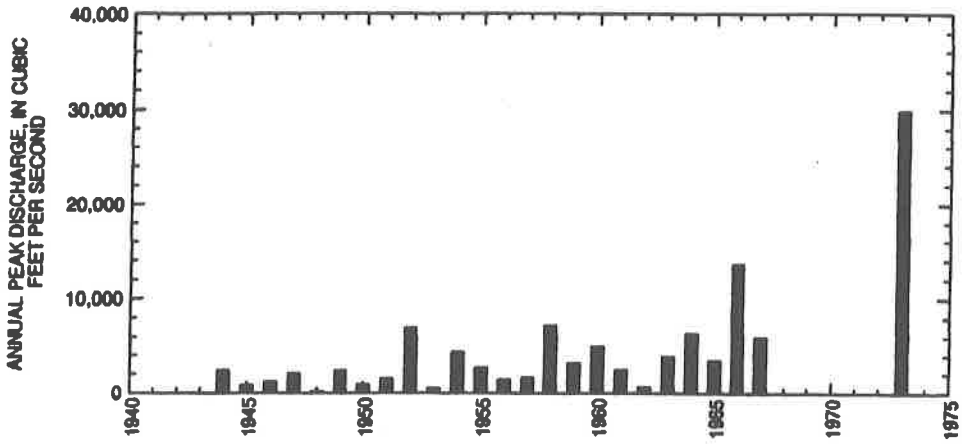
PERIOD (CONSECUTIVE DAYS)	DISCHARGE, IN FT3/S, FOR INDICATED RECURRENCE INTERVAL, IN YEARS, AND EXCEEDANCE PROBABILITY, IN PERCENT					
	2	5	10	25	50	100
	50%	20%	10%	4%	2%	1%
1	290	908	1,780	3,850	6,550	10,800
3	181	532	1,000	2,090	3,460	5,550
7	121	326	584	1,140	1,810	2,790
15	85	215	376	719	1,130	1,720
30	65	147	238	415	608	871
60	48	97	147	238	332	454
90	39	75	113	182	254	349

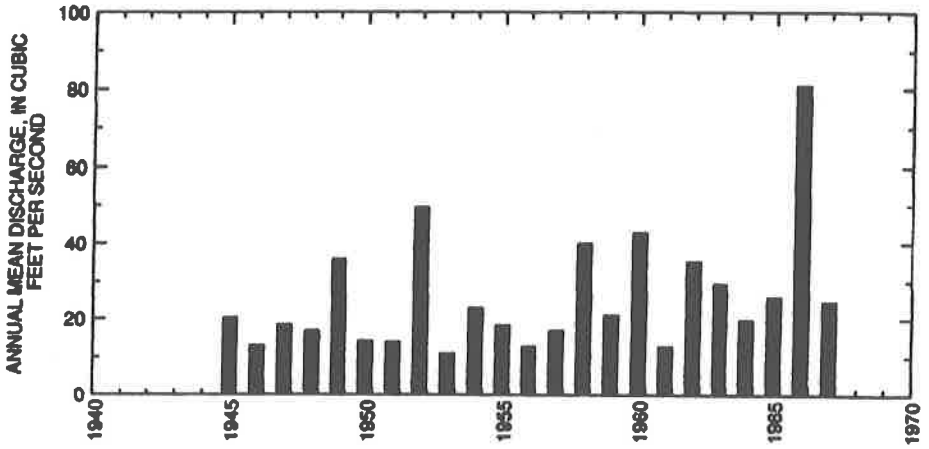
DURATION TABLE OF DAILY MEAN FLOW FOR PERIOD OF RECORD 1945-67

DISCHARGE, IN FT3/S, WHICH WAS EQUALED OR EXCEEDED FOR INDICATED PERCENT OF TIME																
1%	5%	10%	15%	20%	30%	40%	50%	60%	70%	80%	90%	95%	98%	99%	99.5%	99.9%
193	70	38	27	24	20	18	16	14	11	7.9	5.6	4.9	4.2	3.8	2.9	2.4

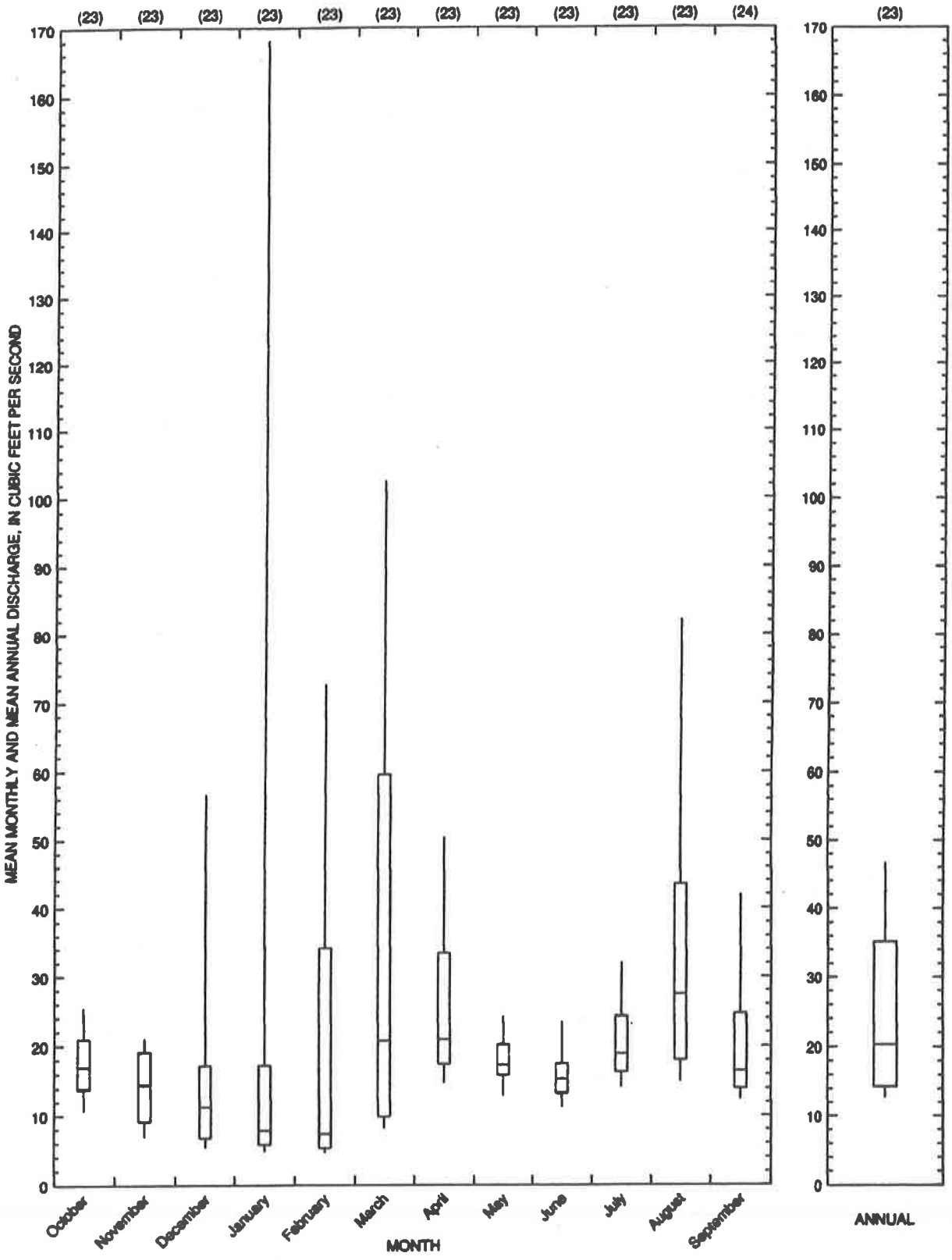
8 Reliability of values in column is uncertain, and potential errors are large.

09446500 EAGLE CREEK NEAR DOUBLE CIRCLE RANCH, NEAR MORENCI, AZ--Continued





09446500 EAGLE CREEK NEAR DOUBLE CIRCLE RANCH, NEAR MORENCI, AZ--Continued



09447000 EAGLE CREEK ABOVE PUMPING PLANT, NEAR MORENCI, AZ

LOCATION.--Lat 33°03'52", long 109°26'30", in SW$^1/_4$SE$^1/_4$ sec.23, T.4 S., R.28 E., Greenlee County, Hydrologic Unit 15040005, on right bank 2 mi upstream from Phelps Dodge Corp. pumping plant, 5 mi west of Morenci, and 12 mi upstream from mouth.

DRAINAGE AREA.--622 mi^2.

PERIOD OF RECORD.--April 1944 to current year.

REVISED RECORDS.--WSP 1850-C: 1966. WDR AZ-88-1: Drainage area.

GAGE.--Water-stage recorder. Datum of gage is 3,673.5 ft above sea level. Oct. 25, 1984 to Mar. 6, 1986, at site 1 mi upstream at datum 24.1 ft higher. Prior to Oct. 25, 1984, at various sites within 1 mi upstream from present site at different datums. Aug. 23, 1950 to Aug. 1, 1981, and since Mar. 6, 1984, supplementary gages at various sites within 1 mi upstream from present site at different datums. Feb. 7, 1993 to July 2, 1993 on right bank at different datum.

REMARKS.--Diversions above station for irrigation of about 500 acres, mostly above Willow Creek. Water from Black River was pumped into Eagle Creek basin, 52 mi upstream from this station, for the entire year and water was pumped from wells into Eagle Creek near Double Circle Ranch below Willow Creek for 7 months. The monthly quantities pumped are shown in table below. Diversion by pumping for industrial and municipal use in and near Morenci and Clifton are made from Eagle Creek, 3 mi downstream from this station and from San Francisco River near Clifton. Monthly quantities diverted are shown in the table below; 98 percent of the pumpage was from Eagle Creek.

AVERAGE DISCHARGE (unadjusted).--52 years, 70.5 ft^3/s, 51,080 acre-ft/yr; median of yearly mean discharges, 38 ft^3/s, 27,500 acre-ft/yr.

EXTREMES FOR PERIOD OF RECORD.--Maximum discharge, 36,800 ft^3/s Jan. 18, 1993, on basis of slope-area measurement; minimum, 2.9 ft^3/s June 25, 1982.

Annual peak discharges

Water year	Date	Annual peak discharge (ft^3/s)	Discharge codes	Water year	Date	Annual peak discharge (ft^3/s)	Discharge codes
1916	01-18-16	36,000	ES,HP	1970	07-23-70	560	
1932	02-10-32	13,000	HP	1971	08-22-71	1,680	
1944	00-00-44	7,500		1972	07-16-72	6,650	
1945	08-11-45	433		1973	10-19-72	14,000	
1946	08-07-46	384		1974	08-03-74	630	
1947	08-08-47	710		1975	09-09-75	1,550	
1948	08-05-48	300		1976	07-29-76	2,250	
1949	01-13-49	2,500		1977	07-31-77	2,190	
1950	07-28-50	470		1978	03-02-78	3,900	
1951	08-28-51	1,260		1979	12-18-78	24,500	
1952	01-14-52	5,340		1980	02-15-80	9,000	
1953	07-25-53	2,780		1981	08-07-81	3,380	
1954	07-22-54	4,930		1982	08-23-82	1,720	
1955	08-06-55	3,260		1983	03-25-83	6,210	
1956	07-30-56	452		1984	10-02-83	36,400	
1957	07-26-57	4,210		1985	12-28-84	8,400	
1958	09-10-58	6,150		1986	10-17-85	1,030	
1959	08-17-59	4,780		1987	11-03-86	1,990	
1960	01-12-60	5,350		1988	08-15-88	3,770	
1961	09-12-61	1,210		1989	08-18-89	97	
1962	07-18-62	1,850		1990	07-16-90	698	
1963	08-30-63	6,150		1991	03-02-91	13,500	
1964	07-15-64	8,620		1992	02-14-92	6,920	
1965	08-01-65	3,080		1993	01-18-93	[1]36,800	
1966	12-30-65	21,000		1994	09-03-94	513	
1967	08-12-67	7,650		1995	01-05-95	20,000	
1968	12-06-70	3,300		1996	09-14-96	95	
1969	07-25-69	250					

[1]Highest since 1916.

09447000 EAGLE CREEK ABOVE PUMPING PLANT, NEAR MORENCI, AZ--Continued

Discharge rating table developed October 1994

Gage height (ft)	Discharge (ft^3/s)	Gage height (ft)	Discharge (ft^3/s)
2.0	42	9.0	7,220
3.0	64	10.0	9,550
4.0	164	11.0	12,100
5.0	655	12.0	14,870
6.0	1,800	13.0	17,830
7.0	3,320	14.0	20,990
8.0	5,130	14.4	22,300

Basin characteristics

Main channel slope (ft/mi)	Stream length (mi)	Mean basin elevation (ft)	Forested area (percent)	Soil index	Mean annual precipitation (in)	Rainfall intensity, 24-hour	
						2-year (in)	50-year (in)
60.9	52.5	6,060	64.0	2.8	19.2	2.0	3.8

09447000 EAGLE CREEK ABOVE PUMPING PLANT, NEAR MORENCI, AZ--Continued

MEAN MONTHLY AND ANNUAL DISCHARGES 1945-96

MONTH	MAXIMUM (FT3/S)	MINIMUM (FT3/S)	MEAN (FT3/S)	STANDARD DEVIATION (FT3/S)	COEFFICIENT OF VARIATION	PERCENT OF ANNUAL RUNOFF
OCTOBER	1,170	13	60	164	2.8	7.1
NOVEMBER	228	10	35	35	1.0	4.2
DECEMBER	884	11	87	160	1.8	10.2
JANUARY	4,440	11	184	630	3.4	21.7
FEBRUARY	1,760	11	135	290	2.1	16.0
MARCH	709	14	109	151	1.4	12.9
APRIL	214	11	53	41	0.78	6.3
MAY	84	9.2	33	16	0.50	3.9
JUNE	49	5.3	25	9.4	0.38	2.9
JULY	98	16	37	17	0.45	4.4
AUGUST	203	19	55	38	0.70	6.5
SEPTEMBER	114	13	35	19	0.54	4.1
ANNUAL	568	17	71	86	1.2	100

MAGNITUDE AND PROBABILITY OF ANNUAL LOW FLOW BASED ON PERIOD OF RECORD 1945-96

PERIOD (CONSECUTIVE DAYS)	DISCHARGE, IN FT3/S, FOR INDICATED RECURRENCE INTERVAL, IN YEARS, AND NON-EXCEEDANCE PROBABILITY, IN PERCENT					
	2	5	10	20	50	100
	50%	20%	10%	5%	2%	1%
1	12	7.2	5.4	4.2	3.2	2.6
3	12	7.6	5.7	4.5	3.4	2.7
7	14	8.4	6.3	4.9	3.7	3.0
14	15	9.8	7.5	5.9	4.5	3.7
30	17	12	9.0	7.2	5.5	4.6
60	19	13	11	8.9	7.2	6.2
90	20	14	12	9.9	8.1	7.1
120	23	16	13	11	9.6	8.5
183	26	20	17	15	13	12

MAGNITUDE AND PROBABILITY OF INSTANTANEOUS PEAK FLOW BASED ON PERIOD OF RECORD 1944-96

DISCHARGE, IN FT3/S, FOR INDICATED RECURRENCE INTERVAL IN YEARS, AND EXCEEDANCE PROBABILITY, IN PERCENT					
2	5	10	25	50	100
50%	20%	10%	4%	2%	1%
2,730	8,300	14,400	24,900	35,000	47,000

WEIGHTED SKEW (LOGS) = -0.32
MEAN (LOGS) = 3.40
STANDARD DEV. (LOGS) = 0.61

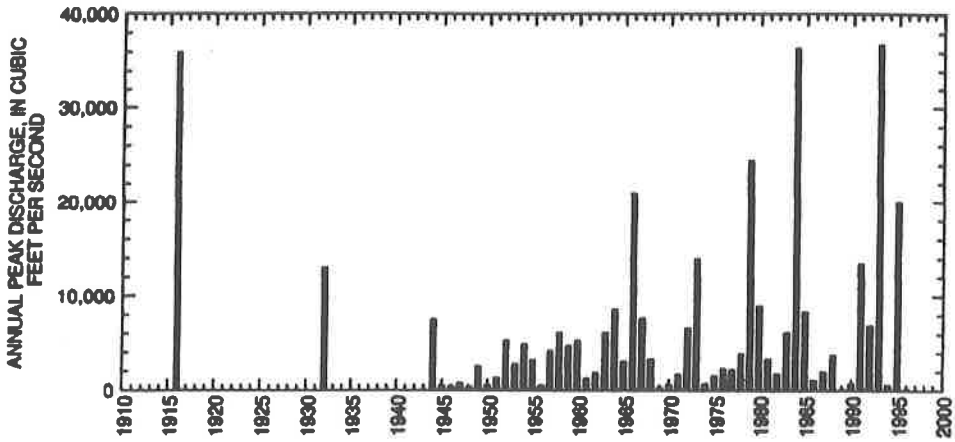
MAGNITUDE AND PROBABILITY OF ANNUAL HIGH FLOW BASED ON PERIOD OF RECORD 1945-96

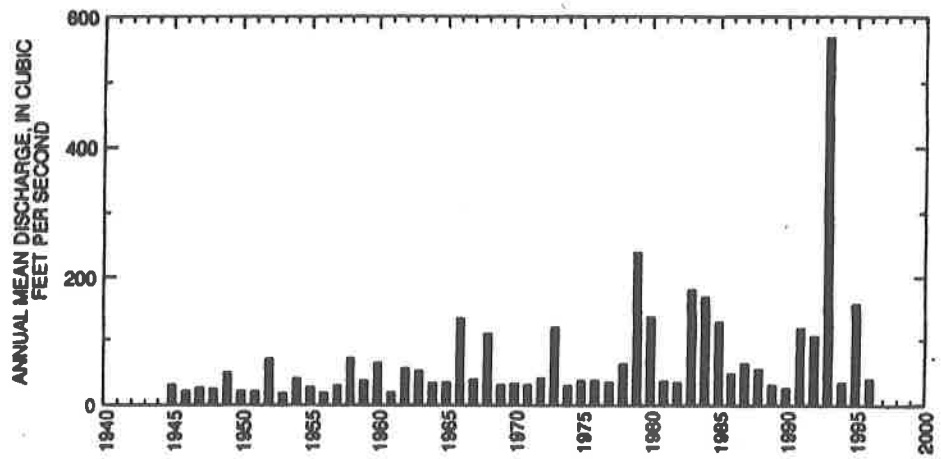
PERIOD (CONSECUTIVE DAYS)	DISCHARGE, IN FT3/S, FOR INDICATED RECURRENCE INTERVAL, IN YEARS, AND EXCEEDANCE PROBABILITY, IN PERCENT					
	2	5	10	25	50	100
	50%	20%	10%	4%	2%	1%
1	708	2,900	6,320	14,900	26,400	44,700
3	428	1,700	3,690	8,860	16,000	27,700
7	271	987	2,080	4,860	8,670	14,900
15	180	605	1,240	2,870	5,120	8,840
30	132	394	756	1,610	2,730	4,480
60	96	267	500	1,050	1,750	2,870
90	79	208	379	769	1,260	2,030

DURATION TABLE OF DAILY MEAN FLOW FOR PERIOD OF RECORD 1945-96

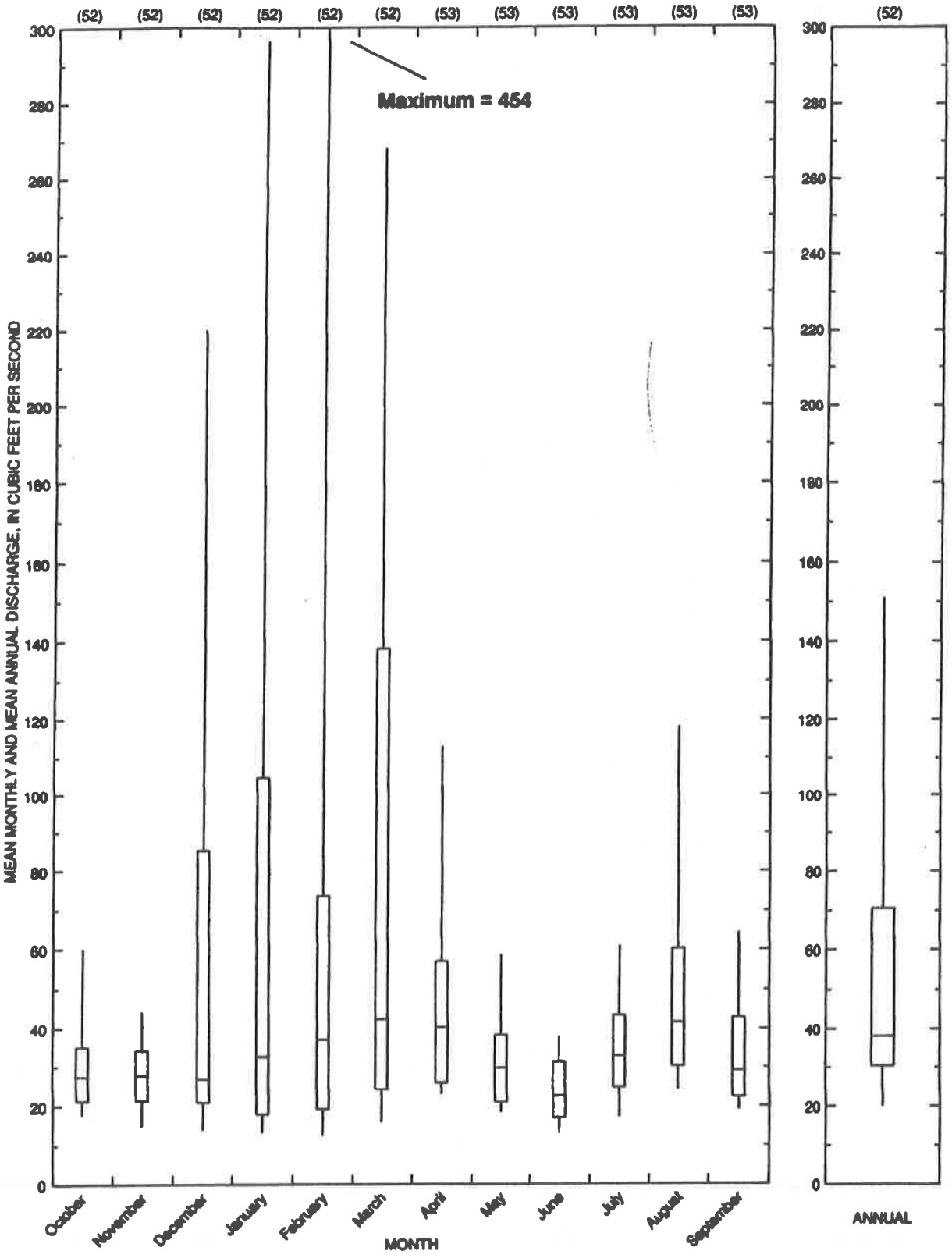
DISCHARGE, IN FT3/S, WHICH WAS EQUALED OR EXCEEDED FOR INDICATED PERCENT OF TIME																
1%	5%	10%	15%	20%	30%	40%	50%	60%	70%	80%	90%	95%	98%	99%	99.5%	99.9%
686	168	88	58	46	38	33	30	26	23	19	15	12	10	9.0	7.3	4.2

09447000 EAGLE CREEK ABOVE PUMPING PLANT, NEAR MORENCI, AZ--Continued





09447000 EAGLE CREEK ABOVE PUMPING PLANT, NEAR MORENCI, AZ--Continued



APPENDIX C.3

GLO SURVEY INFORMATION SUMMARY

EAGLE CREEK: GLO SURVEY INFORMATION

Location Information	Stream Information					Boundary Crossing Location Information		Reference Information		
Section Boundary	Date	Width (Links)	Width (Feet)	Depth (Inches)	Comments	Heading	Measure (Chains)	Surveyor	Volume	Page
4S28E 25/26	12/12/1913	60	39.6	12	course SE	N	14.10	W.B. Kimmel	2773	2
4S28E 25/24	12/20/1913	60	39.6	6	course SW	W	~75.00	W.B. Kimmel	2773	4
4S28E 24/23	12/20/1913	100	66.0	4	south edge of water, 125 ft deep canyon, course SE	N	40.00	W.B. Kimmel	2773	5
4S28E 23/22	12/18/1913	25	16.5	24	south bank, course SE	N	40.35	W.B. Kimmel	2773	11
4S28E 22/15	12/31/1913	60	39.6	5	course SE	W	16.75	W.B. Kimmel	2773	18
4S28E 15/10	1/1/1914	---	---	---	west bank, N-S bluff 100 ft high	E	37.25	W.B. Kimmel	2773	20
4S28E 10/3	1/4/1914	100	66.0	6	course SW	E	62.80	W.B. Kimmel	2773	22
4S28E 3/4	1/5/1914	25	16.5	24	course SE, thence follow west bank	N	33.05	W.B. Kimmel	2773	22
4S28E 3/4	1/5/1914	25	16.5	24	bend from NE course SE	N	42.20	W.B. Kimmel	2773	22
4S28E 4/5	1/7/1914	60	39.6	24	course E, foot of bluff	N	38.00	W.B. Kimmel	2773	25
4S28E 5/3S28E 32	1/7/1914	80	52.8	12	course S	W	42.82	W.B. Kimmel	2773	28
White Mountain Indian Reservation East Boundary Mile 50-51	11/7/1913	60	39.6	---	150 ft precipice, clear water, course E	S	66.98	W.B. Kimmel	2768	40
White Mountain Indian Reservation East Boundary Mile 51-52	11/7/1913	60	39.6	18	75 ft deep canyon, course E	S	~10.00	W.B. Kimmel	2768	41
White Mountain Indian Reservation East Boundary Mile 51-52	11/7/1913	75	49.5	3	course SE	S	44.50	W.B. Kimmel	2768	41
White Mountain Indian Reservation East Boundary Mile 53-54	11/10/1913	20	13.2	24	course W	S	29.35	W.B. Kimmel	2768	44
White Mountain Indian Reservation East Boundary Mile 54-55	11/10/1913	85	56.1	8	course SW	S	11.50	W.B. Kimmel	2768	45
White Mountain Indian Reservation East Boundary Mile 54-55	11/10/1913	75	49.5	6	course SE	S	29.00	W.B. Kimmel	2768	45
White Mountain Indian Reservation East Boundary Mile 54-55	11/10/1913	60	39.6	6	course SW	S	?	W.B. Kimmel	2768	45
2S28E 5/1S28E 32	3/25/1914	10	6.6	24	course SW	W	44.50	W.B. Kimmel	2768	49
2S28E 5/1S28E 32	3/25/1914	30	19.8	8	course NW	W	56.00	W.B. Kimmel	2768	49
White Mountain Indian Reservation East Boundary Mile 36-37	11/2/1913	---	---	---	descend west bank of Eagle Creek, 15 ft	S	50.00	W.B. Kimmel	2768	30
White Mountain Indian Reservation East Boundary Mile 36-37	11/2/1913	---	---	---	thence along old channel of creek	S	52.00	W.B. Kimmel	2768	30
White Mountain Indian Reservation East Boundary Mile 36-37	11/2/1913	---	---	---	one channel of Eagle Creek, course SW	S	56.25	W.B. Kimmel	2768	30
White Mountain Indian Reservation East Boundary Mile 36-37	11/2/1913	70	46.2	3	main channel of Eagle Creek, course SW, clear water	S	63.40	W.B. Kimmel	2768	30
White Mountain Indian Reservation East Boundary Mile 37-38	11/3/1913	50	33.0	3	main channel of Eagle Creek, course SE, clear water	S	8.45	W.B. Kimmel	2768	31
White Mountain Indian Reservation East Boundary Mile 40-41	11/3/1913	---	---	---	main channel of Eagle Creek, course SW	S	23.30	W.B. Kimmel	2768	33
White Mountain Indian Reservation East Boundary Mile 40-41	11/3/1913	---	---	---	channel of Eagle Creek, course W	S	24.25	W.B. Kimmel	2768	33
White Mountain Indian Reservation East Boundary Mile 40-41	11/3/1913	---	---	---	channel of Eagle Creek, course SW	S	27.00	W.B. Kimmel	2768	33
White Mountain Indian Reservation East Boundary Mile 40-41	11/3/1913	---	---	---	enter channel of Eagle Creek	S	37.65	W.B. Kimmel	2768	33
White Mountain Indian Reservation East Boundary Mile 40-41	11/3/1913	---	---	---	point for 40.5 mile corner falls in Eagle Creek	S	40.00	W.B. Kimmel	2768	33
White Mountain Indian Reservation East Boundary Mile 40-41	11/3/1913	---	---	---	leave Eagle Creek, course SW, ascend steep 75 ft bluff	S	67.00	W.B. Kimmel	2768	33
White Mountain Indian Reservation East Boundary Mile 41-42	11/4/1913	60	39.6	12	course SE	S	57.13	W.B. Kimmel	2768	34
White Mountain Indian Reservation East Boundary Mile 42-43	11/4/1913	---	---	---	north bank of 100 ft deep box canyon course S 15° W, Eagle Creek in bottom	S	61.16	W.B. Kimmel	2768	35
1S28E 32/29	3/26/1914	---	---	---	enter Eagle Creek bottom	W	58.00	W.B. Kimmel	2775	22
1S28E 29/20	3/26/1914	---	---	---	no record of Eagle Creek	W	---	W.B. Kimmel	2775	24
1S28E 20/17	3/26/1914	40	26.4	6	course S	W	34.90	W.B. Kimmel	2775	26
1S28E 17/8	3/27/1914	40	26.4	6	course SE	W	44.00	W.B. Kimmel	2775	28
1S28E 8/5	3/27/1914	20	13.2	8	course S	W	58.40	W.B. Kimmel	2775	30
1S28E 5/1N28E 31	10/1/1902	---	---	---	Eagle Creek bottom bears N 20° E and S 20° W	W	79.50	W.H. Thom	1811	13
1N28E 31/30	4/23/1914	65	42.9	4	course S	W	38.60	W.B. Kimmel	2776	25
1N28E 30/19	4/23/1914	120	79.2	1-8	course SE	W	34.80	W.B. Kimmel	2776	27
1N28E 19/18	4/24/1914	40	26.4	14	course SE	W	38.76	W.B. Kimmel	2776	29
1N28E 18/7	4/27/1914	18	11.9	12	course SE	W	50.22	W.B. Kimmel	2776	31
1N28E 7/6	4/27/1914	25	16.5	2-14	course S	W	6.40	W.B. Kimmel	2776	33
1N28E 6/5	4/28/1914	40	26.4	1-12	course SW	W	61.70	W.B. Kimmel	2776	34
1N28E 5/2N28E 32	4/25/1914	30	19.8	1-14	course SW	W	74.25	W.B. Kimmel	2768	52

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