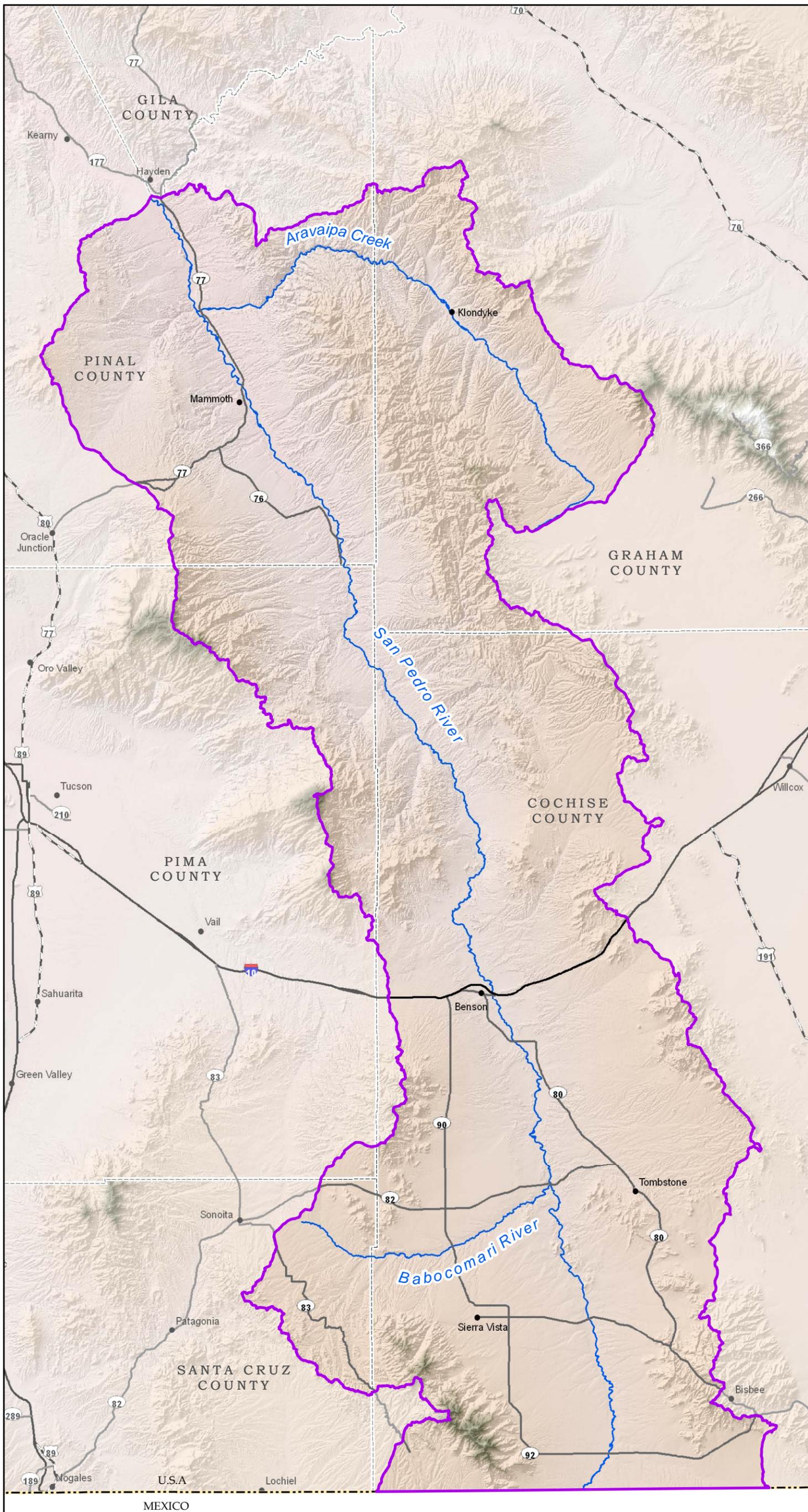


Figures



Legend

Adjudication Area

- Gila River
- Little Colorado River
- City or Town
- Major Stream
- San Pedro River Watershed
- Interstate Highway
- U.S. Route
- State Highway
- County
- State Boundary
- International Boundary

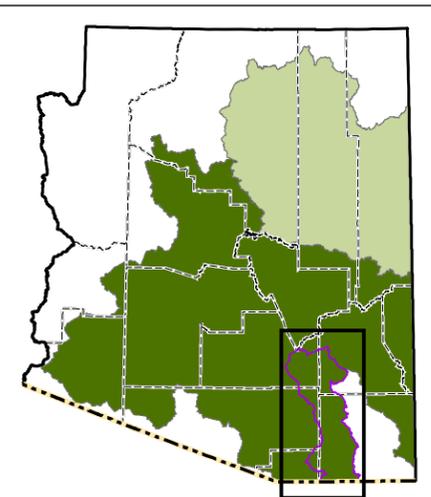
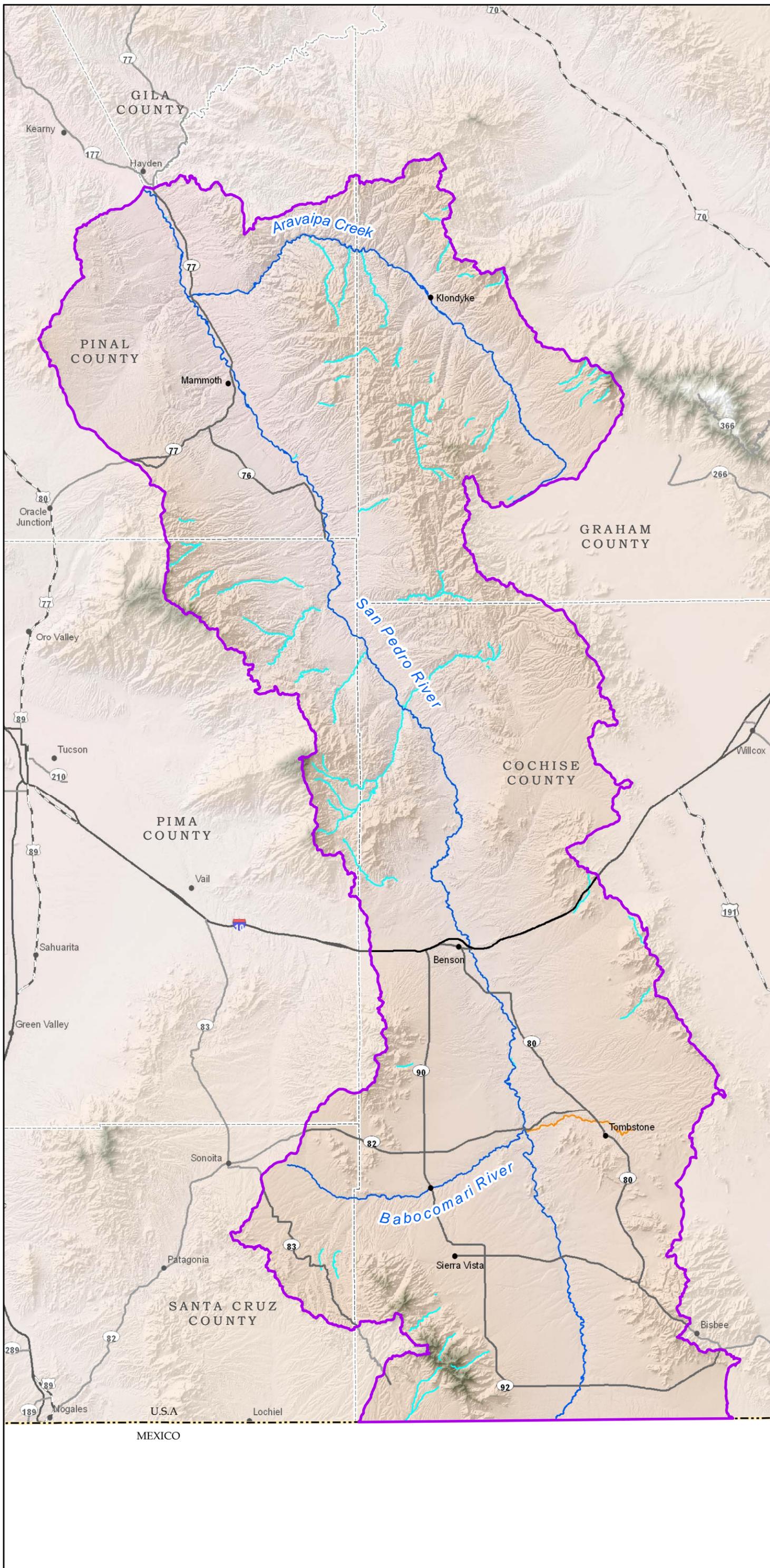


Figure 1-1
Location of the San Pedro River Watershed

Subflow Zone Delineation Report for the San Pedro River Watershed



Legend

-  Potential Perennial or Intermittent Mountain Front Streams (Valencia and others, 1993 and Wahl and others, 1997)
-  Effluent-Dominated Reach (ADEQ, 2002)
-  Major Streams Evaluated in this Report
-  City or Town
-  San Pedro River Watershed
-  Interstate Highway
-  U.S. Route
-  State Highway
-  County
-  State Boundary
-  International Boundary

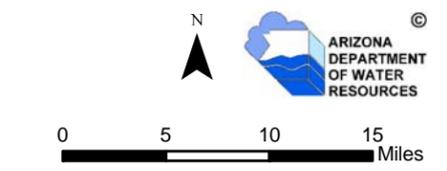
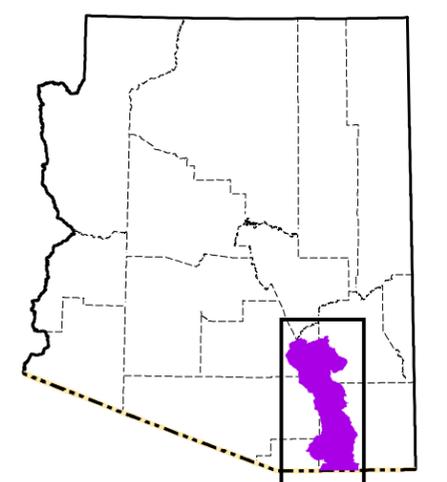


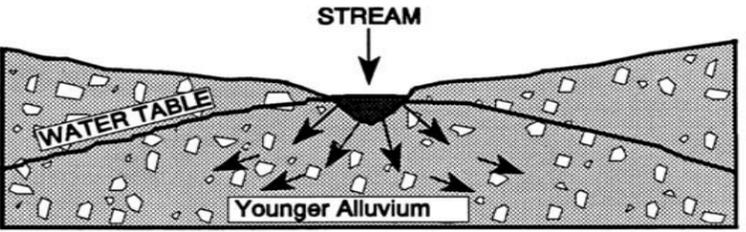
Figure 1-2
 Map of Effluent-Dominated Reaches and Potential Perennial and Intermittent Mountain Front Streams

Subflow Zone Delineation Report for the San Pedro River Watershed

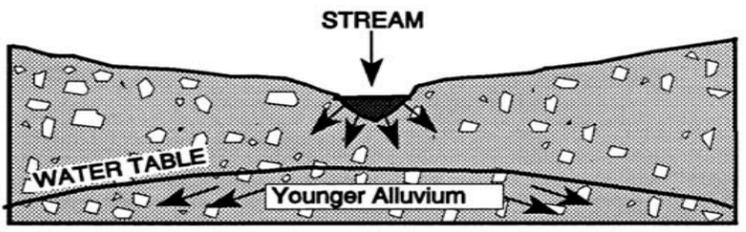
PERENNIAL STREAMS



Gaining Reach

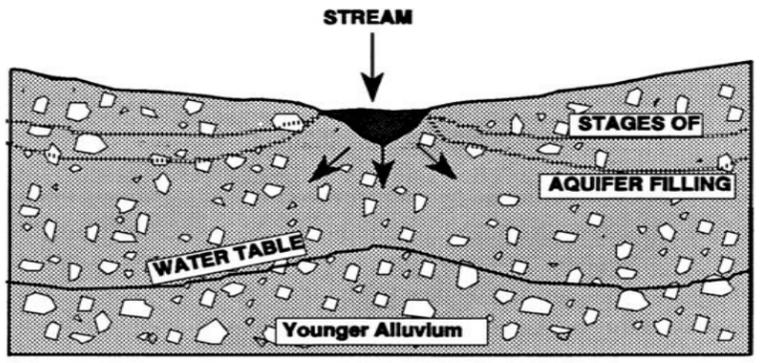


Losing Reach

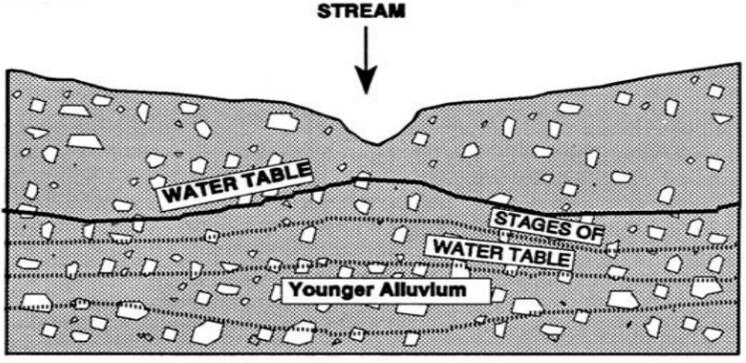


Losing Reach (becoming intermittent or ephemeral)

INTERMITTENT STREAMS



Flowing Reach



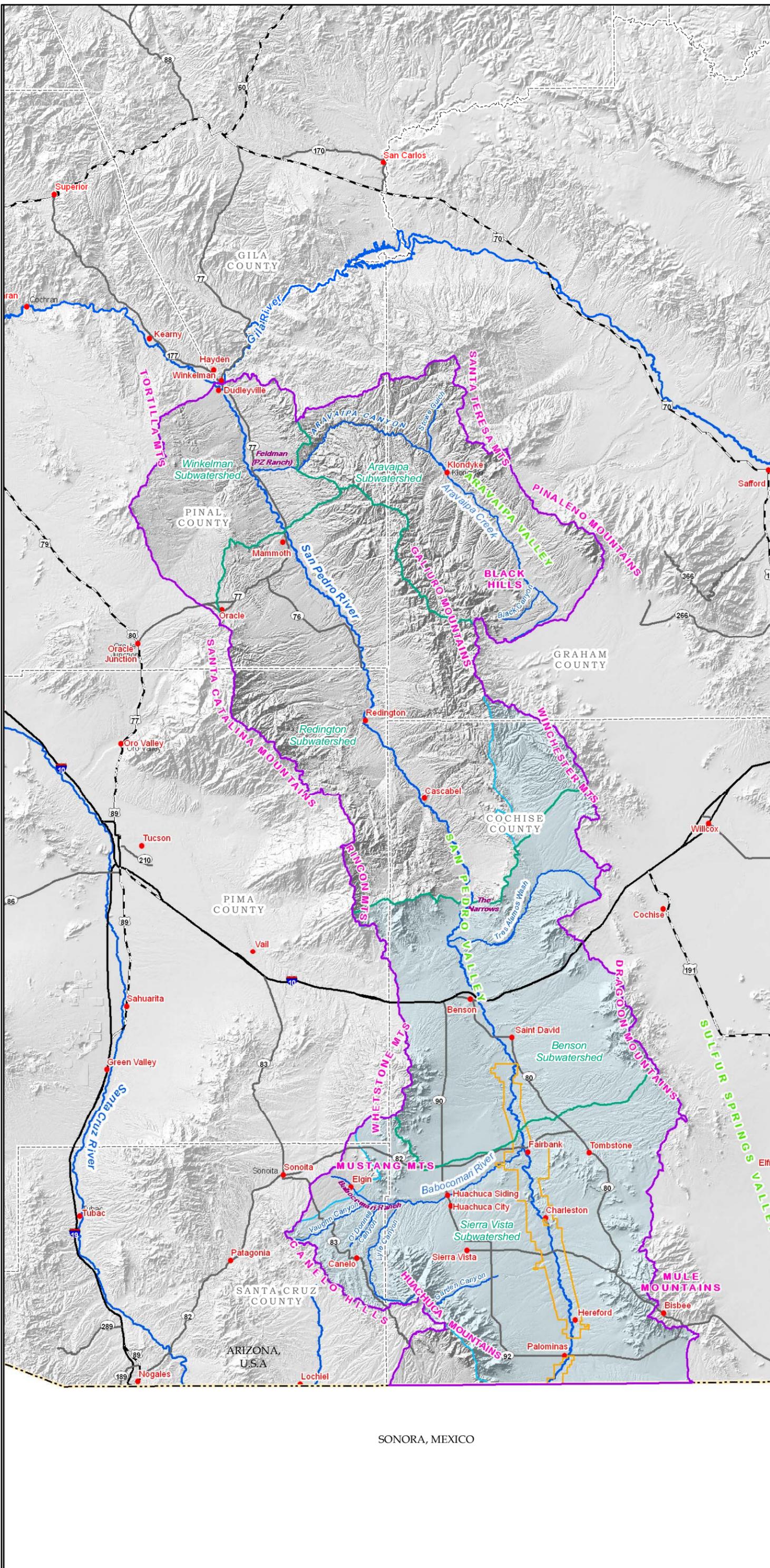
Dry Reach

Figure 2-1
Diagrams of Perennial
and Intermittent
Streamflow Conditions

Subflow Zone Delineation
Report for the San Pedro
River Watershed



Source: ADWR (1993)



Legend

- City or Town
- San Pedro River Watershed
- San Pedro River Subwatersheds
- Upper San Pedro Basin
- San Pedro Riparian National Conservation Area (SPRNCA) Boundary
- ~~~~~ River or Stream
- Interstate Highway
- U.S. Route
- State Highway
- County
- State Boundary
- International Boundary

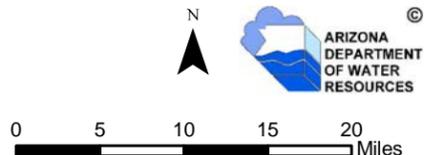
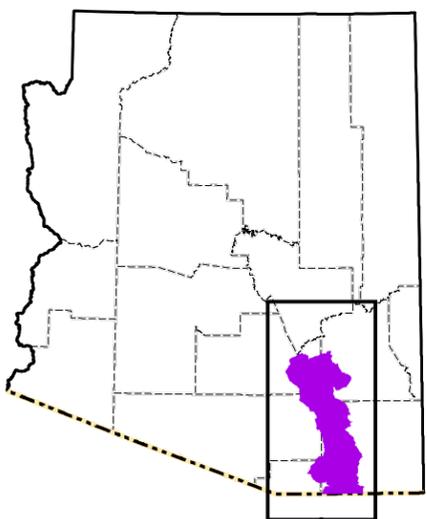
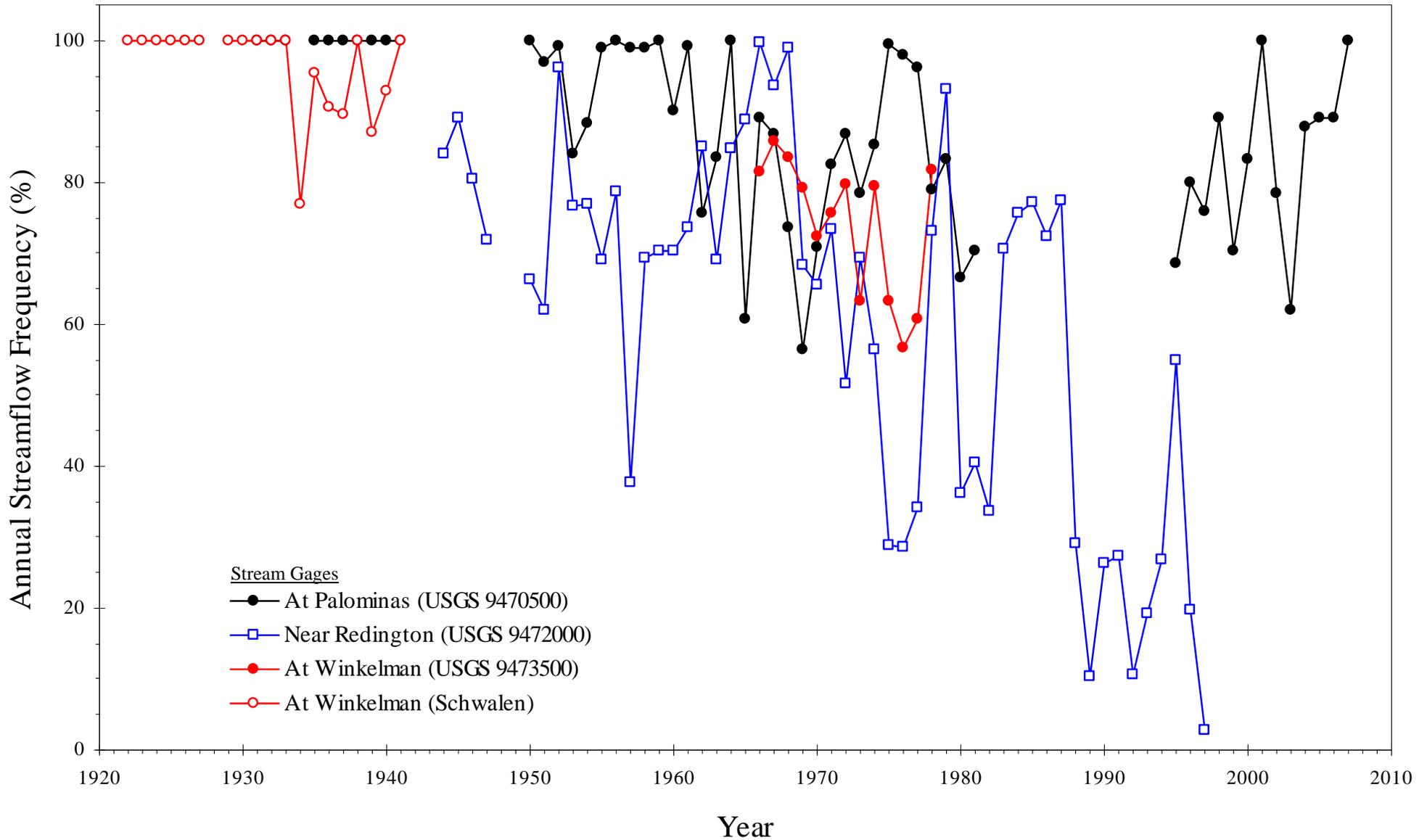


Figure 3-1
 Geographic Features in the San Pedro River Watershed

Subflow Zone Delineation Report for the San Pedro River Watershed



Notes:

- (1) See Figure 3-8 for location of gaging stations.
- (2) Frequency represents percentage (%) of days each year with measurable flow.
- (3) Data gaps reflect break in period of record.

Sources: Schwalen (1922-41) and USGS (2008)

Figure 3-2
 Change in Frequency of San Pedro River Streamflows Since the 1920s
 Subflow Zone Delineation Report for the San Pedro River Watershed



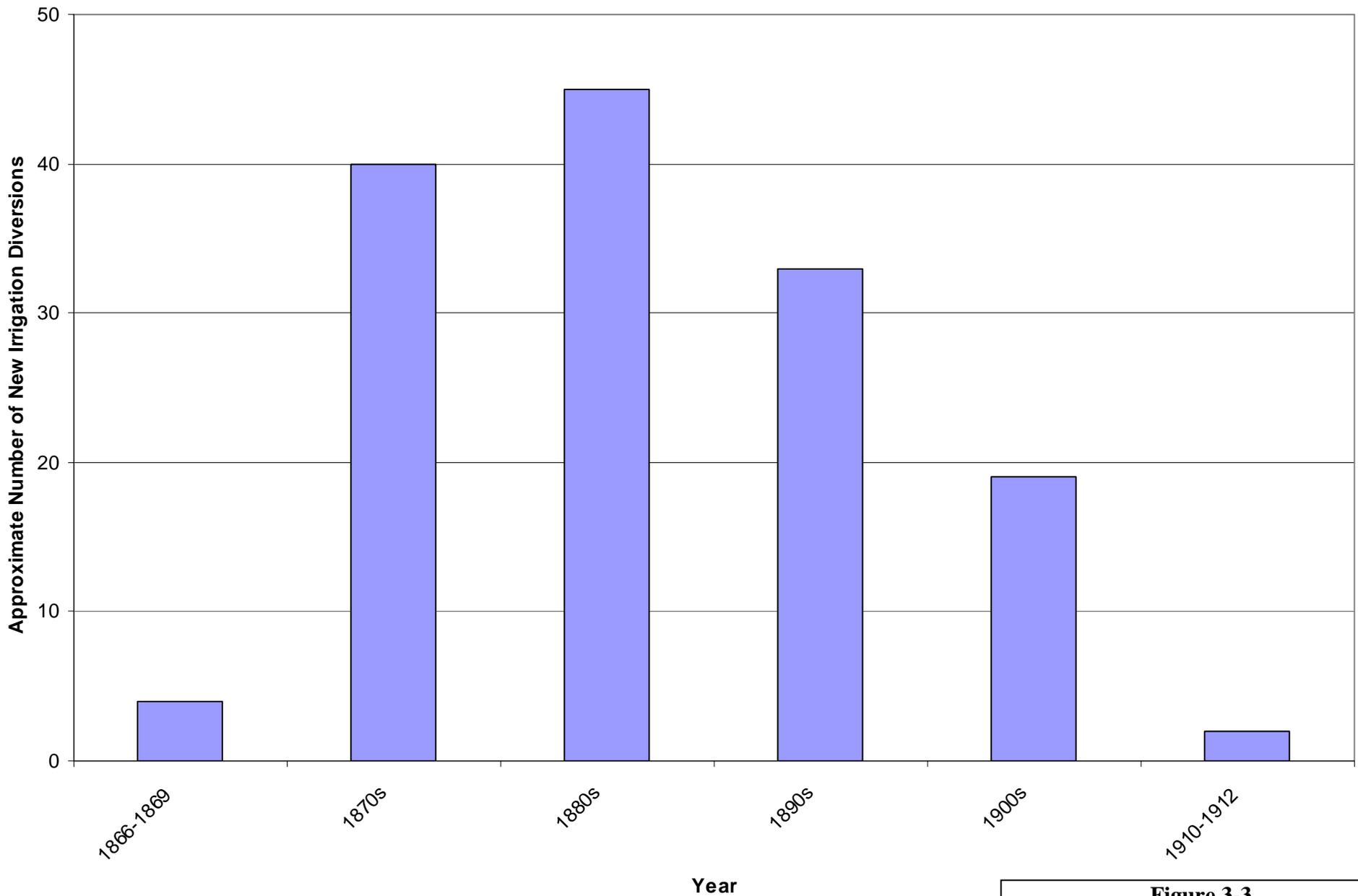


Figure 3-3
 Approximate Number of New Irrigation
 Diversions in the San Pedro River
 Watershed from 1866-1912
 Subflow Zone Delineation Report for the
 San Pedro River Watershed

Note: Some diversions were only specified in Notices Of
 Appropriation (NOAs) and may not have actually been constructed.
 See Section 3.2.2

Source: Rogers (2007)



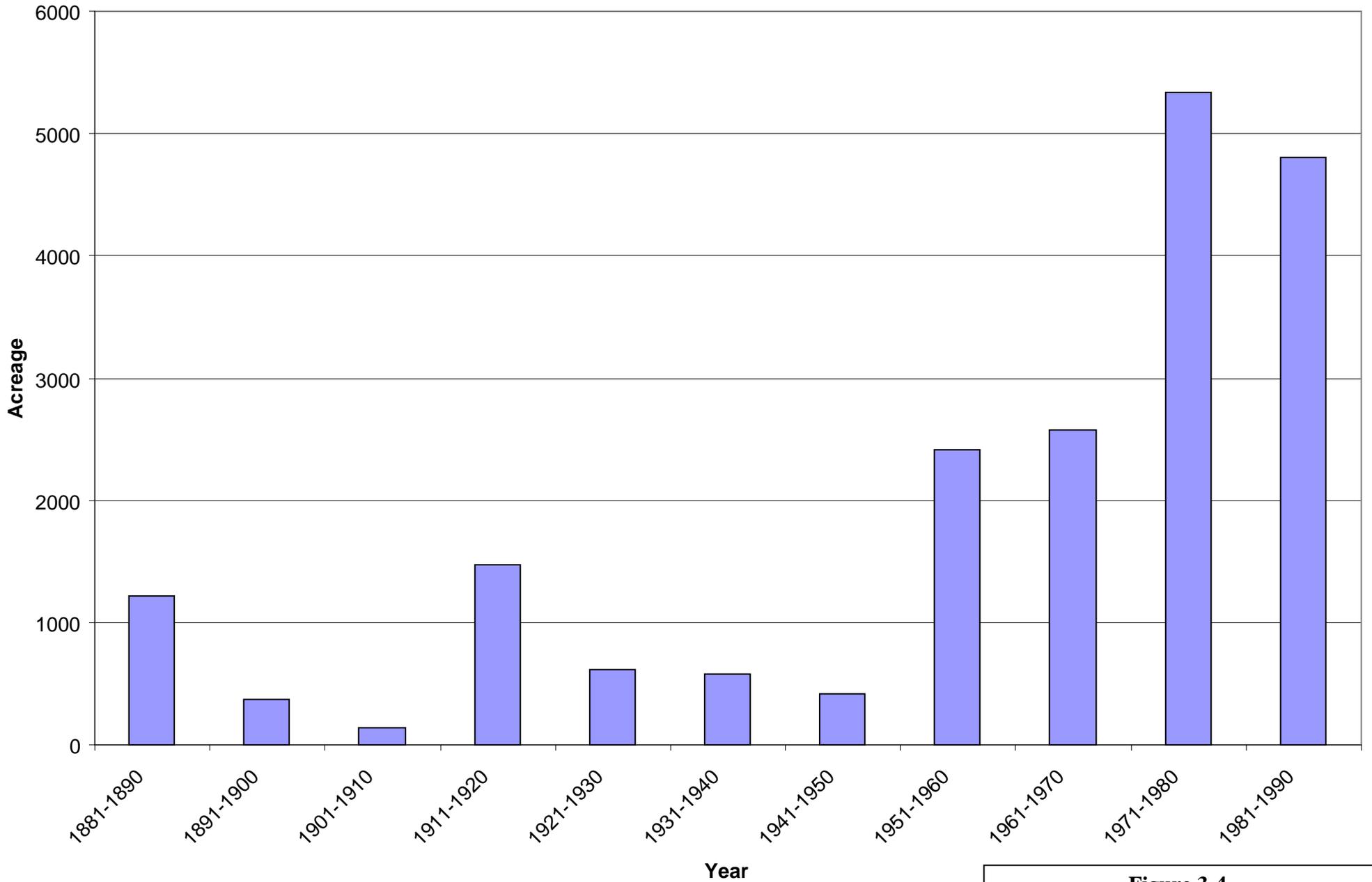


Figure 3-4
 Acreage of Irrigated Lands in the San Pedro River Watershed from 1881-1990
 Subflow Zone Delineation Report for the San Pedro River Watershed

Source: ADWR (1991)



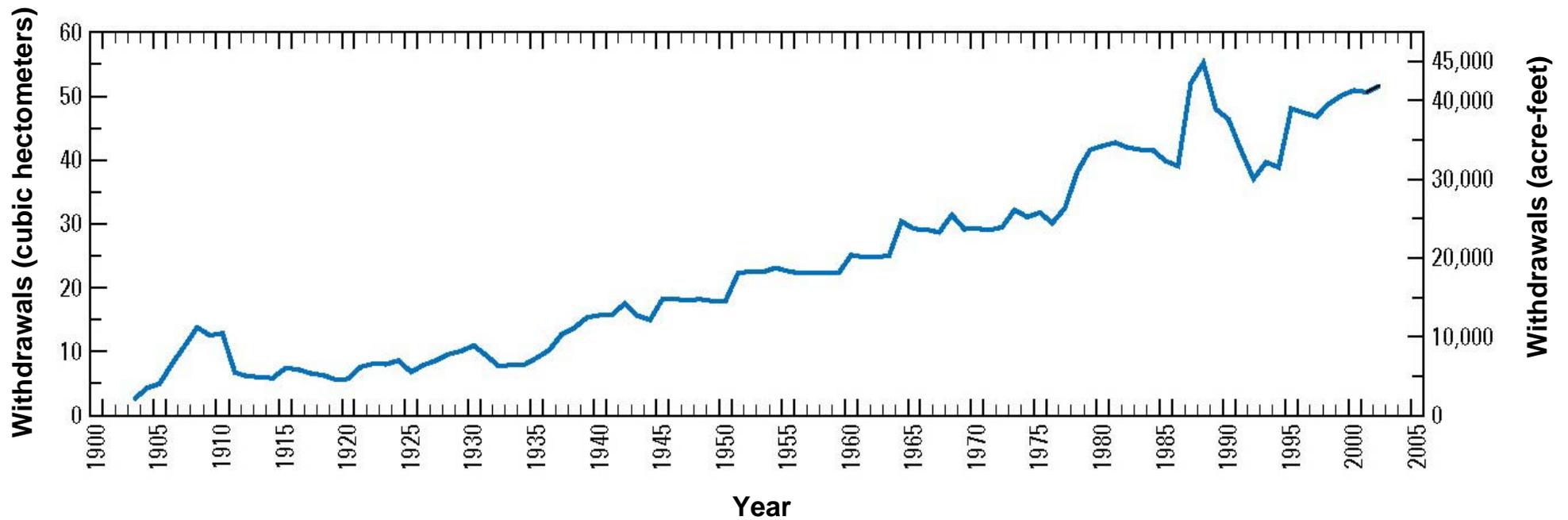
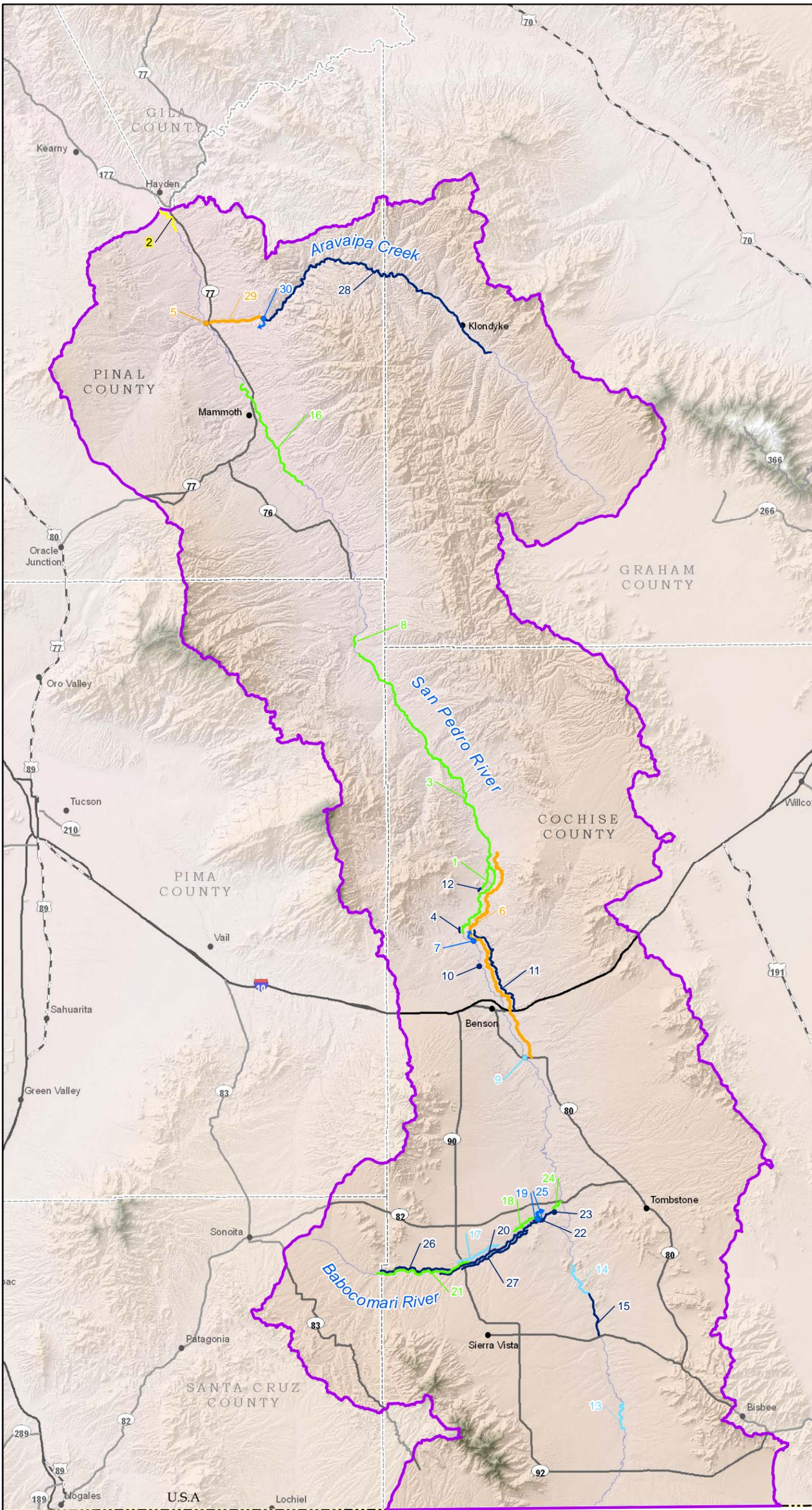


Figure 3-5
 Quantity of Underground Water
 Withdrawn from Wells and Mines in the
 Sierra Vista and Sonoran Portions of the
 Upper San Pedro Basin from 1903-2002

Subflow Zone Delineation Report for the
 San Pedro River Watershed

Source: Pool and Dickinson (2007)





Legend

Streamflow Conditions

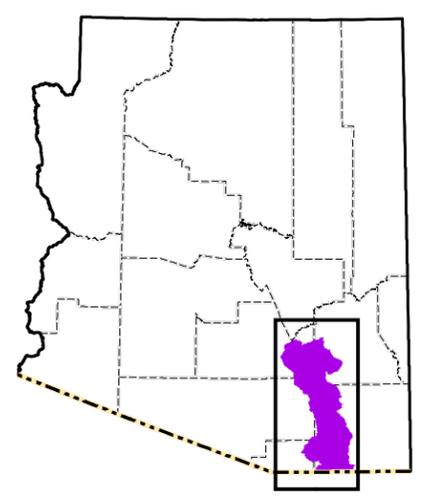
- Perennial/Cienega
- Entire Flow Diverted, Ephemeral Downstream
- Water Available, Flow Not Specified
- Intermittent/ Interrupted Perennial
- Intermittent or Ephemeral
- Ephemeral/No Flow

- San Pedro River Watershed
- City or Town
- Major Stream
- Interstate Highway
- U.S. Route
- State Highway
- County
- State Boundary
- International Boundary

Notes:

(1) See Table 3-1 for map key, data sources and additional information.

(2) Only major streams in watershed considered.

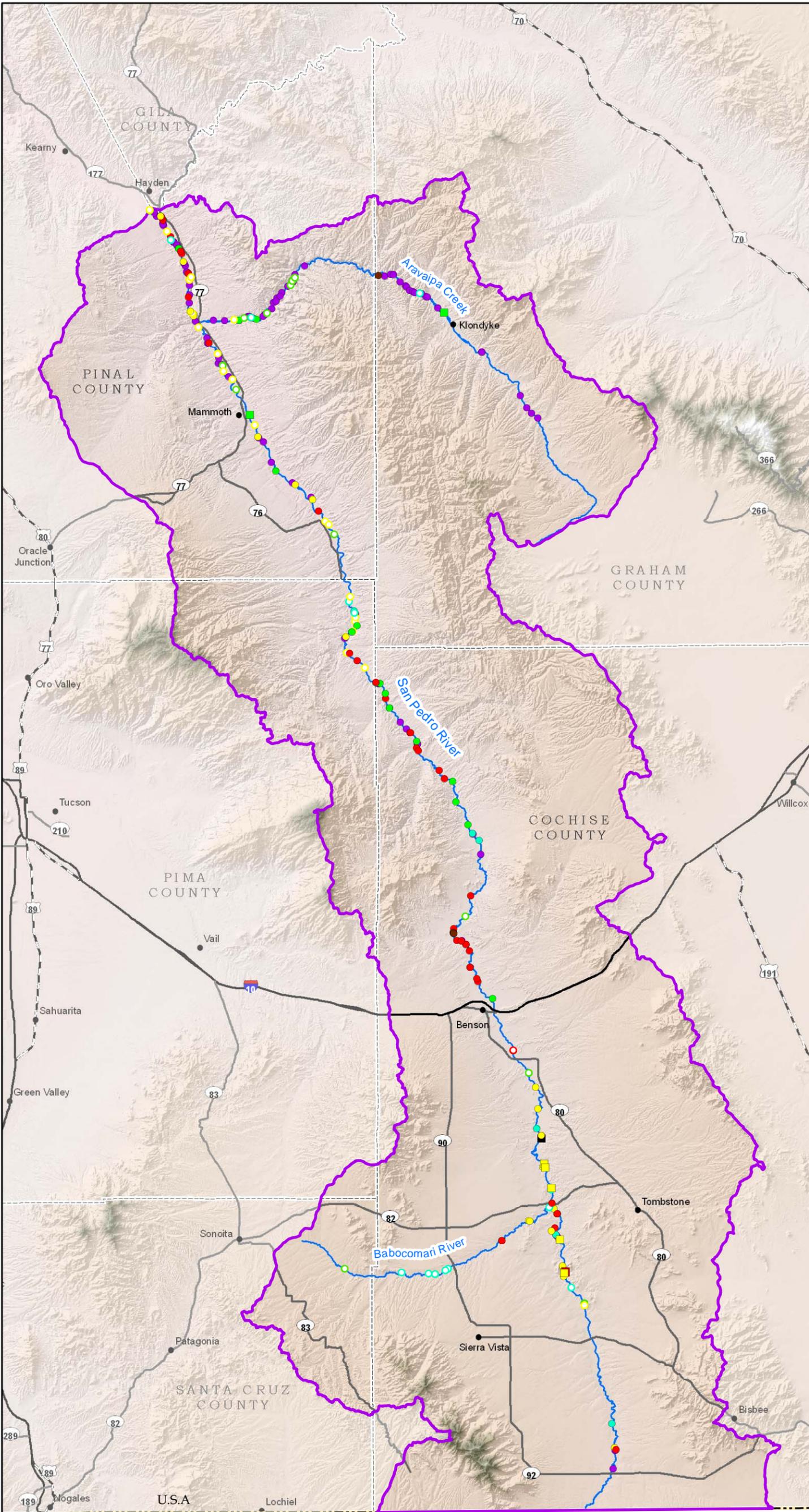


N
 ARIZONA DEPARTMENT OF WATER RESOURCES ©

0 5 10 15
 Miles

Figure 3-6
Historic Accounts of Streamflow Conditions

Subflow Zone Delineation Report for the San Pedro River Watershed



Legend

- Irrigation Ditch Diversions**
- On or before 1869
 - 1870 to 1879
 - 1870 to 1879 (from NOA)
 - 1880 to 1889
 - 1880 to 1889 (from NOA)
 - 1890 to 1899
 - 1890 to 1899 (from NOA)
 - On or after 1900
 - On or after 1900 (from NOA)
 - 1920-1923 Survey

Ore Mills

- 1870 to 1879
- 1880 to 1889
- 1890 to 1899
- Unknown

- San Pedro River Watershed
- ~ Major Stream
- City or Town
- ~ Interstate Highway
- ~ U.S. Route
- ~ State Highway
- County
- State Boundary
- International Boundary

Notes:

- (1) Data from Rogers (2007) except for 1920 to 1923 ditch survey by Arizona State Water Commissioner (1920-1923).
- (2) Based on historic maps, county and court records, government reports, and Notices of Appropriation (NOAs).
- (3) List of ditch and mill names and detailed maps presented in Appendix B-2.
- (4) Only major streams in watershed considered.

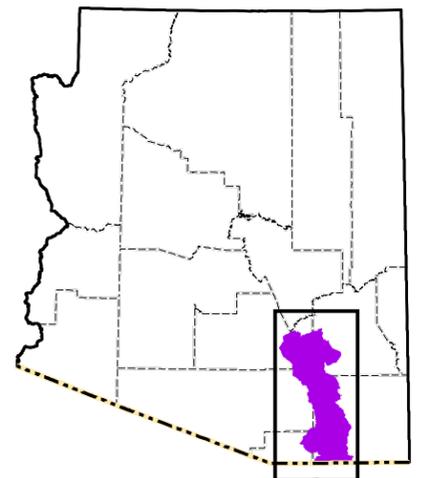
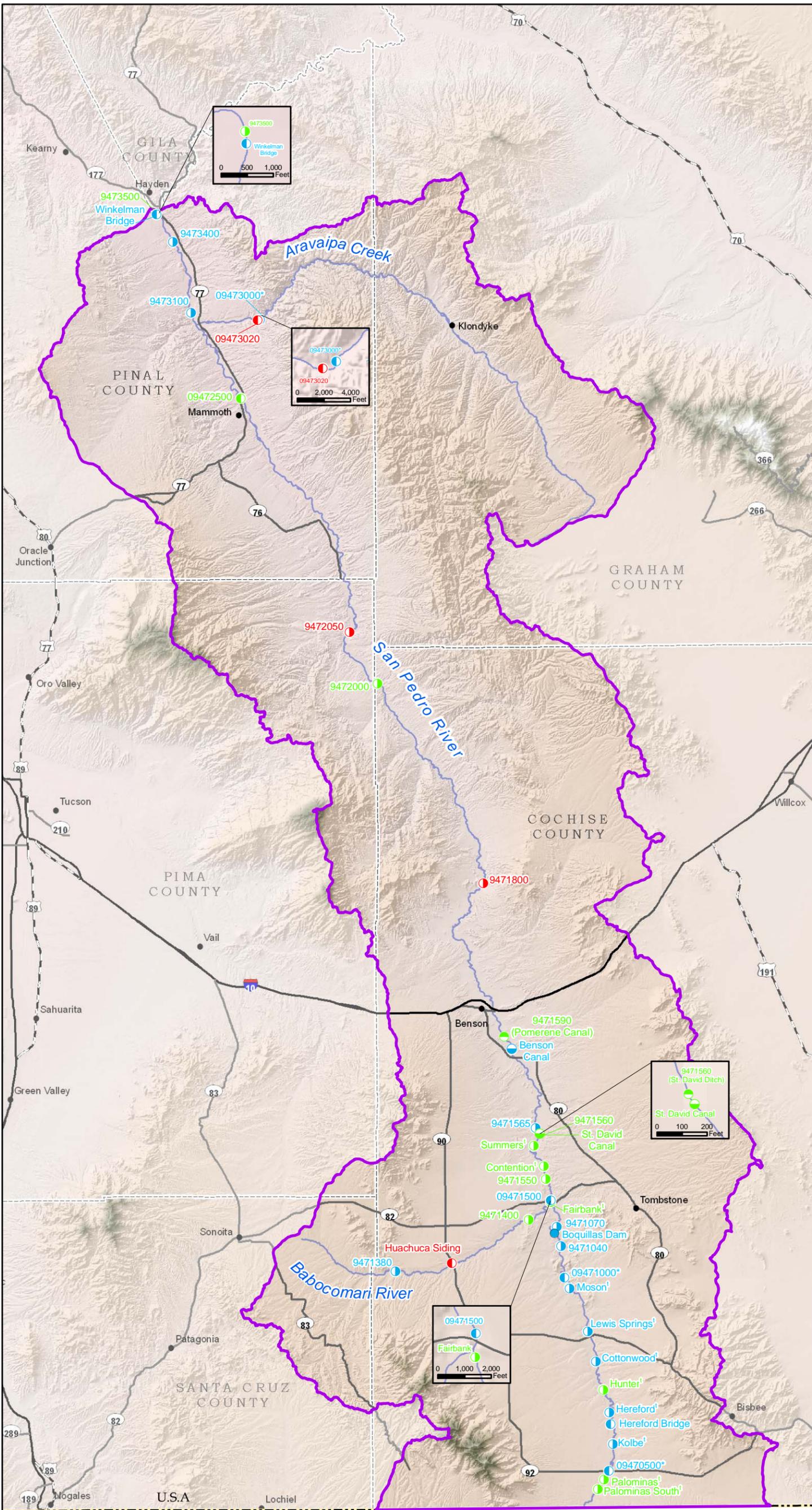


Figure 3-7
Location of Historic Irrigation Ditch Diversions and Ore Mills

Subflow Zone Delineation
Report for the San Pedro
River Watershed



Legend

- Gaging Stations**
- Early Streamflow Records
 - Recent Streamflow Records
 - Early Canal Diversions
 - Recent Canal Diversions
 - Early Dam Stage Measurements

* Both early and recent data available
 † Temporary USGS Gage

- Flow Regime (based on station data)**
- Ephemeral
 - Intermittent
 - Perennial

- Data Sources:**
 Schwalen (various dates) and USGS (2008)
- ▭ San Pedro River Watershed
 - City or Town
 - Major Stream
 - Interstate Highway
 - U.S. Route
 - State Highway
 - ▭ County
 - ▭ State Boundary
 - International Boundary

Notes:
 (1) If early and recent station data are both available, flow regime shown based on early data.
 (2) See Tables 3-2, 3-3 and 3-5 for summary of station data.

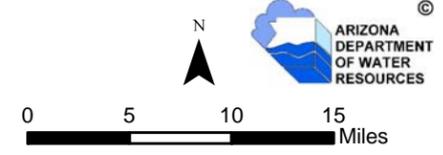
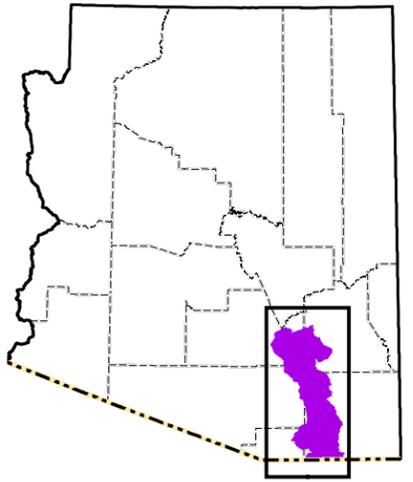


Figure 3-8
 Location of Gaging Stations
 Subflow Zone Delineation
 Report for the San Pedro
 River Watershed

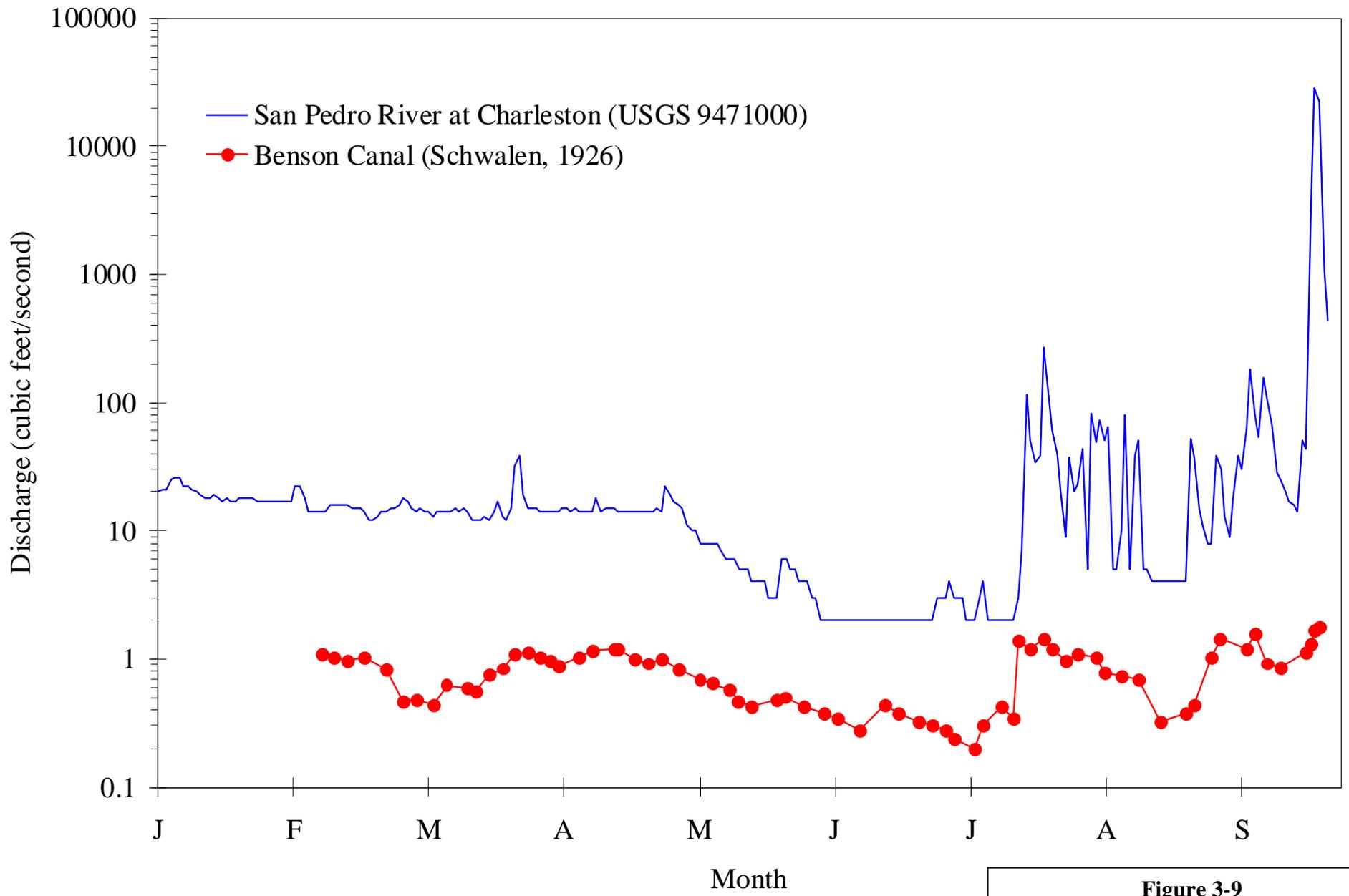


Figure 3-9
 Benson Canal Diversions and Upstream
 San Pedro River Flows During 1926
 Subflow Zone Delineation Report for the
 San Pedro River Watershed



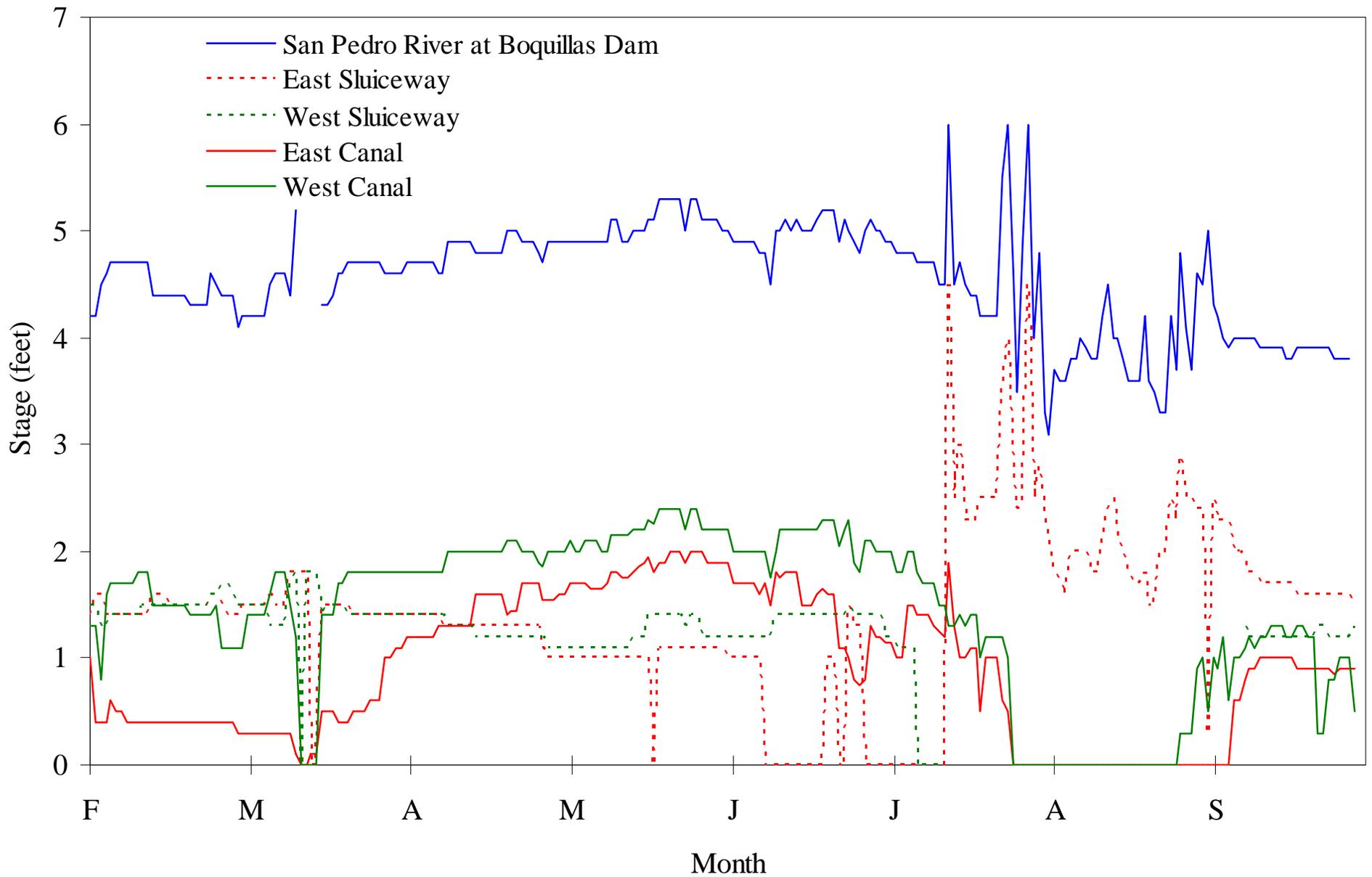
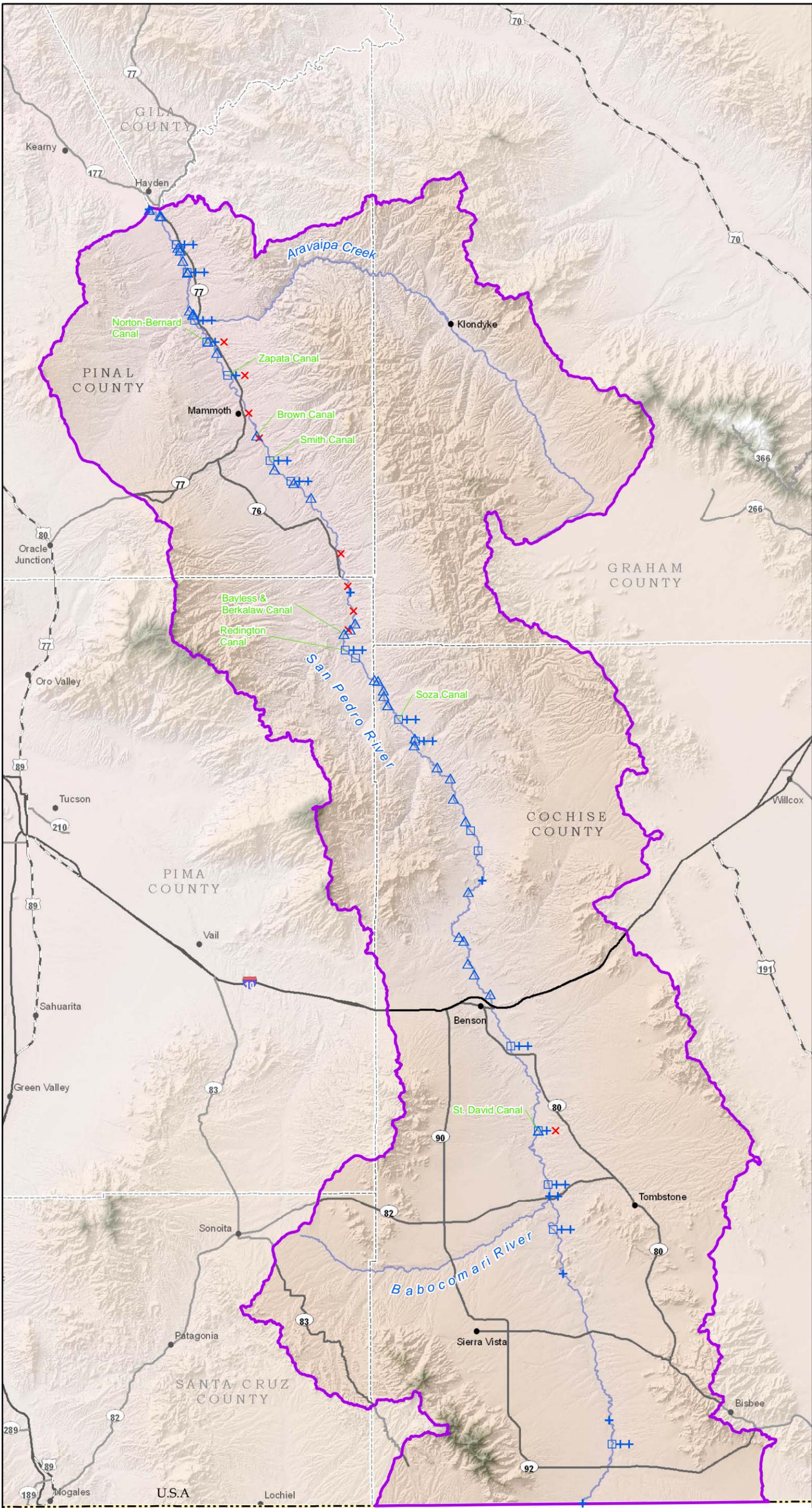


Figure 3-10
 Stage Measurements at Boquillas Dam
 on the San Pedro River During 1912
 Subflow Zone Delineation Report for the
 San Pedro River Watershed

Source: Schwalen (1912)





Legend

Seepage Run Points

- March 1899 (Walcott)
 - △ Diversion Measured
- March 1921 (Schwalen)
 - Diversion Measured
 - + Flow in Stream
 - × No Flow in Stream

- San Pedro River Watershed
- City or Town
- Major Stream
- Interstate Highway
- U.S. Route
- State Highway
- County
- State Boundary
- International Boundary

Note:
 At some Schwalen seepage run points, stream flow was measured immediately above and below diversions. If flow occurred above and below a diversion, ++ is shown next to the diversion symbol. If no flow occurred below the diversion, +x is shown.

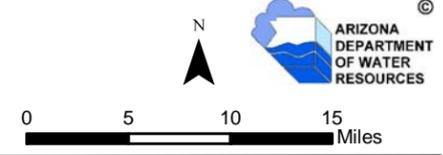
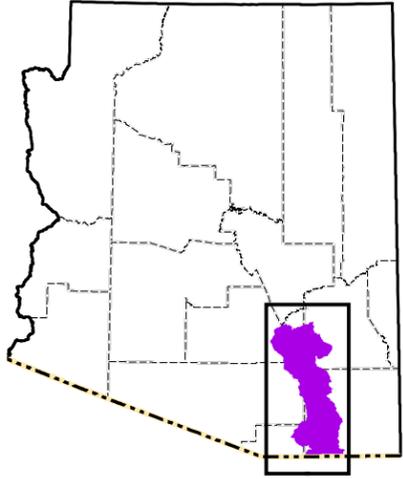


Figure 3-11
 Location of Early Seepage Runs
 Subflow Zone Delineation
 Report for the San Pedro
 River Watershed

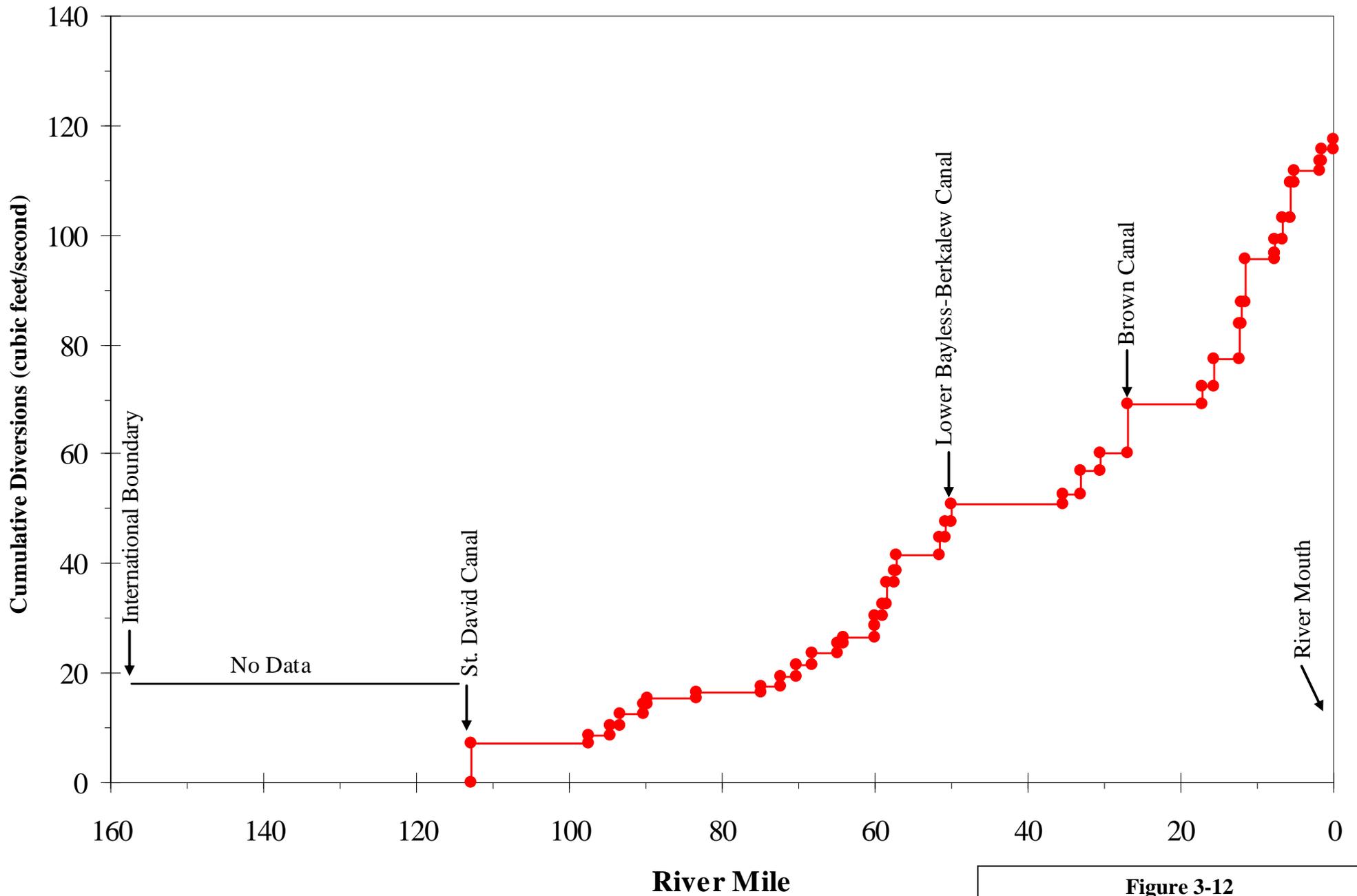


Figure 3-12
 Cumulative Diversions from the San Pedro River in March 1899
 Subflow Zone Delineation Report for the San Pedro River Watershed

Source: Walcott (1901)



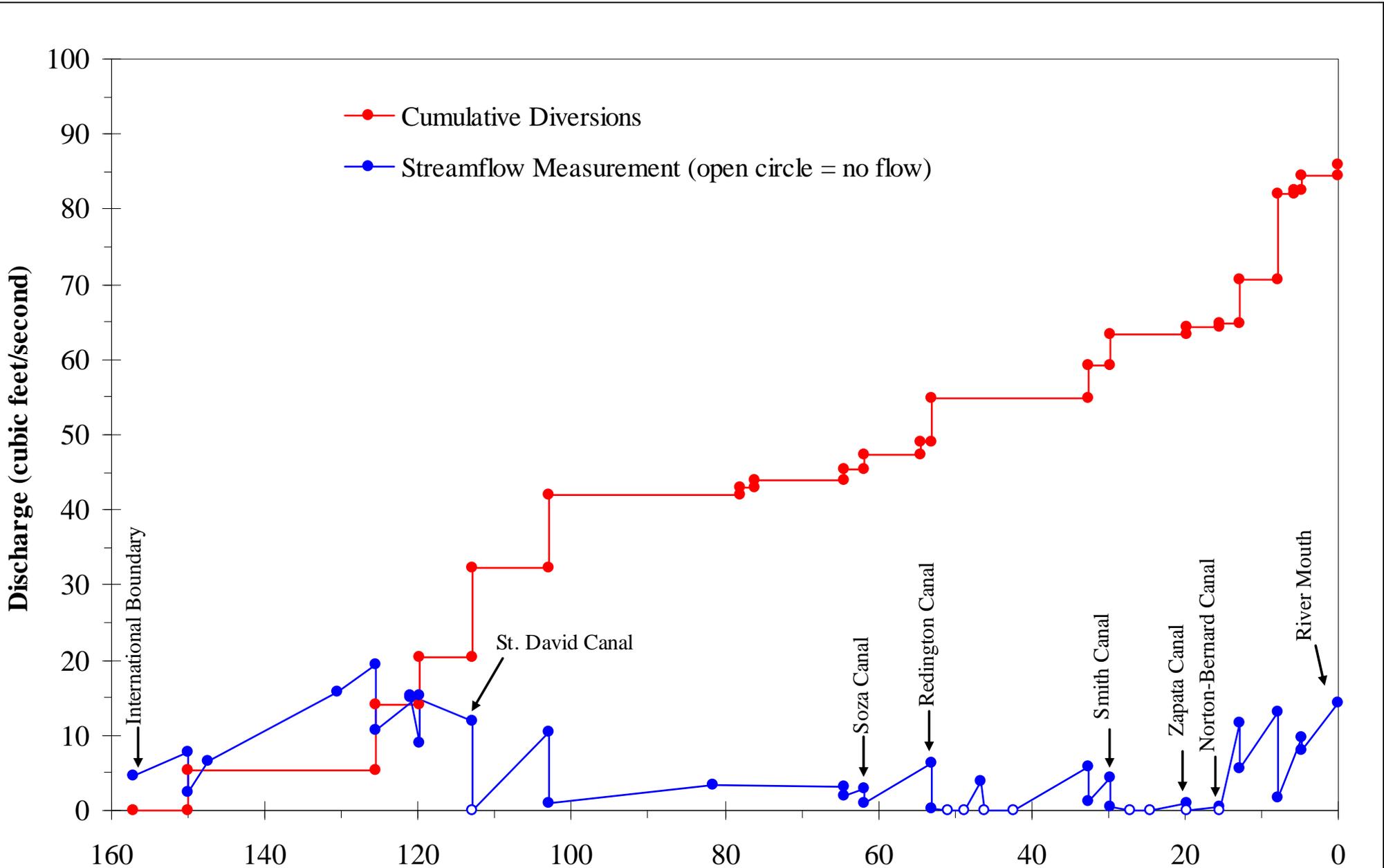
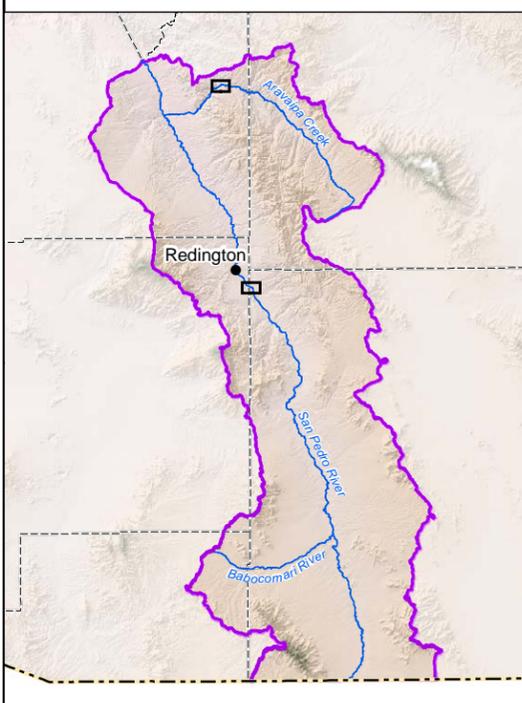
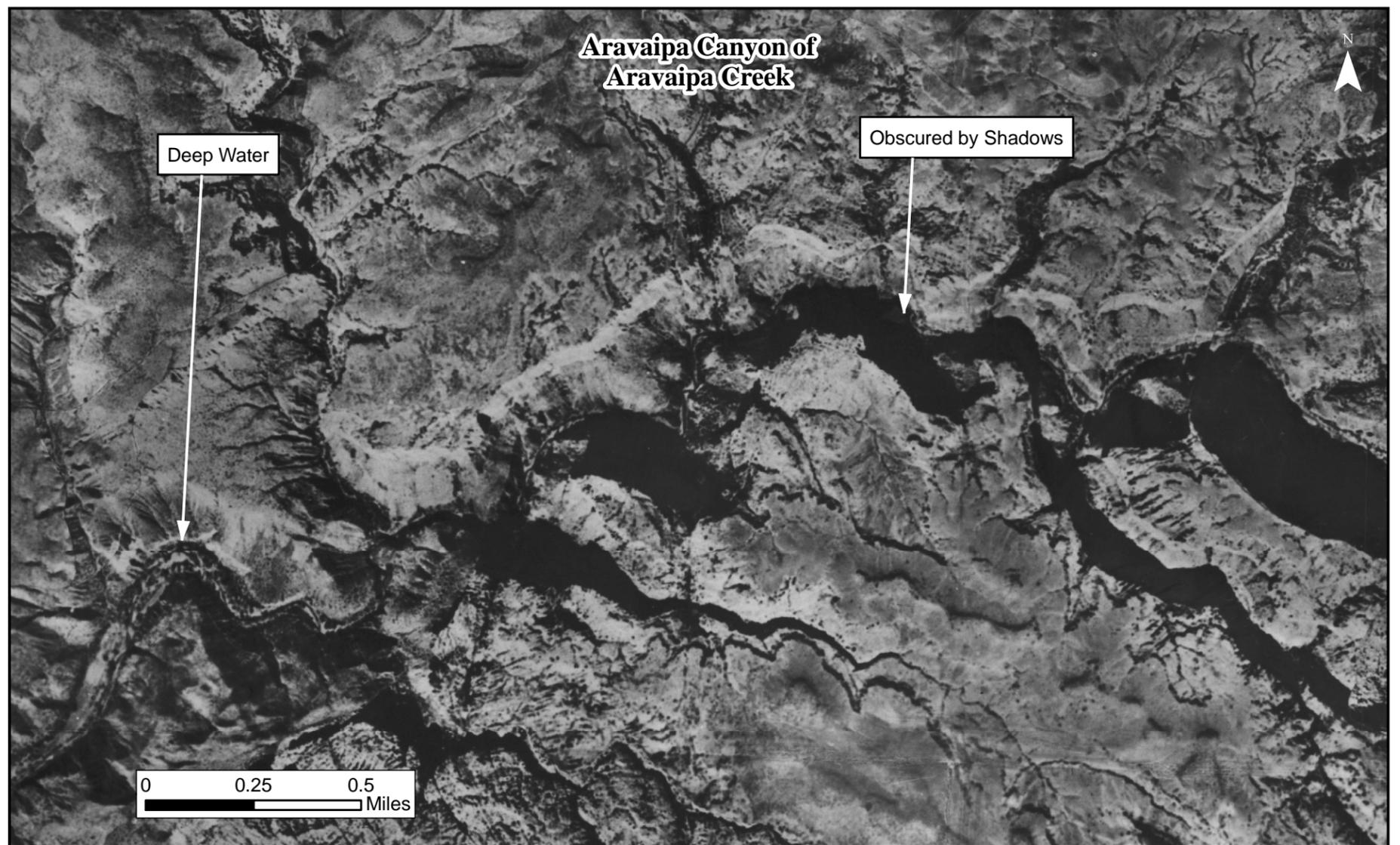
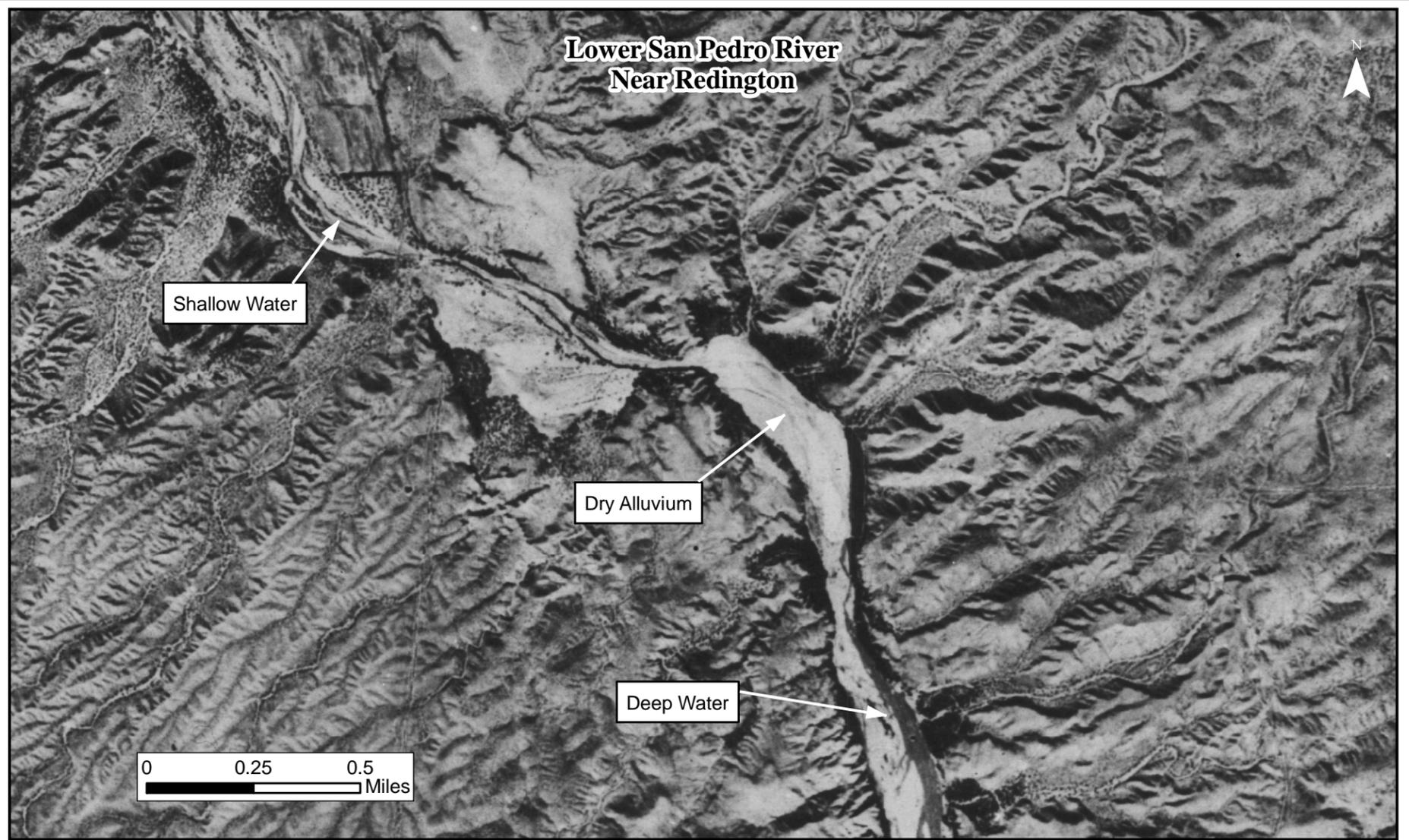


Figure 3-13
 San Pedro River Streamflows and
 Cumulative Diversions in March 1921
 Subflow Zone Delineation Report for the
 San Pedro River Watershed

Source: Schwalen (1921)





Legend

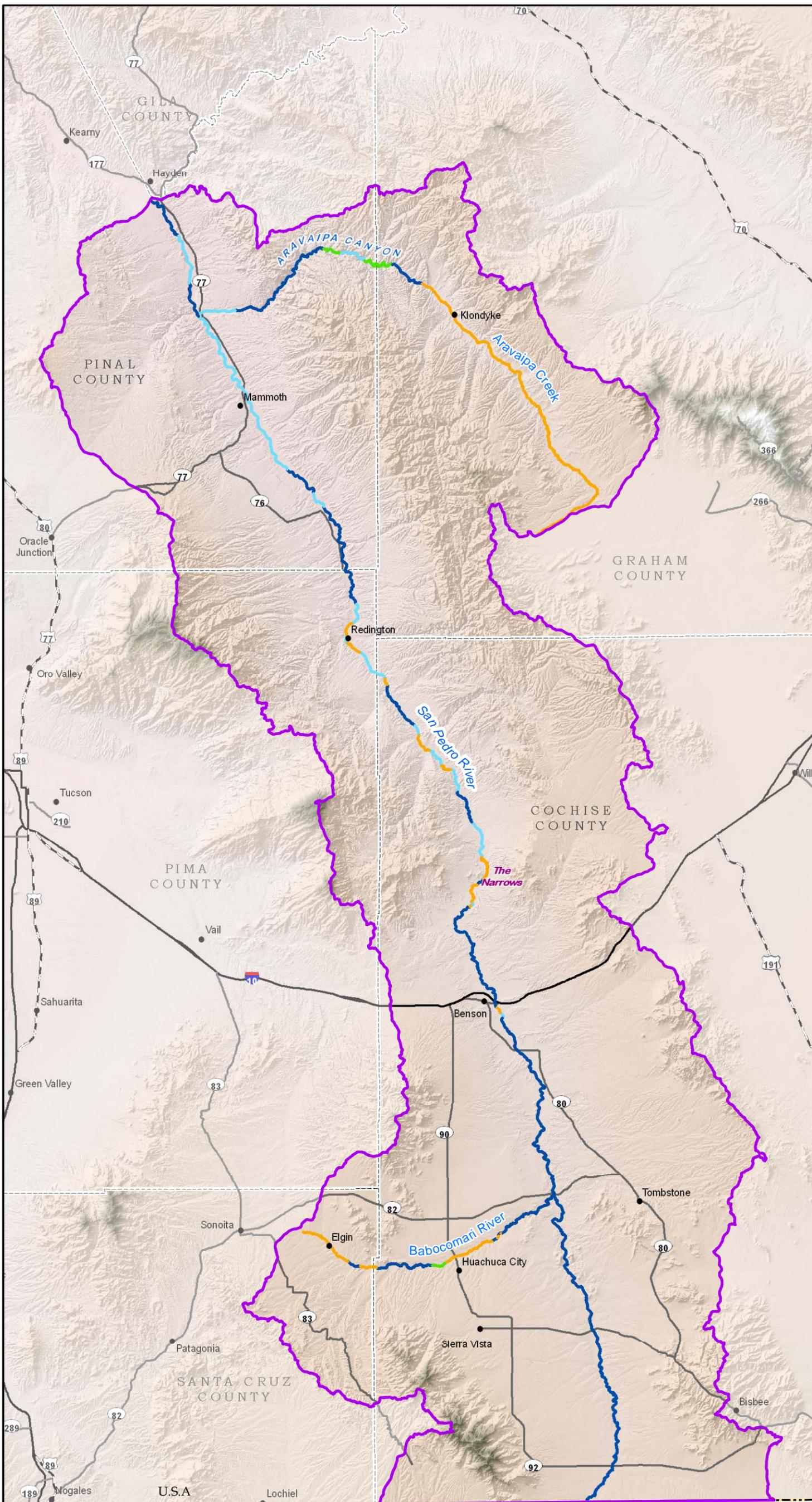
-  Major Stream
-  San Pedro Watershed
-  County
-  International Boundary

Note: Fairchild aerial photographs believed to have been taken between January and March 1935.



Figure 3-14
Examples of Streamflow
Conditions Inferred from
Fairchild Photographs

Subflow Zone Delineation
Report for the San Pedro
River Watershed



Legend

Flow Conditions Inferred by ADWR

- Deep Water
- Shallow Water
- Channel Obscured by Shadows
- Dry Channel
- San Pedro River Watershed
- City or Town
- Interstate Highway
- U.S. Route
- State Highway
- County
- State Boundary
- International Boundary

Note:
 (1) Fairchild aerial photographs believed to be taken between January and March 1935.

(2) Only San Pedro and Babocomari Rivers and Aravaipa Creek analyzed.

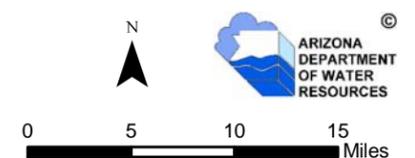
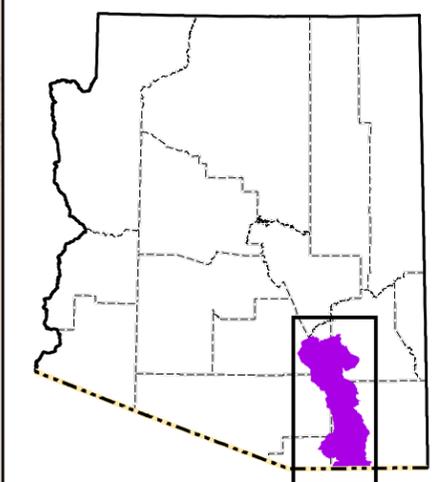
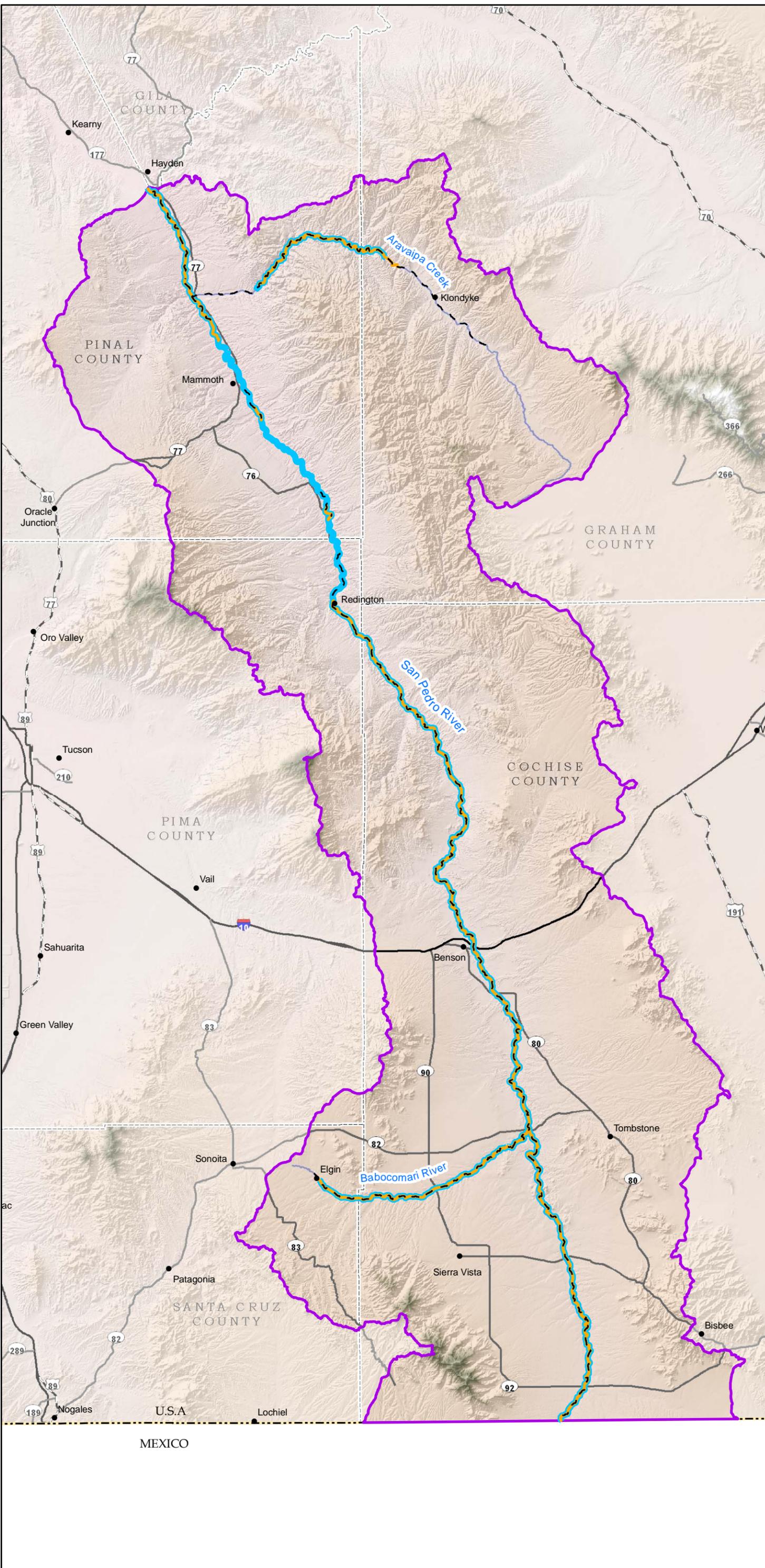


Figure 3-15
 Summary of Streamflow
 Conditions Inferred from
 Fairchild Photographs

Subflow Zone Delineation
 Report for the San Pedro
 River Watershed



Legend

- Predevelopment Perennial Stream Reach**
- Brown and others (1981)
 - - - Hendrickson and Minckley (1984)
 - Freethy and Anderson (1986)
 - San Pedro River Watershed
 - City or Town
 - ~ Major Stream
 - = Interstate Highway
 - = U.S. Route
 - = State Highway
 - County
 - State Boundary
 - - - International Boundary

Notes:

(1) ADWR assumed that recent perennial stream reaches mapped by Brown and others (1981) also existed during predevelopment.

(2) ADWR also assumed that streamflow was perennial through the historic cienagas/riverine marshes mapped by Hendrickson and Minckley (1984).

(3) Only major streams in watershed are shown.

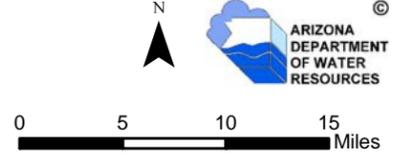
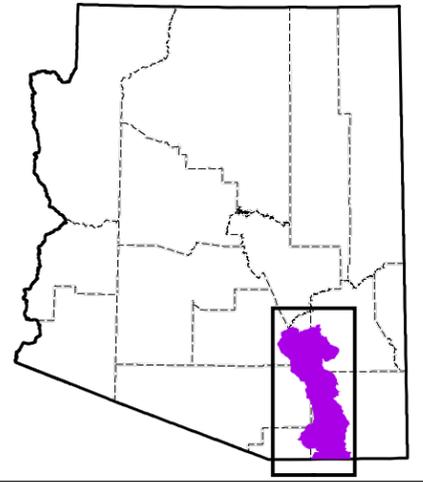
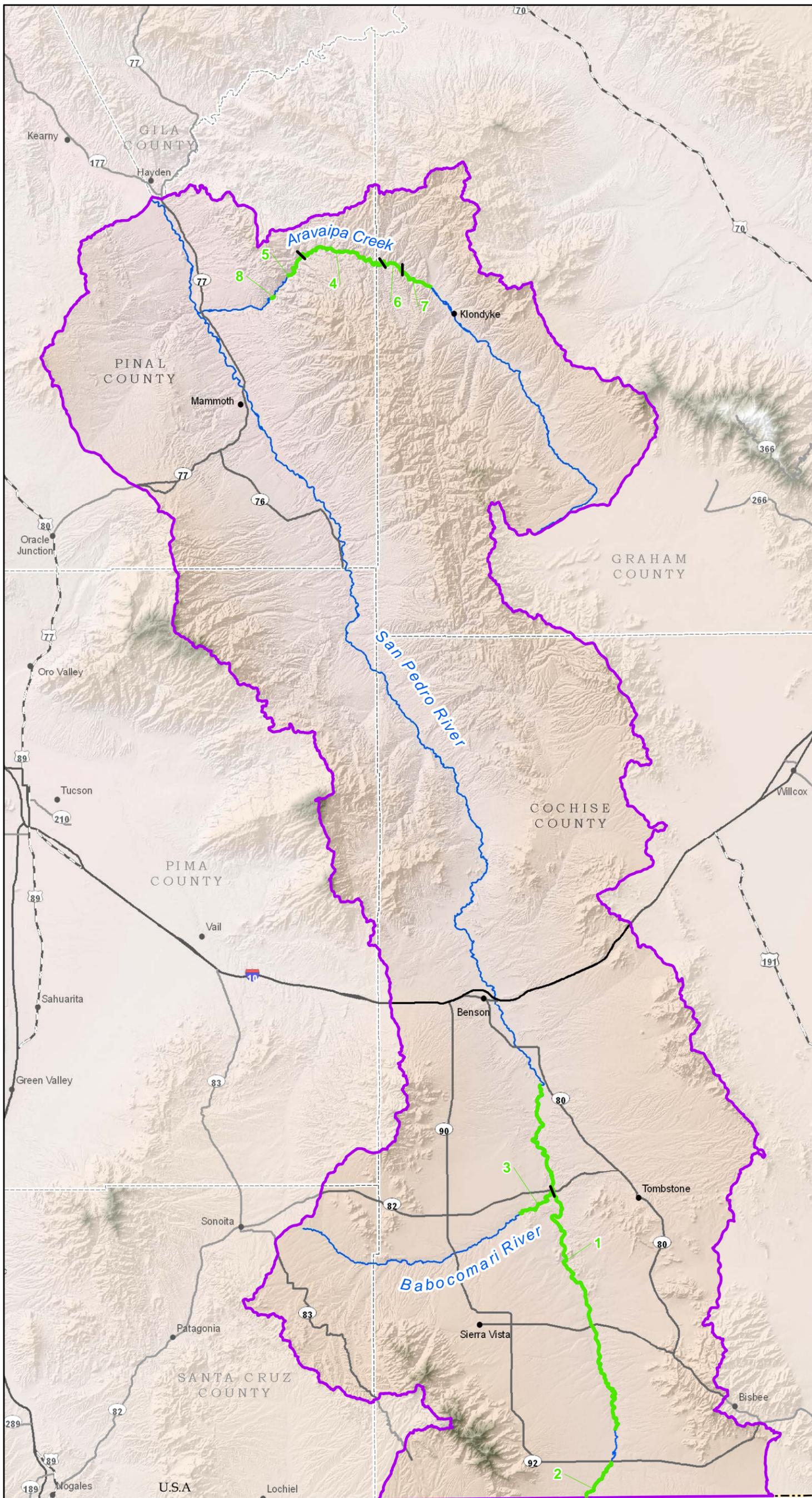


Figure 3-16
Published Maps of
Major Predevelopment
Perennial Stream Reaches

Subflow Zone Delineation
Report for the San Pedro
River Watershed

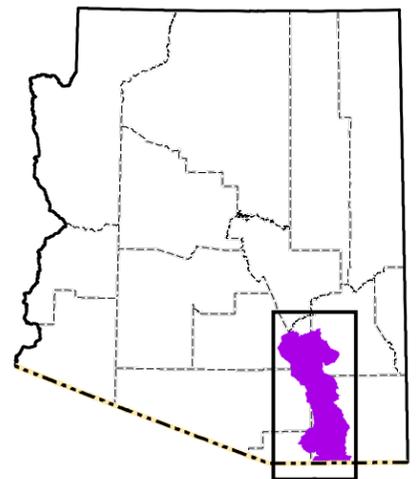


Legend

-  Reach with Instream Flow Claim (See Table 3-4)
-  San Pedro River Watershed
-  City or Town
-  Major Stream
-  Interstate Highway
-  U.S. Route
-  State Highway
-  County
-  State Boundary
-  International Boundary

Notes:

- (1) See Table 3-4 for map key and additional claim information.
- (2) Only claims on major streams in watershed are shown.



N

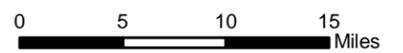
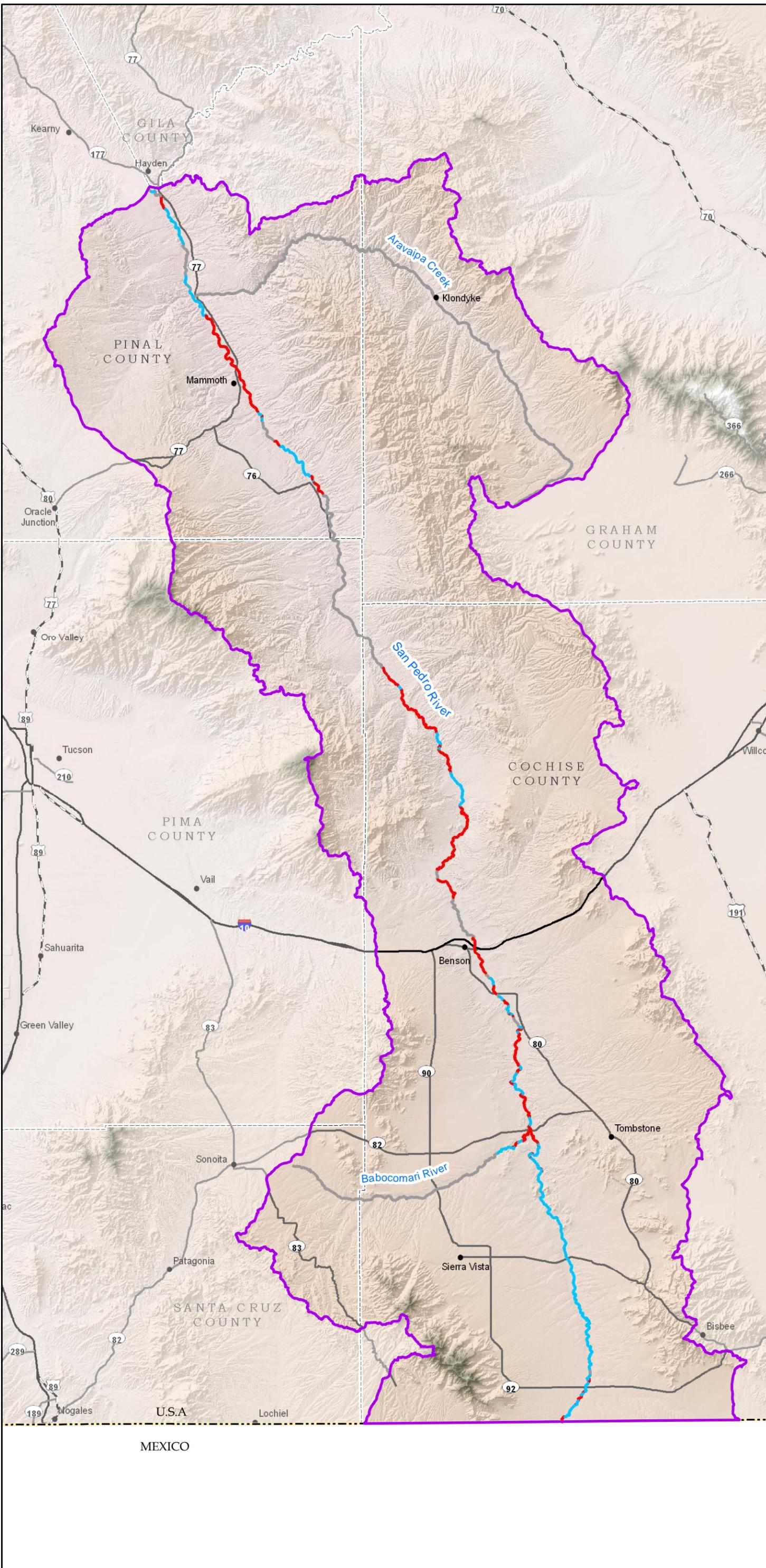


Figure 3-17
Locations of Instream Flow Claims

Subflow Zone Delineation Report for the San Pedro River Watershed



Legend

Channel Condition

- Wet
- Dry
- Not Mapped

Source: TNC (2008a, b)

- San Pedro River Watershed
- International Boundary
- State Boundary
- City or Town
- Interstate Highway
- U.S. Route
- State Highway
- County

Notes:

- (1) Composite of June 2007 and June 2008 wet/dry surveys.
- (2) Wet reaches shown were mapped as wet in at least one year.

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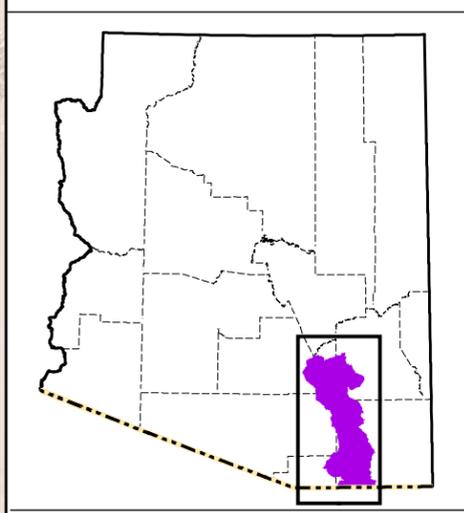
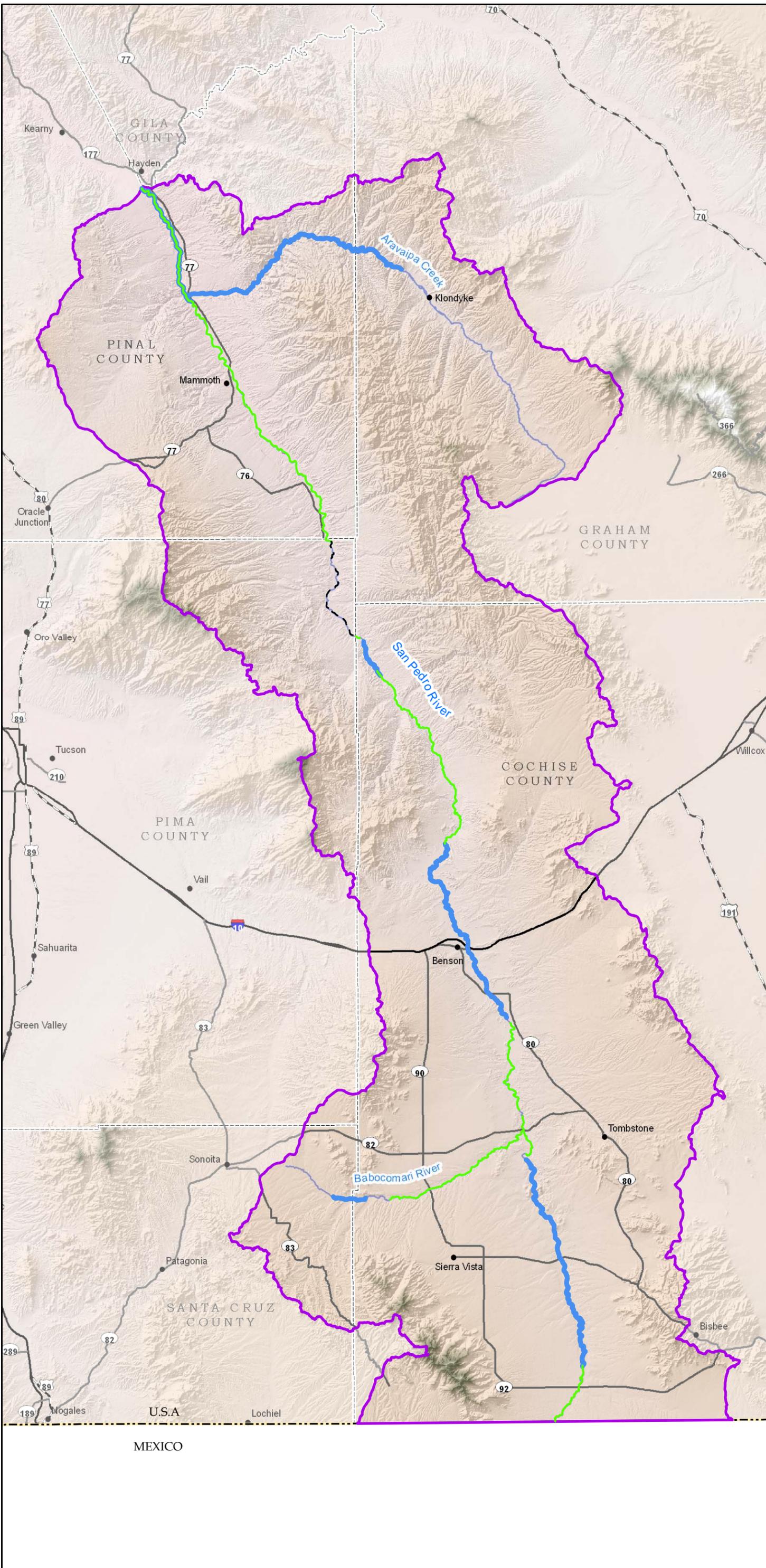


Figure 3-18
Recent Wet/Dry Surveys

Subflow Zone Delineation
Report for the San Pedro
River Watershed



Legend

Recent Perennial and Intermittent Stream Reaches

- Perennial (Valencia and others, 1993)
- Intermittent (Wahl and others, 1997)
- Intermittent (Sonoran Desert Conservation Plan, 2000)

San Pedro River Watershed

- City or Town
- Major Stream
- Interstate Highway
- U.S. Route
- State Highway
- County
- State Boundary
- International Boundary

Note:
 Sonoran Desert Conservation Plan (2000) only mapped perennial and intermittent reaches in Pima County.

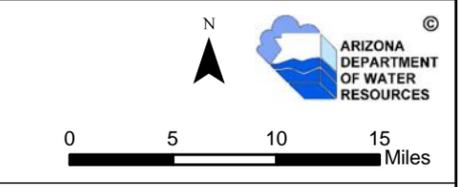
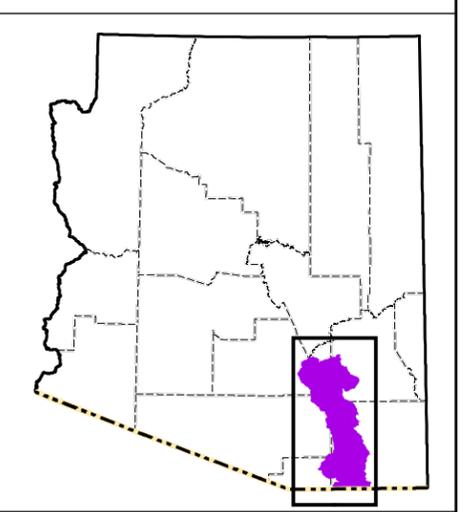


Figure 3-19
 Published Maps of Major Recent Perennial and Intermittent Stream Reaches

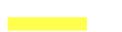
Subflow Zone Delineation Report for the San Pedro River Watershed

Legend

Historic Accounts

(See Figure 3-6)

Streamflow Conditions

-  Perennial/Cienega
-  Entire Flow Diverted, Ephemeral Downstream
-  Water Available, Flow Not Specified
-  Intermittent/Interrupted Perennial
-  Intermittent or Ephemeral
-  Ephemeral/No Flow

Historic Irrigation Ditch Diversions and Ore Mills

(See Figure 3-7)

Ditch Diversions

-  On or before 1869
-  1870 to 1879
-  1870 to 1879 (from NOA)
-  1880 to 1889
-  1880 to 1889 (from NOA)
-  1890 to 1899
-  1890 to 1899 (from NOA)
-  On or after 1900
-  On or after 1900 (from NOA)
-  1920-1923 Ditch Survey

Ore Mills

-  1870 to 1879
-  1880 to 1889
-  1890 to 1899
-  Unknown

Early Streamflow Data

(See Figures 3-8 and 3-11)

Gaging Stations

-  Early Streamflow Records
-  Early Canal Diversions
-  Early Dam Stage Measurements

Flow Regime (based on station data)

-  Ephemeral
-  Intermittent
-  Perennial

Seepage Run Points

March 1899 (Walcott)

-  Diversion Measured

March 1921 (Schwalen)

-  Diversion Measured
-  Flow in Stream
-  No Flow in Stream

1935 Aerial Photographs

(See Figure 3-15)

Flow Conditions Inferred by ADWR

-  Deep Water
-  Shallow Water
-  Obscured by Shadows
-  Dry Channel

Recent Streamflow Data

(See Figures 3-8, 3-17 and 3-18)

Gaging Stations

-  Recent Streamflow Records
 -  Recent Canal Diversions
- Flow Regime (based on station data)
-  Ephemeral
 -  Intermittent
 -  Perennial

Instream Flow Claims

-  Reach with Instream Flow Claim

2007/2008 Wet/Dry Surveys

-  Wet Channel
-  Dry Channel
-  Not Mapped

Overview Map Legend

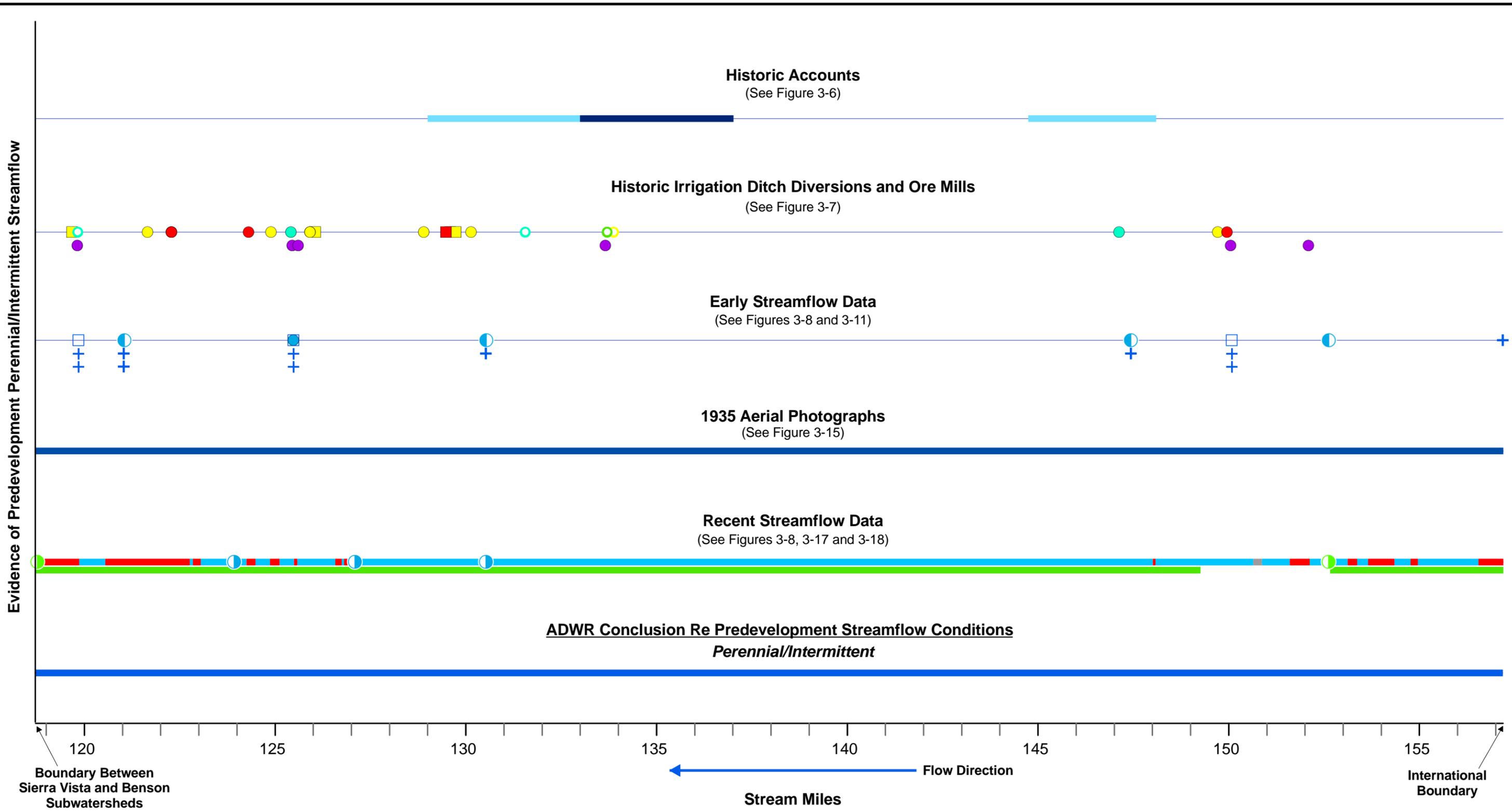
-  Portion of Stream Shown on Graph
-  Major Stream
-  San Pedro River Watershed
-  San Pedro River Subwatersheds

Figure 3-20

Legend for Figures 3-21 through 3-23

Subflow Zone Delineation
Report for the San Pedro
River Watershed





Note:
See Figure 3-20 for legend.

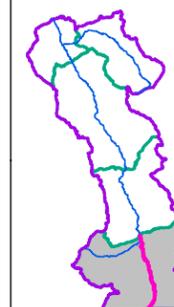
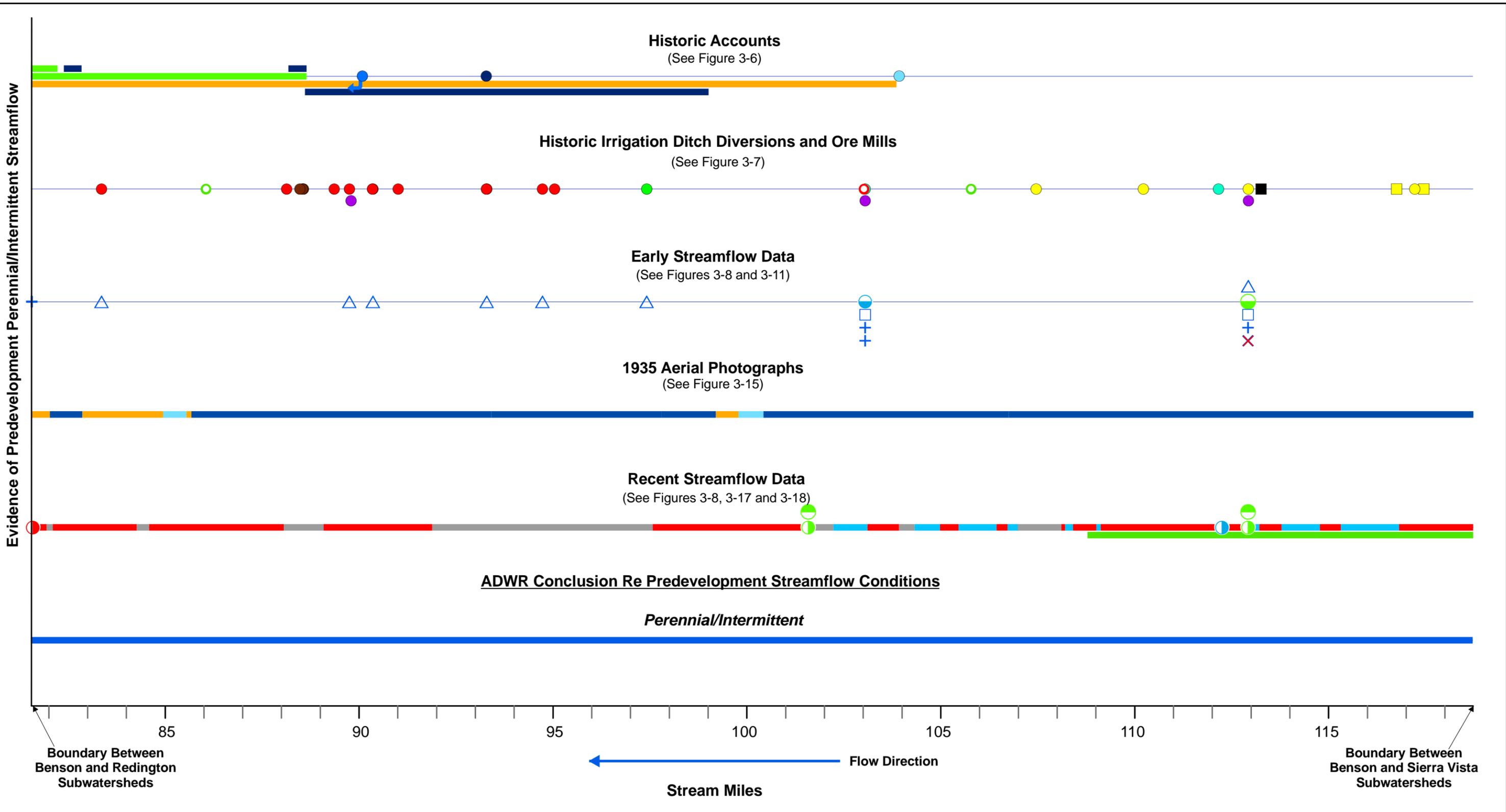


Figure 3-21a
Comparison of Evidence for Predevelopment Streamflow Conditions Along the San Pedro River, Sierra Vista Subwatershed

Subflow Zone Delineation Report for the San Pedro River Watershed



Note:
See Figure 3-20 for legend.

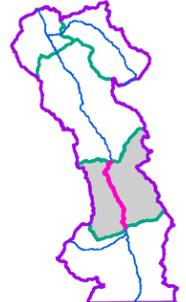
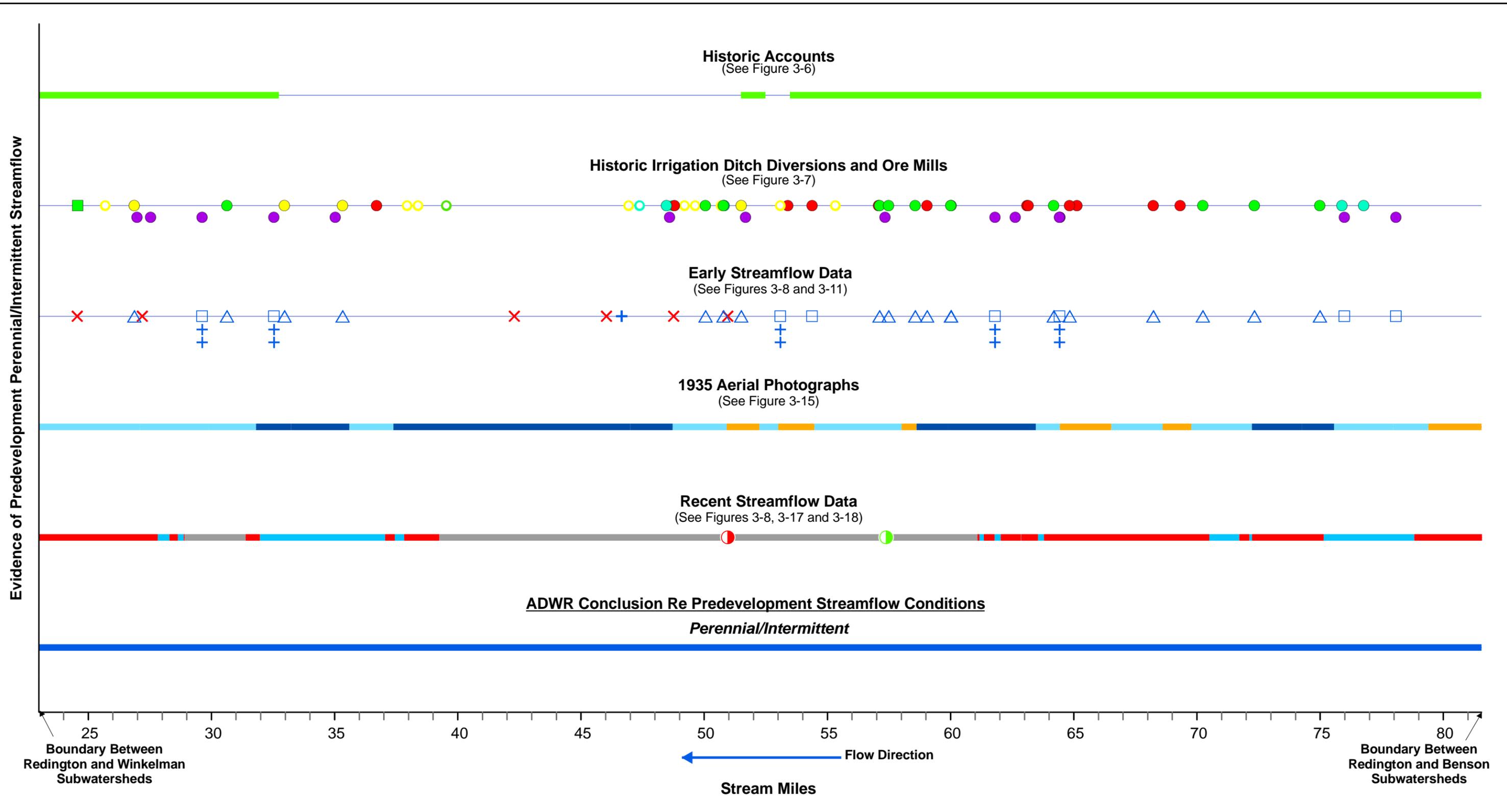


Figure 3-21b
Comparison of Evidence for Predevelopment Streamflow Conditions Along the San Pedro River, Benson Subwatershed
Subflow Zone Delineation Report for the San Pedro River Watershed



Note:
See Figure 3-20 for legend.

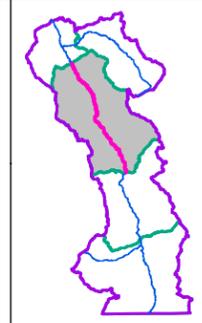
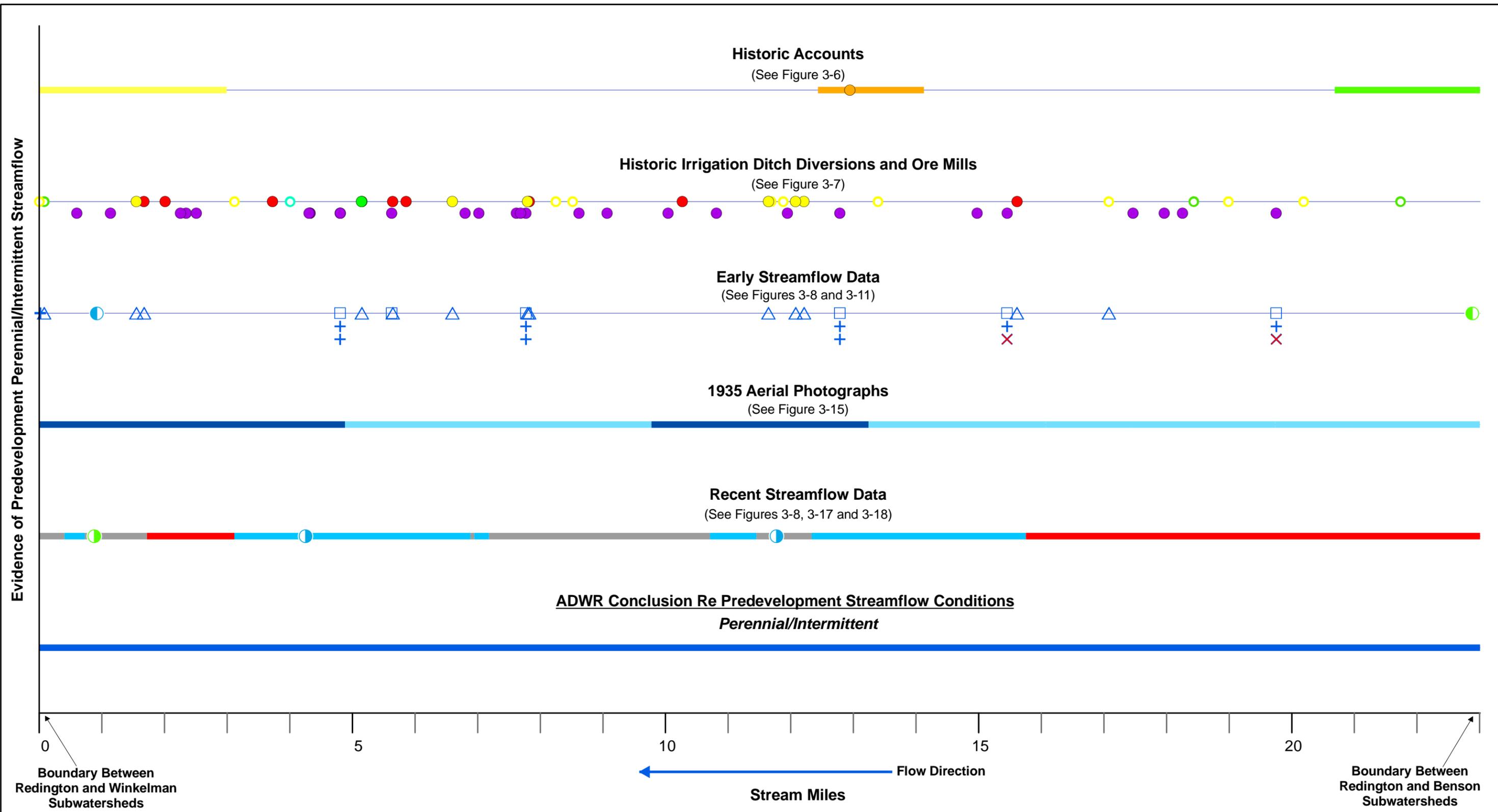


Figure 3-21c
Comparison of Evidence for Predevelopment Streamflow Conditions Along the San Pedro River, Redington Subwatershed

Subflow Zone Delineation Report for the San Pedro River Watershed



Note:
See Figure 3-20 for legend.

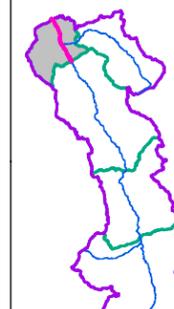
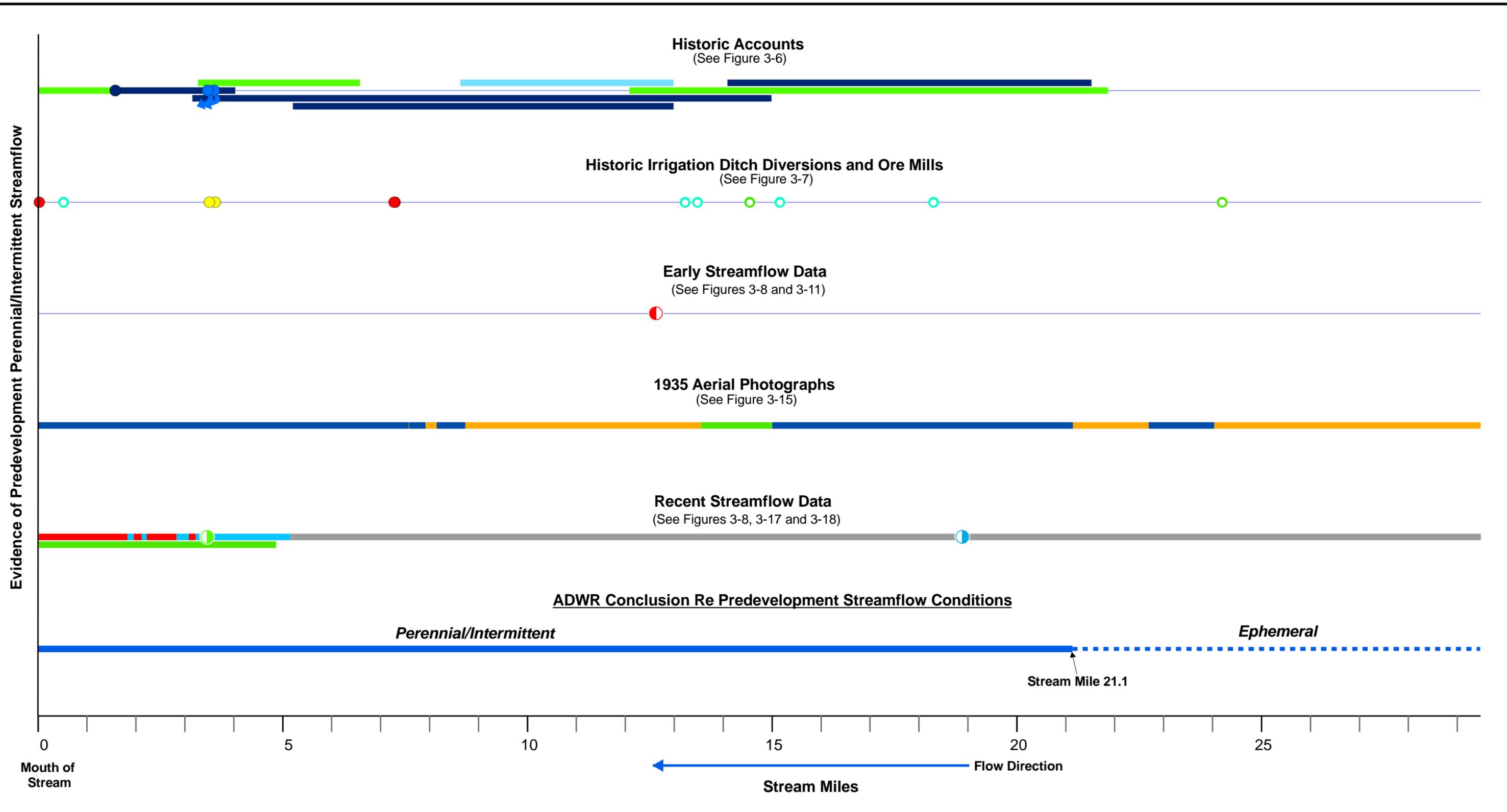


Figure 3-21d
Comparison of Evidence for Predevelopment Streamflow Conditions Along the San Pedro River, Winkelman Subwatershed

Subflow Zone Delineation Report for the San Pedro River Watershed



Note:
See Figure 3-20 for legend.

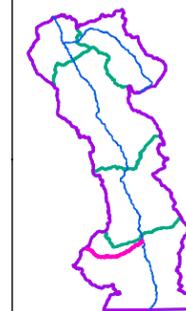
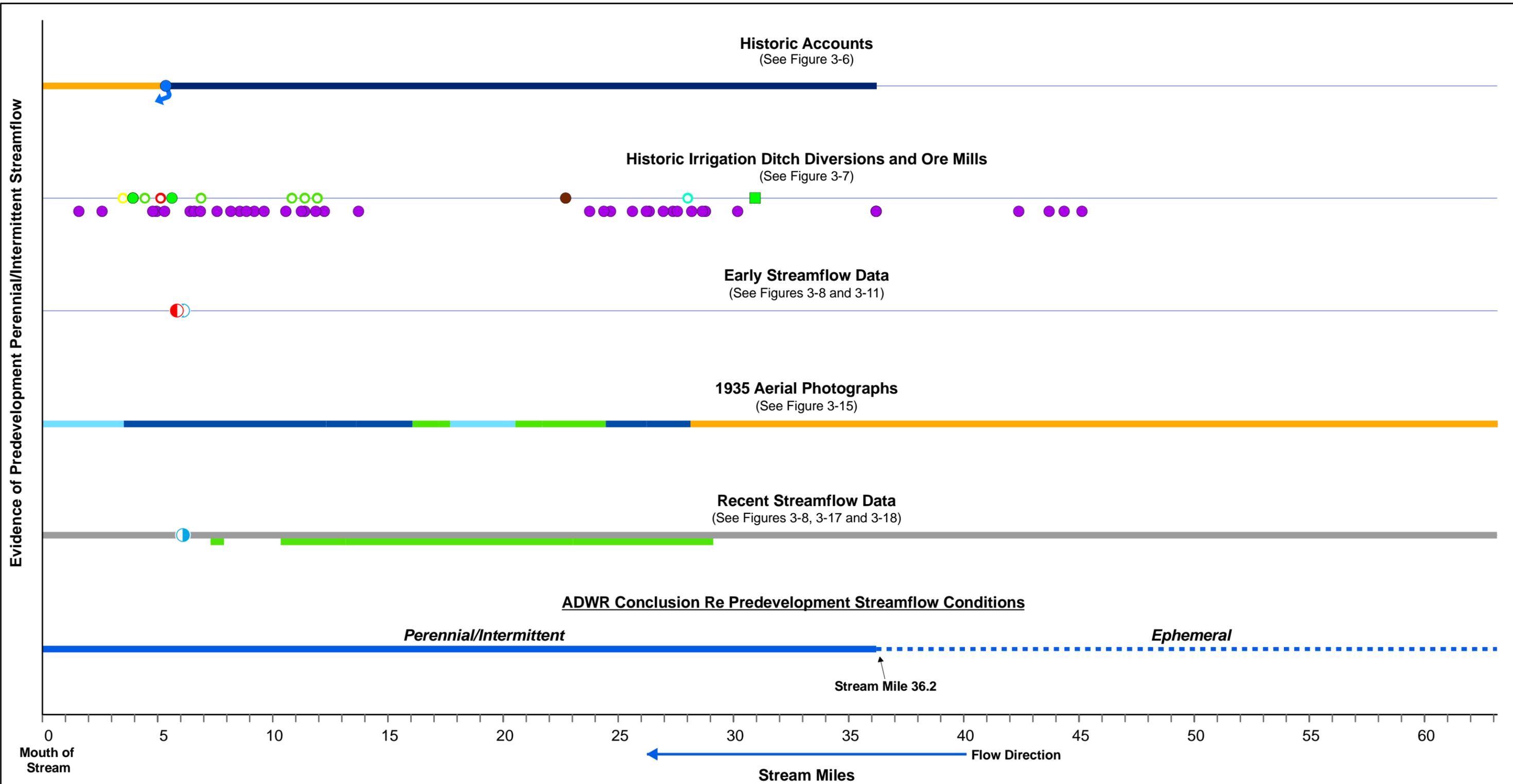


Figure 3-22
Comparison of Evidence for Predevelopment Streamflow Conditions Along the Babocomari River

Subflow Zone Delineation Report for the San Pedro River Watershed



Note:
See Figure 3-20 for legend.

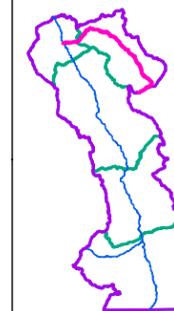
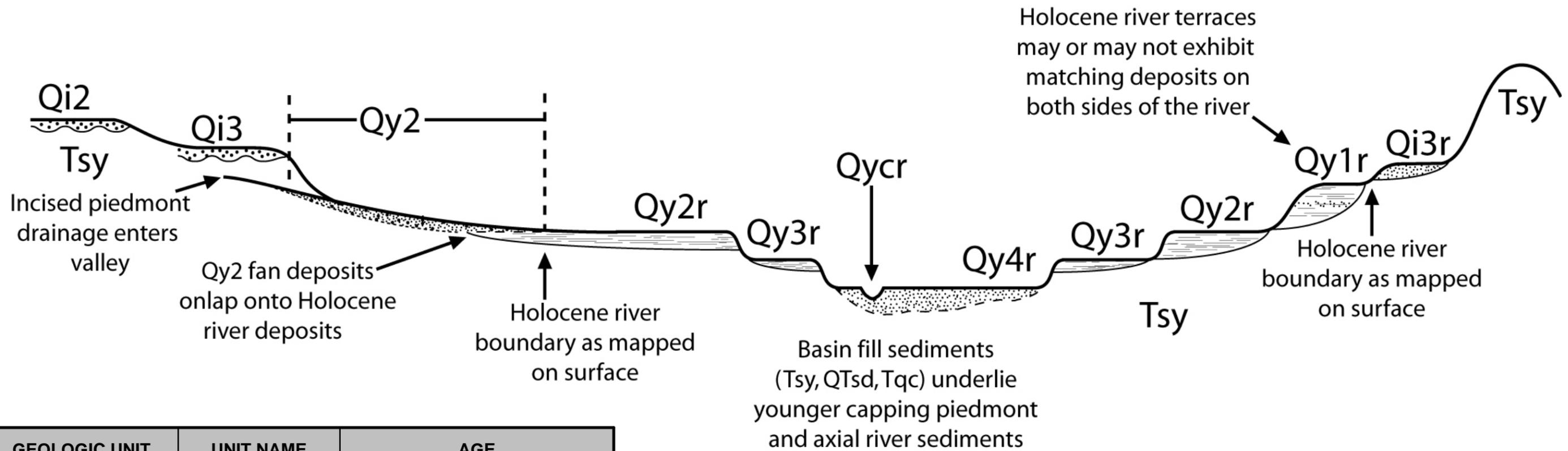


Figure 3-23
Comparison of Evidence for Predevelopment Streamflow Conditions Along the Aravaipa Creek

Subflow Zone Delineation Report for the San Pedro River Watershed



GEOLOGIC UNIT	UNIT NAME	AGE
Active\Modern Channel Deposits	Qycr	Holocene (10,000 years ago to present)
Stream Terraces	Qy4r (youngest)	Holocene
	Qy3r	
	Qy2r	
	Qy1r	
	Qi3r (oldest)	Pleistocene (2 million to 10,000 years ago)
Piedmont Deposits (Tributary Alluvium and Younger Basin Fill)	Qy2 (youngest)	Holocene
	Qi3	Pleistocene
	Qi2 (oldest)	
Older Basin Fill	QTsd (youngest)	Tertiary (2 million years ago and before)
	Tqc	
	Tsy (oldest)	

Source: AZGS (2009)

U:\WorkSpaces\StatewidePlanning\Adjudications\Projects\SanPedro\maps\Subflow_Report_Figures\PPPTFig4-1_GenCrossSection.ppt

Figure 4-1
Generalized Cross Section of Stream Terraces and Piedmont Deposits Flanking the San Pedro River

Subflow Zone Delineation Report for the San Pedro River Watershed





Holocene stream terrace flanking entrenched channel near city of Benson (11/15/07)



Riparian vegetation bordering river meander and point bars near town of Cascabel (11/15/07)



Bedrock-bound channel at inactive USGS streamflow gage (09472000) near town of Redington (11/15/07)



Tributary alluvium deposited in channel near town of Redington (11/15/07)

Figure 4-2
Recent Ground Photographs
of the San Pedro River

Subflow Zone Delineation
Report for the San Pedro
River Watershed





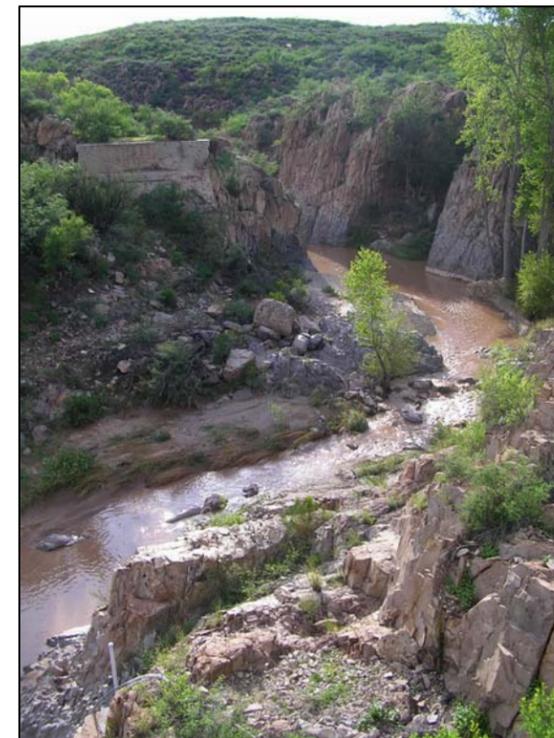
Sediment-filled channel upstream of dam at Babocomari Ranch (2007)



Riparian vegetation bordering flooded channel at USGS streamflow gage (09471400) near Huachuca City (8/4/08)



Pleistocene and Holocene terraces flanking channel near Huachuca City (8/4/08)



Bedrock canyon near confluence with San Pedro River (8/4/08)

Figure 4-3
Recent Ground Photographs
of the Babocomari River

Subflow Zone Delineation
Report for the San Pedro
River Watershed





Channel entrenched in Holocene alluvium near headwaters (8/5/08)



Sediment-filled channel upstream of abandoned dam near Black Canyon confluence (8/5/08)



Upper Aravaipa Canyon near town of Klondyke (8/5/08)



Broad unincised channel near confluence with San Pedro River (8/5/08)

Figure 4-4
Recent Ground Photographs
of Aravaipa Creek

Subflow Zone Delineation
Report for the San Pedro
River Watershed



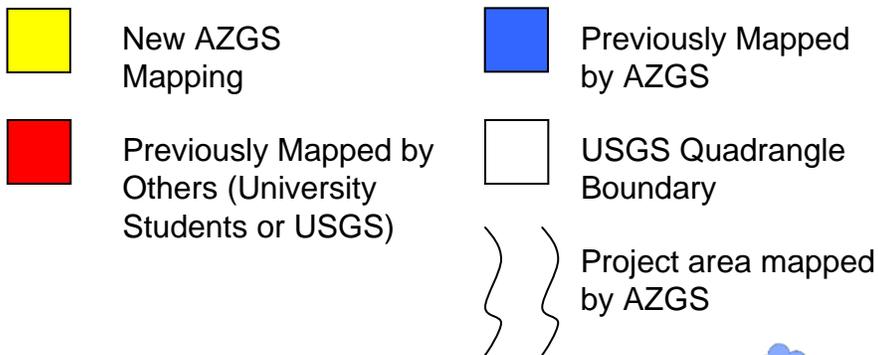
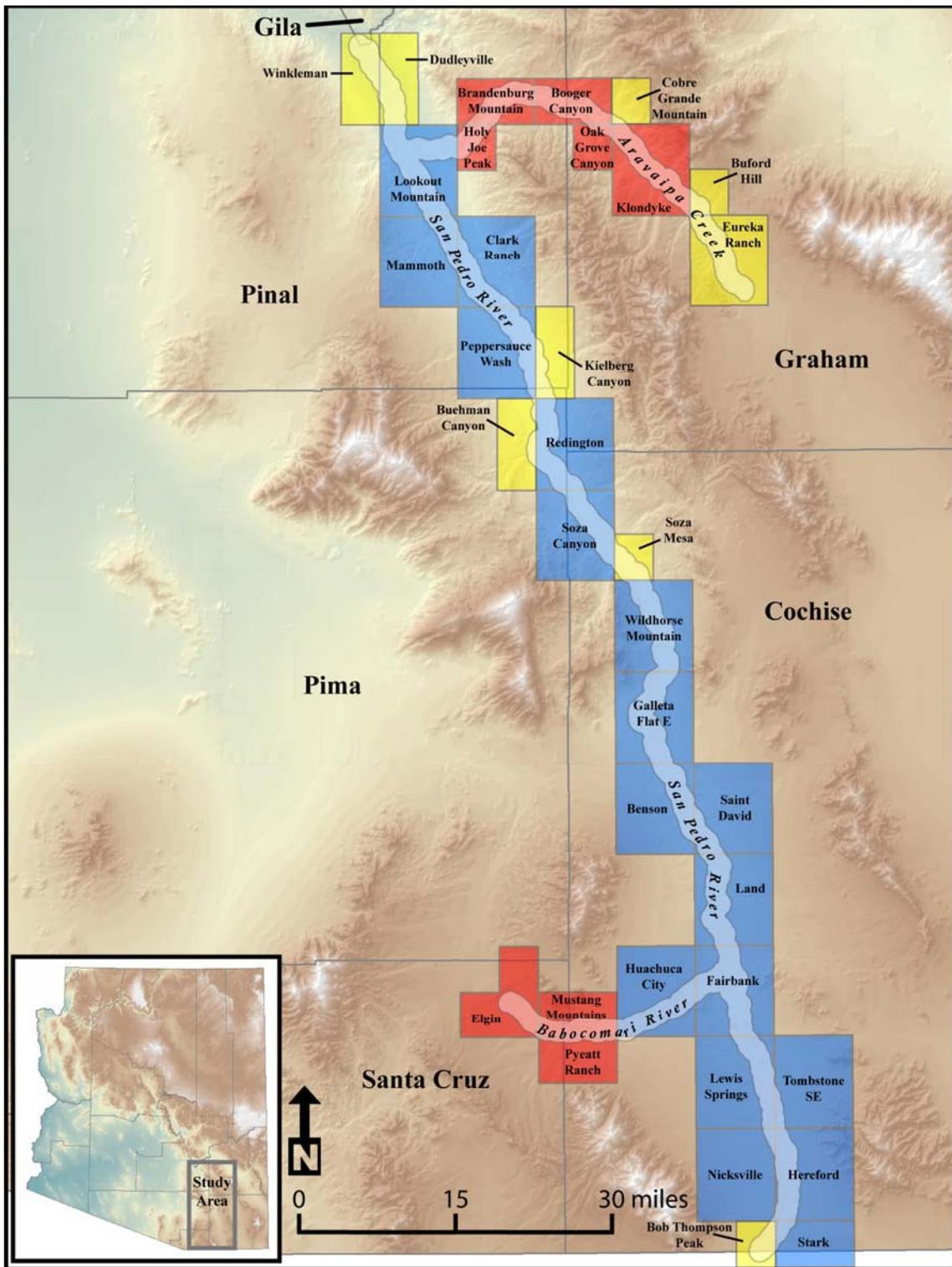
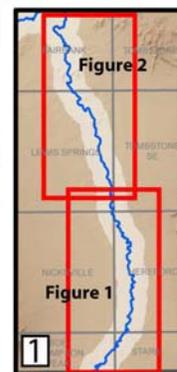
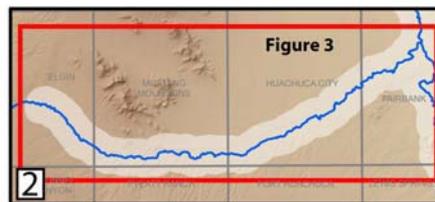
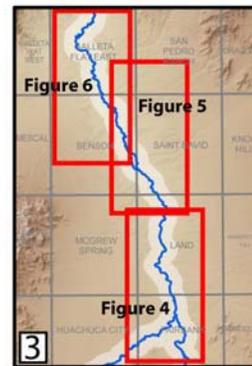
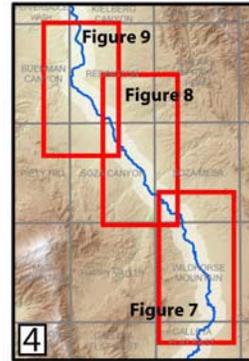
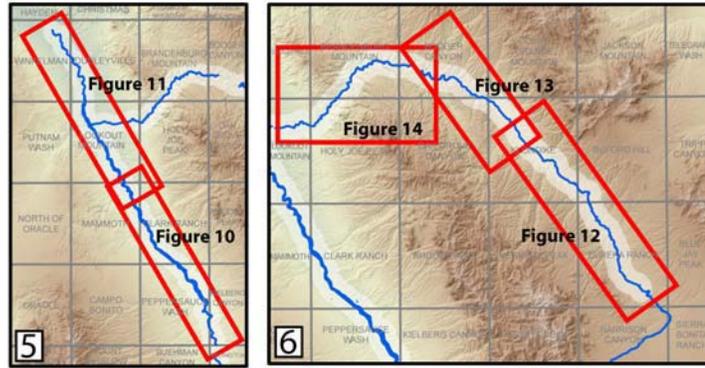


Figure 4-5
 Geology Maps Reviewed By AZGS

Subflow Zone Delineation Report for the San Pedro River Watershed



Source: AZGS (2009)



Statewide Location Map



Map Sheet



Sheet Figure

Figure 4-6

Location of AZGS Map Sheets and Figures

Subflow Zone Delineation Report for the San Pedro River Watershed

Note: Individual sheets and figures are presented in Appendix C-5.
Source: AZGS (2009)



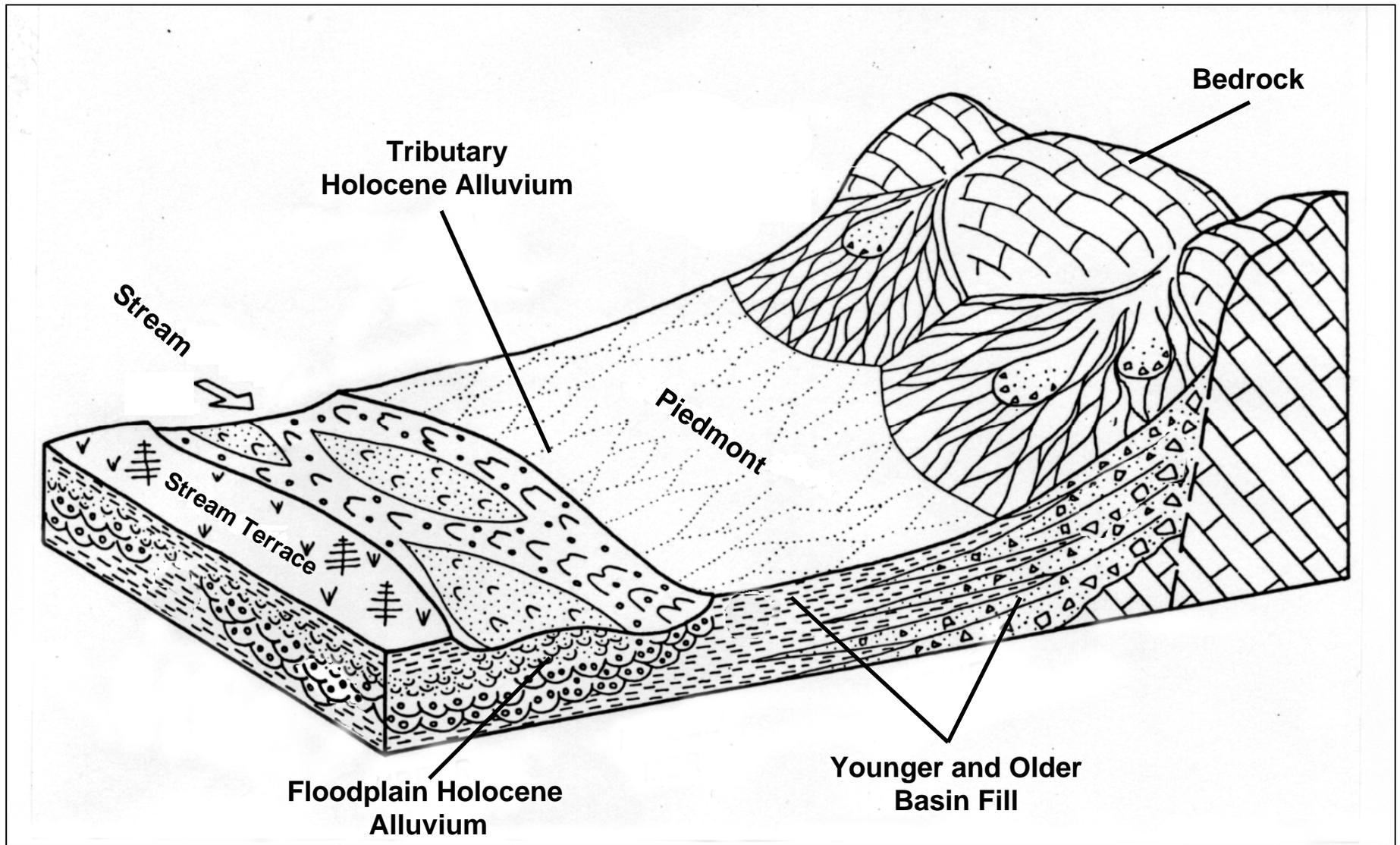
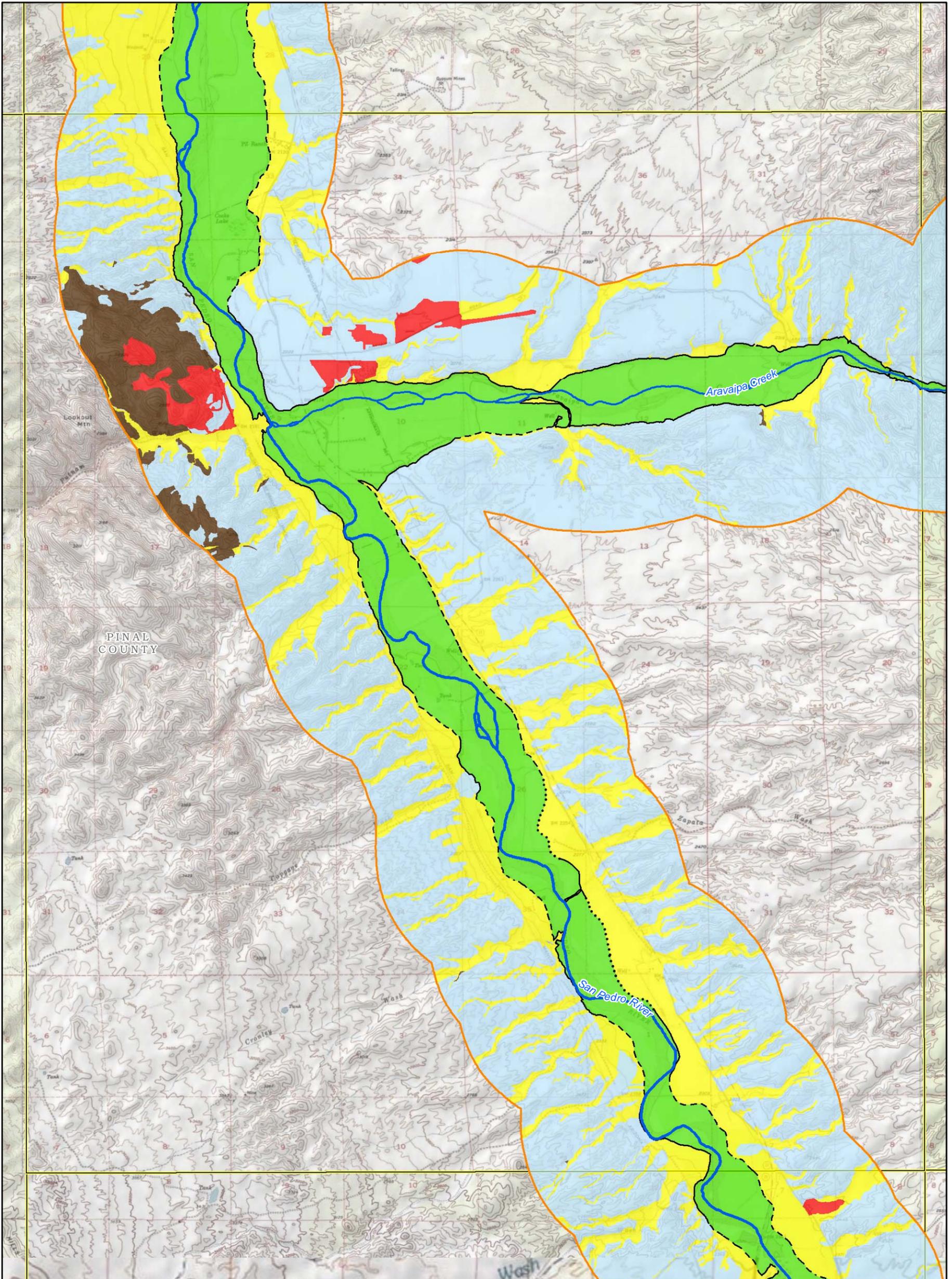


Figure 4-7
Generalized Geologic Units in the
San Pedro River Watershed

Subflow Zone Delineation
Report for the San Pedro
River Watershed

Source: Rust and Koster (1984)





Legend

Area Mapped by AZGS (2009)

Generalized Geologic Units*

- Floodplain Holocene Alluvium (FHA)
- Tributary Holocene Alluvium (THA)
- Disturbed (unit not determined)
- Basin Fill
- Bedrock

*See Table 4-2 for AZGS map units used by ADWR to define generalized geologic units in the San Pedro River Watershed.

Contact Between FHA and Other Mapped Units

- Well Defined (± 25 feet accuracy)
- Subtle or Gradational (± 50 feet accuracy)
- Approximate (± 250 feet accuracy)
- Major Stream
- USGS Topo Quad Boundary

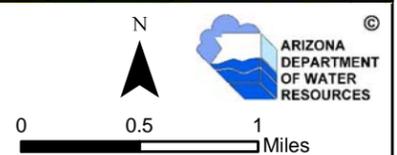
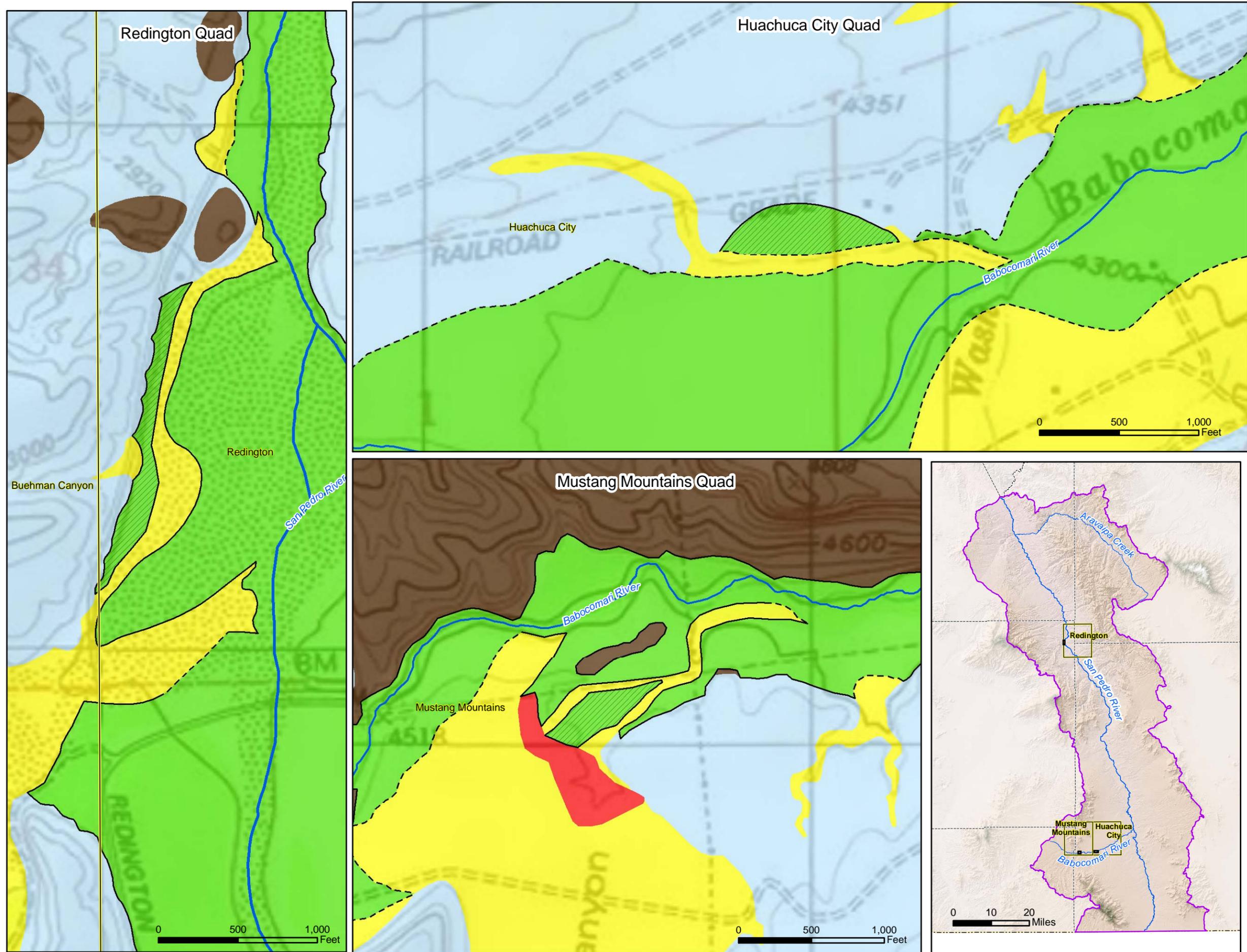


Figure 4-8
Example Map of
Generalized Geologic Units
(Lookout Mountain Quad)

Subflow Zone Delineation
Report for the San Pedro
River Watershed



Legend

- Isolated Deposit of FHA Mapped Near Floodplain
- Generalized Geologic Units***
 - Floodplain Holocene Alluvium (FHA)
 - Tributary Holocene Alluvium (THA)
 - Disturbed (unit not determined)
 - Basin Fill
 - Bedrock

*See Table 4-2 for AZGS map units used by ADWR to define generalized geologic units in the San Pedro River Watershed.

Contact Between FHA and Other Mapped Units

- Well Defined (± 25 feet accuracy)
- Subtle or Gradational (± 50 feet accuracy)
- Approximate (± 250 feet accuracy)
- Major Stream
- San Pedro River Watershed
- USGS Topo Quad Boundary
- County
- International Boundary

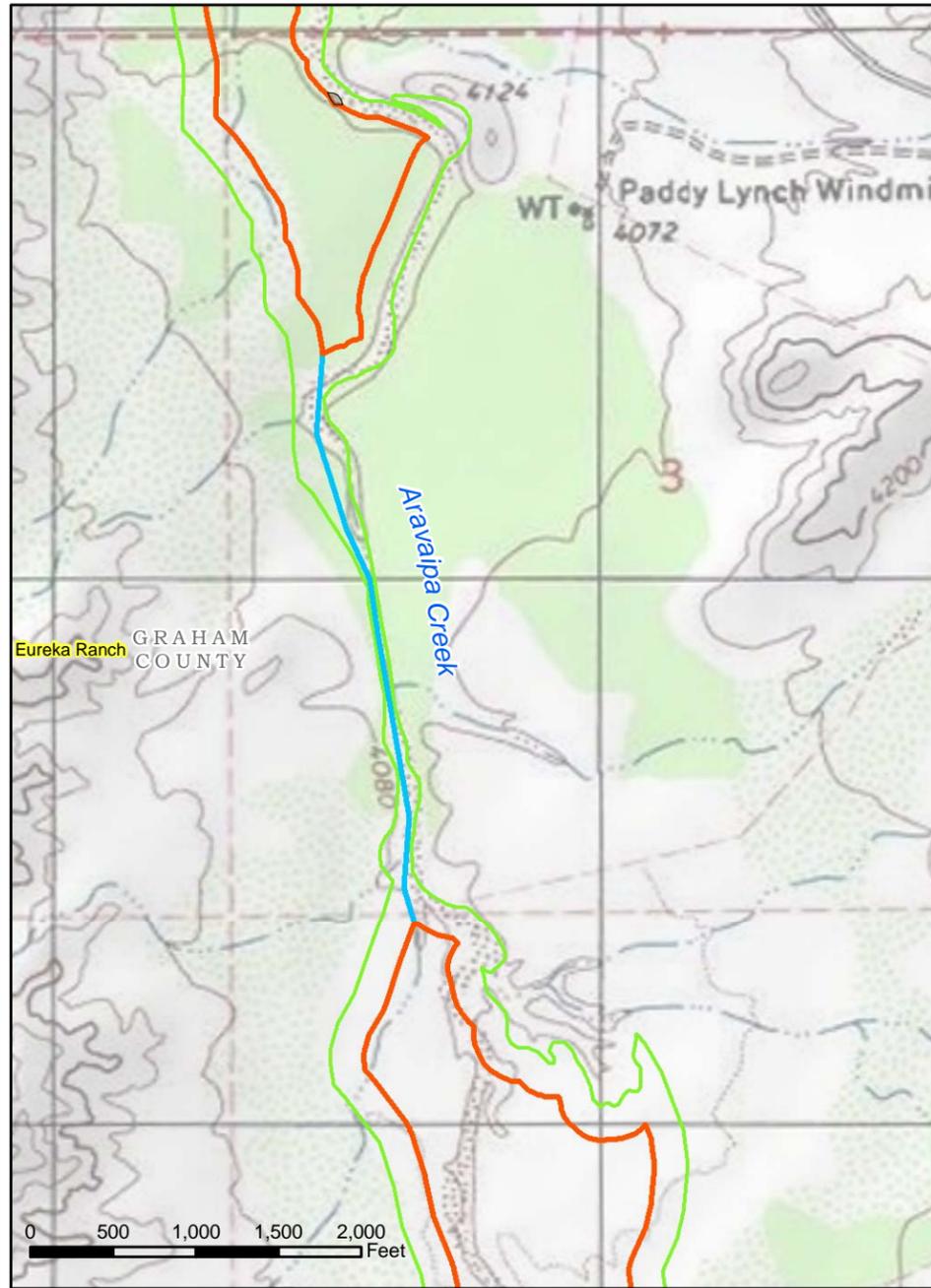
Base Map: USGS 1:24,000 Topo



Figure 4-9
Examples of Isolated Deposits of Floodplain Holocene Alluvium Mapped Near Floodplain

Subflow Zone Delineation Report for the San Pedro River Watershed

Aravaipa Creek



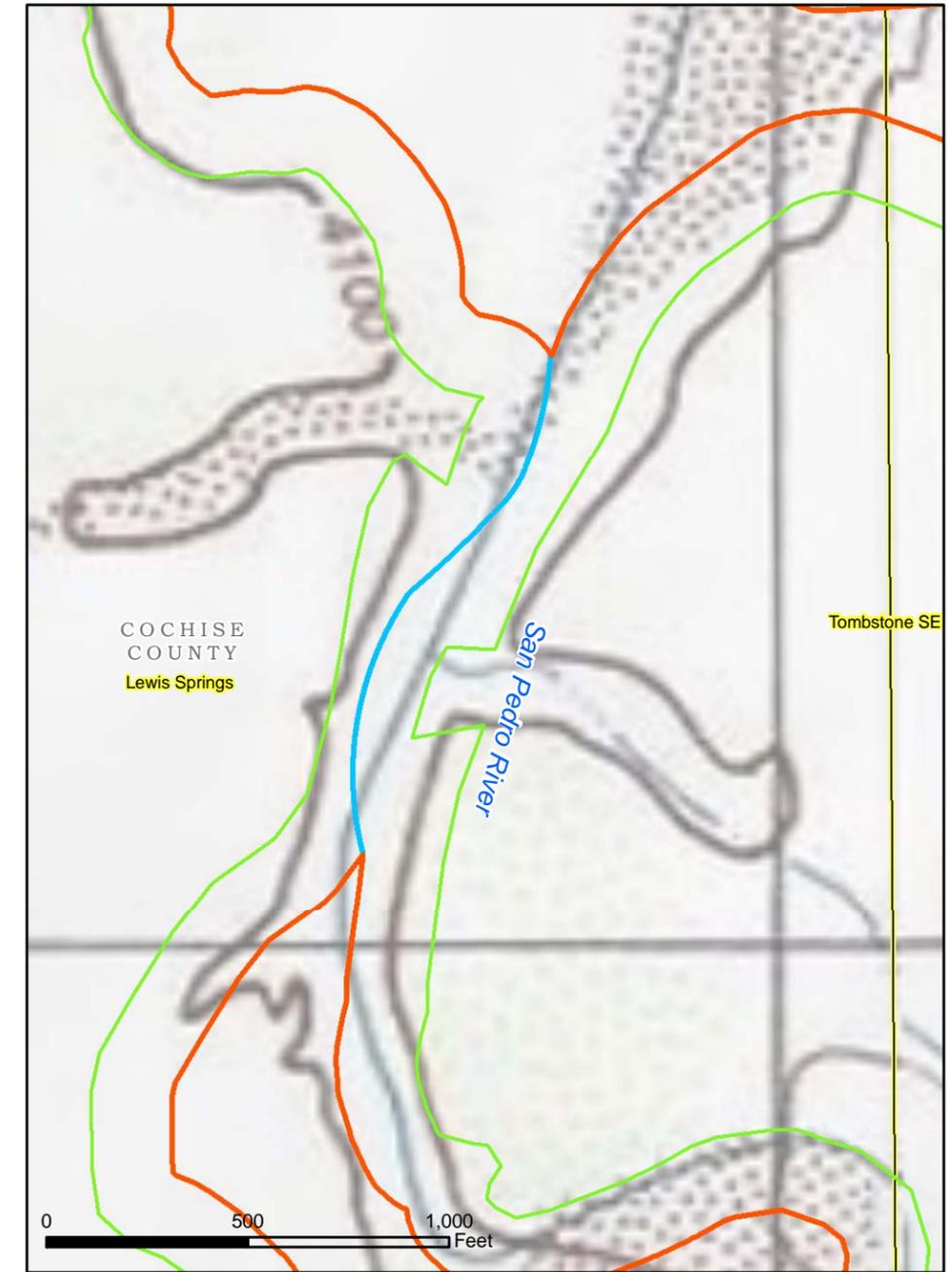
Eureka Ranch Quad

Babocomari River



Fairbank Quad

San Pedro River



Lewis Springs Quad

Legend

-  Extent of Floodplain Holocene Alluvium (FHA) With Setbacks for Side Recharge*
-  Reach where width of setback is greater than width of FHA
-  Reach where FHA not mapped at 1:24,000 scale used by AZGS
-  Extent of FHA**
-  San Pedro River Watershed
-  USGS Topo Quad Boundary

-  County
-  International Boundary

*100-foot and 200-foot setbacks applied where FHA bordered by basin fill and tributary Holocene alluvium deposits, respectively. No setbacks applied where FHA is bordered by bedrock; along these reaches only orange line is shown.

**See Appendices D-1 and D-2 for other generalized geologic units and disturbed areas along the floodplain respectively.

Base Map: USGS 1:24,000 Topo

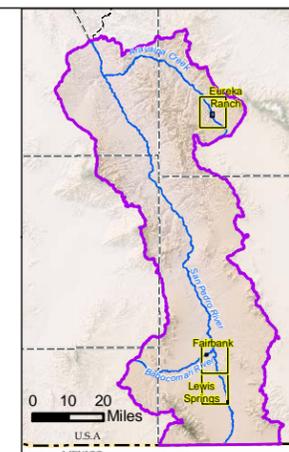
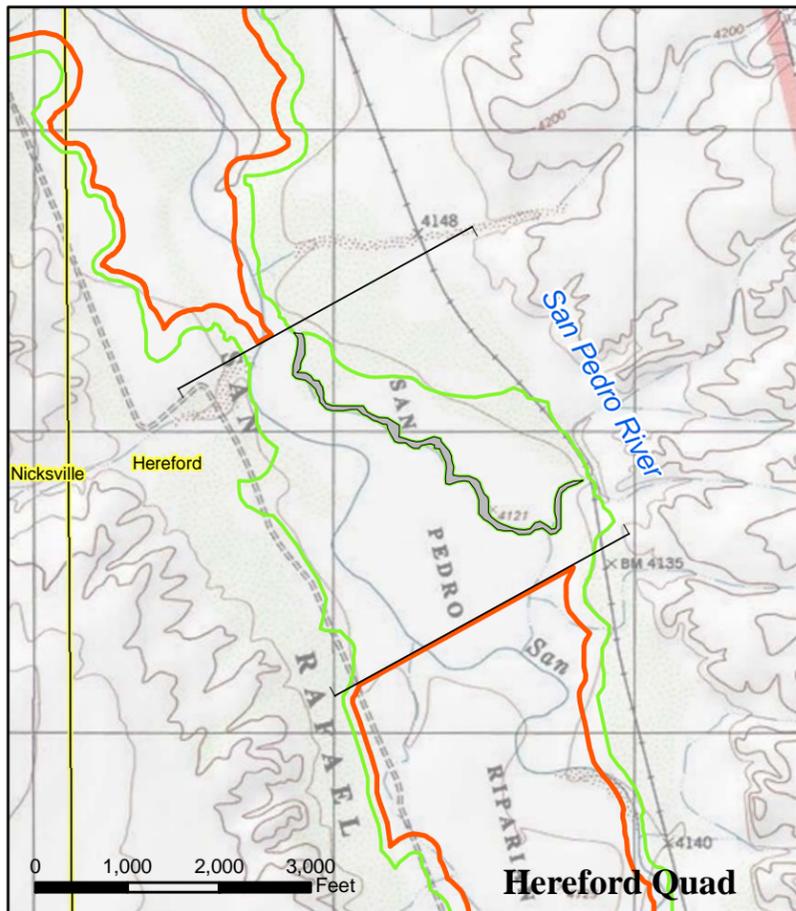
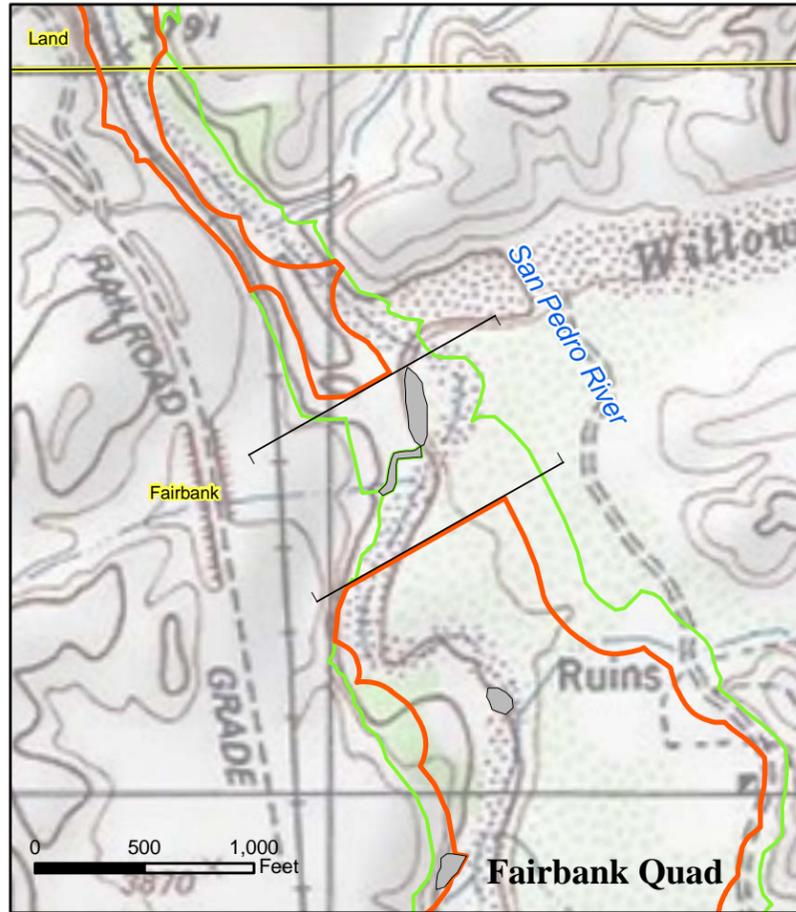


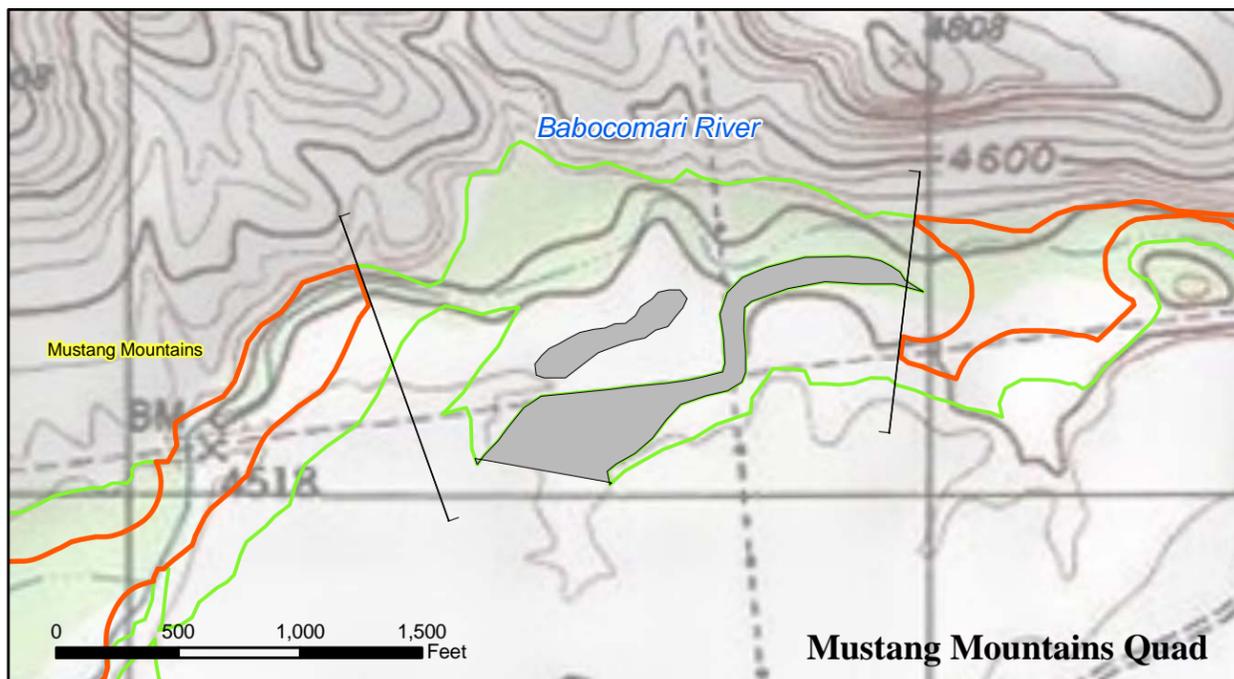
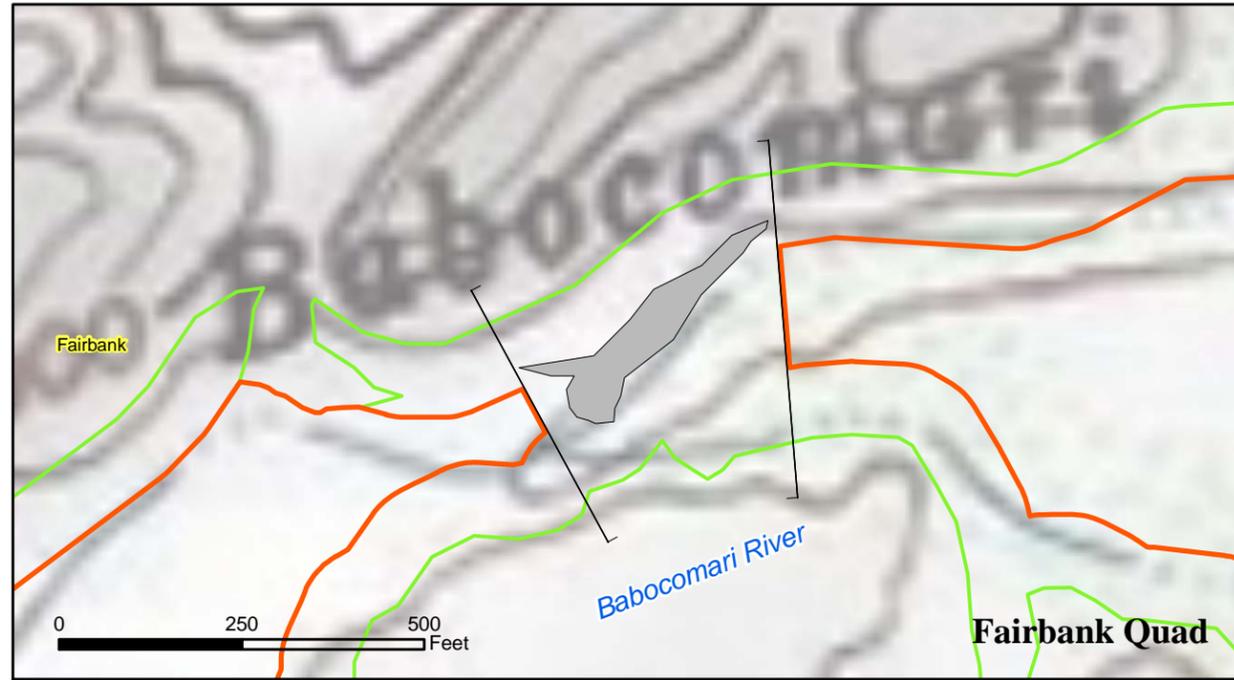
Figure 5-1
Examples Where Floodplain Holocene Alluvium Not Mapped or Setback Width is Greater

Subflow Zone Delineation Report for the San Pedro River Watershed

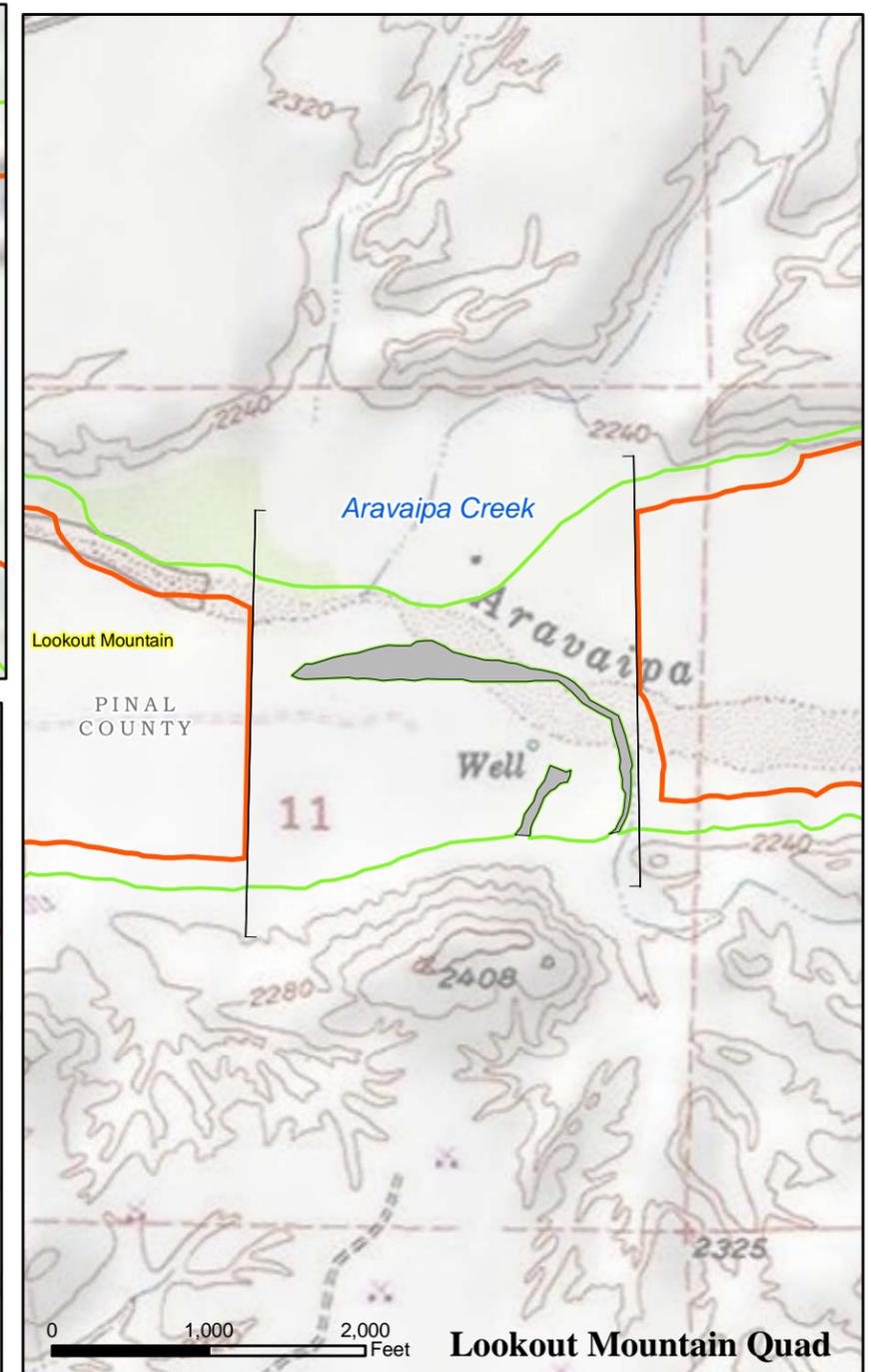
San Pedro River



Babocomari River



Aravaipa Creek



Legend

- Extent of Floodplain Holocene Alluvium (FHA) With Setbacks for Side Recharge*
- Extent of FHA**
- Other generalized geologic unit mapped within floodplain (includes islands of material and some larger fingers of tributary Holocene alluvium)
- Reach where setbacks overlap with other geologic units in floodplain
- San Pedro River Watershed

- USGS Topo Quad Boundary
- County
- International Boundary



*100-foot and 200-foot setbacks applied where FHA bordered by basin fill and tributary Holocene alluvium deposits, respectively. No setbacks applied where FHA is bordered by bedrock; along these reaches only orange line is shown.

**See Appendices D-1 and D-2 for other generalized geologic units and disturbed areas along the floodplain respectively.

Base Map: USGS 1:24,000 Topo

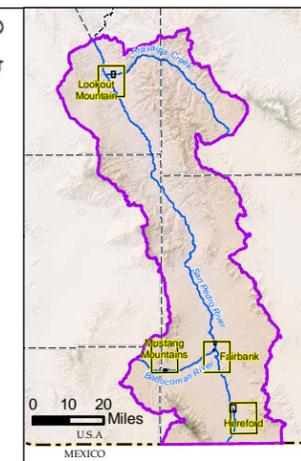
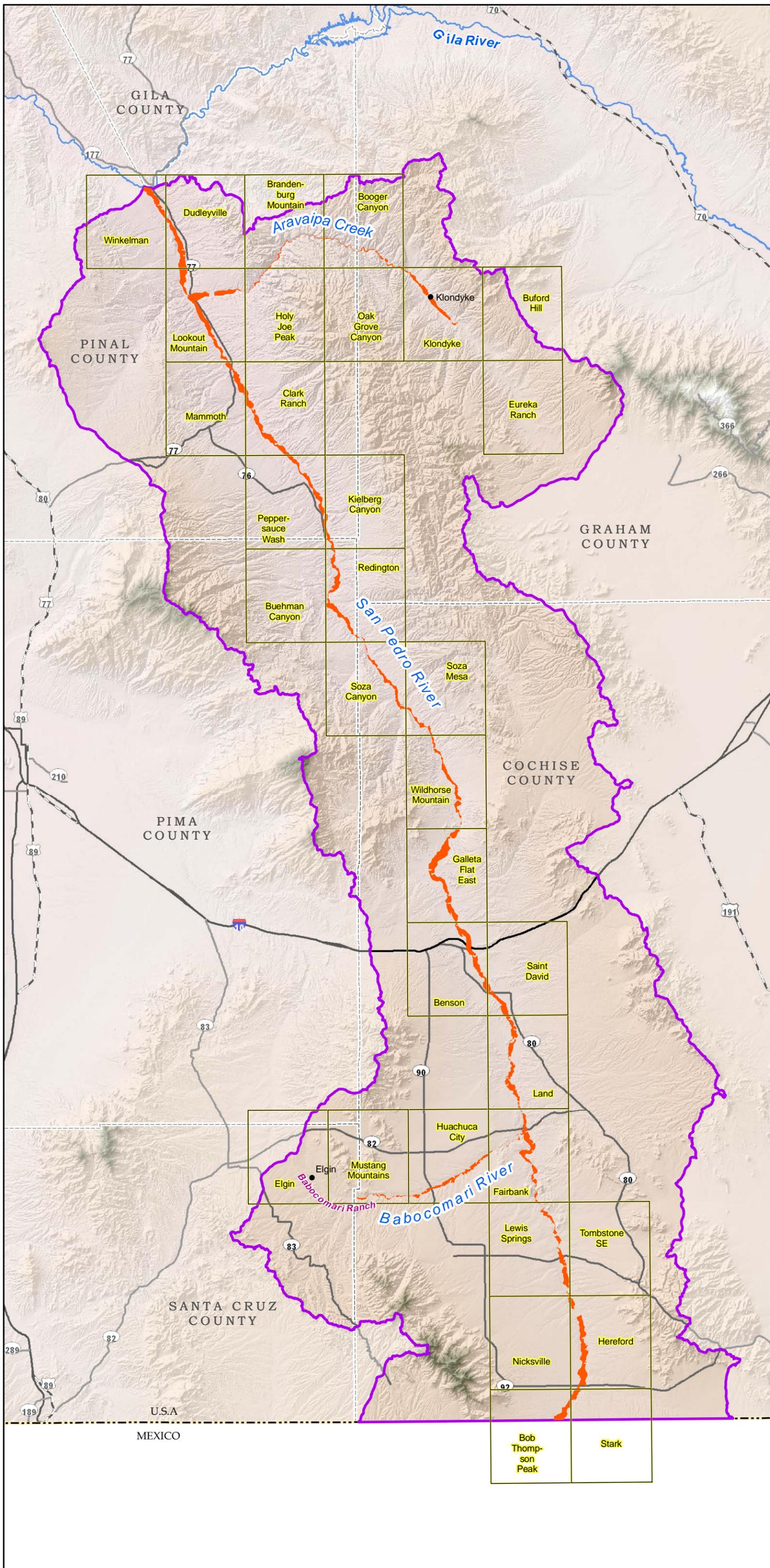


Figure 5-2
Reaches Where Setbacks Not Applied by ADWR Due to Other Geologic Units in Floodplain

Subflow Zone Delineation Report for the San Pedro River Watershed



Legend

- Extent of Subflow Zone
- USGS Topo Quad Boundary
- San Pedro River Watershed
- City or Town
- Gila River
- Interstate Highway
- U.S. Route
- State Highway
- County
- State Boundary
- International Boundary

Note:
See Appendix E for detailed delineation of subflow zone on quad maps.

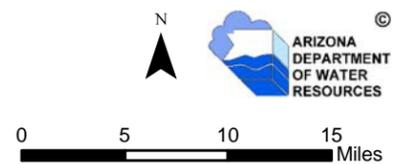
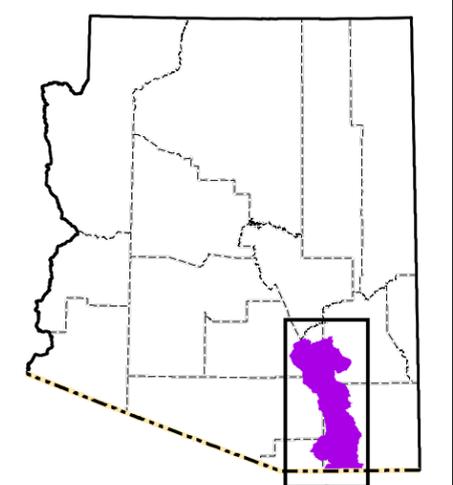


Figure 6-1
Subflow Zone Along Major Streams in the San Pedro River Watershed

Subflow Zone Delineation Report for the San Pedro River Watershed