



Ecological Flows on the BILL WILLIAMS RIVER: A Sustainable Rivers Project

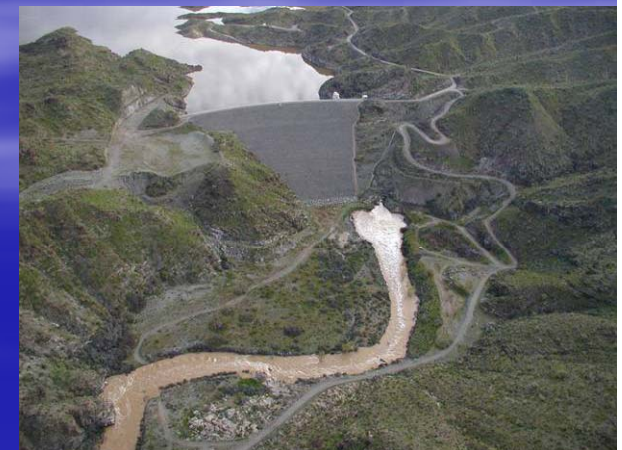


2010 Colorado River Terrestrial and Riparian Meeting (CRTR):

Hosted by LCR-MSCP



Presented by:
Andrew Hautzinger
Hydrologist
USFWS-Southwest Region
Albuquerque, NM



BWR EcoFlows---Talk Outline:

- OVERVIEW of the BWR & ALAMO DAM
- BRIEF DESCRIPTION OF THE BWR CORRIDOR STEERING COMMITTEE & THE SUSTAINABLE RIVERS PROJECT
- REVIEW OF BWR ECOLOGICAL FLOW WORK / TOOL DEVELOPMENT
- LEAVE TIME FOR A FEW QUESTIONS....



Bill Williams River OVERVIEW



Andrew Hautzinger-USFWS
2010 CRTR

ALAMO DAM

Primary Purpose:

- **Flood Control**

Built in 1968

1 MAF Storage Capacity

Maximum Outlet

Capacity is 7,000 cfs

**Flow of 6,800 cfs
(02/23/05)**

Affected Species of Concern:

- Southwestern willow flycatcher
- Yellow-billed cuckoo
- Bald eagles
- Yuma Clapper Rail
- California Black Rail
- Riparian bats
- Butterflies
- Bonytail chub
- Razorback sucker



BILL WILLIAMS RIVER NATIONAL WILDLIFE REFUGE



LONG LIVE PLANET RANCH!



(Andy Pernick, USBR-2006)



ALAMO DAM

An aerial photograph of the Alamo Dam and its reservoir. The dam is a long, grey concrete structure across a valley. The reservoir is a large, calm body of water behind the dam. The surrounding landscape is hilly and green, with a winding road visible. The river below the dam is muddy brown and flows through a narrow channel.

Primary Purpose:

- **Flood Control**

Built in 1968

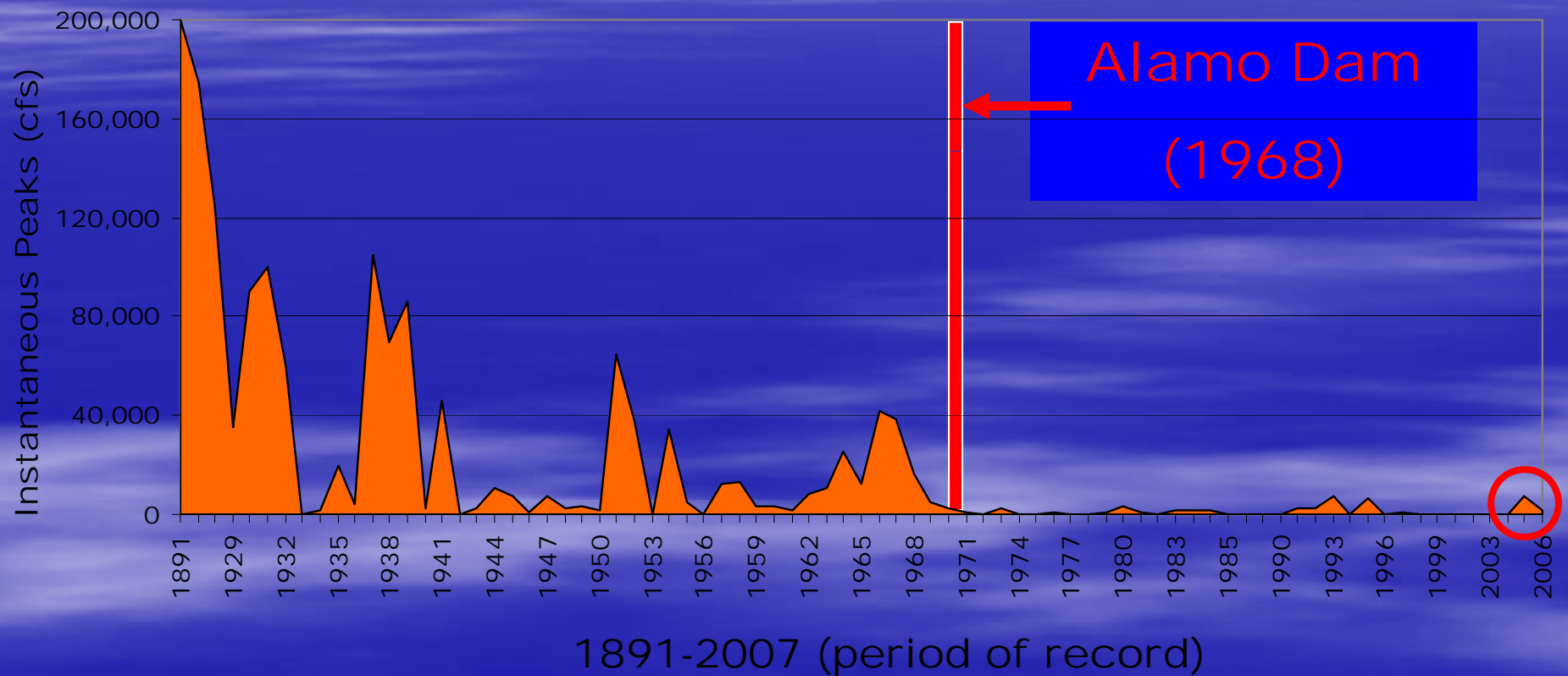
1 MAF Storage Capacity

Maximum Outlet

Capacity is 7,000 cfs

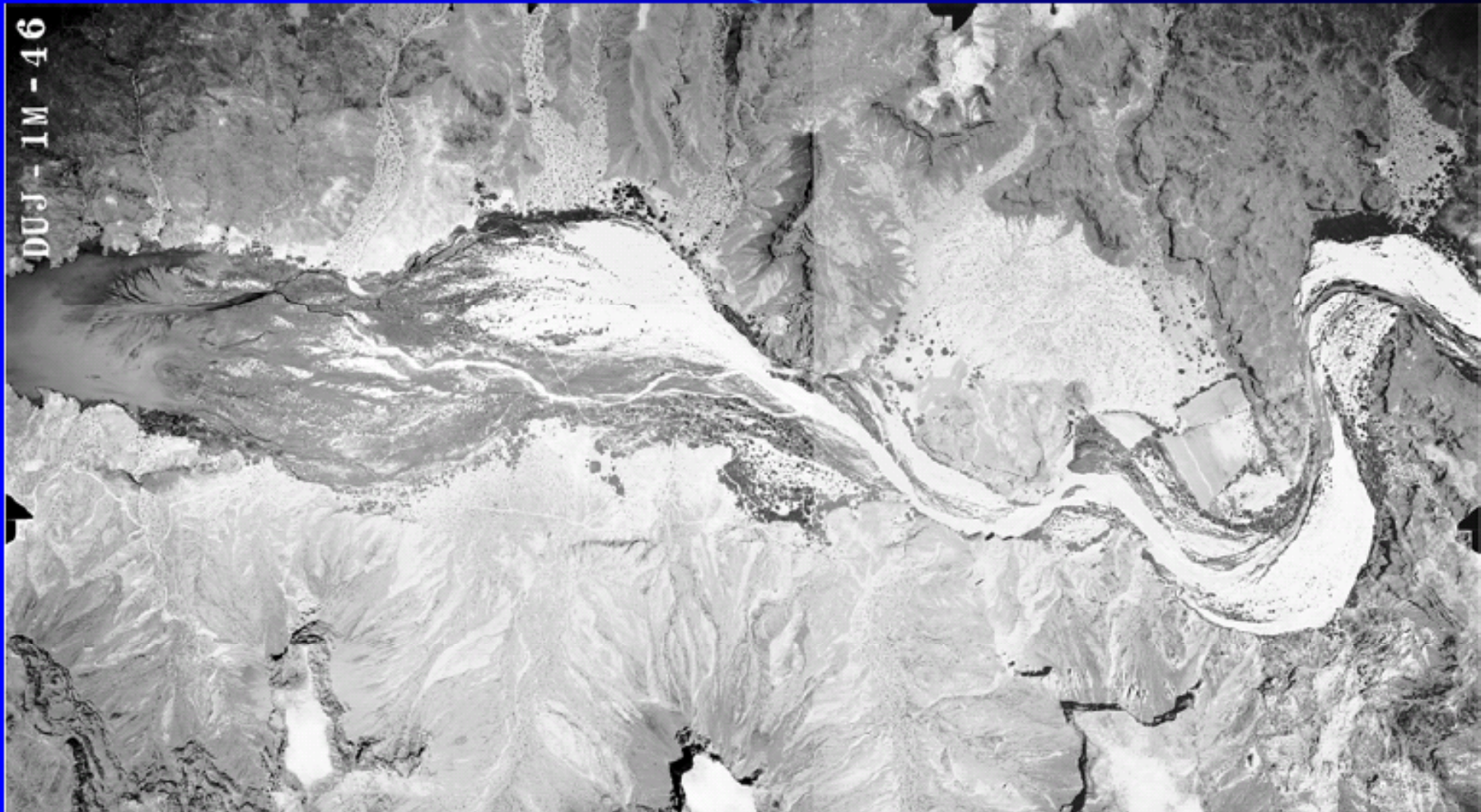
**Flow of 6,800 cfs
(02/23/05)**

Alamo Dam – Peak Flow Hydrograph



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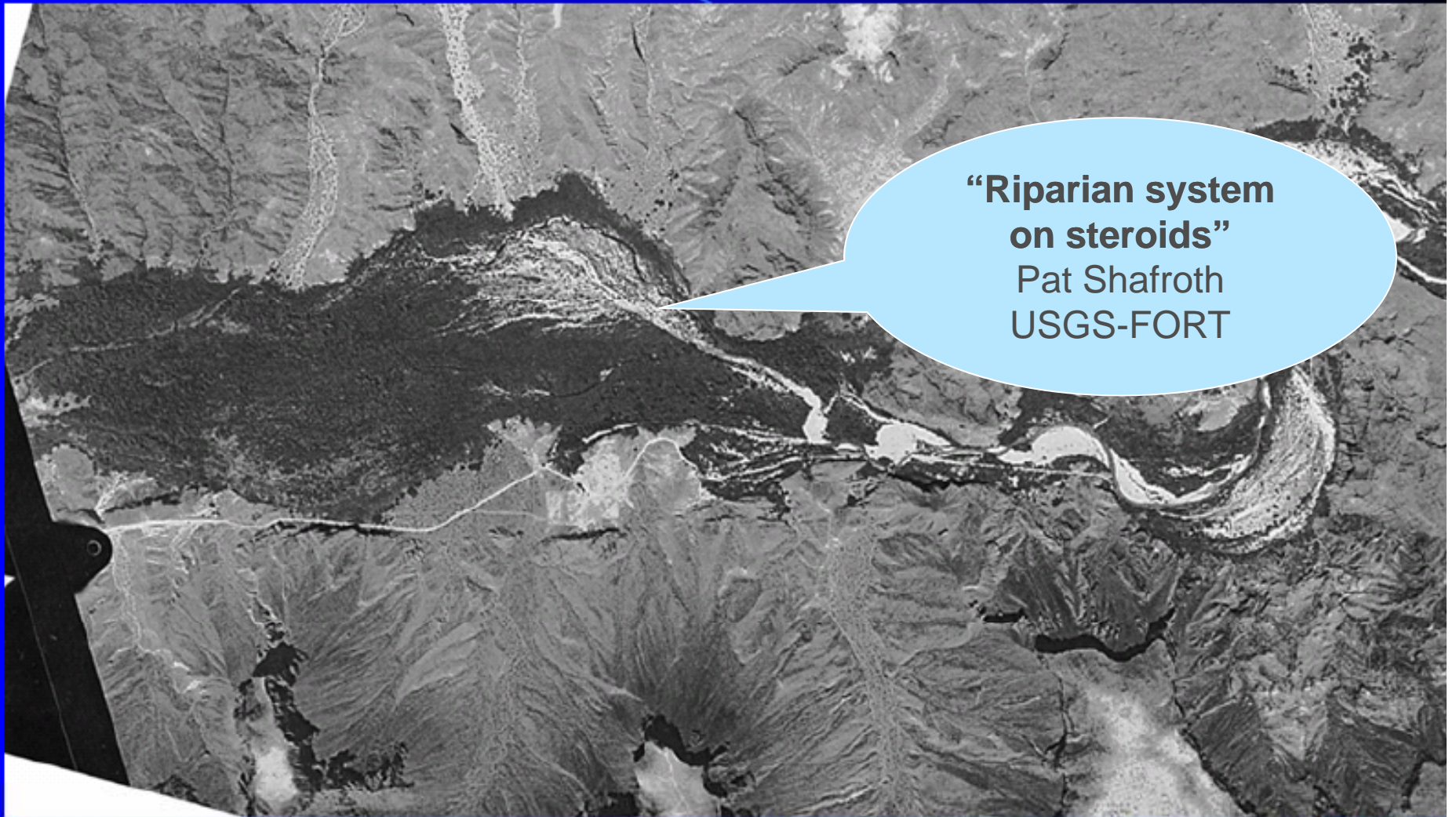
Havasu Delta 1953



BILL WILLIAMS RIVER –
Andrew Hautzinger – Branch of Water Resources

House, 2005

Havasu Delta 1995

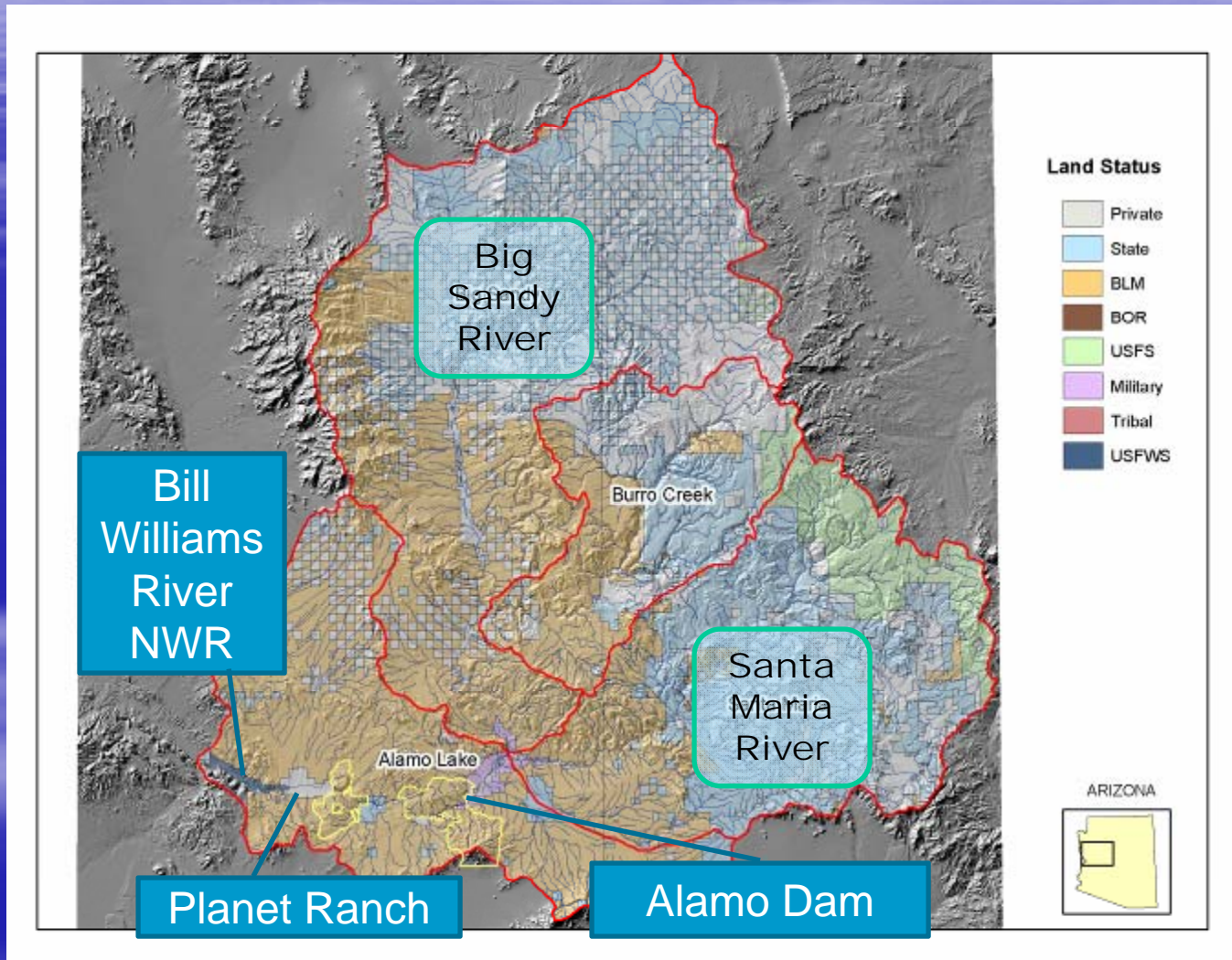


**“Riparian system
on steroids”**
Pat Shafroth
USGS-FORT

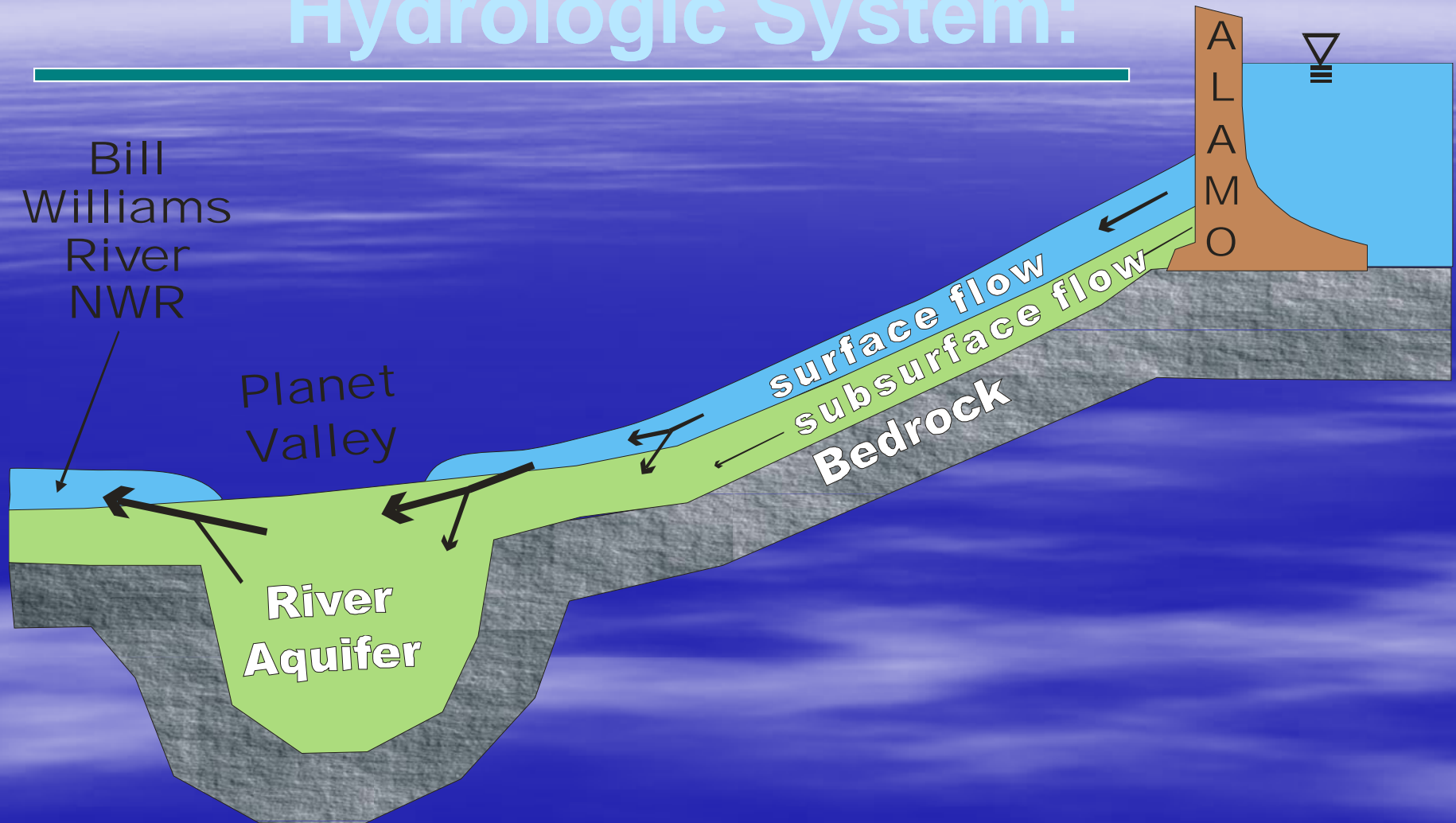
BILL WILLIAMS RIVER –
Andrew Hautzinger – Branch of Water Resources

House, 2005

Bill Williams River Watershed:

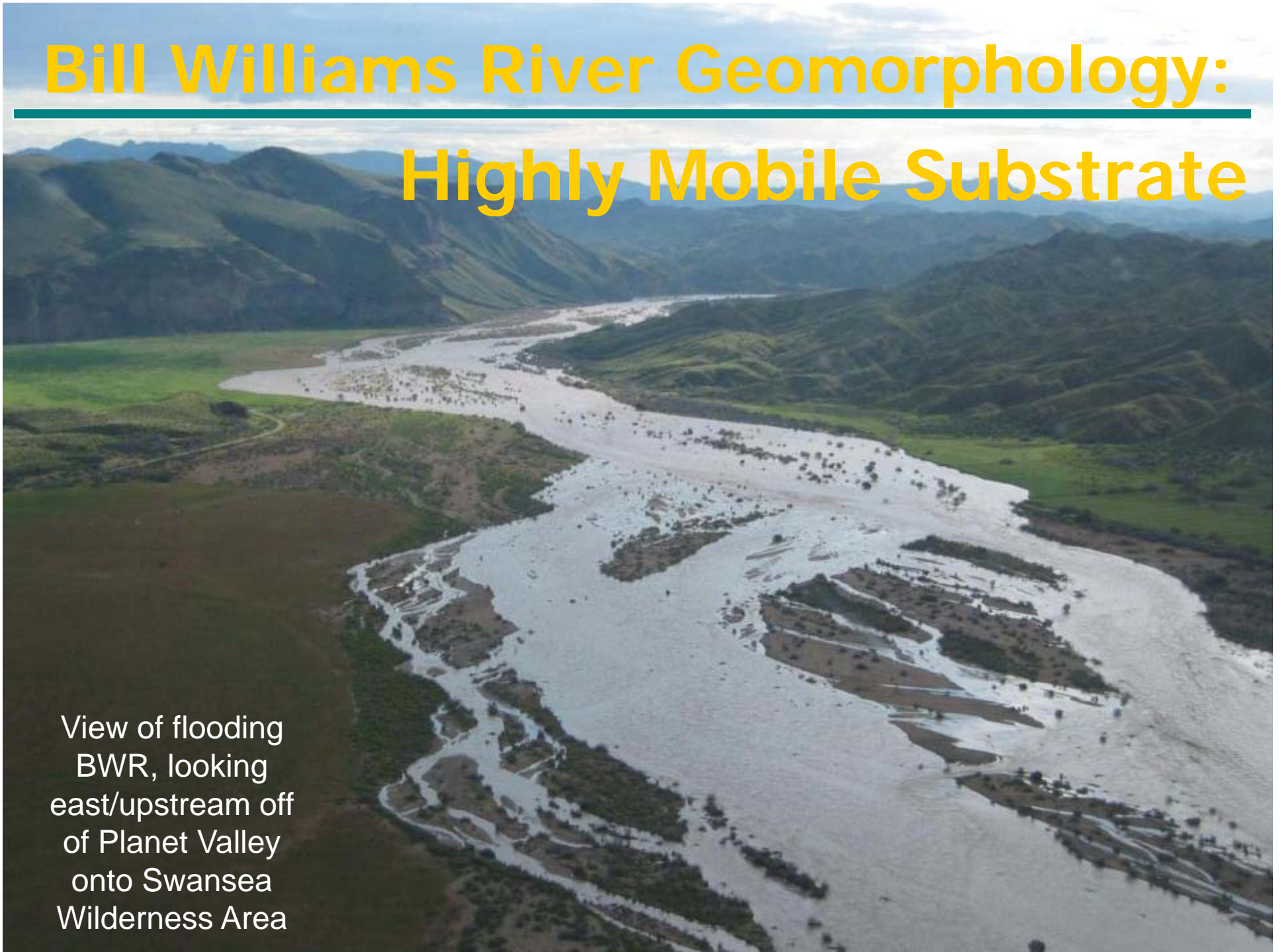


Schematic of Bill Williams Hydrologic System:

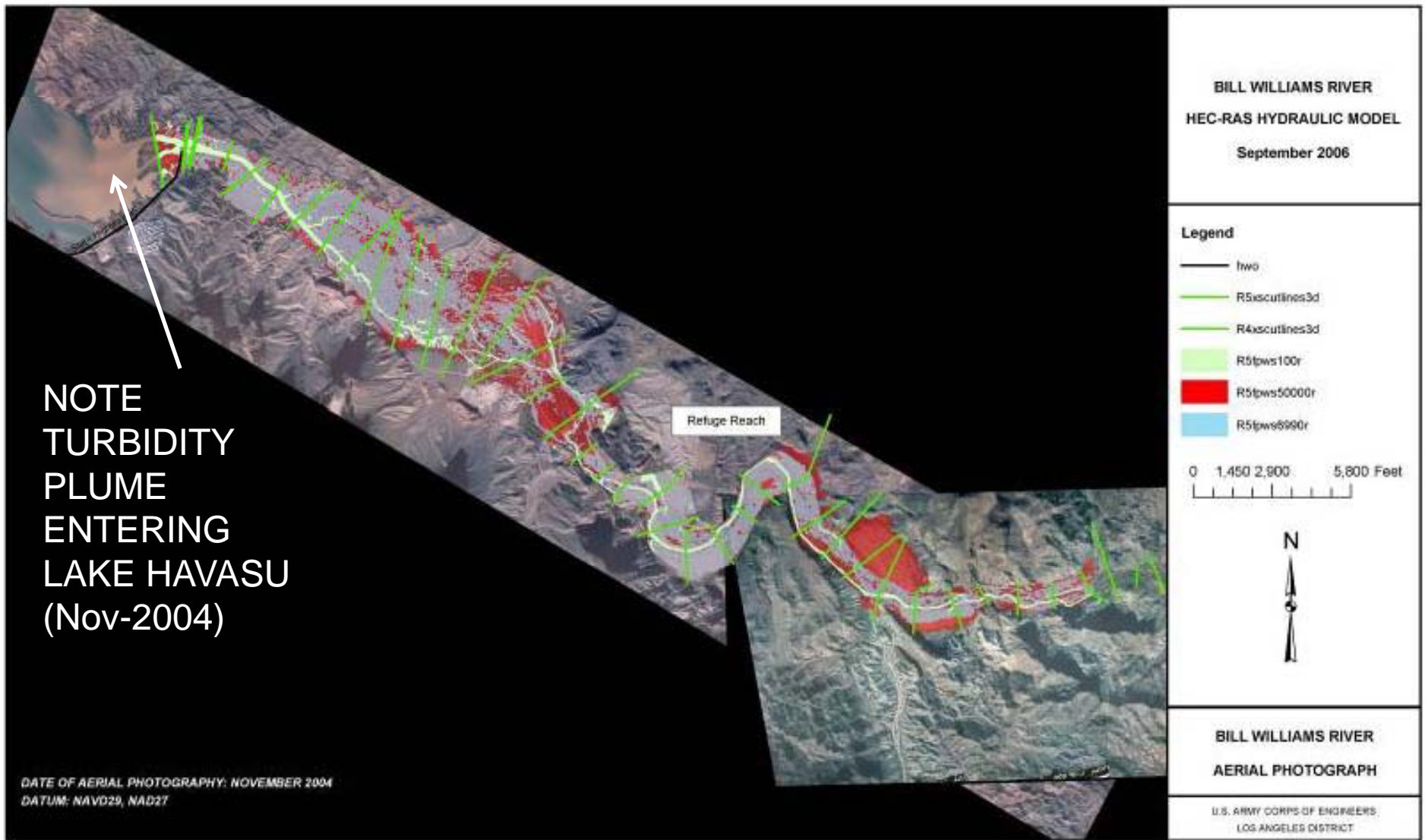


Bill Williams River Geomorphology: Highly Mobile Substrate

View of flooding
BWR, looking
east/upstream off
of Planet Valley
onto Swansea
Wilderness Area



The Bill Williams River & the LCR:



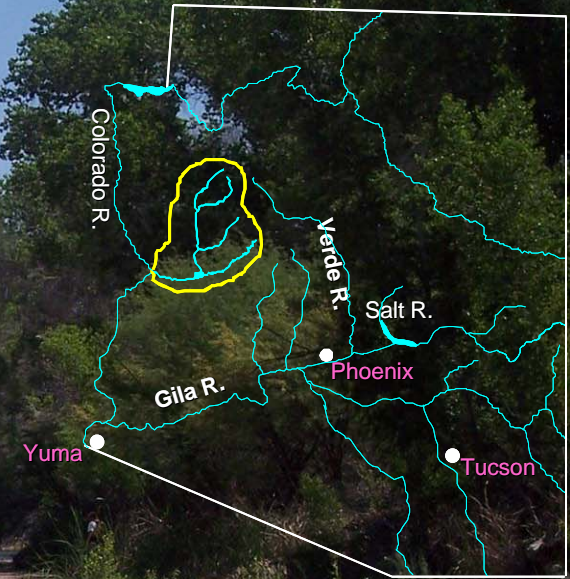
Why the Bill Williams River?

High Ecological Value:

- Intact native cottonwood-willow gallery forest
- +340 species of birds observed in refuge

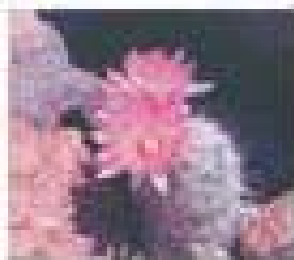
Relatively Light Human Component:

- Watershed population: ~10,000
(permanent pop. below Alamo Dam: 3)
- Straight-forward dam mission (flood control, no hydro. electricity)



Bill Williams River Corridor Steering Committee

Partnership Members:



BILL WILLIAMS RIVER

Corridor Steering Committee

<http://billwilliamsriver.org/>

Bill Williams River Corridor Steering Committee:

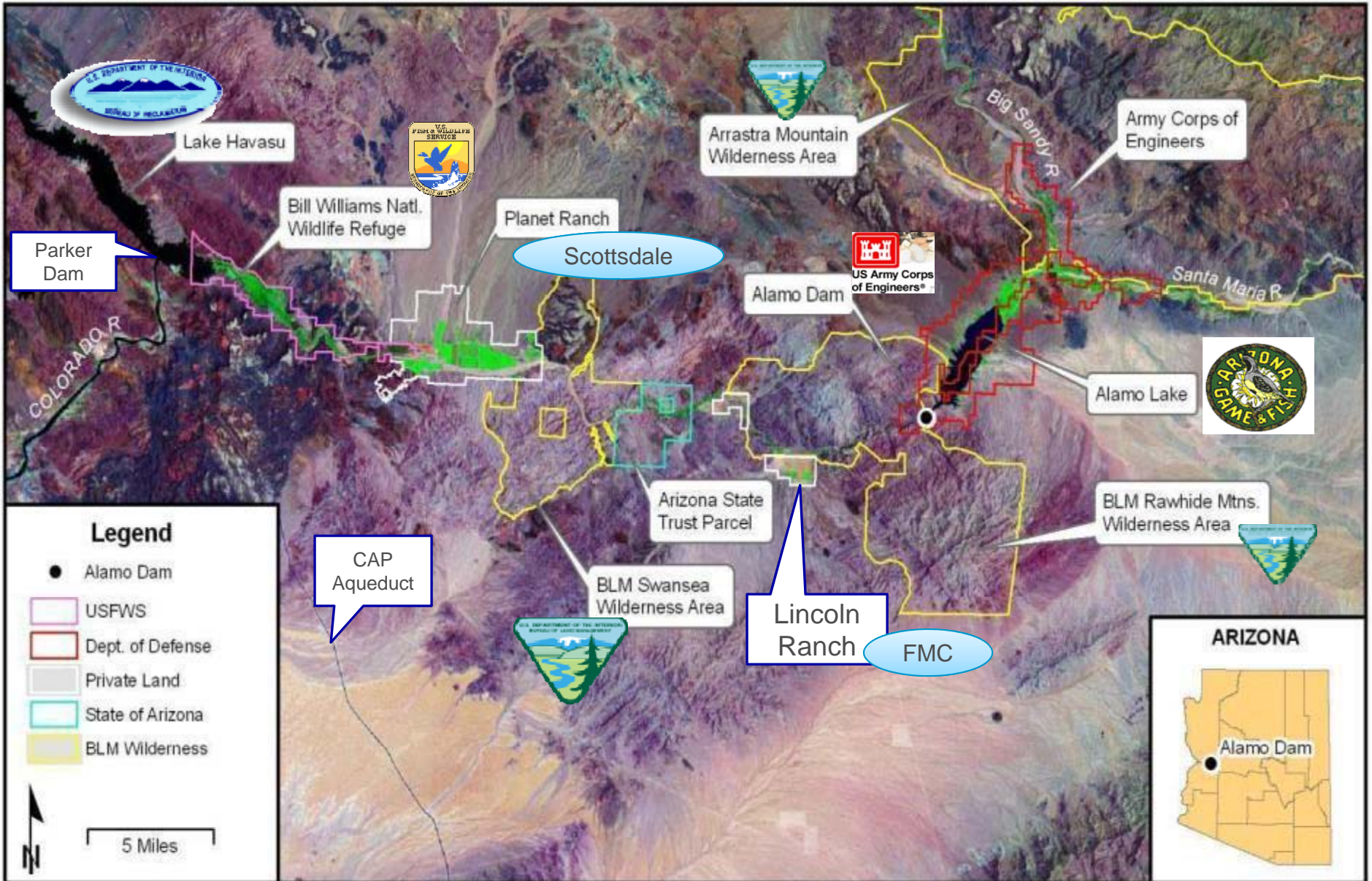


The Mission of the *Bill Williams River Corridor Steering Committee* is to provide a collaborative, science-based framework that can inform decision-making and lead to: (1) the preservation and enhancement of the last, best, intact riparian ecosystem in the **Lower Colorado River** corridor while addressing the flood control, recreation and water supply needs of current and future generations; (2) identification of appropriate data needs and coordination and implementation strategies for maintaining and enhancing the overall health of the Bill Williams River watershed.





BILL WILLIAMS RIVER - ALAMO DAM, AZ



BWR --- Science Strategies

1. Focus on interdisciplinary, integrated river science – linking flow to the biota
2. Bridge science, management & policies
3. Address critical research & monitoring needs

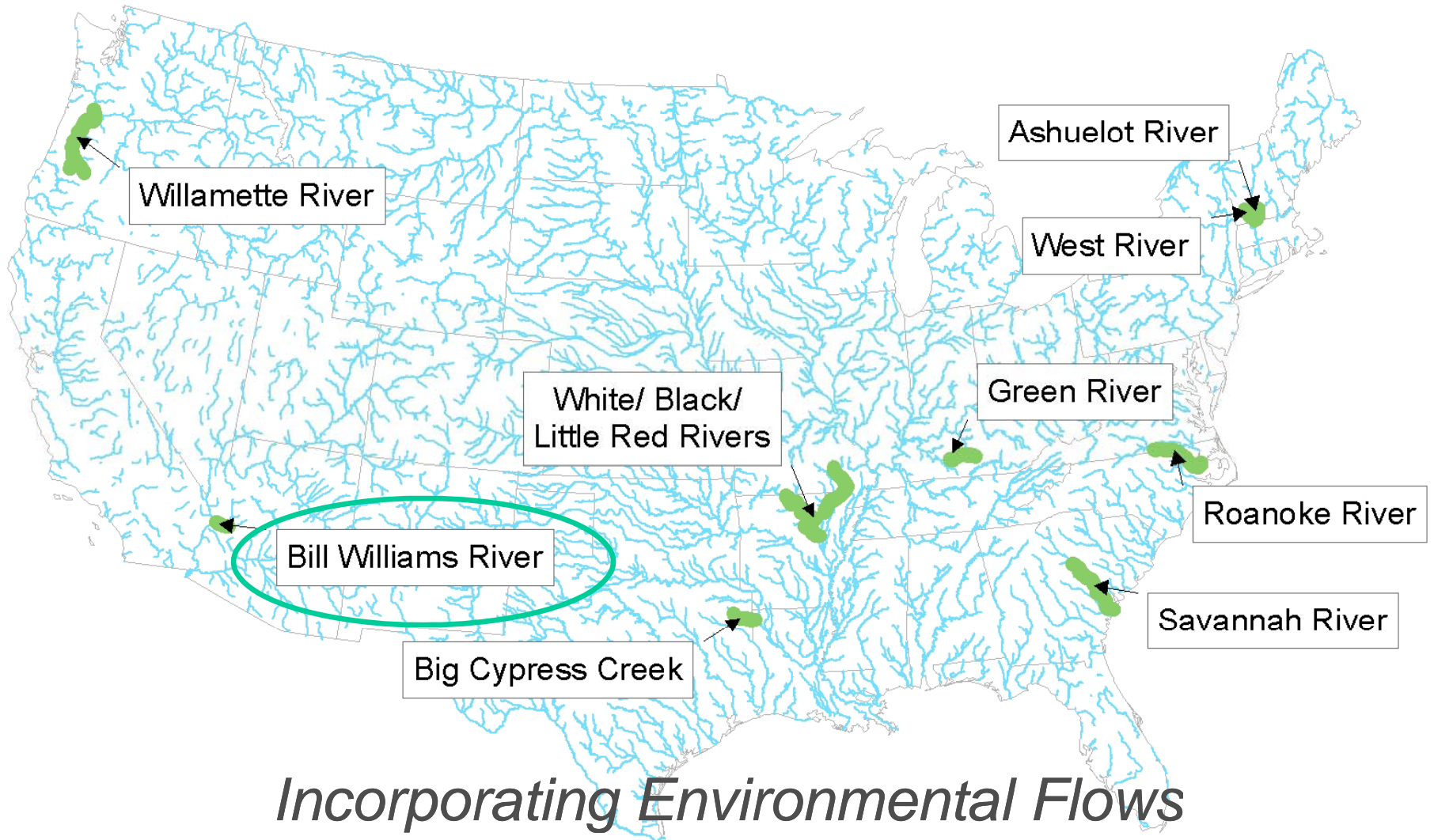


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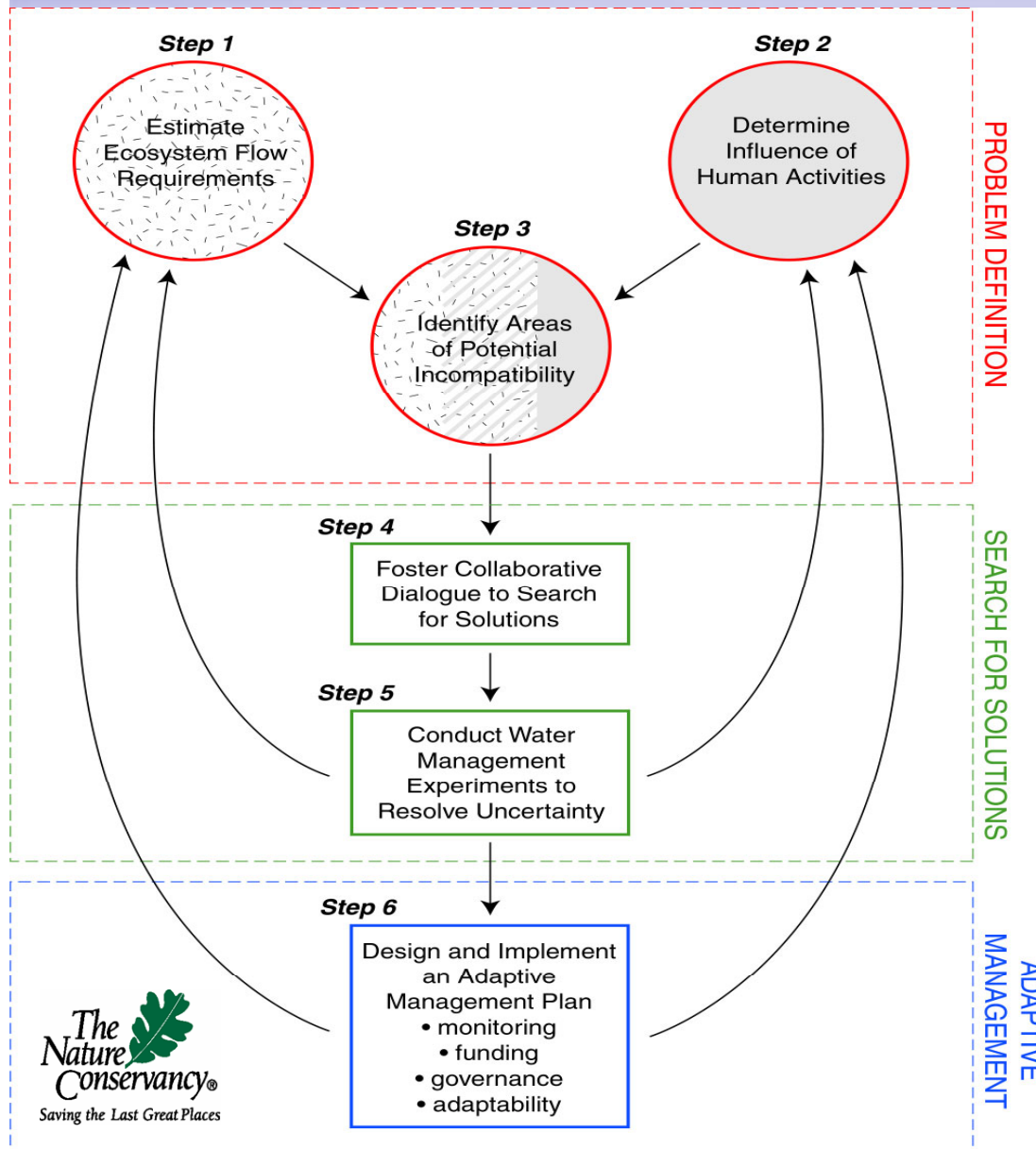
Sustainable Rivers Project

Current Sites



*Incorporating Environmental Flows
into Adaptive Reservoir Management*

SRP: Ecologically Sustainable Water Management



E.S.W.M. Framework:
Iterative Process that
Generates
Environmental Flow
Recommendations:

- Time Specific /
Numeric Goals
- Whole Ecosystem
- Scientifically Credible
- Adaptive
Implementation

Conceptual Ecological Flow Model for a Southwestern River Ecosystem

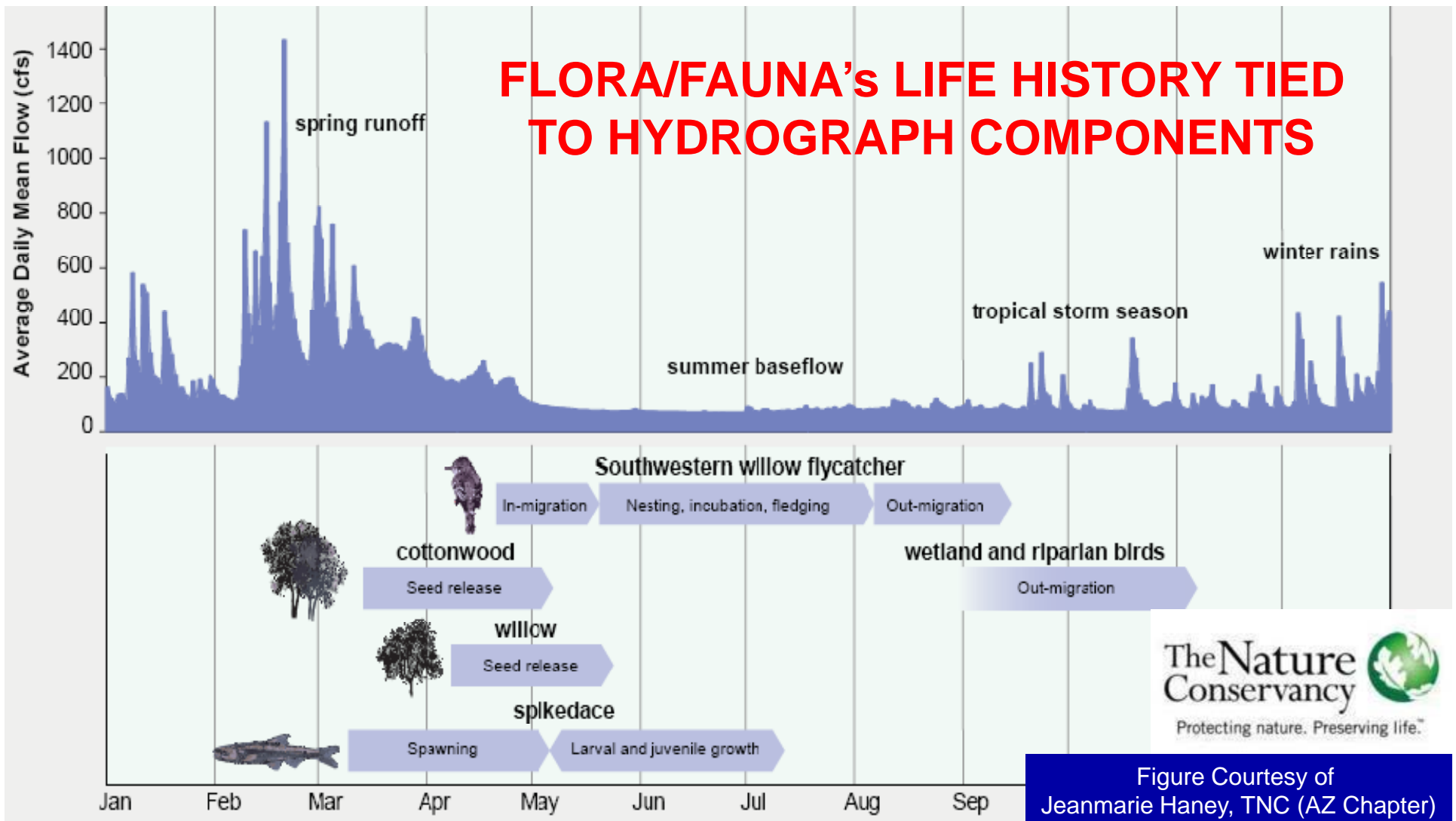


Figure Courtesy of Jeanmarie Haney, TNC (AZ Chapter)

ECOLOGICAL FLOWS on the BILL WILLIAMS RIVER



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2010 CRTR

Bill Williams River Ecosystem

Flow Requirements: Characteristics

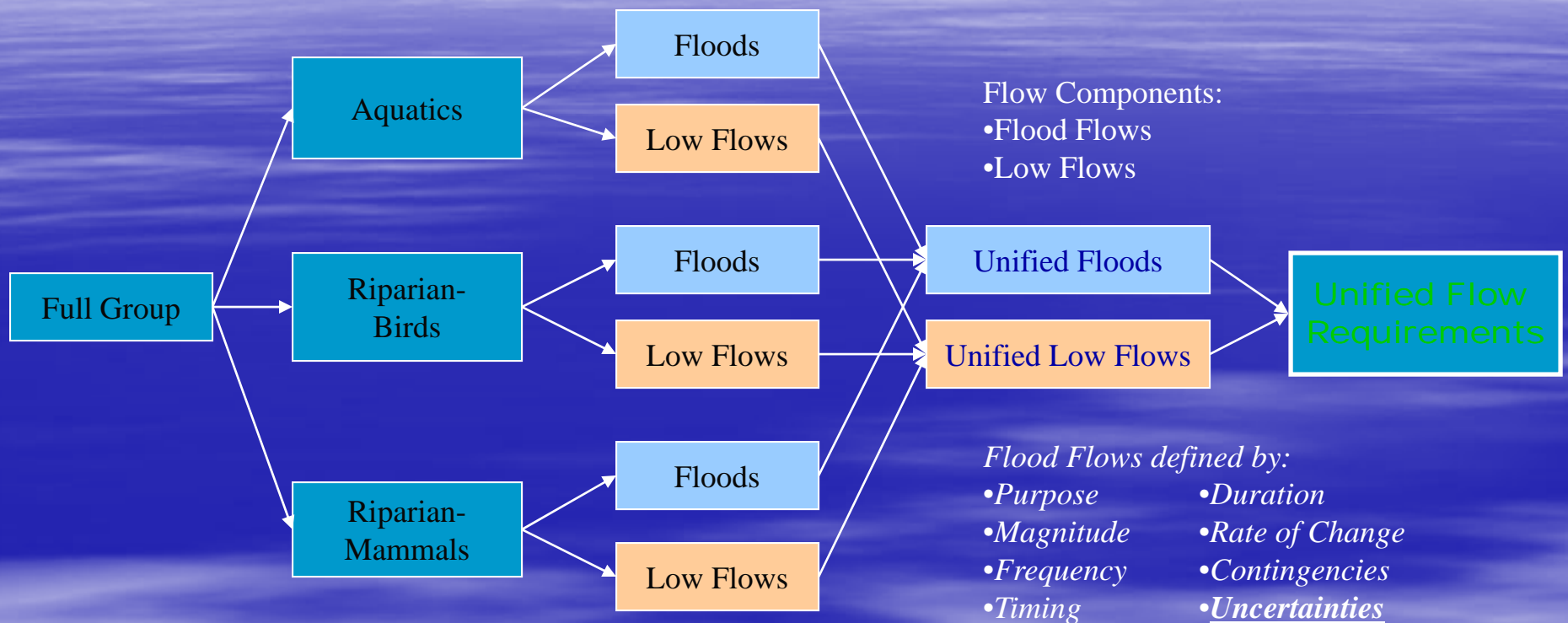
- TIMING (SEASONAL CATEGORIES)
- FREQUENCY
- DURATION
- RATE OF CHANGE
- CONTINGENCIES

ALL LINKED TO LIFE
HISTORY OF BIOTA



Bill Williams River *Ecosystem Flow Workshop*

Held at
ASU,
March 2005



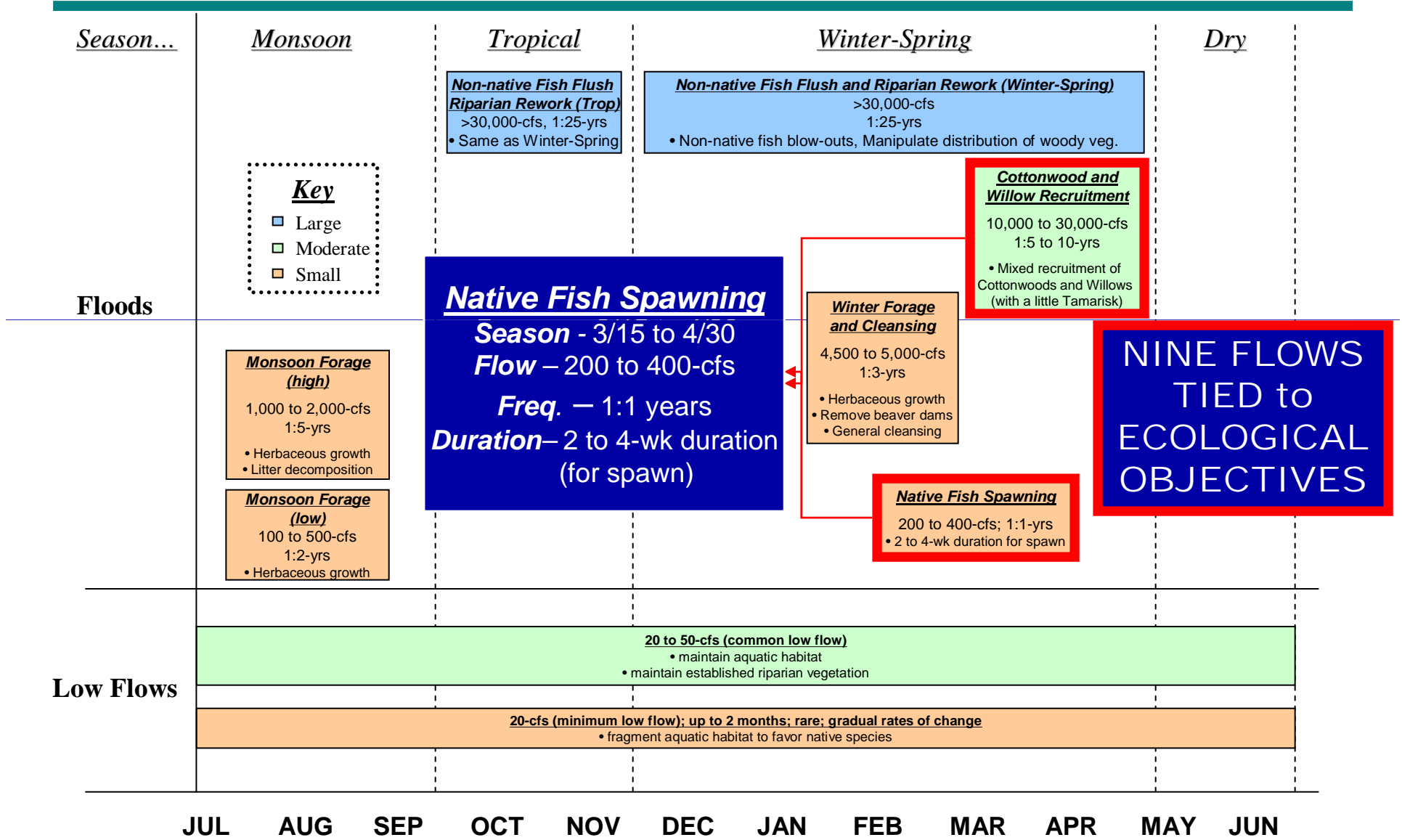
...over 50 scientists, engineers, and natural resource managers - representing more than twenty institutions - working together to reach consensus on a set of flow requirements in only two and half days...



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2010 CRTR

Ecosystem Flow Requirements

Bill Williams River Corridor, below Alamo Dam



Developing Ecosystem Flow Requirements



Defining Ecosystem Flow Requirements

for the Bill Williams River, Arizona

Patrick B. Shafroth and Vanessa B. Beauchamp (editors)



Open File Report (2006-1314)

U.S. Department of the Interior

U.S. Geological Survey



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EcoFlow Tool Development



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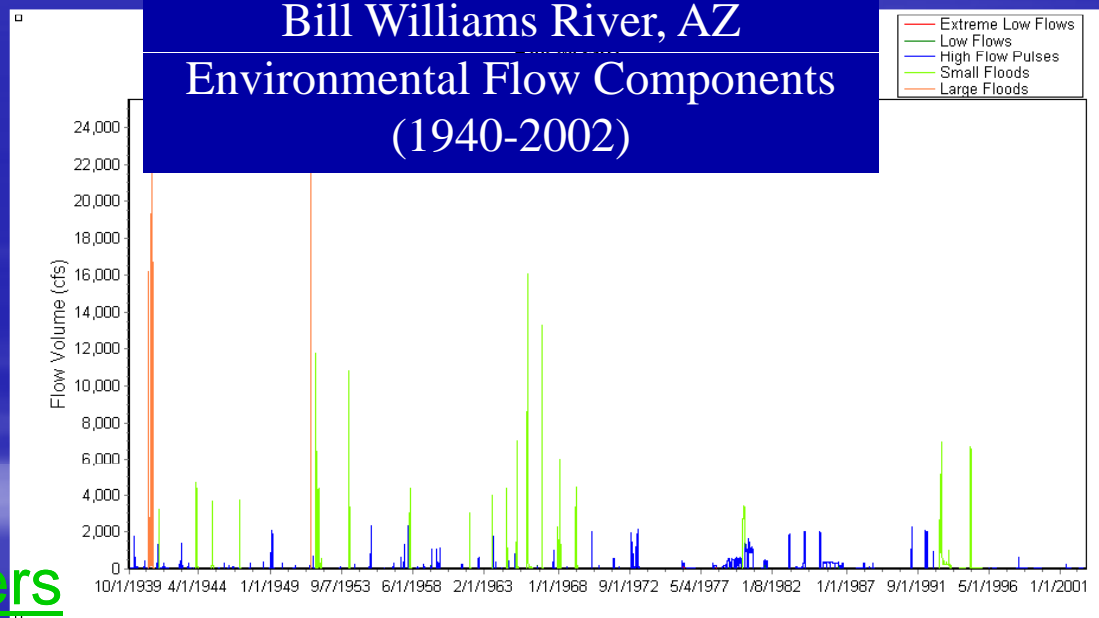


INDICATORS OF HYDROLOGIC ALTERATION SOFTWARE Version 7

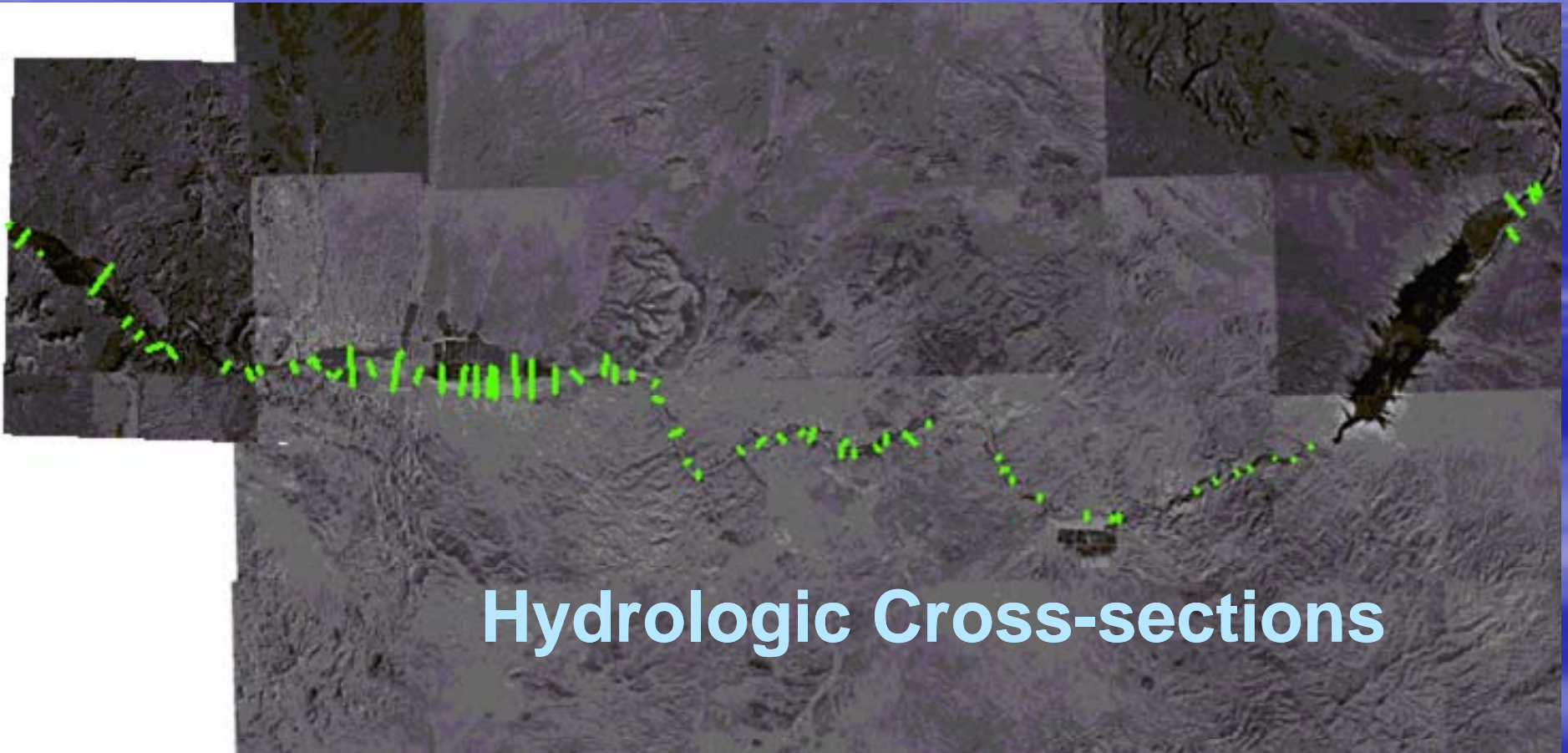
- Analyzes hydrologic characteristics and their changes over time
- Computes 67 ecologically-relevant flow statistics using daily hydrologic data
- Available free:

www.nature.org/freshwaters

Bill Williams River, AZ Environmental Flow Components (1940-2002)



Bill Williams River – Flow Modeling



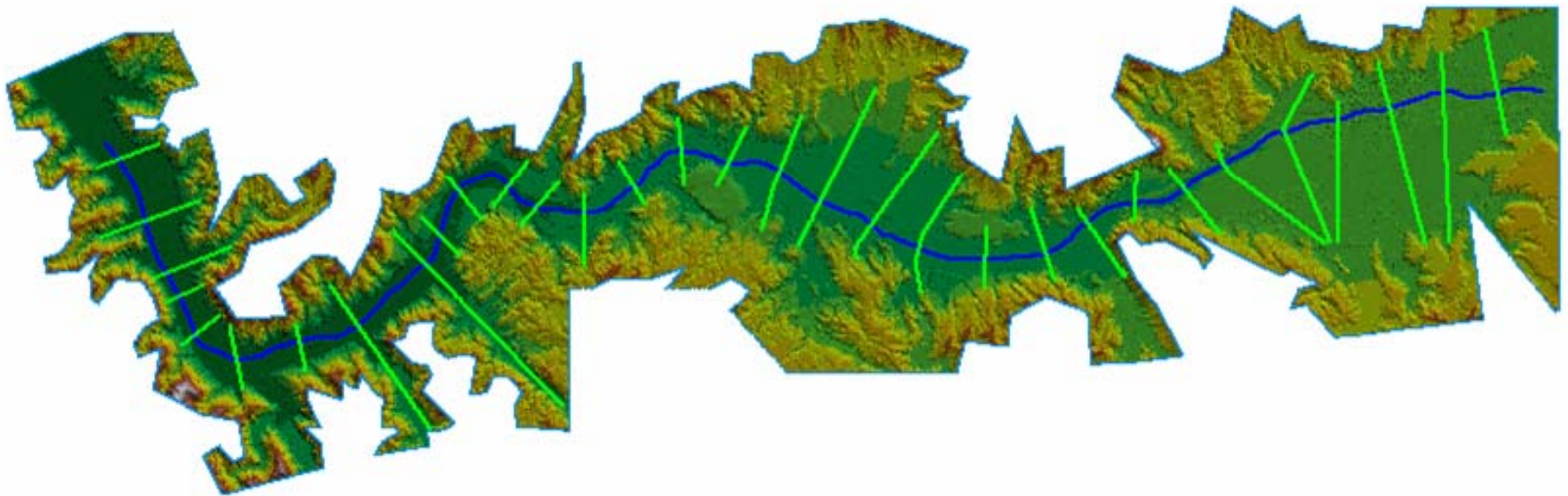
Hydrologic Cross-sections

Figure Courtesy of U.S. Army Corps Of Engineers



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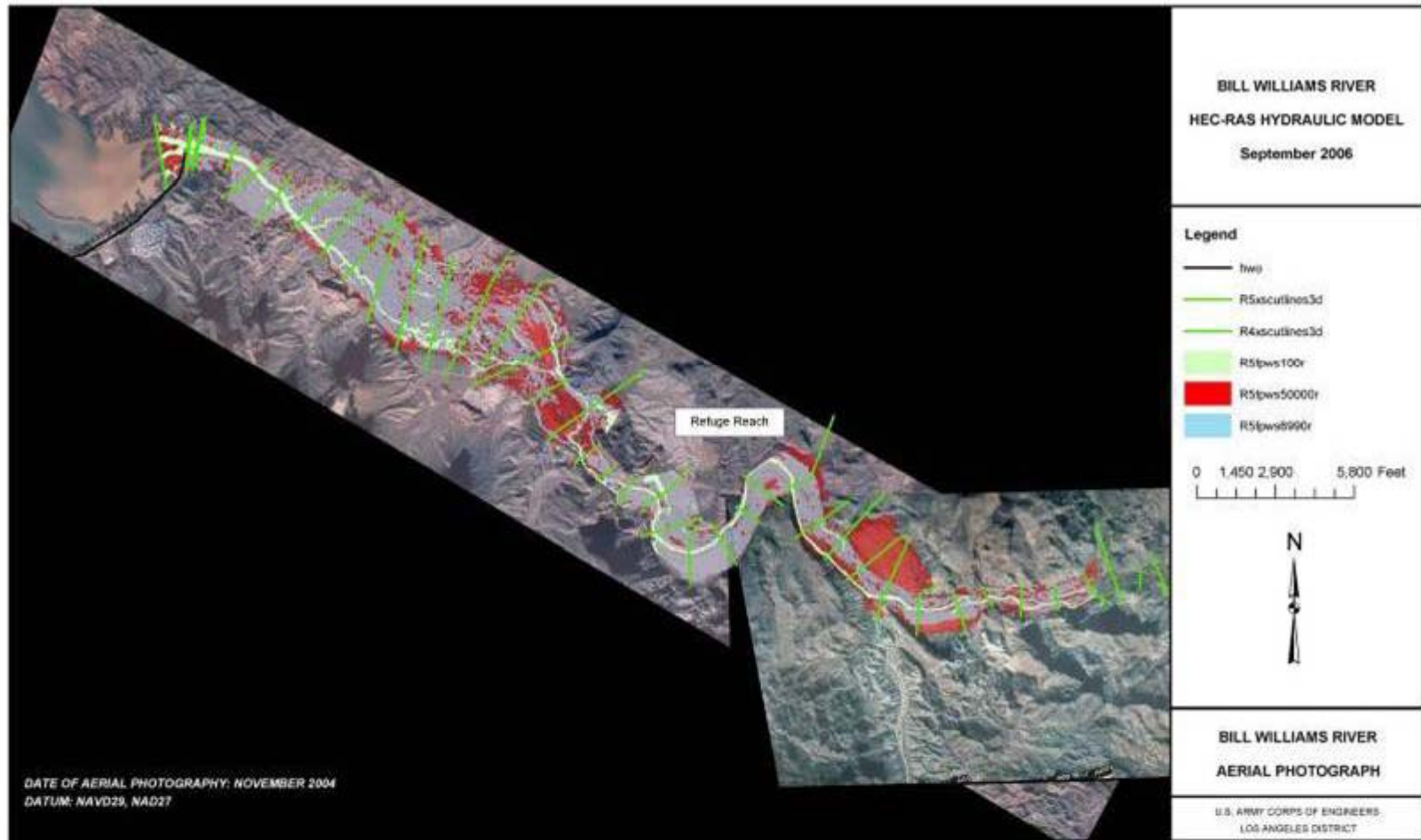
Bill Williams River – Flow Modeling



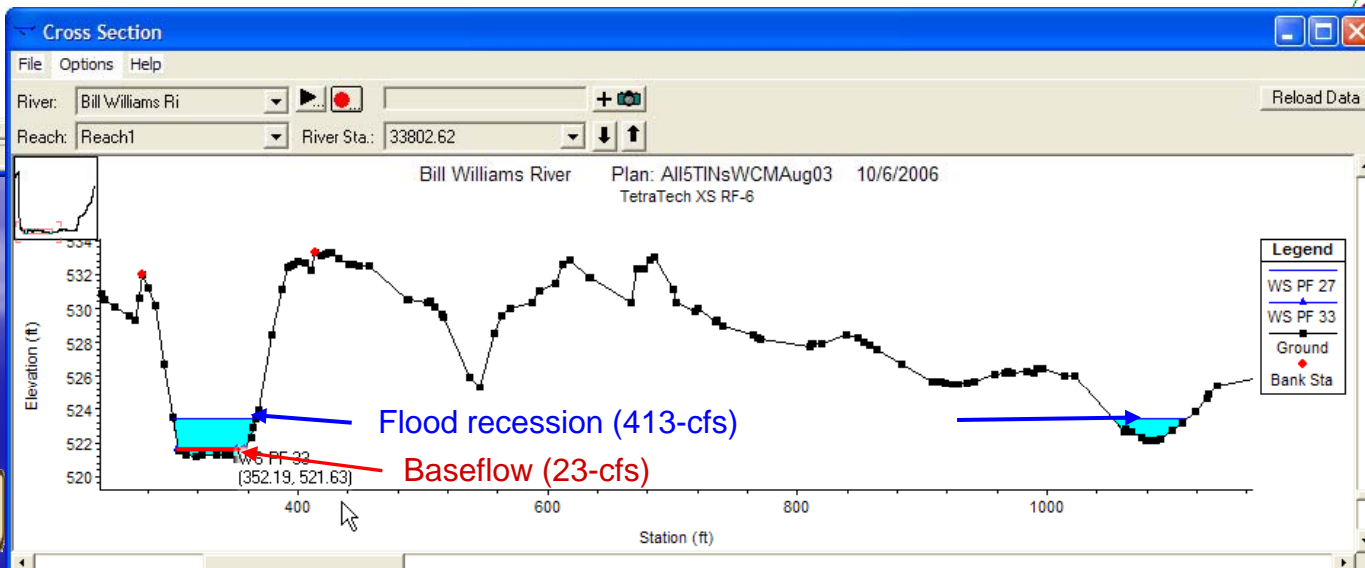
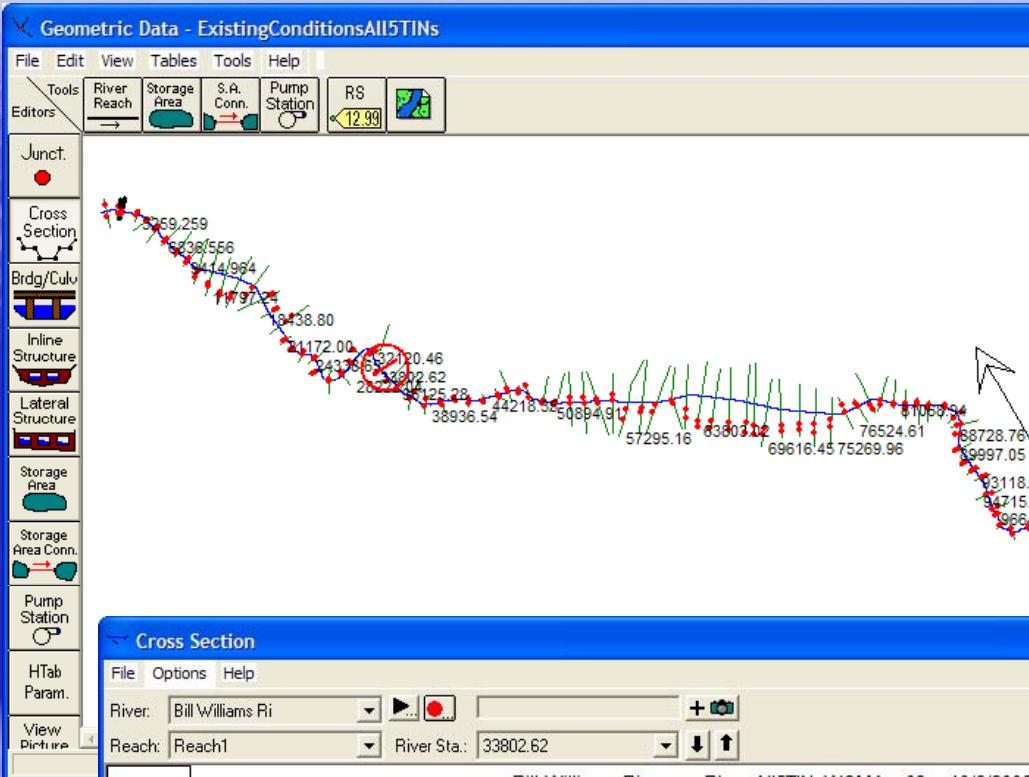
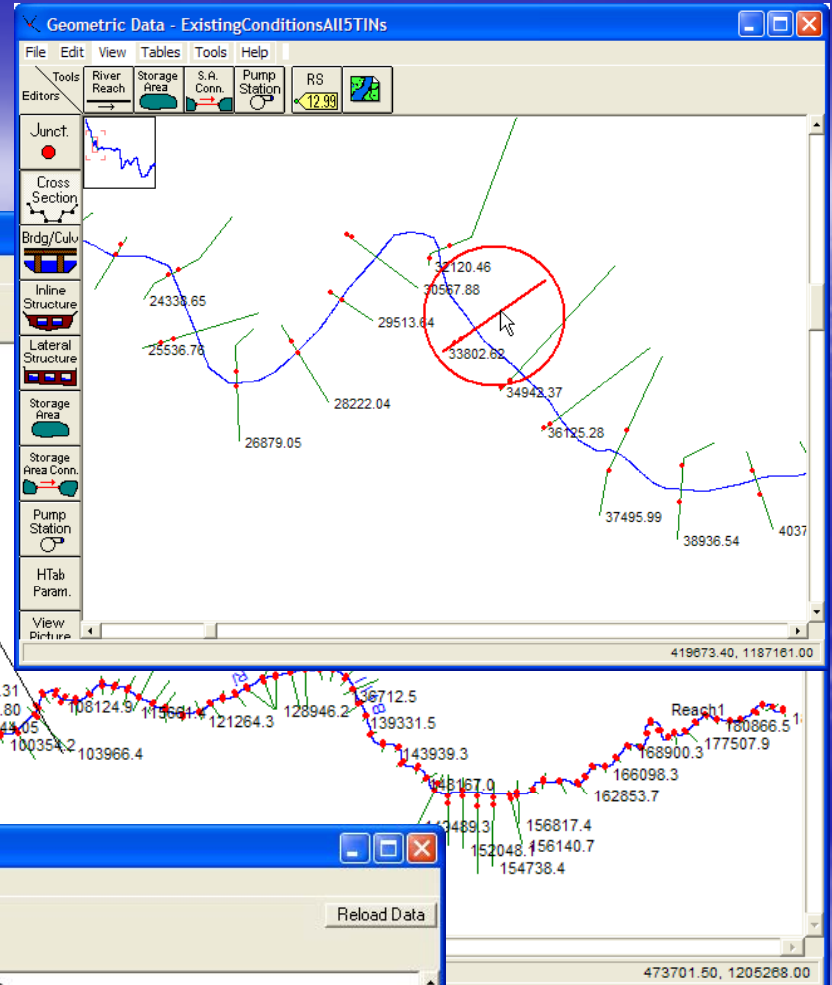
**Example GIS View of Digital Terrain Model (DTM) with
Cross-sections & LIDAR data**



Bill Williams River – Flow Modeling



HEC-RAS 1-D Model



Integrated Modeling:

Combining hydraulic models with models that predict ecologic response to flow:



US Army Corps
of Engineers®

HEC-RAS (hydraulic model)

used with HEC's

**ECOSYSTEMS FUNCTIONS
MODEL (EFM)**

Ecosystem Functions Model (HEC-EFM):

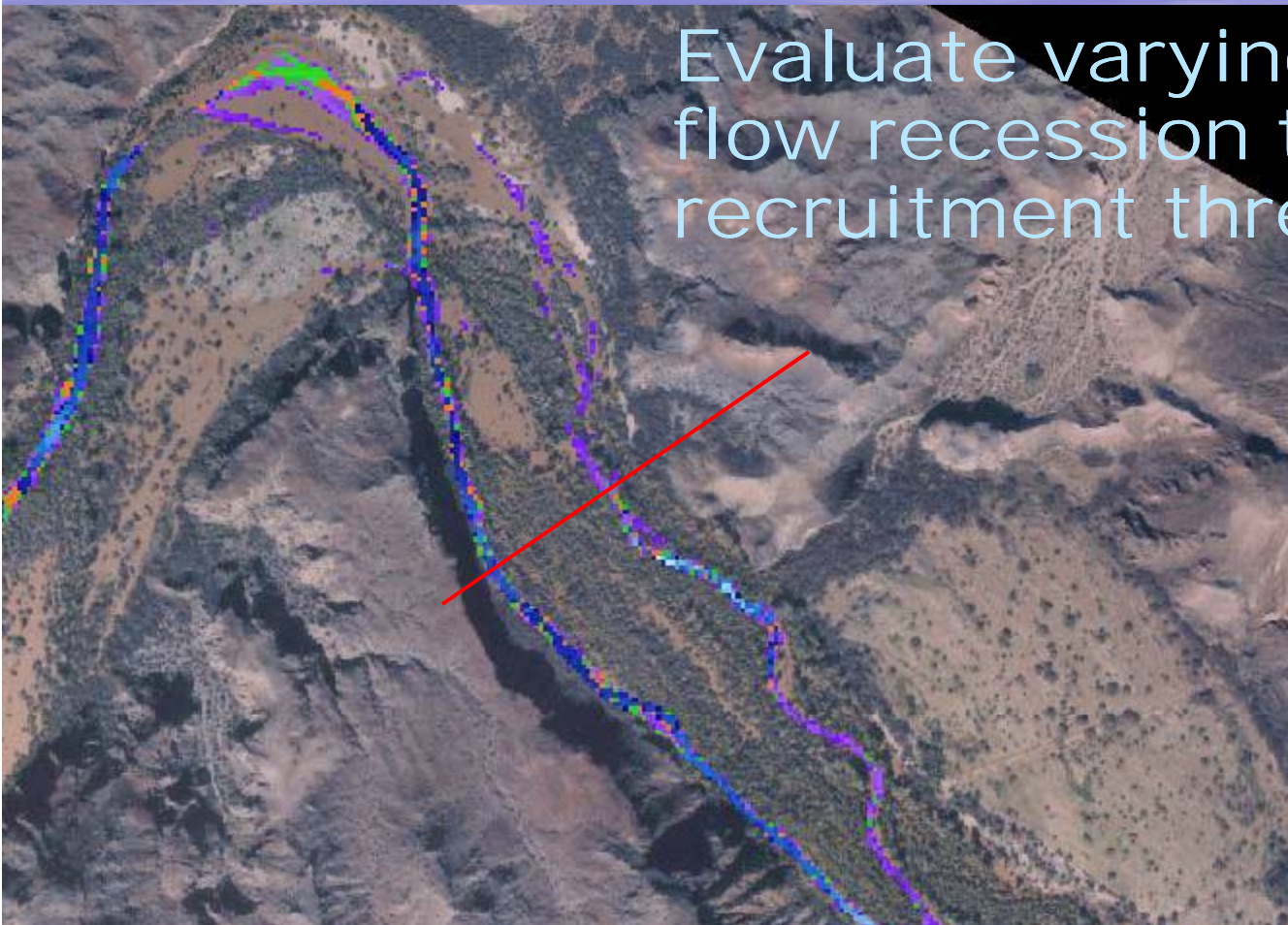
- Links stage/flow data to ecosystem response
- Uses HEC-RAS model for hydraulics
- GIS-based

The Corps' John Hickey is the developer of EFM

HEC-EFM Model Example:

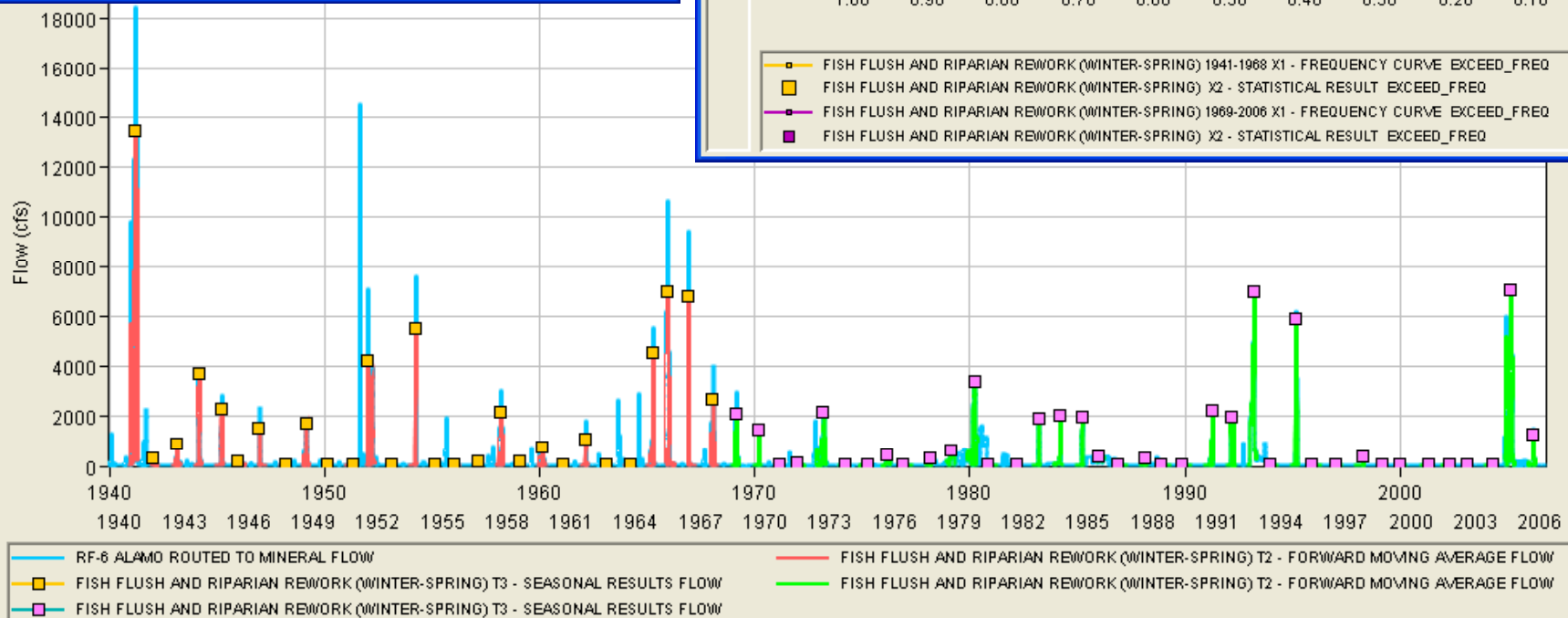
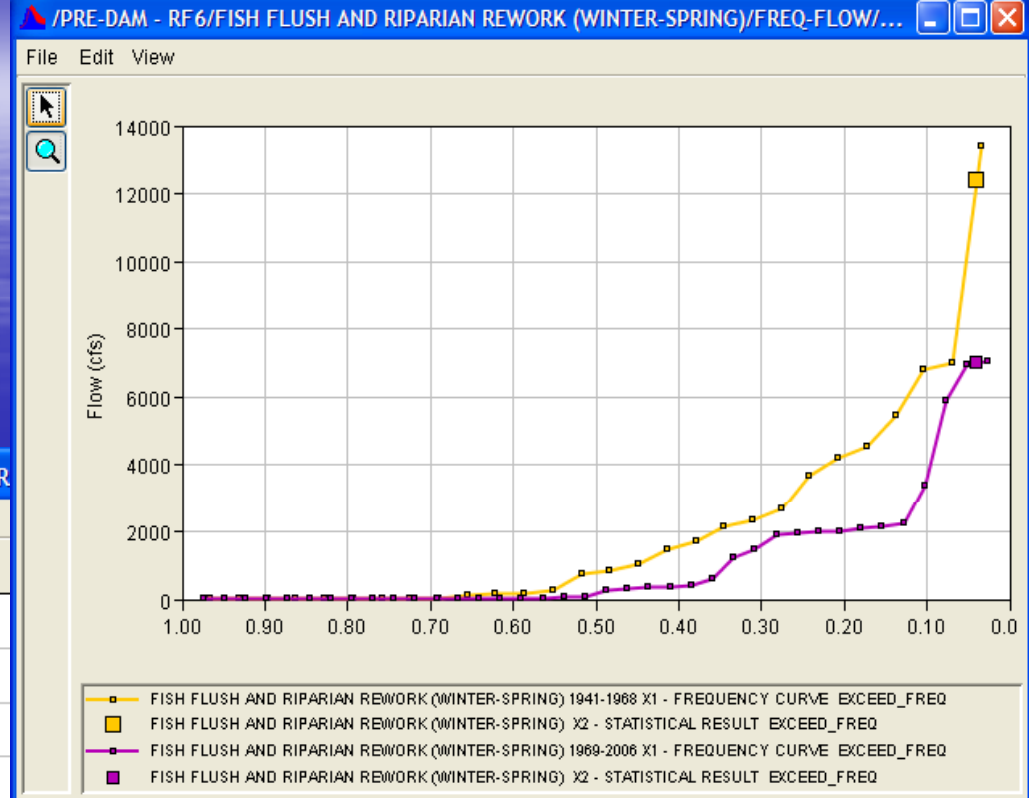
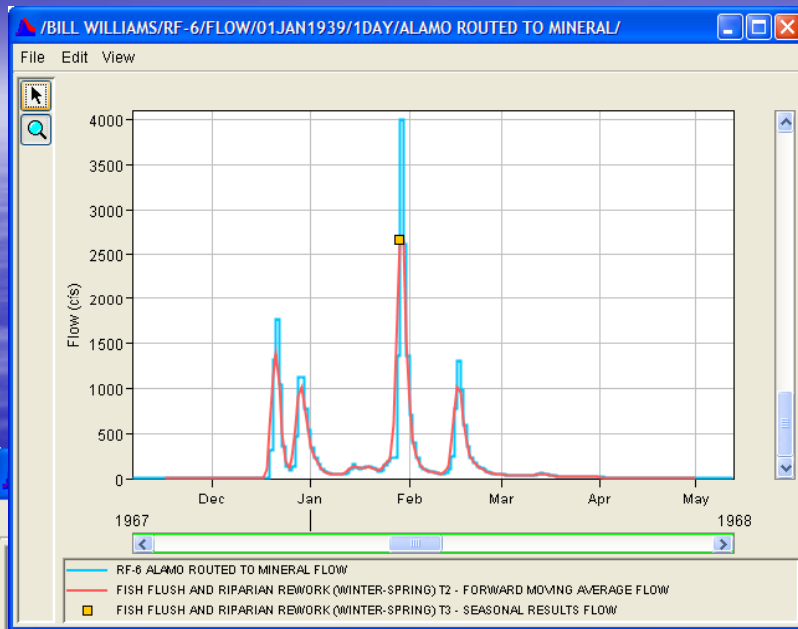
Native Tree Recruitment

Evaluate varying rates of flow recession to predict recruitment threshold:



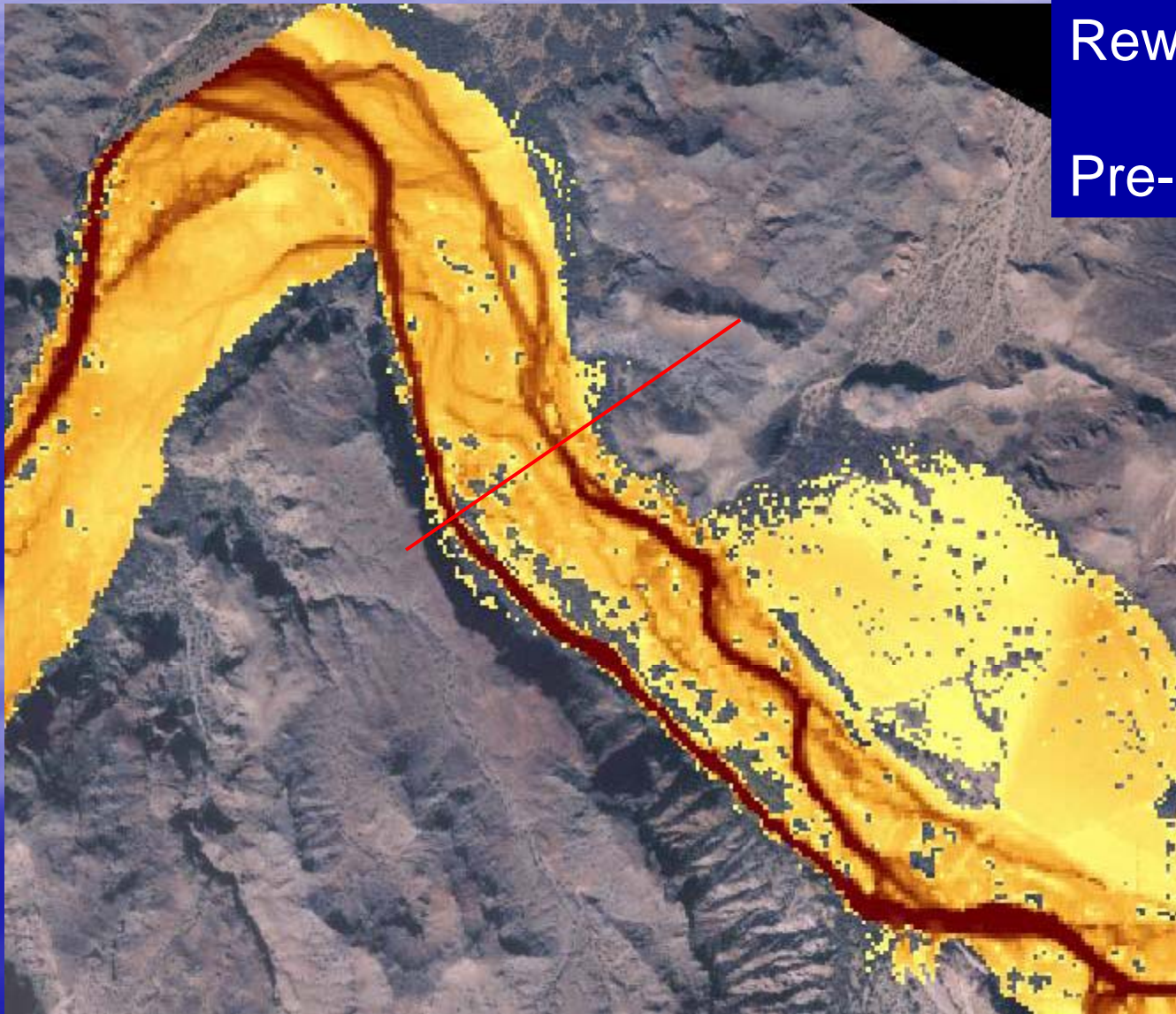
- 1-inch per day recession predicted recruitment in orange
- 2-inch per day recession predicted recruitment in green
- 3-inch per day recession predicted recruitment in purple

Riparian Rework Relationship: Pre- & Post-Dam



Riparian Rework Relationship:

Pre-Dam Conditions (12,371-cfs)

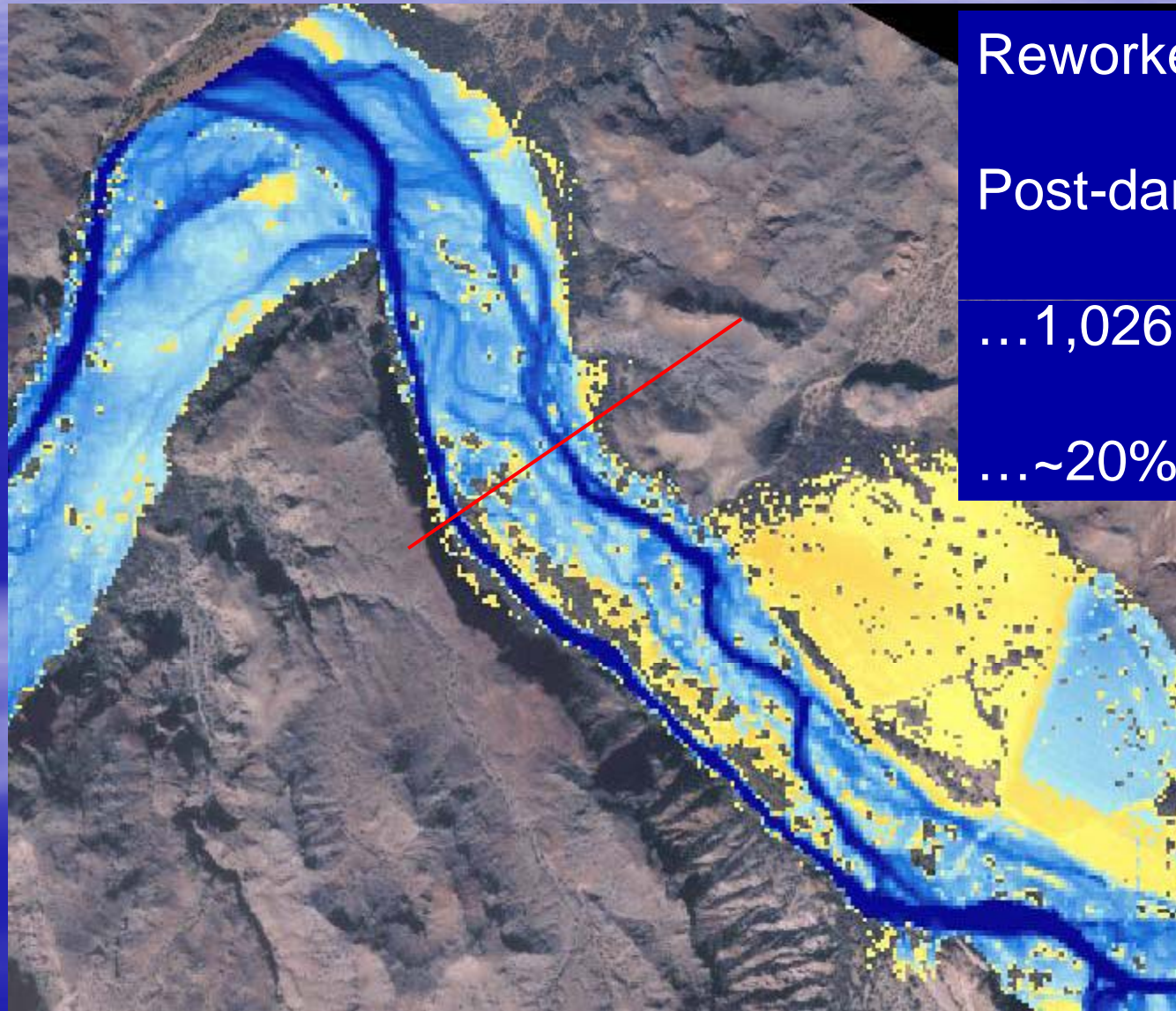


Reworked area...

Pre-dam = 5,528 acres

Riparian Rework Relationship

Overlay Post-Dam Conditions (6,994-cfs)



Reworked area...

Post-dam = 4,522 acres

...1,026 less than pre-dam

...~20% reduction in extent

Bill Williams River SWFL Surveys and Habitat Modeling

(Alamo Lake to BWRNWR)

Scott Blackman and Mike Ingraldi
Research Branch

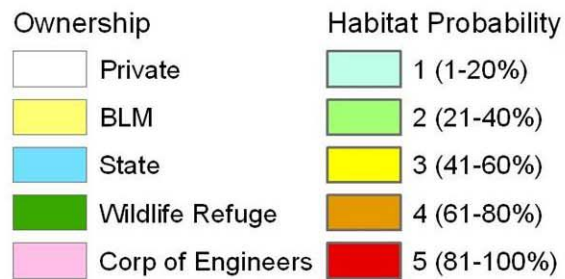
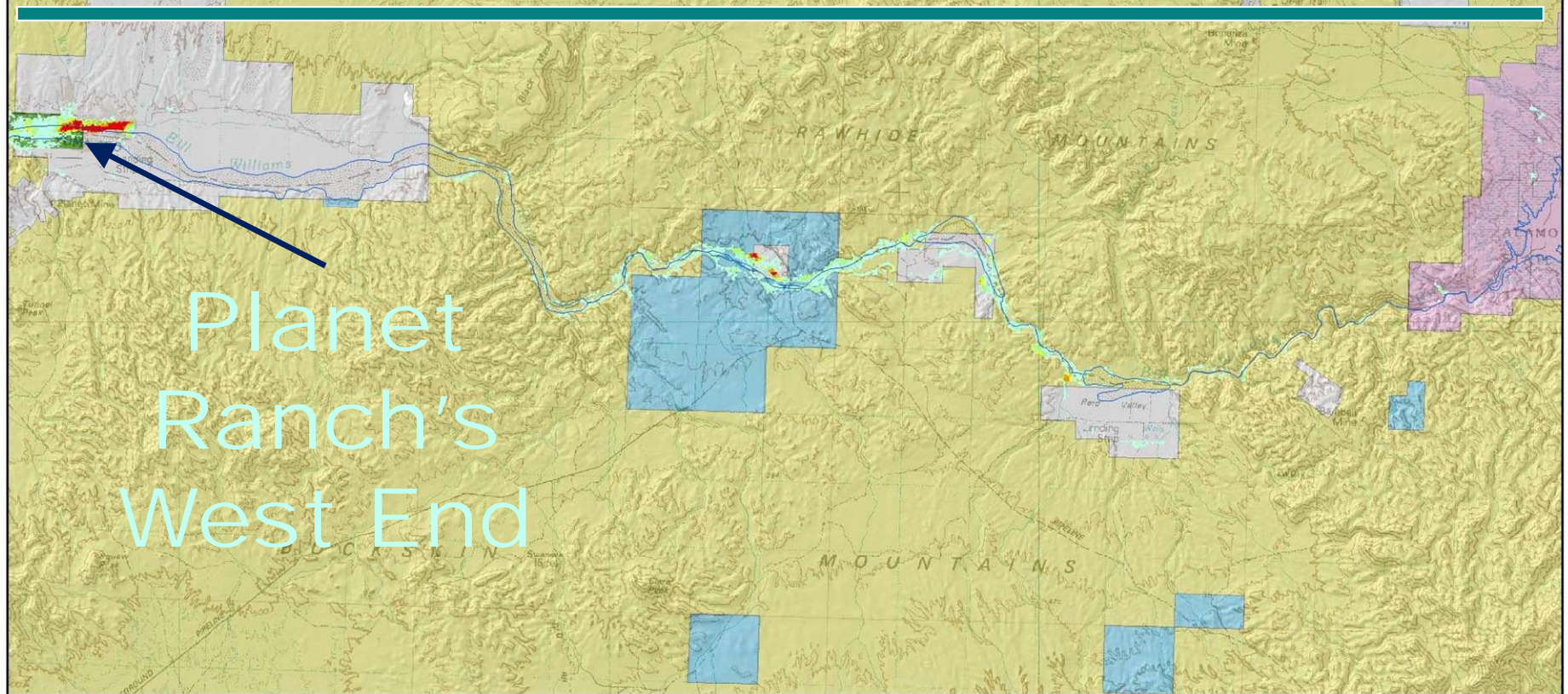


AGFD's BWR SWFL Habitat Study Objectives:

- Prioritize survey areas for SWFL using SWFL Breeding Habitat model (starting with 1999 imagery for NDVI...)
- Then, conduct Field Survey for SWFL occupancy
- **Develop long-term monitoring protocol**



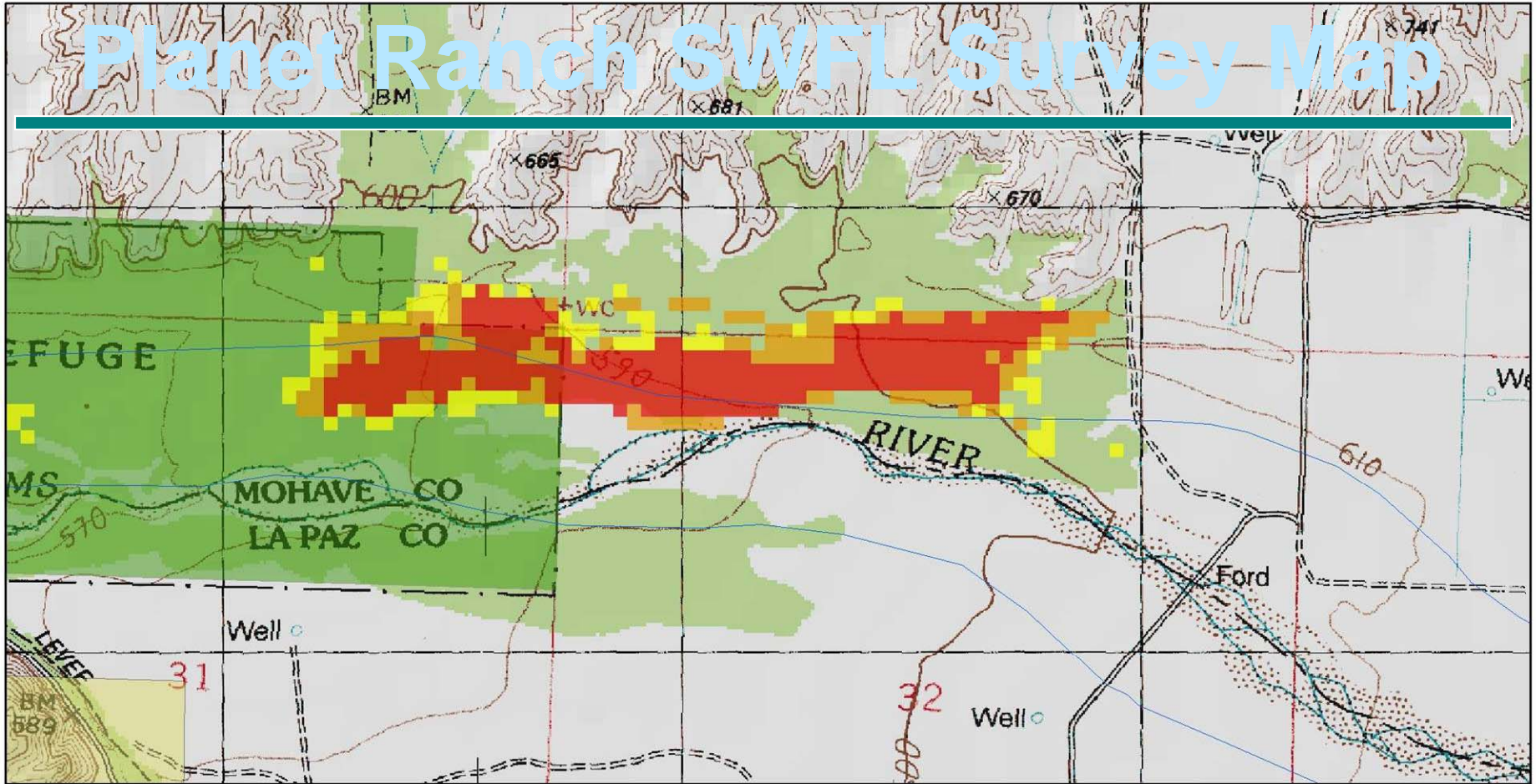
BWR SWFL Habitat Model



Potential Willow Flycatcher
Habitat along the Bill Williams River



Planet Ranch SWFL Survey Map



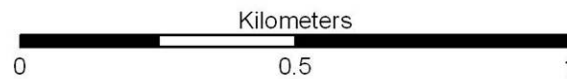
Ownership

- Private
- BLM
- State
- Wildlife Refuge
- Corp of Engineers

Habitat Probability

- 3 (41-60%)
- 4 (61-80%)
- 5 (81-100%)

Potential Willow Flycatcher Habitat along the Bill Williams River



Habitat data from
Nongame Technical Report 223

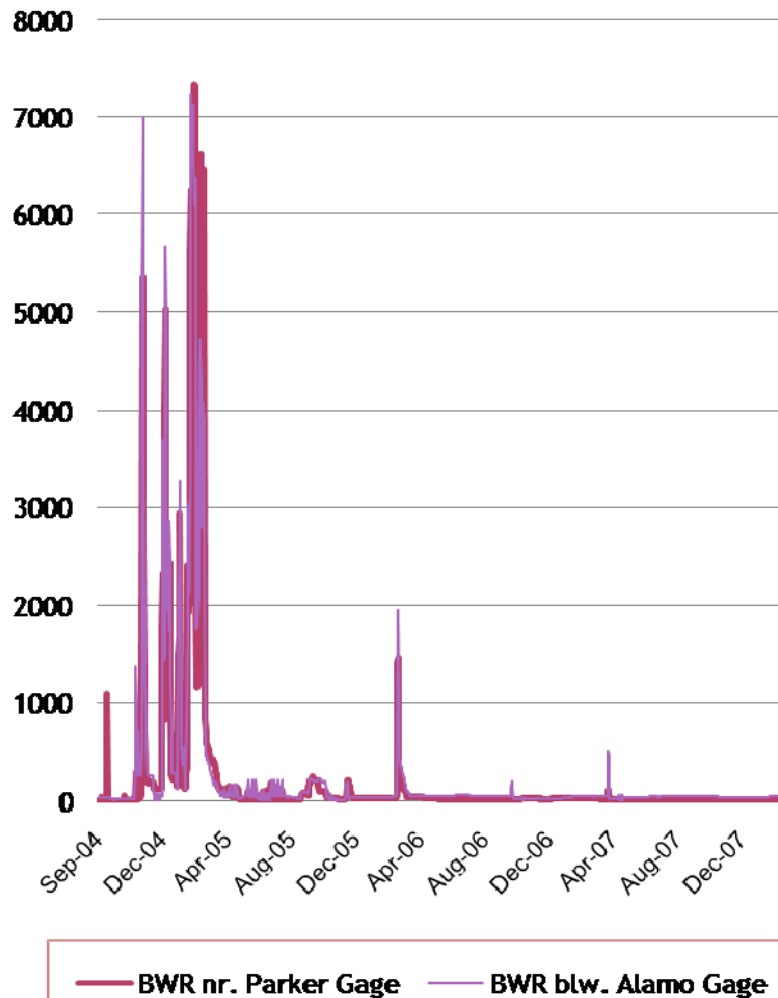
Castaneda Hills SW
1:24000 Quad

Experimental Flows

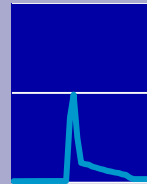


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BWR---Experimental flows:



2005 BIG Floods: sculpted recessional limb post-evacuation



2006 pulse: March-13

- 2,000 cfs for 3 days;
- @ 500 cfs, slow ramp down (-20 cfs / day)
- Sculpted as in '05



2007 pulse: April 9-10

- 1,000 cfs for 16 hours
- Quick spike, rapid ramps;
- Purpose: Q impact on Aquatics / Beaver Dam s



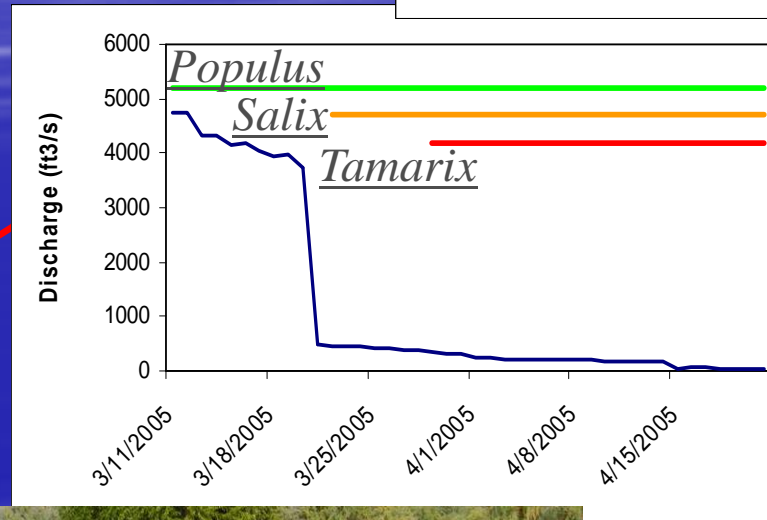
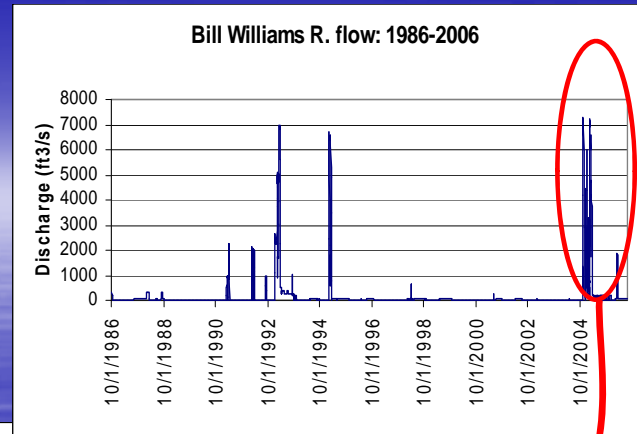
2008 pulse: March 31

- 2,000 cfs for 8 hours;
- Quick spike, rapid ramps;
- Purpose: Q impact on Aquatics / Beaver Dam s

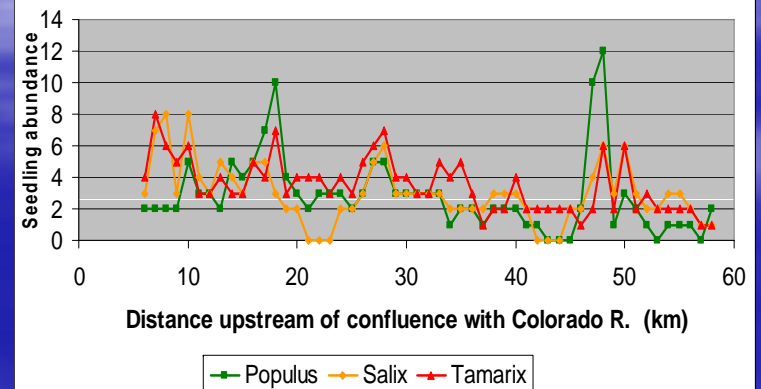


2010: TO BE DETERMINED...

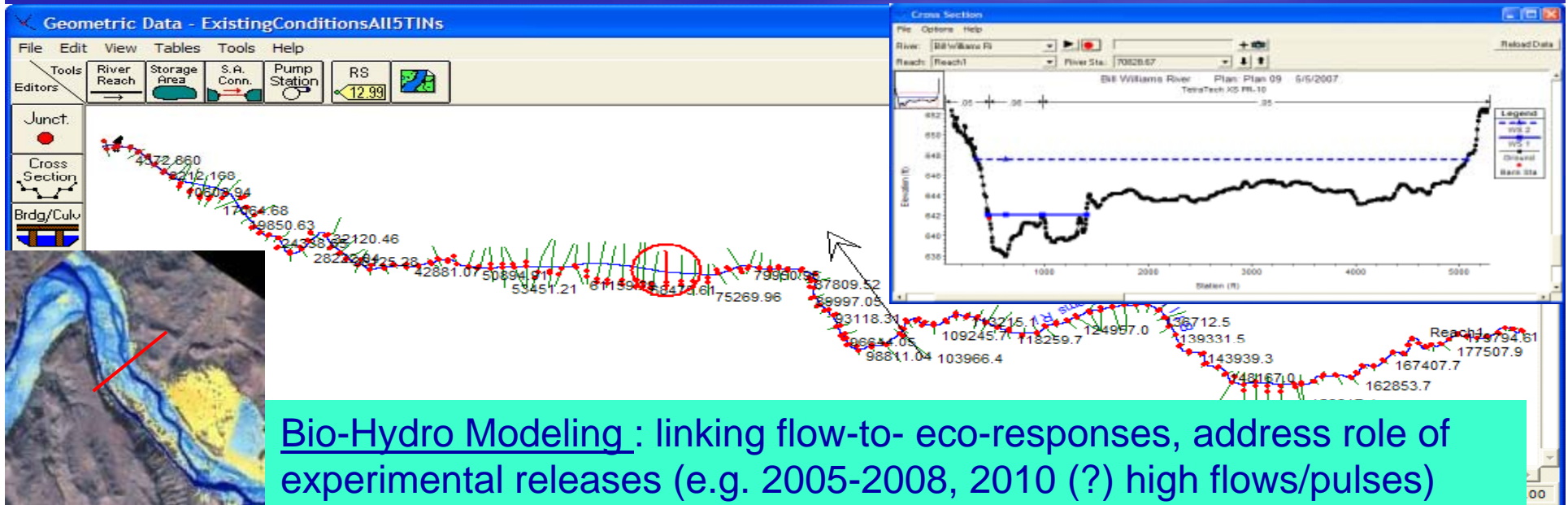
When the rains do come, Manage High Flows with Biotic Goals & Objectives



2005 seedling establishment along main channel



BWR---State of Science: Flow-&-Biota



Questions / Comments? (time permitting)



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2010 CRTR

Website: <http://billwilliamsriver.org>



[Physical Setting](#) | [Riparian Vegetation](#) | [Fish & Wildlife](#) | [Streamflow Management](#) | [Steering Committee](#) | [BWR Library](#)

You are here: BWR

Welcome to the Bill Williams River Web Site

*"I came to a River I called the Rio de Santa Maria. Its bed is very wide but at this time was only one-half full of water. Along its banks are pasturage and every sort of riverland tree. As far as the eye could see it came from the East, from a great mountain range."
Frey Francisco Garcas (August 2, 1775)*

The Bill Williams River Web site is a portal to find a wealth of information concerning one of the American Southwest's best kept secrets. Come view pictures of one of Arizona's last, best stands of mature Cottonwood-Willow trees, or read about the many critters that call the Bill Williams home, including almost 350 birds observed within the basin.

The Bill Williams River is one of the Nation's ecological treasures. Many interested citizens, scientists and resource managers are working hard to improve our ability to manage this system for the benefit of both humans and the area's natural resources. This Web site chronicles those efforts and shares information on the river ecosystem.

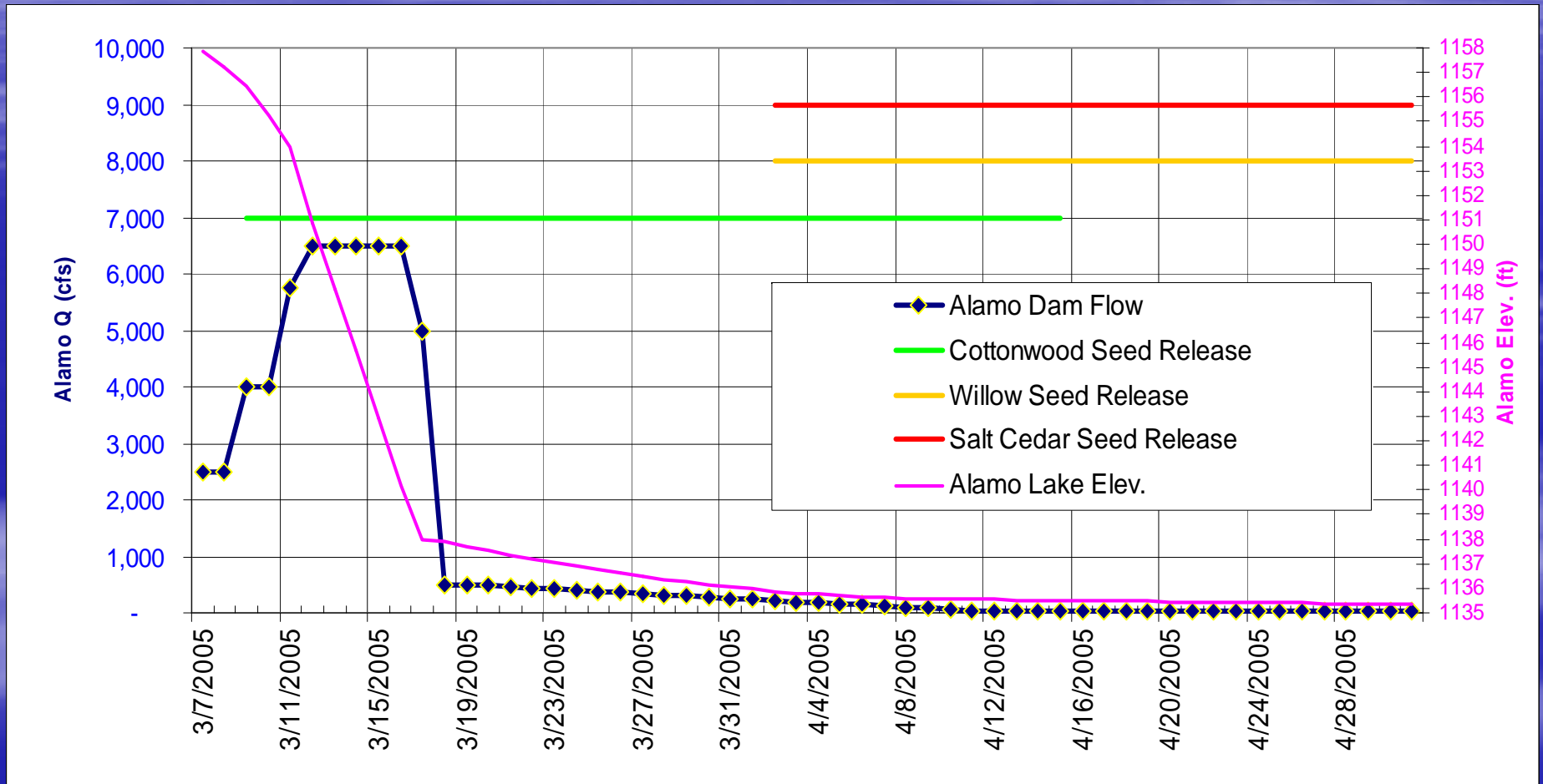
[Top of Page](#)



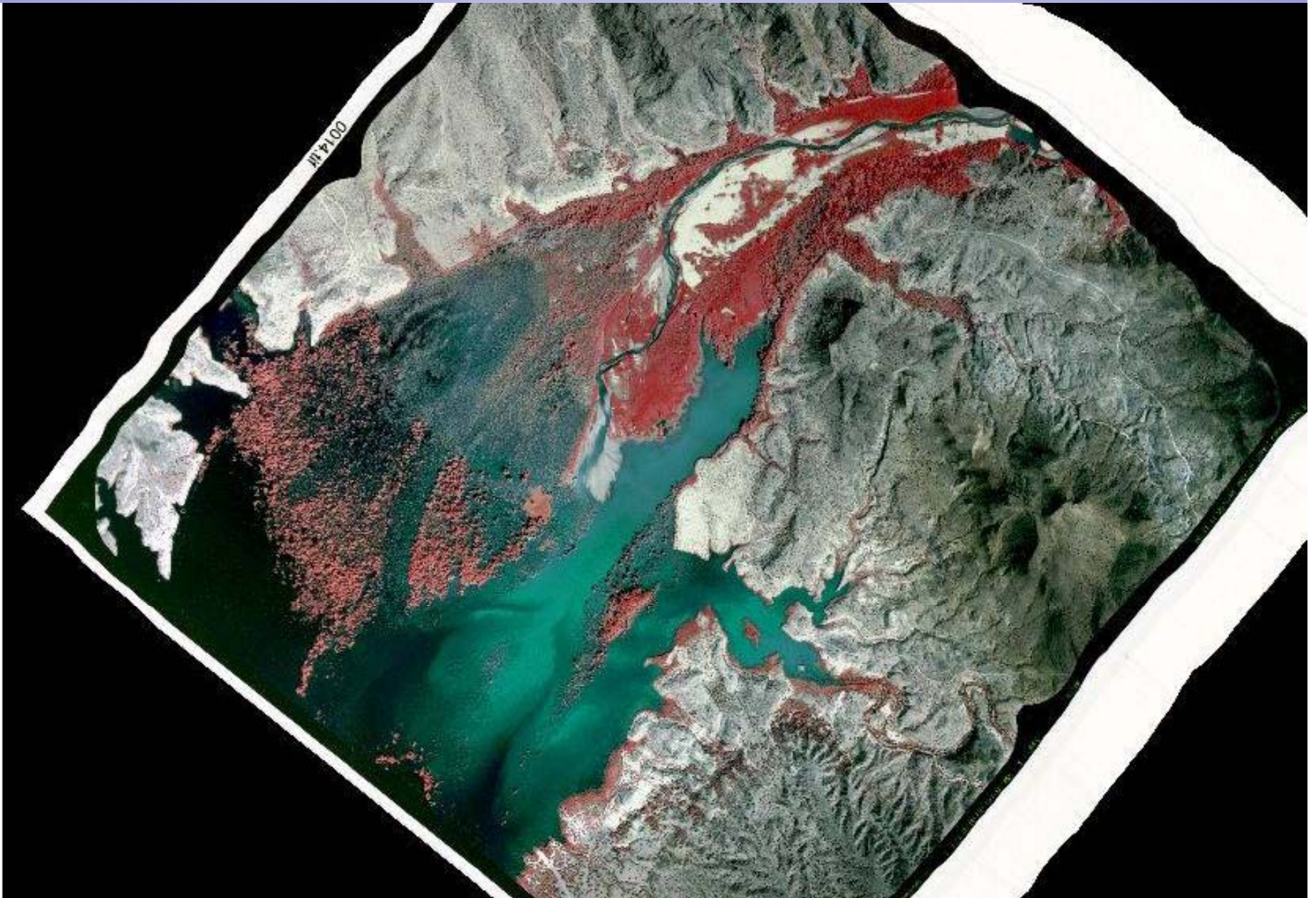
Andre

BWR Floods of 2005 Designed Hydrograph

Goals: reduce conflicts, conserve water, establish native trees, enhance science (hydraulics, sediment budget/geomorph.)



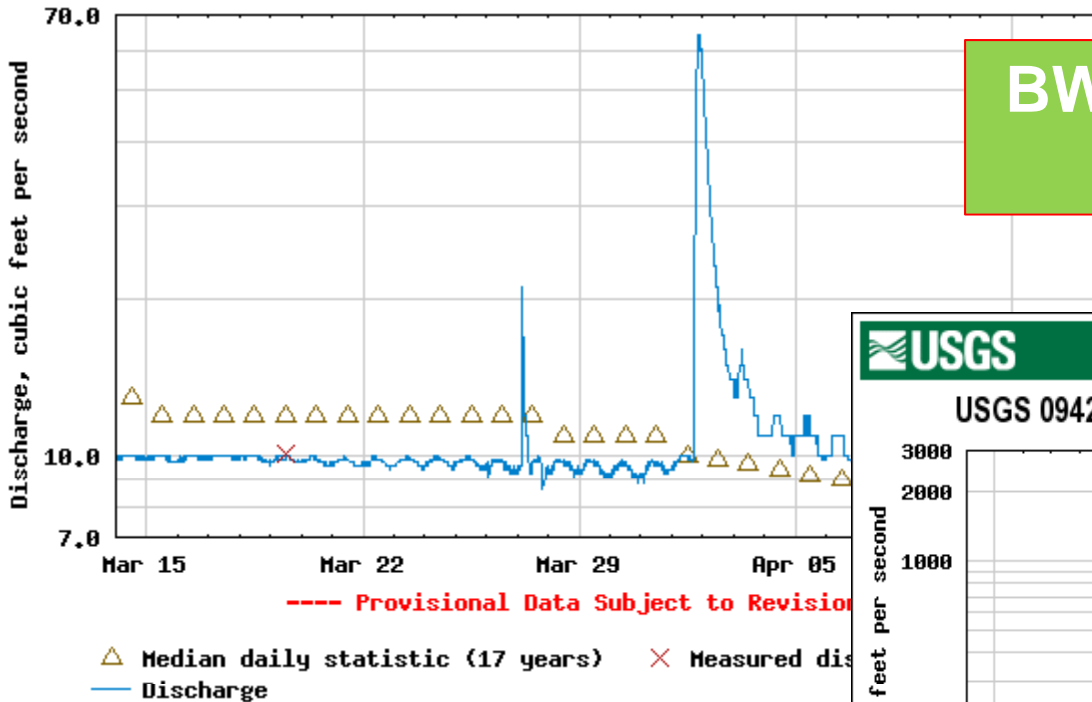
Alamo Lake (Upper)



BWR '08 Pulse...USGS Gages



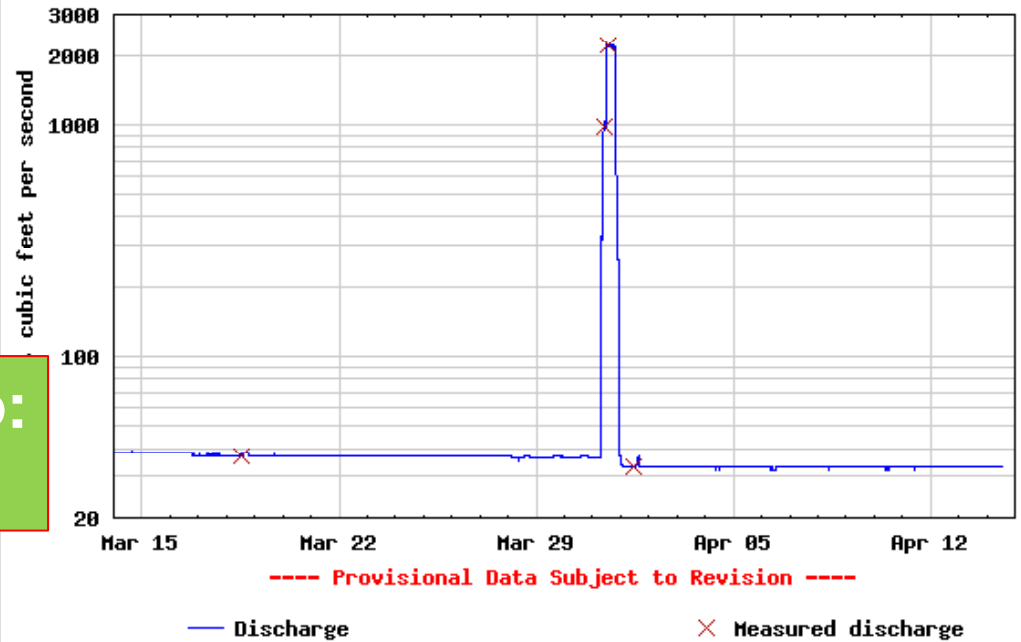
USGS 09426620 BILL WILLIAMS RIVER NEAR PARKER, AZ.



**BWR near Parker:
Max = 72 cfs**



USGS 09426000 BILL WILLIAMS RIVER BELOW ALAMO DAM, AZ



**BWR below Alamo:
Max = 2,210 cfs**



Brown's Xing – Alamo Lake



Brown's Crossing : (above Alamo



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2010 CRTR

Browns Crossing on February 22, 2005. Water elevation = 1,168 feet



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2010 CRTR

Browns Crossing on April 6, 2005

Water Elevation = 1,136 (+15 feet of standing water)



Flooding Big Sandy River (11,000 cfs, on February 22, 2005) (2005 system peak = 89,000 cfs)

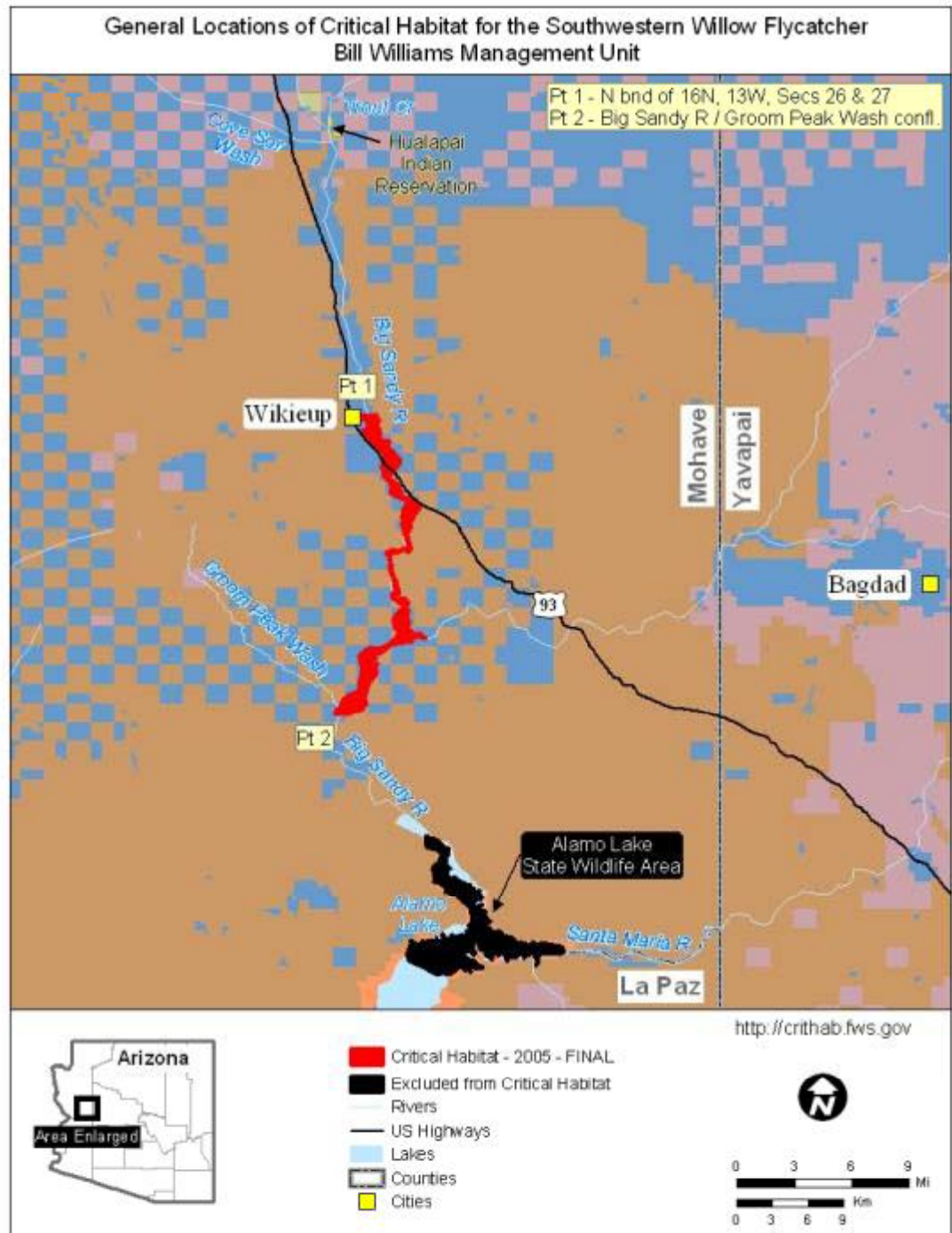


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2010 CRTR

Southwestern Willow Flycatcher critical habitat (above Alamo Lake)



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2010 CRTR



Integrating Hydraulic & Biologic Models:

Typical HEC-RAS Cross Sections

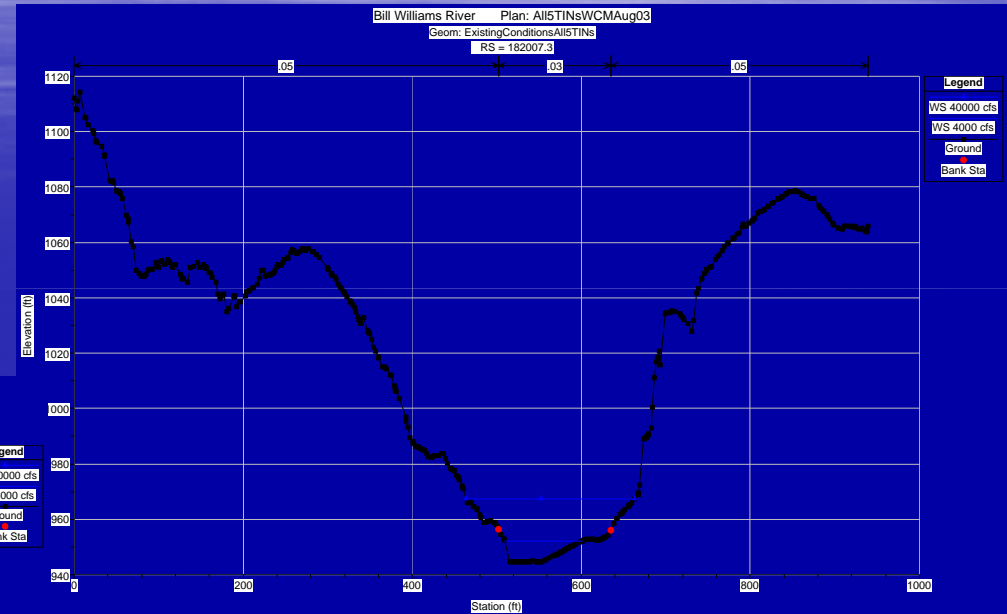
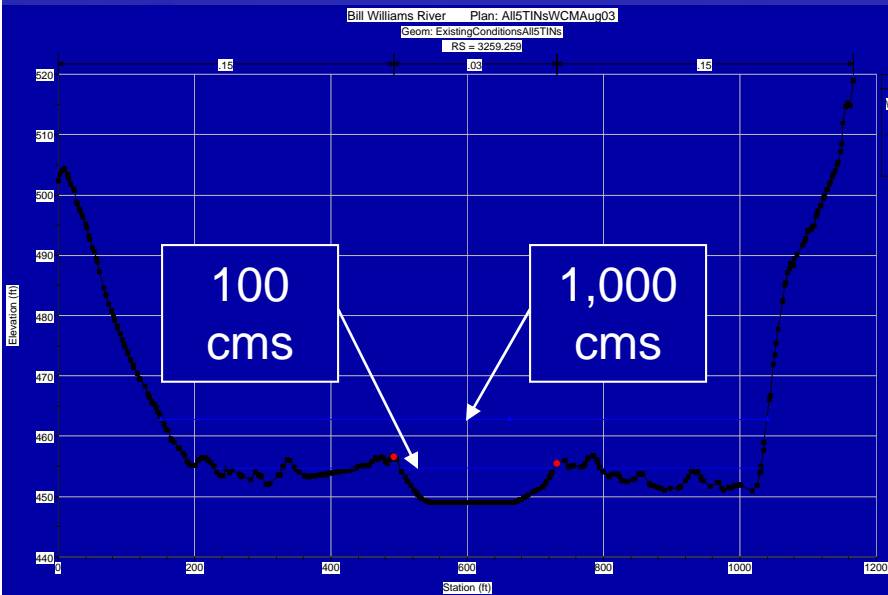


Figure Courtesy of U.S. Army Corps Of Engineers

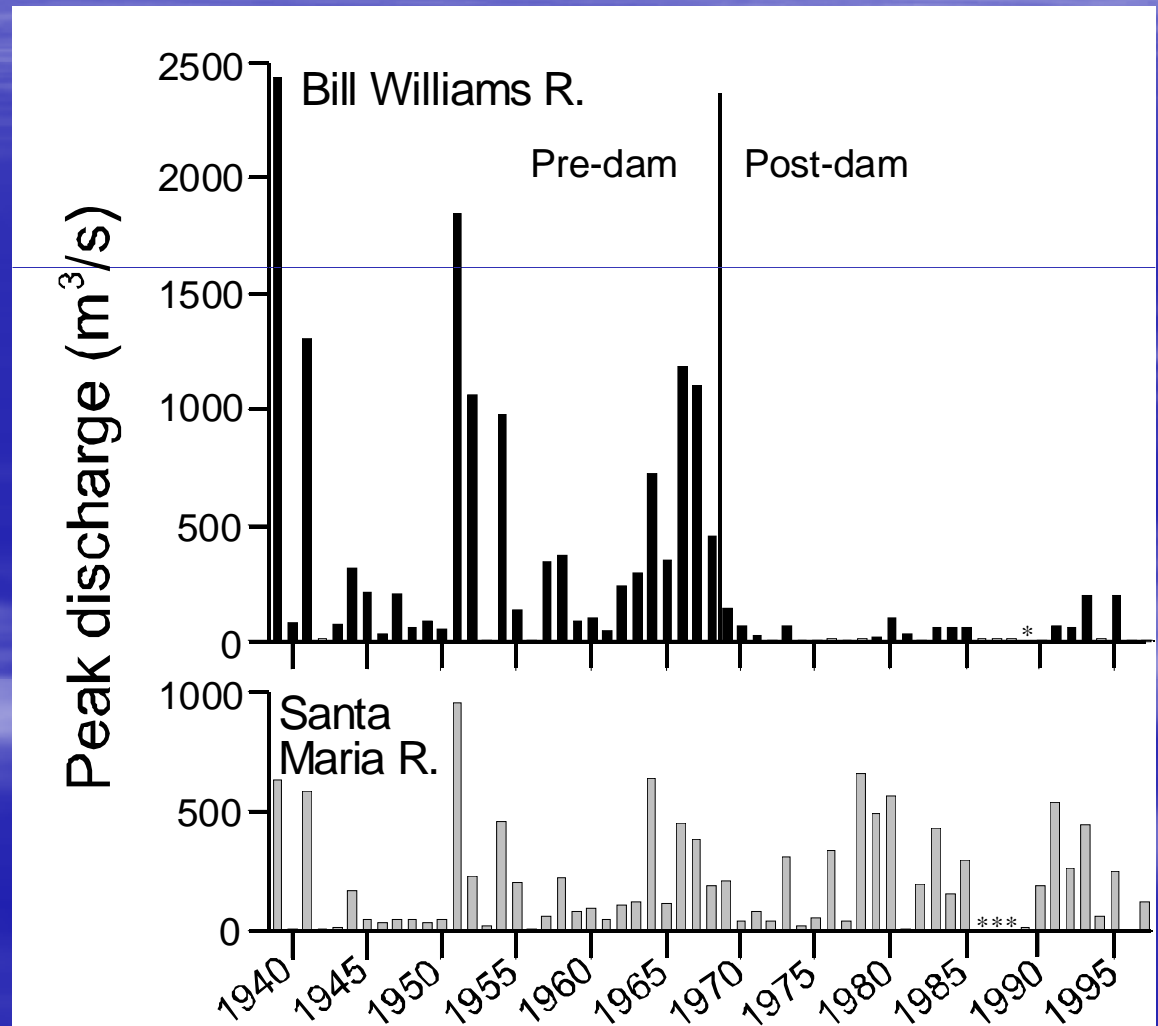


Pre- & Post-Alamo & SMR

Flows:

Santa Maria River

represents great control system f(minimal hydro-alterations)



What is the EFM?

- A planning tool used by biologists, engineers, geomorphologists, scientists...that analyzes eco-response to changes in the flow regime
- Indicates direction and relative magnitude of change(e.g., reservoir operations or channel modifications)
- Use hydrologic and hydraulic data to help predict biological response
- Most any **bio-parameter** that changes with **FLOW** &/or **STAGE** can be modeled



EFM Application: Bill Williams River



BILL WILLIAMS RIVER



(2005)



Informational packet prepared for Jim Kenna, BLM AZ State Director , Re: Planet Ranch Negotiations, Overview of Bill Williams River and Related LCR-MSCP Interests



**Alamo Dam:
23FEB05**



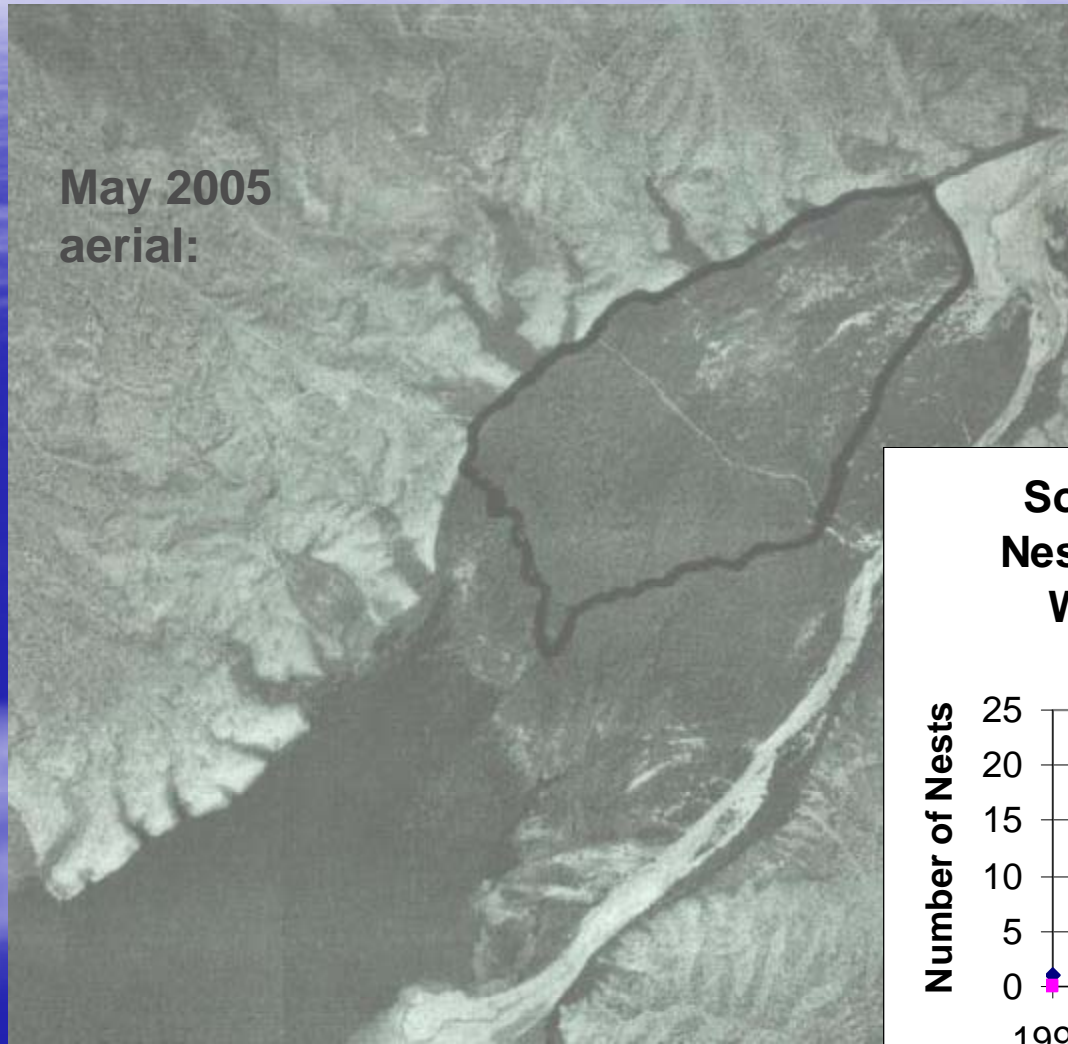
Nov. 12, 2009
briefing

Talk outline:

- Overview of the Sustainable Rivers Project
- Bill Williams River & Alamo Dam
 - EcoFlow Requirements
 - Tool Development:
 - Altered Hydrology modeling (TNC's IHA)
 - Hydraulic modeling (HEC-RAS)
 - Applied Ecological (HEC-EFM)
 - Experimental Flows



Browns Crossing: Southwestern willow flycatcher



Browns X-ing SWIFL
Habitat: willows
established via high lake
elevations in 1993...

**Southwestern Willow Flycatcher
Nests at Browns Crossing and Bill
Williams River, AZ (1997-2005)**

