



University of California, Davis
Department of Land, Air and Water Resources

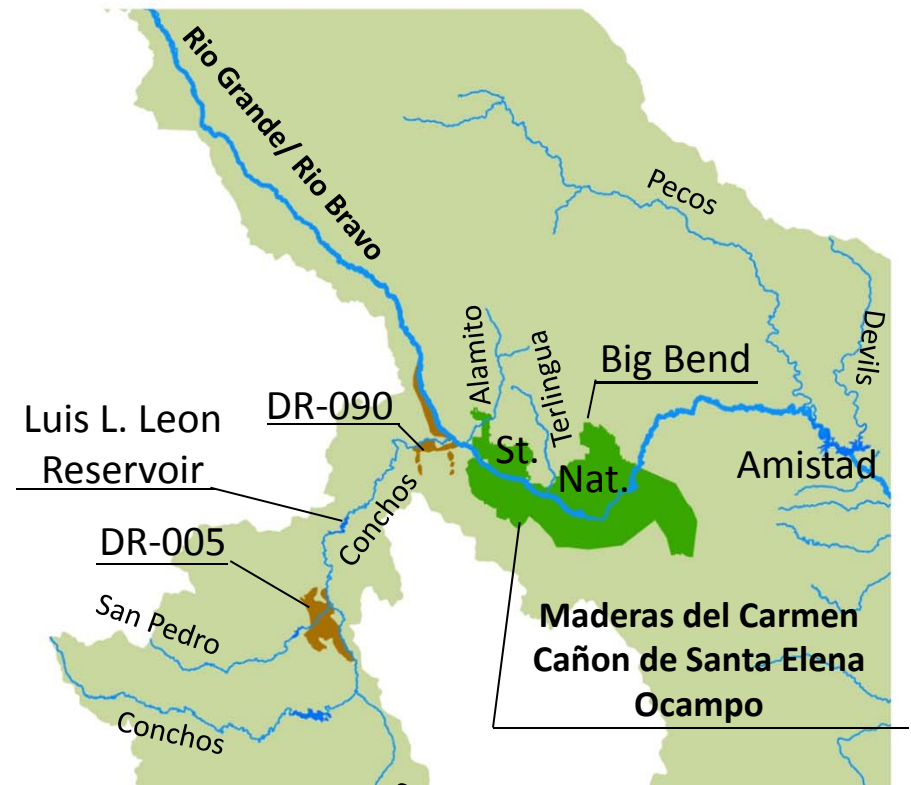
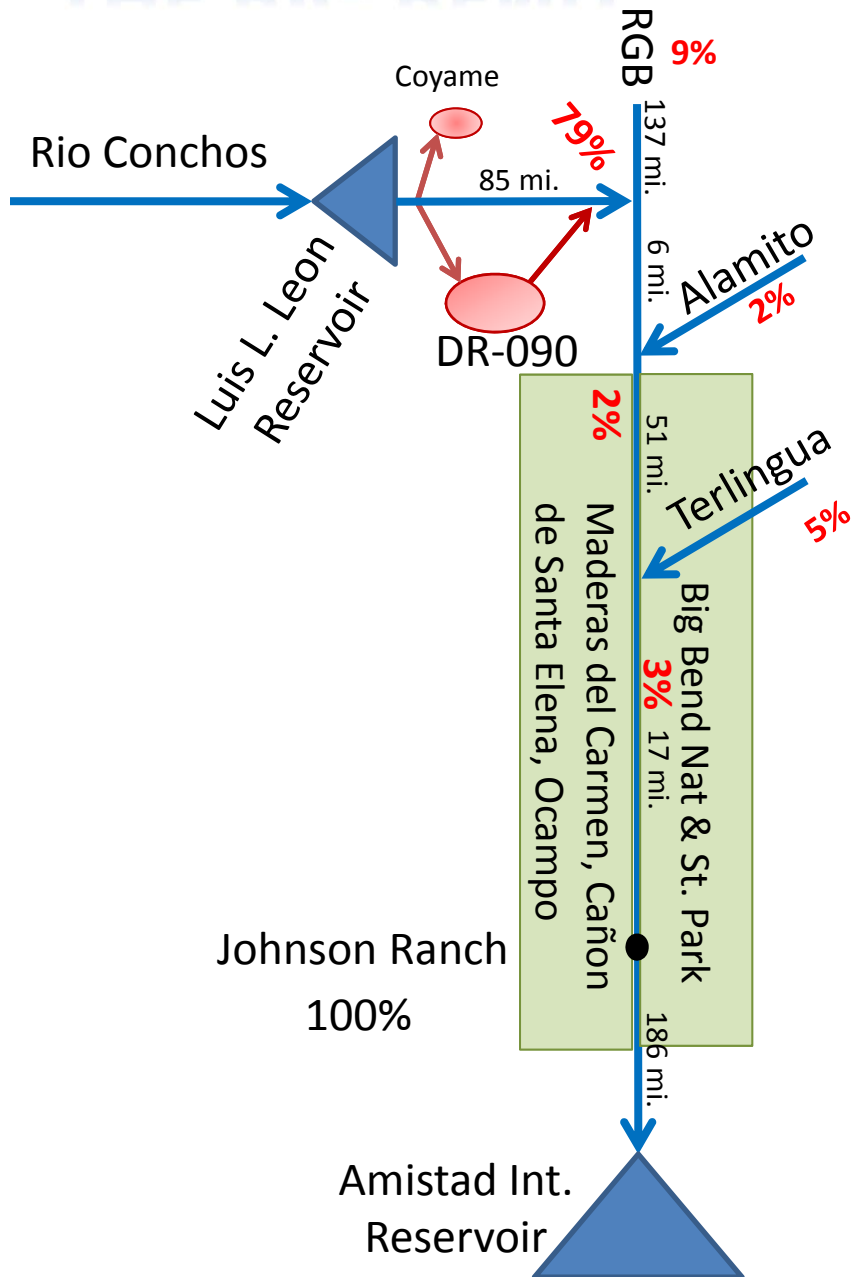


Water Management for Environmental Restoration Flows In the Big Bend reach, Rio Grande – Rio Bravo

46th Annual Meeting
8-9 March, 2012
Alpine, TX

Samuel Sandoval Solis
Assistant Professor
Cooperative Extension Specialist in Water Resources

THE BIG BEND



Quantify the maximum amount of water for Env. Restoration flows in the Big Bend

Constraints

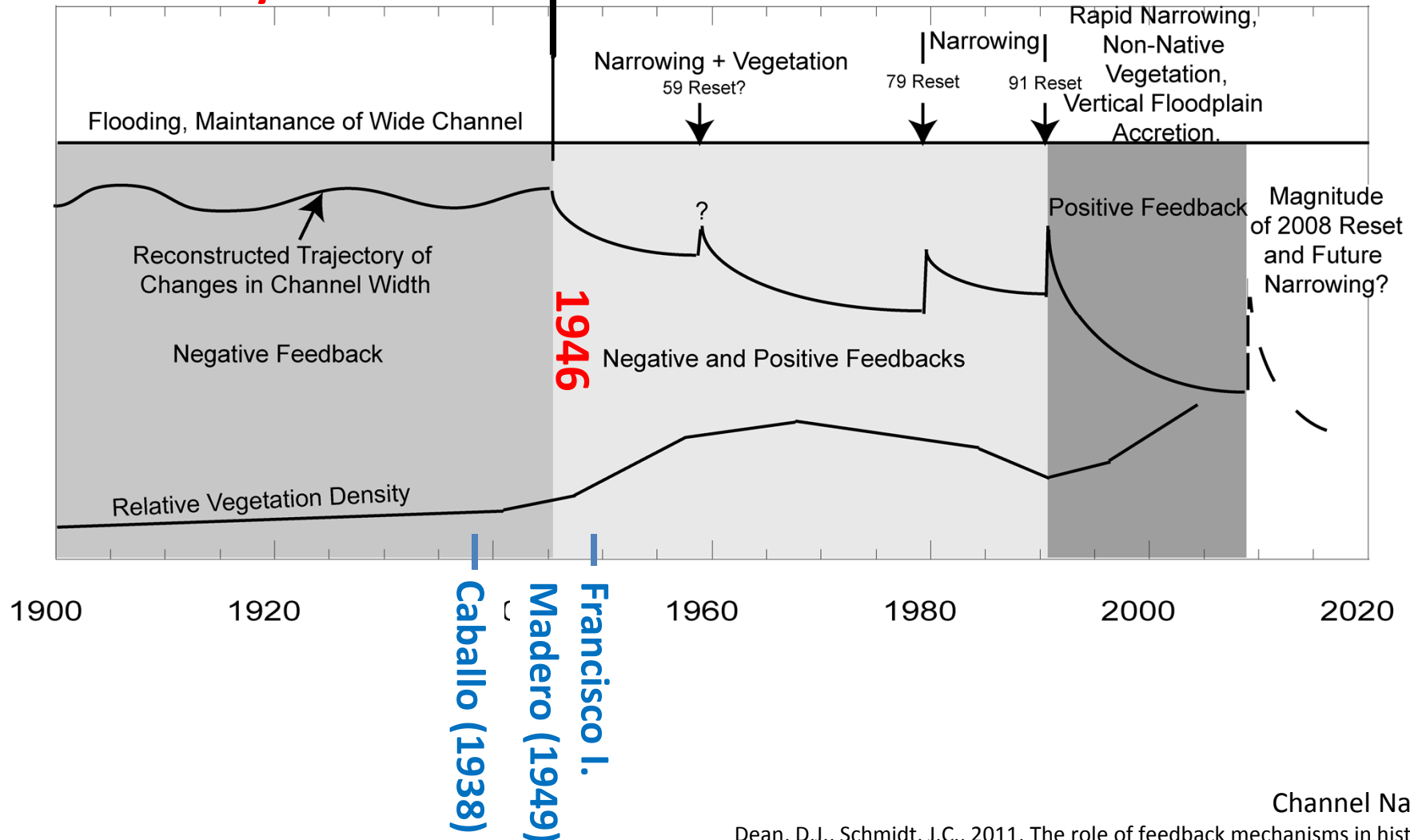
$Q_{Env.}$ Do not affect Water Supply

$Q_{Env.} \leq$ 1944 Treaty Establishes

$Q_{Env.} <$ Presidio Levees Capacity

IDENTIFYING THE HYDROGRAPH

**Natural Conditions
or Healthy River?**

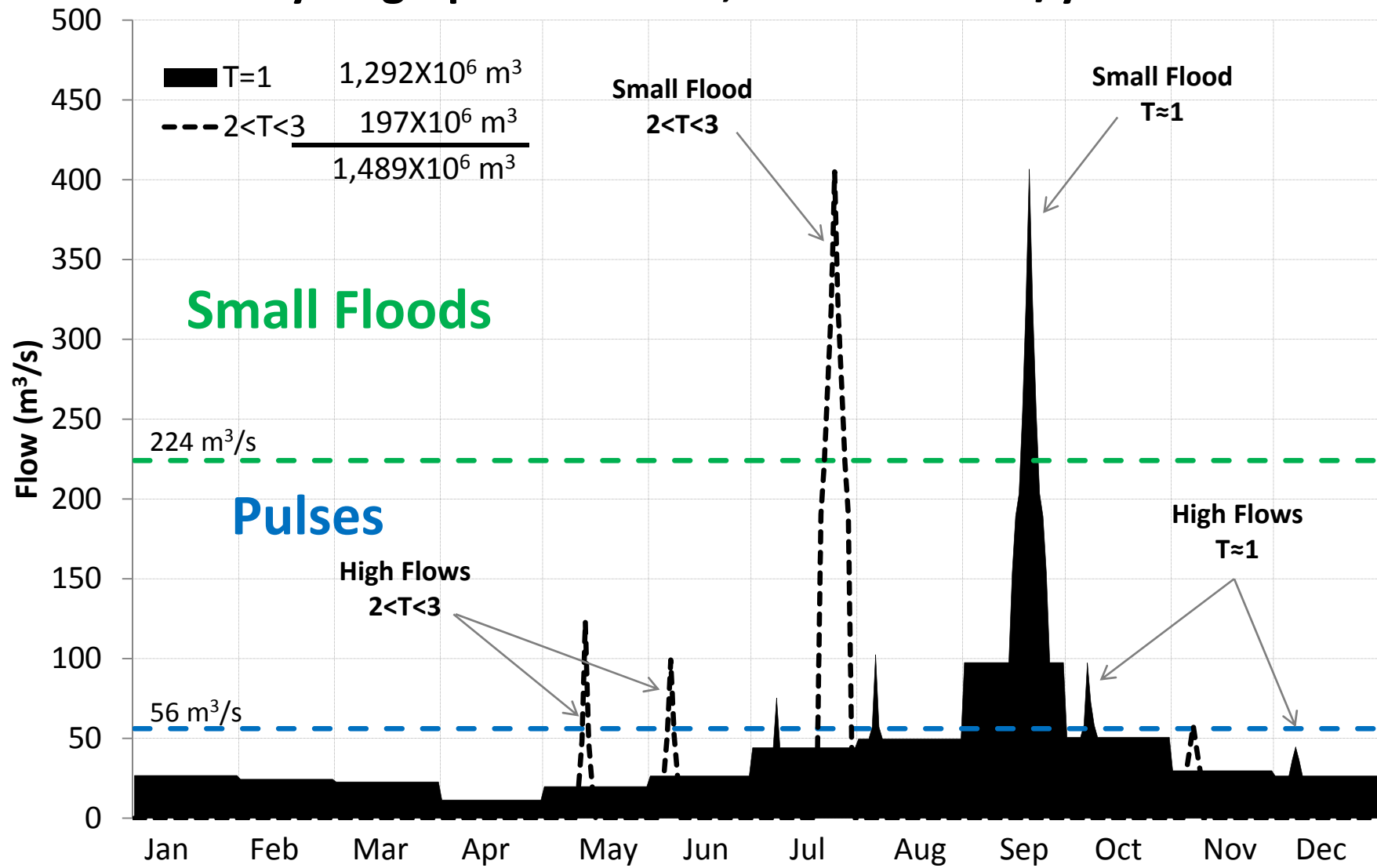


Channel Narrowing *

Dean, D.J., Schmidt, J.C., 2011, The role of feedback mechanisms in historic channel changes of the lower Rio Grande in the Big Bend region, *Geomorphology*, 126, 333-349

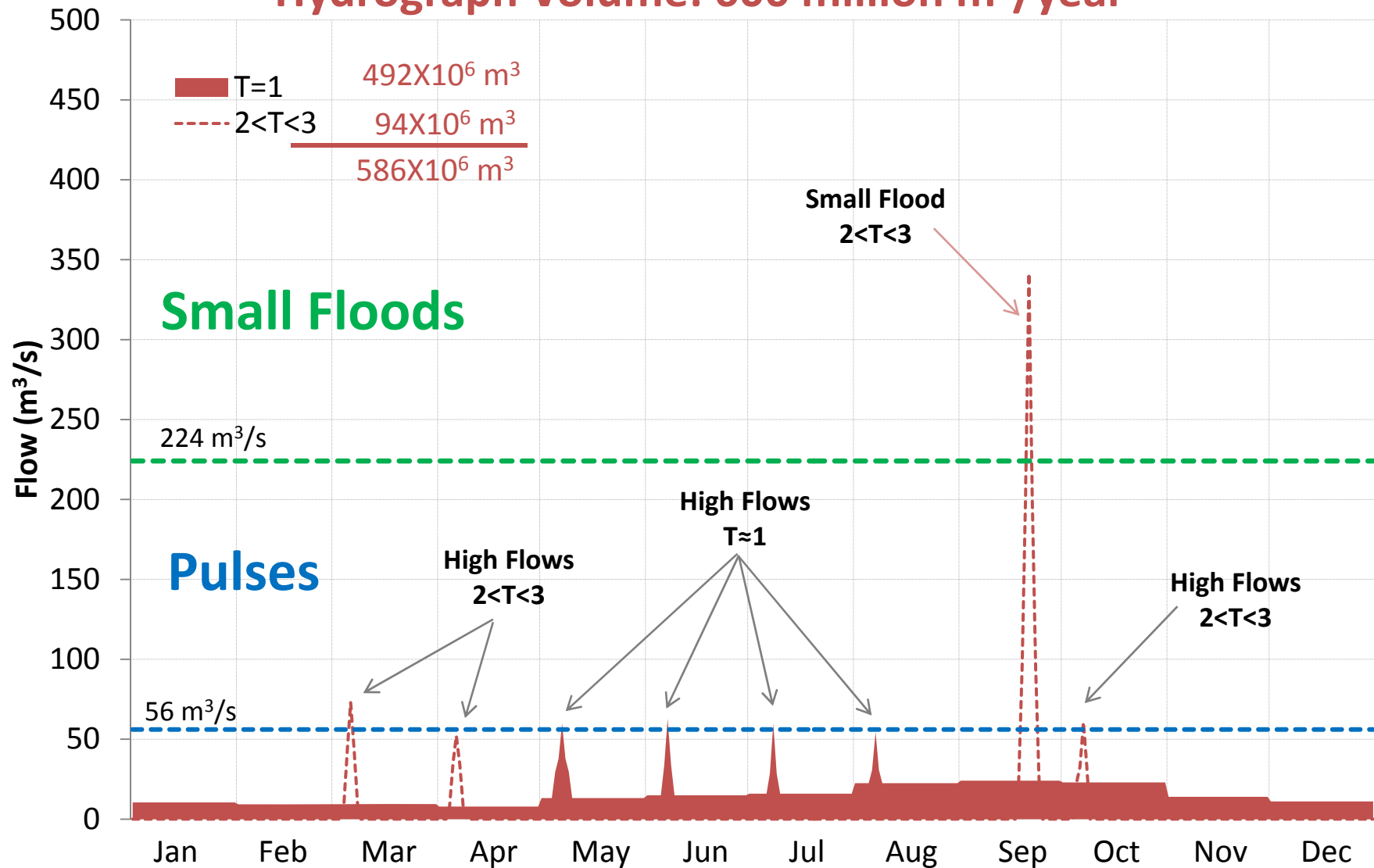
PRIOR DAM ALTERATION REGIME (PRE-1946)

Hydrograph Volume: 1,500 million m³/year



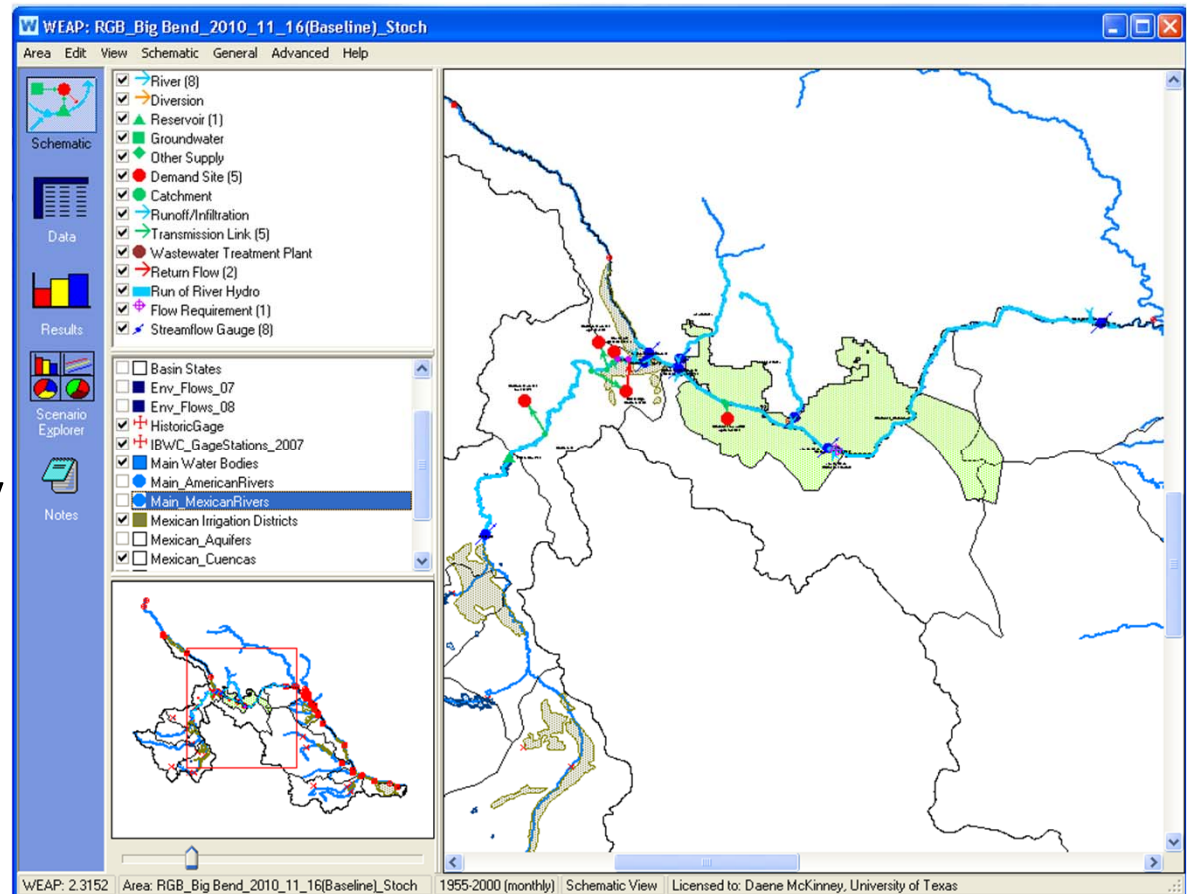
POST DAM ALTERATION REGIME (POST-1980)

Hydrograph Volume: 600 million m³/year

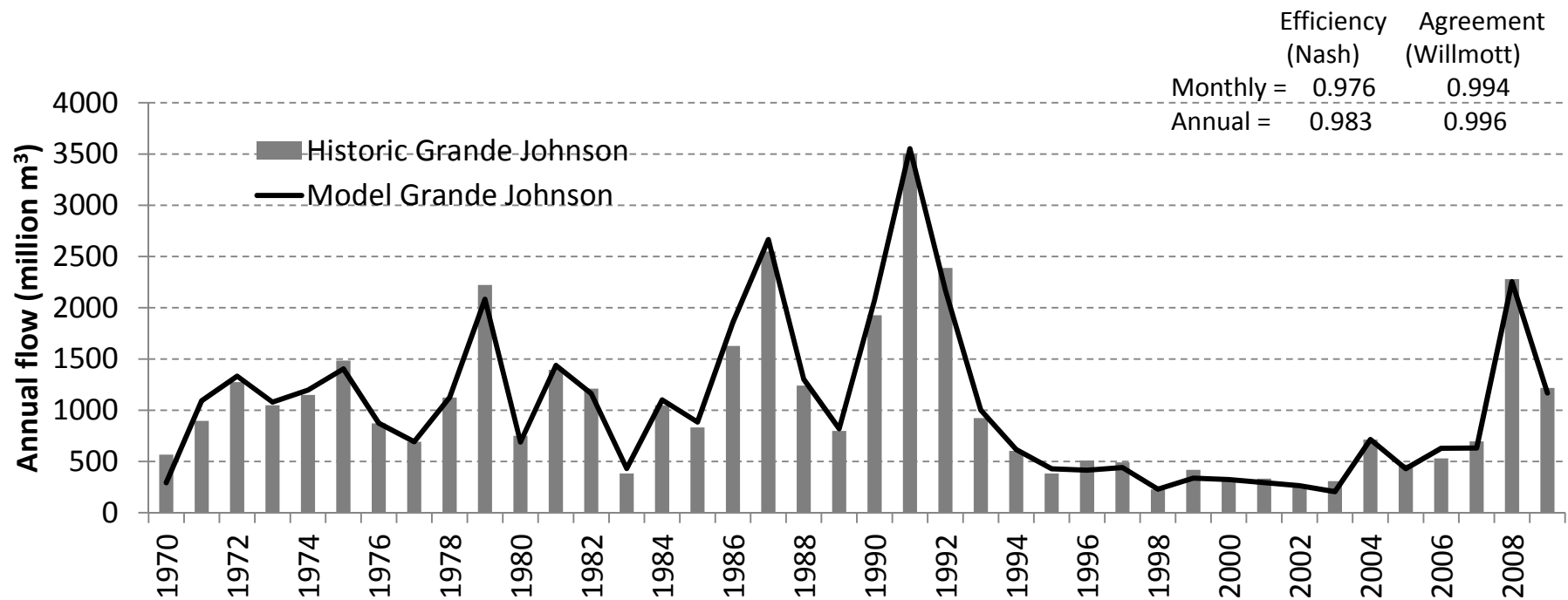
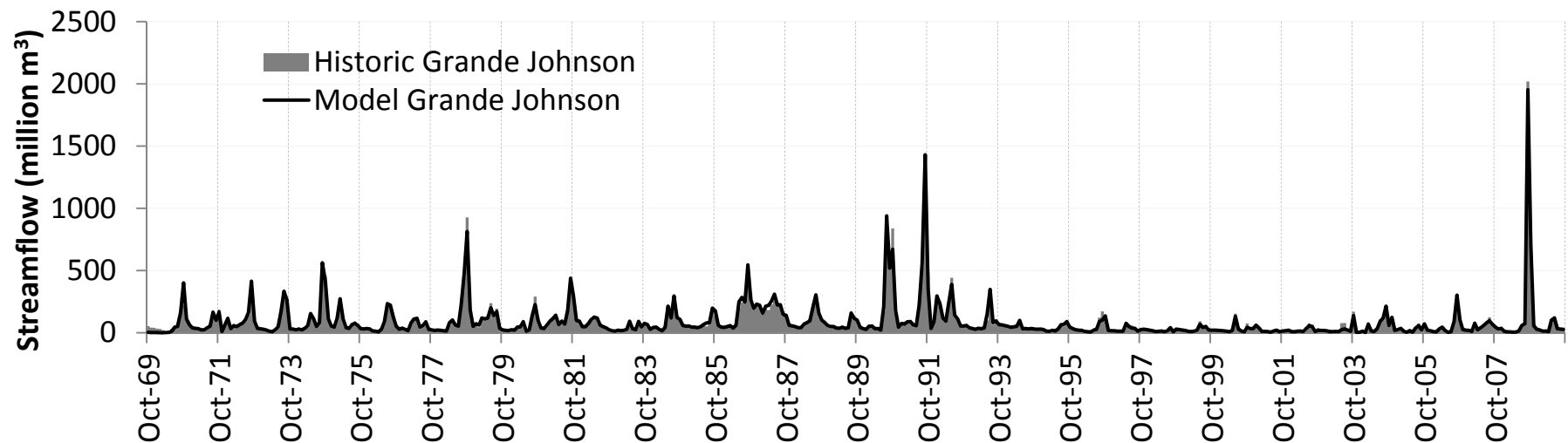


WATER PLANNING MODEL

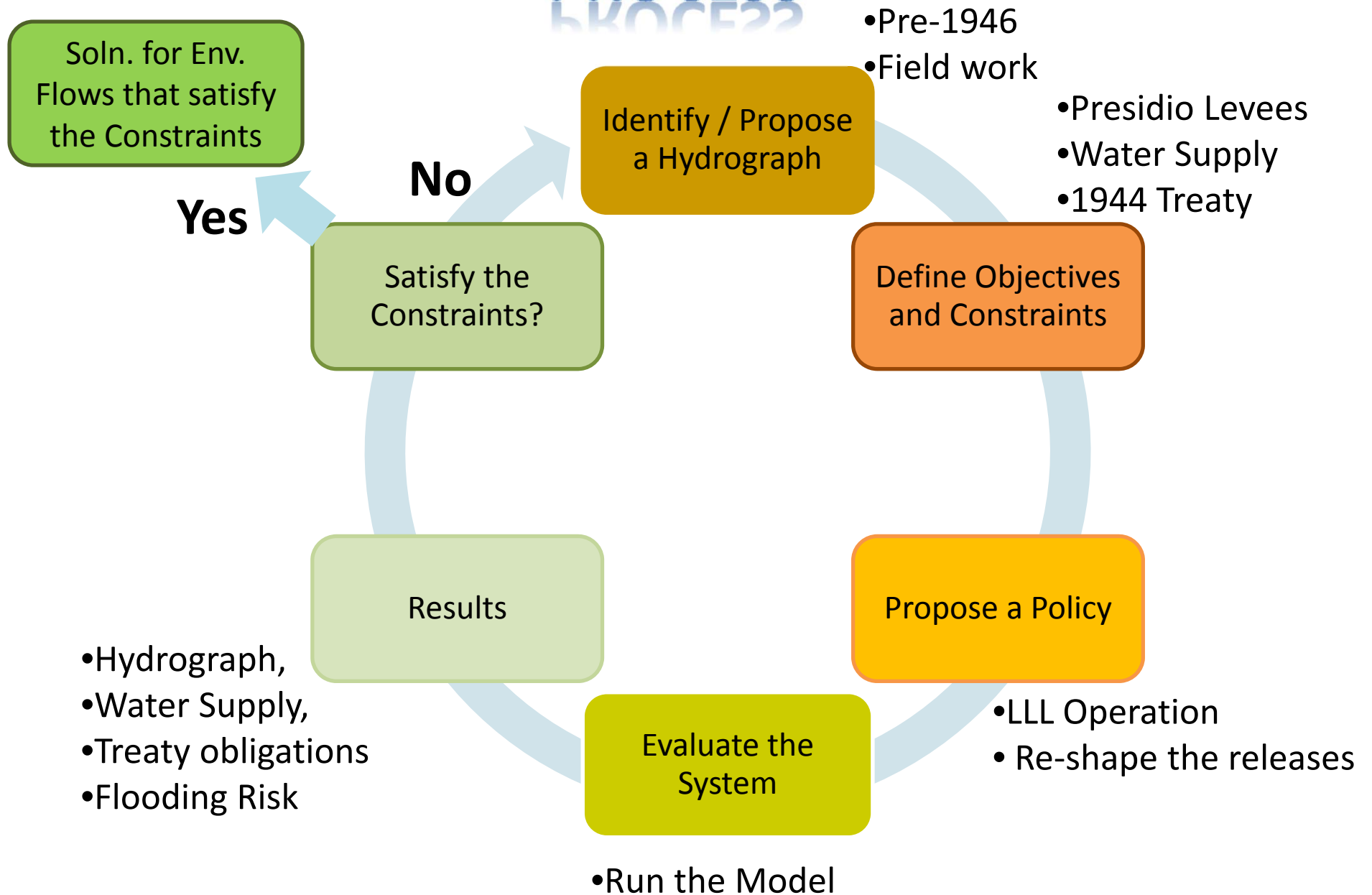
- River Basin Specific Tool
- Broad Spatial Coverage
 - Luis L Leon to Amistad
- Allows Scenario Analysis
- Useful Project Partners
- Capable of
 - Prioritized Water Allocation
 - Link to Groundwater
 - Rainfall-Runoff Hydrology
 - Economic Calculations
 - Links to Water Quality
- Flows
 - 4 Tributary Inflows
 - Incremental Flows
 - Hist. Flows
- 2 Reservoirs
 - Luis L Leon
 - Amistad



RGB AT JOHNSON



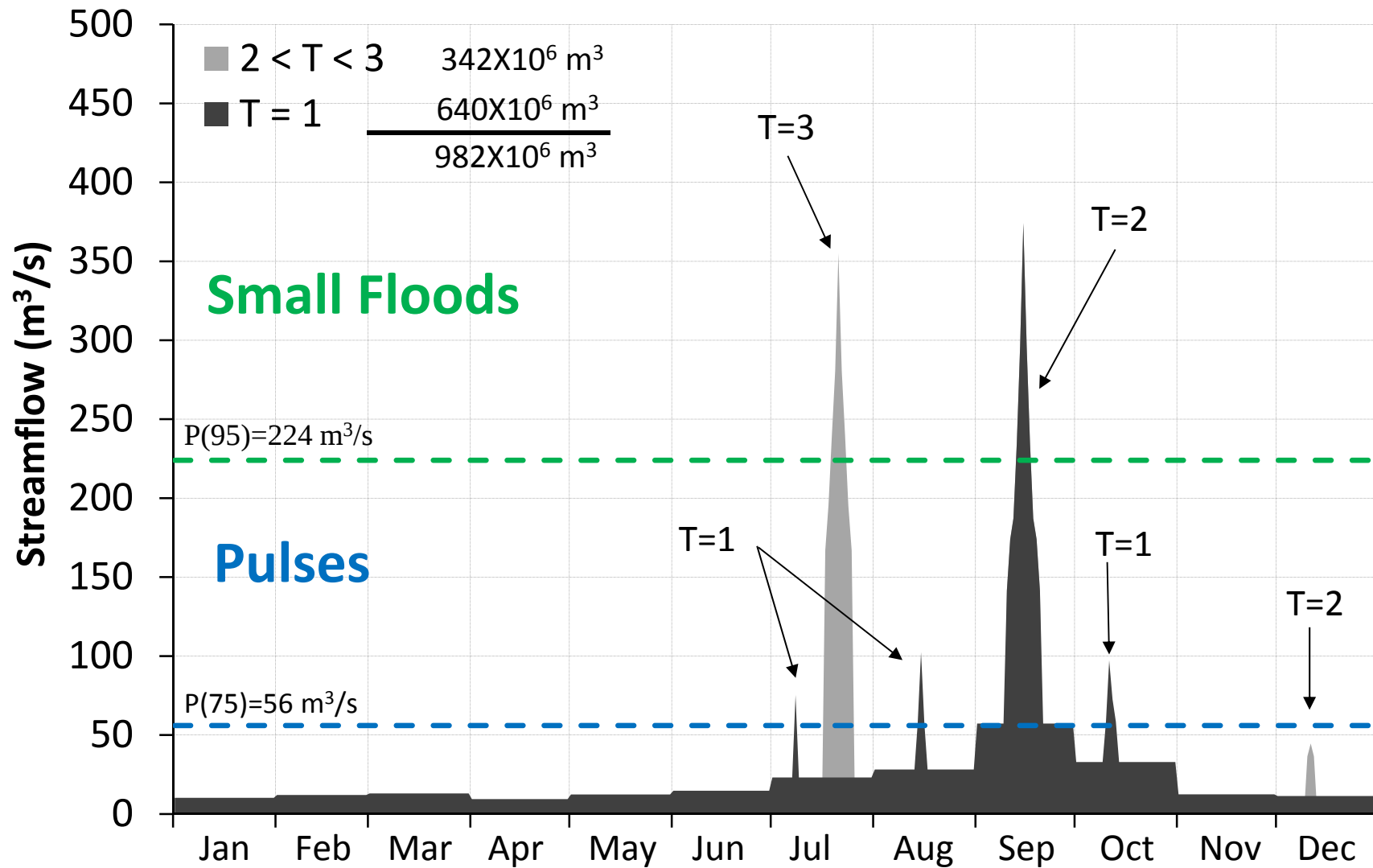
PROCESS



RESULTS

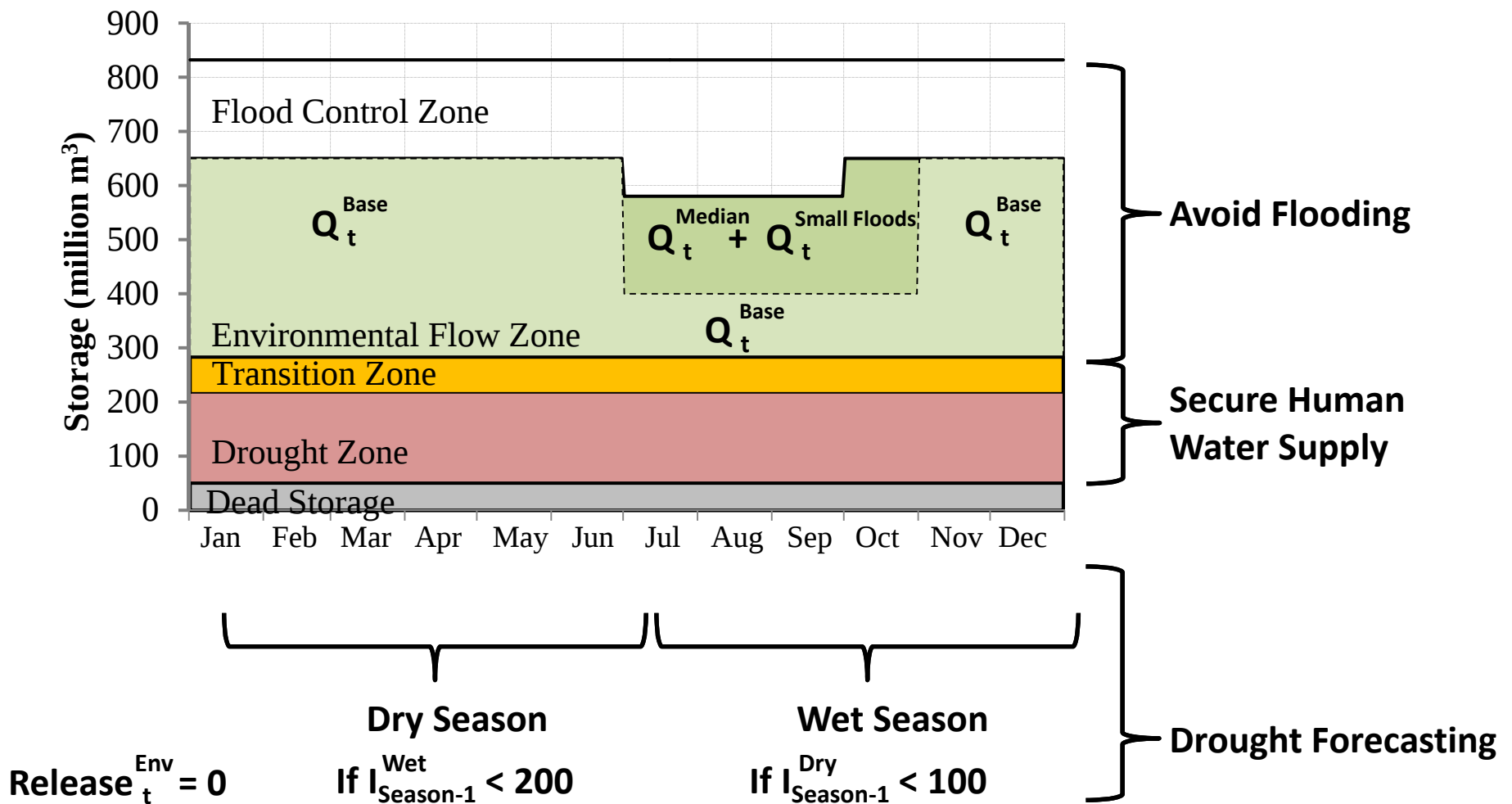
MAXIMUM ENV. RESTORATION FLOW

Max. Hydrograph: 1,000 million m³/year



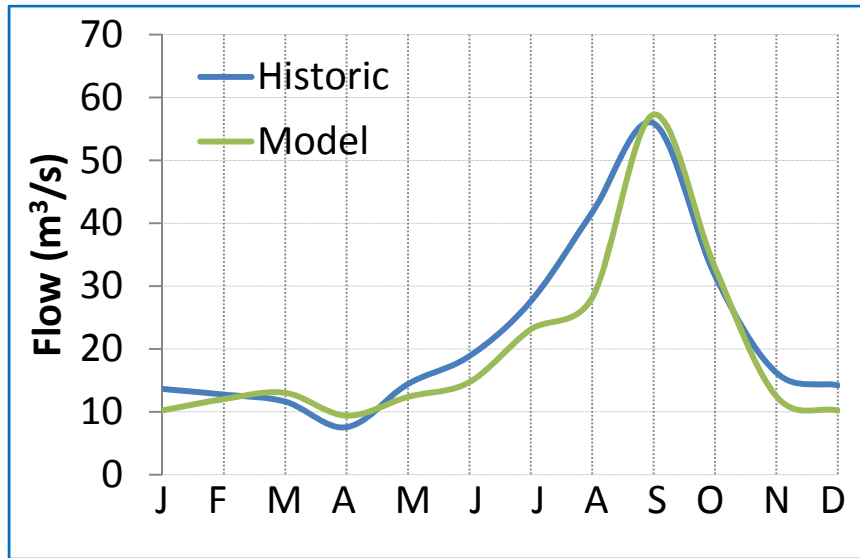
LUIS L. LEON OPERATION POLICY

$$\text{Release}_t^{\text{Env}} = Q_t^{\text{Base}} + Q_t^{\text{Small Floods}}$$

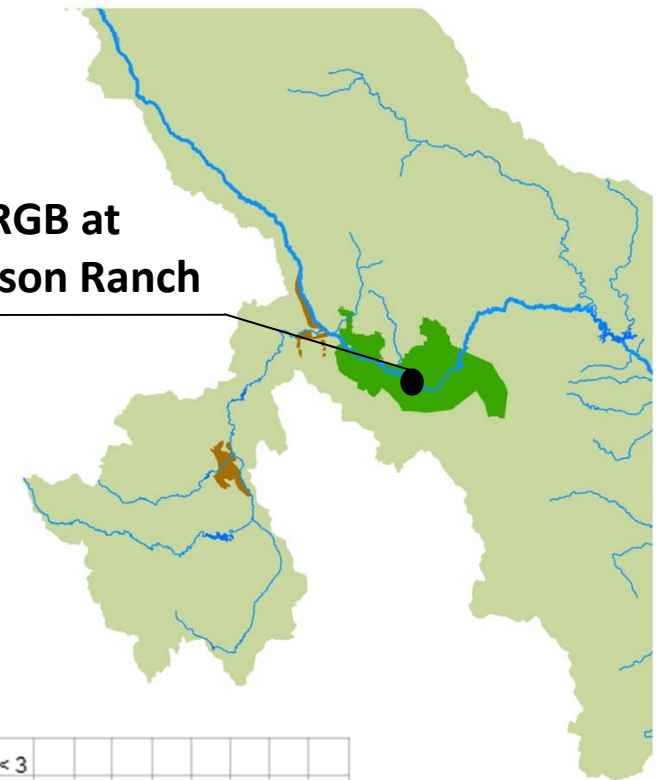


NATURAL RIVER FLOWS

Base Flows



RGB at
Johnson Ranch

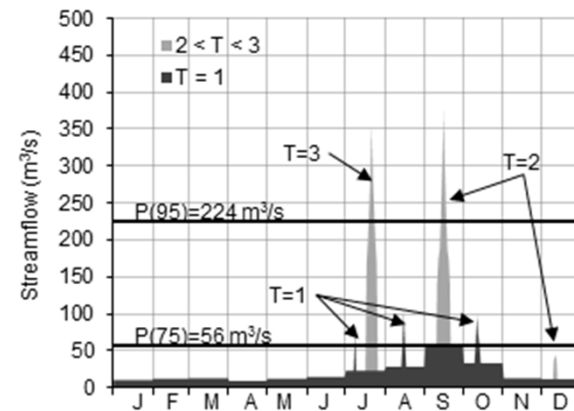


Small Floods – High Flows

Return Period (years)

Every year Every 2-3 years

Hist.	3	6
Model	2	3

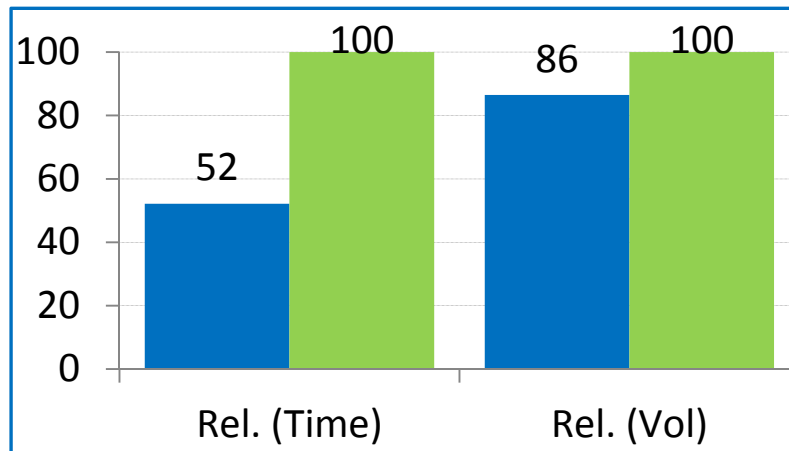


WATER USERS

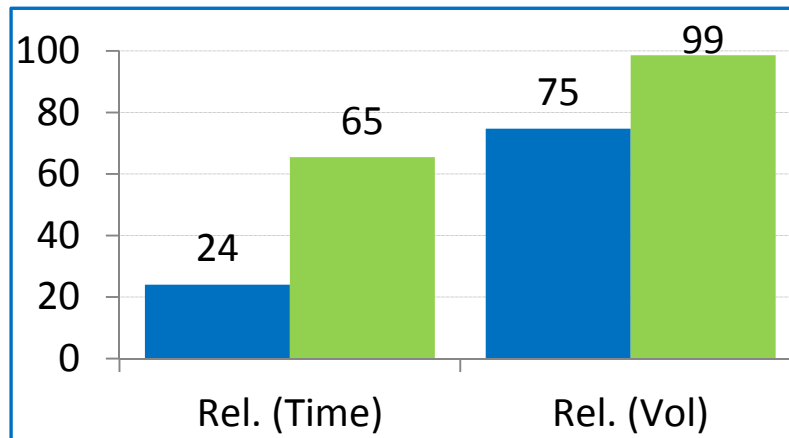


Constraint: Do not harm the water supply for water users

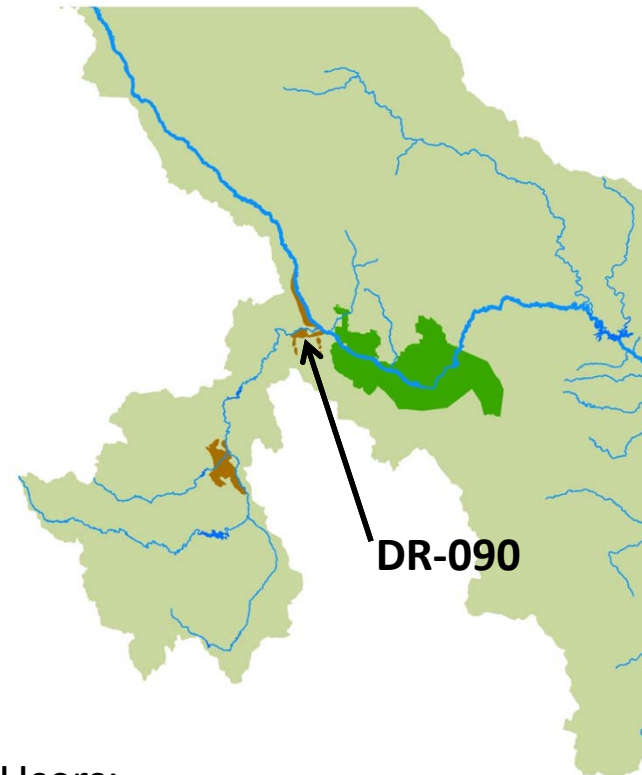
DR-090 Bajo Rio Conchos



Other Users



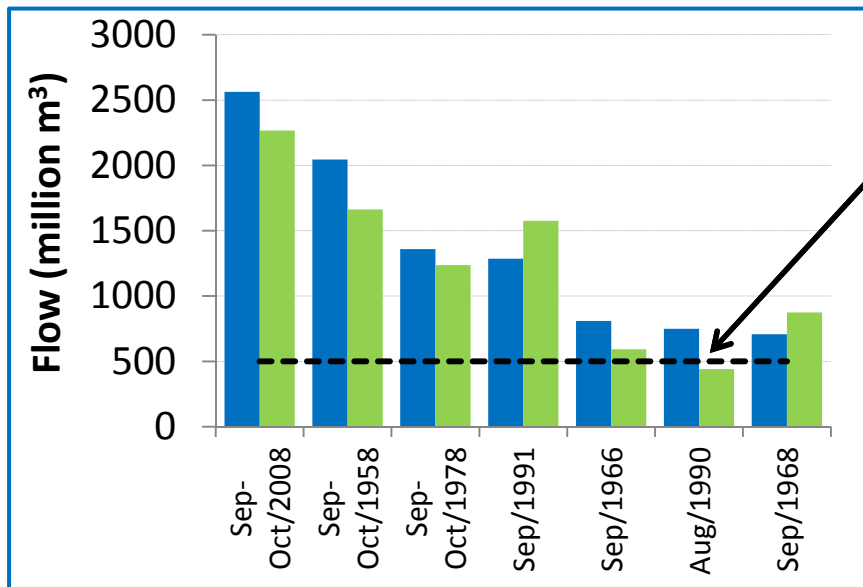
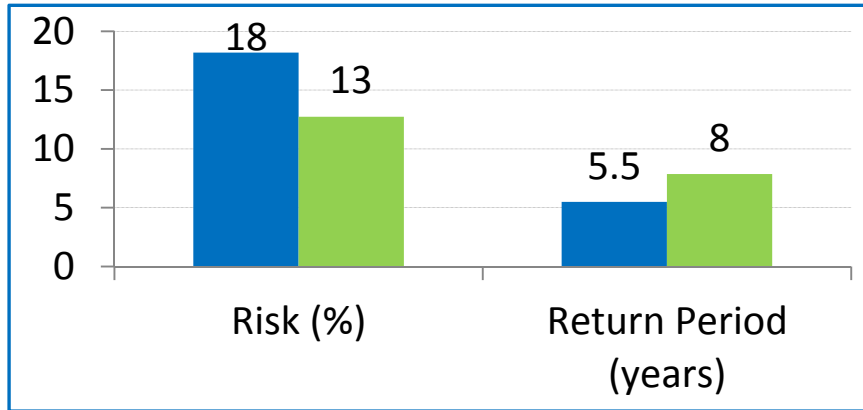
 **Historic**
 **Env. Rest. Flows**



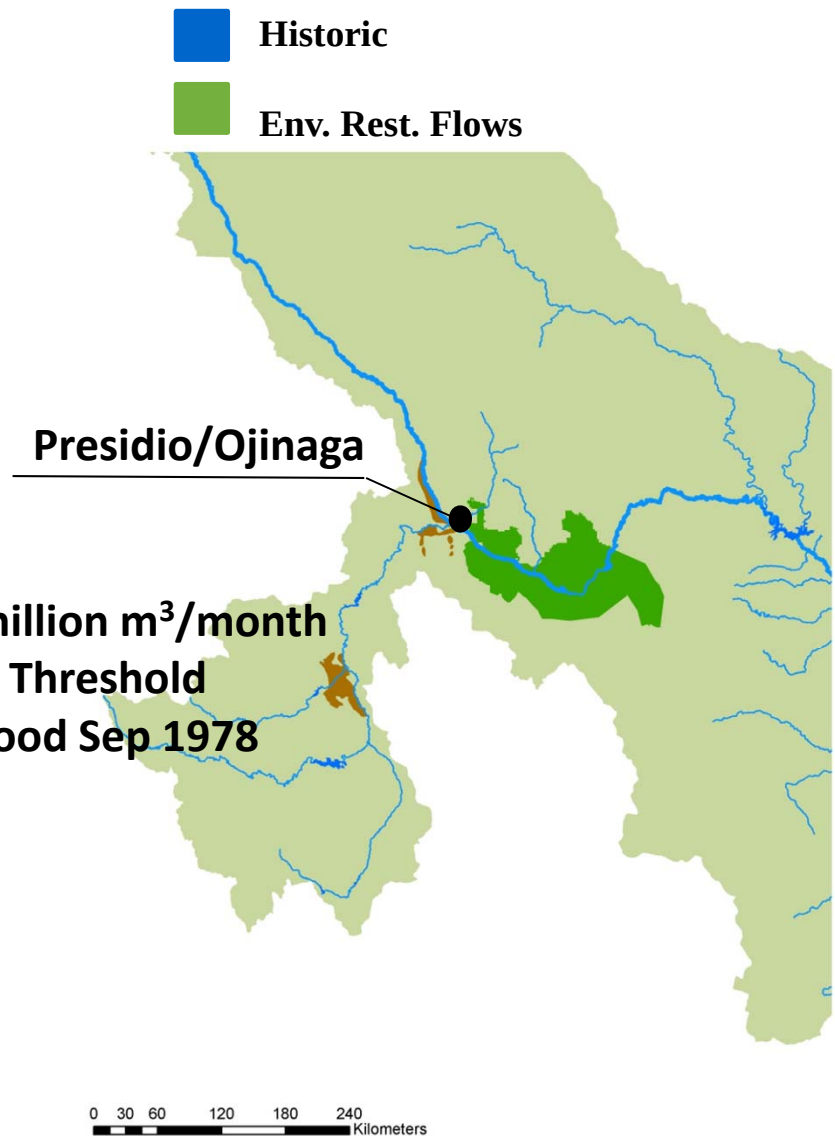
Other Users:
Municipal Rio Conchos
Ag. Rio Conchos
Ag. Rio Grande/Bravo

FLOODING RISK

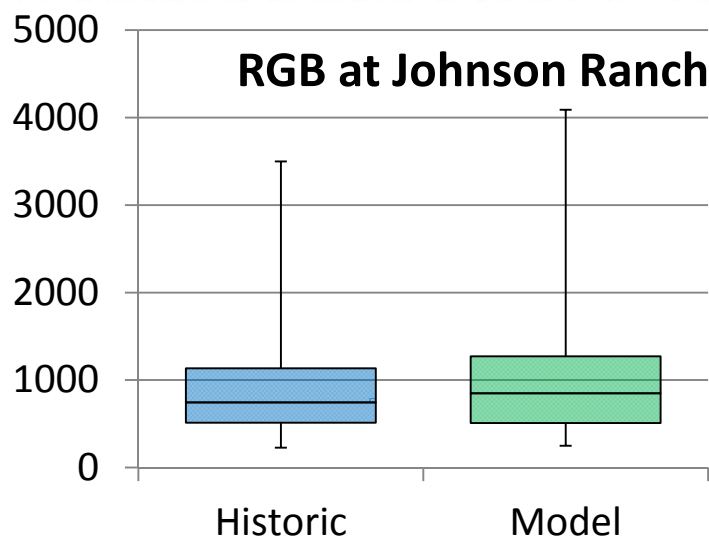
Constraint: Do not increase the flooding risk during monsoon season



500 million m³/month
Threshold
Flood Sep 1978

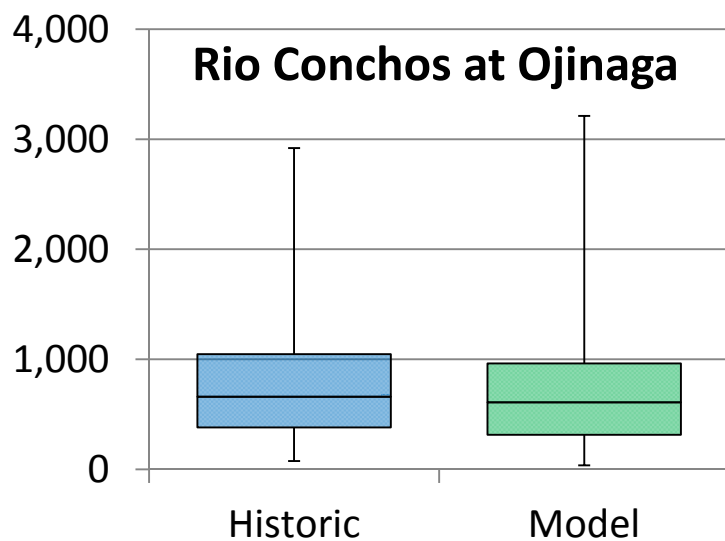


STREAMFLOW STATISTICS

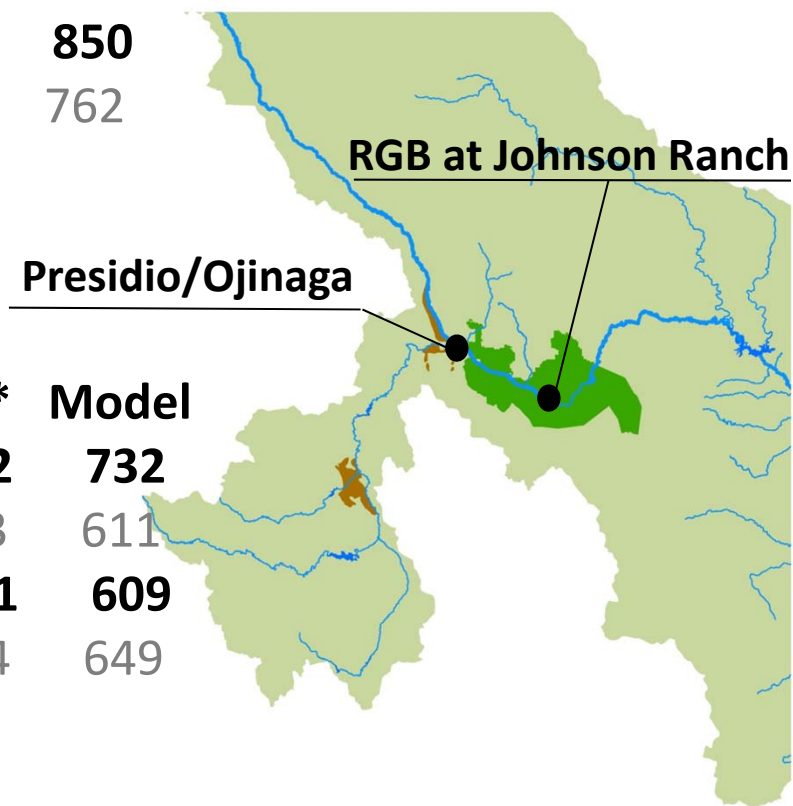


	Hist*	Model
Mean	1004	1038
St. Dev	675	764
Median	832	850
IQR	621	762

 **Historic**
 **Env. Rest. Flows**



	Hist*	Model
Mean	782	732
St. Dev.	583	611
Median	661	609
IQR	624	649



* IBWC, Period 1955-2009

0 30 60 120 180 240 Kilometers

TREATY OBLIGATIONS: ANNUAL ANALYSIS

Constraint: Do not release water above what the 1944 treaty establishes



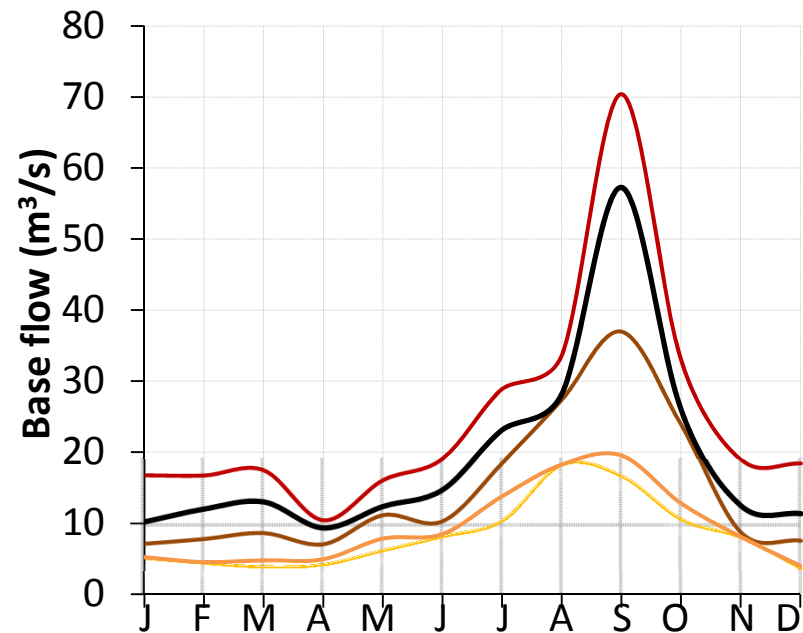
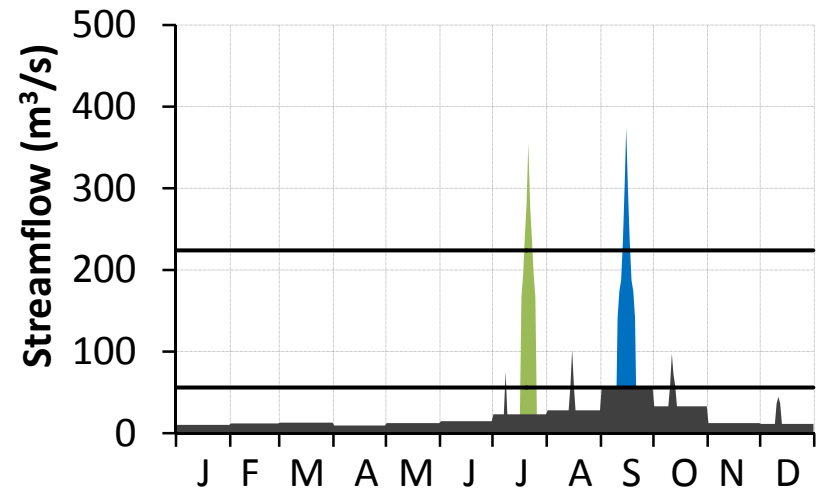
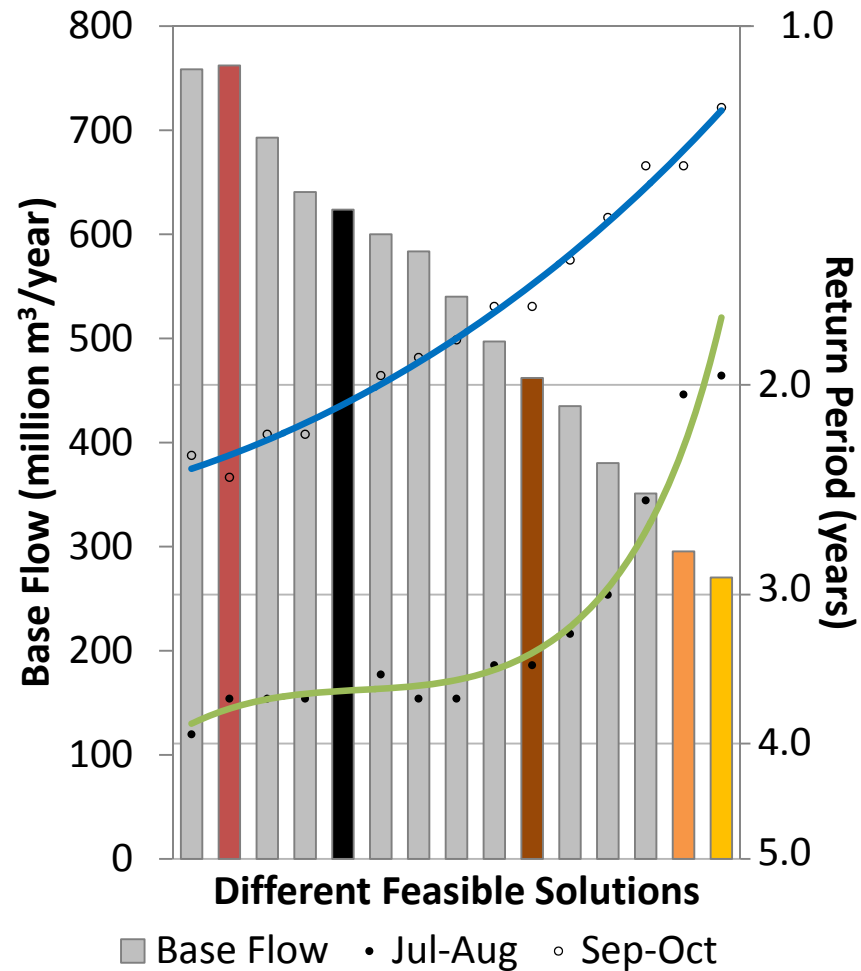
	Treaty Obligations	
	(%)	(million m ³)
Historic	60	782
Model	56	732

*** Average Volume from the Conchos to Treaty = 55% $\approx$ 712 million m³/year**



* IBWC, Period 1955-2009

TRADEOFFS BETWEEN ENV. FLOW CONDITIONS





**A river seems a magic thing. A magic, moving, living part
of the very earth itself**

Laura Gilpin (1949) "The Rio Grande: River of Destiny"