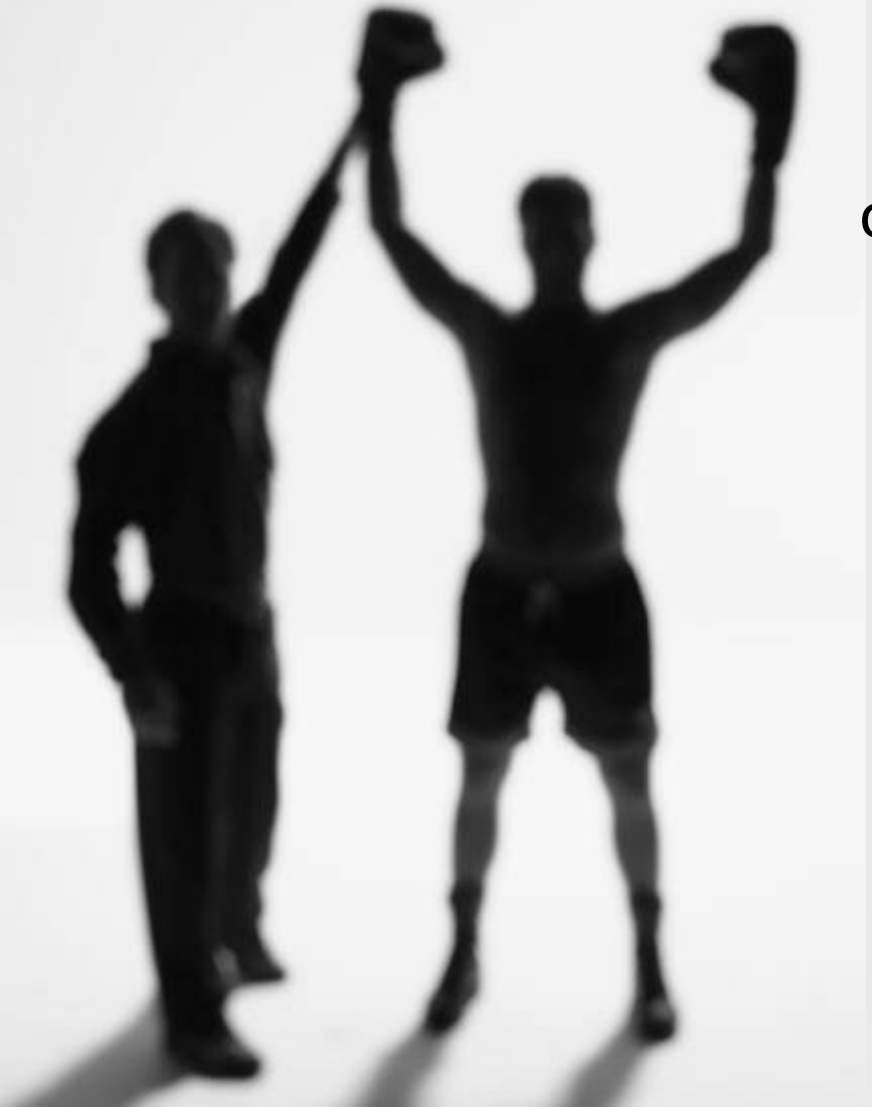
Instream Flows vs. Freshwater Inflows



How can we compare HEFR outputs to Freshwater Inflow Study recommendations for the Guadalupe Estuary?

Presentation to
Trinity-San Jacinto BBEST
April 8, 2009

Dan Opdyke, TPWD
with assistance from TWDB

Objectives of Presentation

- Explore feasibility of comparing

Instream Flow Recommendations
to
Freshwater Inflow Recommendations

- Conceptually
- Quantitatively

Tale of the Tape

Instream Flows		vs Freshwater Inflows
2001	**DOB**	1975
Daily	**Time Step**	Monthly
feet^3/sec	**Units**	acre-feet
Subsistence Base High Flow Pulse Overbank	**Range**	Min Q Sal Min Q Max H
WQ, Habitat, Processes, …	**Objectives**	Salinity, Harvest, Sediment, …

Flow Objectives

Freshwater Inflow Patterns for Bays

- **Min Q Sal:** Minimum flow volume that meets salinity constraints.
- **Min Q:** Minimum flow volume that meets all constraints.
- **Max H:** Flow pattern that meets all constraints and maximizes harvest.

Instream Flow Components for Rivers

- **Subsistence:** Maintain water quality and sufficient population of organisms to support recovery.
- **Base:** Provide suitable habitat conditions.
- **High Flow Pulse:** Maintain physical habitat features and connectivity along the river.
- **Overbank:** Maintain riparian areas and provide connectivity with floodplain.

Possible Outcomes

- If you take care of the river, it'll take care of the bay.
- If you take care of the bay, it'll take care of the river.
- Recommendations for the bay and river will conflict.
- With some effort, bay and river recommendations can be reconciled.

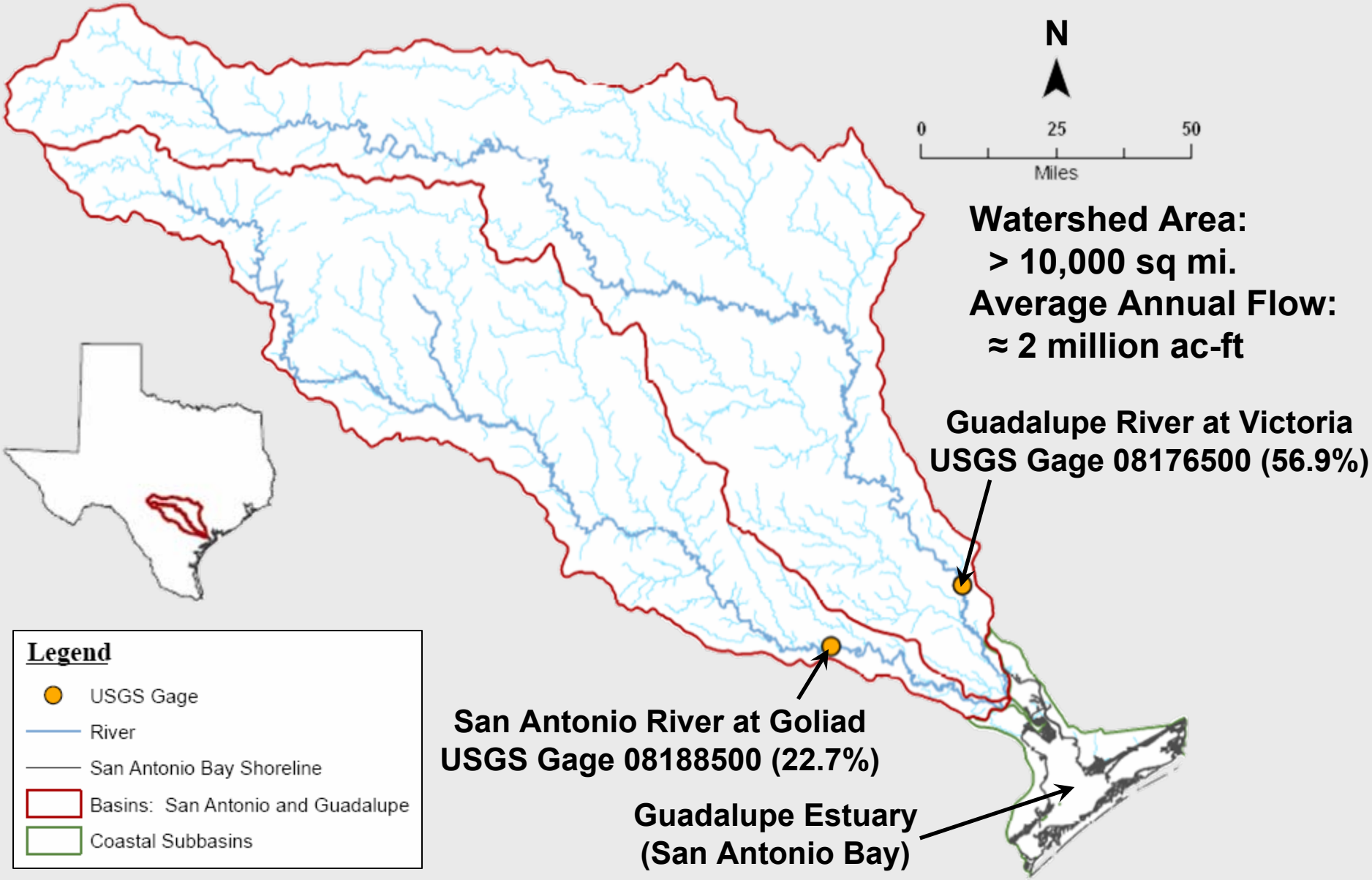
Example: Guadalupe Estuary
(San Antonio Bay)

- Completed Freshwater Inflow Study
  - Inflow recommendations based on historical harvest data
  - Subject to constraints

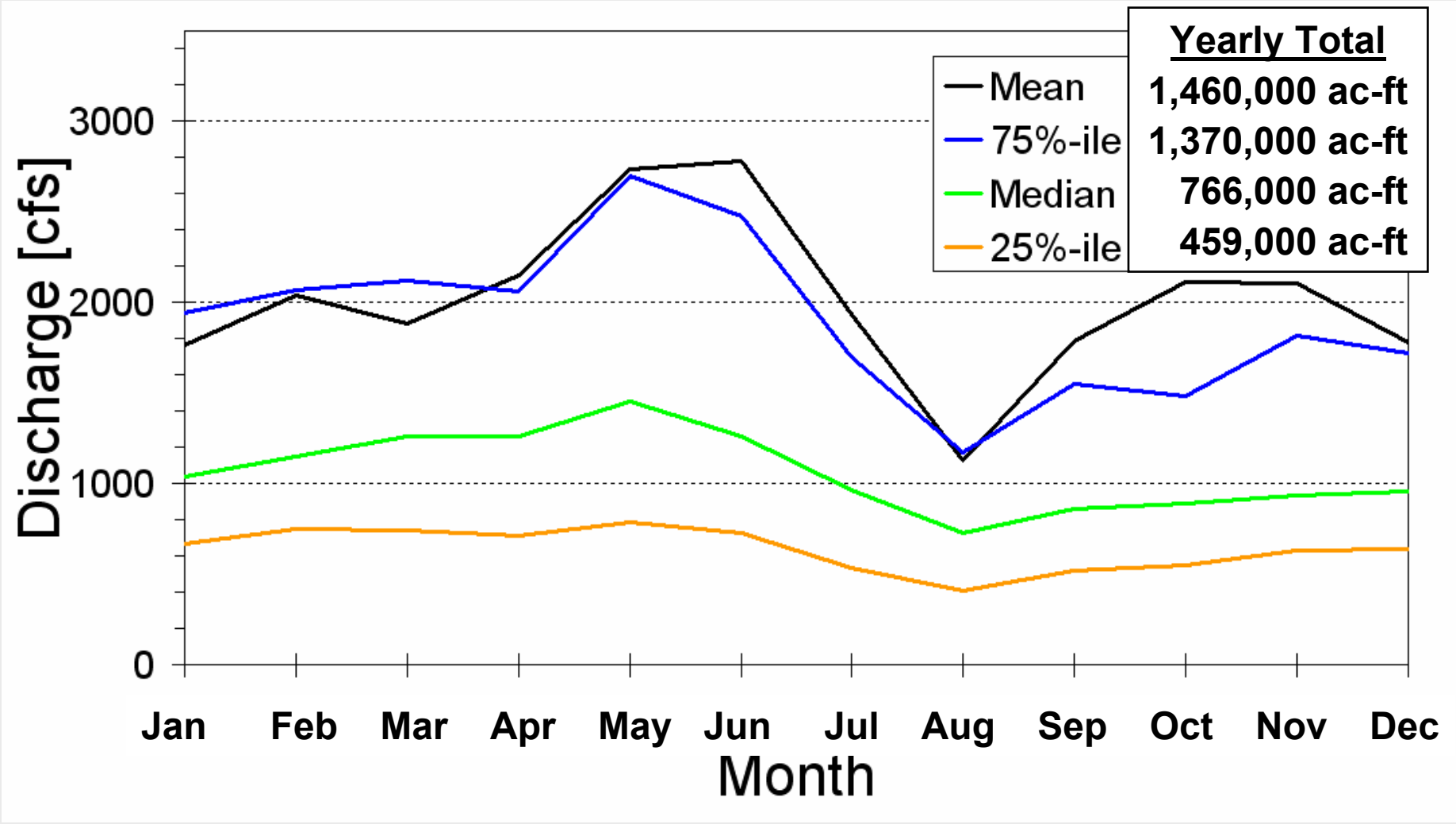
- Example HEFR Instream Flow Numbers

  - Subsistence, Base,
  High Flow Pulse, Overbank Flows

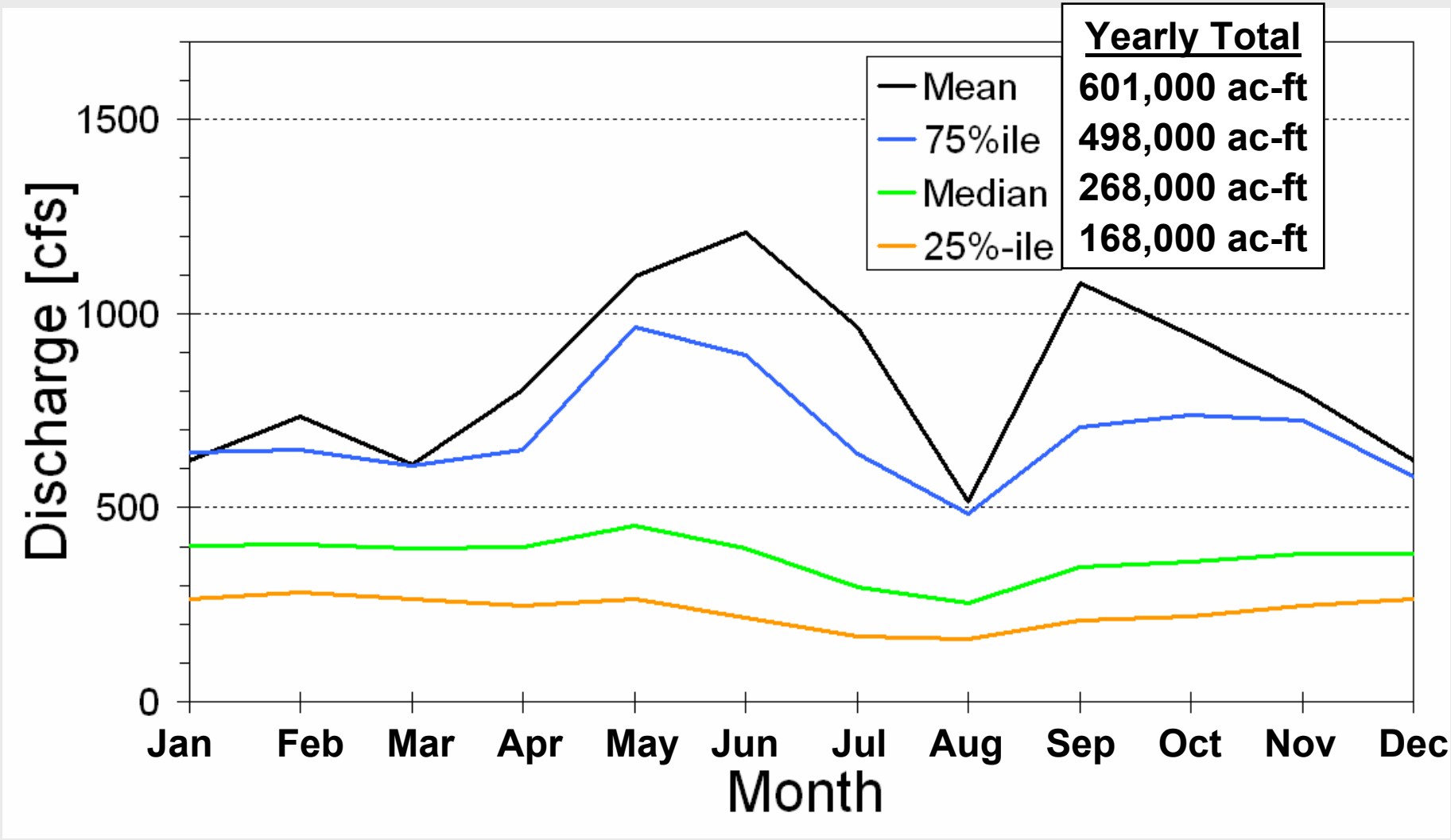
Guadalupe/SA Basin



Guadalupe River at Victoria (1940-2007)



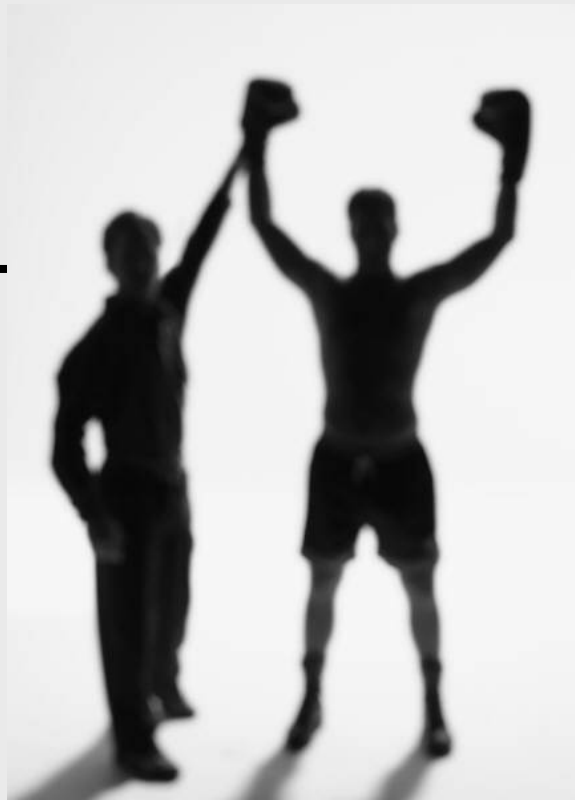
San Antonio River at Goliad (1940-2007)



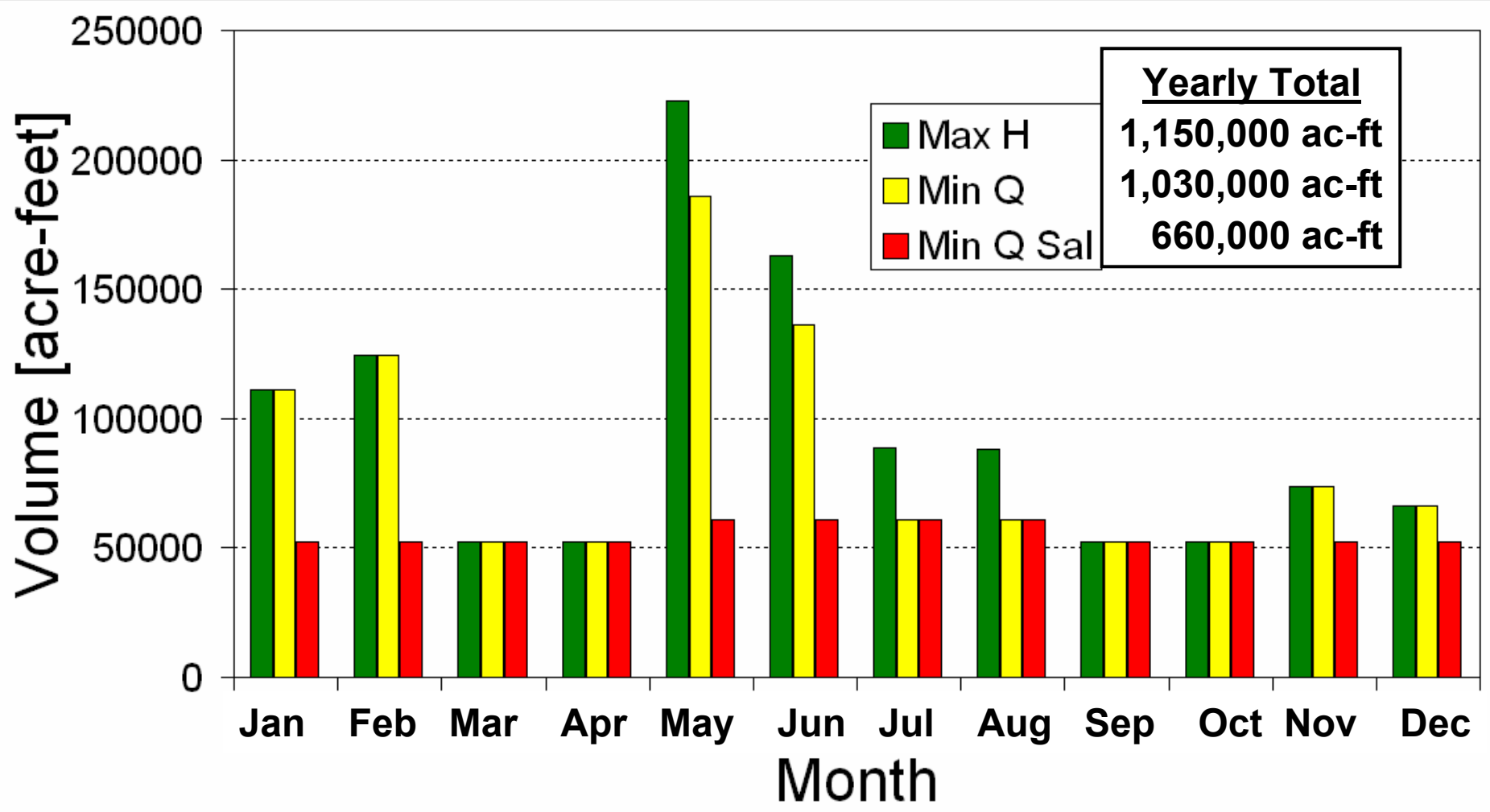
Freshwater Inflows to the Bay

+ Guadalupe River @ Victoria, TX (56.9%)
+ San Antonio River @ Goliad, TX (22.7%)
+ Inflow from ungaged area
- Diversions below gages
+ Return flows below gages

Total Freshwater Inflow to bay



Freshwater Inflow Recommendations



Example HEFR Numbers

Caveats

- Preliminary numbers based only on daily flow records/models and default criteria in IHA/HEFR.
- No site or river basin specific knowledge was used to adjust the numbers.
- Inflow sources were combined into a single, amalgamated, dataset for analysis in HEFR.
- 1977-2004
- 7Q2=Sum of published 7Q2 at Goliad + Victoria

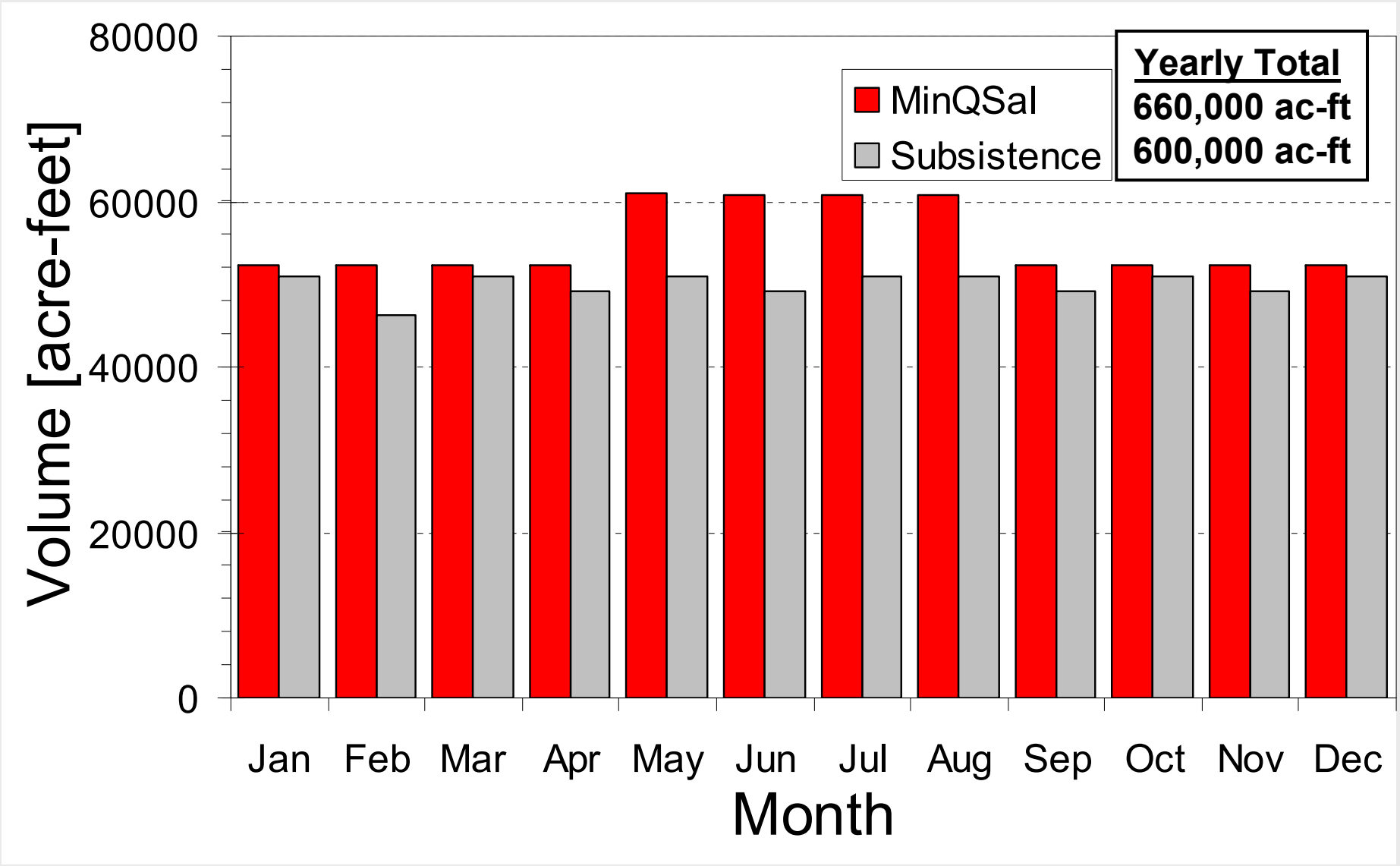
Example HEFR Total Inflow Results

Overbank Flows	Return Period (R) : 0.7 (years)						Duration (D) : 23 (days)					
	Volume (V) : 489751 (ac-ft)						Peak Flow (Q) : 40790 (cfs)					
High Flow Pulses	F: 1	D: 8		F: 1	D: 8		F: 1	D: 7		F: 1	D: 7	
	Q: 8207	V: 70612		Q: 8071	V: 59571		Q: 6641	V: 54290		Q: 7314	V: 53442	
	F: 1	D: 6		F: 1	D: 5		F: 1	D: 5		F: 2	D: 5	
	Q: 4747	V: 35030		Q: 4009	V: 30924		Q: 3840	V: 30742		Q: 4709	V: 31776	
	F: 1	D: 4		F: 1	D: 4		F: 1	D: 3		F: 2	D: 3	
	Q: 3296	V: 18124		Q: 3280	V: 18058		Q: 2207	V: 13000		Q: 3205	V: 13893	
Base Flows (cfs)	2126	2021	1847	2137	1925	1758	1869	1651	1937	1789	1772	1677
	1447	1454	1547	1484	1301	1267	1202	1116	1194	1209	1301	1287
	1010	1177	1111	1101	1031	1014	863	835	887	827	910	883
Subsistence Flows (cfs)	827	827	827	827	827	827	827	827	827	827	827	827
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	Winter			Spring			Summer			Fall		

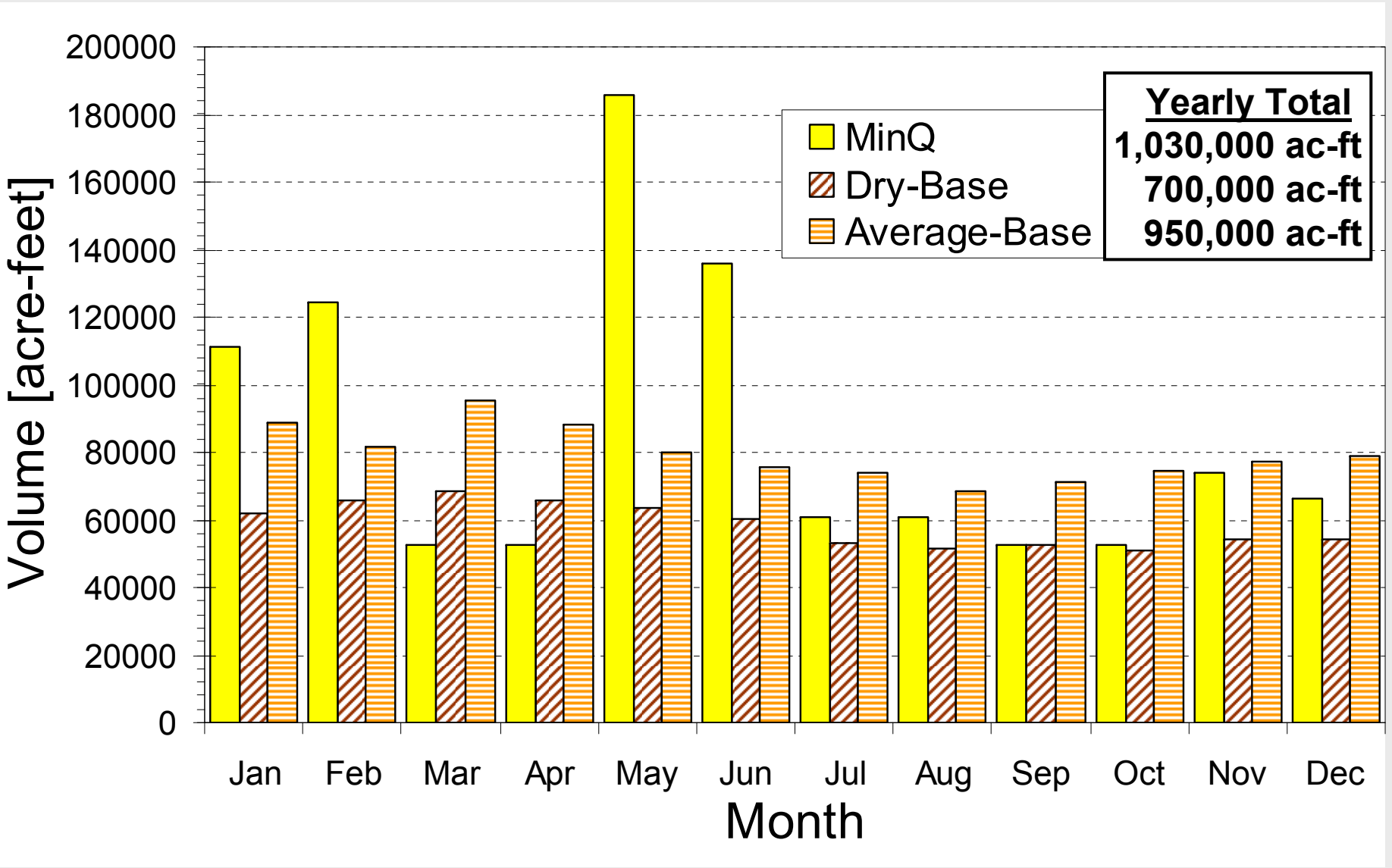
Hydrologic Conditions
Wet
Average
Dry
Subsistence

High Flow Pulse Characteristics
F = Frequency (per season)
D = Duration (days)
Q = Peak Flows (cfs)
V = Volume (ac-ft)

Subsistence vs. Min Q Sal



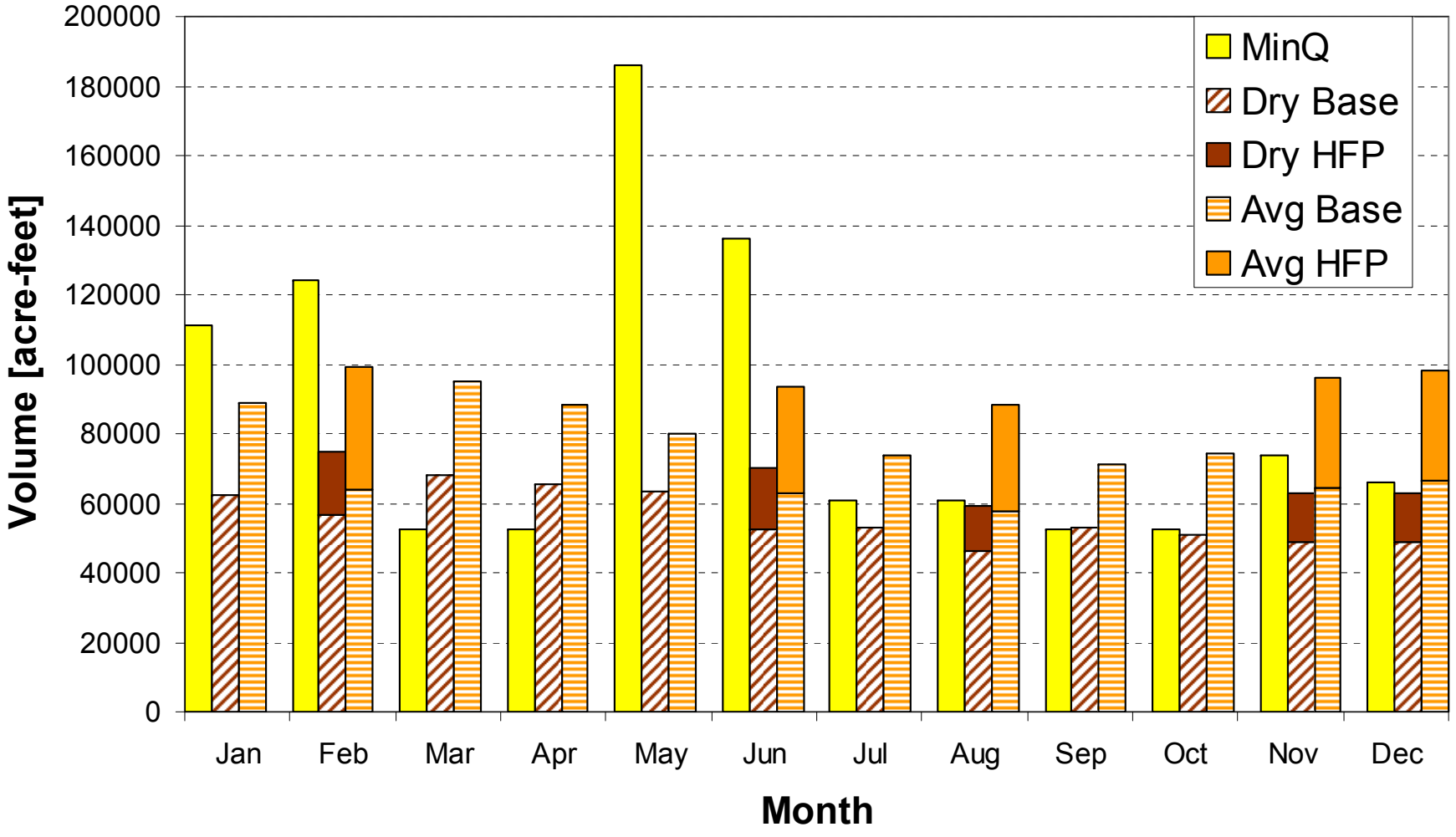
Base Dry and Average vs. Min Q



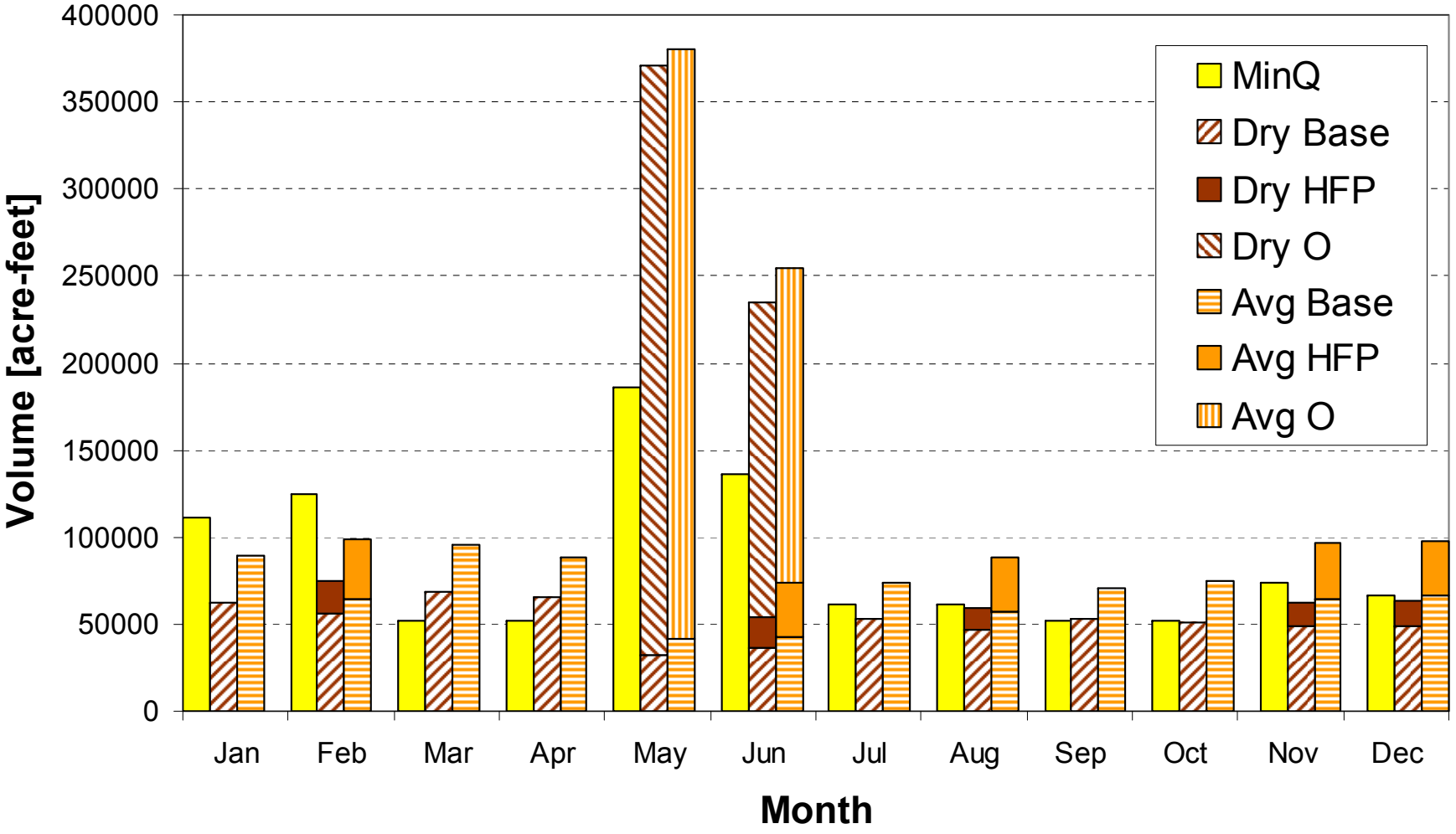
Now for a Little More Complexity…

- High Flow Pulses
  - Winter, 1 pulse/season: assigned to Feb
  - Spring, 1 pulse/season: assigned to June
  - Summer, 1 pulse/season: assigned to Aug
  - Fall, 2 pulses/season, assigned to Nov & Dec
- Overbank Flow Events
  - Approx 1/year, 23 days duration
    - 15 days assigned to May
    - 8 days assigned to June

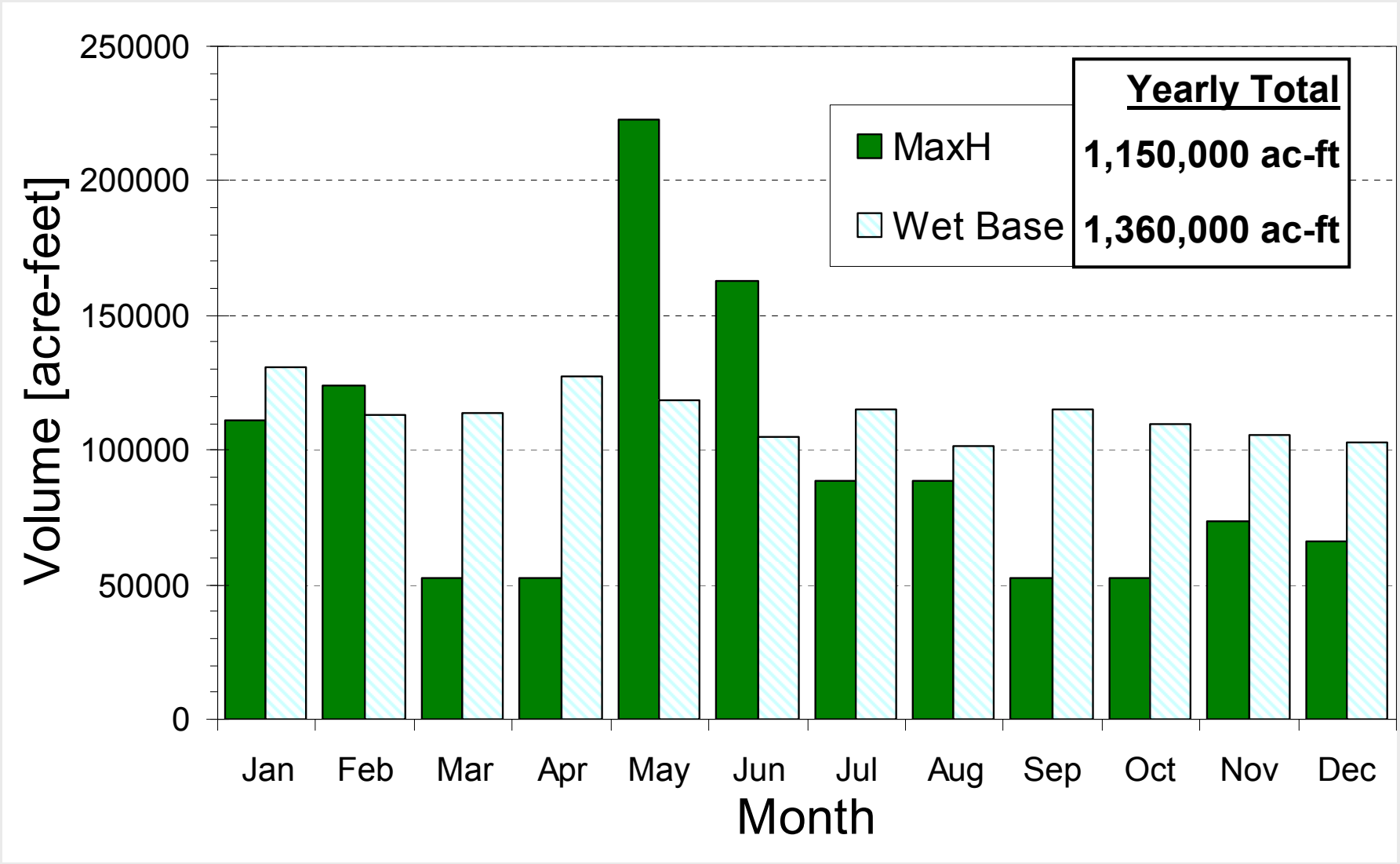
Base Dry and Average Plus HFP vs. Min Q



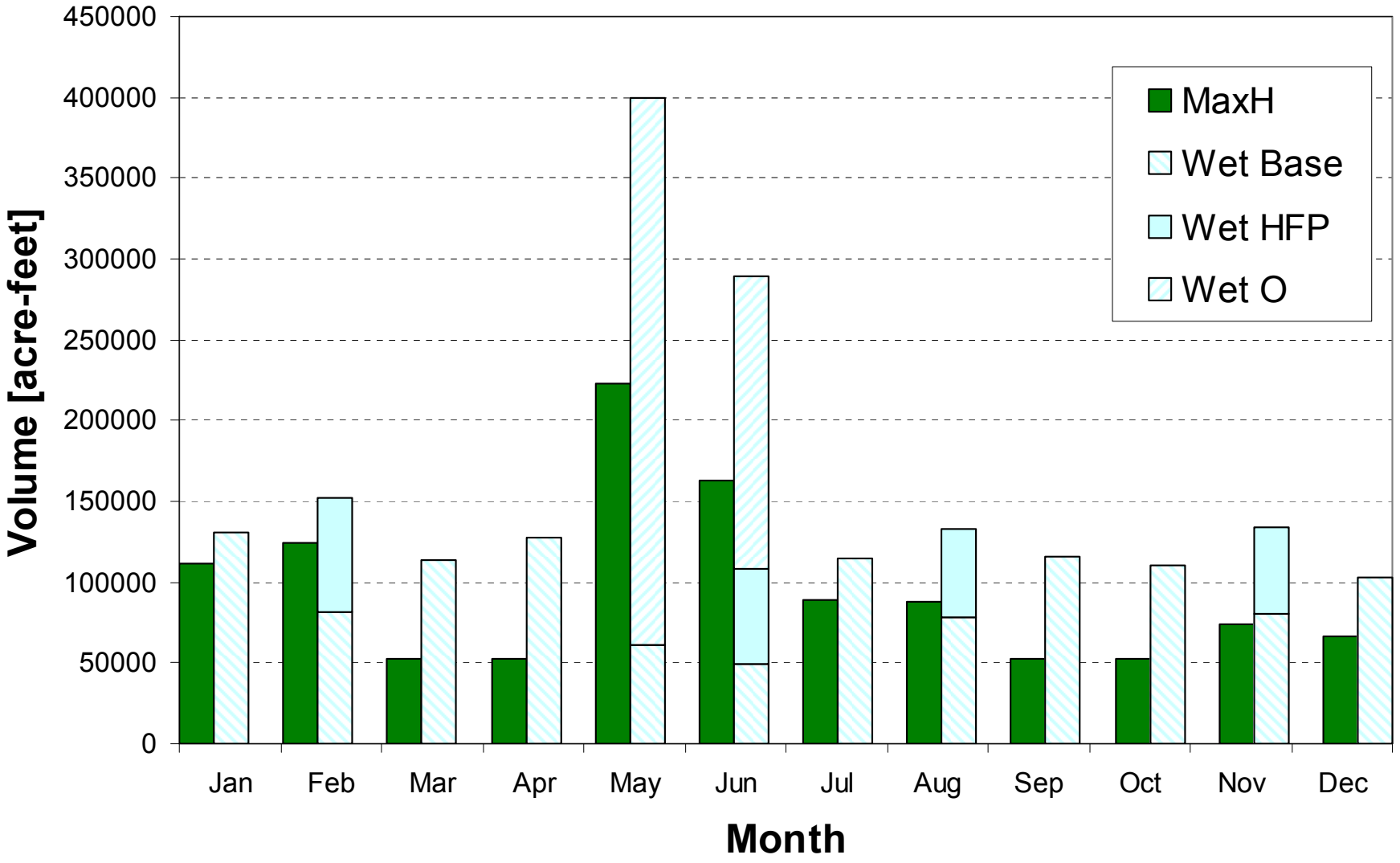
Base Dry and Average Plus HFP Plus O vs. Min Q



Base Wet vs. Max H



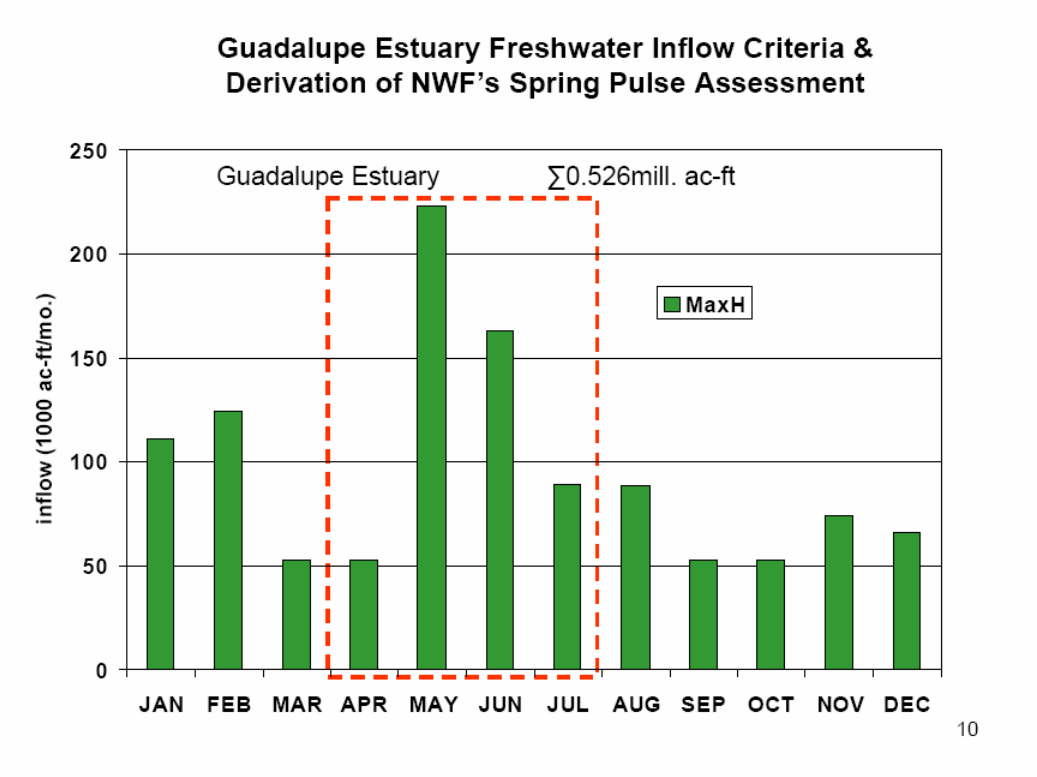
Base Wet Plus HFP Plus O vs. Max H



Example HEFR Numbers vs. Spring Freshwater Pulse to Bay

- **NWF's Spring Pulse Assessment:**

∑Max H (Apr-Jul) = 526,000 ac-ft



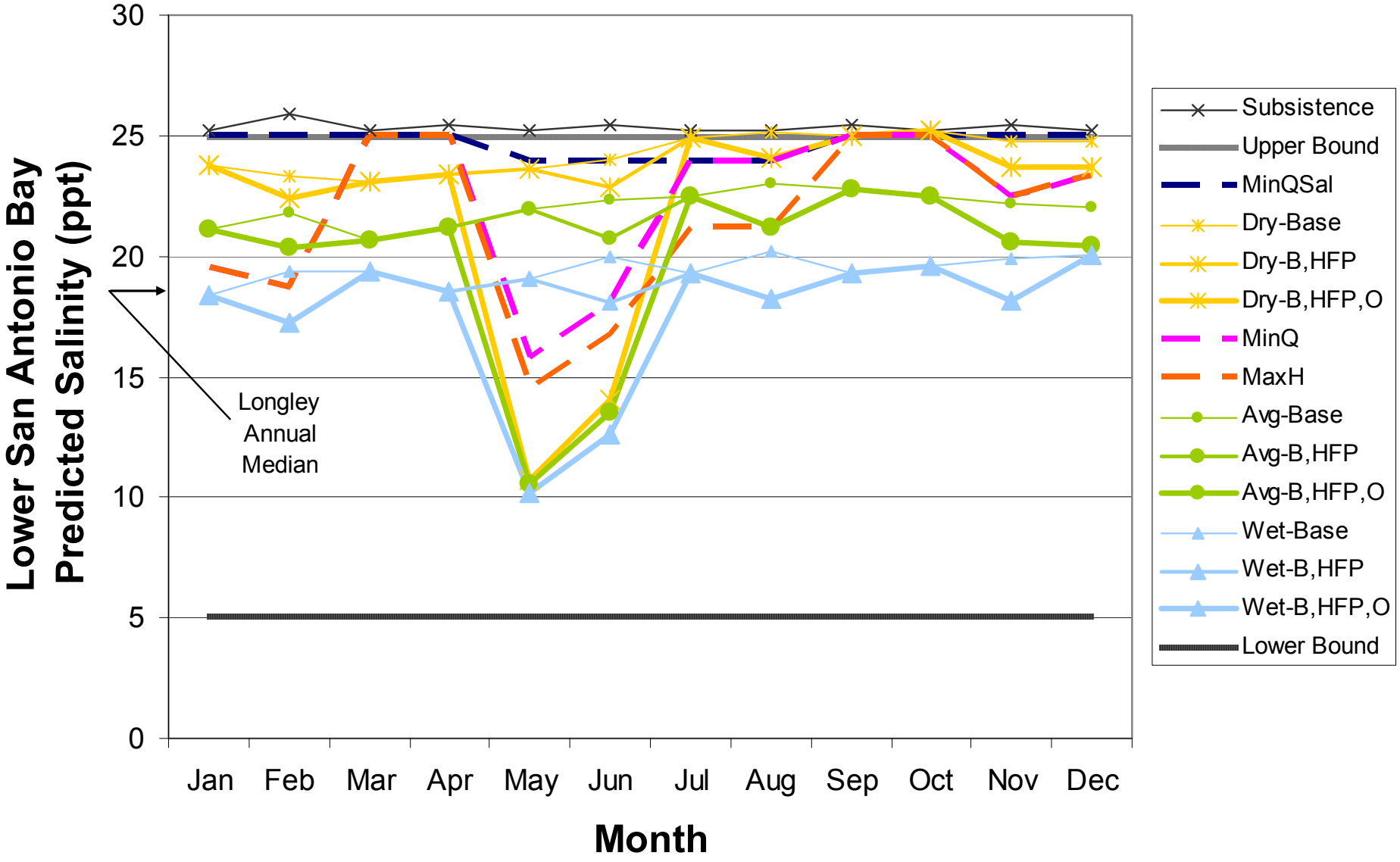
Example HEFR Numbers vs. Spring Freshwater Pulse to Bay

- **Example HEFR Numbers, Apr-Jul:**

	Base Conditions		
	Dry	Average	Wet
No High Flow Pulse	240,000	320,000	470,000 ac-ft
With Spring High Flow Pulses	260,000	350,000	520,000 ac-ft
W/ Spring & Summer High Flow Pulses	270,000	380,000	580,000 ac-ft
Overbank	← +490,000 ac-ft →		

compare with NWF value of 526,000 ac-ft

Salinity Comparison



Conceptual Comparison Conclusions

- Strict comparisons impossible because of different frequency conceptualizations
- Episodic instream flow events must be assigned/distributed to specific months
- Timing of river flows to meet bay targets throughout the year may take some work
- Expansion to salinity (regressions and/or models) is possible
- Methodologies will continue to evolve

Quantitative Comparison Conclusions

- River subsistence flow ≈ Bay Min Q Sal.
- Annual Wet base flow > Max H
  - Makes sense if you think about frequencies
- Wet base flow + HFPs < Max H in May+June.
- Overbank flows in combination with most river scenarios exceed Min Q and Max H targets.
- Salinity values can be roughly compared.
- Numbers are still moving targets

Summary

- With some effort, bay and river recommendations can be reconciled.

- River flow recommendations can be translated to salinity to facilitate evaluation from bay perspective