Estimating California Central Valley Unimpaired Flows

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Outline

- Key Points
- Definition of Unimpaired Flow (UF)
- Assumptions
- History
- Geographic Extent
- Data Sources for Estimating UF
- Sample Estimation Procedure
- Summary of Estimated UFs
- Limitations
- Closing

Key Points

- The unimpaired flows (UF) can be significantly different from the natural flows.
- UF is a conceptual quantity estimated through various means.
- UF is an imprecise estimate, and will require further improvement before being used as an operational flow criterion. This improvement can be made with careful design, time, and expert effort.
- Implementing the proposed flow criteria in real time operations will require timely acquisition of field data needed to estimate the UF.
- Timely acquisition of field data, and, under certain circumstances, forecasting certain components of the UF will pose extra challenges to the project operations.

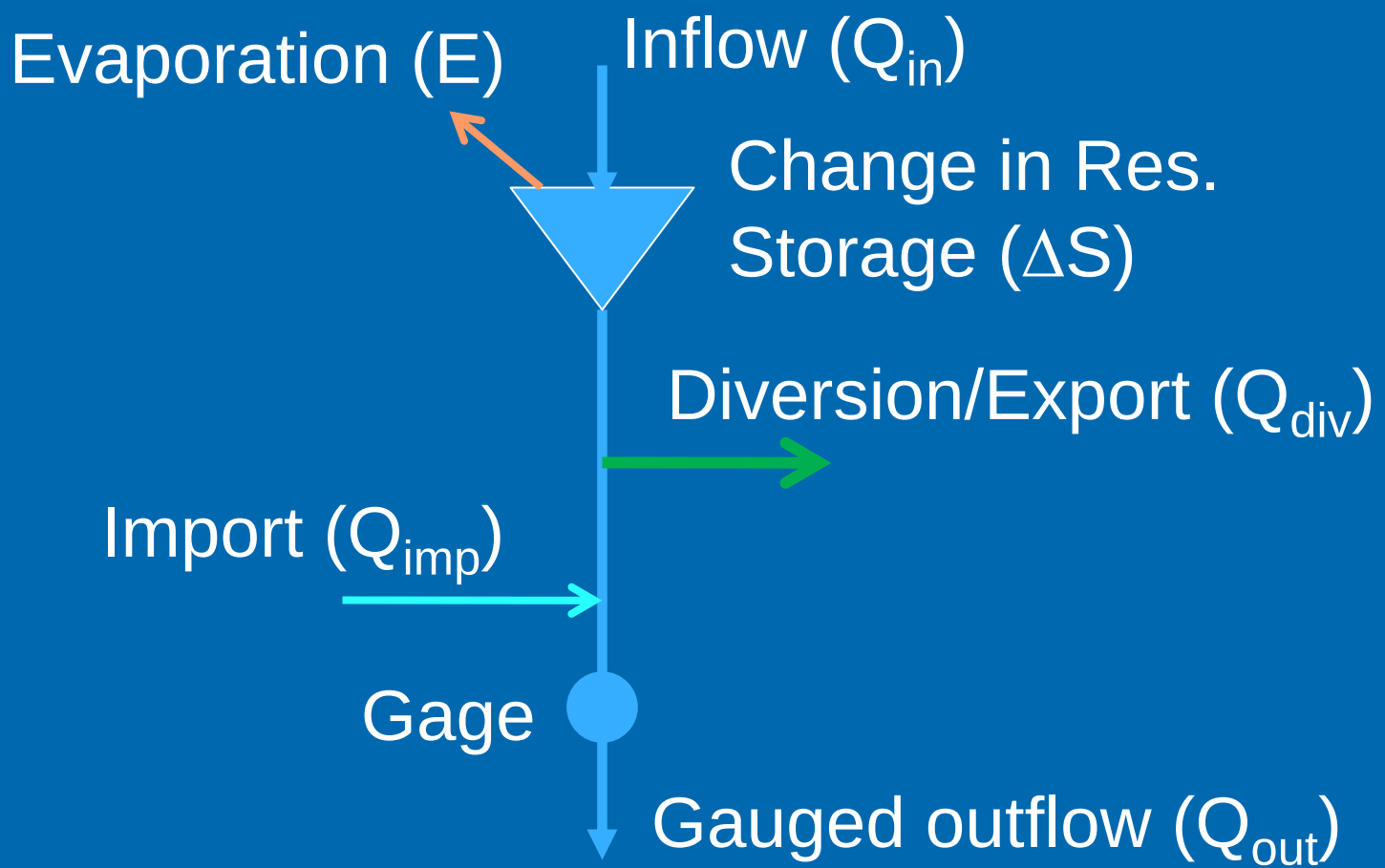
Definition of UF

- The following terms are (have been) used by DWR for UF
  - Full natural flow
  - Natural flow
  - Natural runoff
  - Unimpaired flow
  - Unimpaired runoff
- However, revised Bay-Delta Office Reports make distinctions between “Natural flow” and “Unimpaired flow”
  - Natural flow is a theoretical flow in pre-development or virgin state.
  - UF is an estimated flow for natural flow, not natural flow. The estimation assumes:
    - the existence of the current river configuration.
    - the same groundwater accretion and depletion as in historical condition.

Definition of UF (cont.)

- California Data Exchange Center (CDEC) Definition
  - "Full Natural Flow" or "Unimpaired Runoff" represents the natural water production of a river basin, unaltered by upstream diversions, storage, or by export or import of water to or from other watersheds.
- State Water Resources Control Board
  - Unimpaired flow is the total volume of water that would flow past a particular point of interest if no diversions (impairments) were taking place in the watershed above that point (taken from annual and seasonal unimpaired flow definitions).

Conceptual UF Estimation Procedure



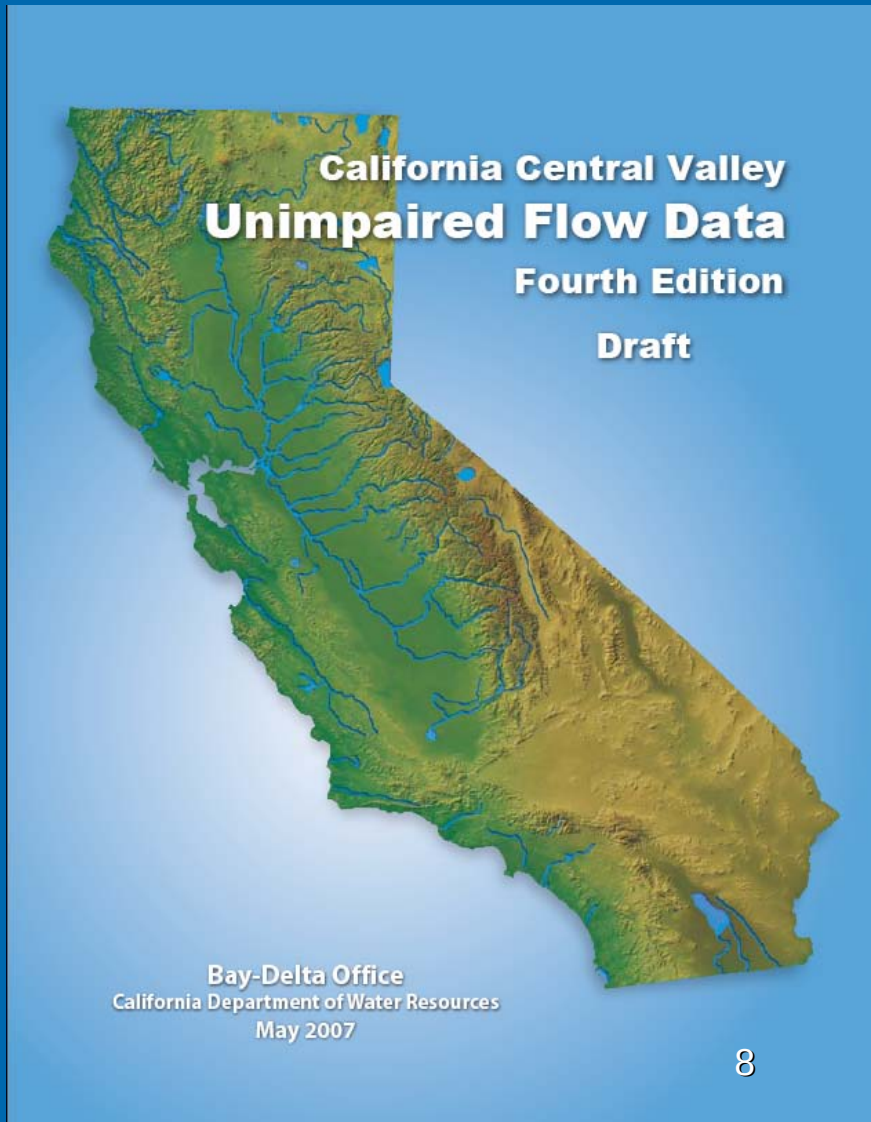
$$UF = Q_{out} - Q_{imp} + Q_{div} + \Delta S + E$$

Assumptions

- Observed (gage) data is reliable.
- Change in stream groundwater interaction due to flow regulation is not included.
- Change in surface retention of precipitation (such as swamps) due to land use development is not included.
- Change in flow due to change in channel reconfiguration is not included.
- Water flow from upstream to downstream of the Sacramento and San Joaquin valleys are instantaneous (no routing).

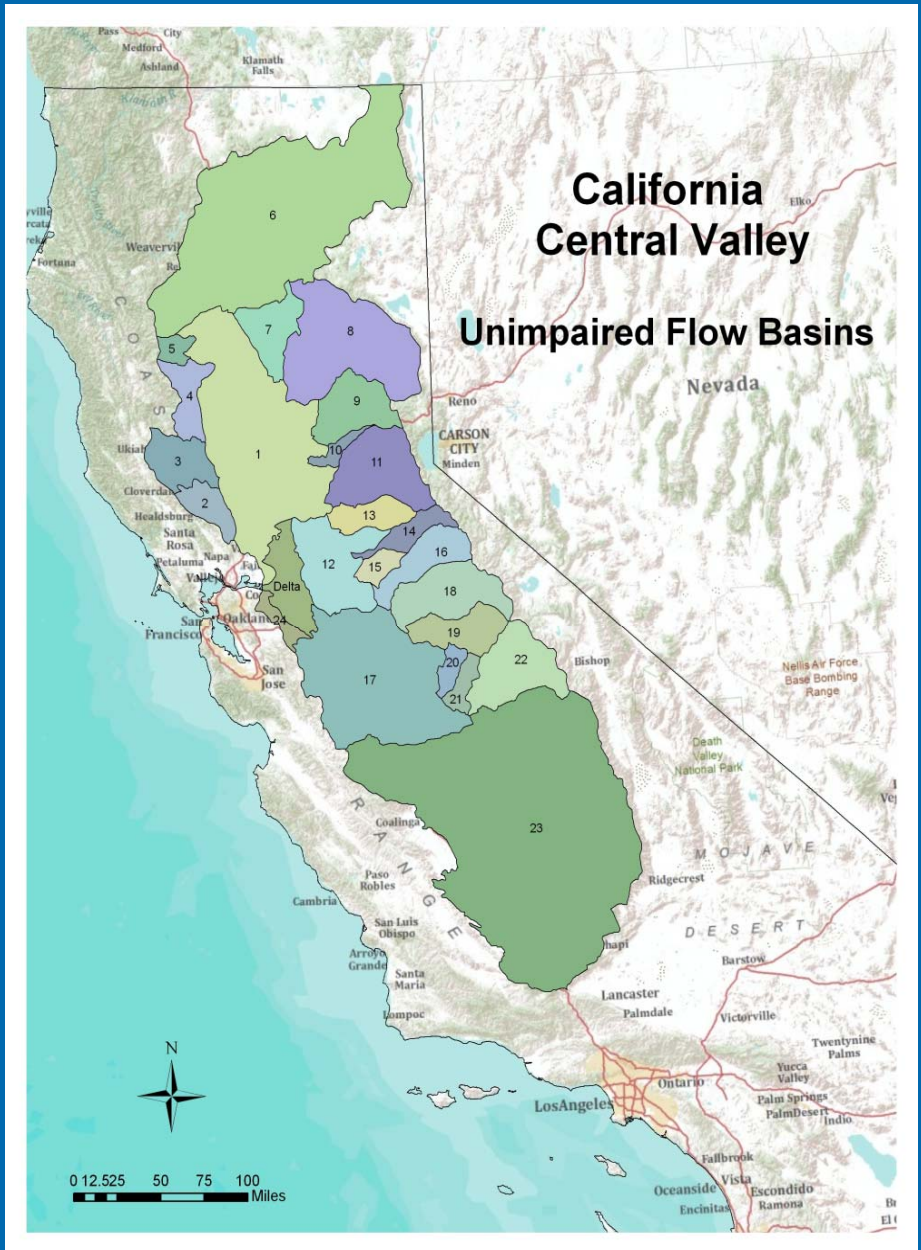
History of UF Development

- First Edition (DWR, Apr 1980): California Central Valley Natural Flow Data
- Second Edition (DWR, Division of Planning, Feb 1987): California Central Valley Unimpaired Flow Data
  - (WY 1921 – 1983)
- Third Edition (DWR, Division of Planning, Aug 1994):
  - (Data extended to 1992)
- Fourth Edition (DWR, Bay-Delta Office, May 2007):
  - Same methodologies as those used in previous reports
  - (Data extended to 2003)



Geographic Extent

- Unimpaired flows are estimated for 24 river basins that are tributary to the Sacramento Valley, Eastside Streams, and San Joaquin Valley.



Data Sources

- USGS gages adjusted for upstream reservoir operations
- Proportionality between UF of unknown basin using UF of known basin in terms of area or precipitation
- Regression analysis (correlation between nearby watersheds)
- Depletion studies

Example : San Joaquin River at Millerton Reservoir (UF 22)

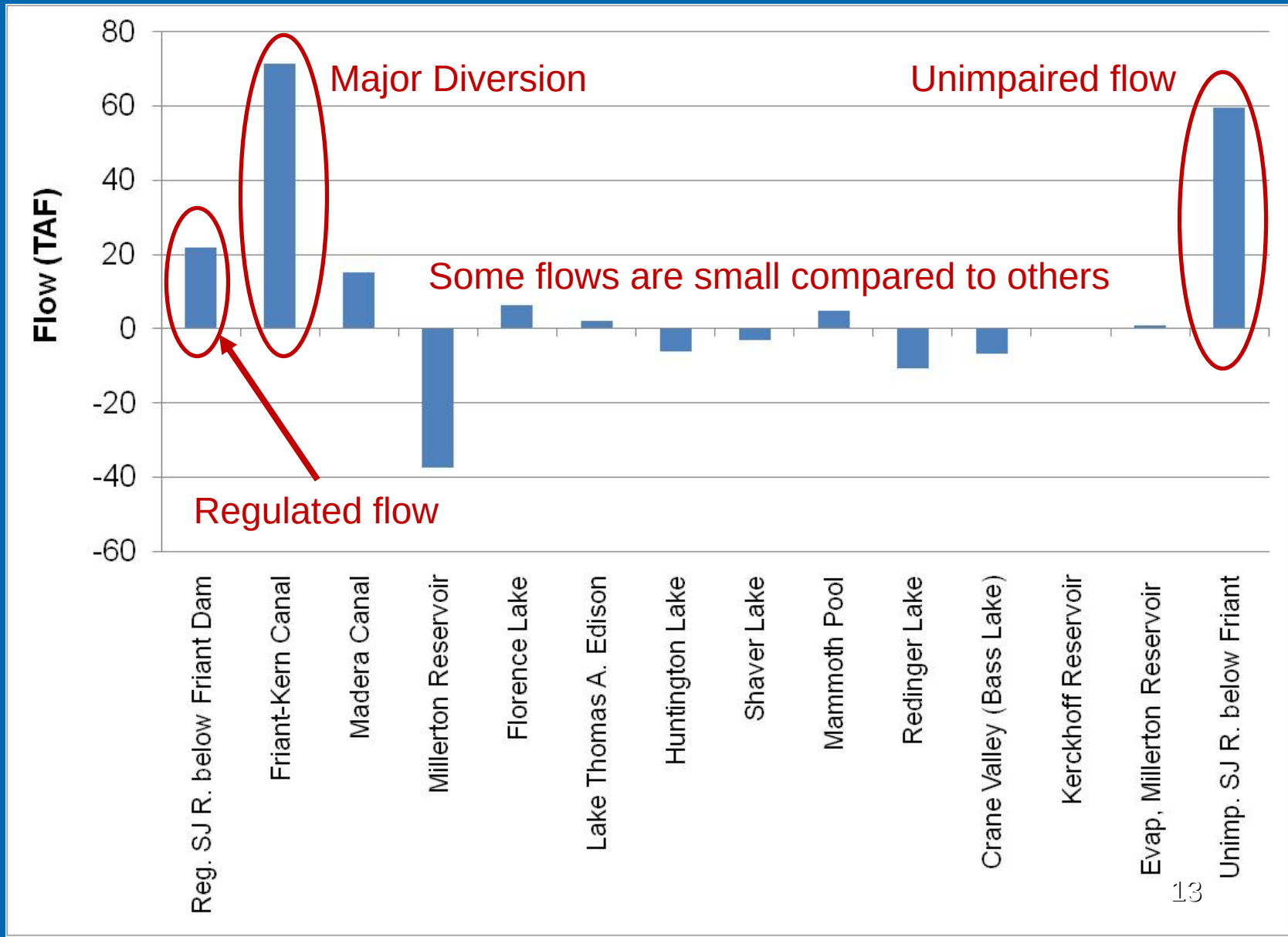
Example (cont.)

Example: San Joaquin River at Millerton Reservoir

Flow category	Adjustment	Flow description	Source
Observed flow	+	San Joaquin River below Friant Dam	USGS gage
Diversion	+	Friant-Kern Canal	MI2
	+	Madera Canal	MI1
Storage gain	+	Millerton Lake	MIL (RECL.)
	+	Florence Lake	FLR
	+	Lake Thomas A. Edison	TAE
	+	Huntington Lake	HNT
	+	Shaver Lake	SHV
	+	Mammoth Pool	MPL
	+	Redinger Lake	RDN
	+	Crane Valley (Bass Lake)	CNV
	+	Kerckhoff Reservoir	KRH
Evaporation	+	Millerton Lake	MIL (RECL.)
Unimpaired flow	Sum	San Joaquin River below Friant Dam	SJF

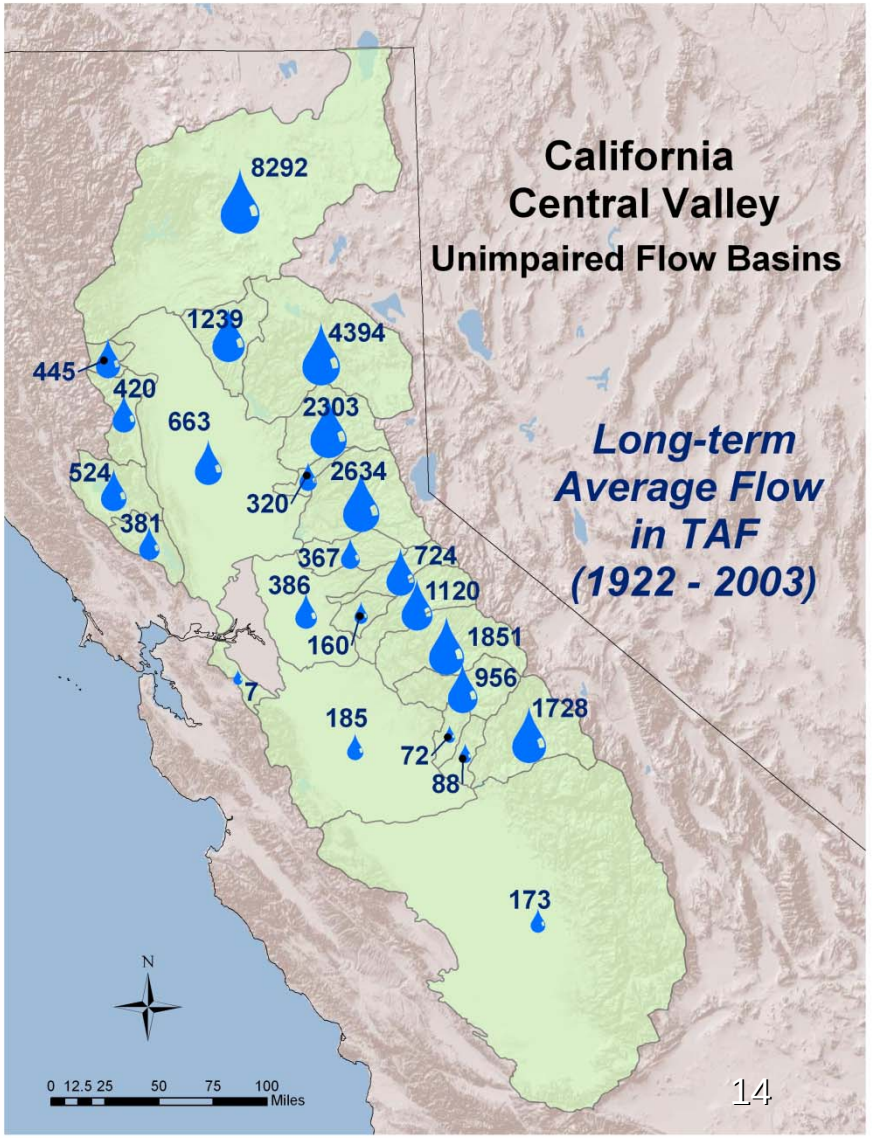
Example (cont.)

Example: San Joaquin River at Millerton Reservoir (October 2010 Data)



Summary of Estimated UFs in the Central Valley

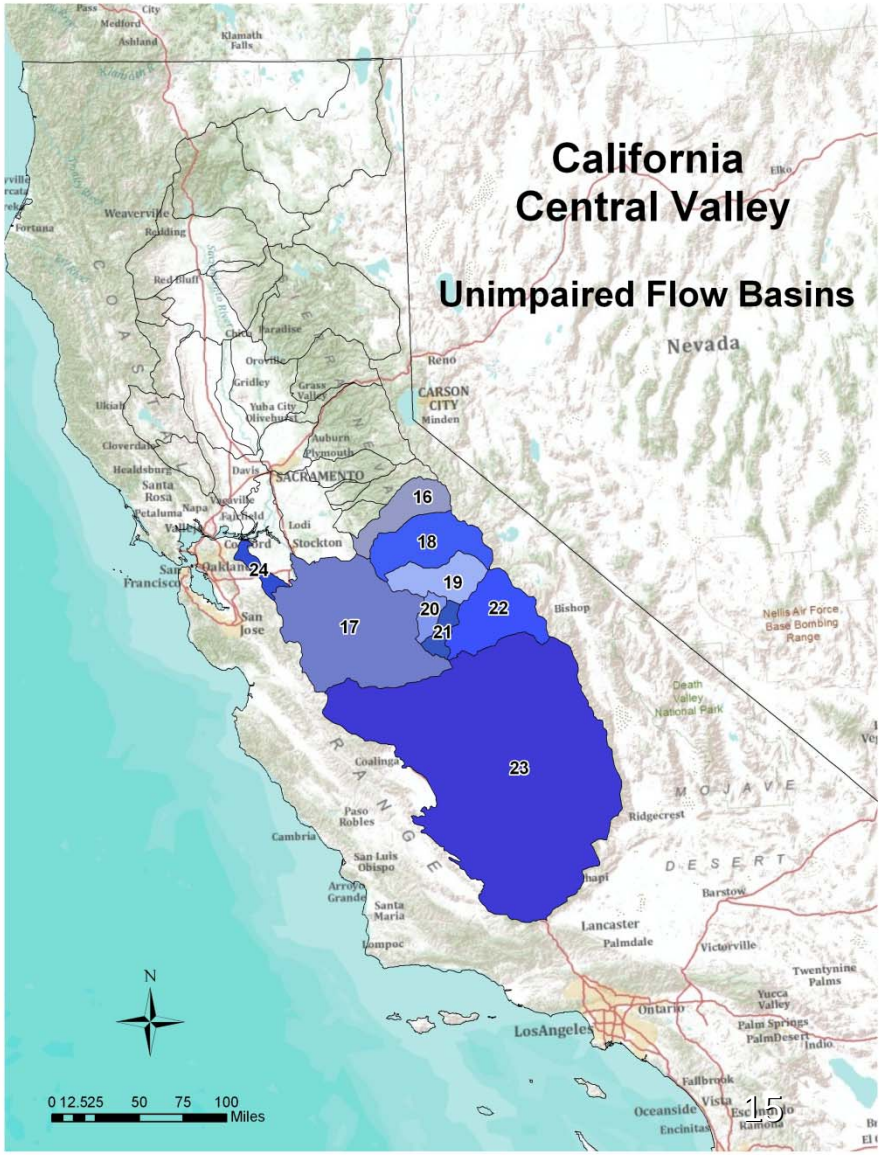
Region	Long-term annual average flow volume (MAF)
Sac Valley	21.6
Eastside Streams	1.6
San Joaquin Valley	6.2
Delta Inflow	29.4



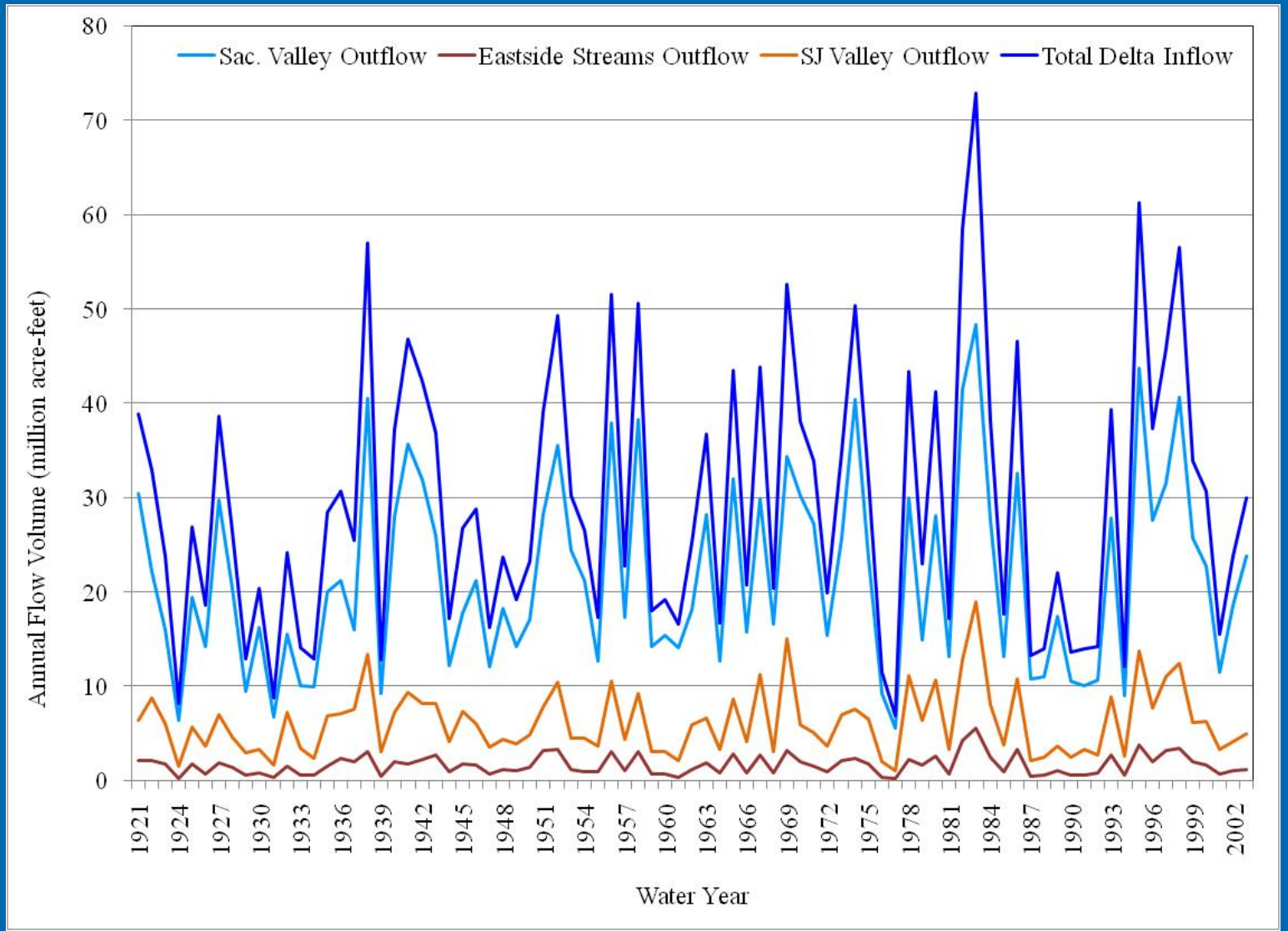
Components of the SJ Valley UF.

San Joaquin Valley outflow to the Delta

- 9 River basins (UF Basin 16 – 24)
- Contributes ~21% of flow to the Delta



Summary of Estimated UFs to the Delta (cont.)



Limitations

- Mixed use as natural flow
- Inconsistency of estimation approaches
- Access to proprietary data
- No flow routing
- Some estimates are based on expert judgment; hence not precise
- Data for early periods are poorly documented
- Groundwater use – recent studies show a significant level of stream-groundwater interaction shift in the Sac Valley

In Closing …

- The UF is viewed as a close surrogate to the natural flow. These two quantities, however, must be distinguished as they can be significantly different depending on the timing and location.

- UF is a conceptual quantity estimated through various means. Direct field measurement of the UF is not possible. UF has been used as an index in D1641 year classification.

- UF is an imprecise estimate requiring further improvement before being used as an operational flow criterion. Refinement is possible given careful design, time, resources and expert effort.

- Applying the proposed flow criteria to real time operations will require timely acquisition of field data that are necessary to estimate the UF. Timely acquisition of needed field data and, under certain circumstances, forecasting certain components of the UF can pose extra challenges to the project operations.

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