Salton Sea Ecosystem Restoration Plan Inflows/Modeling Working Group

August 4, 2005

Ontario, CA

Agenda

- Recap of previous meeting
- Historic inflows
- Projected inflows for No Action
- Approach for addressing future uncertainty
- Projected inflows considering future uncertainty
- Historic and projected salt loads
- Hydrologic model update
- Wrap-up

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Recap of Previous Meeting

- Finalized QSA Inflows
- Discussed approach to Mexico Inflows under No Action
- Agreed on approach to refining historic hydrology for local watershed inflows
- Discussed two approaches to variability
  - Stochastic – Probability
  - Deterministic – Scenario
- Agreed upon stochastic approach to describing future inflow uncertainty/variability
- Initiated discussion on projecting future salt loads
- Continued discussion on model development

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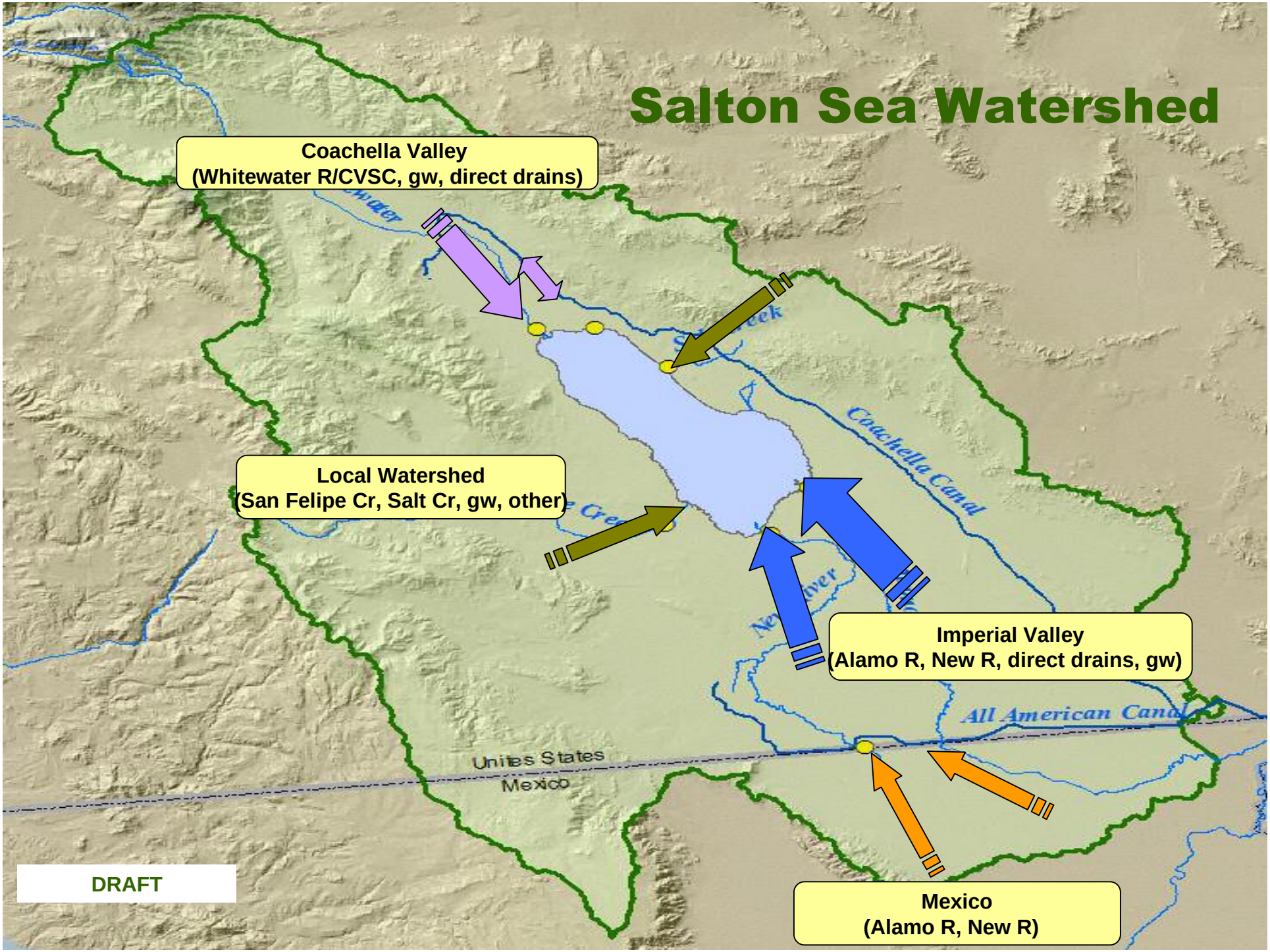
Salton Sea Watershed
Coachella Valley
(Whitewater R/CVSC, gw, direct drains)
Local Watershed
(San Felipe Cr, Salt Cr, gw, other)
Imperial Valley
(Alamo R, New R, direct drains, gw)
Mexico
(Alamo R, New R)
Coachella Canal
All American Canal
Unites States
Mexico
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Historic Inflows: Data Sources and Assumptions

Inflow Component	Data Sources and Assumptions
Mexico	Source: IID (2002) for New and Alamo Rivers. (USGS Gage No. 10254970 for New River at International Boundary used to verify data.)
Imperial Valley	Source: IID (2002) for New and Alamo Rivers, direct drains, and groundwater. (USGS Gage No. 10254730 and No. 10255550 used to verify data.)
Coachella Valley	Source: IID (2002) for Whitewater R/CVSC, direct drains, and groundwater. (Provided by CVWD. USGS Gage No. 10259540 used to verify data.)
Local Watershed	Sources: USGS Gage No. 10255885 and 10254050 for San Felipe and Salt Creeks. Data synthesis based on Brawley and Mecca precipitation to extend records. Ungaged watershed estimated based on discharge relationship with San Felipe and Salt Creeks. Groundwater estimated by Loeltz et al (1975).

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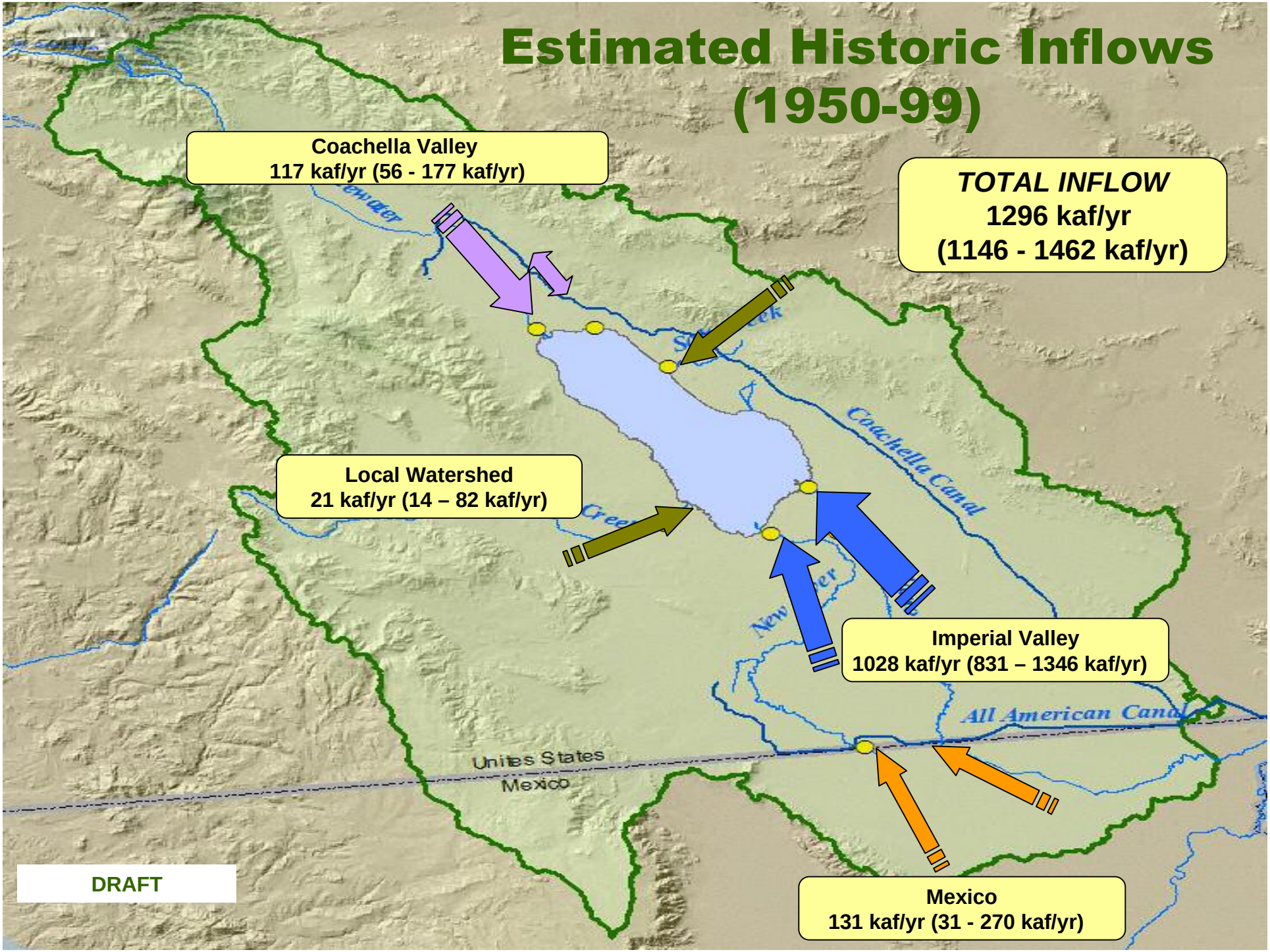
Estimated Historic Inflows (1950-99)



Projected Inflows for No Action: Data Sources and Assumptions

Inflow Component	Data Sources and Assumptions
Mexico	Regression of recent historical flows and Colorado River flows at NIB. Flows at NIB projected through CRSS model simulation and statistical sampling of Gila River flows. Adjustments for new Mexicali power plants and wastewater treatment plant.
Imperial Valley	Source: IID (2002) based on IIDSS model simulations with 1925-99 climate data and 1987-99 cropping patterns. Adjustments for QSA reductions.
Coachella Valley	Source: CVWD (2005) based on groundwater model simulations under Coachella Valley Water Management Plan.
Local Watershed	Regressions based on historic flows and Brawley/Mecca precipitation applied. Precipitation records for 1925-99 used for consistency with IID. Salt Creek seepage flows maintained at 623 af/yr consistent with Coachella Canal mitigation. Other assumptions same as historic.

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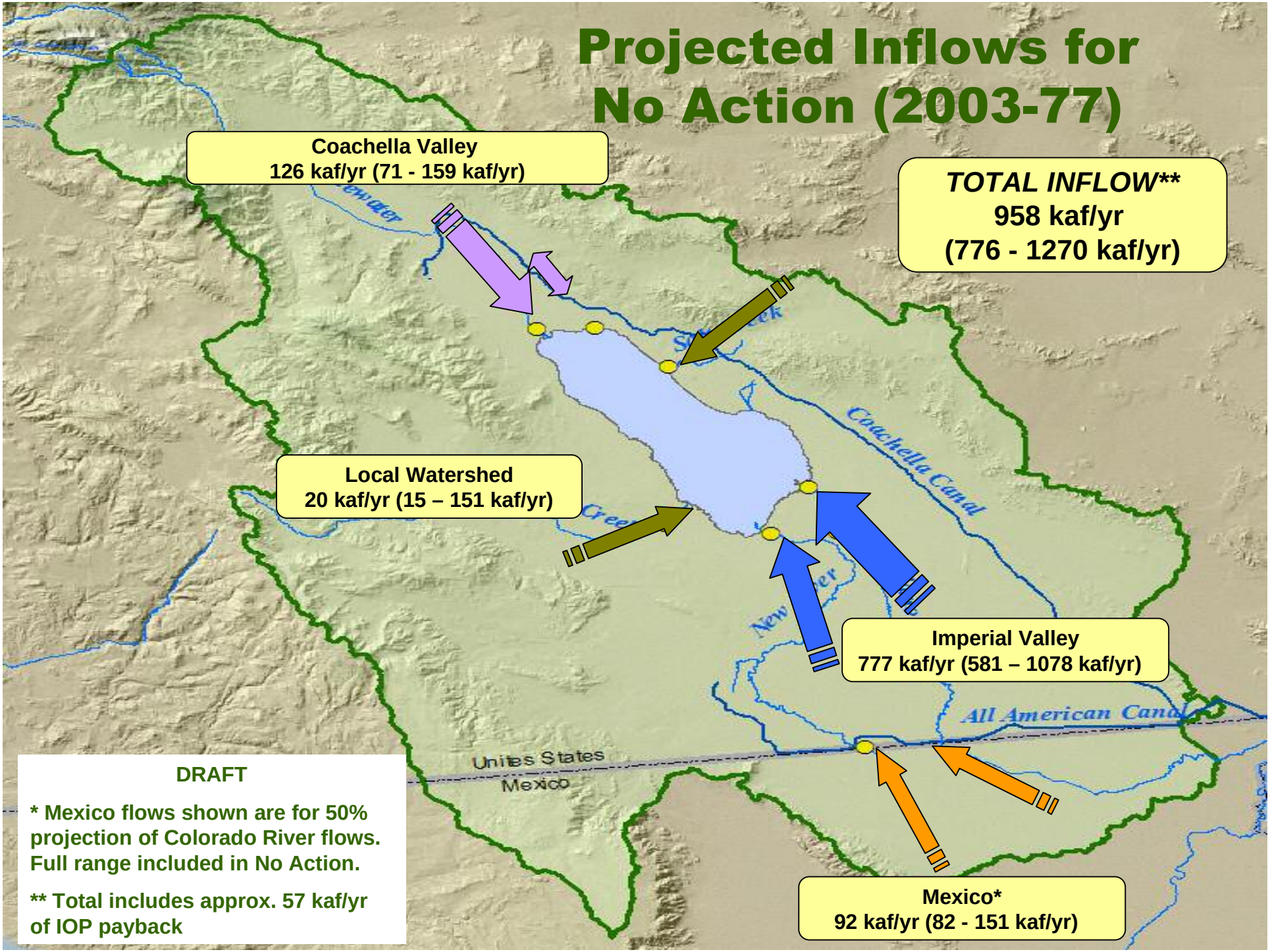
Projected Inflows for No Action (2003-77)



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*** Mexico flows shown are for 50% projection of Colorado River flows. Full range included in No Action.**

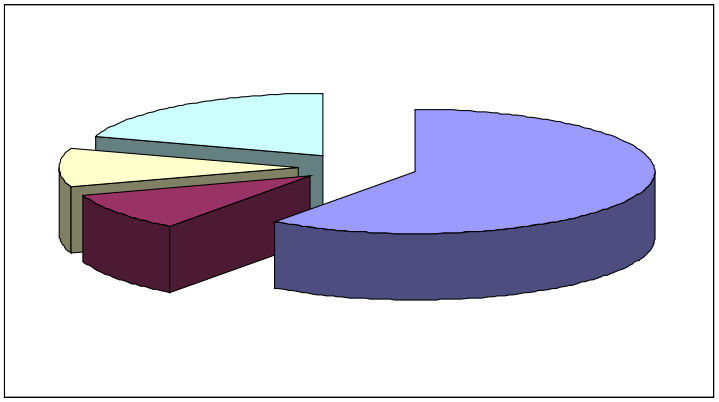
**** Total includes approx. 57 kaf/yr of IOP payback**

Approach for Addressing Future Uncertainty

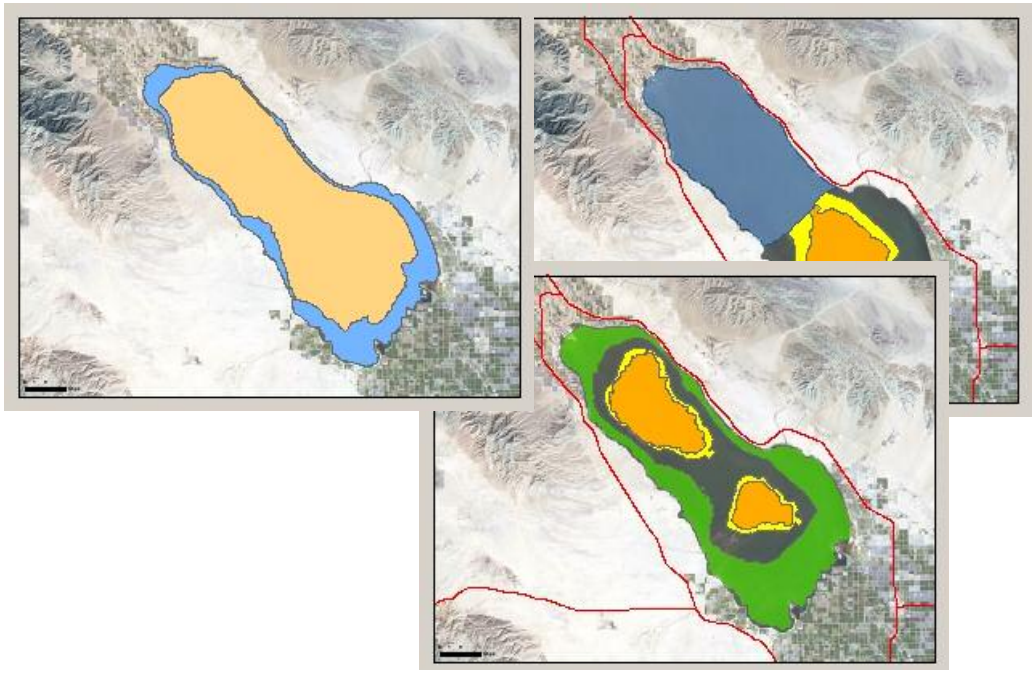
- Importance of inflows
- How will results be used?
- Analytical approach

Importance of Inflows

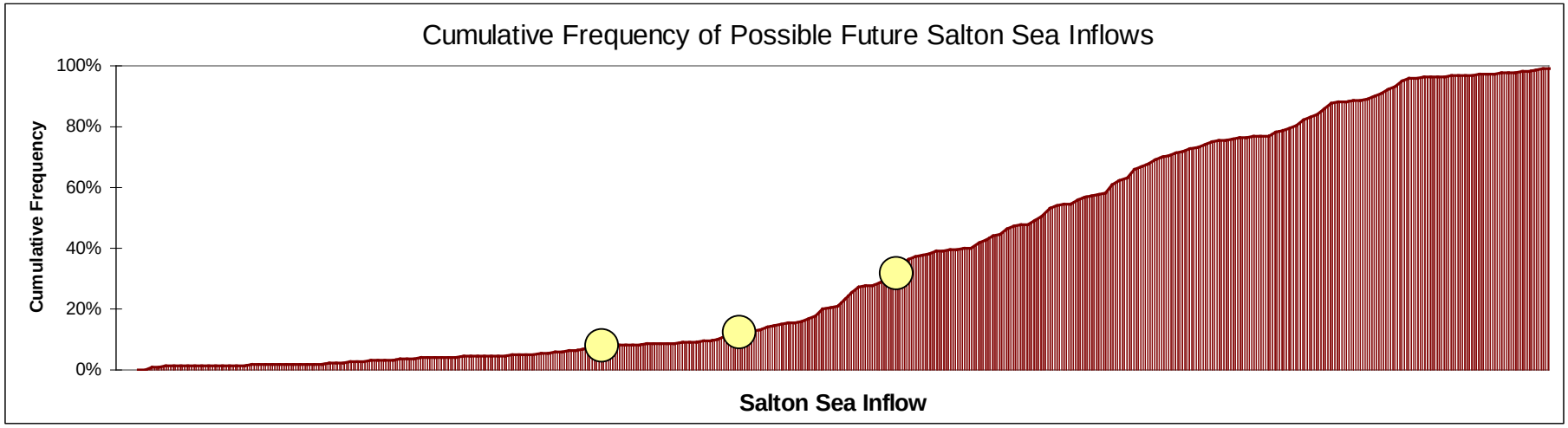
- Projected hydrology defines the water budget which can be allocated to various project components



- Inflows affect the design and performance of alternative configurations

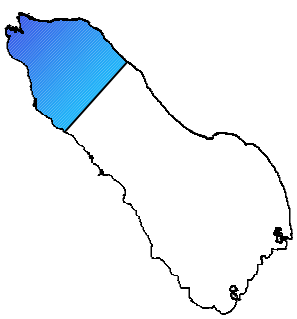


Use of Future Inflow Projections

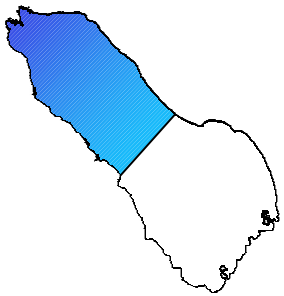


Exceedance Probability of Future Inflows

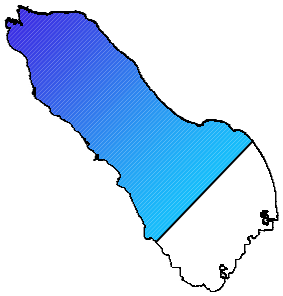
95%



90%



75%



**** Sample only. Shown is an *example* for the North Sea configuration. Similar process will be applied for all Salton Sea Restoration configurations.**

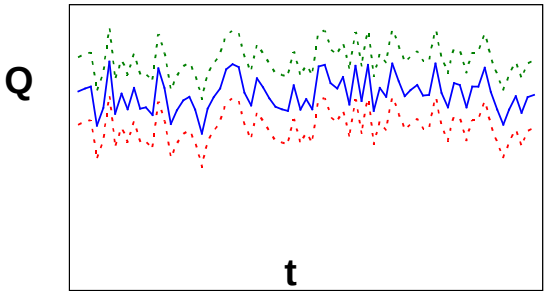
Approach to Inflow Uncertainty

- Stochastic analytical approach
- Hydrologic variability and future uncertainty are expressed as range of possible future inflows to the Salton Sea
- For each inflow source
  - Identify potential drivers of inflow change
  - Identify potential range of inflow resulting from drivers
  - Select probability distribution to describe uncertainty
  - Perform Monte Carlo simulations
- Results
  - Hundreds/thousands of possible inflow traces
  - Probability distribution of inflows

Overview of Analytical Approach

- Incorporates hydrologic variability and future policy uncertainty for each inflow source

Hydrologic variability



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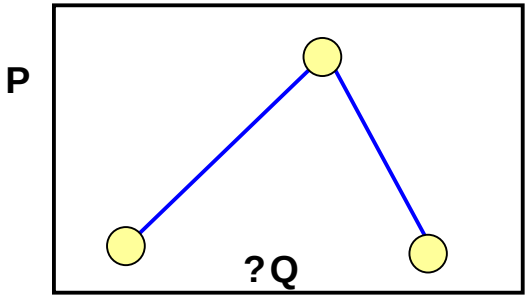
Policy uncertainty



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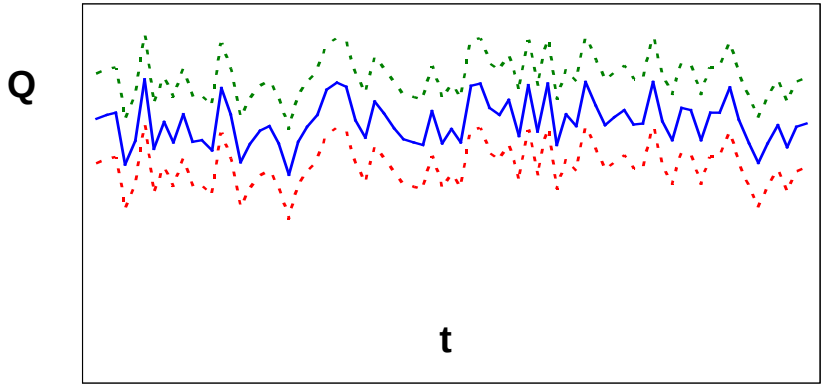

Inflow incorporating hydrologic variability and policy uncertainty

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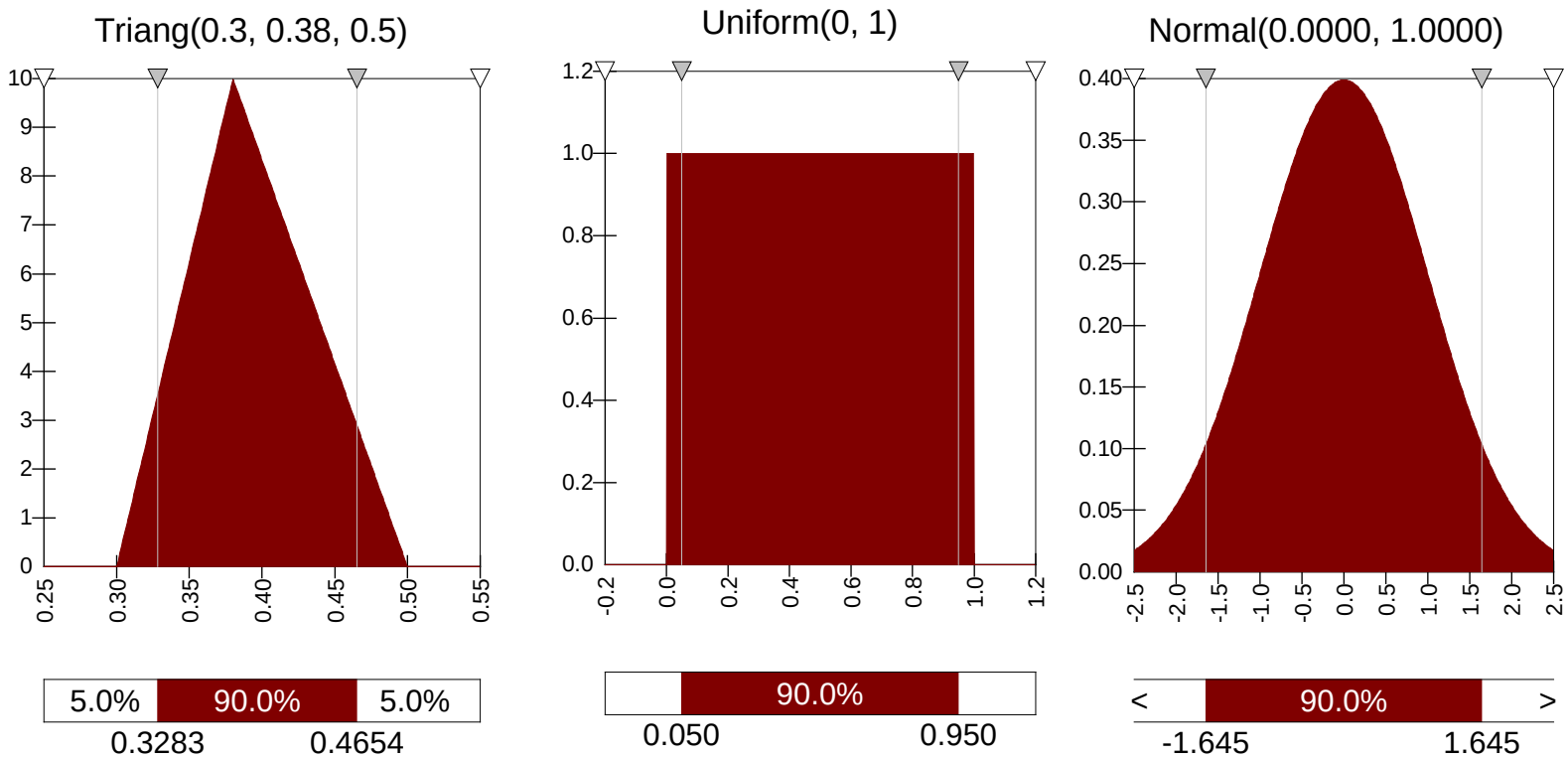
Stochastic Approach to be Applied for Each Major Hydrologic Component

- Mexico inflows from New and Alamo Rivers
- IID inflows from New River, Alamo River, direct drains
- CVWD inflows from Whitewater River, drains, and groundwater discharge/recharge
- Local watershed surface runoff and groundwater inflows
- Local evaporation rate

Probability Distributions Identified for Possible Future Changes to Each Hydrologic Component

- Variety of distributions may be used



Triangular **Uniform** **Normal**

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Approach to Mexico Inflows – Drivers of Uncertainty

- Increased Water Demand in Mexico
  - Increase Reuse of existing wastewater
  - Additional diversion south of future wastewater expansion·
  - Conveyance of conserved water from Mexicali to points west via new pipeline·
  - Increasing population and urbanization replacing agriculture in New River watershed
  - Additional power plants using wastewater
- Climate Change
  - Increased or decreased precipitation
  - Increased temperature
- Decrease in availability of Colorado River surplus flows

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Uncertainty of Future Mexico Inflows

- Uncertainty of Mexico flows based on
  - Inflow projections from Colorado and Gila Rivers
  - Water management in Mexico
- Future inflow variability
  - Stochastic model projections of Colorado flows at NIB
  - Statistical analysis of historical Gila River flows
- Mexico flows related to delivered quantities at NIB and Gila River
- Uncertainty of future water management in Mexico expressed as distribution of conserved fraction of baseline flows

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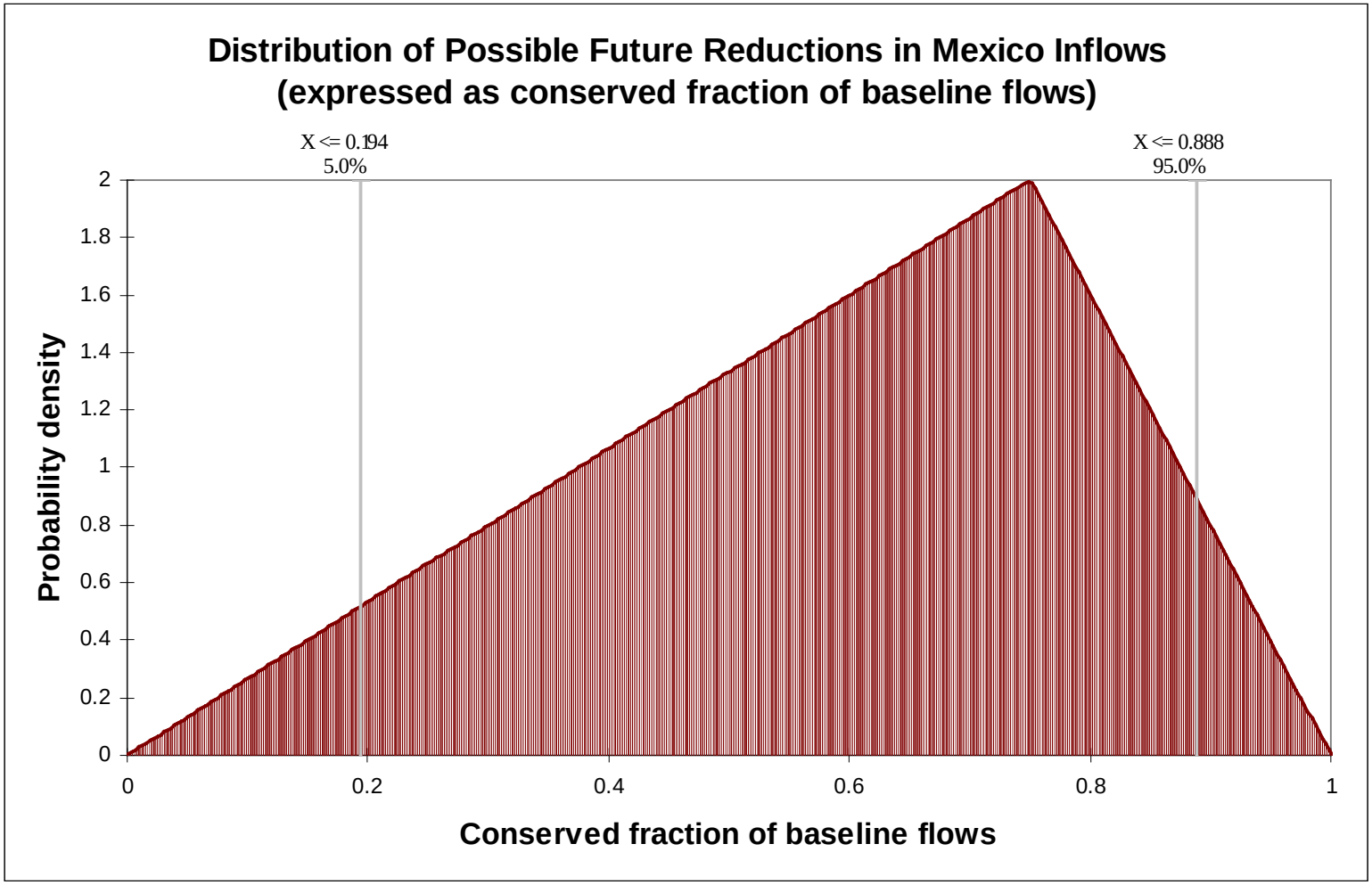
Uncertainty of Future Mexico Inflows - Distribution



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Approach to IID Inflows – Drivers of Uncertainty

- Local Climate Change
- Increased agricultural efficiency
- Implementation of TMDL's
- Population growth leading to conversion of agricultural land uses to urban land uses
- Changing crop patterns
  - New lands into production
  - New crops with higher salinity tolerance
  - Multiple croppings
  - Pest infestations reducing crops
- Rising price of water provides for incentive for water transfers
- Habitat restoration areas with additional water demand
- Urban water conservation efforts
  - reuse of wastewater and stormwater

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Uncertainty of Future Inflows from IID

- Assume responses to drivers are limited to reductions in tailwater
- Tailwater estimates range from 15.4% (IID, 2002) to 27% (Reclamation, 2003) of on-farm delivery
- Tailwater ranges from 39% to 68% of IID drainage to Sea
- Possible future reductions in IID inflows to the Sea expressed as distribution of tailwater reductions between 0% to 100%
  - applied after QSA transfer reductions
- Possible reductions phased in between 2018-25

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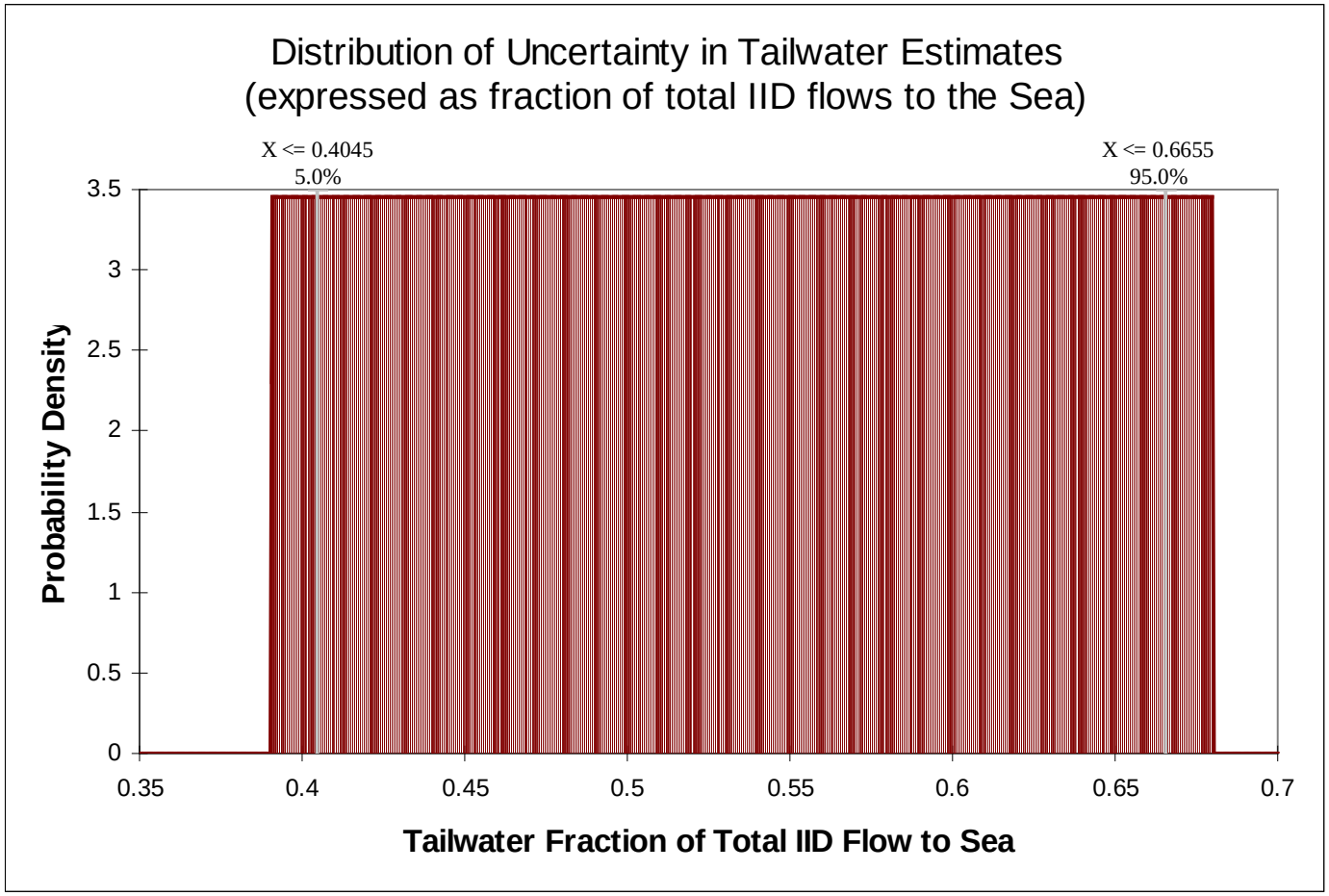
Uncertainty of Magnitude of Tailwater - Distribution



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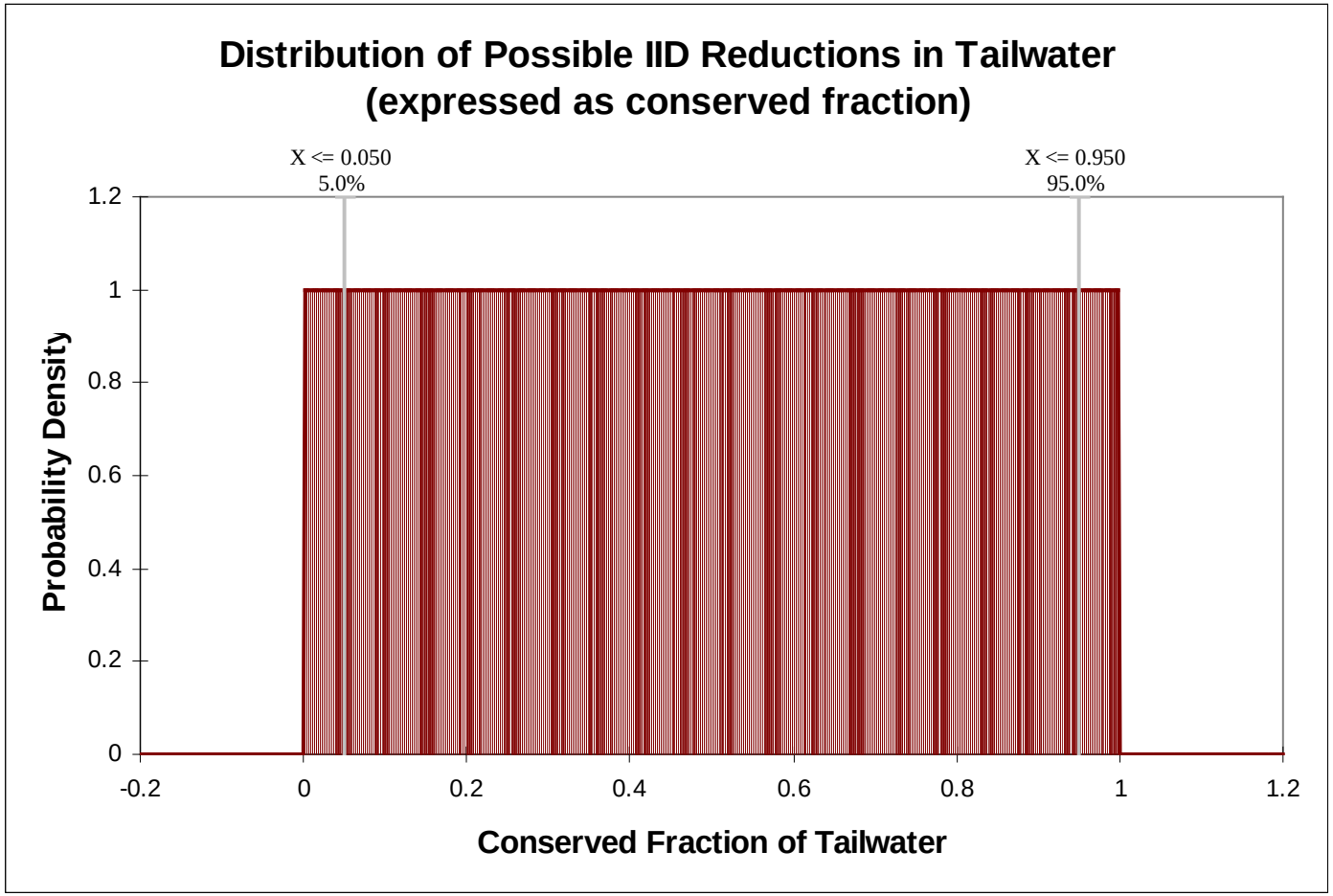
Uncertainty of Future Inflows from IID - Distribution



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Approach to Uncertainty of CVWD Inflows – Drivers of Uncertainty

- Local Climate Change
- Increased agricultural efficiency
- Implementation of TMDL's
- Population growth leading to conversion of agricultural land uses to urban land uses
- Changing crop patterns
  - New lands into production
  - New crops with higher salinity tolerance
  - Multiple croppings
  - Pest infestations reducing crops
- Rising price of water provides for incentive for water transfers
- Habitat restoration areas with additional water demand
- Urban water conservation efforts
  - reuse of wastewater and stormwater

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Approach to Uncertainty of CVWD Inflows

- Any change in groundwater management could affect surface and groundwater interactions and thus predicted drain flows to the Sea
  - CVWD Management Plan = 127,033
  - Pre-Management Plan Flows = 64,875
- Assume distribution of future inflows in range between Management Plan and Pre-management Plan flows

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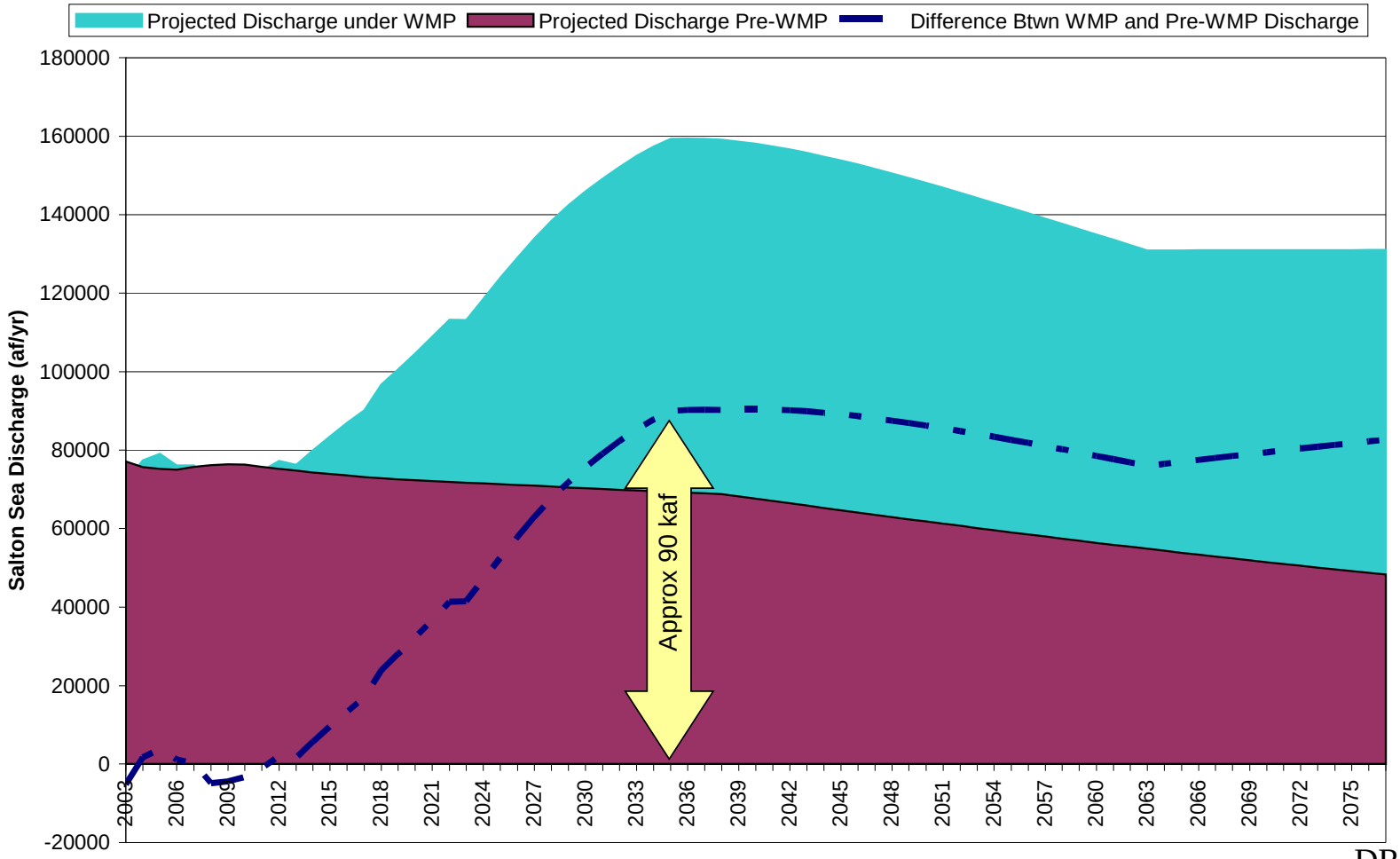
Uncertainty of Future Inflows from CVWD – Management Plan Impacts

Possible Future Inflow Changes from Projected CVWD Water Management Plan



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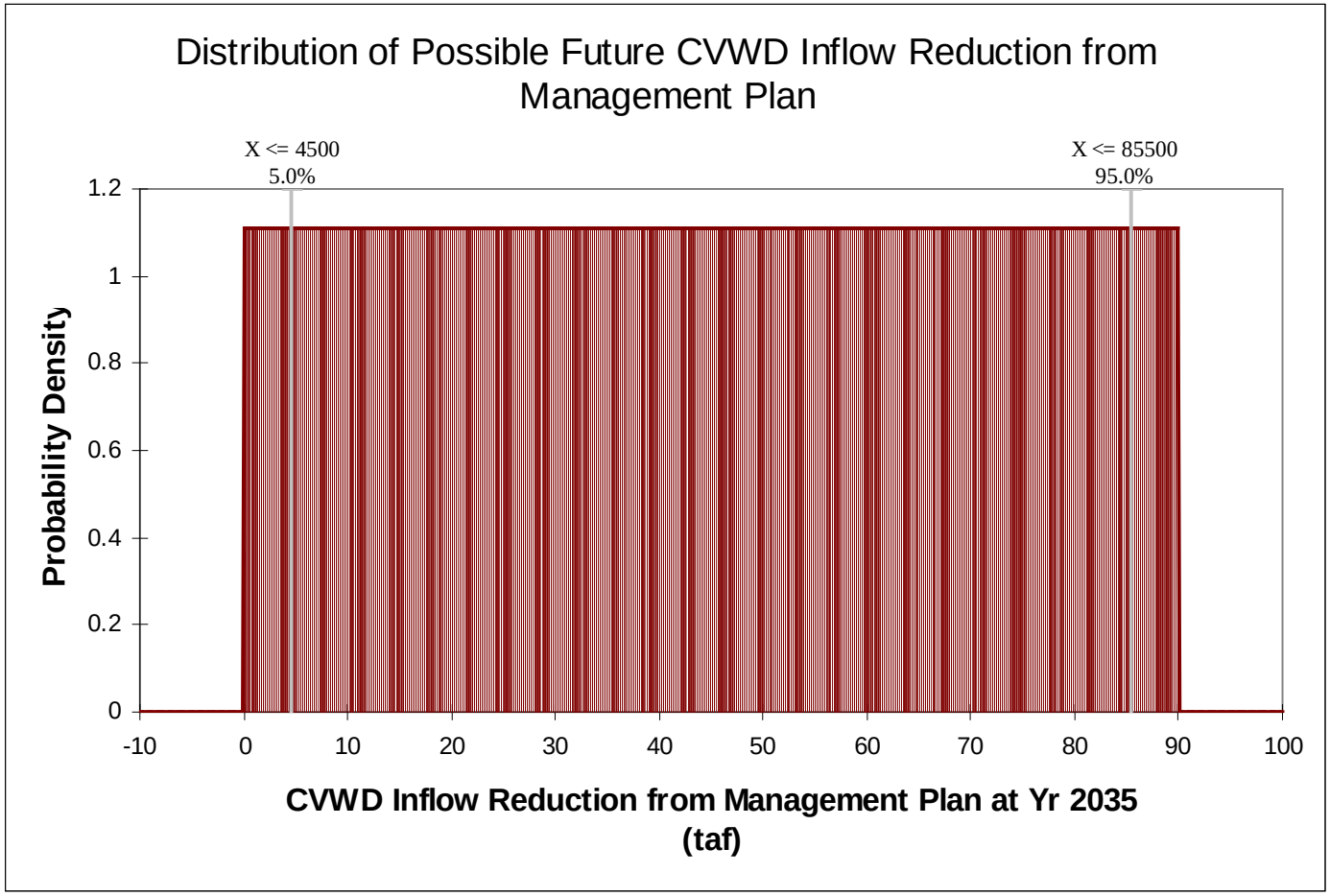
Uncertainty of Future Inflows from CVWD - Distribution



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Approach to Local Watershed Inflows

- Gage data available for Salt Creek and San Felipe Creeks
- Ungaged portion of watershed developed from runoff portion of Salt and San Felipe Creeks flows
- Use historical variability represented in the hydrologic record to predict the future
- Drivers of Uncertainty
  - Local Climate Change – projections not consistent whether precipitation will increase or decrease

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Approach to Uncertainty of Evaporation Rate of Salton Sea

- Driver is local climate change
  - Increased temperature predicted from 1.35-1.6° C by mid-century to 2.3-3.8° C at end of the century
  - Both increased and decreased precipitation predicted
- Increased temperature could increase rate of evaporation by 10-20%
- Assume distribution of possible temperature increases ranging from low to high projections
- Approximate regressions developed relating evaporation rate to temperature
- Effects of precipitation changes on net Sea evaporation considered minor

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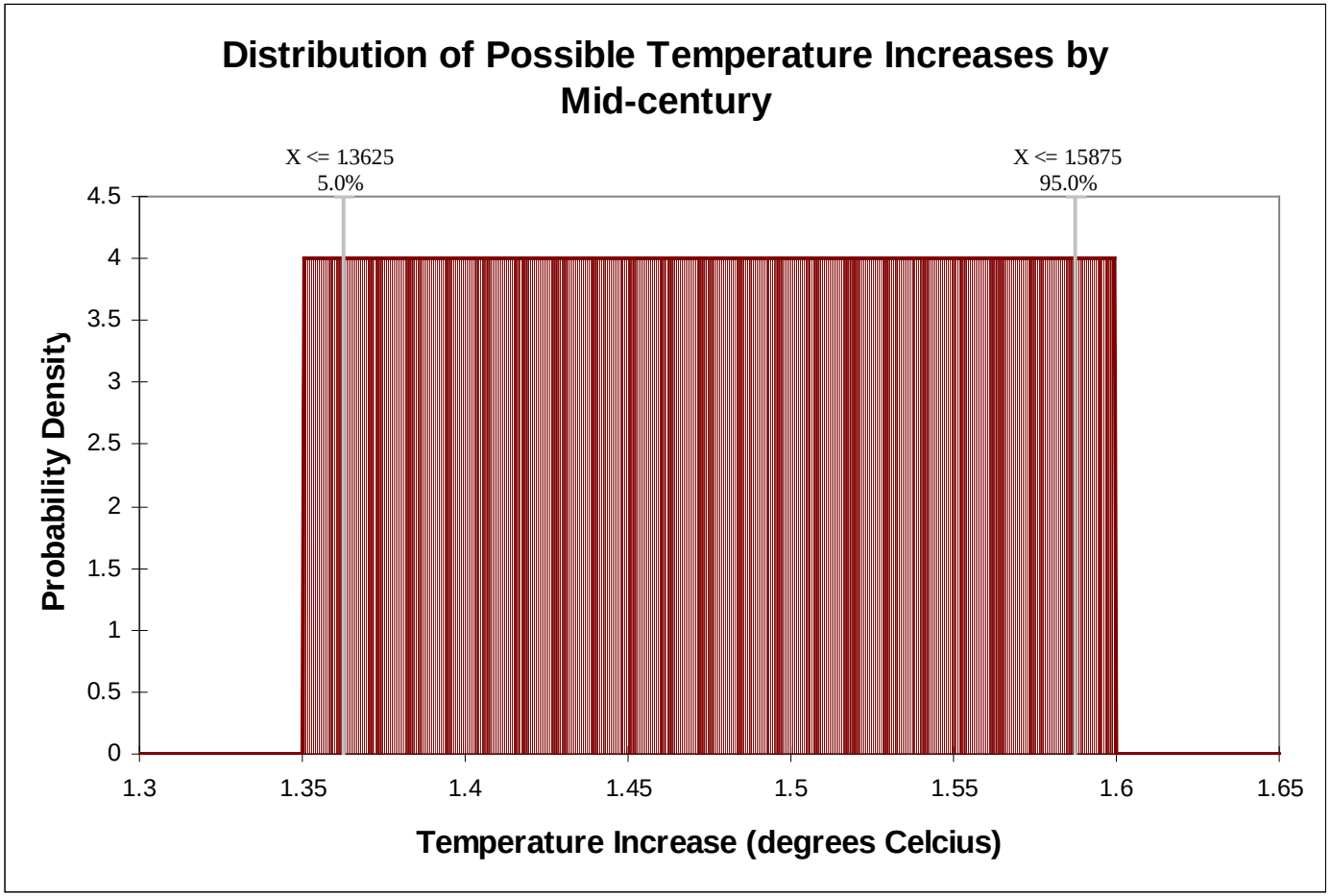
Uncertainty of Future Salton Sea Evaporation Rate



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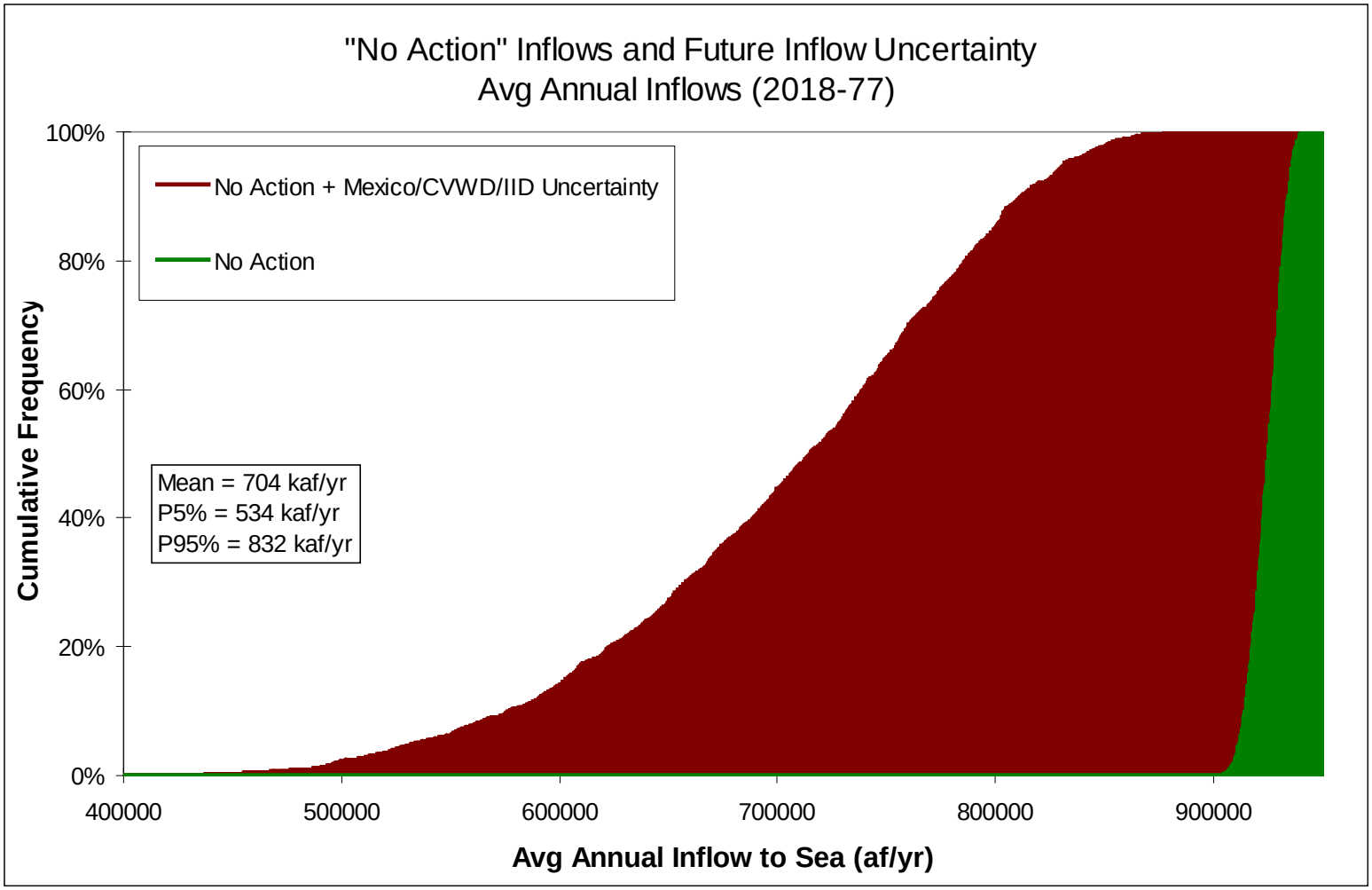
Possible Inflows to the Salton Sea Considering Future Uncertainty



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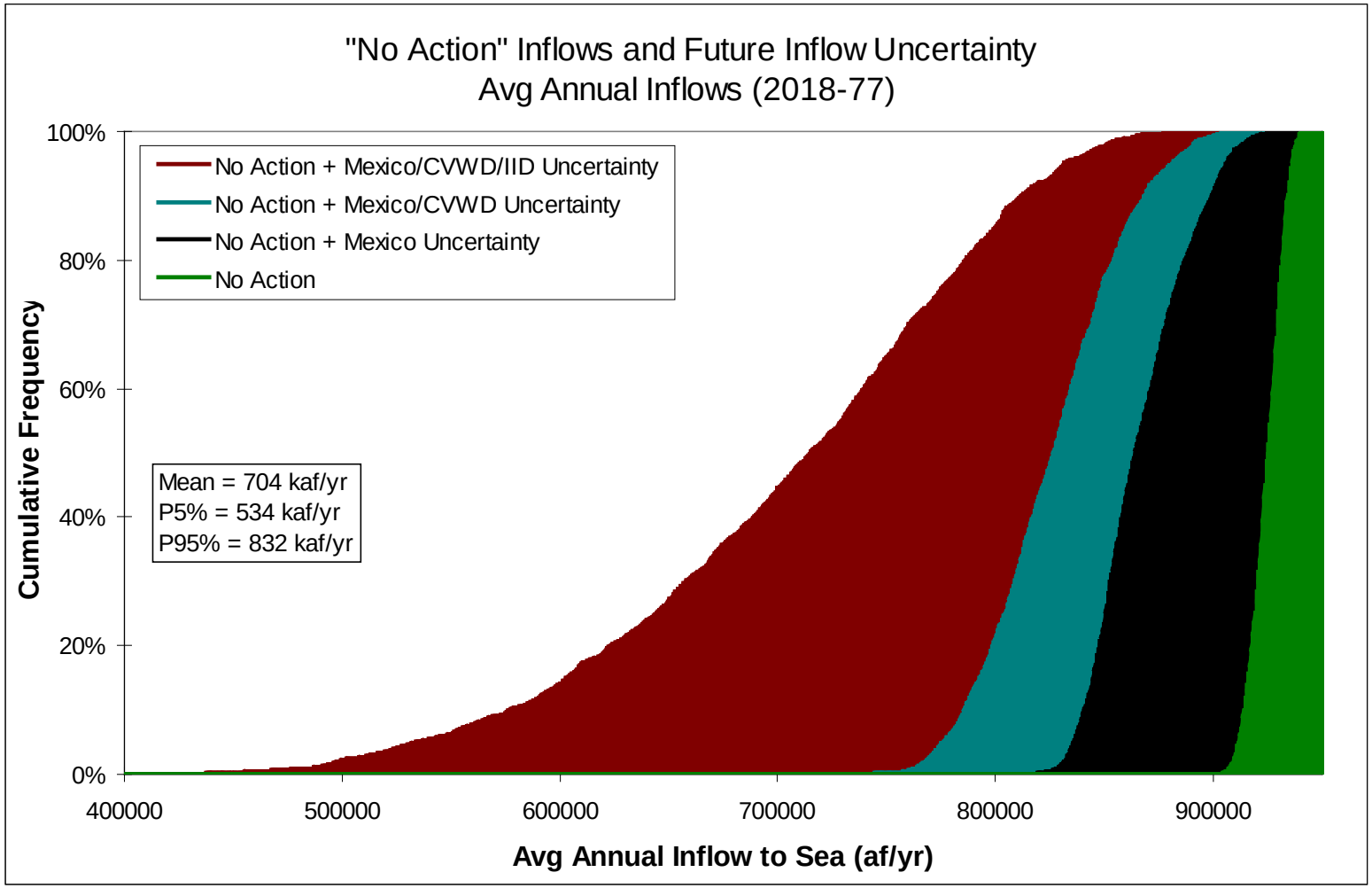
Component Contribution of Total Salton Sea Inflow Uncertainty



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Historic Salt Loads: Data Sources and Assumptions

Inflow Component	Data Sources and Assumptions
Mexico	Source: IID (2002) for New and Alamo Rivers.
Imperial Valley	Source: IID (2002) for New and Alamo Rivers, direct drains, and groundwater.
Coachella Valley	Source: IID (2002) for Whitewater R/CVSC, direct drains, and groundwater.
Local Watershed	Sources: RWQCB (2005) for Salt Creek; extrapolated from RWQCB (2005) for San Felipe Creek and ungaged watershed; Loeltz et al (1975) for groundwater.

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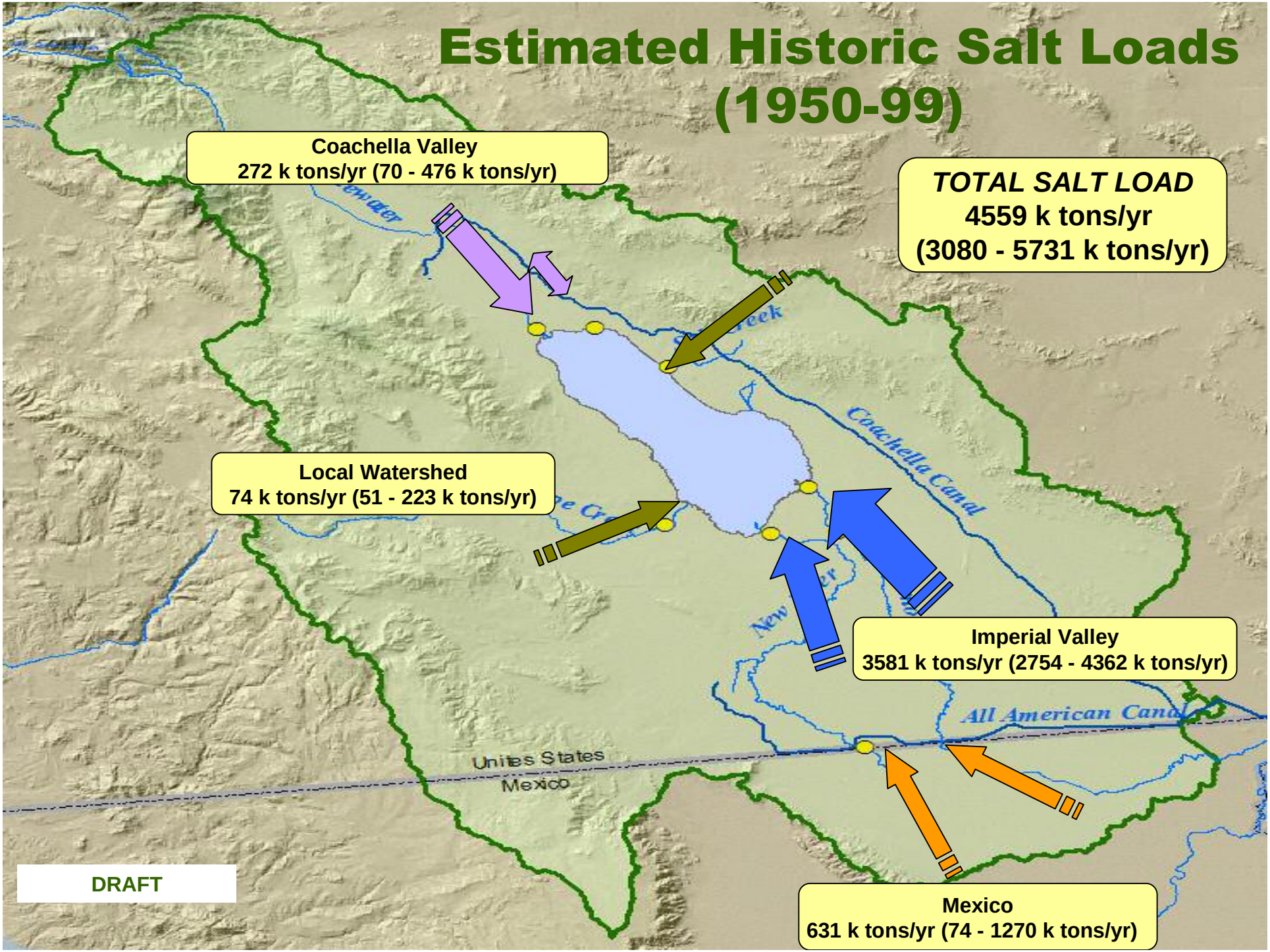
Estimated Historic Salt Loads (1950-99)



Projected Salt Loads for No Action: Data Sources and Assumptions

Inflow Component	Data Sources and Assumptions
Mexico	Recent loads applied to No Action flows (power plant reductions included). Wastewater treatment plant flows will discharge to Rio Hardy.
Imperial Valley	Source: IID (2002) for New and Alamo Rivers, direct drains, and groundwater.
Coachella Valley	Source: CVWD (2005) for Whitewater R/CVSC, direct drains, and groundwater. Consistent with revised flows from Water Management Plan.
Local Watershed	Sources: RWQCB (2005) for Salt Creek; extrapolated from RWQCB (2005) for San Felipe Creek and ungaged watershed; Loeltz et al (1975) for groundwater.

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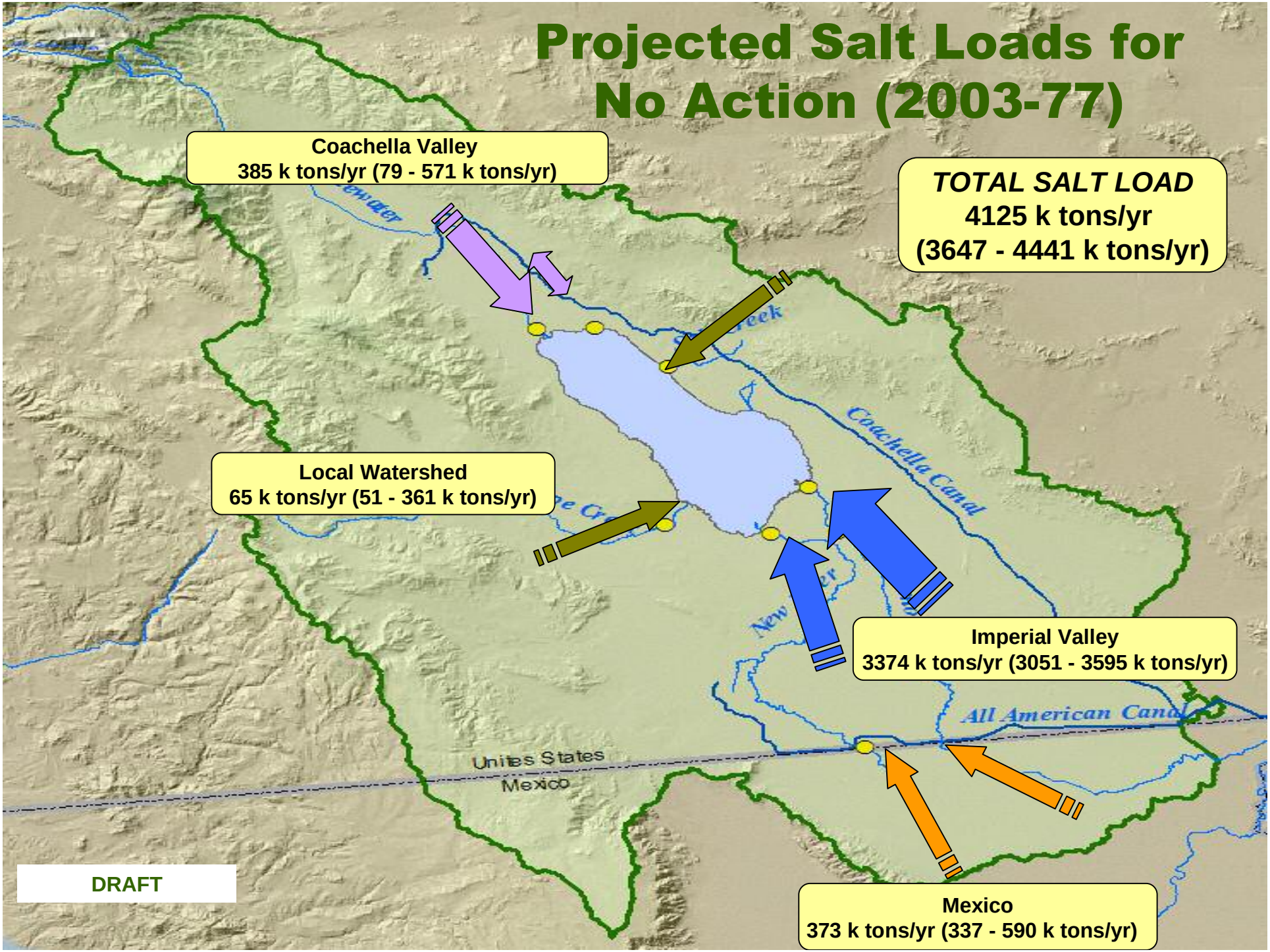
Projected Salt Loads for No Action (2003-77)



Hydrologic Model Update

- CALSIM prototype/test network developed
- Generalized model elements
  - Open water storage elements (SEA)
  - Natural treatment systems (NTS)
  - Mechanical treatment systems (MTS)
  - Habitat wetlands (HAB)
  - Air quality management (AQM) areas
- Consumptive demands computed for NTS, HAB, and AQM elements
- Salt balance algorithm added to model
- Delivery, elevation, and salinity targets achieved
- *Monthly* simulation for 75 years

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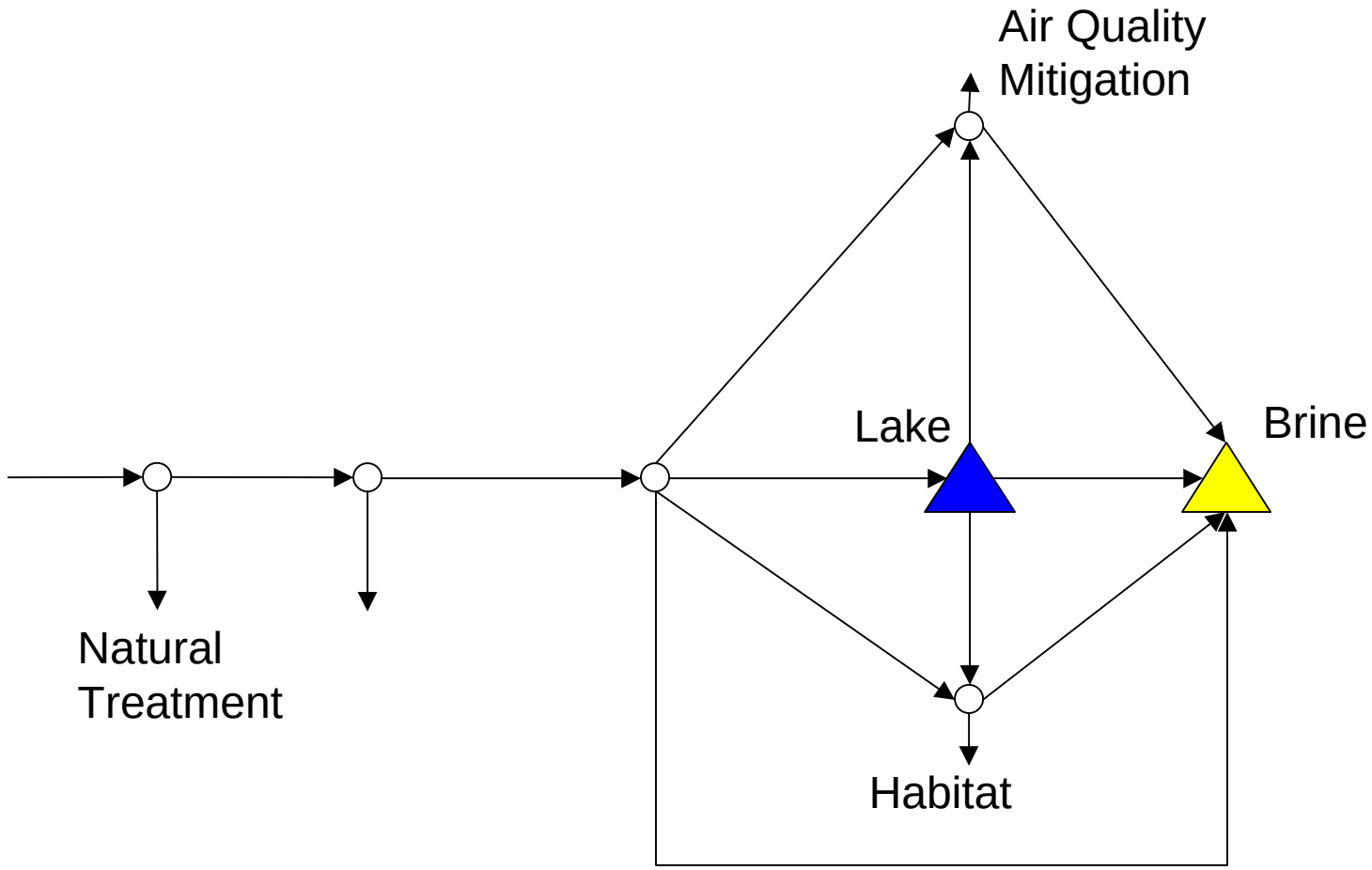
CALSIM Network



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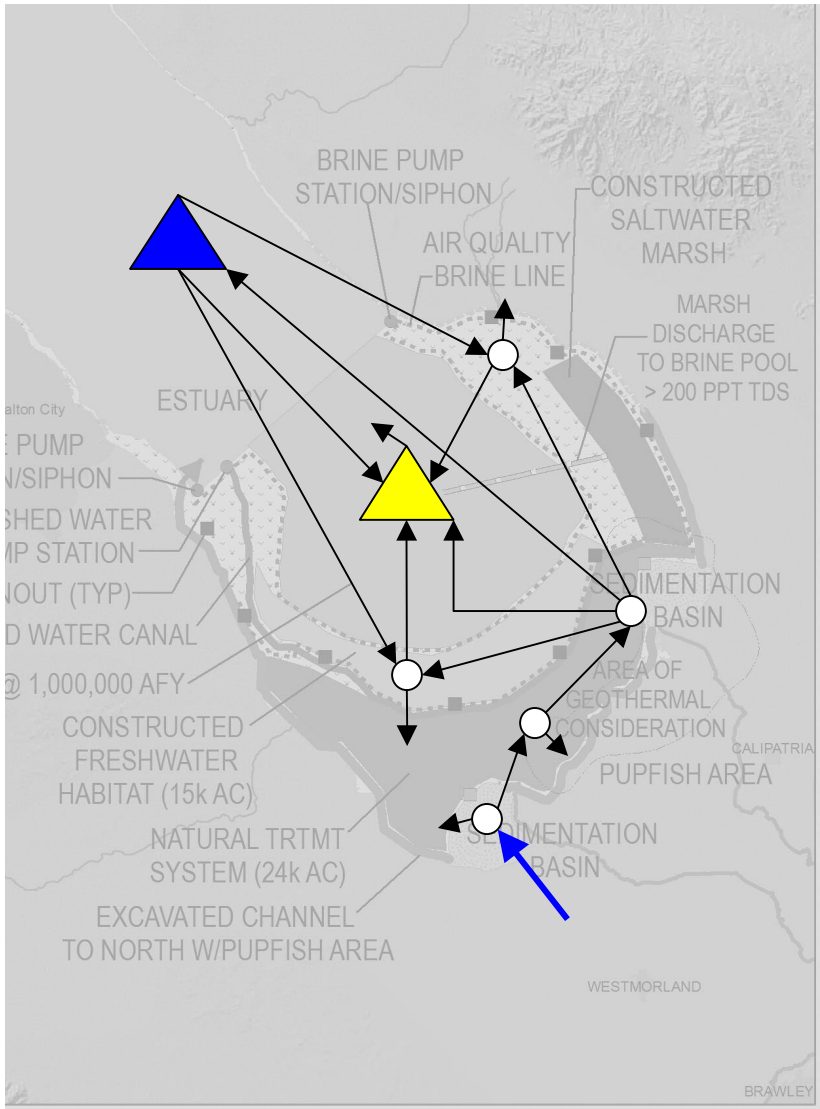
Next Steps for Hydrologic Modeling

- Incorporate functional relationships of evaporation suppression with increasing salinity, salt precipitation, and salt re-dissolution
- Achieve both water allocation targets and delivery water salinity targets
- Incorporate goals to achieve targets within “sideboards”
- Refine inflows to monthly scale
- Calibration/Verification
- Stochastic wrapper
- Model-focused meeting and demonstration in September