Establishing Environmental Flows for the Los Angeles River

Technical Advisory Committee Meeting #3 – September 16, 2019

Meeting Objectives and Agenda

Meeting Objectives:

- Review focal habitats for LA River and key hydrologic needs
- Update on model development
- Discuss potential flow management and restoration scenarios

AGENDA

1. Introductions
2. Recap from last meeting
3. Review focal habitats/spp. and present process for developing hydrologic profiles
4. Update on hydrologic modeling
5. Begin development of flow management scenarios
6. Wrap-up, action items and next steps

New team members

INTRODUCTIONS

PROJECT OVERVIEW

Los Angeles River Environmental Flows Project Goals

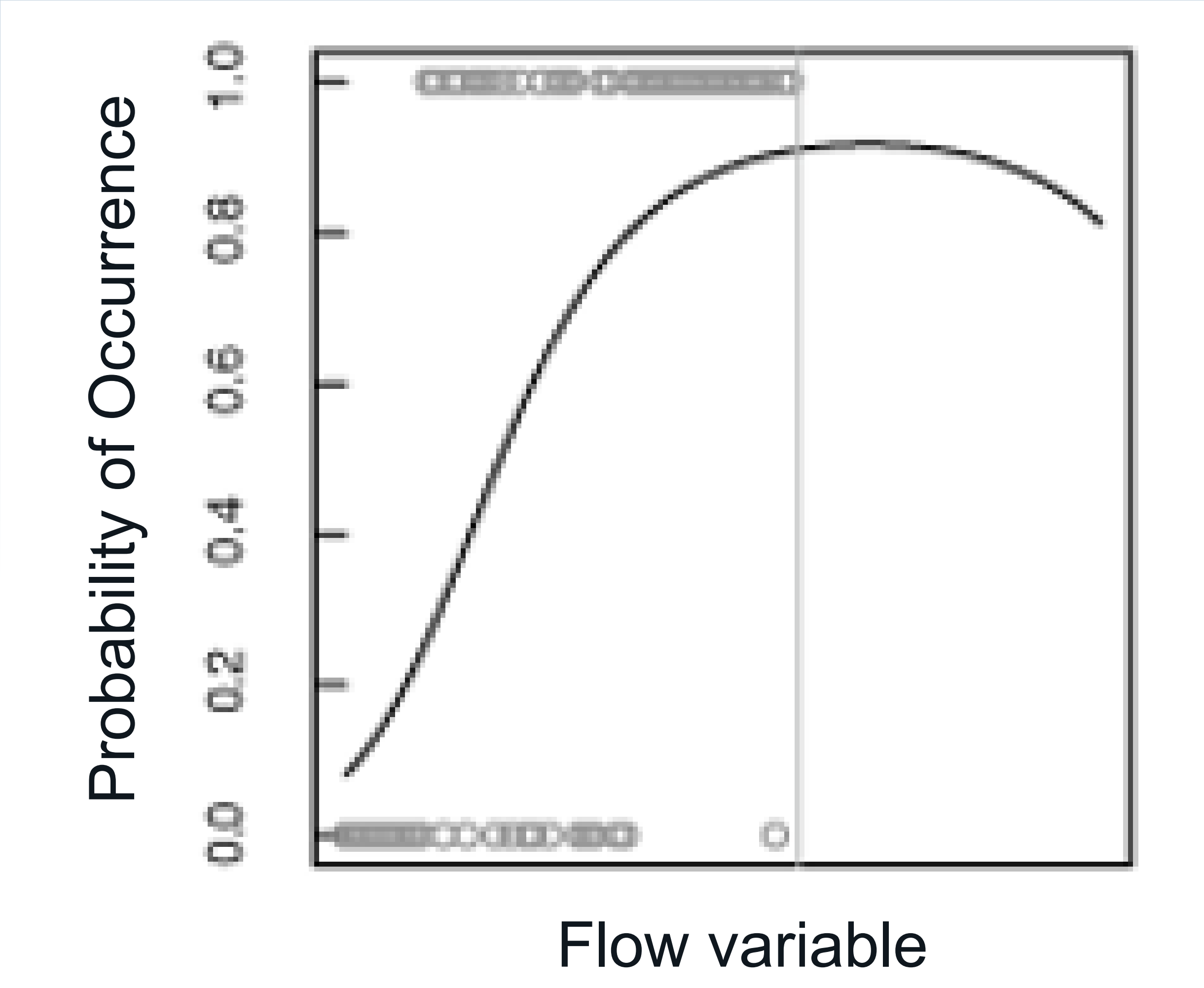
1. Develop technical tools that quantify the relationship between various alternative flow regimes and the extent to which aquatic life and non-aquatic life beneficial uses are achieved

2. Evaluate various flow management scenarios in terms of their effect on uses in the LA River.

3. Engage multiple affected parties to reach consensus about appropriate flow needs and optimal allocation of flow reduction allowances from multiple WRPs in consideration of other proposed flow management actions

What We Want

- Which species?
- Which habitats?
- What seasons?
- What scenarios?
- What management?

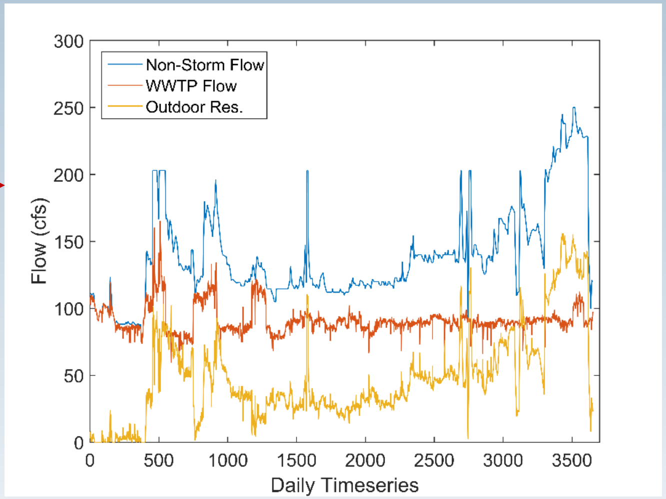


Overall Process for Developing Flow Criteria

Models

Scenario	Description
1	WRP
2	WRP + stormwater
3	WRP + conservation
4	WRP + stormwater + conservation

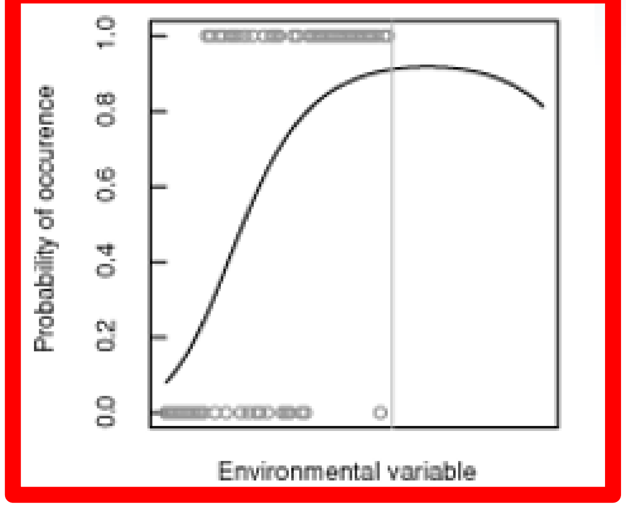
Scenarios



Time series output

Hydrologic	Hydraulic
• Minimum annual flow • Duration of consecutive minimum annual flow • Frequency of high winter flows Oct-March • Frequency of Spring flush flows march-June • Date of latest flood during the winter • Decrease in flow per day in Spring following last Winter flood • Magnitude of summer base flow	• Presence of riffle (moderate depth, swift current, course substrate) habitat in Spring for spawning • Percent of habitat as edgewater, riffle, and pools in the Spring and Summer • Minimum and maximum bottom velocity in the Spring and summer • Minimum depth of water in Spring, Summer, and Fall

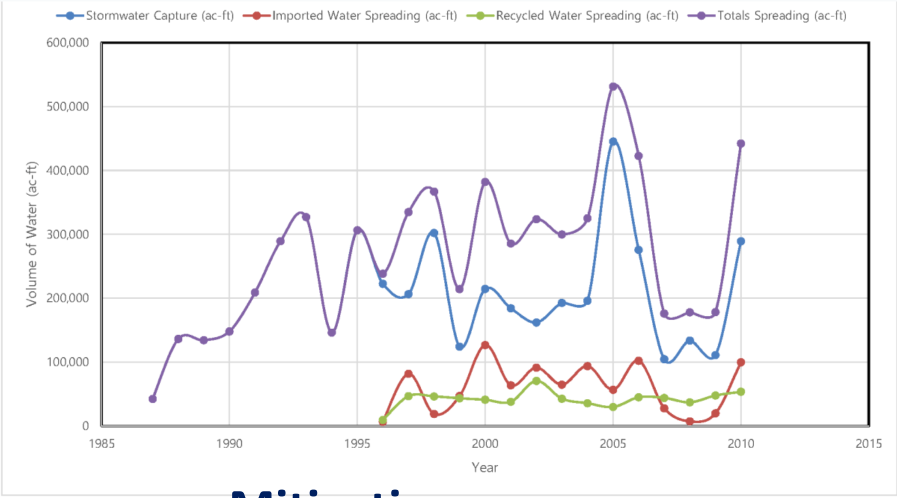
E-flow metrics



Flow-ecology relationships

- **Flow Criteria**
  - ✓ **by reach and season**
- **Management/mitigation recommendations**

Agreed upon criteria



Mitigation measures

Assessing Environmental Flows for LAR

Activity 1: Stakeholder Coordination

Activity 2: Non-aquatic life use assessment

Activity 3: Aquatic life use assessment

Activity 4: Asses effects of flow modification/management

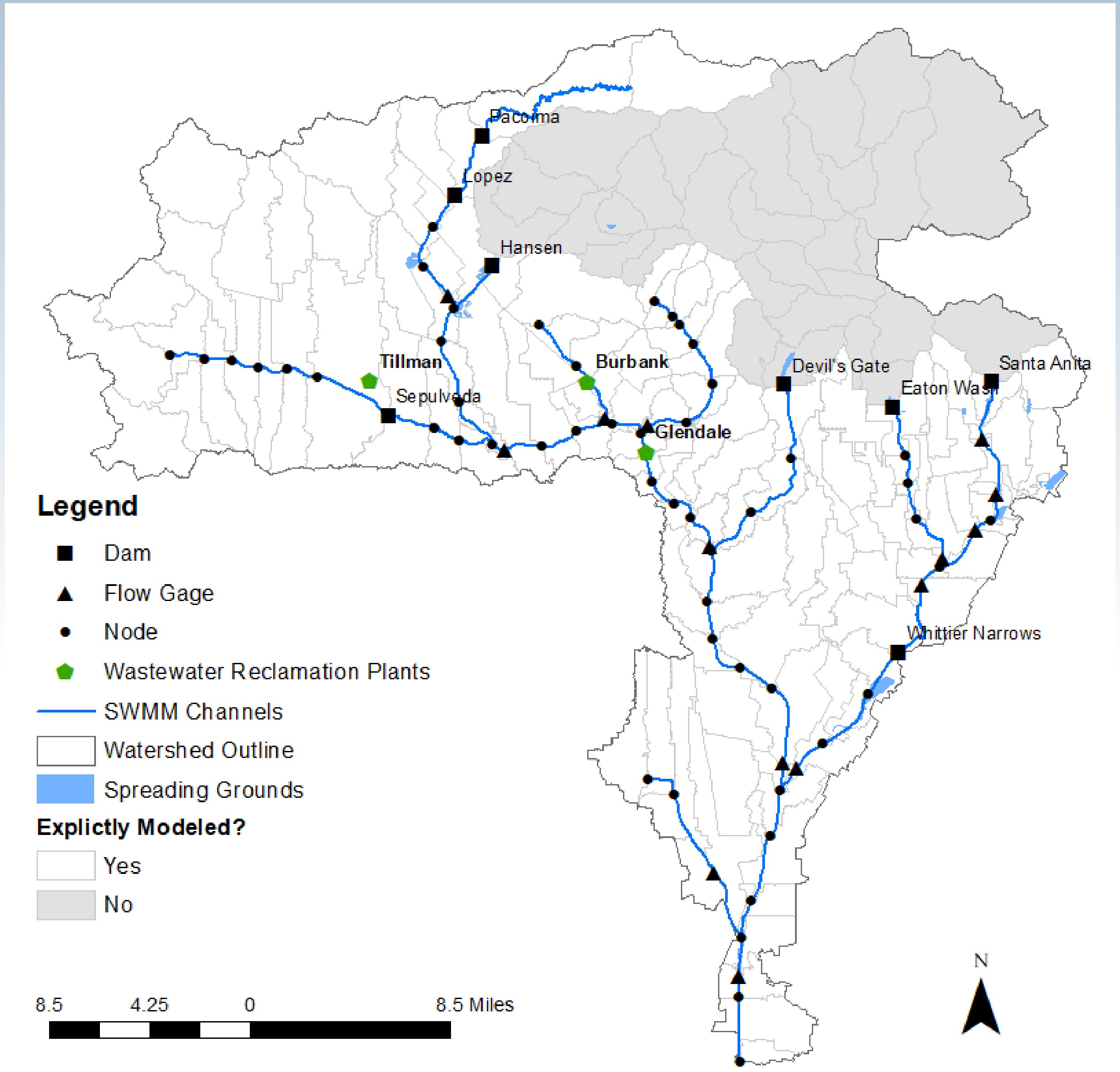
Activity 5: Monitoring and Adaptive Management

WRP Water Reuse

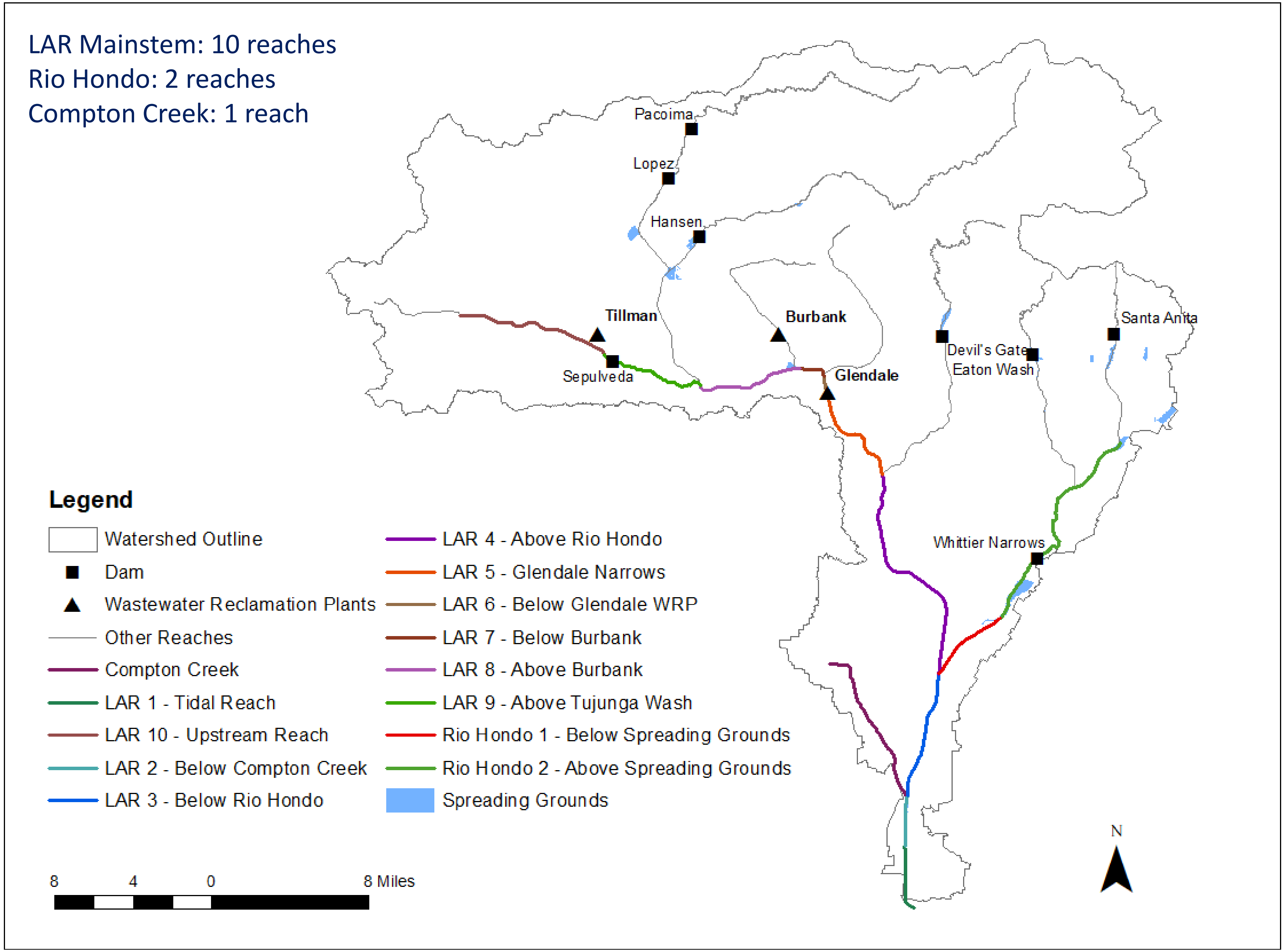
Options for Other Scenarios

- Stormwater
- Groundwater
- Conservation
- Environmental restoration

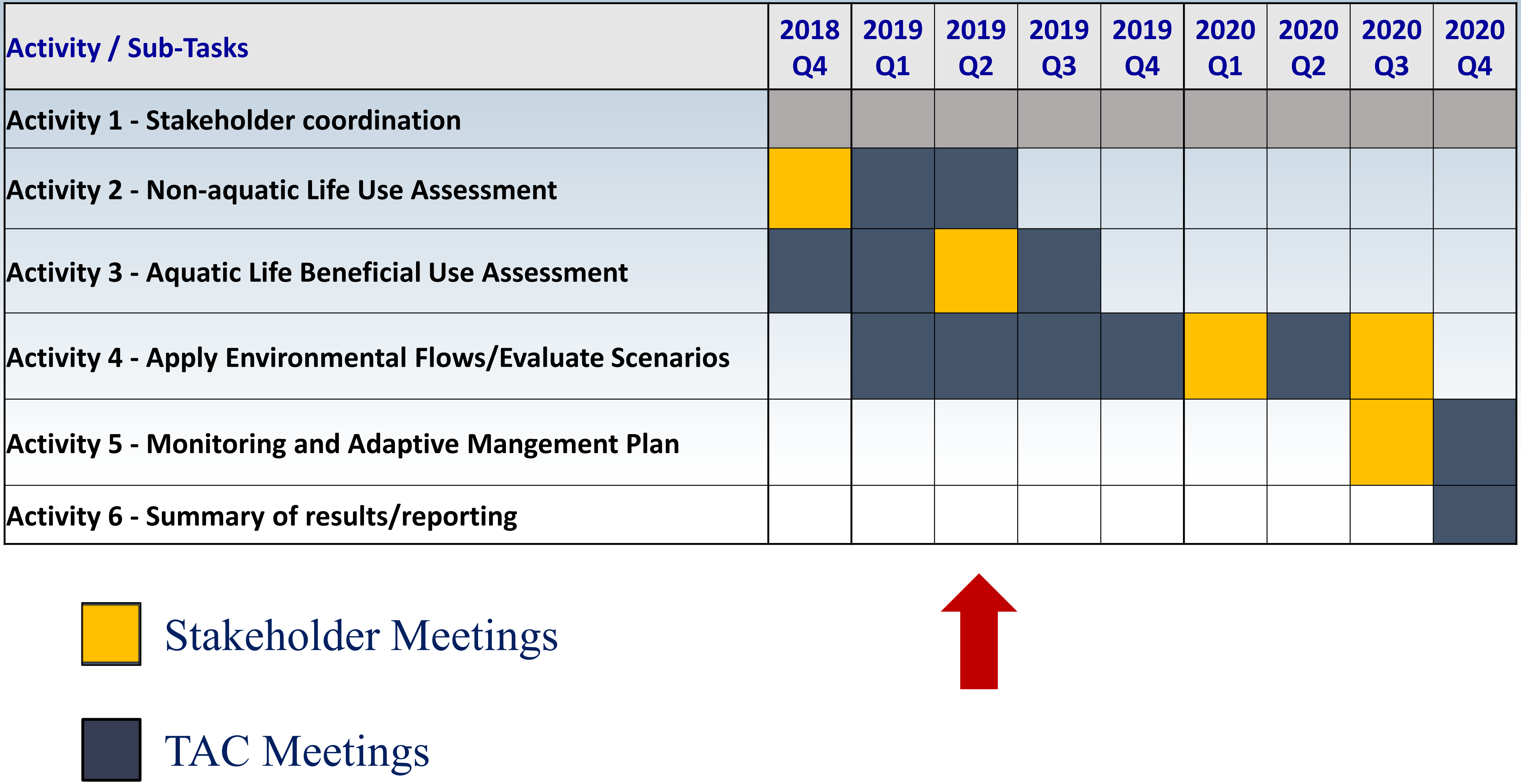
Proposed Model Domain



Proposed Analysis Reaches



Schedule


Activity / Sub-Tasks
2018 Q4
2019 Q1
2019 Q2
2019 Q3
2019 Q4
2020 Q1
2020 Q2
2020 Q3
2020 Q4
Activity 1 - Stakeholder coordination
Activity 2 - Non-aquatic Life Use Assessment
Activity 3 - Aquatic Life Beneficial Use Assessment
Activity 4 - Apply Environmental Flows/Evaluate Scenarios
Activity 5 - Monitoring and Adaptive Mangement Plan
Activity 6 - Summary of results/reporting
Stakeholder Meetings
TAC Meetings

Summary from Last Meeting

- Discussed priority habitats/species and biological modeling options
- Provided overview of hydrologic model set up
- Discussed water quality modeling scope and data needs

Decisions Made:

- Agreed to focus on 5 general habitat types
- Recommended mechanistic modeling approach
- Identified key project milestones for in-person TAC meetings:
  - Scenario development, translation between hydrology & biology, results

Last Meeting: Action Items

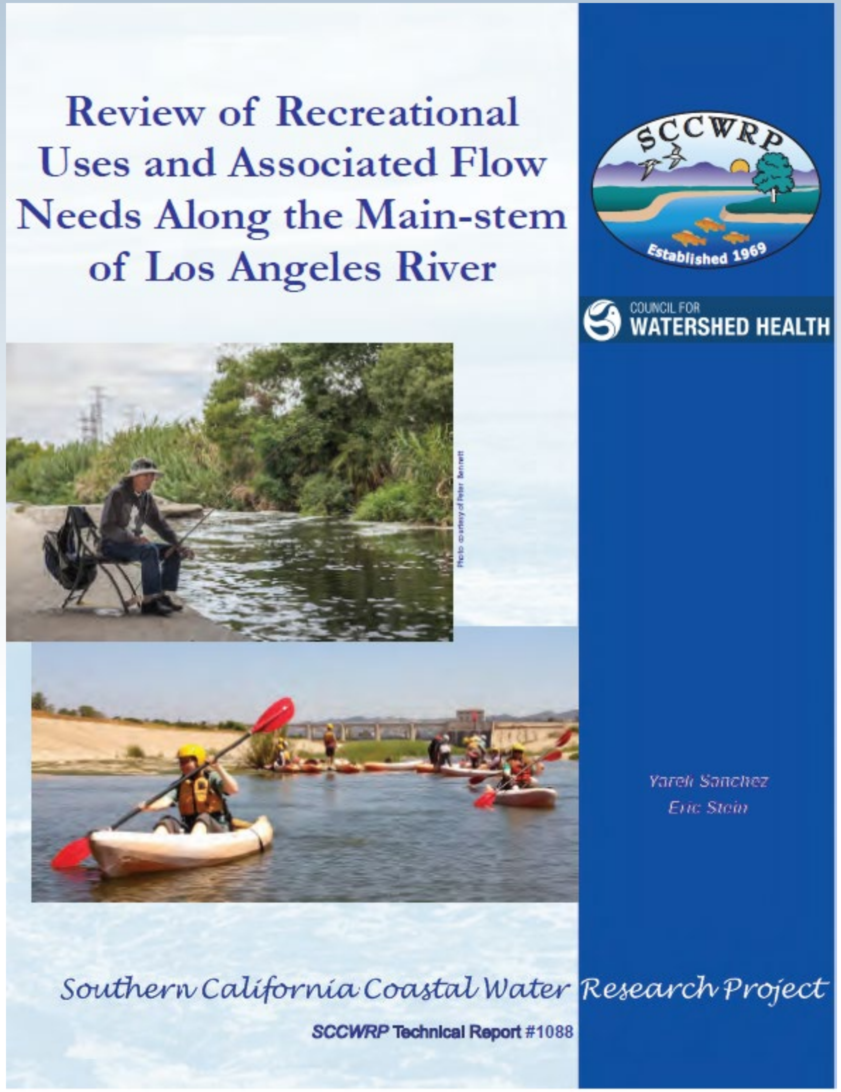
- Further define list of focal habitats and key species supported
- Associate list with species supported by each key habitat
- Pick representative species based on ability to model
- Compile key water quality data and ID data gaps
- Develop a proposed approach for scenarios

Work to Date

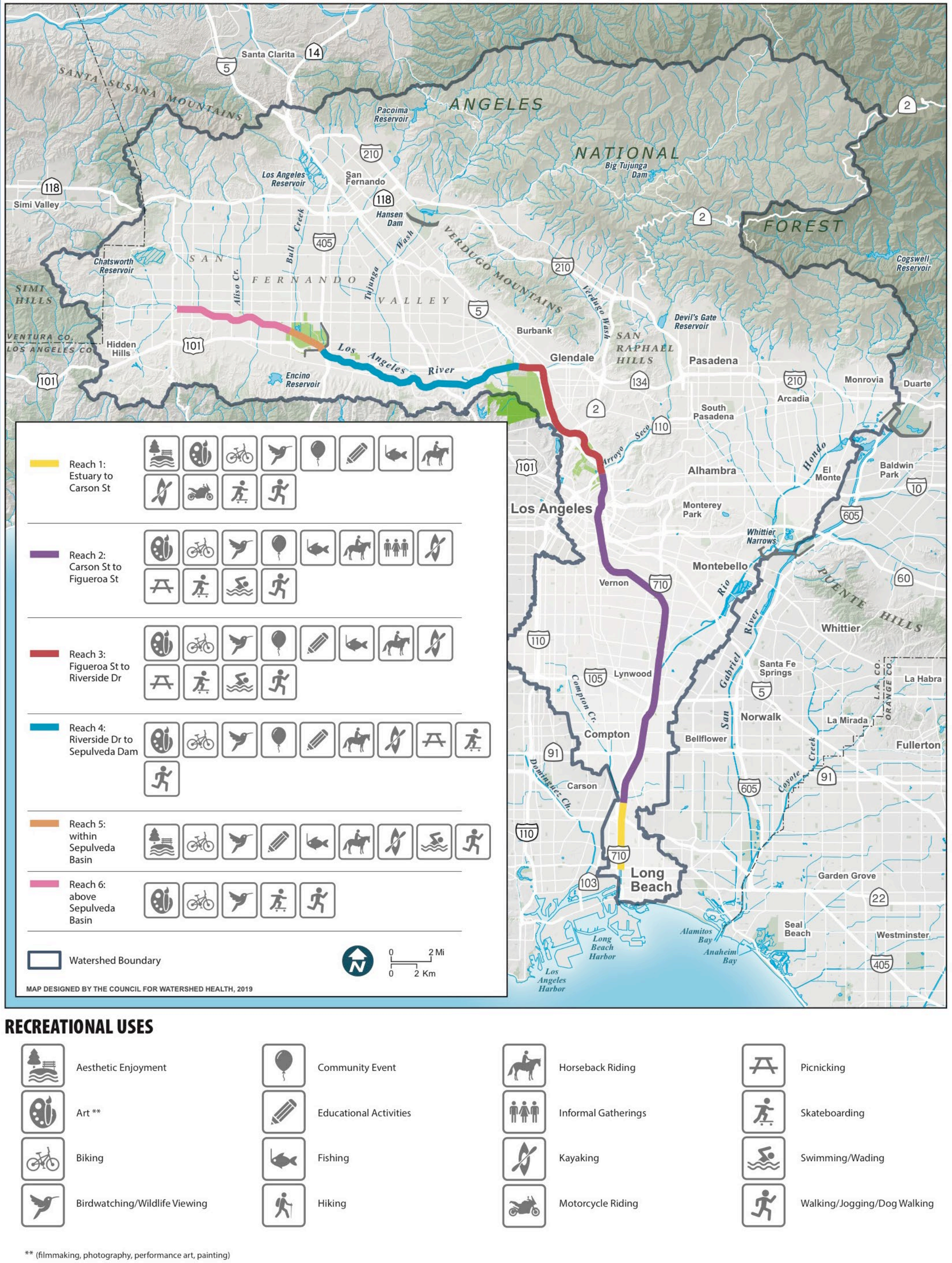
- ✓ Data compilation (recreational uses, species, habitats, environmental conditions)
- ✓ Mapping of aquatic life and recreational uses by reach
- ✓ Completed non-aquatic life use assessment
- ✓ Further defined list of focal habitats and key species
- ✓ Characterized habitat needs and tolerance ranges
- ✓ Initiated review of biological modeling options
- ✓ Set up hydrologic and hydraulic models
- ✓ Compiled water quality data and identified data gaps
- ✓ Held two TAC and one Stakeholder Working Group meetings
  - **Next stakeholder meeting:** October 18th 9am-3pm (Studio MLA, LA)

Non-Aquatic Life Use Assessment

- Conducted targeted interviews with recreational experts on uses and hydrologic needs associated with each use
- Analyzed social media data to compile information on various uses along the river



- Most popular uses are walking (including running, jogging, dog walking), biking, and art/photography



Key Findings

- Experts could easily ID indicators for each use but had difficulty identifying targets that support each use
- Subset of uses can only occur in low flow conditions (i.e. horseback riding, community events) but some uses rely on sustained flow (i.e. wading, boating, fishing, aesthetics)
- Range of observed flow conditions were determined for each use and season

Today's Meeting

- Review focal habitats/spp. groups
- Present process for developing hydrologic profiles for each group
- Update on hydrologic/hydraulic/water quality modeling
- Begin development of flow management scenarios

HABITAT CHARACTERIZATION

Habitat Characterization Process

✓ Last time: Identified major habitats

- Identify assemblages or key species
- Define hydrologic and hydraulic ranges based on key spp.
- Model occurrence of ranges with management scenarios

Focal Habitats

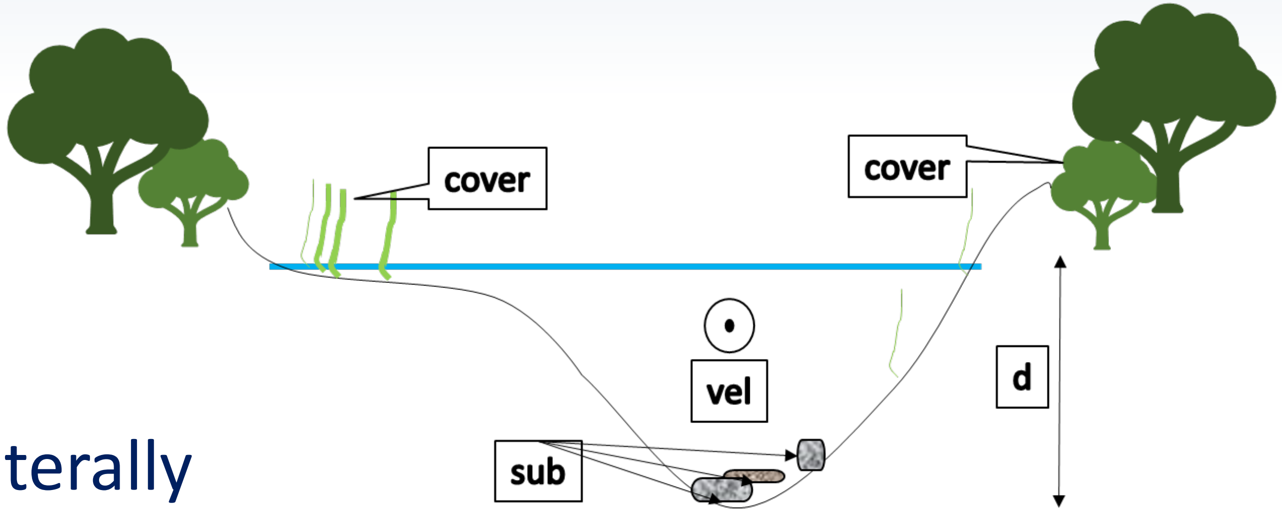
Goal: Finalize habitat groups to be modeled

- **Coldwater fish habitat**
  - cool, gravel/cobble, deep pools, (shallow edgewaters for fry?), well oxygenated, overhanging vegetation/banks
- **Riparian habitat**
  - floodplain with temporary flow or channel bottom with intermittent flow, shallow water table throughout year
- **Freshwater marsh habitat**
  - standing water, near surface water table, or low velocity, fine substrate
- **Wading shorebird habitat**
  - shallow water or mudflat / concrete that supports algae or invertebrates
- **Warmwater, perennial flow habitat** – as a surrogate for invasive spp. habitat
  - warm, perennial flow, slow velocity, shallow to deep, [submerged aquatic vegetation]

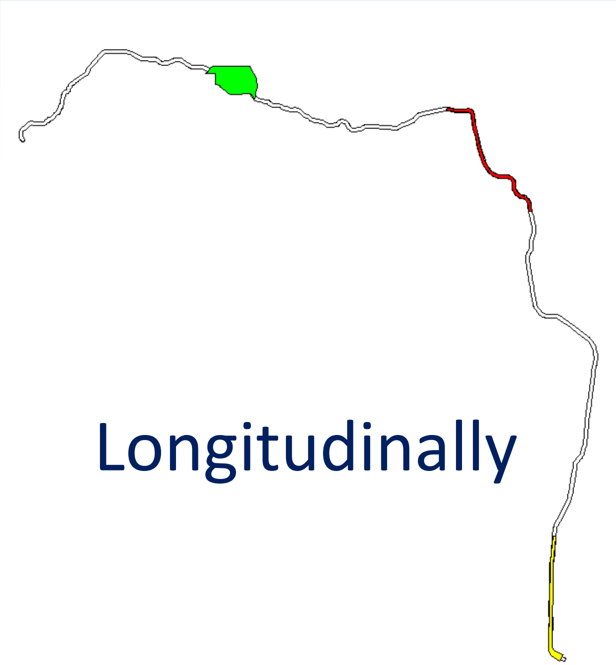
Habitat Selection

How representative are the habitat groups? Are we missing any?

– Select habitats based on representative species usage and consideration of different niches along the river: laterally and longitudinally



Laterally



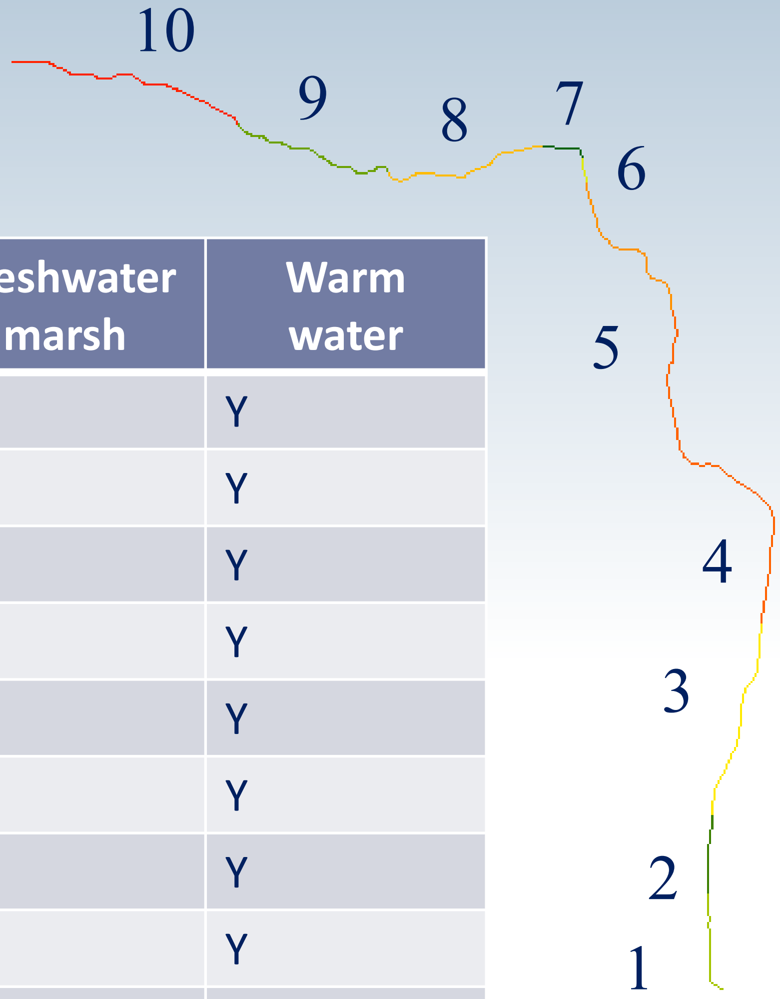
Longitudinally

How Representative are the Habitats?

Longitudinal Occurrence:

✓ Habitat groups occur across model reaches of the mainstem

LAR Reach	Cold water fish	Riparian	Wading shore bird	Freshwater marsh	Warm water
10: concrete + Sepulveda Basin	?	Y	Y	Y	Y
9: concrete: SB - Tujunga					Y
8: concrete Tujunga - Burbank					Y
7: concrete and soft bottom	?	Y		Y	Y
6: soft bottom	?	Y	Y	Y	Y
5: Glendale narrows	?	Y	Y	Y	Y
4: concrete			?		Y
3: concrete: Rio Hondo- Comp Crk			Y?		Y
2: concrete: Comp Crk-Estuary			Y?		Y
1: Tidal			Y	Y	



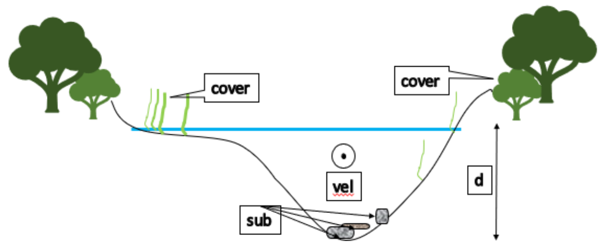
How Representative are the Habitats?

Lateral Occurrence:

Example hydraulic habitat	Coldwater fish habitat	Riparian habitat	Freshwater marsh habitat	Wading shorebird habitat	Warmwater, perennial flow habitat
Seasonally flooded flood plain					
Standing water					
Shallow flats					
Main channel					
Deep permanent pools					
Edgewater					
Shallow side pools					
Fine sediment					
Coarse sediment					

Missing edgewater and shallow pool habitats

Is this important?



Discussion on Habitat Groups

- Groups generally represent the river longitudinally
  - Cold water fish habitat generally absent
  - Remove due to lack of occurrence, or maintain due to potential for occurrence?
- Groups miss a key habitat laterally
  - Edgewater/shallow pools
    - Incorporate with cold water fish
    - Is it independent enough of a separate habitat?
  - Other habitats we missed?
- Categories are not mutually exclusive
  - Can any be collapsed?
  - Ex. Cold water fish overlaps with riparian vegetation (shading and cover)
  - Ex. Wading shorebird bleeds into vegetated marsh

Goal: Finalize habitat groups to be modeled

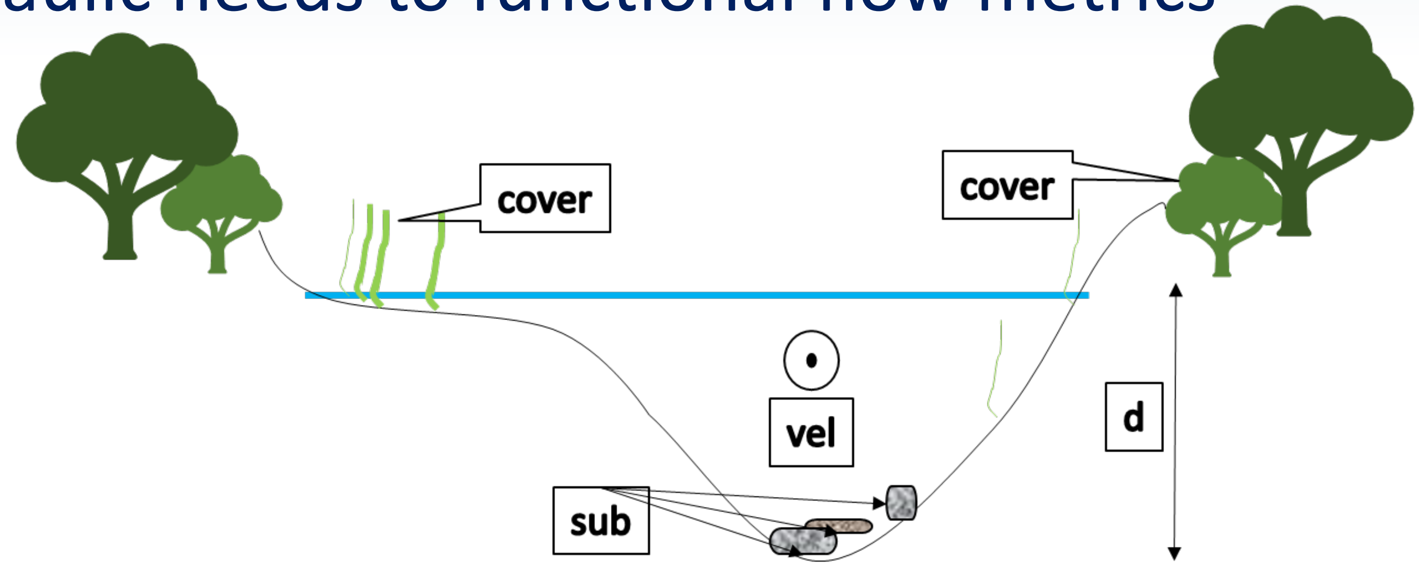
Habitat Characterization Process

✓ Last time: Identified major habitats

- Identify assemblages or key species
- Define hydrologic and hydraulic ranges based on key spp.
- Model occurrence of ranges with CO School of Mines scenarios

Process for Habitat Characterization

- **Goal:** Characterize habitats based on hydrologic/hydraulic needs
- Identify vegetation alliances and key species associated with each habitat type
- Characterize habitat needs (hydraulic/hydrologic thresholds)
- Determine end members at the range of tolerances
- Translate hydraulic needs to functional flow metrics



Example: Riparian Habitat

Vegetation Alliances:

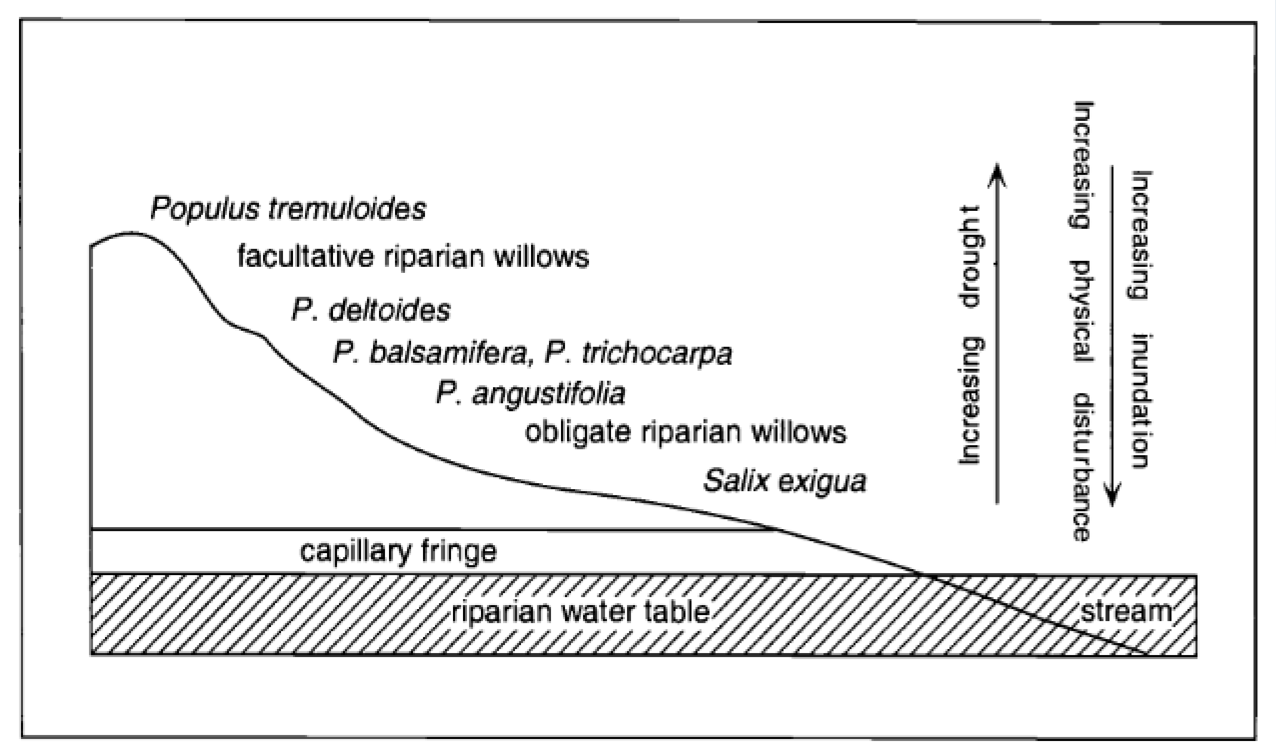
- Salix gooddingii woodland alliance
- Salix exigua shrubland alliance
- Salix laevigata woodland alliance
- Salix lasiolepis shrubland alliance
- Baccharis salicifolia shrubland alliance
- Alnus rhombifolia forest alliance
- Rosa californica shrubland alliance
- Platanus racemosa woodland alliance
- Populus fremontii forest Alliance

Key Species:

- Least bell's vireo
- Yellow warbler
- Yellow breasted chat
- Wilson's warbler
- Red-shouldered hawk
- Common yellowthroat

Determining Habitat Thresholds: Riparian

Spectrum of riparian vegetation based on water needs and disturbance tolerance



Identify "end members" based on ranges of tolerances

Amlin N. A. & Rood, S. B. (2001) Inundation and Tolerances of Riparian Willows and Cottonwoods. Journal of the American Water Resources Association. Vol 37, No 6.

Habitat Needs: Thresholds and Tolerances

Species	Habitat	Flood tolerance	Seed dispersal timing	Flood Timing	Inundation tolerance	Depth	Substrate	Drought tolerance	Recession rate
sandbar willow	Stream edge or sandbar in stream	Some Pioneer species	4-10 weeks Post flood, newly exposed substrate	Before seed dispersal, not after seedling germination	High (preferred) Shoot +root growth	10cm for 60 days – successful growth	Open sandy areas	low	low
red willow	Moist soil, not water logged	Med			Med			↓Growth and biomass	<4cm/day
alder	Above bank full	High			Low		coarse	high	

- Potential to split each species into processes:
  - Seedling dispersal
  - Germination
  - Seedling growth/recruitment

Amlin N. A. & Rood, S. B. (2001) Inundation and Tolerances of Riparian Willows and Cottonwoods. Journal of the American Water Resources Association. Vol 37, No 6.
Dixon, M. D. 2003. Effects of Flow Pattern on Riparian Seedling Recruitment on Sandbars in the Wisconsin River, Wisconsin, USA. Wetlands. Vol 23, No. 1.

Apply Process to Other Habitat Groups

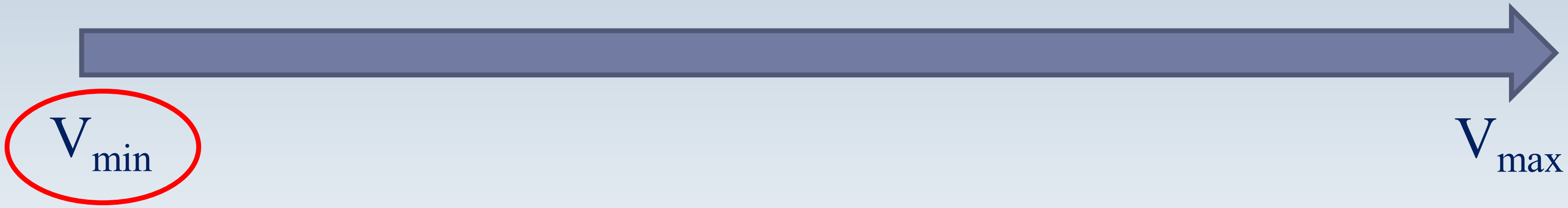
- Wading shorebirds:
  - Birds that peck for semi-terrestrial bugs or inverts in algae → Birds that probe for infauna (dowitcher, curlew, sandpiper) → birds that eat crabs or small fish
  - Birds that stand in submerged areas (egrets + dowitcher?)→ birds that use exposed concrete or sand- or mudflat (willet + dowitcher)→ birds that stay closer to vegetation → birds that used vegetated areas (willet)
- How to handle use of vegetated areas for roosting…..

Armitage, A. R., Jensen, S. M., Yoon, J. E., & Ambrose, R. F. (2007) Wintering Shorebird Assemblages and Behavior in Restored Tidal Wetlands in Southern California. Restoration Ecology Vol. 15, No. 1.

Stenzel, L . E., Huber, H. R. Page, G. W. (1976) Feeding behavior and diet of the Long-billed Curlew and Willet. Wilson Bulletin 88: 314–332

Developing Species Boundary Conditions

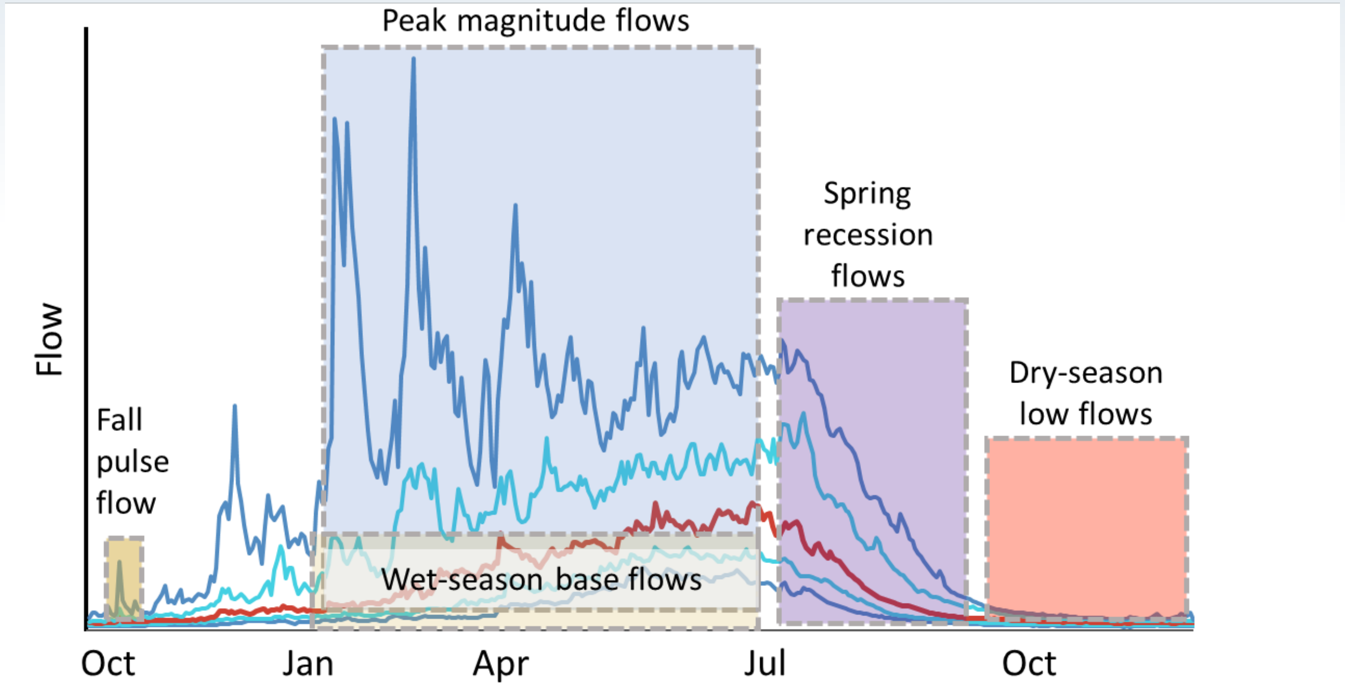
- Cold water fish example: Santa Ana sucker (*Catostomus santaanae*)



Life history	Velocity (m/s)	Habitat	Timing	Substrate	Veg/cover	Depth	Temp (C)
Spawning	0.2-0.24, flowing		Spring-early summer	Gravel		0.5m - 1.5m near deep water	
Fry	low	Quiet edge water near deep flowing water		Silt / sand	High sun exposure <25% canopy cover	<1cm-10cm	18-24
Juvenile	0.0-0.6, flowing	Riffle		Sand / gravel	<25% canopy cover	15-40cm, >35cm	15–22
Adult	0.0-0.5, flowing	Riffle, run, pool, deep holes		Gravel / cobble	<25% canopy cover	>40-70cm	15–22

Translation of Flow Needs

- Translate general flow needs → functional flow metrics
- *Functional flows:* key aspects of the flow regime that directly relate to ecological, geomorphic or biogeochemical processes in riverine systems (Yarnell et al. 2015)



Flow Component	Flow Characteristic	Flow Metric	Flow Metric Description
Fall pulse flow	Magnitude (cfs)	FA_Mag	Peak magnitude of fall season pulse event (maximum daily peak flow during event)
	Timing (date)	FA_Tim	Start date of fall pulse event
	Duration (days)	FA_Dur	Duration of fall pulse event (# of days start-end)
Wet-season base flow	Magnitude (cfs)	Wet_BFL_Mag_10^, Wet_BFL_Mag_50^	Magnitude of wet season baseflows (10th and 50th percentile of daily flows within that season, including peak flow events)
	Timing (date)	Wet_Tim	Start date of wet season
	Duration (days)	Wet_BFL_Dur^	Wet season baseflow duration (# of days from start of wet season to start of spring season)
Peak flow	Magnitude (cfs)	Peak_10, Peak_20, Peak_50	Peak-flow magnitude (10%, 20%, 50% exeedance values of annual peak flow --> 10, 5, and 2 year recurrence intervals)
	Duration (days)	Peak_Dur_10^, Peak_Dur_20^, Peak_Dur_50^	Duration of peak flows over wet season (cumulative number of days in which a given peak-flow recurrence interval is exceeded in a year).
	Frequency	Peak_Fre_10^, Peak_Fre_20^, Peak_Fre_50^	Frequency of peak flow events over wet season (number of times in which a given peak-flow recurrence interval is exceeded in a year).
Spring recession flow	Magnitude (cfs)	SP_Mag^	Spring peak magnitude (daily flow on start date of spring-flow period)
	Timing (date)	SP_Tim^	Start date of spring (date)
	Duration (days)	SP_Dur^	Spring flow recession duration (# of days from start of spring to start of summer baseflow period)
	Rate of change (%)	SP_ROC	Spring flow recession rate (Percent decrease per day over spring recession period)
Dry-season base flow	Magnitude (cfs)	DS_Mag_50^, DS_Mag_90^	Base flow magnitude (50th and 90th percentile of daily flow within summer season, calculated on an annual basis)
	Timing (date)	DS_Tim^	Summer timing (start date of summer)
	Duration (days)	DS_Dur_WS^	Summer flow duration (# of days from start of summer to start of wet season)

Example Translation to Functional Flow Metrics

- Sandbar willow
  - 10 cm depth for 60 days →
    Spring flow duration ≥ 60 days

- Dowitcher
  - Depth < 10 cm → dry season magnitude < 20 cfs
    - based on stage-discharge relationship

Both "raw metrics" and functional flow metrics will be analyzed based on H&H models

Discussion Topics

- Reaction to general approach
- Approach to identifying end member species
- Flow-ecology profiles
- Translation of hydrologic needs to flow metrics

Next Steps

- TAC to receive and review:
  - List of alliances and species for each habitat type (ensure we are not missing important member)
  - Selection of end member species for each habitat type (ensure habitat is fully represented)
  - Flow/hydraulic tolerances for each end member species (ensure tolerances are accurate)
    - Based on observational/experimental studies in lit.
    - Based on expert knowledge (some of you!)
    - Based on hindcasting occurrence data and physical condition
    - How to define cut offs for tolerance ranges?
    - *** likely the most important step in developing the model

HYDROLOGIC & HYDRAULIC MODELING

Dr. Terri Hogue, Dr. Jordy Wolfand, Dr. Reza Abdi, Daniel Philippus, Victoria Hennon, Dr. Nasrin Alamdari

HYDROLOGIC & HYDRAULIC MODELING

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Overview

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1. **Water quantity modeling update**
   - Overall coupled model approach
   - Calibration results

2. **Water quality modeling approach**
   - Water quality data needs
   - Temperature modeling overview

3. **Discussion of scope of estuary model**

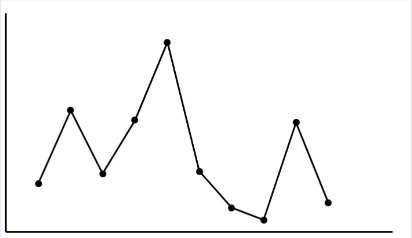
Create model

Hydrology, hydraulics, groundwater, tidal

Management scenarios

Scenario
recycling
recycling + stormwater
recycling + conservation
…

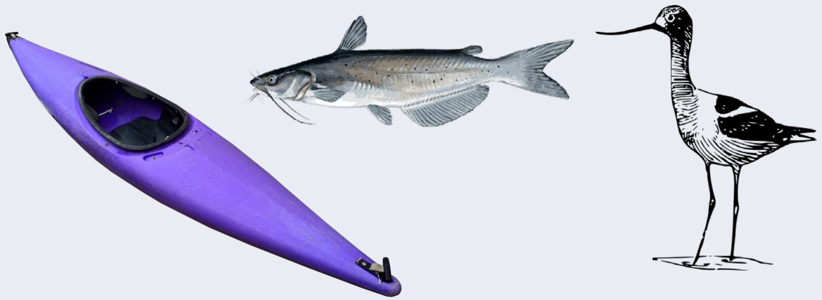
Timeseries output



Flow metrics

- Minimum annual flow
- Date of latest flood during the winter
- Minimum and maximum bottom velocity
- …

Flow metrics → Beneficial uses



Establish flow criteria

- By reach and season
- Management/mitigation recommendations

WATER QUANTITY MODELING UPDATE

Processes to Model

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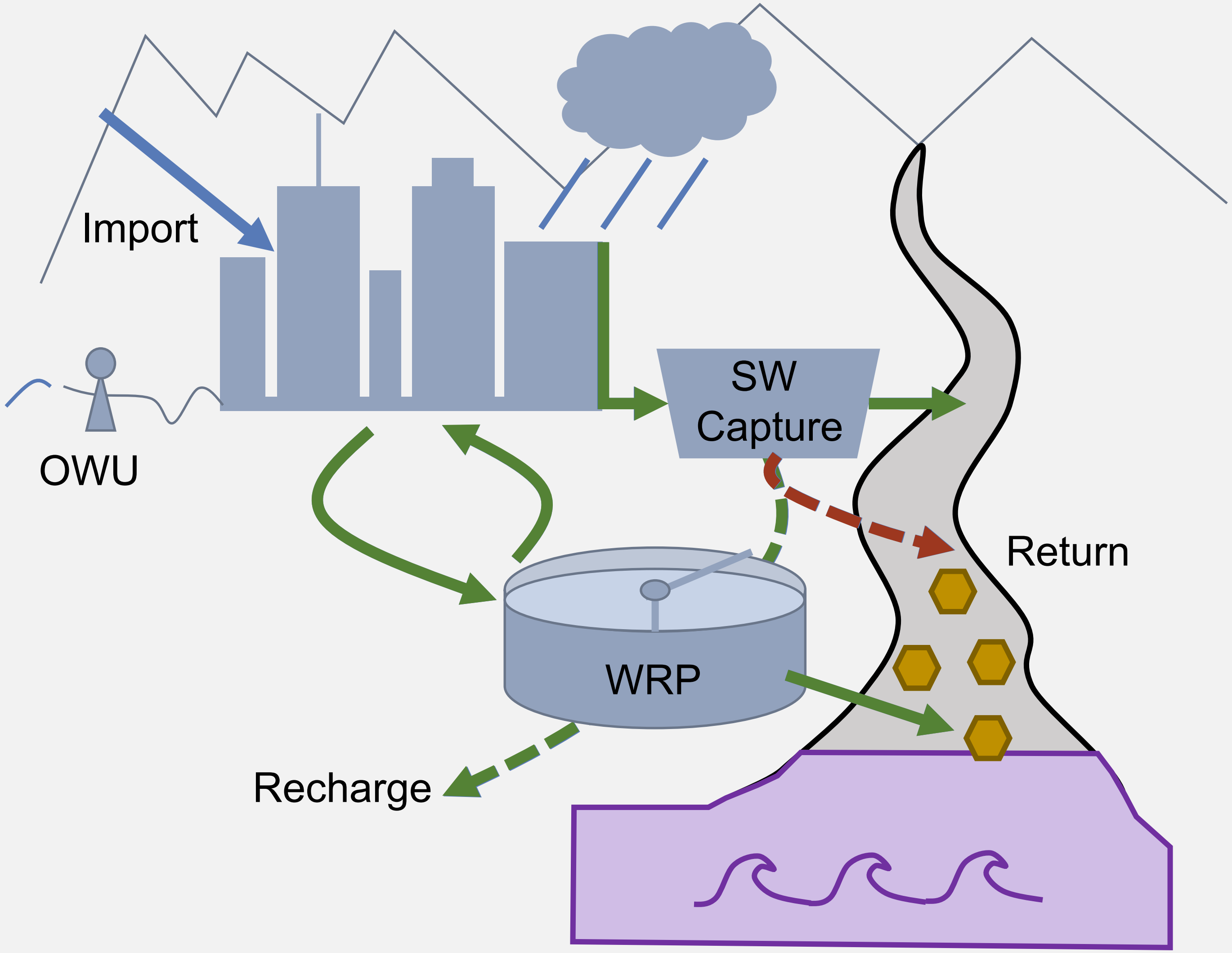
HYDROLOGY (Runoff / Point Sources / Diversions)

HYDRAULICS (Channel flow)

GROUNDWATER

ESTUARY

WATER QUALITY



Hydrology

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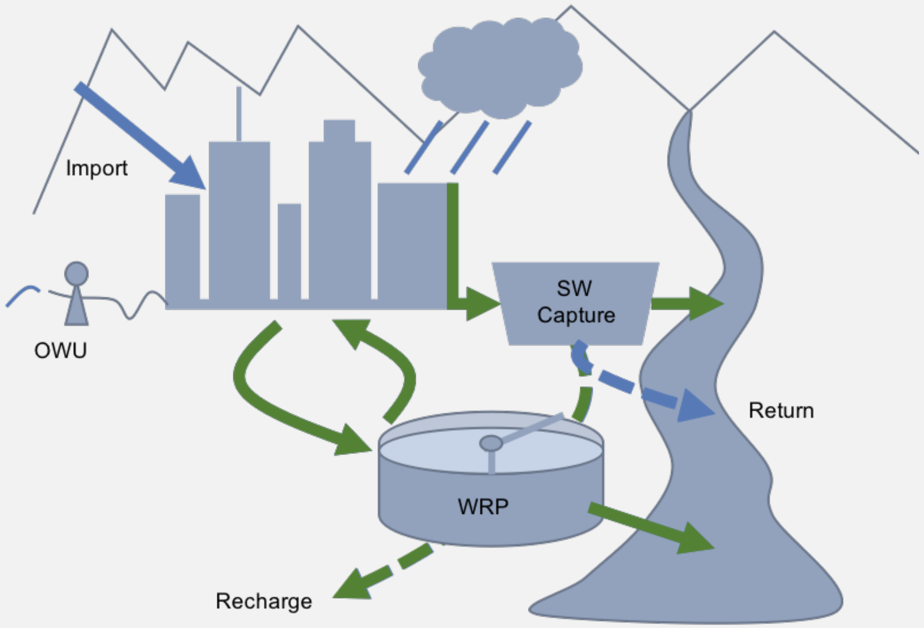


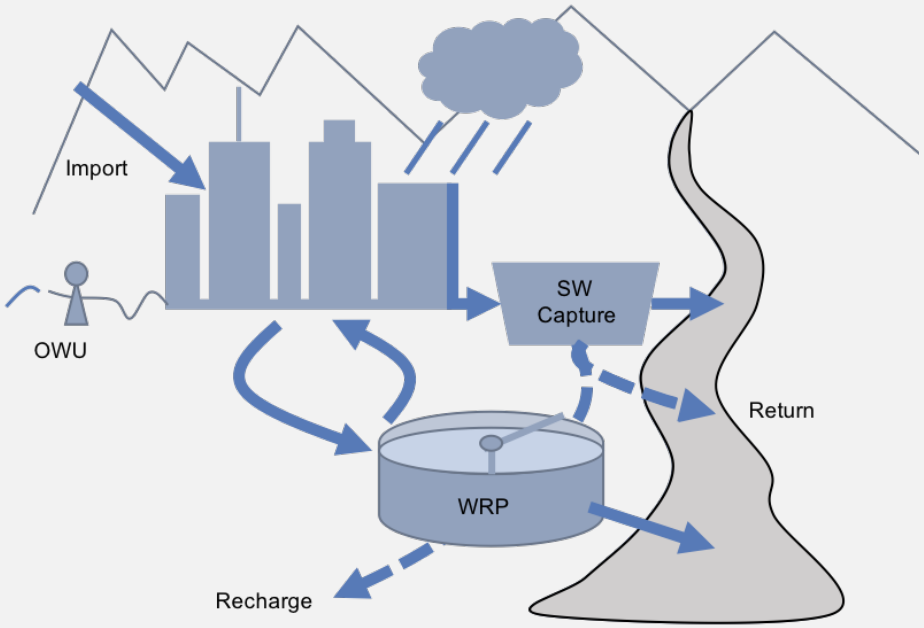
PURPOSE

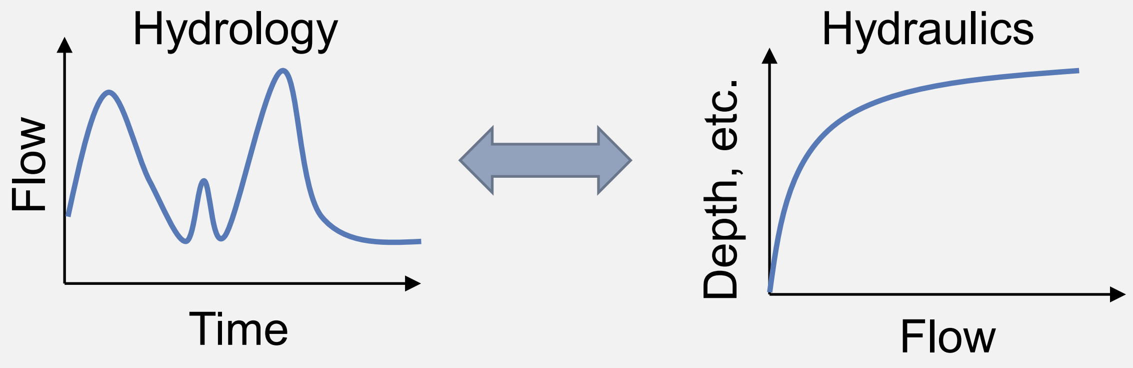
- Generate flow timeseries as inputs to ecological models
- Scenario testing: wastewater reuse, stormwater, restoration/rehabilitation efforts

METHOD

- EPA SWMM

Hydraulics





PURPOSE

- Generate velocity/depth as inputs to ecological models
- Scenario testing: wastewater reuse, stormwater, restoration/rehabilitation efforts

METHOD

- Couple EPA SWMM to USACE HEC-RAS

Groundwater

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Glendale Narrows

PURPOSE

- Simulate losses and gains within the river due to groundwater

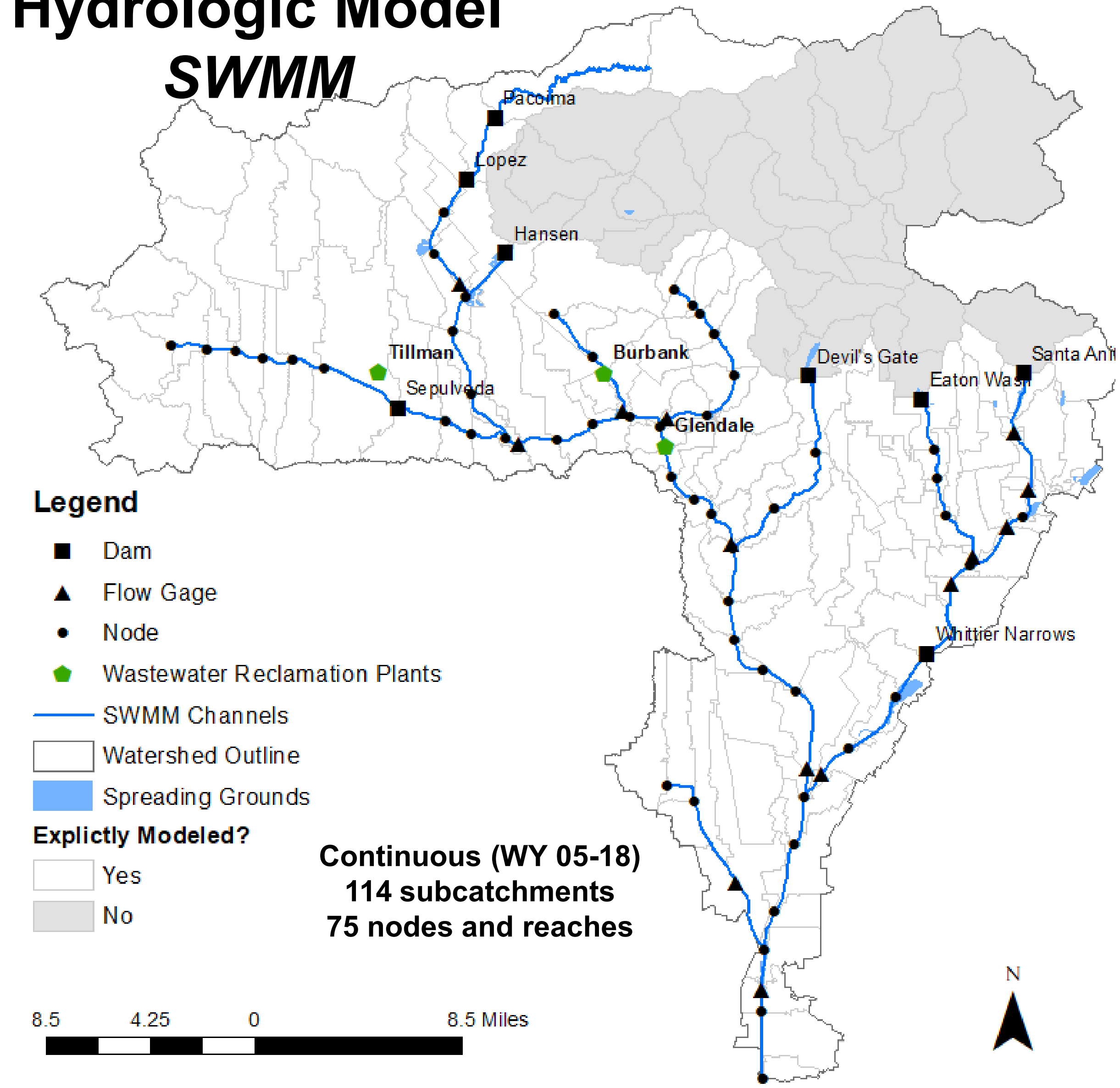
METHOD

- EPA SWMM informed by ***Los Angeles River Coupled Groundwater-Surface Water Study***

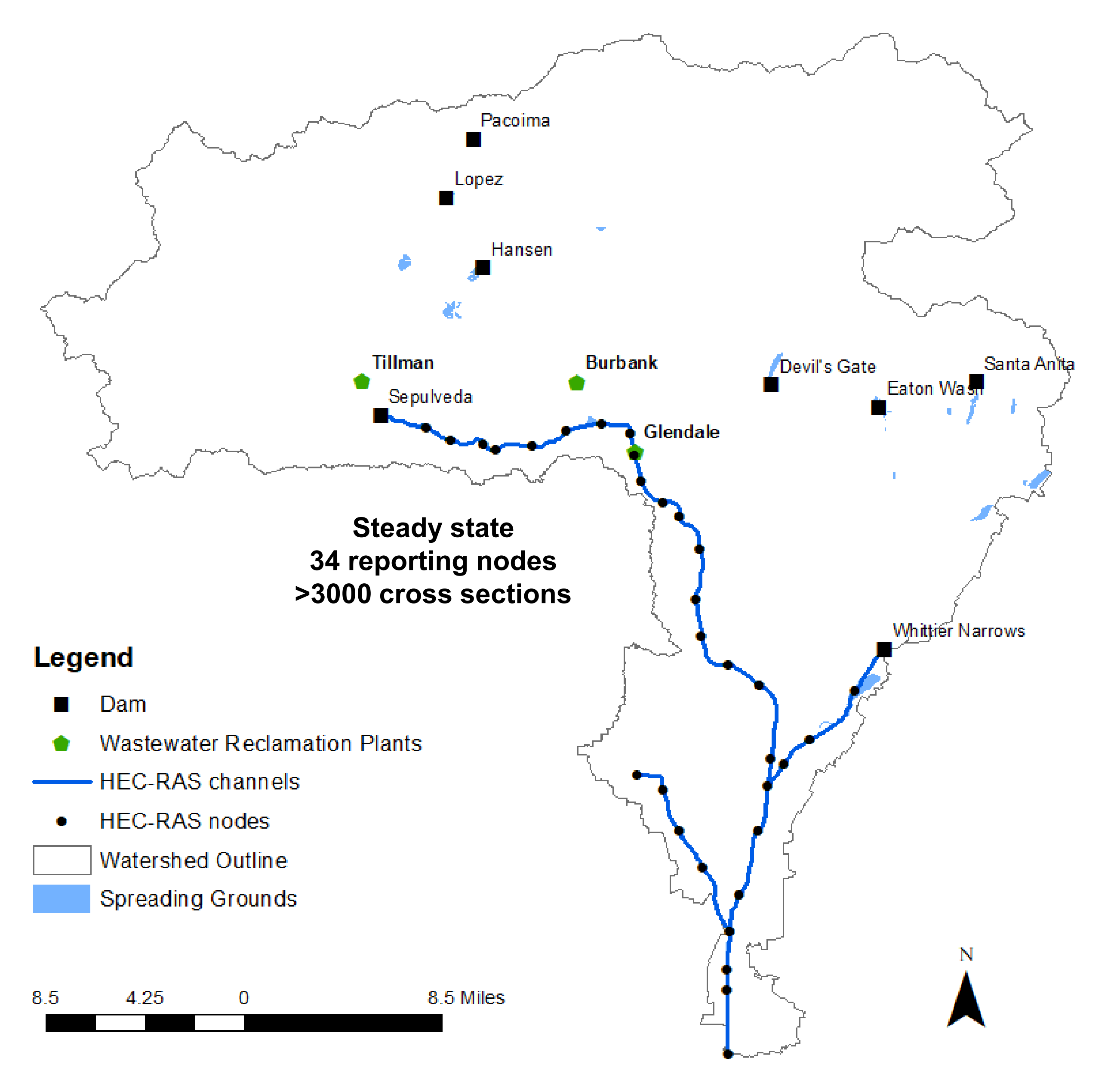
COUPLED HYDROLOGIC & HYDRAULIC MODEL

Coupled SWMM & HEC-RAS Model

Hydrologic Model
SWMM



Hydraulic Model

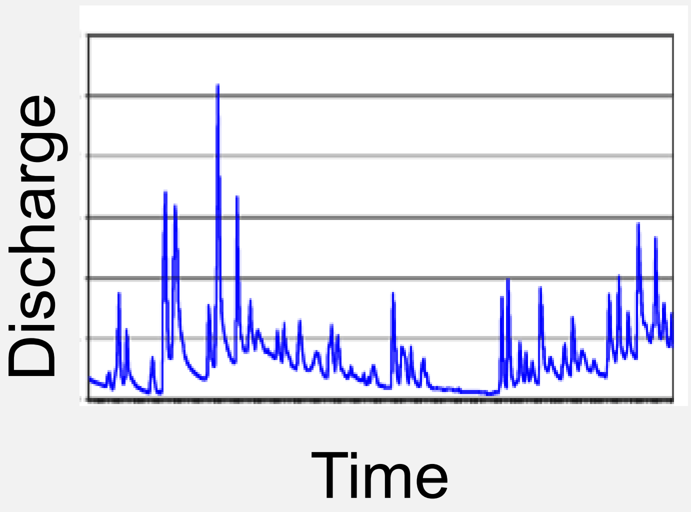


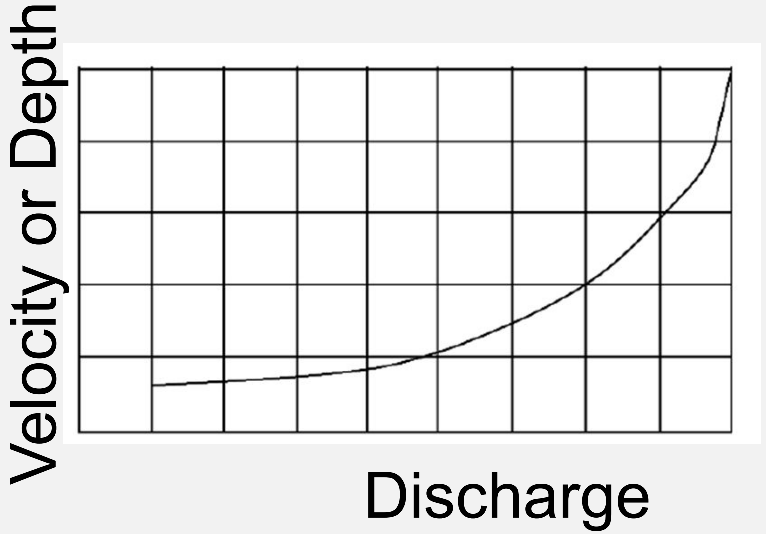
Coupled SWMM & HEC-RAS Model

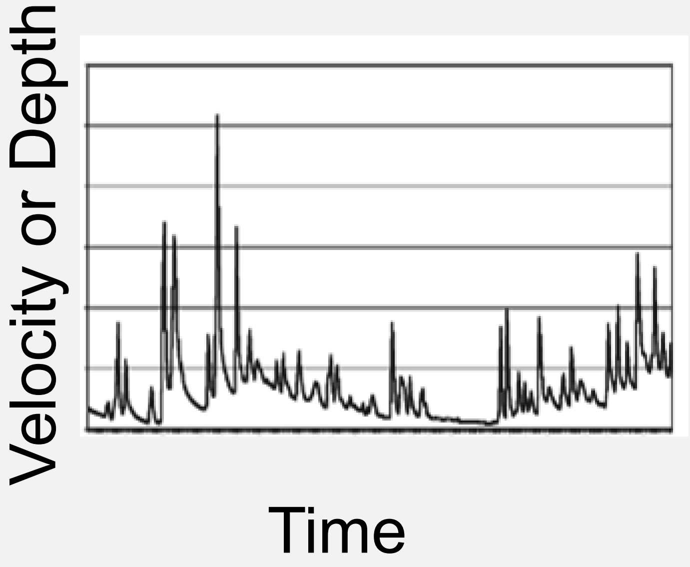
Hydrology Model
SWMM
Unsteady (WY 2005 to 2018, hourly timestep)

Hydraulic Model
HEC-RAS
Steady state to create rating curves

Output
Timeseries

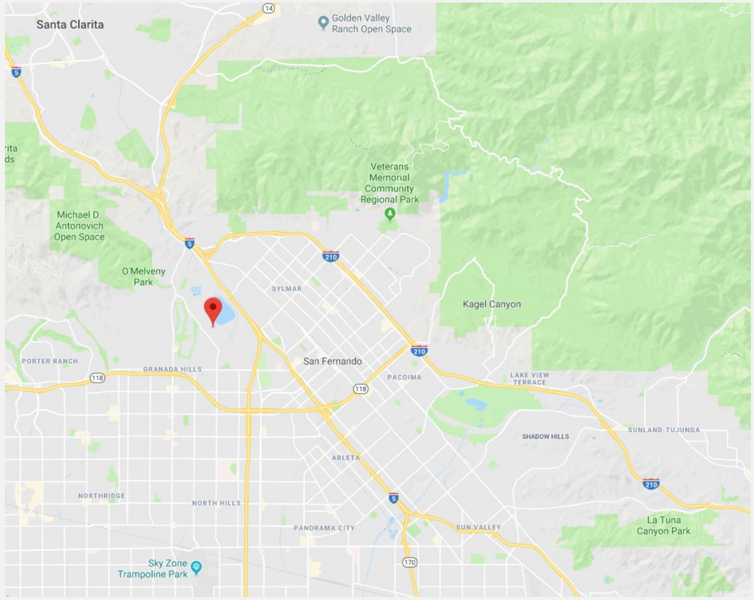






Model inputs

Spatial Data		Data Source
Subcatchments	Area	LA County sewersheds
	Soil parameters	USDA-NRCS SSURGO database
	Slope	National Elevation Dataset DEM, LA LIDAR
	Imperviousness	NLCD, SCAG
Nodes	Invert elevation	National Elevation Dataset DEM
Channels	Flow network	LA County sewer network, NHD flow lines
	Length	NHD flow lines, LA County channel network
	Geometry	LA reports, HEC-RAS models, LIDAR data



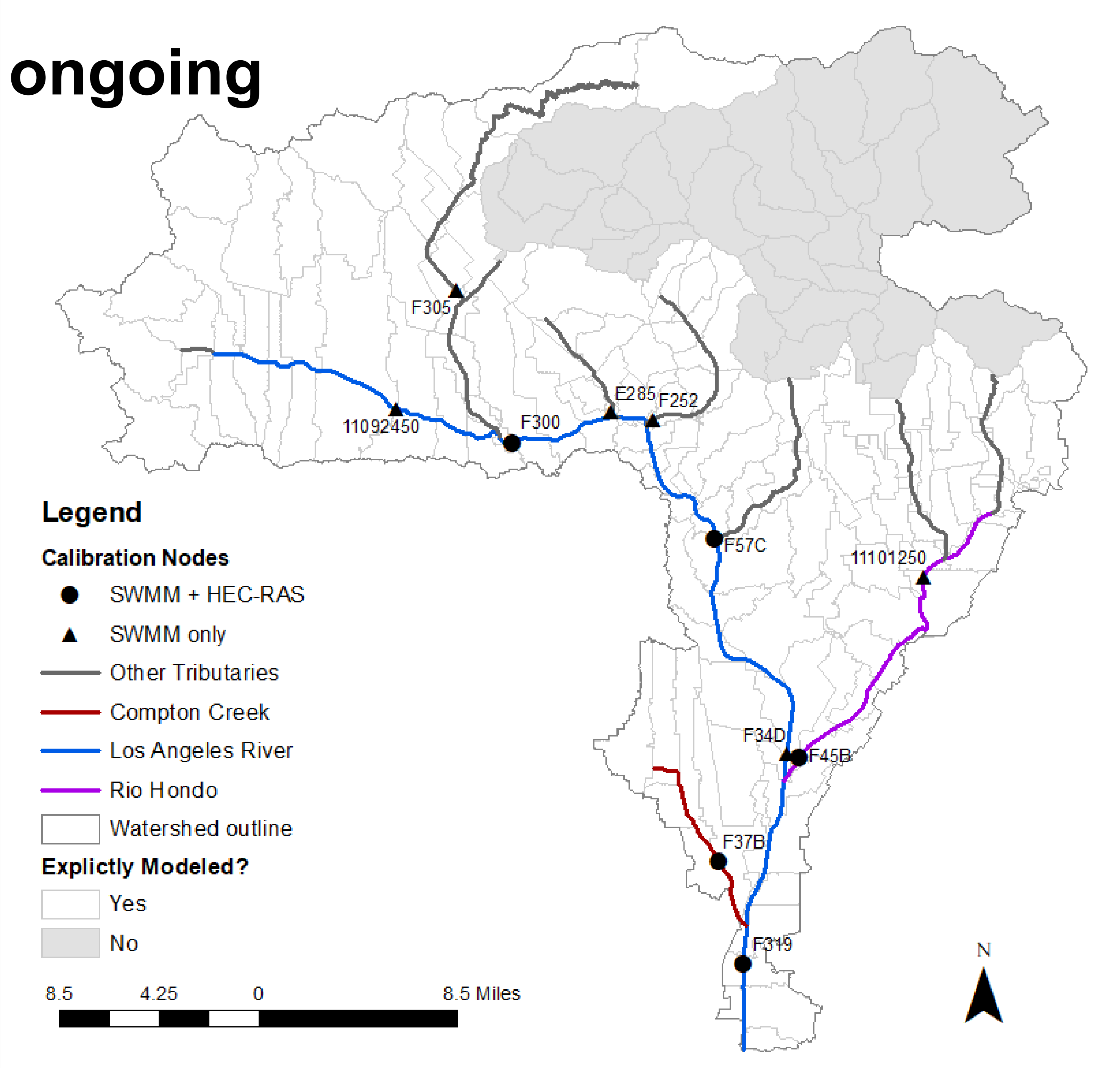
Timeseries Data	Data Source
Dams	LA County, USACE
Spreading grounds	LA County
Water reclamation plants	LA City, others
Precipitation	LA County
Evapotranspiration	CIMIS
Flow	LA County

Does Los Angeles Reservoir (now named Van Norman Lakes Reservoir?) still exist? If so, is there time series data for it?

Still need Burbank WRP discharge

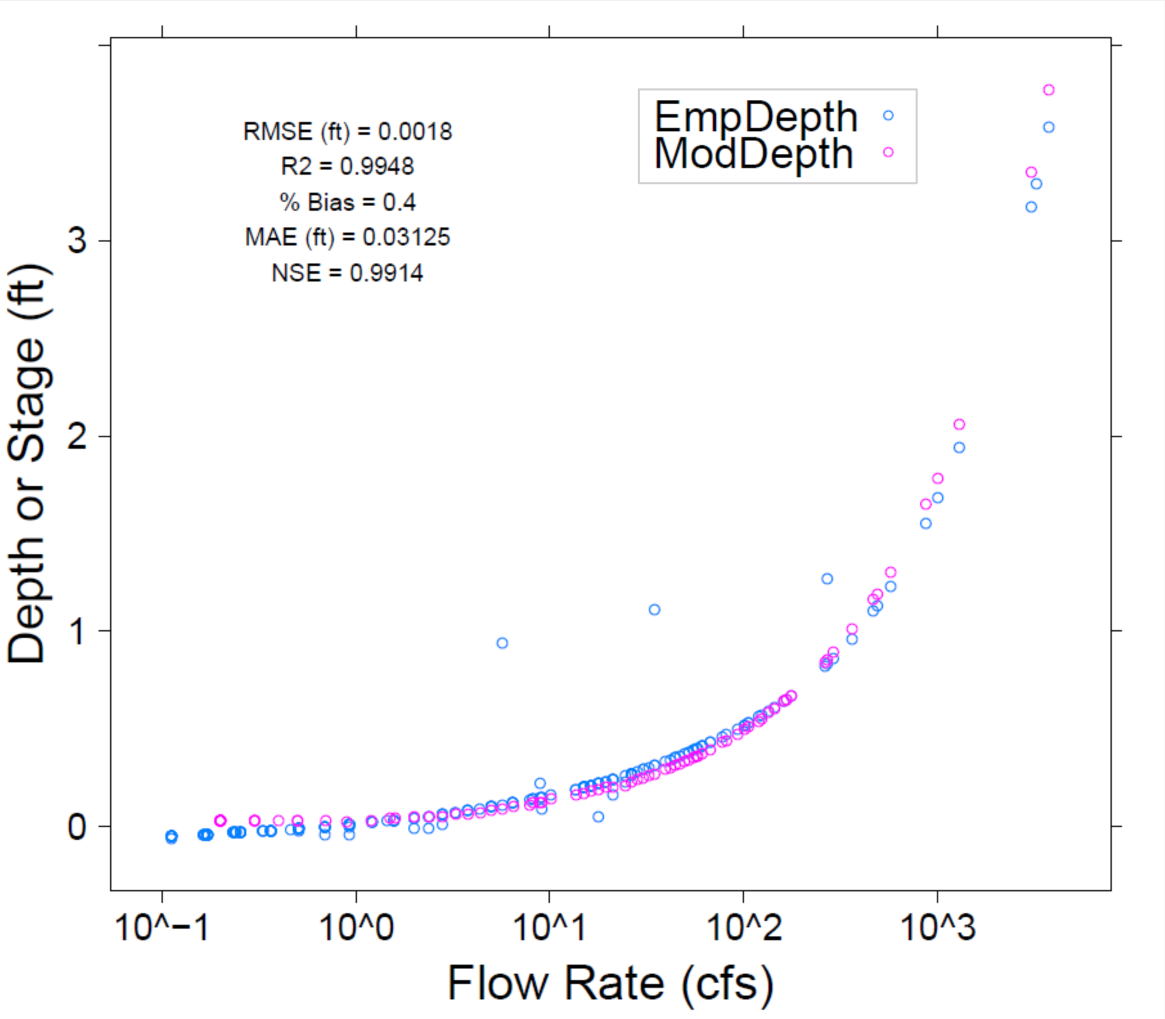
Model Calibration is ongoing

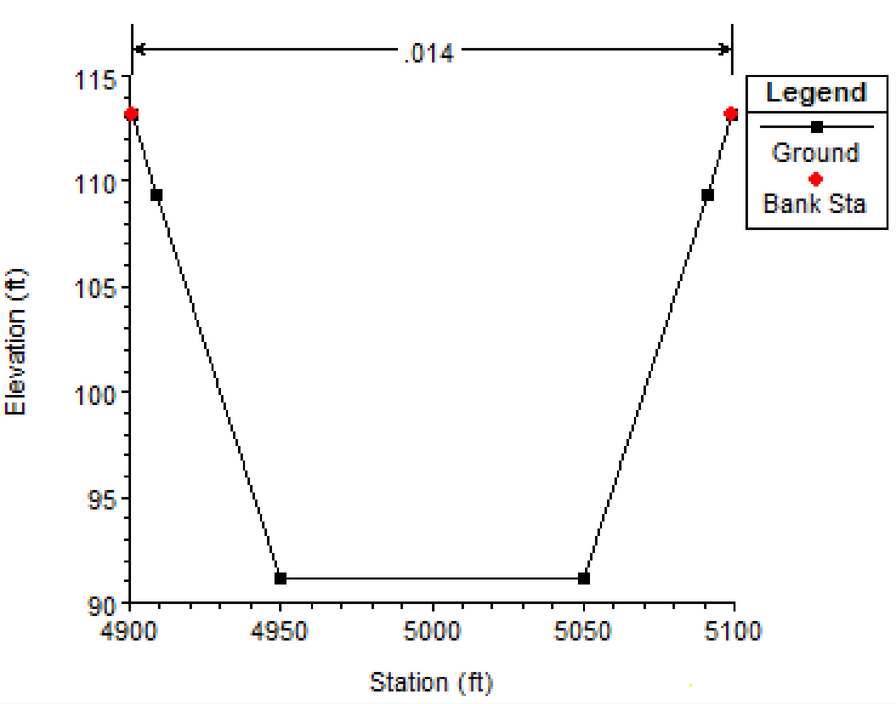
- **HEC-RAS (hydraulics)**
  - 5 gages
  - Manual adjustment of Manning's n
- **SWMM (hydrology)**
  - 11 gages
  - Automated scatter search (NGSA-II) of 500 solutions
  - Adjustment of % directly connected imperviousness, Manning's n, depression storage, catchment width, hydraulic conductivity

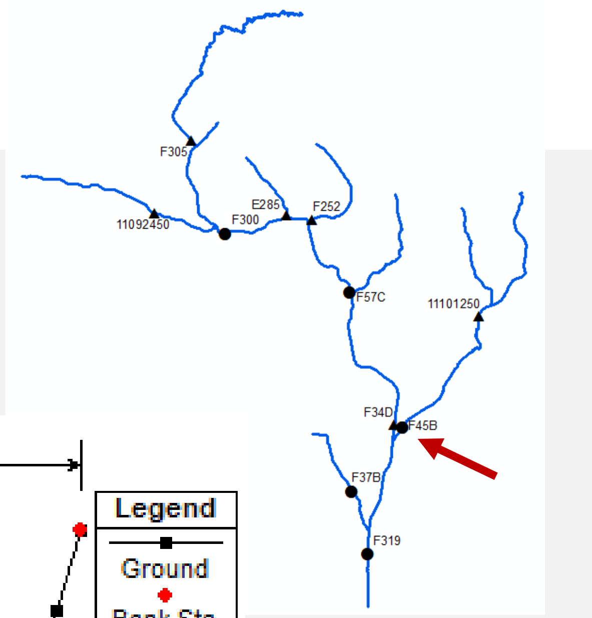


HEC-RAS Model Calibration

Rating Curve at Rio Hondo (F45B)

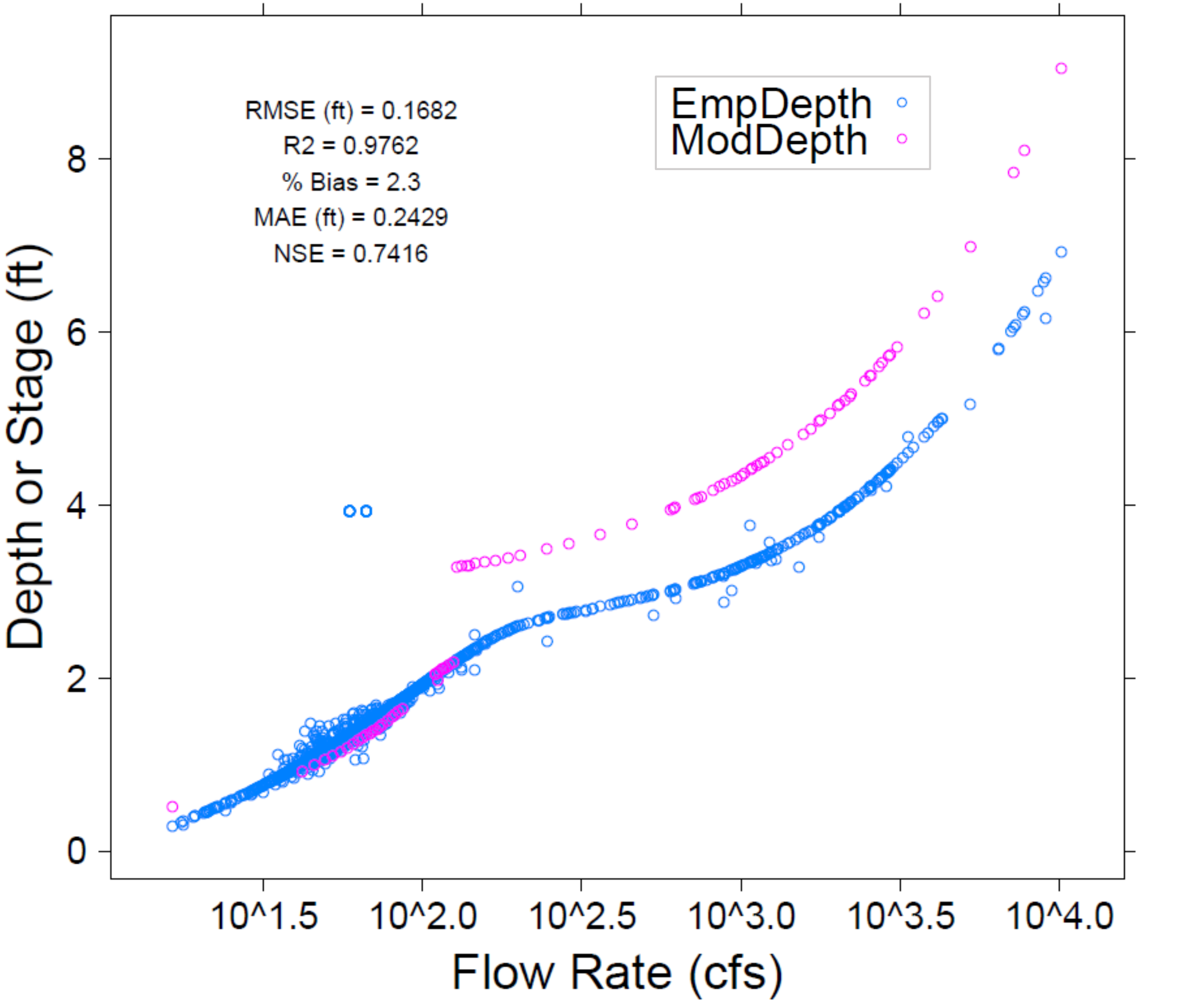


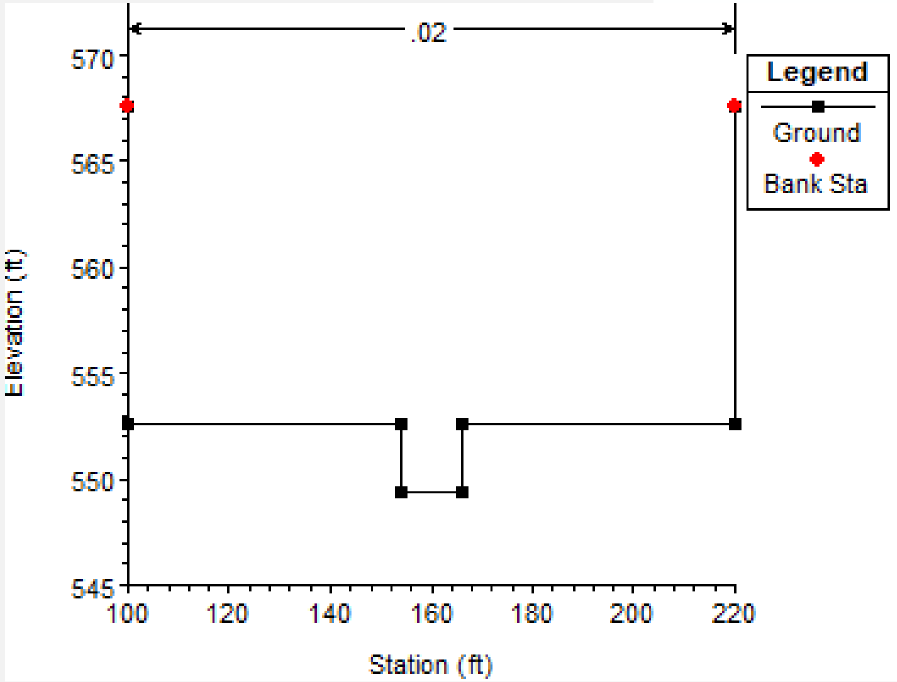


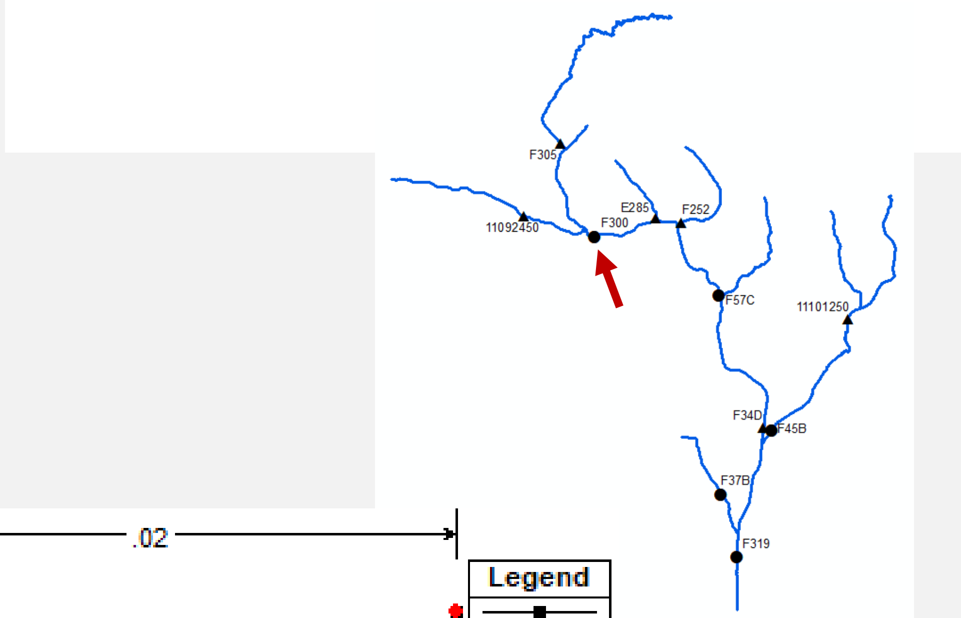


HEC-RAS Model Calibration

Rating Curve at LAR below Tujunga Wash (F300)







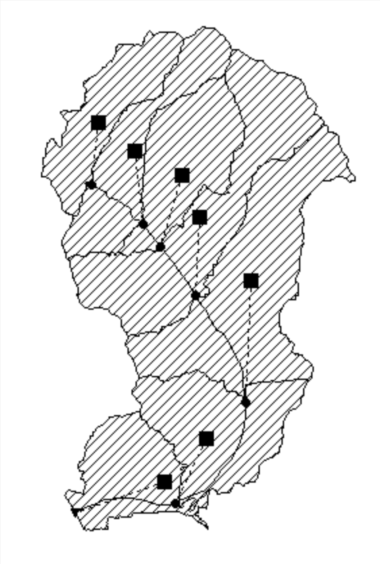
SWMM Calibration

Calibration WY 2012–2018; Validation WY 2005–2011

Flow Gage	Gage Description	Calibrated?	Model Statistics (daily)		
			NSE	R^2	% Bias
F305	Pacoima Diversion	Yes – poorly	-4.7	0.46	357
E285	Burbank Western Channel	Yes	0.77	0.88	-22.5
F252	Verdugo Wash	Yes	0.79	0.89	-3.3
F37B	Compton Creek	Yes	0.62	0.79	36.5
11092450	LAR above Sepulveda	Ongoing			
11101250	Rio Hondo above Whittier Narrows	No			
F34D	LAR above Rio Hondo	No			
F45B	Rio Hondo above LAR	No			
F300	LAR below Tujunga Wash	No			
F57C	LAR above Arroyo Seco	No			
F319	LAR below Wardlow Rd.	No			

SWMM Calibration

Example **Good** Calibration

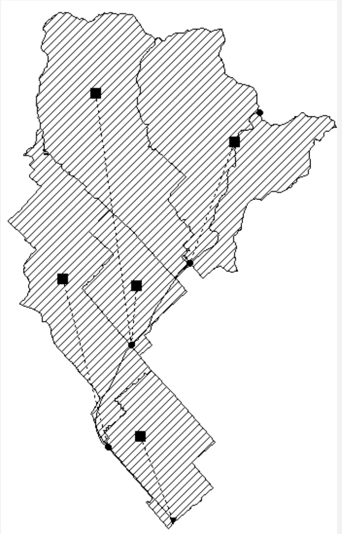


F252: Verdugo Wash at Estelle Ave.

Drainage area = 26.8 mi^2

Metric	Value [daily]
NSE	0.79
% Bias	-3.3
R^2	0.89

Example **Poor** Calibration



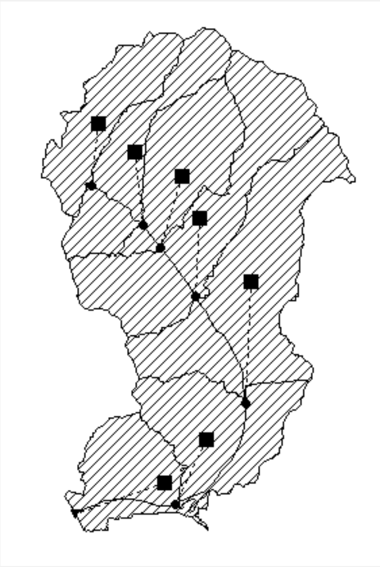
F305: Pacoima Diversion at Branford Street

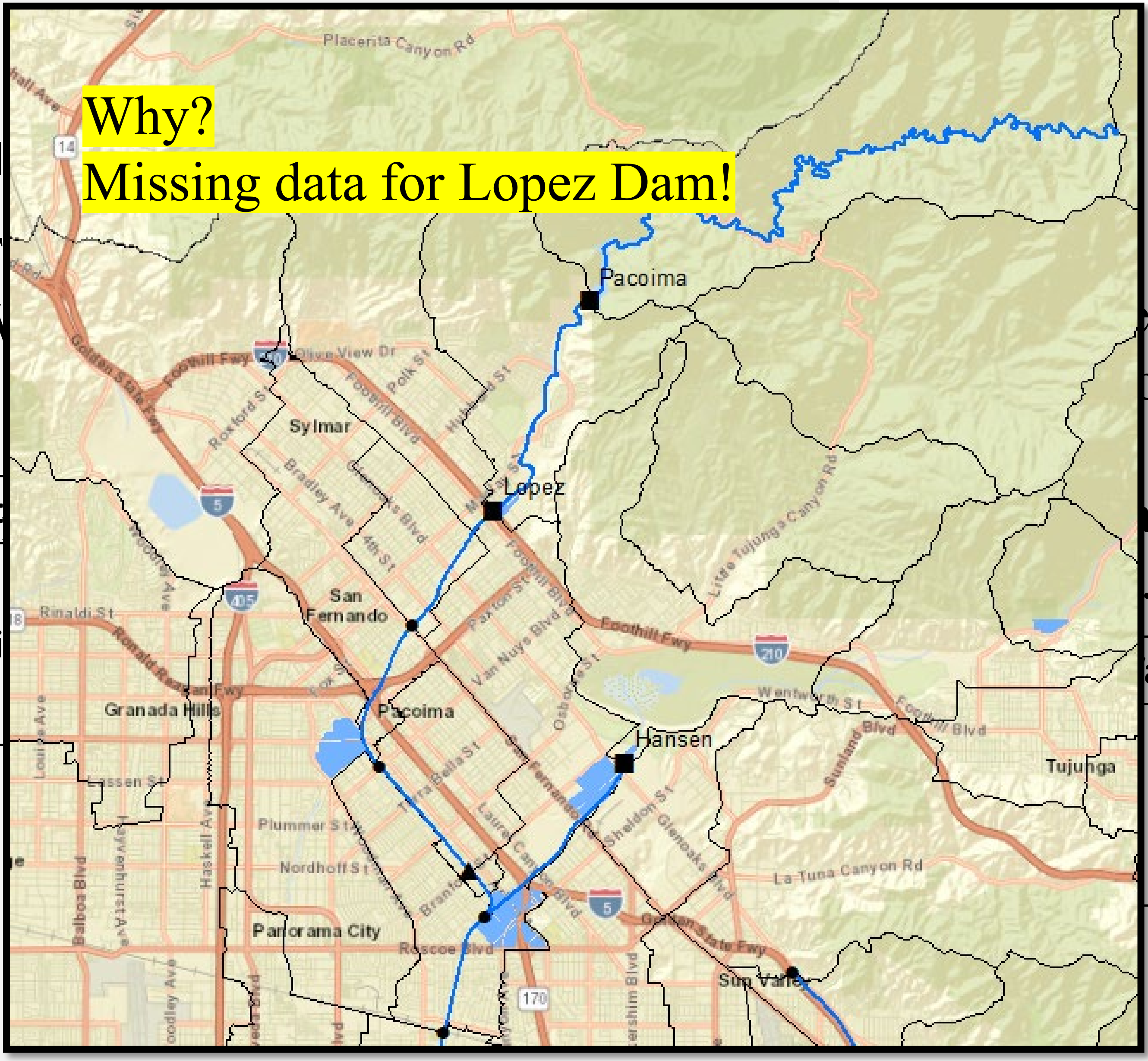
Drainage area = 48.8 mi^2

Metric	Value [daily]
NSE	-4.7
% Bias	360
R^2	0.46

SWMM Calibration

Example **Good** Cal





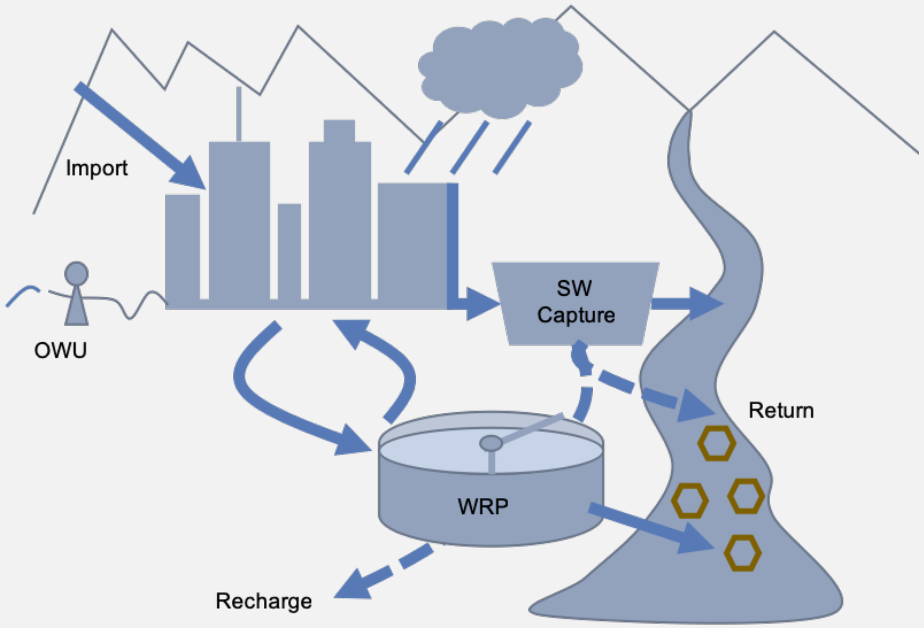
F
W
Pacoima
rsion at
ord Street

D
ge area =
.8 mi^2

Met	alue [daily]
NSE	-4.7
% Bi	360
R^2	0.46

WATER QUALITY

Water Quality



PROPOSED APPROACH

- SWWM coupled with HEC-RAS
- iTree Cool River for temperature

PURPOSE

- Simulate water quality in the LA River mainstem

PARAMETERS

- Temperature
- Metals: Copper, Lead, Zinc
- TSS
- Specific conductance

Water Quality Data

Downloaded Data

- CEDEN (2005-2018)
  - All of La County
  - 65, 5000, 830, 1500 rows
- Mass Emissions (2006-2015)
  - S10 LAR@Wardlow
  - 2100 rows
- MS4 (2015-2018)
  - LLAR, ULAR, Rio Hondo, Compton
  - 200,000 rows

Trying to see if there are overlaps….

Lots of programs in CEDEN….

- Associated QA
- City of Long Beach Nearshore Watershed Management Program IMP
- Harbor Toxics TMDL Compliance Monitoring
- Monitoring Plan for Broadway Neighborhood Stormwater Greenway Project
- Newhall Ranch Water Quality Monitoring Program
- Machado Lake Eutrophic, Algae, Ammonia, and Odors (Nutrient) TMDL Compliance Monitoring
- Palos Verdes Peninsula Cities Coordinate IMP
- Prop 84
- San Gabriel River Regional Monitoring Program
- Southern CA Stormwater Monitoring Coalition
- Surface Water Ambient Monitoring Program
- Cal Trans NPDES Permit
- California Ocean Plan
- Colorado Lagoon TMDL Compliance Monitoring
- EPA Environmental Monitoring & Assessment Program
- Milton Street Vegetative Stormwater Curb Extension Monitoring Plan
- SoCal Bight Program
- Special Protections for Areas of Special Biological Significance
- Surface Water Ambient Monitoring Program

Water Quality Data

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Downloaded Data

- CEDEN (2005–2018)
- Mass Emissions (2006–2015)
- MS4 (2015–2018)

Needed Data

Temperature, TSS, metals, and specific conductance data for:

- WRP discharges
- Mass emissions data at Wardlow pre-2006
- MS4 pre-2015
- What else?

TEMPERATURE MODELING

RIVER TEMPERATURE MODELING METHODS

Statistic

- Description:
  - ✓ Rely on the **correlation** between water temperature and local environmental variables.
- Pros:
  - ✓ Offer a **simple** means of predicting water temperature.
- Cons:
  - ✓ Require large datasets of observed river water and air temperatures.
  - ✓ Based on historical ‘training’ data and therefore have **limited capabilities for scenario modeling** and forecasting.

Mechanistic

- Descriptions:
  - ✓ Simulate the **physical processes** that control a river’s thermal behavior.
- Pros:
  - ✓ **Better suited for predicting** water temperature responses to climate and management scenarios.
- Cons:
  - ✓ Subject to uncertainties as a result of inputs that represent complex processes.
  - ✓ **Need more input data** compared with the statistic models.

Sun et al., (2015); Webb et al., (2008)

HEC-RAS Temperature Modeling Module

Pros:

- Designed for hydraulically-focused projects.
- Has a user-friendly graphical interface and can interface with spatial data

Cons:

- The HEC-RAS model has limits with respect to ecological restoration.
- It neglects the role of riparian shade, substrate temperature, and groundwater-surface water exchange (e.g., hyporheic fluxes).

Drake et al., (2010); Abdi et al., (2019) – Under Review

i-Tree Cool River ver. 1.1
An updated mechanistic model based on HEC-RAS, To create a more holistic package

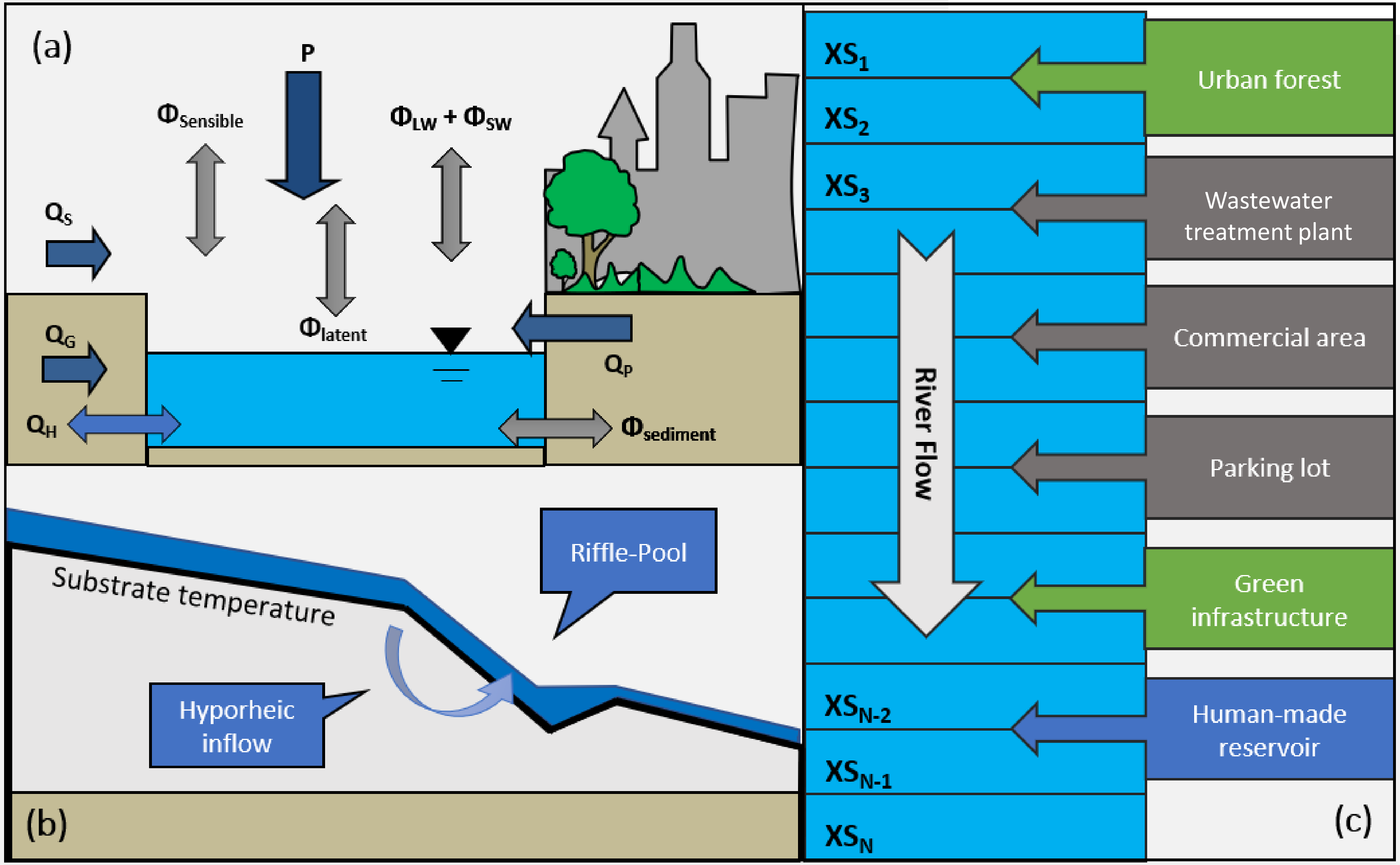
HEC-RAS — Designed for flood hazard mapping

- Running the HEC-RAS for the same domain and providing the outputs of river water surface profiles

i-Tree Cool River — Designed for ecological restoration

- Using the imported results as well as required inputs for the ecological restoration

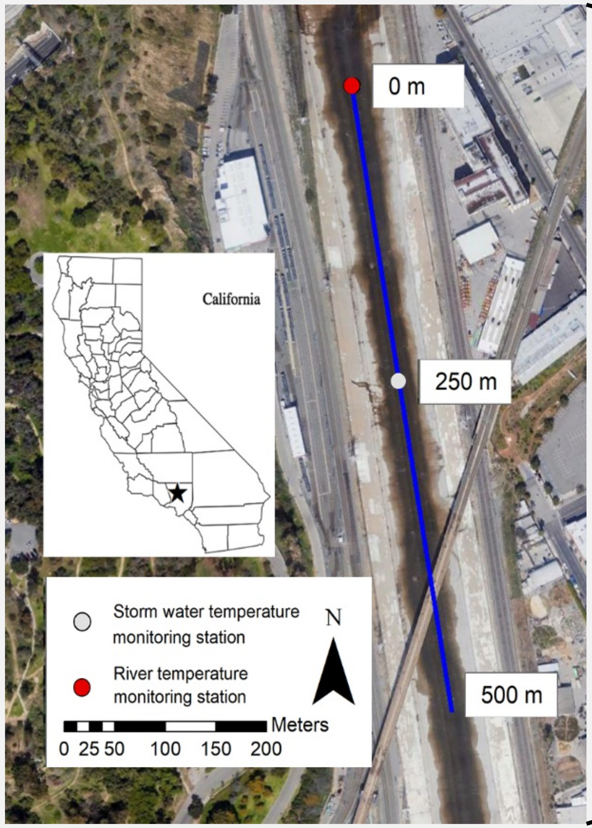
i-Tree Cool River Model Description

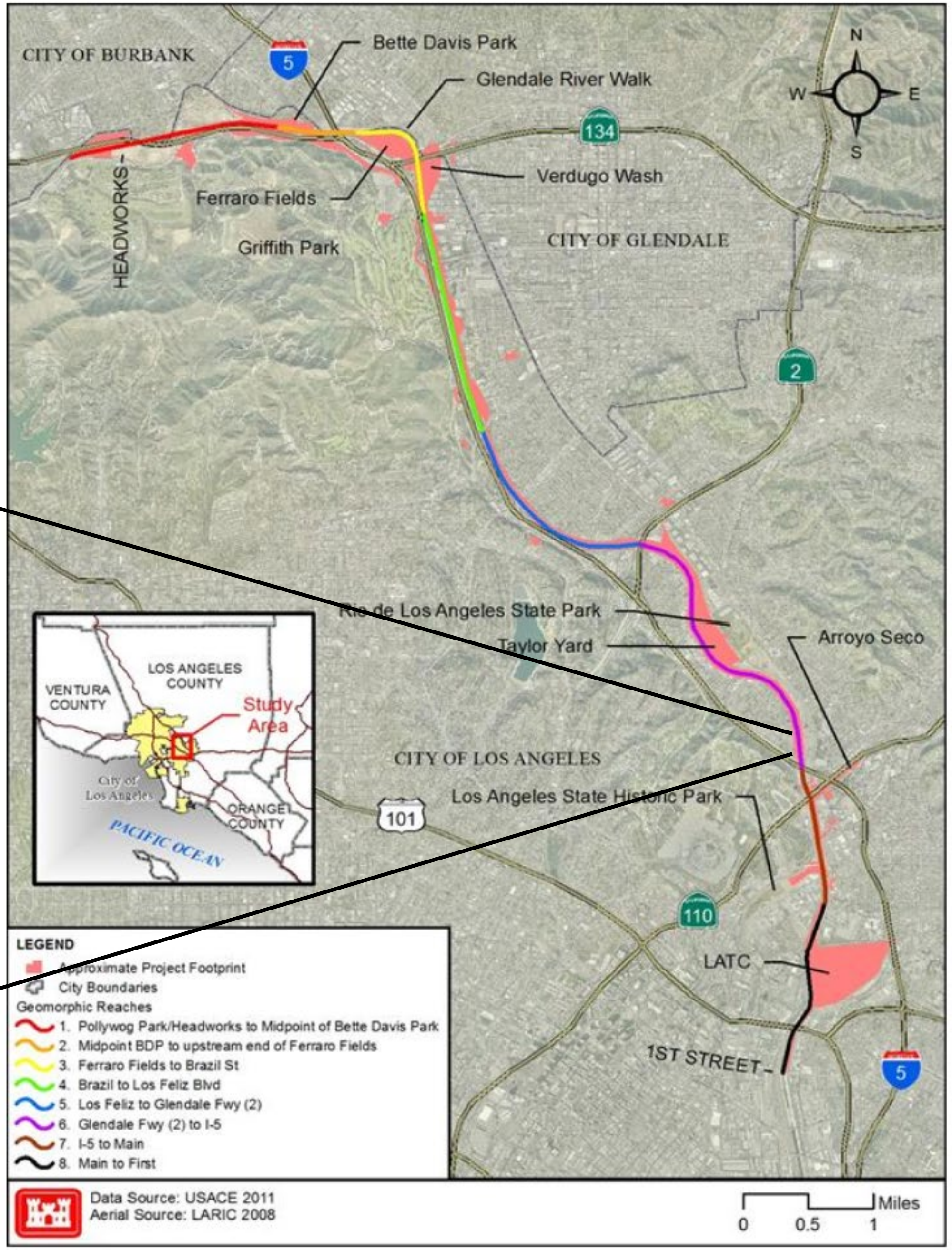


a) River cross-section view, demonstrating the energy and water balances. b) River longitudinal section for a riffle-pool bedform. c) River plan view demonstrating the lateral inflows that can be added to the river flow in either dry or wet weather.

i-Tree Cool River ver. 1.1 (LA River Case Study)

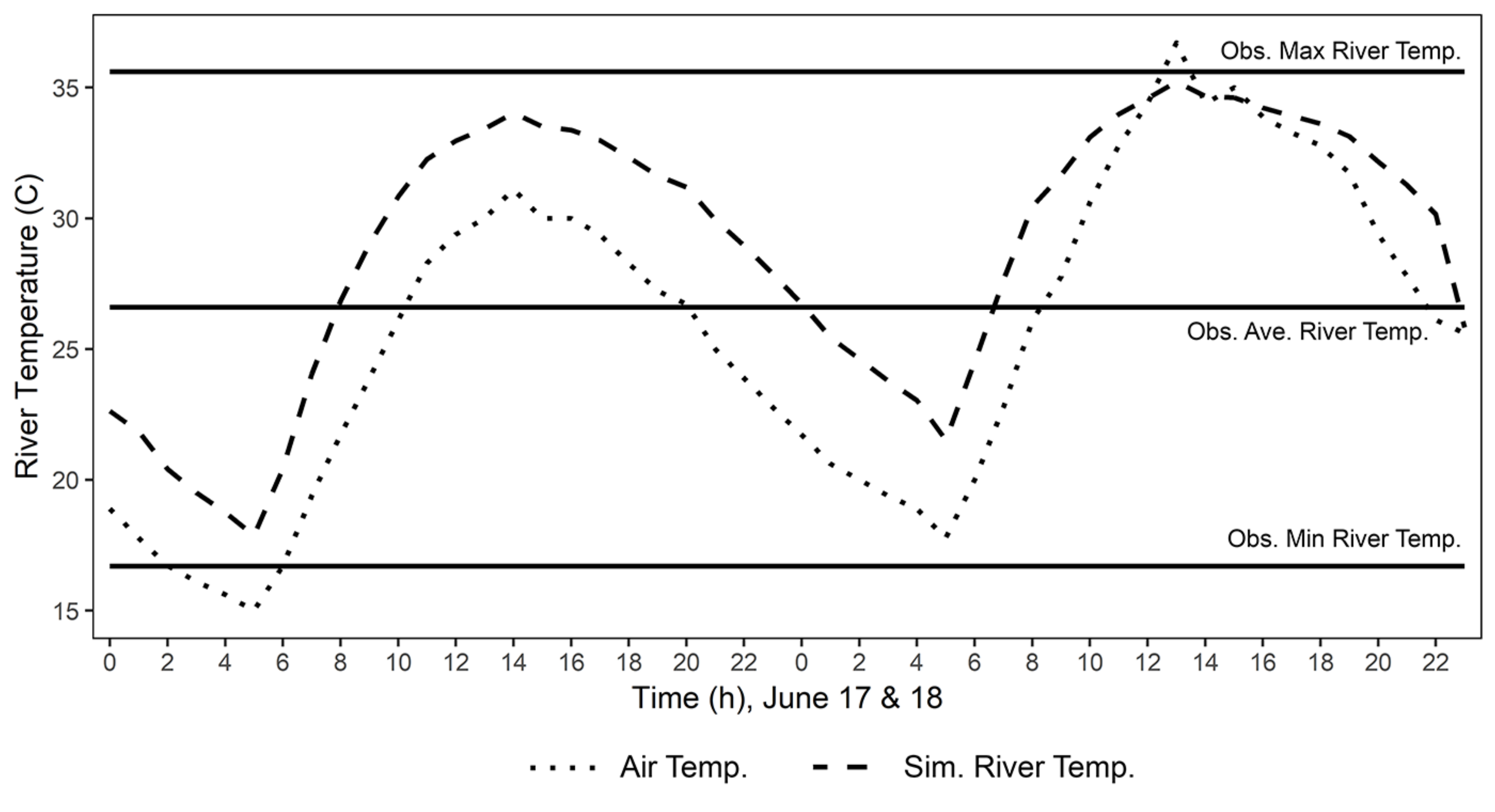
Simulated both a 500 m reach and a 11 mi stretch of LAR





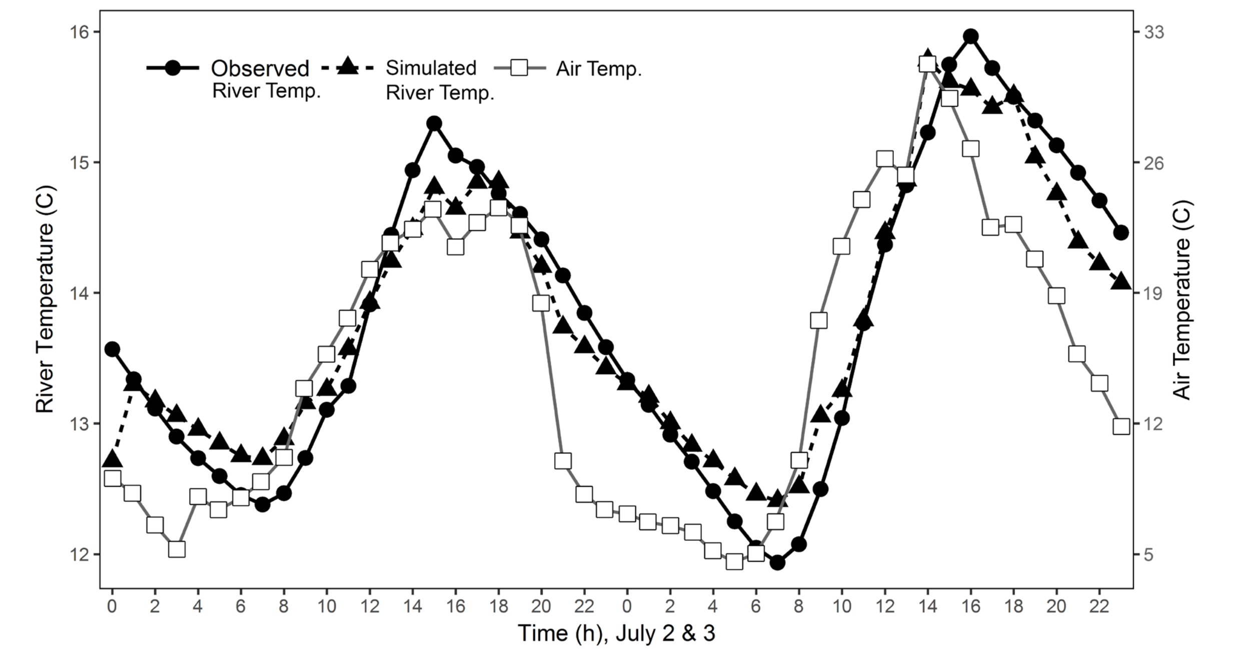
Abdi et al. 2019 – Under Review

Validation of i-Tree Cool River

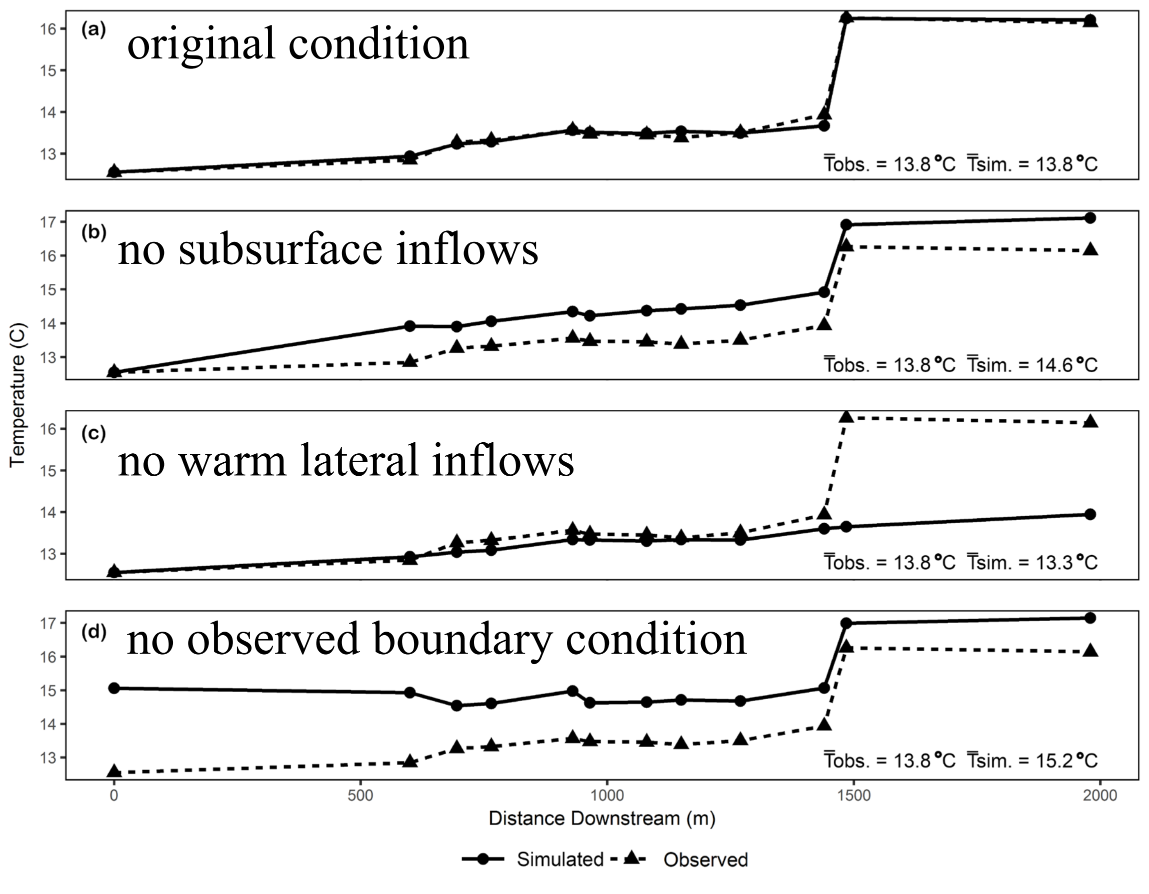


The hourly observed air temperature and simulated river temperature in the LA River for June 17 to 18, 2016

Validation of i-Tree Cool River



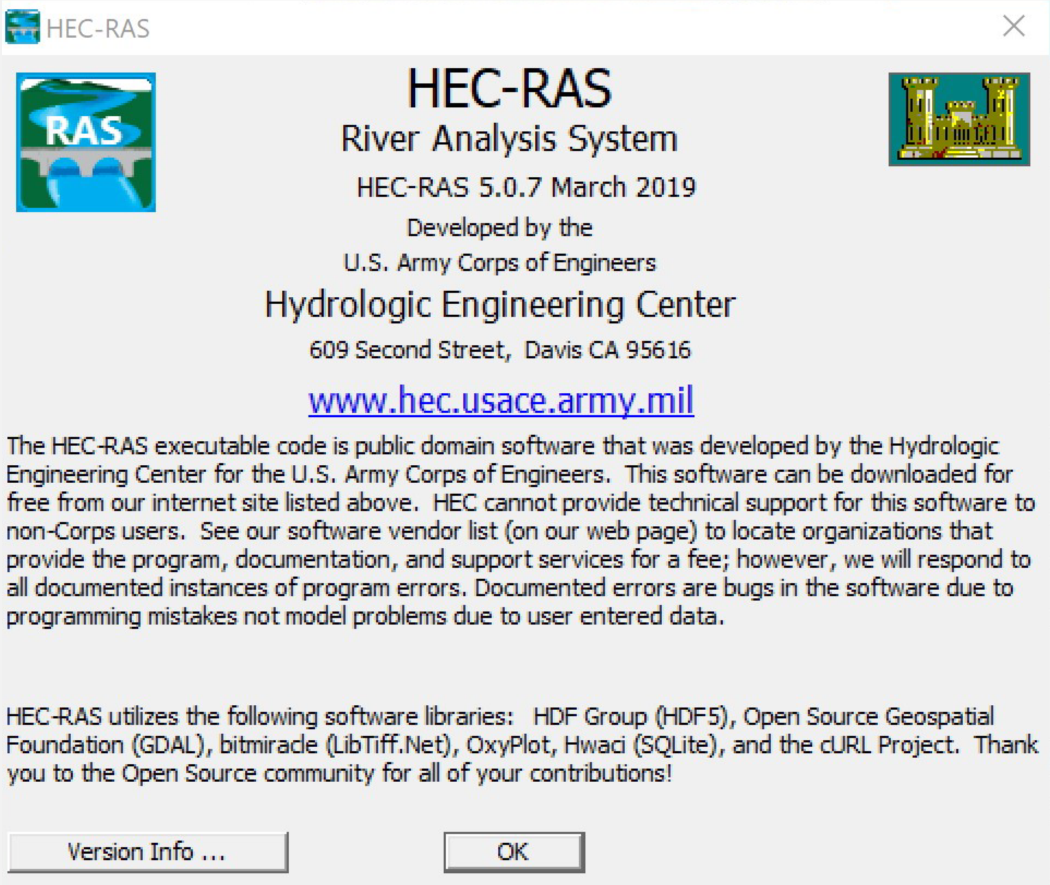
Hourly air temperature and average observed and simulated river temperatures in Sawmill Creek, NY



Observed and simulated river temperatures in Sawmill Creek, NY. The plots represent the average river temperature along the reach for different conditions.

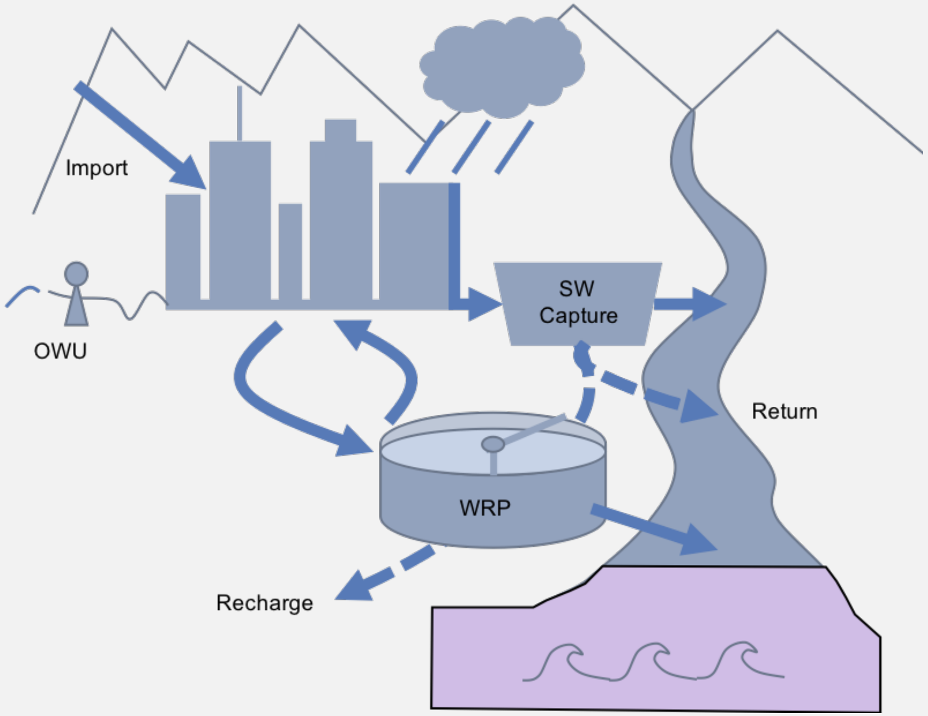
Proposed Approach

Simulate temperature for all the domain via HEC-RAS



Simulate temperature for specific reaches via i-Tree Cool River

Estuary Model



PURPOSE

- Simulate effects of hydrologic changes on beneficial uses in tidally-influence portion of the river
- How do changes in salinity, temperature, and depth impact wading shore birds?

PROPOSED APPROACH

- HEC-RAS for coarse resolution model
- Potentially apply iTree Cool River for temperature

Summary of data needs

- Burbank WRP discharge
- Van Norman Reservoir (?) inflow/outflow
- Water quality data (temperature, TSS, metals, specific conductance)
  - WRP discharges
  - Mass emissions data at Wardlow pre-2006
  - MS4 pre-2015
  - What else?

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MANAGEMENT SCENARIOS

Defining Management Scenarios

- Develop a set of management scenarios that represent a plausible range of potential water use/reuse scenarios that could affect beneficial uses
  - Provide sufficient resolution to inform decisions
- Ensure we consider all "sensitive" reaches of the study area
- Allow for consideration of tradeoffs between different uses along different reaches
- Limit analysis to a reasonable range of scenarios based on allowable time and resources

Elements to Consider in Management Scenarios

- Varying amounts of reduced discharge from three water reclamation plants

- Stormwater capture along Rio Hondo and Compton Creeks
  - Any potential stormwater capture in upper watershed (e.g. Arroyo Seco, Tujunga)?

- Restoration along Compton, Rio Hondo, Arroyo Seco
  - Implications for water consumption
  - Constraints on restoration goals

Bounding Ranges of Scenarios

- Bound scenarios based on extremes
- Define scenarios based on sensitivity of system to response
  - Develop sensitivity curves to help define ranges of scenarios
- Consideration of seasonal effects
- Consideration of cumulative effects of different management actions

Example: Ranges of Management Scenarios

Burbank Reuse	×	Glendale Reuse	×	Tillman Reuse	×	Stormwater Capture
0% recycle		0% recycle		0% recycle		Scenario #1
25% recycle		25% recycle		25% recycle		Scenario #2
50% recycle		50% recycle		50% recycle		Scenario #3
75% recycle		75% recycle		75% recycle		Scenario #4
100% recycle		100% recycle		100% recycle		Scenario #5

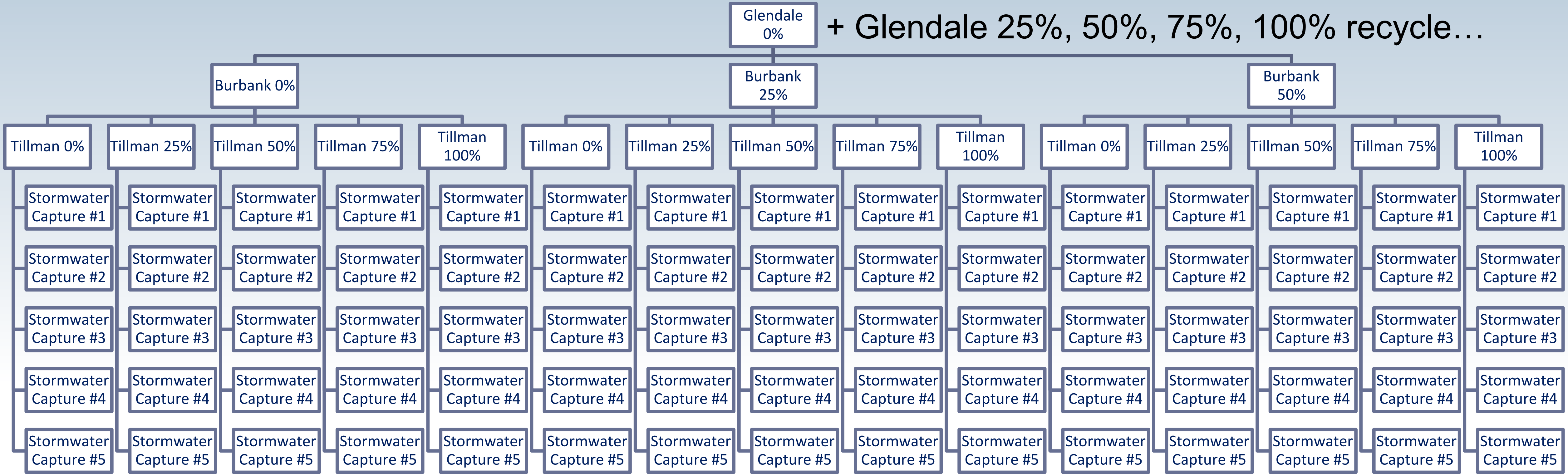
5 x 5 x 5 x 5 = 625 total scenarios

Bounding Management Scenarios by Extremes

Burbank Reuse	×	Glendale Reuse	×	Tillman Reuse	×	Stormwater Capture
0% recycle		0% recycle		0% recycle		No stormwater capture
100% recycle		100% recycle		100% recycle		Moderate stormwater capture
						Max stormwater capture

2 x 2 x 2 x 3 = 24 total scenarios

Bounding Management Scenarios Based on Criteria



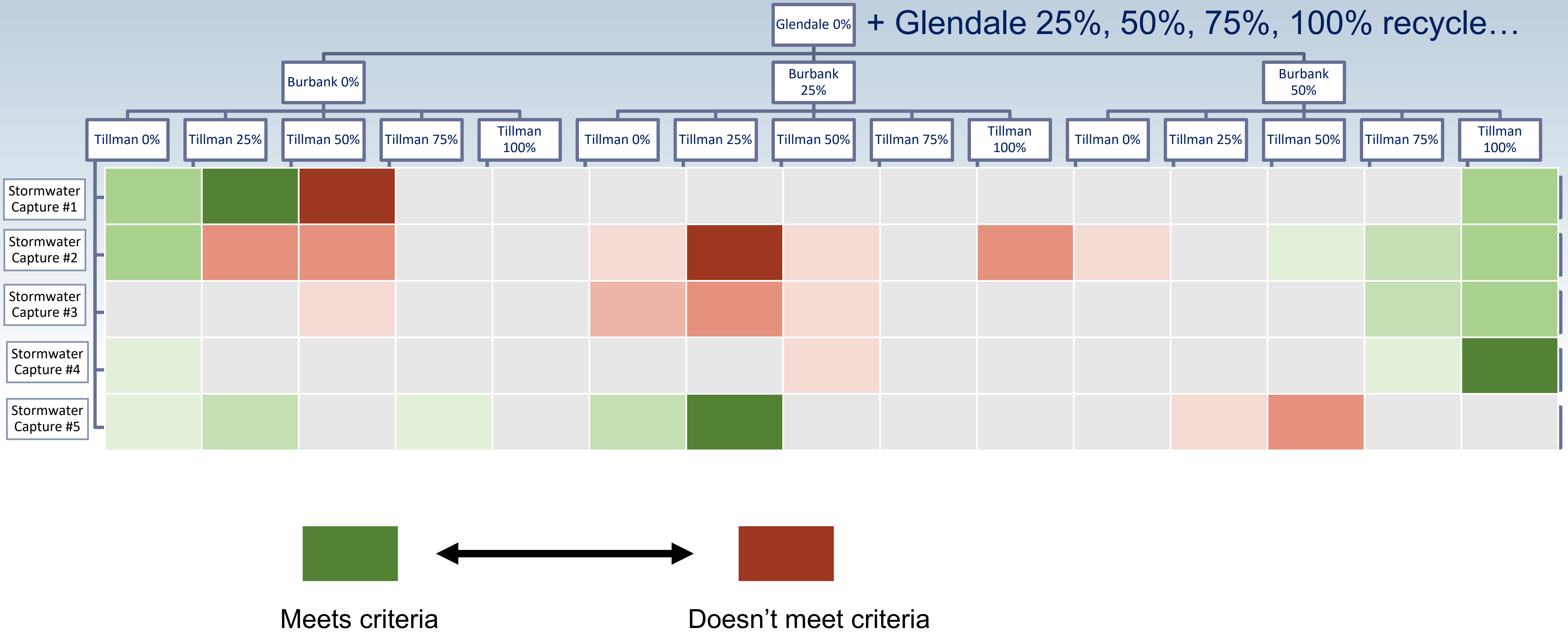
+ Glendale 25%, 50%, 75%, 100% recycle…

Sample Criteria

Criteria would be defined in coordination with Technical Advisory Group based on previously compiled flow-ecology relationships

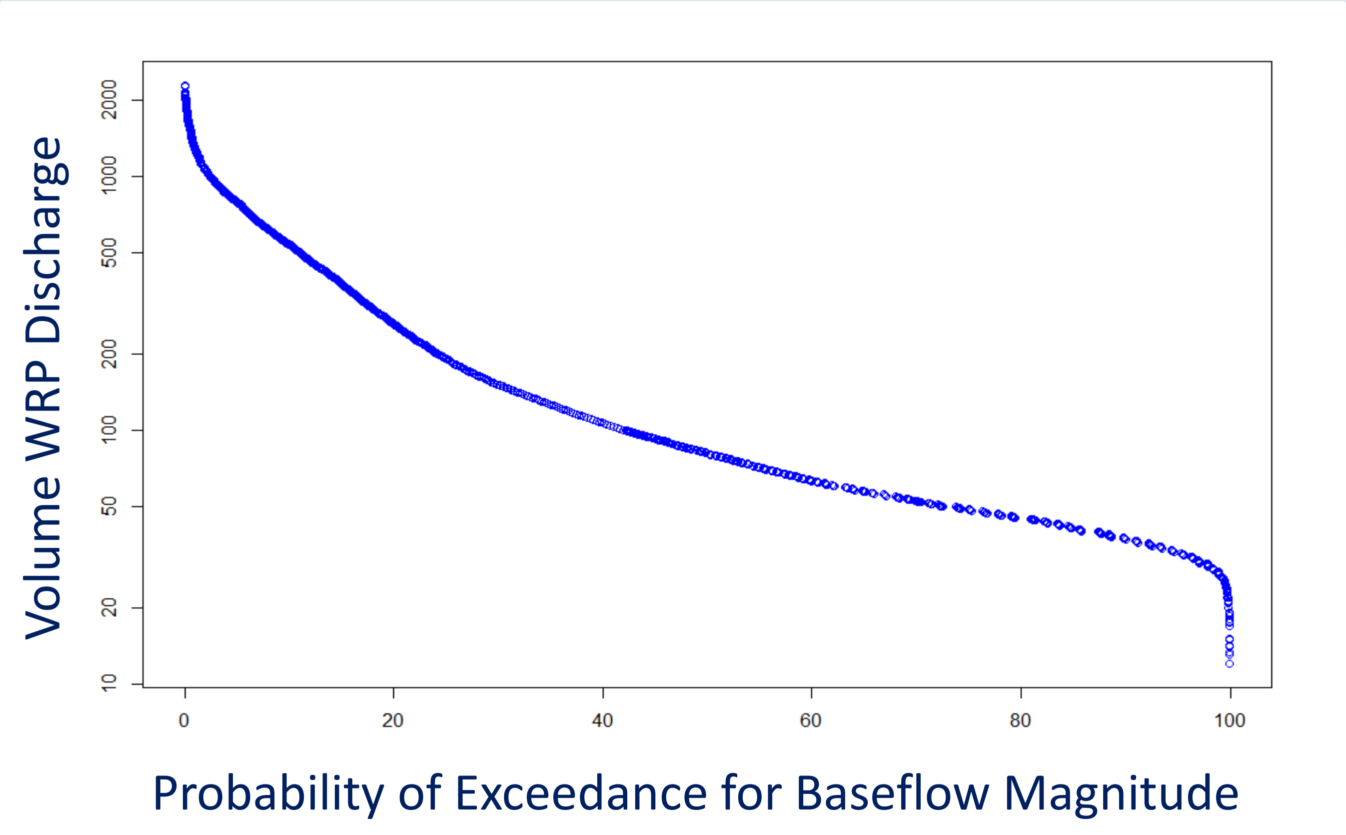
- Minimum change in baseflow at Glendale Narrows
- Ensure depth range in tidal reaches is within tolerances for wading birds
- Ensure water temperature does not increase by more than 20%

Bounding Management Scenarios Based on Criteria



Sensitivity Curves Approach

- Develop curves based on sensitivity of response of specific reaches
  - Based on different flow (or hydraulic metrics)
  - Based on different seasonal flow conditions



Develop multiple sensitivity curves based on key hydrologic properties

Scenario Details: Discussion

- Extremes vs. sensitivities??
- How to bound WRP reuse scenarios?
- How to bound stormwater capture scenarios?

Scenario Details: WRP Reuse

- How do we simulate percentages of recycling?
  - What is “100%”?
  - Take hourly/daily time series and scale?
  - Take annual/daily average and scale?
  - Change timing of flows?
  - Different distributions among each WRP facility
  - Etc.

Scenario Details: Stormwater Capture

- What stormwater reuse scenarios should we model?
  - Flexibility within SUSTAIN to model many types of BMPs, distributed and regional: bioretention, cistern, wetlands, ponds, swales, green roofs, infiltration trenches, detention vaults, porous pavements, etc.
  - Can implement for certain land uses, locations, or percent of total watershed area
  - Can size to 85th percentile storm or other capture volume
  - Can take scenarios from Stormwater Capture Master Plan or other design docs
  - Effects on restoration plans
  - Etc.

Flow Ecology Modeling

ECOLOGICAL EFFECTS

Statistical vs Mechanistic

	Statistical	Mechanistic
Spatial coverage	Regional, broad	Local, site specific
Ability to account for multiple variables?	Statistical combinations	Direct interactions
Data requirements on spp occurrence?	High	Low
Data requirements on life history needs?	Low	High
Easier to validate?	✓	✘
Flexibility in variables for modeling scenarios?	Low-moderate	High

Last time, we decided on a mechanistic approach

Habitat Suitability Model: Mechanistic

Biophysical model
- Activity
- Movement
- Foraging
- Water

- Predicts: Temperature limits

Kearney *et al* 2008

Life history model
- Temperature
- Age at maturity
- Survival
- Fecundity
- Lifespan

- Predicts: Recruitment

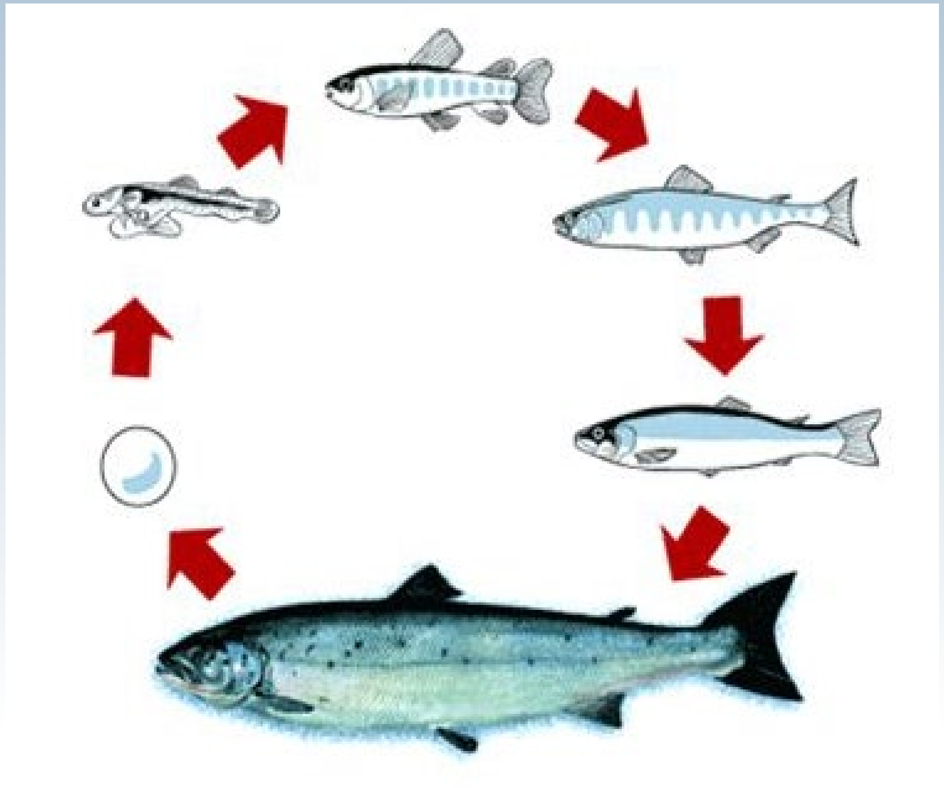
Buckley *et al* 2010

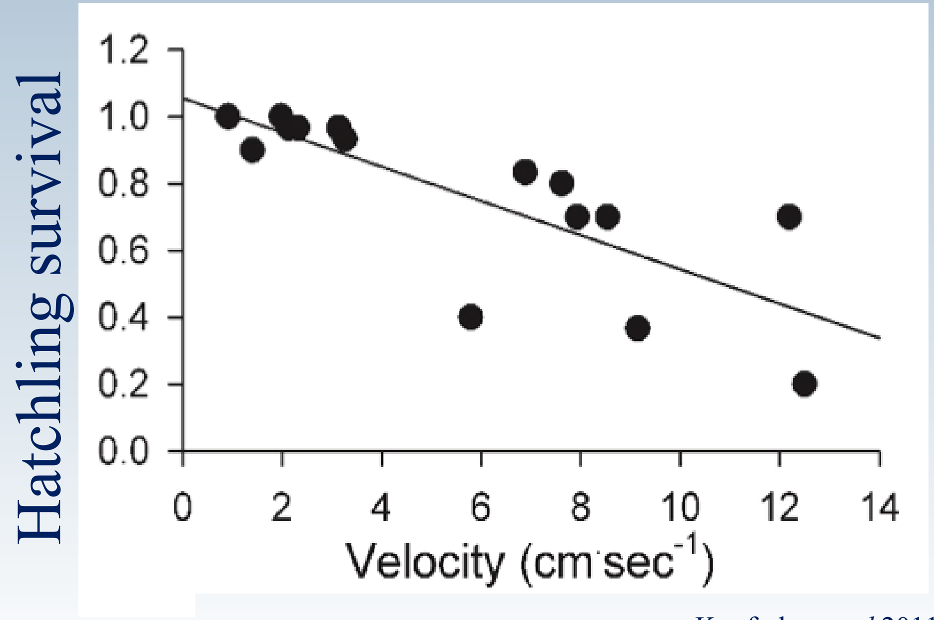
Phenology model
- Germination
- Seedling emergence
- Emergence to end of juvenile phase
- Appearance of pistillate flowers
- Seed maturity

- Predicts: Cold range margins

Chapman *et al* 2014,2017

Habitat Suitability Model: Hybrid





Kupferber *et al* 2011

1) Life cycle
- Separate SDMs for each life stage

Taboada *et al* 2013

2) Mechanistic variables for input into statistical model
- E.g. Survival V velocity = potential hatchling survival

Rodriguez *et al* 2019

3) Range Dynamic model
- Includes information about demography & dispersal

Zurrell *et al* 2016

Beyond our scope

Habitat Suitability Model

- Decide once we have the end member species
  - Species occurrences
  - Define requirements e.g. biophysical, phenological etc
- Species tolerance curves – experiment/literature data?

Focus on this during our next TAC meeting

Action Items and Next Steps

- Share non-aquatic life use assessment technical report
- Share habitat characterization tables
  - TAC review
- Refine flow management scenarios
  - TAC and Stakeholder input
- Fill data gaps:
  - WRP discharge from Burbank
  - Water quality data
- Next TAC meeting – **early January** – web-based or in-person?
  - Flow ecology modeling and prelim. results from hydrologic modeling

Questions

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Activity / Sub-Task	Products	2018	2019				2020			
		Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Activity 1 - Stakeholder coordination										
Stakeholder Advisory Group (SAG) Meetings	Charter, needs assessment, meeting notes		S1		S2		S3		S4	
Technical Advisory Committee (TAC) Meetings	Meeting notes, feedback		T1	T2	T3	T4	T5	T6	T7	
Activity 2 - Non-aquatic Life Use Assessment										
2A Characterize non-aquatic life uses	Map of NAL uses/indicators by reach									
2B Determine flow use relationships	Flow-use relationships & targets									
Activity 3 - Aquatic Life Beneficial Use Assessment										
3A Asses hydrologic baseline condition	Baseline hydrology/data gaps									
3B Identify priority ecological endpoints	List of priority endpoints, data summary									
3C Determine flow ecology relationships for stream endpoints	Flow eco models/targets by reach for BMI & verts									
3D Determine flow ecology relationships for marsh/estuary	Flow eco models/targets for marsh/est habitats									
Activitiy 4 - Apply Environmental Flows and Evaluate Scenarios										
4A Update hydrologic modeling	Hydro & hydraulic models of LAR									
4B Analyze tolerances to flow modifications	Flow tolerance ranges for riparian hab, BMI, verts									
4C Analyze wastewater reuse scenarios	Map wastewater reuse scenario effects on uses									
4D Evaluate stormwater management scenarios	Map of stormwater/wastewater scenarios effects									
4E Evaluate groundwater interaction scenarios	Map of groundwater/wastewater scenarios effects									
4F Evaluate habitat restoration effects	List of potential hab rest projs and map of uses									
4G Evaluate flow alteration effects on tidal portion of LA River	Map of scenario effects on tidal portion of LAR									
4H Establish recommended flow criteria	Recommended flow criteria by reach & season									
Activity 5 - Monitoring and Adaptive Mangement Plan	Proposed monitoring strategy									
Activity 6 - Summary of results/reporting	Draft and final project report									

Identify vegetation alliances within each group

Coldwater fish habitat	Riparian habitat	Freshwater marsh habitat	Wading shorebird habitat	Warmwater, perennial flow habitat (aquatic plants)
	Salix gooddingii woodland alliance	Schoenoplectus (acutus, californicus) hervaceous alliance	Concrete channel alliance	Ceratophyllum demersum Aquatic
	Salix exigua shrubland alliance	Typha (angustifolia, domingensis, latifolia) hervaceous alliance		Ruppia (cirrhosa, maritima) Herbaceous Alliance
	Salix laevigata woodland alliance	Eleocharis macrostachya Herbaceous Alliance		Typha (angustifolia, domingensis, latifolia) hervaceous alliance
	Salix lasiolepis shrubland alliance	Juncus arcticus (var. balticus, mexicanus) Herbaceous Alliance		Lemna (minor) and Relatives Provisional Herbaceous Alliance
	Baccharis salicifolia shrubland alliance			
	Alnus rhombifolia forest alliance			
	Rosa californica shrubland alliance			
	Platanus racemosa woodland alliance			
	Populus fremontii forest Alliance			

Overlap for cover/shading

Some waders and marsh birds overlap

Identify key species within each group

Species	Coldwater fish habitat	Riparian habitat	Freshwater marsh habitat	Wading shorebird habitat	Warmwater, perennial flow habitat
mallard					
western grebe					?
least bittern					
great blue heron					
black-crowned night heron					
common moorhen					
long-billed curlew					
spotted sandpiper					
American bullfrog					
least bell's vireo					
common yellowthroat					
American dipper					
steelhead					
largemouth bass					

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FOR REFERENCE

Stormwater Capture Master Plan - Scenarios

1. **Self-mitigating permeable pavement**
2. **On-site infiltration**: permeable pavement receiving run-on, simple rain garden, complex bioretention, dry wells
3. **On-site direct use**: simple direct use, complex direct use
4. **Green street programs:** permeable pavement receiving run-on, simple rain garden, complex bioretention, ROW bulb-out
5. **Subregional infiltration**: underground gallery, infiltration basin
6. **Subregional direct use**: complex direct use

Stormwater Capture Master Plan

BMP sizes of 1.5, 1.2, and 1 times the 85th percentile storm depth were applied for categories A, B, and C, respectively.

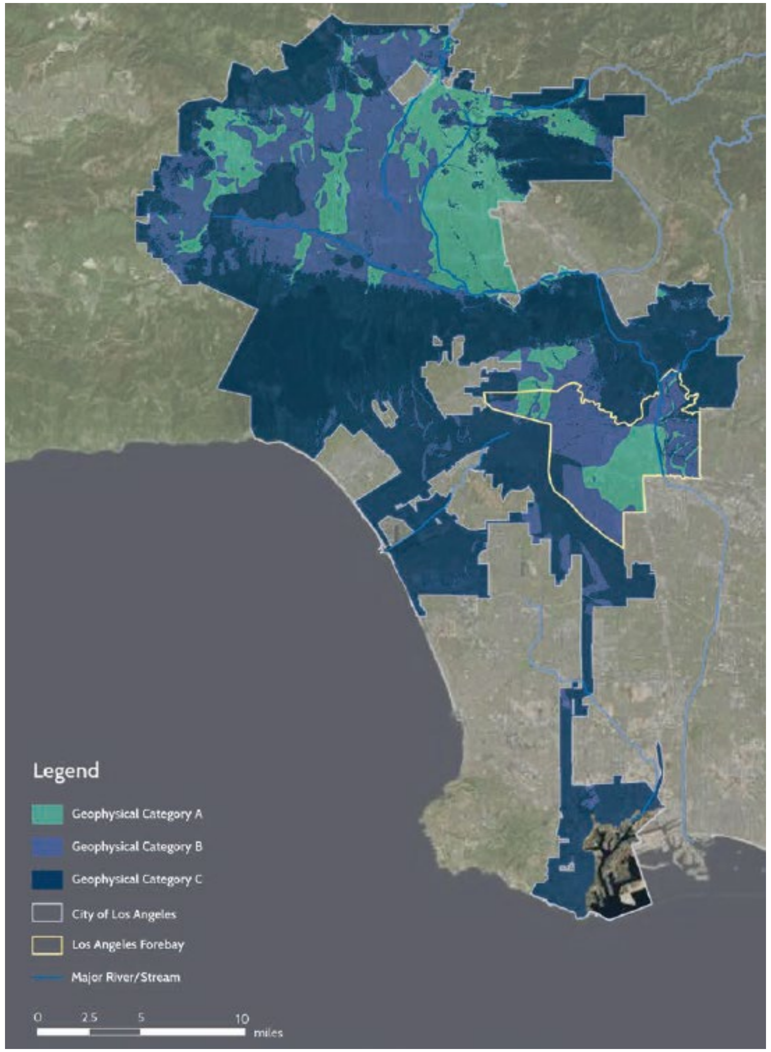

Table 5. BMP Implementation Rates for Geophysical Categorization in the Conservative Scenario

Land use	A	B	C
High Density Single Family Residential	35%	25%	15%
Low Density Single Family Residential with Moderate Slope	30%	20%	10%
Low Density Single Family Residential with Steep Slope	22%	12%	2%
Multi-family Residential	35%	25%	15%
Commercial	37%	27%	17%
Institutional	57%	47%	37%
Industrial	50%	40%	30%
Transportation	52%	42%	32%
Secondary Roads	47%	37%	27%

Table 6. BMP Implementation Rates for Geophysical Categorization in the Aggressive Scenario

Land use	A	B	C
High Density Single Family Residential	50%	40%	30%
Low Density Single Family Residential with Moderate Slope	40%	30%	20%
Low Density Single Family Residential with Steep Slope	25%	15%	5%
Multi-Family Residential	50%	40%	30%
Commercial	55%	45%	35%
Institutional	95%	85%	75%
Industrial	80%	70%	60%
Transportation	85%	75%	65%
Secondary Roads	75%	65%	55%