# Establishing Environmental Flows for the Los Angeles River

**Technical Advisory Committee Special Webinar**
**December 18, 2020**

SCCWRP
Established 1969

CALIFORNIA
Water Boards
STATE WATER RESOURCES CONTROL BOARD
REGIONAL WATER QUALITY CONTROL BOARDS

Council for Watershed Health

COLORADO SCHOOL OF MINES
EARTH • ENERGY • ENVIRONMENT

# LA River's Changing Water Use Practices

What are the potential impacts (+ or -) to existing and potential future instream beneficial uses in the Los Angeles River caused by reductions of wastewater treatment plant discharges and/or stormwater capture?

# LA River Environmental Flows Project Goals

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

2. Engage affected parties to reach consensus about appropriate flow needs and optimal allocation of flow reduction allowances from multiple wastewater reclamation plants, in consideration of other proposed flow management actions

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

4. Support the State Water Resource Control Board's decision-making under Water Code Section 1211.

# Anticipated Products and Outcomes

## Products

- Process for establishing flow criteria
- Application of process to develop potential flow criteria for LA River
- Tools to evaluate management scenarios necessary to achieve criteria

## Outcomes

- Determination of beneficial use attainment
- Implementation plan/strategy
  - Monitoring
  - Adaptive management
- Roadmap for application to other areas

# Summary of Coordination and Outreach

- Year-long scoping process – 4 stakeholder meetings
- Five previous TAC meetings  since January 2019
- Four stakeholder workgroup meetings
- Two workshops on recreational uses
- Numerous briefings and presentations to community groups and associated LA River programs

# Today’s Objectives and Agenda

**Meeting Objectives:**

- Discuss approach for synthesizing flow recommendations
- Review sensitivity curve approach for scenario analysis
- Discuss how to incorporate analysis of stormwater capture

## AGENDA

- Introductions and meeting goals – 9:00 – 9:15
- Review major findings of baseline conditions report – 9:15 – 9:45
- Discuss approach for developing overall flow recommendations – 9:45 – 10:45
  - Synthesizing needs of different species/life stages
  - Preview of product for final recommendations
- Break – 10:45 – 11:00
- Review sensitivity curves approach – 11:00 – 11:45
  - Examples for evaluating reduced WRP discharge
  - Consideration of reduced stormdrain discharge and stormwater capture
- Wrap-up, action items and next steps – 11:45 – 12:00

TAC Webinar #5: May 12, 2020

# RECAP FROM LAST MEETING

# Summary of May 2020 TAC Meeting

- Discussed overall goals of the analysis
  - Evaluate moderate-high probability of flows being able to support focal species
  - NOT to capture the entire range of potential conditions that could support focal species; more appropriate for a restoration planning
- Reviewed details of flow ecology analysis
- Solicited feedback from TAC on details of curve development
- Prepared a detailed response matrix – distributed to the TAC

# Key Recommendations

- Address within channel microhabitats explicitly or spatially interpolate between them
- Add details on any species curve/threshold validation and appropriate caveats and limitations of flow-ecology analysis
- Update data on Santa Ana Sucker
- Revisit thresholds for several species
- Explore more complex models for Typha

# Follow Up From TAC Meeting

Key updates to species habitat models:

- Removal of data from certain species curves
  - Santa Ana Sucker (depth & velocity models)
- Removal of Santa Ana Sucker (Spawning)
  - Due to data limitations
- Updates to species thresholds and curves
  - Steelhead
  - Santa Ana Sucker Fry
  - Adult Willow
  - Boundaries added to Santa Ana Sucker depth curves
  - Review Willow Seedling ~ Shear Stress

Details provided in species model section of presentation

# Baseline Conditions Report - Current Status

- Hydrologic and biologic models are complete
- Current conditions report revisions nearly complete
- Developing preliminary flow recommendations and sensitivity curves
- **Thank you for your input!**

Assessment of Aquatic Life Use Needs for the Los Angeles River:

Los Angeles River Environmental Flows Project


Eric D. Stein[1], Jordyn Wolfand[2], Reza Abdi[3], Katie Irving[1], Victoria Hennon[3], Kris Taniguchi-Quan[1], Daniel Philippus[3], Anna Tinoco[2], Ashley Rust[3], Elizabeth Gallo[3], Colin Bell[3], Terri S. Hogue[3]

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Draft – October 15, 2020

# Finalizing the Baseline Conditions Report

- Updated hydraulic analysis
- Update water quality figures based on model output
- Expanded temperature analysis along mainstem
- Clarified that models assume static upwelling vs. managing groundwater at specific level of discharge
- Updated and revised species occurrence curves
- Separated results for species/habitats between those that are currently supported vs. those that are not currently supported

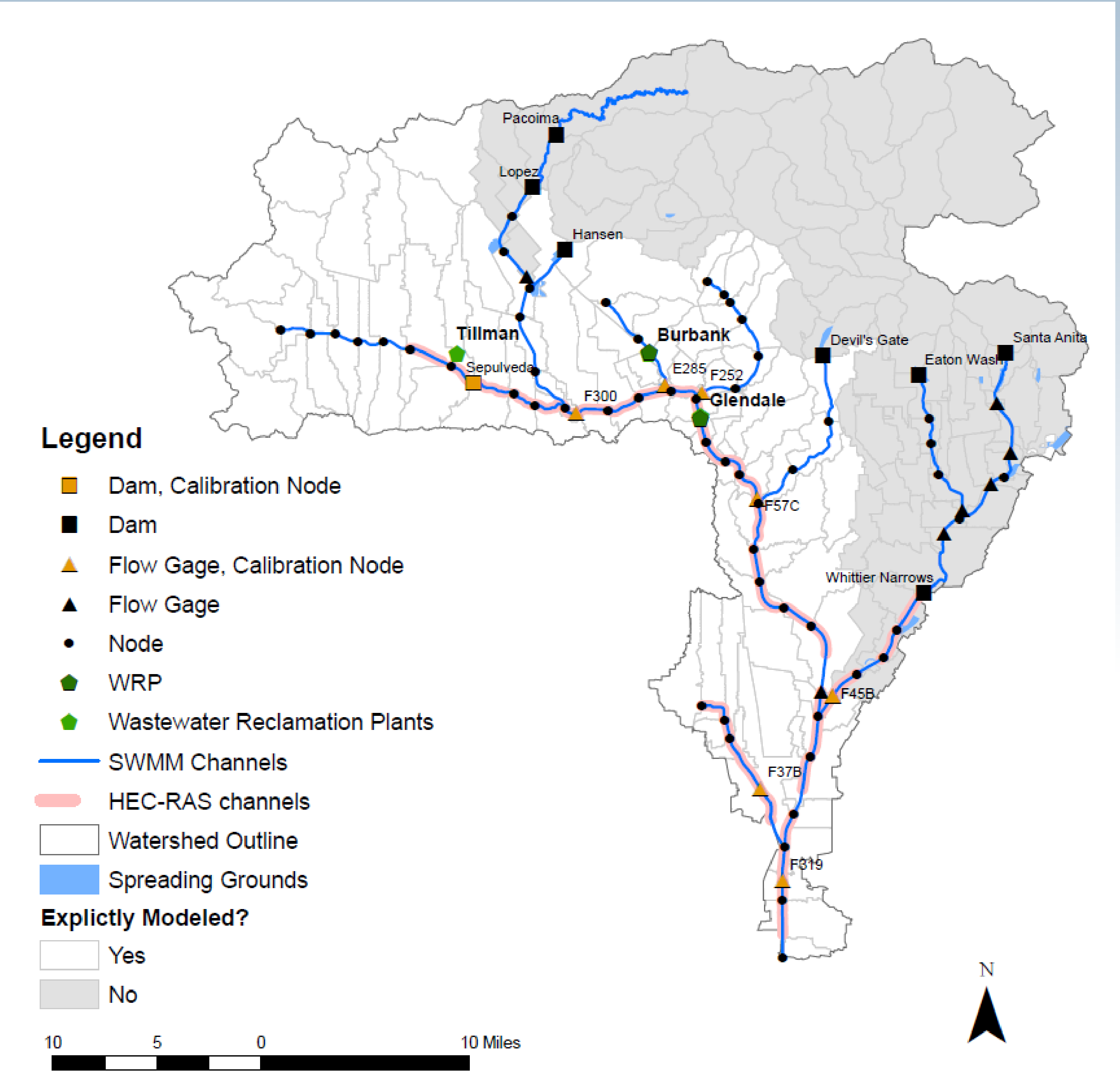
# Today's Meeting

- Review species curve development and thresholds
- Discuss approach for synthesizing flow recommendations
- Review sensitivity curve approach for scenario analysis
- Discuss how to incorporate analysis of stormwater capture

Summary from Baseline Report

# RECAP OF HYDROLOGIC ANALYSIS

# Analysis Domain




**Hydrologic Model (SWMM)**

- Discharge
- Continuous (Water Year 2011-2017)
- 115 Subcatchments
- 76 Nodes and Reaches
- 18 Key Reporting Nodes

**Hydraulic Model (HEC-RAS)**

- Velocity, Depth, Shear Stress
- Steady State
- 34 Output Nodes – 18 Reporting Nodes
- >3000 Cross Sections

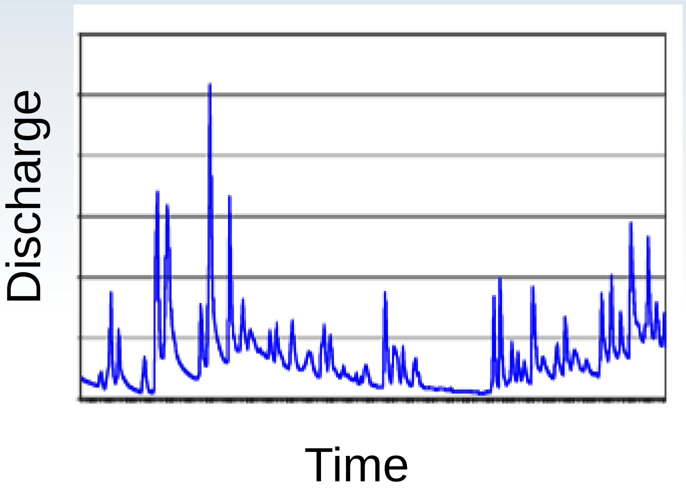
**Temperature Model (i-Tree Cool River)**

# Study Focus

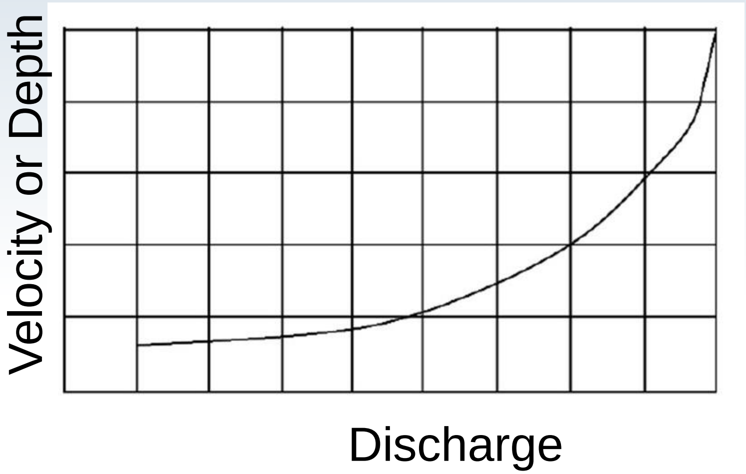

Within the banks of the LA River mainstem
Cypress Park
N
800 m
Google Earth
© 2018 Google

# Coupled SWMM & HEC-RAS Model

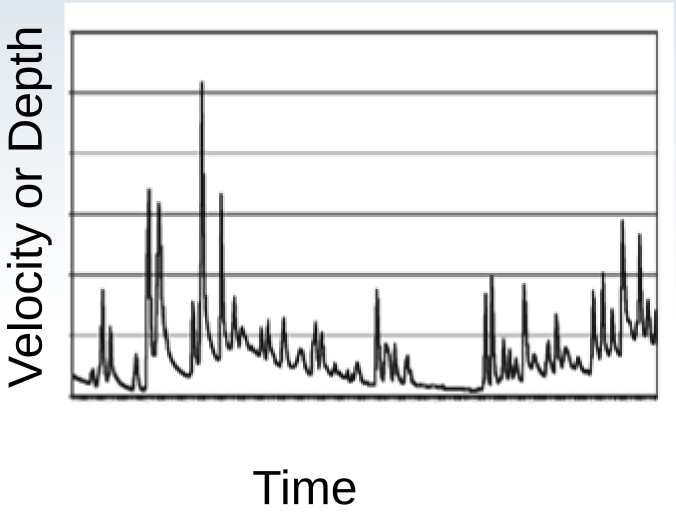
**Hydrology Model**
SWMM
Unsteady (WY 2011 to 2017, hourly timestep)




**Hydraulic Model**
HEC-RAS
Steady state to create rating curves*




**Output**
Timeseries

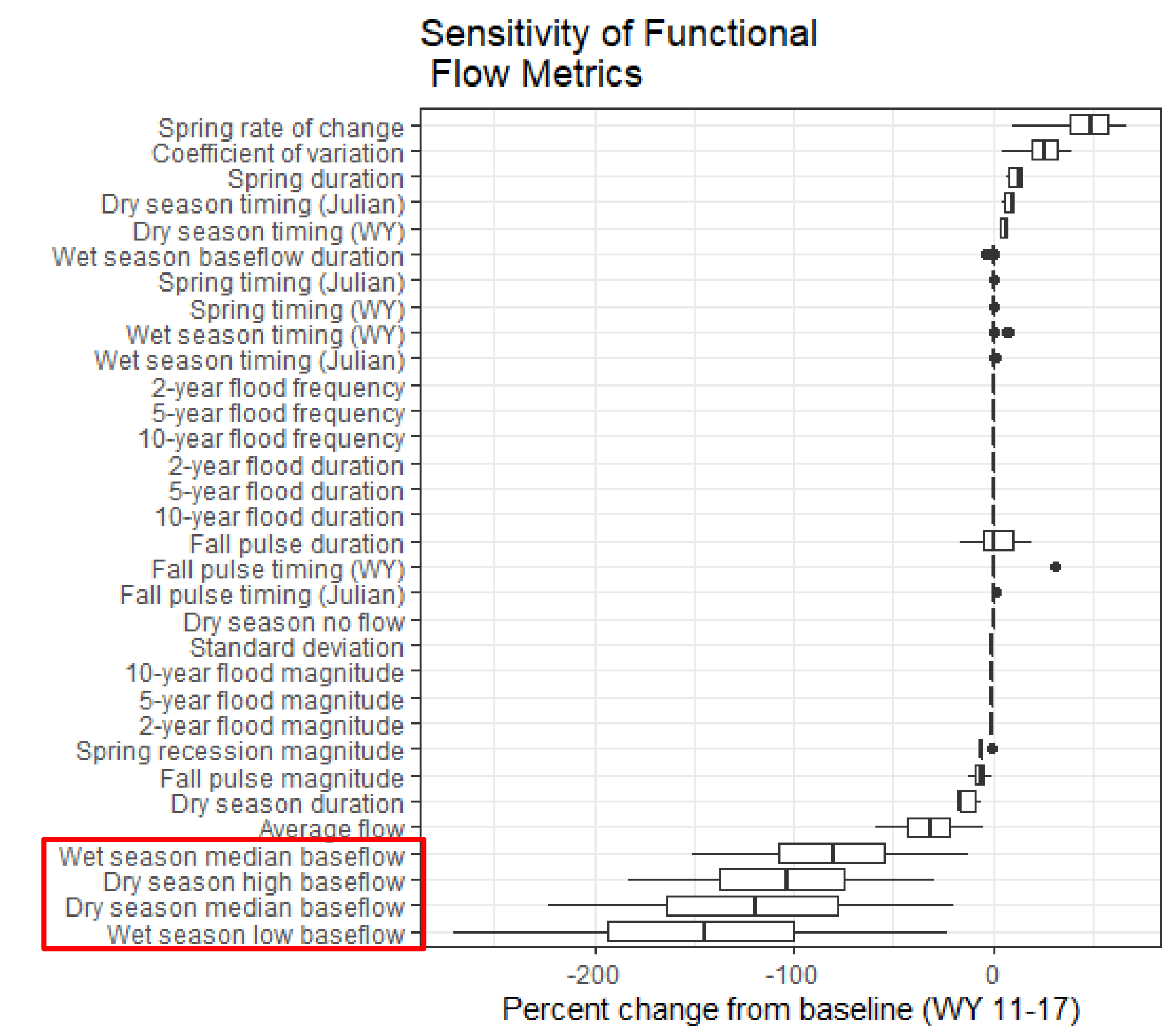



*Rating curves for main channel(s) and overbanks; does not capture edge water conditions

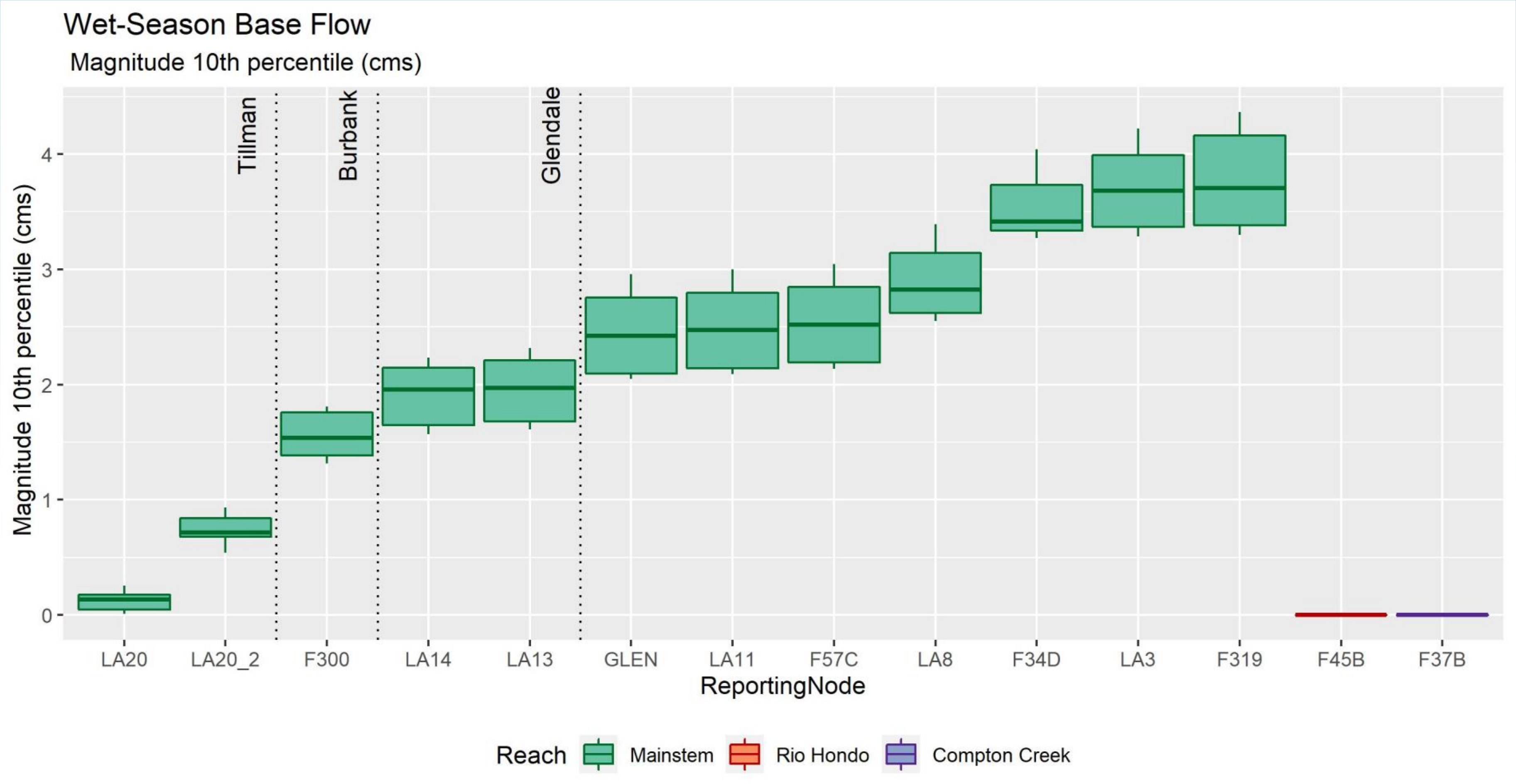
# Functional Flow Metrics from State Env. Flows Framework

| Flow Component | Flow Characteristic | Flow Metric |
|---|---|---|
| **Fall pulse flow** | Magnitude (cfs) | Peak magnitude of fall season pulse event (maximum daily peak flow during event) |
| | Timing (date) | Start date of fall pulse event |
| | Duration (days) | Duration of fall pulse event (# of days start-end) |
| **Wet-season base flows** | Magnitude (cfs) | Magnitude of wet season baseflows (10th and 50th percentile of daily flows within that season, including peak flow events) |
| | Timing (date) | Start date of wet season |
| | Duration (days) | Wet season baseflow duration (# of days from start of wet season to start of spring season) |
| **Peak flow** | Magnitude (cfs) | Peak-flow magnitude (50%, 20%, 10% exceedance values of annual peak flow --> 2, 5, and 10 year recurrence intervals) |
| | Duration (days) | 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 | 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 flows** | Magnitude (cfs) | Spring peak magnitude (daily flow on start date of spring-flow period) |
| | Timing (date) | Start date of spring (date) |
| | Duration (days) | Spring flow recession duration (# of days from start of spring to start of summer base flow period) |
| | Rate of change (%) | Spring flow recession rate (Percent decrease per day over spring recession period) |
| **Dry-season base flows** | Magnitude (cfs) | Base flow magnitude (50th and 90th percentile of daily flow within summer season, calculated on an annual basis) |
| | Timing (date) | Summer timing (start date of summer) |
| | Duration (days) | Summer flow duration (# of days from start of summer to start of wet season) |

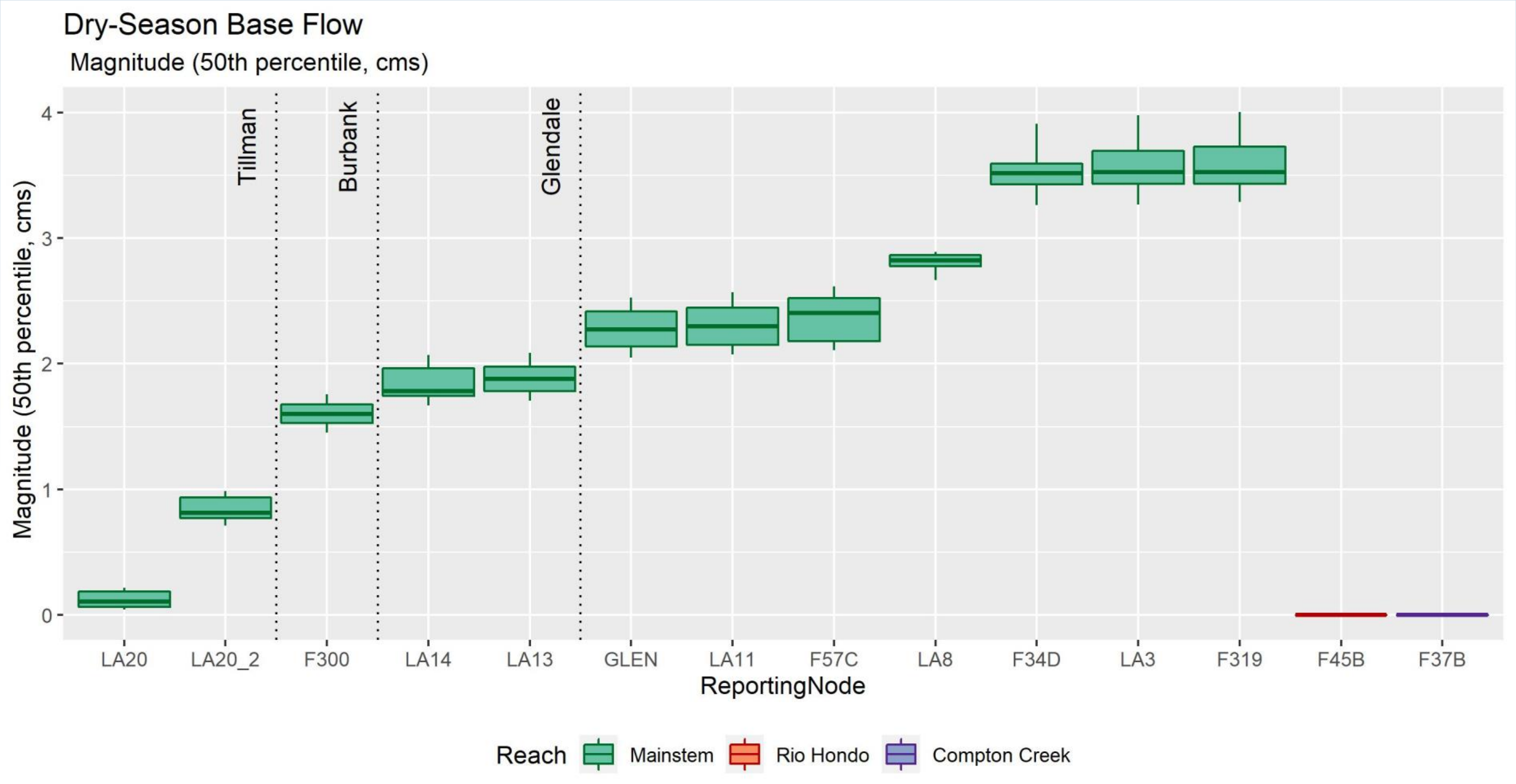
# Sensitivity of Metrics to Reductions in WRP Discharge



# Wet-Season Base Flow



# Dry-Season Base Flow



# Additional Analyses

More details in baseline conditions report:

✓ Verified soft-bottom channel cross sections

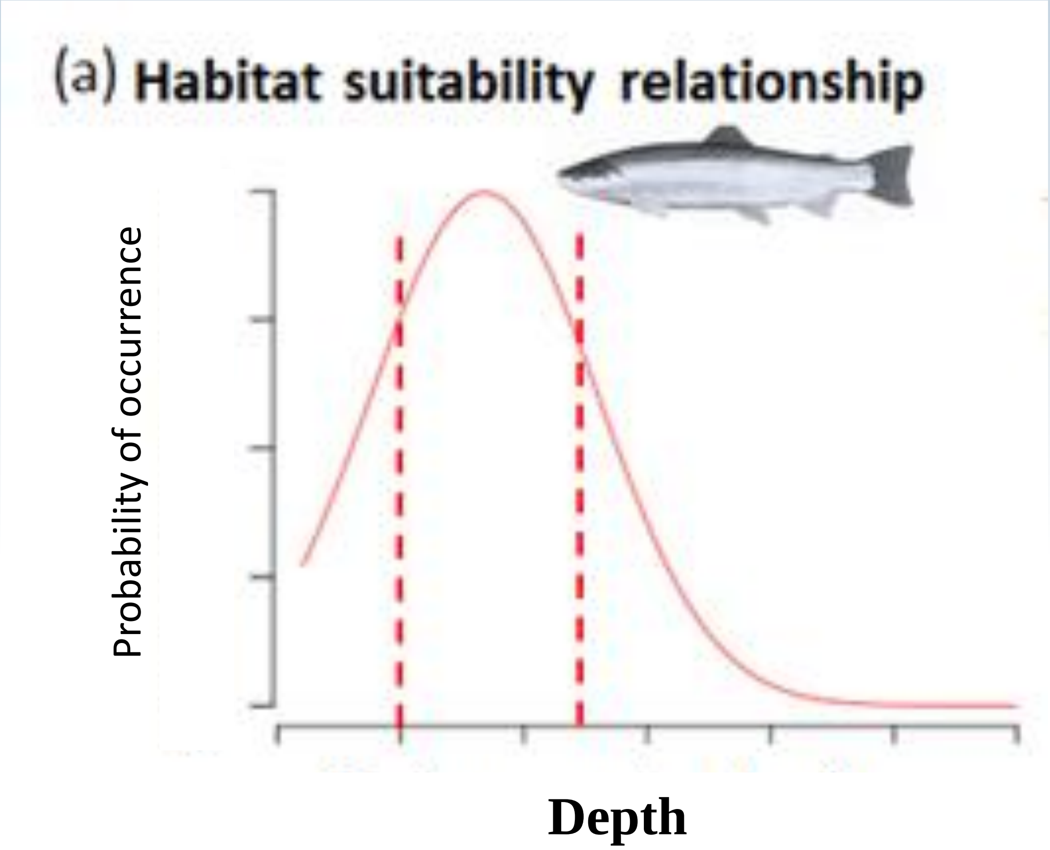
✓ Created hydraulic relationships

- Incorporating tidal reaches (in development)

Habitat Modeling

# REVIEW OF SPECIES CURVE DEVELOPMENT

# Objective: Develop Probability Relationships Based on Observed Species Life History Traits/Occurrences



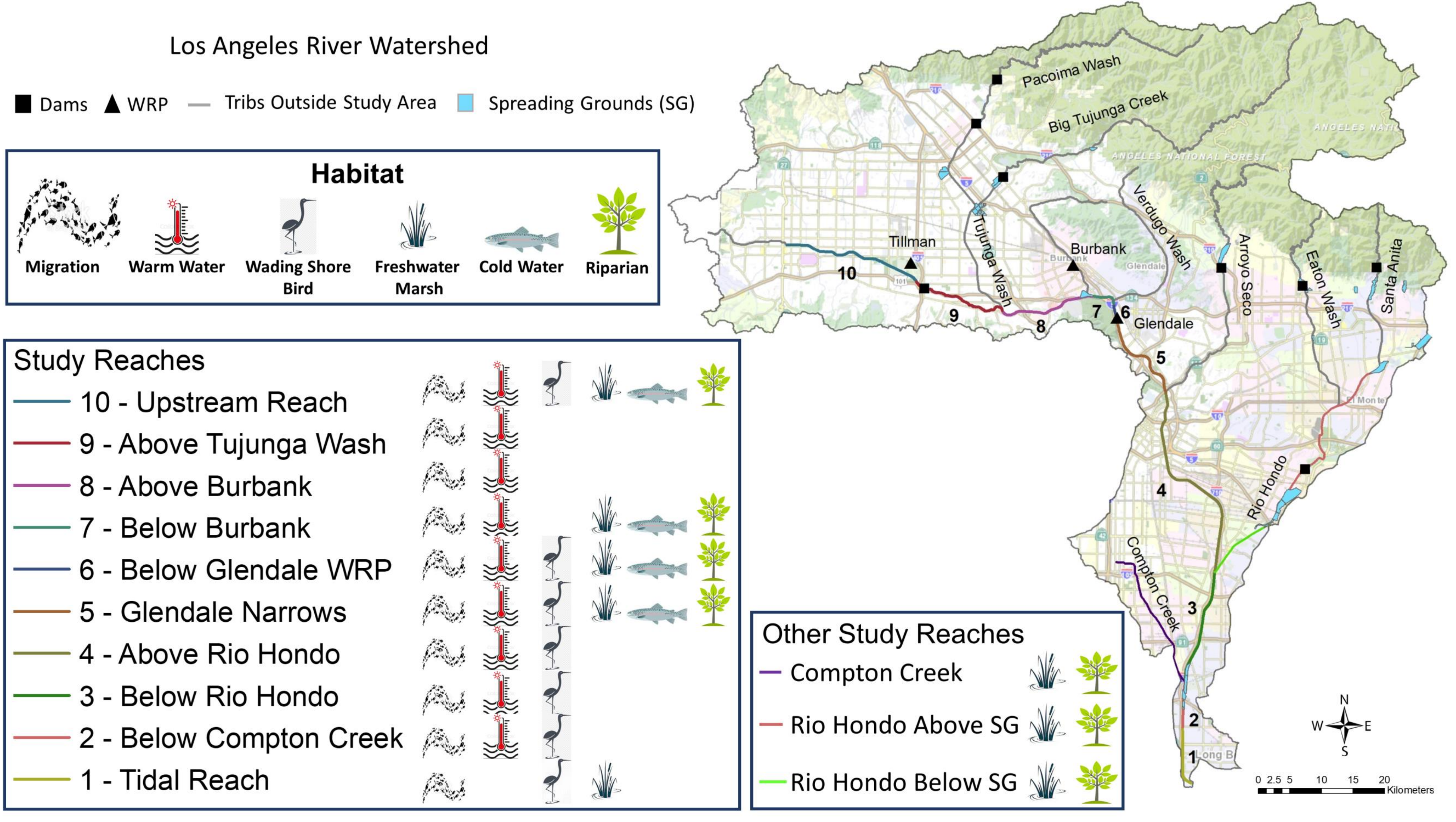

Repeat this process:

- All species & habitats
- All life stages

# Species & Habitats

| Habitat | End member species | Description |
|---|---|---|
| Cold water habitat | Santa Ana Sucker | Not currently present, but could potentially be in the future |
| | Unarmored threespine stickleback | |
| Migration habitat | Steelhead/Rainbow trout | Currently, only designated for Reach 1, but could potentially occur in other reaches in the future.<br>Overlays with other habitats |
| Wading shorebird habitat | Cladophora spp | Green algae to support prey of wading birds |
| Freshwater marsh habitat | Typha | |
| | Duckweed | |
| Riparian habitat | Black Willow | |
| Warm water habitat | African clawed frog | Surrogate for invasive spp. Habitat |
| | Mosquitofish | |

- **Not associated with currently designated beneficial uses**
- **Not currently observed in LA River**


Los Angeles River Watershed
Dams
WRP
Tribs Outside Study Area
Spreading Grounds (SG)
Habitat
Migration
Warm Water
Wading Shore Bird
Freshwater Marsh
Cold Water
Riparian
Study Reaches
10 - Upstream Reach
9 - Above Tujunga Wash
8 - Above Burbank
7 - Below Burbank
6 - Below Glendale WRP
5 - Glendale Narrows
4 - Above Rio Hondo
3 - Below Rio Hondo
2 - Below Compton Creek
1 - Tidal Reach
Other Study Reaches
Compton Creek
Rio Hondo Above SG
Rio Hondo Below SG
Pacoima Wash
Big Tujunga Creek
ANGELES NATIONAL FOREST
Tillman
Tujunga Wash
Burbank
Verdugo Wash
Arroyo Seco
Eaton Wash
Santa Anita
Glendale
Rio Hondo
Compton Creek
El Monte
Long B
10
9
8
7
6
5
4
3
2
1
N
W
E
S
0 2.5 5 10 15 20
Kilometers

# Overall Process

1. Data compilation for focal species habitat conditions
   – Primary and grey literature (surveys, experiments)
2. Species curves/thresholds created from appropriate models
   – Models dependent on data (e.g. probability distribution, linear regression)
3. Apply species model to hydraulic variables at each node
   – Use rating curve to define threshold of flow
4. Calculate amount of time each node is within flow thresholds
   – Estimate suitability of baseline conditions
5. Apply management scenarios to species curves

# Species Curves & Thresholds

- Where possible curves were built to explain the relationship with habitat variable (e.g. Seedling ~ depth)
- In some cases, data limitations meant that thresholds were applied in place of curves (e.g. Migration)
  - Not as flexible as curves
  - But resulted in important species/life stage ~ habitat relationships being retained in the model
  - Thresholds were defined using habitat suitability reports and advice from TAC members

Habitat Modeling

# ENDMEMBER SPECIES ASSOCIATED WITH CURRENT BENEFICIAL USES

# Willow

## Life Stages & Model Types

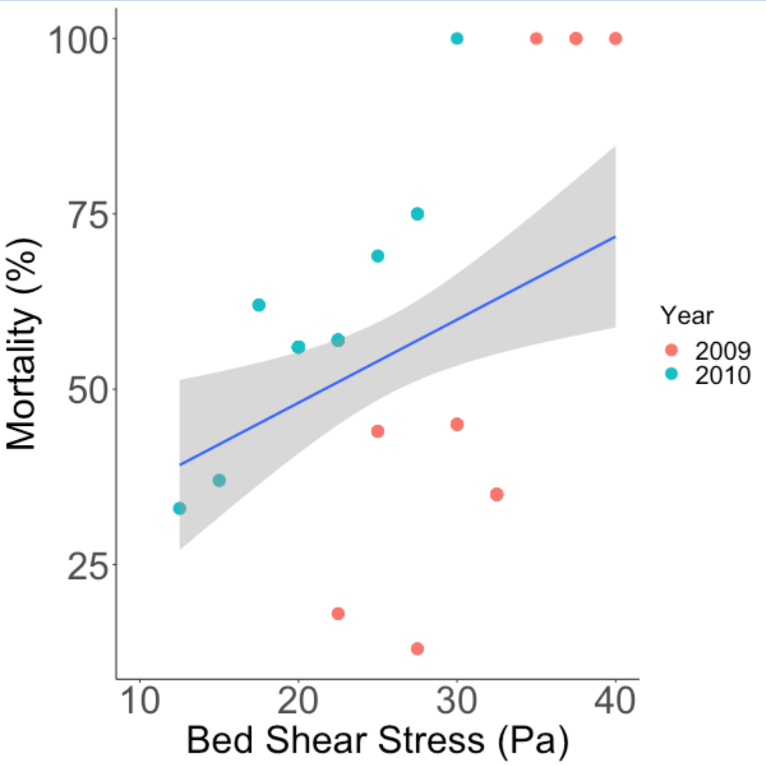
| Life Stage | Habitat Variable | Model Component |
|---|---|---|
| **Germination** | Inundation/depth | Threshold |
| **Seedling** | Shear stress | Linear model |
| | Inundation/depth | Linear model with quadratic term |
| **Adult** | Stream Power | Threshold |

## Thresholds

| Life Stage | Hydraulic Metric | Value | Citation |
|---|---|---|---|
| **Germination** | Depth | > 5 cm (85-280 days) | Nakai and Kisanuki (2007) |
| **Adult** | Stream Power | < 4000 W/$m^2$ | Bendix (1999) |

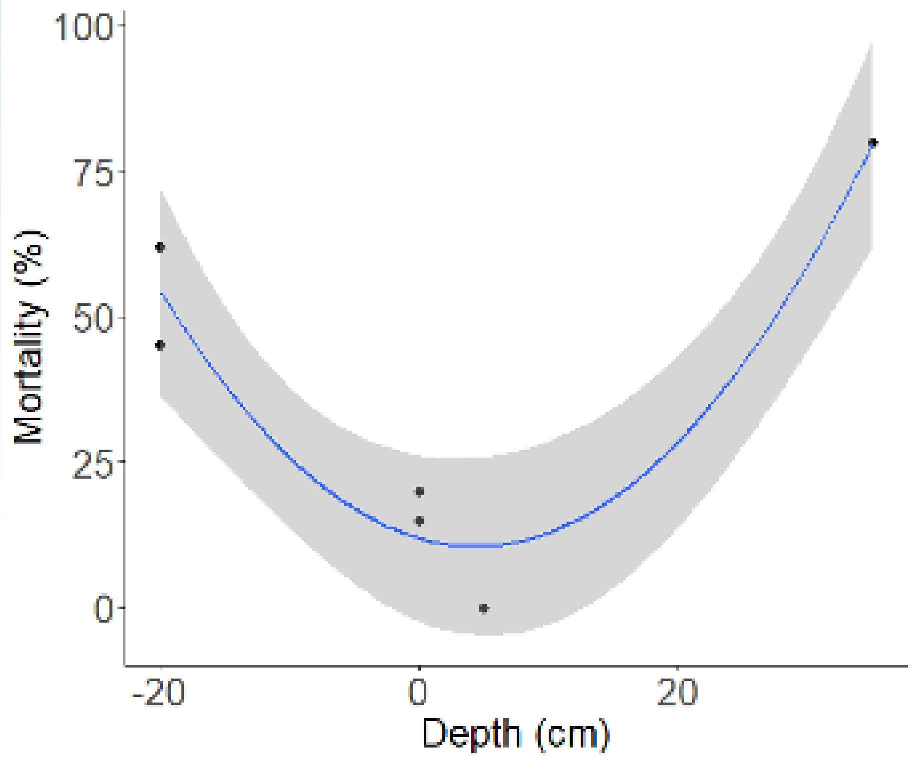
# Willow

## Seedling




Pasquale et al (2004)

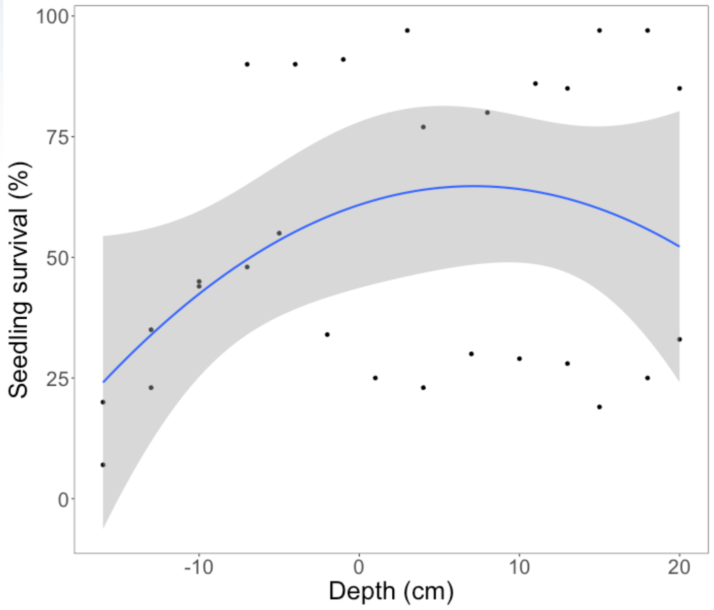
Colored datapoints show linear relationship annually




Tallent-Halsell and Walker 2002
Vandersande et al. 2001

# Typha

| Life Stage | Habitat Variable | Model Component |
|---|---|---|
| **Seedling** | Depth | Linear model with quadratic term |
| **Adult patch** | Depth | Linear model with quadratic term |
| | Velocity | Logistic regression |

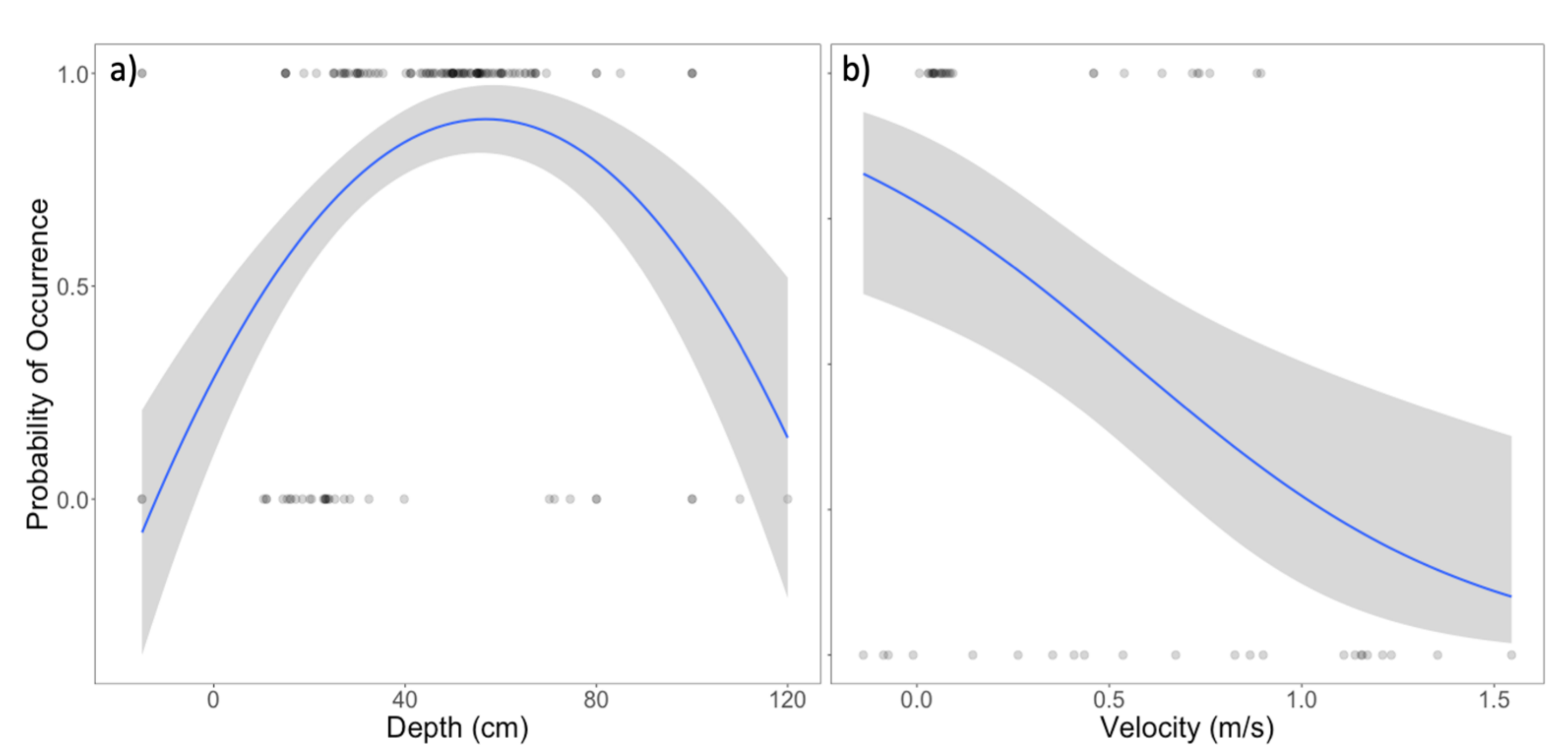



Grace et al (1985)

- Modelled with two species (*Typha latifolia* & *Typha domingensis* )
- Highest probability of seedling survival from 0- 10cm

Simple model retained

# Typha



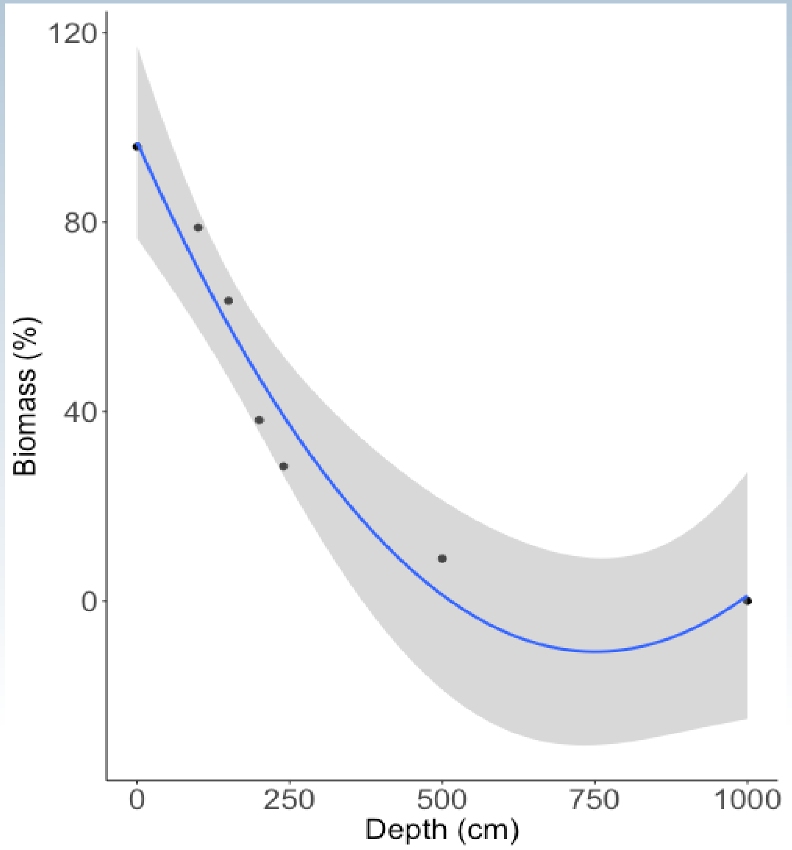

Asaeda et al (2005)
Jones (2003)
Grace & Wetzel (1981, 1982)
Waters & Shay (1992a,b)
Bjornn & Reiser (1991)

Depth: Both very dry and very wet conditions will reduce the probability of occurrence
Velocity: Higher velocities reduce the probability of occurrence

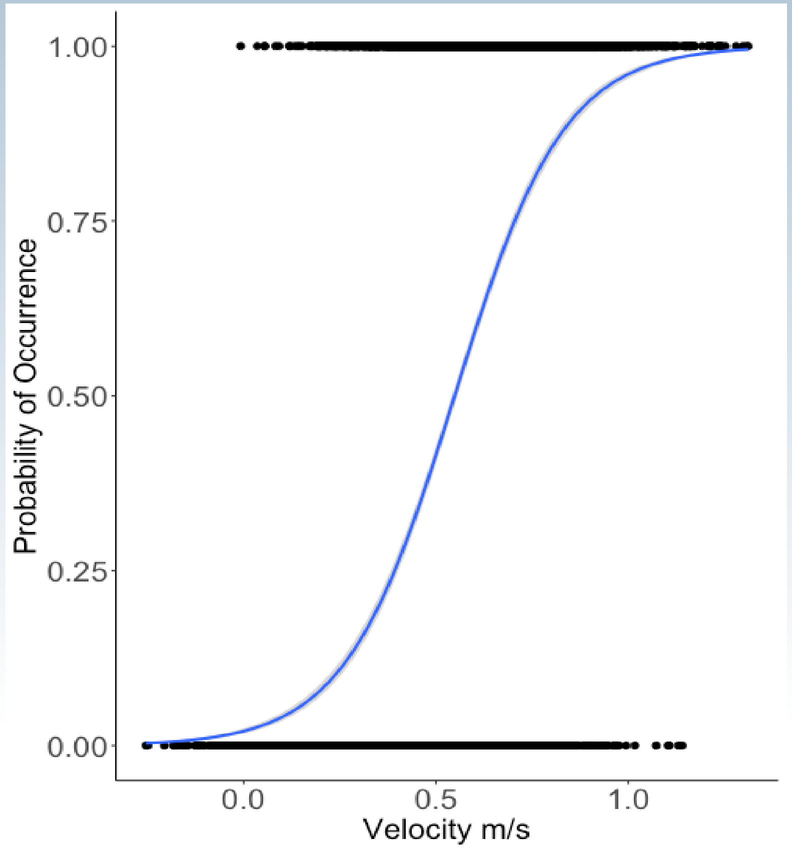
# Cladophora

| Habitat Variable | Model Component |
| --- | --- |
| Depth | Linear model with quadratic term |
| Velocity | Logistic regression |
| Shear Stress | Upper limit = 16.9 Pa (Biggs and Thomsen 1995) |

# Cladophora




Higgins et al (2005)




Flynn et al (2020)

Biomass decreases with depth

Probability of occurrence increases with velocity

Shear stress threshold added in replace of an upper velocity limit

Habitat Modeling

# ENDMEMBER SPECIES NOT ASSOCIATED WITH CURRENT BENEFICIAL USES

# Santa Ana Sucker

## Life Stages and Model Types

| Life Stage | Hydraulic | Type |
|---|---|---|
| Adult | Depth, Velocity | Probability distribution |
| Juvenile | Depth, Velocity | Probability distribution |
| Fry | Depth, Velocity | Thresholds |

## Fry Thresholds

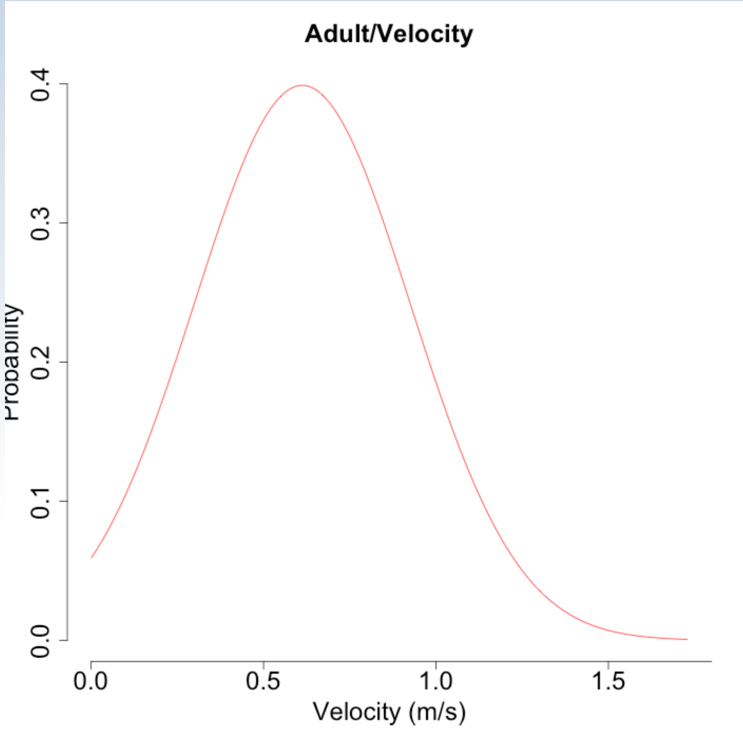
| | |
|---|---|
| **Depth** | 3-10cm |
| **Velocity** | Negligible/undetectable (< 0.05 m/s) |

Haglund & Baskin (2003)
Feeney & Swift (2008)

# Santa Ana Sucker

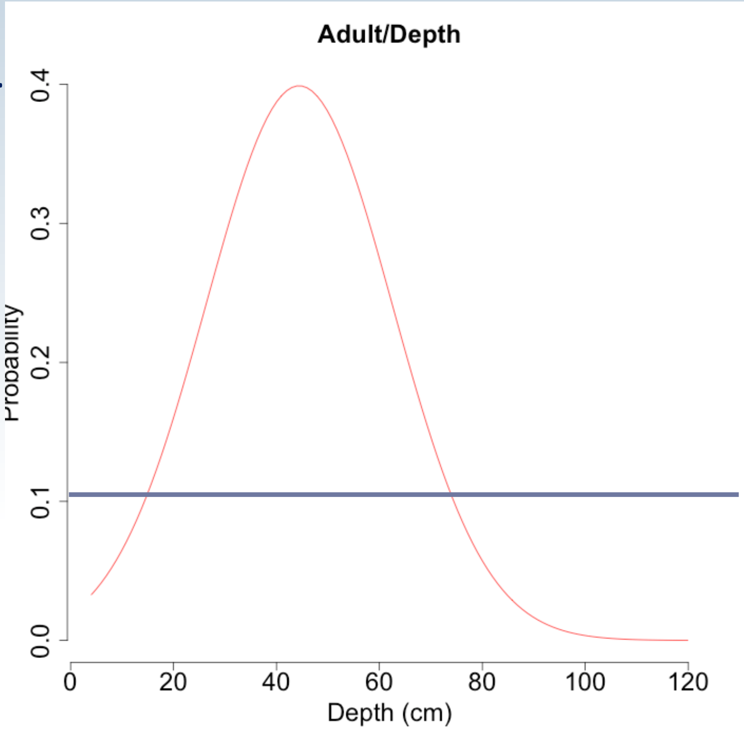
Probability distribution

Velocity




Highest probability = 0.4

Depth




Wulff et al (2015, 2016, 2017)
Saiki (2000)
Haglund & Baskin (2003, 2004)

Same process for Juvenile

Bound at 0.1

# Steelhead

| Migration Events | Velocity (Burst) | Depth (low) |
|---|---|---|
| Adult | <3.1m/s | >18cm |
| Smolt | N/A | >12cm |

| Migration Event | Velocity (Prolonged) | Depth (high) |
|---|---|---|
| Adult | <2m/s | >23 cm |
| Smolt | N/A | >12cm |

Flosi et al (2010)
McEwan & Jackson (1996)
Raleigh et al (1984)
Oroville Facilities Licensing (2004)

- Thresholds taken from habitat suitability Reports
- Two models:
  1. Burst swimming speeds and low depth
  2. Prolonged swimming speeds and higher depth

# Caveats & Limitations

- Data are sourced from a variety of locations to increase data density
  - Some locations are more or less relevant to LA river
  - Includes appropriate information to extrapolate to LA River (where some species are not currently present)
- Range of habitat variables limited to available data and model output from SWMM/HEC-RAS
  - Some caution is needed in interpretation, full range of conditions may not be represented (e.g. substrate)
- Observational validation only possible for species that currently occur
  - Statistical validation on species curves that are not currently present
    - Limited to comparison to values from critical habitat reports and reviewed by TAC.

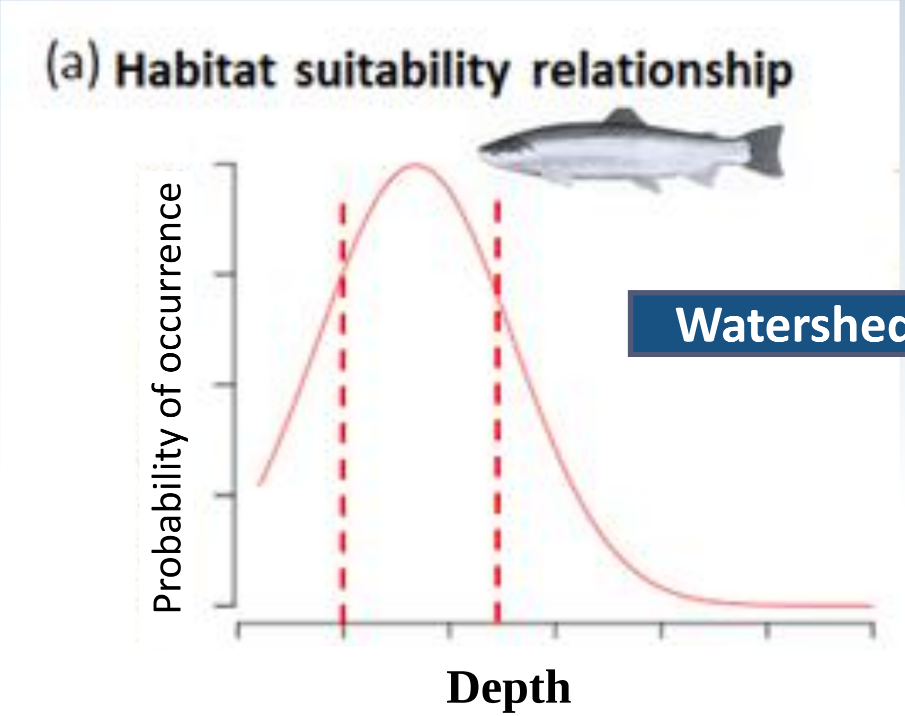
Developing Flow Recommendations

# APPLICATION OF SPECIES MODELS

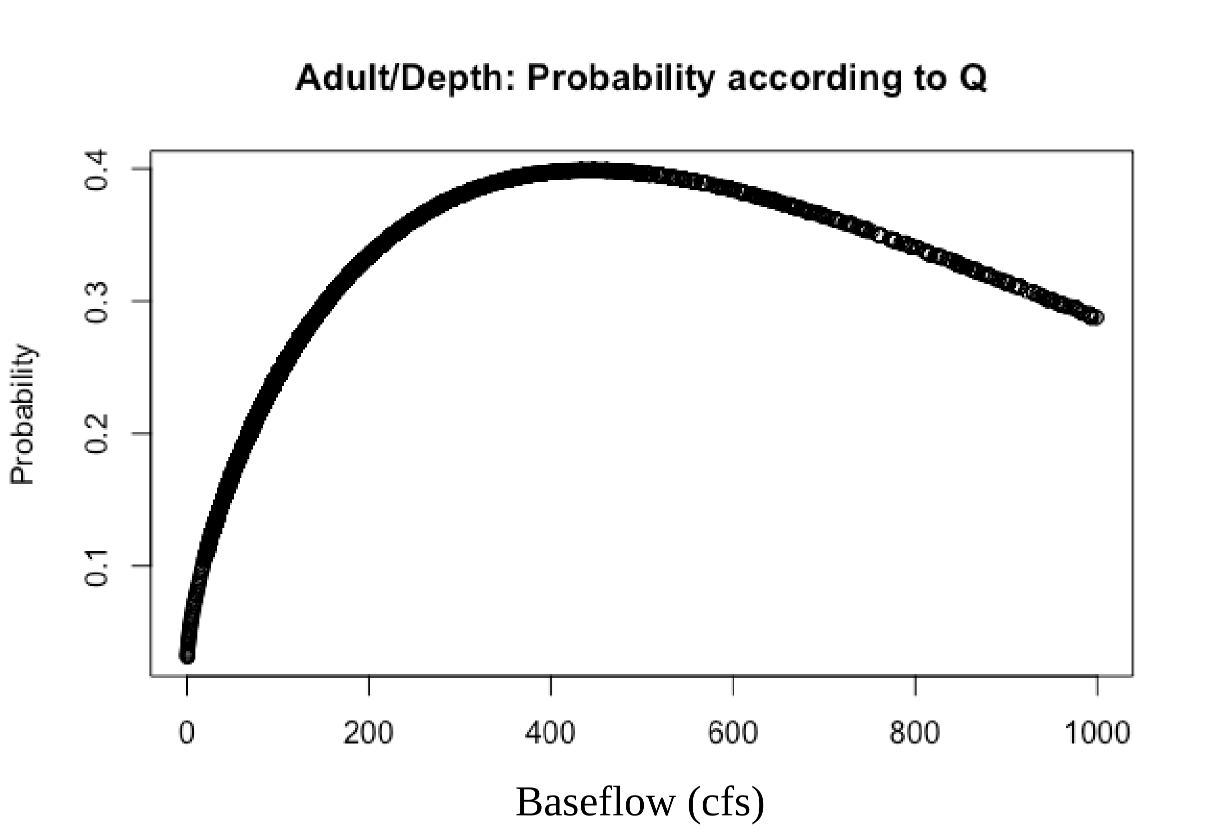
# Overall process

1. Data compilation for local species habitat conditions
   - Primary and grey literature (surveys, experiments)
2. Species curves/thresholds created from appropriate models
   - Models dependent on data (e.g. probability distribution, linear regression)
3. Apply species model to hydraulic variables at each node
   - Use rating curve to define threshold of flow
4. Calculate amount of time each node is within flow thresholds
   - Estimate suitability of baseline conditions
5. Apply management scenarios to species curves

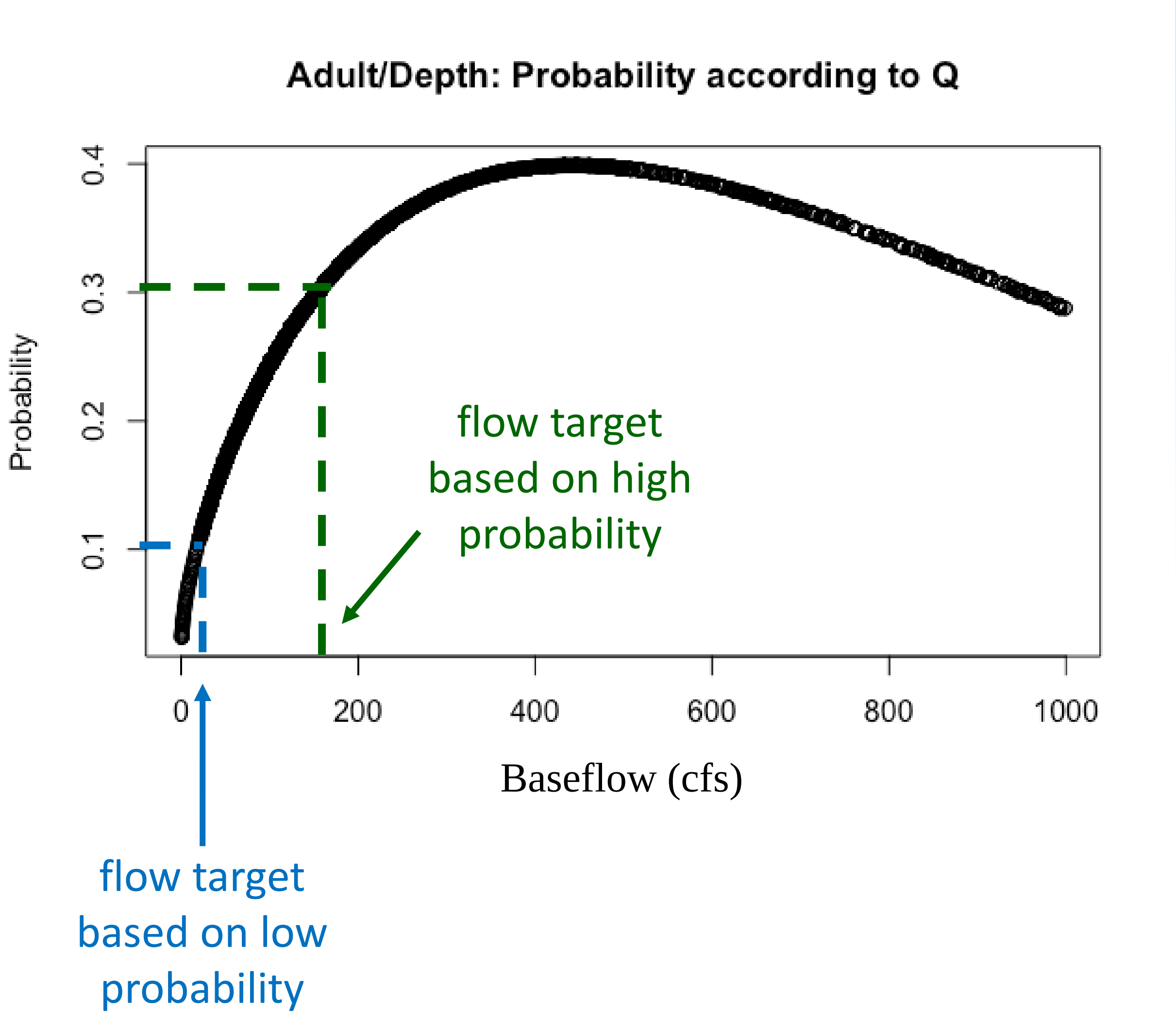
# Relate habitat suitability curves to “Flow” Using Watershed Models




Watershed Models



# Identify High and Low Probability Thresholds from Distribution Curves




Repeat this process:

- All species & habitats
- All life stages

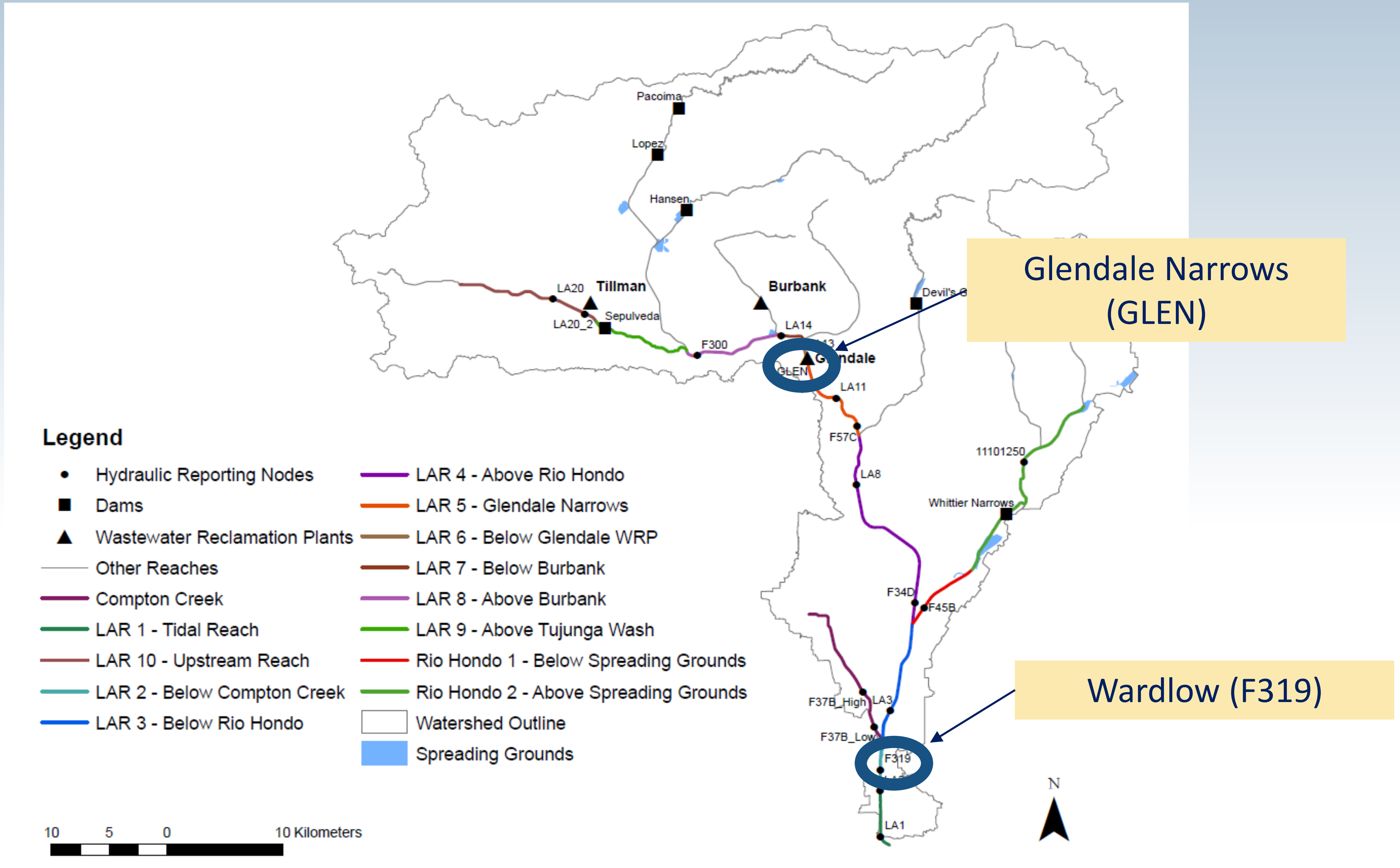
# Suitability Criteria

| General suitability criteria | Habitat suitability curves | Habitat suitability thresholds |
|---|---|---|
| Class | Criteria | |
| High | Probability values for every hydraulic variable are high for minimum 75% overall & 21 days of each month during critical period | All hydraulic variables are classed as suitable |
| Low | Probability values for one hydraulic variable are low for maximum 25% overall & 7 days of each month during critical period | One hydraulic variable classed as unsuitable* |
| Partial | All other combinations* (e.g. high suitability for majority of variables but low suitability for one variable) | N/A |

# Critical Time Period

| Species | Suitability Type | Critical period | Functional Flow Component |
|---|---|---|---|
| Santa Ana Sucker | Adult survival | all year | Dry-Season Baseflow, Wet-Season Baseflow |
| | Growth | March – July | Dry-Season Baseflow |
| Willow | Adult survival | all year | Peak flows |
| | Growth | April – September | Dry-Season Baseflow |
| Typha spp | Adult survival | all year | Dry-Season Baseflow, Wet-Season Baseflow |
| | Growth | April – September | Dry-Season Baseflow |
| Migration | Adult (in) | December – June | Wet-Season Baseflow |
| | Smoltification (out) | December – July | Wet-Season Baseflow |
| Cladophora | Growth | All year | Dry-Season Baseflow, Wet-Season Baseflow |

# Map of Example Locations



# Baseline conditions

| | | Riparian (Willow) | | | Freshwater marsh (Typha) | | Wading bird | Coldwater fish (SAS) | | | Migration | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Reach** | Node | Adult | Germination | Seedling | Adult | Seedling | Cladophora | Fry | Adult | Juvenile | Smolts | Migration |
| **LAR 2 - Below Compton Creek** | F319 | High | Low | High | Partial | Low | Partial | Low | Partial | Partial | High | High |
| **LAR 5 - Glendale Narrows** | GLEN | High | Low | High | Partial | Partial | Low | Low | Partial | Partial | High | High |

Associated with current beneficial use (Riparian, Freshwater marsh, Wading bird)

**Not** associated with current beneficial use (Coldwater fish, Migration)

** Ratings pertain only to flow conditions and do not account for other potential limitations (e.g. temperature, substrate)*

# Sample Flow Recommendations Table

| Current Conditions (i.e., species and habitats currently supported) | | | IN-RIVER FLOW RECOMMENDATIONS | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | summer baseflow | | | winter baseflow | | | winter peak flows | | spring recession flow | | | |
| **Species (habitat)** | **Life Stage** | **Reaches** | magnitude | duration | timing | magnitude | duration | timing | magnitude | frequency | magnitude | duration | timing | rate of change |
| Willow (riparian birds) | growth | 5-7 | | | | | | | | | | | | |
| Willow (riparian birds) | adult | 5-7 | | | | | | | | | | | | |
| Willow (riparian birds) | growth | 10 | | | | | | | | | | | | |
| Willow (riparian birds) | adult | 10 | | | | | | | | | | | | |
| Typha (Freshwater marsh) | growth | 1 | | | | | | | | | | | | |
| Typha (Freshwater marsh) | adult | 1 | | | | | | | | | | | | |
| Typha (Freshwater marsh) | growth | 5-7 | | | | | | | | | | | | |
| Typha (Freshwater marsh) | adult | 5-7 | | | | | | | | | | | | |
| Typha (Freshwater marsh) | growth | 10 | | | | | | | | | | | | |
| Typha (Freshwater marsh) | adult | 10 | | | | | | | | | | | | |
| Wading shorebirds | adult | 1-2 | | | | | | | | | | | | |
| Wading shorebirds | adult | 5-6 | | | | | | | | | | | | |
| Wading shorebirds | adult | 10 | | | | | | | | | | | | |
| **Recreational Uses** | | | | | | | | | | | | | | |
| kayaking | na | 5-7 | | | | | | | | | | | | |
| fishing/wading | na | 1-2 | | | | | | | | | | | | |
| fishing/wading | na | 5-7 | | | | | | | | | | | | |

**for each cell, we would provide a range of flows based on low - high probability of supporting the specific species or recreational use. Ranges could also be expressed and quantitative probability ranges, e.g., 25%, 50%, 75% probability of supporting the use**

# Example recommendations for Willow

Flow recommendations will be provided for relevant life stages, habitat variables and time period

- Critical Time Period:
  - Growth (March – September)
  - Adult (All year)
- Important life stages:
  - Seedling
  - Germination
  - Adult
- Important habitat variables:
  - Depth
  - Shear Stress
  - Stream Power

# Example Recommendations for Willow

**Current Conditions (i.e., species and habitats currently supported)**

| | | | summer baseflow | | | winter peak flows | spring recession flow |
|---|---|---|---|---|---|---|---|
| **Species (habitat)** | **Life Stage** | **Reaches** | **Magnitude (cfs)** | **duration** | **timing** | **Magnitude (cfs)** | **Magnitude (cfs)** |
| Willow (riparian birds) | growth | 5 | 22-452 (High)<br>22-594 (Med)<br>22-706 (Low) | March - September | March | | <452 (High)<br><594 (Med)<br><706 (Low) |
| Willow (riparian birds) | adult | 5 | | | | < 40590 | |

**for each cell, we would provide a range of flows based on low - high probability of supporting the specific species or recreational use. Ranges could also be expressed and quantitative probability ranges, e.g., 25%, 50%, 75% probability of supporting the use**

*Preliminary values based on Glendale Narrows

# Sample Application of Flow Recommendations

Separate table provided for flow recommendations for potential future beneficial uses, i.e., species and habitats not currently supported

**Approach to Using Flow Recommendations Table**

**A. In-river flow recommendations will be provided for:**
- **each reach by species**
- **for all relevant seasonal flow components**

**B. Flow recommendations will be ranges vs. single numbers**

**C. Technical products will include "curves" that relate changes in effluent discharge to resulting changes in in-river flows**

**D. Curves can be used to inform decisions regarding relationship between changes in effluent discharge and potential in-river effects by season and by reach**

# BREAK

WRP and Stormwater Scenarios

# DEVELOPMENT OF SENSITIVITY CURVES

# Sensitivity Curves Approach

***What management options/scenarios can achieve desired flows?***

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

- Evaluate effects of changes in key hydrologic, hydraulic, or temperature properties vs. specific management scenarios

- Can be used to accommodate many different scenarios or combinations of scenarios
  - Flexible and adaptable

# Development of Sensitivity Curves

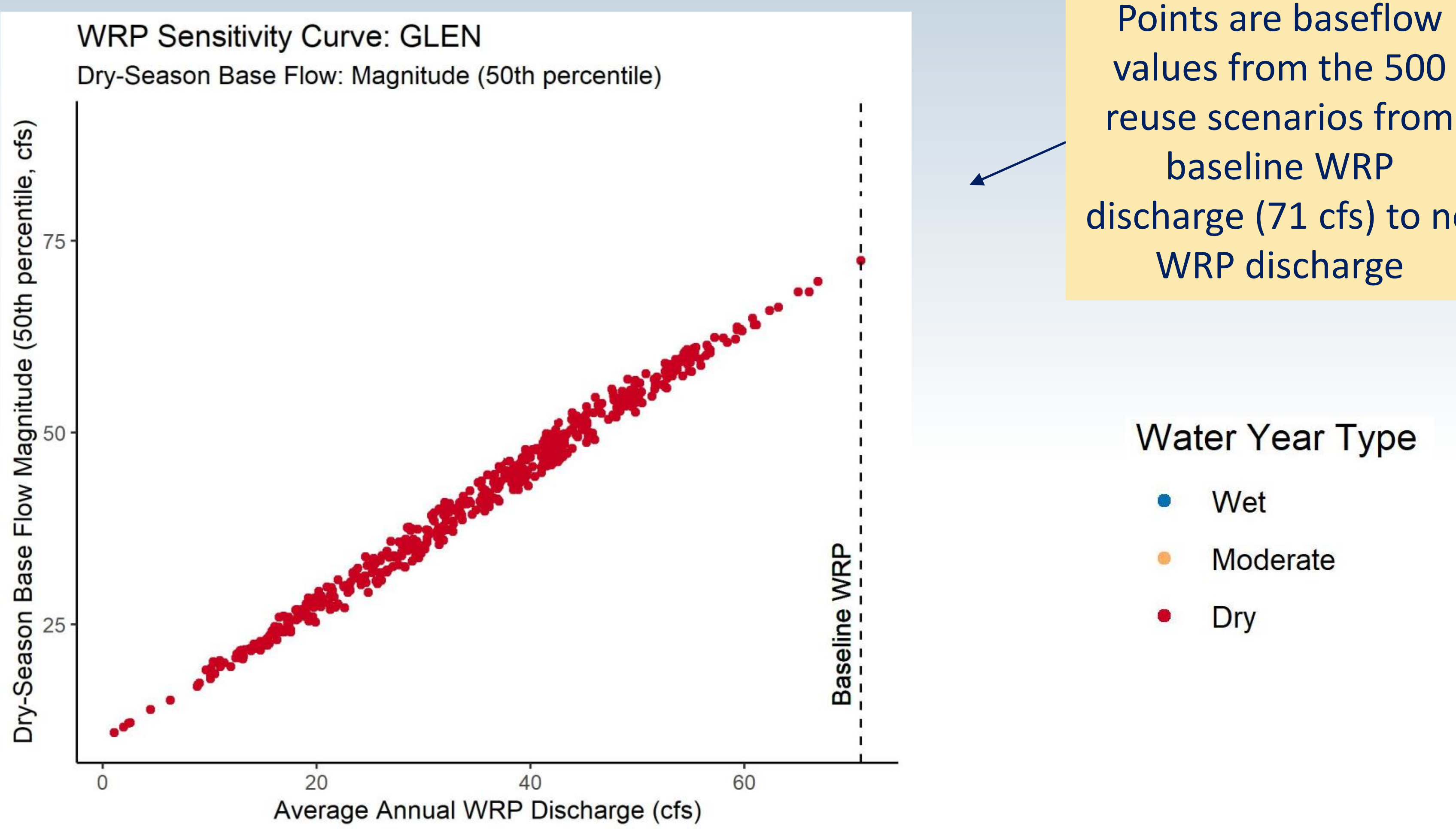
- Run models under a wide range of WRP discharge and retention conditions
- Predict changes in flow, velocity, depth, and temperature associated with different amounts of discharge and “capture”
- Plot response of key variables to ranges of WRP discharge and stormwater capture
- Evaluate curves across multiple:
  - Functional flow metrics
  - Water year types (i.e., wet, moderate, dry)
  - Nodes

Next slides will illustrate process at Glendale Narrows (GLEN) and are ***not*** final recommendations

# Dry-Season Baseflow Sensitivity Plot

# Glendale Narrows

**Glendale Narrows**

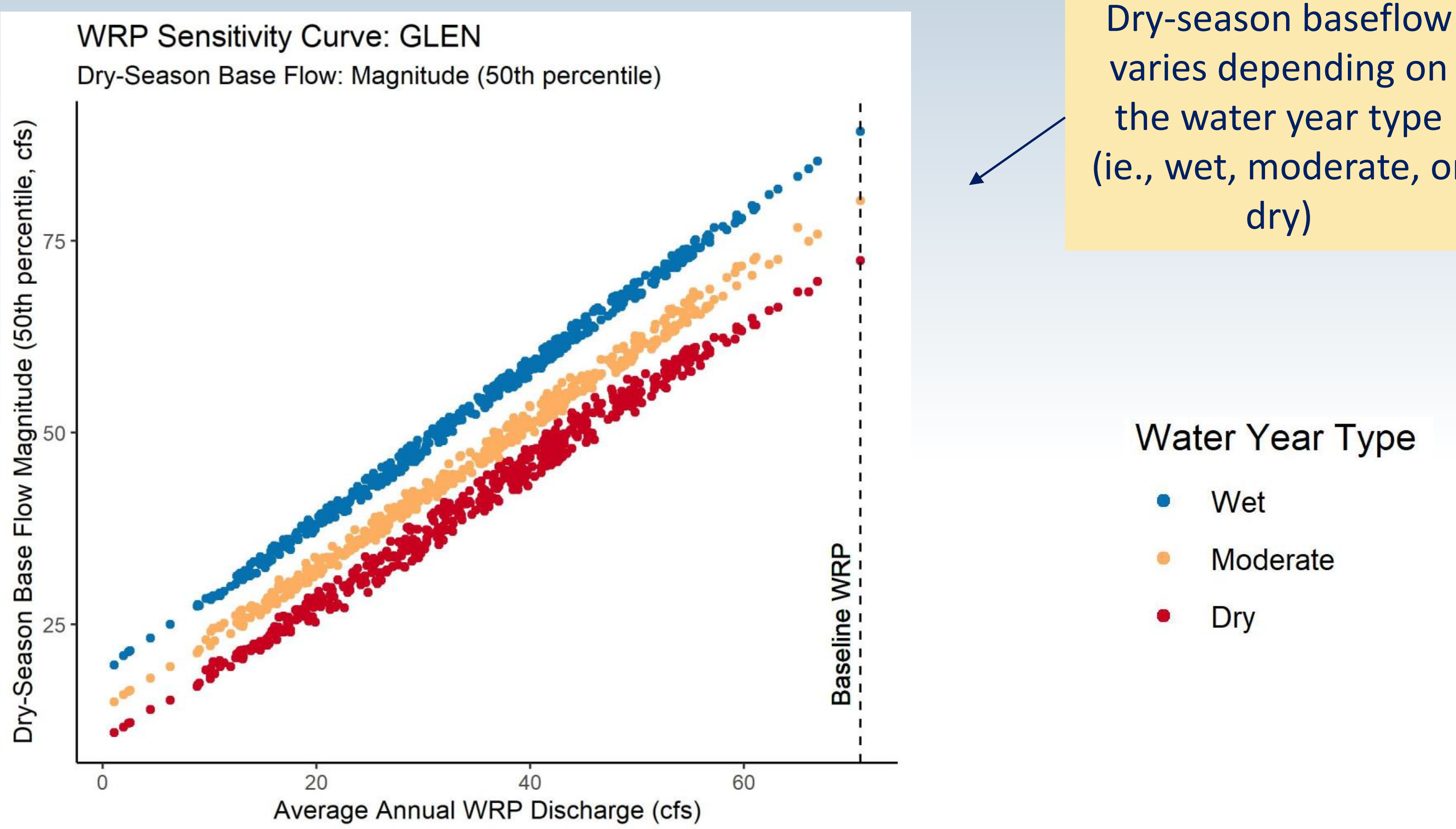



Points are baseflow values from the 500 reuse scenarios from baseline WRP discharge (71 cfs) to no WRP discharge

# Dry-Season Baseflow Sensitivity Plot

# Glendale Narrows

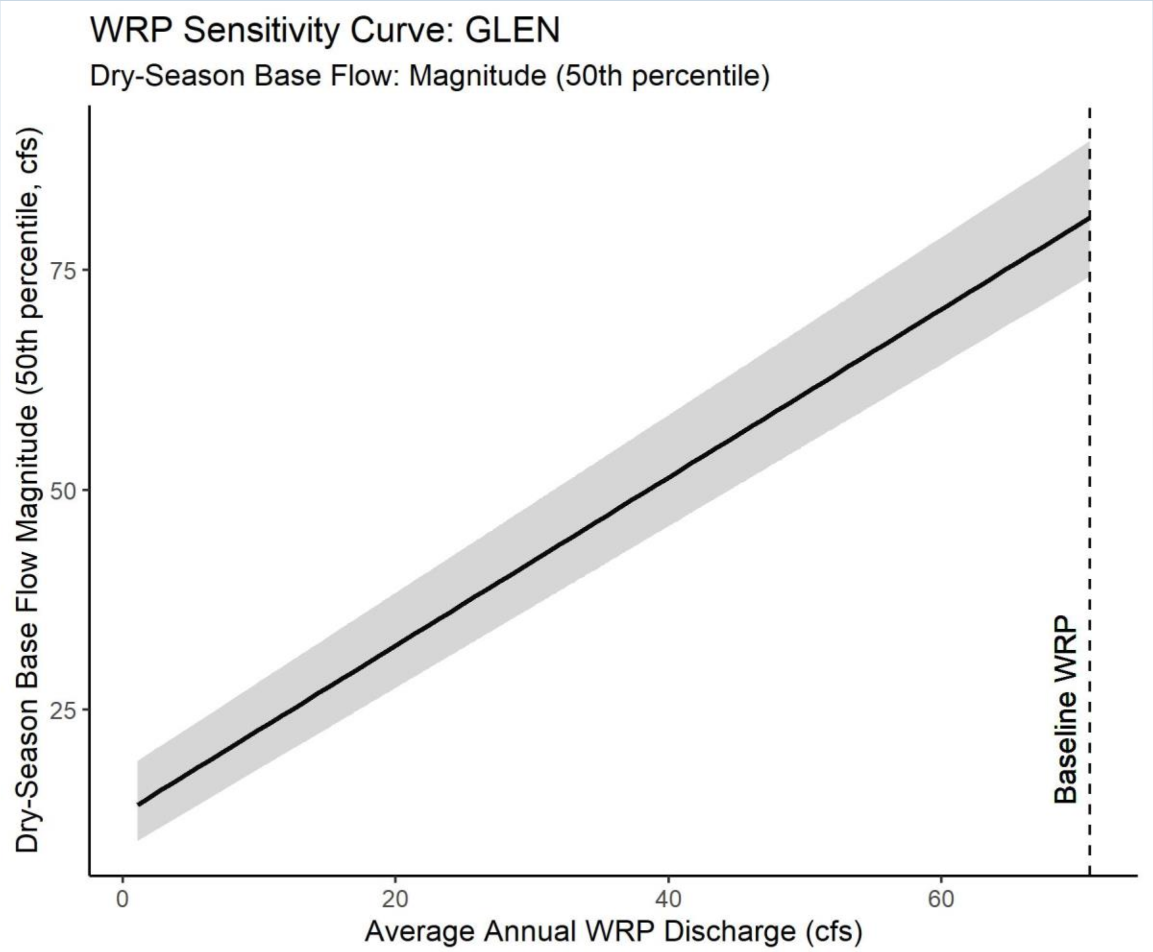
**Glendale Narrows**




Dry-season baseflow varies depending on the water year type (ie., wet, moderate, or dry)

# Dry-Season Baseflow Sensitivity Curve

## Glendale Narrows

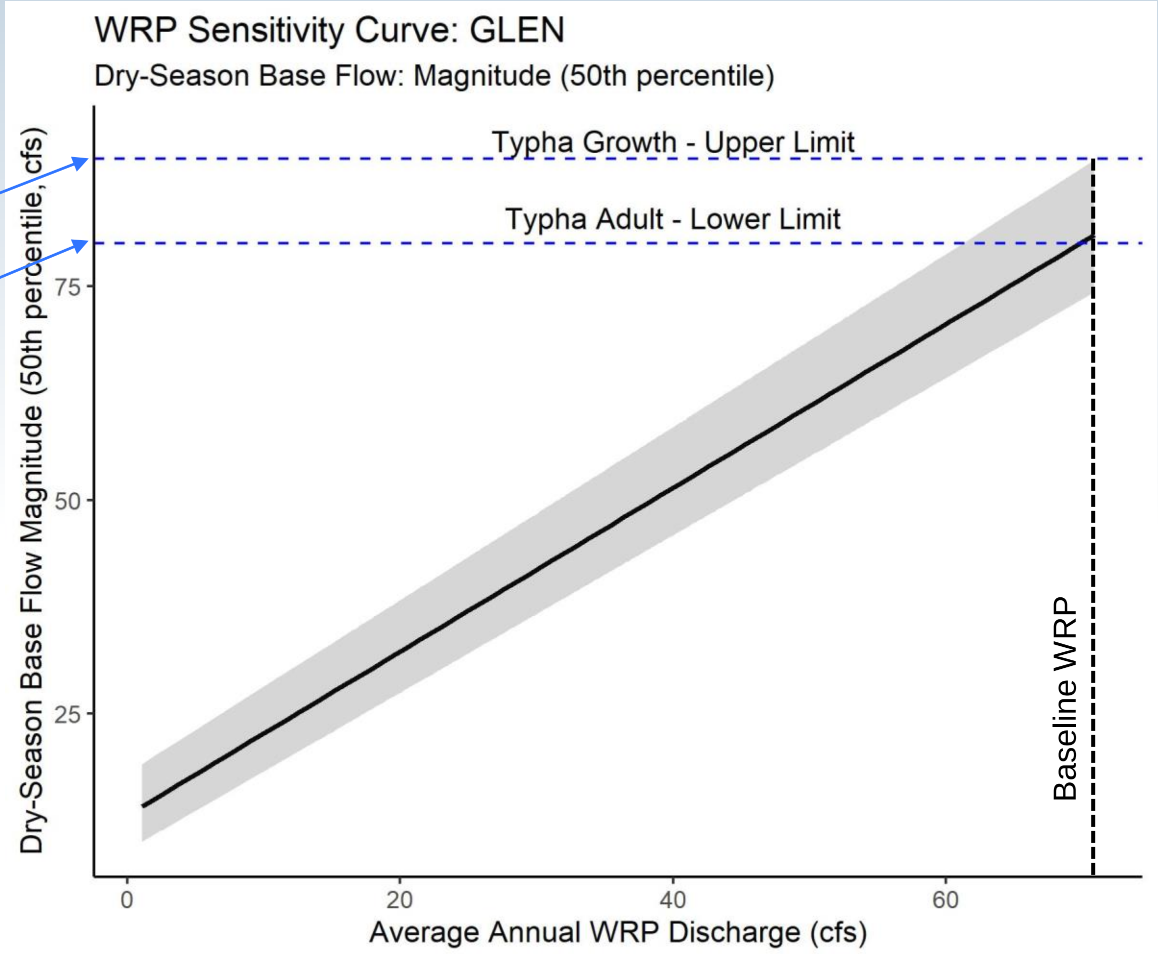



Banded curve that incorporates variability across water year type

# Application of Curves to Species Analysis: Glendale Narrows

**Endmember Species Associated with Current Beneficial Uses**

| | | | Dry-Season Baseflow |
|---|---|---|---|
| **Species (habitat)** | **Life Stage** | **Reaches** | **Magnitude (cfs)** |
| Typha (freshwater marsh) | Growth | 5 | < 90 |
| Typha (freshwater marsh) | Adult | 5 | >80 (High)<br><1242 (Med)<br><1562 (Low) |



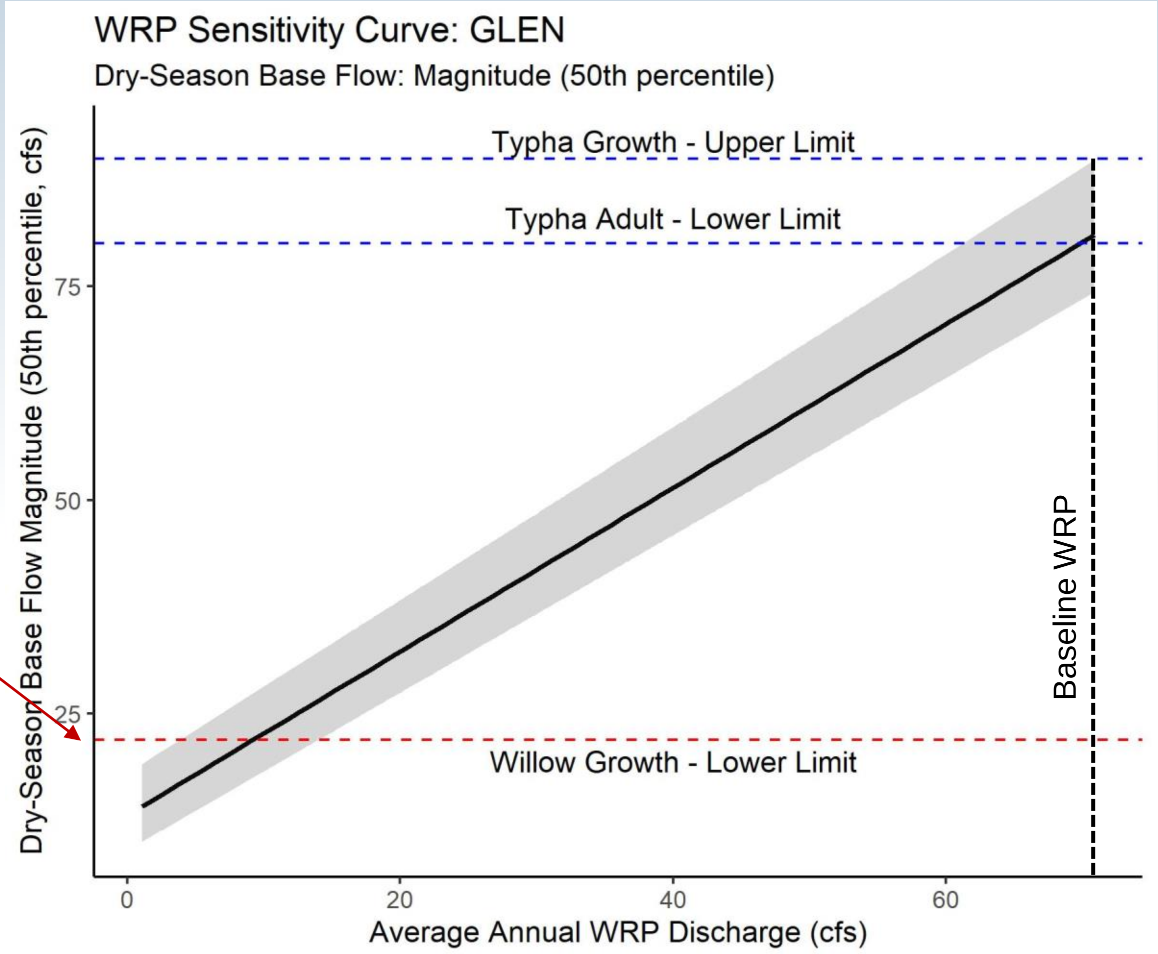

Baseline dry-season baseflows are currently suitable for Typha → any reductions in WRP may impact Typha

# Application of Curves to Species Analysis:

# Glendale Narrows

**Endmember Species Associated with Current Beneficial Uses**

| | | | Dry-Season Baseflow |
|---|---|---|---|
| **Species (habitat)** | **Life Stage** | **Reaches** | **Magnitude (cfs)** |
| Willow (riparian birds) | Growth | 5 | 22-452 (High)<br>22-594 (Med)<br>22-706 (Low) |

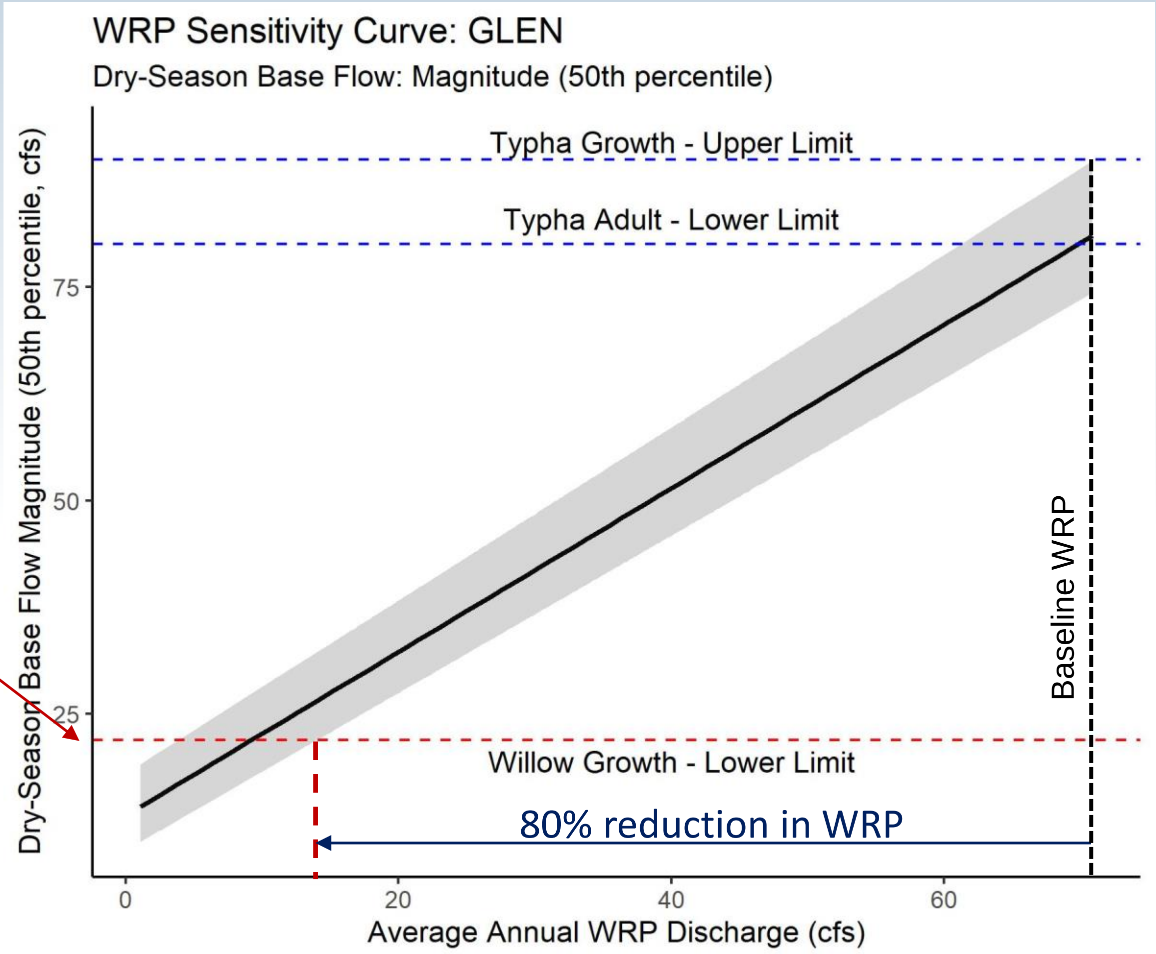


# Application of Curves to Species Analysis: Glendale Narrows

**Endmember Species Associated with Current Beneficial Uses**

| | | | Dry-Season Baseflow |
|---|---|---|---|
| **Species (habitat)** | **Life Stage** | **Reaches** | **Magnitude (cfs)** |
| Willow (riparian birds) | Growth | 5 | 22-452 (High)<br>22-594 (Med)<br>22-706 (Low) |

Could reduce WRP discharge in dry-season by up to 80% and still support Willow



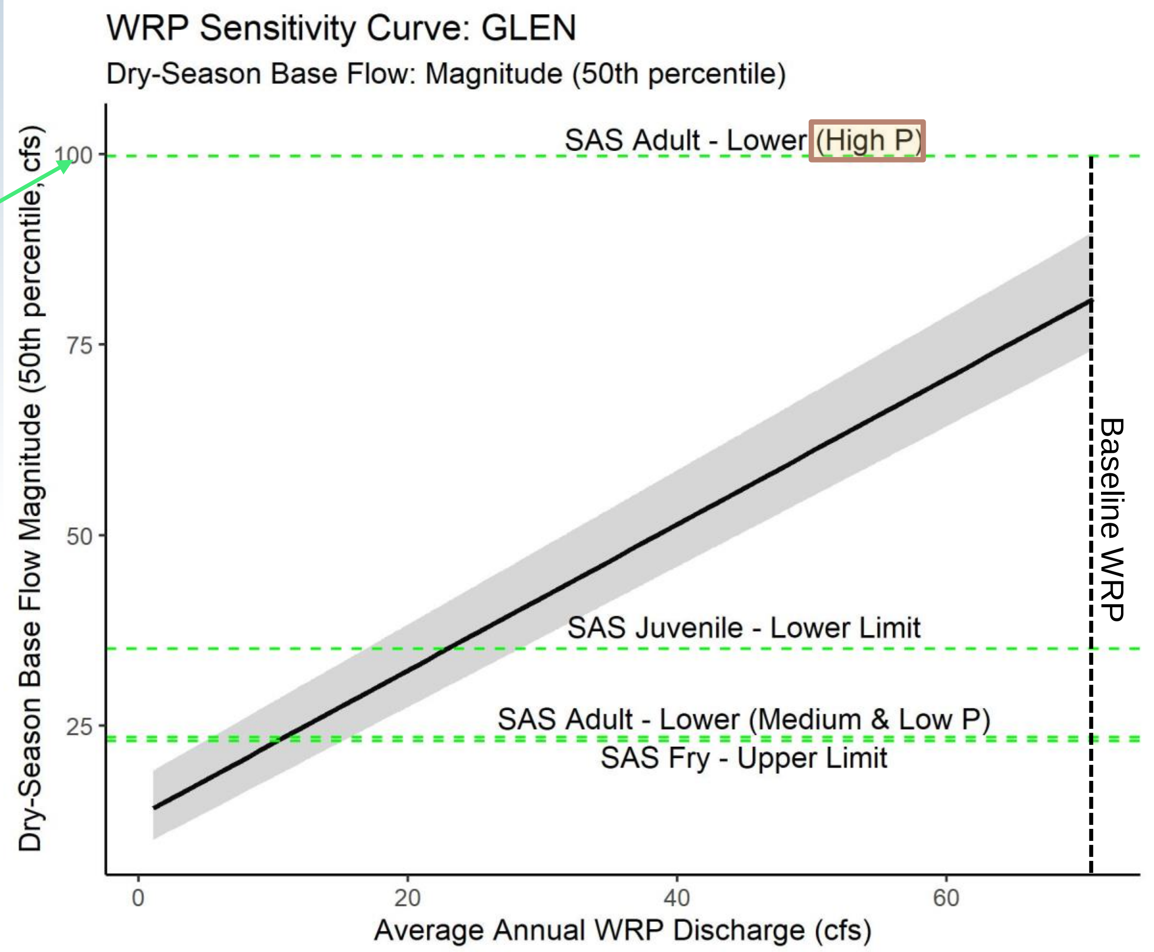
# Application of Curves to Species Analysis:

# Glendale Narrows

**Endmember Species NOT Associated with Current Beneficial Uses**

| Species (habitat) | Life Stage | Reaches | Dry-Season Baseflow Magnitude (cfs) |
|---|---|---|---|
| SA Sucker (cold water) | Adult | 5 | 100-405 (High)<br>23-516 (Med)<br>23-40590 (Low) |
| SA Sucker (cold water) | Juvenile | 5 | 35-274 (High)<br><349 (Med)<br>23-40590 (Low) |
| SA Sucker (cold water) | Fry | 5 | <22 (Threshold) |

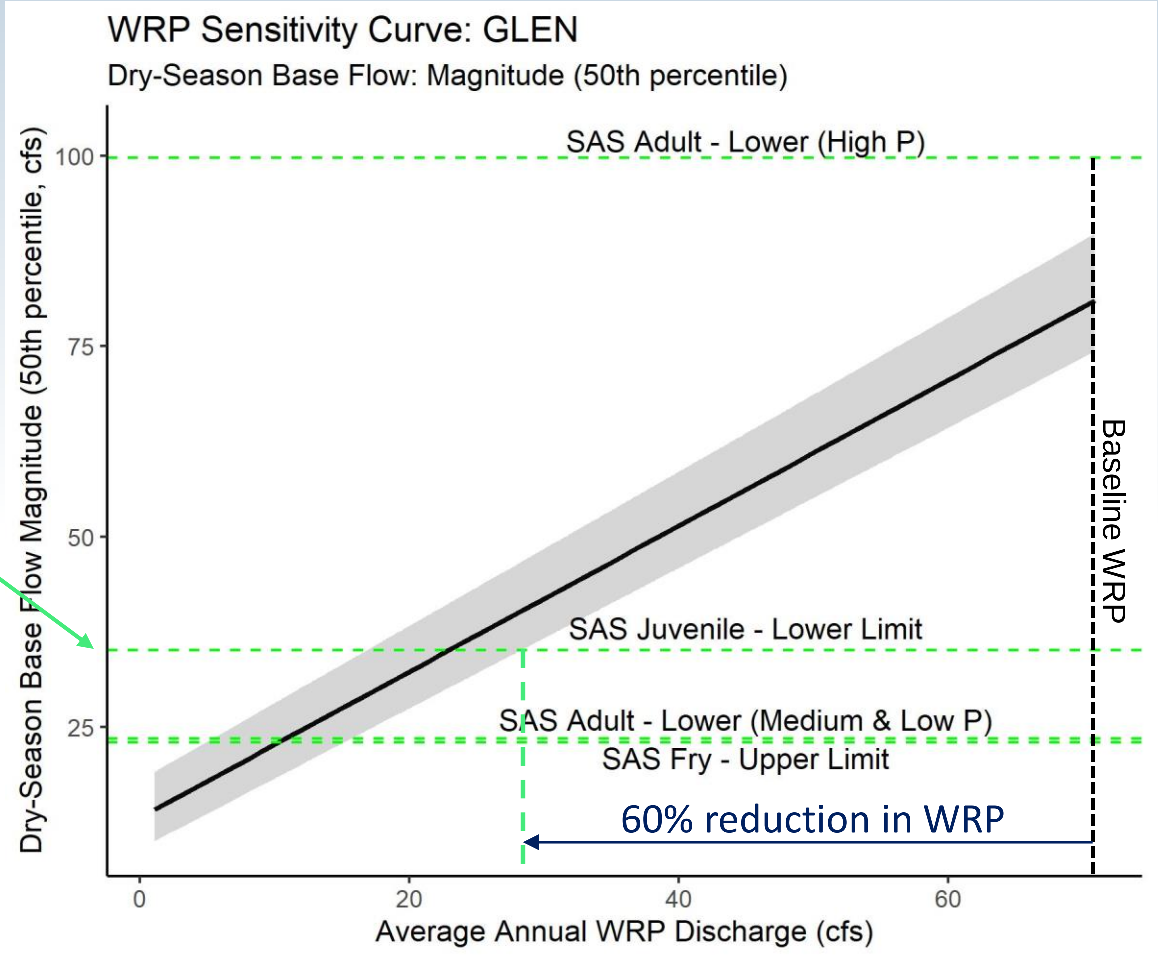
Current dry-season flows too low to support Santa Ana Sucker adult (high probability)



# Application of Curves to Species Analysis: Glendale Narrows

**Endmember Species NOT Associated with Current Beneficial Uses**

| | | | Dry-Season Baseflow |
|---|---|---|---|
| **Species (habitat)** | **Life Stage** | **Reaches** | **Magnitude (cfs)** |
| SA Sucker (cold water) | Adult | 5 | 100-405 (High)<br>23-516 (Med)<br>23-40590 (Low) |
| SA Sucker (cold water) | Juvenile | 5 | 35-274 (High)<br><349 (Med)<br>23-40590 (Low) |
| SA Sucker (cold water) | Fry | 5 | <22 (Threshold) |




Could reduce WRP discharge by up to 60% and flows may still support Santa Ana Sucker juvenile (high probability) and adult (medium probability)

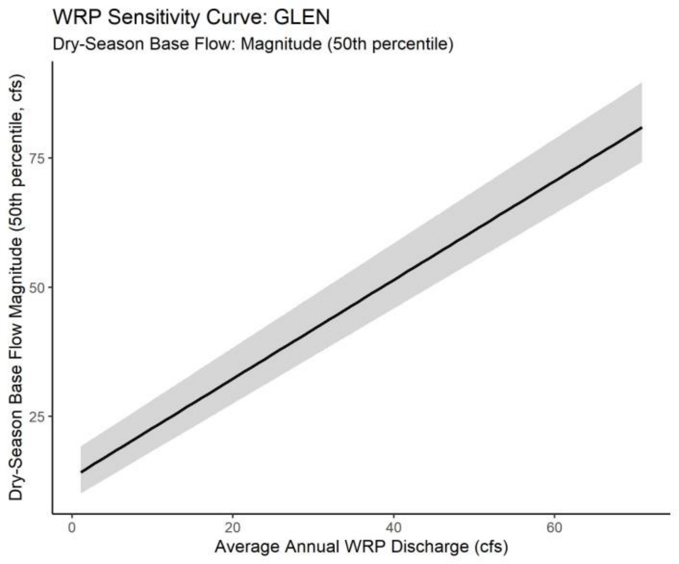
# Preliminary Recommendations:
# Glendale Narrows

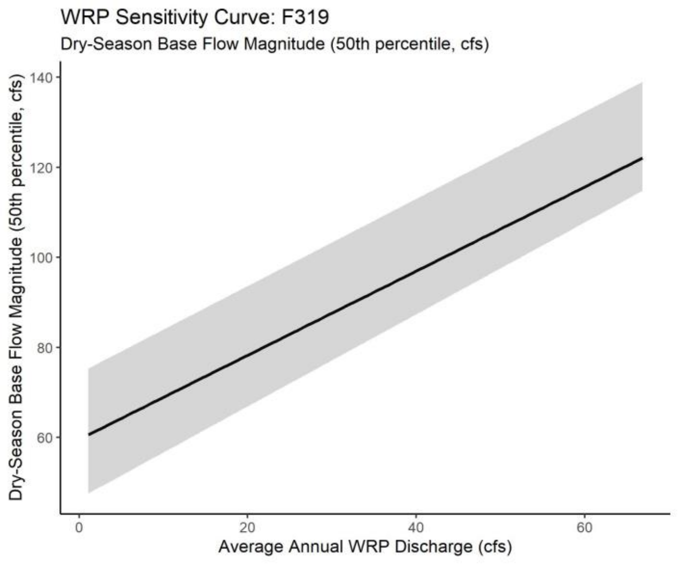
- Could reduce WRP discharge in dry-season by up to 80% and still support Willow
  - However, may impact Typha ← baseline dry-weather conditions are currently suitable

- If trying to restore *flows* for Santa Ana Sucker:
  - Could reduce WRP by up to 60% and flows could still support adult (medium probability) and juvenile (high probability)
  - Adult (high probability): Baseflows are currently too low in dry season
  - Fry: Need edge-water habitat, beyond resolution of hydraulic model

*Example recommendations that can be derived from the scenario analysis*

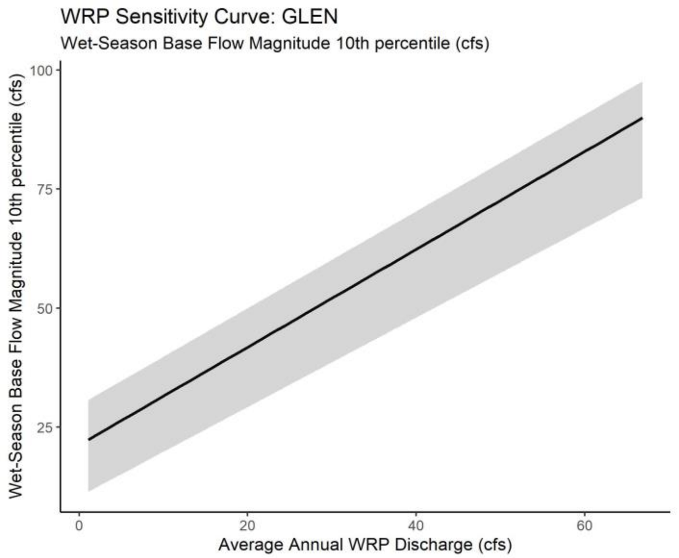
# Library of Curves

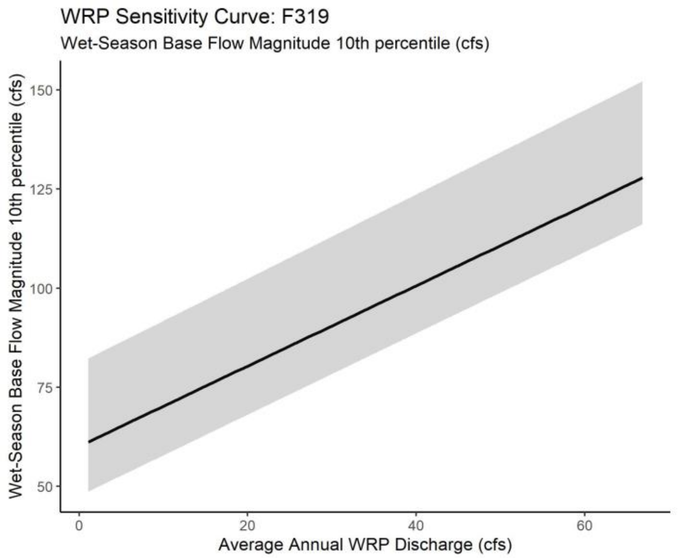



Sensitivity curves will be developed for:

- Multiple locations
- Multiple metrics



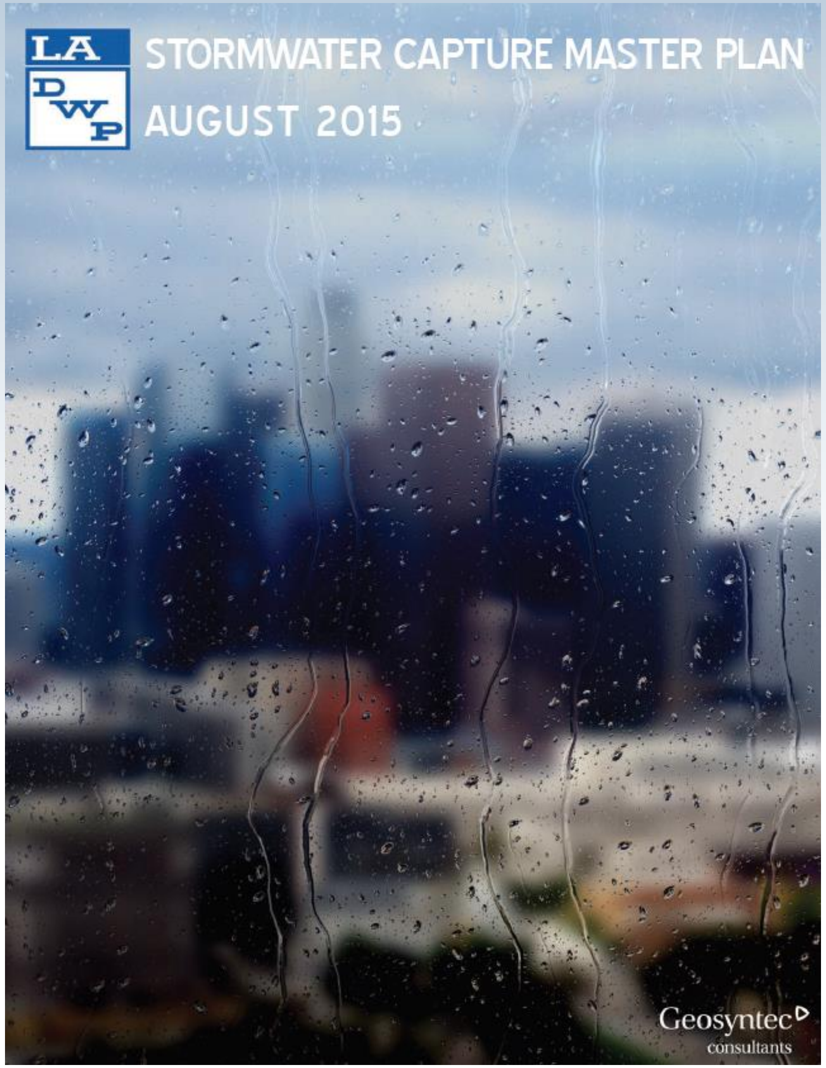



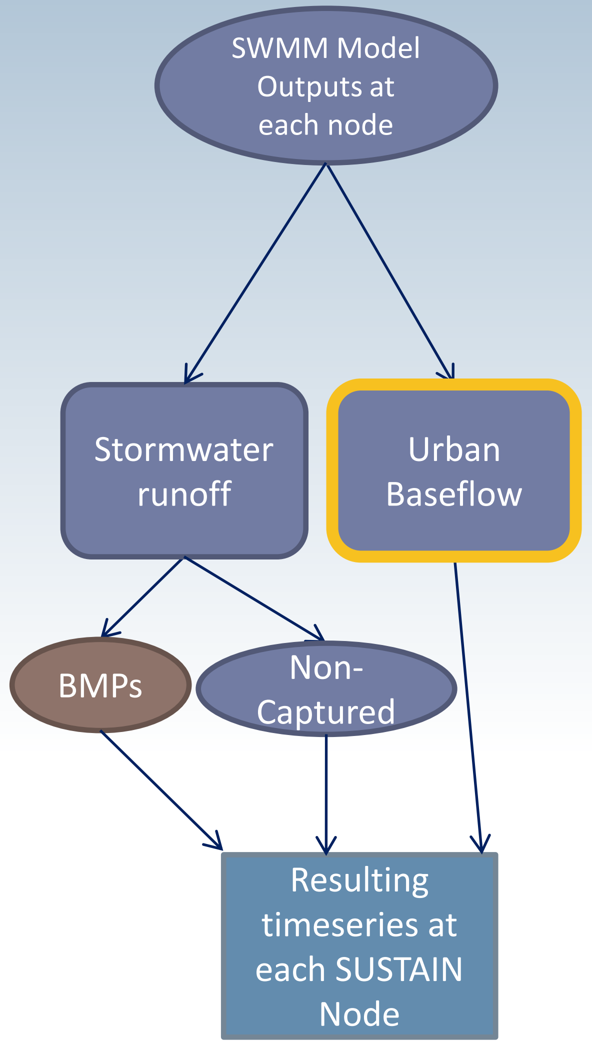
# Discussion

- How do you feel about the overall approach?
- Should we use the wide-band curve or create separate curves by water year type?
- Should we relate WRP discharge to probability of supporting species?

# Stormwater Scenario Curves Process

- Develop stormwater runoff and urban baseflow capture scenarios based on SCMP
  - Combined with WRP scenarios
- Run model scenarios and validate with reductions from SCMP
- Develop sensitivity curves






# Stormwater Scenario Modeling

CSM Team has developed SUSTAIN model for stormwater scenarios

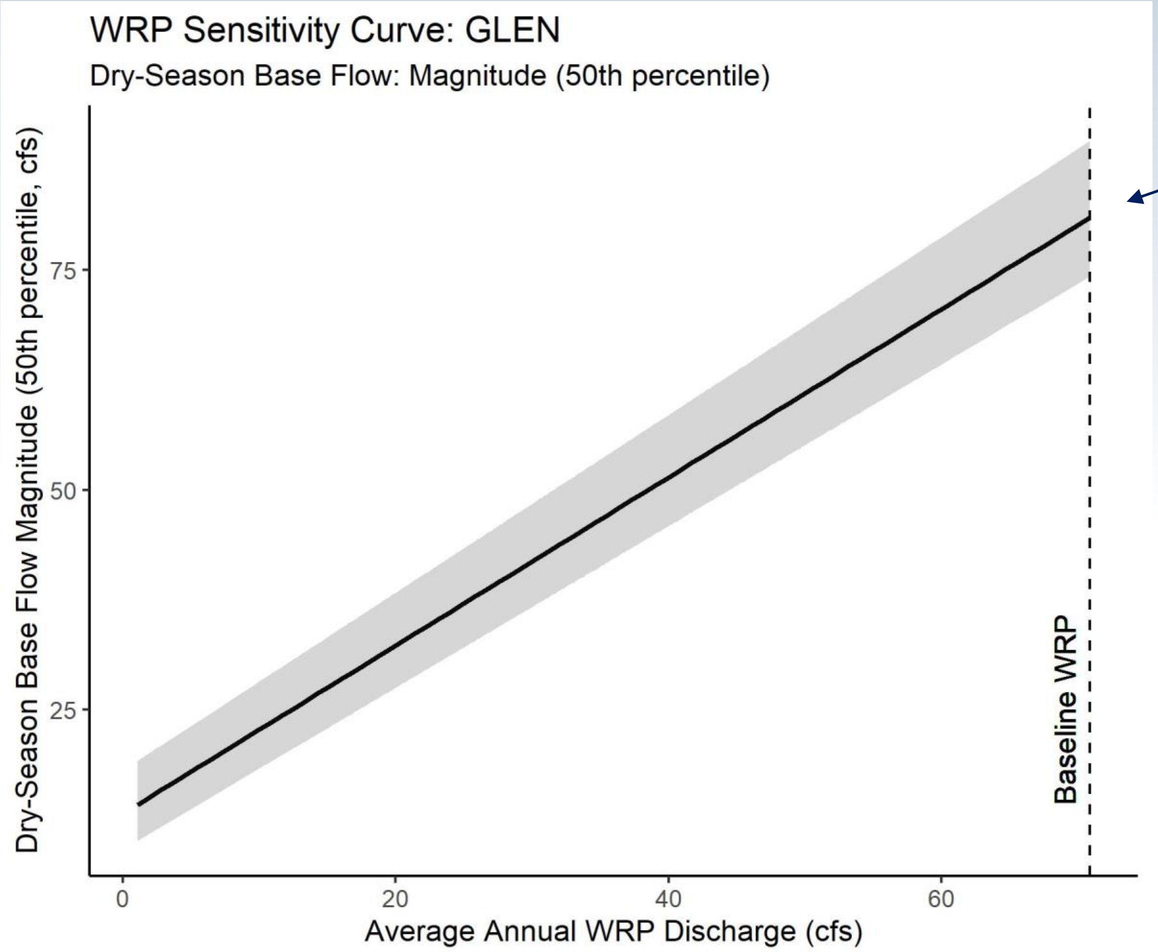
- For stormwater scenarios, we will evaluate reductions in:
  - Stormwater runoff
  - Non-storm urban discharge*

*Currently includes any discharge from urban drool, industrial sources, *dams*, and *upwelling* → For final analysis, we will not include dams and upwelling as urban discharge

Next slides illustrate a simple example of removing all non-storm urban discharges

# Dry-Season Baseflow Sensitivity Curve

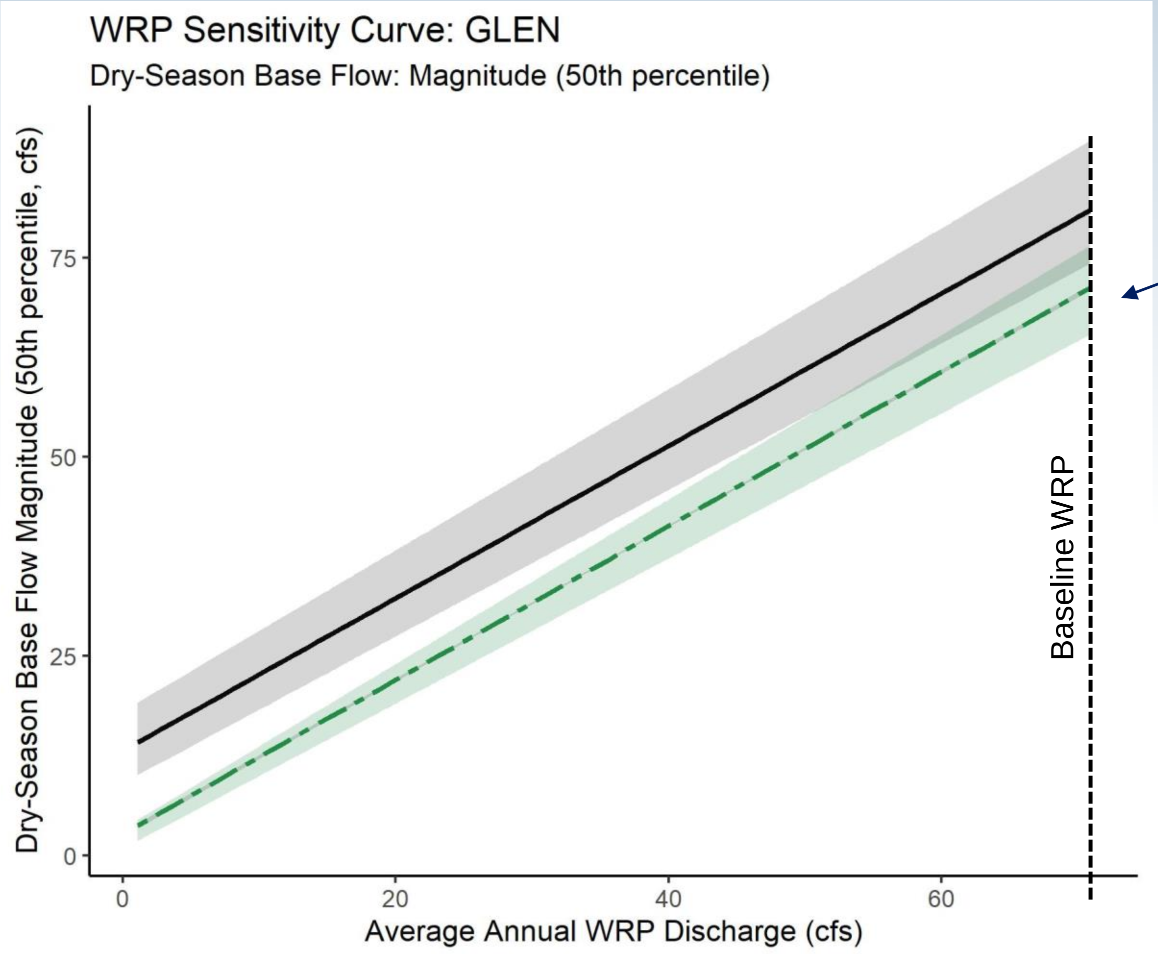
# Glendale Narrows




WRP Sensitivity Curve

# Dry-Season Baseflow Sensitivity Curve

# Glendale Narrows

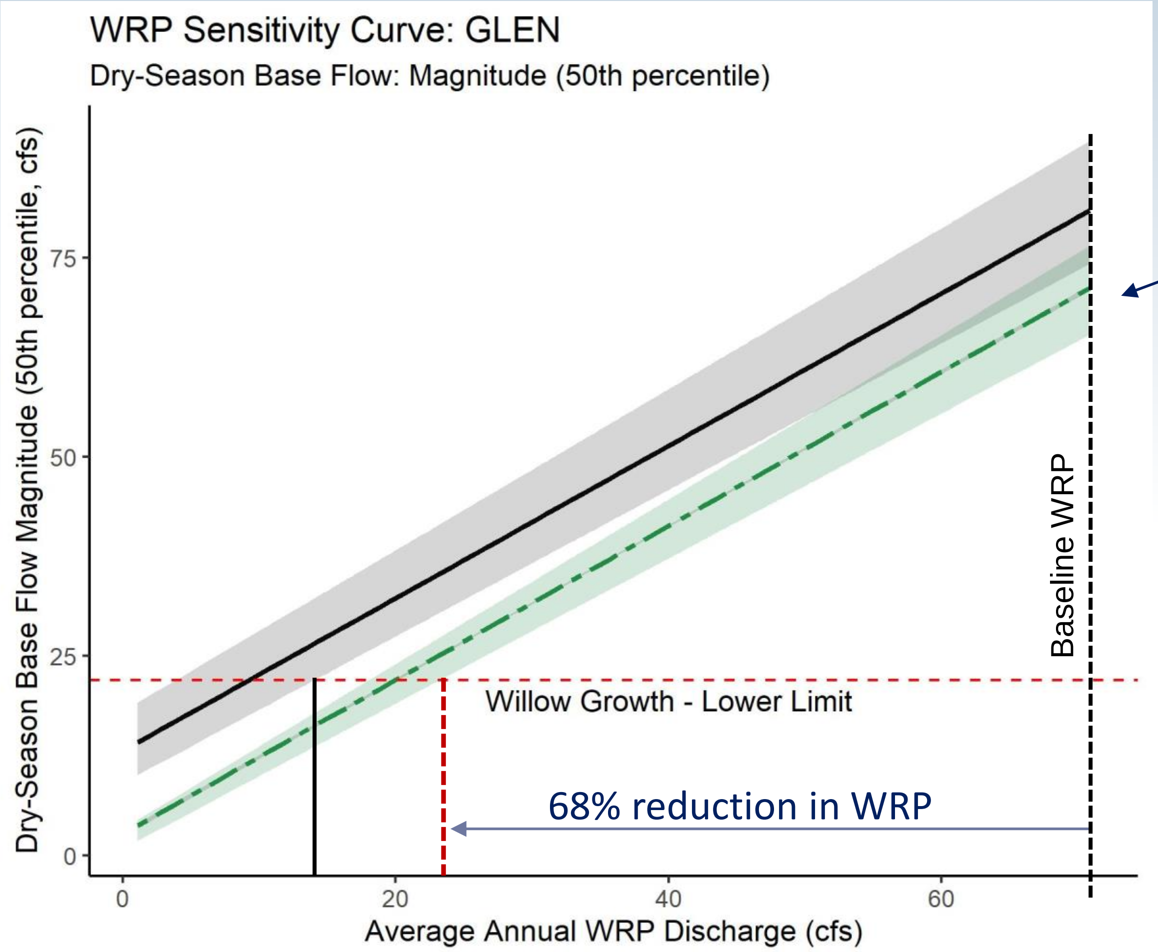



WRP Sensitivity Curve with all urban baseflow removed

*Note: urban baseflow includes upwelling and dam discharges so the green curve is an overestimation of reduction in baseflow.

# Dry-Season Baseflow Sensitivity Curve

# Glendale Narrows




WRP Sensitivity Curve with all urban baseflow removed

If all urban baseflows removed, could reduce WRP discharge by 68% and still support Willow (compared to 80% under no urban removal)

*Note: urban baseflow includes upwelling and dam discharges so the green curve is an overestimation of reduction in baseflow.

# Preliminary Recommendations:
## Glendale Narrows

- If all urban baseflows captured, could reduce WRP discharge by up to 68% and still support Willow
  - With no urban capture, up to 80% WRP reduction
- Under baseline conditions, removing all urban baseflows leads to a 16% reduction in dry-season baseflow

*Example recommendations that can be derived from the scenario analysis*

# Preliminary Scenario Summary:
# Glendale Narrows

| Scenario | Instream Dry-Season Baseflow Magnitude | Reduction in Dry-Season Baseflow Magnitude | | Aquatic Life Use | |
|---|---|---|---|---|---|
| | cfs | % | cfs | Willow | Typha |
| Baseline | 80 | 0 | 0 | High | High |
| Baseline + no urban baseflow | 67 | 16 | 13 | High | Medium/Low |
| WRP 50% reduction | 47 | 41 | 33 | High | Medium/Low |
| WRP 50% reduction + no urban baseflow | 37 | 54 | 43 | High | Medium/Low |
| WRP 100% reduction | 13 | 84 | 67 | Low | Medium/Low |
| WRP 100% reduction + no urban baseflow | 3 | 96 | 77 | Low | Medium/Low |

*Example summary table that can be derived from the scenario analysis*

# General Feedback and Next Steps

- Finalize baseline conditions report (early January)

- **Technical report on flow recommendations and sensitivity curves**
  - **Draft - late January 2021**
  - **Review and comments – February 2021**

- Monitoring and adaptive management recommendations – Feb-March 2021

- Stormwater scenario modeling

- Water quality modeling

- Temperature analysis

- Restoration opportunities

Spring 2021

# Flow Recommendations Report

Late Jan. 2021

- Project overview and objectives
- Brief recap of methods and results detailed in the baseline conditions report
  - Additional details on development of sensitivity curves
- Summary of flow/hydraulic tolerances for focal species
  - Presented as ranges or probabilities of response vs. “bright line” thresholds
- Recommended flow ranges necessary to support:
  - Current beneficial uses
  - Potential future beneficial uses
- Sensitivity curves for wastewater and stormwater scenario analysis
- Opportunities to “mitigate” potential effects through other management actions

# Questions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