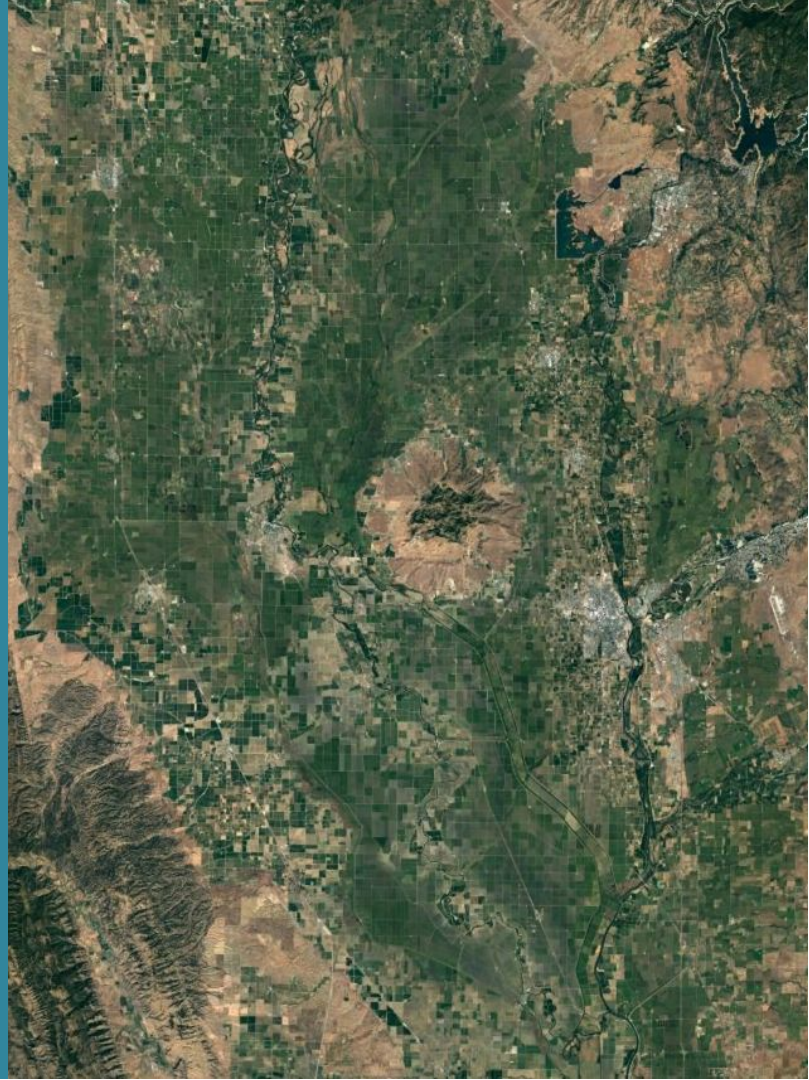


# FLOODPLAINS REIMAGINED

Juvenile salmon habitat  
suitability criteria  
Ad hoc meeting 3

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February 15, 2022



# Outline

- Summary of feedback from November ad hoc
- Sensitivity testing results
- Proposed criteria with questions for discussion

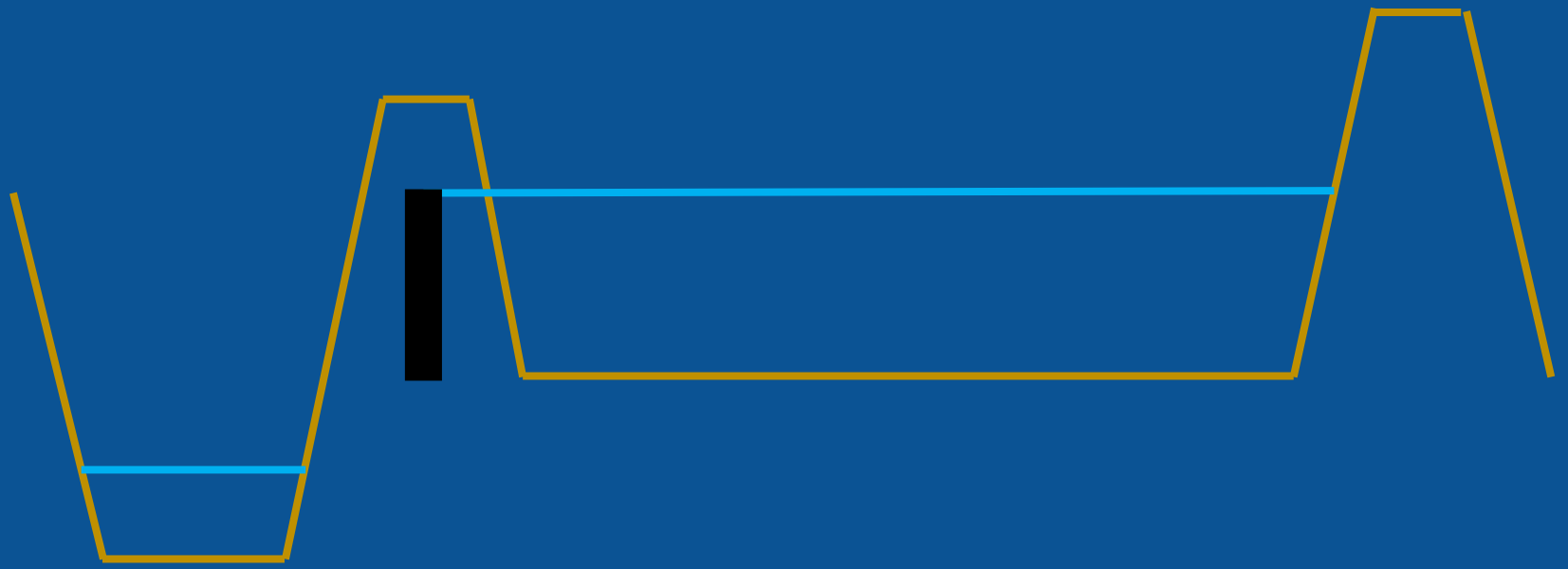
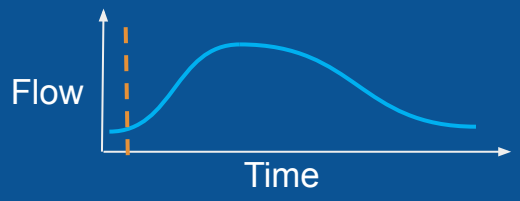
Feedback	Response
<p><b>Inundation frequency</b> - not required, particularly given the plan for a separate productivity assessment</p>	
<p><b>Depth</b> - 0.6 ft min depth should not receive full credit. Remove the upper depth threshold.</p>	
<p><b>Connectivity</b> - extensive discussion, and need for more illustration and sensitivity testing. Uncertainty whether any length of disconnection is allowable.</p>	
<p><b>Land cover</b> - uncertain whether this is valuable, given that turbidity is often the most relevant type of cover for fish</p>	
<p><b>Floodplain conditions</b> - redundant with connectivity criteria. Consider removing.</p>	
<p><i>Approved by group at November meeting: criteria for <u>timing</u>, <u>duration</u>, <u>velocity</u></i></p>	

Feedback	Response
<p><b>Inundation frequency</b> - not required, particularly given the plan for a separate productivity assessment</p>	<p>Inundation frequency criteria removed.</p>
<p><b>Depth</b> - 0.6 ft min depth should not receive full credit. Remove the upper depth threshold.</p>	<p>Removed upper depth threshold to simplify interpretation. Assigned partial credit to depths 0.6-0.9 ft.</p>
<p><b>Connectivity</b> - extensive discussion, and need for more illustration and sensitivity testing. Uncertainty whether any length of disconnection is allowable.</p>	<p>Criteria revised. Created diagrams to illustrate revised criteria, and performed sensitivity testing for review today. No longer allowing any days of disconnection and reconnection to count as “connected”</p>
<p><b>Land cover</b> - uncertain whether this is valuable, given that turbidity is often the most relevant type of cover for fish</p>	<p>Tech team recommends retaining land cover to represent the value of more variable depths and more likely refugia in natural land cover.</p>
<p><b>Floodplain conditions</b> - redundant with connectivity criteria. Consider removing.</p>	<p>Floodplain conditions absorbed by connectivity criteria. Removed as standalone criteria.</p>
<p><i>Approved by group at November meeting: criteria for <u>timing</u>, <u>duration</u>, <u>velocity</u></i></p>	<p>Some duration and velocity sensitivity testing results to share today, no changes recommended.</p>

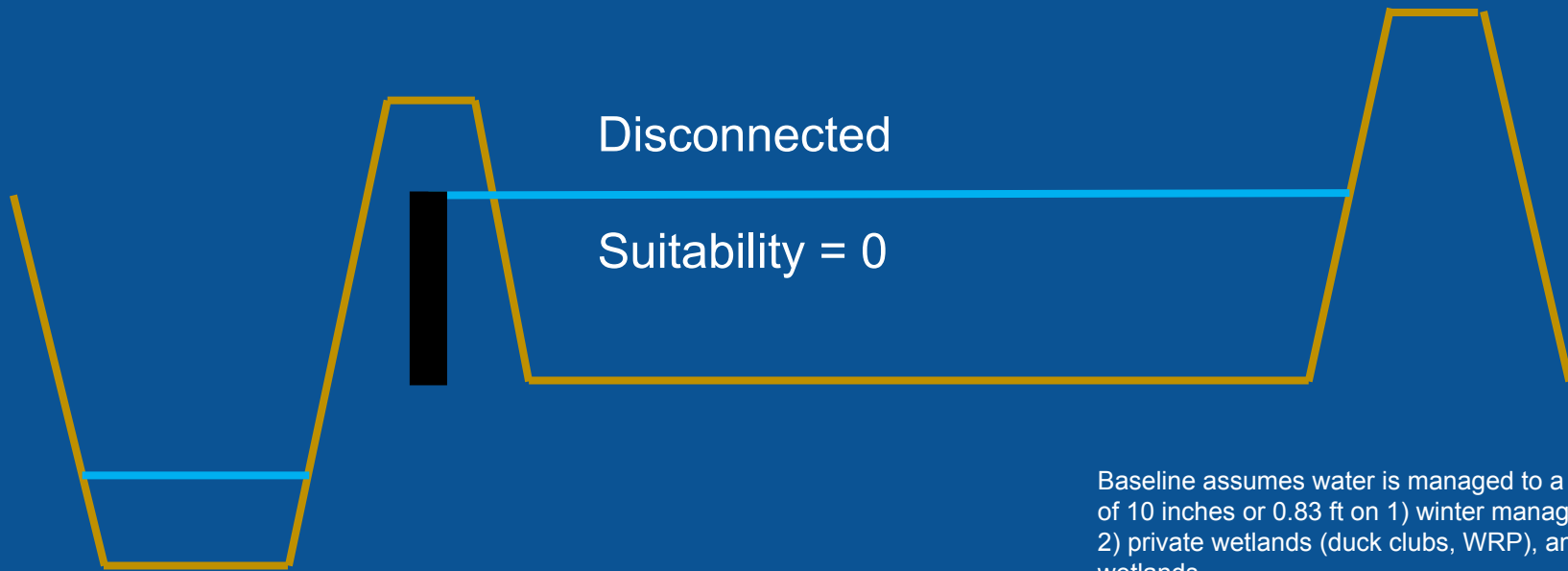
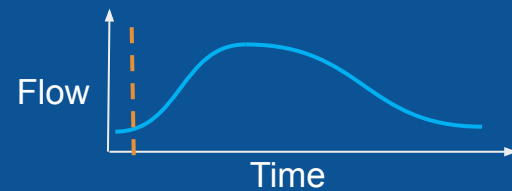
# We assigned three levels of suitability

- Good condition = 1
- Sub optimal = 0.66
- Poor/unsuitable = 0

# Connectivity

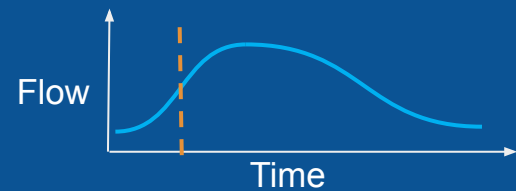


# At managed level, not accessible



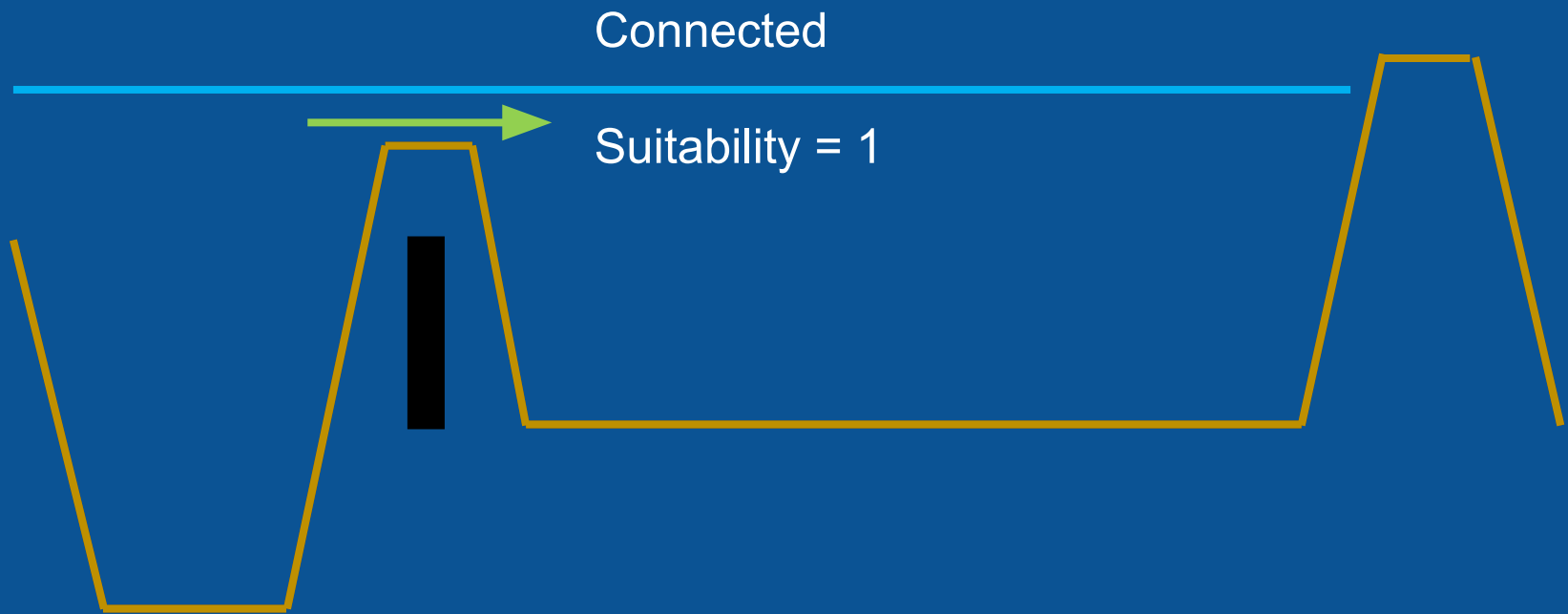
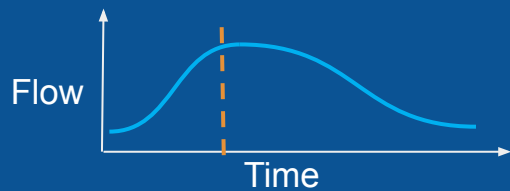
Baseline assumes water is managed to a target depth of 10 inches or 0.83 ft on 1) winter managed rice fields, 2) private wetlands (duck clubs, WRP), and 3) public wetlands

# Outlet overtops, not accessible

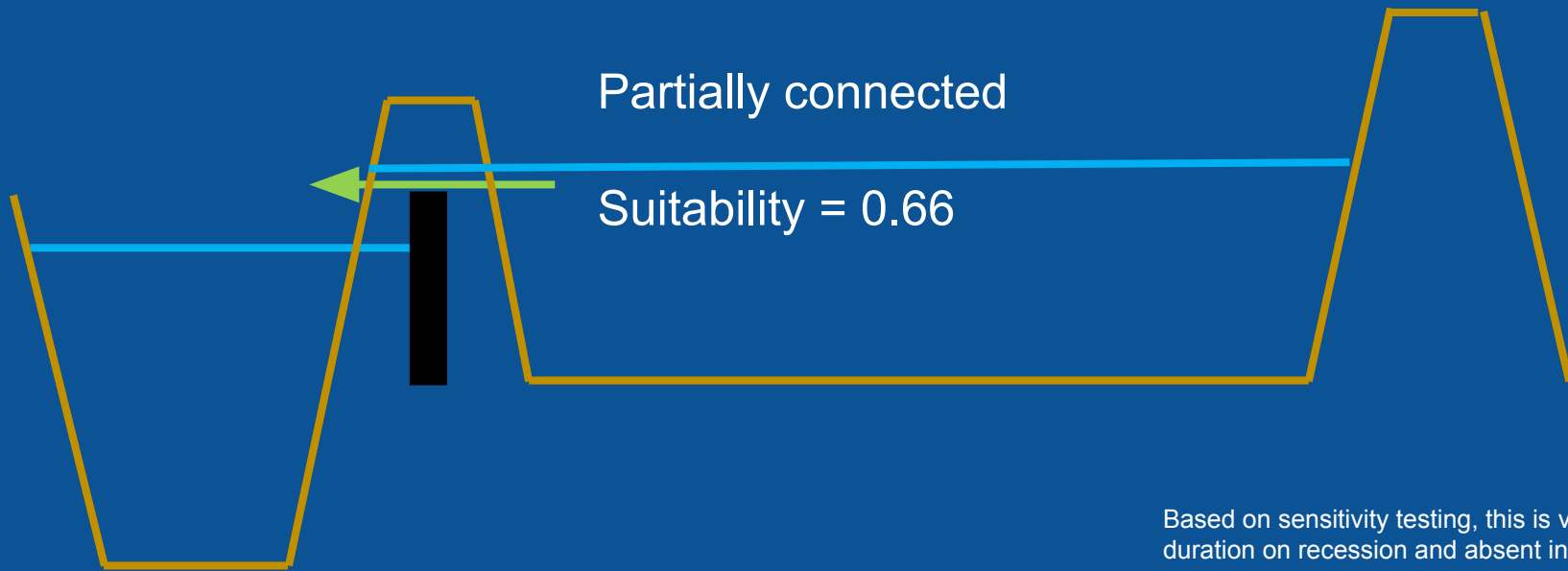
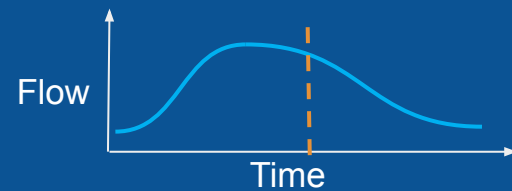




# Berm overtops, juvenile ingress



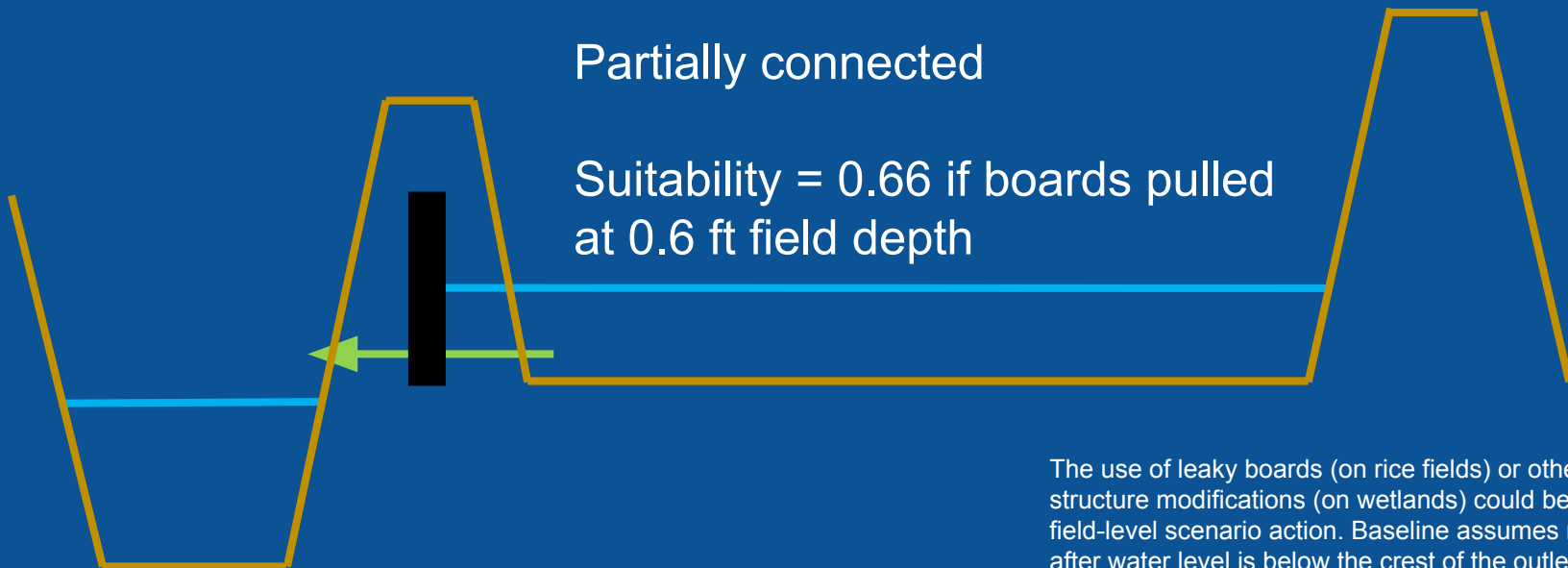
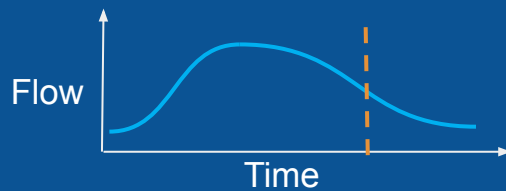
# Receding over outlet weir, juvenile rearing



Based on sensitivity testing, this is very short duration on recession and absent inflow

## Potential management action:

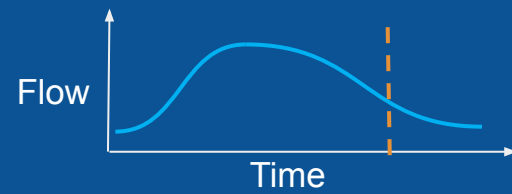
Receding below managed level, flowing thru leaky boards at field depth  $> 0.6$  ft



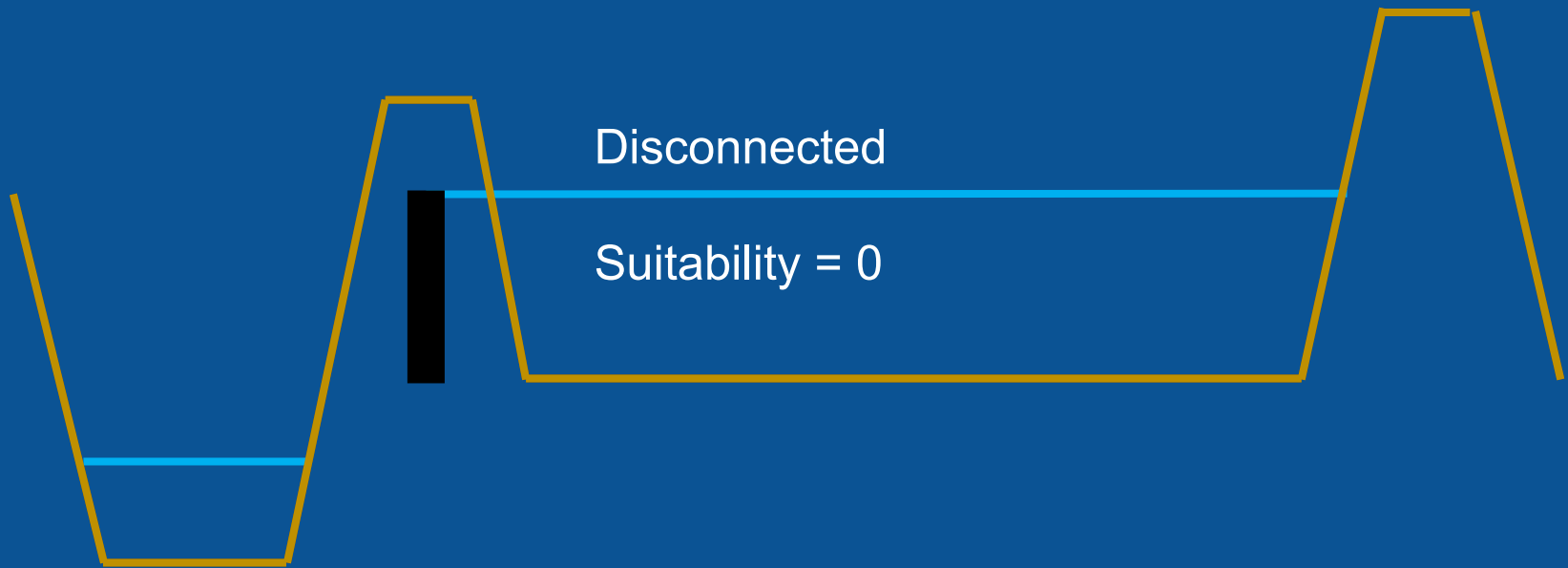
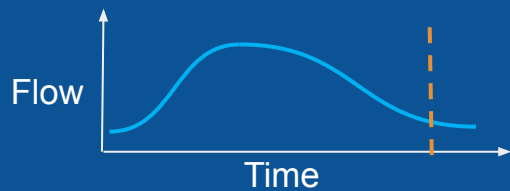
The use of leaky boards (on rice fields) or other outlet structure modifications (on wetlands) could be a potential field-level scenario action. Baseline assumes no connection after water level is below the crest of the outlet structure.

# Potential management action:

Flow through leaky boards < 0.6 ft field depth,  
no habitat



# Reset/refill to managed level



# Sensitivity testing

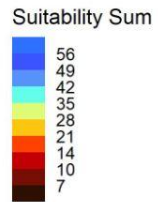
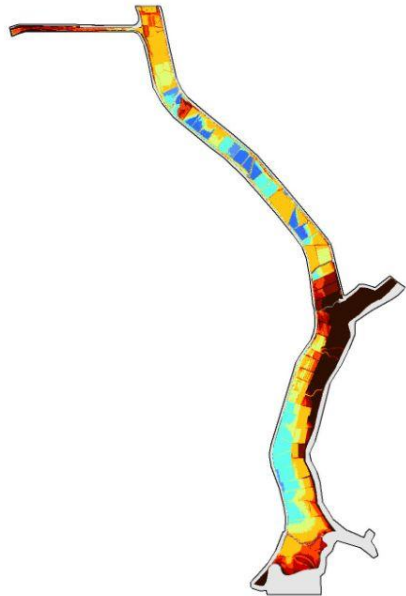
- Evaluated Sutter model of a single baseline condition in water year 2016
- Applied base suitability criteria parameters
- Changed one parameter at a time and compared with the base parameter set to assess sensitivity

# Key questions for sensitivity testing

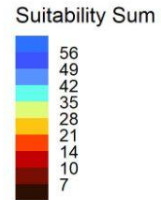
- **Duration:** How does changing optimal duration from 14 to 21 days affect suitability?
- **Depth:** How much does suitability change if everything > 0.6 ft deep is considered suitable? If we have a cap of 6.6 ft, does that exclude potential habitat?
- **Velocity:** How does increasing the max velocity to 3 ft/s affect suitability? Do higher velocity cutoffs result in suitability for “channel-like” areas?
- **Connectivity:** How does connectivity change if no days of disconnection are allowed? If 4 days are allowed?
- **Land cover:** Is this redundant with other criteria?

# Example

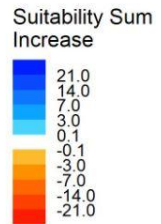
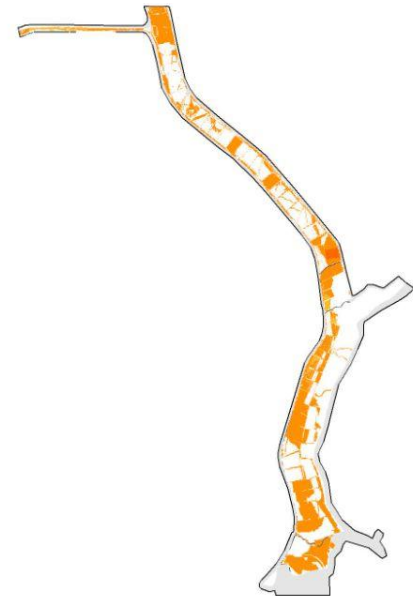
## Base parameters



## Iterated parameters



## Difference

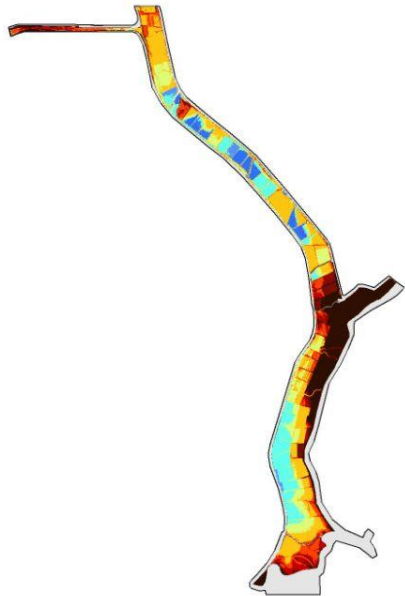




# Duration: Moderate decrease in suitability with increase in min optimal duration

Optimal duration >14 days

Iteration 1  
Base Criteria



Suitability Sum



Optimal duration >21 days

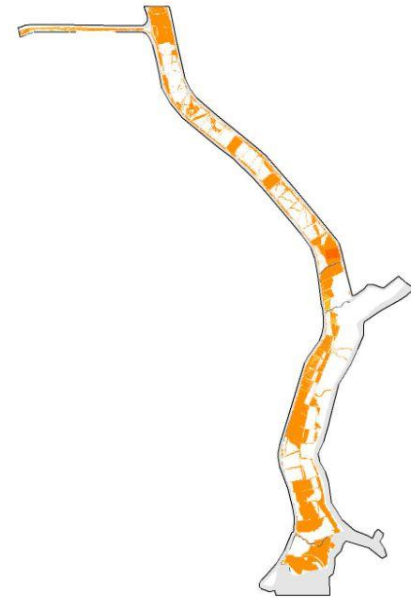
Iteration 2  
Increase Minimum Optimal Duration  
From 14 to 21 Days



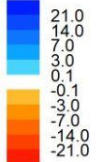
Suitability Sum



Difference



Suitability Sum  
Increase

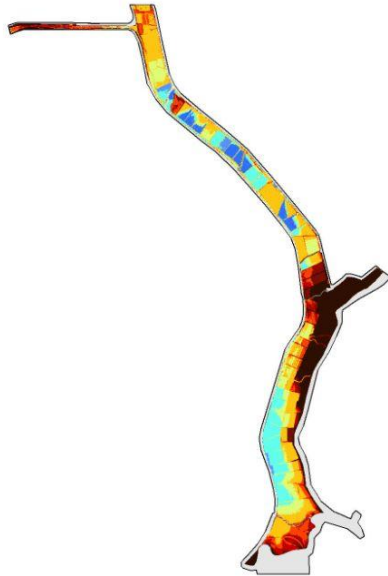


No clear recommendation. Propose retaining 14 days. 17

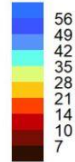
# Depth: Large area receives higher suitability if deeper depths are optimal

Non-optimal > 2 ft (value=0.66)

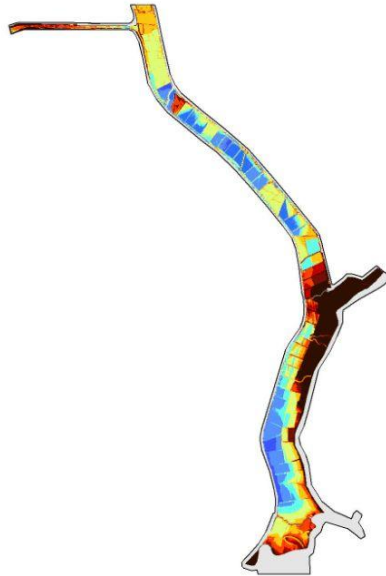
Iteration 1  
Base Criteria



Suitability Sum



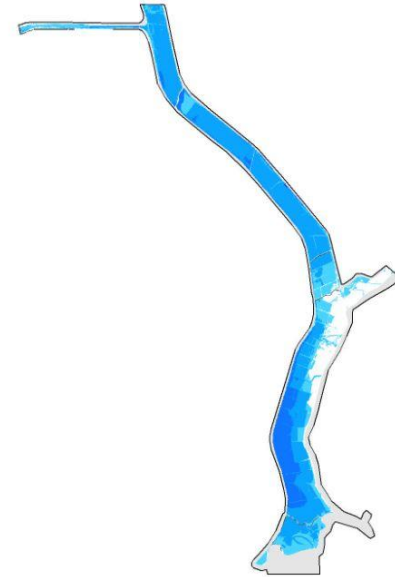
Iteration 5  
Make All Depths Above 0.9 ft Optimal



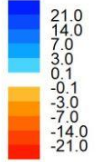
Suitability Sum



Difference



Suitability Sum  
Increase

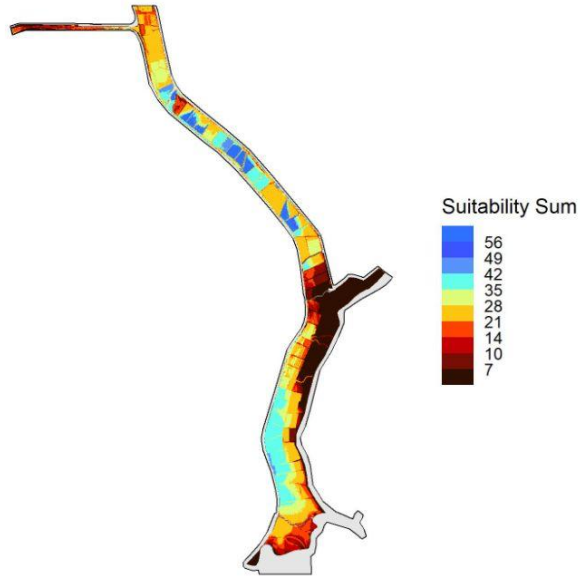


Recommend depth >0.9 ft optimal

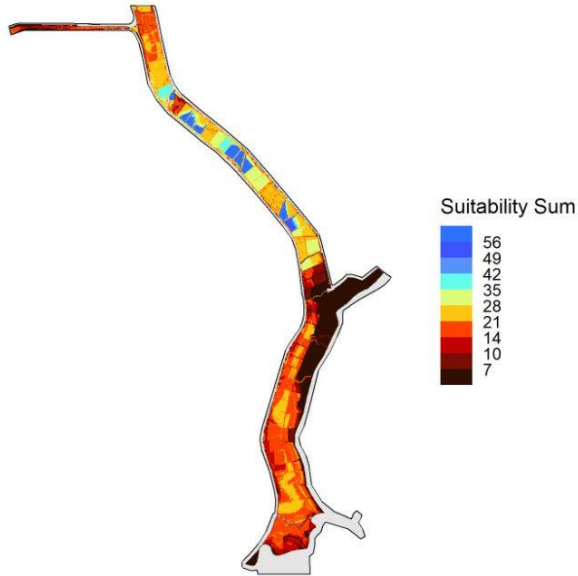
# Depth: Large area excluded with max depth cap

No max depth

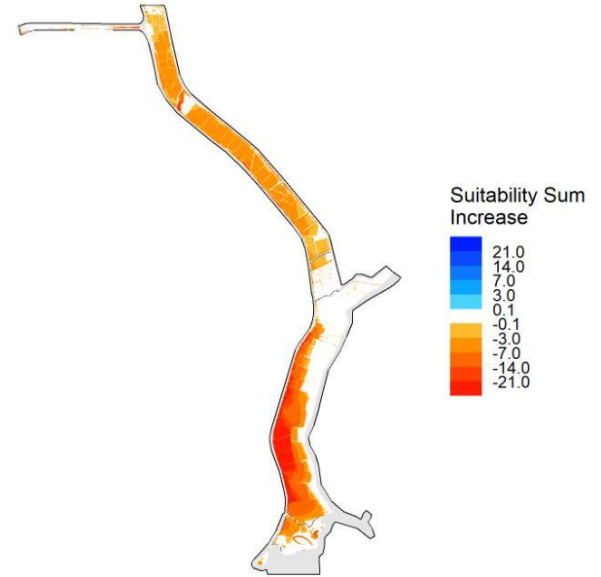
Iteration 1  
Base Criteria



Iteration 7  
Remove All Depths Above 6.6 ft

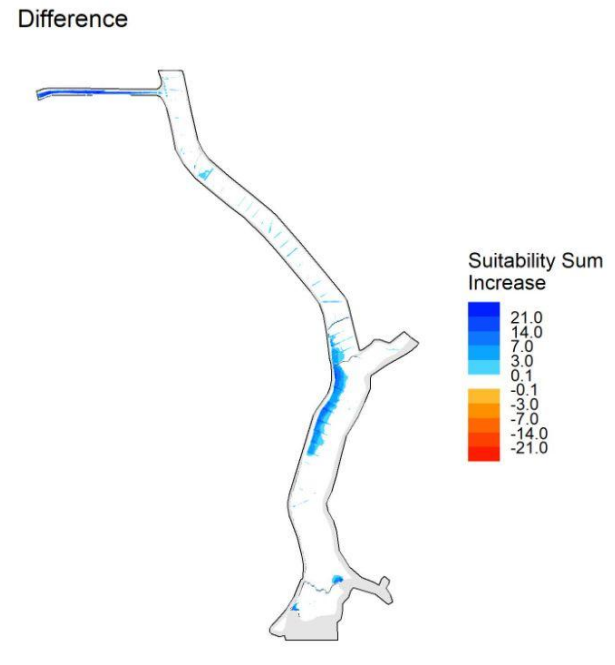
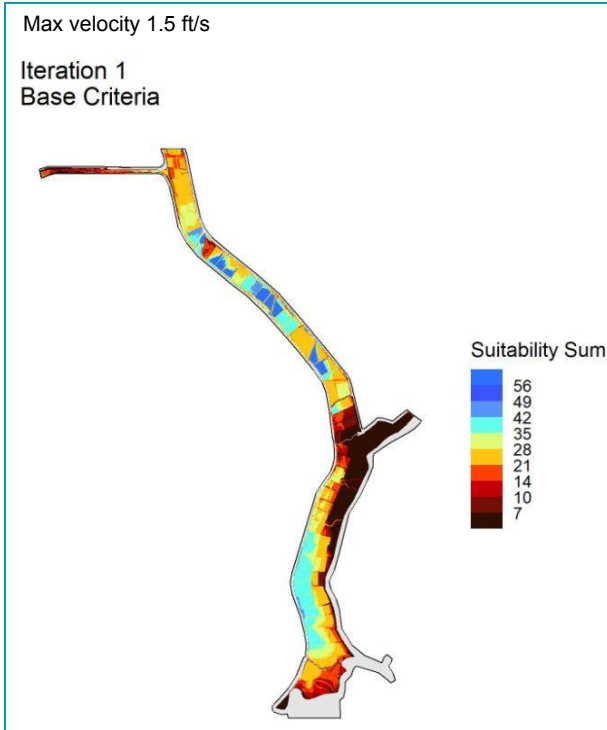


Difference



Recommend no max depth

# Velocity: Minor increase in suitability with increase in max velocity

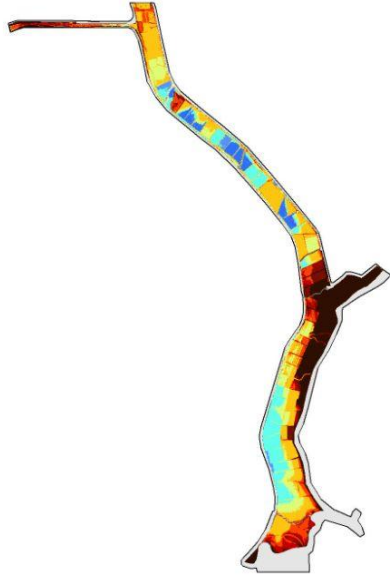


Recommend retaining 1.5 ft/s velocity cap

# Connectivity: Very minor increase in suitability with increase in allowable disconnection from 1- 4 days

1 day disconnection allowed

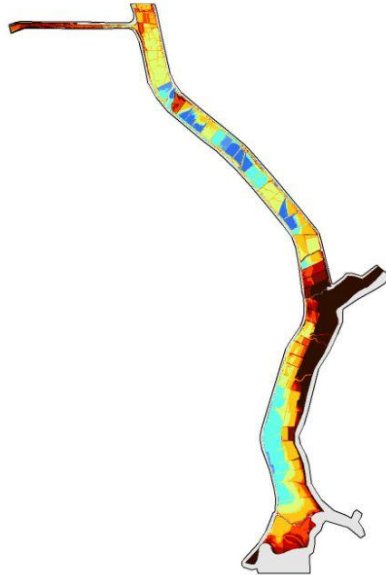
Iteration 1  
Base Criteria



Suitability Sum



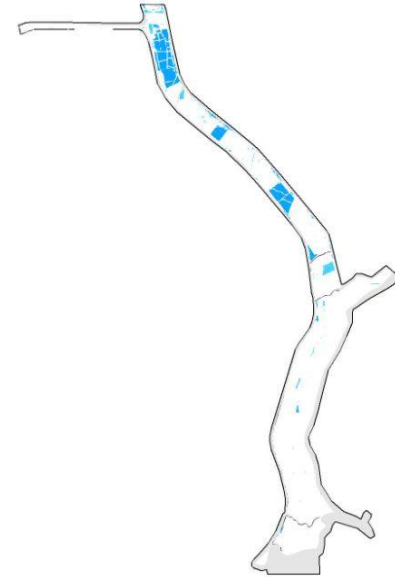
Iteration 11  
Increase Days of Reconnection Allowed  
From 1 to 4 days



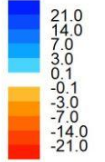
Suitability Sum



Difference



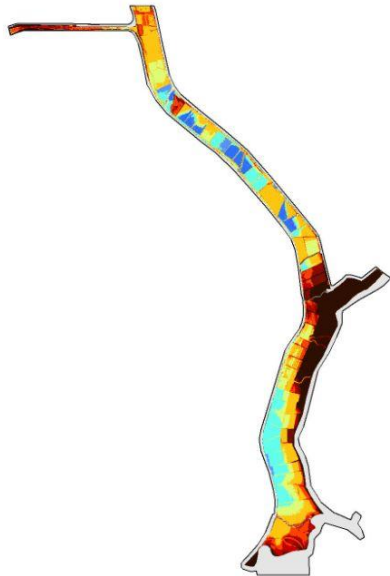
Suitability Sum  
Increase



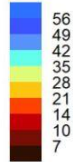
# Connectivity: No difference between 1 and 0 days of disconnection allowed

1 day disconnection allowed

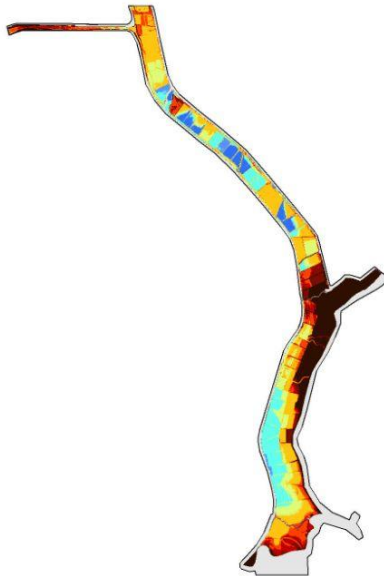
Iteration 1  
Base Criteria



Suitability Sum



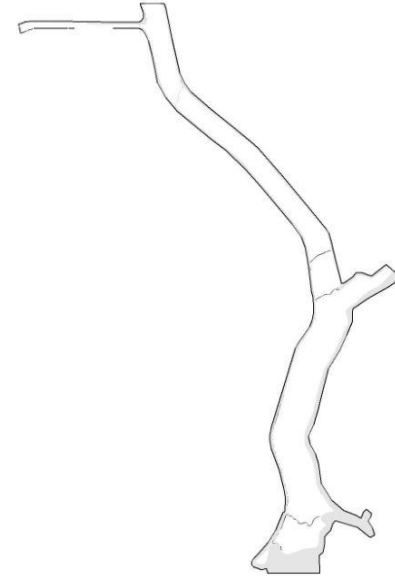
Iteration 10  
No Reconnection Allowed



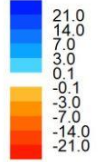
Suitability Sum



Difference



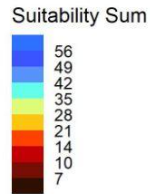
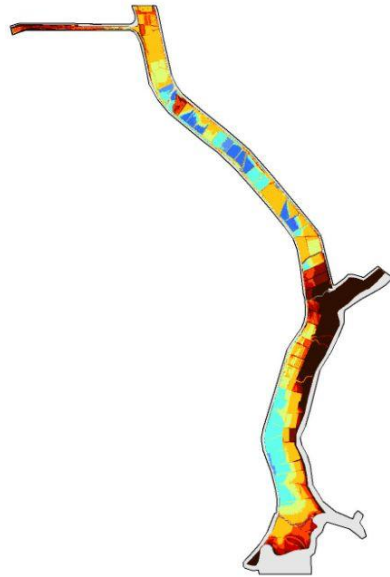
Suitability Sum  
Increase



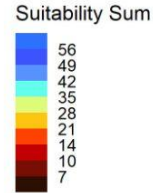
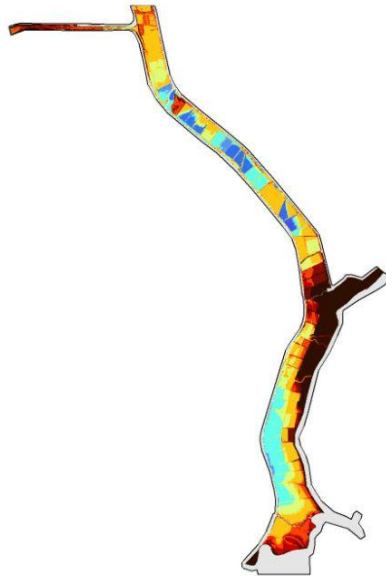
**Recommend 0 day disconnection**

# Connectivity: Very few days only connected through outlet weir

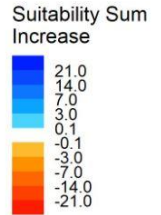
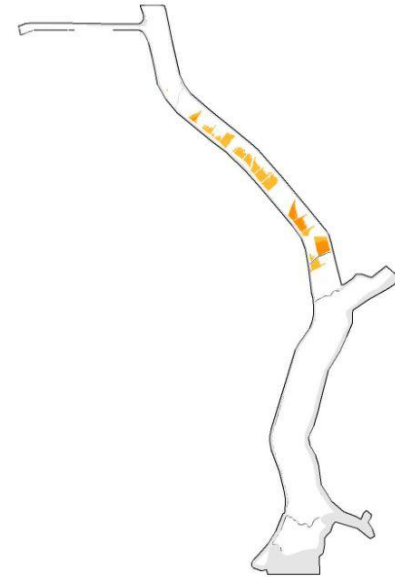
Outlet weir connection still optimal  
Iteration 1  
Base Criteria



Iteration 13  
Lower Field Connectivity HSI When Connected  
Only Thru Outlet Weir from 1 to 0.66



Difference

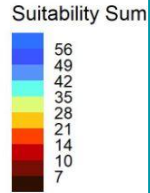
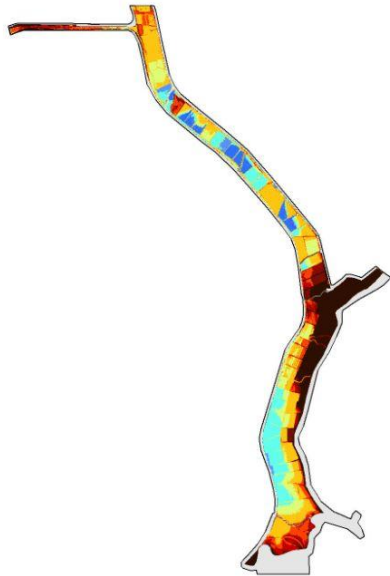


Recommend lower connectivity value when only through outlet weir

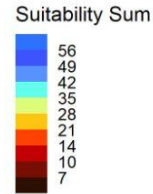
# Land cover: Crop fields are assigned lower suitability

No land cover criteria

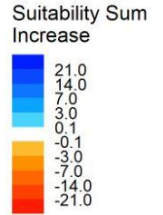
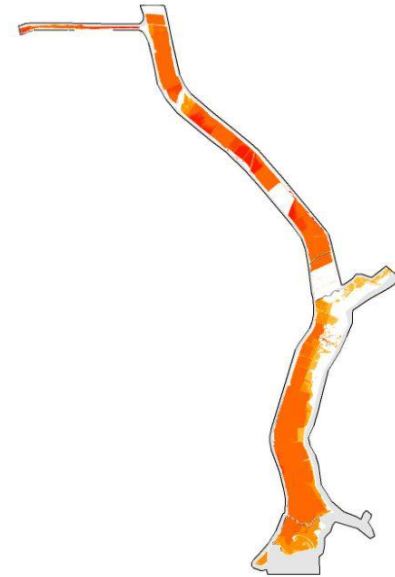
Iteration 1  
Base Criteria



Iteration 12  
Set Cover With Riparian/Wetlands/Water = 1 &  
Rice/Other Ag = 0.66



Difference



Recommend including land cover



# Key questions for sensitivity testing

- **Duration:** How does changing optimal duration from 14 to 21 days affect suitability?
  - **Some minor impacts. Could make alternative scenarios look better (longer duration). Recommend retaining 14 days as start of optimal duration.**
- **Depth:** How much does suitability change if everything >0.6 ft deep is considered suitable? If we have a cap of 6.6 ft, does that exclude potential habitat?
  - **Recommend all depths > 0.9 ft are optimal**
- **Velocity:** How does increasing the max velocity to 3 ft/s affect suitability? Do higher velocity cutoffs result in suitability for “channel-like” areas?
  - **Recommend retaining 1.5 ft/s cutoff**
- **Connectivity:** How does connectivity change if no days of disconnection are allowed? If 4 days are allowed?
  - **Recommend 0 day disconnection allowed. Minimal impact of varying values.**
- **Land cover:** Is this redundant with other criteria?
  - **Recommend including to retain distinction between crop fields and more natural wetlands.**

# Proposed juvenile salmon floodplain rearing habitat suitability criteria

Criteria	Source	Range	Value
Timing	CVHE	November 1 – June 30	1
Duration	SHCM	≥ 14 days	1
		< 14 days	0.66
Depth	CVPIA SIT/ VA/ Yolo 2012 RPA	> 0.9 ft	1
		0.6 - 0.9 ft	0.66
Velocity	CVHE	≤ 1.5 ft/s	1
Connectivity	Based on AHG feedback	Naturally inundated areas are connected if hydraulically connected to each other and upstream/downstream waterways	1
		For managed fields: A connectivity event starts when a field perimeter berm overtops and ends when the field becomes disconnected via all structures or depth drops below 0.6 ft. There are three types of potential connectivity within a connectivity event:	
		Field berm overtopping (initiates connectivity event)	1
		(proposed management action) Within a connectivity event with flow over the outlet weir or through the leaky outlet structure, where field depth is at least 0.6 ft. Assumes that boards are pulled at 0.6 ft depth to allow egress.	0.66
		Outside of a connectivity event	0
Land Cover	based on AHG feedback	Riparian / Wetlands / Open Water	1
		Rice / Other Ag	0.66

# Proposed juvenile salmon floodplain rearing habitat suitability criteria

Criteria	Source	Range	Value
Timing	CVHE	November 1 – June 30	1
Duration	SHCM	≥ 14 days	1
		< 14 days	0.66
Depth	CVPIA SIT/ VA/	> 0.9 ft	1
Are we comfortable with everything longer than 14 days receiving full credit?			
Connectivity	Based on AHG feedback	Naturally inundated areas are connected if hydraulically connected to each other and upstream/downstream waterways	1
		For managed fields: A connectivity event starts when a field perimeter berm overtops and ends when the field becomes disconnected via all structures or depth drops below 0.6 ft. There are three types of potential connectivity within a connectivity event:	
		Field berm overtopping (initiates connectivity event)	1
		(proposed management action) Within a connectivity event with flow over the outlet weir or through the leaky outlet structure, where field depth is at least 0.6 ft. Assumes that boards are pulled at 0.6 ft depth to allow egress.	0.66
		Outside of a connectivity event	0
Land Cover	based on AHG feedback	Riparian / Wetlands / Open Water	1
		Rice / Other Ag	0.66

# Proposed juvenile salmon floodplain rearing habitat suitability criteria

Criteria	Source	Range	Value
Timing	CVHE	November 1 – June 30	1
Duration	SHCM	≥ 14 days	1
		< 14 days	0.66
Depth	CVPIA SIT/ VA/ Yolo 2012 RPA	> 0.9 ft	1
		0.6 - 0.9 ft	0.66
Velocity	CVHE	< 1.5 ft/s	1
<p>Max optimal depth removed to simplify interpretation and to ensure credit is given for high water volume events</p> <p>Sub-optimal suitability value assigned to depths 0.6 - 0.9 ft</p>			
Connectivity	feedback	Field berm overtopping (initiates connectivity event)	1
		Within a connectivity event with flow over the outlet weir or through the leaky outlet structure, where field depth is at least 0.6 ft. Assumes that boards are pulled at 0.6 ft depth to allow egress.	0.66
		Outside of a connectivity event	0
Land Cover	based on AHG feedback	Riparian / Wetlands / Open Water	1
		Rice / Other Ag	0.66

# Proposed juvenile salmon floodplain rearing habitat suitability criteria

Criteria	Source	Range	Value
Timing	CVHE	November 1 – June 30	1
<p>No disconnection allowed to maintain connectivity</p> <p>Potential field-level management of leaky boards</p>			
Velocity	CVHE	≤ 1.5 ft/s	1
Connectivity	Based on AHG feedback	Naturally inundated areas are connected if hydraulically connected to each other and upstream/downstream waterways	1
		For managed fields: A connectivity event starts when a field perimeter berm overtops and ends when the field becomes disconnected via all structures or depth drops below 0.6 ft. There are three types of potential connectivity within a connectivity event:	
		Field berm overtopping (initiates connectivity event)	1
		(proposed management action) Within a connectivity event with flow over the outlet weir or through the leaky outlet structure, where field depth is at least 0.6 ft. Assumes that boards are pulled at 0.6 ft depth to allow egress.	0.66
		Outside of a connectivity event	0
Land Cover	based on AHG feedback	Riparian / Wetlands / Open Water	1
		Rice / Other Ag	0.66

# Proposed juvenile salmon floodplain rearing habitat suitability criteria

Criteria	Source	Range	Value
Timing	CVHE	November 1 – June 30	1
Duration	SHCM	≥ 14 days	1
		< 14 days	0.66
Depth	CVPIA SIT/ VA/ Yolo 2012 RPA	>0.9 ft	1
		0.6 - 0.9 ft	0.66
Velocity	CVHE	≤ 1.5 ft/s	1
Connectivity	Based on AHG feedback	Naturally inundated areas are connected if hydraulically connected to each other and upstream/downstream waterways	1
		For managed fields: A connectivity event starts when a field perimeter berm overtops and ends when the field becomes disconnected via all structures or depth drops below 0.6 ft. There are three types of potential connectivity within a connectivity event:	
		Field berm overtopping (initiates connectivity event)	1
		Retained to represent benefit of more variable depth and more refugia in natural cover types	
		Outside of a connectivity event	0
Land Cover	based on AHG feedback	<b>Riparian / Wetlands / Open Water</b>	<b>1</b>
		<b>Rice / Other Ag</b>	<b>0.66</b>

# Proposed juvenile salmon floodplain rearing habitat suitability criteria

Criteria	Source	Range	Value
Timing	CVHE	November 1 – June 30	1
Duration	SHCM	≥ 14 days	1
		< 14 days	0.66
Depth	CVPIA SIT/ VA/ Yolo 2012 RPA	>0.9 ft	1
		0.6 - 0.9 ft	0.66
Velocity	CVHE	≤ 1.5 ft/s	1
Connectivity	Based on AHG feedback	Naturally inundated areas are connected if hydraulically connected to each other and upstream/downstream waterways	1
		For managed fields: A connectivity event starts when a field perimeter berm overtops and ends when the field becomes disconnected via all structures or depth drops below 0.6 ft. There are three types of potential connectivity within a connectivity event:	
		Field berm overtopping (initiates connectivity event)	1
		(proposed management action) Within a connectivity event with flow over the outlet weir or through the leaky outlet structure, where field depth is at least 0.6 ft. Assumes that boards are pulled at 0.6 ft depth to allow egress.	0.66
		Outside of a connectivity event	0
Land Cover	based on AHG feedback	Riparian / Wetlands / Open Water	1
		Rice / Other Ag	0.66

# Extra slides



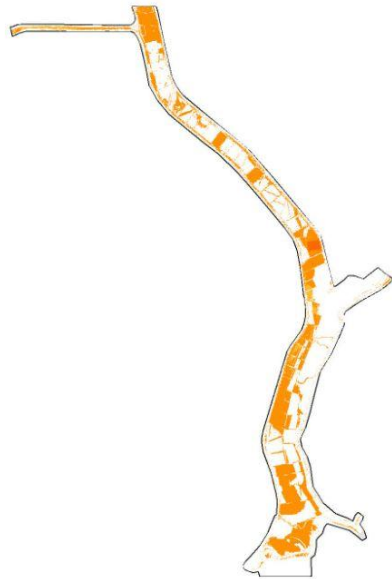
# To be developed: Stranding potential

- Represent changes to stranding potential between baseline and alternative scenarios
- Options
  - Qualitative assessment of potential risk
  - Spatial assessment of locations with potential increased risk of stranding
    - Additional connections
    - Existing connections with additional flow through structures

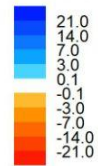
# Duration: Scenario has higher relative suitability (longer duration)

Iteration 2 vs. Iteration 1 - Increase Minimum Optimal Duration From 14 to 21 Days

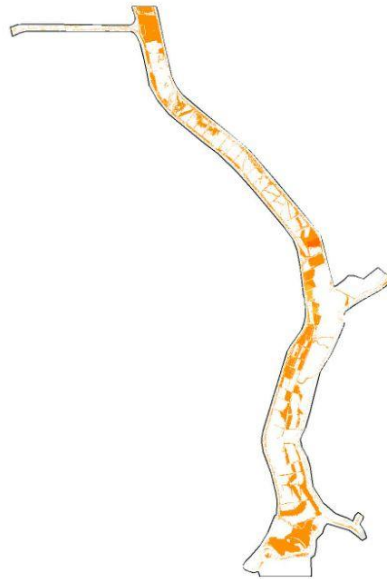
Baseline



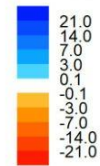
Suitability Sum Increase



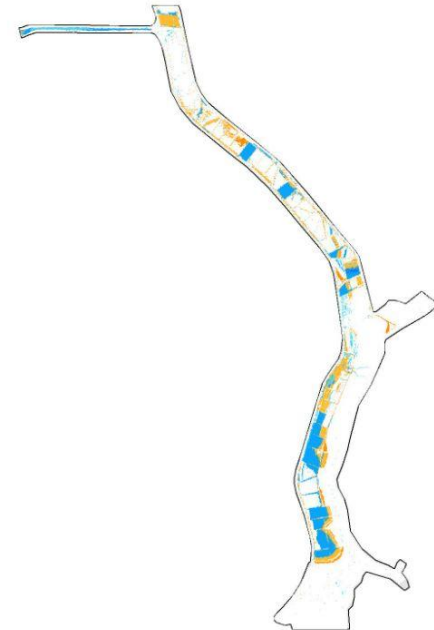
Alternative



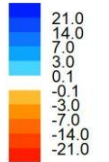
Suitability Sum Increase



Difference of Differences



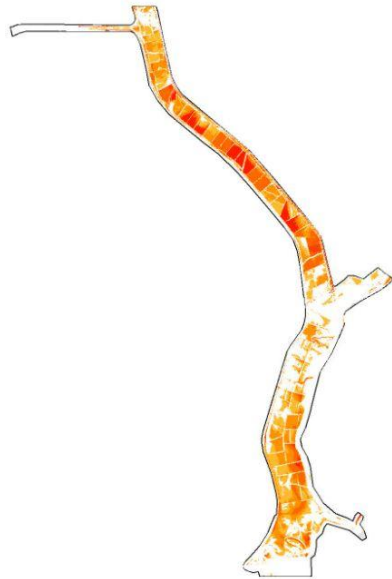
Difference



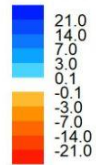
# Velocity: Including a minimum velocity reduces suitability, particularly for the alternative scenario

Iteration 9 vs. Iteration 1 - Remove All Velocities Lower Than 0.1 ft/s

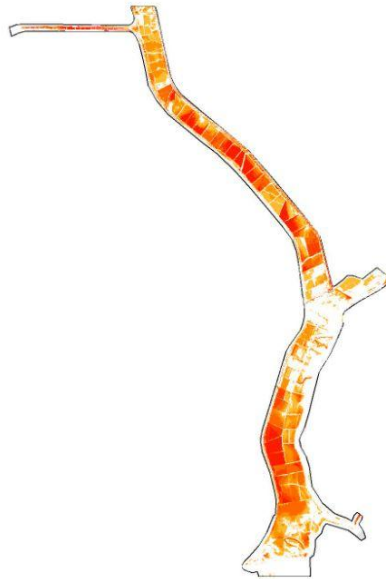
Baseline



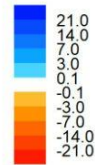
Suitability Sum Increase



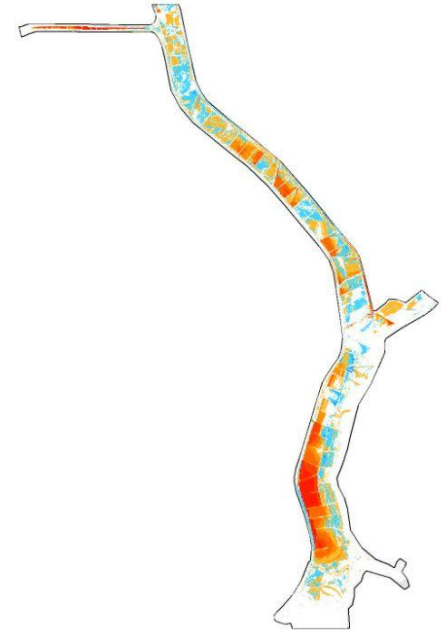
Alternative



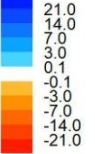
Suitability Sum Increase



Difference of Differences



Difference



**Recommend no change**

Criteria	Source	Range	Value
Timing	CVHE	November 1 – June 30	1
Duration	SHCM	< 14 days	0.66
		≥ 14 days	1
Inundation Frequency	based on AHG feedback	> 1 inundation event	1
		1 inundation event	0.66
Depth	CVPIA SIT/SHCM	0.6 to 6.6 ft	1
Velocity	CVHE	≤ 1.5 ft/s	1
Connectivity	CVHE/Sutter Bypass Management Plan	<ul style="list-style-type: none"> <li>Inundated areas are hydraulically connected to each other and downstream waterways, and if ponding or hydraulic disconnection occurs, the ponded area must reconnect within xx days</li> <li>Managed field units (wetlands, rice) become accessible after the perimeter berm is overtopped (e.g., backwater overtopping of the outlet structure by X inches) for the first time or there is flow through the inlet structure</li> <li>Managed field units (wetlands, rice) are considered hydraulically connected if there is flow through the outlet structure to provide for volitional egress</li> </ul>	1
Land Cover	based on AHG feedback	Riparian / Wetlands / Open Water	1
		Rice / Other Ag	0.66
Floodplain Conditions	based on AHG feedback	Natural/Unmanaged (or managed but the water level is higher than the managed level)	1
		Managed (within the management period)	0.66

For reference:  
November criteria