Agency / NGO Flow Proposal
Stream Reaches *Upstream* of Englebright Reservoir

Yuba River Development Project – FERC no. 2246

April 14, 2015 (update – springtime without project flows element)

- California Department of Fish and Wildlife
- Foothills Water Network
- USDA Forest Service
- USDI Fish and Wildlife Service
- In collaboration with State Water Board staff

Development of the Flow Proposal

- Review of physical, biological, and recreation resource attributes and interests for each stream reach, including:
  - YCWA Tech Memos and maps for all relevant resource areas
  - Rainbow Trout (RBT) and Foothill yellow-legged frog (FYLF) habitat models (PHABSIM, River2D)
  - Historical and modeled hydrology
  - Riparian cross-section tool
  - Reports and published literature on aquatic resources and flows
- Review of project facilities
- Review of YCWA's proposed project – DLA and FLA measures and operations modeling
- Operations modeling – overall and sensitivity
- Review of modeled hydrologic and resource outcomes to assess whether the proposal meets needs/interests

Flow Proposal Element – Springtime Without-Project Flows
Middle Yuba and Oregon Creek

- **Aquatic /Riparian Resource Goals** – Spring/Early Summer
  - Protect and enhance channel maintenance, riparian, fish and amphibian spawning and other biological processes.
  - Reduce the number of years when Middle Yuba and Oregon Creek water is diverted to the North Yuba (NBB) and then NBB spills.

- **Implementation**
  - Provide full without-project flows in the Middle Yuba River below Our House Diversion Dam and in Oregon Creek below Log Cabin Diversion Dam in the wettest water year types from April through September [after August and September, inflow/outflow].
  - April 1 in years when New Bullards storage is at 780 taf or higher at end of day on March 31.
  - During this same time period, fully open the sluice gates to allow flows to recede slowly at the end of spills.

- **Potentially 30% of years, wettest years, during spring/early summer, after water year type is known.**

Project Effects

- The hydrologic and sediment regimes below the diversions differ substantially from without-project flow regimes in the magnitude, and duration of base flows, spills and channel forming flow events.

- Focus on spring/early summer of wet water years.

- Based on ***IHA Analysis*** in Tech Memo 2-2 (YCWA 2012) some key hydrologic effects are:

  - In wet years, without project flows are substantially higher than with project flows from April through July.

Middle Yuba – Table 3.3-1

Month	All Years		Wet	
	Without-Project (cfs)	With-Project (cfs)	Without-Project (cfs)	With-Project (cfs)
October	37.0	33.0	41.2	33.0
November	49.0	33.0	64.5	33.0
December	95.0	33.0	195.0	33.0
January	235.0	33.0	518.0	33.0
February	310.5	33.0	471.3	33.0
March	433.9	33.0	590.7	33.0
April	494.5	53.0	686.6	53.0
May	427.0	53.0	777.0	53.0
June	148.7	43.0	599.2	43.0
July	56.0	33.0	91.7	33.0
August	38.3	33.0	52.0	33.0
September	35.7	33.0	41.6	33.0

Oregon Creek – Table 3.3-6

Month	All Years		Wet	
	Without-Project (cfs)	With-Project (cfs)	Without-Project (cfs)	With-Project (cfs)
October	3.4	3.4	3.7	3.7
November	6.0	6.0	9.2	9.0
December	22.8	9.0	54.4	9.0
January	75.9	9.0	188.5	9.0
February	93.0	9.0	181.6	9.0
March	132.0	9.0	199.9	9.0
April	109.4	13.0	167.6	13.0
May	51.9	13.0	98.7	13.0
June	15.8	11.0	22.8	11.0
July	5.4	5.4	10.4	9.0
August	3.0	3.0	4.3	4.3
September	2.7	2.7	3.2	3.2

Project Effects – hydrology, cont.

- While the number of high flow pulses are similar, the duration of these pulses are substantially shorter under with project conditions.

Middle Yuba – Table 3.3-4

Parameter	All Years		Wet	
	Without-Project	With-Project	Without-Project	With-Project
Number of Low Pulses	4	4	3	7
Duration of Low Pulses	11	32	5	11
Number of High Pulses	6	3	6	7
Duration of High Pulses	4	2	9	3

Oregon Creek – Table 3.3-9

Parameter	All Years		Wet	
	Without-Project	With-Project	Without-Project	With-Project
Number of Low Pulses	4	4	2	2
Duration of Low Pulses	13	13	21	21
Number of High Pulses	5	3	5	6
Duration of High Pulses	4	2	15	4

- The Middle Yuba rise rates are four times slower and fall rates are ten times more gradual without the project. In Oregon Creek these rates are more similar, with project rates are relatively slower than without project, potentially due to the contribution of water from the Middle Yuba River.

Middle Yuba – Table 3.3-5

Parameter	All Years		Wet	
	Without-Project (cfs)	With-Project (cfs)	Without-Project (cfs)	With-Project (cfs)
Median Rate of Rise	20	66	36	127
Median Rate of Fall	-7	-24	-14	-149
Number of Reversals	84	22	87	23

Oregon Creek – Table 3.3-10

Parameter	All Years		Wet	
	Without-Project (cfs)	With-Project (cfs)	Without-Project (cfs)	With-Project (cfs)
Median Rate of Rise	4	1	6	2
Median Rate of Fall	-2	0	-4	0
Number of Reversals	78	45	74	47

Project Effects

- Channel Morphology – ***Middle Yuba and Oregon Creek***
  - Tech Memo 1-1 (YCWA 2013), Table 3.1-1 and Cross section tool (IXsec):
    - Both streams are wider and more entrenched than would be expected on unregulated low gradient streams.
    - Many cross sections have scoured bedrock within the active channel.
    - Bar faces tend to show an abrupt transition to the uplands.
  - Likely due to the lack of sediment resulting in stream channel scour.

- Riparian :
  - There is riparian vegetation encroachment at the edge of the summer low-flow channel.
  - The lack of sediment has reduced scour on areas with a large amount of NNIP on the floodplain, such as the Celestial Valley reach of Oregon Creek.

Project Effects

- Foothill yellow-legged frog (FYLF) populations are small below both diversions compared to upstream of the diversions and compared to unregulated rivers:

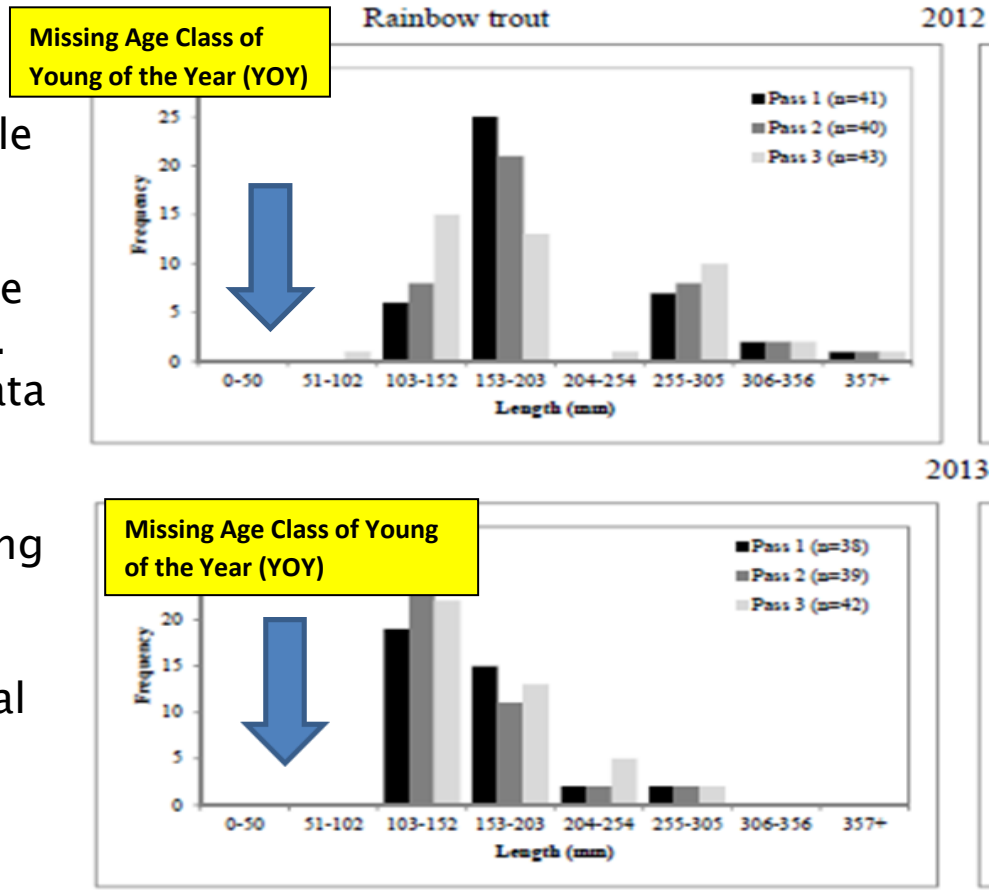
  - *Middle Yuba River* :
    - (2008) At one site, ~ three miles upstream of Our House Diversion Dam, all life stages of FYLF were observed, including over 40 adults, 18 egg masses, and hundreds of tadpoles and young of the year.
    - (2012) At four study sites downstream of Our House Diversion Dam, a maximum total of eight adults, one egg mass, a maximum total of 74 tadpoles and 1 young of the year FYLF were observed.

  - *Oregon Creek* :
    - (2011) At one study site approximately 0.2 miles upstream of Log Cabin Diversion Dam, a maximum of 8 adults, 20 egg masses, and hundreds of tadpoles were observed.
    - (2011) At two study sites downstream of Log Cabin Diversion Dam, a maximum total of two adults and four tadpoles were observed.

  - *North Yuba reference* – (2012) At one study site 21 egg masses, maximum 250 tadpole.

Project Effects

Young of the year (YOY) and immobile life stages of salmonids are of key concern for the resource agencies. Fish population data below Our House Dam (RM 12.5 indicates that young of the year (YOY) comprised of less than 1% of the total population.

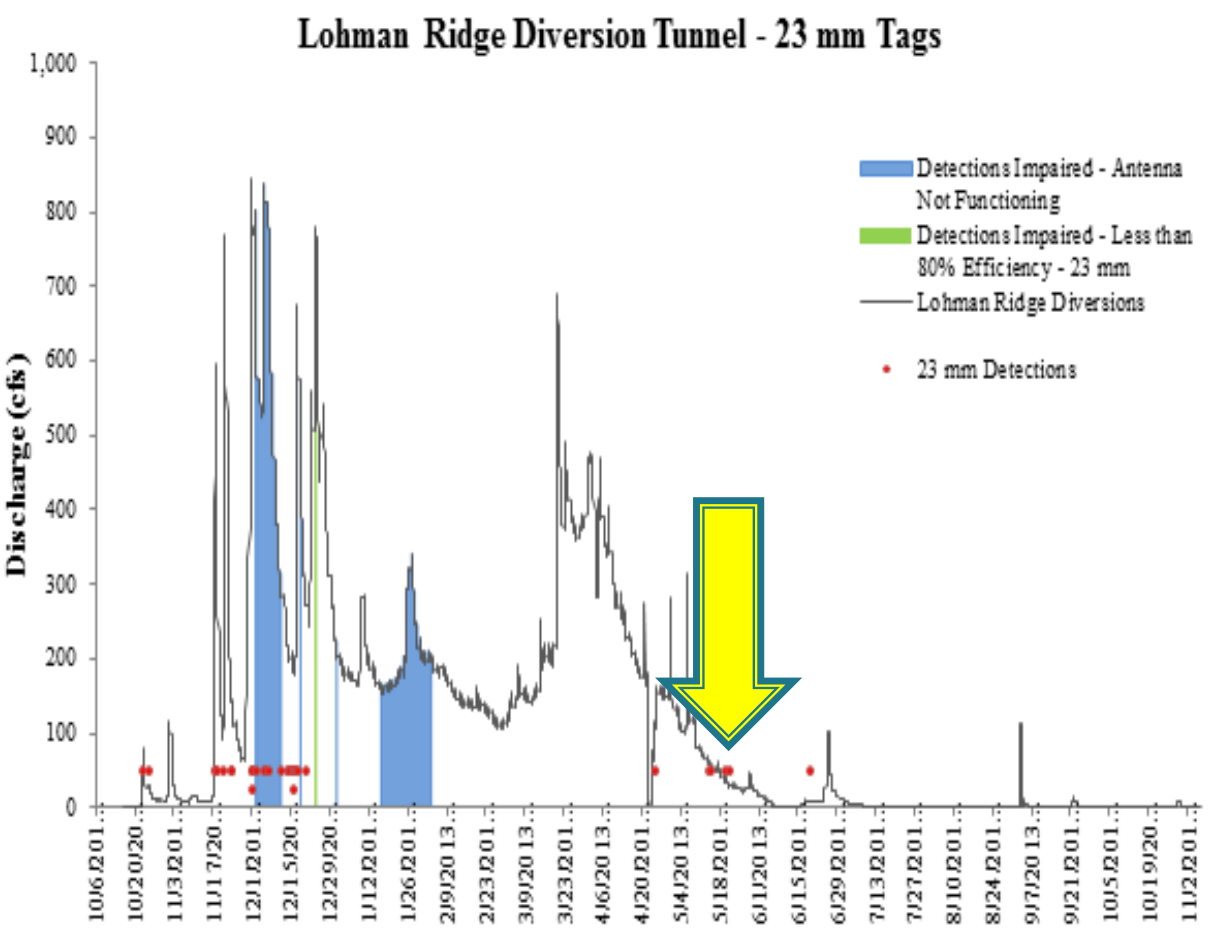


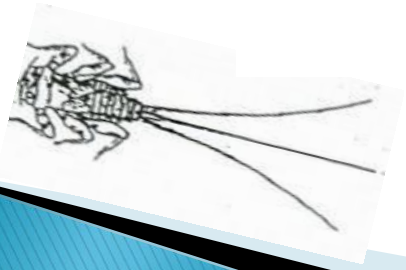
Length-frequency distribution for rainbow trout at the **Middle Yuba River (RM 12.5)** downstream of Our House Diversion Dam Site in 2012 and 2013.

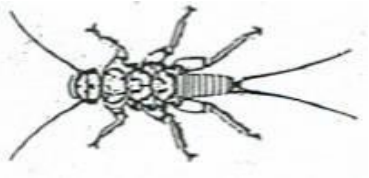
- This data does not exhibit a typical age class structure and does not indicate a healthy population in terms of abundance or productivity. Therefore the Resource Agencies do not consider the fish in the Middle Yuba River downstream of Our House Diversion Dam Reach to be in good condition.

Project Effects

- Known detections of entrainment are occurring after the proposed April 1st closure.
- Lack of suitable spawning gravel below the diversion dams
- LWM deficit





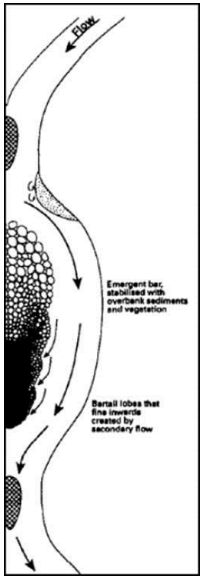


Benefits of Springtime Without-Project Flows

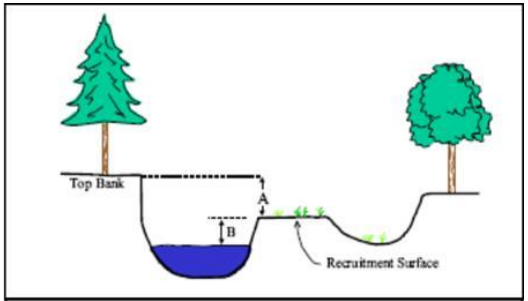
- Unregulated rivers typically have flow recession rates of 4-8 % per day.

- Restoration of springtime high flows and recession flows are expected (when combined with winter sediment pass through):

  - Redistribute and sort stream substrates and restore channel bar formations, specifically:
    - Increase bar area and reduce steepness of bars which improves habitat for FYLF
    - Provide distribution of fines on the floodplain for riparian growth and gravels in the active channel for fish spawning.



  - Encourage more complex riparian development at appropriate locations on the floodplain.



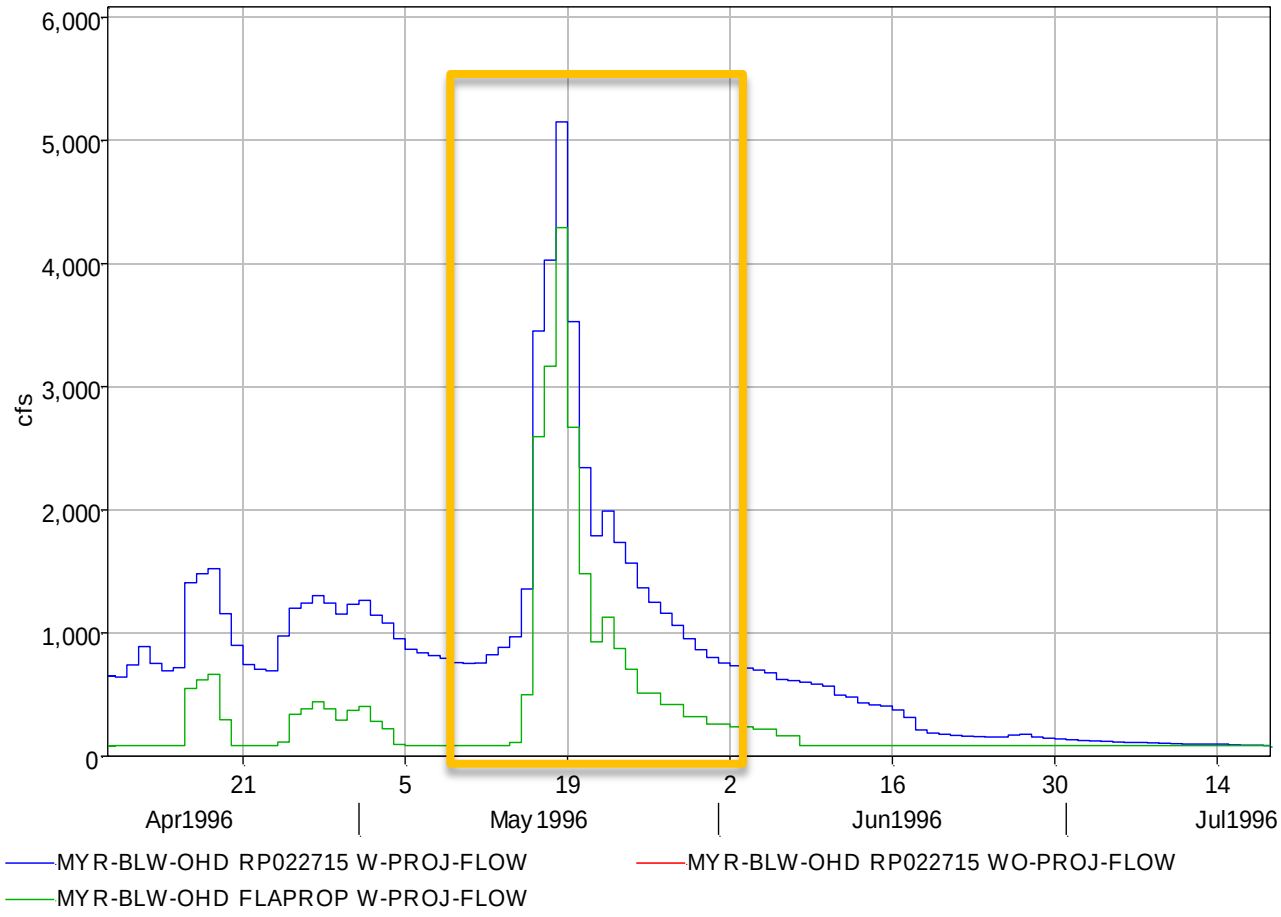
riparian tree seed dispersal and growth

Benefits of Springtime Without-Project Flows, cont.

- Restoration of springtime high flows and recession flows are expected to:
  - Provide a higher base flow to buffer the effects of peak flows and spill events on vulnerable life stages of fish and FYLF.
  - Have recession rates that mimic unregulated rivers and are protective of FYLF egg masses.
  - Improve habitat conditions for native aquatic species via sediment flushing, sorting, and improved morphology of river bars.
  - Extend time in the spring when flows are higher and cooler to support native rainbow trout.
  - Discourage invasive species that are not adapted to higher flows and cooler water temperatures.

Comparisons of Agency/NGO and FLA Flow Modeling

Buffering effect of higher springtime, without-project flows in Middle Yuba



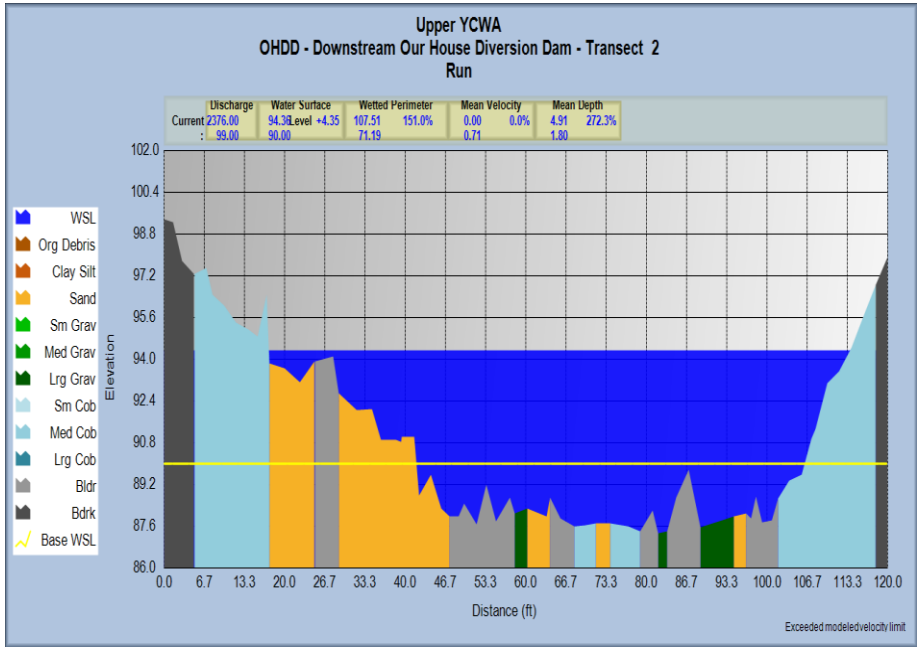
In two days..

- FLA – 97 cfs to 2379 cfs
- Agency/NGO – 964 cfs to 3236 cfs

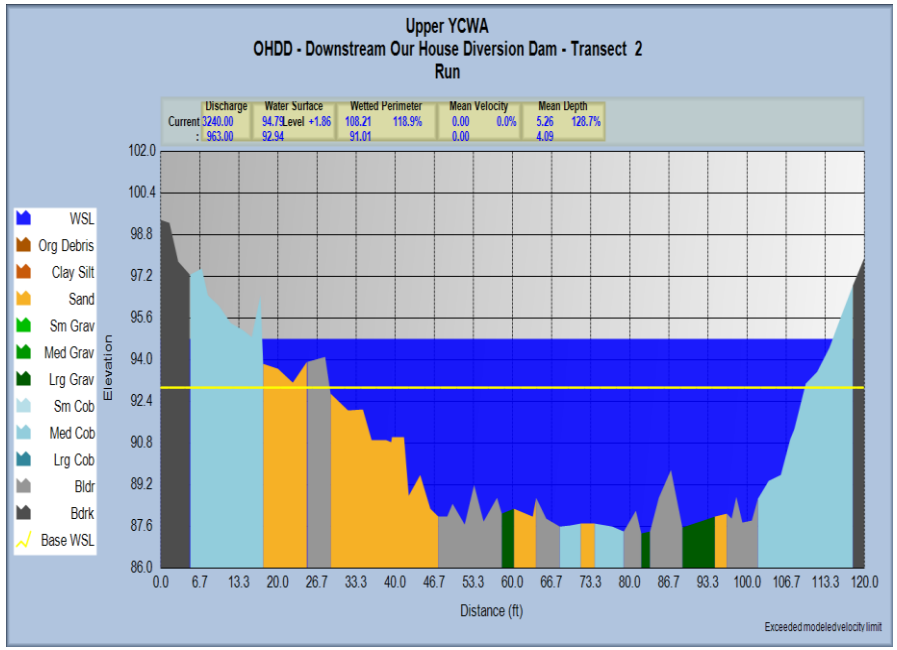
Comparisons of Agency/NGO and FLA Flow Modeling

Buffering effect of higher springtime, without-project flows in Middle Yuba

FLA Proposal



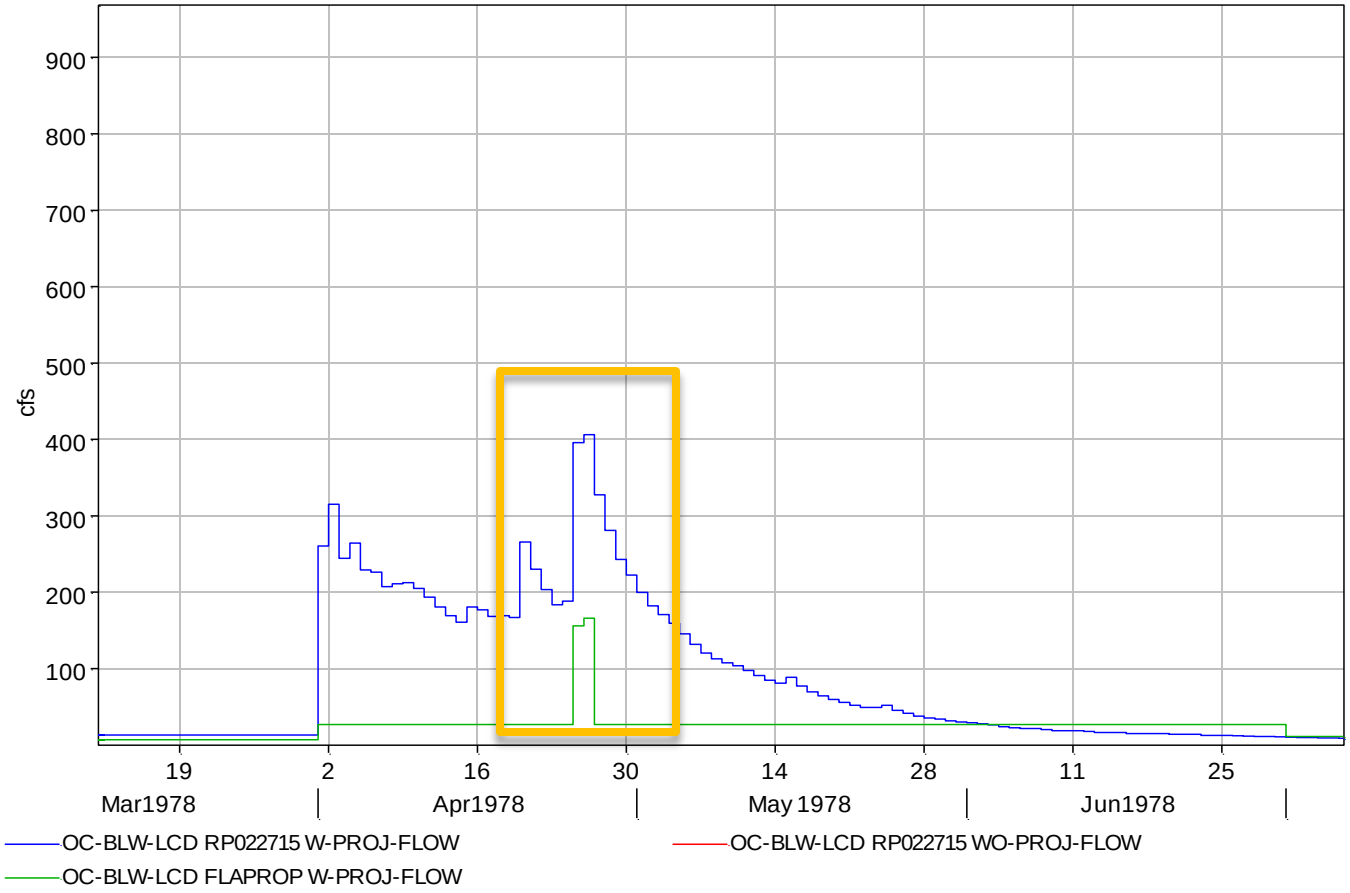
Agency/NGO Proposal



Substantial difference in stage change and water velocities for these two scenarios.

Comparisons of Agency/NGO and FLA Flow Modeling

Buffering effect of higher springtime, without-project flows in Oregon Creek



In two days..

- FLA – 27cfs to 156cfs
- Agency/NGO – 186 cfs to 397cfs

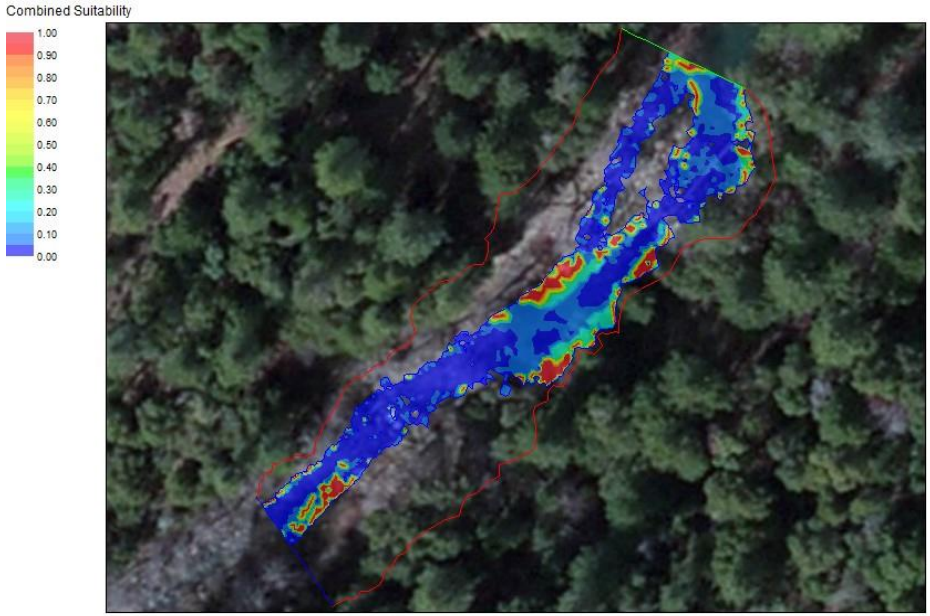
Comparisons of Agency/NGO and FLA Flow Modeling

Buffering effect of higher springtime, without-project flows in Oregon Creek

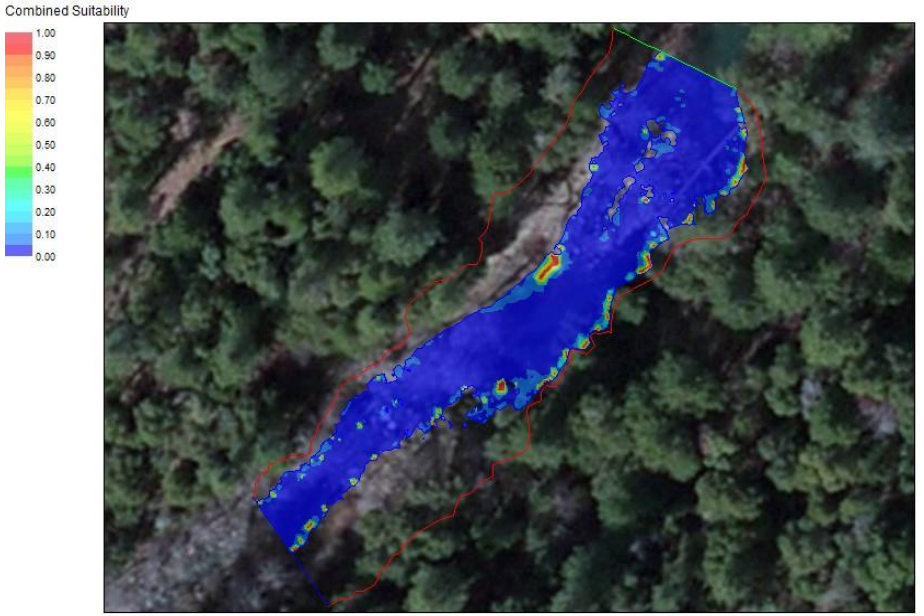
FLA Proposal

Combined FYLF egg mass suitability (depth & velocity)

Before event – 30cfs



During event – 150 cfs



Most of the suitable habitat is no longer suitable for egg masses during storm event.

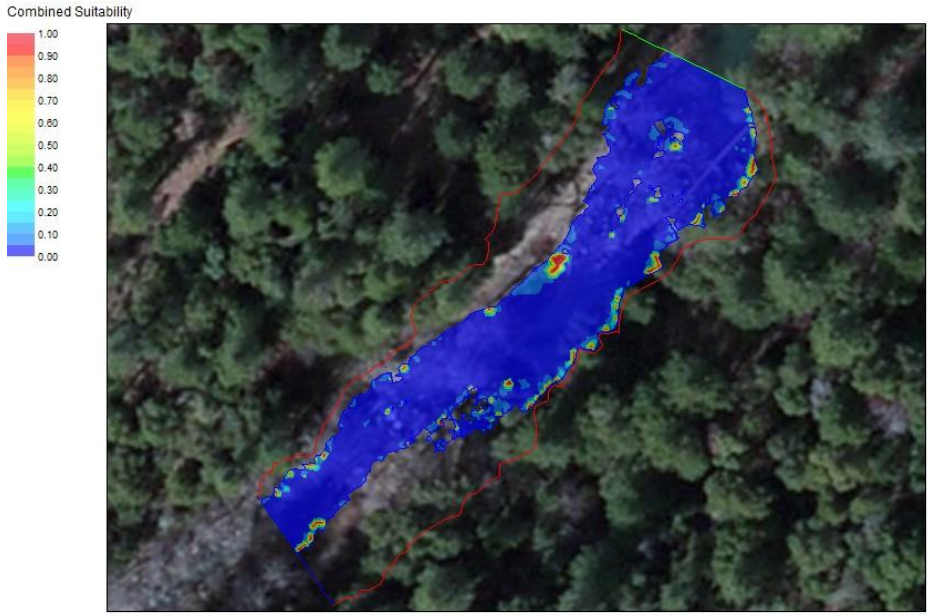
Comparisons of Agency/NGO and FLA Flow Modeling

Buffering effect of higher springtime, without-project flows in Oregon Creek

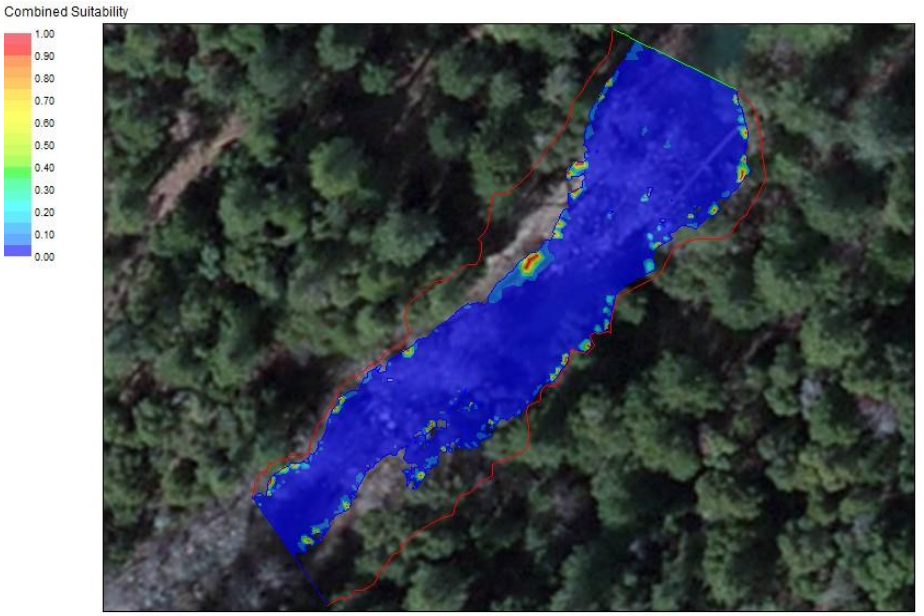
Agency/ NGO Proposal

Combined FYLF egg mass suitability (depth & velocity)

Before event – 200 cfs



During event – 400 cfs



Small suitable habitat patches remain suitable during storm event.

Conclusions

- Restoration of springtime high flows and recession rates:
  - Redistribute and sort stream substrates and restore channel bar formations.
  - Encourage more complex riparian development at appropriate locations on the floodplain.
  - Provide a higher base flow to buffer the effects of peak flows and spill events on vulnerable life stages of fish and FYLF.
  - Improve habitat conditions for native aquatic species via sediment flushing, sorting, and improved morphology of river bars, higher flows, and cooler water temperatures later in the spring.
  - Discourage invasive species that are not adapted to higher flows and cooler water temperatures.