The Yuba River Canyon Restoration Project: Restoring Form and Function

Presented by
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Environmental Science Associates

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PRESENTATION OUTLINE

1. Site Location & Context
2. Site History & Project Need
3. Project Timeline, Planning & Design
4. Access & Construction
CA NATIVE FISHES

83% Extinct or in decline

Moyle, Katz & Quiñones
Biological Conservation,
Vol 144, issue 10, Oct. 2011

N=129
Central Valley Chinook

Of 4 runs
3 are endangered, the other is dominated by hatcheries
Central Valley Water Infrastructure – Dams

Then

Now

80% reduction in spawning habitat

NOAA 2009
Like any chain...
is only as strong as weakest link
Where did the sediment go?
Lower Yuba River at Deer Creek
(1909; G. K. Gilbert)
Englebright Dam was built in 1941 by the U.S. Army Corps of Engineers for the explicit purpose of storing hydraulic gold-mining sediment.
NARROWS 2 POWERHOUSE
Capacity: 55 MW
Rated Head: 236 ft
Rated Flow: 3,400 cfs
Turbine Type: Francis (1)

USACE’s Englebright Reservoir

USACE’s Englebright Dam
Height: 280 ft
Crest Elevation: 527 ft
Type: Concrete, Arch

NARROWS 2 POWERHOUSE BYPASS
Capacity: 3,000 cfs

PG&E’s 12 MW Narrows #1 Penstock and Powerhouse
Rated Flow: 730 cfs

Power Tunnel Intake

Narrows 2 Access Road
(on State & YCWA land)

Yuba River
The dam is a sediment trap….that works!
Too effective?

Gravel Augmentation
Dam Influence on Site-scale Hydraulics & Sediment Supply (think floods!)
Source of Shot Rock
Shot rock
Devolving habitat conditions at the site (1850s-2010s):

• **Channel**: First aggraded, then with the dam, incised
• **Floodplain**: First mined/modified, then capped with shot rock
• **Sediment supply**: virtually eliminated
• **A channel without spawning habitat that is disconnected from its floodplain & side channel areas**
The long road to implementation…

2008 - ESA & AFRP begin to work with landowner

2010 – AFRP funds initial data collection

2014 – AFRP funds Habitat Restor. & Mgt Plan

2016 (fall) – Project ready for Constr.

2017 (spring) – Sustained high flows; No-Go Decision

2018 (summer) – Construction
Magnitude & Certainty of Outcomes for Ecosystem Evaluations

**Magnitude**

Combines scale of action with extent of effects on populations, productivity, and habitats.

**Certainty**

Combines level of understanding about cause-effect relationships, predictability of the ecosystem processes, and extent to which this addresses important cause-effect relationships identified in the conceptual models.
Criteria for Scoring
Magnitude of Ecosystem Outcomes
(positive or negative)

<table>
<thead>
<tr>
<th>Score</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 – High:</td>
<td>Major population level effect (natural productivity, abundance, spatial distribution and/or genetic and life history diversity).</td>
</tr>
<tr>
<td>3 – Medium:</td>
<td>Minor population effect or effect on large area (regional) or multiple patches of habitat.</td>
</tr>
<tr>
<td>2 – Low:</td>
<td>Effect limited to small fraction of population, addresses productivity and diversity in a minor way, or limited habitat effects.</td>
</tr>
<tr>
<td>1 – Minimal or zero:</td>
<td>Conceptual model indicates little or no effect.</td>
</tr>
<tr>
<td><strong>Certainty of Ecosystem Outcomes (positive or negative)</strong></td>
<td></td>
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<tr>
<td>---------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td><strong>4 – High:</strong></td>
<td></td>
</tr>
<tr>
<td>Understanding is high and outcome is largely unconstrained by variability in ecosystem dynamics, other external factors, or is expected to confer benefits under conditions or times when model indicates greatest importance.</td>
<td></td>
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<tr>
<td><strong>3 – Medium:</strong></td>
<td></td>
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<tr>
<td>Understanding is high but outcome is dependent on other highly variable ecosystem processes or uncertain external factors.</td>
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<tr>
<td>-or-</td>
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<tr>
<td>Understanding is medium and outcome is largely unconstrained by variability in ecosystem dynamics or other external factors.</td>
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<tr>
<td><strong>2 – Low:</strong></td>
<td></td>
</tr>
<tr>
<td>Understanding is medium and outcome is greatly dependent on highly variable ecosystem processes or other external factors.</td>
<td></td>
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<tr>
<td>-or-</td>
<td></td>
</tr>
<tr>
<td>Understanding is low and outcome is largely unconstrained by variability in ecosystem dynamics or other external factors.</td>
<td></td>
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<tr>
<td><strong>1 – Minimal or zero:</strong></td>
<td></td>
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<tr>
<td>Understanding is lacking.</td>
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<tr>
<td>-or-</td>
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<tr>
<td>Understanding is low and outcome is greatly dependent on highly variable ecosystem processes or other external factors.</td>
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<tr>
<td></td>
<td><strong>Worth</strong> (Positive Outcomes)</td>
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<tr>
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<td>-------------------------------</td>
</tr>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>Low</td>
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<tr>
<td>2</td>
<td>Low</td>
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<tr>
<td>3</td>
<td>Med</td>
</tr>
<tr>
<td>4</td>
<td>Med</td>
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</table>

Positive Outcomes considered as “Worth”

<table>
<thead>
<tr>
<th></th>
<th><strong>Risk</strong> (Negative Outcomes)</th>
<th><strong>Certainty</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>1</td>
<td>Med</td>
<td>Med</td>
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<td>3</td>
<td>High</td>
<td>High</td>
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<tr>
<td>4</td>
<td>High</td>
<td>High</td>
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</table>

Negative Outcomes considered as “Risk”
<table>
<thead>
<tr>
<th>Standard Outcome</th>
<th>Outcome (brief descriptor)</th>
<th>SCORING</th>
<th>Standard Outcome Code</th>
<th>Outcome (brief descriptor)</th>
<th>WORTH</th>
<th>RISK</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Food</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P3</td>
<td>Incubation - improve water quality so embryos are more efficient with yolk conversion</td>
<td>1</td>
<td>F3</td>
<td>Incubation - improve water quality so embryos are more efficient with yolk conversion</td>
<td>FALSE</td>
<td></td>
</tr>
<tr>
<td>P10</td>
<td>Feeding - increased production, diversity and local availability of aquatic food resources (primary production, copepods, plancton, and other organisms)</td>
<td>1</td>
<td>F10</td>
<td>Feeding - increased production, diversity and local availability of aquatic food resources (primary production, copepods, plancton, and other organisms)</td>
<td>FALSE</td>
<td></td>
</tr>
<tr>
<td>P11</td>
<td>Feeding/Other - increased recruitment and residence time of nutrients</td>
<td>0</td>
<td>F11</td>
<td>Feeding/Other - increased recruitment and residence time of nutrients</td>
<td>FALSE</td>
<td></td>
</tr>
<tr>
<td><strong>Mortality</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P15</td>
<td>Spawning - reduced egg retention due to unsuccessful spawning</td>
<td>1</td>
<td>F15</td>
<td>Spawning - reduced egg retention due to unsuccessful spawning</td>
<td>FALSE</td>
<td></td>
</tr>
<tr>
<td>P16</td>
<td>Spawning - reduced egg retention due to unsuccessful spawning</td>
<td>1</td>
<td>F16</td>
<td>Spawning - reduced egg retention due to unsuccessful spawning</td>
<td>FALSE</td>
<td></td>
</tr>
<tr>
<td>P17</td>
<td>Emergence - increased emergence success</td>
<td>0</td>
<td>F17</td>
<td>Emergence - increased emergence success</td>
<td>FALSE</td>
<td></td>
</tr>
<tr>
<td><strong>Reproduction</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P21</td>
<td>Adult Immigration - reduced toxicity exposure will improve migratory cues</td>
<td>0</td>
<td>F21</td>
<td>Adult Immigration - reduced toxicity exposure will improve migratory cues</td>
<td>FALSE</td>
<td></td>
</tr>
</tbody>
</table>
Outcome = 2016
Habitat
Restoration &
Management
Plan
Key Project Challenges
Figure 1. Potential restoration locations and road access into the YRG.
No geotechnical information

Figure 5. Exposed sediments along the edge of Sinoro Bar.
The left photo shows the overall exposed sediments. The right photo highlights the mixture of sediments that may underlie the area.
Create riffle with cobble-boulder bed and toe overlain with at least 2' of spawning gravel (typical to all riffles)

Preserve willow thicket to provide flow refugia for juvenile salmon

Add cobbles and boulders to rapid to stabilize knickpoint

Excavate and sort bar sediment

Excavate and create side channel

Minimal fill to promote geomorphic stability

Preserve pool for adult salmon holding

Create/enhance 3 riffles for salmon spawning (typical)
PROJECT OVERVIEW

PLN VIEW

SCALE 1" = 60' N

LIMIT OF WORK (TOP)
LIMIT OF GRAADING
LIMIT OF GRAADING

AREA #1
GATEWAY RAPID FILL
AREA #2
SIDE CHANNEL COMPLEX

AREA #3
DOWNSTREAM RIFFLE
AREA #4
MIDDLE RIFFLE

AREA #5
POOL FILL
AREA #6
UPSTREAM RIFFLE

AREA #7
EXCESS FILL
NOTE:
1. THIS PROJECT WILL BALANCE CUT AND FILL ON SITE. CUT VOLUME TO ACHIEVE FINISHED GRADES SHOWN IS 8,589 CY. AN ADDITIONAL VOLUME UP TO 10% OF CUT VOLUME WILL BE OVER DUGGED AND MATERIALS RE-NEEDED.
2. THE FOLLOWING TABLES THE MINIMUM QUANTITIES OF MATERIALS TO BE PLACED IN THE CHANNELS AND IN THE SIDE CHANNEL COMPLEX. ACTUAL QUANTITIES WILL VAR.

RECOMMENDED FILL QUANTITIES

<table>
<thead>
<tr>
<th>AREA</th>
<th>NAME</th>
<th>FLIES (CY)</th>
<th>GRAVEL (CY)</th>
<th>BOULDER (CY)</th>
<th>TOTAL FILL (CY)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>SIDE CHANNEL</td>
<td>1,400</td>
<td>N/A</td>
<td>N/A</td>
<td>1,400</td>
</tr>
<tr>
<td>2</td>
<td>GATEWAY RAPID FILL</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>3</td>
<td>DOWNSTREAM RIFFLE</td>
<td>3,800</td>
<td>100</td>
<td>600</td>
<td>4,500</td>
</tr>
<tr>
<td>4</td>
<td>MIDDLE RIFFLE</td>
<td>1,000</td>
<td>300</td>
<td>1,000</td>
<td>1,300</td>
</tr>
<tr>
<td>5</td>
<td>POOL FILL</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>6</td>
<td>UPSTREAM RIFFLE</td>
<td>1,800</td>
<td>500</td>
<td>1,500</td>
<td>4,800</td>
</tr>
</tbody>
</table>

FOR QUANTITIES ABOVE THE REQUIRED MINIMUM FILL PLACE EXCESS MATERIAL AT INDICATED LOCATIONS, UP TO THE ADDITIONAL FILL VOLUMES SPECIFIED IN THE FOLLOWING TABLE.

ADDITIONAL FILL QUANTITIES

<table>
<thead>
<tr>
<th>AREA</th>
<th>NAME</th>
<th>FLIES (CY)</th>
<th>GRAVEL (CY)</th>
<th>BOULDER (CY)</th>
<th>TOTAL FILL (CY)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>SIDE CHANNEL</td>
<td>6,200</td>
<td>N/A</td>
<td>N/A</td>
<td>6,200</td>
</tr>
<tr>
<td>2</td>
<td>GATEWAY RAPID FILL</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>3</td>
<td>DOWNSTREAM RIFFLE</td>
<td>300</td>
<td>1,000</td>
<td>1,300</td>
<td>2,600</td>
</tr>
<tr>
<td>4</td>
<td>MIDDLE RIFFLE</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>5</td>
<td>POOL FILL</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>6</td>
<td>UPSTREAM RIFFLE</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

TOTAL: 8,589 CY

3. AREA #1: SIDE CHANNEL COMPLEX: EXCAVATE AND SHAPE THIS AREA TO FINISHED GRADES SHOWN. BORROW AREAS MAY BE USED TO OBTAIN HARD MATERIALS IN MIXED TO GENERATE HARD GRADES AND ALSO PROVIDE FILL.
4. AREA #2: GATEWAY RAPID (SLA 4.27 TO 3.45) PLACE BOULDERS TO PLAN THE EXACT VOLUME MAY VARY DEPENDING ON THE VOLUME OF BOULDERS AVAILABLE. ALL BOULDERS ARE IN THIS AREA ARE LOW PROPERTY
5. AREA #3: DOWNSTREAM RIFFLE (SLA 1.79 TO 2.83) PLACE BOULTERS AND GRAVELS PER PLAN. THIS AREA HAS MODERATE PROPERTY
6. AREA #4: MIDDLE RIFFLE (SLA 3.47 TO 3.72) PLACE BOULTERS AND GRAVELS PER PLAN. THIS AREA HAS MODERATE PROPERTY
7. AREA #5: POOL FILL (SLA 3.47 TO 3.42) PLACE GRAVELS PER PLAN
8. AREA #6: UPSTREAM RIFFLE (SLA 3.18 TO 3.25) PLACE BOULDERS AND GRAVELS PER PLAN. THIS AREA IS HIGH PROPERTY
9. MATERIALS WITH CLASIFIED LEVELS OF MERCURY SHALL BE BURIED ON THE SURFACE IN THE BORROW AREAS. DETAILED SHEET 2.2.2.
10. MATERIALS WITH CLASIFIED LEVELS OF MERCURY MAY BE PLACED ON THE SURFACE IN AREA #2 TO DESIGN GRADES (1.83 B.C.1) AND THEN IN EXCESS FILL DISPOSAL AREA #6 (LOW DESIGN GRADES (1.83 B.C.1)) AND THEN IN EXCESS FILL DISPOSAL AREA #6 (LOW DESIGN GRADES (1.83 B.C.1)) AND THEN IN EXCESS FILL DISPOSAL AREA #6 (LOW DESIGN GRADES (1.83 B.C.1))
Valley width and deposition

Note that each depositional feature is located in an area of relatively-high valley width. The low-flow width was digitized from a 2008 1' imagery taken when the flow in the river was approximately 1,000 cfs, whereas the valley width was digitized as the elevation contour at 298 ft on a 30-m DEM (http://projects.atlas.ca.gov/projects/ned).

Figure 18
Valley Width and Low-Flow Width Series for the YRC along with the Location of Depositional Features
Floodplain width: expansion, contraction, velocity reversals & riffle sustainability
Floodplain width: expansion, contraction, velocity reversals & riffle sustainability

Pools scour….riffles deposit

Design surface developed synergisticall y
Site Access
Construction of River Crossing

Screen Plant
Construction of River Crossing
Construction of River Crossing
Construction of River Crossing
In-stream placement of spawning substrate
In-stream placement of spawning substrate
In-stream placement of spawning substrate
Degrading Crossing – last hours of Project
Yuba River Canyon Project Acknowledgements

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Ann Borgonovo, PE

Sean W. Smith – General Engineering Contractor

Cramer Fish Sciences
Rocko Brown, PhD
Joe Merz, PhD