Fifteenmile Creek Fish Passage Improvements at Channel Obstacles

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inter-fluve, inc.

Presentation Overview

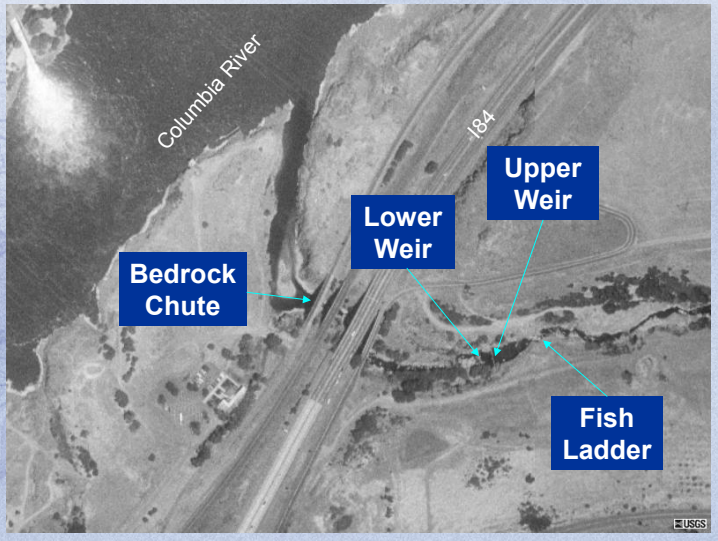
- Project Background
- Constructed Riffles
- Fish Passage Evaluation at a Natural Obstacle

Project Background

- Middle Columbia River Steelhead listed as Threatened (1999)
- Fifteenmile Creek has easternmost population of winter-run Steelhead in Columbia River basin
- Herbicide spill (August, 2000)
- Emergency restoration activities included repair of log weirs to facilitate passage
- Damage assessment included monitoring 2001 adult Steelhead run (concern for avoidance)

Location

Sites



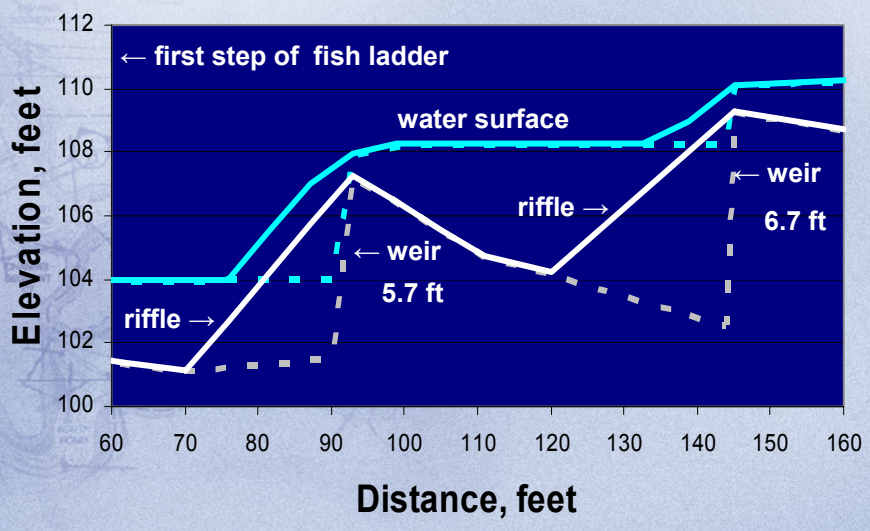
Bedrock Chute

Lower Weir

Upper Weir

Fish Ladder

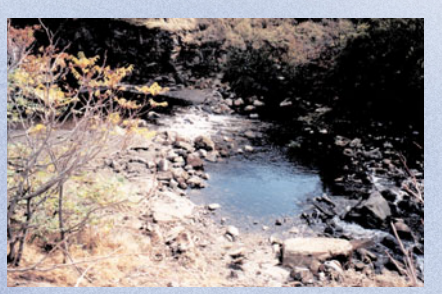
Design



Construction Access

Natural Channel Alternative

Before



After

Natural Channel Alternative

Before

After

Natural Channel Alternative

Fish Passage Evaluation at a Natural Obstacle

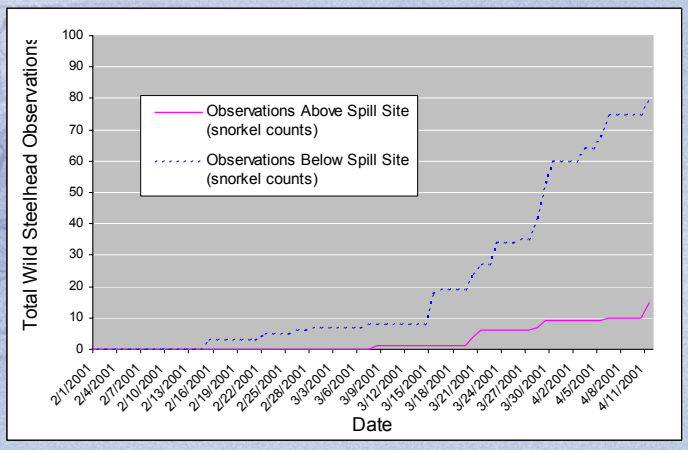
Fish Passage Evaluation

Recap:

- Herbicide spill August 2000
  - Concern that returning steelhead may avoid Fifteenmile Creek.
- Monitor steelhead migration
  - Low flow year (2001)

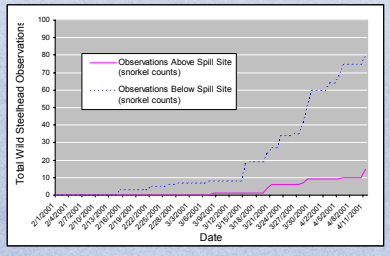
Fish Passage Evaluation

- Early steelhead observations suggested a potential problem.



Fish Passage Evaluation

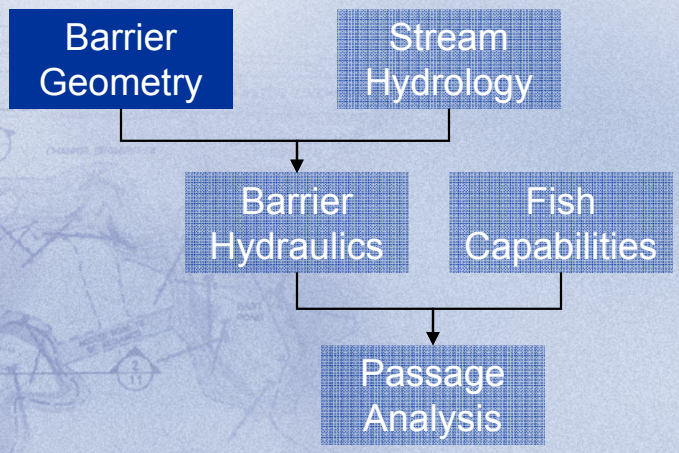
Possible Explanations:



- Temporary passage barrier (low flows)
  → **Conduct Screening Level Barrier Analysis**

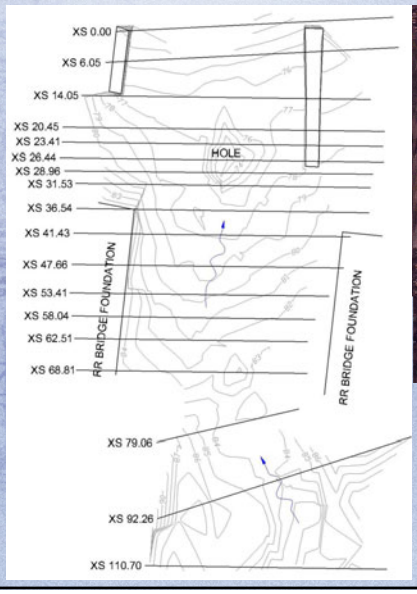
- Unequal observation efficiency
  → **Utilize more effective method**

Barrier Analysis

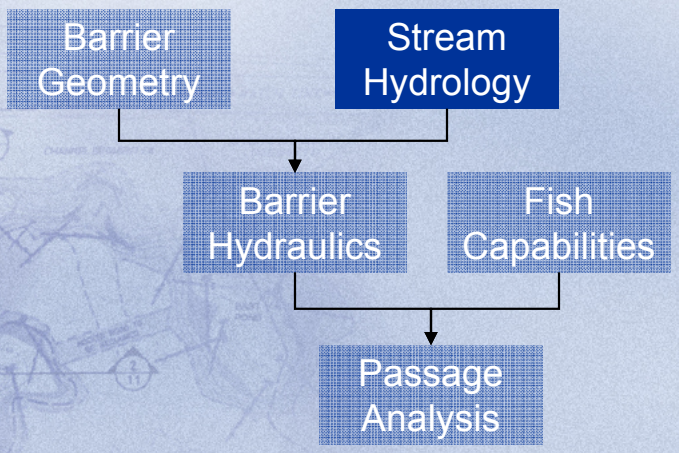


Powers & Osborne (1985)

Barrier Geometry



Barrier Analysis

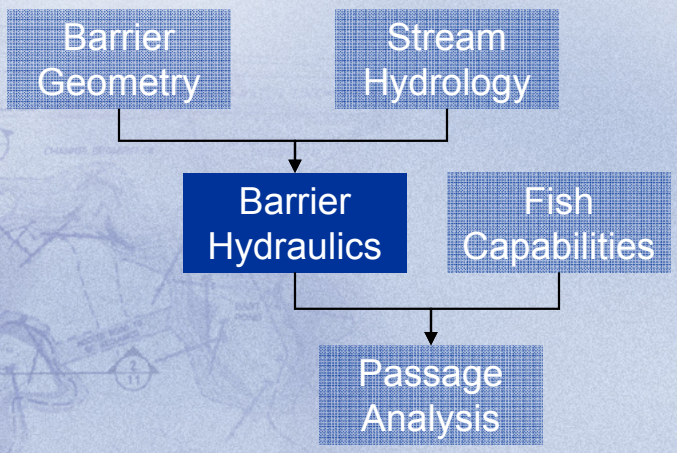


Powers & Osborne (1985)

Stream Hydrology

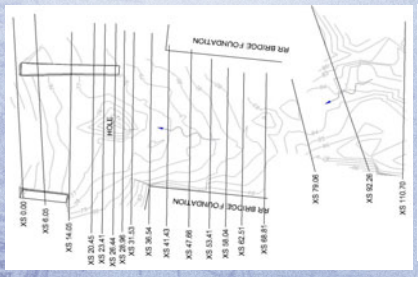
- **Migration Period (Feb-Apr 2001)**
- **Flows**
  - 21 cfs, measured 2001
  - 93 cfs, Q80% (OWRD)
  - 178 cfs, Q10% (ODFW passage criteria)

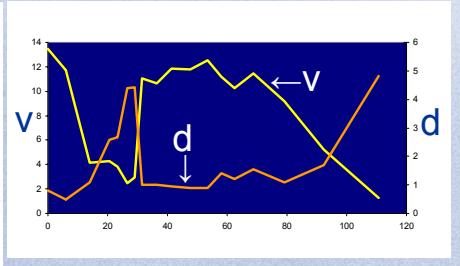
Barrier Analysis

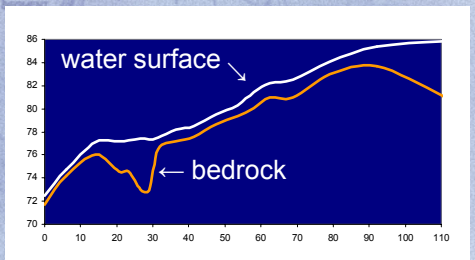


Powers & Osborne (1985)

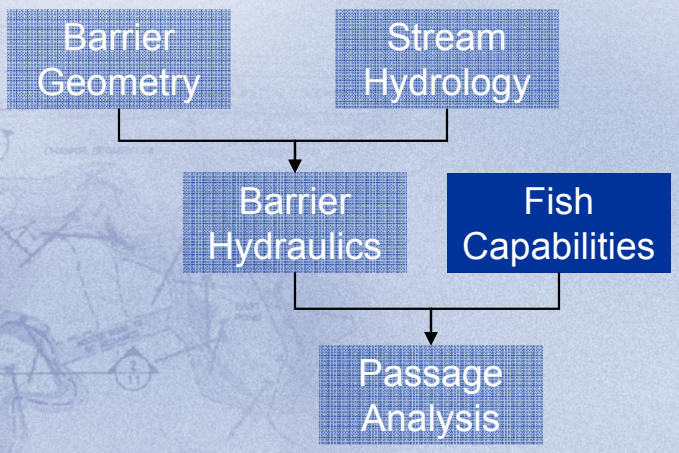
Barrier Hydraulics







Barrier Analysis



Powers & Osborne (1985)

Fish Capabilities

Powers & Osborne (1985)

burst speed x fish condition coefficient = swim speed

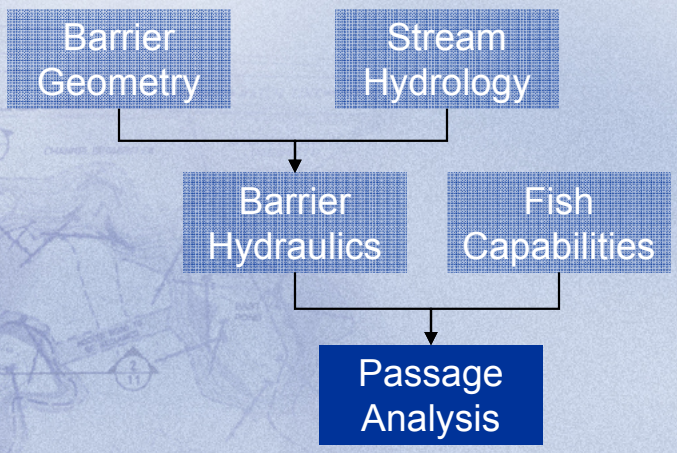
- **19.9 ft/s, 5 sec**
- **10.3 ft/s, 10 sec**

Hunter & Mayor (1986)

a x fish length^{b} x swim duration^{c} = swim speed

- **13.7 ft/s, 5 sec**
- **9.6 ft/s, 10 sec**

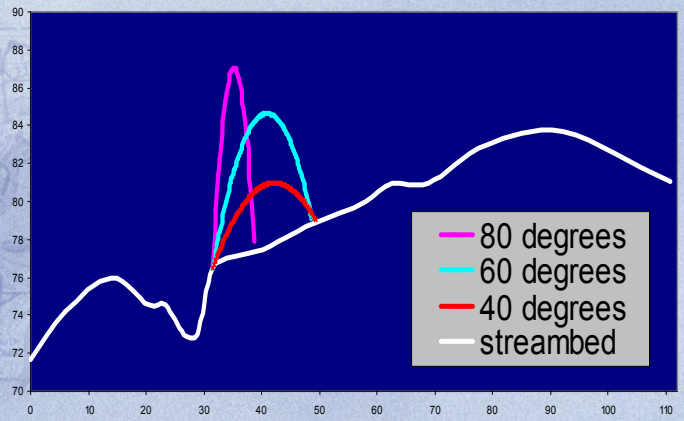
Barrier Analysis



Powers & Osborne (1985)

Passage Analysis

Step 1: Jump or Swim?



Passage Analysis

Step 2: Swimming speed > water velocity?

Fish Speed (ft/sec)	V barrier? $Q_{10\%}$ 11 ft/sec	V barrier? $Q_{80\%}$ 10 ft/sec	V barrier? Q_{2001} 7 ft/sec
19.9	No	No	No
13.7	No	No	No
10.3	Yes	No	No
9.6	Yes	Yes	No

Passage Analysis

Step 3: Flow depth > 6 inches?

Flow, (cfs)	Min Depth, (in)	Barrier?
178	13	No
93	11	No
21	5	Yes

Passage Analysis

Step 4: Length to exhaustion > chute length?

$(V_{fish} - V_{water}) * T_{failure} = L_{swim}$

Fish Speed (ft/sec)	Water Velocity (ft/sec)	Time to Failure (sec)	Distance Fish Can Swim (ft)	Chute Length (ft)	Velocity/ Distance barrier?
19.9	10	5	49	61	yes
15.1	10	7.5	38	61	yes
10.3	10	10	3	61	yes
13.7	10	5	19	61	yes

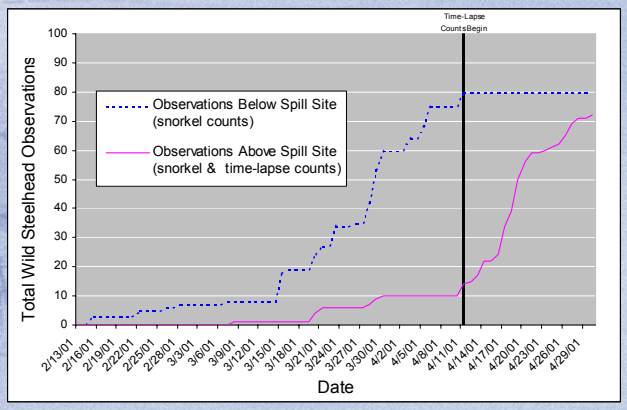
Fish Passage Evaluation

Potential explanations:

- Temporary passage barrier Yes??
- Unequal observation efficiency??
  - Utilize more effective observation method

Fish Passage Evaluation

- Installed time-lapse video monitoring station on April 11th.

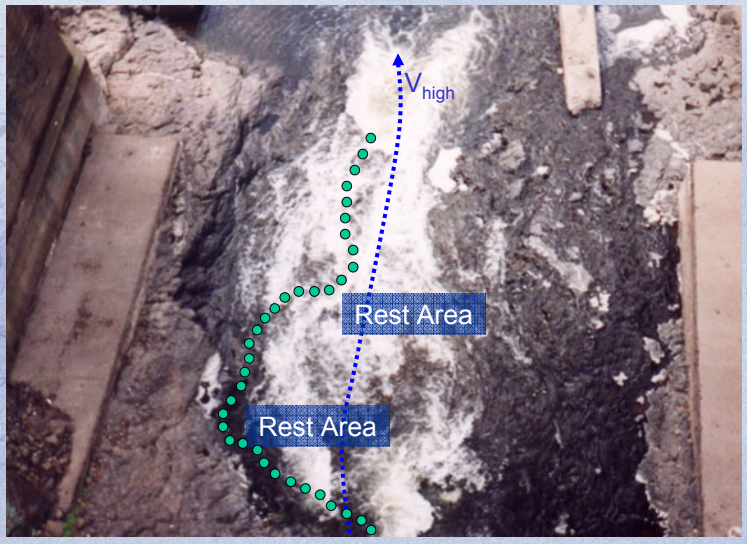


Fish Passage Evaluation

How do these steelhead pass the chute?

- Leaping insufficient
- Burst swimming speed only lasts seconds
  - Not enough time to traverse required distance
- Behavioral adaptations
  - Selection of reduced velocity pathways
  - Energy conservation strategies
    - Resting areas
  - Other innovative tactics

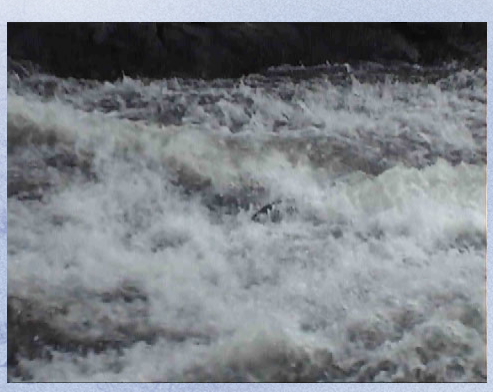
Route 66



Rest Area

R66

Rest Area



Back

Summary

- Constructed Riffles
  - Natural channel alternative to structures
- Fish Passage
  - Research - rules for fish behavior
  - Research - method that combines complex hydraulics, fish behavior, and physiology to predict performance