Whooshh Innovations

Sockeye salmon in the Pacific Northwest

Passage Pilot for Sockeye Reintroduction at Cle Elum

Using the Whooshh Fish Transport System

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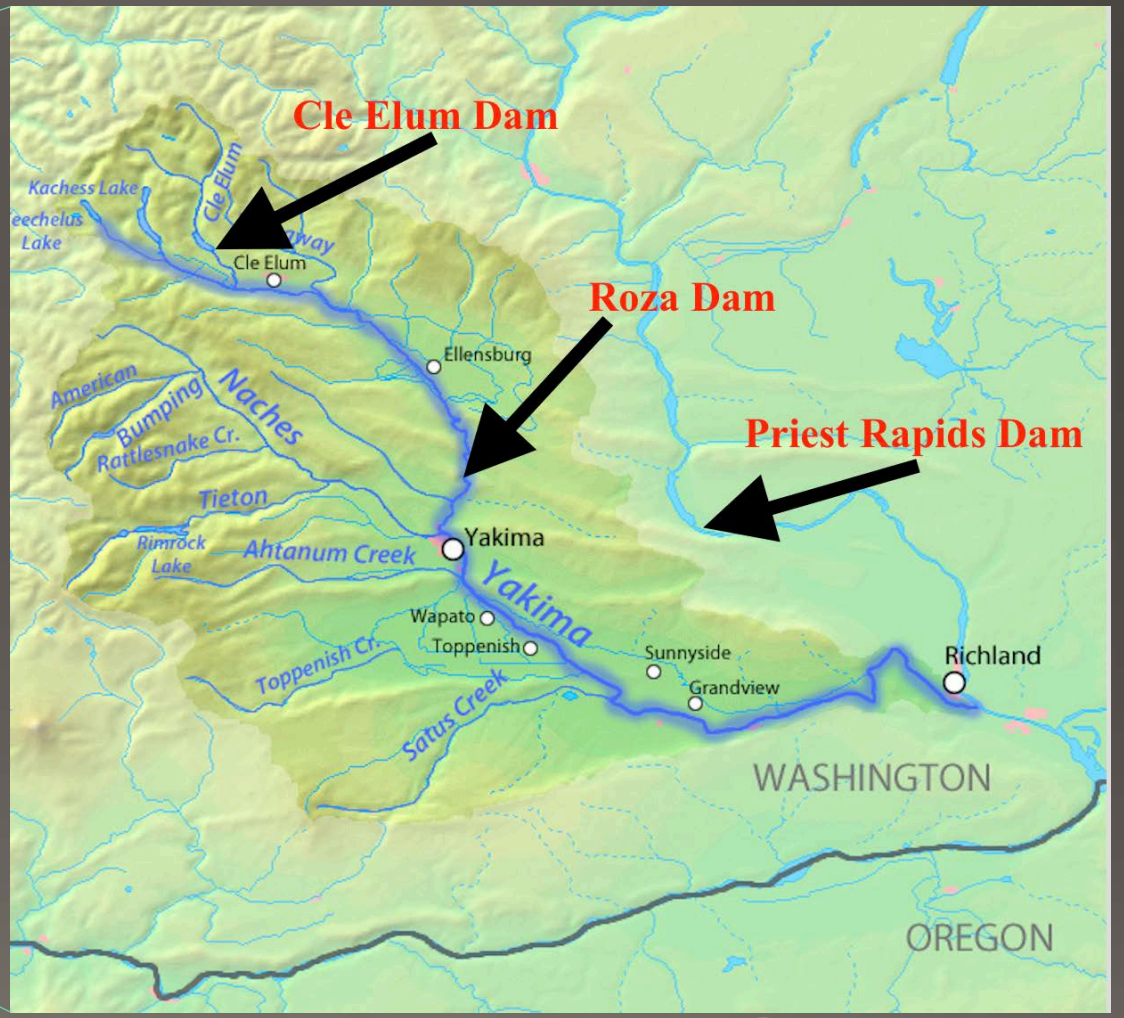
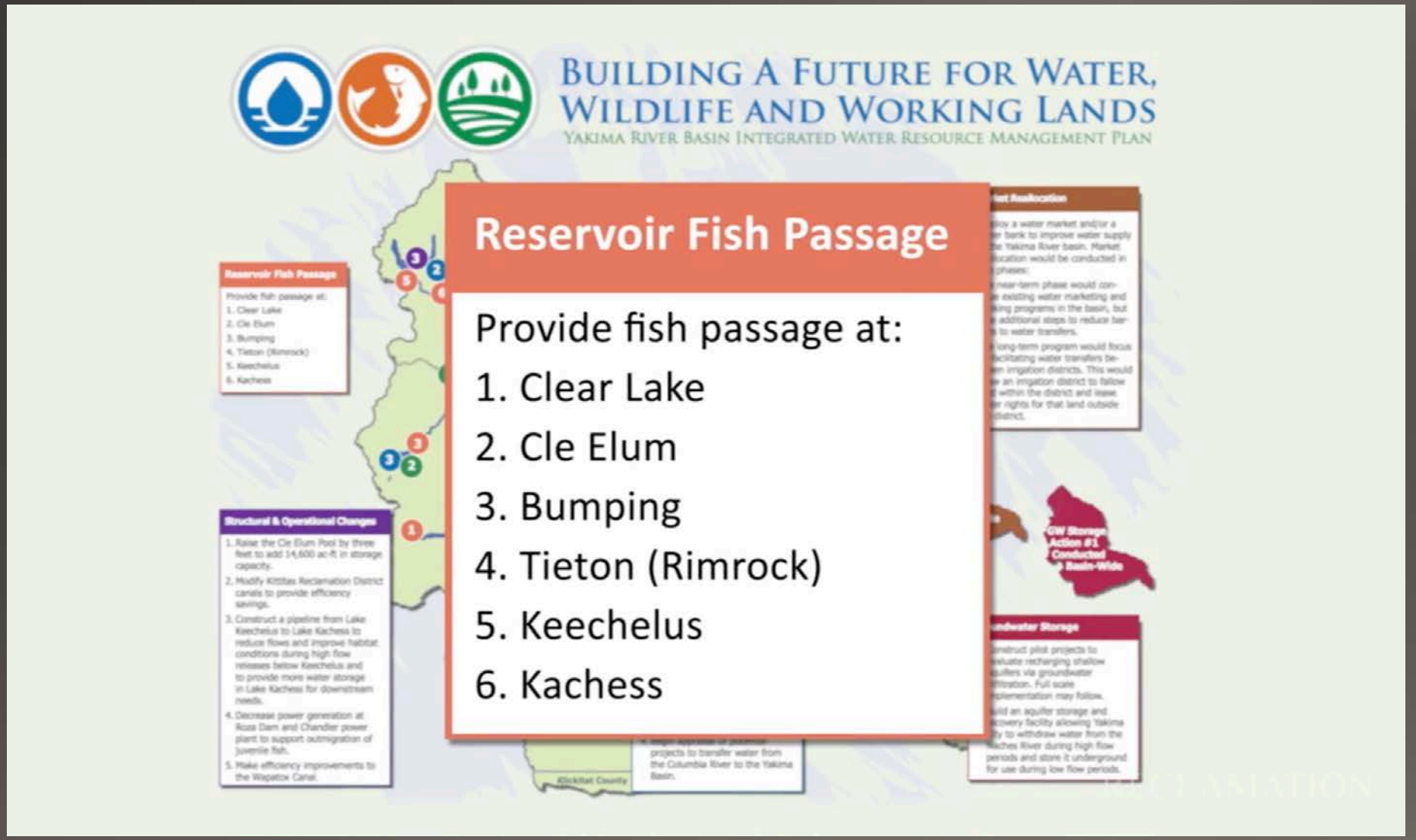
Project Area





Cle Elum Dam – 1,100’ X 165’

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Cle Elum and Reintroduction

- Cle Elum Dam
  - USBR irrigation dam
  - Blockage to anadromous fish since early 1900s
- Yakama Nations reintroduction program
  - 5 species planned, sockeye first
  - Lake seeded with adults for several years
  - New "helix" for downstream
  - Ladder estimate $50M+
  - New sorting/handling facility planned
  - At dam rap and transport planned

Goals for Whooshh Passage study

Can we get fish safely over a dam this size?

- Distance
- Height/grade
- Survival

Can we get fish to *volitionally* pass Cle Elum?

Will Whooshh technology scale to this size challenge?

Site Challenges

1. Technical
   - Two roads
   - Height and length
     - ✓1100’ furthest accomplished before this test
     - ✓~100’ highest to date
   - Grade
     - ✓Low overall
     - ✓35% at steepest point near road crossing
   - Forebay fluctuation
     - ✓70’ drop during test period
   - Tailrace variability
     - ✓5-10’ rise during test period

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Site Challenges

2. Biological

- Available population
  - ✓ No ESA listed so no NMFS delay
  - ✓ Low return numbers from program
    - No prior in–river fish (all trapped and trucked from Rosa)
  - ✓ Introduced fish Wenatchee or Okanagan origin
- Temperature
  - ✓ Ambient temperature 45-95 degrees
- Attraction flows
  - ✓ Limited site placement choices given timing and temporary nature

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Entrance Configuration

- Key components
  - Steep pass for returning fish
  - Flume/pipe for trucked fish
  - Observation/holding tank
  - False Weir
  - Autonomous scanner
  - Sorter
  - Accelerator
  - Bypass tank

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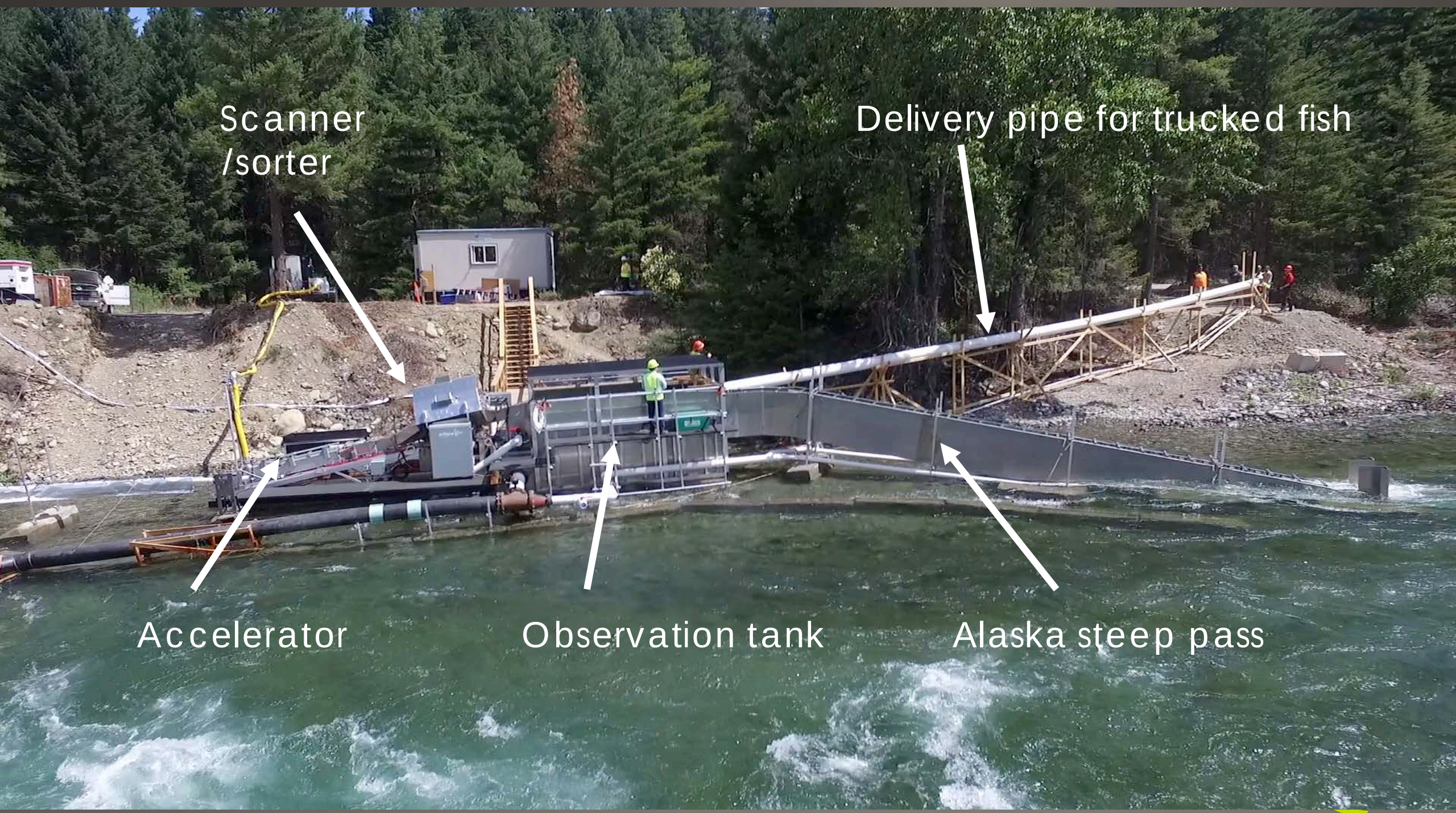
Scanner
/sorter
Delivery pipe for trucked fish
Accelerator
Observation tank
Alaska steep pass

Tube routing and Length

Total length 1700’

Rise 175’

35% maximum angle

Routing

- Under road 1 (existing bridge over spillway)
- Over road 2 (dam crest road)

Cooling jacket

Continuous misting

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Tube Routing

Under……

….over

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Exit configuration

Floating platform

- Accommodate forebay fluctuation
- Anchor/winch

Deflector

- Angle fish for ideal lake entry after tube exit

Booster station before dam crest

- Provide speed control prior to fish exit
- Increase throughput of system

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Exit

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What actually happened

System setup in less than 90 days

- Probably a first for high head dam fish passage

Worst sockeye return on Columbia for 10 years

Fish considerably smaller than 2016 Priest Rapids migration study test

Only ~100 total fish available for Whooshh

- None of Cle Elum origin
- All trucked from Priest Rapids
  - ✓ Okanagan or Wenatchee origin

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RESULTS

Caveats

- ✓Not yet published
- ✓Very limited sample size
- ✓All non-native fish

Both controls and test fish "fell back" in significant numbers

- ✓Multiple detections below the dam

"System shakedown" fish not distinguished from test fish

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Initial Observations

- Needed more fish
- Yes, fish can be successfully transported this distance
- After 2-3 days of tuning, survival performance was equal for both population groups
  - ✓Bodes well for adaptive management
- Once system fully operational, no significant differences from prior tests

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Considerations for Permanent High Head Solutions

Entrance placement

- Consider fish behavior
- Floating option
- Flexibility to change based on results

Ancillary components – place in building

Tube routing

- Permanent enclosure for protection

Exit

- Enclose barge end/permanent shore exit to accommodate wave conditions

Safe

Survival,
Reproduction, Injury,
Behavior, Disease
Transmission

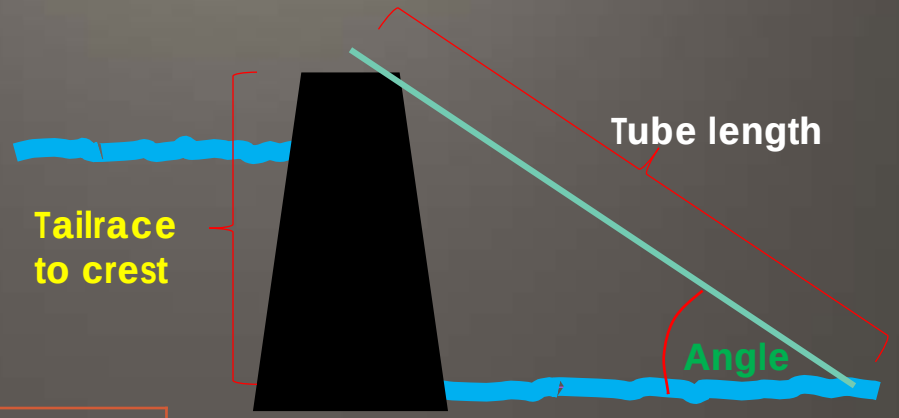
Effective

Migration
Homing
Durable

Timely & Efficient

Volitional
Selective
Passage Time
Energy Reserves
Travel Time
Distance

How High can we go?



Distances in feet				
Tube length	**10**	**20**	**30**	**40**
500	**86.8**	**171.0**	**250.0**	**321.4**
1000	**173.6**	**342.0**	**500.0**	**642.8**
1500	**260.5**	**513.0**	**750.0**	**964.2**
1750	**303.9**	**598.5**	**875.0**	**1124.9**

Dworshak	~ 640’	vs 717’
Grand Coulee	~ 400’	vs 550’
Chief Joseph	~ 180’	vs 236’

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Key Takeaways

- Capital costs typically <20%
- O&M costs <50%
- Deploy in months not years
- Transit in seconds not hours/days
  - ✓ Low energy consumption for fish

- PLUS
  - Scanning enables selective passage (keep invasive species out of the system)
  - Low water usage -> increased power/irrigation options

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AUTONOMOUS, VOLITIONAL, SELECTIVE,

ADULT FISH PASSAGE

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That Was Awesome!
Can we go again?
Questions?
I Feel Good