

Whooshh Innovations

River Connectivity

FLEXIBLE, ADAPTABLE UPSTREAM PASSAGE (FOR REINTRODUCTION)



AGENDA

Reintroduction - context

Upstream specifics

Traditional solutions/limitations

New approach

- Example
- Temporary vs permanent

Comparisons

Conclusions

REINTRODUCTION CHALLENGES

- Initiation “seeding the reach”
- Upstream migration*
- Downstream migration
- Survival
 - Habitat
 - Predation*
 - Competition*

* Whooshh applications

UPSTREAM PASSAGE ISSUES

Cost

- Capital cost
- O&M considerations

Fish volume

- Short term vs long term
- Ability to scale

Time: Planning, design, implementation

Site specific issues

- Attraction
- Entry
- Routing
- Exit

TRADITIONAL SOLUTIONS AND LIMITATIONS

Ladders, Trap and Haul, Fish Lifts

Cost

Planning

Efficacy/efficiency, delays

Selective passage difficult

Routing and siting limitations

The adaptive management quandary

WHOOSH FTS

Volitional	<i>Fish enter on their own</i>
Selective	<i>Automatic removal of unwanted species</i>
Safe	<i>No harm to fish health, migration or spawning</i>
Timely	<i>Transports in seconds, minimal fish effort</i>
Efficient	<i>Scalable for high capacity</i>
Affordable	<i>80% capital savings, 50% O&M savings</i>
Autonomous	<i>No operator presence needed</i>
Flexible	<i>Adaptive management possibilities</i>

WHAT IS IN A WHOOSH SYSTEM?

- Tailrace Entry
- Tube Run
- Forebay Exit



Volitional WFTS Fish Passage



Chinook and Coho to hatchery raceways at Prosser



Chinook and Steelhead to pool at Ringold



Pinks to Truck at Buckley

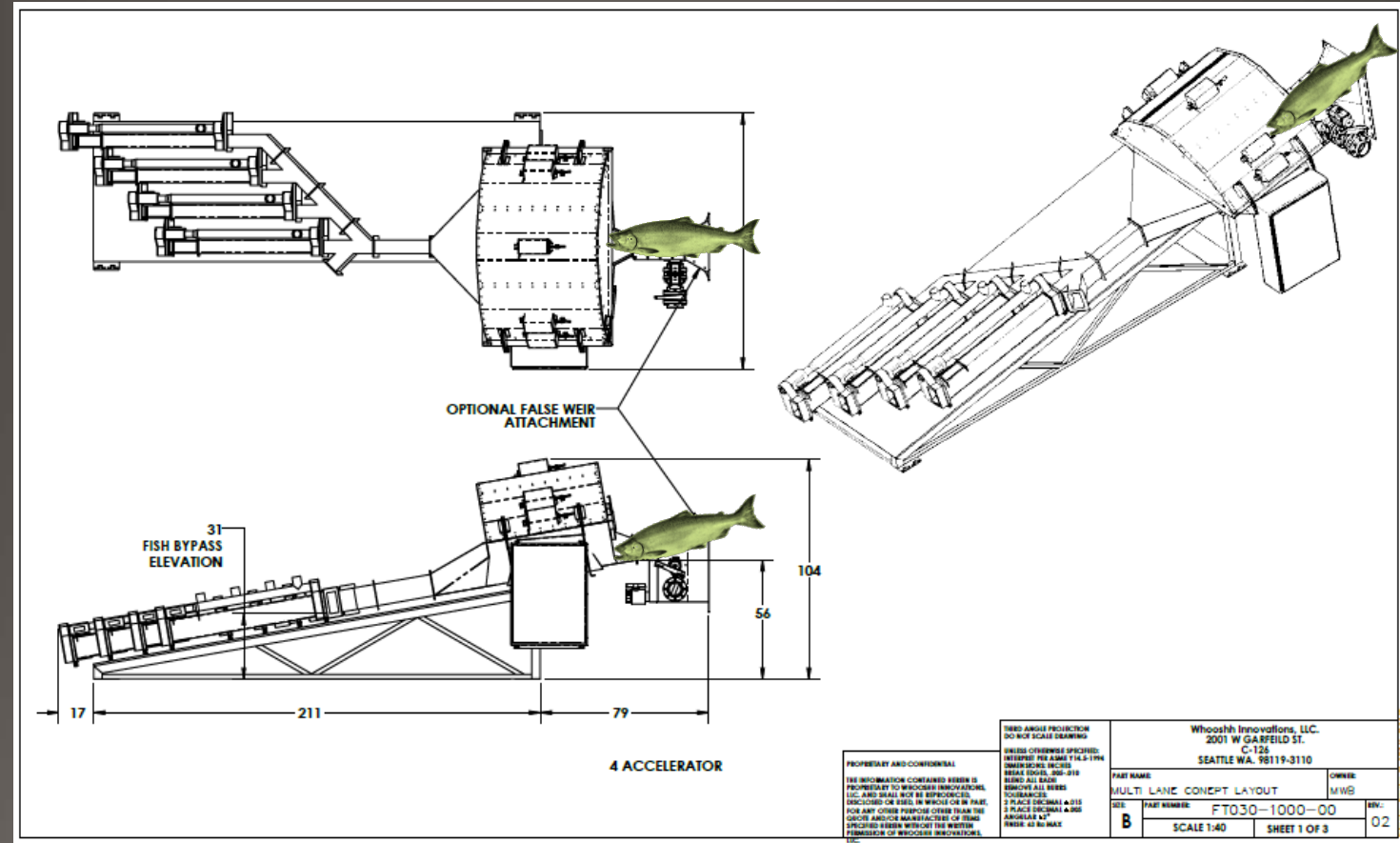


Sockeye
River to Reservoir,
~1700 ft at Cle Elum Dam



MODULAR ENTRY SYSTEM

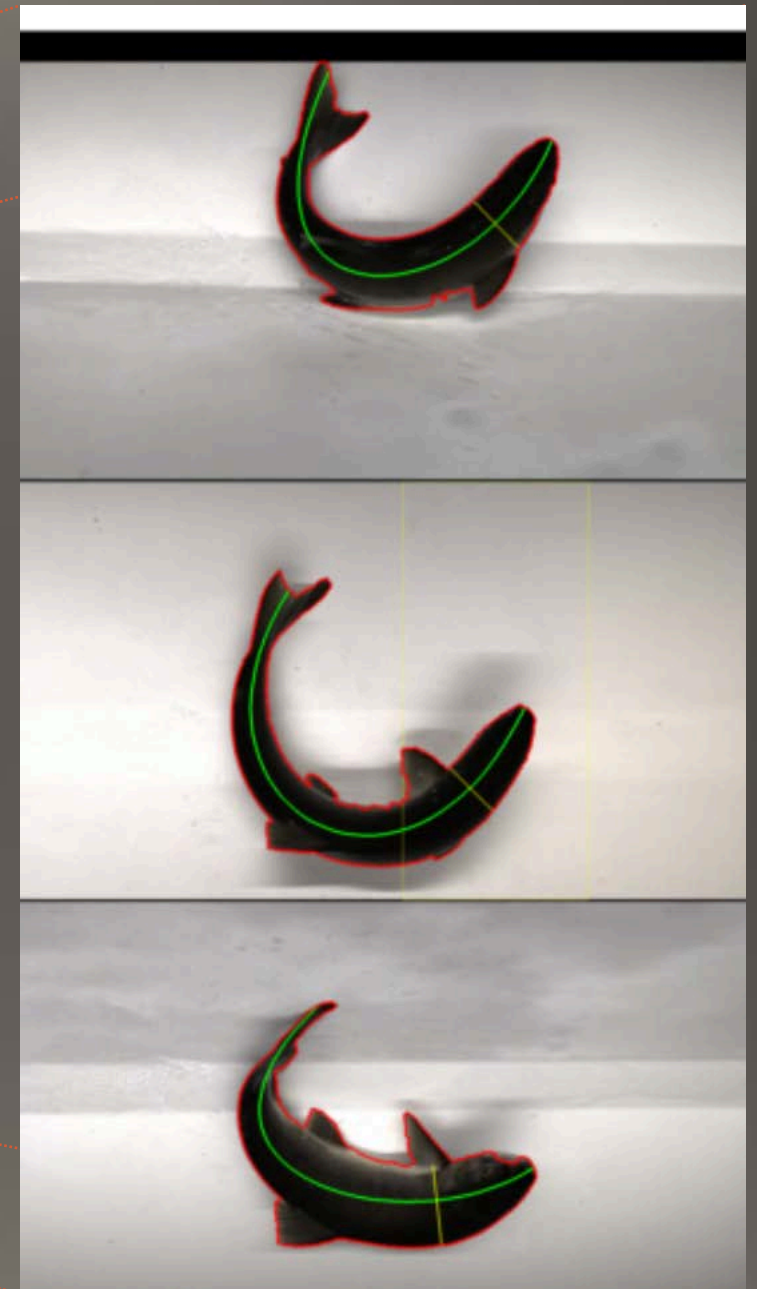
- Volitional Entry
- Machine Vision
- Scanning
- Automated Sorting
 - Inputs
 - Bypass
 - Transport
- Accelerator(s)



MACHINE VISION SCANNING

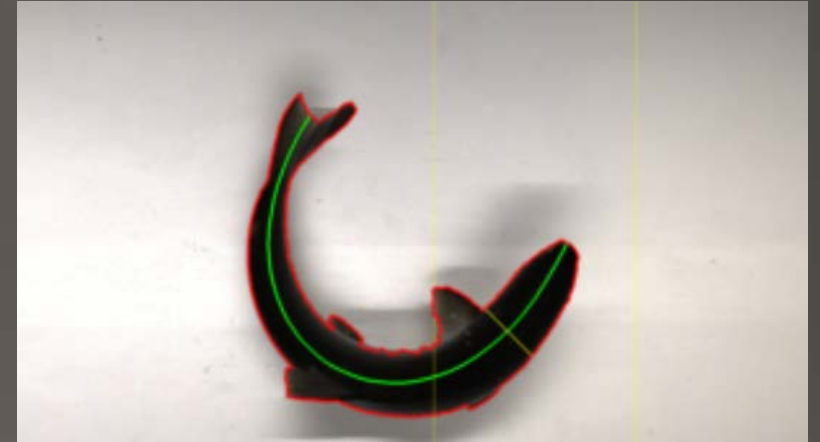


1X Zoom					AutoFit (on)
Show	Length	Diameter	Diameter deviation		
Image 1	---	---	---	---	---
Image 2	513.0 mm	67.6 mm	0.8 mm		No
Image 3	470.7 mm	75.2 mm	0.9 mm		No
Image 4	---	---	---	---	---
Image 5	478.5 mm	84.6 mm	0.7 mm		---
Image 6	533.7 mm	75.7 mm	0.8 mm		No



SCANNING CAPABILITIES

- Current Measurements
 - Size(Girth, Width, Length)
 - Speciation by (Girth, Length)
- Upcoming Developments
- Hatchery vs. Wild
 - Adipose fin presence detection
 - ✓ Testing Summer 2018
- Speciation
 - Morphometrics
 - Color
 - Pattern recognition/machine learning
 - (Asian Carp Testing Q4 2018-Q1 2019)



TUBE RUN

Tube Transit

Booster Station

Mini-Accelerator

Allows tubes to be
coupled in series

Allows long tube
transports without
pressure drop



DECELERATION & EXIT

Linear Deceleration

In-tube Speed monitoring

Flow modulation

Controlled Speed < 25 ft/s

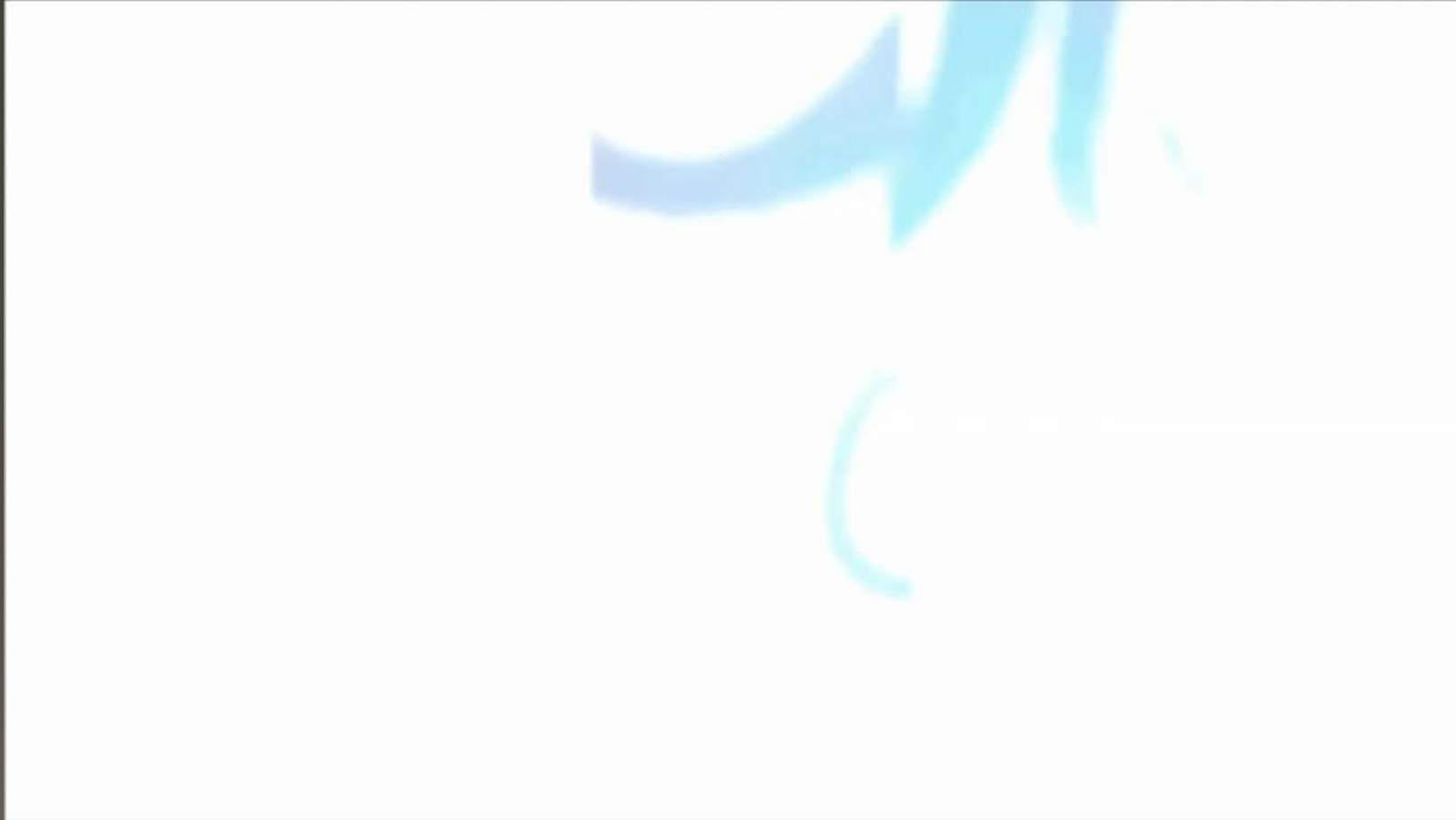
Gentle Exit

Floating options

Fixed or variable locations



CLE ELUM PILOT



WHAT WOULD PERMANENT INSTALLATION LOOK LIKE?

Entry System

Tube Support & Protection

Exit Options



VOLITIONAL ENTRY OPTIONS:

- Fishways
 - Denil Fishway
 - (Short) Pool & Weir Ladder



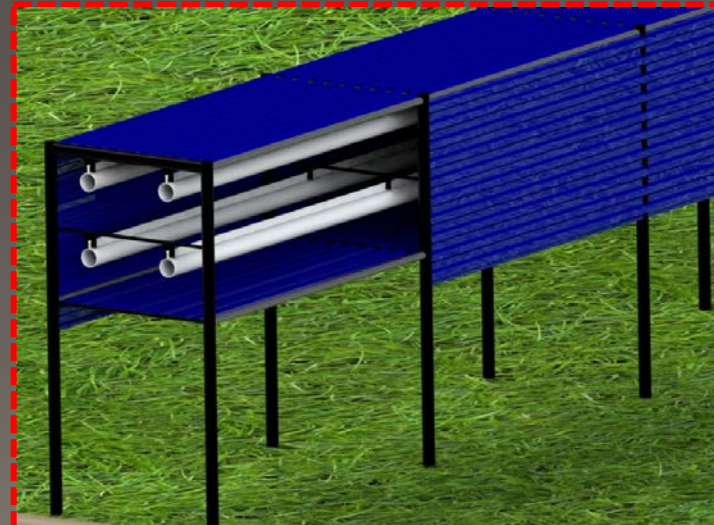
ANCILLARY MECHANICAL COMPONENTS

- Ancillary Systems
 - Power distribution
 - High-pressure / low-volume pneumatics (*actuators*)
 - Low-pressure / high-volume pneumatics (*transport*)
 - Chiller for temperature control
- Modular Container System
 - Mechanical systems pre-assembled off-site
 - Arrive on site pre-tested minimizing troubleshooting
 - Environmental protection with secure access



TUBE SUPPORT & PROTECTION

- Flexible Installation
 - Variable terrain
 - Light construction footprint
 - Minimal excavation & poured concrete
- Environmental Protection
- Accessible for maintenance



SAFE

SURVIVAL,
REPRODUCTION, INJURY,
BEHAVIOR, DISEASE
TRANSMISSION

EFFECTIVE

MIGRATION
HOMING
DURABLE

TIMELY &
EFFICIENT

VOLITIONAL
SELECTIVE
PASSAGE TIME
ENERGY RESERVES
TRAVEL TIME
DISTANCE

KEY TAKEAWAYS

- Fish Friendly
- Transit time in seconds not hours or days
 - Less energy budget depletion
- ~20% of traditional capital cost (Ladder, Trap & Haul)
- 50% lower O&M costs
- Deployment time in months, not years
- Adaptation and expansion easy
- Selective passage/invasive removal possible

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THANK YOU