Dec 13th, 3:40 PM - 5:20 PM

Re-defining upstream fish passage

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Whooshh Innovations

Whooshh Innovations

Fish Passage Solutions

(A Better Way for Fish and the Environment)

WHOOSHH INNOVATIONS

Redefining Upstream Passage

Conventional Passage

- Expensive
- Large construction footprint
- Years to plan & install
- Hours/Days for fish to pass
- Depletes energy reserves
- Uncontrolled invasive spread
- Chronic performance problems requiring adaptive management

Whooshh Passage

- Cost effective
- Minimum impact to environment
- Months to deploy
- Passage in seconds
- Minimal energy expenditure
- Selective passage
- Rapid data driven performance optimization
- Renewable Energy

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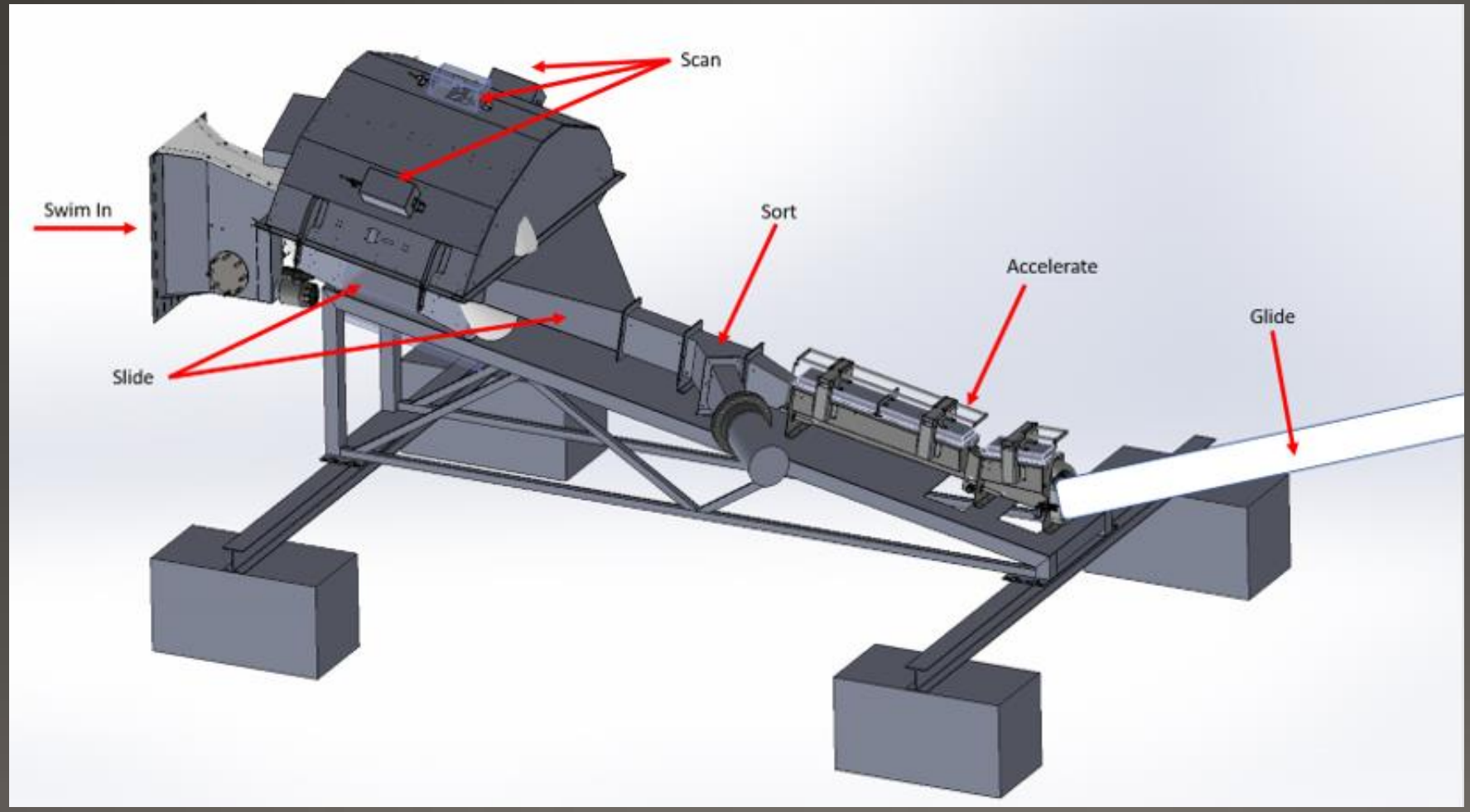
Main entry components



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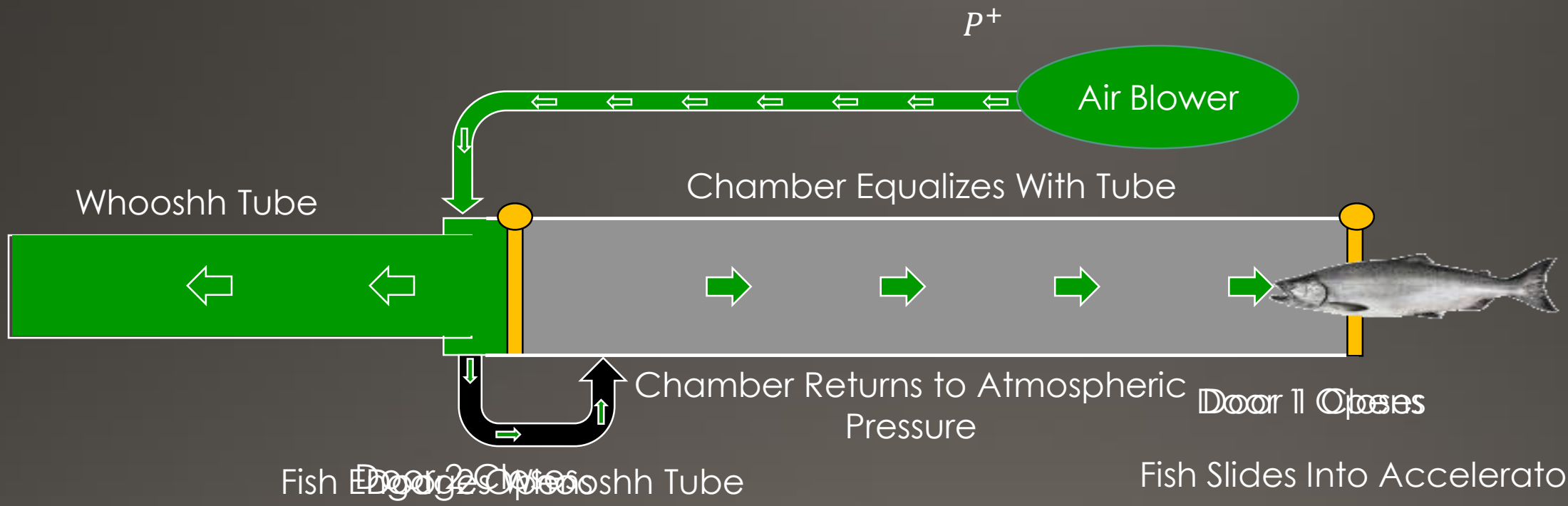
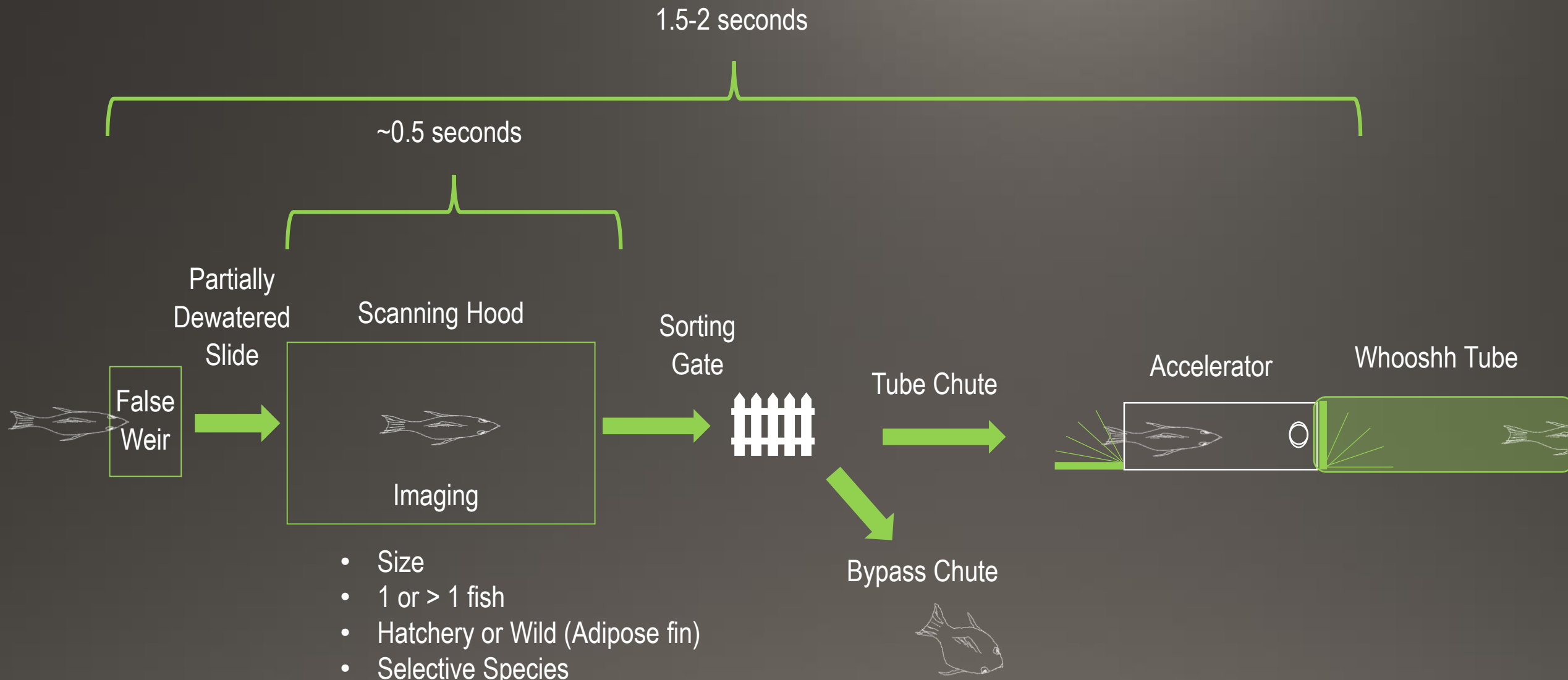
How do the Fish Enter The tube?
The Whooshh Accelerator Sequence



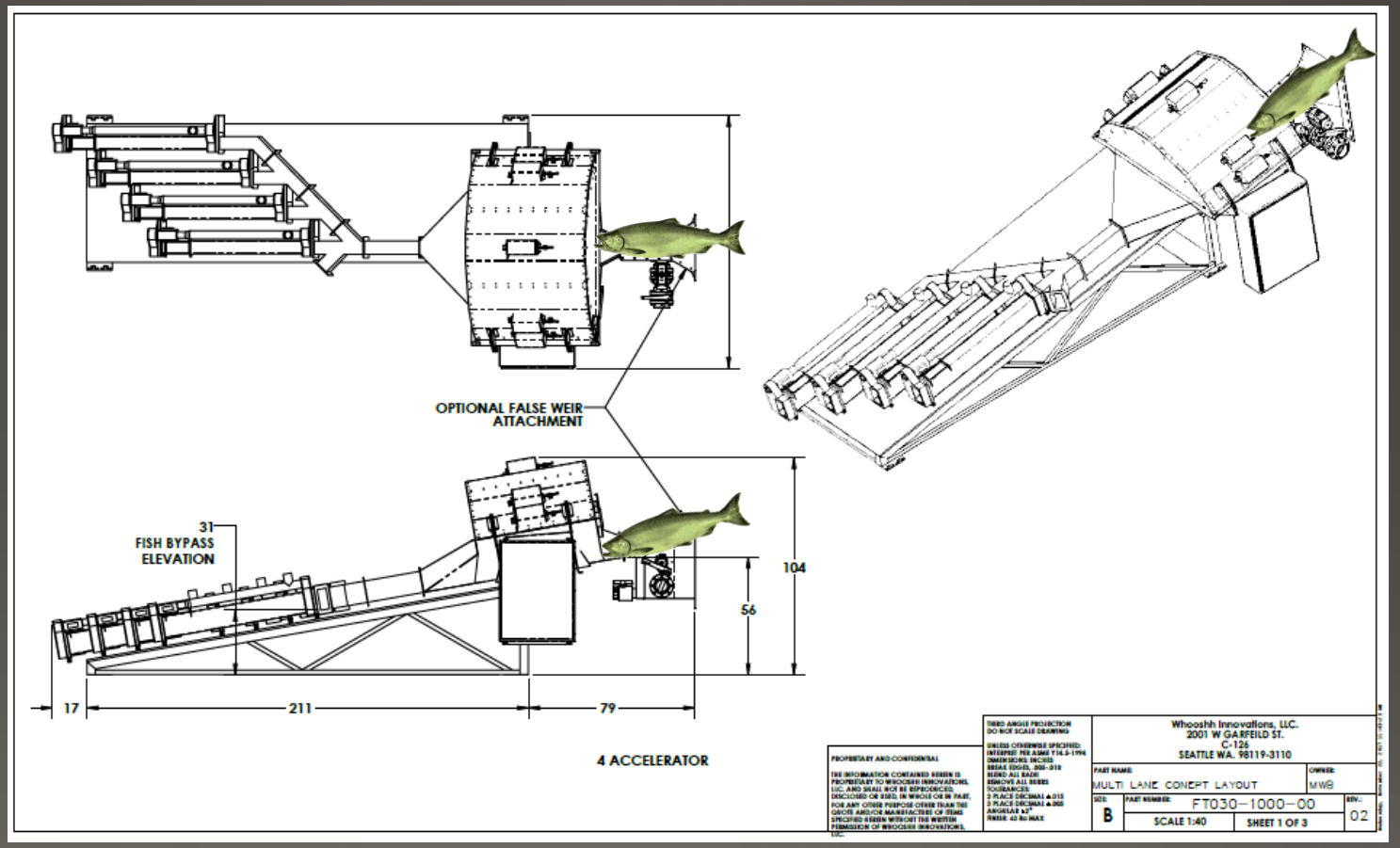


WFTS: Autonomous, Volitional, Selective Fish Passage

WHOOSHH INNOVATIONS

Modular Entry System

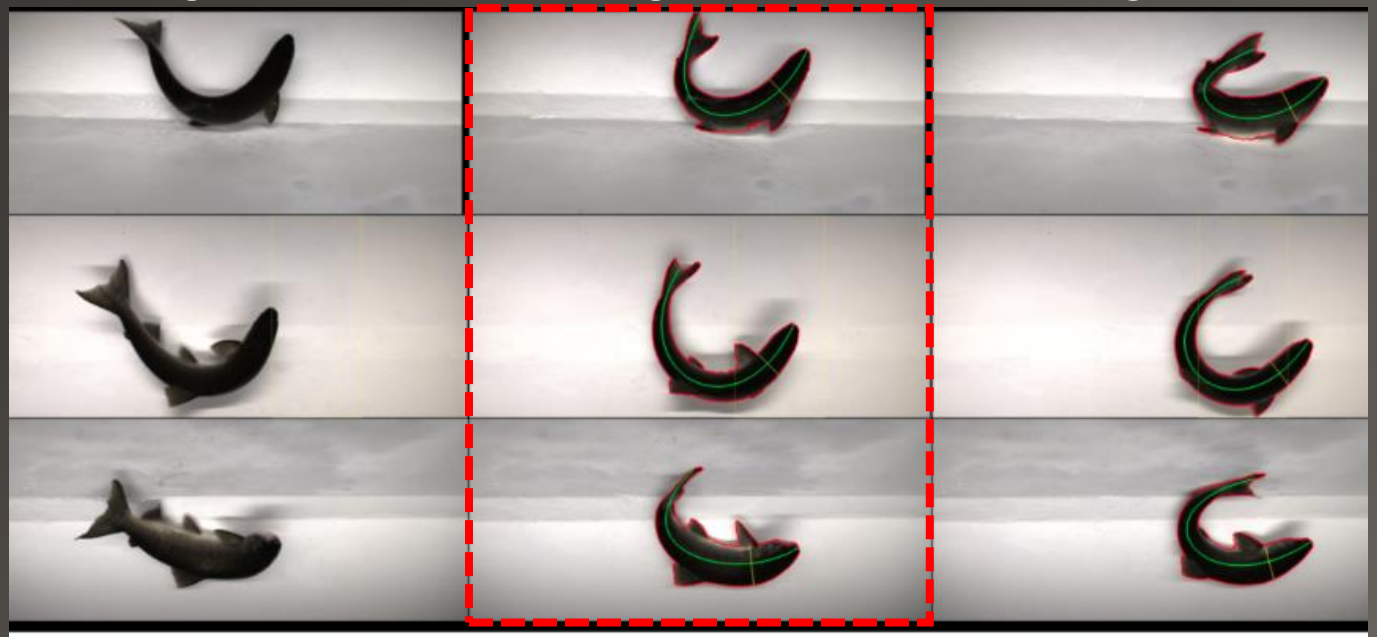
- Volitional Entry
- Machine Vision Scanning
- Automated Sorting
  - Inputs
  - Bypass
  - Sorting gates
- Accelerator(s)



Machine Vision Scanning

Each fish image is captured and analyzed in real-time

Image #1 *Image #2* *Image #3*



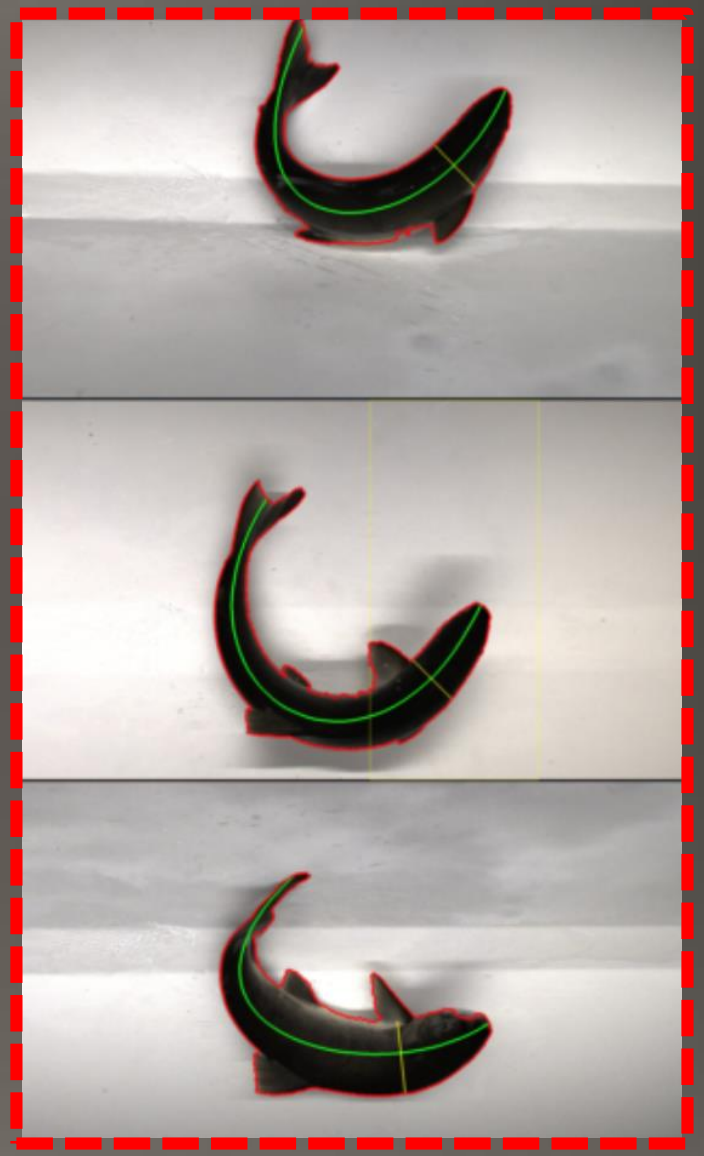
1x Zoom | AutoFit (on)

	Length	Diameter	Diameter deviation	
Show	☑	☑	☑	
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

Left Camera

Top Camera

Right Camera



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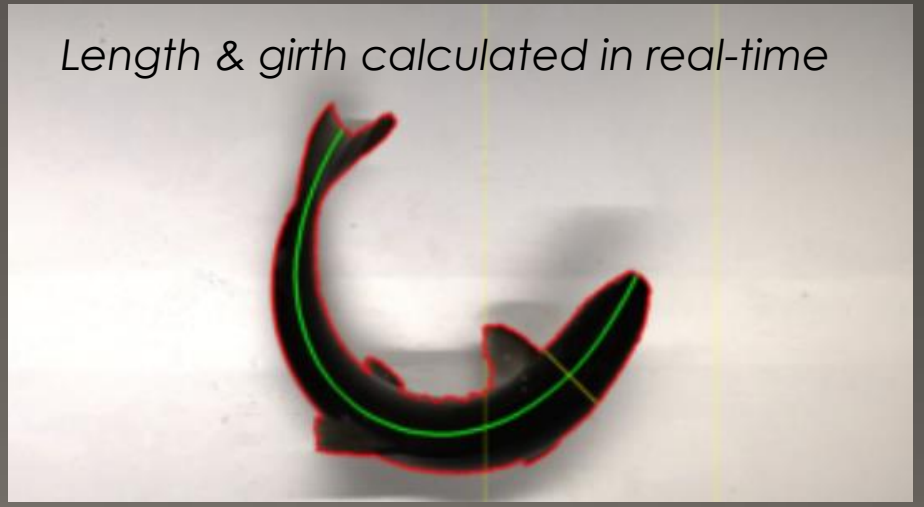
Scanning Capabilities

Current Capabilities:

- Size *(Girth, Width, Length)*
- Speciation by size (Girth, Length)

Upcoming Developments:

- Hatchery vs. Wild
  - Adipose fin presence detection
  - Testing Summer 2018
- Speciation
  - Morphometrics
  - Color
  - Pattern recognition
  - (Asian Carp Testing Q4 2018-Q1 2019)



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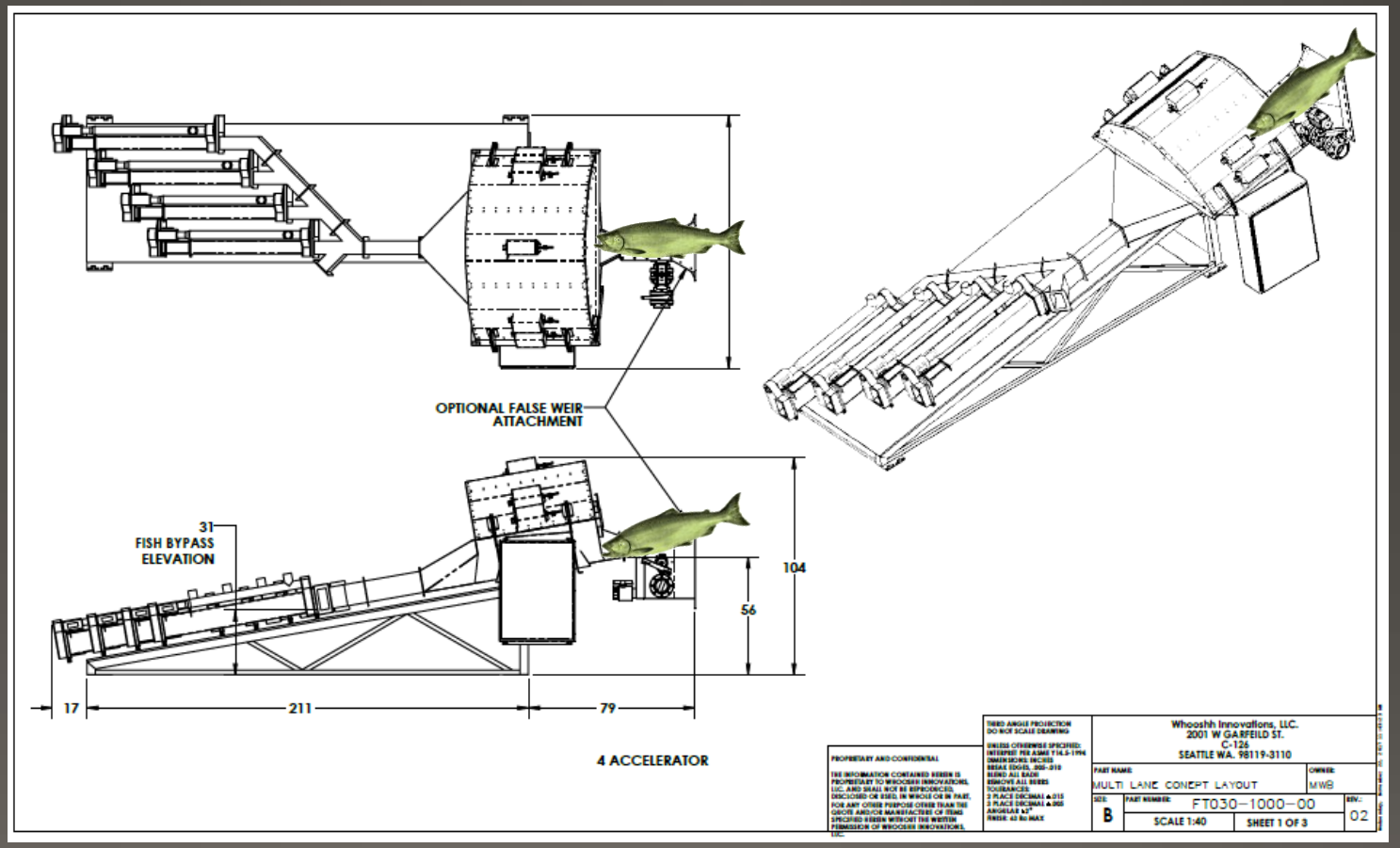

WHOOSHH

AUTONOMOUS, SELECTIVE, VOLITIONAL FISH PASSAGE

Modular System
- Allows you to go over any dam

Active Fisheries Management
- Hatchery vs Wild
- Invasive control
- Species selection

Deployment Speed
- Make an impact sooner

Better fish outcomes
- See www.whoosh.com/studies.html

Iterative deployment possible
- Test before “shovel ready”
- Optimize performance/placement
- Pilot
  - ✓ Incremental results
  - ✓ Staged financing

Deployment Speed
- Months vs Years

Power & water savings
- Enables power generation

Cost effective
- 20% of conventional high head passage capital cost
  - ✓ 35% for low head
- Significantly lower O&M cost

Changes public perception of dams

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Fish Passage Must Be:

Attribute*	Measurement/Evidence
Safe	Survival, reproduction, injury, behavior, disease transmission
Timely and Efficient	Volitional, selective, passage time, energy reserves, travel time and distance
Effective	Migration, Homing, Durable

*NMFS fish passage guidelines

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CLE ELUM PROOF OF CONCEPT

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Cle Elum Pilot

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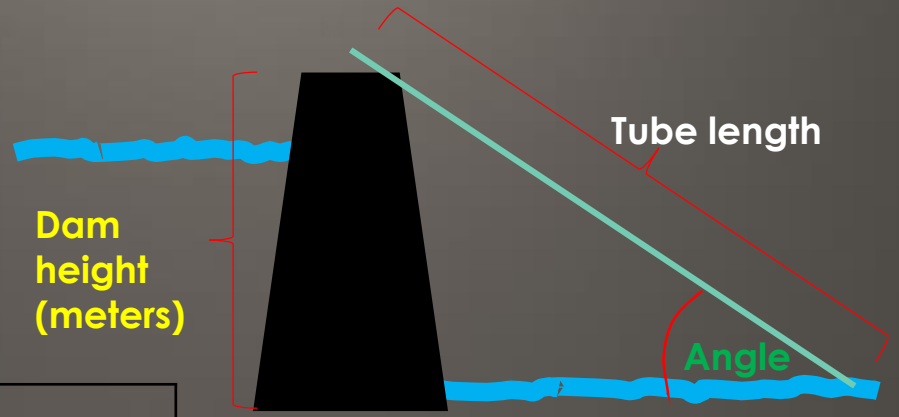
Barrier Heights



	Angle (degrees)				
Tube Length (meters)	0	10	20	30	40
31	0	5	10	15	20
76	0	13	26	38	49
153	0	26	52	76	98
229	0	40	78	114	147
305	0	53	104	153	196
336	0	58	115	168	216
381	0	66	130	191	245
458	0	79	156	229	294
534	0	93	183	267	343

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Key Takeaway's

Autonomous, selective, volitional fish passage

- ~20% of the cost of a traditional system
  - 60-80% savings on the initial capital cost
- ~50% of the O&M cost of a traditional system
- Deploy in months instead of years
- Selective passage automatically
- Fish migrate in seconds instead of hours/days
- More Energy = More Spawning = Nutrient Rich Environment
- Water diversion is not required
  - = ↑ power generation
  - = ↑ water available for irrigation

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THE FIRST AUTONOMOUS, SELECTIVE, VOLITIONAL FISH PASSAGE SOLUTION IN THE WORLD

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