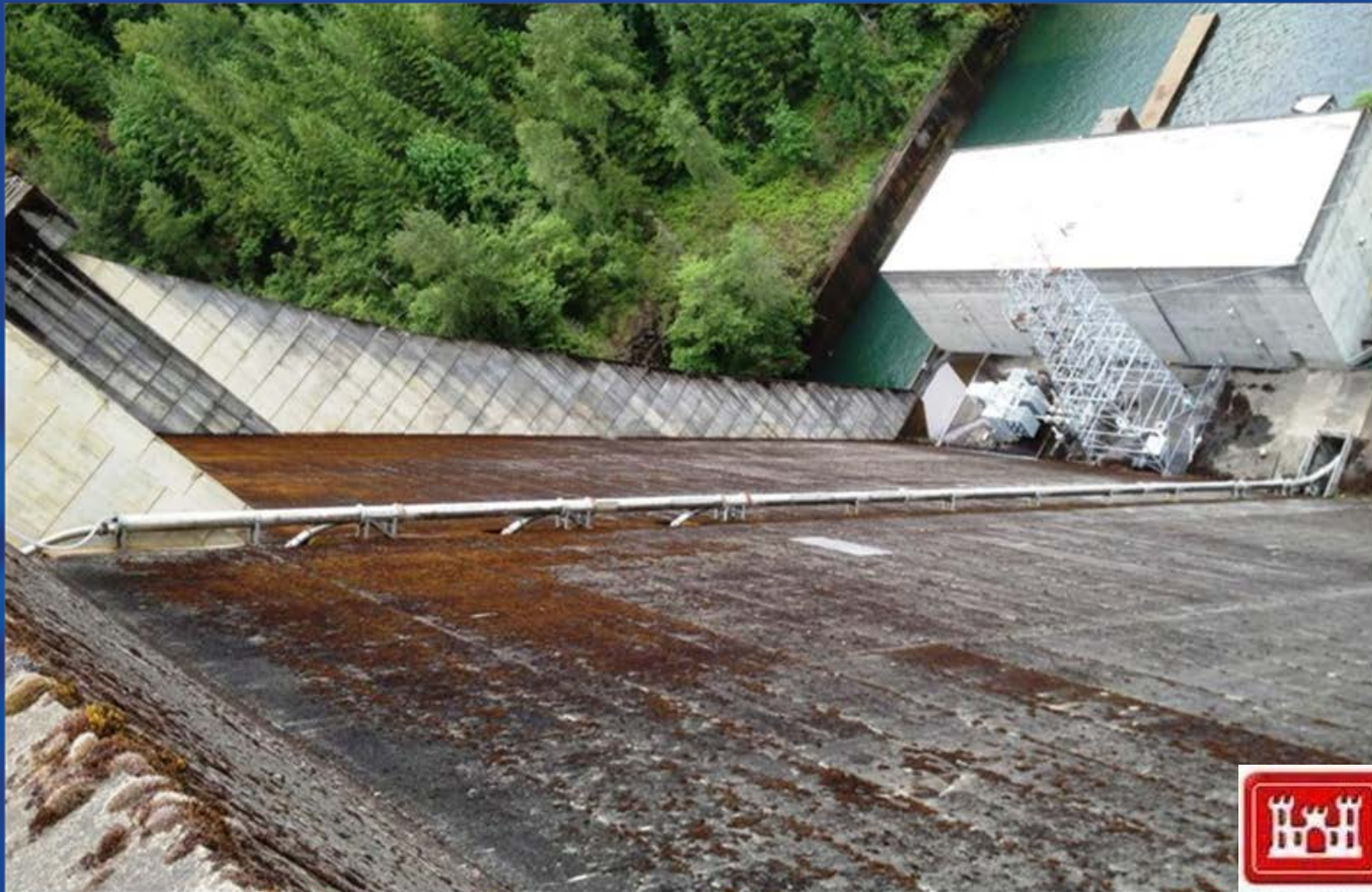


# Biological Fish Injury and Survival at Green Peter Dam, Oregon, 2015

Paul Heisey, Joanne Phipps, and Steve Adams



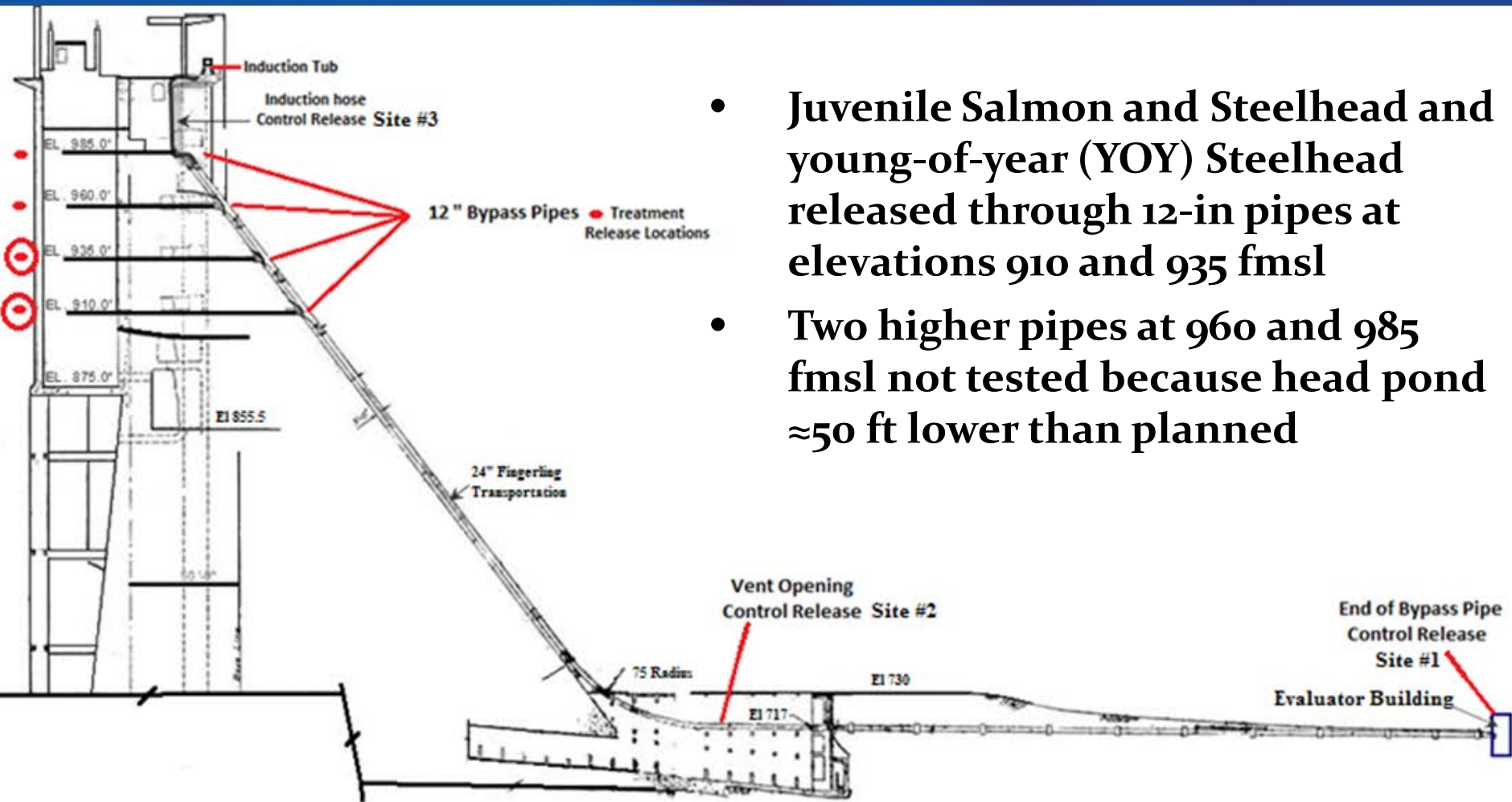
# Background

- Study conducted to provide the USACE with direct survival/injury information for consideration when designing fish bypass systems at high head dams
- Study conducted at abandoned fish bypass system at Green Peter Dam
- Remaining bypass system consists of four 12-in bypass pipes that discharge into a 24-in bypass pipe which empties into fish evaluator



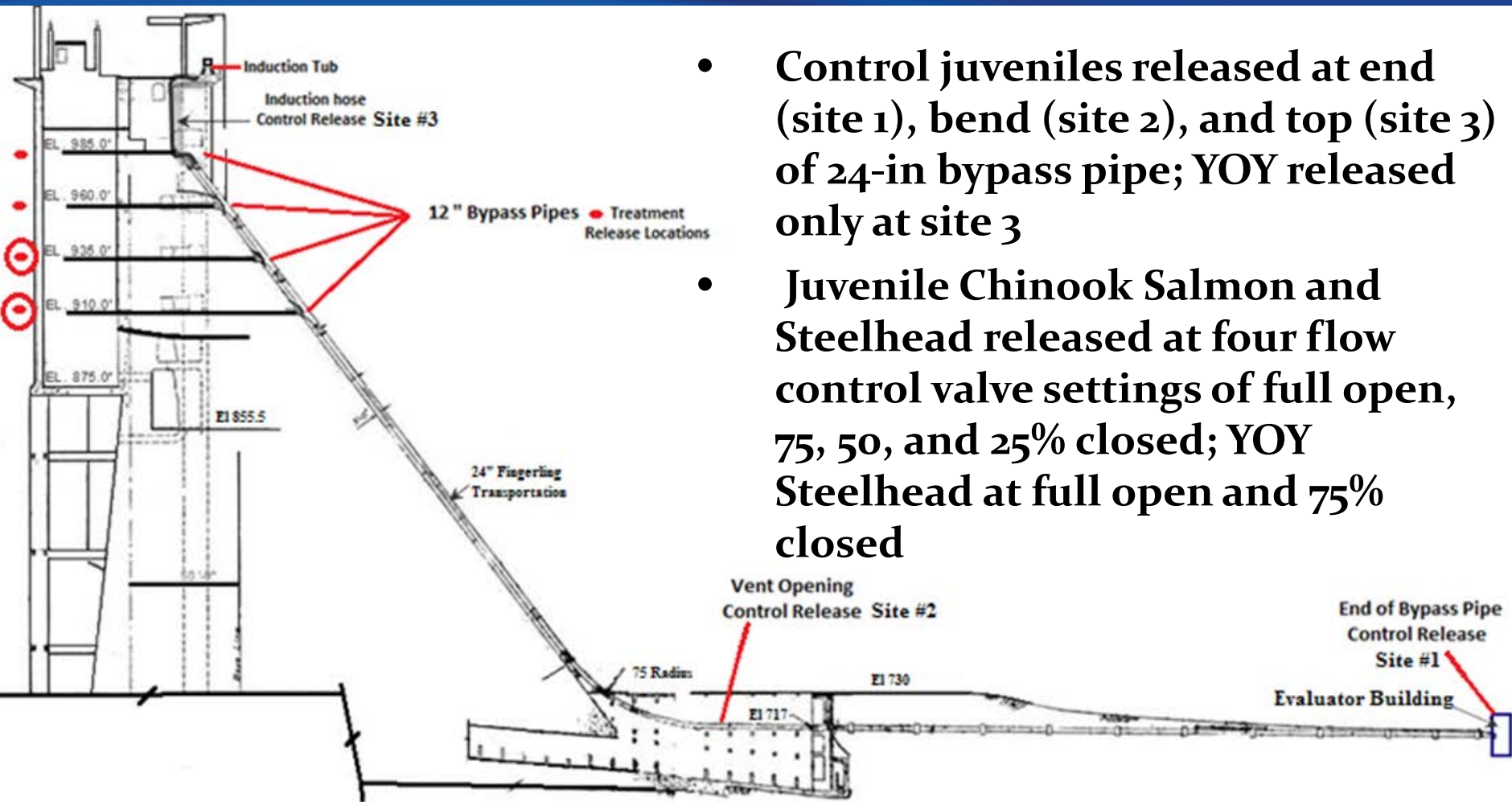
# Methods

# Schematic of Migrant Bypass Pipe



- Juvenile Salmon and Steelhead and young-of-year (YOY) Steelhead released through 12-in pipes at elevations 910 and 935 fmsl
- Two higher pipes at 960 and 985 fmsl not tested because head pond  $\approx$ 50 ft lower than planned

# Schematic of Migrant Bypass Pipe





# Installation of fish release pipes



- Fish recaptured at end of 24-in bypass pipe
- Fish examined for injuries and held 48 h for delayed effects of passage
- Survival and Malady-Free (MF) estimates calculated with and without adjusting for control site 3
- MF fish with out loss of equilibrium, visible injury, and less than 20% scale loss per side

# Sample Size

- Fish from South Santiam Hatchery

	No. Treatment	No. Control	Length TL mm	
			Range	Mean
Chinook	799	200	131-290	202
Steelhead	800	200	121-300	225
YOY Steelhead	400	100	51-100	76



# Results

# Chinook Salmon

- All fish recaptured
- 48 h survival estimates for Chinook Salmon were 91.9 to 99.0%
- Survival estimates were all  $\geq 97.0\%$  at seven of the eight test conditions
- MF estimates were 87.9 to 99.0%
- MF estimates were all  $\geq 92.9\%$  at six of the eight test conditions
- Lowest survival and MF estimates at pipe 910 with flow control valve 75% closed



# Steelhead

- All fish recaptured
- 48 h survival estimates for juvenile Steelhead all 100% except 97.3% at pipe 935 at full open control valve
- MF ranged from 96.0 to 100%
- MF estimates  $\geq 98.0\%$  at five of the eight test conditions

# YOY Steelhead

- All fish recaptured
- YOY Steelhead survival all 100% except 98.8% at pipe 910 with flow control valve 75% closed
- MF all 100%
- High survival and MF rates partially due to similar survival and injury rates for control fish released at top of 24-in bypass pipe control site 3



# Injuries

Treatment injury not adjusted for control fish

- 6.4% of treatment Chinook visibly injured
- 3.3% of treatment Steelhead visibly injured
- 2.3% of YOY Steelhead visibly injured
- Chinook primary injuries were scale loss (2.8%), scrapes/bruises(1.8%), and hemorrhaged eye (1.5%)
- Steelhead primary injuries were scrapes/bruises (1.3%) and hemorrhaged eye (1.1%)
- YOY Steelhead primary injuries were hemorrhaged eye (1.8%)



# Examples of Injuries





# Conclusions/Management Action

- The present study and two previous direct survival/injury studies at the 24-in bypass pipe indicate that the bypass pipes should be able to safely pass  $\geq 96\%$  of the juvenile salmon provided the flow control valves are  $\geq 50\%$  open
- The juvenile Steelhead had higher survival and fewer injuries than juvenile Chinook Salmon
- Additional testing of the 12 and 24-in bypass pipes recommended to evaluate increased pressure and water velocity effects at full head pond

# Acknowledgements/Questions?

U. S. Army Corps of Engineers; Portland District  
Fenton Khan

Advanced Mechanical crew

Cascade Dive Team

Normandeau Associates staff

