

EXHIBIT CT 11

EDWIN T. ZAPTEL, M.S., P.E.
Principal Hydraulic Engineer

Fisheries, Civil, and Hydraulic Design

Mr. Zapfel is a civil engineer with experience in hydraulic, hydrologic, and fisheries engineering developed in a variety of engineering assignments throughout the western United States. These include fish passage facilities for low and high-head dams and reservoirs for both juvenile and adult salmonids, major flood control dam outlet works design, flood control pump station design. He has extensive experience with fish exclusion screen design for water intake structures and reservoir outlet works, sedimentation and erosion analysis and remediation, river engineering, watershed and basin hydrologic analysis, dam safety inspection and remediation, and levee system design, inspection, and repair. He also has significant experience in watershed restoration planning studies, and stream habitat analysis and restoration. Various studies have included restoration of juvenile rearing and adult steelhead spawning habitat, fish ladders, fish passage barrier removal, incorporation of SRA into flood damage reduction channel designs, inspection and evaluation of channel flood capacity, fish collection and behavioral study weirs, and fish screening and water intake facility design. His experience and includes the analysis and design of modifications to complex adult fish attraction, collection, and ladder systems carrying up to 7,500 cfs on the mainstem Columbia River dams. He also has experience in watershed restoration planning studies, and stream habitat analysis and restoration. Mr. Zapfel's experience includes more than seven years in private consulting, two years in academia, and ten years as a hydraulic engineer with the U.S. Army Corps of Engineers' Seattle District.

RELEVANT PROJECT EXPERIENCE

- **Cougar Dam Juvenile Fish Collection:** Design of surface collection and bypass system for Corps of Engineers' hydropower, water supply, and flood control dam on the South Fork MacKenzie River near Eugene, Oregon. Collection system was designed to accommodate up to 130 feet of vertical reservoir elevation variation, and can be used to control temperature of outflows. Study was intended to support reintroduction of anadromous fish runs above Cougar Dam.
- **Cedar Falls Powerhouse Fish Barrier Weir:** Design and physical hydraulic model study of Cedar Falls hydropower plant tailrace fish barrier weir. Physical model tests included evaluation of turbine draft tube exit conditions, needle-type load rejection relief valve operating characteristics, bursting plate emergency load rejection relief operating characteristics, and fish barrier weir performance under load rejection and normal operating conditions.
- **The Dalles Dam High Flow Outfall & Juvenile Fish Bypass and Dewatering System:** Design of high flow outfall and dewatering system for bypassing juvenile salmonids through The Dalles Dam on the Columbia River. Also managed large physical modeling study of outfall and dewatering system for design verification.
- **Lower Monumental Emergency Auxiliary Water Supply (AWS) Study:** Hydraulic evaluation of the adult fishway system. Development of a numerical computer model of the fishway and fish ladder system at Lower Monumental Dam. Fishway system includes two ladders and fishway transportation channels. Completed field pump tests to develop pump curves for the existing AWS pumps (three pumps, rated capacity of 800 cfs). Numerical model development included collecting field data and calibrating model. Numerical model used to develop emergency water supply concepts for the fishway system in the event of a pump failure.
- **Little Goose Dam and Lower Granite Dam Fishways:** Hydraulic evaluation of the adult fishway systems at Little Goose and Lower Granite Dams. Development of numerical models of the fishway systems. Completed field pump tests to determine the performance of the existing AWS pumps. Model development included collecting field data to calibrate model. Completed a hydraulic evaluation of the existing fishway and studied a proposed change to the Little Goose Fishway auxiliary water supply system.
- **Bonneville Fish Ladder AWS Study:** Development of numerical model of Bonneville Dam adult fishway system, and use of this model to study hydraulic changes in the fishway associated with modifications to the auxiliary water supply system. Documented criteria violations in fishway. Developed an operation manual for the fishway for emergency operating conditions when one of the turbine supply sources fails. Collected field velocity measurements and water surface elevations in fishway.
- **John Day Dam Fish Ladder Modifications:** Development of numerical model of adult fishway system at John Day Dam on the Columbia River, and hydraulic analysis of adult fishway system with this model. Also included development of potential modifications to the fish ladders and auxiliary water supply system.
- **Mayfield Dam Fish Tracking and CFD Modeling:** Juvenile salmonid acoustic tracking and Computational Fluid Dynamic (CFD) model of

- Mayfield Dam lowered hydropower intake structure. Managed field tracking studies and managed development of 3D CFD numerical computer model of intake and forebay used in correlating observed fish behavior with velocity and flow patterns in the intake. Measurements of fish movement to less than one body length were recorded, enabling, for the first time, observation of passive and active movement of juvenile salmonids in hydropower intake environments.
- **The Dalles Dam Auxiliary Water Supply to Fish Ladder:** Hydraulic design of large fish ladder water supply system for Columbia River hydropower dam. Included conceptual and feasibility design of fish exclusion screen systems and large scale dewatering facilities.
 - **Howard Hanson Dam Fish Passage:** Design of downstream migrant juvenile anadromous fish passage facility for high head, widely-variable forebay elevation, flood control and water supply dam. Included high flow exclusion screen system and bypass. Three-year study required significant resource agency coordination effort and design formulation and presentation from reconnaissance level design through feasibility level design.
 - **Cedar River Broodstock Collection Weir:** Design and management of overall feasibility design of sockeye salmon broodstock collection weir for the City of Seattle's hatchery facilities at Landsburg.
 - **Stillaguamish River, Washington:** Design of adult fish passage modifications for Cook Slough Sediment Control Weir, Stillaguamish River, Washington.
 - **Cedar River Sockeye Spawning Channel Design:** Design of replacement sockeye spawning channel and intake structure for the Cedar River.
 - **Wynoochee Dam Fish Passage:** Design of downstream migrant juvenile anadromous fish passage facility for high head, widely-variable forebay elevation, flood control, hydropower, and water supply dam. Included complex high-flow fish exclusion screen system and bypass design.
 - **Bonneville Dam First Powerhouse Fish Collection Channel and Dewatering System:** Hydraulic design of juvenile fish collection and bypass add-in water system for Columbia River hydropower dam.
 - **Bonneville Dam Second Powerhouse Forebay Corner Collector:** Hydraulic design of upstream surface-oriented fish collection and bypass system. Included design and evaluation of physical hydraulic model study of collection system.
 - **American River Site 5 Erosion Protection:** Design of erosion protection measures for 2000 foot reach of right descending bank line site on American River. Design featured habitat enhancement with Large Woody Debris and riparian restoration.
 - **California Department of Water Resources Bioengineering Research:** Various projects in the Sacramento River Delta region to improve understanding of fish behavior and fish protection at DWR intakes, Delta Cross Channel, Yolo Bypass Toe Drain, Clifton Court forebay intake structure.
 - **Bahia Lagoon Lock and Lagoon Filling and Drainage System Design:** Design of small boat navigation lock for Bahia Lagoon and fish exclusion and screening system for lagoon filling and water exchange system on the Petaluma River.
 - **Arroyo Pasajero:** Conducted feasibility level hydraulic designs for flood control project elements on the Arroyo Pasajero, Central California. Designs included uncontrolled overflow spillways and a spillway controlled by fusegates.
 - **Glendale Weir Water Intake Diversion Design:** Design of new diversion and intake screening structure for Truckee River in Reno, Nevada that incorporates adult and juvenile fish bypass features for Cui-ui and Lahontan Cutthroat Trout.
 - **Granlees Dam Fish Ladder:** Technical review of fish ladder design for Granlees Dam on the Mokelumne River.
 - **Guadalupe Creek Restoration:** Design of Large Woody Debris features and channel stabilization measures for restoration of Guadalupe Creek in San Jose.
 - **Guadalupe River Downtown Reach Flood Damage Reduction:** Hydraulic design of large bypass conduit for conveying Guadalupe River flood flows through downtown San Jose, California. Capacity of the bypass was about 75% of the total river design flow of up to 20,000 cfs. Bypassed reach included very sensitive riparian and anadromous fish habitat features that required 100% preservation.
 - **Lower Guadalupe River Flood Damage Reduction:** Design of setback levees, low flow channel, channel stabilization, bridge stabilization structures. Designs incorporated habitat enhancement and restoration features such as overbank riparian restoration, grade control structures, fish passage low flow channels, etc.

- **Icicle/Peshastin Irrigation District:** Water conservation study for Icicle/Peshastin Irrigation District in Cashmere, Washington. Field inspection and review of all facilities. Development of facility rehabilitation and water conservation plans and construction schedules.
- **North Fork Newaukum River Erosion Protection:** Design of erosion protection for heavily eroded bank immediately upstream of county road bridge. Design incorporated habitat enhancement features such that river would be encouraged to migrate away from the bank over time and provide shallow water habitat for juvenile salmonids.
- **Skook Creek Fish Passage Barrier Removal and Restoration:** Design of culvert barrier removal for 1000 foot reach of Skook Creek, consisting of multiple grade control structures and Large Woody Debris energy dissipation structures for 5 percent slope stepped boulder stream.
- **Middle Fork Nooksack River Fish Ladder Design:** Design of fish ladder alternatives for the City of Bellingham water supply diversion dam. Design required accommodating large fluctuations in discharge without mechanical mechanisms due to remote location. Worked closely with resource agencies to develop the design. City of Bellingham.
- **Middle Fork Nooksack Diversion Dam Intake Alternatives Analysis:** Design of alternatives to divert discharge to the water supply aqueduct without the need for a dam. Alternatives included pool and chute natural scour pool, low flow channel with multiple intakes, and miscellaneous groundwater and channel screening concepts. The existing diversion dam would be removed under this scenario.
- **Skagit PUD Pump Intake:** Hydraulic design of fish exclusion screening facility for large municipal water supply pump intake facility on the Skagit River.
- **Hiram Chittendon Locks:** Design of new salt water drain intake facility for Lake Washington Ship Canal Hiram Chittendon Locks facility.
- **Elwha Tribal Hatchery Intake Evaluation and Feasibility Design:** Investigation of Elwha Tribal Hatchery intake structure adequacy for anticipated high sediment loads resulting from future Elwha and Glines Canyon dam removal. Feasibility level design of new hatchery intake structure and flood protection works.
- **Columbia and Snake River Gas Abatement Structural Alternatives:** Feasibility-level design development for wide range of structural dissolved gas abatement alternatives for application at all eight lower Snake and Columbia River Corps of Engineers dams. U.S. Army Corps of Engineers.
- **Lower Cedar River Sedimentation:** Sediment transport and hydraulic analysis of the lower two miles of the Cedar River, Washington, for flood damage reduction study, including levee design and initial construction and maintenance dredging.
- **Salinas River Flood Control Reconstruction:** Design of abandonment and/or reconstruction of flood damage reduction setback levee system for Salinas River following large floods in 1995.
- **Santa Ana River Flood Control Levee and Groundwater Recharge Cross Levee Inspection:** Inspection and development of flood damage reduction levee system rehabilitation following 1995 floods.
- **Poway Creek Flood Control Channel Inspection:** Inspection and development of flood damage reduction conveyance infrastructure for Poway Creek

PROFESSIONAL AFFILIATIONS

Registered Professional Engineer, Washington
 Member, American Society of Civil Engineers (ASCE)
 Member, American Fisheries Society (AFS)

EDUCATION

B.S. in Civil Engineering, Washington State University,
 1984 (Honors)
 M.S. in Civil Engineering, Washington State University,
 1987 (Cum Laude)
 *Ph.D. candidate in Fisheries, University of Washington,
 (*prospective completion 2005)

SELECTED PUBLICATIONS

*Larson, L.W., Zapel, E.T., S. J. Schlenker, R.T. Lee, S.C. Milligan; "Predictive Numerical Computer Models of Adult Fishways and Application at US Army Corps of Engineers Dams." Proceedings of the Bioengineering Symposium at 132nd Annual American Fisheries Society Meeting, Baltimore, Maryland, August, 2002.
 *Zapel, E.T., T.R. Molls, S.V. Johnston, P.A. Nealson, M.A. Timko, and M. G. LaRiviere; "Juvenile Salmonid Acoustic Tracking Correlation with CFD-Model Predicted Velocity Fields at the Mayfield Dam Louvered Intake." Proceedings of the Bioengineering Symposium at 132nd Annual American Fisheries Society Meeting, Baltimore, Maryland, August, 2002.

(*under peer review at this time)

Ahmann, M.L. and E.T. Zapel. "Stepped Spillways, a dissolved gas abatement alternative." Proceedings of the International Workshop on Hydraulics of Stepped Spillways. Zurich, Switzerland, March, 2000.

Zapel, E.T., F.A. Goetz, and P.J. Hilgert. "Development of a Downstream Fish Passage System for Anadromous Salmonids at a High-Head Dam." Proceedings of Symposium at 127th Annual American Fisheries Society Meeting, Monterey, California, August, 1997.

Zapel, E.T. "Howard A. Hanson Dam Juvenile Fish Bypass System." Fish Passage Workshop. Milwaukee, Wisconsin, May, 1997.