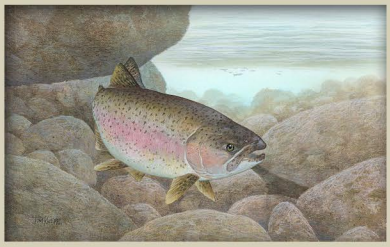


MONTEREY PENINSULA
WATER MANAGEMENT DISTRICT

PROPOSAL FOR ENGINEERING SERVICES

Sleepy Hollow Steelhead Rearing Facility

RAW WATER INTAKE AND WATER SUPPLY SYSTEM UPGRADE

March 6, 2015

TETRA TECH

Submitted to:

Monterey Peninsula Water Management District

In Association with:

Freshwater Institute
Anchor QEA
PanGEO

Image of painting “Sunrise on The Carmel River Lagoon” used with permission of the artist
Robert Lewis
robertlewisart.com

TETRA TECH

March 6, 2015
Mr. Larry Hampson
District Engineer
5 Harris Court Building G
Monterey, CA 93940

Subject: Sleepy Hollow Steelhead Rearing Facility Water Intake and Water Supply System Upgrade

Mr. Hampson and Selection Panel Members:

The efforts of your agency and your community partners to rescue Carmel River steelhead and increase their survivability is just the type of project our team members desire to be a part of. Tetra Tech has been involved in habitat and hatchery improvements for steelhead and other salmonids in the Pacific NW and Alaska for several decades. We offer our knowledge and that of our highly qualified subconsultants to enhance the operation and reliability of the Sleepy Hollow facility. **The Tetra Tech team provides these advantages:**

- Decades of experience by an in house, multi-disciplined team who are able to work efficiently together on fisheries related projects.
- In depth knowledge of the geomorphology of the Carmel River and the impacts of sedimentation from the San Clemente Dam removal. Dr. Bob Mussetter and his team are best able to guide development of the intake location and criteria for the screens.
- The expertise of the Conservation Fund's Freshwater Institute and Brian Vinci in water conservation and recirculating systems for holding and culturing healthy fish.
- Success in designing the Oregon Hatchery Research Center, a research institute studying the behavior of hatchery salmon and steelhead. The facility includes naturalistic channels that mimic native streams.
- In-house state of the art survey capability in our office a few hours away from the project site.
- Experience designing water intake systems for hatchery and municipal water supplies.

The team will be led by Darrel Nice, who brings over 20 years of experience in civil design and hatchery design and construction. He will be supported by veterans Don Beard and John McGlenn, two sturdy pillars of our fisheries engineering program. As principal in charge, it is my job to make sure he succeeds and has access to any Tetra Tech resources needed.

Thank you for considering our sincere interest in this assignment. We look forward to working with the District and your partners on this important undertaking,

Contact Information:

Darrel Nice, PE, Project Manager, 316 W. Boone Avenue, Suite 363, Spokane, WA 99201
(509) 232-4308, (509) 944-1681 (mobile)

Organizational Info:

Tetra Tech was founded in 1966 as a civil engineering firm by four graduates of the California Institute of Technology who provided engineering services for waterways, harbors, and coastal areas. The company has been headquartered in Pasadena, CA since then. In December 1991, Tetra Tech became a publicly traded enterprise (NASDAQ symbol: TTEK. Since its initial public offering, the company has grown substantially, expanding its markets, services, and clientele through internal growth and international acquisitions. In 1995, Tetra Tech acquired Seattle-based KCM, Inc., a multi-discipline engineering firm with an established fisheries engineering practice that remains strong today.

We currently have 13,000 employees in 300 offices in North America and worldwide. From front-end science and planning to design, construction management and operations, Tetra Tech provides best-in-class experts with worldwide project experience to deliver a high level of integrated services for the full project life-cycle in five service areas: water, natural resources, the environment, infrastructure, and energy.

For more information about Tetra Tech's services please visit our website

http://www.tetratech.com/en/our-company

Sincerely,

Tetra Tech
Water, Environment & Infrastructure

H. R. Naderi-Asia

Darrel J. Nice

Hamid Naderi, PE
Vice President

Darrel Nice, PE
Project Manager

SIGNATURE PAGE

ISSUE DATE: January 16, 2015
RFP EXTENSION DATE:

RFP: Sleepy Hollow Steelhead Rearing Facility Raw Water Intake and Water Supply System Upgrade

PROPOSALS ARE DUE IN THE DISTRICT OFFICE BY 3:00 P.M., LOCAL TIME, ON MARCH 6, 2015

MAILING ADDRESS:
Monterey Peninsula Water Management District
5 Harris Court, Building G
Monterey, CA 93940

QUESTIONS ABOUT THIS RFP #10340 SHOULD BE DIRECTED TO
Larry Hampson, larry@mpwmd.net, (831) 658-5620 or (831) 238-2543
Consultant MUST INCLUDE THE FOLLOWING IN EACH PROPOSAL:
1 original plus 3 copies = total of 4 copies plus one CD or DVD (no USB sticks)

☑ ALL REQUIRED CONTENT AS DEFINED PER SECTION 7.1 HEREIN

This Signature Page must be included with your submittal in order to validate your proposal.
Proposals submitted without this page will be deemed non-responsive.

☑ **CHECK HERE IF YOU HAVE ANY EXCEPTIONS TO THIS SOLICITATION.**

Consultant MUST COMPLETE THE FOLLOWING TO VALIDATE PROPOSAL

I hereby agree to furnish the articles and/or services stipulated in my proposal at the price quoted, subject to the instructions and conditions in the Request for Proposal package and the identified exceptions. I further attest that I am an official officer representing my organization and authorized with signatory authority to present this proposal package.

Company Name: Tetra Tech, Inc. Date: March 6, 2015

Signature: H.R. Naderi-Asia Printed Name: Hamid Naderi, PE, VP

Street Address: 1420 Fifth Avenue, Suite 600

City: Seattle State: WA Zip: 98101-2357

Phone: (206) 883-9300 Fax: (206) 993-9301 Email: Hamid.Naderi@tetratech.com

TABLE OF CONTENTS

Licensing Requirements

Tetra Tech hereby acknowledges that the team we are proposing for this project meets the prequalification requirements. We will maintain all permits, licenses, and professional credentials necessary to provide the service specified in the RPF for the *Sleepy Hollow Steelhead Rearing Facility Raw Water Intake and Raw Water Supply System* project.

Our team includes the following individuals with current California professional licenses:

Dan Helt, PE, PLS.....Licensed Professional Surveyor, CA L8925; C69347

Bob Mussetter, PE.....Licensed Civil Engineer, CA C59128

Tim Tipton, PE, SE .....Licensed Civil Engineer, CA 77785

Philip Tunnell, PE.....Licensed Mechanical Engineer, CA M35934

Brian Vinci, PE .....Qualified Aquaculture Specialist

Katie Chamberlain.....CEQA/NEPA Compliance Specialist

Team Member Firms

Tetra Tech

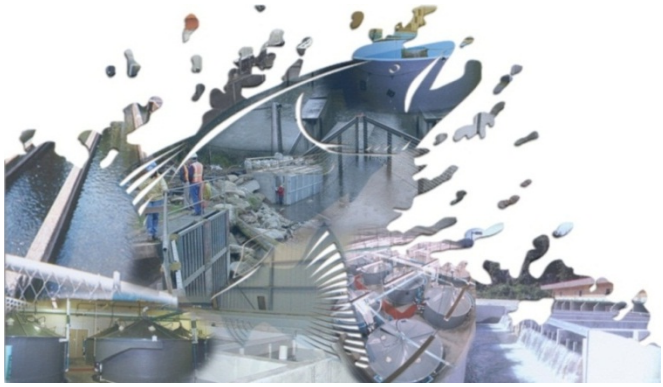
Tetra Tech provides a complete range of civil, environmental, aquaculture / fisheries science, mechanical, electrical, structural engineering and architecture, surveying and mapping services.

Hatchery Engineering

Tetra Tech has four decades of experience designing new hatcheries and renovations to meet both conservation and harvest goals.

Our recent experience includes many projects with requirements similar to the Sleepy Hollow project —programming for native stocks, adaptive management, water conservation and phased construction to keep facilities operating during renovations. These include:

- The Walla Wall Spring Chinook Hatchery, which will upgrade the adult holding and spawning facility to include onsite incubation, rearing and release of 500,000 spring Chinook.
- At the Colville Tribal Resident Fish Hatchery, we are designing the addition of several circular tanks for rearing Rainbow Trout. The circular tanks will be installed using infrastructure that was originally in place for rectangular raceways. Construction will be coordinated with concurrent hatchery operation.



- The Kootenai Twin Rivers (Sturgeon and Burbot) Hatchery is a conservation hatchery that will use locally collected broodstock to incubate and rear young fish for release into the local rivers and streams. This project includes renovations to the existing Tribal Hatchery while the facility is under operation.
- Chief Joseph Hatchery to strengthen both spring and summer/fall Chinook runs throughout the Okanogan River Basin.
- Cedar River Hatchery to enhance and stabilize Sockeye returns to Lake Washington without adversely affecting other wild stocks.
- A hatchery project to incubate and rear salmonid species for stock restoration throughout the Norton Sound Region in Alaska.
- Renovating a closed state hatchery into the Oregon Hatchery Research Center now used to study hatchery/wild fish interaction and the best use of hatcheries to meet conservation objectives.

Fish Passage and Habitat

Our expertise includes fish passage and screening including habitat restoration efforts, replacement of impassable culverts, water intake screening, adult holding and trapping facilities, self-cleaning screens and multi-species fish passage and trapping, and sorting and spawning facilities. Our designs combine biology, hydrology, hydraulics, stream morphology and civil engineering disciplines, tailored to specific project conditions.

Land and Water Surveying

The California Tetra Tech survey team offers a full complement of licensed survey professionals as well as seasoned field survey crews. We have four California Professional Land Surveyors on staff, as well as four dedicated, fully-equipped, survey vehicles. As a whole, Tetra Tech has a total of nearly 30 Professional Land Surveyors and over 100 field and office staff throughout the U.S. With two

field crews in San Luis Obispo, one field crew in Lafayette, and one field crew in Irvine Tetra Tech is capable to support the Sleepy Hollow project. Based on the Tetra Tech Teams past experience with similar projects we believe that a mixture of GPS and traditional total station surveying will be required in order to complete the surveying portion of the project.

Tetra Tech's Project Manager for this task will be Dan Helt, PE, PLS. Mr. Helt is a land surveyor and civil engineer who specializes in overall obtaining survey data for design purposes, as he often performs both roles on projects, land surveyor and civil engineer.

The Conservation Fund's Freshwater Institute

The Freshwater Institute specializes in the production technology and design of aquaculture systems and in solutions to the water quality constraints and impacts. The Freshwater Institute is an internationally recognized program of The Conservation Fund. For more than two decades, they have been one of the nation's premier research and development facilities dedicated to sustainable water use and reuse. Throughout this document we will refer to the organization by a shortened title, *the Freshwater Institute*.

Freshwater Institute staff, including Brian Vinci, have designed several full and partial water reuse systems for hatcheries on the East and West coasts and have conducted a bio-programming analysis for multiple pacific anadromous restoration programs for the Chelan County Public Utility District (PUD). They also conducted an observational study of fish reared in a partial reuse system versus fish in traditional raceway rearing units also for Chelan County Public Utility District (PUD).

They have pioneered the use of new hatchery technologies that better manage effluent waste loads by concentrating, isolating, and removing the majority of waste before its release into surface waters. The application of this technology ranges from standard hatchery settings to land-based, closed containment water recirculation systems that are biosecure and produce healthy and optimally performing fish.

Anchor QEA

Anchor QEA's team of more than 350 staff provide a full range of planning, science, and engineering services to the public and private sectors. Specific to the needs of this project, Anchor QEA provides comprehensive environmental review and natural resources assessment services for development and restoration projects throughout the U.S. They have substantial expertise preparing documentation to support National Environmental Policy Act (NEPA) and California Environmental Quality Act (CEQA) reviews; completing wetland, stream, and other sensitive habitat assessments; obtaining federal, state, and local regulatory permits; and leading Endangered Species Act consultations with the National Marine Fisheries Service, U.S. Fish and Wildlife Service, and California Department of Fish and Wildlife. Anchor QEA's San Francisco-based planning staff have strong relationships with Bay Area regulatory permitting agencies and their biologists are experienced in providing expert analyses, regulatory assistance, and science-based guidance to implement and improve the performance and compliance of hatchery projects.

Anchor QEA has a proven record of success navigating the entitlement process for projects involving sensitive aquatic habitats. They have extensive knowledge of federal, state, and local regulations and are able to identify and complete biological services required to obtain project approvals. Our team includes biologists and scientists with extensive stream, riparian, wetland, and salmonid experience. For the City of Martinez Marina Maintenance Dredging and Renovation project, Anchor QEA planners Ms. Katie Chamberlin and Mr. Nicolas Duffort performed biological resource evaluations of the project area, obtained an incidental take permit from CDFW for potential project impacts on longfin and delta smelt, completed an informal ESA consultation with NMFS for potential project impacts on salmonids and green sturgeon, and completed a formal ESA consultation with USFWS for potential project impacts on salt marsh harvest mouse habitat, which included the development of a mitigation plan focused on salt marsh restoration. Each of these elements was critical to obtaining the full suite of required regulatory approvals.

PanGeo, Inc.

PanGEO is a small business with a staff of 8 engineers and 3 geologists. The firm's three principals have a combined experience of over 70 years in geotechnical practice on hundreds of local and national projects with construction costs in excess of hundreds of millions of dollars. Their diverse experience with major capital projects including dams, hatcheries, waterfront facilities, transportation systems, and buildings. PanGEO has developed a reputation of providing innovative and cost-effective solutions for difficult site conditions earning awards for their work from their peers in the American Society of Civil Engineers and American Council of Engineering Companies. A trusted partner to Tetra Tech for many years, PanGEO will be available to address any geotechnical challenges. One of their principals will be on site to monitor subsurface investigation work that may be conducted to support design assumptions.

Summary of Relevant Experience

We offer a team with a true dedication to the goals of this project – to protect and enhance the Carmel River Steelhead runs and improve the operation of the rearing facility. We also offer unique expertise in the most critical aspects of this project:

- Understanding the geomorphological conditions in the Carmel River that will establish design and operating criteria.
- Knowing how to design a recirculation system that meets biological requirements and is operable, flexible and reliable.
- Meeting the requirements of federal, state and local regulatory and permitting agencies with different perspectives and timeframes.

Fish Culture & Design Projects

Walla Walla Hatchery, near Milton-Freewater, Oregon

Similarities to Sleepy Hollow Project

- River Intake
- Restoration of Depressed Stocks
- Preservation of Existing Hatchery
- Recirculating Aquaculture Alternatives
- Pump Station
- Underground Piping
- Site Work and Utilities
- Structural Concrete

Client:
Bonneville Power Administration
Gerald McClintock (503) 230-5375
gmcclintock@bpa.gov

Owner:
Confederated Tribe of the Umatilla Indian Reservation (CTUIR)
Brian Zimmerman (541) 276-3447
BrianZimmerman@ctuir.org

Duration or Date Completed
01/2014 – 04/2017

Construction Value:
$11,477,147

Team Member Roles on Project

- John McGlenn, Project Manager
- Don Beard, Design Manager
- Darrel Nice, Assistant Design Manager/Mechanical Engineer

- Brian Vinci, Aquaculture Engineer
- Joe Miller, Bioprogramming, Liaison to Scientific Review Panel
- Richard Hensel, Electrical Engineer
- Erik Nordholm, Civil Engineer
- Ryan Maas, Structural Design
- Hamid Naderi, PIC

Description of Services Performed

Bonneville Power Administration selected Tetra Tech / Goodfellow Bros. Inc. to provide design/build services for scientific support, analysis of alternatives to the 30% predesign, final design, and construction services for the Spring Chinook Hatchery Facilities on the South Fork of the Walla Walla River (SFWW) near Milton-Freewater, Oregon.

History & Data Compilation:

Prior to Tetra Tech beginning this project work had been done by others to prepare a master plan, a 30% design, a hatchery genetic management plan, and submittal to the Northwest Power and Conservation Council (NPCC). These documents were compiled by the project engineer and used to refine the Owner's desired direction of the project. Ultimately a basis of design document was prepared that outlined the direction for proceeding with design phases.

The project began with an assessment of the existing facility—a Spring Chinook adult holding and spawning facility operated by CTUIR since 1996. Existing infrastructure at the site includes a river water intake, pump station, water supply piping, adult holding raceways, spawning building, ozone water treatment building, staff housing, effluent pond, and effluent discharge line.

Other initial activities included review and establishing the rearing program goals for the project. This process helped to direct what physical investigations, studies, alternatives analysis and permitting activities were needed. As part of restoration of spring chinook in the South Fork Walla Walla basin the Umatilla Basin was also looked at to be included in the facility. An alternative was to upgrade the Umatilla Hatchery. Our team conducted an assessment of the Umatilla Hatchery including review of the hatchery genetic management plan, current operations, and record drawings. Then an extensive analysis of reuse options with design alternatives and estimated construction costs was prepared. Many of these tasks took place simultaneously including an integrated hydraulic and sediment transport assessment, cold weather and debris testing of the intake system, pump inspection and performance testing, evaluation of existing intake screen functionality related to sweeping velocity and fish bypass compliance.

Collecting and Analyzing Survey Data:

Preliminary survey for this project utilized County survey records and record documents from the initial construction. As part of the river hydraulic and sediment transport study, river and site cross section surveys were completed. The river survey was tied to previously established control monuments and significant site structure elements.

Civil Engineering and Design/Cost Estimating:

The project includes review of preliminary design elements, design, procurement of materials and equipment, construction, and supporting services for expanding the hatchery. New facilities developed include a building for egg incubation and early fish rearing and a sufficient number of rearing containers for full-term rearing of 500,000 spring Chinook through the smolt stage. Connection of the

new facilities to existing water supply and effluent discharge systems are included in the design. In addition, improvements to adult fish trapping facility and fish transfer equipment at the Nursery Bridge Dam is included in the project.

Further objectives are to: (1) provide scientific and engineering input during Steps 2 and 3 of the NPCC's 3-Step planning Review process; (2) provide support associated with managing the technical work group process that involves fishery co-managers and regulators; and (3) provide technical assistance in: (a) evaluating alternatives for incubation, filtration, and rearing methods and infrastructure; and (b) identifying environmental and construction permitting requirements.

The South Fork Walla Walla River has scoured the area in front of the hatchery in the last 18 years reducing the depth of water at the intake. Tetra Tech performed an integrated hydraulic and sediment transport assessment of the reach upstream and adjacent to the hatchery. As part of this study an in stream riffle was proposed to restore river elevation and improve habitat. A preliminary design of the riffle has been prepared and it is being integrated with intake improvements to solve several intake concerns.

Tetra Tech performed a cold weather test on the current intake and screen, which was done during a week long period of outside temperatures below zero at night and highs in the teens. A low water temperature of 32.1F was observed. Currently, the intake and fish screen does not function as originally designed due to reduced water depths. Once water depths are restored the system still does not meet current standards for sweeping velocity and fish bypass. Two screening and bypass options are being reviewed including using fabricated cone style screens with hydraulically operated exterior cleaning brushes.

Aquaculture and Mechanical Engineering Design

The project included analysis of recirculating aquaculture systems for implementation at two facilities the existing Umatilla Hatchery and the new Walla Walla Hatchery. Through this evaluation process a decision needed to be made whether to move the rearing of 850,000 spring chinook from the existing Umatilla Hatchery to the proposed Walla Walla Hatchery and combine them with the Walla Walla program of 500,000 fish.

At the Umatilla Hatchery there are existing raceways that have already implemented a serial reuse system. The facility raises steelhead, fall chinook, and spring chinook. The concern at the facility was to optimize the fish rearing environment, and reduce water requirement due to the increasing reduction in well water capacity. A site visit was conducted by Brian Vinci, Darrel Nice, and Joe Miller to evaluate the biological program, civil and mechanical infrastructure, current reuse system performance, and options for adding recirculating aquaculture. The effort resulted in conceptual layout of a six circular dual drain tank, three module reuse system installed in place of two future rearing ponds. The systems were sized for rearing 810,000 fish using 1,710 gpm of makeup water and a total recirculation flow rate of 5,700 gpm. The estimated cost of this system was eight million dollars.

At the SFWW facility where the new Walla Walla Hatchery is proposed there were a different set of limitations. During master planning this hatchery was proposed to rear 500,000 spring chinook. Due to growing concerns about water supply availability at the Umatilla Hatchery the project required

analysis for rearing all 1.35 million spring chinook at the SFWW facility. Site limitations and water requirements make the increased production possible only by utilizing recirculation aquaculture systems. Brian Vinci, Darrel Nice, Joe Miller, Don Beard, and others on the Tetra Tech team evaluated the biological program, civil and mechanical infrastructure, water supply requirements, effluent waste treatment requirements and options for implementing recirculating aquaculture. Site investigations were conducted and a detailed study of existing infrastructure was performed by both document review and onsite inspection. Operating personnel were interviewed to verify actual functionality and performance of equipment.

Once the program goals and site specific limitations were established, schematic designs of multiple recirculation aquaculture options were prepared. In order to accurately prepare cost estimates the designs were carried out to a high level of detail. The basic elements included dual drain circular rearing tanks, reuse treatment, recirculating pumping equipment, and effluent treatment with radial flow settling units. These systems were configured in multiple tank arrangements and multiple modules. Up to nine three tank modules were looked at as an option.

In addition to recirculating aquaculture the facility required review of the existing pumping and piping facilities. An existing hydraulic profile was established and the modified hydraulic system was integrated. The existing pumping systems include a river pump station, fire pumping system, and utility water booster system. Due to a differing total dynamic pumping head from the original design the main river water pumps do not fit the proposed design conditions. The pumps will be reviewed for compatibility with the system hydraulic curve using modified impellers and replacement of the motor. If necessary new pumps will be specified.

Analyzing Impacts/Environmental Review Documents

This project involves building a hatchery to produce fish needed to restore an extirpated Spring Chinook population in the Walla Walla subbasin. The project is part of the NPCC's Fish & Wildlife program, and is a component of the Fish Accord between BPA and the Confederated Tribes of the Umatilla Indian Reservation (CTUIR).

Tetra Tech is providing technical input to BPA staff as they prepare a Biological Assessment and a NEPA EIS.

Kootenai Twin Rivers Sturgeon and Burbot Hatchery, Bonners Ferry, ID

Similarities to Sleepy Hollow Project

- Two River Intakes
- Settle Basin and Drum Filtering
- Restoration of Depressed Stocks
- Preservation of Existing Hatchery
- Underground Piping and Site Work and Utilities
- Structural Concrete

Client
Kootenai Tribe of Idaho
Susan Ireland (208) 267-3620

Duration or Date Completed
Planning/Design Phase:
2006 – 5/2013
Construction Phase
6/2013 – 9/2014

Construction Value
$14,681,000 (Partial)

Team Member Roles on Project

- Darrel Nice, Design and Construction Oversight
- John McGlenn, Project Manager/Principal
- Richard Hensel, Electrical Engineer
- Steve Kraushaar, Civil Engineer

Description of Services Performed

Libby Dam has disrupted natural reproduction of sturgeon and burbot in Northern Idaho. The goals of this hatchery, at the confluence of the Moyie and Kootenai Rivers, are to incubate and rear locally collected progeny of both species for release in the Kootenai River system in order to establish a naturally reproducing population of sturgeon and burbot.

History & Data Compilation:

As the lead engineering consultant on the project, Tetra Tech worked with the Owner and a team of fisheries biologists creating a hatchery plan that included genetics, broodstock collection plans, incubation and rearing procedure, release strategies regarding locations, timing and target fish sizes. The facility is set up for maximum flexibility in water supplies and rearing strategies because sturgeon rearing for conservation is still in its early development, and burbot rearing has only been accomplished at a University research scale.

Collecting and Analyzing Survey Data:

Site topographic survey was performed by an outside survey firm. Tetra Tech compared the survey data to record drawings and created a base map for the project that included best information available on locations of existing utilities. Bathymetric survey was performed by Tetra Tech staff and added to the base map drawings.

Civil Engineering and Design/Cost Estimating:

Tetra Tech performed fisheries, civil, structural, architectural, landscape, mechanical, electrical and instrumentation design services from conceptual master planning through preliminary and final design. Goodfellow Bros. construction was asked to join the team to manage the complex in-river and site work based on their past performances on the Kootenai River Restoration projects. Bonners Ferry Builders, as a local building contractor, was retained to construct the hatchery building. To ensure the project could be accomplished within budget, both contractors, Tetra Tech and the Owner meeting in 3 internal VE sessions shaved $5 million from the earlier estimate so that the Kootenai Tribe of Idaho could proceed with firm fixed price construction contracts.

Tetra Tech is the construction management consultant including commissioning, start-up, and testing of the systems. The team's work includes

preparation of operation and maintenance manuals.

Aquaculture and Mechanical Engineering Design

The project includes river intakes, a groundwater well field, influent and effluent settling basins, a new 36,000-square-foot hatchery building, renovating the existing sturgeon hatchery, two residences, a 6,400 square foot vehicle storage and maintenance building. The mechanical systems inside the hatchery will allow for heated or chilled water to be distributed throughout the facility as needs define. Sturgeon and burbot will be incubated and reared in round tanks located inside the hatchery building.

The Kootenai River intake will be the primary hatchery water supply.

Work included site evaluation, river surveys, hydraulic modelling, development of conceptual designs, and preliminary cost estimates for the new intake structures, intake screens, intake pipe, and pump clear well at the Kootenai River and Moyie River intake sites. Intake screens proposed for the site had to meet all state and federal juvenile fish screen criteria, had to minimize maintenance requirements for the screen, and needed to operate at anticipated low flow water surface elevations.

Screens selected for the project needed to deal with a wide range of river elevations and bed load conditions. An ideal screen for this application is the self-cleaning cone screen utilizing wedge wire screen material with 1.75mm opening and a hydraulically driven brush system. Hydraulic brushes utilize a hydraulic pump, hoses, and simple direction sensor. The pump and control panel can be located almost any distance from the screen. At the Kootenai intake the there are two cone screens located in a deep pool with trash rack protection.

After the cone screen the water flows by gravity to the pump wet well where submersible pumps are installed and utilize guide rails for mounting and maintenance removal. Water is pumped from the wet well to a concrete settling basin where fine sediment settles out before water passes through a drum filter system and is then pumped into the hatchery for further treatment by UV disinfection, gas stabilization and cooling/heating.

The Moyie River intake will be utilized during runoff periods when there is a higher loading of fine sediment in the Kootenai River or when Kootenai Rivers are not at an ideal temperature. Much of the year Moyie River water is cooler than Kootenai.

The Moyie intake uses similar components to the Kootenai, but the arrangement is different. At the Moyie intake the cone screen is located downstream from the intake pool. A pipe connects the intake structure to the screen vault. Fish passage is provided for within the screen structure allowing leave through a bypass pipe. The screen vault is located adjacent to the pump station.

Chief Joseph Hatchery and Okanagan River Acclimation Ponds
Columbia River near Bridgeport, WA

Similarities to Sleepy Hollow Project

- River Intakes
- Restoration of Depressed Stocks
- USACE, NMFS consultation and permits
- NEPA EIS
- Water Reuse
- Site Work and Utilities
- Structural Concrete

Client

Confederated Tribes of Colville Reservation,
Patrick Phillips, Hatchery Manager
(509) 631-1870,
Patrick.Phillips@colvilletribes.com

Durations

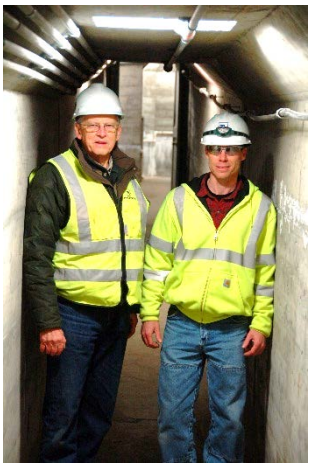
Planning /NPCC Review Phase: 2004–2009
Construction Phase: 6/2010 – 6/ 2013

Construction Value

$50.8 million

Team Member Roles on Project

- John McGlenn, Project Director,
- Darrel Nice, Design and Construction Engineer
- Don Beard, Water Supply and Quality
- Richard Hensel, Electrical and Controls
- Steve Kraushaar, Intakes and Pump Stations



John McGlenn and Darrel Nice on the job at CJH.

Description of Services Performed

History & Data Compilation:

In 2008 federal agencies and the Columbia basin tribes reached a historic agreement on a plan for fish culture and habitat restoration to compensate for the federal dams that blocked fish passage up the Columbia River to native spawning grounds. Tetra Tech's involvement in the project began in 2004 supporting development of a Master Plan and three year approval process. While this was an entirely new facility, preparation of the Master Plan required extensive literature review to confirm the biocriteria and consistency with regional salmonid recovery plans. The project included repurposing an irrigation port in the face

of the USACE's Chief Joseph Dam to provide one water supply. This necessitated research into archival drawings, thorough inspection and assessment of the innards of the dam structure and underwater inspections.

Collecting and Analyzing Survey Data:

The Tetra Tech team gathered data compiled by the USACE on bathymetry and river currents in order to locate and design the Ice Harbor style fish ladder. Additionally a 60 cfs river intake was required on the face of Chief Joseph Dam. The basis of the intake design was established on USACE as-built drawings for the dam and underwater conditions as confirmed by the contractor's diving and underwater construction team.

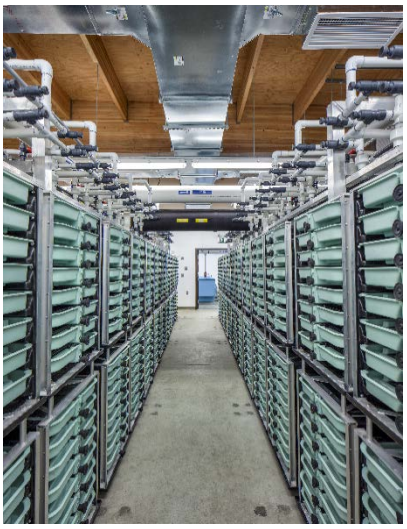
Civil Engineering and Design/Cost Estimating:

The project included the main hatchery complex with fish production, laboratory, facility maintenance, a visitor center and residential areas for hatchery managers. An important aspect of the project is to restore runs of naturally spawning Chinook to the Okanogan River. This involves transferring some fry from the hatchery to sites along the river. Tetra Tech designed two new acclimation ponds and improvements at three existing pond sites.

The Tetra Tech team reviewed each acclimation site and studied the site's biological, river hydraulics, design and permitting issues. Work at the two new sites included design of new intakes on the Okanogan River and involved development of conceptual designs, hydraulic modeling, and project designs for the proposed intake structure, intake screens, and intake pipes for the Omak and Riverside sites. The intake cone screens meet state and federal juvenile fish screen criteria and provide design flows at anticipated river discharges that range from annual low flows during periods of ice cover to high spring rain on snow events. The water is diverted from river section that is typically less than 2 feet deep and is subject to heavy debris and ice conditions.

The screens allow the intake to draw water from depths between 1 and 12 feet deep. A well water sprinkler system is used in conjunction with the effective brush cleaning system to prevent the intake from icing conditions should they occur. The critical intake operates year round in all river conditions.

Aquaculture and Mechanical Engineering Design



The hatchery is programmed to produce 2.0 million summer/fall Chinook and 0.9 million spring Chinook. The design includes forty 10' x 100' raceways, three rearing ponds each having up to 50,000 cubic feet volume, spawning facilities, a degassing headbox for up to 60 cubic feet per second of flow, drum screen filtration and UV disinfection of the reservoir water supply, process water distribution to incubation and rearing facilities, cleaning waste treatment facility, low head oxygen supplementation, adult return fish ladder and broodstock holding and spawning facility.

Twenty raceways and the three ponds can be **operated by reusing water leaving the first 20**

raceways. This serial reuse system implements low head oxygenation devices and a central oxygen generation system to supplement DO to an acceptable level.

Startup and Training. Tetra Tech acted as the Owner's Representative during the commissioning, start-up and training on the hatchery systems. The three water systems, along with the systems at the hatchery site are all monitored and controlled by a central computer. Tetra Tech worked closely with the Contractors for equipment ordering, pre-installation testing, testing at installation and overall system testing. Tetra Tech also coordinated the training of the operators by the equipment vendors and installing contractors; prepared an Operations and Maintenance manual and provided support to the operators during the initial "shake out" period and assisted in identifying and tracking warranty issues.

Analyzing Impacts/Environmental Review Documents

Tetra Tech supported the BPA's preparation of a NEPA EIS by providing all the technical documents.

Cedar River Sockeye Hatchery, Landsburg, King County, WA

Similarities to Sleepy Hollow Project

- Bio-programming
- Master Planning
- 34 Million Fry
- State Environmental Policy Act EIS

Client

Seattle Public Utilities, Ms. Pat Lee, Senior Civil Engineer (206) 615-1315
Paul Faulds, Fish Program Manager, (206) 423-2280

Durations

Planning/Design Phase: 2001-2008
Construction Phase 8/2009 – 8/2011

Construction Value

$7.3 million

Team Member Roles on Project

John McGlenn, Project Manager
Don Beard, Design Engineer Water Quality/Rearing Facilities
Steve Kraushaar, Civil Engineer

Description of Services Performed

One of the first major sockeye hatcheries in Washington State, the Tetra Tech-designed

facility can produce up to 34 million fry annually, but it is also a laboratory for fish scientists to adaptively manage the culture of hatchery fish in a way that does not harm the co-existence of wild salmonid stocks in the Cedar River drainage area. The bio-program was developed based upon the principle that the fish produced in the hatchery are not to be detrimental to existing populations of fish, including the existing sockeye that have evolved from the Baker River stock that was introduced 80 years ago.

Collecting and Analyzing Survey Data:

A variety of data was utilized for preliminary studies including department of transportation aerial photos, Army Corps as built plans, and previous bathymetric surveys. Tetra Tech staff worked with a survey firm and used a project filing system to track surveys as they were performed and amended.

Civil Engineering and Design/Cost Estimating:

The project includes a 15,000-square-foot hatchery building with offices and laboratory as well as two separate residences and supporting infrastructure, a spring water system for the fish processes and a well for domestic use, pollution abatement ponds, a septic system, a vehicle storage canopy and a storage building for fish trap accessories. The hatchery was designed to use existing water rights to spring water from the left bank at Landsburg Dam. A site several miles downstream of the hatchery was selected to build an access road and a system of floating weirs and traps to collect adult sockeye. The system has proved effective for its sockeye collection success while allowing Chinook to be passed upriver with no impacts on the fish. Additionally the new floating system is much more resistant to damage from high river flows and can be removed from the river channel relatively quickly when required.

Aquaculture and Mechanical Engineering Design

The design a number of techniques to minimize the risk of hematopoietic necrosis (IHN), a viral disease and malnutrition after release which could devastate populations of fry. Water from an existing spring system on the south side of the Cedar River is collected and pumped by two small pump stations to the hatchery on the north side of the river. Water is supplied from a head box via numerous discrete supply lines so that each small group of eggs makes contact only with its own supply of water. Using this manner of isolation prevents spreading disease should one incubator become contaminated.

Reducing malnutrition and predation in Lake Washington requires that the hatchery fry enter the lake at the proper time, coincident with the plankton blooms that support wild and hatchery fry. Preventing premature

development of fry at the hatchery is accomplished by tempering the spring water with the cooler river water via a heat exchanger. This saved energy over mechanical cooling.

Otolith marking is used to determine which practices in the hatchery result in the most successful survival to spawning. The hatchery facility is designed to allow for fry outmigration and release at the site or to a truck loading area from which fry can be transported to different release sites downstream in the Cedar River. As return data is analyzed, more successful release sites can be utilized more intensively and less successful release sites can de-emphasized.

Analyzing Impacts/Environmental Review Documents

Tetra Tech's team provided technical support for the preparation of the State Environmental Policy Act EIS. This process was rigorous due to several years of lawsuits and appeals by a few fish hatchery opponents. Although the opposition added time and effort to completing the project, the final decision was that the Cedar River hatchery is located in the right place and is programmed in the proper way to be an asset without causing significant risk to the environment, including populations of listed steelhead and Chinook.

The adaptive management goals were refined by a scientific group on the Tetra Tech team. SPU staff and the Tetra Tech team worked with this group to define a structure for the AMP and set the overall policies that were then adopted by a small management group who meet regularly to continue the process of implementation and refinement of the AMP.

Sandy Hatchery and Intake, Sandy, OR

Similarities to Sleepy Hollow Project

- Intake and Screening Upgrades
- Adult Holding Improvements
- Design to NOAA criteria

Client

Oregon Department of Fish and Wildlife
Ray Hartlerode, Chief Engineer
(503) 947-6215

Durations

Planning Phase: 2/1997 – 6/2011
Planning took several years due to changes in project goals by the Owner.

Construction Phase: 6/2011–10/2011

Construction Value

$3.2 million

Team Member Roles on Project

- Steve Kraushaar, Project Manager
- Eric Nordholm, Design Engineer

Description of Services Performed

The Oregon Department of Fish and Wildlife (ODFW), in collaboration with regulatory agencies and other interested entities, has developed objectives and a scope of work for the Cedar Creek intake and fish passage improvements. The design objectives and goals are to make improvements to enhance the viability of fish species in Cedar Creek, in conformance with management objectives, including upgrade intake screens and related features to conform to current NOAA and ODFW criteria; provide for trapping, sorting, hauling, and delivery back to Cedar Creek of wild fish to access 12 miles of habitat upstream from the intake on Cedar Creek; provide for fish passage for all life stages and species present in conformance with ODFW's approved management plan; and provide improvements for performance and maintenance of existing facilities.

History & Data Compilation:

Tetra Tech performed programming and evaluation of fish passage, trapping, and intake improvements. This involved data collection, studies and development of recommendations for screening, maintenance, and fish passage improvements at the intake and trapping facilities, filtration and disinfection of hatchery water supply, and new acclimation pond facilities.

Civil Engineering and Design/Cost Estimating:

Tetra Tech designed the following improvements:

Intake and Screening. The intake was rebuilt with a lower head water pool, replacing an impassable dam with passage weirs and NOAA compliant screening to allow the use of gravity flow all year and replacing an impassable picket weir with an adjustable inflatable weir. These improvements provide ODFW with maximum operational flexibility at a lower cost than the other alternatives.

Trap and Sort. The holding area in the same location is now 2 feet deeper, with wider raceways and all new structural concrete, increased holding volume. It now includes a false weir for in-water upstream passage and mechanical crowding and lifting to the sorting area. The increased holding capacity is a critical factor in meeting the intent of NOAA Fisheries' fish holding and handling criteria. There was also concern that the existing concrete structures, in particular the 5-inch floor slab, would not have enough strength or integrity to support the proposed new walls and related structural loads from the crowder and fish lock. The design replaced the existing structure will new concrete as the cost-effective solution.

Nome Central Incubation and Rearing Facility, Nome, AK

Similarities to Sleepy Hollow Project

- Increase salmon reestablishment efforts in local streams

- Water intake
- Water quality for incubation

Client

Norton Sound Economic Development Council
Charlie Lean, (907) 443-2477

Durations

2013-Current

Construction Value

To be determined

Team Member Roles on Project

- Don Beard, Project Manager
- Bridget LaPenter, Conceptual Planning

Description of Services Provided

Salmon populations have been declining in the drainages around Norton Sound, Alaska since the early 1990s. In an effort to address this issue, NSEDC has contributed to a variety of fisheries projects in the region. Many of these projects have focused on the re-establishment and restoration of salmon runs. Thus far, NSEDC's re-establishment projects have been modest, involving remote egg takes from streams with declining returns, moist air incubation of the eggs in Nome, and re-planting of eyed eggs into their respective streams of origin. Through the design and construction of a central incubation facility, NSEDC aims to increase their re-establishment projects and, in addition, supplement the cost of these projects with commercial fisheries enhancement programs.

Tetra Tech has been contracted to assist the NSEDC with preliminary planning and development of designs for a central incubation and rearing facility near Nome. Preliminary plans call for several re-establishment programs of chum, chinook, and coho stocks, each in the range of 100,000 to 300,000 eggs. These would be complemented by a chum enhancement program of approximately 55 million eggs.

Our present level of involvement includes:

- Development of fish cultural objectives and design criteria for both re-establishment and enhancement projects, including an annual operating schedule.
- Development of a conceptual model of process and program space requirements.
- Site selection and feasibility study including water quality and quantity.
- Development of conceptual design including: floor plans, water supply, drainage systems, and infrastructure designs including hydropower.

Water Conservation and Recirculation Systems

Chiwawa Acclimation Site Partial Water Reuse System, Leavenworth, WA

Similarities to Sleepy Hollow Project

- Steelhead Conservation Recirculation/Reuse Water System
- ESA compliance
- Permit Negotiations

Client

Chelan Public Utility District
Samuel Dilly, PUD Engineer, 509-661-4566
Sam.dilly@chelanpud.org

Team Member Roles on Project

Brian Vinci, Process Design
Joe Miller, Client Project Manager

Duration

2009-2013

Construction Value

$500,000

Description of Services Provided

Staff from the Freshwater Institute (**Brian Vinci**) and Anchor (**Joe Miller**) worked together on this project that involved process engineering design, commissioning and operational support for a partial water reuse system for 25,000 steelhead smolt. The steelhead partial water reuse system was designed to allow the Public Utility District to utilize their existing surface water intake – this avoided the delay associated with permitting and construction of a new intake for a large flow-through water requirement. The partial water reuse system was constructed and commissioned in 2009. First year results of fish health and performance indicate that the steelhead raised in this system outperformed their cohorts in flow-through raceways.

As the Client Project Manager, Mr. Miller worked closely with the engineering and fish health experts from the Freshwater Institute from conceptual design to finished construction.

Aquaculture and Mechanical Engineering Design

The water reuse system at the Chiwawa Fish Hatchery utilizes surface water from the Wenatchee River to supply 20% of the total water required to over-winter and acclimate ESA-listed Wenatchee River steelhead; the remaining 80% of water required is provided through the water reuse system. The water reuse system has two 20-ft diameter by 4-ft deep fish culture tanks for rearing 25,000 steelhead and associated equipment to filter solids, remove carbon dioxide, oxygenate and UV disinfect the fish culture water to maintain strict high water quality standards. Makeup supply water from the Wenatchee River (120 gpm) is combined with reuse water (400 gpm) from the fish tanks prior to the reuse equipment in order to allow for pre-treatment of the river water along with the reuse water, ensuring good biosecurity. Uneaten feed and fish feces are quickly flushed from the two self-cleaning, dual-drain, circular fish culture tanks and combined with solids removed by the microscreen filter for treatment in a 10-ft diameter radial flow settling unit. Solids are captured, thickened and stored in the radial flow settling unit for removal and beneficial reuse at the end of each rearing cycle.

The high quality design and fish health evaluations led by Dr. Vinci played a key role in securing approvals from state, federal and tribal managers for project implementation. The approval process was under heavy scrutiny because there were no other examples where Endangered Species Act listed steelhead had been reared in a water reuse system.

Monitoring and Evaluation (2009-2013): Following construction of the Chiwawa Acclimation facility, Mr. Miller managed within-hatchery and post-release steelhead performance evaluations. These included monitoring and analyzing survival, migration rate, residualism, and adult returns for fish reared using water re-use. Mr. Miller also managed the development and successful installation of a volitional release exit for fish reared in the reuse vessels. This was an important adaptation that allowed the facility to comply with Endangered Species Act requirements.

Regulatory: Mr. Miller was responsible for ensuring that the Chiwawa steelhead acclimation site complied with Endangered Species Act Section 7 and Section 10 requirements. The new acclimation site was developed without additional consultations because Mr. Miller successfully argued that the project was within the scope of existing permits and consultations.

Facility Planning and Water Reuse System Design, Aquatic Research Lab, Richland, WA

Client

Pacific Northwest National Laboratory
Greg Turpen, AIA
(509) 371-7947
greg.turpen@pnnl.gov

Duration

February 2011 – December 2012

Construction Value

$3 - $4 million

Team Member Roles on Project

- Brian Vinci, Process Design Lead

Description of Services Provided

The Pacific Northwest National Laboratory (PNNL) Aquatic Research Laboratory (ARL) facility provides fish culture resources for PNNL researchers. Prior to a 2011 design and renovation, fish culture resources were primarily outdoors and after renovation all facilities are housed in a new 5,500 ft2 facility designed for the purpose. Aquatic resources include fish culture space that can be tailored to the necessary environment for research purposes as well as for raising 40,000 to 50,000 juvenile Chinook salmon. Spring and summer Chinook salmon are produced to meet this year-round need by manipulating the source water temperature for rearing. Manipulation of the source water temperature had required significant heating and chilling energy in the past. This design and renovation focused on reducing the energy required for heating and chilling of water. The process design utilizes partial water reuse technologies to achieve a 75% reduction in water use and energy for heating and chilling. During operation only a small portion of makeup water is required from the Columbia River (20% of total flow required). This makeup flow is treated with

sand filters and UV disinfection to maintain excellent biosecurity.

Chelan Falls Rearing and Acclimation Facility Design, Chelan Falls, WA

Client

Chelan County PUD
Steve Weist, (509) 661-4268
Steve.Weist@chelanpud.org

Duration

2010-2011

Construction Value

$3.75 Million

Team Member Roles on Project

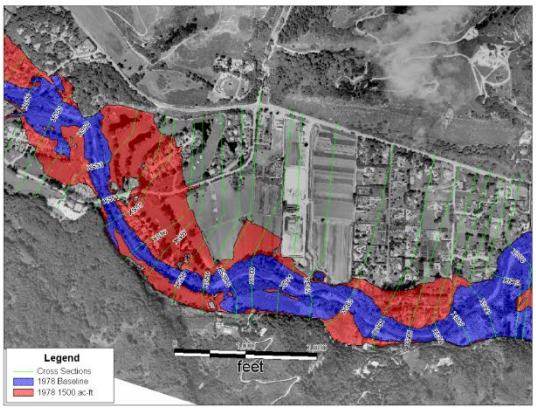
- Brian Vinci, Project Manager

Description of Services Provided

Freshwater Institute conducted an alternative analysis for using circular dual-drain tanks instead of raceways for the Chelan Tailrace Summer Chinook Acclimation Facility, then completed the conversion of this facility from raceways to circular tanks. The facility now rears and acclimates 800,000 summer Chinook salmon using dual-drain circular tank technology. Brian Vinci completed the alternative analysis and the process design which included radial flow settling units for waste capture and volitional and forced release design features. Brian Vinci was involved in commissioning the facility in 2011 and provided operational support during the first year of operation.

Geomorphology

San Clemente Dam Seismic Retrofit Study, River and Reservoir Modeling



Similarities to Sleepy Hollow

- Statistical Analysis of Gage Records
- Flood Impacts
- Sediment-Transport Modeling
- Hydraulic Modeling
- Fluvial Geomorphology
- Environmental Restoration
- Environmental Impacts
- Reservoir Routing
- GIS CADD
- Field Data Collection
- Design

Client:

California Dept. of Water Resources
Mr. Kevin Faukenberry (916) 653-5791

American Water Works Company
Mr. John Kilpatrick (856) 346-8200

Duration or Date Completed
2002 - 2015

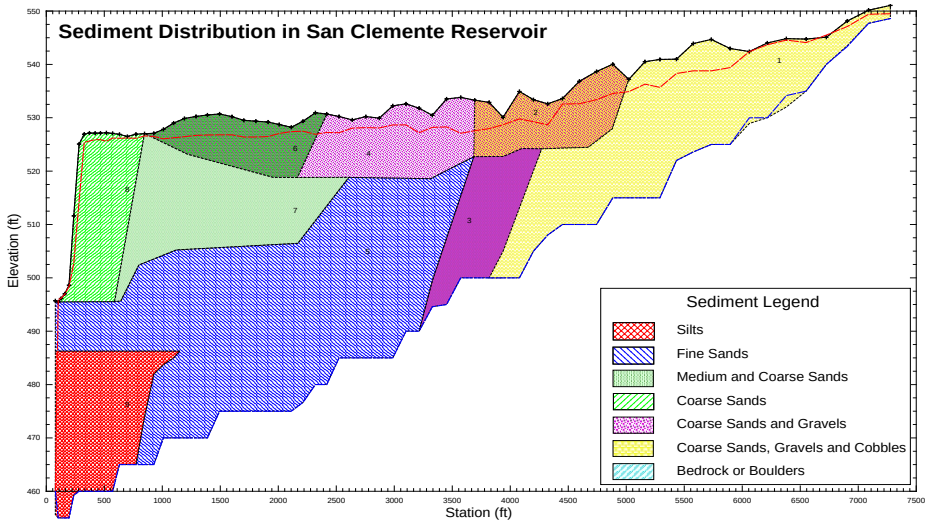
Project Value:
$896,000

Team Member Roles on Project

- Bob Mussetter, Project Manager and Principal Engineer
- Stu Trabant, Senior Engineer and Lead Sediment-transport Modeler

Description of Services Performed

Tetra Tech, Inc. (Tetra Tech) performed detailed modeling of potential dam removal/retrofit alternatives for San Clemente Dam, including flood hazard studies of the Carmel River in the approximately 18-mile reach between the dam and coast. The reservoir behind the dam is nearly filled with sediment, and release of this sediment may cause aggradation in the downstream valley, which in turn may increase the flooding potential. The purpose of the studies was to quantify the entrainment of sediment from the existing reservoir deposits under a variety of dam removal scenarios that ranged from buttressing the existing dam and providing a sluice gate to provide a suitable channel across the reservoir deposits for fish passage to complete removal of the dam. The complete dam removal scenarios included phased notching of the dam to control downstream sediment releases, excavation and removal of the deposits to the approximate pre-dam topography, and the alternative that is currently being implemented that involves isolating the bulk of the reservoir deposits in Carmel River arm of the reservoir, removing the deposits in the San Clement Creek arm and then rerouting the river into San Clemente Creek, significantly limiting the amount of sediment that could potentially be moved into the downstream river. HEC-6T modeling was performed to quantify sediment movement from the reservoir and through the downstream river, and the results were then used to assess potential geomorphic and flood capacity impact of the altered sediment load.



History and Data Collection

The results of the studies were used to assist the stakeholders and regulatory agencies in selecting a preferred alternative for retrofitting the dam to meet safety standards. Tetra Tech was responsible for all aspects of the analysis,

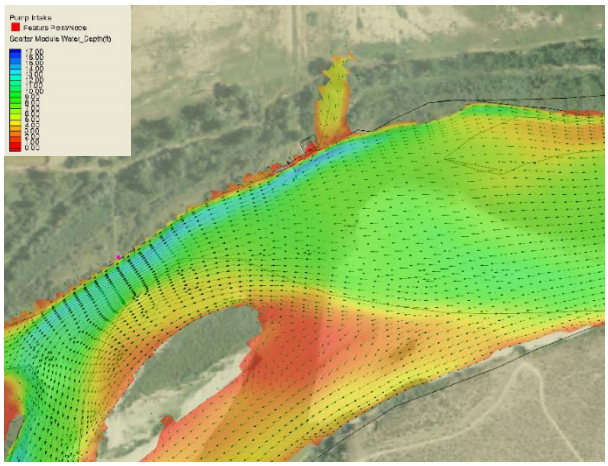
including coordination of topographic mapping of the approximately 18-mile study reach, field data collection of sediment samples in both the river and reservoir, hydrologic analysis of gage records, development of hydraulic and sediment-transport models of the reservoir and river, and evaluation of the hydraulic and geomorphic implications of the model results. As part of this work, Tetra Tech worked with Kleinfelder to perform a subsurface investigation to characterize the existing sediment deposits.

In developing the HEC-6T model for the project, Tetra Tech worked closely with the original author of HEC-6 and HEC-6T to modify the computer code to more realistically simulate erosion of the delta and the river's response to high sediment loads. Tetra Tech also developed algorithms for extracting important information from the model in an efficient manner to facilitate evaluation of the results. These modifications were successfully implemented and significantly improve the utility of the model for evaluating dam removal impacts.

Coordination with Regulatory Agencies

Tetra Tech also coordinated closely with technical representatives from a variety of regulatory agencies and stakeholders, including the California Department of Water Resources, National Marine Fisheries Service, California Department of Fish and Game, U.S. Fish & Wildlife Service, Monterey Peninsula Water Management District, Monterey County Flood Control, and American Water Works Service Company. Flooding impacts associated with the project were critical to the investigation, as there are currently about 1,400 residential structures that could potentially be affected by increased water-surface elevations. Flood boundary and flood depth maps were prepared for each scenario to assist in evaluating these impacts. The study reach also contains important Steelhead and Red-legged Frog habitat, and the model results were used to evaluate potential impacts to this habitat. Tetra Tech is currently assisting Granite Construction in the design-build project.

Hydraulic and Sediment-transport Evaluation, Uintah Water Conservancy Pumping Plant, Utah



Similarities to Sleepy Hollow Project

- Bathymetric and topographic surveying
- Two-dimensional Hydraulic (SRH-2D) Modeling
- Sediment-transport Analysis
- Hydraulic Analysis
- Channel Stability Evaluation
- Water Intake Design and Sediment Management Plan

Client:
Bowen Collins & Associates, Inc.
Bob Mayers (801) 495-2224)

Duration or Date Completed
2008 – 2010

Project Value:
$77,471

Team Member Roles on Project

- Bob Mussetter, Project Manager and Principal Engineer
- Mike Harvey, Principal Geomorphologist
- Chad Morris, Senior Engineer and Lead Hydraulic Modeler
- Dai Thomas, Senior Engineer and Lead 2-D Hydraulic and Sediment-transport Modeler

Description of Services Performed

Tetra Tech, as a subcontractor to Bowen, Collins and Associates, Inc., performed a study for a new proposed Pumping Station on the Green River just upstream from the Ouray National Wildlife Refuge (ONWR) near Vernal, Utah that is being designed for the Uintah Water Conservancy District. The study included an evaluation of channel stability, sediment transport and local scour conditions in the vicinity of the proposed pumping station, and provides recommendations regarding the location of the pumping station, and bank protection and other measures to limit the potential for sedimentation problems at the intake. The study also provided river hydraulic data to design the pump intake.

A field reconnaissance was conducted by Tetra Tech in August 2009 to collect samples to characterize the existing bed material in the study reach, and to conduct a bathymetric and topographic survey of the project reach using a survey-grade Global Positioning System (GPS). The survey data, together with historical mapping and aerial photography, were used to evaluate historical river planform changes in the study reach between 1953 and 2009 and to identify the most likely future conditions at the pumping station.

A relatively high-resolution 2-D hydraulic model was developed for the 4-mile long project reach using the surveyed bathymetry and the SRH-2D computer program. The model, which contained approximately 40,000 elements, was calibrated to measured water-surface elevations and high-water marks, and applied for a range of flows up to the bankfull flow (24,000 cfs). Hydraulic output from the 2-D model were used to develop stage-discharge curves at the pump to facilitate design of the pump intake, evaluate the flow

patterns and the sediment transport characteristics of the reach, and in particular, at the pump intake, and perform a scour analysis for the proposed sheet pile bank stabilization.

Results from the analysis indicate that sedimentation problems could occur at the currently proposed location in the near future due to continued high-flow deposition and subsequent re-incision into the deposits at low to intermediate flows that could cause the existing bank-attached sandbars to migrate farther downstream across the intake or cause avulsion of the primary flow path away from the intake. Results from the analysis strongly suggest that an alternative location 600 feet to 800 feet downstream from the initially proposed location would be preferable from a sedimentation perspective.

Sediment-transport Analysis of the Gila River at the Proposed AWSA Diversion Site

Similarities to Sleepy Hollow Project

- Geomorphic and Geologic Analysis
- Topographic Surveys, Field Data Collection
- Flood Frequency and Flow-duration Analysis (HEC-FFA)
- One-dimensional (HEC-RAS) Computer Modeling
- Sediment-transport (HEC-6T) Modeling
- Design of Water Intake with Sediment-reduction Elements

Client:

New Mexico Interstate Stream Commission
Craig Roepke (505) 827-6117

Duration or Date Completed

05/2014 – 12/2014

Project Value:

$92,000

Team Member Roles on Project

- Stu Trabant, Project Manager, Lead Engineer
- Bob Mussetter, Technical Oversight, QA/QC
- Mike Harvey, Principal Geomorphologist
- Tom Smrdel, Scientist, Modeler

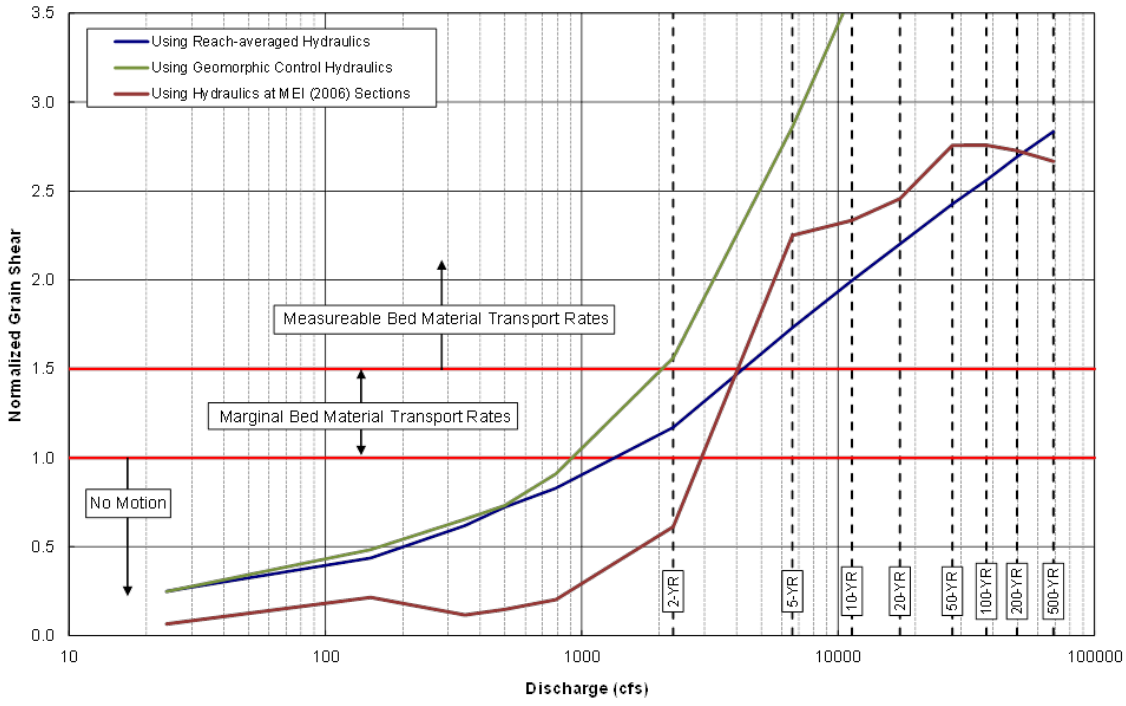
Description of Services Performed

As part of the Arizona Water Settlements Act (AWSA) process, stakeholders in Southwest New Mexico have proposed to construct a diversion structure on the Gila River northeast of Cliff, NM that would deliver diverted flows to a tunnel for purposes of conveyance to downstream storage facilities. Bohannan Huston, Inc. (BHI) prepared the preliminary engineering report for the project which included conceptual designs of the diversion structure and tunnel. In general, the current proposed design includes an inline partial weir and bypass channel for conveying the bypass flows. The weir is to be outfitted with a wire mesh screen, sometimes referred to as a Coanda-effect Screen to limit the amount of sediment delivered to the tunnel.

As part of BHI's continued evaluation of the project, Tetra Tech was retained to assist BHI

and NMISC in evaluating the hydraulic, geomorphic and sediment-transport conditions of the Turkey Creek project reach. The evaluation included updates to the hydrologic analysis that was conducted for previous studies and a site reconnaissance of the project reach to identify the most suitable location for the diversion structure and to conduct sediment sampling. The evaluation also included topographic and bathymetric surveys, development of hydraulic and sediment-transport models, and an assessment of suspended-sediment loads and incipient motion conditions. The hydraulic modeling was performed using HEC-RAS and the sediment-transport modeling was conducted using HEC-6T and included a 50-year simulation of existing (baseline) and with-project conditions. These analyses were then used to estimate the volume of sediment that would be delivered to the tunnel and the potential for sediment deposition within the tunnel.

The bedrock outcrops along the valley bottom, and to a lesser extent remnant debris flow material delivered by the tributaries, provide the primary geomorphic and hydraulic controls along the project reach. In the alluvial areas, the primary determinant of the channel morphology is the occurrence of infrequent, large magnitude floods (≥15,000 cfs) of long duration that cause lateral erosion and widening of the channel. Between large floods, channel narrowing occurs. The sediment loads convey a very broad range of sediment sizes, ranging from silt and clay particles up to boulder-sized material. The 50-year sediment-transport model simulation under existing conditions indicates that the configuration of the valley bottom controls the response of the system to sediment loading, with aggradation occurring in areas where the valley bottom is wide and upstream from valley constrictions, and degradation in areas where the valley bottom is narrow. Changes in mean bed elevation at the end of the simulation are generally less than 2 feet along the majority of the reach. The 50-year

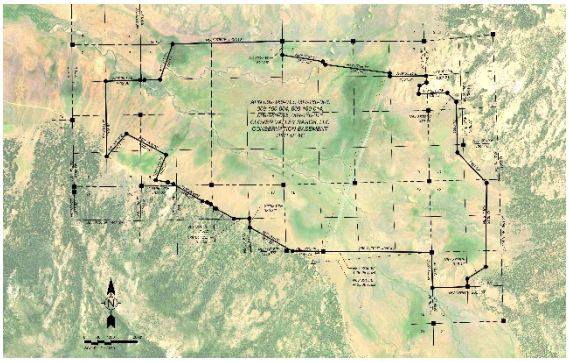


sediment-transport model simulation for project conditions includes the geometry of the diversion structure but does not account for flow diversions. This model indicates that the structure will have a relatively small effect on the overall sediment-transport characteristics of the project reach. It can be expected, however, that deposition will occur in the local backwater area upstream from the structure during higher flows.

Estimated sediment loading to the tunnel indicates that the volume of annual sediment delivery will depend on the hydrologic conditions in the watershed (i.e., the river discharge) and the diversion discharge schedule. Very little sediment would be delivered in a representative dry year and the volume of sediment delivery varies from about 18 ac-ft during average years to about 44 ac-ft during wet years. The potential for sediment deposition in the tunnel depends on the amount of sediment delivered to the tunnel, as well as headwater and tailwater conditions.

Surveying /Civil Design

FY12, FY13, and FY14 Boundary Surveys for NRCS Easements, Northern California



Similarities to Sleepy Hollow Project:

- Data collection of topographic survey
- Performed surveying tasks on sensitive habitat areas.
- Provided high accuracy data of existing features

Client:

United States Department of Agriculture
Natural Resources Conservation Services
430 G Street, Room 4164
Davis, CA 95616
Mr. Dean Kwasny, Easement Programs Specialist, (530) 792-5648

Duration or Date Completed

20012 – Ongoing

Project Value:

$3.2M

Team Member Roles on Project

- Mauricio Argente, R.L.A. Program Manager
- Dan Helt, P.E., P.L.S., Project Manager
- Jason Fussel, P.E., P.L.S, LEED AP, Project Engineer and Surveyor

Description of Services Performed

Tetra Tech was selected three years in a row by the Natural Resources Conservation Service (NRCS) to provide survey services in support of the Wetlands Reserve Program (WRP), a program that provides help to landowners for their wetland restoration efforts. Tetra Tech is providing boundary surveys, legal descriptions and exhibits, GIS data, boundary monumentation, easement signage, and for most sites topographic features, for over 50 sites in 22 Northern California counties. Project sites range in size from 11 to 2,871 acres and are mostly located in wetlands areas, riparian areas, agricultural crop or grazing land.

History & Data Compilation:

The project consists of two phases. The first phase involves preparing the documentation to create the easement. To do this, Tetra Tech and the NRCS met with each landowner to define the proposed boundary for the WRP easement. Where the boundary is coincident with the parent parcel boundary, a boundary survey was performed. Where not coincident, a topographic survey was performed to establish the location of the physical object that would define the WRP easement boundary. A plat map, and legal description and exhibit were prepared using the survey data. The NRCS will then pair the legal description and exhibit with their warranty deed for the landowner's signature, thereby creating the easement. This first phase of the project must be completed within 90-days of the initial site visit. Once the landowner has signed and recorded the warranty deed, the second phase of the project begins. This phase involves setting monuments at all WRP easement corners, placing signage at 500-foot intervals on the WRP boundary, and submitting records of survey to the county in which the WRP easement is located. The second phase must be completed 22 days after recordation of the warranty deed.

Collecting and Analyzing Survey Data:

In all cases, survey monumentation and the data gathering was acquired using Trimble R8 GNSS enable surveying set ups. Depending on the existing control, the surveys were either performed on constrained RTK networks, or post processed using OPUS for final adjustments.

Peck Park Canyon Stormwater Quality Enhancement Project, San Pedro, California

Client:

City of Los Angeles Bureau of Engineering
Department of Public Works Bureau of Engineering
1149 South Broadway, Suite 630
Los Angeles, CA 90015
Mr. John Saldin, Project Manager
Proposition O Implementation Program
213-485-1411

Duration or Date Completed

2008 – 2011

Construction Value:

$3.8M

Team Member Roles on Project

- Mauricio Argente, R.L.A. Project Manager
- Jason Fussel, P.E., P.L.S, LEED AP, Project Engineer

Description of Services Performed

The 31-acre Peck Park Canyon is located in an undeveloped segment of the greater 76-acre Peck Park, a Los Angeles city park. Surface water runoff from the Canyon flowed into the Los Angeles Harbor. The goal of the Peck Park Canyon Enhancement Project was to improve the quality of stormwater entering and leaving the Canyon. The project provided water

quality benefits by reducing the bacteria in the Canyon's stream and in the Los Angeles Harbor.

History & Data Compilation:

Tetra Tech performed a thorough site investigation, topographic, soils and geotechnical investigation, and infrastructure analysis. A hydrology model of the watershed was prepared. Best Management Practice selection was evaluated so that the selected BMPs could be optimized prior to implementation. Tetra Tech also performed an analysis of the information gathered with the development of aesthetic and circulation alternatives for the parking lot. Public outreach and permitting support, landscape architecture and interpretive design, cost analysis and value engineering were also provided.

Collecting and Analyzing Survey Data:

Given the large size of the project area, a combination of aerial photogrammetry and conventional surveying methods were utilized to create a digital terrain model (DTM). The topographic map that was created from the aerial photogrammetry was augmented with more detail surveying of specific project areas. Both, a total station and GPS units, were used in the detail topographic survey. The survey aimed to not only create a more accurate DTM, but also to capture the precise location of relevant surface features and other underground utilities that would affect the design.

Civil Engineering and Design/Cost Estimating:

The project incorporated the latest design strategies in water quality improvement, BMPs, Landscape Architecture, Low Impact Development (LID), Leadership in Energy and Environmental Design, engineering and public outreach. This was achieved through the implementation of bioswales and infiltration strips at the top of the Canyon, using stepped and armored channels, dissipaters and stilling basins to reduce runoff velocities and erosion throughout the remainder of the Park. Also included were reconstructed trails, passive recreational amenities and interpretive signs. Additional Low Impact Development techniques such as pervious pavement, connector pipe screens (CPS), and automatic retractable screens (ARS) were installed as BMP measures. LID involves the use of natural processes to minimize the amount of pollutants in the stormwater before it is discharged into the Los Angeles Harbor and San Pedro Bay. Previously, all stormwater flowed directly to two channels within Peck Park. These flows conveyed large amounts of trash, debris, pollutants and sediment directly to the channel. The LID/BMP measures greatly reduced the amount of foreign objects that were discharged to the harbor.

Tetra Tech also provided construction support services for the project, including assistance with all requests for information and change orders. Tetra Tech played a key role in reviewing all submittals, and worked closely with the Contractor on all rejected items in order to prevent delays. Recommendations were provided for stormwater pollution prevention, and for construction deficiencies.

Tetra Tech performed structural observations of pedestrian abutments and bridges, including caisson reinforcement, abutment reinforcement and formwork, and observed the bridge placement. Tetra Tech also observed mock-ups of key features, and provided a landscape mock-up and irrigation spray check. Additionally, Tetra Tech combined as-built data onto AutoCAD files. The team attended construction meetings as needed and requested by the City, as well as performed site visits and inspections at key milestone points during construction and performed a final site walk along with preparing a punchlist.

Analyzing Impacts/Environmental Review Documents

Tetra Tech assisted the City in preparing the Mitigated Negative Declaration (MND) as required by CEQA. In addition, Tetra Tech prepared, submitted and obtained a 401 (RWQCB) and 404 (ACOE) permits as the improvements within the channel impacted Waters of the US. Tetra Tech was very effective in obtaining these permits ahead of schedule, insuring that no permitting delays would impact the construction schedule which was constrained by expiring grant funding.

CEQA/NEPA

Carmel River Lagoon Water Augmentation

Similarities to Sleepy Hollow Project:

- Monterey County experience
- Habitat assessment
- Impact avoidance and minimization

Client

Carmel Area Wastewater District

Duration

Summer 2011

Construction Value

NA

Team Member Roles on Project

- Julia King, Lead Biologist

Description of Services Provided

The Carmel River Lagoon Water Augmentation project involved investigations of lands adjacent to the Carmel River and lagoon to determine the potential locations for the placement of a proposed water percolation test pond for the Carmel Area Wastewater District (CAWD). The study area was evaluated with consideration of avoiding impacts to wetlands and special-status species, such as red-legged frog.

Anchor QEA's Julia King led habitat assessment and mapping exercises for the early planning phases, including site selection for water percolation test ponds. Ms. King also conducted field surveys and mapped the existing habitats located to the south of the CAWD facility, linking signatures on aerial photographs to vegetation types observed on the ground.

CalAmerican Coastal Waters Project Marina, California

Carmel River Lagoon and Wetlands Natural Reserve, Photo by Harvey Barrison

Similarities to Sleepy Hollow Project:

- Monterey County experience
- Habitat surveys and assessment
- Impact avoidance and minimization

Client

California American Water Company

Duration

Summer 2012

Construction Value: NA

Team Members Roles on Project

- Julia King, Lead Biologist

Description of Services Provided

The CalAmerican Coastal Waters Project consists of a proposed desalinization plant and the associated delivery infrastructure to be situated between Marina and Carmel, California. Due to the increased water flow requirements in the Carmel River to meet regulatory agency requirements, water draws from the river have been reduced. Alternate water sources are needed to meet domestic needs in the Carmel Valley, which the desalinization plant is intended to fulfill. The scope of work for the biological resources included surveys in the CEMEX dunes lands due to the known high likelihood of special-status plants and animals surveys.

Anchor QEA's Julia King led special-status plant surveys of more than 500 acres of coastal dune habitat associated with the CEMEX lands to the north of Marina State Beach using GPS to map state and federally listed species. Ms. King also coordinated the production of special-status species maps to be used in the planning process to assist in the placement of project infrastructure. Constraints were identified within the project area, and avoidance of special-status species was accomplished.

Maintenance Dredging and Mitigation Planning, Martinez, California

Similarities to Sleepy Hollow Project

- Regulatory permitting - federal and state
- ESA consultations
- Impact avoidance and minimization; mitigation planning
- Agency coordination

Client

City of Martinez, CA

Duration

2009-2013

Construction Value

$1.5 Million

Team Member Roles on Project

- Katie Chamberlin, Project Manager, Environmental Planner
- Nicholas Duffort, Project Planner

Description of Services Provided

In early 2012, Anchor QEA planners and engineers began assisting the City of Martinez with planning for maintenance dredging of the Martinez Marina. The upland dredged material placement ponds are adjacent to the marina and were historically used to stockpile hydraulically dredged material. Throughout the past use of the ponds for dredged material placement, portions of the pond system became vegetated by pickleweed (Salicornia virginica). Anchor QEA biologists completed surveys of the ponds to evaluate potential habitat for salt marsh harvest mouse (Reithrodontomys raviventris), a federally endangered and fully state-protected species that is closely associated with pickleweed and salt marsh habitat. Anchor QEA prepared all regulatory permit applications and coordinated with the Dredged Material Management Office.

While the dredged material placement ponds are relatively isolated from known salt marsh harvest mouse habitat, the U.S. Fish and Wildlife Service (USFWS) considered the area to be potential salt marsh harvest mouse habitat, and formal Endangered Species Act (ESA) consultation for potential impacts on the species was required. Because the maintenance dredging project would result in temporary inundation of the pond system, USFWS required that the City mitigate for the project's temporary impacts. Anchor QEA led all mitigation negotiations with USFWS and the U.S. Army Corps of Engineers (USACE), and developed a mitigation concept for the project, consisting of salt marsh habitat enhancement at the adjacent Martinez Regional Shoreline Park.

In addition to the formal ESA consultation for salt marsh harvest mouse, the project also required an informal consultation with the National Marine Fisheries Service for salmonids for work occurring outside of the programmatic dredging work window. The project also required a California Endangered Species Act (CESA) consultation with the California Department of Fish and Wildlife for potential impacts on longfin smelt (Spirinchus thaleichthys) and delta smelt (Hypomesus transpacificus) associated with hydraulic dredging in the Carquinez Strait.

Port of Stockton, Stockton, California

Similarities to Sleepy Hollow Project

- Regulatory permitting
- CEQA compliance
- Federal ESA consultations
- Impact avoidance and minimization; mitigation planning; agency coordination

Client

Port of Stockton, CA

Duration

2012-Present

Construction Value

$3 Million (several projects)

Team Member Roles on Project

- Katie Chamberlin, Project Manager, Environmental Planner
- Nicholas Duffort, Environmental Planner. Biologist
- Julia King, Biologist

Description of Services Provided

For the past several years, Anchor QEA has assisted the Port of Stockton with permitting, biological evaluation, and regulatory strategy needs for both routine maintenance as well as development projects. Key efforts are described below.

Anchor QEA represents the Port of Stockton in its role as non-federal sponsor and California Environmental Quality Act (CEQA) lead agency for this project. The program involves phased deepening of the John F. Baldwin and Stockton Deep Water Ship channels. Contra Costa County and the Western States Petroleum Association are close project partners to the Port of Stockton, with the U.S. Army Corps of Engineers (USACE) San Francisco District acting as the National Environmental Policy Act (NEPA) lead. Anchor QEA facilitates local sponsor meetings and serves as the Port of Stockton's primary point of contact for interactions with USACE. Anchor QEA has worked closely with the local sponsors and USACE to integrate multi-purpose planning involving navigation and ecosystem restoration (at Big Break, Little Franks Tract, and Franks Tract) into Phase II of the program, which will involve deepening of the Stockton Deep Water Ship Channel. We also work with the local sponsor team to manage resource-specific evaluations; negotiate mitigation needs in support of both phases of the project; ensure that the Environmental Impact Statement/Environmental Impact Report(EIS/EIR; led by USACE) is fully compliant with CEQA; and prepare and review sections of the EIS/EIR and Biological Assessment.

Anchor QEA routinely provides regulatory and biological support for projects located on the Port of Stockton's property. Specifically, Anchor QEA has:

- Completed all state and federal permitting documents as well as an EIR addendum for the Port of Stockton's West Complex rail line extension project; currently leading a consultation with USFWS for potential project impacts to the federal threatened giant garter snake (Thamnophis gigas)
- Prepared the 404(b)(1) Alternatives Analysis and addressed regulatory agency comments for the Docks 16-20 maintenance dredging project
- Conducted a biological evaluation of the Rough and Ready dredged material placement site and addressed regulatory agency comments regarding the Port of Stockton's proposed use of the site
- Conducted a delineation of waters of the United States and State of California on Rough and Ready Island and developed a Jurisdictional Delineation Report summarizing the findings
- Prepared NEPA compliance documents for the San Joaquin International Gateway Project.

Sacramento River Deep Water Ship Channel EIS/EIR

Similarities to Sleepy Hollow Project

- NEPA/CEQA compliance
- Federal and state ESA consultations
- Impact avoidance and minimization; mitigation planning; agency coordination

Client

U.S. Army Corps of Engineers San Francisco District, San Francisco, California

Duration

2009-2012

Construction Value

NA

Team Member Roles on Project

- Katie Chamberlin, Project Manager/Environmental Planner
- Pradeep Mugunthan, Hydrodynamic Modeler
- Nicolas Duffort, Environmental Planner/Biologist

Description of Services Provided

Anchor QEA staff managed the preparation of a Supplemental EIS (SEIS)/Subsequent EIR (SEIR) for the Sacramento River Deep Water Ship Channel (SRDWSC) maintenance dredging project. The SRDWSC is a cost-shared federal project between the USACE San Francisco District and the Port of West Sacramento. The project involved evaluation of dredging extensive portions of the Sacramento River to improve navigation and commerce at the Port of West Sacramento and in the region. Anchor QEA staff were responsible for preparation of the SEIS/SEIR on behalf of the USACE and the Port of West Sacramento, including management of the public process and development of all related technical issues.

As part of this effort, our team assisted USACE in its federal ESA consultations with the USFWS for delta smelt and NMFS for salmonids and green sturgeon. Anchor QEA biologists and planners met with the resource agencies and USACE staff biweekly throughout the project to ensure that information needs were met and that the impact analyses in the Biological Assessment and SEIS/SEIR were consistent with resource agency expectations.

San Francisco Bay LTMS Program Facilitation

Similarities to Sleepy Hollow Project

- Agency coordination
- Regulatory permitting
- Federal and state ESA consultations
- impact avoidance and minimization

Client

U.S. Army Corps of Engineers San Francisco District, San Francisco, California

Duration

2009-2014

Construction Value

NA

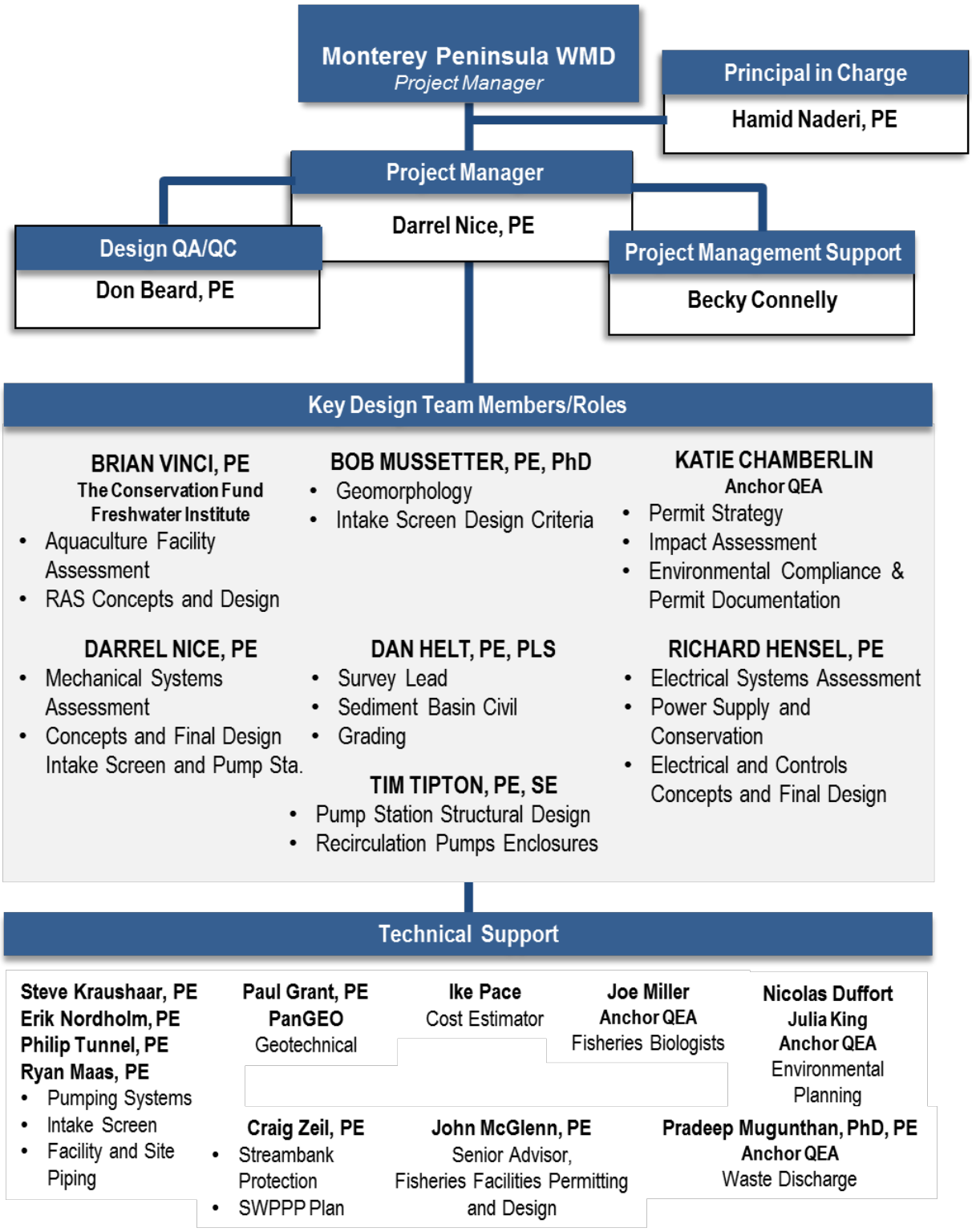
Team Member Roles on Project

- Katie Chamberlin, Project Manager/Environmental Planner
- Nicolas Duffort, Environmental Planner/Biologist

Description of Services Provided

Under contract to USACE, Anchor QEA facilitated the San Francisco Bay Long-term Management Strategy (LTMS) program for dredging and dredged material management in the region. As the conduit between the LTMS agencies and stakeholders, Anchor QEA led program manager and stakeholder-attended subcommittees meetings, maintains the LTMS website, prepares white papers, and organizes symposia on various technical issues relevant to the program. In 2010, Anchor QEA staff chaired the Dredging 201 workshop and LTMS Science Workshop. In 2012 and 2013, Anchor QEA managed the LTMS 12-year review process, which involved facilitating a series of five stakeholder meetings, preparing documentation for public review, and addressing stakeholder comments on 12-year review findings. Anchor QEA provided assistance to the LTMS agencies as they completed programmatic consultations for endangered species and essential fish habitat for maintenance dredging projects in the Bay Area.

Project Team Organization



Key Staff Qualifications

The team we are proposing has a track record of working together on similar fisheries projects to produce excellent results for our clients. The organization chart identifies the key personnel and the technical staff who will assist in developing design concepts and preparing final bid documents. This team draws on staff in Tetra Tech's offices in the NW and California to provide a broad range of experience and local knowledge of the Carmel River management issues relevant to the success of the Sleepy Hollow facility from permitting through facility startup and operations. Our team is also qualified in assisting with construction phase services and facility startup. Their qualifications are briefly described below and resumes for all staff involved are provided in the Appendix.

Darrel Nice, PE, Project Manager

Darrel has 21 years of experience in the planning, design and construction of a wide variety of fish culture and civil engineering projects including hatcheries, acclimation ponds, pump station and hydraulic structure design, wastewater treatment and collection systems. His recent experience includes:

•Managing the alternatives analysis and design of the expansion of the Walla Walla Hatchery near Milton-Freewater, OR for the Confederated Tribes of the Umatilla Indian Reservation. This project will provide incubation and rearing facilities for up to 500,000 spring chinook.

- Civil design and on site engineer for Chief Joseph Hatchery, Bridgeport, WA. This $80M chinook production facility and related acclimation ponds involved intake structures, bypass structures and fish culture facilities aimed in part at restoring fish runs on the Okanagan River.
- Construction administration on the new Penticton Hatchery for the Okanagan Nation Alliance, a project to support long-term reintroduction of sockeye into the upper Okanagan River system and Lake Skaha, British Columbia. The hatchery has sockeye production goals to provide an annual egg take of up to 8 million.
- Construction administration for the Twin Rivers Hatchery for the Kootenai Tribe of Idaho. This facility will culture white sturgeon and burbot to restore populations below Libby Dam. The new facilities include improved river intakes and filtration systems to address high turbidity in the Kootenai River.

Don Beard, PE, Senior Environmental Engineer, Quality Assurance

Don Beard has over 35 years of experience on major hatcheries throughout Southeast and South Central Alaska, in Washington and Oregon and internationally. Don's expertise includes site and biological production-related master planning, water supply and effluent treatment, facility hydraulics, design documents for buildings and facilities, construction oversight and startup. Don has been a key member of the design team for the Chief Joseph Hatchery, the Cedar River Sockeye Hatchery and numerous hatcheries for the State of Alaska and private and tribal enterprises, including several private non-profit corporations that are presently performing upgrades on aging state-owned facilities throughout Alaska.

John McGlenn, PE, Vice President, Senior Fisheries Advisor

John McGlenn is a registered civil and structural engineer with four decades of experience and a special interest in fish culture facilities design. He was principal-in-charge for planning, design and construction phases of the new Chief Joseph chinook hatchery on the Columbia River; Okanagan Sockeye Reintroduction Project; the Cassimer Bar steelhead hatchery expansion for the Colville Tribes and the Kootenai white sturgeon/burbot hatchery. John was also the project manager for the City of Seattle's Cedar River Hatchery and broodstock collection project oversaw design of the Oregon Hatchery Research Center near Alsea, OR. John served for 12 years on the Washington Fish and Wildlife Commission, four as Chairman. In this position, he was involved in adoption of the Wild Salmonid Policy for Washington State.

Bob Mussetter, PhD, PE, Geomorphology

Dr. Mussetter has over 30 years of experience in analysis and design for a broad range of water-resource and civil engineering projects. His primary area of expertise involves integration of hydrology, hydraulic engineering, and river mechanics with fluvial geomorphology to solve river stability, flooding, and environmental problems. He was the principal engineer and project manager for the San Clemente Dam Retrofit Study which detailed the potential impacts on flooding, river stability and instream habitat in an 18-mile reach of the Carmel River associated with various options for retrofitting San Clemente Dam to meet seismic safety standards. He is currently Engineer-of-Record for design of the reconstructed Carmel River channel through the former impoundment of San Clemente Dam, as part a design-build team.

Brian Vinci, PhD, PE, Senior Engineer, The Conservation Fund, Freshwater Institute

Brian Vinci has 21 years' experience in fisheries bioengineering including experience with Pacific Northwest hatchery facilities design and construction. He has in-depth knowledge of environmental regulations for fisheries facilities. Brian was involved in publications assessing the suitability of a partial water reuse system for rearing juvenile Chinook salmon for stocking in Washington in 2011; performance characterization of influent and effluent treatment systems for the Craig Brook Nation Fish Hatchery in 2008; design of partial water reuse systems at the White River National Fish Hatchery for production of Atlantic salmon smolt for restoration stocking in 2004; and oxygenation and carbon dioxide control in water use systems in 2000. Brian is currently working with Tetra Tech on the Walla Walla Hatchery project.

Kristi Chamberlain, Environmental Compliance

Ms. Chamberlin has 10 years of experience, specializing in federal, state, and local environmental permitting and regulation, as well as in preparation of state and federal environmental documentation related to waterfront development, sediment management, and transportation. She has managed complex Environmental Impact Statements (EISs) and Environmental Impact Reports (EIRs) for the National Park Service and the U.S. Army Corps of Engineers (USACE) in the San Francisco Bay Area and Sacramento Delta, respectively. She has significant experience in developing permitting strategies for projects located in the coastal zone, and routinely leads permitting efforts related to waterfront development and maintenance projects for numerous marinas, ports, and ferry operators throughout California.

Dan Helt, PE, PLS, Survey Lead

Dan Helt is experienced in both civil engineering and land surveying aspects of construction and land development projects. Mr. Helt has performed field boundary and topographic surveys, as well as construction staking, certification and monitoring, and ALTA/ACSM surveys. He has considerable experience researching boundary and chain of title information, and preparing legal descriptions.

Dan has extensive knowledge in the use of Autodesk's Civil 3D software for both conceptual and detailed design studies, as well as the production of construction plan sets. He also has significant experience using Hydraflow and Hydraflow Express for flow modeling and storm routing and HEC-RAS, USEPA SWMM and Storm and Sanitary Analysis for stormwater system design and modeling.

Richard Hensel, PE, Electrical and Controls Engineer

Richard Hensel is an electrical and controls systems engineer with 17 years of experience in energy management, municipal and industrial projects. Richard was the lead electrical/controls designer for the Kootenai Twin Rivers Hatchery. Richard also performed the power system design for the Chief Joseph Hatchery facility and water supply. Richard designed the power distribution and lighting systems for the hatchery building, visitor's center, fish ladder, relief tunnel pump station and equipment additions to the existing Chief Joseph dam spillway.

Tim Tipton, PE, SE, Lead Structural Engineer

Since joining Tetra Tech as a graduate engineer, Tim has become a member of the fisheries design group, supporting the design of Chief Joseph Hatchery, the Cedar River Hatchery, the Kootenai Twin Rivers Hatchery the Sandy Hatchery intake, and the expansion of the Macaulay Pillar Creek and Kitoi Bay hatcheries in Alaska. Structural design for these project included a variety of requirements for concrete, structural steel, wood frame and prefabricated metal buildings. Tim is skilled in the use RISA-3D and RISAFoot for structures and foundation engineering.

Technical Support Team

Steve Kraushaar, PE, Intake and Pump Station Detail Design

Steve Kraushaar has over 35 years' experience in the planning, design and construction of a wide variety of civil engineering projects. Steve has provided civil engineering design on numerous recent Tetra Tech fisheries projects, including the Kootenai (Twin Rivers and Moyie intakes), Chief Joseph (Omak and Riverside acclimation ponds), Cedar River, Sandy and Quinault hatcheries and wastewater treatment facilities for the hatchery at the Bonneville Dam. Steve was also the project manager for the Silverton Creek Water Intake. Steve's professional experience also includes projects related to stormwater planning and facilities design, pump station and hydraulic structure design, wastewater treatment and collection systems facility planning and design, water distribution systems, hydraulic and hydrologic modeling, floodplain studies, streets, park site design and residential and commercial land development.

Erik Nordholm, PE, Site/Civil Engineering

Erik has 16 years' experience in design, construction, and surveying on sewer, water,

and street projects. While with Tetra Tech, Erik has been involved with wastewater and water pipeline design, sewer and water system modeling, planning and design and street design projects. He has provided civil engineering design on numerous recent Tetra Tech fisheries projects, including the Cedar River, Chief Joseph, Kootenai and Penticton hatcheries. Erik has modeling experience using the Hydra Sewer Modeling Software, WaterCAD Water Distribution Modeling Software, and the EPA's EPANET2 Software. Prior to joining Tetra Tech, Erik assisted, as a Portland Bureau of Environmental Services staff member, in management of construction contracts totaling $45 million for the installation of 10,900 feet of 144 inch diameter jacked and open-cut pipeline and 7,200 feet of 72 inch diameter open cut pipeline.

Philip Tunnel, PE, Mechanical Engineer, Pump Station

Philip Tunnell, a registered mechanical engineer in California, has experience in many facets of water and wastewater engineering. His technical design experience includes preparing plans, specifications, and cost estimates for reservoirs, pump stations, wells, pipelines, and chlorination facilities, as well as performing analysis of existing systems including pump station operations, and feasibility studies for reservoir siting. He has experience in construction administration, including overseeing the construction of pipelines, reservoir rehabilitation, and pump station upgrades. He is currently the lead project engineer for the Water Reclamation Plant No. 10 Secondary Effluent Pump Station for the Coachella Valley Water District in Palm Desert, CA. The project involves design of a secondary effluent pump station, including approximately 8,800 linear feet of piping for the suction and discharge lines and all piping appurtenances. This 21 mgd capacity pump station pumps secondary effluent from the existing SE ponds on site, and discharges either to percolation ponds for settling/ground recharge, or back to the headworks and aeration basins to aid in operation during low incoming flow periods.

Pradeep Muguntan, PhD, PE, Effluent Treatment

Dr. Mugunthan has more than 12 years of experience in water quality evaluations. He has led or managed water quality studies to support evaluations of management alternatives, permitting, and environmental impact assessment. His water quality work focuses on the management of temperature and eutrophication in lakes and streams. He has led model development for various water quality and contaminated sediments remediation projects. He has led or leads the development and application of several surface water models to support various applications including water quality studies to determine impacts of salmonid rearing in hatcheries and acclimation facilities, support evaluations on biological habitat improvements, and evaluate water quality management alternatives for riverine and lacustrine systems. Dr. Mugunthan has also led the development of several groundwater models, specifically focusing on groundwater-surface water interactions. He has designed monitoring programs to support model development and has performed numerous

statistical evaluations of environmental data. He has presented his evaluations to various stakeholders and regulators, and has provided strategic technical support for his clients on water quality management and National Pollutant Discharge Elimination System (NPDES) permitting issues.

Joe Miller, Biologist

Joe Miller is a fisheries scientist with extensive experience interpreting fisheries resource issues within biological, regulatory, and hatchery compensation frameworks. He specializes in developing strategic approaches to achieve production goals and meet compliance trajectories for hatchery projects. He has played a key role in gaining support from regulators, tribes, and other stakeholders for the adoption of innovative hatchery technology including water-reuse and circular vessel technology. As a senior manager at the Washington Department of Fish and Wildlife (WDFW) and Chelan Public Utility District (PUD, he has been responsible for obtaining and maintaining Endangered Species Act (ESA) coverage for hatchery production while adapting to new science and regulations. Joe has also managed large-scale hatchery monitoring and evaluation programs that support both conservation and harvest objectives. Joe is working with Tetra Tech on the Walla Walla Hatchery.

Ryan Maas, PE, Structural Design

Ryan Maas is a structural with Tetra Tech. Ryan graduated with his master's degree in structural engineering in 2011. Ryan specializes in structural steel, concrete, timber; foundation design; structure failure investigations and bridge rating and field testing. Ryan has been providing structural engineering design on the Kootenai Sturgeon Burbot Hatchery in Bonners Ferry Idaho, the Kitoi Bay Hatchery in Alaska, and the Penticton Sockeye Hatchery in Canada.

Hamid Naderi, PE, Principal in Charge

Hamid Naderi's 33 years of experience includes management and technical leadership on a variety of high profile structural projects. As Tetra Tech's Director of Structural Engineering in the Northwest, he is responsible for managing workflow; technical oversight for standard details, specifications, analysis and design calculations of all structural engineering products; discipline training; and mentoring staff. As a designer, he has worked on industrial buildings, parking garages, chemical facilities, federal correctional facilities, bridges, and numerous elevated/surface water storage tanks. Hamid was the chief structural engineer on the Chief Joseph Dam Hatchery for the Colville Tribes and the Sturgeon/Burbot Hatchery for the Kootenai Tribe of Idaho.

Tetra Tech, Inc. is subject to certain claims and lawsuits typically filed against the engineering and consulting professions, primarily alleging professional errors or omissions. Tetra Tech carries professional liability insurance, subject to certain deductibles and policy limits against such claims. Tetra Tech believes that the resolution of these claims will not have a material effect on our financial position or results of operations.

Assurance of Meeting RFP Scope of Work

Our proposal is inclusive of all elements necessary to complete the described scope of work within 18 months of the executive of the Agreement.

Section 6 – Technical Aspects

Within the Request for Proposal (RFP), the Monterey Peninsula Water Management District (MPWMD) included a guide line scope of work and a number of technical discussions about the facility operations and concerns. In the following paragraphs, the activities to be completed for each task will be described to illustrate our technical approach to the project. Our approach will follow the outline provided in the RFP and supplement with descriptions of the proposed process to accomplish the Sleepy Hollow Rearing Facility (SHRF) objectives.

Task 1 – Assessment of the Operation and the Facility

We have already started this work during our review of the detailed information that MPWMD and others have prepared prior to issuing this RFP. This phase of the work will integrate with the separate specialty area design work such that the intake, pump station, and aquaculture design engineers will all take part in this assessment phase. Other technical disciplines will be engaged at the appropriate time including geotechnical, electrical, structural, water quality (both supply and discharge), and permitting.

Available documentation, will be gathered, distributed as appropriate, and reviewed prior to the technical team making the coordinated site visit. Even though, much of the needed information about the operation and the facility will be available prior to the visit we recommend adequate time is arranged to give the engineers with the facility managers and operators the opportunity to evaluate SHRF conditions, make initial findings, and identify needs.

During the site visit the engineers will review existing conditions, meet with the managers and operators, and tour and inspect SHRF. Facility information will be gathered, records reviewed, and it will be determined if there are any information gaps. SHRF biological programing, facility needs, and projected production requirements will be discussed with facility managers and operators.

Listed below are items that will be part of the assessment and will be described in a technical memorandum documenting the existing conditions. The technical memorandum will establish the Basis of Design for SHRF, and include proposed improvements to be reviewed further as part of preliminary design.

- Establish Biological Program and Operating Schedule (coordinated with Task 3)
- Assess Primary Mechanical Systems and the Backup Systems (coordinated with Task 2)
- Assess the Intake Screening and Sediment Control (coordinated with Task 2)
- Complete a Catalog of Equipment
- Review Energy Needs and Power Supply
- Perform a Pipe Capacity Analysis
- Review the Cooling Water Systems

- Study the existing Alarms and Monitoring Protocols
- Review the Effluent Filtration and Discharge Limitations
- Document the Aquaculture Parameters (coordinated with Task 3)
- Evaluate the Proposed Design and Operation (coordinated with Task 2 and 3)

As noted in the list above this assessment will include proposed design and operation improvements. These proposed improvements will be based on a preliminary review and on input from the managers, operators and project partners during the initial meetings. In order to meet the project schedule and allow permitting review to start, an early understanding of the range of alternatives is needed. This will facilitate determining if a highest impact alternative can be developed to concept level drawings that can be used for the "project description" in the permit applications.

Tasks 2 and 3, Water Intake Design and Recirculation Aquaculture System (RAS) design, respectively, will be coordinated with this task and concept level alternatives will be included. This coordination will also help with recommendations for integration or replacement of existing systems with proposed improvements. Information gathered during the assessment will be utilized in Tasks 2 and 3, and the design criteria established during the preliminary steps of Task 2 and 3 will be incorporated into the Basis of Design. Work related to Task 5, Permitting, will also begin as part of the assessment. Permitting specialists will review the site, existing permits and summarize permitting issues and implications of different design alternatives, especially as they relate to schedule.

Task 1 Deliverables:

- Kick off meeting – We assume Teleconference is acceptable or it could be coordinated with the assessment site visit. Teleconference will be attended by all key team members.
- Assessment Site Visit – We assume 2 day for this visit and there will be meeting time MPWMD office and time at the SHRF site. At this time we assume this visit will be attended by the Project Manager, Aquaculture Specialist, and Electrical Engineer.
- Technical memorandum describing the Basis of Design for SHRF in PDF format. This document will provide complete documentation of information gathered during the assessment.

Task 2 – Water Intake Preliminary Design

Work under this task will focus on the assessment and preliminary design of improvements to the SHRF water supply system. There are several components of this system which require involvement of different engineering disciplines and coordination with RAS design and permitting. Assessment of existing conditions will be done during Task 1.

A river intake that consists of a fish exclusion screen meeting National Marine Fisheries Service (NMFS) facility design requirements is utilized to divert water to the facility. The intake is affected by the river conditions, which will be assessed as part of a surface water study that involves hydraulic and sediment transport analysis. This will identify

the anticipated sediment size and quantity and will give options for reducing sedimentation. A description of this analysis is given later in this section.

Currently the fish screen is not a self-cleaning type and is vulnerable to clogging especially under conditions when water is high and maintenance cleaning cannot be performed. On several of the projects listed in our experience section of this proposal we have had good results designing intakes that utilized the cone style screen with hydraulically operated brushes to self-clean. This type of screen will improve maintenance and reduce small gravels and grit entering the pumping chamber. In order to estimate fees our design cost assumes a self-cleaning cone screen type of system installed near the existing intake.

After water passes the river intake, a pumping station is utilized to lift the water to the facility where it is cooled and supplied to the rearing containers and rearing channel. Existing pumping systems will be assessed for hydraulic capacity, mechanical condition, and electrical supply and control. Improvements to these systems will be recommended and will be coordinated with revised operations for single-pass, partial water reuse, and full recirculation. Some settling prior to pumping is desirable, but this may not be feasible for the project due to site conditions, difficulty of maintenance, and costs. We anticipate a reduction in grit with the intake and screen improvements discussed above. This will be analyzed as part of the sediment-transport analysis. Pump selection will choose pumps that can tolerate the anticipated level of grit. Positioning pumps to keep them out of the 1998 high water elevation will contribute to the pump selection process and wet well configuration. Pumps such as self-priming centrifugal located outside of the wet well may be acceptable. Some of these pumps have an ancillary vacuum assist system to ensure keeping them primed. Other options are submersible effluent pumps installed in the wet well or vertical suction centrifugal with the motor mounted above

Currently there is no settling and filtering of water that passes through the intake screen. Review of options for reducing sediment will be coordinated with improvements to the intake, changes in operations with addition of water reuse/recirculation, and selection of pumps that are less grit susceptible. For maintenance, cost and permitting purposes an above grade settling basin is a good option, but other factors will be examined during this analysis. Our design fees are based on a concrete settling basin that is integrated with the RAS equipment including integration with the RAS pumping. Low maintenance options for disposal of accumulated sediment will consider placement in an inundated area depending permitting considerations.

A summary of the work items involved in this task is listed below; a detailed outline of the sediment-transport work proposed follows.

A summary of the work items involved in this task are listed below.

- Establish the Facility Water Budget
- Establish Hydraulic Profile at three River Stages, which result in three different Recirculation Operating Conditions

- Sediment Transport Analysis including bedload and debris review, and recommended intake location
- Site Survey in areas where improvements must be designed
- Geotechnical investigation and report
- Intake and Screening Option 1
- Intake and Screening Option 2
- Pumping and Conveyance Option 1
- Pumping and Conveyance Option 2
- Screen bank Protection Plan
- Maintenance Access Plan
- Settling, Filtering, and Waste Materials Disposal
- Preliminary Design Drawings of Existing and Proposed
- Preliminary List of Specifications for Materials and Equipment
- Preliminary Cost Estimates

River Intake Hydraulic and Sediment Transport Analysis

Having worked on a wide variety of studies related to the removal of San Clemente Dam since 2001, Tetra Tech's hydraulic engineers and geomorphologists (formerly Mussetter Engineering, Inc.), have unparalleled knowledge of the sediment-transport characteristics of the Carmel River below the current dam. Through these studies, team members have worked closely with MPWMD, SCC, American Water Works Service Company (Cal-Am), NOAA Fisheries, California Department of Fish and Game, California Department of Water Resources, U.S. Fish and Wildlife Service and a variety of other agencies and stakeholders, and are very familiar with the hydrologic, hydraulic and sediment-transport conditions that will affect the design of the SHSRF retrofit. Tetra Tech is currently a member of the Granite Construction Design-Build Team for the Carmel River Reroute and Dam Removal (CRRDR) Project, where we are responsible for design of the reconstructed reach of the river through the former reservoir and re-route cut. Dr. Bob Mussetter, PE, will be the Engineer-of-Record for that portion of the CRRDR project.

Based on our past work, we believe that the available sediment-transport data is sufficient to prepare the design of the water intake structure and associated sediment management facilities. Although additional sediment-transport data would benefit the analysis and design, it is probably not practical to collect this information during the relatively short period leading up to the analysis and design phases. List Engineering Company (LEC, 2003) compiled bed load and suspended sediment load estimates developed by MEI (MEI, 2003) under baseline conditions, but these estimates do not represent conditions that will occur after completion of the CRRDR project. Results from the residual sediment analysis [MEI, 2006 (revised 2007)] indicate that the volume of sediment stored in the Carmel River below the existing dam would increase by 10 to 12 percent over existing conditions, and most of this increase would occur during the first 10 years following construction of the CRRDR project. Some of the most significant increases would occur in the vicinity of the SHSRF (Subreach 4.3), where the volume of sediment storage would increase by 25 percent to 65 percent, depending on the hydrologic conditions following construction. We do not believe this increase would be a significant design

constraint because some of the increase in sediment storage would occur along the overbanks during periods of high flow, and the volume of sand sized bed material that would be of most concern to the design of the intake structure only increases by 2 percent to 5 percent. The hydraulic and sediment-transport models that were developed to evaluate the CRRDR project will be updated to represent the proposed project conditions. Results from this modeling, including estimated bed material loads and suspended sediment concentrations, will be used to prepare the design of the intake structure and develop a maintenance plan for sediment disposal.

To reduce the amount of sediment that enters the intake structure as part of their preferred alternative, LEC recommended that parallel, buried river water clarifiers be installed upstream from the pumps. To further reduce the amount of sediment that enters the intake structure, Tetra Tech recommends that a self-cleaning screen [i.e., a cone screen, Coanda-effect screen (Wahl, 2003) or similar apparatus] be installed at the entrance weir. These types of screens would eliminate all but the finest fractions of the sediment load from entering the intake, thereby reducing the amount of material that would need to be removed by the sand removal pumps. Results from the sediment-transport modeling will be used to determine the fraction of the sediment load are finer than the design screen mesh that would ultimately enter the intake structure to assist in designing the sand removal pumps identified as part of the preferred alternative and preparation of an associated maintenance plan.

The current intake structure is located along a relatively straight reach of the Carmel River. The preferred alternative includes an entrance weir oriented parallel to the direction of flow. A parallel weir orientation should be sufficient if the cone-screen is included in the design; however, if it is determined that a Coanda-effect screen would better eliminate sediment loading to the intake structure, the weir would need to have an orientation that is generally perpendicular to the direction of flow. (Based on previous work with similar intake structures, the weir would not necessarily have to span the entire width of the channel.) To avoid the potential for flanking of a perpendicular weir and subsequent undermining of the intake structure, it may be advisable to relocate the weir and intake structure about 80 feet upstream where the natural topography limits flow conveyance in the right (north) overbank. The final location for the intake structure will be identified during a field reconnaissance of the project reach and will be selected in a manner that provides the highest benefit in terms of geology, geomorphology and hydraulic connectivity. Some form of bank protection will be required along the left (south) bank at and upstream from the intake structure. Although a traditional riprap revetment may be warranted in the immediate vicinity of the structure, it is likely that bio-engineered bank protection (i.e., boulder toe material with vegetated, soil encapsulated lifts making up the upper bank) would be sufficient in the approach section.

Optional Task

Another step that could be taken to update the model is to consider other proposed activities that could also have an effect on the

SHSRF retrofit. Old Carmel River Dam, located about 1 mile upstream from the SHSRF and about 2,000 feet below San Clemente Dam, may be removed as part of the CRRDR project. Although there is not a significant amount of sediment stored above the old dam, removal of the dam could affect sediment-transport conditions in the vicinity of the structure. MPWMD has also proposed removal of the concrete crossing and construction of a new bridge at Sleepy Hollow Ford, located about 550 feet upstream from the intake structure, to improve upstream spawning and rearing habitat for Steelhead Salmon. Construction activities associated with this project could also result in slightly elevated sediment loads, especially during the period following removal of the crossing. It is unlikely that either of these activities would result in a significant, long-term increase in sediment loads. Nevertheless, the sediment-transport model could be adjusted to incorporate the physical changes that would result from these actions to evaluate the effects on sediment loading at the intake structure. We will review this with the District prior to beginning work.

The specific steps that will be carried out to analyze the sediment-transport issues in the vicinity of the intake and prepare recommendations for the design of the intake are as follows:

1. Conduct a field reconnaissance of the reach between the existing San Clemente Dam and the SHSRF to identify an appropriate location(s) for the intake structure.
2. Update the existing 1-D hydraulic model in the vicinity of the SHSRF to reflect the preliminary design of the intake structure.
3. Optional Task: This is an optional step and the estimated cost is shown separately in the pricing section. Update the existing sediment-transport (HEC-6T) model that was prepared for the Carmel River Reroute and Dam Removal project to incorporate elements associated with the preliminary design, and incorporate changes at Sleepy Hollow Ford and removal of Old Carmel Dam.
4. Evaluate sediment loading to the intake and revise the preliminary design for the weir and intake screen, as necessary. This step may require updates to Steps 2 and 3, above.
5. Use the results from the 1-D hydraulic and sediment-transport modeling to prepare scour estimates at the intake structure, including long term (general) scour and appropriate local scour estimates.
6. Prepare recommendations for the design, preliminary design of a diversion for dewatering, and outline a sediment-management plan for disposal of sediments that are delivered to the intake structure.

Task 2 Deliverables:

- Technical memorandum describing the Water Intake Preliminary Design. This will include studies and documentation on all aspects of the water intake system.
- Review meeting – A meeting to review the Preliminary Water Intake Design. We assume this meeting date can be coordinated with the Task 3 meeting. Meeting will be attended by the Project Manager, Aquaculture Specialist, Surface Water Engineer. Others including Permitting Specialist and Electrical Engineer may join by teleconference.

Task 3 – RAS Preliminary Design

Water supply concerns for the SHSF dictate that an evaluation of the feasibility and alternatives for reusing water is critical to ensure the long-term operation of the facility. Water reuse and recirculation technologies for fish culture have advanced in the last 15 years and new technologies are available to efficiently address SHSF water supply concerns. Feasibility evaluation and alternatives analysis for water reuse/recirculation will begin with a review of the existing infrastructure to determine the capacity of and potential reuse of equipment. Infrastructure assessment will be coordinated with Task 1, as will the identification of the biological design criteria and bioplanning of the existing steelhead program. The alternatives analysis will take into account the water supply and need for any influent treatment as a first step; second will be to determine the feasibility of implementing of a water reuse/recirculation system to accommodate a range of available supply water, from a high water exchange rate (50–75%, i.e., partial water reuse) to an almost zero water exchange rate on a flow basis (0.5–0%, i.e., fully recirculating). It will be important to evaluate both ends of the spectrum of water reuse/recirculation. A partial water reuse system lends itself to programs with a short operational period because it does not require a biofiler that takes time to become fully operational and once operational cannot be shut down and restarted quickly. However partial reuse systems can typically only reuse up to 75% of system water and maintain good water quality because ammonia concentrations will increase to toxic levels at reuse over approximately 75%. If water supplies can be expected to decline to zero then a full recirculating system would be necessary to recirculate 99.5–100% of the system water. The ability to accommodate high levels of recirculation comes at an increased cost over partial water reuse; development of both options at the concept design level allows for a logical decision based on funding availability and risk tolerance. Final selection of the optimal water reuse/recirculation alternative will be made in concert with the project partners.

A summary of the work items involved in this task are listed below; a detailed outline of the work proposed follows.

- River Water Quality Review
- Integrate with Water Budget and River Stages
- RAS Schematic Diagram and Operating Scenario
- Mass Balance Calculation
- RAS and Effluent Water Quality Analysis
- Effluent Treatment and Solid Waste Management
- Water Delivery methods, Pipe Calculations and Sizing
- Disinfection and Water Quality Control
- Feeding System Analysis
- System Monitoring and Alarm Communication
- Predesign of Full Recirculation Alternative
- Predesign of Partial Recirculation Alternative
- Predesign Drawings of RAS Alternatives
- Preliminary List of Specifications for Materials and Equipment

- Preliminary Cost Estimates

Proposed Work

A. Review of existing conditions. Inspect and assess existing SHRF infrastructure age and condition. Determine the suitability of existing structures and equipment for renovation and reuse in the context of a new water intake and a water reuse/recirculation system.

B. Identification of biological and physical design criteria so that critical design decisions may be resolved. Specific biological criteria that will be identified include SHRF biological holding/production objectives, biological growth regimes, fish rearing density criteria, and fish culture methods specific to the rearing channel facility. Specific physical criteria that will be identified include available space for all related processes and hydraulic gradeline limitations.

C. Alternatives analysis for water reuse/recirculation implementation. The following tasks will be completed.

1. Evaluate the surface water supply and the need for treatment in order to be used in the SHRF under flow-through and potential water reuse/recirculation. Biosecurity and pathogen disinfection are the focus of this analysis:

a. Review existing water quality data for the surface water.

b. Determine additional water quality data needs and request data as required.

c. Review existing fish disease and pathogen information.

d. Determine additional fish health and pathogen data needs and request data as required.

e. Analyze all water quality data and determine feasible influent water treatment processes for solids control and pathogen disinfection.

f. Develop a design strategy that will address influent water quality deficiencies and provide adequately treated water for fish culture and holding in the SHRF. Treated water quality shall have levels of dissolved gases, pathogens, and other constituents that are suitable for all species and life stages of fish being held and/or cultured.

2. Determine the feasibility of implementing of a water reuse/recirculation system for the SHRF to accommodate a range of available supply water, from a high water exchange rate (50–75%, i.e., partial water reuse) to an almost zero water exchange rate on a flow basis (0.5–0%, i.e., fully recirculating).

a. Complete mass balance calculations for oxygen, carbon dioxide, and ammonia-nitrogen for determining the required water flows to maintain good water quality at times of maximum steelhead holding and culture in the SHRF for upper and lower-end water exchange rate conditions (partial water reuse and fully recirculating systems).

b. Review temperature profiles of the water supply sources and ambient air to determine the feasibility of providing water temperature conditioning using the existing evaporative cooling and/or supplemental heat transfer processes within a reuse/recirculation water treatment loop.

c. Develop process designs to provide the water flows through the rearing channel (and structures) and treatment equipment, as well as initial water reuse/recirculation equipment sizing for upper and lower-end water exchange rate conditions (partial reuse and fully recirculating systems).

d. Identify facility size and equipment power requirements for the water reuse/recirculation system options.

e. Develop process flow diagrams, plan and section drawings of the treatment equipment detailing preliminary treatment equipment design and sizing for the water reuse/recirculation system options.

f. Preliminary treatment equipment list for manufactured equipment and material quantity list for the water reuse/recirculation system options.

D. Integration of the design criteria, feasibility analysis and identified design elements into a complete concept design for supply water treatment and water reuse/recirculation systems. Conceptual design packages will include unit process design and selection, process layout, and concept-level cost estimation.

1. Preliminary design of equipment and modifications required as applicable to the existing infrastructure. This includes associated equipment, preliminary piping sizes, utility needs, loading requirements, detention times, pump sizes, etc., to provide complete conceptual designs for both partial water reuse and fully recirculating system concept designs.

2. Preparation of conceptual plans which will include:

a. General site plans showing the proposed influent water treatment and water reuse/recirculation system options, including any major site features.

b. Plan and profiles of supply water treatment and both water reuse/recirculation system options with approximate floor plans, building sections and layout of proposed equipment, piping and appurtenances.

c. Plan of modifications to the existing infrastructure as required. Existing infrastructure includes the influent water supply lines and effluent discharge lines.

d. Construction cost estimate for definable features of the proposed design for both water reuse/recirculation system options.

E. Facilitate the selection of a concept design to develop to the final design phase in cooperation with project partners. The concept design will incorporate influent

water treatment and either of partial water reuse and/or fully recirculating system options.

Task 3 Deliverables:

- Technical memorandum describing the RAS Preliminary Design. This will include studies and documentation on all aspects of the water intake system.
- Review meeting – A meeting to review the RAS Preliminary Design. We assume this meeting date can be coordinated with the Task 2 meeting. Meeting will be attended by the Project Manager and Aquaculture Specialist. Others including Civil Engineer, Permitting Specialist and Electrical Engineer may join by teleconference.

Task 4 – Final Intake and Recirculating Aquaculture System Design

Final design will involve preparation of Draft and Final plans, specifications, and estimates (PS&E) for review. General descriptions of Draft and Final PS&E processes are describe in the next paragraphs followed by a more detailed description of the work involved for Water Intake and RAS Final Design.

Draft PS&E

Once the final design option has been agreed upon by MPWMD and other partners, we will prepare draft PS&E design documents. The draft design package will identify all program elements with enough detail to allow preparation of an estimate of probably construction cost. For this package, civil, mechanical, electrical, and structural details will be prepared. Attention will be given to communication among all design disciplines to ensure a well-coordinated set of drawings and specifications. Internal Quality Control (QC) review of the design will be performed then the documents will be submitted to MPWMD.

Draft plan documents will include:

- Dewatering Plan and Erosion Control Plans
- Process Diagrams
- Intake, Screen, Wet Well Structures
- Recirculating Pump Enclosure
- Piping Plan
- Electrical Plan
- RAS System and Filters
- Alarms and Control System Plan
- Grading Plan and On Site Disposal Plan

Draft specifications documents will include:

- Materials and Equipment
- Construction Methods and Requirements

A design review meeting will occur after submittal, and comments will be incorporated into the next design stage.

Final PS&E Design

After review and input from MPWMD and other project partners, the design team will make additions or modifications required to the final design drawings and specifications. At completion of final design, the documents will be reviewed for overall compliance with commitments from the client and with Tetra Tech's internal standards for quality. Final PS&E documents will be ready for signature and final review by MPWMD.

Water Intake and RAS Final Design

The water intake and water reuse/recirculation options selected in Tasks 2 and 3 will be developed for final design. The detail design of the water reuse/recirculation

system for the selected option will be completed via three-dimensional CAD modelling in order to integrate the water reuse/recirculation process design with other disciplines and prevent any conflicts. Final design will include selection of manufactured treatment equipment and design of custom equipment as required:

- Identification of water intake and water reuse/recirculation process equipment footprint, elevations, and layout.
- Completion of head loss calculations for the water intake system and through the water reuse/recirculation process equipment.
- Determination of pipeline elevations and diameters related to intake, pump station, settling and filtration, and water reuse/recirculation process equipment.
- Identification of water intake and water reuse/recirculation process equipment electrical, drainage, and operational requirements.
- Completion of settling and filter backwash/solids management process flow.
- Design of process instrumentation, control and alarming systems required for the water intake and water reuse/recirculation system. Instrumentation, control and alarming will be integrated in the existing SHRF automated calling system to the extent possible.
- Identification of backup systems required.

The water reuse/recirculation process design will be translated from the three-dimensional CAD model into design documents for the construction process. The design documents for water intake and water reuse/recirculation will include design drawings, equipment schedules, select equipment specifications, and select material specifications. The design documents will include the following:

- Plan, section and detail drawings of the intake screen, pumping, piping, settling and other process equipment
- Plan, section and detail drawings of integrated water reuse/recirculation system
- Piping and instrumentation diagrams of the intake screen, pump station, water reuse/recirculation systems, and other water-related infrastructure
- Specifications for screening, pumping, piping, filtering, aquaculture equipment, and general construction requirements in standard Construction Specifications Institute format (i.e., MasterFormat 2010 Update)
- Detailed engineer's cost estimate of construction

Task 4 Deliverables:

- Draft Plans, Specifications, and Estimates for Review
- Draft Plan Review Meeting – Plan review will be held at the MPWMD office and attended by key team members, others by teleconference.
- Final PS&E Documents for Review
- Final Plan Review Meeting – Plan review will be by teleconference and attended by key team members.

Task 5—CEQA/NEPA Analysis and Permit Acquisition

This approach based on our review of the scope of work and additional documentation relating to permitting and review of the

project under the California Environmental Quality Act (CEQA) and the National Environmental Policy Act (NEPA). We believe that a Mitigated Negative Declaration will be the appropriate CEQA document for the project, and that the proposed improvements will require new permits and associated biological studies and consultations.

Project Description

Our team will work with the District to prepare the new project description package, which will outline construction means and methods, facility operations, proposed best management practices and mitigation measures, and other information required for permit applications and the CEQA review. This will require input from the design team at a level of design suitable for permitting. We anticipate that a project description suitable for permitting and CEQA review purposes can be achieved using 30% design plans.

Assumptions:

- There will be up to two client meetings to complete this task; one will be in person at the District's office and will include a site visit.

CEQA Documentation and Coordination

Specific to the project's CEQA review, Anchor QEA will prepare the Initial Study (IS) for the project. The District may choose to prepare either a Negative Declaration or Mitigated Negative Declaration (MND), based on the results of the IS. Due to the presence of endangered species and the likely need for new permits, Anchor QEA expects that an MND may be the appropriate type of CEQA document for the project. We have assumed that the project's NEPA review will be completed by the U.S. Army Corps of Engineers (USACE) through their standard internal process for permit issuance.

Assumptions:

- A Negative Declaration (ND) or Mitigated Negative Declaration (MND) will be the appropriate CEQA document; an Environmental Impact Report will not be required. The ND/MND will be limited to available and existing information and information developed by the design team; new quantitative studies (e.g., air and traffic studies) are not included as part of this task.
- Draft and final versions of the IS and ND/MND will be prepared. One round of review by the District is assumed.
- This task includes circulating the Public Notice; compiling, evaluating, and addressing up to 20 comments received on the IS and ND/MDN; and preparing transmittals and submitting required copies (up to 5) to the State Clearinghouse.
- The District will be responsible for all required fees associated with noticing or other requirements.
- There will be up to three client meetings to complete this task; one will be in person at the District's office.

Federal, State, and Local Permits

We are assuming that it is unlikely that the USACE's Regional General Permit (RGP) 24460S and associated California Department of Fish and Wildlife (CDFW) and Regional Water Quality Control Board (RWQCB)

approvals will cover the proposed activity. The proposed improvements would be outside the scope of coverage of the RGP, which applies to maintenance and restoration projects that are only generally related to the proposed improvements. Based on this conclusion, we expect that USACE will require issuance of a new permit (either a Nationwide or Individual Permit depending on the nature and degree of project impacts to waters of the U.S.). Assuming that a new permit from USACE is required, the U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) may need to initiate new consultations under the federal Endangered Species Act (ESA) for California red-legged frog (federally threatened) and steelhead (federally threatened), respectively. Based on our review of the RFP, we have assumed that consultations can be completed informally.

Our team understands that a new Streambed Alteration Agreement (SAA) and review under the California ESA (CESA) will be required from the CDFW; however, it does not appear that any CESA-listed species are present in the project area (the California red-legged frog is a California state species of special concern). Lastly, a new 401 Water Quality Certification will be required from the RWQCB. In the interest of due diligence and upon completion of the project description, Anchor QEA will complete a pre-application consultation with the resource agencies to confirm that new permits are indeed required. The scope of work and cost estimate may be revised should the existing permits be determined to be applicable.

Once the project description and supporting studies have been completed and reviewed, Anchor QEA will work with the District to begin preparing the permit applications concurrent with commencing the IS. We anticipate submitting the permit applications as soon as they are complete, regardless of whether the CEQA review has concluded. The RWQCB and CDFW require the CEQA review to be complete prior to permit issuance. The USACE permit and federal ESA approvals can be issued prior to completion of the CEQA review. The team will also work with the District to pursue the required local permits from Monterey County.

Our team has the experience and capacity to achieve the anticipated construction schedule, and our strategy includes completing the CEQA review and permitting tasks in tandem. Given the target construction period of the spring of 2017 for the larger project, it is imperative that the CEQA review process and permit acquisition process occur as efficiently as possible. Our planning staff includes several former federal and state regulators. Their familiarity with agency staff helps streamline communication for permitting efforts and maintain project priority during permit review. Anchor QEA planners often use pre-submittal agency meetings to inform the regulatory staff of the project details and facilitate effective and streamlined agency negotiations. This approach has allowed us to meet challenging construction schedules. Most recently, our team of planners and biologists implemented a concurrent CEQA review and permitting process for work on the Port of Stockton's West Complex rail extension project as part of our on-call contract, where urgent construction needs required the concurrent completion of biological investigations, CEQA analysis, and

permit acquisition. We are confident that a similar approach will help achieve the District's schedule goals.

Assumptions:

- Anchor QEA will complete a pre-consultation meeting with the resource agencies to confirm that new permits are indeed required. The scope of work and cost estimate may be revised should the RGP be determined to be applicable.
- Draft and final versions of the required permit applications will be prepared. One round of review by the District is assumed.
- USACE will require issuance of a new permit (either a Nationwide or Individual Permit depending on the nature and degree of project impacts to waters of the U.S.). Preparation of National Environmental Policy Act (NEPA) documentation for the U.S. Army Corps of Engineers (USACE); it is assumed that USACE will prepare their own NEPA documentation. This task does not include preparation of the Public Notice text, will be required if an Individual Permit from USACE is required.
- There will be no requirement for a formal ESA consultation (e.g., a take permit) with the USFWS and NMFS and federal ESA consultations can be completed informally.
- A new SAA will be required from CDFW.
- A new 401 Water Quality Certification will be required from the RWQCB.
- The existing NPDES general permit will be sufficient for the proposed modifications. If water quality evaluations under the proposed modifications indicate that the existing general permit will not be sufficient, Anchor QEA will provide a separate cost estimate for securing permit approvals with the RWQCB.
- There will be up to four client meetings to complete this task; two will be in person at the District's office or on site.
- The District will be responsible for all permit application fees.
- Costs do not include permitting or approval of any separate/additional tasks not presented in the RFP.

Optional Tasks

We have identified several potential optional permit-related tasks that could be required based on either the proposed design and/or the discretion of the regulatory and resource agencies.

If the ultimate design is determined to constitute an effect on the species or their critical habitat, then a Biological Assessment (BA) must be prepared to support a formal consultation. Specific to CESA, it does not appear that any CESA-listed species are present in the project area (the California red-legged frog is a California state species of special concern). If CDFW requires submittal of a biological report, it is assumed that the BA and biology report can be combined into a single document. In addition, should it be

determined that wetlands may be impacted as a result of the project, a Jurisdictional Delineation Report may be required.

It is possible that the existing permits could cover the proposed upgrades to the existing intake structure, which are planned to occur in the spring of 2016. Once additional details on the nature of the intake upgrades are known, we will work with the District and regulatory agencies to determine whether the intake upgrades require new permits or are considered covered by the existing permits for the facility. If they are determined to be covered, we will process the necessary documentation to inform the federal, state, and local agencies of the action. If the intake upgrades are determined not to be covered, we believe it is still possible to obtain separate permits and CEQA approvals for the action by the spring of 2016. Neither of these efforts are assumed in our cost proposal; both would be considered optional tasks. Alternatively, the District could elect to include the intake upgrades with the permitting and CEQA review effort for the larger project, which would be covered by our team's proposed costs.

A water quality analysis will be undertaken to determine effluent water quality compliance under the existing National Pollutant Discharge Elimination System (NPDES) general permit for the proposed modifications. If it is determined that modifications to the existing general permit are required to accommodate the project, our team will work with the San Francisco Bay Regional Water Quality Control Board to process any required modifications to the existing permit, including any evaluations of additional treatment options and their effects on effluent and downstream water quality. Costs associated with permit modifications are considered an optional task and are not part of our cost proposal. If the optional task becomes necessary our water quality team will provide a cost estimate for the same.

Assumptions:

- Wetland delineation costs assume a single day of field work and an area of less than 1-acre; additional field work and overhead expenses (i.e., per diem lodging, meals, and equipment) may be required for direct- or indirect-impact area of greater than 1-acre.
- If the ultimate design is determined to require a take permit, then a Biological Assessment (BA) must be prepared to support a formal consultation. Our proposal assumes only steelhead and California red legged frog will be considered in the documents.
- CDFW may require preparation of a biological report. Our cost proposal assumes that the BA and CDFW biology report can be combined into a single document.
- There will be up to two full day site visits/client meetings to complete the Biological Assessment/CDFW Biology Report, including the field assessment and ESA document preparation and consultation support.

Task 6—Project Management

Tetra Tech's successful delivery of projects derives from strong project management training and processes, systematic quality controls, and strong communications. Tetra Tech's proposed project manager, Darrel Nice,

will be the key contact with the MPWMD, and will manage and direct the project team. He will employ Tetra Tech's management strategies to keep the project on schedule and on budget and to deliver a quality project that meets the needs of the District's and their partners.

Scheduling

For every project, Tetra Tech develops a project plan that specifies all scope-of-work elements, the individuals responsible for each element and staffing and schedule requirements with key internal and external milestones. A startup meeting early in the project establishes a common ground for team participants to interact and leads to a better understanding of project objectives.

Regular progress meetings with the client allow joint review of schedule and budget, progress on specific work elements, potential problem areas, work items planned in the next progress period, and the resources needed to complete them.

To keep each project on track, a computerized schedule will be maintained as part of the project plan. The schedule will inform the District, review agencies and each team member of the status of project tasks. For simple projects, the schedule may be a simple bar graph; for more complex projects, Microsoft Project is used to correlate resources, effort and tasks and to define critical paths. When progress deviates from the plan, project engineers and the project manager will develop and implement corrective action.

Budget Tracking

Tetra Tech's internal accounting procedures provide reports to the project manager every week. These reports show project budgets for Tetra Tech and each subconsultant. Progress is monitored against established milestones and task budgets, with corrective action taken as necessary. Tetra Tech has a long history of keeping within budget for both design and construction.

Invoicing and Scope Changes

Tetra Tech employs an effective project management reporting system that provides regular reports to the Project Manager concerning budget status by task. The system also generates an Effort Report that indicates budget and actual effort expended by task. This report is compared with a monthly "estimate to complete" chart prepared by project staff and is incorporated into a cost to complete graph. These reports are available to the District's Project Manager for review. This process can identify schedule and budget problems early on so they can be managed effectively by shifting resources, adjusting schedules and modifying the scope to better meet actual conditions.

Tetra Tech will invoice the District monthly based on the previous month's efforts. Draft invoices are provided to project managers before the 10th of the month for review and corrections, and preparation of progress reports that identify the work accomplished during the previous month, compare expenditures to task budgets, provide documentation for invoices and progress of the schedule. These invoices and progress reports are then finalized and forwarded to

the District project manager within two to three days.

Changes in Scope

Tetra Tech's approach to managing changes during the work include informing the District project manager about changed conditions and about options for dealing with changes prior to expending any time, effort or budget on the contemplated work.

This gives the District the greatest flexibility in dealing with potential changes. Options to be formally approved by the District could include budget trading between tasks, further District involvement, or a contract modification. In any event, work related to changes in scope will not proceed until there is direction and authorization from the District.

If the District requests changes to the negotiated scope of work and budget, Tetra Tech will provide a revised scope and fee estimate for the requested changes. Additional services can be negotiated and estimates provided.

Communication

The Tetra Tech team recognizes the importance of maintaining close communication with client staff throughout a project. Our project manager and task leaders have been selected because they possess strong communication skills in addition to their technical strengths. Tetra Tech uses the following steps to ensure close regular communication and client/consultant interaction:

- Begin the project with a startup meeting for key Tetra Tech team members, District staff, and project partners. This meeting will identify project goals, establish design standards, map communication channels for participants, and provide a venue to raise concerns regarding the project.
- Maintain communication channels during the project with outside groups, regulatory agencies. At appropriate intervals, the Tetra Tech team will inform these parties about project progress and solicit comments on matters of interest to them.
- Hold progress meetings with affected parties through predesign and more frequently during final design not to exceed more than once a month.
- Make key project decisions on a consensus basis at regular or special project meetings, using issue papers and technical memorandums to identify and review design alternatives.
- Coordinate all staff assignments through Tetra Tech's project manager, with notice and approval by District staff.

Summary of Anticipated Meetings

This is a list of meetings on site at the MPWMD Offices or at SHRF. Consultant staff and key team members to attend meetings in person or by teleconference will be discussed with MPWMD prior to the meeting.

- Kick-off meeting
- Aquaculture Review of Existing and Proposed Operations with MPWMD Staff
- Joint Preliminary Design Review Meeting for Water Intake and RAS
- Draft PS&E Review Meeting
- Final PS&E Review Meeting

QA/QC Plan

Tetra Tech has a formalized quality assurance and quality control (QA/QC) program set out

in the company's Production Policies and Procedures Manual, updated regularly and distributed to all employees. The procedures require designated reviewers to review and sign-off on work products before they are submitted to clients. They provide flexibility to deal with a variety of projects and complexities. The QC lead calls on senior specialists to do independent reviews of products for completeness, design intent, fulfillment of contract requirements, document clarity, and constructability.

Quality Control Plan. Our quality control process begins with a project-specific QC Plan. The plan, based on project scope, budget and schedule, is used to ensure that our work meets client requirements. Appropriate staff and resources are assigned, and a preliminary work breakdown and schedule are developed, identifying deliverable products, key review dates and project coordination meetings. The objective of the plan is to ensure that the project meets requirements defined by the scope of work, that construction requirements are clearly and accurately delineated in the drawings and specifications, that work conforms to technical and life safety standards, and that the project is constructible within project cost limitations.

Quality Assurance is achieved by periodic in-house technical reviews at key points throughout the duration of the project. Technical reviews include at least one senior level Tetra Tech engineer who is not part of the project team. General quality reviews of work products are performed by designated team members familiar with Tetra Tech procedures and any other standards required for the project. These reviews are directed at making certain that the goals of the scope of work have been met and that the project deliverables are completed in a quality manner.

Budget for Engineering Services

Our estimate of professional services to complete this work is $373,000. This fee corresponds with our approach presented in this proposal. We present this estimate as a basis for further negotiations if Tetra Tech is selected to perform these services.

Table A Cost Estimate for Professional Services	
Task 1: Assessment of the Operation and the Facility	$52,000
Task 2: Water Intake Preliminary Design	$68,000
Task 3: RAS Preliminary Design	$41,000
Task 4: Final Intake and Recirculating Aquaculture System Design	$94,000
Task 5: CEQA/NEPA Analysis and Permit Acquisition	$87,000
Task 6: Project Management	$31,000
Total Anticipated Costs	**$373,000**

Optional Tasks:

- Wetland Delineation - $13,000
- Formal Federal and State ESA Consultation Support Including Biological Assessment/CDFW Biology Report - $25,000
- Update sediment-transport model for proposed design and incorporate changes at Sleepy Hollow Ford and removal of Old Carmel Dam - $8,000

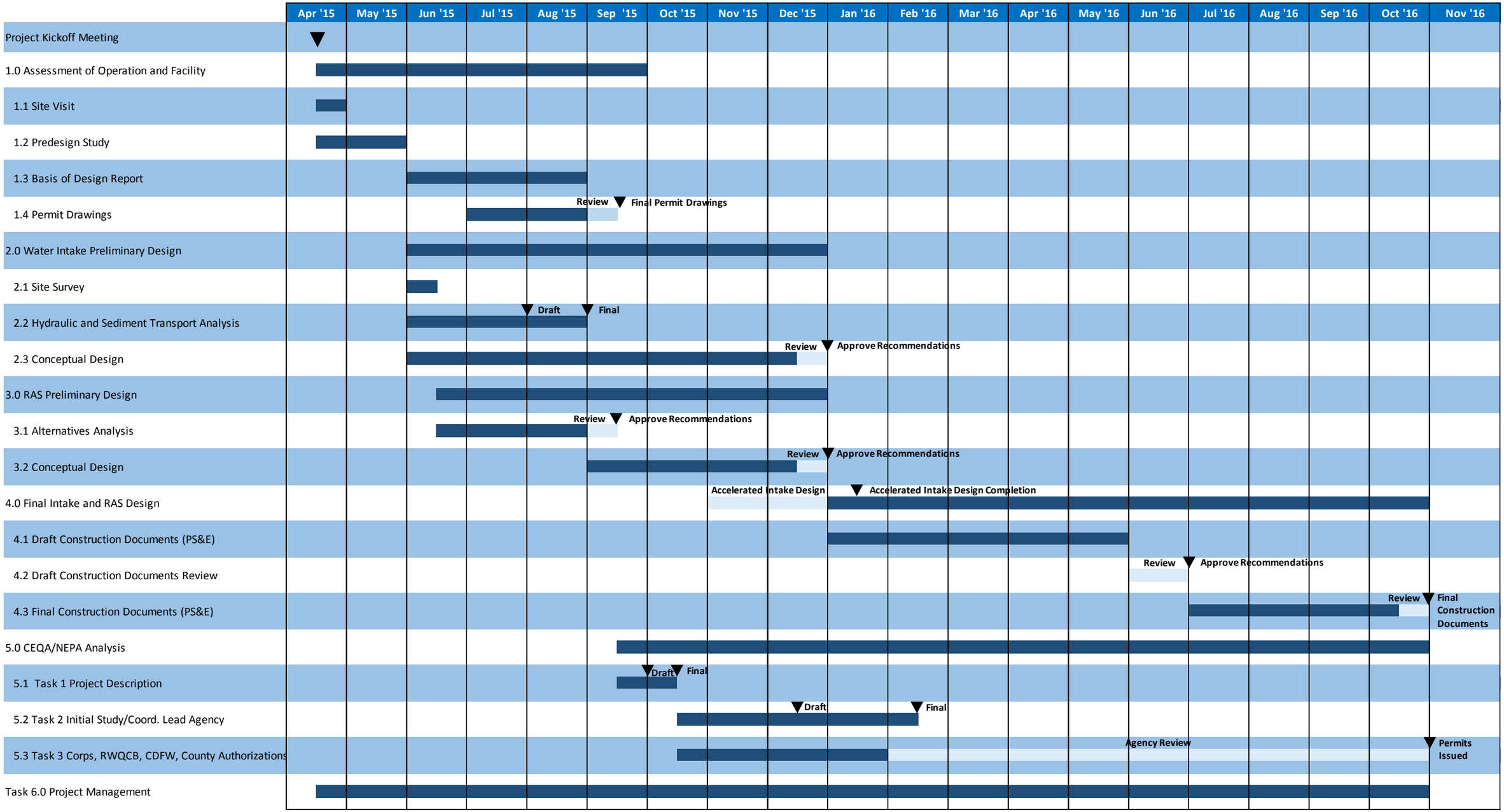
Schedule

We have prepared a project schedule and timeline that runs from a notice to proceed and project start in April 2015 through project completion by October 2016. This timeline is driven by two main items 1) is that the RFP indicated the work should be complete in 18 months, and 2) if new permits are required the permitting timeline will drive the construction start date. The timeline shows developing Permit Drawings by September 2015 in order to keep the permits on schedule by October 2016.

Tetra Tech has developed the proposed work schedule based on the anticipated work tasks needed to complete the assessment, design, and permitting. We anticipate the District's review and input at 6 stages through the design process and several stages of the permitting process. Based on our understanding that the desired construction time is in the spring of 2017, before the facility starts operation in May, this schedule leaves some room for the District to obtain funding and bid the project.

We have also shown an accelerated time line for the water intake work. This will be dependent the outcome of the assessment and feasibility phase of the work, and what permits are needed to accomplish the construction. It will require coordinating the design with the later pump station, settling basin, and RAS improvements.

Work Plan Schedule - Sleepy Hollow Project



Exceptions to Contract Language

EXCEPTION TO MONTEREY PENINSULA WATER MANAGEMENT DISTRICT SOLICITATION FOR SLEEPY HOLLOW STEELHEAD REARING FACILITY INTAKE UPGRADE

Page 37, Section II. Compensation, B. Method of Payment, 2nd paragraph.

Retention is not customary for design professional services. Request Ten percent retention be deleted.

EXCEPTION TO MONTEREY PENINSULA WATER MANAGEMENT DISTRICT SOLICITATION FOR SLEEPY HOLLOW STEELHEAD REARING FACILITY INTAKE UPGRADE

Page 38, Section II. Compensation B

D. Late Performance Penalty.

For professional consultants, time is of the essence should exercise professional judgment and particularly when related to schedules that may beyond control of consultant, etc.

Propose the following change:

“Time is of the essence for this agreement and each and all of its provisions in which performance is a factor, subject to the applicable professional standard of care.”

D. Language following time is of the essence.

It is not customary for consulting professionals to pay liquidated damages (LD’s) for their type of services nor are they included in design contracts. Consultants carry Professional Liability for contractual issue.

Propose deleting all language following time is of the essence in Section D, including to discretionary withholding of additional 10% of fee as well as 2nd paragraph related to reducing maximum payment in Section II, paragraph C of this Agreement by 20% and said reductions shall be deemed liquidated damages.

As written, there could be many contributing factors to delay of performance not based solely on consultants – other parties, force majeure. If no revisions, would need force majeure clause and possibly other clarifications.

EXCEPTION TO MONTEREY PENINSULA WATER MANAGEMENT DISTRICT SOLICITATION FOR SLEEPY HOLLOW STEELHEAD REARING FACILITY INTAKE UPGRADE

Page 38, Section IV, Ownership of Project Report and Equipment Purchased. As document ownership is specified, consultants need release of liability for reuse. Following is consultant-recommended language:

"Consultant shall not be held liable for reuse of documents or modifications of the subject data thereof, including documents on electronic media, by MPWMD or its representatives, for any purpose other than the original intent of this Agreement."

EXCEPTION TO MONTEREY PENINSULA WATER MANAGEMENT DISTRICT SOLICITATION FOR SLEEPY HOLLOW STEELHEAD REARING FACILITY INTAKE UPGRADE

Page 39, Section V Time of Performance. Time is of the essence is referenced in Section II, Compensation B.

Propose deleting 2nd sentence is section related to same or revising as indicated in Section II.

EXCEPTION TO MONTEREY PENINSULA WATER MANAGEMENT DISTRICT SOLICITATION FOR SLEEPY HOLLOW STEELHEAD REARING FACILITY INTAKE UPGRADE

Page 39, Section VI Responsibilities, F. Indemnity.

Consultant indemnity is for its client and third parties (agents, etc.) are not part of a contractual privity and are not owed the same obligation**.**

Propose revision as follows: "The Consultant agrees to indemnify, defend and save harmless MPWMD, its officers, and employees from any claims and losses to the extent arising or resulting from the negligent acts, errors, and/or omissions of the Consultant, Consultant's employees, or Consultant's subconsultants in the performance of this Agreement."

Appendix

Additional Relevant Project Experience

The following projects were completed more than five years ago but present highly relevant experience relative to the Sleepy Hollow project. They were completed by team members who will be assigned to the Sleepy Hollow project.

Oregon Hatchery Research Center, Alsea, OR

Client

Oregon Department of Fish & Wildlife, Oregon Hatchery Research Center (541) 487-5510

Duration

2005 project completion

Team Member Roles on Project

- John McGlenn, Project Manager
- Don Beard, Project Engineer

Description of Services Provided

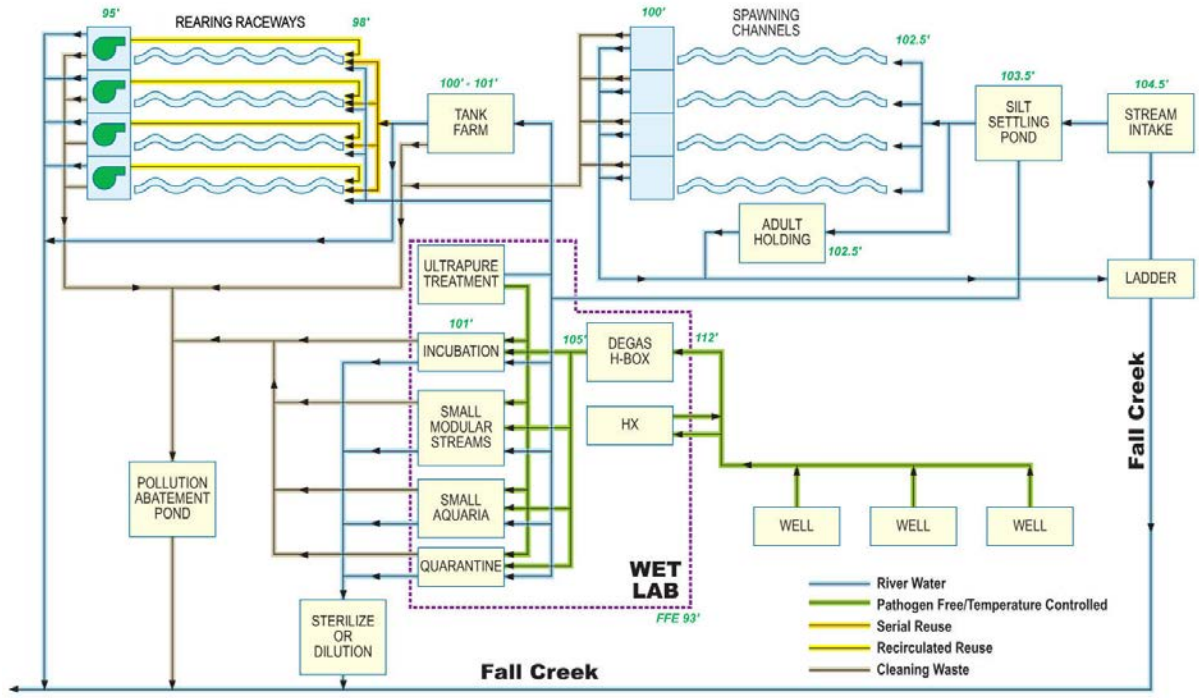
Oregon Department of Fish and Wildlife (ODFW), in collaboration with several stakeholders (including Oregon State University, National Oceanic and Atmospheric Administration, United States Fish and Wildlife Service), selected Tetra Tech as prime consultant for the programming and design of a fisheries research center to be constructed at the site of the existing Fall Creek Hatchery. The existing hatchery, located 25 miles inland from Waldport, has been converted from a production facility to a research center. This project complies with State of Oregon

sustainable design mandates and the Oregon Department of Energy SEED requirements. The facility was designed to meet three major program goals:

- Understand mechanisms that may create differences between hatchery and wild salmon and steelhead
- Develop approaches to best manage differences to meet fishery and conservation objectives.
- Help Oregonians understand the role and performance of hatcheries in responsibly using and protecting Oregon's native fish.

Tetra Tech's team was selected to perform programming, design, bidding, construction administration and closeout services for the Hatchery Research Center project. The project included programming to meet the planned research objectives; site surveying and mapping; floodplain determination; site utility evaluation; and facility design. The hatchery features a NOAA-compliant fish way and intake screening system, four artificial stream channels for long-term studies, a learning research building, a dormitory, a maintenance shop, restrooms, storage and residences. Infrastructure improvements included hatchery water supply and distribution, with a settling pond and disinfection; domestic water supply with treatment, storage and distribution; and collection, treatment and disposal of hatchery and domestic wastewater.

A new river intake with associated facility piping capable of diverting creek water to the scientific programs in the tank farm and **simulated streams** was the key engineering design element. The circulatory system required initial settling of unacceptable silt loads, screening of leaves and debris, and disinfecting critical portions of fish pathogens in several areas of the facility operations (flow diagram below). Custom designed research facilities included four 200-foot-long simulated stream channels. Several sizes of fiberglass round tanks from 3 foot to 12 foot diameter can be configured in flexible arrangements with quick connects to an underground pipe system for supply, drain and cleaning waste conveyance.



The new research building is 18,000 sf, including wet lab, quarantine lab (with effluent disinfection) and dry lab facilities. A 10,000 square foot tank farm area is located adjacent to the new research building. (Underground piping system is shown under construction at right.)

Silt Settling Pond. Water diverted from Fall Creek via the new intake is routed to a flow splitter box where it can be routed directly to the central site, or to the silt settling pond.

Simulated Streams. Four concrete channels, 25 feet wide by 200 feet long, were constructed to contain the simulated stream improvements. Water flow at the stream inlets is controlled by a replaceable glu-lam beam weir. Design flows of 1 to 3 cfs per stream will vary seasonally, as does the natural stream flow in Fall Creek. An innovative air lift pumping system will recirculate

up to 1 cfs from the tail end to the head end of the streams during low flow periods. At the downstream end of the stream channels, a concrete chamber allows crowding and trapping of juvenile fish. Valves control whether the flow is routed to cleaning waste, the central site tank farm via re-use pipes, or allowed to overflow to Fall Creek.

A mixture of river gravels and woody debris was placed to provide improved habitat. Shade cloth suspended above the streams simulates tree cover.

See also attached article on the OHRC Project from Oregon State University.

Recirculating Aquaculture Systems Design, Franklin, ME

Client

US Dept. of Agriculture. Agricultural Research Service, Bill Wolters, (207) 422-2467

Duration

2005-2007

Construction Value

$13 Million

Team Member Roles on Project

- Brian Vinci, Process Engineer

Description of Services Provided

The National Cold Water Marine Aquaculture Center (NCWMAC) is a research facility established by USDA ARS to improve the efficiency and sustainability of coldwater marine finfish farming.

Challenge: Researchers wanted a flexible facility to raise Atlantic salmon from eggs to 4-year-old fish that met strict biosecurity standards. The nature of available water supply sources at the site necessitated the use of recirculation technologies. Additionally, all effluent from the facility had to be filtered, disinfected, and fish excluded prior to being discharged into the bay.

Solution: Eight separate production systems were designed, enabling the facility to culture 200+ salmon families. Seven recirculating systems, ranging in size from 1,000 to 5,000 L/min, were designed for the salmon breeding program. A disinfected surface water source and three wells onsite provide makeup water at a range of salinities (0–35 ppt) to all systems, satisfying individual bioplan requirements. Recirculating systems include microscreen filtration, biological filtration, carbon dioxide removal, supplemental oxygenation, ozonation, and ultraviolet treatments. The wastewater treatment system designed for the facility includes solids

filtration, thickening, and storage; fish and egg escapement prevention; and effluent disinfection.

Results: Construction of the facility was completed ahead of schedule in the spring of 2007. The fish culture systems were subsequently stocked with fish that were being raised in temporary facilities.

Hatchery Planning & Partial Water Reuse System Design, White River National Fish Hatchery, Bethel, VT

Client

USFWS Region 5 Fisheries Bioengineering and Process Engineering
Duncan Creaser / Dale Aubin
(413) 253-8297 / (413) 253-8230

Duration

2005 construction completed

Team Member Roles on Project

- Brian Vinci, Task Manager

Description of Services Provided

The hatchery was designed to raise Atlantic salmon smolts using 10,000 gpm of water from the nearby White River; however, this has never been realized due to lower than expected flows, poor water quality, and disease problems in the river. As a result, the hatchery had to cut back its production and obtain most of its water supply from wells.

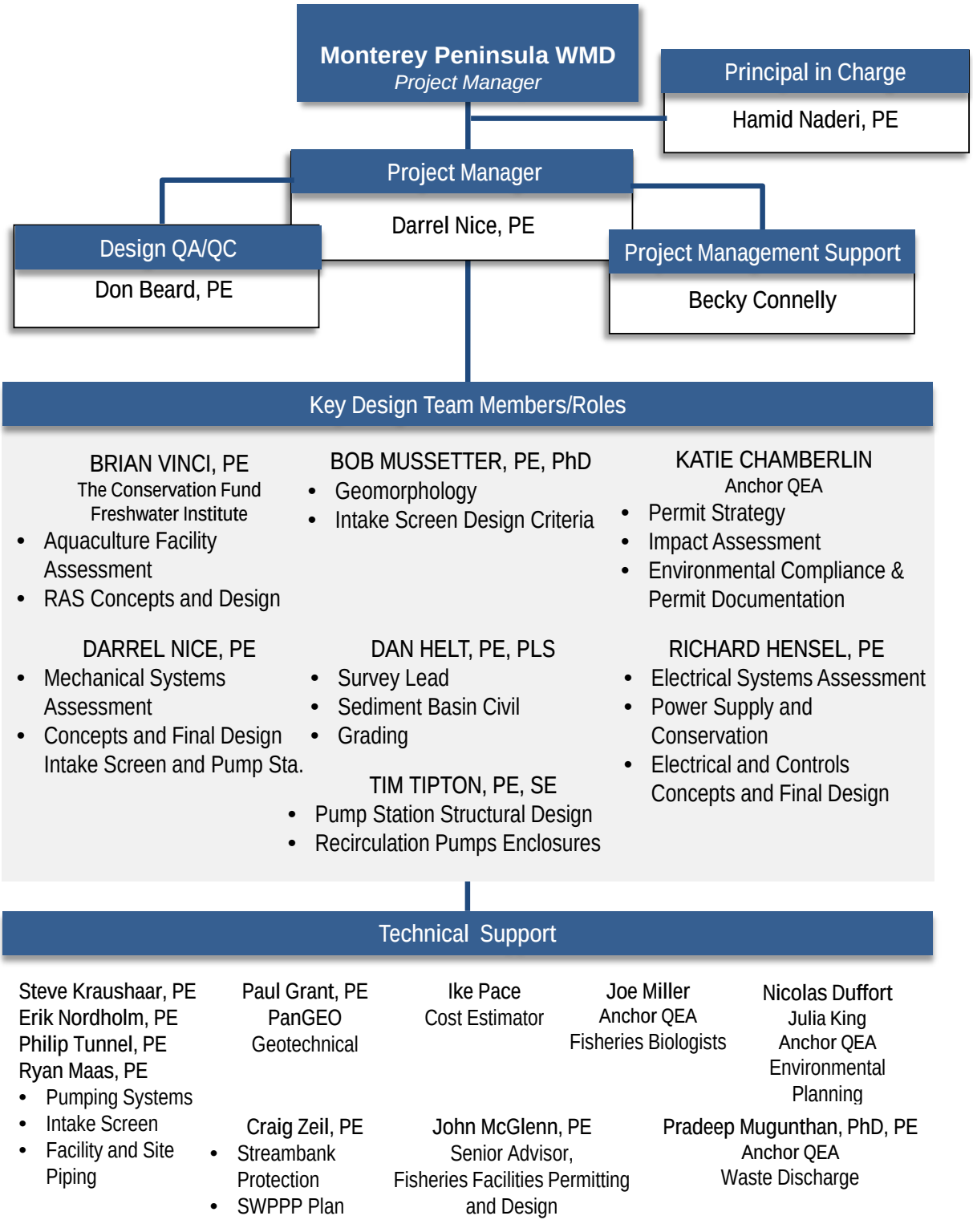
Partial water reuse technology was recommended for the hatchery to augment its limited water supply. Two partial water reuse systems were designed to accommodate the biological parameters of Atlantic salmon smolt production. Eight existing 30-ft diameter concrete fish tanks were retrofitted and refinished with fiber-reinforced plastic (FRP) coating, and a new building with water treatment equipment for both systems was designed.

Construction of the partial water reuse systems was completed in 2005. The systems allow the hatchery to utilize existing infrastructure and raise upwards of 200,000 Atlantic salmon smolts on just 640 gpm of well water. The new technologies reduce labor requirements by employing self-cleaning tank hydraulics, concentrate waste into a small effluent flow, and provide a major portion of the programmatic capacity the facility was originally intended to have.

2005 Carl V. Anderson Award of Merit Project –Association of Conservation Engineers

Resumes

Resumes are provided below in an order following the project organization chart (repeated here for reference).



TETRA TECH

Darrel J. Nice, P.E.
Project Manager

Darrel has experience in the planning, design and construction of a wide variety of civil engineering projects. These include projects related to fisheries design, stormwater planning and facilities design, pump station and hydraulic structure design, wastewater treatment and collection systems facility planning and design, hydraulic and hydrologic modeling, streets, park site design and residential and commercial land development.

Darrel has diverse technical expertise involving project engineering, design, inspection, surveying, and construction. His commercial construction experience helped him to better understand several aspects of the industry including client, consultant, contractor relationship and constructability considerations. Darrel was on the design team for the recently completed Chief Joseph Hatchery and he was Tetra Tech's on site engineer throughout the three-year construction of this $50 million complex near Bridgeport, WA. His design experience includes all aspects of civil and process mechanical design from private subdivision to regional wastewater treatment facilities.

EXPERIENCE

Tribal Resident Fish Hatchery – Circular Tank Fish Rearing, Colville Confederated Tribes, WA, Current – Project Manager for design of a circular fish culture tanks system at the existing trout hatchery. Design single supply dual drain circular tanks configured to meet the rainbow trout fish criteria. Incorporate the use of existing LHO's and connection of the system to the existing supply and drain piping.

Walla Walla Spring Chinook Hatchery, Bonneville Power Administration and Confederated Tribes of the Umatilla Indian Reservation, Milton-Freewater, OR, Current – Project Design Manager for analysis and design of architectural, electrical/controls, HVAC/plumbing; and structural efforts for incubation, early rearing, grow-out and related support facilities. The design includes river intake pump station, utility water supply systems, groundwater supply system and water quality for domestic use on-site; effluent ozone-gas generation and side stream disinfection, storage, handling and chemical feed system and adult broodstock collection and handling at the Nursery Bridge fish ladder facility.

Twin Rivers Hatchery, Kootenai Tribe of Idaho (KTOI), Bonners Ferry, ID, 2012 to 2014 – Project Engineer and onsite representative for construction of the $16 million Twin Rivers and Tribal Hatcheries, including water intakes off the Kootenai and Moyie Rivers, intake pump stations and force main to the Hatchery, influent and effluent treatment basins, hatchery effluent piping, and site work. The Twin Rivers Hatchery includes a new 13,500 square feet building with filtered and UV treated process water systems including heated, chilled, and ambient ground and river water systems.

Chief Joseph Dam Hatchery, Confederated Tribes of the Colville Reservation Bridgeport, WA, 2004 to Present – Civil Engineer for the project. During Step 1, he assisted with conceptual site and utility plans at the hatchery and six acclimation sites located along the Okanogan River. In Step 2 Darrel assisted with site plans, piping plans, and coordination of survey and permitting tasks. Darrel was in charge of designing the well water pumping and conveyance system, housing site design, and design of the acclimation sites. Development of

Project Role:

Project Manager
Mechanical Systems Assessment
Concepts and Final Design of Intake Screen and Pump Station

Education:

B.S., Mechanical Engineering, Washington State University, 1991

Registration/Certification:

Mechanical Engineer, Washington, No. 35304

Professional Affiliations:

American Waterworks Association

Years of Experience:

21

Years with Tetra Tech:

14

Areas of Experience:

Pipeline and Pumping Systems

Process Water Systems

Hydraulic Analysis and Hydraulic Structures

Construction Engineering and Management

Field Testing and Commissioning

Site Work and Facility Design

Chemical Storage and Dosing Systems

Water Supply Systems

On Site Sewer Design

Storm and Wastewater Conveyance Systems

two new acclimation sites included designing screened intakes in the Okanogan River. Four of the acclimation sites consisted of an existing water storage and pumping facility that required upgrades for reliable and safe fish rearing. He designed water supply for both potable and fishery use, and onsite wastewater disposal for the hatchery staff buildings. Water supply is a significant engineering effort as it includes three sources, each of which are required to produce in excess of 20 cfs. One of the sources, a dam relief tunnel, required constructing a pump station within a new concrete wetwell/drywell that is 24 feet diameter and 80 feet deep.

Darrel oversaw the final design of the water supply system design including transient analyses for five proposed water distribution pipelines including a 12,900LF HDPE pipeline with a diameter ranging from 14-42 inch diameter and with a peak flow rate of 40 CFS; a 36-inch steel and HDPE pressure pipeline from the reservoir with peak flow of 60 CFS; a 24-inch steel and HPDE pumped transmission line with 3600 LF and a peak flow of 20 CFS, as well as two shorter acclimation pond supply pipelines.

During construction, Darrel was the Owner's onsite representative and quality assurance engineer. He also worked with the hatchery manager to find and design functional modifications that better fit the final program and work these updates into the construction schedule. As construction neared completion, Darrel was responsible for writing operations manuals. Darrel continues to assist Pat Phillips, Hatchery Manager, with warranty items as they occur.

Penticton Sockeye Reintroduction Project, Okanagan Nation Alliance Enterprise Ltd, Westbank, BC, Current – Project Engineer performing construction administration for Penticton Hatchery improvements for annual production of up to 8 million sockeye salmon to support long-term reintroduction of the species into the upper Okanagan River system.

Solomon Gulch Hatchery Upgrades, Prince William Sound Aquaculture Corporation, Valdez, AK, Current – Project Engineer for design of major improvements to an existing pink and coho salmon hatchery. Improvements include upgrades to the water supply system to allow for expansion to approximately 300 million egg capacity for the pink salmon program.

Cassimer Bar Hatchery, Confederated Tribes of the Colville Reservation, Brewster, WA, 2006 – Civil Engineer for evaluation and recommendation of improvements of a Kelt hatchery located near Brewster WA. The project consists of performing engineering services to expand the existing facilities at Cassimer Bar Hatchery from the present 80,000-smolt capacity to rear a minimum of 200,000 steelhead smolts and to recondition at least 200 steelhead kelts. The primary purpose of the project is two-fold: 1) to provide a site planning document showing the general arrangement and orientation of a multi-use incubation, rearing and office building; a double-wide manufactured home; a concrete pad for a temporary mobile home plus the outdoor raceways and tanks, piping systems and related infrastructure necessary to support the smolt rearing and kelt reconditioning programs; and 2) construction documents for the multi-use building to accommodate incubation, early rearing, and a staff office space.

Mt Spokane Road Improvement, Washington State Parks and Recreation Commission, Mt Spokane, WA, 2001 – Project Engineer supporting the Tetra Tech effort to perform study level and design level services for the hydrology and utility elements of 10 miles of road improvements within Mount Spokane Park. These services included public meetings, streambank protection, utility coordination/relocation, fish passage, hydrologic modeling of 15 square miles of mountainous terrain, and cost estimating. Design was performed according to WA State Park, WSDOT, Spokane County, WA, State Department of Ecology, and WA Department of Fish and Wildlife guidelines.

Crewport and Buena Water System Improvements, Yakima County Public Works Yakima, WA – Project Manager for this Yakima County Public Works project to provide design and construction administration assistance for improvements to Crewport Water System and Buena Water System. Scope of services included evaluation of alternatives for replacement of an existing 50,000-gallon elevated steel water storage tank. Scope included plans and technical specifications for a new 250,000-gallon Crewport water reservoir, site piping, structural design of the foundation, and FAA top mounted obstruction lighting; plans and specifications for the Crewport well house electrical wiring, pump controls, monitoring and recording equipment, and autodialer; Scope also included specifications for the Buena pump controls, connections to existing monitoring and recording equipment, and connection to autodialer.

TETRA TECH

Donald R. Beard, P.E.

Director, Senior Civil Engineer

Don Beard is a civil engineer with experience in fisheries projects, utility systems, hydraulic and hydrologic studies, and water and wastewater treatment facilities. Since 1972, Don has participated in all phases of the design process, including feasibility studies, master planning, preliminary and final design, contract documents, construction administration, onsite observation and start-up. As a project leader, he has been responsible for design projects in Alaska, Washington, Oregon and overseas. He has extensive experience in Alaska with particular emphasis in design for cold remote regions.

EXPERIENCE

Walla Walla Spring Chinook Hatchery, Bonneville Power Administration, Confederated Tribes of the Umatilla Indian Reservation, Current – Design Manager for preliminary design of a new hatchery to rehabilitate and enhance Chinook salmon runs in portions of Columbia-Walla Walla River systems. Hatchery to produce 500,000 spring Chinook for release at the hatchery site and other locations along the South Fork of the Walla Walla River.

Nome Central Incubation and Rearing Facility, Norton Sound Economic Development Corporation, Nome, AK, Current – Project Manager for planning and design of a new hatchery in the vicinity of Nome. The project is an integral part of NSEDCs plans to restore depleted subsistence stocks around Norton Sound and provide the economic benefits of enhanced fisheries. Preliminary programming is aimed at restoration of about six stocks of chum, coho and chinook salmon and enhancement of commercial coho and chum fisheries in the sound.

Main Bay Hatchery Improvements, Prince William Sound Aquaculture Corporation, Current – Project Manager for design and construction assistance of new warehouse/apartment building and replacement hydroelectric turbine at a remote hatchery in Prince William Sound. The new turbine will produce about 200 kw while providing design flows of about 20 cfs to the hatchery

Evaluation of Gunnuk Creek Hatchery, Northern Southeast Aquaculture Association, 2013 – Project Manager for review of a private non-profit facility being evaluated for renovation. The project included preliminary scoping of upgrades required to produce 30 million chum salmon with a surface water supply that presents temperature and turbidity challenges.

Frazer Lake Fish Pass Improvements, Alaska Department of Fish and Game, Kodiak Island, AK, Current – Project Manager for the design of upgrades to an existing fish pass system that was installed in the 1960s to create a sustainable sockeye return to a previously-non-anadromous lake remotely located in the Kodiak National Wildlife Refuge. The goals of project include renovation of a deteriorating adult fish weir and improving the geometry and water flow characteristics of the ladder entry to reduce bear predation. Constructability and access are major issues in the design.

Hatchery Evaluations of Nine Salmon Hatcheries, Alaska Department of Fish and Game, 2011 – Project Engineer for civil and hatchery process reviews of State-owned facilities presently operated by private non-profit organizations throughout Alaska. Project included field investigations of existing conditions and development of summary reports for each facility.

Project Role:

Design QA/QC

Education:

M.S., Sanitary Engineering, University of California, Berkeley, 1971

B.S., Civil Engineering, University of California, Berkeley, 1970

Registrations/Certifications:

Civil Engineer, AK, 1976 (AK Registration #CE4225)

Civil Engineer, WA, 1975

Professional Affiliations:

Member, American Society of Civil Engineers (ASCE)

Member, Association of Conservation Engineers (ACE)

Office:

Juneau, Alaska

Years of Experience:

40

Years with Tetra Tech:

39

Key Areas of Experience:

Fisheries

Municipal Facilities

Water Supply Systems

Wastewater Systems

Construction Administration

Macaulay Salmon Hatchery Expansion, Douglas Island Pink and Chum, Inc., Juneau, AK, 2011-Current – Project Manager for design of a new raceway building and a warehouse building to allow for expansion of chinook and coho production and consolidate maintenance and storage operations at an existing hatchery and visitor center. The raceway building includes an elevated walkway for accessible visitor viewing of coho and chinook fingerlings.

Cannery Creek Hatchery Improvements, Prince William Sound Aquaculture Corporation, 2010-Current – Project Manager for design and construction assistance of new incubation building, fuel storage and diesel generation facilities at a remote hatchery in Prince William Sound. The new incubation building will accommodate expansion of the pink salmon production to approximately 300 million.

Kitoi Bay Hatchery Improvements, Kodiak Regional Aquaculture Association, Afognak Island, AK, 2010-Current – Project Manager for planning and design of improvements to the hatchery, which was originally constructed in the 1960s. Major new facilities include: bunkhouse upgrades, a new sockeye incubation and rearing building, a new pink incubation building and replacement of water supply piping and old hatchery water systems.

Pillar Creek Hatchery Improvements, Kodiak Regional Aquaculture Association, Kodiak, AK, 2010-Current – Project Manager for planning and design of improvements to the hatchery. Major new facilities include: a new oxygen generation building, roof structures over both sockeye and sportfish raceways, and repairs to the aging incubation building.

Solomon Gulch Hatchery Upgrades, Prince William Sound Aquaculture Corporation, Valdez, AK, Current – Project Manager for design of major improvements to an existing pink and coho salmon hatchery. Improvements include upgrades to the water supply system to allow for expansion to approximately 300 million egg capacity for the pink salmon program.

Chief Joseph Dam Hatchery, Confederated Tribes of the Colville Reservation, Bridgeport, WA, 2002-2012 – Design Manager for preliminary design of a new hatchery to rehabilitate and enhance chinook salmon runs in portions of Columbia-Okanogan River systems. Hatchery to produce 3 million summer and spring chinook for release at the hatchery site and to new and retrofitted acclimation ponds along the Okanagan River.

Sawmill Creek Hatchery, Northern Southeast Regional Aquaculture Association, Sitka, AK, 2007 – Project Manager, assisted NSRAA with preliminary design of elements of a new coho salmon production facility located at the former site of a pulp mill in Sitka, Alaska.

Cedar River Sockeye Hatchery, Seattle WA, 2006–2012 – Project Engineer for preliminary design and oversight reviews of sockeye salmon hatchery on the Cedar River east of Seattle. The project was designed to produce approximately 34 million sockeye fry for release into the Cedar River system entering Lake Washington.

Water Treatment Equipment, Sheldon Jackson Hatchery, Sheldon Jackson College, Sitka, AK, 2003 – Project Engineer for assistance with equipment acquisition and installation to upgrade water quality at existing research and educational hatchery.

Fish Ladder Replacement, Solomon Gulch Hatchery, Valdez Fisheries Development Association, Valdez, AK – Project Manager for design of a new fish ladder at a relatively large pink and coho salmon hatchery.

Yana River Hatchery, Magadan-Nikkeiren, Joint Venture, Magadan Province, Russian Far East – Project Engineer from conceptual design through construction of a hatchery facility designed to produce 30 million chum salmon fry and 800,000 coho salmon fingerlings for release to the Sea of Okhotsk.

Kasilof Salmon Hatchery, Alaska Department of Fish and Game, Kasilof, AK – Project Engineer for design of water system improvements for sockeye and king salmon incubation facility, including a new water intake structure, a settling and filtration system, and additional adult holding facilities; significantly reduced water quality problems that had seriously impacted the success of the hatchery's operations.

Chinook Expansion, Hidden Falls Hatchery, Alaska Department of Transportation and Public Facilities, Baranof Island, AK – Project Manager, schematic design through construction services for $2.0 million in improvements to water supply system and fish rearing facilities, including installation of large-diameter siphon and addition of (38) 20-ft-dia tanks.

Brian J. Vinci, Ph.D., P.E.

Senior Engineer

EXPERIENCE

Chelan County Public Utility District Fisheries Bioengineering and Fish Health Services, 2007 to Present

Chiwawa Hatchery Pilot Reuse System Design, Design Engineer—Completed the process engineering design for a steelhead rearing system based on water reuse technologies. Sub-tasks included the incorporation of existing infrastructure to allow new technology and water conservation measures. Project included the preparation of a conceptual design report and drawings and specifications for the public bid process. Worked with PUD engineers and the PUD's selected A/E firms to complete the bid documents. Commissioned the facility and provided operational support during the first year of operation.

Chelan Falls Rearing and Acclimation Facility Rearing Tank Design, Design Engineer—Completed the rearing tank design for a Chinook salmon rearing and acclimation facility based on dual-drain circular tank technology. Sub-tasks included the incorporation of radial flow settling units and volitional and forced release design features. Project included the preparation of a conceptual design report and drawings and specifications for the public bid process. Commissioned the facility and provided operational support during the first year of operation.

USFWS Region 5 Fisheries Bioengineering and Process Engineering, 1999 – Ongoing

Region-wide Hatchery Evaluation and Planning, Project Manager—Project manager for a region-wide study of the existing conditions, capacity, and needs of the hatcheries and technology centers in the Northeast region. In cooperation with internal staff and FWS staff, developed a feasibility study report for each facility that fully details the program, priority needs, and presents conceptual designs for facility improvements. Feasibility reports were successfully used to secure funding for priority projects identified.

Craig Brook NFH Wastewater Treatment Design, Project Manager—Project manager for the process design of a wastewater treatment system to treat 2,400 gpm of effluent from this flow-through salmon culture facility. Worked as part of a team to develop a design that addresses solids and nutrient removal, pathogen containment, fish exclusion, and manure management.

White River NFH Hatchery Renovation Design, Task Manager—Managed the process engineering for multiple water treatment projects at this hatchery. Sub-tasks included the re-design of all hatchery mechanicals and the renovation of existing infrastructure to incorporate new technology and water conservation measures. The partial water reuse system designed incorporated conservation hatchery protocols and water conservation strategies. The system was constructed and commissioned in 2003. The system design was documented and reported in a scientific journal publication. The design and construction of the partial water reuse system was awarded the Association of Conservation Engineers Conservation Engineering Award of Merit in 2005.

Recirculating Aquaculture Systems Design, Franklin, ME—Process Design Engineer for eight separate production systems to enable the facility to culture 200+ salmon families. Seven recirculating systems, ranging in size from 1,000 to 5,000 L/min, were designed for the salmon breeding program. A disinfected surface water source and three wells onsite provide makeup water at a range of salinities (0–35 ppt) to all systems, satisfying individual bioplan requirements. Recirculating systems include microscreen filtration, biological filtration, carbon dioxide removal, supplemental oxygenation, ozonation, and ultraviolet treatments. The wastewater treatment system designed for the facility includes solids filtration, thickening, and storage; fish and egg escapement prevention; and effluent disinfection.

Project Role:

Recirculating Aquaculture System Specialist

Education:

Ph.D., Biological and Environmental Engineering

M.E./B.S., Agricultural and Biological Engineering

Registrations/Certifications:

Professional Engineer, NY, PA

Office:

West Virginia

Years of Experience:

22

Years with The Freshwater Institute:

15

Key Areas of Experience:

Bioengineering

Northwest Hatchery Facility Design

Environmental Regulations of Fisheries Facilities

TETRA TECH

Bob Mussetter, PhD, PE

Principal Hydraulic Engineer

Dr. Mussetter has over 30 years of experience in analysis and design for a broad range of water-resource and civil engineering projects. His primary area of expertise involves integration of hydrology, hydraulic engineering, and river mechanics with fluvial geomorphology to solve river stability, flooding, and environmental problems. His experiences includes projects throughout the United States and internationally involving a broad range of stream types and physical environments, varying in scope from collection and analysis of field data through development and application of mathematical models to evaluate sediment transport in both sand-bed and gravel-bed systems. He has extensive experience with the full suite of hydrologic, hydraulic and sediment transport models, including HEC-HMS, HEC-RAS (including the developmental, beta-test Version 4.2), HEC-6 and HEC-6T, RMA-2V, FLO-2D, and SRH-2D, and many other similar models. Dr. Mussetter is nationally recognized as an expert in hydraulic and sediment transport analysis, and in that context has conducted several Independent Technical Reviews of related studies for the Sacramento, Seattle and Los Angeles Districts of the Corps of Engineers.

Project Role:

Geomorphology

Intake Screen Design Criteria

Education:

Ph.D./1989/Civil Engineering

M.S./1982/Civil Engineering

B.S./1976/Civil Engineering

Registrations/Certifications:

Registered Professional Engineer: 1983/Colorado, 1984/Arizona, 1984/Montana, 1994/New Mexico, 1998/Idaho, 1995/South Dakota, 1999/ California, 2002/Texas, 2005/Wisconsin, 2006/Louisiana

Professional Affiliations:

American Society of Civil Engineer

American Water Resources Association

American Academy of Water Resources Engineers (Diplomate)

American Geophysical Union

Office:

Fort Collins, Colorado

Years of Experience:

35

Years with Tetra Tech:

21

RELEVANT EXPERIENCE

San Clemente Dam Retrofit Study, Carmel River, Carmel, California (2007) Principal Engineer and Project Manager for a detailed study of the potential impacts on flooding, river stability and instream habitat in an 18-mile reach of the Carmel River associated with various options for retrofitting San Clemente Dam to meet seismic safety standards. Project responsibilities included study plan development, supervision of subcontractors for topographic and bathymetric surveys and reservoir sediment sampling, collection of sediment and other physical data, hydraulic (HEC-RAS) and sediment transport (HEC-6T) modeling, and interpretation of model results. His responsibilities also included extensive coordination and communication with agencies and interest groups concerned with public safety, water supply, instream habitat and endangered species issues. The study was performed for the California Department of Water Resources and California-American Waterworks Company.

San Clemente Dam Removal and Carmel River Reroute, California: Design Build (Ongoing) Engineer-of-Record for design of the reconstructed Carmel River channel through the former impoundment of San Clemente Dam, as part a design-build team led by Granite Construction and Kleinfelder. The work is culmination of the decisions made from the studies performed for the above project description, and is also being performed for the California-American Waterworks Company. Specific responsibilities include hydrologic analysis, 1-dimensional and 2-dimensional hydraulic modeling, sediment transport analyses, and use of the results to design a stable stream channel that provides passage for steelhead in the reconstructed segment of the river.

Two-dimensional Hydrodynamic and Sediment-transport Analysis of the Sacramento River in the Vicinity of the M&T Pump Intake at RM192.5 (2011) Principal Engineer and Project Manager for a study to evaluate hydraulic and sediment transport conditions in the vicinity of the M&T pump intake at RM 192.5 on the Sacramento River near Chico, CA, and to design habitat-friendly channel protection measures to mitigate the effects of sediment deposition on pumping and fish screen operations. Project responsibilities included managing hydrologic (HEC-FFA), hydraulic (UNET, HEC-RAS, RMA-2V) and sediment transport analyses of existing conditions and with-design conditions that consisted of series of eight spur dikes that are intended to prevent further bank erosion and bar development at the Mouth of Big Chico Creek. Coordinated physical modeling of the site with subconsultant Colorado State University. The project was conducted as part of a CALFED grant for Ducks Unlimited.

Project Manager and Principal Engineer, San Joaquin River Restoration Program and Settlement Agreement, Various Locations, CA, California Dept. of Water Resources (Ongoing) Project Manager and Principal Engineer for a multi-year IDIQ contract with the California Department of Water Resources to provide water resources engineering and geomorphology services to support restoration for the upper 150 miles of the San Joaquin River. Project elements have included: development of HEC-RAS, Steady and Unsteady models of the river and bypasses, appraisal-level design and cost estimates for restoration, including fish screens and fish passage structures, analysis of non-damaging flow capacities for the levees and flood damage assessments,.

Hydraulic and Sediment-transport Evaluation, Uintah Water Conservancy Plumping Plant, Utah (2009) Project Manager and Principal Engineer for a hydraulic and sediment-transport evaluation to assist in design of the Uintah Water Conservancy Pumping Plant on the Green River near the Ouray National Wildlife Refuge in Utah. Project consisted of the two-dimensional modeling of the area to evaluate the sediment-transport and local scour conditions at the site and development of recommendations for bank protection measures that are compatible with the needs of endangered fish species while protecting the pumping plant and associated infrastructure.

Sediment-transport Analysis of the Gila River at the Proposed AWSA Diversion Site (2014) Principal Engineer and QA/QC for a study to evaluate the hydraulic, geomorphic and sediment-transport conditions of the Turkey Creek project reach. The evaluation included updates to the hydrologic analysis that was conducted for previous studies and a site reconnaissance of the project reach to identify the most suitable location for the diversion structure and to conduct sediment sampling. The evaluation also included topographic and bathymetric surveys, development of hydraulic and sediment-transport models, and an assessment of suspended-sediment loads and incipient motion conditions. The hydraulic modeling was performed using HEC-RAS and the sediment-transport modeling was conducted using HEC-6T and included a 50-year simulation of existing (baseline) and with-project conditions. Project was completed under a subcontract with Bohannan Huston for the New Mexico Interstate Stream Commission.

Katie Chamberlin

Managing Environmental Planner

Ms. Chamberlin has 10 years of experience, specializing in federal, state, and local environmental permitting and regulation, as well as in preparation of state and federal environmental documentation related to waterfront development, sediment management, and transportation. She has managed complex Environmental Impact Statements (EISs) and Environmental Impact Reports (EIRs) for the National Park Service and the U.S. Army Corps of Engineers (USACE) in the San Francisco Bay Area and Sacramento Delta, respectively. She has significant experience in developing permitting strategies for projects located in the coastal zone, and routinely leads permitting efforts related to waterfront development and maintenance projects for numerous marinas, ports, and ferry operators throughout California. Ms. Chamberlin formerly worked as a Federal Project Manager for the Washington State Department of Ecology, where she reviewed projects for compliance with Section 401 of the Clean Water Act (CWA).

EDUCATION

M.A., Marine Affairs, University of Washington, 2004

B.A., International Studies, University of Washington, 2002

Project Experience

Marina Maintenance Dredging and Restoration

City of Martinez, California

Ms. Chamberlin led the environmental permitting process for replacement of a breakwater wall, maintenance dredging, and upland placement of dredged material at the Martinez Marina. She worked with the Dredged Material Management Office to obtain a Section 404 Nationwide Permit from USACE, Section 401 Water Quality Certification from the San Francisco Bay Regional Water Quality Control Board (RWQCB), and a Minor Permit from the San Francisco Bay Conservation and Development Commission (BCDC). She successfully completed California Endangered Species Act (CESA) consultations for longfin smelt (*Spirinchus thaleichthys*) and delta smelt (*Hypomesus transpacificus*) with the California Department of Fish and Wildlife, and federal Endangered Species Act (ESA) consultations for salt marsh harvest mouse with the U.S. Fish and Wildlife Service (USFWS) as well as for salmonids with the National Marine Fisheries Service (NMFS). Working closely with USFWS, Ms. Chamberlin also negotiated and developed the mitigation plan for salt marsh harvest mouse (*Reithrodontomys raviventris*) habitat at a nearby park site.

Project Experience (Continued)

San Francisco Bay to Stockton Navigation Improvement Study *Port of Stockton* *Stockton, California*	Ms. Chamberlin is assisting the Port of Stockton by providing regulatory and permitting support, assisting in developing the California Environmental Quality Act (CEQA)/National Environmental Policy Act (NEPA) document, and providing general technical support for the San Francisco Bay to Stockton Navigation Improvement Study. The project involves deepening the federal navigation channels that span from the San Francisco Bay to the Port of Stockton. In this role, Ms. Chamberlin provides ongoing coordination and review related to the project's impacts on ESA and CESA-listed species and their habitat, sediment management issues, salinity mitigation, and other complex regulatory permitting issues.
Sacramento River Deep Water Ship Channel Supplemental EIS/Subsequent EIR *USACE* *San Francisco, California*	Ms. Chamberlin led the development of the Sacramento River Deep Water Ship Channel (SRDWSC) EIS/EIR. The project involved deepening the SRDWSC to -35 feet mean lower low water for a span of 35 miles. In this role, Ms. Chamberlin was the primary point of contact with USACE and the Port of West Sacramento and managed the team of authors of the EIS/EIR. Ms. Chamberlin also coordinated with the USFWS, NMFS, and California Department of Fish and Wildlife on ESA and CESA issues, respectively, associated with the deepening project.
West Complex Rail Line Extension *Port of Stockton* *Stockton, California*	Ms. Chamberlin is leading the permitting process for the Port of Stockton's West Complex Rail Line Extension project. The project involves permanent fill of waters of the United States and freshwater emergent wetlands in order to construct two railway crossings. The project area is considered potentially suitable habitat for the giant garter snake, a federal and state threatened species. Ms. Chamberlin led the consultation with the USFWS to address potential project impacts to the giant garter snake.
San Francisco Bay Long-term Management of Strategy Facilitation *USACE* *San Francisco, California*	Since 2009, Ms. Chamberlin has facilitated the San Francisco Bay Long-term Management Strategy (LTMS) program, which is focused on dredging and sediment management policies in the San Francisco Bay. Ms. Chamberlin facilitates meetings, prepares technical white papers, and coordinates symposia on various technical issues key to the concerns of the LTMS, including beneficial reuse of dredged sediment, the protection of endangered and threatened species during dredging and upland placement activities, and dredging policy, among others.

TETRA TECH

Dan Helt, PE, PLS

Survey Manager/Project Engineer

Dan Helt is experienced in both civil engineering and land surveying aspects of construction and land development projects. He has designed and prepared both small and large federal, municipal, commercial, and residential grading and drainage plans, as well as utility plans and project associated public improvement plans. Mr. Helt has prepared a variety of hydrology and hydraulic documents for review of analysis and compliance with codes and standards. He has prepared and reviewed specifications, calculations and other basis of design documents.

Mr. Helt has performed field boundary and topographic surveys, as well as construction staking, certification and monitoring, and ALTA/ACSM surveys. He has considerable experience researching boundary and chain of title information, and preparing legal descriptions.

Dan Helt has extensive knowledge in the use of Autodesk's Civil 3D software for both conceptual and detailed design studies, as well as the production of construction plan sets. He also has significant experience using Hydraflow and Hydraflow Express for flow modeling and storm routing and HEC-RAS, USEPA SWMM and Storm and Sanitary Analysis for stormwater system design and modeling.

EXPERIENCE

Boundary Surveys for NRCS Easements, Natural Resources Conservation Services, CA 2012-Ongoing – Survey Project Manager and Surveyor of Record responsible for providing boundary surveys for the Natural Resources Conservation Services (NRCS) Wetland Restoration and Protection (WRP) Easement Program. Tetra Tech was contracted by the NRCS to provide boundary surveys, legal descriptions and exhibits, and GIS data for 33 separate sites in 12 Northern California counties. Project sites range in size from 11 to 2871 acres and are mostly located in agricultural crop or grazing land. The survey work consists of performing field boundary surveys to define the parent parcel, and topographic surveys to define the WRP easement boundary. Once the boundaries are defined, legal descriptions and plats are produced to accompany warranty deeds, thus creating the easements. The final stage of the project includes monumenting the angle points of the easement. Tetra Tech will install easement witness posts at 500 foot intervals along the boundary of the easement. Once these tasks are completed, Tetra Tech will file Records of Survey for the boundaries in the county in which the WRP easement is located. Critical to this project is adherence to an aggressive schedule of 90 days for completion of each site's survey tasks. Mr. Helt's ability to organize field and office personnel, as well as dynamically track and change the project schedule with changing site and weather conditions, and the changing schedules of the NRCS and landowners, has been paramount to the continued success of the project.

Air National Guard Installation Boundary Mapping, National Guard Bureau, Various Bases, 2012-Ongoing – Survey Project Manager and Surveyor of Record for the southwestern portion of this national contract to establish boundary line locations, set monuments and file the appropriate documentation for existing Air National Guard bases across the United States. Some of the contracted tasks include courthouse and facility records research,

Project Role:

Survey Lead
Sediment Basin Civil Grading

Education:

B.S., Civil Engineering, Cal Poly, San Luis Obispo, 2003

Registrations/Certifications:

Professional Engineer, California, No.C69347

Professional Land Surveyor, California, No.8925

Professional Affiliations:

American Society of Civil Engineers

California Land Surveyors Association

Office:

San Luis Obispo, CA

Years of Experience:

11

Years with Tetra Tech:

Three

and field reconnaissance. Tetra Tech will be required to field tie existing property and controlling corners to geodetic coordinates. Additional tasks include data reduction, boundary resolution, calculations, mapping and setting final corner monuments for the subject properties. Of particular importance to the ANG is the organization of record information, along with the conversion and/or cataloguing of that information and the established boundary in GIS for use with SDSFIE 3.0, as mandated by the Air Force. Tetra Tech will also be responsible for helping the ANG develop a standard operating procedure so that personnel can better manage their GIS records keeping, as the real property boundaries associated with their various facilities and assets change in the future.

Control Network Establishment Survey Naval Air Station (NAS) Fallon, NAVFAC SW, Fallon, NV, 2014 – 2015 –Survey Manager responsible for overseeing the establishment of new horizontal and vertical control monuments and new values to existing control monuments at NAS Fallon. New monuments were set at key locations, to provide indivisibility and convenience of location for future construction projects. The new and existing monuments were observed with Static GPS and digital level loops meeting Federal Geodetic Control Committee (FGCC) standards for establishment of horizontal and vertical control networks and level loops. The data was then post processed using Trimble Business Center, performing a minimally constrained horizontal adjustment and a fully constrained vertical adjustment. A report detailing the survey procedure, the coordinates of the new points, the considerations in the adjustment, and the errors in the network was prepared. Other deliverables included an overall map for Fallon's Engineering and GIS Department to show graphically the establishment of the points and their locations, and datasheets showing photos of the monuments, a sketch of location, and coordinates of the point for use by installation personnel and distribution to contractors.

Templeton to Atascadero Connector, County of San Luis Obispo, Templeton, CA, 2014–Ongoing – Survey Manager responsible overseeing topographic and right-of-way survey services, and for coordinating with UPRR for survey site access. Tetra Tech is currently providing design services for a multi-use pathway including completing the California Environmental Quality Act (CEQA) and National Environmental Policy Act (NEPA) processes, right-of-way acquisition, permits, construction documents and grant administration. The ultimate goal of the pathway network is to provide connectivity between Templeton and Atascadero, facilitating safe and attractive transportation between these two towns and encouraging alternative transportation modes.

Topographic Mapping and Site Survey for P-327 F-35C Operational Training Facility, Naval Air Station (NAS) Lemoore, NAVFAC SW, Lemoore, CA, 2014 –Survey Manager responsible for providing topographic mapping and location of underground utilities in support of future construction of the FY15 F-35C Joint Strike Fighter Operational Training Facility. Mr. Helt attending a project kick-off meeting with NAVFAC to meet with personnel, review the scope of work, and coordinate access for ground personnel, as well as flyover clearance for the aerial data acquisition phase of the project. Field Survey work of hardscape areas was performed along with the setting of aerial targets. Essential to the successful completion of this project was the seamless and precise integration of the aerial topographic survey with the field surveyed data.

Map Checking Services, City of Pismo Beach, Pismo Beach, CA 2013–Ongoing – Contract City Surveyor responsible for providing map checking and certification services to the City of Pismo Beach. Responsibilities include plan checking Parcel Maps, Tract Maps, Certificates of Compliance and easement submittals for the City, and redlining submitted check prints in order to address necessary changes and/or omissions based upon the requirements of The Subdivision Map Act and local City Ordinances.

TETRA TECH

Richard Hensel, P.E.
Senior Electrical Engineer

Richard is an electrical and controls systems engineer with 22 years of experience in municipal utility, energy management, and industrial projects. Richard's electrical and controls design experience includes projects involving SCADA systems, water and wastewater automation, telemetry, power generation and distribution, and equipment power. His controls design and programming experience includes projects utilizing Programmable Logic Controllers (PLCs), communications networks, database servers, and graphics stations for process monitoring and control.

EXPERIENCE

Chief Joseph Hatchery, Colville Confederated Tribes, Bridgeport, WA 2008-2011 – Electrical Engineer. Performed the power system design and ongoing construction support for the hatchery facility and water supply The Hatchery is designed to produce 2.9 million salmon per year. Three separate water supply sources are being constructed, consisting of ground water wells, a reservoir outfall, and reservoir relief pump station. Also designed the power distribution and lighting systems for the hatchery building, visitor's center, fish ladder, relief pump station and equipment additions to the existing Chief Joseph dam spillway.

Mobile Wastewater Pumping System, City of Spokane, WA 2010-2011 – Electrical Engineer. Designed the power and control components for a trailer-mounted pumping system. Features include operation on a trailer mounted generator, variable frequency drives, and motor connection equipment that can support simultaneous operation of multiple combinations of two submersible pumps, each of varying sizes ranging from 100 hp to over 200 hp. The drives include selector switches that allow the parameters to be configured automatically for each combination. A simple float-based control system allows for duty-standby, fixed lead-lag or automatic alternation without the need for a PLC.

Kootenai Twin Rivers Sturgeon and Burbot Hatchery, Bonners Ferry, ID, 2013-2014 – Electrical Engineer. Provided control system, instrumentation, and SCADA system design for new site development and multi-building hatchery complex within existing Tribal campground property. Hatchery was for Sturgeon and Burbot rearing at the confluence of the Kootenai and Moyie Rivers. In addition to rearing and water treatment processes in the main hatchery, the site includes ground water well pumps, two river intake pump stations, each consisting of triplex variable speed submersible pumps, a booster pump station with filtration equipment, and a standby generator. The control system is based on a distributed PLC architecture running on a fiber optic Ethernet network. The SCADA system integrates the process controls with aspects of the building automation system (BAS).

Water Filtration Plant Chemical Feed SCADA, City of Everett, WA, 2007-2008 – Electrical Engineer provided SCADA programming for the upgrade to the Soda Ash, Alum and Liquid Polymer feed system at the Water Filtration Plant. Richard developed the program for the new PLC that was installed for the Hypochlorite System used to control the new chemical feeders. A new touch panel PC running a Wonderware SCADA software was installed in the chemical feed area to monitor and control the chemical feed pumps.

Water Treatment Plant SCADA, John W North Water Facility, City of Riverside, Grand Terrace, CA, 2008 – Electrical Engineer; provided the SCADA system design for the balance of plant systems, including a 1200

Project Role:

Electrical Systems Assesment
Power Supply and Conservation Electricaland Controls Concepts and Final Design

Education:

BS Electrical Engineering, University of Washington, 1992

MS Electrical Engineering, University of Washington, 1999

University of Washington, Network Engineering, Certification, 2007

Registration/Certifications:

Professional Engineer-Electrical
Washington, 2002, No. 38424
California, 2008, No. E18510
Oregon, 2014, No. 89631PE

Office:

Seattle, Washington

Years of Experience:

22

Years with Tetra Tech:

8 (8/2006)

Key Areas of Experience:

Wastewater, water system, industrial, and power generation projects

Design of electrical power and control systems

Plant control and SCADA system programming, start-up, and commissioning

PLC and embedded controller programming

combined hp booster pump station, sodium hypochlorite pretreatment, 1500 kW standby generator, membrane pre-filtration, and motor operated valves. Responsibilities included managing PLC control panel fabrication, developing Schneider-Telemechanique Quantum PLC and Wonderware HMI programming for all balance of plant systems, design of Ethernet and Modbus RS-485 serial networks, coordination with the City's existing radio telemetry infrastructure, integration with the membrane treatment vendor's control system, and start-up commissioning. Also provided on-site assistance to the electrical contractor and training to City personnel for system operation and software maintenance.

Irvine Ranch Water District As-Needed Contract, Irvine, CA, 2009-2010 – Electrical Engineer assisted in development and deployment of PLC programs based on District standard for water distribution SCADA system. Work included development of control strategies and PLC programs to control pump station and reservoir facilities.

Water Treatment Facility, Moclips River Estates, Quinault, WA, 2000-2002 – Project Electrical Engineer for this water treatment system, consisting of a well house, treatment building, booster pump station, and 95,000-gallon reservoir. The well house, located 1,200 feet from the treatment building, included 480V power and controls for a 15hp well pump. All monitoring and controls for the well pump, booster pumps, reservoir, and treatment building were designed to be handled by a single PLC. On-site monitoring and control set point adjustments were made through a touch screen type operator interface. A facility auto dialer provides alarm indication to off-site operations personnel. The design combined the convenience and flexibility benefits of modern automation technology with the client's desire to minimize complexity and maintenance costs.

Westridge Pump Station, City of Anaheim PUD, CA, 2012-present – ElectricalEngineer for evaluation of the existing hydraulics and control system to determine the reason for, and corrective actions of large discharge pressure swings. Project included hydraulic and mechanical equipment analysis as well as troubleshooting and reprogramming of the existing controls.

Gabbert Road Water Booster Station, City of Gresham, OR, 2000-2002 – Electrical Design Engineer and electrical project manager for this new booster station. The station is designed to operate in an alternate reservoir fill mode in addition to the normal pressure boosting mode. Developed a control system configuration that allowed precise control of pressure by variable speed control of a lead 10hp and lag 30hp pump using a process controller. The station design fully automated by telemetry. Emergency power can be provided by a portable generator via kirk-key interlock with the main service breaker.

Machias Water Booster Pump Station, Snohomish PUD, Everett, WA, 2000-2002 – Project Engineer for this water booster pump station. The station consisted of (2) 60 hp VFD driven pumps with provision for (3) additional 60 hp pumps. The design included emergency generator receptacle and manual transfer switch to allow operation of critical station equipment by a mobile generator. Designed the control equipment to include an automatic adjustment of the DC undervoltage trip setting of the VFDs to allow reliable operation when running on generator power.

Water Filtration Plant Clearwell Addition, City of Everett, WA, 2005-2007 – Electrical Engineer responsible for the Allen Bradley Controllogix PLC programming and start-up support for the Backwash Pump Station. The Backwash Pumps were programmed to start and stop when commanded during a filter backwash cycle. All Operator Interface panels and the new PLCs were connected on a new fiber optic Ethernet network. The new Controllogix PLC communicated with the Plant's older Siemens 505 PLC using an Ethernet/IP communications module.

Water Filtration Plant PLC Replacement, City of Everett, WA , 2013-Present – As the Electrical Engineer Richard contributed to the design for the PLC conversion project in progress at the Water Filtration Plant's hypochlorite disinfection facility. As the lead control system programmer he is also responsible for the programming and commissioning of the new high-capacity replacement PLC. The new PLC is a redundant controller and communicates over an industrial Ethernet network with several touch panel operator interface terminals located throughout the Plant, as well as with a pair of SCADA master workstations located in the operations room.

TETRA TECH

Tim Tipton, P.E., S.E.
Senior Structural Engineer

Tim began his career in engineering in early 2007 as an engineering intern for Tetra Tech, where he was signed full time after graduating from Seattle University. Since graduation, his work has brought him a variety of project experience involving structural design, specifications and drawing development.

EXPERIENCE

Kootenai Sturgeon Burbot Hatchery, Fish Conservation Aquaculture Program, Bonners Ferry, Idaho, 2013 – Structural design engineer for the expansion of an existing hatchery as well as the design of a new hatchery. Structures included two pre-engineered vehicle storage buildings, masonry hatchery building, wood construction staff residences, below grade concrete influent basin, masonry influent pump station, below grade concrete effluent basin and two river intakes. Performed design on the staff residence and the hatchery building, coordinated structural drawings with all disciplines, and provided construction administration.

Cannery Creek Hatchery Expansion, Prince William Sound Aquaculture Corp, Valdez, Alaska, 2013 – Structural Design Engineer for the expansion of the Cannery Creek Hatchery. The expansion consisted of decommissioning eight 100' long raceways and capping them with a new structural floor for the 100'x100' incubation and processing rooms. The new building is a pre-engineered metal building and is supported on a combined system of existing raceway walls and new footings. A new set of raceways was designed to replace the old raceways. Analyzed the foundation system with RISAFoot using the loads supplied by the metal building manufacturer. Coordinated the metal building with the new foundation, a new stair tower, and the architectural and mechanical systems.

Chief Joseph Hatchery, Confederated Tribes of the Colville Reservation, near Bridgeport, WA, 2009-2013 – Design Engineer for structural engineering for the Chief Joseph Hatchery and evaluation of the existing Chief Joseph Dam on the Columbia River. Evaluation work included the existing 165-ft-deep and 220-ft-tall concrete dam monolith and a previously designed 48-ft-diameter and 80-ft-deep secant pile shaft, both of which were modeled using finite element analysis. Performed structural design of the Hatchery including raceways, vaults, platforms, hatchery building, and storage building. Most of the design was completed and verified using RISA-3D. The main structural elements in this project included concrete footings, elevated slabs, shear walls, concrete and steel columns and beams, metal roof decking with steel joist girders, and plywood roof decking with glulam girders and lumber purlins. This project was large and had a diverse amount of structural systems and materials.

DIPAC Design Services, Macaulay Fish Hatchery Expansion, Juneau, Alaska, 2011-2012. – Structural design Engineer for the expansion of the Macaulay Fish Hatchery, which consisted of three structures: the raceway building, a pedestrian bridge from the existing hatchery to the raceway building, and the warehouse building. Structural design consisted of concrete foundations for the pre-engineered raceway and warehouse buildings, concrete and aluminum design of the raceways, structural steel design of the pedestrian bridge and structural steel design of the viewing platform within the raceway building. The structural analysis of both pedestrian bridges was performed using RISA-3D.

Sandy Hatchery Improvements, Oregon Department of Fish and Wildlife, Sandy, Oregon, 2009-2011 – Structural Design Engineer on the design of an addition to the Sandy Fish Hatchery. Design included the concrete foundation

Project Role
Pump Station Structural Design
Recirculation Pumps Enclosures

Education
B.S.C.E, Seattle University, 2007

Registration/Certification
Professional Engineer:
CA, #77785, 2010;
WA, #50303, Civil,v2013;
Structural, 2014

Professional Membership
ASCE
AISC
ACI

Office
Seattle, Washington

Years of Experience
6

Years with Tetra Tech
6

Key Areas of Experience:
Structural Steel

Structural Concrete

Structural Timber

Structural design for:

Industrial projects

Commercial projects

Environmental projects

for an in-river inflatable weir, a 48' long weir across the river, a concrete retaining wall, and the concrete fish ladder. The new concrete fish ladder was integrated into the existing concrete fish ladder.

Kitoi Bay Hatchery Expansion, Kodiak Regional Aquaculture Association, Kodiak, Alaska, 2011 – Structural Design Engineer for an addition to the existing two-story wood bunkhouse at the Kitoi Bay Hatchery. Design included a two-story addition on one side of the structure and a one-story addition on the opposite side, including a wrap-around porch. The addition consisted of wood shear walls and continuous concrete footings to resist high wind and snow loading. The design accounted for additional loads imposed on the existing structure.

Cedar River Sockeye Hatchery, City of Seattle, Four Corners, Washington, 2008-2011 – Structural Design Engineer for a new Sockeye Hatchery for the City of Seattle. Performed design on an adult holding raceway with an integrated spawning shed. There are four 60' raceways with electrical crowders. The spawning shed is wood framed with glulam roof beams. In addition, a wood framed single-story storage building and a below-grade concrete vault were included in the designed.

Pillar Creek Hatchery Expansion, Kodiak Regional Aquaculture Association, Kodiak, Alaska, 2012 – Structural Design Engineer for 27'x16' one-story equipment building. The equipment building is wood framed and is supported above grade by six concrete columns on spread footings.

Port Hadlock Wastewater Treatment Facility, Jefferson County Department of Community Development, Port Hadlock, Washington, 2013 - Structural design engineer on the design team for a 0.5 mgd wastewater reclamation plant currently under design. The plant includes an influent pump station, below grade headworks, membrane bioreactor treatment process facility, UV disinfection, percolation ponds, mechanical equipment building and an administration building. Challenges included designing a partially below grade concrete treatment facility that met the process requirements. Performed analysis on the administration building, which consists of light-gage metal stud walls, metal roof diaphragm, and flat-strap tension braces. Analyzed the building using all applicable AISI codes, including a full wind and seismic analysis. Prepared and delivered drawings, specifications, and calculations to the client.

Amtrak Maintenance Facility, Seattle, WA, 2010 – Design Engineer for structural engineering for the Maintenance Building at the Amtrak Cascades Yard in Seattle. Coordinated with the Architect, contractor, and client to produce calculations and drawings. The Maintenance Facility is a 652-ft-long by 82-ft-wide pile supported concrete structure. Analysis and design of the structure included driven grout piles, concrete mats, walls, elevated composite slabs, slabs-on-grade, masonry shear walls, steel columns and beams, and cast-in-place anchors. The lateral system consisted of special reinforced concrete moment frames and special masonry shear walls. Design accounted for train and vibratory equipment loading.

Amtrak Operations Building, Seattle, WA, 2010 – Junior Design Engineer for structural engineering for the Amtrak Operations Building at the Amtrak Cascades Yard in Seattle. Coordinated with the Senior Structural Engineer and Architect to produce calculations and drawings. The Operations Building is a 3-story, 38,000-sf office building. The structure is steel framed with a composite concrete floor system. Analysis and design of the structure included the composite floor system, steel columns, and the lateral system and connections. The lateral system consisted of special steel-braced frames. Structural analysis was carried out using STAAD and RISA.

King County Metro Transit Atlantic/Central Bus Base Expansion: Operations Building Renovation and Expansion, King County Dept. of Transportation, Seattle, WA, 2009 – Structural Design Engineer for the Atlantic/Central Operations Building renovation and expansion portion of this multi-facility bus base expansion project. The project includes renovation of the existing 24,000 sf operations building and approximately 40,000 sf of expansion to house the operations administration and driver support for two bus bases, a Transit Police facility, transit service quality unit, and training facilities. Performed preliminary design of a two-story, ordinary concentrically-braced frame, structural steel, and deep foundation using RISA-3D.

Seattle Fleets and Facilities Building A, Seattle DOT Metro Transit, WA, 2009 – Design Engineer for structural engineering on an HVAC replacement project for the City of Seattle. The project included replacement of three roof-mounted HVAC units. Design included evaluation of the existing two-way roof slab and installation of additional steel beams beneath the slab to support the new units.

TETRA TECH

John McGlenn, P.E.
Vice President

John McGlenn is Chief Engineer of Tetra Tech with project experience spanning over 30 years, including design and construction of a wide range of projects throughout the Northwest and beyond. He has been Project Manager or Principal-in-Charge for both civil and structural projects, including Fish hatcheries, reservoirs and reservoir covers, piers and related waterfront structures, roads and bridges, parking garages, office and commercial buildings, heavy maintenance facilities, warehouses and schools, parks and recreational facilities, and wastewater treatment plants. John has taught Structural Design at Seattle University and Lateral Forces Design at the University of Washington. For nine years he prepared and graded portions of the structural engineers' licensing exam for the Washington Board of Registration. John has served on a number of conservation, wildlife, and ecological committees, including the State Fish and Game Commission.

EXPERIENCE

Walla Walla Spring Chinook Hatchery, Bonneville Power Administration and Confederated Tribes of the Umatilla Indian Reservation, Milton-Freewater,OR, Current – Principal-in-Charge for analysis and design of architectural, electrical/controls, HVAC/plumbing; and structural efforts for incubation, early rearing, grow-out and related support facilities. The design includes river intake pump station, utility water supply systems, groundwater supply system and water quality for domestic use on-site; effluent ozone-gas generation and side stream disinfection, storage, handling and chemical feed system and adult broodstock collection and handling at the Nursery Bridge fish ladder facility.

Kootenai Sturgeon and Burbot Hatchery, Kootenai Tribe of Idaho, Bonners Ferry, ID, 2014 – Principal-in-Charge for final design and construction administration of the $16 million Twin Rivers and Tribal Hatcheries, including civil/site, water supplies, structural, landscape, architecture, mechanical and electrical controls.

Cedar River Sockeye Hatchery, City of Seattle Public Utilities King County, WA, 2010 – Project Manager for conceptual planning and design for this 34 million egg sockeye salmon facility located in the Lake Washington watershed east of Seattle. One of the first major sockeye hatcheries in Washington, the project includes extensive monitoring and evaluation programs to be incorporated into adaptive management of the operating facility. Seattle Public Utilities, who is responsible for water supply in the Seattle metropolitan area, is preparing the design of a hatchery designed to restore the runs of sockeye in the Cedar River, a river that has historically maintained the largest sockeye runs south of Alaska. The hatchery is part of the Cedar River Habitat Conservation Plan, an agreement among a number of federal, state, and local agencies, tribes, commercial fishing interests, and sports fishing organizations, which is intended, among other things, to mitigate the impacts of the construction of the City of Seattle water supply facilities on the Cedar River around the turn of the century.

Chief Joseph Dam Hatchery, Confederated Tribes of the Colville Reservation, Omak, WA, 2013 – Principal-in-Charge for development of conceptual plan through final design and construction of a new Chinook hatchery, modifications to existing and design of new off-channel acclimation

Project Role:

Senior Advisor, Fisheries Facilities Planning and Design

Education:

M.S., Civil Engineering, 1966, University of Washington

B.S., Ceramic Engineering, 1960, University of Washington

Registration/Certification:

Civil Engineer: Alaska, 1977; Colorado, 1985; Idaho, 1987; Montana, 1990; Oregon, 1994; Texas, 1992; Utah, 1991; Washington, 1968; Wisconsin, 1992; Wyoming, 1993

Structural Engineer, Oregon, 1994; Washington, 1970

Professional Affiliations:

Fellow, American Consulting Engineers Council

Lifetime member, American Society of Civil Engineers

Structural Engineers Association of Washington

Office:

Seattle, Washington

Years of Experience:

41

Years with Tetra Tech:

32

Areas of Experience:

Project Management

Design/Build

Wastewater/Hazardous Waste Facilities

Piers and Marine Facilities

Fisheries Facilities

Highway Bridges

Commercial and Industrial Buildings

facilities for fall and winter fish rearing and release into the Okanagan and Columbia Rivers. Overall supervision of project to ensure consistence with Genetic Management Plan and requirements of the NW Power Planning Council funding and scientific parameters.

Hatchery Research Center, Oregon Department of Fish & Wildlife, Alsea, OR – Principal-in-Charge and Project Manager for programming and schematic design phases for this project to convert an existing hatchery to a research facility to study the interaction of hatchery fish with wild fish. The facility will test modified hatchery techniques to improve the health and survivability of hatchery fish. State of the art techniques using simulated streams and feeding methods will be incorporated into the design.

Makah Fish Hatchery, U.S. Fish and Wildlife Service, **Neah Bay, WA** – Principal-in-Charge for task order under IDIQ contract to evaluate the existing intake screens and develop conceptual designs for new intake screens that meet all current state and federal intake screen criteria. The project also included final design and construction (under a design build contract) of gravity flow piping improvements to experimental tanks, an accessible ramp and emergency repairs to an electric fish weir. The project was completed on time and under budget.

Kootenai River Native Fish Restoration and Conservation Aquaculture Step 1 and 2, D.J. Warren and Associates, Inc., Bonners Ferry, ID, 2006 – Principal-in-Charge for planning and preliminary design of a new $12M sturgeon and burbot aquaculture research and production facility, under a program funded under the BPA 3-Step process. The project is part of a major collaborative effort led by the Kootenai Tribe of Idaho, involving state, federal and tribal resource managers, to restore naturally reproducing populations of white sturgeon and burbot to the Kootenai River. The new facility will have river water intakes on the Kootenai and Moyie Rivers, as well as a groundwater supply system. The surface water supplies will require filtration, disinfection, degassing and precise water temperature control systems to meet various life stage spawning, incubation and rearing criteria.

Penticton Sockeye Hatchery Design, British Columbia, Okanagan Nations Alliance, Penticton BC, 2014 – Principal-in-Charge for site evaluation and planning phase for a new 8 Million egg sockeye hatchery in central British Columbia. Project elements include development of a 2,500 gpm well water supply system, central degassing headbox, 50 kitoi box incubators, 26 rearing raceways, large energy efficient water chilling system and innovative fry transfer piping system.

Sandy Hatchery Passage and Intake Study, Oregon Department of Fish and Wildlife, Sandy, OR – Principal-in-Charge for planning and design of variety of improvements at ODFW's Sandy Hatchery. Project elements included a 23 cfs hatchery intake screening system, replacement of barriers to fish passage in Cedar Creek with fish friendly structures, a trap and sort facility for handling adult fish and 60,000 cubic foot acclimation pond design.

Snettisham Salmon Hatchery, Alaska Department of Transportation , Snettisham, AK – Principal-in-Charge overseeing the schematic design through preparation of operations and maintenance manuals for an approximately US $7 million remotely located incubation and grow-out facility with major elements, including incubation building, rearing raceways, water supply system, adult fish return facilities, staff housing, and food storage facility.

Washington Salmon Enhancement Program, Washington Department of Fisheries, WA – Developed cost estimating tools for a wide range of new hatchery and rearing facilities, from small to large and simple to complex, using parameters such as flow, volume of tanks, and pounds of production.

Hidden Falls Hatchery Renovation, Alaska Department of Transportation near Sitka, AK – Principal-in-Charge for Architectural/Engineering design and bioengineering to renovate multiple level lake water intake, rearing tanks, hatchery building, net pen system, and effluent treatment

Cassimer Bar Step 1 Master Plan, Confederated Tribes of the Colville Reservation, Confluence of Okanagan and Columbia Rivers, WA – Principal-in-Charge for renovation and expansion of the existing artificial production facilities at Cassimer Bar Hatchery, collection of broodstock at sites throughout the Okanogan River Subbasin, acclimating smolts before release, and experimental reconditioning steelhead kelts. Extent and suitability of receiving habitats and the contribution of Canadian steelhead stocks to Upper Columbia steelhead stocks will also be investigated. The Master Plan focuses on the development of viable summer steelhead runs in three tributaries of the Okanogan River: Omak Creek, Loup Creek, and Salmon Creek. These streams were identified in the Okanogan Subbasin Management Plan (NPCC 2004) as having the greatest potential for re-establishment of natural-origin populations through habitat improvement and restoration.

TETRA TECH

Hamid R. Naderi, P.E.
Vice President

Hamid Naderi's 33 years of experience includes management and technical leadership on a variety of high profile structural projects. As Tetra Tech's Director of Structural Engineering in the Northwest, he is responsible for managing workflow; technical oversight for standard details, specifications, analysis and design calculations of all structural engineering products; discipline training; and mentoring staff. As a designer he has worked on elevated/surface water storage tanks, industrial buildings, parking garages, chemical facilities, federal correctional facilities, and bridges.

Hamid's design analysis is enhanced by the use of computer modeling with software programs such as PCI Mat, Risa -3D, and Intergraph Microstation for 3D Industrial Design. Heavily involved in design/build projects with a former employer, he is adept at constructability and cost assessments and very experienced in providing on-site construction engineering support. In all design/build projects, he was involved in value engineering and evaluating different design concepts and providing cost comparison analysis for optimum solution. He was also the main contact for all field problems during construction of the projects.

EXPERIENCE

Chief Joseph Dam Hatchery, Confederated Tribes of the Colville Reservation, Bridgeport, WA, 2010 - As lead structural engineer, oversaw the detail design of several structures, including the administration/visitor center; main hatchery building; river intake, raceway, and spawning structures; and shop and maintenance facility.

Queen Anne Water System Improvement, Seattle Public Utilities, WA, 2006 - As lead structural engineer supervised the detail design effort for replacing two existing water tanks and designing ring foundation, construction shoring and concrete vaults for the one larger diameter tank and related pump station and valves. Project design required complete seismic calculation of the ring foundation and of the impact of new excavation and installation of new foundation on the adjacent existing Fire Station Building.

Equalization Storage Facility and Street Reconstruction, City of Blaine, WA, 2007 - Structural engineering quality control for a $4 million project that included a 400,000 gallon sanitary sewer flow equalization storage facility and reconstruction of 2,500 lf of Marine Drive.

Brightwater Conveyance System, North Creek Facilities, King County DNRP WTD, 2008 - Designed pile foundation and the concrete superstructure for the odor control facility. Also, performed structural quality control for entire facilities which included diversion structure, flow monitor structure, drop structure and reclaimed water structure.

South Magnolia CSO Control Project, King County DNRP Wastewater Division, Seattle, WA, 2013 - Led the structural team for detail design of a 1.9 mg cast-in-place reinforced concrete Combined Sewer Overflow (CSO) facility currently under design. The main CSO storage tank is 136' long x 86.5'wide and features one isolated and three partially separated bays for sequential filling. To accommodate sequential filling, weirs were provided at the lower end of each bay. In order to resist bouncy forces and passing through a liquefiable soil layer directly under the structure, this tank is supported by a 12' thick mass concrete structure. The roof of the storage tank is designed to carry a combination of AASHTO HL-93 traffic loading, ancillary equipment building and between 2-4 feet of earthen cover for landscape planting. The facility is located in an environmental and geological sensitive region adjacent to Puget Sound where soft fill soils and a high

Project Role

Project Manager

Education

M.S., Civil Eng. in Structure, Wayne State University, 1988

M.S., Civil Eng. in Hydraulics, University of Iowa, 1990

B.S., Civil Engineering, University of Iowa, 1980

Registration/Certification

Professional Engineer: Alaska, Arkansas, Arizona, California, Florida, Georgia, Illinois, Indiana, Iowa, Minnesota, Montana, Nebraska, Oklahoma, Pennsylvania, South Dakota, Tennessee, Texas, West Virginia, Washington

Cold Region Engineering Course

Office

Seattle, Washington

Years of Experience

33

Years with Tetra Tech

8

Key Areas of Experience:

Structural Engineering including concrete, steel and masonry structures

Above- and below-grade liquid containment structures

Heavy industrial structures such as mining and petrochemical facilities

Design-Build

Construction Engineering

groundwater level both combine to create challenges in resisting uplift and liquefaction during a seismic event. Average interior depth of the storage tank is approximately 22 feet. The facility utilizes tipping buckets for flushing of settled debris common in retention basins, thereby requiring a corridor of large lift slab and access platforms for bucket maintenance and removal. Additional structures include reinforced cast-in-place concrete upper and lower diversion structures and an odor control vault.

King County Kirkland Pump Station Project, King County DNRP Wastewater Division, Seattle, WA, 2010 — As a lead structural engineer worked on the upgrade of the Kirkland Pump Station and Force Main to replace aging pump station equipment and to increase the capacity of the pump station. Part of the existing structure was utilized and the remaining structure was added to house the additional pumps and generator equipment. 3' diameter secant pile system were used for shoring and dewatering the foot print of the structure for the construction of the below grade new wet well structure. Also the secant piles were designed to resist all the lateral earth and seismic forces. A partial new CMU building was added to house the new standby generator, pumps and electrical control panels. Project challenges included designing in such a way as to allow continual operation of the station while retrofitting existing structure and nearly doubling the square footage of the facility

Winslow Wastewater Treatment Plant Upgrade, City of Bainbridge Island, WA, 2009 - Design involved liquid process improvement as well as class A biosolids upgrade of an existing 2.4 mgd to a 3.6 mgd facility. As lead structural engineer supervised the detail design effort for solid handling structure, blower / generator building, aeration basin improvement and headwork structures.

West Point Treatment Plant, Multi-Use Facility Building 717, King County DNRP WTD, Seattle, WA – Structural Engineer for seismic analysis. Existing building was to be retrofitted to house new COGEN equipment and a mezzanine floor added to the structure. This modification required a complete seismic evaluation of the existing structure. Project was cancelled at 30% design, due to over price bid of adjacent and necessary Co-Gen project.

East Side CSO Tunnel Project, City of Portland, Bureau of Environmental Services, OR, 2006 - Designed various underground structures associated with alignment of 5 miles of 17- to 22-foot-diameter tunnel on the east side of the Willamette River. Design included vortex drop structures, junction and flow diversion structures, outfall structures, and access manholes ranging in size up to 70 feet in depth.

Wastewater Treatment Plant Facility, Jefferson County Department of Community Development, Port Hadlock, WA, 2013 - Led the structural design team for a 0.5 mgd wastewater reclamation plant currently under design. The plant includes an influent pump station, headworks, membrane bioreactor treatment process, UV disinfection, percolation ponds, mechanical equipment building and an administration building. Concrete structural elements such as wall top beams and tie struts also serve as walkways and as miscellaneous mechanical and electrical equipment support. Administration building was designed with cold form metal stud building and opens web steel joist system. Mechanical building is a concrete masonry building with open web steel joist roof members.

Amtrak Maintenance Facility, Seattle, WA, 2010 – Led the detail structural design effort for the Maintenance Building at the Amtrak Cascades yard in Seattle. The Maintenance Facility is a 652-ft-long by 82-ft-wide pile supported concrete structure with pre-engineered metal building. Assisted in analysis and design of the structure which included driven grout piles, concrete mats, walls, elevated composite slabs, slab-on-grade, masonry shear walls, steel columns and beams, and cast-in-place anchors. The lateral system consisted of special reinforced concrete moment frames and special masonry shear walls.

Juneau Seawalk, City & Borough of Juneau, AK, 2008 – Lead structural engineer performed detail design of a 17-ft-wide x 730-ft-long elevated boardwalk supported by 16" diameter steel pipe piles driven to bedrock. The gravity framing system is 12'x 6' wood decking supported by a series of 27" x 8 ¾" glulam beams. The lateral system is composed of field-welded steel moment frames in transvers direction and battered piles in longitudinal direction. Annually, it is estimated that more than 500, 000 people use this boardwalk along Miner's Cove, from the cruise ship dock to downtown Juneau.

TETRA TECH

Steve Kraushaar, P.E.
Senior Civil Engineer

Steve Kraushaar has over 35 years of experience in the planning, design and construction of a wide variety of civil engineering projects. These include projects related to stormwater planning and facilities design, fisheries design, pump station and hydraulic structure design, wastewater treatment and collection systems facility planning and design, and hydraulic and hydrologic modeling. Steve also has several years' experience as a senior civil engineer for a municipality of 55,000 persons, responsible for review of engineering planning studies and development plans. He has been the designated City Engineer for the City of Gervais, Oregon since 1993.

EXPERIENCE

Kootenai Sturgeon/Burbot Hatchery, Kootenai Tribe of Idaho, Bonners Ferry, ID, 2014 – Lead Civil Engineer for final design of the $16 million Twin Rivers and Tribal Hatcheries, including water intakes off the Kootenai and Moyie Rivers, intake pump stations and force main to the Hatchery, influent and effluent treatment basins, hatchery effluent piping, and site design.

Chief Joseph Hatchery, Colville Confederated Tribes, Omak, WA, 2013 – Lead Civil Engineer. Assisted with design and construction administration of a new Chinook hatchery, consisting of modifications to new off-channel acclimation facilities for fall and winter fish rearing and release into the Okanagan and Columbia Rivers.

Bonneville Hatchery Wastewater Treatment Plant Improvements, Bonneville, OR, 2011 – Lead Civil Engineer for evaluating ODFW's Bonneville Hatchery waste loads entering the Bonneville Lock and Dam Southshore Sanitary Facilities. The purpose of the study was to identify upgrades necessary to address aging equipment and provide appropriate reliability and redundancy in conformance with NPDES permit requirements and Oregon Department of Environmental Quality (ODEQ) regulations.

Cedar River Sockeye Hatchery, Seattle Public Utilities, Seattle, WA 2012 – Civil Project Engineer for construction engineering for this 34 million egg sockeye salmon facility located in the Lake Washington watershed east of Seattle. Seattle Public Utilities, responsible for water supply in the Seattle metropolitan area, managed the design to restore the runs of sockeye in the Cedar River, a river that has historically maintained the largest sockeye runs south of Alaska.

Minto Fish Collection Facility Site Development, US Army Corps of Engineers, Lyons, OR, 2010 – Project Manager for site development and lead engineer for wastewater design of Minto Fish Collection Facility near Lyons, Oregon. Wastewater efforts include permitting assistance and design for an on-site sand filter system sewage disposal system for the facility. The design includes pumping and conveying sewage from the existing facility to the new property across the highway for treatment and disposal. A new sewage pump station will have duplex pumps and controls, pressure pipe, back flow preventers and a control system. The disposal system will be sized to treat sewage from a future manager residence on the new property as well as flows from the existing facility, in accordance with Marion County flow projection criteria. The complete system will meet or exceed county and state requirements. Also provided design criteria and system components for the water system by model,

Project Role:

Pumping Systems
Facility and Site Piping

Education:

B.S., Civil Engineering, University of Colorado, 1977

Registration/Certification:

Civil Engineer, Colorado #22364, 1981

Civil Engineer, Oregon #15332, 1990

Professional Engineer, Civil, Washington, 48614, 2011

Office:

Portland, Oregon

Years of Experience:

35

Years with Tetra Tech:

22

Areas of Experience:

Water and Wastewater System Planning and Design

Pump Station Design

Fisheries Design

Drainage System Planning and Design

Hydraulic and Hydrologic Modeling

Floodplain Studies

Street and Roadway Design

Commercial and Residential0 Land Development

capacity, and brand, all meeting or exceeding county and state regulations. The water system uses two existing wells and was designed to provide potable water for both the fish collection facility and for the new property and caretaker's residence north of Highway 22.

Water Supply Sediment Pond and Hatchery Effluent Water Quality Improvements, U.S. Fish and Wildlife Service, Quinault National Fish Hatchery, WA, 2010 – Project Engineer for preparation of a preliminary design report and final design documents for improvements to an existing water supply sediment pond and hatchery effluent water quality at the Quinault National Fish Hatchery. The improvements are intended to make it easier for the hatchery to comply with NPDES requirements without interruption of the hatchery water supply to incubation and rearing facilities.

Hatfield Marine Science Center Effluent Discharge, Newport, OR, 2010 – Project Manager for design of a chlorination and dechlorination disinfection system for salt water exhibit and aquatics laboratory effluent discharged to Yaquina Bay. The system consisted of influent pumping, sodium hypochlorite and bisulfite metering systems, chlorine residual monitoring, fiberglass chlorine contact tanks, static mixing, and discharge piping.

Sandy Hatchery Supply Pipe Replacement, Oregon Department of Fish and Wildlife, Sandy, OR, 2011 – Design Engineer for preparation of final design drawings and specifications for replacement of the hatchery supply pipe including 1000 feet 30-inch diameter PVC pipe, valves and connections.

Silver Creek Intake and Supply Line, City of Silverton, Silverton, OR, 2011 – Project Manager for design and permitting for the upgrade and replacement of the water intake pump station structure located along Silver Creek and approximately 2,300 lineal feet of supply line from the intake structure to the water treatment plant. The project includes a predesign report to identify project opportunities, benefits, costs, alignment, permitting requirements, and other relevant information as needed to be used to support and identify the project elements.

Springfield Millrace Stormwater Outfall Relocation, City of Springfield, OR, 2008 – Project Manager for the design of the relocation of approximately 350 feet of 66-inch stormwater pipe including the outfall at the Middle Fork of the Willamette River. The pipe is owned by the City of Springfield and the project involves review by the City as well as the US Army Corps of Engineers.

Rock Creek Influent Pump Station Discharge Valve Actuator Relocation, Clean Water Services, Current – Project Manager for design of the relocation of four 36-inch knife valve actuators from the lower level of the dry well to the mezzanine level of the influent pump station. The purpose of the project was to provide improved maintenance access to the electrically powered actuators.

Royal Woodlands East Sewer Rehabilitation, City of Beaverton, OR, Current – Project Manager for predesign, design and construction administration for rehabilitation and/or replacement of sanitary sewer, drainage, and water system improvements within a 60 year old subdivision.

Royal Woodlands West Sewer Rehabilitation, City of Beaverton, OR, Current – Project Manager for predesign, design, and construction administration for approximately 5,800 lineal feet of replacement 8- and 10-inch sanitary sewer line including manholes and miscellaneous appurtenances, approximately 6,340 lineal feet of sewer service line replacement, approximately 2,665 lineal feet of 8-inch water line replacement, and approximately 2435 lineal feet of 10-inch through 24-inch storm drain installation. The project includes approximately 3,500 square feet of riparian area enhancement.

Webb Mitigation Pump Station, Big River Construction, Cornelius, OR, 2008 – Project Manager for design for the reconstruction of the existing Webb Flood Control Pump Station with two new 200 hp 28,500 gpm propeller pumps and dual 30-inch steel discharge pipes. The new cast-in-place concrete pump station included a pile foundation, screened forebay and pump roof with roof hatches for pump removal.

Columbia Way Stormwater Control Project, City of Vancouver, Vancouver, WA, 1999 – Project Manager for the design of a 5,300-gpm pump and control gate system retrofitted into a 48-inch stormwater outfall serving the Mill Plain area, including Pearson Area Park and a portion of State Route 14. The project eliminated flooding of the Area Park and SR 14 caused by high Columbia River levels.

TETRA TECH

Erik Nordholm, P.E.
Civil Engineer

Erik has 17 years of experience in design, construction, and surveying on sewer, water, and street projects. While with Tetra Tech, Erik has worked on the planning and design of water and wastewater treatment facilities, pump stations, fisheries, storm water and street improvement projects. Erik has extensive experience in the use of Autodesk Civil 3D software as well as hydraulic modeling experience in the areas of gravity pipelines and water distribution networks.

EXPERIENCE

Walla Walla Spring Chinook Hatchery, Bonneville Power Administration and Confederated Tribes of the Umatilla Indian Reservation, Milton-Freewater, OR, Current – Project Design Engineer for analysis and design of architectural, electrical/controls, HVAC/plumbing; and structural efforts for incubation, early rearing, grow-out and related support facilities. The design includes river intake pump station, utility water supply systems, groundwater supply system and water quality for domestic use on-site; effluent ozone-gas generation and side stream disinfection, storage, handling and chemical feed system and adult broodstock collection and handling at the Nursery Bridge fish ladder facility.

Kootenai Sturgeon/Burbot Hatchery, Kootenai Tribe of Idaho, Bonners Ferry, ID, Current – Project Engineer for final design of the $16 million Twin Rivers and Tribal Hatcheries, including water intakes off the Kootenai and Moyie Rivers, intake pump stations and force main to the Hatchery, influent and effluent treatment basins, hatchery effluent piping, and site grading and storm water design.

Kitoi Bay Hatchery, Kodiak Regional Aquaculture Association, Kodiak, AK, Current – Project Engineer assisted in conducting an evaluation of Kitoi Bay Hatchery and providing recommendations for system upgrades with budget estimates to increase hatchery production. Worked on the design and hydraulic modeling of upgrades to the 20 cfs water supply piping system and new vacuum degassing columns.

Penticton Sockeye Reintroduction Project, Okanagan Nation Alliance Enterprise Ltd, Westbank, BC, Current – Project Engineer for design of hatchery improvements for possible annual production of up to 8 million sockeye salmon to support long-term reintroduction of the species into the upper Okanagan River system.

Chief Joseph Dam Hatchery, Colville Confederated Tribes Bridgeport, WA, 2013 – Project engineer for the design of a new $50 million Chinook hatchery. Competed in 2013, the hatchery will produce up to 2.9 million Chinook salmon annually. Design efforts included the 40 cfs well water pumping and conveyance system, 60 cfs river water intake screen and conveyance system, site grading design, and site piping design. Erik also worked on the design on two acclimation sites, each of which included intake screens, 15 cfs pump stations and a conveyance pipeline.

Cedar River Sockeye Hatchery, Seattle Public Utilities, Seattle, WA 2012 – Civil Project Engineer for construction engineering for a 34 million egg sockeye salmon facility. Work included construction management and design clarifications.

Sandy Hatchery Supply Pipe Replacement, Oregon Dept. of Fish and

Project Role:
Pumping Systems
Facility and Site Piping

Education:
B.S., Civil Engineering, Oregon State University, 1997

Registration/Certification:
Professional Engineer: Oregon #57186, 2003

Office:
Portland, Oregon

Years of Experience:
17

Years with Tetra Tech:
15

Areas of Experience:
Wastewater Collection and Treatment Facilities

Pump Station Design

Water Treatment, Distribution and Storage

Street and Roadway Design

Stormwater Planning and Design

Hydraulic Analysis & Modeling of Pipeline Systems

Construction Observation / Contract Administration

Wildlife, Sandy, OR, 2011 – Design Engineer for preparation of final design drawings and specifications for replacement of the hatchery supply pipe including 1,000 feet 30-inch diameter PVC pipe, valves and connections.

Minto Fish Collection Facility Site Development, US Army Corps of Engineers, Lyons, OR, 2010 –

Project Engineer for site development and wastewater design. Efforts include permitting assistance and design for an on-site sand filter system sewage disposal system for the facility.

Water Supply Sediment Pond and Hatchery Effluent Water Quality Improvements, U.S. Fish and Wildlife Service, Quinault National Fish Hatchery, WA, 2010 – Project Engineer for preparation of final design documents for improvements to an existing water supply sediment pond and hatchery effluent water quality at the Quinault National Fish Hatchery. The improvements are intended to make it easier for the hatchery to comply with NPDES requirements without interruption of the hatchery water supply to incubation and rearing facilities.

Silver Creek Intake and Supply Line, City of Silverton, Silverton, OR, 2011 – Project Engineer for design and permitting for the upgrade and replacement of the water intake pump station structure located along Silver Creek and approximately 2,300 lineal feet of supply line from the intake structure to the water treatment plant. The project includes a predesign report to identify project opportunities, benefits, costs, alignment, permitting requirements, and other relevant information as needed to be used to support and identify the project elements.

Water Intake Pump Station, City of Molalla, Molalla, OR, 2011 – Project Engineer for predesign and design of upgrades to the three existing vertical turbine intake pumps and building which were relocated after the floods of 1996. In addition to providing two new or rehabilitated 100-hp pumps, this will include new VFDs or other pump control devices, HVAC system and mechanical modifications to the piping and valves inside the building.

Cascade Crossing Transmission Project, Portland General Electric, OR, 2012 – Project Engineer assisting in the design to develop road crossing, specifications, cost estimates, and erosion and sediment control plans. Work included assisting in evaluating road crossing risks and stream simulation data collection at field sites located in Oregon.

Barnaby Creek Culvert Replacement, Confederated Tribes of the Colville Reservation, Inchelium, WA, 2011 – Project Engineer for a culvert replacement project near Inchelium, WA to provide adult and juvenile fish passage into Barnaby Creek. Responsible for analysis and design of the replacement of 97 inch span by 66 inch rise corrugated metal culvert.

Upper Hoh Road Culvert Replacements, Jefferson County, Jefferson County, WA, 2010 – Project Engineer for hydraulic analysis and site grading design for the replacement of three culverts to improve fish passage and reduce flooding. The new culverts were three sided, precast concrete structures with granular rock channels.

Meacham Creek Habitat Enhancement, Umatilla Tribe of Oregon, 2010 – Project Engineer for the design of a new channel alignment to reconnect the channel with the historic floodplain to reestablish natural channel functions and fish habitat. Responsible for the layout of the new channel alignment, development of bank stabilization structures, design of the new channel profile, incorporation of fish habitat features into the channel design, preparation of the construction logistics plan, preparation of the construction specifications package, and preparation of the project cost estimate at all design levels. Project design package included 27 drawings detailing the construction of the new channel, construction of the new floodplains, installation of the bank stabilization structures, installation of the fish habitat features, construction sequence, access, and backfill of the existing channel.

Royal Woodlands West Sewer Rehabilitation, City of Beaverton, OR, Current – Project Engineer for predesign, design, and construction administration for approximately 5,800 lineal feet of replacement 8- and 10-inch sanitary sewer line including manholes and miscellaneous appurtenances, approximately 6,340 lineal feet of sewer service line replacement, approximately 2,665 lineal feet of 8-inch water line replacement, and approximately 2435 lineal feet of 10-inch through 24-inch storm drain installation. The project includes approximately 3,500 square feet of riparian area enhancement.

Rock Creek Ranch #3 Pump Station Improvements, Clean Water Services, Current – Project Manager for predesign, and design of a complete mechanical, electrical and controls upgrade to the existing 150 gpm wastewater pump station.

TETRA TECH

Philip D. Tunnell, P.E.

Design Engineer

Philip Tunnell has experience in many facets of water/wastewater engineering. His technical design experience includes preparing plans, specifications, and cost estimates for reservoirs, pump stations, wells, pipelines, and chlorination facilities, as well as performing analysis of existing systems including pump station operations, and feasibility studies for reservoir siting. He has experience in construction administration, including overseeing the construction of pipelines, reservoir rehabilitation, and pump station upgrades. Philip Tunnell has considerable drafting experience and is proficient with the current versions of AutoCAD. He also has experience in hydraulic modeling. He has used and is familiar with the H2ONET computer program. In addition, Philip Tunnell is familiar with other computer programs including Excel and PowerPoint. Rounding out Philip Tunnell's experience is work he has done in inspection, construction administration, shop drawing review, and plan checking.

EXPERIENCE

Westridge Pump Station, City of Anaheim, Anaheim, CA, 2012 – Project Engineer for evaluation of existing pump station pumping efficiency. Evaluation considered replacing four existing pumps of varying capacity with three or four pumps of different capacities to more efficiently pump common low flows while maintaining higher domestic flow and fire flow capacity. Objectives also included evaluation of control algorithms to reduce pressure fluctuations when pumps turn on and off.

I-5 Water Main Relocation Florence Avenue and Valley View Avenue Segments, Santa Fe Springs, CA, 2013, On-going – Project Lead Engineer for design of the relocation of approximately 4,800 linear feet of 8-inch (Florence) and 2,900 linear feet of 12-inch (Valley View) water main. These projects were required due to the widening of the I-5 Freeway and the impacts on frontage streets and ramps. Each project includes bore and jack construction under the I-5 Freeway. Many issues made these projects complex as existing frontage roads and most other utilities were being relocated on various schedules. An innovative setup was implemented to make the Plans easier to read given the amount of existing and relocated utilities and roads, whereby two separate plan views and a profile are shown on each sheet, to separate the original or existing conditions on one plan view from the future conditions on the second. The projects included preparation of complete bid documents including preparation of Plans, Specifications, Cost Estimate, required permit applications (from State and multiple Cities), all in accordance with relevant legal guidelines, including CalOSHA, CDPH, NPDES, SWPPP and others. Construction phase services include shop drawing review and approval, response to all RFIs, design revisions per field conditions, and providing As-Built drawings.

I-5 Water Main Relocation Carmenita Road Segment, Santa Fe Springs, CA, 2012-2014 – Project Lead Engineer for design, construction management, and construction inspection services for relocation of approximately 13,500 linear feet of 12-inch and 16-inch water main. This project was required due to the widening of the I-5 Freeway and the impacts on frontage streets and ramps. The project included three bore and jacks for construction under the I-5 Freeway, under Carmenita Road, and under the railroad. Many issues made this project very complex including hydrocarbon contaminated soils, other simultaneous construction, congested utilities, moving existing streets in various phases of

Project Role:

Pumping Systems
Intake Screen
Facility and Site Piping

Education:

B.S. Mechanical Engineering, Colorado School of Mines, Golden, CO, 2003

Registrations/Certifications:

Professional Mechanical Engineer, California, 2011, No. 35934

Professional Affiliations:

N/A

Office:

San Dimas, CA

Years of Experience:

10

Years with Tetra Tech:

Seven

Key Areas of Experience:

Reservoirs

Pump Stations

Wells

Pipelines

Modeling

construction, and heavy truck traffic on Carmenita Road. The design phase of the project included preparation of complete bid documents including initial utility mapping requests, and preparation of Plans, Specifications, Cost Estimate, required permit applications (from State, City, and Railroad), all in accordance with relevant legal guidelines, including CalOSHA, CDPH, NPDES, SWPPP and others, and overseeing bid opening and Contractor selection. The construction management phase included all contract administration duties including shop drawing review and approval, all RFIs, reviewing field change requests and issuance of Field Orders, reviewing and processing Contractor Change Orders, design revisions per field conditions, coordination with Caltrans and other utilities, and providing As-Built drawings. During construction, he coordinated field inspection, and conducted weekly progress meetings with the agency, contractor, and related utility representatives, including providing meeting minutes for each meeting.

State Route 91 HOV Water Main Relocation, City of Riverside, Riverside, CA, 2012 – Project Designer for Caltrans' plan to add High Occupancy Vehicle lanes to State Route 91 that required the City of Riverside relocate two water mains. The relocation required a bore and jack tunneling under the freeway for a 24-inch carrier pipe as well as bridge crossing over the freeway and another bridge crossing over a railroad. Work included geotechnical bores/analysis; traffic control plans; permitting for CalOSHA, Caltrans, and coordination with BNSF railroad; four bid document review submittals; potholing; and construction services. A very aggressive project schedule was adopted in order for the relocations to be completed prior to Caltrans construction work on the freeway. The schedule allowed for 70 days for design, 36 days for bidding, and another 75 days for construction.

Carlsbad Conveyance Pipeline – Flow Control Facility, Poseidon Resources, Carlsbad, CA – Lead Design Engineer for design and layout of flow control facility site, connecting a 54-inch conveyance pipeline to San Diego County Water Authority pipelines. The facility includes above grade and buried 54-inch steel pipe connecting two turnout vaults (one 96-inch and one 66-inch) to the main pipeline, including flow metering and automated flow control valve, chloramination equipment, and all mechanical appurtenances with cathodic protection, with flows ranging from 15 to 150 CFS. Buried turnout vaults and above grade buildings included HVAC systems and all structural and electrical coordination. One turnout vault is buried under public right-of-way and the other structures are on the SDCWA-owned site, which was improved as part of the design. This design-build project is a partnership with Kiewit Shea Desalination.

Water Reclamation Plant No. 10 Secondary Effluent Pump Station, Coachella Valley Water District, Palm Desert, CA, On-going, est. 2015 – Project Lead Engineer for design of a secondary effluent pump station, including approximately 8,800 linear feet of piping for the suction and discharge lines and all piping appurtenances. This 21 mgd capacity pump station pumps secondary effluent from the existing SE ponds on site, and discharges either to percolation ponds for settling/ground recharge, or back to the headworks and aeration basins to aid in operation during low incoming flow periods. The pump station includes six VFD-controlled vertical turbine pumps in a wet well, including a motor operated sluice gate and traveling screen at the entrance. There are three 7 mgd pumps and a 3 mgd jockey pump to handle the range of flows to the percolation basins. There are two 5 mgd pumps that discharge to the headworks/aeration basins. Power and controls are in a separate electrical building along with a 1,250 kW emergency generator. The suction and discharge piping range from 8- to 30-inches, at depths of more than 25 feet, and include a large flow diversion vault and several smaller vaults housing motor operated isolation valves and flow meters. Other upgrades at the site include overflow and inlet structures at the percolation ponds, conversion of the existing pump station into a storage facility, and new sliding gates at the flocculators and tertiary filters. All related electrical and structural design was also coordinated.

Miscellaneous Booster Upgrades, City of Pomona, Pomona, CA, 2009 – Engineer involved in construction management for various pump replacements and installing various new pumps in existing facilities including two 60 hp 1,000 gpm vertical turbine pumps; two 100 hp 1,000 gpm vertical turbine pumps; one 150 hp 3,500 gpm vertical turbine pump; and one 150 hp 1,800 gpm horizontal split case pump, related piping and appurtenances. The improvements included civil, mechanical, and electrical.

TETRA TECH

Ryan Maas, P.E.
Structural Engineer

Ryan Maas has participated in a wide variety of structural engineering projects, including failure investigations, structure inspections, condition assessment and repair of existing structures and building envelopes. As an Engineering Intern at the CN Railroad he performed analytical bridge ratings on existing steel and timber structures, assisted in field testing bridge performance and performed damage assessment due to vehicular impact. His work at Tetra Tech has included detailed structural design of a variety of structures for the Freeport-McMoRan Copper & Gold Bagdad mining facility, among which were a 215-foot-diameter elevated tailings thickener tank and various pump stations. Other projects include structural design of water distribution facilities at fish hatcheries throughout Washington and Alaska, as well as design of sewage storage, treatment and pumping facilities.

EXPERIENCE

Kootenai Sturgeon Burbot Hatchery, Fish Conservation Aquaculture Program, Bonners Ferry, ID, 2013 – Structural Design Engineer for the expansion of an existing hatchery as well as the design of a new hatchery. Structures included two pre-engineered vehicle storage buildings, masonry hatchery building, wood construction staff residences, below grade concrete influent basin, masonry influent pump station, below grade concrete effluent basin and two river intake structures. Performed design and analysis of reinforced concrete influent and effluent basin. Performed design and analysis of reinforced masonry pump station building. Performed design and analysis of concrete foundations for two pre-engineered vehicle storage buildings. Performed design and analysis of concrete river intake structure and steel debris deflector. Used AutoCAD to produce structural plans, sections and details based on structural calculations and coordination with other disciplines.

Kitoi Bay Hatchery Building Mezzanine, Kodiak Regional Aquaculture Association, Kitoi Bay, AK, 2013 – Structural Design Engineer for the design of an elevated aluminum mezzanine and elevated headbox in an existing hatchery building. Challenges included integrating the mezzanine structure and headbox into the existing operational hatchery which was space limited.

Penticton Sockeye Hatchery, Okanagan Nation Aquatic Enterprises Ltd, Penticton, BC, 2013 – Structural Design Engineer for the design of a reinforced concrete below grade settling basin, steel degassing tower and concrete outlet structure for the Penticton Sockeye Hatchery. Challenges included integrating the design with that of another consulting firm.

Port Hadlock Wastewater Treatment Facility, Jefferson County Department of Community Development, Port Hadlock, WA, 2013 – Structural design engineer on the design team for a 0.5 mgd wastewater reclamation plant currently under design. The plant includes an influent pump station, below grade headworks, membrane bioreactor treatment process facility, UV disinfection, percolation ponds, mechanical equipment building and an administration building. Determined structural design criteria for the treatment facility and headworks, including seismic hydrodynamic effects. Designed the reinforced concrete treatment facility and headworks in accordance with ACI350 procedures for environmental structures. Performed gravity and lateral analysis for the flexible diaphragm, reinforced masonry mechanical building. Used AutoCAD to produce structural plans, sections and details based on

Project Role

Structural Engineer
Pumping Systems
Intake Screen

Education

M.S., Structural Engineering, University of Washington, 2011

B.S., Civil Engineering, Illinois Institute of Technology, 2010

Registration/Certification

Professional Engineer, California, #C82349, 2013

Office

Seattle, Washington

Years of Experience

Two

Years with Tetra Tech

Two

Key Areas of Experience:

Structural Steel

Structural Concrete

Structural Timber

Foundation Design

Structure Failure Investigation

Bridge Rating and Field Testing

Structural design for:

- Industrial projects
- Commercial projects
- Environmental Projects

structural calculations and coordination with other disciplines. Challenges included designing a partially below grade concrete treatment facility that is structurally attached to the masonry mechanical building.

South Magnolia CSO Control Project, King County DNRP Wastewater Division, Seattle, WA, 2013 – Structural Design Engineer for detail design of a 1.9 mg cast-in-place reinforced concrete Combined Sewer Overflow (CSO) facility. The main CSO storage tank is 136' long x 86.5'wide and features one isolated and three partially separated bays for sequential filling. To accommodate sequential filling, weirs were provided at the lower end of each bay. In order to resist bouncy forces and passing through a liquefiable soil layer directly under the structure, this tank is supported by a 12' thick mass concrete structure. The roof of the storage tank is designed to carry a combination of AASHTO HL-93 traffic loading, ancillary equipment building and between 2-4 feet of earthen cover for landscape planting. The facility is located in an environmental and geological sensitive region adjacent to Puget Sound where soft fill soils and a high groundwater level both combine to create challenges in resisting uplift and liquefaction during a seismic event. Average interior depth of the storage tank is approximately 22 feet. The facility utilizes tipping buckets for flushing of settled debris common in retention basins, thereby requiring a corridor of large lift slab and access platforms for bucket maintenance and removal. Additional structures include reinforced cast-in-place concrete upper and lower diversion structures and an odor control vault. Determined structural design criteria for the tank, including seismic hydrodynamic effects. Utilized the 3D finite element capabilities of RISA 3D to analyze the reinforced concrete structures. Designed reinforced concrete structures in accordance with ACI350 procedures for environmental structures. Used AutoCAD to produce structural plans, sections and details based on structural calculations, coordination with other disciplines and client direction.

Wet Weather Clarifier Wear Strip Repairs, City of Portland Bureau of Environmental Services, Portland, OR, 2013 – Prepared a technical memorandum that discussed the failures of the wear strips in the rectangular wet weather clarifiers at the Columbia Boulevard Wastewater Treatment Plant. The preparation of the report included an engineering analysis of the existing wear strips, determination of probable failure mechanisms and development of alternatives for structural modifications to the wear strips. Challenges included limiting the construction impacts to maximize availability of the clarifiers and designing modifications in such a way as that they can be performed on an as needed basis by either a contractor or in house staff.

Pullen Creek Streamwalk Phase 1, Corvus Design Inc., Skagway, AK, 2013 – Structural design engineer for the design of a 60' single span glulam pedestrian bridge, fishing platform and rockery walls. Challenges included integrating the structural design with the natural features and landscape design of the Pullen Creek Streamwalk.

Holbrook Basin Potash Mine, American West Potash, Holbrook, AZ, 2012 – Structural design engineer for the feasibility study for the Holbrook Basin Potash Mine. Developed initial layout drawings of structures and performed preliminary 3D structural analysis in order to determine material quantities for each structure. Structures included elevated conveyors, change house, laboratory, administration building, warehouse, machine shop, truck wash, electrical shop, guard house, two thickeners, mill building, sylvite building, rail car inspection, rail car wash and three bulk storage buildings. Total material quantities for the project are 89,000 cubic yards of concrete and over 18,000 tons of structural steel.

Thickener Circuit Expansion, Freeport-McMoRan Copper & Gold, Bagdad, AZ, 2012 – Structural design engineer on the design team for the detail design of the foundation for the thickener tank, an elevated circular steel structure 215 feet in diameter with a conical bottom. The tank is supported on five tiers of steel columns for a total of 160 columns oriented radially in multiple rings. A slurry inside this tank is stirred by an agitator which has an arm of 105 feet long. A 10-ft-diameter center shaft supports the agitator and a maintenance walkway with spiral stair case. The foundations had to accommodate a sloping bedrock subsurface which daylighted across the diametrical center of the thickener. To minimize the potential for differential settlement, the bedrock was over-excavated and a blanket of engineered compacted fill was placed on top. Assisted in the design and analysis of the thickener foundation. Utilized RISA Foundation's 3D capabilities to analyze the complex foundation.

TETRA TECH

Craig Ziel, P.E.
Project Engineer

Craig Ziel's experience includes the design and preparation of construction documents for sewer, water, and storm pipelines, preparing grading and drainage plans for roads, mass grading, finish grading, and grading for Low Impact Development (LID) projects.

Craig is skilled in the use of AutoDesk's Civil 3D, as well as various hydraulic/hydrologic analysis software programs. He is qualified to prepare Stormwater Pollution Prevention Plans (SWPPP) for the purposes of eliminating pollutant discharges during construction. He is also experienced in preparing Water Quality Management Plans (WQMPs) for development and redevelopment projects.

EXPERIENCE

Carlsbad Seawater Desalination Conveyance Pipeline, Poseidon Resources Corporation, Carlsbad, CA, 2013 – Project Engineer responsible for providing the Stormwater Pollution Prevention Plan (SWPPP) for the 82,000 linear feet of pipeline that serves the product water from the planned 50 million gallons per day desalination plant in the City of Carlsbad. Pipeline diameters ranged from 24-inch to 54-inch welded steel pipeline operating at a maximum pressure of 800 psi. Seven flow control facilities were planned. The pipeline was routed through the cities of Carlsbad, San Marcos, Vista and Oceanside. In addition, there were two bridge crossings, Caltrans right-of-way crossing, railroad crossing, and several bore and jack crossings located throughout the project. The project is a design-build project with a fast paced schedule. The SWPPP was prepared in phases in order to allow for construction to begin with the first portion of the pipeline and then updated to include the additional segments.

Boundary Surveys for NRCS Easements, Natural Resources Conservation Services, CA, 2012 - Ongoing – Project Engineer responsible for providing boundary survey legal descriptions for the Natural Resources Conservation Services (NRCS) Wetland Restoration and Protection (WRP) Easement Program. Tetra Tech was contracted by the NRCS to provide boundary surveys, legal descriptions and exhibits, and GIS data for 33 separate sites in 12 Northern California counties.

Final Engineering Services for Margarita Tract 2428, Midland Pacific Homes, San Luis Obispo, CA, 2014 – Ongoing – Project Engineer responsible for providing final engineering design services for this 180-lot residential development within the City of San Luis Obispo. The improvement plans for Tract 2428 include the design of roads, sewer, water, and storm drain facilities. Hydrology/hydraulic studies were performed to support the on-site improvements. AutoCAD Civil 3D's Hydraflow Hydrographs was used to determine on- and off-site runoff flow rates and Hydroflow Storm Sewers was used to analyze the storm drain network. 100-year water surface elevations were determined for the existing drainage courses using HEC-RAS to verify that pads are set well above the flood elevation. Survey services provided involved the preparation of the final map, and will include setting monuments and property corners throughout the project area.

Stormwater and Safety Improvement Project at Central Los Angeles Recycling and Transfer Station (CLARTS), MWH Americas, Los Angeles, CA, 2013 – Project Engineer responsible for hydrology calculations at CLARTS, a large volume materials recycling facility and transfer station built over an old

Project Role:
Project Engineer/SWPPP

Education:
B.S., BioResource and Agricultural Engineering, California Polytechnic State University, San Luis Obispo, 2006

Registrations/Certifications:
Professional Engineer, California, 2009, No. 74743

Qualified SWPPP Developer/Practitioner, QSD/QSP

Professional Affiliations:
American Society of Civil Engineers

Office:
San Luis Obispo, CA

Years of Experience:
Seven

Years with Tetra Tech:
One

inert landfill. The improvements will include a new clarifier or hydrodynamic separator, storm drain infrastructure and Low Impact Development (LID) features. Bioswales and raised planter areas were sited to prevent conflict with existing truck circulation patterns and facility operations. Drop inlet filters were proposed at all new inlets in order to reduce the total suspended solids, heavy metals and other debris from entering the storm drain system and being conveyed to the Los Angeles River.

Santa Ana River Interceptor Relocation Project, Orange County Flood Control District, 2013 –Project Engineer responsible for preparing the Water Quality Management Plan (WQMP). Tetra Tech was contracted to provide preliminary and final design services for relocation of 19,500 linear feet segment of 54-inch trunk interceptor, 6,000 linear feet of 15- and 18-inch sewer mains, flow metering station and the decommissioning of the existing trunk interceptor segment for Orange County Flood Control District. Project responsibilities included the preparation of the WQMP for the project in accordance with the Orange County and the Santa Ana Regional Water Quality Control Board's requirement. The WQMP was a necessary permitting tool to ensure that appropriate Low Impact Development (LID) and Best Management Practices (BMPs) were selected to prevent hydromodification of the watershed.

La Palma & State College Intersection Widening, Anaheim, CA, 2013 – Project Engineer responsible for the preparation of the Water Quality Management Plan (WQMP) for the La Palma & State College Intersection Widening Project. WQMP for the project provided analysis and reporting of Low Impact Development (LID) and Best Management Practice (BMP) techniques that were incorporated into the project limits to mitigate the increased stormwater runoff. The WQMP incorporated catch basin and tree box filters due to the limited space available and to prevent conflict with existing traffic circulation patterns, buildings and underground utilities. Said improvements provide stormwater quality treatment in order to comply with the County of Orange National Pollution Discharge Elimination System (NPDES) program.

Carson Transfer Station Storm Water Quality Improvements, Waste Management, Carson, CA, 2013 – Project Engineer responsible for analyzing site hydrology at the Carson Transfer Station, and calculating design flow rates and volumes for treating the design storm. The existing facility is approximately 6.1 acres, of which more than 90 percent is covered by impervious surface. Carson Transfer Station lacks permanent structural Best Management Practices (BMPs) to help keep storm water runoff under the effluent benchmark limits, as mandated by the Industrial Storm Water General Permit. Mr. Ziel was also responsible for sizing filters and specified treatment media to address site specific pollutants of concern; locating BMPs to minimize impacts to site traffic/operations; and preparing improvement plans and site specific details for installing the proposed BMPs.

South Gate Transfer Station Storm Water Quality Improvements, Waste Management, South Gate, CA, 2013 – Project Engineer responsible for analyzing site hydrology at the South Gate Transfer Station and calculating design flow rates and volumes for treating the design storm. The existing facility is approximately 2.4 acres, of which more than 90 percent is covered by impervious surface. South Gate Transfer Station lacks permanent structural Best Management Practices (BMPs) to help keep storm water runoff under the effluent benchmark limits, as mandated by the State Industrial General Permit. Mr. Ziel was responsible for sizing the infiltration basin based on site specific percolation data; placing BMPs in specific locations to preserve the exiting site traffic and operations; utilizing the existing pervious areas to treat and infiltrated stormwater runoff; and preparing improvement plans and site specific details for installing the proposed BMPs.

Air National Guard Installation Boundary Mapping, National Guard Bureau, Various Bases, 2012 - Ongoing – Project Engineer for the southwestern portion of this national contract to establish boundary line locations, set monuments and file the appropriate documentation for existing Air National Guard bases across the United States. Some of the contracted tasks include courthouse and facility records research, and field reconnaissance. Tetra Tech will be required to field tie existing property and controlling corners to geodetic coordinates. Additional tasks include data reduction, boundary resolution, calculations, mapping and setting final corner monuments for the subject properties. Tetra Tech will also be responsible for helping the ANG develop a standard operating procedure so that personnel can better manage their GIS records keeping, as the real property boundaries associated with their various facilities and assets change in the future.

Ike Pace, P.E., C.C.P.
Cost Engineer

Ike Pace has 18 years of experience managing and performing cost engineering in support of numerous projects for federal, state, municipal, and private clients. In execution of cost estimating task orders, Mr. Pace has provided cost engineering support for numerous recreation, water resources management, river restoration, fish passage, flood control and flood mitigation analysis projects. These projects have enabled him to gain valuable experience with Micro-Computer Aided Cost Estimating System, Microsoft Projects, and Crystal Ball, including preparation of cost estimates and cost and schedule risk analyses on virtually all types of projects across the nation. Mr. Pace has provided cost engineering support on projects ranging from conceptual alternative analysis level; to feasibility level; to engineering and design level; to final plans and specifications level for use as the independent government estimate when comparing contractor construction bids.

Project Role:
Cost Estimator

Education:
BS, Civil Engineering, 1996

Registration/Certifications:
Professional Engineer, CA #59152

Certified Cost Professional #64484

Office:
Irvine, CA

Years of Experience:
18

Years with Tetra Tech:
17

Key Areas of Experience:
Cost Engineering

EXPERIENCE

John Day Dam Mitigation – Ringold Springs Fish Hatchery, US Army Corps of Engineers, Portland District, Mesa, WA, 2012 – Cost Engineer responsible for review and quality control of a detailed MII MCACES cost estimate, abbreviated risk analysis, and cost engineering appendix. This work was in support of the construction work designed to increase the amount of fish that could pass through the Ringold Springs Fish Hatchery. The project design features included earthwork, demolition of some existing facilities, bio-filtration swales, storm drains, septic system, potable water well, water supply intakes, process water supply lines, process water discharge lines, distribution tower, fish ladders, sorting ponds/facilities, holding ponds, return flume, incubation building, pollution prevention pond, rearing ponds, electrical system, and paving.

Fort Peck Dam Water Temperature Control Curtain, US Army Corps of Engineers, Omaha District, Valley County, MO, 2012 – Cost Engineer responsible for review and quality control of a detailed MII MCACES cost estimate and cost engineering report. The project proposed the installation of temperature curtains that would pass warmer water from the upper portion of the water column to the intake are of the existing outflow from the dam. Extensive use of dive crews were estimated for placement of the curtain structure. Design features included wharf construction, buoy, chain support system, curtain placement, concrete anchors, ballast lines, buoyance lines and ice boom placement.

San Joaquin River Mendota Pool Bypass Restoration Project, California Department of Water Resources, Mendota, CA, 2010 – Cost Engineer responsible for preparation and development of a detailed cost estimate. The project will include a new dam per ASDSO requirements within the Fresno Slough to replace the Mendota Dam and a new bi-furcating structure and fish screen upstream within the San Joaquin River to divert water to the Fresno Slough Pool. Project elements include cofferdams, tremie concrete, secant pile cut-off wall, ground improvements, reinforced concrete dam structure with steel tainter gates, earthen embankment, structural steel closures and fish screen, electo-mechanical hoist operating equipment.

Wynoochee Dam, Section 1135 Fish Restoration Project, US Army Corps of Engineers, Seattle District, Lake Quinault, WA, 2003 – Project Engineer. The project consisted of replacing a portion of the penstock with an Eicher Screen to bypass fish into a pressurized pipeline, which dumped the fish into an open

channel flume and then into the river tailwater. He prepared the Design and Cost Estimate Appendix for the project alternatives. He developed design drawings of the fish bypass and other project features and MCACES cost estimate.

Cape Fear Fish Passage, US Army Corps of Engineers, Wilmington District, NC – Project Manager responsible for preparation and development of a detailed MII MCACES cost estimate and cost engineering report. The project includes removal and salvaging an existing fish ladder, demolition of steel piling, construction of steel retaining wall and return, construction of anchorage and flow deflection sheeting; and placement of geotextile, underlayer stone, armor stone and weir stone.

Donna to Brownsville Levee Rehabilitation Design, Hidalgo and Cameron Counties, TX – Senior Project Manager for the engineering analyses and design of a 65.0-mile levee rehabilitation along Rio Grande for the U.S. International Boundary and Water Commission. The engineering analyses and design were performed in accordance with the FEMA 44 CFR 65-10 and the U.S. Army Corps of Engineers criteria to allow for future certification of levee. Tetra Tech produced five sets of construction plans, technical specifications, construction estimates, and design reports.

East Garden Grove – Wintersburg Green Channel Cost Estimate for the County of Orange, Huntington Beach CA – Project Manager responsible for review and quality control of a detailed cost estimate and cost engineering report. Design features of the project include channel excavation; riprap slope protection; geotextile fabric; sheet piling; soil-mix columns; bridge removal; utility relocations; disintegrated granite; wood post fencing; chain link fencing; signs; reinforced concrete; sub-grade drainage systems; tree plantings; inlet drainage structures; and Filterra drainage units.

Red Rock Dam Rehabilitation, for the U.S. Army Corps of Engineers, Rock Island District, Des Moines, IA – Project Manager responsible for preparation and development of a detailed MII MCACES cost estimate and cost engineering appendix. The rehabilitation for Red Rock Dam includes; motor rehabilitation; brake replacement; cleaning and greasing of couplings, bearings, and pinions; helical and worm gear inspections; replacement of drive shaft pillow block bearings; wire rope replacement; new limit switch coupling; new access hatches; new seal clamp bars; sand blasting and painting; new traveling hoist system and bulkhead; new control panel; and new lighting system.

FEMA Levee Certification, County of Ventura, CA – Project Manager for providing engineering services for approximately 9.3 miles of levees, in compliance with FEMA's nationwide levee certification program. It includes extensive data collection, field inspection, hydrologic and hydraulic analysis, geotechnical investigation, structural and system analyses, and preparation of construction plans, specifications and estimate based on U.S. Army Corps of Engineers design guidance for the repair of the ASR-2 Floodwall and the Sespe Creek Levee. Mr. Pace prepared several critical documents and a levee brochure for the County to convey information to the stakeholders and public. He was also instrumental in formulating possible partnership paths between the County and the Corps for Corps built levees needing improvements.

Colorado River Ecosystem Restoration Project for the US Army Corps of Engineers, Sacramento District, Mesa County, CO – Project Manager responsible for preparation and development of a detailed MII MCACES cost estimate and cost engineering appendix. The project includes invasive species removal, bank restoration, re-vegetation, boat ramp, and twelve recreational outlook sites.

Tres Rios Del Norte Ecosystem Restoration Project for the US Army Corps of Engineers, Los Angeles District, Tucson, AZ – Cost Engineer. Mr. Pace was responsible for preparation and development of a detailed MII MCACES cost estimate, and cost and schedule risk analysis. The project, located along an 18-mile stretch of the Santa Cruz River, includes measures for ecosystem restoration, infrastructure support, flood damage reduction, water supply and recreation. The cost estimate was certified by the Cost Dx through the agency technical review process.

Potomac Park Flood Protection Improvements for the US Army Corps of Engineers, Baltimore District, Washington D.C. – Cost engineer responsible for review and quality control of a detailed MII MCACES cost estimate and abbreviated risk analysis for the flood protection improvements at three locations within Washington D.C. At two of the sites levees are proposed to be constructed, and at the third site a floodwall is proposed. Other design features of the project include asphalt demolition and placement, water main replacement, manhole installation, tree removals, stop log structures, and landscaping.

W. PAUL GRANT, P.E.
PRINCIPAL GEOTECHNICAL ENGINEER

EDUCATION

M.B.A., Business, University of Washington, 1996
M.S., Civil Engineering, University of California, Berkeley, 1971
B.S., Civil Engineering (Summa Cum Laude), University of Vermont, 1970

PROFESSIONAL REGISTRATIONS

Professional Engineer: Washington (20099), 1978; Alaska (4261), 1977; California (23000), 1973

PROFESSIONAL AFFILIATIONS

American Society of Civil Engineers, 2004 – 2007 Seattle Section President, 1993-1996 Seattle Section Board
Puget Sound Engineering Council – 2007-2010 President
ASCE GeoInstitute Seattle – Distinguished Service Award 2012
ASCE Technical Committee Chair on Lifeline Earthquake Engineering (Seattle Section) 1990-1991
Consulting Engineers Council of Washington, 1992-94 Board of Directors
International Society for Soil Mechanics and Foundation Engineering
Earthquake Engineering Research Institute
Seismological Society of America
Structural Engineers Association of Washington
American Public Works Association
Tau Beta Pi
Chi Epsilon
Washington Society of Professional Engineers – 2006 (Professional) Engineer of the Year Award

Paul is the President and co-founder of PanGEO and has over 40 years of experience in conducting and directing geotechnical and earthquake engineering studies for both public and private sector projects located throughout the United States. He has successfully managed multi-year geotechnical engineering contracts for federal, state, and local agencies. He has participated in various Value Engineering Studies and constructability reviews for public sector clients resulting in construction cost savings in excess of several million dollars. He has conducted extensive research in earthquake engineering and has received numerous research grants from the U.S. Geological Survey, the U.S. Nuclear Regulatory Commission, and the National Science Foundation. On a state and national level, he has participated on committees developing earthquake criteria for the design of new structures or the rehabilitation of existing facilities. Mr. Grant has received numerous awards for engineering excellence from the American Society of Civil Engineers and the American Council of Engineering Companies. He also received the 2006 Professional Engineer of the Year Award from the Washington Society of Professional Engineers.

EXPERIENCE

Chief Joseph Dam Hatchery, Bridgeport, Washington. Principal-in-charge of geotechnical and hydrogeology studies to provide nearly 50 cfs of water for a fish hatchery for the Confederated Colville Tribe that was constructed on the right bank of the Columbia River, just downstream of the Corps of Engineers Chief Joseph Dam. Preliminary planning for the hatchery identified three potential sources of water for the hatchery: 1) Water from the reservoir from the dam, 2) Water from a relief tunnel underlying the right abutment of the dam, and 3) Water from a well field approximately 2 miles upstream from the dam. Besides developing recommendations for the foundations for the hatchery and associated buildings and roadways, the major geotechnical challenges of the development was in developing recommendations to secure and transmit water from the three different sources without impacting the stability or groundwater regime at the dam and the right abutment of the dam. These concerns stem from the fact that while the left abutment of the dam is founded on rock, the right embankment is underlain by pervious flood deposits, which resulted in the construction of the drainage relief tunnel to control seepage at the right abutment. After the dam construction was complete and the reservoir brought to its operating level, flows in the relief tunnel were approximately 90 cfs, which raised concerns about the stability of the right abutment. Subsequently, the Corps installed approximately 4,000 linear feet of upstream drainage blanket, which reduced flows in the relief tunnel to about 20 cfs. The geotechnical challenge of removing water from the relief tunnel focus upon developing construction schemes to construct a pipeline leading to and into the relief tunnel that does not disrupt the groundwater levels adjacent to the tunnel or flows within the tunnel. Schemes considered for

this work ranged from micro tunneling to ground freezing. Other geotechnical challenges included the design and construction of pipelines down the face of the right abutment slope without compromising the stability of the dam. The pipeline design required special provisions to detect and collect potential leakage and other measures to stop flow within the pipeline in the event of a major breach of the line.

Mr. Grant also assisted in preparing an EIS for the fish hatchery program. He was responsible for providing input on the Earth section, including a discussion of the geology, seismicity, climatology and hydrogeology of the region as well as specific location of the project, providing discussions of the impacts of the project and mitigating measures to reduce impacts. Major issues affecting the earth section of the EIS included slope stability as related to existing facilities at Chief Joseph Dam as well as slope stability at the acclimation ponds located adjacent to the Okanogan River. Another major concern was the potential effects of groundwater withdrawal for the hatchery and its potential effects on other groundwater uses. Mr. Grant's studies concluded that the project would not compromise slope stability because lined ponds would be used at the hatchery and acclimation sites and special above-ground pipelines with shutoff valves would be used over the embankment slopes at Chief Joseph Dam to reduce the potential for instability associated with any leakage of the lines. Finally, he indicated that the well field supplying water to the hatchery would be controlled by recharge from the Rufus Woods Pool and not an adjacent aquifer.

Seismic Improvements, Makah National Fish Hatchery, Noah Bay, WA. Project manager. A site specific response analysis was conducted to develop earthquake ground motions consistent with events having return intervals of 475 and 2,475 years. Because of its location on the coast, the earthquake performance of the site is dominated by the potential occurrence of subduction zone earthquakes. Consequently, the site specific analyses were conducted using three subduction zone events that were only modified for amplified effects to match expected rock motions at the site. The results of the analyses were about 20% lower than standard design curves, indicating that conventional design parameters could be used for the site evaluations.

Middle Fork Nooksack River Water Intake Study, Whatcom Co., WA. Principal-in-charge of geotechnical studies to develop preliminary plans to remove an existing concrete dam on the Middle Fork of the Nooksack River and to reconstruct the water intake structure for the City of Bellingham in one of the concrete monolith structures that will form a constriction in the channel but yet will allow fish passage. Project challenges included determining the depth to bedrock in the area of the new channel construction and along the alignment of the water intake line, the presence of recent alluvium with car size boulders in the river channel and the juxtaposition of differing bedrock materials underlying the left and right banks of the river. Geotechnical recommendations were developed for design and construction of the concrete monoliths comprising the channel constriction as well as for construction of the new water intake tunnel. Recommendations were also developed as construction sequencing notes for the design drawings, which were complicated by the high water levels in the channel and the presence of large boulders in the channel. The recommendations included pre-excavating the boulders from the channel to allow the installation of sheet piles to achieve a lined temporary channel for diversion of the river.

Lyle Falls Fishway Improvements, Lyle, WA. Principal-in-charge and project manager of geotechnical studies for extensive improvements to the Yakama Nation's fishway on the Klickitat River. The improvements included a new 400 foot long transportation channel, new fishway entrance and exits, a unique fish lift facility, adult capture and sorting facilities, an equipment and control building, new water intake supply lines, and various roadway and grading improvements. Significant engineering challenges included the presence of shallow, hard bedrock over much of the site requiring special blasting provisions to avoid damaging existing facilities. Other challenges includde 20 foot deep excavations through both rock and alluvium in close proximity to the Klickitat River.

Canyon Creek Fish Ladder, Dungeness Fish Hatchery, Sequim, WA. PIC and project manager for renovations of the Canyon Creek Fish Ladder and Intake which provides water supply to the Washington Department of Fish and Wildlife's hatchery. Improvements included a fish ladder to restore passage into Canyon Creek and remedial measures to address undermining and scour beneath the Canyon Creek Intake Dam. Project complications include physical constrictions of the narrow rock canyon within which the Dam and Intake were constructed and the location of a County Bridge immediately above the intake. Because the new intake would require a 20 to 30 foot deep rock cut extending within a few feet of the bridge abutment, hydraulic breakers and rock bolting were recommended to minimize disturbance to the rock mass. Because the dam had been undermined by seepage and scour, a diversion dam was recommended which would allow excavation beneath the intake to be conducted in the dry as well as construction of a cutoff wall to extend at least 6 feet below the apron. With these improvements, more water would be available for the intake and fish ladder and the likelihood of scour beneath the dam would be greatly reduced.

Joe Miller

Managing Scientist

Mr. Joe Miller is a fisheries scientist with extensive experience interpreting fisheries resource issues within biological, regulatory and hatchery production frameworks. He specializes in developing strategic approaches to achieve production goals and meet compliance trajectories for hatchery projects. Mr. Miller has played a key role in gaining support from regulators, tribes and other stakeholders for innovative hatchery designs, including water reuse, that meet stakeholder objectives and comply with Endangered Species Act (ESA) regulations. He has held senior management positions at the Washington Department of Fish and Game and Chelan Public Utility District and has been responsible for implementing regulatory and hatchery compensation components of two major Habitat Conservation Plans (HCPs). In these capacities, Mr. Miller has been responsible for securing regulatory and fish manager approvals for hatchery operations and improvements at multiple facilities. Mr. Miller has also managed large-scale hatchery monitoring and evaluation programs that support both conservation and harvest objectives.

Education

M.S., Fisheries, University of Washington, 1998

B.S., Fisheries, University of Washington, 1995

Registrations/Certifications

American Fisheries Society

Professional History

Anchor QEA, Managing Scientist, 2013 to present

Chelan Public Utility District, Fisheries Manager, 2011 to 2013; Hatchery Program Manager, 2009 to 2011; Senior Biologist, 2008 to 2009

Washington Department of Fish and Wildlife, Regional Program Manager, 2005 to 2008

National Park Service, Fish Biologist, 2001 to 2005

National Marine Fisheries Service, Endangered Species Act Biologist, 2000 to 2001

Project Experience

Walla Walla Spring Chinook Hatchery

Bonneville Power Administration
Mission, Oregon

As a sub-consultant to Tetra Tech, Mr. Miller is leading the science portion of the NPCC Steps 2 and 3 processes for the Walla Walla Master Plan based on demonstrated expertise evaluating hatchery operations within regional fisheries management contexts and developing and interpreting monitoring and evaluation plans to make science-driven decisions. The design selected for the Walla Walla facility uses an innovative circular design that improves rearing conditions for juvenile fish.

Chiwawa Steelhead Water Reuse

Chelan Public Utility District
Chiwawa River, Washington

As the Client Project Manager, Mr. Miller worked closely with the engineering and fish health experts from the Freshwater Institute to develop a partial water reuse system for steelhead at the Chiwawa Acclimation Facility. Mr. Miller was able to obtain approvals from state, federal and tribal managers for project implementation despite the fact that there were no other examples where ESA-listed steelhead had been reared in a production facility using water reuse system.

Chelan Falls Acclimation Program

Chelan Public Utility District
Wenatchee, Washington

As Hatchery Program Manager, Mr. Miller led the implementation of a new summer Chinook acclimation program on the Chelan River. The program required the determination of biological objectives, consensus agreement on a basis-of-design, and design and construction of an $8 million hatchery facility for 600,000 smolts. Using adaptive management principles and scientific evidence provided by fisheries scientists and engineers, Mr. Miller modified the facility design to a non-conventional circular configuration that resulted in improved

	smolt performance.
Rocky Reach and Rock Island Habitat Conservation Plans *Chelan Public Utility District* *Wenatchee, Washington*	Serving as Fisheries Manager at Chelan Public Utility District (PUD), Mr. Miller successfully guiding Chelan PUD to its first 10-year "No-Net-Impact" milestone. The HCPs mitigate salmon and steelhead project mortality with hatchery and habitat compensation using a consensus-based, decision-making framework. The HCPs represent the conservation and enhancement interests of multiple state, tribal, and federal signatories while providing long-term ESA coverage for Chelan PUD's hydropower production.
Multiple Hatchery Genetic Management Plans *Chelan Public Utility District* *Wenatchee, Washington*	As Senior Fisheries Biologist, Hatchery Program Manager, and Fisheries Manager, Mr. Miller successfully negotiated and managed the delivery of Hatchery Genetic Management Plants (HGMPs) for two of Chelan PUD's ESA-listed spring Chinook and steelhead hatchery programs. Mr. Miller also played a significant role in developing HGMPs for non-listed summer Chinook and sockeye programs in the Upper Columbia Basin. Mr. Miller's ESA expertise has also played a critical role in identifying situations where new HGMPs are not warranted.
Hatchery Recalculation *Chelan Public Utility District* *Wenatchee, Washington*	As fisheries manager, Mr. Miller was responsible for ensuring that Chelan PUD's hatchery production levels were adjusted in concert with the first 10-year anniversary of the HCPs. Mr. Miller and his technical staff developed the quantitative, science-based analyses to incorporate project survival estimates and hatchery performance criteria into a compelling narrative for change. Ultimately, all of the HCP signatories approved Chelan PUD's recalculated values, and Chelan's production levels were reduced significantly.
Okanagan Nation Alliance Sockeye Mitigation *Chelan Public Utility District* *Penticton, British Columbia*	As Senior Fisheries Biologist, Hatchery Program Manager, and Fisheries Manager, Mr. Miller managed the design and delivery of a multimillion dollar mitigation package for Chelan PUD's sockeye compensation requirements. This provided funding for a $10 million hatchery facility designed to release 5 million sockeye fry and a monitoring and evaluation program designed to support reopening and repopulating Skaha Lake, which has been blocked to anadromous passage for nearly 100 years.
Blackbird Island Pond Acclimation Facility *Collaborative effort between Trout Unlimited, Chelan Public Utility District, and Washington Dept. of Fish and Wildlife*	Anchor prepared engineering plans for the inlet, pump station, and outlet to Blackbird Pond Acclimation Facility adjacent to the Wenatchee River in Leavenworth, WA. The intake is a 1.5-cfs Pump Rite screen set into the Wenatchee River, which feeds into a pump station to lift water into a pond used for steelhead rearing. The pond mimics natural rearing conditions where fish feed on available invertebrates, are exposed to predation, and receive surface water flow from the Wenatchee River. This pilot project raises between 25,000 and 50, 000 ESA-listed steelhead smolts each year. Mr. Miller lead the monitoring and evaluation effort associated with the use of the new pond.

Nicolas Duffort

Environmental Planner and Biologist

Nicolas Duffort is an environmental planner and biologist with Anchor QEA. Mr. Duffort has prepared or performed habitat assessments, vegetation surveys, wetland delineations, mitigation plans, and special status species consultations for projects throughout California, with a focus on riparian, wetland, coastal, and open water habitats. He provides biological and construction monitoring services for a variety of projects with the potential to affect sensitive habitats and species. Mr. Duffort has extensive knowledge of federal, state, and local regulations, including familiarity with policies administered by the U.S. Army Corps of Engineers (USACE), the Regional Water Quality Control Board (RWQCB), the California Department of Fish and Wildlife (CDFW), the California Coastal Commission (CCC), the San Francisco Bay Conservation and Development Commission (BCDC), and the California State Lands Commission (CSLC).

EDUCATION

University of California, Santa Cruz, B.A., Environmental Studies, 2005

Project Experience

Travis Air Force Base South Gate Improvement

Reyes Construction
Fairfield, California

Mr. Duffort co-authored the restoration and revegetation plan to address California tiger salamander (*Ambystoma californiense*) habitat impacts resulting from the U.S. Air Force's Travis Air Force Base South Gate Improvement Project. The U.S. Air Force's project entailed roadway improvements to facilitate access to Travis Air Force Base. These activities resulted in 1.95 acres of temporary disturbance to the federal threatened California tiger salamander. Mr. Duffort developed a restoration and revegetation plan to address these impacts; the plan went to review and approval by the U.S. Fish and Wildlife Service (USFWS).

Project Experience (Continued)

NIMITZ Marine Facility Research Vessel Berthing Pier Replacement

University of California
San Diego, California

Mr. Duffort was responsible for preparing the majority of the Environmental Assessment/Environmental Impact Statement for replacement and renovations to the NIMITZ Marine Facility wharf and pier, with the University of California San Diego and U.S. Navy acting as the California Environmental Quality Act/National Environmental Policy Act lead agencies. Resource topics evaluated by Mr. Duffort included aesthetics; biological resources; Coastal Zone Management Act compliance; geology and soils; hazards and hazardous materials; hydrology and water quality; and cumulative impacts. The impact analysis included an evaluation of noise impacts from pile driving to Essential Fish Habitat (EFH) and protected marine mammals. Mr. Duffort also assisted the U.S. Navy with National Marine Fisheries Service consultations for project impacts to EFH and the federal threatened green sea turtle (*Chelonia mydas*).

Martinez Marina Renovation

City of Martinez
Martinez, California

The Martinez Marina Renovation project includes two separate but related elements: installation of a new breakwater and marina dredging of 45,000 cubic yards of sediment. For both elements of the project, Mr. Duffort prepared the permit applications to obtain USACE, RWQCB, and BCDC approval. Mr. Duffort also assisted with preparing the upland habitat delineation, including conducting multiple vegetation surveys, and leading the project's federal and state Endangered Species Act consultation efforts for delta and longfin smelt (*Spirinchus thaleichthys*), salmonids, and salt marsh harvest mouse (*Reithrodontomys raviventris*). He authored a Combined Biological Assessment and Mitigation Plan addressing potential endangered salt marsh harvest mouse habitat impacts and mitigation at a nearby park site for submittal to USFWS.

Rough and Ready Island Wetland Delineation

Port of Stockton
Stockton, California

Mr. Duffort acted as the lead biologist in delineating the jurisdictional resources present on the Port of Stockton's Rough and Ready Island (otherwise known as the West Complex). He prepared a Jurisdictional Delineation Report summarizing the findings of the field effort, which was submitted for approval by USACE, RWQCB, and CDFW. The findings of the delineation will be used by the Port of Stockton in avoiding and minimizing impacts to jurisdictional resources associated with future development projects proposed on Rough and Ready Island.

Project Experience (Continued)

West Complex Rail Line Extension
Port of Stockton
Stockton, California

Mr. Duffort prepared jurisdictional agency permit applications for the West Complex Rail Line Extension Project located on the Port of Stockton's Rough and Ready Island. The project requires permanent fill of waters of the United States and freshwater emergent wetlands in order to construct two railway crossings. Mr. Duffort prepared permit applications to USACE, RWQCB, and CDFW. Mr. Duffort is also assists with USFWS consultations to address potential project impacts to the state and federal threatened giant garter snake (*Thamnophis gigas*).

Bair Island Seawall Repair
California Recreation Company
Redwood City, California

Mr. Duffort prepared jurisdictional agency permit applications for the Bair Island Seawall Project located at Bair Island Marina in Redwood City, California. The project includes removal of the existing seawall coating and application of a new coating to ensure the long-term viability of the wall and prevent much more significant repairs. Mr. Duffort prepared a Joint Aquatic Resources Permit Application for submittal to USACE and RWQCB. The permit applications and project impact analysis included an evaluation of potential noise impacts, and development of avoidance and minimization measures to address these impacts.

Julia King

Senior Biologist

Julia King is a senior biologist with 20 years of professional experience in biological consulting, specializing in field investigations to determine the presence of wetlands and special-status plants and animals. She has expertise in the flora and fauna of Northern California, including terrestrial, freshwater aquatic, and estuarine environments. Ms. King has experience in the Sacramento Valley, San Joaquin Valley, San Francisco Bay Area, and Sierra Nevada foothills, and has led special-status species investigations in a broad range of habitats, including serpentine, vernal pool, alkali sink, chaparral, valley and foothill grassland, and riparian soil associations. She is a highly trained and experienced wetland scientist, and her expertise includes the delineation of wetlands, Clean Water Act Section 404 and Section 401 permitting, mitigation planning, and the creation, restoration, and monitoring of wetland and riparian habitats. She has performed wetland delineations on sites up to 15,000 acres and prepared both Nationwide and Individual permits for development and infrastructure projects.

Education

B.S., Botany, University of California, Davis, 1993

Project Experience

Monterey Peninsula Water Supply Slant Test Well Project (MPTWP)

California American Water Company
Marina, CA

The MPTWP includes the drilling of three monitoring wells and one slant well for the first phase of the CalAmerican Desalination Plant Project. Ms. King performed daily surveys of the project area during construction of the monitoring and test wells to ensure that mitigation measures were followed to protect special-status plants and animals. She coordinated with contractors in the field to maintain established construction boundaries specified by agencies.

Carmel River Lagoon Water Augmentation Project

Carmel Area Wastewater District
Carmel, CA

The Carmel River Lagoon Water Augmentation project involved investigations of lands adjacent to the Carmel River and lagoon to determine the potential locations for the placement of a proposed water percolation test pond for the Carmel Area Wastewater District (CAWD). The lands where the placement of the percolation pond were analyzed with consideration of avoiding wetlands and special-status species such as red-legged frog.

Ms. King led habitat assessment and mapping exercises for the early planning phases, including site selection for water percolation test ponds. She conducted field surveys and mapped the existing habitats located to the south of the CAWD facility, linking signatures on aerial photographs to vegetation types observed on the ground.

Project Experience

BART to Livermore Extension Project

Bay Area Rapid Transit
Livermore, CA

The BART to Livermore Extension Project, which is being developed in partnership with the City of Livermore, consists of a 4.8-mile San Francisco Bay Area Rapid Transit District (BART) extension along I-580. Ms. King conducted wetland delineation field work and prepared reports for submittal to the U.S. Army Corps of Engineers (USACE) for five project sites ranging from 5 to 140 acres along the corridor, including portions of Arroyo Las Positas, Altamont Creek, and seasonal and alkali wetlands. Ms. King led botanical surveys to identify state and federally listed special-status plants, mapped populations identified using GPS, and summarized findings in botanical reports for submittal to regulatory agencies.

Stanford University Steelhead Habitat Enhancement Program

Stanford University
Palo Alto, CA

The Steelhead Habitat Enhancement Project (SHEP) involved the alteration to water control structures Los Trancos Creek and San Franciscquito Creek to improve instream water flows for the protection of salmonids. Stanford University requested template creation and organization of data gathered by Stanford University monitors at mitigation sites. The project scope included the preparation of the annual reports for mitigation monitoring at the riparian restoration sites and the herbaceous vegetation establishment at Felt Lake. Information gathered by Stanford University was incorporated into documents for annual reporting submittal to the USACE, Regional Water Quality Control Board, and California Department of Fish and Wildlife (CDFW).

Ms. King coordinated the production of a series of regulatory agency mitigation monitoring reports for post-construction conditions, riparian survivorship monitoring, project effectiveness, and CDFW Streambed Alteration Agreement compliance for the SHEP. Ms. King analyzed field data to provide survival results for riparian mitigation sites, conducted peer reviews, consolidated data from Stanford sources, and prepared text for mitigation monitoring reports.

CalAmerican Coastal Waters Project

California American Water Company
Marina, CA

The CalAmerican Coastal Waters Project consists of a proposed desalinization plant and the associated delivery infrastructure to be situated between Marina and Carmel, California. Due to the increased water flow requirements in the Carmel River to meet regulatory agency requirements, water draws from the river have been reduced. Alternate water sources are needed to meet domestic needs in the Carmel Valley, which the desalinization plant is intended to fulfill. The scope of work for the biological resources included surveys in the CEMEX dunes lands due to the known high likelihood of special-status plants and animals surveys.

Ms. King led special-status plant surveys of more than 500 acres of coastal dune habitat associated with the CEMEX lands to the north of Marina State Beach using GPS to map state and federally listed species. She coordinated the production of special-status species maps to be used in the planning process to assist in the placement of project infrastructure. Constraints were identified within the project area, and avoidance of special-status species was accomplished.

Pradeep Mugunthan, Ph.D., P.E.

Managing Engineer

Dr. Mugunthan has more than 12 years of experience in performing hydrodynamic, sediment transport and water quality evaluations. He is also experienced in working with stakeholders and state and federal regulators on Clean Water Act, ESA and FERC-related environmental issues. He has led several studies on modeling flow, temperature and water quality to assess changes in environmental conditions and biological habitat in response to proposed management actions such as construction of dams for flood control and water resources management. Dr. Mugunthan has also led the development of several groundwater models, specifically focusing on groundwater-surface water interactions. He has designed monitoring programs to support model development and has performed numerous statistical evaluations of environmental data. He has presented his evaluations to various stakeholders and regulators, and has provided strategic technical support for his clients on water quality management and National Pollutant Discharge Elimination System (NPDES) permitting issues.

Education

Ph.D., Civil and Environmental Engineering, Cornell University, 2005

M.S., Civil and Environmental Engineering, Carnegie Mellon University, 2001

B.E., Mining Engineering, Anna University, Chennai, India, 2000

Licenses/Certifications

Registered Professional Engineer, State of California (No. 6486, Chemical)

Project Experience

Onondaga Lake Water Quality Model *Department of Water Environment Protection* *Onondaga County, New York*	Dr. Mugunthan was the technical lead for hydrothermal and water quality modeling. He was responsible for development, calibration, and validation of a complex water quality modeling framework for eutrophic Onondaga Lake. The model is being used for various managerial decisions, including an evaluation of the efficacy of treatment upgrades to the Syracuse Metropolitan Wastewater Treatment Plant, diversion of the wastewater effluent to the adjacent Seneca River, and point and non-point source actions in the watershed. This model is also being used by the state regulators for the development of phosphorus load allocations to the lake.
Mid-Columbia Coho Restoration Project *Yakama Nation* *Wenatchee and Methow Watersheds, Washington*	Dr. Mugunthan was the technical lead for discharge evaluation and data collection guidance to determine the environmental impact of acclimation ponds that will be used for reintroducing coho salmon in the tributaries of the Columbia River System. His responsibilities included determining acclimation-related phosphorus loads and studying the impacts to the Wenatchee River through mechanistic modeling. He authored water quality evaluations in the NEPA document for the project. He also provided NPDES permitting strategy support for proposed discharges in the lower Wenatchee River.

Sacramento River Deepwater Ship Channel Deepening Project *U.S. Army Corps of Engineers, San Francisco*	Dr. Mugunthan served as the technical writer for the draft SEIS/SEIR sections relating to salinity impacts of proposed deepening of the Sacramento River Deepwater Ship Channel. He translated the results of 3-D hydrodynamic modeling and scenario evaluations, and drafted analyses assessing overall impacts into the EIS.
Spokane Hatchery Water Quality Studies *Washington Department of Fish and Wildlife (through a subcontract to Tetra Tech, Inc.)* *Spokane, Washington*	Dr. Mugunthan was the technical lead for developing a water quality program to collect water quality and flow data from Spokane Hatchery as part of a hatchery redevelopment project. Data from this study will be used for supporting redevelopment of the hatchery and will support the NPDES permit application for the hatchery.
Chehalis Basin Strategy: Reducing Flood Damage and Enhancing Aquatic Species *Office of Financial Management, State of Washington*	Dr. Mugunthan was the technical lead for the development of two water quality models to simulate temperature and dissolved oxygen changes in the Chehalis River from a proposed multi-purpose reservoir in the Upper Chehalis River. The evaluations were used to support a biological model for assessing fish habitat changes in the Chehalis River.
Cushman Hatcheries Water Quality Evaluations *Tacoma Power* *Mason County, Washington*	Dr. Mugunthan was the technical lead for evaluating water quality impacts of discharges on the Skokomish River and on Hood Canal from two proposed fish hatcheries that were required to meet Federal Energy Regulatory Commission licensing requirements for generating hydroelectric power at Cushman Dam. Dr. Mugunthan conducted water quality evaluations and authored sections of the engineering report that was required for obtaining the NPDES permit.

Presentations and Publications

Mugunthan, P., G. Ferguson, C. Andonaegui, and J.R. Rhea, 2011. Evaluating the Water Quality Impacts of Discharges from Proposed Fish Acclimation Ponds in a 303(d) Listed Water Body in Central Washington. Presented at the Water Environment Federation's Impaired Waters Symposium 2011, Miami, FL. January 12-13, 2011.

Mugunthan, P., J.R. Rhea, D. Glaser, K. Russell, L. Zheng, and J.J. Mastriano, 2008. Development and Calibration of a Water Quality Management Model of Eutrophic Onondaga Lake, NY. Presented at the World Environmental & Water Resources Congress 2008, Honolulu, HI. May 12-16, 2008.

Mugunthan, P., and C.A. Shoemaker, 2006. Assessing the Impact of Parameter Uncertainty for Computationally Expensive Groundwater Models. *Water Resources Research*, 42, W10428, doi:10.1029/2005WR004640.

Mugunthan, P., C.A. Shoemaker, and R.G. Regis, 2005. Comparison of Function Approximation, Heuristic, and Derivative-based Methods for Automatic Calibration of Computationally Expensive Groundwater Bioremediation Models. *Water Resources Research,* 41, W11427, doi:10.1029/2005WR004134.

McDonough K.M., D.C. Lambert, P. Mugunthan, and D.A. Dzombak, 2005. Processes Governing Flow and Chemical Characteristics of Discharges from Free-draining, Underground Coal Mines. *Journal of Environmental Engineering* 131(10):1361-1368.

Mugunthan, P., C.A. Shoemaker, and R.G. Regis, 2004. Time Varying Optimization for Monitoring Multiple Contaminants under Uncertain Hydrogeology. *Bioremediation Journal* 8(3-4):129-146.

Oregon Hatchery Research Center

Issue 1

Winter 2006-2007

OHRC PROGRESS

A State of the Art Laboratory in a Natural Environment

OREGON HATCHERY RESEARCH CENTER

OHRC Mission

- Understand mechanisms that may create differences between hatchery and wild salmon and steelhead
- Develop approaches to best manage differences to meet fishery and conservation objectives
- Help Oregonians understand the role and performance of hatcheries in responsibly using and protecting Oregon's native fish

OREGON Fish & Wildlife

Oregon State University OSU

OHRC: A FLAGSHIP RESEARCH FACILITY

The Oregon Hatchery Research Center is a unique and dynamic facility located next to Fall Creek in the Oregon Coast Mountain Range near the town of Alsea between the cities of Corvallis and Waldport.

The center will help scientists and researchers answer questions related to fish recovery and hatchery programs.

The nearly eight million dollar Research Center is similar to several other facilities in the Pacific Northwest, but includes a unique feature, four parallel artificial streams in which to do research.

The four artificial streams are 200 feet long and 25 feet wide. Gravel, tree branches and root wads help simulate a natural stream environment.

Water moving through the artificial streams can be recirculated to augment flows during periods of low stream discharge or whenever increased flows are required. Habitat conditions are replicated in each channel, so if scientists observe something happening to fish in one channel, they can see whether the same thing occurs in another under the same conditions.

They can also slightly alter the conditions in one channel relative to another to find out what impact that has on fish.

Currently, there are 44 tanks - in a variety of diameters - that make up the tank farm. There is room for expansion of up to 88 tanks or more. Scientists will be able to rear individual families of fish, or groups of fish under replicated conditions.

Four refurbished raceways from the old hatchery are located in front of the new 18,000-square-foot building. These raceways will

(Continued on page 5)

ADVISORY COMMITTEE A "NATURAL RESOURCE" FOR SENIOR SCIENTIST

As the senior scientist for the Oregon Hatchery Research Center, Dr. David Noakes knows he doesn't walk alone in managing the state-of-the-art facility. In addition to the Oregon Department of Fish and Wildlife and Oregon State University professionals who work at the center, Dr. Noakes can rely on the OHRC Advisory Committee to help achieve his goals. The committee is made up of 15 individuals representing federal and local government agencies; sport and commercial fishing industries; watershed, tribal and education (K-12) organizations; resource producers (agriculture, timber, gravel); conservation interest groups;

(Continued on page 2)

Noakes' Notes

Dr. Noakes and long time supporter, Wayne Giesy talk at the opening ceremony.

At the Oregon Hatchery Research Center we are studying the differences between wild and hatchery salmon and trout. These same questions are among the most fundamental in the area of science known as EvoDevo (Evolutionary Developmental biology)—the interface of evolutionary biology and classical studies of development or embryology.

This approach investigates the relative contributions of genes, the environment, and the interactions between genes and the environment. Almost everyone has a strongly held opinion on the distinctions between hatchery and wild fish, despite a lack of critical experimental evidence. Hatchery fish may be exposed to artificial selection and domestication, in addition to striking differences in their early rearing environment. Wild fish are exposed to natural selection, and different environmental conditions. We are investigating how these differences in genes and environments can produce differences between the fish. We are able to conduct controlled experiments, on a scale not possible at other institutions, to keep Oregonians at the forefront of responsible management of native fishes.

David L. G. Noakes has more than 30 years experience at universities in Canada, the USA, Japan, China, Iceland, England, Korea and Scotland. He is currently a Professor in the Department of Fisheries and Wildlife at Oregon State University and is the Senior Scientist at the Oregon Hatchery Research Center. His teaching and research focus on fish behavior, ecology and evolution.

"The more people that give us insight and conduct research here, the better. There's no limit to what we can do here."
Dr. David Noakes, Senior Scientist, Oregon Hatchery Research Center

Advisory Committee

(continued from page 1)

and public-at-large and science-at-large representatives. The committee, appointed by ODFW and OSU, advises Dr. Noakes on activities and functions related to the operation and maintenance of the OHRC.

"The committee is a valuable resource for assisting with developing policies and procedures and providing helpful insight on goals and expectations for the facility," said Dr. Noakes.

Recently, the committee developed three subcommittees on operations, research and outreach and developed goals and objectives for each committee.

"It is a really exciting opportunity for the committee to be involved with all aspects of the OHRC, and we look forward to a long and productive working relationship," said Cindy Heller, a public -at-large committee member.

OHRC Outreach Opportunities

The Oregon Hatchery Research Center receives, on average, two organized tours a week, or over 100 organized visits per year. One example of the type of interaction and educational opportunities provided during these sessions was a visit of 63 elementary school kids from an after school program in Waldport.

The kids were separated into four groups.

Each made observations in the stream channels, including identifying spawning areas, fish hiding areas, fish feeding areas and rearing areas for benthic invertebrates.

The groups shared their findings and then created maps from the observations made in each simulated stream. The simulated stream channels provided an excellent educational opportunity.

For tours, contact:
Ryan Couture
OHRC Facility Manager
2418 East Fall Creek Road
Alsea, OR 97234
(541) 487-5510
ryan.b.couture@state.or.us

OHRC Completes "Shakedown"

A thorough "shakedown" of the Hatchery Research Center occurred over the past year to test, adjust and improve all fish rearing components.

The "shakedown" tested and verified all water supplies and drains, flows and water chemistry, electronic systems, uniform characteristics among tanks and replicate stream channels and fish performance in tanks and replicate stream channels.

The OHRC has an extensive and elaborate water intake cleaning system that redirects river water through a series of pipes to the silt settling pond and the research raceways.

According to contractors, there is an estimated eight miles of underground piping that supports the OHRC.

Testing and updating the water intake cleaning system included increasing the size of the drive motors and installing a spray bar system to supplement the brush cleaners. A large log, donated by Weyerhaeuser, was placed in front of the intake structure to help deflect debris. The embankment around the intake was stabilized with about 50 yards of boulders.

Four refurbished raceways in front of the OHRC building

A communications system is being installed at the center that will use video cameras to monitor fish movements and behavior in the simulated streams, fish ladder and wet lab. The video feed will be linked to the interpretive center. This system will allow staff and visitors an opportunity to watch salmon spawning without interfering or being detected.

"These cameras will help researchers document the behavior patterns of adult and juvenile hatchery and wild fish as they interact with each other and their habitats in the simulated stream channels," said Ryan Couture, OHRC facility manager .

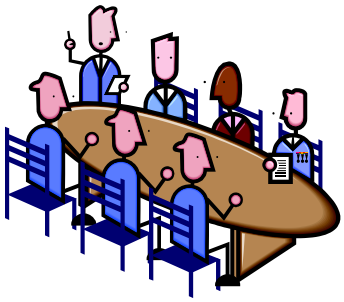
The cameras will work under extremely low light conditions and will provide complete coverage of the four simulated channels.

Images captured are planned to be available for public viewing at OHRC, OSU, Hatfield Marine Science Center and the Internet.

"The research goals of this facility are critical to future management of salmon and steelhead in Oregon."
Dan Edge, Chair, Oregon State University Department of Fisheries and Wildlife

OHRC Advisory Committee Members

Judy Gordon, federal government
Mark Labhart, local government
Dennis Richey, sport fishing
Bruce Buckmaster, commercial fishing
Stan Van de Wetering, tribal
Chris Vandenberg, resource producers
Tom Davis, watershed councils
Bill Hansumaker, education K-12
Cindy Heller, public-at-large
Dr. Wayne Hoffman, public-at-large
Dr. Thomas Ebert, science-at-large
Dr. Jeff Hard, science-at-large
Barry McPherson, science-at-large
Dr. Ben Stout, science-at-large
Tom Gilg, conservation



ENGINEERING FIRM WINS NATIONAL AND STATE AWARDS FOR OHRC DESIGN

Tetra Tech/KCM won the 2006 Carl V. Anderson Award of Merit—a national-level award—for designing the Oregon Hatchery Research Center.

The presentation was made in October at the Association of Conservation Engineers (ACE) awards ceremony in Erie, Penn.

The award is the second highest award given by ACE and recognizes engineering design practices that best exhibit the goals and objectives of ACE as judged by peers and associates.

In addition to the national recognition, Tetra Tech/KCM was also the recipient of two state-level awards.

In January, Tetra Tech/KCM was presented with the 2006 Grand Award for Engineering Excellence by the Oregon Chapter, American Council of Engineering Companies for Engineering.

They also received the 2006 Gold Award for Contribution to the Engineering Profession, by the Washington Chapter, American Council of Engineering Companies.

The Oregon Department of Fish and Wildlife's goal was to convert a "well used" production hatchery into a state-of-the-art research center that would provide a scientific basis for modified hatchery practices and programs so that negative impacts on wild populations are eliminated or controlled to a known and accepted level.

The OHRC tank farm provides a location for rearing larger groups of fish for experiments using different lineages, spawning and rearing conditions.

Tetra Tech/KCM was selected by ODFW to perform civil, architectural, biological and engineering services including programming design, bidding, construction administration and closeout services.

Tetra Tech/KCM's design team included four highly-regarded fisheries scientists to bridge the gap between science and engineering.

Included were a previous ODFW senior scientist, a University of Washington fisheries professor specializing in salmon research, a genetics consultant associated with the University of Idaho and an environmental scientist with the University of Idaho with expertise in natural stream habitat.

Tetra Tech/KCM was created in 1943 and works with clients to develop or improve water, wastewater, transportation and surface water management systems, buildings and structures ranging from military facilities to hatcheries, aquariums, visitor centers and zoos.

Shade cloth suspended above the artificial streams to replicate shade.

(Continued from page 1)
allow comparisons of experimentally-reared fish with traditional hatchery rearing.
The new research building houses the visitor and interpretive center that offers a place for K-12 youth and the public to learn about hatcheries as a fish management tool, and about fish ecology and watershed processes.
An in-house wet and dry lab allows for additional experiments and fish processing. Additionally, the building includes dormitory-style living quarters that provide rooms for up to 24 researchers, students and natural resource professionals conducting long-term projects or attending conferences.

It Takes A Team

To operate the OHRC facility requires staff to live onsite. Ryan Couture, OHRC facility manager, Joseph O'Neil, assistant manager, and Joyce Mahr, technician, work together to oversee maintenance and safety, conduct education and outreach activities, and provide fish-culture guidance

Ryan Couture (left) and Joseph O'Neil (right)

Mahr "sweeps" debris from one of the raceways

OHRC Current Research Projects

Isotopic Analysis of Diets
We are collaborating with scientists from the EPA Corvallis Laboratory in a study of diets and growth in juvenile steelhead. We are feeding juveniles on diets with high and low isotopic composition and tracking changes in muscle tissue and mucus of the fish. This allows us to calculate growth rates, and to calibrate this technique to determine diet switching in wild fish. The results will be applied to studies on the effectiveness of salmon carcass placement in Oregon watersheds. Mucus can be used as an alternative to invasive tissue sampling from wild fish.

Effects of Early Rearing on Brain Structure in Steelhead
This research was initiated to test findings reported from rainbow trout in California (Marchetti et al 2004, 2006). Results from rainbow trout showed larger and more complex cerebellum brain structures for fish reared on gravel, compared to those raised on bare substrate. Those results lead to the hypothesis that early rearing experience would alter brain structure associated with orientation and movement of fish. Fish reared in gravel (= "natural") substrate would thus enjoy an advantage in survival and growth, compared to those reared on bare hatchery substrates. We reared steelhead under a much greater range of conditions, for much longer periods of time, to test the predictions from that hypothesis. We reared fish at three different temperatures (cold, ambient, warm), with and without formalin or ultraviolet sterilization of water, in conventional hatchery trays and in simulated stream gravel. The results from this study will help us understand the effects of early experience on later survival and migratory behavior of salmon and trout.

Genetics of Growth and Survival
We are collaborating with Professor Michael Banks of the Hatfield Marine Science Center to measure the genetic basis for differences in survival and growth of salmon and trout.
We collect small tissue samples from adults and juveniles so we can assign parents and progeny to fish in the simulated stream channels, in hatchery tanks, and in natural populations. We track the survival and growth of identified juvenile fish in relation to their feeding behavior, habitat choice and social interactions. This information can be used to better manage hatchery production, or wild breeding populations.

(Continued on page 6)

"Investing in fish is investing in Oregon's economy, as well as the state's future."

Governor Ted Kulongoski

ODFW
3406 Cherry Ave NE
Salem, OR 97303

OREGON HATCHERY RESEARCH CENTER

Construction of the Oregon Hatchery Research Center made possible by these supporters.

Oregon Hatchery Research Center

The OHRC was featured on Oregon Public Broadcasting's Oregon Field Guide November 2, 2006. The episode highlighted the unique features of the facility and the important research that will take place here. Dr. David Noakes and Ryan Couture were interviewed for the episode and provided an inside perspective on this one-of-a-kind facility. Go to http://education.opb.org/programs/ofg/episodes/view/1805 to view the story.

The OHRC was also the cover story on Oregon State University's Agricultural Progress, Spring 2006, Volume 52, Number 1. Reprints of the article are available from the OHRC, or the article can be downloaded from the OSU information website http://extension.oregonstate.edu/oap/story.php?S_No=160&storyType=oap&page=1

WORK IN PROGROSS: KIOSKS

Kiosks are located on the path that borders Fall Creek. Soon informational graphics will be mounted to the kiosks highlighting local wildlife and fish populations.

(Research continued from page 5)

Handling, Food Deprivation and Stress in Steelhead Smolts

Experiment was designed and conducted in collaboration with Dr. Carl Schreck and the Fish Coop Unit at OSU – Fisheries and Wildlife Department. Experiment has been completed, data have been analyzed and a manuscript is being written.

OHRC on the web: http://www.dfw.state.or.us/OHRC/

The Oregon Hatchery Research Center is a new facility on Fall Creek, in the central Oregon Coast Range.

The mission of the Oregon Hatchery Research Center is to:

- Understand mechanisms that may create differences between hatchery and wild salmon and steelhead
- Develop approaches to best manage differences to meet fishery and conservation objectives
- Help Oregonians understand the role and performance of hatcheries in responsibly using and protecting Oregon's native fish

The Oregon Hatchery Research Center received $7.8 million total funding:

- $4 million from Ballot Measure 66 capital funds
- $1.125 million from the OWEB Restoration and Protection Research Fund
- $1.875 million from ODFW
- $.84 million from the ODFW Fish Restoration and Enhancement Program

Research will provide information to help:

- Use hatchery fish responsibly to support viable populations of wild fish and sustain sport, commercial and tribal fisheries
- Understand biological processes and management implications on landscape scales
- Identify hatchery practices that minimize the impact of hatchery facilities on the natural environment

The OHRC staff includes:

- A Senior Scientist to oversee research and operations, identify research priorities, plan and conduct research, collaborate with fishery professionals and students, and coordinate with an advisory team
- A facility manager, assistant manager and one technician to operate the facility, oversee maintenance and safety, conduct education and outreach activities, and provide fish-culture guidance

For more information about the Oregon Hatchery Research Center:

- Call the center at 541-487-5510
- Visit the website at **http://www.dfw.state.or.us/OHRC/**

Oregon's Agricultural Progress is published by the Oregon Agricultural Experiment Station (Thayne Dutson, director). It is a report to taxpayers, who help fund Oregon Agricultural Experiment Station research. For a free subscription call: 1-800-561-6719, or subscribe to Oregon's Ag Progress Online at: http://eesc.oregonstate.edu/oap/

Editor Peg Herring
Designer Tom Weeks
Writer Carol Savonen
Photos Lynn Ketchum

Oregon State University | Agricultural Experiment Station

Recycled Paper

OREGON STATE UNIVERSITY AGRICULTURAL EXPERIMENT STATION

OREGON'S AGRICULTURAL PROGRESS

Hatching Wild Ideas

HATCHING NEW IDEAS ABOUT WILD SALMON

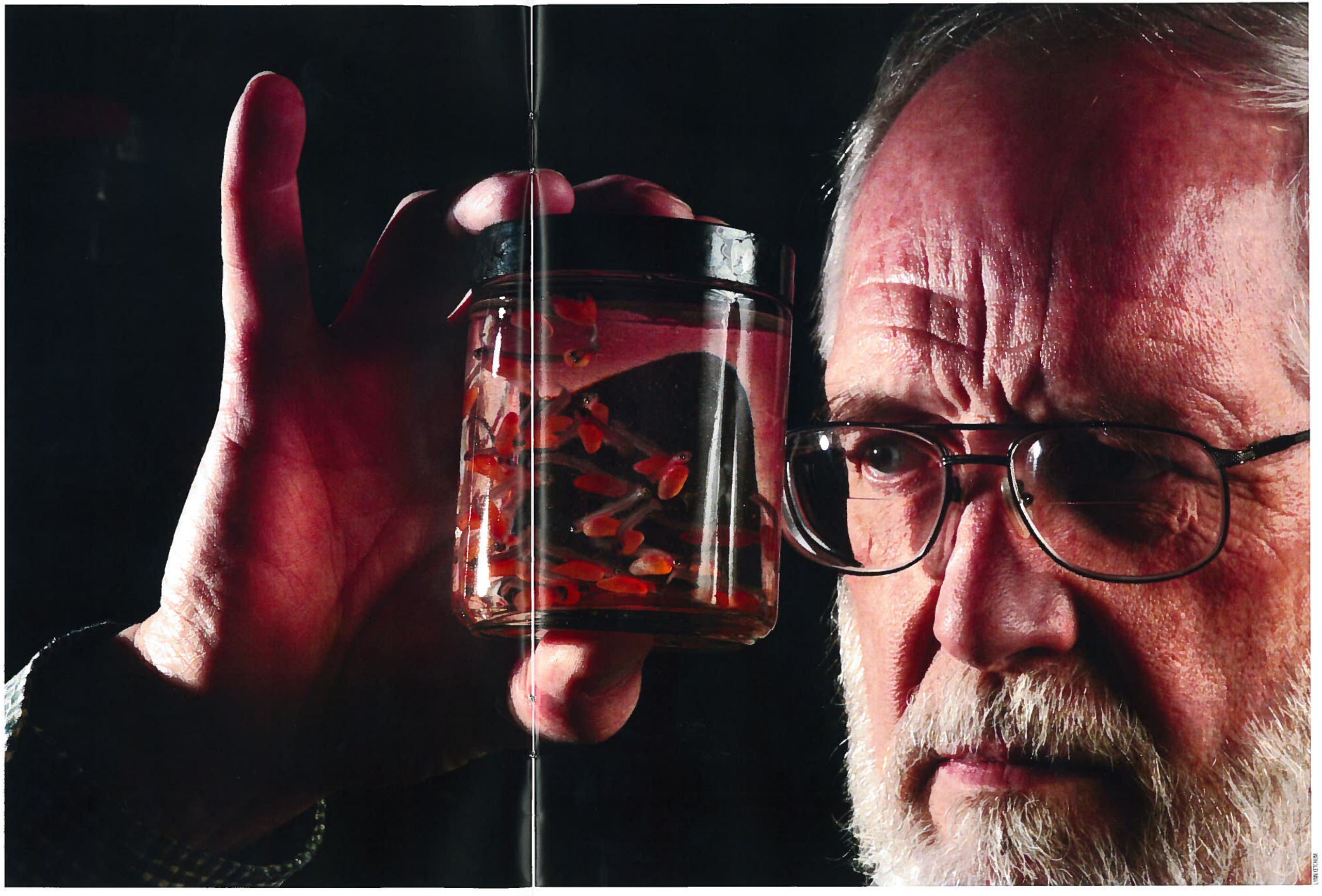
BY CAROL SAVONEN

Nestled in a steep green valley outside of the tiny Coast Range community of Alsea, a new research fish hatchery is a far cry from the typical production hatchery that turns out salmon fingerlings by the ton.

The jade-colored water of Fall Creek flows into the hatchery and through a fish trap before it splits into four virtually identical stream channels. These parallel channels look like natural streams, filled with river-rounded gravel, broken tree limbs, and identically placed meanders and pools. The streams look so natural that dippers fly in and scout the stream beds for aquatic insects crawling in the submerged pebbles.

The new Oregon Hatchery Research Center is designed to study the influences of hatchery salmon and steelhead trout on their wild relatives. The $7.5 million state-of-the-art facility opened in October, 2005, as a joint venture between the Oregon Department of Fish and Wildlife (ODFW) and Oregon State University's Department of Fisheries and Wildlife. Here, scientists, students, and citizens will be able to study hatchery and wild fish together.

Wild salmon runs are threatened or endangered in two-thirds of their ranges in Oregon, Washington, Idaho, and California. Fisheries scientists often attribute salmon decline in our region to the "Four H's"—habitat loss, harvest, hydropower, and hatcheries. If you examine



David Noakes, director of the Oregon Hatchery Research Center, examines newly hatched steelhead trout.

(PHOTOS: LYNN KETCHUM)

closely any of these factors, you'll find a tangled web of issues.

Today, more than 70 percent of Oregon's salmon start life not in streams but in a fish hatchery. Hatchery salmon have been compared to farm animals, bred to be the biggest, the earliest returning, or the brightest colored. The characteristics that make them a desirable catch for people do not necessarily help them survive better in the wild.

"Farmed" salmon and "hatchery" salmon are not the same. Hatchery salmon live most of their lives in the wild, while farmed salmon are raised in captivity and fed manufactured food.

Scientists often attribute salmon decline to the "Four H's"—habitat loss, harvest, hydropower, and hatcheries.

Hatcheries have helped boost salmon numbers and maintain viable fisheries, stopping or reversing salmon decline in some areas and sometimes playing a crucial "stop-gap" role in restoring wild runs.

But many studies have shown that hatchery-bred salmon may harm native fish by spreading diseases or by contaminating their genetic fitness for conditions in a particular watershed. Hatchery fish have been found to compete with wild fish, by using up available food and habitat. Raised in raceways, munching on fish chow, these fish become easy targets for predators.

Though hatchery and wild salmon each have their proponents, most fisheries scientists are coming to realize that both are needed, explained Carl Schreck, OSU fisheries professor and member of the Oregon Cooperative Fish and Wildlife Research Unit at OSU. Scientists need to learn enough to produce hatchery fish in a way that is compatible with remnant wild fish stocks, he said.

"We have to learn how to do aquaculture successfully to be able to rehabilitate endangered wild fish," said Schreck, who serves on the science

Water from Fall Creek flows into four parallel experimental channels, protected by netting from fish-eating birds.

Fish trapped at the research center are measured and recorded before they are released into the experimental channels for observation.

team advising the state government's Oregon Plan for Salmon and Watersheds. "We have to develop ways of rearing salmon very different from old production methods. We have to learn to do no harm to wild stocks."

Gil Sylvia, a natural resource economist with OSU's Coastal Oregon Marine Experiment Station, thinks the new facility will help illuminate economic aspects of salmon management.

"We all want to save the salmon… but at what cost? We need a healthy ecosystem for both its human use and for nature," said Sylvia. "So much money in Oregon goes to salmon—close to $1 billion per year, including lost hydropower revenues, so we need to find the biggest bang for our buck to increase salmon populations. Will it be to reduce commercial fishing? To increase spill over the dams? Do hatchery fish actually compete with wild fish? Should we make them more like wild fish or make them so different they don't interact? These are the kinds of questions that we would hope to be able to answer."

A hatchery dedicated solely to research, teaching, and extension is very rare, according to David Noakes, the research director of the new hatchery. "Most all other hatcheries are 'production' hatcheries," he said. "Their sole objective is to produce fish, much like a factory produces products. Production hatcheries generally don't research new ideas; they don't do experiments. But our new facility is designed and planned from scratch to answer research questions."

"Salmon are symbolic, almost totemic, in people's minds. Everyone here seems to hold strong opinions about salmon."

Noakes, who came to OSU from Canada's University of Guelph, is one of the world's leading experts on fish biology and behavior. "In terms of fish, the Pacific Northwest is much more productive than northeast Canada," he said. "Salmon and trout play an integral role in the ecosystem here in a way that they don't back East. The salmon were mostly gone from eastern North America a century ago. It is fascinating that the Pacific Northwest has an ecosystem with migratory salmon coming in from the ocean, carrying their influence inland.

"Salmon have different implications for people here," he continued. "They are symbolic, almost totemic, in people's minds. Everyone here seems to hold strong opinions about salmon."

Research conducted at the Oregon Hatchery Research Center may help bring more scientific evidence to some of those opinions. A new research building with outdoor tanks and raceways provides a laboratory for experiments, and an interpretive center, living quarters, classrooms, and conference rooms make it easier to involve researchers and students.

Talk to any OSU or ODFW fish researcher, and they'll tell you they're most excited about the four experimental streams at the new research hatchery.

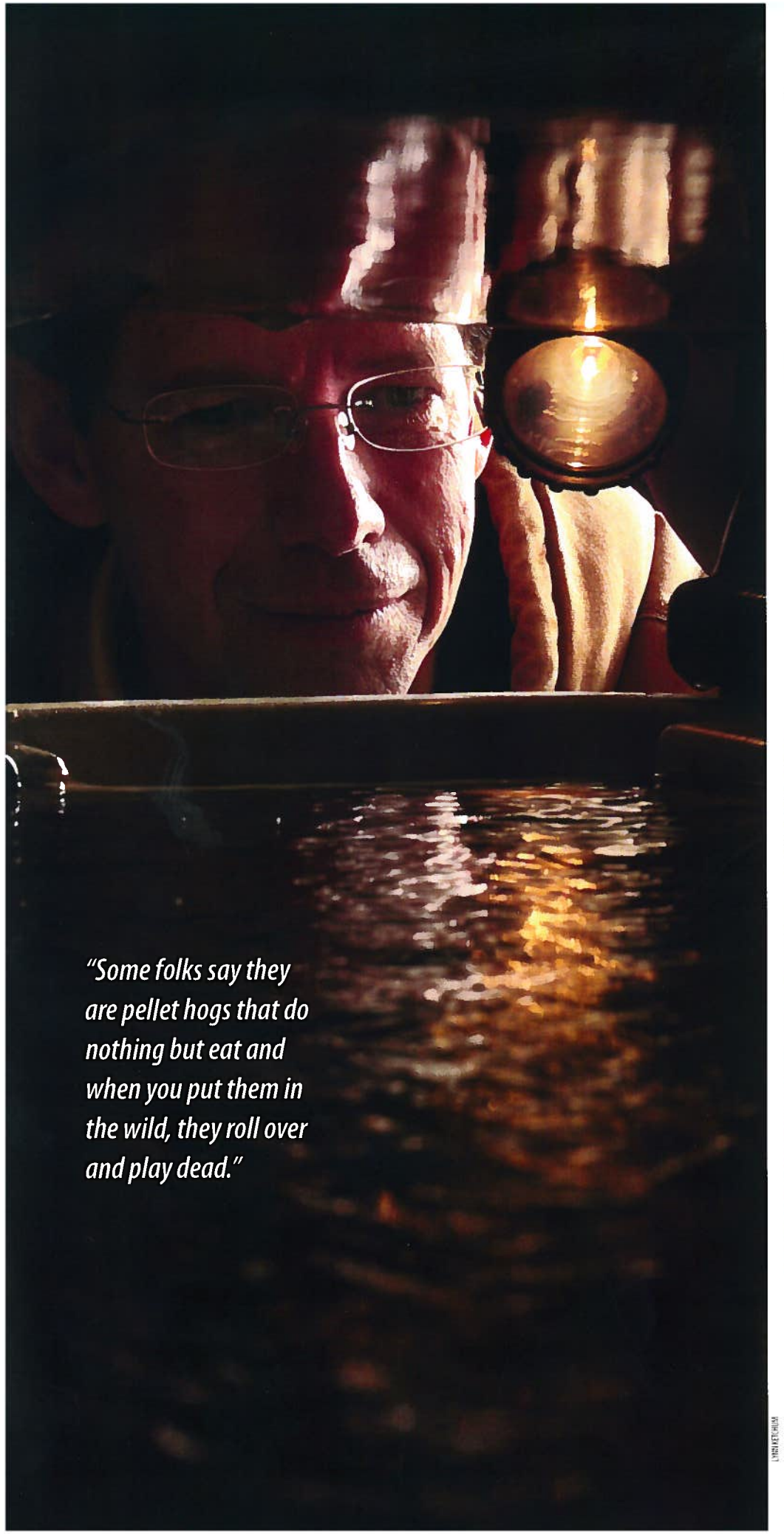
"Other artificial stream channels are not like this," said OSU Extension fish ecologist Guillermo Giannico. "These are natural looking, with meanders, downed wood, stream gravel. They mimic many hydrological processes. Most other artificial streams are more like wide cattle troughs with a little gravel sprinkled on the bottom."

These natural-style stream channels make it possible to observe wild and hatchery fish together, observations that might improve hatchery and wild fish management. This is integral to the center's ambitious mission—to conduct studies that will shed light on the differences and interactions between hatchery and wild salmon and steelhead. Once differences are better understood, managers can further develop practices that help conserve wild stocks.

With their eyes on the future, young steelhead emerge from eggs incubated at the hatchery research center.

Research is just beginning at the new hatchery. Resident ODFW hatchery staff are testing basic hatchery functions as well as rearing fertilized salmon eggs, raising young salmon and trout under varying temperature regimes, and recording where wild and hatchery adult steelhead spawn in the artificial stream channels. The staff is testing sanitation methods using ultraviolet light versus formalin to combat disease on incubating eggs.

"We want to be asking questions all the time," said Noakes.

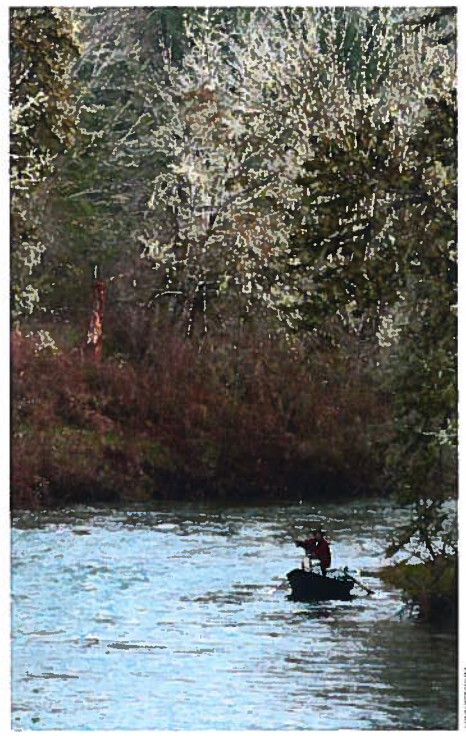


How do salmonids choose mates, spawn, grow up, travel, and compete for food? How do hatchery and wild fish interact as juveniles? As returning adults? Where do they spawn? Where do they go after they are released? Where do they spend time in the gravel and how do they develop under different temperature, disease, and food and light regimes?

"We can see how wild fish and hatchery fish compete."

"One of the questions we want to investigate is: Are hatchery fish competent?" Noakes said. "Some folks say they are pellet hogs that do nothing but eat and when you put them in the wild, they roll over and play dead. Others say that hatchery fish are the source of all evil, that they take over and crowd out wild fish. And many others see hatcheries as the only realistic option for supplementing and conserving fish species.

"We can see if hatchery fish will spawn with wild fish, or if they will crowd them out of spawning beds. We can compare juvenile growth rates and survival. We can see how wild fish and hatchery fish compete."



▲ New information may help researchers understand when and where hatchery fish can be caught without impacting wild runs.

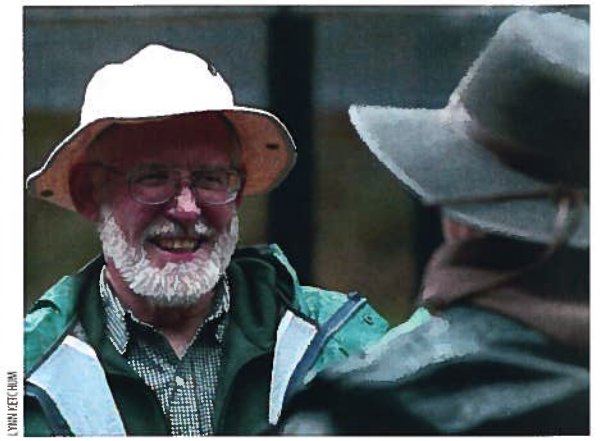
◀ Joseph O'Neil pores over the progress of young salmon in the Oregon Hatchery Research Center, where he is assistant manager.

Most hatcheries have an objective of producing as many young salmon as they possibly can. Is this the right way of doing business? Schreck sees the Oregon Hatchery Research Center as an excellent place to determine the optimal density for raising young salmon smolts. "Maybe we can test to see if it is more cost effective and successful to produce fewer high-quality, not high quantities, of fish at hatcheries," he said.

"I would be really interested in looking at the competition between hatchery and wild juvenile fish in those experimental streams," said Giannico. "Young salmonids compete for territories in streams. One could look at the effect that sequence of arrival to a territory, or relative size differences among fish, may have on the outcome of wild and hatchery fish competition for the best feeding spots in a stream reach. This kind of information could help design hatchery release strategies that minimize undesirable impacts on wild salmonids."

Experimental streams mimic natural features with gravel bars, woody debris, and natural meanders and pools.

Noakes wants to make sure that the research at the center is interdisciplinary and far ranging. He's formed several advisory committees, including an advisory committee to review research proposals and a stream advisory committee with hydrologists, stream ecologists, and forest engineers.



David Noakes sees the center as a place to bring together researchers, students, and the community.

"The more people that give us insight and conduct research here, the better," he said. "There's no real limit to what we can do here."

"I could see the center as a good place for watershed councils, conservation groups, commercial fishers, and angler groups to participate in workshops and other information sharing," said Giannico. "Local students will have a great opportunity to study natural science here, not only at the hatchery, but in the surrounding watershed itself."

Patience on the part of citizens and scientists will be required, as funding and results are not going to be instantaneous. "There's a huge potential here to benefit the people and fisheries of Oregon," said Schreck. "But people have to give it time to succeed. Salmon life cycles are long. It takes three to six years to follow one generation of salmon from egg to a spawning adult. None of this is quick."

Carol Savonen is a communications specialist in OSU's Department of Extension and Experiment Station Communications.