January 23, 2017 • Seattle Daily Journal of Commerce

ACEC2017

ENGINEERING EXCELLENCE AWARDS

The promenade has glass pavers that help migrating salmon by allowing sunlight to reach beneath the water.

PHOTO COURTESY OF MAGNUSSON KLEMENCIC ASSOCIATES

Environmental design

National finalist: Platinum award

Magnusson Klemencic Associates

Project: Elliott Bay Seawall habitat and public space
Client: City of Seattle

Seattle's downtown waterfront is a critical economic center for the city and the region, with more than 19 million visitors annually generating more than $9 billion in tourism revenue and $623 million in state and local taxes. One of the waterfront's main players, the Port of Seattle, generates $19.8 billion in business revenue and $894.4 million annually in state and local taxes.

But a dark cloud hung over the city.

Even with the removal of the Alaskan Way Viaduct, Seattle's downtown waterfront seawall was at great risk of collapse in the next earthquake, with its liquefiable soils, and having been pummeled by tidal forces, wind-driven waves and underground marine borers for the past 75 years. The Seattle Department of Transportation, in response, developed the Central Seawall Project (CSP) to replace 3,700 linear feet of the dilapidated seawall with a stronger, better and more seismically resistant seawall that would last at least another 75 years.

From the start, the city's goals were clear: Provide a new earthquake-resistant seawall, improve the near-shore marine environment, and restore a long-interrupted salmon migration route. The city selected a team headed by Parsons, but stipulated that Magnusson Klemencic Associates must be part of the team in a key leadership role based on their past work for the city. MKA became the "public realm lead," responsible for integrating all urban design, art, and landscape and habitat components into CSP's construction documents.

One of the big challenges of the project was to improve the waterfront's adjacent marine environment. The canyons and shadows created by Seattle's urbanized shoreline were drastically impacting native salmon traveling along their waterfront migration route, delaying their journey, limiting food sources and exposing them to predators. Research had shown that 29 percent of the area's pre-settlement salmon population had become extinct, and 27 species are threatened, including the chinook.

With 90 percent of Seattle's central waterfront shoreline covered by piers, the project had to include bringing natural light beneath the promenade since research had shown salmon migration was encouraged by as much natural light as possible. Traditional steel grating and other openings in the promenade were ruled out because they would compromise safety for pedestrians above.

MKA needed to come up with another answer. The firm conducted a customized two-month study of potential light levels using movie industry technology that included positioning light meters at key elevations in a model to observe how light moved through the promenade surface to the water surface, and even to fish-eye depth.

MKA's engineers then created a custom light-penetrating pedestrian promenade using glass pavers that is stacked over the salmon migration corridor by siting the new seawall face 15 feet landward of its old location. This innovation gives both human and fish habitats ample space to thrive.

MKA also conducted research into marine surface texture designs that would increase habitat biodiversity and encourage marine life attachment, guiding the development of a two-inch-thick "texture zone" of the precast concrete seawall that had textured bands of sea organisms layered to ocean habitat, plus imprints of tidal transitions.

The Central Seawall Project's very sensitive nature, highly public location, extremely large size and long list of "neighbors" required that MKA have excellent communication and project management skills, as well as technical expertise and creative problem-solving abilities. The list of actively involved agencies and stakeholders included Washington State Ferries, the U.S. Army Corps of Engineers, the U.S. Fish & Wildlife Service, the state departments of Natural Resources and Ecology, several Native American tribes, the Seattle Office of Arts & Culture, waterfront pier owners and businesses, and many more.

John Buswell, roadway structures manager for Seattle's Department of Transportation gave special kudos to MKA for their pioneering light-penetrating surface, which "has never been used in a waterfront setting. This unique and innovative design is a first for providing both a functional pedestrian surface and needed sunlight to marine habitat…This system is a model for other waterfront communities."

Judges commented that replacing the existing seawall in downtown Seattle was a complex undertaking in its own right. But finding a way to incorporate ecological enhancements into the basic structural requirements of the new seawall made this project stand out.

MKA GETS PLATINUM FOR SEAWALL WORK

Magnusson Klemencic Associates received the platinum award at the 50th annual Engineering Excellence Awards for their design and project leadership of the Elliott Bay Seawall habitat and public space.

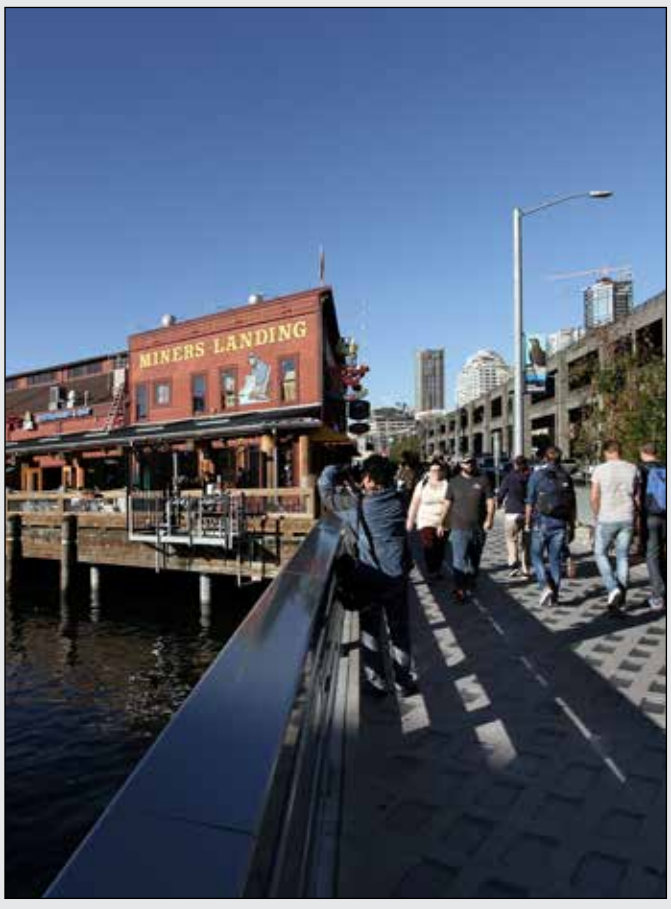
The awards are sponsored by the Washington state chapter of the American Council of Engineering Companies.

This year, ACEC Washington honored 42 projects representing a wide range of engineering achievements and demonstrating the highest degree of skill and ingenuity.

The top seven awards — one platinum and six gold — will go on to compete in the ACEC national competition in Washington, D.C., in April.

Entries were evaluated by a five-judge panel. The members were Rich Reis, engineer and consultant; Jeff Carpenter, state design engineer at the Washington State Department of Transportation; Steve Johnston, retired engineer; Bob Axley, retired engineer; and Benjamin Minnick, construction editor at the Daily Journal of Commerce.

The American Council of Engineering Companies of Washington is a professional trade association representing consulting engineering, land surveying and affiliated scientific and planning firms statewide.



ON THE COVER:

Magnusson Klemencic Associates won ACEC Washington's platinum award for its role as the public realm lead in the Elliott Bay Seawall project in Seattle.

PHOTO COURTESY OF MAGNUSSON KLEMENCIC ASSOCIATES

DJC SPECIAL SECTION TEAM

SECTION EDITOR: JON SILVER • SECTION DESIGN: JEFFREY MILLER
WEB DESIGN: LISA LANNIGAN • ADVERTISING: MATT BROWN

NATIONAL FINALISTS

PLATINUM AWARD

ENVIRONMENTAL DESIGN

MAGNUSSON KLEMENCIC ASSOCIATES
Project: Elliott Bay Seawall habitat and public space
Client: City of Seattle

GOLD AWARDS

STUDIES, RESEARCH AND CONSULTING

WSP PARSONS BRINCKERHOFF/ENVIROISSUES
Project: Sound Transit regional high-capacity transit system plan (ST3)
Client: Sound Transit

STRUCTURAL SYSTEMS

COWI NORTH AMERICA
Project: World Trade Center Transportation Hub
Client: The Port Authority of New York and New Jersey

STRUCTURAL SYSTEMS

HDR ENGINEERING
Project: State Route 520 Bridge replacement and HOV program
Client: Washington State Department of Transportation

WASTE AND STORMWATER

BROWN AND CALDWELL
Project: Chambers Creek Regional Wastewater Treatment Plant expansion
Client: Pierce County Public Works and Utilities

WATER RESOURCES

SHANNON & WILSON
Project: Fir Island farm estuary restoration
Client: Washington Department of Fish and Wildlife

TRANSPORTATION

MCMILLEN JACOBS ASSOCIATES
Project: University Link extension
Client: Sound Transit

BEST IN STATE

GOLD AWARDS

UNIQUE OR INNOVATIVE APPLICATIONS

OTAK
Project: Willapa Hills Trail bridge replacements
Client: Washington State Parks and Recreation Commission

FUTURE VALUE TO ENGINEERING PROFESSION

DLR GROUP
Project: American Airlines Arena solar canopy
Client: The Heat Group

SOCIAL, ECONOMIC AND SUSTAINABLE DESIGN

LANDAU ASSOCIATES
Project: Waterfront Place cleanup and infrastructure
Client: Port of Everett

COMPLEXITY

BERGERABAM
Project: P-990 explosives-handling wharf No. 2
Client: Naval Facilities Engineering Command Northwest

COMPLEXITY

WOOD HARBINGER
Project: State Route 520 Evergreen Point Floating Bridge
Client: Washington State Department of Transportation (KPFF for design; KGM for commissioning)

SUCCESSFUL FULFILLMENT OF CLIENT/OWNER NEEDS

WELCH COMER ENGINEERS
Project: Hawthorne Avenue from Walnut to Crestview
Client: City of Colville

WSP/Parsons Brinckerhoff and EnviroIssues led planning and outreach for Sound Transit's $54 billion voter-approved transit plan.

SOUND TRANSIT PHOTO

Studies, research and consulting

National finalist: Gold award

WSP Parsons Brinckerhoff/ EnviroIssues

Project: Sound Transit regional high-capacity transit system plan (ST3)
Client: Sound Transit

In November, 54 percent of the voters in King, Snohomish and Pierce counties approved a $54 billion, 25-year update to Sound Transit's regional high-capacity transit system (HCT) plan — aka ST3 — that will enhance connectivity and provide reliable transit options as well as a strong, supportive infrastructure. But this critical vote didn't happen in a vacuum.

Months earlier, Sound Transit tapped WSP/Parsons Brinckerhoff and EnviroIssues to help build the foundation for an update of Sound Transit's long-term regional HCT system plan. Originally adopted in 1996, the plan has needed updating over the years, and its progress was approved by the public.

The vote this past November ensures the continued growth of Sound Transit's "spine," connecting major cities in the region from Everett to Tacoma, and to Redmond and Issaquah on the Eastside.

The new ST3 revision of the HCT plan includes a range of transit investments that will add 62 new miles of light rail, introduce new bus rapid transit service, expand Sounder commuter rail, and provide additional facility and service improvements. These improvements are projected to reduce annual auto vehicle travel in the area by 362 million miles by 2040, resulting in a reduction of more than 130,000 metric tons of emissions annually.

WSP/Parsons Brinckerhoff was the prime consultant, leading a team of seven firms to complete the transit and transportation planning, conceptual engineering, cost estimating, financial analysis and ridership forecasting for the ST3 effort. Then it was up to EnviroIssues to convey to the public how the engineering and technical information — and resulting system updates — would improve their lives.

EnviroIssues developed an interactive, web-based communications tool to engage with community members throughout the plan development process. More than 183,000 unique users visited the website. Nearly 35,000 people across the three counties responded to an online survey, and some 500,000 people viewed an advertisement for the plan via social media.

Sound Transit's Ric Ilgenfritz wrote, "The planning, design, and cost estimating efforts conducted by the WSP/Parsons Brinckerhoff team enabled us to put this plan together efficiently and confidently, while the public involvement and communications set the stage for us to quickly launch project implementation in the coming months."

Awards judge Jeff Carpenter said, "This study updated and validated Sound Transit's bold plan for the Puget Sound light rail. It laid the groundwork for a successful funding campaign which received the approval of the voters."

This Santiago Calatrava-designed structure at the World Trade Center Transportation Hub consists of two parallel arches supported by narrowly spaced columns.

PHOTO COURTESY OF COWI NORTH AMERICA

Structural systems

National finalist: Gold award

COWI North America

Project: World Trade Center Transportation Hub
Client: The Port Authority of New York and New Jersey

One hundred feet above the ground at the tip of New York's Manhattan Island, a giant steel-and-glass, dome-like structure rises over the new World Trade Center Transportation Hub.

The eye-catching structure, designed by world-renowned architect Santiago Calatrava, is inspired by what appears to be a pair of hands releasing a white dove. The structure, called Oculus, consists of two parallel arches spanning a 300-foot-long oval-shaped opening in the roof, supported by columns spaced five-and-a-half-feet apart. Glass panels fit in between the columns, allowing natural light to bathe the 200,000 daily commuters below.

Yes, it is beautiful and inspiring, but it also was an extremely complex and complicated structure to design and build. In fact, because of its bridge-like design, the Port Authority of New York and New Jersey didn't seek out a traditional structural engineering company to help build it. Instead, the port hired for the project a top bridge-engineering firm, COWI North America, and its New York bridge division, Buckland & Taylor International.

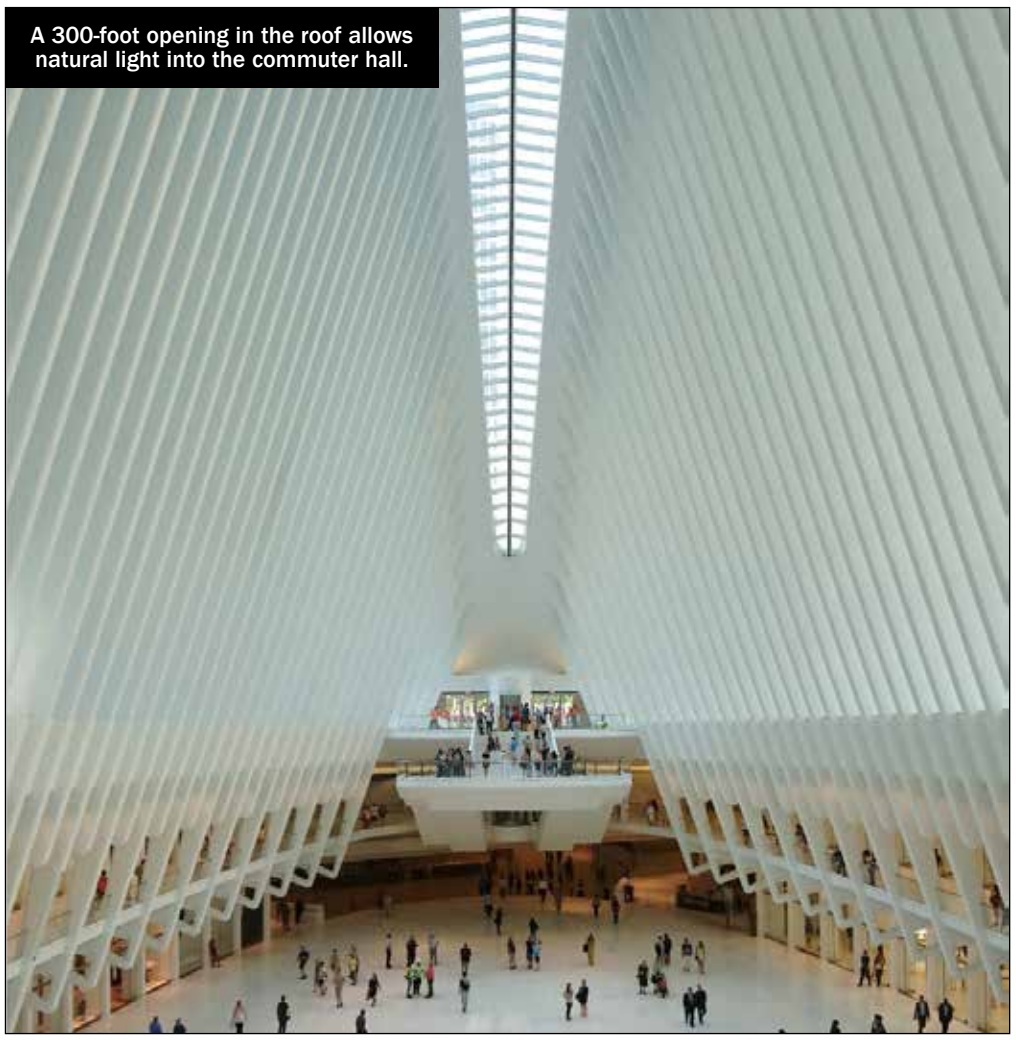
A sequential erection scheme, used in bridge construction, was deemed the ideal approach. Essential to this scheme was a custom "finite element analysis" model that determined the cambered shape of each individual steel segment and computed the stresses in the structure and the position of the geometry control points during each stage of the erection.

Constant monitoring with the model helped define erection sequence, maintain tight geometric tolerances, achieve schedule and reduce costs, and allowed for slight alterations and adjustments as construction progressed.

The project team also identified significant risks associated with traditional "field welding." To mitigate these risks, COWI replaced welded splices in the arches with bolted connections. Fully connecting an arch piece by field welding required almost three weeks, but with bolts, the connection could be completed in two days.

Dan Payea, a vice president for Skanska, the contractor, wrote, "Applying bridge engineering concepts and first principles to the erection of the building allowed this highly complex project to be completed safely and accurately."

Awards judge Jeff Carpenter, state design engineer for the Washington State Department of Transportation, added, "COWI's Oculus structural lift plan highlighted the challenges engineers can face when embracing bold architecture."



A 300-foot opening in the roof allows natural light into the commuter hall.

The new state Route 520 Bridge is supported by 21 of the heaviest, widest, deepest and longest floating bridge pontoons ever built.

PHOTO COURTESY OF HDR ENGINEERING

Structural systems

National finalist: Gold award

HDR Engineering

Project: SR 520 Bridge replacement and HOV program
Client: Washington State Department of Transportation

The greater Seattle area is expected to grow by at least 1 million more people and 40 percent more traffic in the next 25 years. So how do you fix the state Route 520 Bridge — one of the largest, most obsolete transportation corridors in the area — especially when it crosses the state's second-largest lake?

One of the main problems facing the Washington State Department of Transportation was that water gathered in the hollow pontoons supporting the bridge, requiring regular pumping. The bridge deck was less than eight feet above Lake Washington's surface, so heavy rains and winds would create waves that would crash onto the deck, endangering motorists and bicyclists, and pedestrians were forbidden on the bridge. In addition, approach spans were at risk of collapse since they did not meet current seismic standards.

Still, more than 115,000 vehicles crossed the bridge daily, and it operated near capacity for more than 13 hours daily.

WSDOT needed an engineering team that could hit the ground running, and hired HDR Engineering as the general engineering consultant to oversee preliminary design, preparation of requests for proposals, construction management and environmental mitigation.

Even though the project included roadway renovation on either side of the bridge, the complexity of the challenge was exacerbated by the bridge's location over Lake Washington, which plunges to a depth of more than 200 feet over the top of another 200 feet of soft silt — not the best bridge anchoring scenario. So HDR's team simplified things by turning the marine job into a land job whenever possible, even though there was just a 150-foot-wide stretch of shoreline for all land access to over-water construction activities.

The new bridge is supported by 21 of the heaviest, widest, deepest and longest floating bridge pontoons ever built. At 360 feet long, 75 feet wide and 28.5 feet high, the longitudinal pontoons weigh nearly 22 million pounds each.

The pontoons are anchored by 3 1/8-inch-diameter cables (nearly an inch thicker than the old cables) that descend as much as to 1,000 feet into the lake and tie into one of 58 anchors. The bridge now can resist up to 98 mph winds, equivalent of a 100-year storm, and its higher bridge deck (20 feet over the lake versus the old eight feet) prevents large waves from washing over traffic.

The new bridge deck is 56 feet wider than the old bridge deck and includes a 14-foot-wide bicycle-pedestrian path with several "belvederes," or viewpoints, along the way. It also provides six travel lanes for vehicular traffic, including a dedicated transit and high-occupancy vehicle lane in each direction. Also, the team prepared the new bridge for light rail with a design that allows pontoons to be added and the bridge to be widened.

"The new bridge will give our state's most populous and economically robust region much safer, more reliable, and more environmentally responsible transportation for decades to come," said Roger Millar, secretary of WSDOT.

On opening day, a representative from the Guinness Book of World Records certified that the 7,708-foot-long bridge — 130 feet longer than its predecessor — was, indeed, the longest floating bridge in the world.

In addition to the many technological challenges involved, the project team successfully integrated other aspects into the design such as fire/life safety, emergency power, communications, sustainability, future expansion capability and community concerns.

Waste and stormwater

National finalist: Gold award

Brown and Caldwell

Project: Chambers Creek Regional Wastewater Treatment Plant expansion
Client: Pierce County Public Works and Utilities

Public utilities across the country are struggling with aging facilities that need major renovations at a time when water quality regulations are tightening along with local government budgets.

Brown and Caldwell won this gold award because they were able to make the impossible possible and in the process far exceed expectations for the client, Pierce County Public Works and Utilities, as well as the citizens who need the public services.

The Chambers Creek Regional Wastewater Treatment Plant is located on 180 acres within a 920-acre regional park with 2.5 miles of marine waterfront on Puget Sound. The Chambers Bay golf course, also in the park, was the site for the 2015 U.S. Open tournament. In addition, the park shelters a wetland/watershed reserve.

Great credentials for a public park, yes, but with a projected service population increase of at least 130 percent over the next 30 years, some serious planning and renovations were needed. Not only did Pierce County need to upgrade its wastewater treatment plant, but it also needed to plan for continual tightening of environmental regulations as well as the eventual need for even more expansion of service.

This is when Brown and Caldwell (B&C) entered the picture. First, they designed an integrated facilities plan spanning 30 years that provides the county with a clear strategy for adjusting the rate of level-of-service improvements in tune with regulatory changes, public demand, and the need to create cutting-edge technology to remove contaminants from the water.

Then B&C tapped a relatively new proprietary technology developed at the University of Innsbruck in Austria called Demon. This technology treats high-strength ammonia streams through "deammonification," a process where naturally occurring bacteria remove ammonia from wastewater with minimal energy input.

B&C and Pierce County conducted one of the first pilot tests of the technology in the United States, proving its efficacy as well as the substantial environmental and economic benefits the county could realize. In fact, Demon enabled the county to reduce the size of the biological treatment system by 20 percent and cut chemical and oxygen demands by 50 percent and 25 percent, respectively.

Leading up to the facilities planning effort, B&C conducted a plant performance test that resulted in a re-rating of the plant's National Pollutant Discharge Elimination System permitted capacity from 18 million to 31.7 million gallons per day without any capital expenditures, saving the county more than $50 million.

An interesting side story to this project is that the plant renovations took place during the 2015 U.S. Open golf tournament at Chambers Bay. With 30,000 daily visitors plus logistics for a national sporting event, construction was carefully coordinated around a two-month window in early summer 2015 with no visible construction, limited traffic access and no off-site impacts. In fact, during the event, the project's construction offices were even used as a security command post.

This project ultimately pioneered a model for sustainably co-locating community infrastructure within a highly visible and publicly cherished recreational area without compromising the utility's ability to provide a high level of service.

Expansion work took place during the 2015 U.S. Open golf tournament at nearby Chambers Bay.

PHOTO COURTESY OF BROWN AND CALDWELL

Shannon & Wilson worked to restore 130 acres of tidal marsh and estuary habitat for Skagit County.

PHOTO COURTESY OF SHANNON & WILSON

Water resources

National finalist: Gold award

Shannon & Wilson

Project: Fir Island farm estuary restoration

Client: Washington Department of Fish and Wildlife

The Skagit River is the largest tributary to Puget Sound and home to 10 salmon species, including the chinook, which is listed as threatened under the Endangered Species Act.

Chinook smolt rely on estuaries for food and protection as they transition from fresh water to salt water. But the Skagit River delta had lost approximately 85 percent of its historic estuary, and in 2005 the state's Skagit River Chinook Recovery Plan identified estuary habitat as an important limiting factor for recovery.

Enter Shannon & Wilson and the Fir Island farm estuary restoration project.

The Washington Department of Fish and Wildlife partnered with Shannon & Wilson and Imco General Construction to provide a feasibility study, design and permitting, public outreach and construction of the Fir Island farm estuary. The project team delivered a large-scale, highly complex habitat restoration, coastal flood protection and drainage project that balances the needs of fish, farmers, flooding and snow geese on the Skagit River delta.

A key challenge with estuary restoration, particularly in the Skagit River delta, is that the areas most important for chinook salmon are also some of the most agriculturally productive farmlands in the world, supporting up to 80 different crop varieties and serving as a worldwide producer of vegetable seeds. Much of the farmland, however, is subtidal and reliant on a complex system of dikes and drainage infrastructure, presenting quite a challenge to engineers tasked with rebuilding the estuary for wildlife.

The project design elements included a mile-long levee setback, a 9,000 gallons-per-minute automated pump station, five tide gates, a 50-acre storage pond, and restoration of 130 acres of tidal marsh and estuary habitat critical for juvenile chinook recovery. The project is expected to increase juvenile chinook smolt to between 65,000 and 350,000 each year.

Another challenge to the project was developing levee design criteria that considered current engineering design standards as well as climate change and sea level rise.

The current design guidelines of the U.S. Army Corps of Engineers and the Natural Resources Conservation Service were not specific for sea level rise and coastal resiliency design in Puget Sound, so Shannon & Wilson performed additional technical studies, modeling, and risk and uncertainty analyses to come up with new design criteria.

The Fir Island farm estuary restoration project was delivered under budget and on schedule. In fact, the final construction budget was $2 million less than original cost estimates, allowing the state to use those funds for other salmon habitat restoration projects.

Transportation

National finalist: Gold award

McMillen Jacobs Associates

Project: University Link extension
Client: Sound Transit

University Link's twin-bored tunnels pass just 13 feet below the bottom of Montlake Cut.

PHOTO COURTESY OF MCMILLEN JACOBS ASSOCIATES

While Bertha, the state Route 99 tunneling machine, garners media coverage for all its milestones, relatively few people are aware of the intensive engineering and construction that took place to complete the University Link extension.

McMillen Jacobs Associates (MJA) was tapped by Sound Transit to serve as managing partner of the Northlink Transit Partners Joint Venture, responsible for project management of the University Link extension tunnel design, station initial and final structural design, and geotechnical engineering.

The University Link extension, part of a 1996 voter-approved mass transit system plan, connects the state's three largest urban centers — downtown Seattle, Capitol Hill and the University of Washington — over 3.15 underground miles. This critical light-rail connecting project required MJA and its team to think outside the box to tackle the challenges.

For instance, the tunnel alignment travels east from downtown, crosses under the nine-lane, two-story Interstate 5 to reach the Capitol Hill Station, then continues north under the Montlake Cut to reach the University of Washington. The twin-bored tunnels pass beneath existing facilities and traffic at particular locations with less than one tunnel diameter — about 13 feet — of ground cover.

At the same time, to clear a path for the tunneling machine, the team had to remove a number of below-grade portions of existing cylinder pile retaining walls along I-5, an extremely risky proposition. To mitigate risk of movement and maintain ground stability, the team designed the passageway using four large-piled and top-down constructed concrete boxes for support and access. This effort resulted in less than an inch movement of the retaining walls and less than a quarter of an inch movement in the roadway pavement.

The construction of the Capitol Hill station required extensive street utility coordination along with the complex siting and coordination of three separate station access points.

The University of Washington station platform is about 60 feet below groundwater level, requiring the station walls and base slab to be designed to resist full groundwater and soil pressures as well as the uplift pressures. A cost-saving top-down construction method used in the UW station involved constructing floors as the excavation proceeded so that they could also serve as bracing for the walls during construction.

Another component of the project was construction of the 427-foot-long Montlake Triangle pedestrian bridge that connects the University of Washington campus with Husky Stadium and the popular Burke-Gilman Trail. The bridge is one of the first U.S. applications of highly curved post-tensioned concrete in lieu of steel. The safety impacts of this pedestrian bridge are expected to increase by 2030 when more than 25,000 people will cross it every day.

The University Link extension increases mobility for residents but also reduces the city's reliance on cars in this corridor, providing a relatively low-impact form of transportation that integrates well with other forms of public transit, including buses, streetcars and ferries.

Construction of the University Link extension was completed approximately six months early and about $200 million under budget.

Unique or innovative applications

Best in state: Gold award

Otak

Project: Willapa Hills Trail bridge replacements
Client: Washington State Parks and Recreation Commission

Otak managed the installation of this Willapa Hills Trail bridge, replacing a trestle that was destroyed during the 2007 Chehalis River flood.

PHOTO COURTESY OF OTAK

In the late 1800s, the Northern Pacific Railway's South Bend Branch line was built to connect Chehalis and South Bend. The line allowed the delivery of lumber and farm products to the rest of the country.

In 1993 as railroad commerce died out in the area, the Washington State Parks and Recreation Commission bought the railroad and converted the route into Willapa Hills State Park.

The park includes numerous stream and river crossings, including the two largest over the Chehalis River — at Spooner and at Dryad — about nine miles apart. In 2007, a devastating flood completely destroyed the two trestles, sending the center steel truss spans downriver. Ultimately, the Federal Emergency Management Agency (FEMA) approved funding to replace both bridges.

Otak was hired as prime consultant for the Willapa Hills Trail bridge replacements. The firm was responsible for project management, bridge engineering, trail design, landscape architecture and construction support.

Challenges facing the design team included performing a detailed hydraulic analysis on the river to determine the maximum probable flood elevations, since the Chehalis River was well known for its flash floods and large wood debris pileups from the surrounding forests.

After completing extensive geotechnical and environmental reconnaissance, 10 bridge options were studied for each site. Ultimately, the team decided that a 300-foot clear-span bridge with a steel-truss superstructure design would work best for both bridges. But the design team realized that the typical 20-foot-high truss sections (to accommodate a 300-foot clear span) would be extremely difficult to get to the remote sites, and it would be too expensive to assemble the trusses piece by piece.

The solution involved the use of post-tensioning tendons inside a grouted duct installed inside a bottom chord, a technique rarely done with steel trusses. But the truss height needed to be limited for shipping while still maintaining deflection control.

The contractor, Quigg Bros., was able to adjust the final level or camber of the bridge by varying the amount of post-tensioning. Quigg Bros. also devised and constructed unique long-span erection platforms that allowed the bridge erection to occur without any supports in the river, allowing the team to work outside of the normal fish window.

One of the project's unique problems was the ultimate thinness of the overall structures and whether they would be stable enough for trail users. A thorough analysis of bridge movement revealed that the final stiffness and mass of the structures yielded dynamic characteristics that were in the nearly imperceptible range.

The new crossing structures are well above the new predicted flood elevations, with ample clearance for large debris flows. Also, the foundations for the structures are set far back on the bank and protected with riprap, reducing the potential for scour or lateral river movement.

The reopening of the trail section over the two new pedestrian bridges represents part of the long-term goal of the State Parks Commission to have a trail system that connects the Idaho border to the Pacific Ocean. At a total cost of $3.4 million, or about $400 per square foot, the design and construction costs for the two bridges were about 50 percent less than the typical long-span pedestrian bridge.

"Constructing two 300-foot span bridges at remote locations was a challenging endeavor," wrote Brian Yearout, project manager with State Parks. "Otak produced a design that satisfied permit requirements, design requirements, FEMA, and was aesthetically pleasing."

NATIONAL SILVER AWARDS

TRANSPORTATION/JUDGES AWARD

AECOM
Project: First Hill streetcar
Client: Seattle Department of Transportation

STRUCTURAL SYSTEMS

DEGENKOLB ENGINEERS/HART CROWSER
Project: Elementary school and tsunami safe refuge
Client: Ocosta School District

REID MIDDLETON
Project: University of Alaska Anchorage School of Engineering and pedestrian bridge
Client: University of Alaska

TRANTECH ENGINEERING
Project: Broadway Bridge replacement
Client: City of Everett

TRANTECH ENGINEERING
Project: Tacoma Avenue South Bridge rehabilitation
Client: City of Tacoma

ENVIRONMENTAL

INTEGRAL CONSULTING
Project: Terminal 117 streets and yards early action
Client: City of Seattle

WASTE AND STORMWATER

PARAMETRIX
Project: Point Defiance stormwater project
Client: City of Tacoma

WATER RESOURCES

PND ENGINEERS/GEOENGINEERS
Project: Permanent Canal Closures and Pumps cofferdam and permanent wall design
Client: U.S. Army Corps of Engineers

TRANSPORTATION

HNTB CORP.
Project: Interstate 405/Northeast Sixth to Interstate 5 widening and express toll lanes project
Client: Washington State Department of Transportation

Solar cells on this 24,000-square-foot canopy produce 34,000 kilowatt hours of energy a year.

PHOTO COURTESY OF DLR GROUP

Future value to engineering profession

Best in state: Gold award

DLR Group

Project: American Airlines Arena solar canopy
Client: The Heat Group

When the American Airlines Arena was built in 1999 to host the Miami Heat basketball team, it was built to the highest sustainable green standards, and in 2009 it was one of the first two arenas in the country to receive LEED certification from the U.S. Green Building Council.

This means the stadium is on the cutting edge of sustainability, including green roofing materials, reduced overall energy consumption, water-efficient landscaping, underground parking, and "walk-off carpets" that trap dirt and contamination to improve indoor-air quality.

In 2016, the DLR Group helped the arena gain another sustainable feather in its cap: a solar canopy. This 24,000-square-foot canopy entryway integrates 14 solar skylight rings with photovoltaic cells that produce approximately 34,000 kilowatt hours of energy annually.

Concealed within the soffits of each skylight is a dynamic, color-changing LED light system that can be programmed to illuminate the skylight cavities with changing light patterns, creating a vibrant, high-energy environment for fans. Coupled with the solar production of the skylights, the lighting system represents a net-zero energy addition to the facility.

DLR Group was the lead design firm on the project and provided electrical and structural engineering.

One of the biggest design challenges was the site's potential for high winds. Its location on Biscayne Bay has a "Wind Exposure Category D" rating, where the canopy structure is expected to withstand wind speeds of 186 mph and a design pressure of more than 250 pounds per square foot.

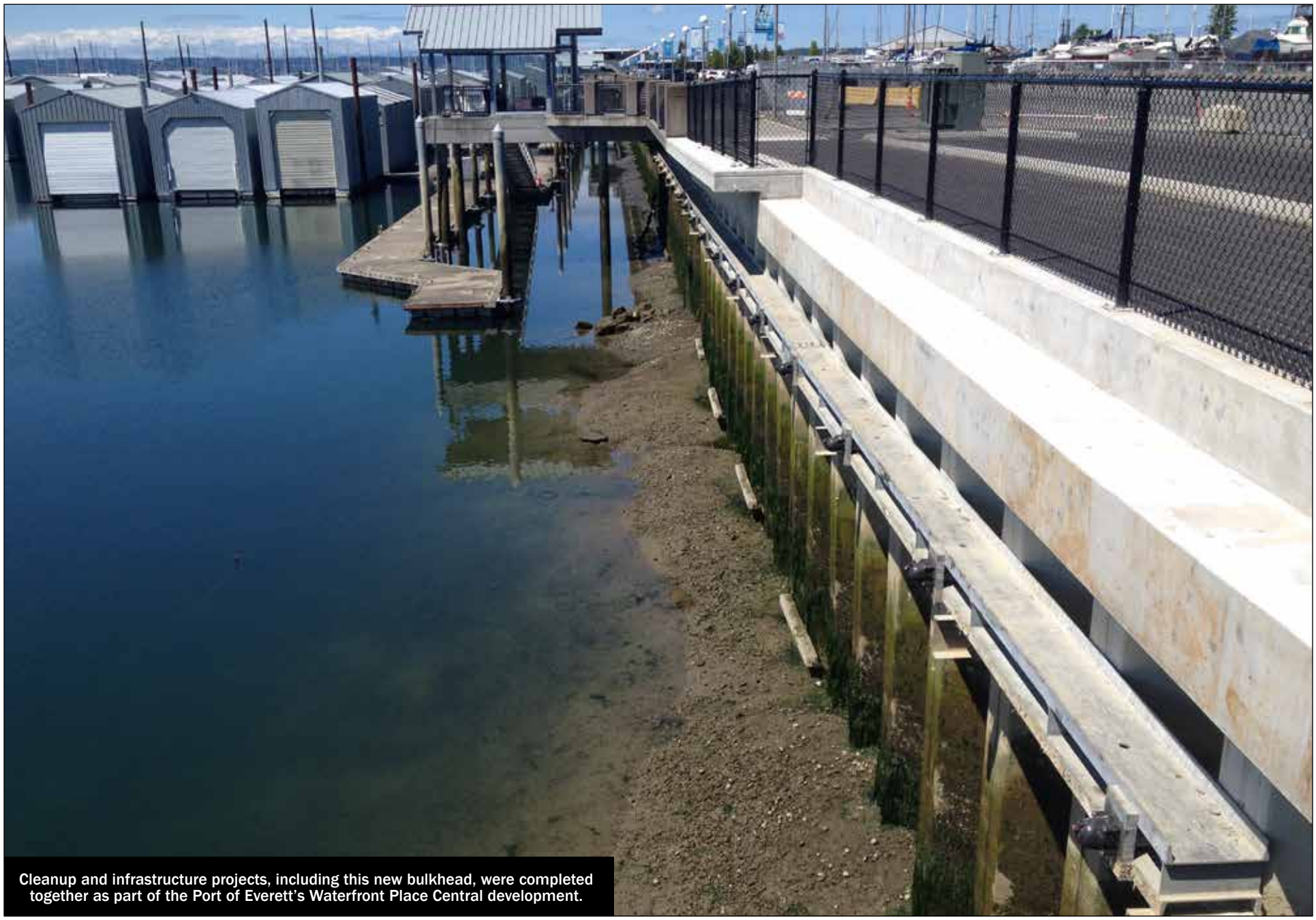
Also, since the canopy was to be supported by the existing arena structure and an adjacent structure, it had to be lightweight and geometrically compatible. DLR Group designed a structural steel framing system that incorporated large-diameter, thick-walled steel columns, moment frames and multidirectional cantilevers.

The columns provided the necessary strength to resist gravity, lateral and uplift loads. They also allowed room for the conduits that carried electrical and AV wiring, and facilitated welded connections to provide stability to the arena structure.

The columns were partially filled with cast-in-place concrete to make them more fire-resistant.

The canopy provides a new fan amenity space that has a bar, food and beverage locations, advertisement displays and retail outlets, enabling the Miami Heat to capture additional revenue from game-day concession sales and as a rental space during non-game days.

During game days, the plaza is a hive of activity before the event and during halftime. On non-game days, revenue-generating functions like corporate and charity events, group sales and post-game parties dot the arena's calendar. The arena has also served as a concert venue for Jennifer Lopez, U2, Lady Gaga, Adele, Britney Spears, Taylor Swift, Celine Dion, Katy Perry and the MTV Video Music Awards.



Cleanup and infrastructure projects, including this new bulkhead, were completed together as part of the Port of Everett's Waterfront Place Central development.

PHOTO COURTESY OF LANDAU ASSOCIATES

Social, economic and sustainable design

Best in state: Gold award

Landau Associates

Project: Waterfront Place cleanup and infrastructure
Client: Port of Everett

The old Everett Shipyard site sits along Everett's waterfront within the Port of Everett's North Marina redevelopment project.

From 1947 to 2009, Everett Shipyard and its predecessors used the site as a boat building, maintenance and repair facility that included marine vessel repairs, tank evacuations, equipment disassembly, sandblasting, woodwork, metal work, painting/coating and mechanical repairs.

Soil, groundwater and marine sediment samples tested from the 1980s to 2007 contained measurable levels of contaminants such as petroleum and marine paint additives. But now the site was within a state-designated Puget Sound Initiative Priority Area that was the subject of special focus by the Washington State Department of Ecology's Toxics Cleanup Program to clean up and restore bays within Puget Sound by 2020.

The Port of Everett faced two major problems: First, it needed to clean up the contaminated soil, groundwater and sediment at the old shipyard site. Second, it needed to construct new infrastructure to support the planned 65-acre Waterfront Place Central, a new commercial, recreational and residential district.

Construction of Waterfront Place Central could not begin until the cleanup and infrastructure projects were completed.

The solution to both problems was to integrate the site cleanup with the infrastructure improvements as a single project in order to leverage financial, permitting and schedule efficiencies, and to complete the work on an aggressive schedule. This was a tall order that Landau Associates, as design and construction team lead, embraced and completed in 41 months, allowing construction of Waterfront Place Central to begin last June.

Landau's remediation team, composed of geologists, environmental and geotechnical engineers, environmental scientists, attorneys and biologists, was augmented with civil and structural engineers, maritime industry economists and marina planners. This diverse team allowed for rapid and comprehensive problem-solving and an integrated design that took into account the full range of technical, environmental, economic and regulatory needs and challenges.

The scope of the cleanup action included the excavation and off-site disposal of about 17,000 tons of contaminated soil, and the dredging and off-site disposal of about 11,000 tons of contaminated sediment. Also, the marine railway, the boat haul-out piers, and four of the marina docks needed to be removed to allow dredging and to realign the old diagonal navigational traverse of the docks.

Approximately 230 meters of bulkhead, including 110 meters of creosote-treated timber bulkhead, needed to be replaced with a new epoxy-coated steel sheet-pile bulkhead, and an array of untreated stormwater outfalls needed to be reconfigured into just three outfalls with in-line water filter treatment systems just upstream of each outfall.

The project incorporated the construction of a 230-meter shoreline walkway and guardrail system that is supported by the new bulkhead and a new pile-supported wharf on the northeast corner of the Central Marina as part of the shoreline public access amenities.

These amenities helped facilitate the permitting process. In fact, the integration of site development with environmental cleanup accelerated and streamlined permitting for the infrastructure improvements.

The U.S. Army Corps of Engineers and state and federal resource agencies were responsive to the project because of the environmental benefit achieved by remediating contaminated sediment.

The Port of Everett estimates that private development at this site will generate $8.6 million annually in state and local sales taxes.

Port Commission President Troy McClelland said, "It is in the best interest of the community and the port to turn these brownfield sites into economic assets, which is why we have taken an aggressive approach to our environmental cleanups. These cleanups don't get less expensive or less complex."

Complexity

Best in state: Gold award

BergerABAM

Project: P-990 explosives-handling wharf No. 2
Client: Naval Facilities Engineering Command Northwest

Naval Base Kitsap, where the Naval Facilities Engineering Command Northwest is located, is the third-largest Navy base in the U.S. and is the command for the Navy's fleet in the Pacific Northwest.

It features one of the Navy's four nuclear shipyards, one of two strategic nuclear weapons facilities, the only West Coast dry dock capable of handling a Nimitz-class aircraft carrier and the Navy's largest fuel depot. One key component was missing, though: an explosives-handling wharf to serve the Trident submarine, a project that was not only extremely complex but that also required an elevated level of security.

BergerABAM was the prime design engineering consultant and the engineer of record.

The project, which consisted of 226,900 square feet of pile-supported, over-water construction, included upland vehicular access and supporting utilities, approach trestles, the main wharf plus a warping wharf (a long narrow wharf extension used to position submarines prior to their moving into the operations area). The project also included a steel-framed, high-bay wharf cover with two 120-ton overhead bridge cranes, a multistory support building, on-wharf utilities and six lightning-protection towers.

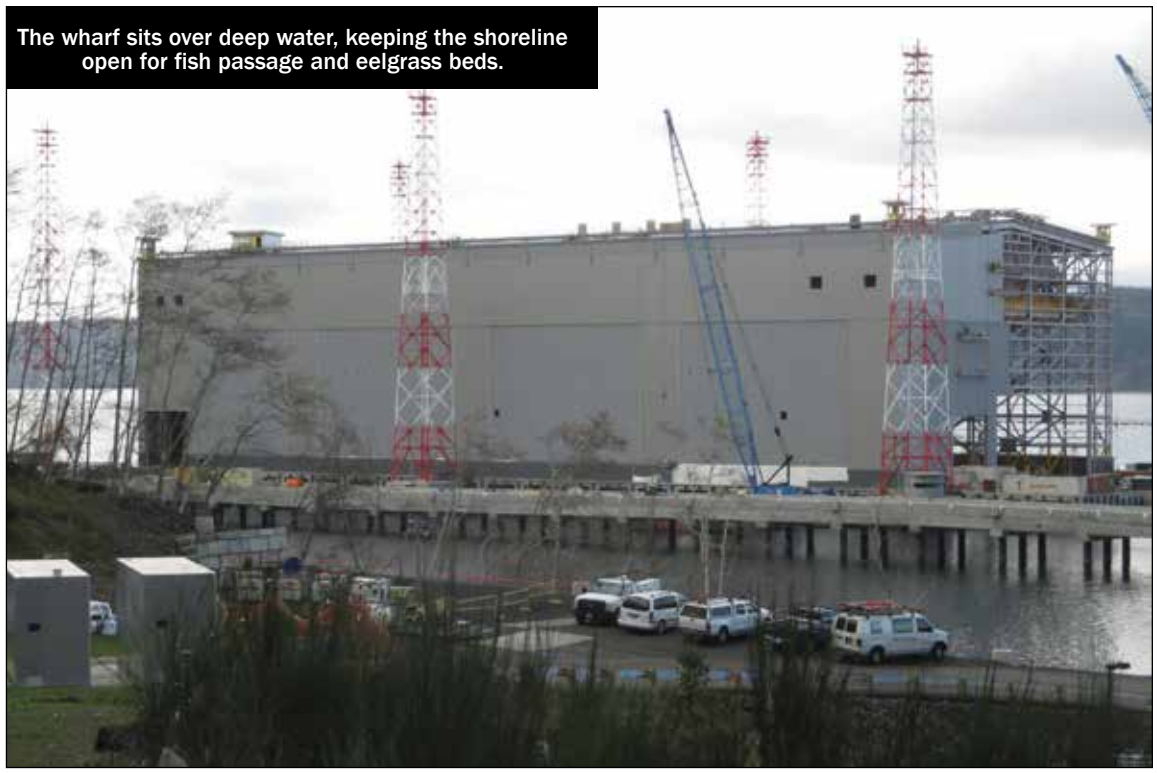
The facility is situated in a seismically active area in deep water. It is positioned offshore to reduce the effect on the close-in habitat of Hood Canal. Only a slender trestle crosses the intertidal zone, keeping the main portion of the pier and its associated piling and overwater shading in deeper water to keep the shoreline open for fish passage and eelgrass beds.

In fact, the existing shoreline is maintained in a nearly undeveloped state, creating a cultural and economic resource of shellfish harvesting for the local Indian tribes. Even stormwater from the trestles and warping wharf is captured and conveyed to on-site water-quality catch basins where it is treated before being discharged.

For construction, instead of implementing the traditional cost-prohibitive and inefficient batter-pile systems, BergerABAM designed an innovative combination of steel plumb piles in bending and lead rubber bearings (LRBs) mounted on cast-in-place concrete pile caps supported on piles. This design stabilized the LRBs and pile-to-deck connections, allowing the wharf cover, plumb piles and wharf LRB dolphin piles to remain elastic during a seismic event, effectively providing base isolation for the wharf and wharf cover and reducing lateral load demands in these structures

The design also included precast pile cap and deck elements fabricated off-site at concrete plants where quality of materials and fabrication could be better controlled. The project incorporates the use of composite submarine "camels" — an advanced fiber-reinforced polymer composite material that provides improved corrosion resistance, and reduced maintenance and overall life-cycle costs.

"This project is extremely important to the mission of the Navy and to our national security, and you can be proud of the results of your efforts in meeting our needs," David Gibson, a Navy project manager, wrote to the BergerABAM team.



The wharf sits over deep water, keeping the shoreline open for fish passage and eelgrass beds.

PHOTO COURTESY OF BERGERABAM

Complexity

Best in state: Gold award

Wood Harbinger

Project: State Route 520 Evergreen Point Floating Bridge
Client: Washington State Department of Transportation (KPFF for design; KGM for commissioning)

The replacement of the state Route 520 floating bridge over Lake Washington was one of Washington state's largest transportation projects in recent history, involving many engineering and design firms, plus specialty consultants and contractors.

Wood Harbinger was part of the team, hired to provide electrical and fire protection engineering as well as commissioning services. This included lighting for the roadway, navigation, pontoons and under the deck, as well as medium-voltage power distribution systems that support the east landings roadway, the 20,000-square-foot maintenance facility and the floating bridge systems.

Wood Harbinger also engineered a standalone fire-suppression system that extracts water from Lake Washington and distributes it through more than two miles of piping. Finally, the firm provided commissioning services for the maintenance facility building and all systems controlled by the bridge-control system, including electrical, fire protection, leak detection, cathodic protection, alarms and a weather station.

The entire electrical distribution system designed by Wood Harbinger includes 300 miles of electrical wiring. Instead of a traditional conduit system, the firm used strong yet flexible CLX cable that enabled long, continuous runs even over expansion joints in the bridge.

The CLX cable was looped at these joints to accommodate expansion and ultimately required about 150 less splices, increasing the reliability of the power distribution system. A backup diesel generator ensures that all bridge equipment will remain in continuous operation with or without utility power for an extended period of time.

Wood Harbinger worked closely with the bridge-control system designers to develop a reliable communication network. The system comprises the bridge's central nervous system, a network of electrical systems communicating over fiber optics.

The communication cabling is also a looped system connected to each pontoon, so if there is a break in the fiber loop, bi-directional communication will continue on both sides of the break. Key systems are all included in this network and can be remotely monitored and controlled from the maintenance facility.

The fire protection systems design presented some unique challenges. Because the road deck sits 20 feet above the water at midspan, and higher at each of the landing approaches, it would not be possible for a fire truck to draw water out of the lake to fight a car fire on the bridge.

So Wood Harbinger designed a system that includes four vertical turbine fire pumps, a 1.4-mile-long, 8-inch standpipe, and a dozen hydrant connections on the road deck for fire department use. When the fire-protection system is activated, the piping fills with lake water in less than 10 minutes, supplying 1,000 gallons per minute to a single fire hydrant.

The traffic-management center operator can remotely start the fire pumps to allow time for the fire-suppression system to fill while the fire department is in transit to the scene.

In its commissioning role, Wood Harbinger developed a tailored commissioning plan, witnessed system installation and startup, and developed and performed integrated functional testing for the systems. Throughout the commissioning, Wood Harbinger engineers scaled the 10-story sentinel tower stairs to access the site, climbed up and down pontoon cell access ladders, walked miles across the bridge, sometimes exposed to the cold, wind and rain, and dealt with the high humidity that kept it cold inside the concrete pontoons during the winter.

The electrical distribution system for the new 520 bridge (right) includes 300 miles of electrical wiring.

PHOTO COURTESY OF WOOD HARBINGER

This street segment in Colville was rebuilt to narrow the roadway, eliminate on-street parking and add a shared-use trail and wider sidewalk.

PHOTO COURTESY OF WELCH COMER ENGINEERS

Successful fulfillment of client/owner needs

Best in state: Gold award

Welch Comer Engineers

Project: Hawthorne Avenue from Walnut to Crestview
Client: City of Colville

The city of Colville is the county seat of Stevens County in northeastern Washington. Its 4,700 residents work predominantly in agriculture, timber and mining. They also are committed to making their community safe, accessible and more livable.

Hawthorne Avenue crosses the city from east to west, connecting schools, churches, a city park and many residences, but the deteriorated street was very wide and difficult to cross. Its on-street parking was rarely used, and there were no pedestrian or bicycle facilities, nor was the street ADA-compatible due to uneven surfaces and connections with driveways.

In 2013, Welch Comer Engineers helped the city develop the Hawthorne Avenue Strategic Plan, which included utility coordination, conceptual roadway designs, estimated costs, public involvement and a strategy for funding. The plan recommended two new strategies: a road diet and the "complete streets" ethic.

The road diet modifies an existing public right-of-way from one that gives full priority to motor vehicles to one that is designed for all users, including pedestrians and bicyclists. The complete streets ethic is used to evaluate the best use of public space to balance the needs of all users.

After the first phase of renovations to Hawthorne Avenue in 2015, the city hired Welch Comer Engineers to help them with phase two of the redesign and reconstruction, this time between Walnut Street and Crestview Drive.

The project provided for the narrowing of the roadway, eliminating on-street parking, then reconfiguring the extra space for a shared-use pathway and a wider sidewalk separated from the street by a "hardscaped" buffer. The buffer was made primarily of colored and scored concrete punctuated with drought-resistant trees that would require little to no irrigation or maintenance.

This phase of the Hawthorne Avenue reconstruction faced challenging road profile grades of up to 13 percent, meaning driveways frequently didn't match up with the road, a situation that would make travel by the disabled difficult to impossible. Also, the ground beneath the city is mostly clay and silt, which is not ideal for building heavily traveled roads.

Welch Comer worked with a geotechnical firm to design a cement-treated base to strengthen, or "bridge," the weak material. Once the subgrade elevations were established, specific quantities of cement and water were mixed with the clay/silt soils to create a 10-inch layer of rigid foundation material over which sealing, leveling and asphalt were applied.

This construction innovation was even used under the pedestrian ramps to prevent seasonal differential frost heaving between the road and the ramps.

The ever-present groundwater obstacle was another challenge in this project. Groundwater was so prominent that it was actually seen flowing into open trenches. Waterline and storm sewer construction required excavating deep into saturated clay soils and flowing water. Any saturated material removed from these utility trenches was replaced with existing base rock and ballast material that was reclaimed from the existing road section.

According to Eric Durpos, municipal services administrator for Colville, "Welch Comer's skill in helping the city prioritize, develop a vision, and construct community-inspired projects are some of the reasons our collaboration has resulted in successful projects like Hawthorne Avenue, Walnut to Crestview."

BEST IN STATE

SILVER AWARDS

UNIQUE OR INNOVATIVE APPLICATIONS

HWA GEOSCIENCES
Project: Corrosive issues for U.S. Embassy in Mauritania
Client: U.S. Department of State

WOOD HARBINGER
Project: Enatai Elementary School
Client: Bellevue School District/Integrus Architecture

FUTURE VALUE TO ENGINEERING PROFESSION

NOTKIN MECHANICAL ENGINEERS
Project: Historic Pacific Tower renovation
Client: Seattle Central College/Schreiber Starling Whitehead Architects

SOCIAL, ECONOMIC AND SUSTAINABLE DESIGN

DLR GROUP
Project: Google Kirkland campus — Building D
Client: SRMKII, LLC

HERRERA ENVIRONMENTAL CONSULTANTS
Project: Port Angeles landfill cell stabilization
Client: City of Port Angeles

COMPLEXITY

DAVID EVANS AND ASSOCIATES
Project: Cushman Trail
Client: City of Gig Harbor

DOWL
Project: Boeing 737 Max flight line utilities
Client: Boeing Co.

SUCCESSFUL FULFILLMENT OF CLIENT/OWNER NEEDS

JACOBS ENGINEERING GROUP
Project: Lodge Creek culvert replacement
Client: Kittitas County

RH2 ENGINEERING
Project: Butterfield Water Treatment Plant intake
Client: City of Pasco

BEST IN STATE

BRONZE AWARDS

DAVID EVANS AND ASSOCIATES
Project: Potter Road, South Fork Nooksack River Bridge No. 148 replacement
Client: Whatcom County Public Works

DCI ENGINEERS
Project: Spokane Convention Center expansion
Client: Spokane Public Facilities District

EXELTECH CONSULTING
Project: Redondo Boardwalk repair project
Client: City of Des Moines

GEOENGINEERS
Project: Sanpoil River/state Route 21 emergency spill response
Client: Able Clean-up Technologies

KLEINFELDER
Project: Runway 16C-34C reconstruction
Client: Port of Seattle

OTAK
Project: Bucklin Hill Bridge and estuary enhancement
Client: Kitsap County

OTAK
Project: Dungeness River railroad trestle replacement
Client: Jamestown S'Klallam Tribe

PARAMETRIX
Project: LOTT Budd Inlet Treatment Plant SES replacement
Client: LOTT Clean Water Alliance

T-O ENGINEERS
Project: Felts Field taxiways and taxilanes reconstruction
Client: Spokane Airports

TRANSPO GROUP
Project: Madigan access improvement project
Client: City of Lakewood

WSP PARSONS BRINCKERHOFF
Project: Swift Green Line Small Starts grant submittal
Client: Community Transit

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Tom Leonidas, President/CEO

"Participation in ACEC provides Landau Associates an unparalleled opportunity to network with and learn from our professional peers, as well as to increase our ability to positively shape our profession and enhance its image with the public, legislators, and regulators. Affiliation with ACEC provides opportunities to interact and shape the opinions of those who impact the engineering consulting profession. Simply put, active ACEC affiliation increases our collective influence and helps secure and build the future of our industry."

Scott Woerman, MBA, ACEC Past Board Chair, Landau Associates

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David Winter, ACEC PAC Sponsor, Hart Crowser, Inc.

"ACEC has given HWA GeoSciences Inc. an active voice in the industry, a resource for the latest information to keep us up to date, and an outlet to regularly engage with our peers to help promote the viability of each other's businesses. As with most firms, relationship building is one of the keys to our success. ACEC provides the right atmosphere and venue that has had a direct impact on HWA's growth, both financially and professionally."

Kris Purrier, President/Principal, HWA GeoSciences Inc.