CUTTERHEAD

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PARSONS®

INSIDE

Front Cover:
Louis-Hippolyte-La Fontaine Tunnel, Quebec, Canada

Photo Credit:
Ministère Des Transports Et De La Mobilité Durable

Photo Credit: Sanitation Districts of Los Angeles County

JOINT WATER POLLUTION CONTROL PLANT (JWPCP) SEWER TUNNEL OUTFALL PROJECT

Los Angeles, California

We completed the final design and bidding phases for the Joint Water Pollution Control Plant (JWPCP) Effluent Outfall Tunnel project and are in the engineering services phase during construction. The Sanitation Districts of Los Angeles County (Sanitation Districts) are 24 independent special districts serving the wastewater and solid waste management needs of approximately 5.6 million residents in Los Angeles County. Seventeen of the Sanitation Districts are signatory to a Joint Outfall Agreement that provides for a regional, interconnected system of wastewater management facilities known as the Joint Outfall System (JOS).

The JOS provides wastewater collection, treatment, reuse, and disposal for residential, commercial, and industrial users, and it includes seven treatment plants, the largest of which is the JWPCP, located in the City of Carson. Currently, secondary treated effluent from the JWPCP is conveyed through two 6-mile-long tunnels, 8 and 12 feet in diameter, to a manifold structure located near White Point on the Palos Verdes Peninsula. Four sea-floor outfalls extend offshore from the manifold structure. The two main outfalls are 90 and 120 inches in diameter and extend approximately 1.5 miles offshore, discharging at a depth of approximately 200 feet below sea level. The new effluent outfall tunnel will be approximately 7 miles long, have an 18-foot internal diameter, and include 1,350 feet of 16-foot diameter steel liner at crossings of the Palos Verdes Fault. The new tunnel will allow for inspection of the existing tunnels, provide redundancy for the effluent management system, ensure capacity for future growth, and convey peak storm flows. The upstream end of the project will include the construction of junction structure to connect the tunnel to an active 14-foot-diameter force main. The existing manifold structure at the downstream end project will be demolished and a new manifold structure will be constructed. Since the existing tunnels and main outfalls are always required to be in service, a temporary bypass system will be constructed and operated during this phase of the project.

Construction of the tunnel and associated structures was packaged under a single contract, and was awarded to Dragados USA (DUSA) in January 2019. Notice to Proceed (NTP) was received in April 2019 and construction is expected to be completed in seven and a half years. The 21-foot diameter Tunnel Boring Machine (TBM) was fabricated in Germany and assembled on-site in May 2021. TBM advance started in October of 2021. In April 2022, the TBM and launch shaft were reconfigured for continuous production tunneling, which started in May 2022. Currently, tunneling is approximately 33 percent complete (12,030 linear feet of 36,806 linear feet). Preconstruction activities have started for the junction (upstream) and manifold (downstream) structures. These activities include potholing and survey of the existing facilities.

The overall project is estimated to be completed in 2026. Once built, the 18-foot tunnel and associated structures will ensure that the wastewater needs of the JOS are fulfilled for the foreseeable future.

LOUIS-HIPPOLYTE-LA FONTAINE TUNNEL

Quebec, Canada

The Ministère des Transports et de la Mobilité durable is currently undertaking a major rehabilitation project for the Louis-Hippolyte-La Fontaine Tunnel to ensure the sustainability of this infrastructure and that it can continue to play its key role in the mobility of people and goods along Highways 20 and 25. Inaugurated in 1967, the Louis-Hippolyte La Fontaine Tunnel is an important road link for for users and freight transport not only in the region but also in Quebec and Canada. As an integral part of Highway 25, it connects the east end of the Island of Montreal to Longueuil, via Île Charron. It's the largest underwater tunnel in Canada, 1.5 kilometers long and connected to a 457-meter-long bridge.

Parsons, in a joint venture (JV) with TetraTech, has been acting as the owner's engineer on this mandate since March 2018 using a design-build finance project delivery contract. The JV was in charge of preparing the technical specifications and establishing the performance criteria. The JV also assisted the client during the request for proposal and is presently providing technical support throughout the construction.

Construction in progress

- Wall and vault repair in tunnel traffic tube
- Wall repair in the tunnel corridor
- Wall repair at the portals and approaches
- Airlock chambers for evacuation purposes
- Replacement of portal concrete support beams
- Saccardo ventilation system installation

Completed construction

- Saccardo ventilation building at the portals
- Electrical building construction near the ventilation towers
- Placement of portal steel support beams
- Construction of three incentive parking lots for public transit
- Road works on Highway 20, including new pavement, drainage, and signage
- Multi-use path and noise barrier wall bordering Curatteau Street

Construction to come

- Repair of the Souligny Interchange structures
- Rehabilitation of various components of the tunnel, including the concrete screed, joints, and drainage
- Modernization of electrical, lighting, ventilation, monitoring, and communication systems
- Construction of a covered structure at the portals
- Addition of rockfill over the tunnel
- Addition of fire protection equipment
- Reconstruction of the concrete pavement of Highway 25 on either side of the tunnel between Île Charron and Sherbrooke Street in Montréal
- Implementation of mitigation measures in public transit, including a highway widening and the addition of bus-dedicated lanes at different locations of the provincial roadway network
- Tunnel architectural features i.e., covered structure at the portals, lighting, and landscaping

Louis-Hippolyte-La Fontaine Tunnel

PROJECT WINS

PHASE 2 LOS VAQUEROS RESERVOIR EXPANSION (LVE)

San Francisco, California

We've been awarded a contract for Project Management Services, Phase 2 for the Los Vaqueros Reservoir Expansion (LVE) in San Francisco, as a subconsultant to GEI Consultants, Inc. (GEI).

Parsons will provide Contra Costa Water District (CCWD) Capital Project Management Services for Phase 2 of the Los Vaqueros Reservoir Expansion (LVE) located in the San Francisco Bay Area. As a major subconsultant to GEI Consultants Inc. (GEI), we will deliver an updated project management plan, cost estimating, budget and funding tracking, risk management, project reporting, technical reviews, O&M assistance, and contract management assistance. The project goals and benefits include improving regional water supply resiliency, mitigating droughts, and boosting the local economy.

In addition, the team will leverage the transformative power of Parsons X to recommend and procure Program Management and Construction Management Information Systems (PMIS/CMIS) which will digitize business processes, integrate with CCWD's financial accounting system, and provide timely and actionable dashboards and reports. These new digital capabilities will improve transparency, efficiency, and collaboration for this critical project.

"We are excited to partner with GEI and CCWD to assist with the improvement of regional water supply resiliency, drought mitigation, and economic vitality for the San Francisco Bay Area," said Mark Fialkowski, president, mobility solutions business unit for Parsons. "As innovators, we combine unique technology solutions with our project expertise to guide our clients through their digital journeys, breaking down data silos to synchronize people and processes, and ultimately solve some of their toughest water treatment challenges."

CCWD delivers drinking water to over 500,000 customers in the East Bay. The Phase 2 LVE project will increase the reservoir from 160,000 to 275,000 acre-feet with a goal of improving water supply reliability and water quality for San Francisco Bay Area water users, while protecting Delta fisheries and providing refuge water supply benefits. The Phase 2 LVE project is aligned with state and federal objectives and will receive state and federal funding, as well as funding from each of the nine members of the newly formed Joint Powers Authority in October 2022.

We have decades of experience creating and maintaining safe, efficient, and sustainable water facilities and processes. Our expertise in program and construction management (PM/CM) and engineering have helped us transform the industry through some of the most complex water and wastewater projects in the world.

Parsons X unifies the company's digital solutions and reinforces data-driven results across all of our services and markets. This enterprise approach drives efficiency and agility, helping us deliver innovative solutions to the world's most pressing challenges and opportunities.

ZACATE CREEK INTERCEPTOR

Laredo, Texas

The City of Laredo's Wastewater Department awarded a design-build contract to BRH-Garver with Ardurra Group, Inc as the Lead Designer and Parsons as the Tunnel Lead Engineer. The project requires the design, engineering, and construction of an estimated 7,400 LF of a 42-inch sanitary sewer line to transmit by gravity influent received from the Zacate Wastewater Treatment Plant to the existing 54-inch sanitary sewer main along the east side of Chacon Creek known as Chacon Interceptor. The length of the alignment, topography, and existing site features necessitate the use of trenchless construction technology for installation of most of the pipeline. The proposed pipe will be constructed using centrifugally cast, fiberglass-reinforced pipe and will be installed by micro-tunneling method. The tunnel portion of the alignment is approximately 1.25 miles long, with invert depth varying between 25 and 35 feet and installed at a slope over its length to enable gravity flow.

The project team's design and risk mitigation solutions account for microtunneling beneath Kansas City Southern Railroad tracks, a city park, and through a residential neighborhood. While the pipeline predominantly lies under City right-of-way, to cross Chacon Creek a 170-foot daylighted section will be camouflaged with artistic design. This project has the objective of removing the Zacate Creek Wastewater Treatment Plant from service and transforming that site overlooking the Rio Grande for other public uses. The plant is old and would require expensive upgrades to comply with future permit requirements. By utilizing an alternative delivery method, the Owner is working collaboratively with the specialized design-build contracting team to negotiate project costs, accelerate the schedule, and mitigate construction risks.

RUA AL-MADINAH PROJECT

Al-Madinah Al-Munawarah, Saudi Arabia

We've been selected to provide construction project management consultancy and contract administration services for a mega real estate project in Saudi Arabia, which includes a 5 km tunnel.

Under the US$15 million contract, which is part of the Rua Al-Madinah project in the holy city of Al-Madinah Al-Munawarah, we will manage the main infrastructure works, including the tunnel, road, and utility works.

The vehicle tunnel will be a concrete rectangular structure measuring 32 m x 10 m. Situated in a central area of the city, the tunnel is designed to improve the traffic flow to the city center where Al-Masjid an-Nabawi, known in English as the Prophet's Mosque, is located.

The Rua Al-Madinah project is a key initiative of Saudi Vision 2030, designed to elevate the city's cultural and historical heritage, improve the quality of life for its residents, and enrich the visitor experience for Islamic pilgrims. The 1.5 million m^2 development will provide open, green spaces and new modes of transport that will provide easy access to the mosque, surrounding residences, and commercial spaces.

Rua Al-Madinah Project

DELAWARE AQUEDUCT BYPASS TUNNEL (BT-2)

Newburgh, New York

Parsons continues to provide construction management (CM) services for New York City's Delaware Aqueduct Bypass Tunnel project located in the Mid-Hudson Valley of Lower New York. We have been the CM on the project since construction began in January 2013, now approaching close to 10 years of continuous service. The Bypass Tunnel is part of the Delaware Aqueduct, in service since 1944, which supplies upwards of 50 percent of New York City's daily water consumption. At 85 miles long, the Delaware Aqueduct is the longest tunnel in the world. The Bypass Tunnel is designed to replace a leaking portion of the Delaware Aqueduct, and considered the most significant, capital construction repair project in the history of New York City's drinking water supply system.

Construction of the new Bypass Tunnel began in 2013. The initial phase of construction included two deep shafts in rock—one 900 feet deep and another that was 760 feet deep. Once the shafts were completed, more than 1,300 feet of tunnel was excavated by drill and blast techniques followed by a 12,500 long bored tunnel, using a Robbins manufactured TBM. The TBM bored tunnel was completed in August of 2019. The state-of-the art, hard rock TBM was designed to withstand 30 bars of water pressure as it mined under the Hudson River through zones of highly permeable and heavily fractured ground. Once the TBM bore was completed a reinforced, concrete final lining of the tunnel was constructed. The final lining included a unique, 1-inch thick, 16-foot diameter, solid steel interliner pipe that was sandwiched in between two layers of reinforced concrete to withstand the high-water pressure inside and outside of the tunnel. The final lining was completed in a ten-step process by November of 2021. Once the final lining was completed, two surface structure access chambers were constructed at the top of each shaft to serve as entry points to the new tunnel and facilitate connection to the existing active tunnel. The access chambers will allow for inspection and repair of the tunnels and possible distribution of drinking water in the future.

As the access chambers were completed, we moved into the next phase of work that included construction of a critical support structure that will allow for the connection of the Bypass Tunnel to the Delaware Aqueduct. The Delaware Aqueduct will be dewatered as the Bypass Tunnel is connected. To manage water levels at the primary supply reservoir a large-scale siphon system was constructed that serves as a reservoir water level control system during storm events.

The siphons include three 48-inch diameter flanged, steel spiral pipes running approximately 450 feet from the subsurface of the Rondout Reservoir up and over the Merriman Dam to siphon water into the spillway to avoid uncontrolled storm surges and potential spill events while the Bypass Tunnel is being connected to the Delaware Aqueduct. The construction included drilling soil and rock anchors from the water surface on a barge, installing precast concrete anchor blocks on the reservoir bottom as foundations for the siphon pipes up to the spillway. Additional "dry" cast-in-place concrete thrust blocks and steel pipe supports where installed to anchor the siphon pipes in the spillway. The work required a complex sequence of construction utilizing large scale 450-ton crane. The siphons include a sophisticated network of support equipment-vacuum priming pumps, programmable logic controllers, submersible pumps, and valves to modulate siphon flow rate. The siphon network was successfully installed and tested in December of 2022.

Thoughout the related Bypass Tunnel construction work this year, we managed and coordinated the planning phase and ironed out workplans for the next key step of the work, connecting the Bypass Tunnel to the Delaware Aqueduct, Phase II of the Bypass Tunnel contract. Phase II is expected to take six months to complete the connection. The Bypass Tunnel contract allows for three annual opportunities to make the Phase II connection, starting in October of years 2022, 2023, or 2024. The start of the connection phase is contingent on several things, most importantly weather patterns.

Last fall, The City decided to proceed with the Phase II connection in year 2023 or 2024. Consequently, we are presently in what is termed, Stand-by Mode. The stand-by component of the contract allows for upgrades to several supporting shaft sites and preparation and implementation of a Spring Pre-test, which is two-week shutdown of the Delaware Aqueduct to monitor water levels in the tunnel and run a network of pumping systems that will dewater the Aqueduct. Presently, we are preparing for the Phase II work to begin in October 2023. We provide planning, including preconstruction services, CM, environmental health and safety, ISO 9000 quality assurance/quality control, risk management, regulatory compliance, community outreach, and communications/coordination. We received an Excellence Award in Construction Management from the NYCDEP in 2017. Our team looks forward to implementing a unique approach to connect the new tunnel to the existing tunnel, which will reduce time of the shutdown tunnel outage from 16 months to six months.

Delaware Aqueduct Bypass Tunnel – Siphon Pipe Alignment and Testing

CALIFORNIA HIGH-SPEED RAIL PROJECT – CONSTRUCTION PACKAGE 1

Madera To Fresno, California

Tutor-Perini/Zachry/Parsons (TPZP) crews working on the Fresno Trench portion of the California High-Speed Rail Project – Construction Package 1 (CP1) completed the staged, top-down construction of the box underneath State Route 180. The construction team continues to construct the Fresno Trench heading north and construct substructure walls for the Tulare Street Undercrossing.

The construction team is using a trenchless technique to construct several large-diameter storm drain segments under existing railroads with as-needed ground improvements. The trenchless segments consist of open-shield tunneling and horizontal directional-drilling activities.

CITY OF HOUSTON FACILITIES CONSOLIDATION – CHELFORD CITY DIVERSION PACKAGE 3

Houston, Texas

We are providing engineering services to the City of Houston for the Chelford City Diversion Package 3 project. The project scope is to design gravity sewers to abandon the Green Crest Lift Station (LS) and divert the flow to the Upper Braes Wastewater Treatment Plant (WWTP). This project is the fourth segment of the overall plan to divert wastewater flows currently being treated at the Chelford City WWTP to the City of Houston Upper Braes WWTP. The project consists of the following: 6,500 linear feet of 24-inch HOBAS pipe to be installed by microtunneling, 800 linear feet of 36-inch steel casing to be installed by microtunneling with 24-inch carrier pipe for a crossing beneath State Highway 6, three diversions of flow from existing surface sewers, and decommissioning and demolition of Green Crest LS after the proposed gravity sewer is in service. Project is under construction. Completion date is September 2024.

HAMPTON ROADS BRIDGE-TUNNEL (HRBT)

Hampton And Norfolk, Virginia

We supported Virginia Department of Transportation's (VDOT) Hampton Roads District Special Structures Office (HRSS) in the investigation of conceptual design alternatives for enhancing the efficiency of processing over-height (OH) vehicles in the Westbound (WB) Tunnel of the Hampton Roads Bridge Tunnel (HRBT).

The HRBT is a 3.5-mile-long combination bridge-tunnel crossing Hampton Roads that carries Interstate 64 (I-64). The Eastbound (EB) Tunnel has a posted vertical clearance of 14 feet 6 inches and the WB Tunnel has a posted vertical clearance of 13 feet 6 inches. Despite signage and a warning system, 16 to 22 OH vehicles on average still approach the WB Tunnel and must be turned around daily on the HRBT South Island. Each turnaround stops I-64 traffic for 9 to 12 minutes, and these stoppages delay motorists and impact the efficient movement of goods, the safety and reliability of the interstate, and the quality of life in the region. We investigated the feasibility and provided conceptual construction alternative methodologies and cost-to-benefit

analyses for increasing the vehicular clearance of the WB tunnel incrementally by 2 to 12 inches.

Both the EB and WB Tunnels utilize a full transverse ventilation system, consisting of a supply air duct running under the roadway and an exhaust air duct over the roadway with ventilation buildings positioned at each of the portals. The ceilings serve as the floor of the exhaust air ducts, anchored to the interior substrate of the tunnel tubes. The current system requires an upgrade/ replacement to extend the service life and improve safety of the HRBT. We provided alternative solutions to upgrade the ventilation system including construction sequences and methodology for each alternative which included an alternative that transitioned to a longitudinal ventilation system with jet fans, upgrades to the Supervisory Control And Data Acquisition systems (SCADA), and other tunnel systems to satisfy NFTA 502.

MATTAWA DUNDAS SANITARY TRUNK SEWER PROJECT

Mississauga, Ontario, Canada

We were retained by the Regional Municipality of Peel (Peel Region) to provide design and services during construction for the Mattawa Dundas Sanitary Trunk Sewer Project located in the City of Mississauga, Ontario, Canada. Peel Region's Water and Wastewater Master Plan (updated in 2013) identified the need for upgrades to the existing sanitary trunk sewers and watermains in the southeast area of the City of Mississauga to address forecasted long-term servicing needs in the Region to the year 2031. Specifically, 650 meters of new 1200 mm diameter sanitary trunk sewer was proposed to address the needed improvements at several locations within the existing sanitary trunk sewer network located near Dundas Street East and Mattawa Avenue, as well as to provide security and operational redundancy to the Region's sanitary trunk sewer network.

As the existing sanitary sewer on Dundas Street East between Mattawa Avenue and Dixie Road is noted to have capacity limitations, particularly the inverted siphon passing underneath an existing watercourse, the proposed solution needed to address the requirement to provide sufficient capacity for the future rehabilitation of the existing sanitary trunk sewer, while continuing to maintain uninterrupted sewer services to the surrounding businesses and residents.

A new 1200 mm diameter sanitary trunk sewer is proposed on Mattawa Avenue to divert flows upstream of the existing siphon and diverting the flows back to the existing sanitary trunk sewer downstream. A diversion chamber will be constructed to divert the existing flows from the existing trunk sewer to the proposed trunk sewer down to the Region's interceptor trunk sewer downstream.

The design and construction strategy were to minimize impacts to public, minimize impacts to the environment within the regulatory boundary limits, and reduce the property acquisition requirements. The tunnelling construction methods include approximately 650 meters of 1200 mm diameter tunneling and four tunneling shafts with the tunnel construction primarily located within a shale limestone formation. The tunnel construction is expected to utilize an open face micro tunnel boring machine. The construction activities are expected to commence in September 2023 and estimated to be completed in the Spring 2025. The project's total estimated construction cost is approximately $22 million.

California High-Speed Rail Project – Construction Package 1

DEER CREEK SANITARY TUNNEL AND PUMP STATION

St. Louis, Missouri

We have been working with the Metropolitan St. Louis Sewer District (MSD) since 2011 on these projects. In 2016, design work was completed for the Deer Creek Sanitary Tunnel project. The contract was awarded to SAK Construction for $147.8M and construction began in the Fall 2017. The tunnel is approximately 4-miles long with an inside diameter of 19-feet and is located 175-feet below the surface in solid rock in a highly urbanized area of St. Louis. It has capacity to store more than 38 million gallons during wet-weather events and will be pumped dry after high flows have subsided and the downstream treatment plant has available capacity. SAK constructed eight additional shafts to provide essential access to collection sewers and the downstream pump station. Diversion structures divert flow to the tunnel once the flow in the existing sanitary sewer system has reached a critical depth. Gates will control the flow in the existing sewer and prevent sewer surcharging that could cause basement back-ups during wet-weather events. Mining of the tunnel was completed in only 11 months with a 22-foot diameter tunnel boring machine (TBM), maneuvering through 14 designed curves at a grade of 0.20% and arriving at the planned horizontal and vertical location. Cast-in-place lining, diversion structures, adits, and site restoration efforts are complete. One additional sewer connection will be constructed once the pump station is online.

Design of the pump station was completed in February 2020. KCI Construction began construction in September 2020 at a cost of $29M. The pump station was designed to control the discharge rate from the tunnel which will be limited due to downstream sewer capacity issues and capacity issues at the treatment plant serving the project area. Different pump types were evaluated to determine which system is the most economical, reliable and maintainable. Work on this contract includes one wet well and two dry wells in shafts previously constructed by SAK, one wet well building, one dry well building, one effluent vault structure, and numerous site improvements. The project suffered a delay due to unexpected flooding in July 2022, when St. Louis received over nine inches of rain in a 24-hour period. The contractor expects final completion in June 2023.

Deer Creek Sanitary Tunnel

DELTA CONVEYANCE PROJECT

Sacramento, California

We continue to provide program management services to the Delta Conveyance Design and Construction Authority (DCA).

We provide overall management, technical/engineering consulting, and project controls for the DCA, including staffing and software for activity scheduling and reporting, risk management, program budget/cost planning and monitoring, performance metrics development and reporting, program documentation, and other related professional services.

Delta conveyance refers to State Water Project (SWP) infrastructure in the vast network of waterways comprising the Sacramento-San Joaquin Delta (Delta) that collects and moves fresh, clean, and affordable water to homes, farms, and businesses throughout major regions of the state from the Bay Area to Southern California.

The Delta is at the center of California's vital water distribution system. The State Water Project collects and delivers water from the Delta to more than 27 million Californians and 750,000 acres of farmland. The infrastructure that enables conveyance for California's primary water supply is critical to the health of local communities and the success of the state's economy.

Because the SWP relies on the Delta's natural channels to convey water, it is vulnerable to earthquakes and sea level rise. Upgrading SWP infrastructure protects against these threats and secures the longevity of the SWP and the future reliability of SWP water supplies.

Department of Water Resources' (DWR's) fundamental purpose in proposing the project is to develop new diversion and conveyance facilities in the Delta to restore and protect the reliability of SWP water deliveries.

DWR is considering the Delta Conveyance Project to address sea level rise and climate change, minimize water supply disruption due to seismic risk, protect SWP water supply reliability, and provide operational flexibility to improve aquatic conditions in the Delta.

The Delta Conveyance Design and Construction Authority (DCA), under the direct supervision of the DWR, conducts concept engineering and design work to better position the DWR environmental review process for the proposed Delta Conveyance Project to accurately assess impacts and identify effective mitigation measures, and to better inform concepts in the final environmental documents.

DWR has released a draft environmental impact report which proposes a 6000 cfs tunnel along the Bethany Alternative Alignment.

DC-02 AND DC-03 SANITARY RELIEF SEWER

St. Louis, Missouri

We designed the DC-02 and DC-03 Sanitary Relief Sewer project, which was divided into two construction phases. Both phases are complete. Construction of Phase I by J.H. Berra consisted of 5,075 linear feet of 8-inch to 78-inch diameter sanitary sewers and appurtenances, one diversion structure, eight junction chambers, 24 manholes, three flow metering manholes, and other associated

Purple Line Extension Section 1

work. Phase II by Kolb Grading consisted of 8,190 linear feet of 8-inch to 72-inch diameter sanitary sewers and appurtenances (including 1,780 feet of tunnel), six junction chambers, 28 manholes, one flow metering manhole, and other associated work. Challenges presented by the project included a mixture of suburban and wooded areas, active railroad crossings, arterial roadways and interstate highway crossings. Construction of the sewer was by open cut excavation, trenching, and tunnelling. Tunneling allowed construction to avoid congested commercial areas, interstate highways, and railroads.

In addition to the sewer work, we designed a major diversion structure to divert excess flows from the DC-02/03 Sanitary Relief Trunk Sewer to the Deer Creek Sanitary Storage Tunnel and Pump Station.

With the completion of the Deer Creek Sanitary System program, our client will have additional system capacity and will be complying with an EPA consent decree by removing sanitary sewer overflows and helping to prevent sewer backups during wet weather.

We performed preliminary design for the entire project and were responsible for the final design of Phases I & II of Four. We were also retained by the Metropolitan St. Louis Sewer District (MSD) engineering services during construction. Construction cost for Phase I was $20.8M and for Phase II was $25.5M.

DOWNTOWN RAIL EXTENSION PROJECT

San Francisco, California

We provide General Engineering Consultant (GEC) services to Transbay Joint Powers Authority (TJPA) for the Transbay Program. GEC services include project management, project development, and project procurement, as well as engineering support during construction for the next phase of the Transbay Program. The Downtown Rail Extension (DTX) project, now also known as The Portal, will connect Caltrain's regional rail system and the California High Speed Rail Authority's statewide system to the Salesforce Transit Center in the heart of downtown San Francisco. The rail alignment will be constructed principally below grade to provide a critical link for Peninsula commuters and travelers on the state's future high-speed rail system. Major elements of the project include the DTX tunnel using both cut-and-cover and mined tunneling methods, a new underground Fourth and Townsend Street Station, emergency egress and ventilation structures, systems and trackwork, fit-out of the below-grade rail station at the Salesforce Transit Center, and a train box extension of the existing station structure. At the end of 2022, we completed the preliminary engineering design for the project and wrapped up the project development phase. We are now supporting TJPA moving into the project procurement phase. This includes advancing engineering designs for enabling works projects, as well as supporting the development of Progressive Design Build procurement documents.

FOOTHILL GOLD LINE EXTENSION, PHASE 2

Glendora, San Dimas, La Verne, And Pomona, California

In October 2019, the Foothill Gold Line Construction Authority awarded a design-build (DB) contract for Phase 2B of the Foothill Gold Line extension to Kiewit-Parsons, a joint venture (KPJV). This project will extend the current Metro Gold Line 9.1 miles and add four new Light Rail Transit (LRT) stations in the cities of Glendora, San Dimas, La Verne, and Pomona. The four-station light rail project is now more than 65 percent complete overall, with the grade crossing work more than 86 percent complete, freight track relocation more than 80 percent complete, and the bridgework nearing 60 percent complete (90 percent of the freight bridge construction is now complete). KPJV is also constructing pedestrian underground crossings and ramps, guideway retaining walls, and protect in place buried structures as part of this DB contract.

HORIZONTAL LATERAL PROJECT

Las Vegas, Nevada

We have been selected by the Southern Nevada Water Authority (SNWA) to continue providing program and construction management services to improve and increase the water supply to Las Vegas. Continuing a partnership that began in 1993, the new contract will focus on water distribution and watershed sustainability. We will support program and construction management, construction inspection, project controls, labor relations and compliance, and project management information system support.

As part of the major construction and capital plan (MCCP) by SNWA, we are currently working on Horizon Lateral Project. The Horizon Lateral Project is a $2.4 billion water transmission pipeline, including eight miles of tunnels, to the southwestern part of the Las Vegas Valley. There are two tunnel alignments being considered. Currently preliminary design, survey, right-of-way, and geotechnical drilling are proceeding for both alignments. The final design of the selected alignment is anticipated in 2024-2025, and construction is anticipated to commence in 2025.

PURPLE LINE EXTENSION SECTION 1

Los Angeles, California

Los Angeles Metro's Purple Line Extension Section 1 project is the first of three sections along the new 9.1-mile subway corridor. Section 1 extends the subway 3.92 miles starting at the existing Wilshire/Western station and ending in Beverly Hills. Section 1 will consist of three new stations constructed along the alignment. The permanent underground structures include stations at Wilshire/La Brea, Wilshire/Fairfax, Wilshire/La Cienega and a

Purple Line Extension Section 1 – Wilshire/Western Cross-passage

Photo Credit: LA Metro

transition structure at Wilshire/Western. Section 1 of the Purple Line Extension is scheduled to be operational in 4Q 2024.

The overall project is currently 82 percent complete. Tunneling of the twin bore tunnels was completed in May 2021 and both tunnel boring machines have been disassembled and are in the process of being removed from the tunnel. Construction of all tunnel cross-passages has been completed and tunnel work is now focused on tunnel walkway concrete, installation of rail track supports and the laying of the permanent rail.

Station construction is also on-going. Station equipment is being installed and entrance structures for each of the stations are in progress. Structural concrete for the roofs of all three stations is nearly complete. Temporary street deck panels have been removed and final street restoration work has started at the Wilshire/Fairfax station. Temporary decking at the Wilshire/La Cienega station started in late April 2023 and will continue over 17 consecutive weekend closures. Decking removal at the Wilshire/La Brea station is anticipated to start in Fall 2023. Construction of final street improvements along Wilshire Boulevard and the adjacent side streets will extend into 2024. Street improvement work will include new pavement, bus pads, curb and gutter, lane restriping, street lighting and traffic signals.

Parson's role in the project continues as the prime designer for the design-build team and design engineer of record (EOR) for the project.

SAN FRANCISCO PUBLIC UTILITIES COMMISSION (SFPUC) SEWER SYSTEM IMPROVEMENT PROGRAM

San Francisco, California

Since 2011, Parsons, in a joint venture with AECOM, has been providing program management services for the SFPUC's $6.9 billion Sewer System Improvement Program (SSIP), which includes various conveyance and flood resilience projects. We assisted in several tunneling and trenchless projects, providing tunneling and geotechnical expertise to SFPUC and San Francisco Public Works, for alternative analyses and conceptual engineering reports, independent reviews, technical expertise, and final design reviews of SSIP projects. Example projects include the Kansas and Marin Streets Sewer Improvement Design-Build, Folsom Area Stormwater Improvement, 15th Avenue and Wawona Street Stormwater Management, Lower Alemany Area Stormwater Improvement, and Channel Force Main Redundancy projects. In a separate contract, we are also providing ongoing construction management services for SFPUC's Southeast Treatment Plant improvement projects.

TUNNEL STABILIZATION AND SEWER PIPELINE REPLACEMENT

Laguna Beach, California

The South Coast Water District operates the Beach Interceptor Sewer Tunnel located beneath the coastal bluffs in the city of Laguna Beach, California. The rehabilitation efforts of

the 70-year-old sewer tunnel include the stabilization and enlargement of a 10,000-foot horseshoe-shaped tunnel from five feet wide by six feet high to eight feet wide by eight feet high horseshoe-shaped tunnel using roadheader excavation and conventional ground support. Additionally, the existing deteriorated 'Techite' and VCP pipes are being replaced with a new 24-inch DR-25 PVC sewer pipe.

We provided preconstruction services including value engineering, seismic stability analyses and risk assessment to the South Coast Water District. Additionally, Parsons has been providing bid support, design reviews, and construction management services since 2016. Construction is currently in the final of four phases. Tunnel excavation and support were completed in May 2022, and the installation of the new 24-inch PVC sewer pipe is ongoing with a completion date in June 2023. The final completion of the project is expected in November 2023.

WEST VAUGHAN SEWAGE TUNNEL PROJECT

West Vaughan, Ontario, Canada

The Regional Municipality of York (the Region) is located within the Greater Toronto area in Ontario, Canada.

The Region intends to implement regional sewage servicing in the City of Vaughan, in particular for the west Vaughan area. The objectives for the West Vaughan Sewage Servicing Project are to accommodate future growth servicing demands and to provide sustainable wastewater servicing.

The work includes construction of the Tunnel Phase 1 trunk sewer and related shafts. The sewer will be approximately 11 kilometers long with a 3.0 meter internal diameter. The sewer conveyance tunnel in the City of Vaughan, Ontario, Canada, will run primarily along Highway 27, Highway 7, and terminate at the York Region Humber Sewage Pumping Station off Steeles Avenue. The shafts and tunnel will convey sanitary flow from connections at Huntington Road and other local connections to the upgraded Humber Sewage Pumping Station.

The sewer alignment is divided into three segments (South, Central, and West), where tunnel boring machines (TBMs) will be used for excavation, with an internal diameter of 3.0 meters and precast concrete segments for tunnel liners.

The Tunnel Phase 1 work contract will be preceded by the Humber Sewage Pumping Station advanced contract (Contract A) where a new pump station will be built and commissioned. Construction of the launch shaft (7L) will be part of Contract A scope which will be handed over to the tunnel contractor to be used as the launching point for the South segment drive. The tunnel contractor is to supply two TBMs to execute the 3.0 meter tunnel (internal diameter) and the 250 mm thickness precast concrete segments (PCTL) necessary for tunnel lining.

Parsons is providing detailed design services for a new sewer main and pumping station upgrade to provide additional capacity for future development in Vaughan.

Tunnel Stabilization And Sewer Pipeline Replacement

CATSKILL AQUEDUCT REPAIR AND REHABILITATION PROJECT (CAT-RR)

Newburgh, New York

In 2022, the New York City Department of Environmental Protection (DEP) announced the completion of the Catskill Repair and Rehabilitation (CAT-RR) project to clean, upgrade and rehabilitate the Catskill Aqueduct, which delivers approximately 40 percent of the city's drinking water each day. To facilitate work inside the structure and at connected facilities, the aqueduct was shut down from November to January for four consecutive years between 2018 and 2021. During that time, upwards of 200 workers were deployed at more than a dozen locations in Ulster, Orange, Putnam and Westchester counties to clean the inside of the aqueduct, repair cracks and other defects, and replace valves connected to the aqueduct.

The three CAT-RR projects were designed to restore the capacity of the Catskill Aqueduct, which has been lost over time due primarily to the accumulation of biofilm (a naturally occurring layer of microorganisms) along the aqueduct's interior surface. To maintain capacity improvements after cleaning, chlorine will be added to the aqueduct to prevent the regrowth of biofilm. A new chlorination facility has been constructed at the Ashokan Screen Chamber in Ulster County, New York, with a dechlorination facility located 74 miles downstream in Westchester County, New York, just north of the Kensico Reservoir.

"This complex project to rehabilitate the Catskill Aqueduct has required more coordination and flexible planning than perhaps any in the history of our water supply," DEP Bureau of Engineering Design & Construction (BEDC) Deputy Chief of Staff Vincent Sapienza said.

The 92-mile-long Catskill Aqueduct stretches from Ashokan Reservoir in Ulster County to Hillview Reservoir in Yonkers. The rehabilitation project focused on the 74 northernmost miles of the aqueduct, from Ashokan to Kensico Reservoir in Valhalla. The aqueduct was shutdown by the NYCDEP without affecting the reliable supply of water to New York City or the 20 communities in Ulster, Orange, Putnam and Westchester counties that usually draw their drinking water from the aqueduct.

The Tunnel Repair Contractor was awarded Substantial Completion by the NYCDEP in November 2022, while the Chlorination Facility was operational in October 2021 and the Dechlorination Facility in March 2023.

Preparing for the Delaware Aqueduct Bypass Tunnel

DEP's work on the Catskill Aqueduct was key to preparing for a shutdown of the Delaware Aqueduct in 2022. The 85-mile-long Delaware Aqueduct is the longest tunnel in the world. It begins at Rondout Reservoir in Ulster County and conveys about half of New York City's drinking water every day.

Over the past decade, DEP has worked on several projects to ensure New York City will have a reliable supply of drinking water during the Delaware Aqueduct shutdown. The rehabilitation of the Catskill Aqueduct, including increased transmission capacity, is key to those efforts.

Catskill Aqueduct

POLYMER CONCRETE IN SEGMENTED LINERS

By Jon Kaneshiro, PE, GE, PG, CEG; and Pooyan Asadollahi, PhD, PE

The use of polymer concrete in the tunnelling industry was first considered in the early 1970's by the U.S. Bureau of Reclamation. Research at the time was geared toward polymer impregnated concrete, which is no longer used in the polymer concrete industry in general because of poor cost and performance balance. The first polymer concrete segmented liner construction completed tunnels in 2002 in Offenbach, Germany (Figure 1) with internal diameters of 1.3 m and 2.0 m, with glued joints.

For Oakland-Malcomb North Interceptor East Arm Tunnel, an existing 1.4 km long by 5.3 m ID tunnel with an average depth of 15 m to invert was constructed in the early 1970's within the Detroit Metropolitan Sewer Services District and will be partially relined for 85 m with 4.88 m ID by 76 mm thick by 2.13 m long (with tongue and groove joints) that are glued together (Figure 2).

The Silicon Valley Clean Water in 2018 considered a polymer concrete liner versus a two-pass system with 3 m and 3.4 m ID corrosion resistant pipe; for example, centrifugally cast fiber reinforced polymer mortar pipe (CCFRPM) or filament wound fiber reinforced plastic pipe (FWFRP) in the progressive design build 5.3k m by 4.1 m ID/4.9 m OD tunnel. Polymer concrete design innovations could have provided a cost savings; however, it is understood that the role of precedence in civil engineering practice led to SCVW staying with the two-pass CCFRPM system.

Besides the savings in schedule and cost from a smaller diameter bore and elimination of a second pass, a design innovation that has made polymer concrete more cost competitive includes the introduction of lightweight Styrofoam cores (Figure 3). Some manufacturers of polymer concrete that release no volatile organic compounds during production and have a significantly reduced carbon footprint by as much as about five times less than conventional concrete and 2.5 times less than environmentally "green" concretes. Also, polymer concrete does not consume water. While polymer concrete may have higher capital costs, life-cycle costs of polymer concrete can be more beneficial.

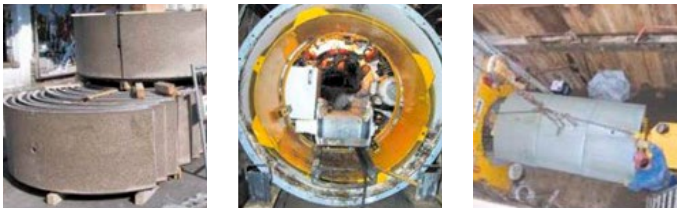

Figure 1. 3-piece 1.3 m dia. polymer concrete segments.

Figure 2. Precast polymer concrete tunnel reline segments. Washington, Indiana Plant

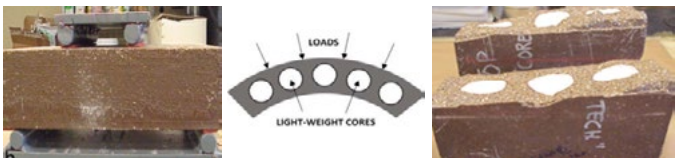

Figure 3. Precast polymer concrete segments using patented solid core technology (Rockhardscp®) and samples tested in 4-point bending.

Acknowledgement: This article is an exerpt from "Kaneshiro, Asadollahi, Dawson and Hunt (RETC, 2023), "Gravity Sewer Tunnel Liner Corrosion Protection – Part Two".

Publications

Title	Author(s)
Rapid Excavation and Tunneling Conference (RETC), June 11–14, 2023, Boston, MA	
Gravity Sewer Tunnel Liner Corrosion Protection–Part Two	**Jon Kaneshiro, Pooyan Asadollahi, Eric Dawson,** and Steven Hunt
Evaluation of Long Term Loads on Freight Tunnels in Chicago	**Alireza Ayoubian** and Richard Finno
CIC 2023: The 2nd International Conference on Civil Infrastructure and Construction, February 5–8, 2023 Doha, Qatar	
A Side by Side comparison of Shaft Excavation locally in Qatar	**John Brown, Sunit Saurabh,** Ahmed Akslakhi, and Eisa Al-Mohannadi
Launching a 148m Long Tunnel Boring Machine from a 15m Diameter shaft	**Volkan Salepciler, John Brown,** Jacek Bogdan Stypulkowski, and Sheikh Abdulrahman Al-Thani
Backfilling Manhole Surround Using Recycled Concrete Waste Material	**John Brown, Suvish Valsan, Nand K Vashisht,** Anna Olliver, and Eisa Abdulla S A Al Mohannadi
Implementation of Odour Control Systems for Nuisance-free and Public friendly environment in Qatar	**Spyridon Trikis, Vaibhav Sumant, Muhammad Arshad,** Anna Olliver, Meshaal Jarallah Abushereeda, and **John Brown**
Lecture at University of Chile, April 20, 2023, Santiago, Chile	
Tunnel Engineering in Countries Susceptible to Large Earthquakes	**Jon Kaneshiro**
The Geological Society of America, Connects 2022, October 9–12, Denver, CO	
The Geological Findings of the NYDEP Bypass Tunnel Alignment and Implications on the Structural Geology of the Mid0Hudson Valley of New York	**Eric Jordan**
North American Tunneling Conference (NAT), June 19–22, 2022, Philadelphia, PA	
Tunnel Rehabilitation Through Historic Landslides in Laguna Beach	**Scott Zylstra** and **Shimi Tzobery**
Microtunneling Short Course, April 27–29, 2022, Scottsdale, AZ	
Houston's Approach to Microtunneling	**Monica Suarez** and Markos Mengesha

Bold Names denote Parsons' employee.

AWARDS AND RECOGNITIONS

LAGUNA BEACH MAYOR AND COUNCIL MEMBER VISIT PARSONS TUNNEL REHAB PROJECT

Laguna Beach, California

On June 9th, 2022, we were pleased to host the Mayor of Laguna Beach, Sue Kempf at our Laguna Beach Tunnel Rehabilitation project site. The tour participants also include City Council member, Toni Iseman, Former South Coast Water District (SCWD), Eric Jensen, SCWD Project Manager, Joe Sinacori, Public Information Officer (PIO), Sheena Johnson, and PIO assistant, Melissa Torres. A presentation about project status, progress, and achievements was given by Parsons' Construction Manager, Shimi Tzobery, and a guided tunnel tour was conducted by Parsons' Assistant CM, Kevin Kilby and Parsons' Resident Engineer, Trimbak Vohra. The visit was highly informative and hailed as a great success by the mayor, council, and client members.

From left to right: Sheena Johnson, Joe Sinacori, Kevin Kilby, Trimbak Vohra, Toni Iseman, Laguna Beach Mayor, Sue Kempf, and Eric Jensen.

The SCWD operates the Beach Interceptor Sewer Tunnel located beneath the coastal bluffs in the city of Laguna Beach, California. We have been providing value engineering, construction management services, bid support, design reviews, and risk assessment for the project since 2015. The rehabilitation efforts of the 70-year-old sewer tunnel includes the stabilization and enlargement of a 10,000-feet from 5-foot-wide by 6-foot-high tunnel to an 8-foot-wide by 8-foot-high horseshoe-shaped tunnel. Additionally, the existing deteriorated sewer pipes will be upgraded to a new 24-inch DR-25 PVC pipe. The project is being constructed in four phases and is currently in the last phase of construction with forecasted completion by June 2023.

Here's a quote from South Coast Water District's tweet "This team has been a part of this project for six-plus years and continues to provide high-quality work with 5-star service. We greatly appreciate Kevin, Shimi, and Trimbak for providing a safe and informative tour for us!."

2022 GOLD AWARD FROM THE ROYAL SOCIETY FOR THE PREVENTION OF ACCIDENTS

Our Wakrah-Wukair Drainage Tunnel Project in Qatar has earned three international awards for its safety and risk management excellence. The project team, Parsons (supervision consultant), Ashghal (client), and two of the package contractors, have been awarded three Gold Awards from ROSPA (Royal Society for the Prevention of Accidents), a prestigious and renowned scheme that honors organizations and individuals who achieve very low levels of harm and loss and exceptional control of risk in their workplaces. ROSPA awards span nearly 50 countries and receive almost 2,000 entries every year. We have won two Gold awards for 2022 and 2023 for the Wakrah-Wukair Drainage Tunnel and one Gold award in 2023 for the Wakrah-Wukair TSE Line, showing that we have upheld consistent high quality of construction safety across our projects. These accolades are a testament to our strong team, who have embodied and upheld Parsons' six core values throughout our construction projects.

ALIREZA AYOUBIAN BECOMES A PARSONS FELLOW

Reza is a senior supervising geotechnical engineer with extensive professional experience in design, construction, and management of transportation and underground projects. He maintains an impressive balance of project delivery in both bridge and tunnel projects, participates in multiple organizations submitting and reviewing leading-edge technical works, and conducts ongoing research with Northwestern University. From bridge foundations to tunnel boring machines, Reza has delivered on a broad array of project types on multiple continents for Parsons. He looks forward to engaging with the Fellows to expand our geotechnical reach across business units.

It takes the world's greatest minds and technology to solve humanity's biggest challenges. Our Fellows Program brings together our industry's brightest experts to foster engagement and mentorship.

FELLOWS
Science • Engineering • Technology

The Parsons Fellows Program recognizes our top technical experts and promotes innovation in solving our customers' most difficult technical challenges. It is a collaborative network of motivated and passionate subject matter experts.

JOHN BROWN BECOMES A FELLOW OF INSTITUTE OF MATERIALS MINERALS AND MINING

The award recognizes those who have made a significant contribution or established a record of achievement in the materials, minerals or mining fields, or other disciplines within the technical outreach of the Institute of Materials, Minerals and Mining (IOM3).

The award of Fellowship is a measure of esteem for both those working in academia and industry. IOM3 appointed John a fellow of the institute of materials minerals & mining in 2022.

John is a results-driven professional with over 25 years of comprehensive experience working on large-scale civil and structural engineering projects, working as part of the owner, consultant, and contractor teams to manage and deliver safety, quality, and schedule. He has 20 years of direct mechanized tunneling (EPB and Slurry Shield), NATM, SEM and shaft, and cross-passage comprehensive construction experience including drill and blast.

PROFESSIONAL ENGINEERS

Congratulations to Alberto Hermoso Diaz who recently passed the Structural Engineering exam in Illinois and is now a licensed engineer in the state of Illinois.

Alberto is a Structural Engineer in our Chicago, Illinois office and has a PE license in the state of California as well.

NEW HIRES

Ankush Tikhe
Senior Tunnel Engineer

Ankush joined Parsons in April 2021 as a Senior Tunnel Engineer and part of the design team working on the Wakra-Wukair Drainage Tunnel Project in Qatar. Ankush has more than 17 years of experience in design, design review, and supervising for TBM tunnels, NATM tunnels, micro-tunnels, deep shafts, underground metro stations, and temporary and permanent structures. He has worked on preliminary design, detail design, report writing, tendering documentation, and specifications writing including review and supervision stages for mega underground metro projects along with drainage tunnels.

Tayo Roberts
Geotechnical Lead

Tayo joined our team in December 2022 as the Delivery Service Lead for Geotechnical Engineering in the MEA region.

His background covers geotechnical and tunnel engineering and he brings 21 years of experience (17 years in the Middle East), ranging from analytical design to the comprehensive practicalities of construction on major geotechnical and tunneling projects.

His tunnel experience includes working on preliminary and detailed designs, associated design reports, tender documents, and associated specifications, review of designs and supervision of several underground tunnels, including the Strategic Tunnel Enhancement Programme (STEP) Tunnel in Abu Dhabi, the Muharraq Tunnel in Bahrain and the Inner Doha Re-Sewerage Implementation Strategy (IDRIS) Tunnel in Doha.

RECENT TUNNEL EXPERIENCE

PROJECT TITLE	Drill And Blast	Adits To Tunnel Connection	Deep Shaft	Conventional Support	Water Control Grouting	Critical Schedule	Underground Safety	Design	Study	Geotech	Program Management	Construction Management	Construction Inspection Services	General Engineering Consultant	Procurement Method	Length (ft)	Diameter (ft)	Ground Type	Tunnel Methodology	Tunnel Type	Year(s)
West Vaughan Sewer Tunnel			✔	✔	✔	✔	✔	✔	✔	✔					DBB	49,000	12.1	S	EPB	WW	2015-2028
San Francisco Downtown Rail Extension (DTX), Design-Build		✔		✔	✔	✔	✔	✔	✔	✔				✔	DB	6,900	varies	S	TBM & NATM	TR	2005-2031
Deer Creek Sanitary Tunnel			✔	✔	✔		✔	✔		✔	✔				DBB	20,000	18.0	HR	TBM	WW	2012-2023
NYDEP Delaware Aqueduct Bypass Tunnel	✔		✔	✔	✔	✔	✔					✔		✔	DBB	16,000	22.0	HR	TBM, D&B	W	2012-2025
Beach Interceptor Tunnel Stabilization		✔		✔		✔	✔		✔			✔		✔	DBB	10,500	varies	HR	Roadheader	WW	2017-2023
LA Metro Purple Line Extension, Design-Build		✔		✔	✔	✔	✔	✔		✔					DB	2 x 18,000	19.0	SR	EPB, NATM	TR	2014-2023
Dubai Strategic Sewerage Tunnel, Design-Build								✔	✔		✔				DB	230,000	12-25	SR	EPB	WW	2016-2030
LACSD JWPCP Tunnel And Ocean Outfall			✔		✔	✔	✔	✔	✔	✔					DBB	100,000	22.0	SR	EPB	WW	2002-2027
Riyadh Metro, Design-Build		✔		✔	✔	✔	✔				✔	✔		✔	DB	79,000	33.0	SR	EPB, CC	TR	2013-2021
California High-Speed Rail, CP1, Design-Build				✔	✔	✔		✔	✔	✔			✔		DB	510	35 x 50	S	CC	TR	2013-2023
Dubai Metro Route 2020: Red Line Extension To EXPO 2020, DB					✔	✔	✔				✔	✔			DB	10,500	30.5	S	EPB	TR	2016-2020
Ohio Canal Interceptor Tunnel (OCIT)	✔	✔	✔	✔	✔	✔	✔					✔	✔	✔	DBB	6,250	30.5	S	EPB, D&B	WW	2014-2020
South Hartford Conveyance And Storage Tunnel	✔			✔			✔		✔			✔			DBB	22,000	22.0	HR	TBM	WW	2013-2023
Maliakos-Kleidi Motorway And Tunnels, Greece, P3	✔	✔	✔	✔	✔		✔	✔							PPP	42,650	33 x 54	HR, SR	D&B	TR	2010-2018
Lake Mead Intake No. 2 And No. 3 Project, Design-Build	✔	✔	✔	✔	✔	✔	✔		✔		✔	✔		✔	DB	22,150	14 - 20	HR	TBM, D&B	W	1996-2017
Ohio River Bridges - East End Crossing Tunnel, P3	✔			✔	✔	✔	✔		✔	✔		✔		✔	PPP	2 x 1,710	32 x 55	HR	NATM, D&B	TR	2007-2017
DC Water Anacostia River Tunnel (ART), Design-Build		✔	✔	✔	✔	✔	✔	✔		✔			✔	✔	DB	12,300	23.0	S	EPB, NATM	WW	2013-2017
Eglinton Crosstown East Tunnel, Canada, P3		✔	✔	✔	✔	✔	✔					✔		✔	PPP	2 x 10,800	21.7	S	EPB	TR	2013-2017
Downtown Tunnel/Midtown Tunnel/MLK Extension, P3							✔		✔		✔				PPP	4,300	28 x 54	S	Immersed Tube	TR	2012-2016
South Cobb SSO Tunnel	✔		✔	✔	✔	✔	✔					✔		✔	DBB	29,000	24 - 27	HR	TBM, D&B	WW	2008-2015
Caldecott Tunnel New Fourth Bore				✔		✔	✔	✔	✔		✔				DBB	3,450	40.0	SR	NATM	TR	2009-2014
San Vicente Pipeline Tunnels	✔		✔	✔	✔	✔	✔		✔		✔	✔		✔	DBB	57,400	12.0	HR, SR	TBM, D&B	W	2001-2011
Dubai Metro Red And Green Lines						✔	✔				✔	✔			DBB	70,550	33.1	S	EPB	TR	2005-2011

LEGEND

DBB: Design-Bid-Build
PPP: Public-Private Partnership
DB: Design-Build
HR: Hard Rock
WR: Weathered Rock
S: Soil
SR: Soft Rock
NATM: New Austrian Tunneling Method
TBM: Tunnel Boring Machine
EPB: Earth Pressure Balance
SPB: Slurry Pressure Balance
D&B: Drill And Blast
CC: Cut-And-Cover
TR: Transportation Tunnel
WW: Wastewater Tunnel
W: Water Tunnel

Photo Credit: Ministère Des Transports Et De La Mobilité Durable

Louis-Hippolyte-La Fontaine Tunnel, Quebec, Canada

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