URBAN PASSENGER RAIL

Metros

We are WSP

As one of the world's leading professional services firms, WSP exists to future-proof our cities and environment. We provide strategic advisory, engineering, and design services to clients in the transportation, infrastructure, environment, building, energy, water, and mining sectors. Our 66,000 trusted professionals are united by the common purpose of creating positive, long-lasting impacts on the communities we serve through a culture of innovation, integrity, and inclusion. Sustainability and science permeate our work. In 2022, WSP derived more than half of its $11.9 B (CAD) revenues from services that support the UN Sustainable Development Goals. The Corporation's shares are listed on the Toronto Stock Exchange (TSX:WSP).

Riding Metropolitan Railways
Into the Future

As cities focus on creating sustainable places to work, play, live and move about, they are turning greater attention to passenger rail systems—modernizing existing rail systems or establishing rail as the backbone of an emerging public transport network.

Many cities are challenged to manage traffic congestion toward improving mobility, supporting sustainable urban development as populations rise, and fostering economic growth. Upgrading and expanding metro systems—aka tube, underground and subway—will provide essential infrastructure to help reach these objectives and support the shift away from car-centric cities to pedestrian- and bicycle-friendly environments. Understanding how metro systems can advance priorities such as the decarbonization of transport is fundamental to delivering each city's vision and defining its own character.

Passenger rail is already considered a safe and sustainable form of transport. Yet, current needs and issues challenge the industry to progress even further. The worldwide mandate to reduce carbon footprints calls for metros to utilize innovative strategies and techniques to transition to zero emission for the whole of their operations. Determining how new mobility technology can help shape customer-centric services is essential for the development of Future Ready®[1] passenger rail systems that will work for today's populations and tomorrow's generations. Designing resilience into metros will allow these intricate, far-reaching systems to endure and perform in the face of climate change impacts and rapid technological development. Keeping all people and their different needs at the forefront of planning and decision-making will advance accessibility and equitable outcomes.

WSP has developed and earned a strong presence in the metro domain for over 100 years, advising as well as contributing diverse technical expertise to long-established and new systems. Building on that experience, our collaborative and multidisciplinary international teams are addressing evolving public transport needs and expectations through infrastructure projects and large-scale programs across the rail spectrum.

Here is an in-depth look at our work in metros toward delivering envisioned outcomes for cities around the world. Enjoy the ride

[1] Future Ready® is WSP's global innovation program that seeks to better understand the key trends in climate change, society, technology, and resources and how they are impacting our world, locally and globally. Future Ready® is a registered trademark of WSP Global Inc. in Canada and New Zealand. WSP Future Ready (logo)® is a registered trademark of WSP Global Inc. in Europe, Australia and in the United States.


SOUND TRANSIT
1
SOUNDTRANSIT

Table of Contents

Also see our Light Rail Transit and Stations Brochures

MARTA
Transit System

Location
ATLANTA, GEORGIA, UNITED STATES

Client
METROPOLITAN ATLANTA RAPID TRANSIT AUTHORITY (MARTA)

Status
ONGOING

STATIONS
38

LENGTH
77 km

ANNUAL RIDERSHIP
50,288,800 (2021)

WSP's association with the Metropolitan Atlanta Rapid Transit Authority (MARTA) began in 1966 when the firm established a joint venture to assist the newly created agency with the planning and development of a rapid transit system. The plans for the system have evolved since then to encompass 96.6 km of rapid transit lines, a 6km express busway corridor, 45 metro rail stations, and park-and-ride facilities for more than 33,000 automobiles. Services provided by the WSP-led general engineering consultant (GEC) joint venture for the heavy rail system include project management, engineering, development of design criteria, design of system-wide features and specific stations and line sections, quality control, and procurement and construction management.

The joint venture employed partnering, total quality management, value engineering, and "look-ahead scheduling" to cut 15 months off normal construction durations to open MARTA's 11.3km North Line extension in time for Atlanta to host the 1996 Summer Olympics. The joint venture also fast-tracked the design and construction of the Perry Boulevard bus facility, a combined operating garage and fuelling station for compressed natural gas-fuelled vehicles, for opening in June 1996.

In November 1994, a new joint venture was formed to serve as GEC for a five-year contract to accomplish the extension of the North Line to Sandy Springs and North Springs Stations, design and procurement of 100 new rail cars, and assist MARTA in its development of the new rail maintenance facility.

In July 2001, a new WSP-led joint venture, Regional Transit Partners, was selected by MARTA for negotiation of a new five-year contract. The new GEC Team assisted MARTA in its transformation from a new and expanding system into a mature one whose primary focus is on maintenance, rehabilitation and improved customer service. Assignments included project management, design and construction management of track rehabilitation, capital asset cataloging and evaluation, capital improvement program development, design services and construction management for a new rail maintenance and overhaul facility, bus radio replacement, and information technology system improvements.

Since 2013, WSP has continued to provide planning and technical services, supporting MARTA on a variety of task orders for operational analysis, environmental documentation, transit expansion studies, and transit-oriented development. WSP is also providing ongoing bus and rail vehicle support, systems, engineering, operations and maintenance, and infrastructure architectural and engineering support. WSP also served as lead designer for contractor Archer Western on the tunnel ventilation system Upgrade for the MARTA system, substantially completed in 2022.

Location
AUCKLAND, NEW ZEALAND

Client
CITY RAIL LINK LTD.

Status
ONGOING

TWIN TUNNELS LENGTH

3.45 km

EMBODIED CARBON REDUCTION TARGET

15 percent

COLLABORATING COUNTRIES

30+

City Rail *Link*

The City Rail Link (CRL) is the largest transport infrastructure project in Aotearoa (New Zealand) and will unlock Auckland in a way that will transform the city.

Between 2003 and 2017, the city's population grew by 28 percent, yet public transport patronage increased by 63 percent—more than double the population growth. With Auckland's population projected to reach two million by 2030, the CRL will help the city keep pace with its growth. It will connect with the existing overground rail network and double the amount of people living within 30 minutes of the city centre.

WSP is one of seven companies including CRL Ltd. that make up an alliance partnership, the Link Alliance—to deliver the City Rail Link by 2024. Together with our Alliance construction partners, Vinci, Downer and Soletanche Bachy, WSP is delivering 60 percent of the CRL. This includes 3.45 kilometres of twin 7.15-metre-diameter rail tunnels and three stations including a redeveloped Mt Eden station, together with two 200-metre-long mined platform caverns up to 42 metres deep at Karangaphape Station and similar platforms within the 11-metre-deep station box at Aotea Station.

Our services include engineering–civil, structural, mechanical, electrical, fire and hydraulics; rail systems; and digital. Services also include architecture, landscape architecture, urban design, requirements management, human factors and whole of life assessments. The Alliance Design Partners—WSP, Tonkin & Taylor, and AECOM are pushing the boundaries of what is possible for this project, including the following:

- It is recognized as one of the most digitally advanced projects in Aotearoa and the globe, securing First Place – Global AEC award: Digital delivery of large (>$500M) infrastructure projects. Using a multiple connected common data environment has allowed mobilization of a global workforce to work simultaneously on the digital model.

- The Link Alliance has set out to achieve a 15-percent reduction in embodied carbon—based on the pre-tender referenced design and pre-alliance design. A hybrid system of cutting-edge cloud-based technology provides feedback and embodied carbon emissions metrics to both design and construction teams at all stages of the project.

- The combined tunnel design team has been technically led by WSP experts from Australasia, with designs using tapered mined tunnel and bored construction techniques appropriate for Tāmaki Makaurau Auckland's variable sandstone geology.

- Integrated rail systems delivered as a fully operational extension to the rail network.

Image Courtesy of Link Alliance and CRL Ltd

BTS
Silom Line Extension

Location
BANGKOK, THAILAND

Client
BANGKOK METROPOLITAN ADMINISTRATION

Status
COMPLETED IN 2013

Bangkok Transit System (BTS) is an elevated rapid transit system in Bangkok, Thailand. Previously, the system consisted of two lines: the Sukhumvit Line from Mo Chit Station (N8) to Bearing Station (E14) and the Silom Line from National Stadium Station (W1) to Wongwian Yai Station (S8). The Silom Line has been extended 5.3 km from Wongwian Yai Station (S8) to Bang Wah Station (S12). The extension has been open for revenue service since 2013.

WSP was engaged by the Bangkok Metropolitan Administration as the lead company of the consortium to provide independent certification engineering and operation management services for the 5.3km extension. The scope of work includes the following:

- to certify that the works—including civil, structure, architecture, building services, track and railway systems—are safe and ready for revenue service.
- to certify that the operations and maintenance services provider is competent and ready to provide services for the extension.
- to ensure that the risks of major safety incidents during operations have been minimized by applying a structured risk management process from the commencement of the project through to revenue service.
- to ensure that the system as delivered will achieve reliability, availability, maintainability and safety performance as specified.
- to ensure the complete functionality of the extension and its seamless interface with the existing system.
- to ensure that the remaining and remedial works at the commencement of revenue service do not affect the opening of the extension and are not related to safety issues.

BTS
Sukhumvit (Light Green) Line 1st Extension

Location
BANGKOK, THAILAND

Client
KRUNGTHEP TANAKOM

Status
COMPLETED IN 2011

The Bangkok Mass Transit System, commonly known as the BTS Skytrain, became the first electric mass transit railway system to commence operations in Thailand. This elevated rapid transit system is operated by Bangkok Mass Transit System PCL (BTSC), a subsidiary of BTS Group Holdings, under a concession granted by the Bangkok Metropolitan Administration (BMA).

For the BTS Sukhumvit Line 1st Extension, from Station E9 (On Nut) to Station E14 (Bearing), BMA was responsible for the construction of the civil infrastructure together with procurement and installation of the railway systems to extend the service route approximately 5.25 km with the addition of five new stations.

WSP was appointed by BMA as the lead consultant in association with MAA Consultants Co., Ltd., the railway systems consultant for the procurement and installation of railway systems for this section, which opened revenue service in 2011.

Railway systems expanded from the BTS existing system:

- signalling and train control system
- backbone communications system
- radio system
- public address system
- telephone system
- closed-circuit television system
- master clock system
- power supply system (traction and stations)
- SCADA System

BTS
Sukhumvit (Light Green) Line – 2nd South Extension

There are two further extensions to the existing Sukhumvit Line after the 1st extension of the line to Bearing: the south extension from Bearing to Samut Prakan and the north extension from Mo Chit to Khu Khot. These extensions are operated as an integral part of the complete Sukhumvit Line system with uninterrupted passenger services running from Khu Khot to Samut Prakan.

The Sukhumvit Line will help relieve traffic congestion as well as population congestion within Bangkok. The city will be able to spread to Samut Prakan province, resulting in a decrease in traffic and population density in Bangkok while providing communities in Samut Prakan with a better quality of life.

The Sukhumvit Line south extension route is elevated starting at the end of the existing Bearing Station and ending in front of the Bangping electrical substation. The total distance of this project is 12.8 km with 9 elevated stations, 1 depot and workshop, and 1 park and ride.

The works under the design-and-build railway systems contract were supervised by WSP and include the supply of all railway systems: signalling and train control, traction and auxiliary power supply, communications systems, automatic fare collection system, platform screen doors, SCADA, depot and workshop equipment as well as additional civil enabling works required for railway operations.

The construction supervision scope of services for the design-build railway systems contract includes project control and contract administration, review and approval of all engineering submissions, interface and coordination management with other contractors, inspection of works, providing engineering advice to the client and the contractor, and coordination with the independent safety certification engineer in certifying the system prior to commercial operation.

Location
BANGKOK, THAILAND

Client
KRUNGTHEP TANAKOM (KT)

Status
COMPLETED IN 2021

MRT
Yellow Line

Location
BANGKOK, THAILAND

Client
MASS RAPID TRANSIT AUTHORITY OF THAILAND

Status
ONGOING

The Mass Rapid Transit Authority of Thailand (MRTA), Ministry of Transport, the Kingdom of Thailand, is implementing the public-private partnership net cost scheme for the monorail system of the MRT Yellow Line Lat Phrao-Samrong section. The concession period will be 33 years and three months (with the construction period lasting three years and three months, and the operation period extending 30 years).

MRTA has engaged Eastern Bangkok Monorail Company Limited (EBM), the concessionaire for design-build and supply of civil works, monitoring and evaluation of systems including monorail rolling stock, operations and maintenance services and other related systems of the Yellow Line Monorail project, Lat Phrao-Samrong section. The first monorail project to be implemented in Thailand, the Yellow Line is 30.4km-long, running from Lat Phrao to Samrong in Bangkok. Twenty stations plus one depot and one park-and-ride building are being built. (Three additional stations are planned for future expansion.)

WSP's main responsibility is rail as well as mechanical and electrical systems, overall system safety certification and tasks related to:

- design review, approval and coordination
- project management and coordination
- systems integration
- rail systems safety
- inspection, testing and commissioning support
- quality assurance

First Metro
Line of Bogota

Location
BOGOTA, COLOMBIA

Client
ML1

Status
ONGOING

LENGTH
23.96 km

PASSENGERS PER HOUR IN EACH DIRECTION
72,000

STATIONS
16

Since October 2020, WSP supports the introduction of Colombia's first metro in its capital city. Elevated on a viaduct, the 23.96km metro will be fully automatic, driverless and integrate with the existing Bus Rapid Transit (BRT) system – currently the main form of public transport available to Bogota's +7 million citizens – at ten of its stations.

Bogota Metro Line 1 will accommodate 72,000 passengers per hour in each direction, amounting to 1.05 million a day. Each driverless train will be able to carry 1,800 passengers, of which 15 percent will be seated, and will travel at an approximate average speed of 42.5km/h in 90 second intervals, making journeys from one end of the line to the other take as little as 27 minutes.

WSP is the lead Civil and Systems detailed designer. We are not only responsible for integrating designs and managing the design approval process, but also for supporting the client throughout the three design phases and ensuring they achieve their environmental and social goals.

Some of the key professional services we have provided on Bogota's metro include:

- GoA4 signalling system development and technical advisory
- Full Civil and Rail Systems detailed design and specifications
- System-wide integration
- Depot design and operational analysis
- Management of local and international contractors
- Construction technical support
- Safety integration and quality management up to line opening
- Stations design and integration of full M&E services

WSP is ensuring that designs for the new metro system are future ready – able to run off renewable energy, cope with a growing population, and take advantage of technological advances.

The 100 percent electrically powered mass transit system will offer a quicker, greener mode of transport to residents and visitors of the city. It is expected that this will increase demand for public transport and subsequently reduce traffic congestion, avoiding the emission of 171,000 tons of CO_2 per year by 2030.

Designs also include provisions to incorporate 19km of bike lanes, further supporting greener modes of transport.

The entire project is being produced in BIM to a high level of detail (LOD300/350) and the WSP design teams are coordinating interfaces in 3D using collaborative processes. The eventual system will be designed to a high specification utilising many technology developments in Telecomms and Radio whilst assisting Colombia in its transition to a low carbon economy.

Credit: Metro de Bogotá

Caracas *Metro*

Location
CARACAS, VENEZUELA

Client
C. A. METRO DE CARACAS (CAMC)

Status
COMPLETED IN 1984

AVERAGE DAILY RIDERSHIP
250,000

LINES
4

STATIONS
53

The Caracas Metro is a mass rapid transit system serving Caracas, Venezuela.

WSP has played a significant role in the development of the CAD 1.3 billion Caracas Metro project from its inception. Caracas Metro helped relieve the main freeway in Venezuela's capital, one of the most congested cities in South America. The complex project included design and construction services for the 55.8-km-long network of tracks, street improvements and training programs.

Throughout the project, our team provided feasibility and preliminary studies such as ventilation and metro environmental control development, land use analyses, traffic and pedestrian circulation planning and train controls and communications.

We designed the concrete tunnel liners used in twin-tunnel sections between Propatria and Agua Salud and Fuerzas Armadas and Bellas Artes.

Construction of such a large-scale project in a city as congested as Caracas poses many problems both to the construction team and to residents. WSP provided traffic management services to help maintain and improve surface traffic operations during the metro construction, resulting in significant construction cost savings and accelerated construction in difficult areas.

Following a WSP environmental study which identified problems with the heat balance within the entire metro system, our team developed an exhaust system for the tracks which reduced the heat buildup on the platform.

Credit: Metro de Bogotá

Doha Metro
Phase 1

Location
DOHA, QATAR

Client
QATAR RAILWAYS COMPANY

Status
COMPLETED IN 2019

LENGTH
76 km

STATIONS
37

LINES
3

The Government of Qatar has launched a major rail-based mobility and transportation program known as the Qatar Integrated Rail Program (QIRP), developed by the Qatar Rail Company (QRail), to support the goals of the Qatar Rail Development Program (QRDP).

The broad goals of the QRDP are to deliver a world class, environmentally friendly, safe and reliable rail network for Qatar, and to support the Qatar 2030 Vision for achieving the highest economic, social and environmental development standards for the Qatar community through a sustainable urban development plan.

Qatar needed to upgrade its infrastructure in order to attract businesses to the region and prepare for the 2022 FIFA World Cup. The country had a modern highway system, but no rail network.

The Doha Metro Program is a proposed network of metro corridors to be constructed at-grade, elevated and underground—consisting of four lines: the Red Line, Green Line, Gold Line and Blue Line. Qatar completed the construction of Phase 1 of the Doha Metro project encompassing the Red, Green and Gold.

WSP, in a joint venture consortium with Egis Rail, was selected by QRail for providing project management consultancy services for the 14.4km long Gold Line, the Msheireb and Education City stations, and the elevated and at-grade packages of phase 1 of the Doha Metro Program.

Located in the centre of Downtown Doha, the Msheireb Station—the major interchange station for the Red, Green and Gold Lines—is now the hub of the metro network.

The Education City Station, located in the educational part of the city, was originally designed to be an interchange station to link the Green Line with the future high speed, trans-Gulf long-distance passenger rail network.

The elevated and at-grade package included three 6km viaducts for the Red Line South, Red Line North and Green Line, in addition to six aboveground stations and depot-enabling works.

The City Rail Loop, *Pisara*

Location
HELSINKI, FINLAND

Client
CITY OF HELSINKI

Status
ONGOING

The City Rail Loop is a planned urban railway line for commuter trains in Helsinki. According to the plan, the loop-shaped railway would start in Pasila and run in a tunnel via Töölö, Helsinki city center, Hakaniemi and back to Pasila.

WSP's scope in the project included structural engineering in the design phase for Hakaniemi station and bridges.

The public transport system must be able to accommodate a continuously growing number of passengers. Now there are nearly 1.4 million inhabitants in the Helsinki region. This number is expected to increase by 40,000 by the end of 2030 and by more than 400,000 during the next few decades.

Capacity project of Helsinki *Metropolitan area metro*

Location
HELSINKI METROPOLITAN AREA, FINLAND

Client
CITY OF HELSINKI AND LOCAL TRANSPORT OPERATORS

Status
ONGOING

In the spring of 2021, WSP and the Helsinki City Transport (HKL) entered into a four-year framework agreement to advance the Helsinki metropolitan area metro capacity project. Our client's goal is to utilize expert support to plan the further development of the metro's traffic control system so that the implementation of the project can start during 2024.

The framework agreement includes project management services and expert assignments, which include various studies and models concerning, for example, capacity, passenger safety and operation and maintenance. WSP, together with HKL, plans to invite a tender for the metro traffic control system and is preparing for further development and possible renewal of the system.

The metro in Greater Helsinki is a key part of the public transport system. According to traffic forecasts, metro capacity will start to be at its extreme within the next 10 years, though travel habits will be affected by the increase in remote work and other factors.

WSP in Finland is leading this project, collaborating with WSP experts from Sweden, the United Kingdom and Hong Kong. In this way, WSP can combine the experience of local liaison officers, who have worked with HKL, with extensive international expertise, drawing on experience from similar projects.

Ho Chi Minh City
Metro Line 1

Location
HO CHI MINH CITY (HCMC), VIETNAM

Client
HCMC MANAGEMENT AUTHORITY FOR URBAN RAILWAYS

Status
COMPLETED IN 2018

LENGTH
20 km

STATIONS
14

SPEED
110 km/h

The Ho Chi Minh City (HCMC) Metro Line 1 extends from downtown Ben Thanh Market to Suoi Tien in District 9. The route is approximately 20 km long with 3 underground stations, 11 elevated stations and a depot. The system includes a major balanced cantilever bridge crossing the Saigon River.

The system was produced for heavy rail, is powered by a 1.5k V dc overhead catenary system, and is based on the Japanese Standard Urban Railway System for Asia (STRASYA) specification with a top design speed of 110 km/h.

The entire HCMC rapid transit system has 6 lines and a total of 107 km of track.

In this Japanese funded project, the consortium of WSP together with seven Japanese and Vietnamese firms was appointed by MAUR in December 2007 as the general consultant responsible for design, procurement, construction, commissioning and operation and maintenance planning of the railway.

WSP's primary responsibilities included:
- overall project management
- preliminary design of viaducts and elevated stations
- preliminary design of all MEP systems and tunnel ventilation
- preliminary design of the depot and depot equipment
- review of contractors' design submissions
- systems integration
- planning and schedule control
- preparation of contract documentation and construction specifications
- construction management
- testing and commissioning

South Island Line *(East)*

Location
HONG KONG

Client
MTR CORPORATION LTD.

Status
COMPLETED IN 2017

LENGTH
7 km

STATIONS
5

CAPACITY
Medium

The South Island Line (East) is about 7-km long running from Admiralty in tunnel to Nam Fung Road of Aberdeen, then on viaduct to Ocean Park and Wong Chuk Hang stations, crossing the Aberdeen Channel to Ap Lei Chau. The railway on Ap Lei Chau, including stations at Lei Tung and South Horizons, is underground.

Consultancy Agreement C902
WSP was responsible for developing and preparing the detailed design of the tunnels as well as civil, structural and mechanical and electrical design for the stations. Project elements included:

Lei Tung Estate Station – a two-level cavern station, constructed by drill and blast and (20-m wide, 160-m long, 20-m high) located 40 m below ground. The upper level serves as the concourse with two entrances, and the lower level comprises an Island platform.

South Horizons Station – a two-level underground station (20 m wide, 160 m long, 20 m high) constructed by the cut-and-cover method. The station is located 10 m below ground and will have two entrances.

Nam Fung Tunnel – a 3.3-km drill-and-blast twin-track tunnel, drill-and-blast tunnel at Lei Tung, cut-and-cover tunnel at Ap Lei Chau Drive, ventilation buildings at Hong Kong Park, Nam Fung, and Lee Wing Street.

Consultancy Agreement C903
WSP served as the lead mechanical and electrical consultant within a multidisciplinary team, with responsibility for the detailed design of:

Wong Chuk Hang, an elevated station; Ocean Park elevated stations and associated entrances, footbridges, ancillary and ventilation facilities and property enabling works; viaducts from Nam Fung Portal to Ap Lei Chau, totalling 3.7 km in length, connecting bridges, public interchanges, and park-and-ride facilities.

Consultancy Agreement C956
WSP served as the lead consultant with responsibility for the detailed design of the trackside auxiliaries services including:

- design of tunnel engineering and mechanical services including a tunnel hydrant system, cable/pipe supporting system, trackside lighting and small power, trackside sump pump system and earthing.

- coordination of services by means of combined services drawings and structural engineering and mechanical drawings including system-wide services in the tunnels, such as signalling, communications, overhead line, main control system, power supply, tunnel drainage and trackwork.


出
EXIT
海洋公園
Hong Kong

Tuen Ma *Line*

Location
HONG KONG

Client
MTR CORPORATION LTD.

Status
COMPLETED IN 2021

LENGTH
56.2 km

STATIONS
27

FULL JOURNEY TIME
73 minutes

The 56km-long Tuen Ma line is the longest line of Hong Kong's mass transit railway network, connecting the former West Rail Line and Ma On Shan Line with six new stations.

WSP was heavily involved in the West Rail Line, which was completed in December 2003 and at that time Hong Kong's largest civil construction project. The West Rail Line, now part of the Tuen Ma Line, consisted of nine stations and Asia's largest maintenance facility—Pat Heung Maintenance Centre.

The West Rail Line, a strategically placed 30.5km-long domestic passenger railway, continues to provide a much-needed link for areas of increasing population in the Northwest New Territories and urban Kowloon.

As lead consultant and project manager for the Pat Heung Maintenance Centre, Kam Sheung Road Station, and the headquarters building, we carried out full engineering detailed design and construction supervision covering civil, structural, electrical and mechanical engineering works, railway engineering interface and alignment, as well as maintenance planning, traffic, environmental, town planning and cost control consultancy. We were also appointed as the lead mechanical and electrical consultant for the Tuen Mun Station and Siu Hong Station; in this capacity, we supervised the design and construction of these systems.

Moreover, we were the lead consultant for the system-wide tunnel ventilation system design for the West Rail Line, from detailed design and subway environment simulation modelling to SCADA system for power, environment and other sub-system status. We also provided additional services including vehicle inspection services, design for the viaduct between the Tin Shui Wai Station and Siu Hong Station and reprovision of two affected light rail stops.

As part of the Tuen Ma Line project, WSP was the building services detailed design consultant for the modification of the existing Ma On Shan Line stations from original 4-car train operations to 8-car train operations, as well as the new Hin Keng Station. Modifications works included lengthening the existing platform and retrofitting the automatic platform gate onto the extended platform.

Our latest involvement in the Tuen Ma Line is the full multidisciplinary engineering design of Hung Shui Kiu Station. Located between Tin Shui Wai Station and Siu Hong Station, it will be Hong Kong's first station to be built on live tracks of existing railway viaducts.

Credit: Pat Heung Maintenance Centre

Hyderabad *Metro*

Location
HYDERABAD, INDIA

Client
HYDERABAD METRO RAIL LIMITED

Status
COMPLETED IN 2020

LENGTH
69.2 km

STATIONS
56
elevated stations including
3 interchange stations

LINES
3

The Hyderabad Metro Rail project is the world's largest public-private partnership project (PPP) in the metro sector. The metro network covers a total distance of around 69.2 km across three corridors, transporting Hyderabad into the future. In the Urban Mobility India Conference 2018, Hyderabad Metro Project was selected as the "Best Urban Mass Transit Project."

With the growing population and number of vehicles on the road, the city's transportation system has come under immense pressure to develop a metro rail project. The new metro rail shortened the travel time by 50 to 70 percent and is expected to reduce carbon emissions by up to 3,100 tonnes a year. The metro project is designed with a capacity of 60,000 passengers per hour during peak times. The frequency of the service is around one train every five minutes.

The Hyderabad Metro project is a completely elevated system. The viaduct structure for the elevated system is a box girder carrying two tracks on a single pier located on the median of the road.

The track gauge is a standard gauge (1435 mm), and the electrical traction is a 25 kV AC, 50 Hz overhead traction system. The signalling system caters to the needs of a designed speed of 80 km/h with state-of-the-art features consisting of automatic train control (ATC) and automatic train protection (ATP), which can be upgraded to automatic train operation (ATO). The project brings together best-in-class technology, including automatic fare collection, power supply, traction, supervisory control and a data acquisition system, signaling and train control system, telecommunications and systems for mechanical, electrical and plumbing.

L&T Metro Rail Hyderabad Ltd (LTMRHL), a special purpose vehicle (SPV), was set up to implement the project on a design-build-finance-operate-and-transfer (DBFOT) basis. WSP was appointed to provide independent engineering services, which included review of designs and technical documents, inspection and monitoring of construction works, review and inspection of systems works, testing and commissioning activities, and inspection and monitoring of operations and maintenance activities.


CENTRO
CENTRO

East London
Line Extension

Location
LONDON, UNITED KINGDOM

Client
TRANSPORT FOR LONDON

Status
COMPLETED IN 2010

LENGTH
14 km

CONNECTED BOROUGHS
20

PROGRAM MANAGEMENT TEAM
80+

When it officially opened in 2010, the extended East London line introduced a new rail route for London and with it a new range of travel possibilities for millions of passengers, offering fast and frequent train services between the capital's eastern and southern suburbs.

At CAD +2.44 billion (+£1.5 billion), the East London Line Extension (ELLX) was the largest transit transport project the capital city had seen in over a decade. It involved the reconstruction and extension of existing and redundant lines—including the historic 1843 Thames Tunnel river crossing—and the introduction of new track, structures, power systems, signalling and step-free stations along a 14-km route. Its connection with the UK national rail network meant it was the first Transport for London (TfL) project that had to meet with UK mainline railway standards.

Subject to intense public scrutiny, it was critical that the extension was delivered on time for the London 2012 Olympics and ready for a massive influx of visitors. To accomplish this, the project was split into three phases, the first creating the London Overground service between Dalston Junction and New Cross, Crystal Palace and West Croydon, with the two further extensions to Highbury and Islington and then to Surrey Quays to complete the orbital railway.

Appointed by TfL in 2005, WSP supplied the program management services for phase one, our experts co-locating and integrating seamlessly with the client team to achieve every key milestone and deliver this transformative project. Our remit included redeveloping and extending the existing East London Line system, providing four new stations, managing interfaces and agreements with Network Rail and London Underground for their related works, and introducing new rolling stock. By applying a progressive systems integration approach to every stage of the design-and-build process, we delivered the project early and on budget with high levels of performance from day one.

Together with the North London Line upgrade, for which WSP provided project development and implementation oversight management for phase one of this two-phase project, the ELLX enabled TfL to achieve an orbital railway that has helped to regenerate some of London's most deprived areas.

Elizabeth *Line*

Location
LONDON, UNITED KINGDOM

Client
CROSSRAIL LTD

Status
COMPLETED IN 2022

LENGTH
96.5 km

STATIONS
41

ANNUAL CAPACITY
200 million passengers

WSP supported Crossrail Ltd's delivery of the landmark Elizabeth line, which opened to the public on 24 May, 2022.

At the height of construction, Crossrail was Europe's largest infrastructure project. Once fully open the Elizabeth line will stretch over 96.5 km and serve 41 stations, including ten new stations.

London's newest railway has capacity for over 200 million passengers annually.

Multidisciplinary engineering and design teams from WSP helped deliver key stations including Paddington, Tottenham Court Road and Farringdon, and the firm was also the leading engineering consultant on Bond Street station, providing a full multidisciplinary design service as well as structural engineering services for one of the over-site developments.

At Paddington station, where the heritage of the existing Grade I station has been reflected and preserved, WSP's 60-strong team comprised of MEP (mechanical, electrical, and public health) engineers, facade engineers, engineering safety management specialists, fire engineers and RAMS engineers.

In 2010, WSP was appointed to undertake design and consultancy services for the south-east section of the Crossrail project from Plumstead portal to Abbey Wood.

WSP's team led the multidisciplinary engineering design, project engineering management, environmental consultancy, and systems integration across the entire project, including civil and geotechnical engineering, highways and bridges, drainage, and signalling and electrification.

In 2019, WSP was appointed to establish and lead a systems integration capability to provide a holistic and targeted approach to bring together and integrate critical activities. Through WSP's role of System Integrator, it seconded a team into Crossrail to help manage the overall integration and migration of the railway into service, applying its SI:D³ system integration methodology.

"WSP have been valued partners throughout the Crossrail programme, particularly in my time as CEO. I have found them to be very collaborative and always acting from a whole-system approach, an essential mindset when delivering something as big and complex as Cross rail.

I was always very impressed by WSP leadership in difficult and challenging areas such as in the trains and signalling interface. As with all good leadership in this arena they had the innate and valuable ability to simplify the complex".

- **Mark Wild**, CEO of Crossrail Ltd, June 2022

Thameslink *Programme*

Location
LONDON, UNITED KINGDOM

Client
NETWORK RAIL

Status
COMPLETED IN 2019

NEW STATIONS
70

NEW TRAINS
115

NEW MOBILITY
Delivering a world-first digital railway

The Government-sponsored CAD 12 billion (£7 billion) Thameslink Programme is an ambitious 10-year program of extensive infrastructure enhancements. It will deliver 115 new trains that will bring faster, more frequent, more reliable, better connected journeys for passengers—transforming north-south travel through London.

Thameslink operates on one of the busiest and most congested parts of the rail network. The program is delivering new infrastructure, better stations, new technology and new trains on an expanded Thameslink network, which will provide significant improvements that respond to the growth in passenger demand now and into the future.

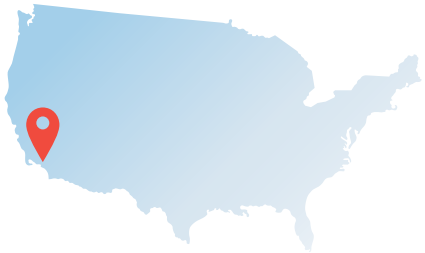
As well as helping to clarify the "big picture" solution with early construction planning and systems integration services, and detailed railway systems and station design, WSP provided a myriad of supporting services. This included work on the "Digital Railway", resulting in the world-first application of Automatic Train Operation technology on a mainline railway.

Key Output 2 (KO2) was the largest and most complex part of the ambitious Thameslink Programme. WSP provided industry-level and project-level systems integration and early construction planning to help the client define requirements and develop a feasible solution. To support delivery of KO2, which ran from 2013-2018, WSP contributed to track, signalling and station remodelling works at London Bridge station, overhead line equipment, a grade-separated junction at Bermondsey, and stabling reconfiguration and design of six depots.

As the fourth-busiest station in the UK, with approximately 55 million passengers passing through each year, the station's redevelopment was critical to the success of the Thameslink Programme. To accommodate the desired train throughput, and enhance the commuting experience for an additional 42 million passengers per year, the station underwent a significant transformation, realigning 15 tracks and platforms and introducing a 92,000-square-foot retail concourse — the UK's largest station concourse, the size of Wembley Stadium football pitch.

Its complex construction strategy, which involved a phased demolition and reconstruction with over 70 sub-stages, ensured the station remained operational throughout the five-year construction period to minimize disruption for passengers.

Los Angeles *Metro Rail*



Location
LOS ANGELES, CALIFORNIA, UNITED STATES

Client
LOS ANGELES COUNTY METROPOLITAN TRANSPORTATION AUTHORITY (METRO)

Status
1983-ONGOING

LENGTH
127 km

LINES
4

TUNNELS
58 km

WSP, as a member of various joint ventures, has provided a range of services to the Los Angeles Metro Rail subway system including planning, design and program management. The firm has served Los Angeles Metro since its creation in 1993 and prior to that worked for Metro's predecessor agencies. WSP led the development of tunnels and one of the country's highest ridership systems with nearly 100 stations, including:

The Blue Line is a 35-km line from Los Angeles to Long Beach. WSP also provided preliminary engineering and environmental studies, and construction, which included at-grade and elevated sections and a .8-km underground segment, began in 1985. WSP provided construction management and general engineering services.

WSP provided program management and tunnel design for all segments of the Red Line. Construction on the 28-km line began in 1986 and was completed in 2000. The first 7-km extension was opened in 1993. A 3.4-km extension opened in July 1996. A 7.4-km segment was completed in 1999. The final 10.1-km segment was completed in 2000.

Opened in 1995, the 26-km Green Line extends from Norwalk in the east to Redondo Beach in the west, with a connection to the Blue Line at the Imperial/Wilmington/Rosa Parks station.

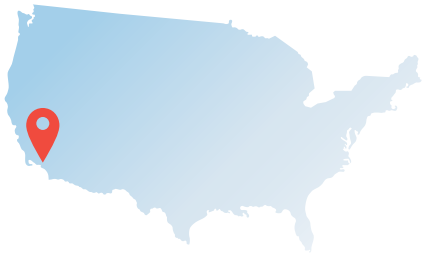
The Gold Line, which opened in 2003, extended 22 km and included at-grade, elevated and underground sections. In 2009, Metro completed a 10-km extension of the Gold Line. For the Eastside Extension, WSP provided environmental clearance, preliminary design of the at-grade system, final design and construction services for a 2.7-km tunnel segment.

Since 2007, WSP has worked on the Purple Line Extension, providing program and engineering management services as the general engineering and planning consultant. The extension is nine tunnel miles, with seven underground stations and three park-n-ride areas.

The Los Angeles Regional Connector is a 3-km underground rail tunnel that will link three light rail transit lines and the city's heavy rail subway when it is completed in 2021. WSP prepared the conceptual engineering plans and is currently providing design support services during construction.

Expo Line Phase 2 (Expo 2) - the 10.6-km extension of the Expo line opened - connects the Westside to Santa Monica. The Expo Line Extension to Santa Monica opened in 2016. WSP served as lead designer for the design-build team.

LA Metro
Westside Purple Line Extension



Location
LOS ANGELES, CALIFORNIA, UNITED STATES

Client
LOS ANGELES METRO

Status
ONGOING

LENGTH
14.5 km

STATIONS
7

DOWNTOWN LA TO WESTWOOD
25 min

The Westside Subway Extension is a 14.5 -km (9 miles) heavy rail line that will operate as an extension of the Los Angeles County Metropolitan Transportation Authority (LA Metro) Purple Line from its current terminus at Wilshire/Western Station to a new western terminus in West Los Angeles near the Veteran's Administration West Los Angeles Medical Center in Westwood. This extension construction, which will be completed in three sections, includes seven underground stations.

WSP performed conceptual engineering and achieved consensus on alignment, mode and minimum operating segments; developed environmental clearance and delivery strategies; and provided technical solutions for constructing nine miles of tunnels and seven underground stations in an urban area.

We worked closely with Los Angeles Metro to deliver station design, urban design, transit-oriented development (TOD), and engineering solutions, and to develop the long-term financial plan for the proposed CAD 12.2 billion (USD 9.2 billion) extension of the project. WSP has provided program and engineering management services as the general engineering and planning consultant. We supported LA Metro in developing technical provisions, and delivery strategies and contract packages that include a mix of design-build and design-bid-build delivery.

Our modelling staff helped LA Metro enhance the forecasting model to include crowding, capacity, and bus-bunching features. WSP helped to shape the project's design and defined a multiyear path for LA Metro and the cities of Los Angeles and Beverly Hills to capture the land use benefits. Scenario testing helped to frame TOD planning. WSP prepared a station urban design report, recommendations on station locations and portal placement, assessed local plans and policies for transit-friendliness, and developed a TOD program for the corridor.

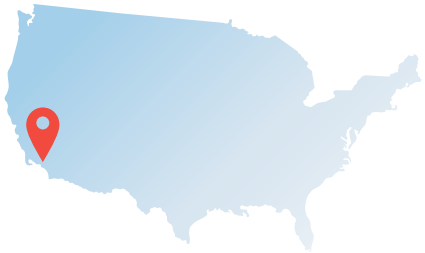
WSP solved complex planning and design challenges, such as constructing stations and tunnels below one of Los Angeles's busiest streets, Wilshire Boulevard, and working with physical and environmental constraints, including a seismically active area, naturally occurring methane hydrogen sulfide gases, tar seeps and possible abandoned oil wells and tunneling in gassy conditions.

WSP provided conceptual, preliminary engineering and advanced preliminary engineering services and produced request for proposal documents which were issued to prospective bidders for tunnels, stations and systems for the three sections, including value engineering, travel forecasting, cost estimating, constructability reviews and risk assessments.

WSP continues to support Metro providing engineering services during construction for all three sections of the Westside Purple Line project.


Westwood / UCLA

Regional Connector *Transit Corridor*



Location
LOS ANGELES, CALIFORNIA, UNITED STATES

Client
LOS ANGELES COUNTY METROPOLITAN TRANSPORTATION AUTHORITY (METRO)

Status
ONGOING

DEPTH
30.5 m

REGIONAL CONNECTOR LENGTH
3.05 km

TWIN-BORE TUNNEL LENGTH
1.65 km

The Los Angeles County Metropolitan Transportation Authority's Regional Connector Transit Corridor project is a 3.05km, fully underground light rail link that will allow passengers to travel in regional destinations through downtown Los Angeles.

The USD 1.9 billion (CAD 2.5 billion) project will extend from the Little Tokyo/Arts District Station to the existing 7th Street/Metro Center Station in downtown Los Angeles, allowing passengers one-seat rides among the A (Blue), E (Expo) and L (Gold) LRT lines and connections to the B (Red) and D (Purple) heavy rail lines. When completed, passengers will be able to travel from Azusa to Long Beach, or from East Los Angeles to Santa Monica, without transferring trains. WSP has worked on the Regional Connector project since 2008, providing planning, environmental and engineering services through conceptual engineering, preliminary engineering, and the bid process, as well as on-site design services during construction. In earlier stages of the project, WSP led the preparation of the New Starts application to the Federal Transit Administration (FTA) to enter preliminary engineering, and the preparation of the bid-documents for the design-build contract. WSP currently provides technical support during systems integration, testing, and pre-revenue service as the project works toward the start of revenue operations, scheduled in early 2023.

The project includes the construction of twin bore tunnels, cut-and-cover tunnels, three new underground stations—Little Tokyo/Arts District Station at 1st Street and Central Avenue, Historic Broadway Station at 2nd Street and Broadway, and Grand Avenue Arts/Bunker Hill Station at 2nd and Hope streets. The project also includes LA Metro's first cavern excavated in soft rock by the sequential excavation method. Its 17-metre-wide 10-metre-high, horseshoe-shaped, nearly 31-metre-long rail crossover cavern was completed in 2021.

It will also be the first time for Los Angeles transit that high-speed elevators are used for passenger access instead of escalators. Located approximately 30.5 metres below the surface, the Grand Avenue Arts/Bunker Hill Station will have six high-speed elevators with the hoisting equipment below the ground surface to avoid the visual impact at the station entrance pavilion.

Awards

- *2020 Project of the Year from Underground Construction Association.*
- *2020 Tunnel Achievement Award from Tunnel Business magazine.*
- *2019 ITA (International Tunneling and Underground Space Association) Project of the Year (between €50M and €500M)*

Location
MAHARASHTRA, INDIA

Client
MUMBAI METRO RAIL CORPORATION LIMITED (MMRCL)

Status
ONGOING

LENGTH

33.5 km
(Completely Underground)

STATIONS

27

TECHNOLOGY USED

- TBM
  for tunnelling and NATM for stations
- Grade of Automation –
  automatic train operations (GoA4)

Mumbai Metro
Line 3

Mumbai Metro Line 3 (MML-3), or the Aqua Line, is a key project to improve the transportation scenario in Mumbai, financial capital of India. The project is a 33.5- km-long corridor and is completely underground, which will greatly assist to decongest the traffic situation in Greater Mumbai. Mumbai Metro Rail Corporation Limited (MMRCL) is the nodal agency responsible for the implementation of this project.

The Aqua Line is expected to bring multiple benefits, such as comfortable travel, reduction in travel time, reduction in air and noise pollution, improving safety and security of the citizens. Upon completion, this fully underground corridor with 27 stations will connect business districts, educational institutes, recreational facilities and domestic as well as international airport terminals. It will have five interchange points for the suburban railway and one each for Monorail and Versova-Andheri-Ghatkopar Metro 1.

MML-3 has been envisioned to be the modern transport of the 21st century. State-of-the-art technologies would be used during the construction of the project to ensure protection to existing building structures. The project involves a very challenging task of constructing tunnels and underground stations, which was accomplished by deploying technologies such as tunnel boring machines for tunnels and a combination of cut and cover and NATM (New Austrian Tunnel Method) for station construction.

WSP and three other firms in a consortium are engaged by Mumbai Metro Rail Corporation Limited (MMRCL) to provide general consultancy services for Mumbai Metro Line 3. The general consultancy services include planning and program management, contract administration and management, preliminary design/tender design for civil and systems, procurement management, review of contractor's detailed design, supervision of works to ensure safety, quality and environmental aspects, systems integration, interface management, and testing and commissioning of the entire system

The alignment starts at Colaba (southern end of Mumbai City), passing through major parts of Mumbai City, serving areas in South Mumbai as well as the western suburbs, including prominent locations such as Bandra Kurla Complex (commercial hub in western Mumbai) and both airports (domestic and international) before ending at SEEPZ special economic zone in Andheri.

With an estimated daily ridership of 1.6 million /day, Mumbai Metro Line 3 will be the first underground metro line in Mumbai to provide commuters with connectivity to the airport and Mumbai Central railway station. It will also provide a much-needed connectivity between the business hubs of MIDC (Maharashtra Industrial Development Corporation) which are not currently connected by Mumbai's local trains.

Mumbai Metro
Line 4

Location
MAHARASHTRA, INDIA

Client
MUMBAI METROPOLITAN REGION DEVELOPMENT AUTHORITY (MMRDA)

Status
ONGOING

The Mumbai Metro Line 4 will be over 32km long, an entirely elevated corridor with 1 depot and 32 stations, connecting Wadala in central Mumbai to Kasarvadavali. Expected to reduce travel time between Wadala to Kasarvadavali by 50 to 75 percent, the Mumbai Metro Line 4 aims to provide interconnectivity between the eastern expressway, central railway, Mumbai Monorail that is partially in operation, proposed Metro Line 2B (D N Nagar and Mandale), proposed Metro Line 5 (Thane to Kalyan), proposed Metro Line 6 (Swami Samarth Nagar to Vikhroli) and proposed Metro Line 8 (Wadala to General Post Office). This metro line will help alleviate traffic congestion and provide better connectivity between Central Mumbai and Thane district. The project will provide rail-based access to various commercial, government and geographical landmarks in Mumbai.

WSP along with two other firms in a consortium are engaged by Mumbai Metropolitan Region Development Authority (MMRDA) to provide general consultancy services for implementation of the project. The general consultancy services include planning and program management, contract administration and management, preliminary design/tender design for civil and systems, procurement management, review of contractor's detailed design, supervision of works to ensure safety, quality and environmental aspects, systems integration, interface management, and testing and commissioning of the entire system.

With an estimated daily ridership of 44,880 per hour per direction, MMRDA plans to use the latest technologies for its automatic fare collection (AFC) system to allow QR codes and phones enabled with near-field communication (NFC) to utilize the system.

Navi Mumbai
Metro Line 1

Location
MAHARASHTRA, INDIA

Client
CITY AND INDUSTRIAL DEVELOPMENT CORPORATION (CIDCO)

Status
ONGOING

Navi Mumbai, built as a satellite city for Mumbai, has developed by leaps and bounds over the past decade. An integrated metro rail corridor is being implemented in Navi Mumbai to ease the pressure on the modes of transport and to establish connectivity between all the residential nodes. The metro rail is expected to not only improve the city's transit system but also boost economic growth.

In line with the Navi Mumbai Metro master plan, the City and Industrial Development Corporation (CIDCO) are currently implementing the Line 1 project. The fully elevated corridor is 11.1km long with 10 stations and has an estimated passenger capacity of 21,394 passengers per hour during peak times.

WSP is providing general consultancy services for implementation of the Navi Mumbai Line 1 project. The scope of the consultancy services comprises planning, preliminary design/tender design for civil and systems, procurement management, review of contractor's detailed design, supervision of works to ensure safety, quality and environmental aspects, and testing and commissioning the entire system.

Metro *Tunnel*

Location
MELBOURNE, AUSTRALIA

Client
RAIL PROJECTS VICTORIA

Status
ONGOING

TWIN TUNNELS
9 km

STATIONS
5

INCREASED CAPACITY
504,000

The 10.23 CAD (AUD 11 billion) Metro Tunnel is Melbourne's biggest rail project since the City Loop was built in the 1970s. It includes 9 km of rail tunnels and 5 underground stations at North Melbourne, Parkville and Anzac, with 2 new central business district (CBD) stations—State Library and Town Hall—which will directly connect to the City Loop.

At Parkville, Metro Tunnel will provide access to the University of Melbourne and health facilities, such as the Royal Melbourne Hospital, the Royal Women's Hospital and the Victorian Comprehensive Cancer Centre.

The new Anzac Station in Domain will significantly improve access to the St. Kilda Road precinct and key Melbourne landmarks, such as the Shrine of Remembrance, the Royal Botanic Gardens and Albert Park.

WSP, together with Arup and Arcadis, is in a design joint venture working with CYP Design & Construction (John Holland, Lend Lease and Bouygues Construction) to deliver the Tunnels and Stations package of works as a public-private partnership.

WSP is involved in the tunnel, civil, structure, surface transport, and rail infrastructure design, together with the mechanical, electrical and hydraulic design. We are also delivering specialist services including tunnel ventilation, fire and life safety, security and blast assessment, pedestrian modelling, noise and vibration, and environmental and sustainability services.

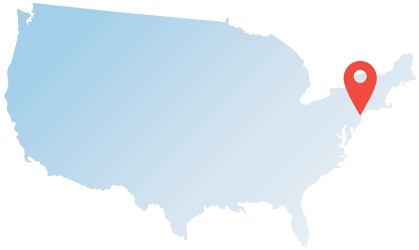
Metro Tunnel's two new CBD stations will be built as "trinocular" caverns whereby three overlapping tunnels are mined by road headers, creating a wide-open space that allows the concourse and platforms to be integrated on a single level.

The result will be a spacious station with vaulted ceilings. At 19 m, the underground metro platforms will be among the widest in the world.

The project will create:

- more room on the network, enabling over 500,000 additional passengers per week to use Melbourne's train network during peak periods, plus time savings of up to 50 minutes per day when travelling to Parkville and/or St Kilda Road.
- new stations (Parkville and Anzac) in areas not currently served by trains, improving access to a combined catchment of more than 200,000 jobs, enrolled students and residents.
- new, modern-technology trains to run every two to three minutes, beginning the transformation into a "turn up and go" rail system for Melbourne.

New York *Subway*



Location
NEW YORK CITY, NEW YORK, UNITED STATES

Client
BOARD OF RAPID TRANSIT RAILROAD COMMISSIONERS

Status
COMPLETED IN 1904

SPEED
Up to 64 km/h

PASSENGERS ON 1ST DAY
150,000

WORKFORCE
7,700 to 12,000

At the turn of the 20th century, New York City was finally ready to begin construction of an underground transit system to rival those in cities such as London, Glasgow, Budapest and Boston. In 1900, the winning bidder, John B. McDonald, agreed to build a 34-km (21-mi.) system of rapid transit, including terminals and stations, and to complete the work in four and a half years.

The subway would begin at City Hall and continue north to 42nd Street, where it would turn west to Times Square and follow Broadway up to the Bronx. Above 96th Street, a second line would extend east under Central Park, ending at what is now the site of the Bronx Zoo. Although it was commonly called the subway and included 24 km (15 mi.) of tunnel, the project also included nearly 6 miles of viaduct.

August Belmont, Jr., who represented the interests of the Rothschild banking family in the United States, agreed to arrange the financing. Belmont established the Interborough Rapid Transit Construction Company, with himself as president and McDonald as contractor, to carry out the work.

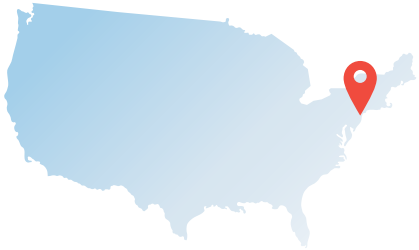
Although Belmont's company would be responsible for building the subway, supplying the equipment and operating the system for a period of 50 years, William Barclay Parsons, one of the original founders of Parsons Brinckerhoff, now known as WSP, was the mastermind of the endeavor. As chief engineer of the Board of Rapid Transit Railroad Commissioners, Parsons was responsible for overseeing the work of his own engineering staff of 300, as well as McDonald's company, a dozen subcontractors and a workforce variously estimated at 7,700 to 12,000.

In 1902, the Board of Rapid Transit Railroad Commissioners awarded a second contract, known as Contract No. 2, to Belmont's company, for a 5-km (3.1-mi.) extension of the subway from City Hall in Manhattan, under the East River, to Atlantic Avenue in Brooklyn.

Following the inaugural run on October 28, 1904, the subway was opened to the public. Nearly 150,000 people rode the subway that first day.

Additional segments of the subway soon opened, with 26 km (16 mi.) completed by the end of 1904. The 39-km (24-mi.) subway was completed in 1908 with the opening of the line to the Atlantic Avenue Terminal in Brooklyn.

New York
City Subway No. 7 Line Extension



Location
NEW YORK CITY, NEW YORK, UNITED STATES

Client
MTA NEW YORK CITY TRANSIT AND MTA CAPITAL CONSTRUCTION

Status
COMPLETED IN 2015

LENGTH OF EXTENSION
2.4 km

STATION DEPTH
38 m

TUNNEL BORING MACHINES
2

The Hudson Yards overbuild development (11.3-ha; 28 ac.) and No. 7 Line Subway Extension represents the kind of integrated, comprehensive approach to infrastructure development that WSP can bring to cities. In 2005, the City of New York launched its planned transformation of the Far West Side of Manhattan, an area known as Hudson Yards. The No. 7 Line would support a new vision for high-density office, commercial, and residential development—also known as transit-oriented development.

WSP led the multidisciplinary team of planners, engineers, architects and environmental specialists that prepared a final environmental impact statement for the proposed No. 7 Subway Extension, the expansion and modernization of the Jacob K. Javits Convention Center, the development of a new multi-sports, entertainment, and exhibition facility (the New York Sports and Convention Center), and the rezoning of the Hudson Yards area.

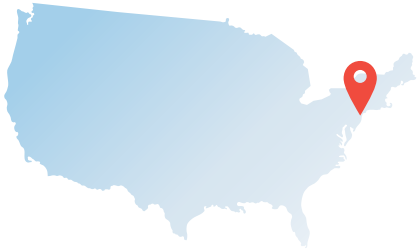
The project involved the completion of the conceptual, preliminary and final design services for the extension of the No. 7 Line from its terminus in Times Square to a new station at 11th Avenue and West 34th Street, an extension totalling 2.4 km.

Final design services included all passenger facilities, right-of-way and systems work, as well as the station entrance and public spaces at Hudson Yards. Our firm also assisted the MTA in developing an overall construction program and contract packaging plan, provided construction support services, and served as systems integrator for all mechanical, electrical and plumbing systems.

The final configuration comprises approximately 2.4 km of running twin tunnel-boring-machine tunnels; one underground terminal station constructed in rock; four ancillary/system buildings housing mechanical, electrical and communications systems; and two station entrances serving the new terminal station. WSP's responsibilities included preparation of final design documents including communications, utilities, structural, geotechnical, drainage, groundwater control, architectural, mechanical, electrical, and environmental engineering designs.


Exit
Track 1
7
Track 2

Second Avenue *Subway Phase 1*



Location
NEW YORK CITY, NEW YORK, UNITED STATES

Client
METROPOLITAN TRANSPORTATION AUTHORITY (MTA) NEW YORK CITY TRANSIT

Status
COMPLETED IN 2021

LENGTH OF TUNNELS
2.4 km

NEW STATIONS
3

WEEKDAY PASSENGERS
200,000

The Second Avenue Subway (SAS) is the first major expansion of New York City's subway system in more than 50 years. It is set to reduce overcrowding and delays on the Lexington Avenue line and improve access to mass transit for those living on Manhattan's Upper East Side and Harlem. When fully completed, the line will stretch 13.7 km along the East Side, from 125th Street in Harlem to Hanover Square in Lower Manhattan.

The SAS project is being planned in four phases. WSP served as a prime consultant during phase 1 construction totalling USD 4.4 billion (CAD 5.9 billion). The project elements included construction of 2.4 km of two-track tunnels along the length of Manhattan's East Side (beneath Second Avenue), three new subway stations along Second Avenue (96th Street, 86th Street and 72nd Street), rehabilitation of the existing station at Lexington Avenue and 63rd Street, and installation of transit systems through the entire 3km length.

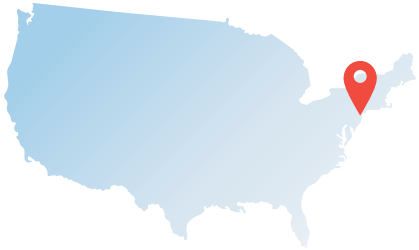
One of the most significant challenges involved an area of poor soil that was not suitable for excavation by tunnel boring machine (TBM), which is designed for hard-rock conditions. WSP met this construction challenge by using different techniques for the projects: TBM (used for the majority of the two-track line), cut-and-cover (used at the 96th Street station locations), and drill-and-blast (used on two station caverns at 86th and 72nd streets and portions that were too short to make tunnel boring cost-effective).

WSP served as the consultant construction management firm responsible for the overall management of multiple interfacing construction contracts. In addition, we managed all the environmental components associated with the construction effort, such as soil management, dewatering, noise mitigation, historic and archeological resource protection, asbestos abatement, waste disposal, storm water management, dust control and air monitoring.

During construction, at least four lanes of Second Avenue remained open to traffic, and efforts were made to maintain access to businesses and residences. Structural and ground improvement techniques were used to minimize ground settlement and to preserve the structural integrity of various facilities, including utility lines, buildings, tunnels and ramps.


TH
E
SE
CO
ND
SU
BW
EXCELSIOR
Uptown to
96 Street
Downtown &
Brooklyn
Uptown

Second Avenue *Subway Phase 2*



Location
NEW YORK CITY, NEW YORK, UNITED STATES

Client
METROPOLITAN TRANSPORTATION AUTHORITY (MTA) CONSTRUCTION AND DEVELOPMENT

Status
ONGONGING

LENGTH OF TUNNELS
3 km

NEW STATIONS
3

WEEKDAY PASSENGERS
100,000

The Second Avenue Subway (SAS) is the first major expansion of New York City's subway system in more than 50 years. It has already improved access to mass transit for those living on Manhattan's Upper East Side and has led to the reduction of overcrowding and delays on the Lexington Avenue line. When fully completed, the line will stretch 14 km along the East Side, from 125th Street in Harlem to Hanover Square in Lower Manhattan and provide service to areas that lack adequate transit service.

The SAS project is being constructed in four phases. Phase 1 opened in 2017 and involved construction from 63rd Street to 96th Street. WSP USA served as the consultant construction manager for the completion of the USD 4.4B (CAD 5.9B) Phase 1 Construction.

As part of Phase 2, WSP USA is in a joint venture that is currently serving as the general engineering consultant to the MTA. As part of this role, WSP USA has developed the extended preliminary engineering documents for the extension of the present Second Avenue Subway Service (the Q Line) from its current terminus at 96th Street to a new terminal at 125th Street and Lexington Avenue. The extension will also include new stations along Second Avenue at 106th Street and 116th Street.

Phase 2 will involve cut-and-cover construction, rehabilitation of tunnels that were constructed in the 1970s, newly constructed tunnels by tunnel boring machine, and caverns mined in rock.

The project consists of transit connections between the Lexington Avenue Subway (4/5/6 Lines) and the Metro-North Railroad, both along 125th Street. It will also be constructed in multiple design-build contracts and include an early utility relocation and building remediation contract, which will be design-bid-build.


EXISTING SECTION 13
REHABILITATION
ANCILLARY 1
ENTRANCE 1
ENTRANCE 2
116TH STREET STATION
SECTION 13 MODIFICATION
BELLMOUTH
ANCILLARY 2
RUNNING TUNNEL
(TBM)
125TH STREET STATION
(MINED CAVERN)
ENTRANCE &
ANCILLARY 1
TAIL TRACKS
(TBM)
ANCILLARY 2
ENTRANCE 1
EXISTING IRT
LEXINGT
3RD AVE
2ND AVE
120TH ST
125TH ST

Tyne and Wear *Metro*

Location
NEWCASTLE-UPON-TYNE, UNITED KINGDOM

Client
NEXUS

Status
ONGOING

STATIONS
60

STATE-OF-THE-ART TRAINS
42

ANNUAL RIDERSHIP
40 million

The UK's first modern light rail system, the Tyne and Wear Metro, has been a vital part of the North of England's infrastructure since it came into operation in 1980, connecting Newcastle, Gateshead and Sunderland.

For nearly two decades, WSP has been helping Nexus, the Tyne and Wear Passenger Transport Executive, to introduce an extensive program of renewals that will reinvigorate the aging metro service with new rolling stock that will enhance the comfort and journey experience of over 40 million passengers a year.

In 2006, WSP developed a robust strategy for infrastructure investment following the securing of £350 million (CAD 596 million in government funding by Nexus. Our team provided independent reviews that would shape the 11-year capital investment program, informing the renewal strategy for assets, including metro car rolling stock, communication systems, signalling systems, and station and depot structures. Along with trackside and site surveys, we assessed the condition of assets against Network Rail standards and helped establish a detailed asset maintenance and renewal timeframe.

In 2014, we delivered a feasibility study to help Nexus establish the case for a street-running extension of the light rail metro in Gateshead. Following the successful delivery of this study, we secured a framework appointment to develop proposals for schemes starting in 2015-16 that form part of the funding proposals submitted to central government by the North East Local Enterprise Partnership.

Following approval of these proposals, in 2016 we were appointed by Nexus to provide design and engineering services as part of a four-year technical and commercial consultancy services framework.

Following this success, in January 2022, WSP was appointed to deliver engineering and commercial consultancy services under a new five-year framework. Through this framework we will continue to deliver the modernization program, providing bridge assessment, bridge design, track detection and signalling system upgrades that will bring Metro into the modern era with the first batch of state-of-the-art trains expected in 2023.


South Ruiton
109
M
4017

Fornebu Line

Location
OSLO AND FORNEBU, NORWAY

Client
SPORVEIEN OSLO AS

Status
ONGOING

The Fornebu Line, an extension of Oslo Metro, will connect Oslo, the capital city of Norway, to Fornebu peninsula in Bærum. It is Oslo's largest metro project in over 20 years.

The Fornebu Line will extend the existing Oslo Metro by adding an 8.5-km-long underground tunnel and new stations in Oslo and Bærum. The line will stretch for 5.6 km in Oslo, while the remaining 3.1-km section will be built in Bærum.

The Fornebu Line will have six underground stations, namely Fornebu Centre Flytårnet, Fornebuporten (former Arena), Lysaker, Vækerø, and Skøyen. Each station will have a length of 120 m. The design concept of the Fornebu Centre Station was inspired by Norway's mountainous landscapes and canyons.

Fornebuporten Station entrances will feature two different civic spaces at street level. The station will have an oval canopy toward the north side and a layered orthogonal pavilion and public piazza toward the south side. Atmospheric lighting within the station will adjust to the changing Oslo sky.

Vækerø Station will have a long continuous connection between two elevated entrances, connected together with a gold-finished sculptural sky made of golden metal. The station will also have underground bicycle parking areas, which will be accessible by cycle ramps.

The Østensjø Line

Location
OSLO, NORWAY

Client
SPORVEIEN OSLO AS IS A MUNICIPALLY OWNED PUBLIC TRANSPORT OPERATOR IN OSLO, NORWAY

Status
ONGOING

The Østensjø Line part of the Oslo Metro, runs 9 km from Brynseng to Mortensrud through the primary residential areas of Bøler, Østensjø and Søndre Nordstrand. It shares track with the Lambertseter Line along the 2.5-km section from Tøyen to Brynseng.

The project spans approximately 8 km, from just beyond Hellerud Station, where the Østensjø Line and Furuset Line diverge, up to and including Mortensrud Station. The project included the following: upgrade of 7 metro stations to the required standard, renovation of 7 station buildings/ technical buildings, construction of 1 new technical building, construction of 1 new personnel building, complete renovation of 2 tunnels, construction of new walkways in 3 tunnels with a combined length of 1.8 km, renovation of a rectifier substation, upgrade/repair of 12 bridges, construction of a new pedestrian bridge, construction of a 280 m long pile-supported concrete slab under the metro corridor, renovation of the current signalling and interlocking systems, new substructure for 5.2 km of double-track metro line and new superstructure for 5.7 km of double-track metro line.

The upgrade of the Østensjø Line has followed an extremely tight schedule, both in terms of the design and execution of the construction work. In addition, major work had to be completed on a site that was long and narrow with limited access and restricted space for equipment and storage.

Panama
Metro Line 2

Location
PANAMA

Client
METRO DE PANAMA, S.A.

Status
COMPLETED IN 2019

LENGTH
21 km

CAPACITY PER DIRECTION
Max 40,000/hr

STATIONS
16

The very restricted growth capacity of the existing road system in Panama City, due to the narrow and elongated configuration of the metropolitan area, determined the development of solutions with mass transport systems, including Line 2 to serve the east area of the capital. Before commencing the operation of Line 2, the average travel time in public transport from outlying areas to the center of the city during peak hours went from as little as 90 minutes to in excess of two hours.

It is expected that by the year 2035 the population of Panama East will surpass 750,000 inhabitants, with the number of daily trips to downtown Panama City surpassing 400,000. Therefore, serving Panama East with metro Line 2 emerged as the best option to reduce the travel times significantly, thus ensuring a better quality of life for the resident population in the area.

In 2014, WSP, in joint venture with Ayesa and Transports Metropolitans de Barcelona, was commissioned by Metro de Panama S.A. to provide project management services and technical assistance for the Panama Metro Line 2 project.

Overall, project management services included revising the basic and detailed architectural, structural, facilities, electromechanical systems and integrated rail systems designs. The services also included revising the corresponding specifications, calculations, and operation and maintenance manuals.

WSP's key responsibilities focused on advisory and assistance throughout the bidding process, evaluation of proposals, and negotiation and formalization of contracts necessary for correct and timely decision-making. WSP was also responsible for supervising the construction of the Line 2 project, which involved the inspection, monitoring and administration of the construction contract, including the work program and costs.

Riyadh
Metro - Package 3

Location
RIYADH, KINGDOM OF SAUDI ARABIA

Client
ROYAL COMMISSION FOR RIYADH CITY (RCRC)

Status
ONGOING

LENGTH
63.6 km

LINES
3

STATIONS
24

The city of Riyadh, capital of the Kingdom of Saudi Arabia, has expanded by 500 times over the past 70 years and is today spread over 1,000 km². The city boasts 6.5 million people, and by 2030 the population is expected to reach 8.3 million. Riyadh's streets currently witness more than 9 million car trips per day—raising problems of congestion, pollution and reduced mobility, all of which threaten to choke economic growth. Therefore, the development of a comprehensive public transportation system is paramount.

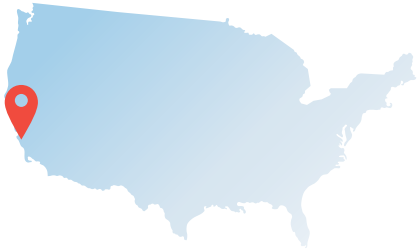
The Riyadh Metro Project, commissioned by the Riyadh Development Authority (RDA), constitutes the backbone of the future public transport system of the capital. With its 6 lines totaling 176 km and 85 metro stations, the metro network will cover most of the densely populated areas, public facilities, as well as governmental, educational, commercial and medical institutions. The Riyadh Metro Project, a state-of-the-art fully automated transit network, will provide all population groups in the capital with a cost-effective way to move around the city, which will increase their productivity and reduce their dependency on private cars.

In August 2013, WSP and Hill International, were awarded a CAD 354 million (USD 265 million) contract by the Riyadh Development Authority (RDA) for providing project management and construction management services for Package 3 (lines 4, 5 and 6) of the Riyadh Metro project. The contract was awarded to the joint-venture Riyadh Advanced Metro Project Execution and Delivery (RAMPED), in which WSP is a 55-percent majority partner and Hill International is a 45-percent partner.

As the intermediary between RDA and the design-build contractor, the RAMPED joint venture oversees design-and-construction deliverables through the project life cycle for Package 3. Package 3 includes Lines 4, 5 and 6 and covers 63.6 km of track, with 33.2 km of elevated alignment, 8.3 km at-grade, 13.3 km bored tunnel and 8.8 km of cut-and-cover tunnel, 24 stations and 2 depots with one being totally underground and constructed through some of the most congested districts in Riyadh.

The overall value of the Riyadh Metro Project is approximately CAD 31 billion (USD 23 billion), and Package 3 is valued at CAD 11.5 billion (USD 8.6 billion).

Bay Area *Rapid Transit*



Location
SAN FRANCISCO, CALIFORNIA, UNITED STATES

Client
SAN FRANCISCO BAY AREA RAPID TRANSIT DISTRICT

Status
1953-ONGOING

STATIONS
48

WEEKLY PASSENGERS
743,000

LENGTH
180 km

The San Francisco Bay Area Rapid Transit (BART) district was formed in the 1950s. Currently, BART includes Alameda, Contra Costa and San Francisco counties. Between 1959 and 1962, engineering plans were developed for a system that would usher in a new era in rapid transit. WSP participated in the planning, design and construction of the original system. Since that time, WSP has provided continuous improvements, and currently serves as one of BART's general engineering consultants.

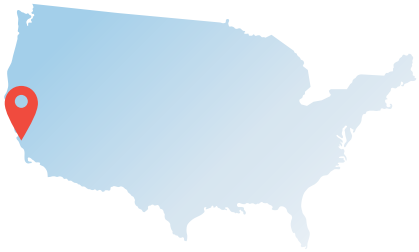
Construction of the BART system began with a groundbreaking ceremony in June 1964. After eight years of construction, a 42-km segment between Oakland and Fremont in the East Bay was opened to the public in September 1972. Additional segments were opened in phases, culminating in the completion of the initial 121-km system in September 1974, when the first trains whisked through the Trans-Bay Tube, making the long-awaited connection between San Francisco and the East Bay. The system, at least in its design, was the most technologically advanced rapid transit system in the world and included the longest and deepest immersed tube tunnel in the world.

Since the building of the original system, WSP has been involved with a number of the system's extensions including the BART Extensions Program from the 1980s involving 48-km of rapid rail line and 10 stations. Most recently, WSP served as the sole general engineering contractor responsible for preparing design-build documents for the 8.7 km Warm Springs extension. WSP was responsible for providing system design and design support services during construction for the Santa Clara Valley Transportation Authority's Phase I BART to Silicon Valley Extension and is currently providing program management services, as part of a joint venture, for Phase II.

Today, the BART system consists of 180 km and 48 stations, 17 of them underground.


PASSENGER
PICKUP ON
OTHER SIDE
OF STATION

San Francisco
Central Subway



Location
FREMONT, SAN FRANCISCO, CALIFORNIA, UNITED STATES

Client
SAN FRANCISCO MUNICIPAL TRANSPORTATION AGENCY

Status
COMPLETED IN 2023

PHASE 2 STATIONS
5

LENGTH OF TUNNEL
2.7km

EXPECTED JOB CREATION
45,000+

During the first half of last century, streetcars travelled up and down Three Street, shuttling riders between downtown and points along the Bayshore Corridor. Now, decades later, the Third Street Light Rail Project has re-established rail service along this corridor. The project has been structured to improve service reliability and travel times, enhance transit connections, and help generate economic opportunities and jobs for local residents and business owners.

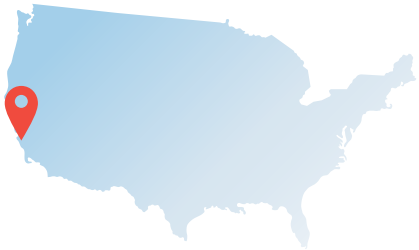
Phase I extended the Muni Metro light rail service. In 2007, the T Third Street opened, running to the southern border of the city from the Caltrain depot station. It runs through some of San Francisco's most economically depressed areas, and will likely bring a much needed boost to the prospects of those neighborhoods.

Phase II will extend light rail service north. When the Central Subway opens to the public in 2019, it will vastly improve transit options for residents of one of the most densely populated neighborhoods in the country.

After completing preliminary engineering in 2009, WSP took the lead of two other joint ventures responsible for the final design of the tunnels and stations. The first joint venture is responsible for utilities relocation and design, as well as design support during construction of the twin tunnels, the tunnel boring machine (TBM) launch and retrieval shafts, five cross passages, settlement monitoring and instrumentation, portal construction, and mitigation measures for controlling tunnelling-related settlement.

The second joint venture currently led by WSP is responsible for the final design and design support during construction of the three underground stations: the Yerba Buena/ Moscone Station, the Union Square/Market Street Station and the Chinatown Station.

BART *Warm Springs Extension*



Location
FREMONT, SAN FRANCISCO, CALIFORNIA, UNITED STATES

Client
BAY AREA RAPID TRANSIT DISTRICT

Status
COMPLETED IN 2018

LENGTH OF EXTENSION

8.7 km

SUSTAINABLE FEATURES

Solar panels

ENVIRONMENTAL MITIGATION

10-acre wetland habitat

Nestled between the Fremont Hills and the San Francisco Bay, the Warm Springs station is the 46th station in the Bay Area Rapid Transit (BART) system, and serves as a gateway to Silicon Valley, enhancing regional connectivity for passengers throughout the Bay Area. The extension is an 8.7-km, new double-trackway extension from the existing Fremont Station to Warm Springs and includes all BART lines, tracks, systems and station components. It features a tunnel that includes a ventilation system designed in compliance with BART Facilities Standards and National Fire Protection Association 130 (a technical systems code).

As BART's general engineering consultant, WSP was responsible for updating BART's design criteria and provided effective coordination with the Union Pacific Railroad (UPRR) for work along its right-of-way, preparing the design-build documents and serving as owner's engineer during station construction. The team reviewed the BART Facilities Standards and then established guidance for all issues and matters related to the application of design, engineering and operations criteria. The team also provided preliminary engineering design of two rail lines, three control rooms, five track power facilities, and two box tunnels, including 100-percent design of the cut-and-cover tunnel under Lake Elizabeth in Fremont's Central Park.

The Warm Springs Station provides an architecturally pleasing, easily accessible entrance with a pedestrian walkway and rotunda, and features state-of-the-art sustainable components. Various environmental regulatory agencies required mitigation for the project footprint, which impacted existing wetlands and open waters. This resulted in WSP designing an approximately 4-ha site which consisted of wetlands, riparian zones and open waters, to replace the ones affected by the construction. The station offers advanced communications, traction power, automatic train control, and automatic fare collection systems.

Innovative features include the use of resilient ties and tire-derived aggregate for sections of the trackway. Innovation is the approach for the alignment and trackwork to accommodate significant seismic earth movements with as little damage as possible at the two Hayward Fault crossings, one at Walnut Avenue and the other near the intersection of Washington Boulevard and Osgood Road.


3
7
C1

Tren Urbano

Location
SAN JUAN, PUERTO RICO

Client
COMMONWEALTH OF PUERTO RICO HIGHWAY AND TRANSPORTATION AUTHORITY

Status
COMPLETED IN 2004

LENGTH
17.2 km

STATIONS
16

TUNNELS
1.7 km

The island of Puerto Rico including San Juan and its contiguous communities has one of the highest population densities in the nation. In addition, it has a sparse transportation network and a concentration of most of the island's employment centers. Together these factors negatively impact the quality of life of the residents as well as the area's attractiveness for commercial development and tourism. To alleviate these transportation infrastructure shortfalls, the Puerto Rico Highway and Transportation Authority (PRHTA) decided to build a 17.2-km heavy rail guideway transit system to serve the communities of San Juan, Bayamon and Guaynabo as the first phase of a planned areawide transit system. The project also included 1.7 km of tunnels, 16 stations, 74 vehicles and a maintenance and storage depot.

As a subcontractor, WSP provided program management and design and construction interface coordination services for all operational systems (MEP and SCADA) and commissioning. We provided management and interface coordination of all systemwide elements, including vehicles, train control, electrification, trackwork, and communication systems as they relate to the fixed facilities of this double-track heavy rail system. WSP also provided safety, quality assurance and quality-control plans and implementation during this CAD 3 billion design-build-operate-maintain project, as well as safety certification of the project. As part of a separate contract with PRHTA. WSP provided construction oversight, including safety and quality assurance and control.

Location
SANTIAGO, CHILE

Client
METRO DE SANTIAGO

Status
COMPLETED IN 2019

LENGTH
26 km

STATIONS
19

MAINTENANCE SITE
15 ha

Santiago
Metro Line 7

The Santiago Metro Line 7 project is part of the Urban Transport Investment Plan for the city of Santiago and will be incorporated into the current Metro network. Line 7 is 26-km long with an estimated investment of CAD 3.36 billion.

This new line will have 19 stations, 2 terminals and 13 stops. Four stops will connect with other existing metro lines. The layout is entirely underground with an average distance of 1.4 km between stations.

The route of Line 7 goes west to east in the city, passing through seven districts. Line 7 is expected to help decongest an important section of the current Line 1, which is the most overloaded in the network. Part of Line 7 will run parallel to the central sector of Line 1.

In July 2018, Santiago Metro assigned to the WSP Geocontrol consortium the feasibility study of civil works engineering of Line 7, to be developed over 11 months. The contract also includes the development of an environmental impact study.

The consortium developed the project in the following main disciplines: layout, architecture, civil engineering, structural engineering, mechanical engineering, electrical engineering, environmental studies, tunneling using the New Austrian Tunnel Method (NATM) and Tunnel Boring Machine (TBM) construction methods, and scheduling and cost estimation.

The scope of the civil works consists of the design of 17.5 km of inter-station tunnels and 2.3 km of station tunnels applying NATM and approximately 6 km using the TBM method. The 19 stations are mostly built by means of vertical circular shafts and connecting galleries, thus reducing the impact on the city during construction. The project also includes the design of workshops and garages for the correct operation and maintenance of the trains and equipment of the line on a 15-ha site, the linking of the railway to the main line and the development of the layout of all the buildings, facilities and technical areas.


← Salida
Desplázate a lo largo del andén

Passenger Commuter Train
Melipilla - Santiago

Location
SANTIAGO, CHILE

Client
EMPRESAS DE FERROCARRILES DEL ESTADO (EFE)

Status
ONGOING

LENGTH
61 km

STATIONS
11

TRAVEL TIME SAVING
2 hours

The passenger commuter train project will run from Estación Central to the district of Melipilla in a 61 km-route with 11 stations and connections to Metro lines 1, 5 and 6.

This initiative, with an estimated cost of CAD 1.9 billion, will enable travel-time savings for commuters of up to two hours per day.

It is estimated that the new route will have a demand of approximately 50 million passengers per year for an area of influence of more than 1.1 million inhabitants.

WSP developed basic and detailed engineering with the participation of the following disciplines: architecture; structural engineering, bridges, roads, mechanical engineering, electrical engineering, sanitary engineering; environmental studies; hydraulic engineering, among others.

The project includes the construction of 11 rail bridges, 13 uneven vehicular crossings; 32 uneven pedestrian connections; 16 automated level crossings; a workshop and garages; and the installation of new signaling, communications and electrical energy systems.

The project is being carried out through a consortium with WSP and Systra, which provides the design of the railway systems. It also involves support from other WSP offices with the following disciplines: bridges (Spain), soil engineering (Panama); architecture (Peru); electricity (Peru) and structures (Peru and Mexico).

The detailed engineering, as of January 2022, 80 percent complete. The construction phase is expected to finish in 2026.


Salida

Incheon *International Airport Railroad*

Location
SEOUL, SOUTH KOREA

Client
KOREA DEVELOPMENT BANK

Status
COMPLETED IN 2011

LENGTH
61 km

STATIONS
10

AVERAGE DAILY RIDERSHIP
210,080 (2018)

Incheon International Airport, the largest airport in South Korea, opened for business in March 2001. Immediately, a railroad that would provide rapid and convenient connectivity to link the airport to the Seoul capital area was required. The line was initially announced in July 1998, and the project was launched as South Korea's first public-private partnership (PPP) project in the build-transfer-operate type of arrangement franchise.

Construction for phase 1 (the first segment from IIA Terminal 1 to Gimpo Airport, 40.3 km, 6 stations including 2 interchange stations) of the line started in 2001, and phase 1 opened in March 2007. Meanwhile, construction for phase 2 (the extension from Gimpo International Airport to Seoul Station, 20.7 km, 4 interchange stations) commenced in 2004, and the entire line opened for regular service in December 2010. Total route length of the two phases is approximately 61 km, including 10 stations and 1 depot. The concession period for operation is 30 years, following completion of phase 2. The system comprises two services: a regular commuter train and airport express train.

WSP provided professional services including the project feasibility study for the project financing and independent consultancy engineer (ICE) and the lender's technical advisor (LTA). The ICE and LTA's key role was the railway PPP advisory service including technical appropriateness, construction progress, contracts, cost, and risk management during the construction stage.

Incheon International Airport Railroad is a milestone project as we created and applied the ICE-LTA service model for stakeholders in PPP schemes of South Korea. All PPP rail project schemes of South Korea now include this service model, and WSP has been involved in all of them since this one.


EXPRESS
AREX

Seoul
Metro Line 9 – Phase 1

Location
WEST SEOUL TO EAST SEOUL, SOUTH KOREA

Client
SHINHAN MACQUARIE FINANCIAL ADVISORY (SMFA)

Status
COMPLETED IN 2011

LENGTH
25.5 km

STATIONS
25 (13 interchange, 1 depot)

AVERAGE DAILY RIDERSHIP
668,409 (2018)

Subway Line 9 – phase 1 refers to the route from the Gimpo International Airport area of Gangseo-gu, through Yeouido, to Sinnonhyeon Station of Gangnam-gu, which is linked to most of the lines in the city. Subway Line 9 is the only line in Seoul that operates an express line in the entire metro system. The first section of Line 9 commenced in April 2002 and was completed in 2009. Line 9 stretches 25.5 km (25 Stations including 13 interchange stations, and 1 depot).

This project was awarded to the Seoul Metro Line 9 Corporation under a public-private partnership (PPP) project in a build-transfer-operate (BTO) arrangement with Seoul City Government. WSP was engaged as the lender's technical advisor (LTA) and independent consultancy engineer (ICE) for technical appropriateness, construction progress, contracts, cost, and risk management during the construction stage.

During the beginning of the operation stage, WSP also provided the review of regular operation performance and operation management status based on the operations and maintenance (O&M) plan and contract; the review of asset management, performance management, and safety management of the operator; and the review of the annual operation plan and performance record during the O&M stage.

Shinbundang
DX Line

Location
SEOUL METROPOLITAN AREA, SOUTH KOREA

Client
KOREA DEVELOPMENT BANK

Status
ONGOING (PHASE 3)

LENGTH
33.87 km

STATIONS
15

NEW MOBILITY
Completely driverless metro line

Shinbundang DX Line, or Dynamic Express Line, is a 31km long line of Seoul Metropolitan Subway, enhancing the connectivity from various residential districts of Gyeonggi Province to the Gangnam-daero area in southern downtown Seoul and alleviating heavy traffic from nearby large apartment complexes. It is the first line to operate South Korea's next-generation subway car with the travelling speed of over 90 km/h, the fastest average speed of any subway in the country. Shinbundang Line is the world's fifth subway to run completely driverless and the second to so do in South Korea.

This public-private partnership (PPP) project in the build-transfer-operate arrangement began in 2005. The first and second phases have been in revenue operation since 2011 and 2016 respectively. The construction for the first segment of the phase 3 extension northwards from Gangnam station to Shinsa station commenced in 2016 with the opening planned in 2022.

WSP provided professional services including the project feasibility study for the project financing and independent consultancy engineer (ICE) and the lender's technical advisor (LTA). The ICE and LTA's key role was the railway PPP advisory service including technical appropriateness, construction progress, contracts, cost, and risk management during the construction stage.

For the beginning of the operations and maintenance (O&M) stage of phase 1, WSP was also employed to carry out routine inspections of the operator for the review of the following: regular operational performance and operational management status based on the O&M plan and contract; asset management, performance management, safety management of the operator; and the annual operation plan and performance record.


DXLINE
DXLINE
DXLINE
S102

Shenzhen
Metro Line 3

Location
SHENZHEN, CHINA

Client
SHENZHEN METRO NO. 3 LINE INVESTMENT CO. LTD.

Status
COMPLETED IN 2011 (PHASE 1 AND PHASE 2)

LENGTH
41.66 km

STATIONS
30

OPERATING SPEED
85 km/h

With the rapid development of the city—including the economy, population and transportation demand in Shenzhen—the municipal government realized the importance of establishing a rail transit system as the backbone of transportation. The objective was to solve traffic congestion, facilitate further city development, and an efficient, safe and clean transportation choice for the public.

Line 3 has a total length of 41.7 km and 30 stations and was completed in two phases. It is the first metro system in China which uses 1,500V DC third rail traction power supply system. Six-car train sets are operated at a maximum speed of 100 km/h.

Phase 1 of Line 3 was opened to the public in December 2010. It has a total route length of 32.9 km (21.7 km elevated, 8.5 km underground and 2.6 km at grade) and 22 stations enabling passengers to interchange with Line 1 and Line 11, Guangzhou-Shenzhen Railway and Pearl River Delta Inter-city Express Line. A double-deck depot of 32.3 ha was constructed in Wanggang with a stabling capacity of 34 trains. It was then the first-of-its-kind in China. The overall investment of phase 1 work was approximately CAD 1.72 billion.

WSP was the lead consultant working in association with the Shanghai Tunnel Engineering & Rail Transit Design and Research Institute (STEDI). The scope of WSP's work included the following services:

- project management
- project planning and project controls
- tendering and construction management
- investment and funding plans analyses
- value engineering and facilitation of workshops
- contract strategy and management
- testing and commissioning (including systems commissioning)
- design management and checking
- safety assurance
- training of client's management and technical staff

During the construction of phase 1, the municipal government decided to embark on the implementation of phase 2, and the client thus further extended the services of WSP in March 2007 to cover the overall project. Phase 2 works comprised 8.8-km tunnels with eight stations and one underground stabling yard. It further strengthens the rail network of Shenzhen and its connectivity with other cities in Guangdong province and Hong Kong. It was opened in June 2011 before the Universiade summer games hosted by Shenzhen.

Thomson
East Coast Line

Location
SINGAPORE

Client
LAND TRANSPORT AUTHORITY OF SINGAPORE

Status
ONGOING

LENGTH
43 km

STATIONS
32

WORLD'S FIRST
4-in-1 rail and bus depot

The Eastern Region Line (ERL) is an underground mass rapid transit system with an approximate route length of 13 km, comprising ten stations that connect a series of residential estates from Changi, Upper East Coast, Bedok South, Siglap, Marine Parade, and Tanjong Rhu to the central business district in Marina Bay—to improve public transport connectivity in the eastern areas of Singapore.

Together with the Thomson Line (TSL), the ERL merged to form the 43km Thomson-East Coast Line (TEL) with 32 new stations added to the existing rail network including seven interchange stations linking the East-West Line, North-South Line, North-East Line, Circle Line, and the Downtown Line (DTL).

The 13km ERL is the first mass rapid transit project that adopts the building information modelling (BIM) approach for the mechanical and electrical services.

The ERL also boasts the world's first 4-in-1 rail and bus depot designed as an efficient structural solution to address the land scarcity issue in Singapore.

This unique stacked rail depot comprises the following:

- an at-grade depot serving the TEL, a stabling yard for 76 trains and inspection / repair workshop for 76 trains.
- an underground depot serving the DTL, a stabling yard and inspection workshop for 75 trains and overhaul workshop for 156 trains.
- an elevated depot serving the East West Line (EWL), a stabling yard and inspection workshop for 76 trains.

The separate multistory bus depot is located next to the rail depot and can house approximately 550 buses.

This project by the Land Transport Authority was the first to be fully implemented with BIM. (REVIT and AECOSIM platforms were also used.)

It was also awarded the Minister's Value for Money Award in 2014 by the Ministry of Transport.

WSP is the architectural and engineering consultant for this unique megadepot. BIM management WSP services also cover the concept and detailed design, tender documentation, and design services during construction.


MAYFLOWER

Singapore
Circle Line

The Circle Line (CCL) is the medium-capacity Mass Rapid Transit line that is completely automated and also among the world's longest driverless rapid transit lines. As the name implies, the line is an orbital circle route linking all radial routes that lead to the city.

The alignment for Stages 4 and 5 of the Circle Line MRT follows a loop from the North (Braddell) to the South (Harbourfront) through the Central-Western areas of Singapore which include Bukit Brown, Botanic Gardens, Holland Village, Buona Vista, Science Park, and Pasir Panjang.

Stage 4 consisted of eight stations with connecting tunnels and crossover tracks. The underground route length is approximately 10.11 km.

Stage 5 consisted of five stations with connecting tunnels and crossover tracks. The underground route length is approximately 7.15 km.

The underground tracks are designed to be constructed by bored tunnelling, except at crossover, turnback and cripple-siding locations where the structural forms are cut-and-cover box shape.

WSP was appointed by the Land Transport Authority (LTA) as the architectural and engineering consultant for stages 4 and 5 of the Circle Line.

Services provided included:
- Architectural, civil, structural and mechanical / electrical design of 11 stations
- Civil, structural, mechanical and electrical design services for 27 km of tunnels
- Design of tunnel systems including the tunnel ventilation system and station environmental control system with Subway Environment Simulation computer simulation analysis.
- Construction management support during the construction stage which commenced in August 2004.

Location
SINGAPORE

Client
LAND TRANSPORT AUTHORITY OF SINGAPORE

Status
COMPLETED IN 2011

Roslag Line

Location
STOCKHOLM, SWEDEN

Client
NATIONAL SWEDISH RAIL ADMINISTRATION

Status
ONGOING

Originating from the late 19th century, the Roslag Line is a local narrow-gauge railway, running between the station Stockholm East to the northeastern parts of the county. The line divides into three branches, and the total length is 65 km with 38 stations.

As the northeastern municipalities grew, the number of travellers increased. The Roslag Line was mainly a single-track railway which made the traffic flow susceptible to disturbances. Expanding to double tracks would enable increased traffic and facilitate the traffic flow, to create a more efficient and sustainable public transport system.

The main challenge for the client was to extend the line to a double-track railway and refurbish the existing line without interrupting ongoing traffic. In addition, the soil condition with soft and sensitive clay, was very sensitive to groundwater lowering.

WSP provided the feasibility study, preliminary design and detailed design as well as construction documents for 30 km of the line. The scope of services included permanent way design, geotechnics, rock mechanics, geohydrology, road design, cost estimates, architecture, landscape architecture, traffic, an environmental impact assessment, use of a geographic information system, virtual reality, and operation and maintenance.

City Line

Location
STOCKHOLM, SWEDEN

Client
SWEDISH TRANSPORT ADMINISTRATION

Status
COMPLETED IN 2017

RAIL CAPACITY
24 to 48 trains/hour

RAIL TUNNEL
6 km

DEPTH
10 to 40 m

Stockholm's railway network dates back to late 19th century. In 1871, there were 10 trains running daily on two available tracks. Almost 150 years later, the same two tracks served 500 trains each day, 60 percent of them being commuter trains.

The increasing demand for public transit called for capacity extension, and in 2009 a CAD 2.5 billion project started, scheduled to last eight years and involving approximately 200 WSP employees.

Given the presence of the medieval old town and classified buildings nearby, adding a third track to the existing railway aboveground network was impossible. The solution was to build City Line as a tunnel, a good option since Stockholm sits on stable hard crystalline granite. The project required excavating a 6-km long rail tunnel under the city at 10- to 40-m depth, from Tomteboda in the northwest to Stockholm South Station, using the drill-and-blast construction method.

WSP is responsible for delivering the largest and most complex part of the project, providing multidisciplinary services, including tender documents, detailed design, project management and technical support during construction. The three contracts cover about 2 km of the line—the Norrmalm Tunnel, Norrström Tunnel and City Station.

Our market-leading expertise in using BIM tools proved to be an integral part of the project. 3D CAD was used to create the most precise design of the tunnels leading in different directions, which could not be drawn in 2D. Geotechnical surveys, rock surveys and other information were added to the model to help interconnect disciplines.

Opened to traffic in 2017, City Line provided more frequent, punctual and faster train service in the Stockholm region and across the country, as 80 percent of all trains in Sweden travel to or from the Stockholm region. The new line doubles the rail capacity through Stockholm, from 24 to 48 trains per hour. It has been estimated that each commuter train reduces road traffic load by 1,000 cars. Passengers changing from commuter trains to metro or buses and vice versa shorten their travel time significantly thanks to the enhanced network accessibility.

Finally, City Line delivers several tangible benefits, including increased road safety and significant positive impact on the environment.

Cross Link

Location
STOCKHOLM, SWEDEN

Client
STOCKHOLM PUBLIC TRANSPORT ADMINISTRATION

Status
ONGOING

LENGTH
18 km

STATIONS
26

DAILY PASSENGERS
90,000

Cross Link is a modern light rail in Stockholm that connects commuter rail, underground stations and suburban areas transversely, so there is no need to pass through the city center.

The first part of the tramway was completed in 2000 when traffic started between Gullmarsplan and Liljeholmen. Since then, Cross Link has been extended, and the latest section opened in 2014. Today it is a 19-km single line with 26 stops that stretches from Sickla, south of the Stockholm city centre, to Alvik, west of the city, and then north to Solna Station. About 90,000 passengers use Cross Link daily. Further extensions are planned, and the construction of a branch from Norra Ulvsunda to Helenelund started in 2018.

WSP has been the chosen consultant from the first planning phase in the 1990s. We have participated in most parts of the planning and design phases for the original line and the extensions: feasibility studies, early planning, preliminary and detailed design, and redesign of the original line to adapt to extensions. The WSP assignment has also included stations and tunnels. The route has several rock and concrete tunnels; the largest is 330 m long and 24 m wide with double tracks.

Technical areas participating include rail design and engineering, rock engineering, bridge design, street design, landscape design, road traffic, water and wastewater, geotechnics and signals.

One of the major challenges was determining where to build the new tracks in the existing environment and with current traffic conditions. Other challenges have been working with the very complicated geotechnical conditions and finding smart solutions for relocating and re-routing pipelines in the ground.

WSP has won the BIM category in Tekla Sweden Awards for one of the Cross Link subprojects: Ekensberg bridge. This truss concrete bridge is over one of the busiest main rail tracks in Sweden. A 3D model was used in all project stages, from sketch to reality.

WSP mobilized experienced multidisciplinary teams of engineers, architects, urban traffic and construction planners, cost managers and environmental specialists—which established a clear strategy to reduce the risk profile and provided development and clarity to the delivery program.

Stockholm
Metro Extension
Yellow Line

Location
STOCKHOLM, SWEDEN

Client
STOCKHOLM COUNTY COUNCIL (ADMINISTRATION FOR EXTENDED METRO)

Status
ONGOING

NEW TRACKS
2

NEW STATIONS
3

DAILY PASSENGER INCREASE
170,000

Stockholm is one of Europe's fastest-growing cities; the population increases by 40,000 people every year. The metro network is widely used and carries on average 1.1 million passengers daily.

To increase capacity, Stockholm decided to expand the metro network. The extension project is instrumental to the development of the entire Stockholm region, with 82,000 additional homes to be built in the immediate vicinity of the extended metro network. Once completed, the daily capacity of the network will increase by 170,000 passengers.

The expansion of the metro encompasses different routes. WSP has a major role in the Yellow Line project, a new 4.1-km underground route between Odenplan and Arenastaden that entails two new tracks and three new stations. The route is expected to be completed by 2025.

Odenplan Station, an existing station, will become an important transport hub. By connecting City Line with the Yellow and Green lines, travellers can switch between the metro and commuter trains, thus reducing the passenger load at Stockholm Central Station.

Hagastaden Station will be located in an entirely new district built on the overdecking of two highways and one railway. The station will also serve Karolinska University Hospital, and one of the exits leads directly to the hospital's main entrance. Södra Hagalund Station marks the beginning of the development of another completely new district consisting of both apartments and offices.

The final stop is Arenastaden in Solna, where new apartments and office blocks are being built next to the national football stadium and the shopping center Mall of Scandinavia. The area development will increase the number of travellers in the years to come and enhance demand for rail transport.

WSP's assignment encompasses a pre-feasibility study, preliminary design, environmental impact assessment, detailed design, tender documents and "as built" documents. Our services consist of rock mechanics, structures, geohydrology, water and sewage, geotechnics, electrical, telecommunications, SCADA, HVAC, elevators, escalators, lighting, construction planning, environment and cost calculation, management and sustainability.

WSP combines extensive experience of infrastructure projects with market-leading expertise in the latest BIM tools. Data, such as geotechnical and rock surveys, were added to the model, enabling collaboration between disciplines. The BIM tools are also enabling the client and the contractor to be directly involved in the design.

Sydney
Metro Northwest

Location
SYDNEY, AUSTRALIA

Client
SYDNEY METRO

Status
COMPLETED IN 2019

FULLY-AUTOMATED METRO
1st in Australia

TWIN TUNNELS
15 km

NEW RAILWAY STATIONS
8

Sydney Metro Northwest (formerly North West Rail Link) is the first stage of Sydney Metro — Australia's largest public transport project, set to be the first fully-automated metro rail system in the country.

The Sydney Metro Northwest project includes development of 36 km of rail line from Rouse Hill to Chatswood, construction of 8 new stations, and the upgrade of 5 existing stations. The project creates 15 km of twin tunnels between Epping and Bella Vista, a 4-km elevated skytrain between Bella Vista and Rouse Hill, and a 270-m cable-stayed bridge over Windsor Road at Rouse Hill. To support the roll-out of metro trains, it converted the heavy rail line between Epping and Chatswood to metro standards, and provides a stabling facility at Tallawong Road Rouse Hill, as well 4,000 commuter car parking spaces and bus, taxi, kiss-and-ride, pedestrian and cycling facilities at all stations.

WSP was technical advisor on the project, undertaking due diligence on information related to engineering and infrastructure. We applied computerized alignment design to verify and optimize the alignment and minimize impact on properties while maximizing train speeds, and used GIS tools to investigate hydrology impacts and produce aerial flyovers. This approach gave the client the confidence to investigate options and make strategic decisions in liaison with key stakeholders.

We were responsible for the studies, investigations, designs and documentation required to produce the feasibility design report and product definition report.

The scope of services covered:
- underground works, including tunnels, caverns, cut and cover structures and shafts
- route alignment & track geometry
- civil and structures
- hydrology and drainage
- geotechnics, hydrogeology and topography
- assessment of existing infrastructure
- electrical and mechanical systems
- vertical transportation
- buried services and utilities
- traffic and transport advice to support temporary line closures of Epping to Chatswood Railway for construction

We also created a virtual railway of the completed metro to provide a detailed investigation of rail operations — exploring journey times, timetable analysis, and impacts of tunnel, ventilation and associated systems.

WSP's property team was engaged separately during delivery to provide detailed design documentation for the operations, trains and systems package, as well as sustainability, acoustic and environmental requirements for the surface and viaduct civil works package.

Sydney *Metro City & Southwest*

Location
SYDNEY, AUSTRALIA

Client
SYDNEY METRO

Status
ONGOING

LENGTH
30 km

TWIN TUNNELS
12.5 km

HOURLY PASSENGER INCREASE
100,000

Sydney Metro City & Southwest is the second stage of Sydney Metro and will deliver 30 km of new metro rail between Chatswood and Bankstown including new twin tunnels under Sydney Harbour and the upgrade and conversion of all 11 stations between Sydenham and Bankstown to metro railway standards. The project will also bring new stations at Crows Nest, Victoria Cross, Barangaroo, Martin Place, Pitt Street and Waterloo along with new underground platforms at Central Station.

The extension provides a faster and more reliable service—increasing train numbers by 60 percent during peak periods and serving an extra 100,000 customers per hour.

Transport for NSW engaged WSP as their technical advisor. The team worked collaboratively to provide the engineering, rail infrastructure and architectural design support to develop the reference design, detailed design, tender documentation and final business case for the preferred alignment and station arrangements.

Together, the multidisciplinary team resolved complex issues including tunnelling methodologies, station depths and arrangements, interfaces and interchanges with the existing transport network—particularly in the dense North Shore and central business district environments. We provided robust input to the options process including alignment development, station arrangement and connectivity design, constraints mapping and risk assessment.

The project is notable for its collaborative, technology-driven approach in early design. This included developing a bespoke digital engineering approach that combines data management and virtual reality to visualize customer experience and optimize tunnel and underground station design, modelling of passenger flow to optimize the location of station elements, as well as designing for future scenarios such as climate change for drainage and flooding, and allowing for potential new developments.

The project is due to be completed in 2024.

© Sydney Metro

Sydney
Metro West

Location
SYDNEY, AUSTRALIA

Client
SYDNEY METRO

Status
ONGOING

NUMBER OF PASSENGERS PER HOUR
40,000

NUMBER OF SERVICES PER DAY
200

INCREASE IN NETWORK CAPACITY
60 percent

Sydney Metro West is the third stage in the Sydney Metro network. It will connect Parramatta and the Sydney central business district and become the fastest, easiest and most reliable way to travel between the two locations. The project includes proposed stations at Westmead, North Strathfield (adjacent to the existing suburban station on the T1 Northern Line), Burwood North, Five Dock, Parramatta, Sydney Olympic Park, the Bays and the Sydney central business district.

WSP was engaged to develop the scoping and definition design to support the final business-case development of Sydney Metro West. We are delivering this work as part of the Central City Metro team, together with AECOM, Cox, Farrells and Woods Bagot, supported by the Customer Experience Company, and Balarinji.

Our scope of work includes engineering and rail systems: civil, structural, geotechnical, mechanical and electrical engineering; sustainability; and architectural and heritage design.

Some of the key design tools used on the project include WSP Create and the Customer Connectivity Tool. WSP Create was developed off the back of the digital engineering approach that was developed for Sydney Metro City and Southwest. It acts as a centralized digital data environment which hosts real-time information in a secure and categorized way.

The Customer Connectivity tool allows for a rapid new method of testing and designing railway alignments for optimal customer and community benefit. It uses open-source transport data to inform high-level transport planning decisions regarding placement and integration of new rail infrastructure into the existing public transport network. The Customer Connectivity tool keeps customers at the centre of all transport planning decisions and gives us a way to measure customer outcomes very early in the design process. Through it, the client has been able to quantify the benefit of different options early in design and support a much more agile development cycle. This is the first time such a tool has been used in a New South Wales transport project.

The project is due to be completed in 2030.

GO *Transit Train Control Centre*

Location
TORONTO, ONTARIO, CANADA

Client
METROLINX

Status
ONGOING

MEMBERS OF DB TEAM

150+
(including 30+ from WSP)

SCOPE

Multidisciplinary

SYSTEM IMPLEMENTATION SERVICES

Go Transit Control Centre

WSP is part of the Alstom team that was awarded a CAD 160 million contract for the design and implementation of a new computer-based integrated train control centre for the control and management of all GO Transit Rail Territory, which includes the Union Station rail corridor, and all seven rail corridors branching out from Union Station. The GO Transit Train Control System (GTCS) project goes hand-in-hand with the ongoing Union Station Rail Corridor (USRC) Signalling System project, which WSP is also supporting.

The outcome for this project is that the GO trains will be fully controlled by Metrolinx via a state-of-the-art Control Centre (GTCC) that is backed up by an alternative Control Office (BRC). This will guarantee a high level of availability of the service, hence significantly reducing the probability of revenue losses.

For this multidisciplinary project, WSP is responsible for providing a wide range of services: communications testing; requirements management; structural, geotechnical, environmental, and electrical professional services; project management; and quality assurance/quality control. The GTCS project requires numerous entities within and outside of WSP to work in collaboration. WSP provides key personnel in project management, design and systems engineering. The civil/structural and geotechnical work includes the design and testing of foundations work, along with electrical power supply design as part of the electrical scope; this work is in addition to the required support in areas such as environmental engineering, geomatics and communication testing.

The project commenced in August 2015. The GO Transit Train Control Centre is expected to be in service in five years. The project team consists of over 150 staff, including more than 40 from WSP. The key WSP staffing is located at the project management office situated within 1 km of Union Station. The GTCS project has offered WSP and Alstom the opportunity to build upon the relationship developed during the Union Station Rail Corridor (USRC) Signalling project, leaving WSP well placed to partner together again in delivering future rail systems projects in Canada.

Courtesy of Alstom

Metrolinx
Regional Express Rail Program (GO Expansion)

Location
TORONTO, ONTARIO, CANADA

Client
METROLINX

Status
ONGOING

ELECTRIFICATION SCOPE
Entire system

HEADWAY ON CORE LINES
15 minutes

WEEKLY TRIPS INCREASE
300 percent

Year after year, train by train, bus by bus, Metrolinx has committed to improving transit for people living in in the Greater Golden Horseshoe. Now, that work is taking on a whole new energy. Thanks to a huge investment in infrastructure, Metrolinx is working to add more GO Rail service and improve customer experiences. The GO Expansion Program will realize significant benefits to transit users, drivers, and the region as a whole. By leveraging an existing network of over 400 km of railway, GO Expansion will unlock the potential of the region. GO Expansion will nearly double GO Rail's ridership. By 2055, annual ridership will exceed 200 million (compared to 105 million without GO Expansion). This ridership gain includes nearly 60 million additional off-peak and counter peak trips, a net increase of 210 percent.

As Canada's largest commuter rail project, this transit expansion involves building and upgrading existing stations, adding new track, building and opening new maintenance and storage facilities, expanding and revitalizing bridges around our region and improving pedestrian connections. Upon the completion, GO Transit will operate a two-day, all-day rapid transit system throughout the Greater Golden Horseshoe and will provide a new option for customers to choose transit first.

WSP, as a member of the 4Transit Joint Venture, is providing technical advisory services to Metrolinx for Package 1 and Package 2 contracts under the GO Expansion Program. The team was established in February of 2017.

The Metrolinx GO Expansion program is structured into three work packages. Package 1 consists of active capital projects and early works. Package 2 concentrates on off-corridor works at stations, relating to station access, tunnels, bridges, rail platforms, parking, station and ancillary buildings, and track and signal infrastructure at new stations and existing stations. Package 3 consists of on-corridor works: systems design and civil infrastructure for electrification, signalling, Union Station, tracks, bridges, procurement or rolling stock, and operations and maintenance of the complete system for a period of 30 years.

Due to the vastness and complexity of the GO Expansion program, WSP is involved in multiple projects at various stages, including feasibility studies, preliminary design, procurement and engineering during construction. On all assignments, our teams work closely with Metrolinx, as well as our joint venture partners and other stakeholders, including provincial and municipal authorities to address project challenges across the program by developing customized approaches to meet each project's requirements.


605

Scarborough Subway Extension *Yonge North Subway Extension Line 1*

Location
GREATER TORONTO AREA, ONTARIO, CANADA

Client
TORONTO TRANSIT COMMISSION / METROLINX

Status
ONGOING

YNSE WILL CONNECT
4 Cities

SSE IS PROJECTED TO REDUCE GHG EMISSIONS ANNUALLY
10,000 tonnes

TTC L1 TARGET HORIZON YEAR
2037

WSP has been engaged on three major ongoing subway projects within the Greater Toronto Area (GTA):

Scarborough Subway Extension (SSE) (2015-2030 est.) under Metrolinx will introduce three new stations along a 7.8km north-easterly expansion of the Toronto Transit Commission's (TTC's) Line 2, joining at Kennedy station and ending at Sheppard Avenue and McCowan Road. The project was originally under the TTC, where WSP was engaged to provide overall project management and systems design services including signalling, traction power, communications, and tunnel ventilation in the form of Project Specific Output Specifications and Reference Concept Designs.

Following the provincial uploading of subway programs to Metrolinx, WSP has been re-engaged on the SSE project as subject matter experts. Because of WSP's familiarity with TTC as the end user, the extensive knowledge and exposure to TTC's manuals and specifications, WSP is well positioned to facilitate stakeholder engagement between TTC and Metrolinx.

Yonge North Subway Extension (YNSE) (2020-2030 est.) under Metrolinx is an 8.6km northern extension of the Yonge Street side of TTC's Line 1. Emanating from Finch station, it will introduce four new stations and terminate just past Highway 7 within the Regional Municipality of York. A train storage facility is also included as part of this subway expansion project.

From the outset of the YNSE project, WSP was awarded the role of subject matter experts, again drawing on the expertise and knowledge gained with the SSE project—but beyond the initial systems design services, to expand and incorporate other disciplines and services needed by Metrolinx, such as track alignment, system integration, structural design, and duct banks.

Line 1 Capacity Enhancement (2020-2031 est.) is one half of an overall TTC RFP competition seeking consulting services for each of TTC's Line 1 and Line 2 subways, with the highest scoring bidder being awarded Package 1 (i.e., Line 1). The first stage of this project is to identify key systems that represent a limitation to increasing capacity of the subway line's expected demand growth. The second stage is to perform feasibility studies: explore, assess, recommend improvements and solutions toward overcoming these limitations. Over the 11-year term of the contract, the range of areas to be investigated as well as the engineering services are quite extensive.


6055
UNITE THE NORTH
#STRONGERTOGETHER
DWA

Toronto Transit Commission

Toronto York Spadina Subway Extension (TYSSE)

Location
TORONTO, ONTARIO, CANADA

Client
TORONTO TRANSIT COMMISSION

Status
COMPLETED IN 2008

STATIONS
6

BUS TERMINALS
3

LENGTH
8.6 km

WSP was a member of a joint venture consortium (Spadina Link Project Managers) with two other engineering firms. Spadina Link Project Managers was awarded the Project Management Services contract for the Toronto-York Spadina Subway Extension project (TYSSE) managed by the Toronto Transit Commission (TTC).

TYSSE was the first expansion of the TTC subway system in 15 years. Sponsored by four levels of government—Government of Canada, Province of Ontario, City of Toronto and Region of York—the CAD 3.2 billion TYSSE project was the first time the TTC subway network was extended outside the limits of the City of Toronto.

The TYSSE extended the Spadina subway line by 8.6 km from the existing Downsview Subway Station (now Sheppard West Station) northwest to the York University campus and terminated at the Vaughan Metropolitan Centre in York Region. The project included six new stations, three bus terminals, five emergency exit buildings, four substations, three surface parking facilities, and involved major utility relocations, traffic diversions, bridge construction, and environmental regulation compliance.

The TYSSE project commenced in April 2008 and achieved revenue in service in December 2017. The joint venture's team of approximately 200 people (including more than 50 from WSP) were dedicated to the project. Headquartered at TTC's TYSSE project office as part of an integrated team led by the TTC, WSP provided the following services on the TYSSE project: project management, design management, computer-aided design and drafting management, permitting and approvals, public relations, property coordination, traffic and transportation coordination and subject matter expertise including electrical, structural, mechanical and surveying.

Location
TORONTO, ONTARIO, CANADA

Client
METROLINX

Status
ONGOING

CONTRACT MODEL

Canada's first major alliance procurement project

SERVICE OPERATION

Two-way, all-day service every 15-minutes

TRANSIT INFRASTRUCTURE

Two new wide GO train platforms

Union Station *Enhancement Project (USEP)*

As Union Station was built nearly a century ago, significant improvements are needed at the station and across the GO Transit network to meet growing ridership demand and support future service increases. Within the Union Station Rail Corridor (USRC) program, there are multiple projects in planning and implementation, one of which is USEP.

USEP is a GO Expansion Enabling Works project that is required in advance of the On-Corridor (OnCorr) Works project in order to facilitate future track closures for the reconstruction of platforms within the existing trainshed, and to optimize the overall OnCorr Works construction schedule. This project is the first major Canadian project that utilizes the Alliance contracting model for project procurement and delivery.

WSP is a prime team member and lead designer as part of the ONTrack Alliance team. WSP provided design in relation to all required disciplines including building and rail corridor design. Overall scope highlights include structural modifications between two bridges to open access between York and Bay Street, station platform modifications, a new signal system, all associated drainage systems in the rail corridor, BIM modelling, and systems engineering and integration including defining project requirements and tracking throughout the design.

USEP scope includes construction of new platforms with canopies and vertical access elements including stairs and elevators. The construction of two new tracks that allow future passenger trains to travel at higher speeds. Construction of new concourse area below the new platforms that will connect York, Bay, Via Concourse, Union Scotiabank Galleria, and both York and Bay Streets.

In addition, ONTrack Alliance team, which is made up of Metrolinx, Infrastructure Ontario, Kiewit, Alberici, WSP Canada Inc. (WSP), and MASS Electric, has achieved ISO 44001:2017 Collaborative Business Relationships certification. The team's collaborative relationship management system for the Union Station Enhancement Project (USEP) is the first in Canada to meet all the requirements for this international standard.

USEP will optimize rail capacity in the south train shed, provide additional station capacity and connectivity throughout the station, and enable the GO Expansion program (OnCorr). The completion of the USEP scope of work will allow for greater train and pedestrian capacity throughout the station.

Image created by A49 as part of ONTrack Alliance

Union Station *Rail Corridor Signalling System Project*

Location
TORONTO, ONTARIO, CANADA

Client
METROLINX

Status
ONGOING

STATION TRACKS
14

SIGNALS
180

SWITCHES
250

WSP is a part of the Alstom joint venture Team that was awarded a CAD 500 million contract for the replacement of signals as well as electrical and communications infrastructure with modern, state-of-the-art equipment to provide a flexible and an efficient system capable of supporting the service patterns and volumes forecast for the next 30 years.

WSP is responsible for providing professional engineering and design services for this multi-disciplinary project, which requires numerous entities within and outside of WSP to work in collaboration for the successful completion of the client's deliverables. In addition, WSP provides project management, schedule management, quality assurance, civil inspection and testing, surveying, environmental services, cost control and document control for the entire project lifecycle as it relates to the WSP design scope.

WSP is also responsible for the management of subsystem requirements including derivation of requirements, determination of verification and validation attributes, and requirements traceability for the WSP design scope using IBM Rational DOORS. Following the notice to proceed, WSP was approached by Alstom directly to assist with requirements management in another subsystem.

Electrical scope includes the design of electrical bungalows and wayside power cases for redundant power supply to the signalling system and other related wayside devices, system-wide cable routing, as well as cable trough and conduit layouts.

Mechanical scope includes the design of fire detection and suppression, redundant HVAC for electrical and signalling bungalows, natural gas piping for supply of switch clearing devices (heaters), as well as building information modelling (BIM) of the signalling and electrical bungalows.

The success of this project represents the continuation of a mutually beneficial and ultimately successful relationship between WSP and Alstom, a partnership that came together to secure the contract for the Union Station Rail Corridor's sister project, the GO Transit Train Control System, and will likely do so again to deliver future rail projects in the Greater Toronto and Hamilton Area.

Dulles Corridor *Metrorail Project*

Location
FAIRFAX AND LOUDOUN COUNTIES, VIRGINIA, UNITED STATES

Client
VIRGINIA DEPARTMENT OF RAIL AND PUBLIC TRANSPORTATION*

WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY

METROPOLITAN WASHINGTON AIRPORTS AUTHORITY

Status
ONGOING

LENGTH
37 km

STATIONS
11

CAR STORAGE CAPACITY
250

WSP has played a role in the development of the USD 6.01 billion (CAD 8 billion) Dulles Corridor Metrorail Project for more than 25 years. The purpose of the project is to provide high-quality, high-capacity transit service in the Dulles Corridor.

WSP led the development of the Alternatives Analysis and Major Investment Study for the Virginia Department of Rail and Public Transportation (DRPT), which advanced to the selection of the alignment and modal alternative.

WSP was part of a joint venture providing general engineering consultant services for the Washington Metropolitan Area Transit Authority (WMATA), which included preparing the environmental impact statement and conceptual engineering for the Silver Line extension project. The team provided financial planning and New Starts project development services that helped secure the project's Record of Decision from the Federal Transit Administration (FTA) and provided the basis for FTA project funding and selection of the public-private partnership delivery method used to build the project. WSP led the design of the alignment and structures and site-selection process for the operation and maintenance facilities.

WSP then served as the lead in the Dulles Rail Consultants joint venture completing preliminary engineering and preparing the design-build procurement solicitation package for the Phase 2 Silver Line 18.3km extension from Wiehle Avenue through Dulles International Airport to Ashburn. Project elements included at-grade and aerial segments; median-running stations and associated automobile, bus, bike and pedestrian access/egress; parking garages at four of the five stations; a signature station at Dulles Airport; and associated roadway improvements, surface parking lots, station facilities, utility relocations, substations, guideways, rail tunnels, maintenance and overhaul shop and a 250-rail car storage facility.

WSP managed design activities; topographic surveys; geotechnical investigations; station planning and design; systems, civil and structural engineering; architectural design; right-of-way requirements; cost estimates; lifecycle analysis; utility relocation plans; review/updates of environmental documents; and extensive coordination with federal, state and local agencies. The work also included preparation of design-build performance specifications, performance criteria, and design criteria for track work, systems and stations.

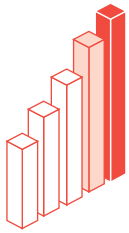
WSP provided direct support to the Metropolitan Washington Airports Authority (MWAA) during the development of the design-build solicitation documents and continues to support the Authority in addressing design and construction issues that arose during that phase of the project.

*Client varies by assignment—Environmental Impact Statement was completed with the Washington Metropolitan Area Transit Authority, and design and construction is being completed by the Metropolitan Washington Airports Authority (MWAA)

International Agility

66,200

EMPLOYEES



8.9B

2022 NET REVENUES* (CAD)

*Non-IFRS measure

ENR
Engineering News-Record

Top International Design Firm

#1

TRANSPORTATION

#1

MASS TRANSIT AND RAIL

Source: ENR Global Sourcebook 2022

Our Guiding **Principles**

We value our people and our reputation.

We are locally dedicated with international scale.

We are future-focused and challenge the status quo.

We foster collaboration in everything we do.

We have an empowering culture and hold ourselves accountable.

Our Urban Passenger Rail *Community*

Global

Eric Peissel
+1 514 346 7336
eric.peissel@wsp.com

Australia

Sam McWilliam
+61 409 600 279
sam.mcwilliam@wsp.com

Canada

Jennifer Verellen
+1 647-531-3194
jennifer.verellen@wsp.com

Chile

Velko Zuvic A.
+ 56 9 6587 9213
velko.zuvic@wsp.com

Colombia

Javier E. Lancheros
+ 57 310 854-8159
javier.lancheros@wsp.com

Denmark

Rasmus Walter
+ 45 27643624
rasmus.walter@wsp.com

Germany

Martin Baitinger
+49 151 51029140
martin.baitinger@wsp.com

Hong Kong

Joseph Wong
+852 2579 8615
joseph.wong@wsp.com

Malaysia

David Starbuck
+60 322957816
david.starbuck@wsp.com

Middle East

Ahmed Fouda
+971 50 772 1260
ahmed.fouda@wsp.com

Nordics

Eva Helena Dahl
+46 76 8343047
evahelena.dahl@wsp.com

New Zealand

Sean Myers
+64 9 918 5166
sean.myers@wsp.com

Singapore

James Pang
+65 6395 7756
james.pang@wsp.com

South Africa

Tshepo Motsie
+27 78 310-9515
tshepo.motsie@wsp.com

United Kingdom

Darren Reed
+44 20 7337 8672
darren.reed@wsp.com

Pradeep Vasudev
+44 79 2110 6744
pradeep.vasudev@wsp.com

United States

Jannet Walker-Ford
+904 540 3504
jannet.walker-ford@wsp.com

Can we anticipate the unforeseeable,
perceive the unexplainable,
and plan something unbelievable?

What if we can?

WSP Global Inc.
1600, René-Lévesque Blvd. W.
16th Floor
Montreal, Quebec
H3H 1P9

wsp.com