South Shore Access Project: At-Grade Road Reconfiguration and Improvements

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Abstract

The South Shore Access Project reduces Port of Vancouver traffic congestion via the construction of a multi-span overpass for truck vehicles that provides a direct access to the Centerm Container Terminal and segregates the major traffic from existing at-grade rail crossings. The existing road including the portion below the new overpass was re-purposed to a 1.95 km long local access road connecting to other industrial facilities, accessible via either end of the new overpass. The South Shore Access Project was developed in conjunction with the Centerm Expansion Project, together providing for an increase of 67% of throughput capacity of the terminal while simultaneously reducing greenhouse gas emissions associated with its operation.

The design of the local access road accommodated numerous site constraints including those imposed by the new overpass and existing infrastructure, especially adjacent the historic Rogers Sugar building. The access road (Stewart Street) in front of this building was restrained to a width for single lane traffic only to be shared by a rail siding for the facility. This segment of road was designed with automatic road and train signaling systems for bi-directional vehicle traffic and train use independent of each other. Sensors, traffic lights and train gates were implemented to regulate traffic for safe passage. At the east end of the project near the Clark Road vehicle access control gates, a roundabout was designed to provide for 10 separate traffic movements in an efficient manner. A loop ramp was designed at the mid-length of the road (Centennial Road) to direct terminal arrival/departure truck

traffic and local traffic road usage. At the western extent, the existing East Waterfront Road was extended to connect to West Waterfront Road providing for through access to Main Street and beyond. This allows for all Port traffic to remain within the industrialized area and facilitated the removal of the Heatley Overpass to the Downtown East Side

The South Shore Access Project provides a continuous Port road from Canada Place to Highway 1 with minimal disruption from at-grade crossings, with the reconfigured 1.95 km at-grade road maintaining local access to all Port tenants and providing improved routing optionality. Complex geometric modeling of the reconfigured network as well as advanced solutions such as road sensors, automated monitoring, signalization and dynamic messaging all contribute to the enhance resulting traffic flow.

The on-terminal Centerm Expansion Project received the 2023 Canadian Consulting Engineering Award in the Transportation Category. This paper is intended to illustrate the associated off-terminal road enhancements that provide the necessary logistics improvements, their objectives and methodology in detail.

Project Location and Traffic Management Features

The Port of Vancouver is the largest port in Canada and the fourth largest in North America by tonnes of cargo, facilitating trade between Canada and more than 170 world economies. The South Shore Access Project is the off-terminal work of the Centerm Expansion Project. Centerm is an existing container terminal on the south shore of Vancouver's inner harbour and handles one-fifth of goods shipped in containers through the Port of Vancouver. The Centerm Expansion Project and South Shore Access Project comprise a series of improvements, with a capital cost exceeding $400 million, that increase both throughput and sustainability of the terminal.

The road network is a critical component of this project, and significantly improves the movement of goods to and from the Port of Vancouver by providing rail and road grade separation (the Centennial Road Overpass) for through traffic, and eliminates delays caused by active rail crossings. As part of this project, an at-grade service road is maintained under the overpass, providing access to other terminal tenants, transport of oversized loads, and alternative routing for other traffic including emergency vehicles. The result of the revised configuration is dramatically increased traffic capacity and reduced delays for all traffic to and from terminals on Vancouver's south shore. The overpass is essential to the goal of increasing Centerm' s throughput by 67% to 1.5 million 20-foot equivalent unit containers (TEUs), while only increasing its physical footprint by 15%.

The Project is in East Vancouver at the north end of Main Street along Waterfront Road and extends 1.95 km eastward to connect Centennial Road and Stewart Street at the north end of Clark Drive. The at-grade road generally consists of one eastbound and one westbound lane and a single sidewalk for shared pedestrian and cycle use. The following are also incorporated in the design along this roadway (figure 2):

- Accesses for six reconstructed or existing staff parking lots;
- T intersections for facility access;
- Truck gates for entry and exit of the Centerm Container Terminal;
- Approaches to the Centennial Road Overpass;
- Loop ramp for VFPA Maintenance Building and Rogers Street;
- Lantic West access;
- Roundabout at Clark Drive;

- Project Cargo Connection i.e. oversize vehicle access;
- Rogers Street Alternate Access i.e. a 5m wide single-lane, two-way signalized service road below the Centennial Road Overpass;
- At grade track crossings;
- 1.5 m wide sidewalk throughout, except at Rogers Street Alternate Access

The project was designed to work cohesively with adjacent terminals, businesses, and railways, all of which remained operational during construction. Detailed construction staging and access planning were thus key elements of the design brief.

The design of the single lane counterflow road with train occupancy was to overcome the most geometrically constrained area on the project (Figure 1). The Rogers Street Alternate Access is restricted by the train yard and the Rogers Sugar Building. The counterflow was also required to accommodate the train operation in front of the building. In addition, the spatial requirement for constructing the foundation and substructure of the Centennial Road Overpass within the width of the existing road also posed significant challenges on designing this segment of the road network.

Figure 1. Rogers Street Alternate Access nearing construction completion

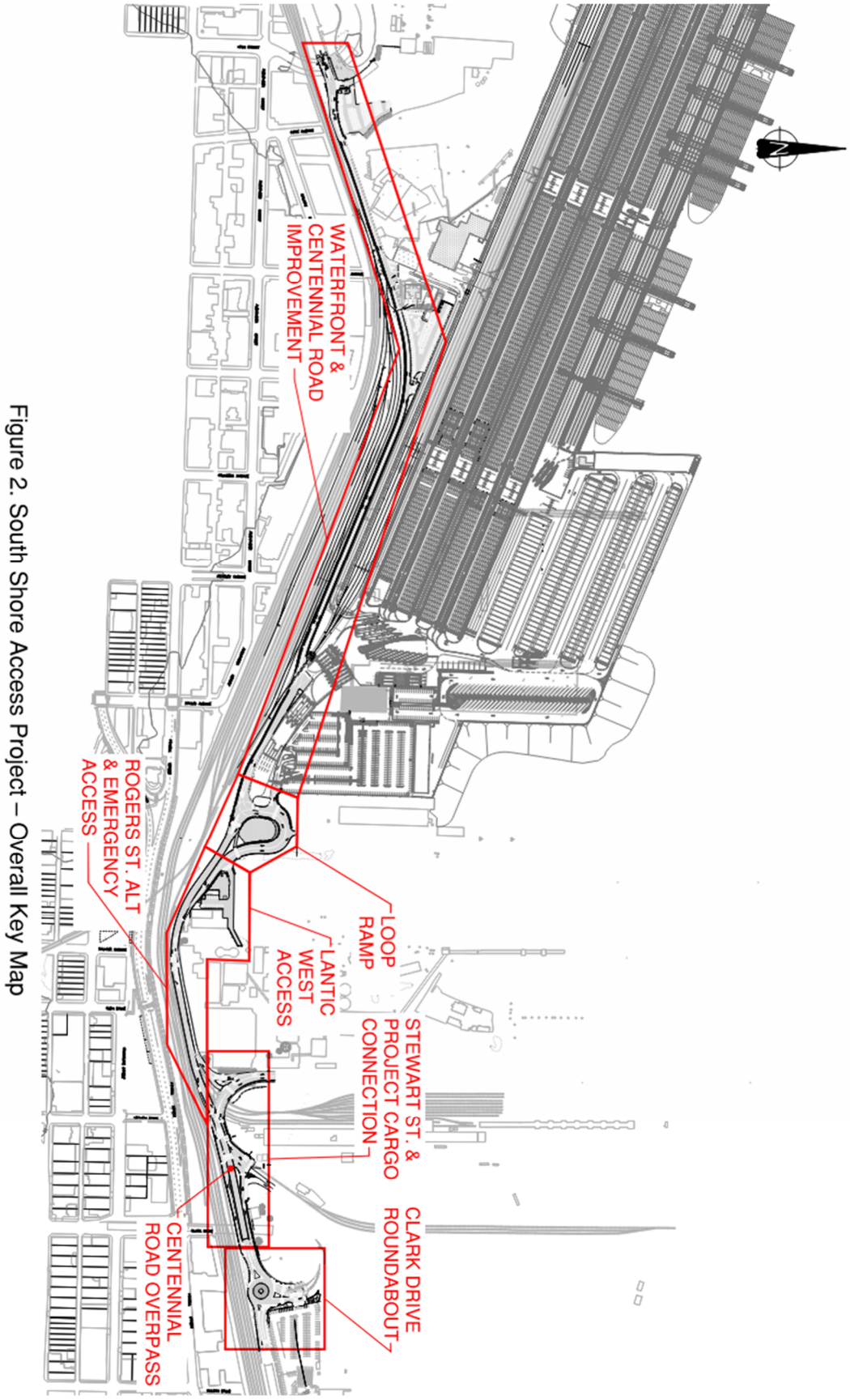


Figure 2. South Shore Access Project – Overall Key Map

Road Network of the South Shore Access Project

The 1.95 km road improvement of this project consists of the following areas from west to east (see figure 2 on page 6):

- Waterfront Road improvement and extension;
- Centennial Road reconfiguration;
- VFPA Maintenance Building loop ramp;
- Lantic West Access;
- Rogers Street Alternate Access and Emergency Access Route;
- Project Cargo Connection;
- Stewart Street reconfiguration;
- Centennial Road Overpass;
- Clark Drive and Stewart Street Intersection/roundabout

The geometry of each area was specified and designed to meet the port and terminal operational requirements. The areas interface with each other, with the objective to improve emergency response, streamline traffic and movement of goods between the road and rail, and the local users.

Waterfront Road Improvement and Extension

The proposed Waterfront Road alignment starts under the Main Street Overpass and ends at Centennial Road. The design upgraded and improved the existing Waterfront Road and required new roadway infrastructure works to connect the extension to Centennial Road. The geometric design of the roadway is following the Off-Terminal Roadways Geometric Design Criteria table below. The proposed roadway includes 3.5 m wide lanes in each direction along with a 1.5 m wide pedestrian pathway on the south side. The proposed design maintains all of the existing accesses, including Main Street Dock, Canfisco, Mission to Seafarers, Centerm CSSF, CP Rail's Dunlevy Avenue railway crossing and swing gate, and the CP Rail corridor on the south side of Waterfront Road, immediately east of the Main Street Overpass. The accesses accommodate design vehicle and turning movements as indicated in the figures below. WB-20 design vehicle as defined by the Transportation Association of Canada is designed for maneuvering over the roadway infrastructure as required by the project requirements.

Off-Terminal Roadways Geometric Design Criteria - Waterfront Road Extension									
Classification	Posted Speed	Design Speed	Design Vehicle	Number of Basic Lanes	Min. Radius	Min. Grade	Max. Grade	Min. K Crest	Min. K Sag
UCU	50km/h	50km/h	WB-20	2	125m	0.5%	3.0%	7	6

Off-Terminal Roadways Geometric Design Criteria - Waterfront Road Extension									
Superelevation	Lateral Friction Factor	Min. Crossfall	Max. Crossfall	Min. Stopping Sight Distance	Min. Lane Width	Max. Lane Width	Shoulder Width Outside	Shoulder Width Inside	Sidewalk Width
Normal Crown	0.18	2.0%	2.0%	65m	3.5m	3.5m	0.5m	N/A	1.5m

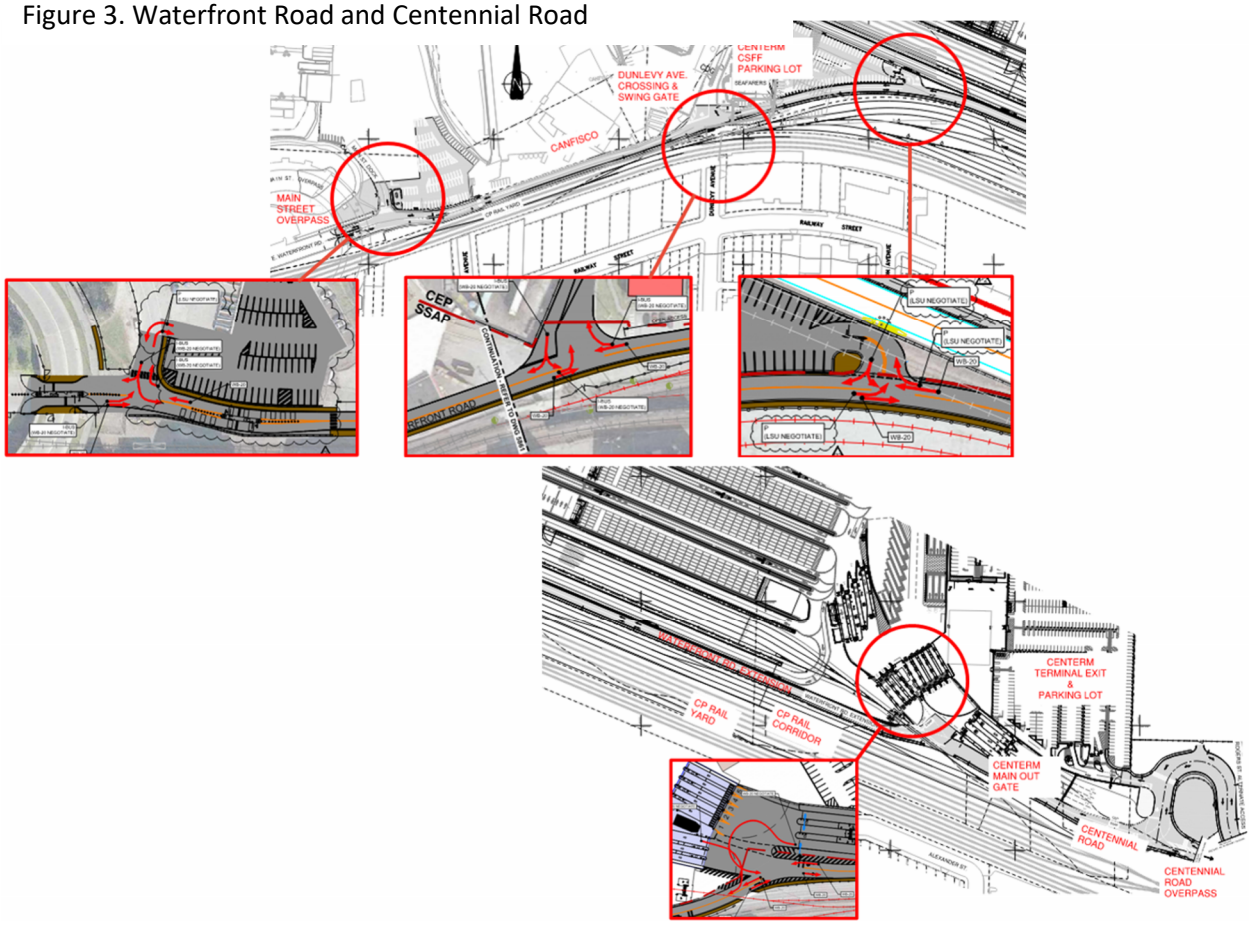
Centennial Road

The proposed alignment starts at a Centerm main out gate intersection and ends at the Centennial Road Overpass (CROP). The intersection connects the Waterfront Extension road, Centennial Road and the Centerm Terminal exit. The roadway includes 3.5 m wide lanes in each direction with a raised 1.5 m wide pedestrian pathway on the south side. Access to the Centerm operators and office employee parking lot (Centerm COF) and Centennial Road through a T-intersection, with priority given to through traffic movement on CROP. A dedicated left-turning lane was provided at the Centerm Terminal intersection with capacity to store at least three passenger vehicles clear of the eastbound traffic lane leading to CROP.

Off-Terminal Roadways Geometric Design Criteria - Centennial Road									
Classification	Posted Speed	Design Speed	Design Vehicle	Number of Basic Lanes	Min. Radius	Min. Grade	Max. Grade	Min. K Crest	Min. K Sag
UCU	50km/h	50km/h	WB-20	2	125m	0.0%	3.0%	7	6

Off-Terminal Roadways Geometric Design Criteria – Centennial Road									
Superelevation	Lateral Friction Factor	Min. Crossfall	Max. Crossfall	Min. Stopping Sight Distance	Min. Lane Width	Max. Lane Width	Shoulder Width Outside	Shoulder Width Inside	Sidewalk Width
N/A	0.18	0%	3.0%	65m	3.5m	N/A	0.5m	N/A	1.5m

Figure 3. Waterfront Road and Centennial Road

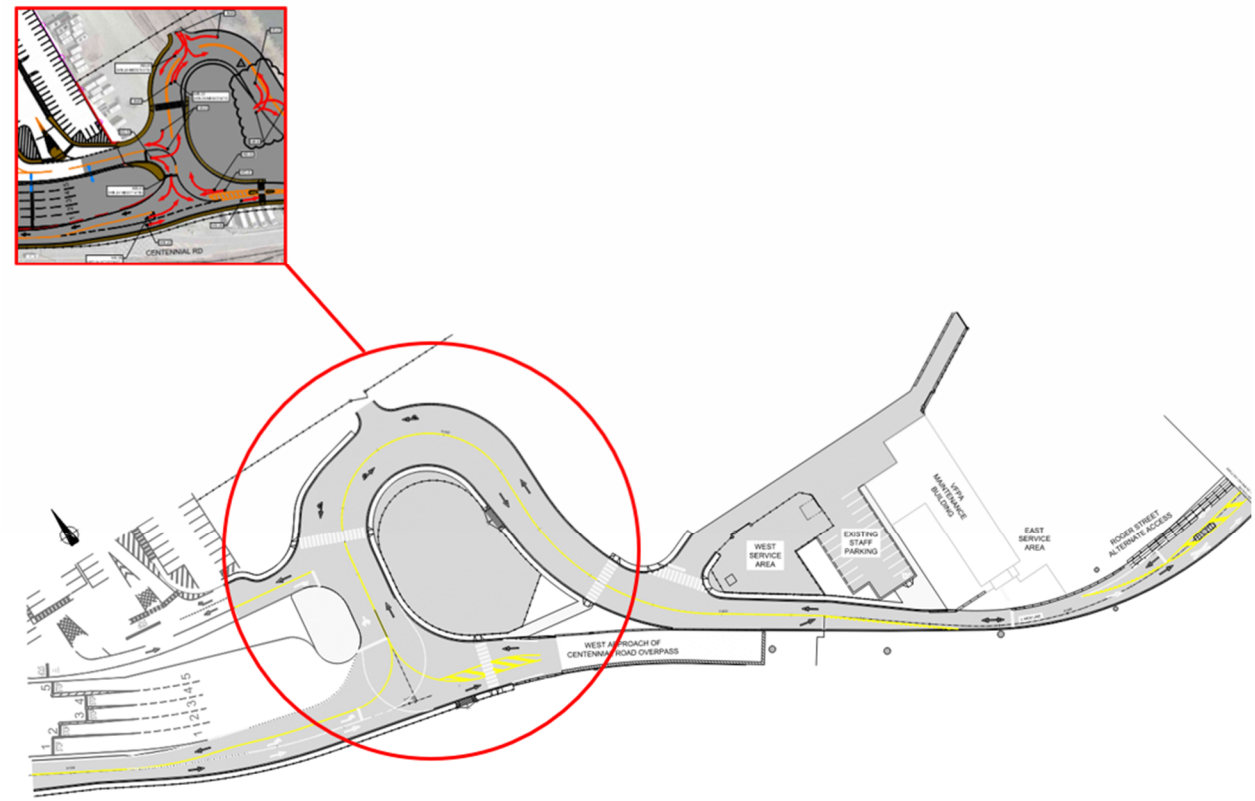


VFPA Maintenance Building Loop Ramp

The loop ramp connecting to the west approach of the Centennial Road Overpass was designed to allow accessing the Maintenance Building clear of any and all signals and vehicle detection systems associated with the counter-flow lane operation on the Rogers Street Alternate Access below the overpass. The access was also tied into the existing staff parking area, east service area, and a new service area to the west of the staff parking area. Each area was reconfigured as necessary to accommodate the new access, ensuring no net loss in staff parking stalls, and not restricting vehicle movements in any way. The existing, southern accesses to the staff parking area and service area to the east of the facility is closed except that I-BUS design vehicle access between Rogers Street Alternate Access and the east service area must be permitted under signalized traffic control incorporated into the counter-flow lane operation on Rogers Street Alternate Access. The access has a minimum width of 6.5m, graded such that the maximum grade does not exceed 5% in any direction, and paved with asphalt supported by appropriate granular material designed for CL-625 loading. Other features include:

- Type F0 security fencing completed with an automated and chain-link cantilever gate;
- Gate control and monitoring;
- Regulatory signage similar to BCMoTI sign R-009-2 with R015-Tc;
- Illuminated roadway for night time use;

Figure 4. VFPA Maintenance Loop Ramp

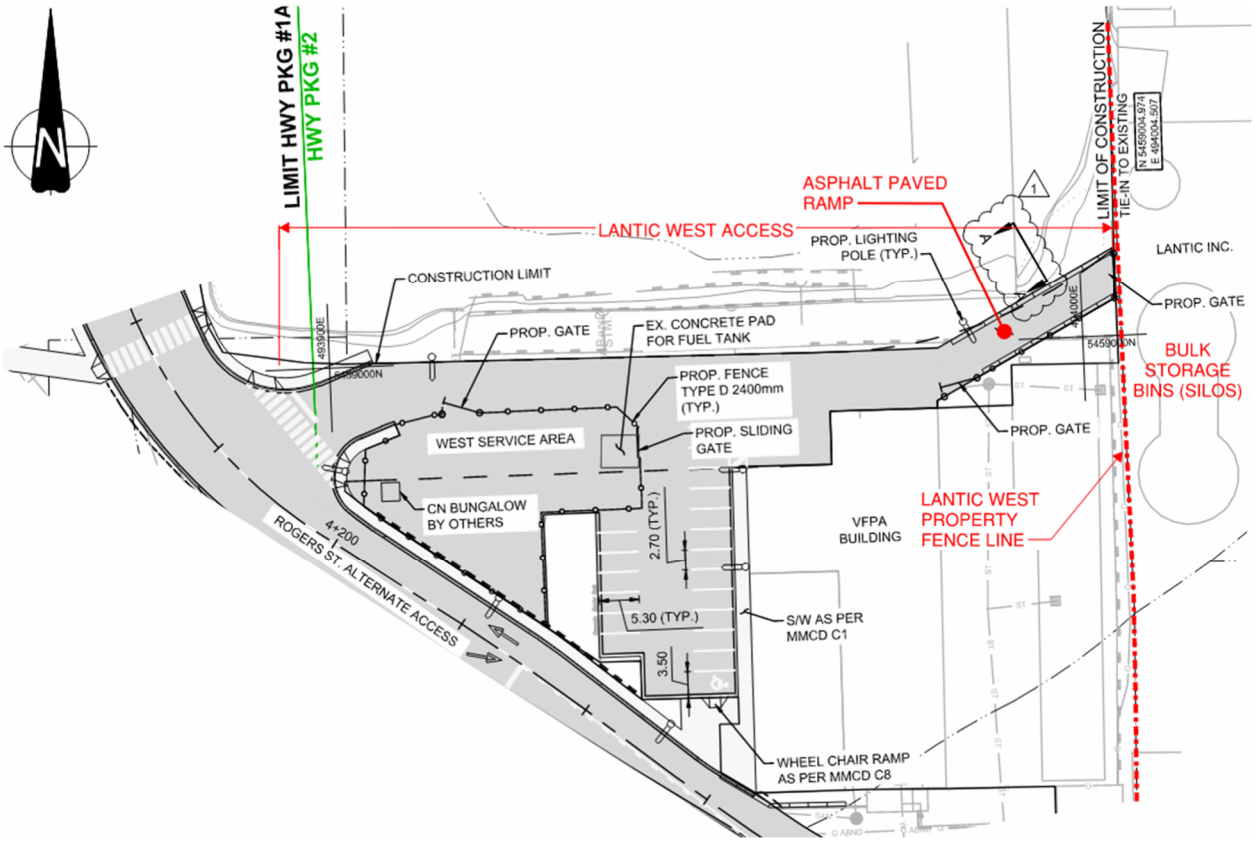


Lantic West Access

An asphalt paved ramp was designed to connect the Lantic facility. This new vehicular access, referred to as the Lantic West Access was provided to Lantic's western property line, north of the bulk storage bins (silos) and south of the No. 3 Hotweel. The area north of the VFPA Maintenance Building, staff parking lot and west service area was repurposed for this access and is connected to the Loop Ramp and the Rogers Street Alternate Access. The ramp is 4.5 m wide and graded such that it ties into the existing Lantic facility. The maximum grade does not exceed 5% in any direction. Grade breaks did not exceed 5%. Pavement with asphalt and granular material was design for the Canadian Highway Bridge Design Code CSA-S6 CL-625 Highway Truck Loading.

Signage and pavement markings were designed to indicate that the area shall be kept clear at all times;

Figure 5. Lantic West Access



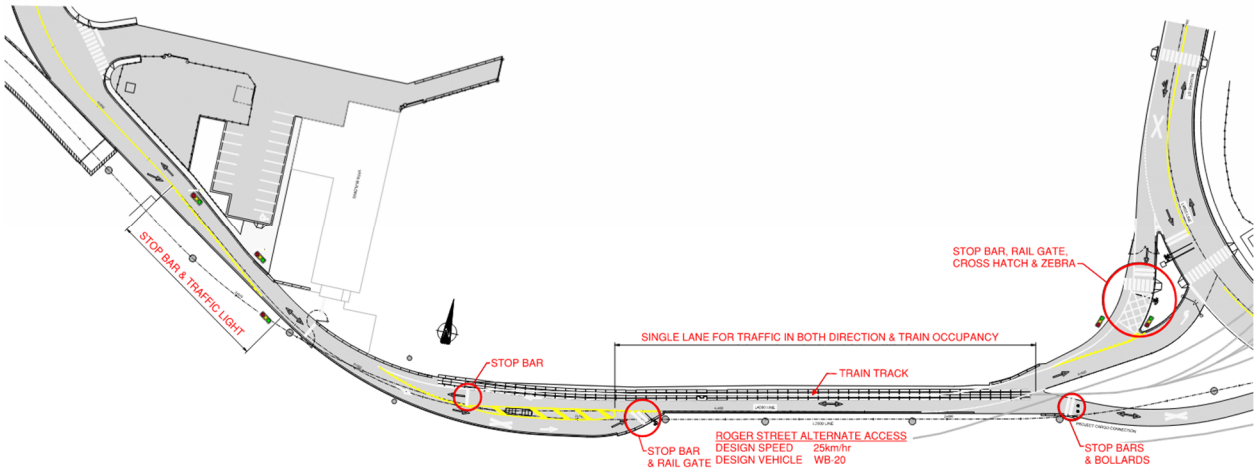
Rogers Street Alternate Access and Emergency Access Route

Rogers Street Alternate Access consists of a single lane counter-flow arrangement between VFPA Maintenance and Rogers Street including a separate phase to control service vehicles departing from the southern access to the east service area at VFPA Maintenance, as a part of Rogers Street Alternate Access. Traffic signals were installed at either end of the single lane roadway, and at the southern access to the east service area at VFPA Maintenance, in order to control counter-flow traffic. Actuated controllers were used and include vehicle detection, on both approaches to the signal, and at the southern access to the east service area at VFPA Maintenance, through the use of in-ground vehicle loops; Additional vehicle detection were provided to detect vehicle movement along the single lane

roadway and extend the phase time, as necessary, to provide sufficient clearance time for slow moving vehicles to transit the length of the roadway. Signal crossing gates were designed to control traffic and at-grade track crossings. As Rogers Street is managed by City of Vancouver, construction of Rogers Street north of the Lantic tail track has been constructed in accordance with their construction specifications.

This segment of the road is also part of the emergency access route. The design provided fire truck access to the hydrants without occupying the Lantic tail track along Stewart Street adjacent the Rogers Sugar Building. Pedestrian route was designed to connect Rogers Street and VFPA Maintenance Building.

Figure 6. Rogers Street Alternate Access and Emergency Access Route



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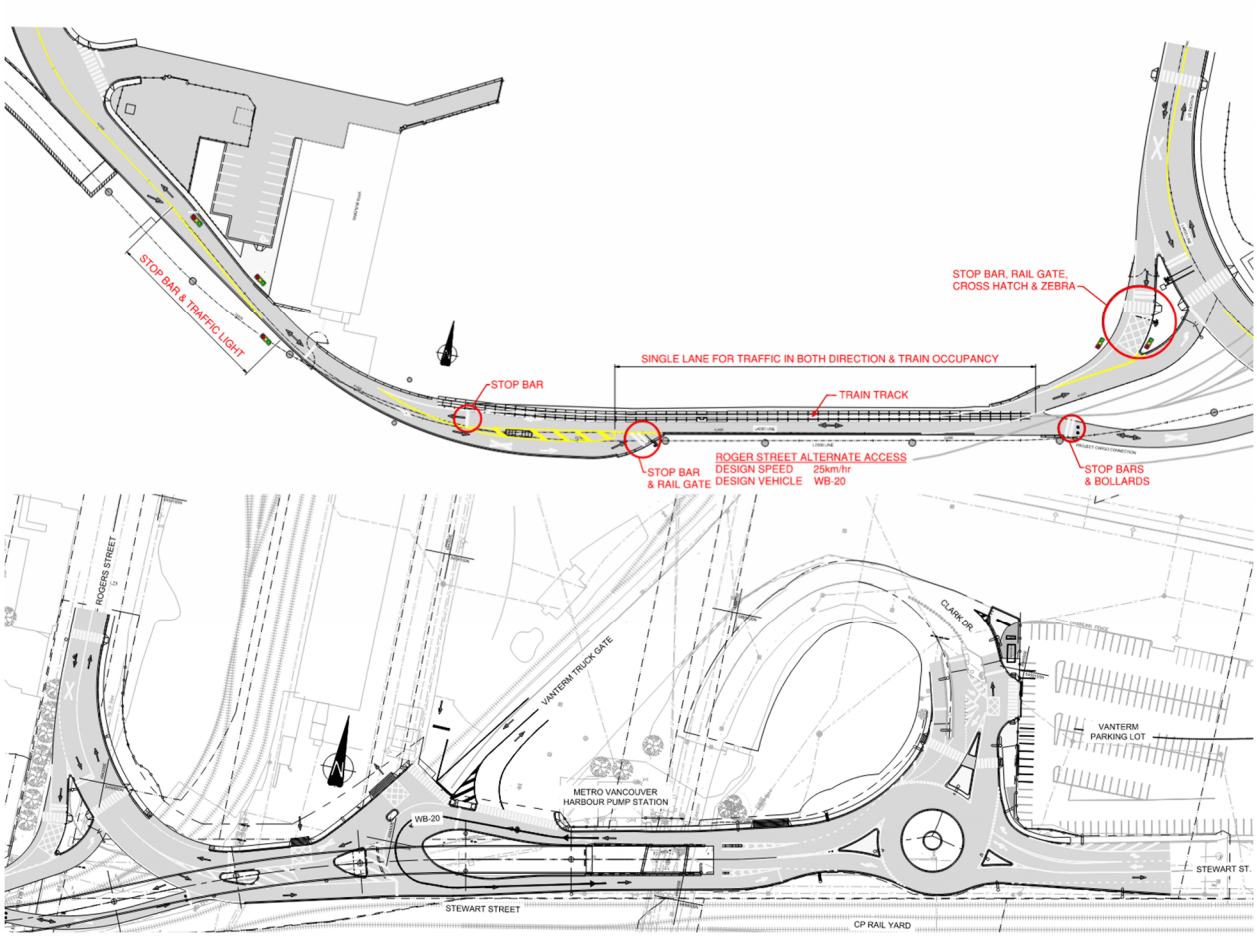
Off-Terminal Roadways Geometric Design Criteria – Rogers Street Alternate Access									
Classification	Posted Speed	Design Speed	Design Vehicle	Number of Basic Lanes	Min. Radius	Min. Grade	Max. Grade	Min. K Crest	Min. K Sag
ULU	20km/h	25km/h	WB-20	2	21m	0.0%	3.0%	2	2

Off-Terminal Roadways Geometric Design Criteria – Rogers Street Alternate Access									
Superelevation	Lateral Friction Factor	Min. Crossfall	Max. Crossfall	Min. Stopping Sight Distance	Min. Lane Width	Max. Lane Width	Shoulder Width Outside	Shoulder Width Inside	Sidewalk Width
N/A	0.25	0%	3.0%	25m	4m	6m	0.5m	N/A	1.5m

Project Cargo Connection

The Project Cargo Connection was designed to cater for WB-24 cargo movement and fire trucks access from the east, via Stewart Street, and from the west via Rogers Street Alternate Access. Bollards and signage were used to restrict access to Project Cargo Connection. The bollard system allows fire truck access using push-over type bollards which do not damage the bollard or the vehicles and be able to be re-set, in all weather conditions by VFPA Maintenance staff without the need for special tools or parts other than shear pins or similar. The design also accommodated at-grade railway crossings for AGT and Vanterm West. In additional, the minimum number of design ESALs for Project Cargo Connection, Rogers Street Alternate Access and Waterfront Road Extension is 1,000,000 per lane.

Figure 7. Project Cargo Connection



Off-Terminal Roadways Geometric Design Criteria – Project Cargo Connection									
Classification	Posted Speed	Design Speed	Design Vehicle	Number of Basic Lanes	Min. Radius	Min. Grade	Max. Grade	Min. K Crest	Min. K Sag
ULU	Negotiation Only	Negotiation Only	WB-24	1	N/A	0.0%	3.0%	N/A	N/A

Off-Terminal Roadways Geometric Design Criteria – Project Cargo Connection									
Superelevation	Lateral Friction Factor	Min. Crossfall	Max. Crossfall	Min. Stopping Sight Distance	Min. Lane Width	Max. Lane Width	Shoulder Width Outside	Shoulder Width Inside	Sidewalk Width
N/A	N/A	0%	3.0%	N/A	4.0m	6.0m	Varies	N/A	N/A

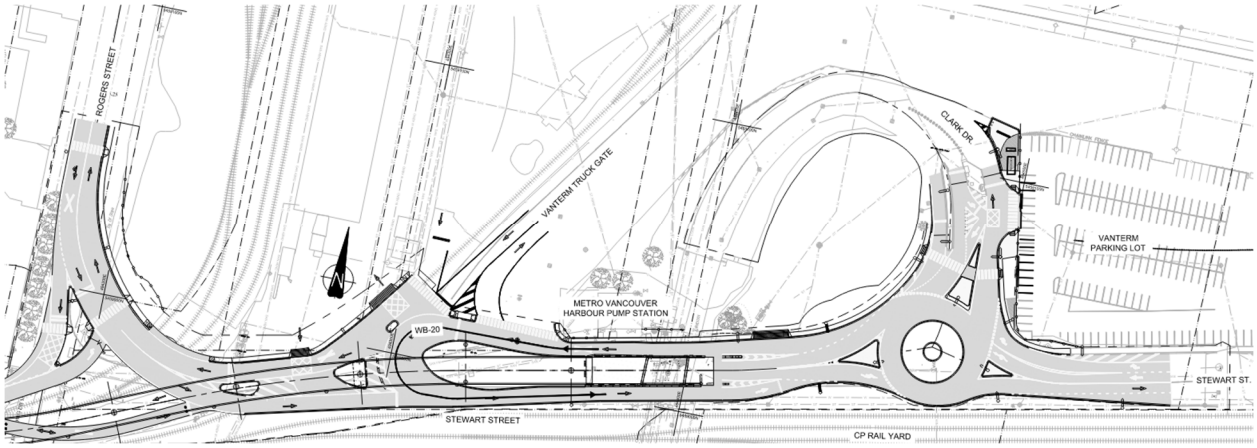
Stewart Street

Stewart Street starts at Rogers Street and end just after the intersection with Clark Drive. The design addressed utility constraints, the existing rail track, and the CROP pier locations.

The street design is at-grade at the Vanterm parking lot, Metro Vancouver Harbour Pump Station, Vanterm truck gates, Alliance Grain Terminal (AGT), and Rogers Street. Modifications to the Vanterm intersection design allows U-turn movement for westbound container trucks (WB-20) and prevents intersecting the clearance envelope of the existing Vanterm rail track.

A pedestrian facility with a raised concrete sidewalk and a delineated pathway was constructed between Rogers Street and Clark Drive. Concrete roadway barriers was constructed to protect the pathway at places where it is not separated from the road.

Figure 8. Stewart Street



Off-Terminal Roadways Geometric Design Criteria – Stewart Street									
Classification	Posted Speed	Design Speed	Design Vehicle	Number of Basic Lanes	Min. Radius	Min. Grade	Max. Grade	Min. K Crest	Min. K Sag
UCU	40km/h	40km/h	WB-20	2	66m	0.0%	6.0%	4	4

Off-Terminal Roadways Geometric Design Criteria – Stewart Street									
Superelevation	Lateral Friction Factor	Min. Crossfall	Max. Crossfall	Min. Stopping Sight Distance	Min. Lane Width	Max. Lane Width	Shoulder Width Outside	Shoulder Width Inside	Sidewalk Width
N/A	0.21	0%	3.0%	45m	4.0m	N/A	Varies	Varies	1.5m

Centennial Road Overpass

The Centennial Road Overpass is a two-lane bridge structure constructed as part of the on-shore improvements for the Centerm Expansion Project and South Shore Access Project. The structure is comprised of a 3.3 m lane in both directions, with a minimum of a 1 m shoulder. The western approach embankment is a typical pair of retaining walls backfilled with soil. The eastern approach embankment utilizes EPS. In order to achieve required clearances below, both of the approach embankments are at the maximum allowable grade of 8%. This steep grade combined with horizontal curves at the west end required additional stopping sight distance resulting in shoulder widening.

The minimum allowable radius according to project specific in the Table below is 125 m. Due to the steep grades, this number was adjusted as per the BC MoTI supplement to TAC to 150 m. The minimum radius in the current design is 160 m which exceeds the calculated minimum.

Figure 9. The Centennial Road Overpass

Off-Terminal Roadways Geometric Design Criteria – Centennial Road Overpass									
Classification	Posted Speed	Design Speed	Design Vehicle	Number of Basic Lanes	Min. Radius	Min. Grade	Max. Grade	Min. K Crest	Min. K Sag
UCU	50km/h	50km/h	WB-20	2	125m	0.5%	8.0%	7	6

Off-Terminal Roadways Geometric Design Criteria – Centennial Road Overpass									
Superelevation	Lateral Friction Factor	Min. Crossfall	Max. Crossfall	Min. Stopping Sight Distance	Min. Lane Width	Max. Lane Width	Shoulder Width Outside	Shoulder Width Inside	Sidewalk Width
Normal Crown	0.18	2.0%	2.0%	65m	3.3m	3.3m	1.0m	N/A	N/A

Clark Drive Overpass and Stewart Street Intersection

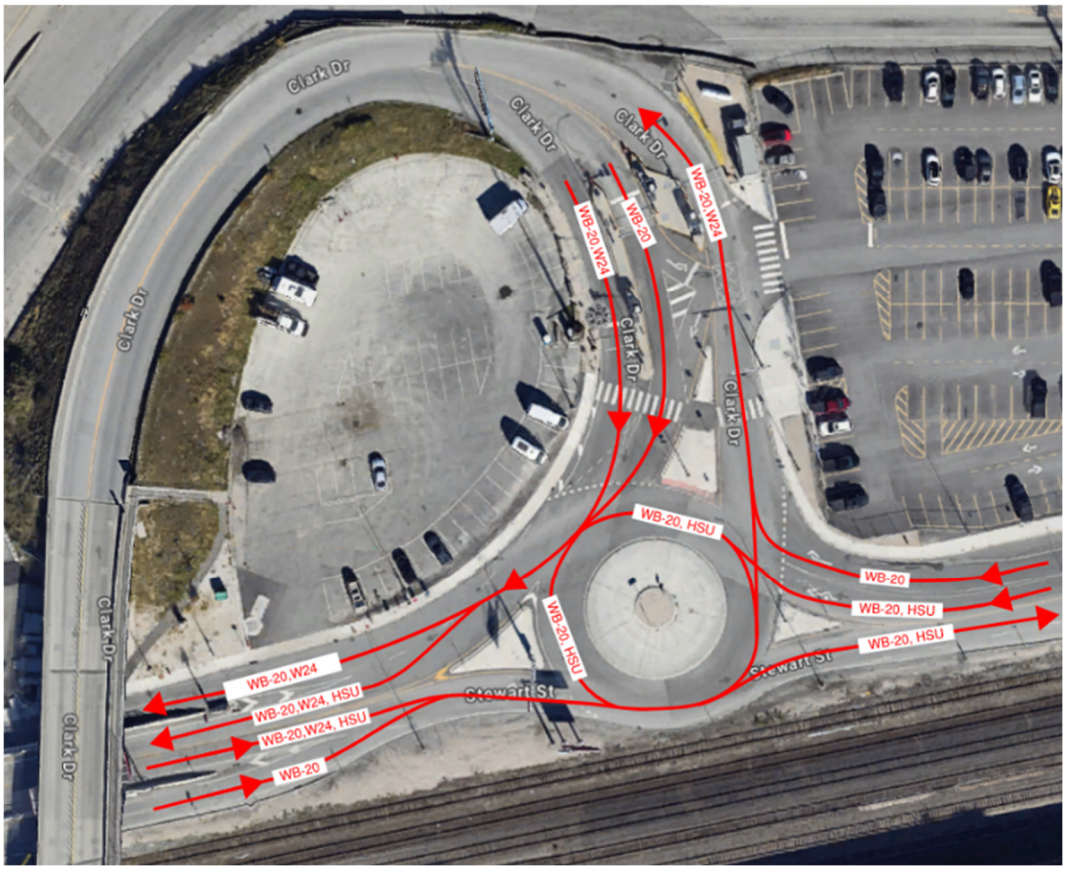
Minor improvements were made to Clark Drive, mainly to align the proposed roundabout geometry to match with the existing parking lot and the security gate. Channelization improvements to align with the planned roundabout optimized functionality. Improved access to the existing parking area on the northeast corner of Cark Drive and Stewart Street was also included.

A roundabout intersection was designed for the solution to cater to the needs of existing and future traffic accessing port. The importance of the intersection has been thoroughly assessed as it directly impacts the inbound and outbound container traffic operation efficiency.

The roundabout and all the road networks considered recommendations based on Road Safety Audit during design development. The proposed design consists of a single lane roundabout and satisfies the project design criteria for geometric and traffic operational requirements. The project specific turning movement counts for morning and evening peak hours have been adopted for the traffic operational analysis, which suggests that the intersection meets the project performance criteria. The roundabout design addresses the WB-20 design vehicle requirement to not to encroach upon the truck apron for the following the movements:

- Clark Drive Overpass to Centerm/Vanterm
- Commissioner Street Overpass to Centerm/Vanterm
- Centerm/Vanterm to Commissioner Street

Figure 10. Vehicle Turn Templates for the Roundabout



Design Approach

Hatch aimed for a collaborative approach to the design in order to achieve a cost-effective solution for all stakeholders with minimal operational impact through construction. In the pre-construction stage, value-engineering was performed for the best value between the utility relocation concepts versus the utility protection and monitoring configuration eventually adopted at the Rogers Street Alternate Access. An extensive utilities identification program was developed with the contractor and in conjunction with review of record drawings and aerial photos, a detailed 3D model was created to coordinate new foundation piling, and construction was completed with no field conflicts encountered. Other design considerations included bridge structure, road, and underground civil design, electrical, rail, geotechnical, environmental, and architectural inputs all within a context of constructability for achieving multi-party stakeholder buy-in. Weekly design review meetings with construction specialists and other subject matter experts were held throughout design development. In the construction phase, site crews worked closely with the design office for timely responses when issues needed to be resolved when unexpected field conditions were encountered. Complex transportation logistics and operational impacts were avoided that would result in increased costs by evaluating different approaches of resolving site conflicts.

Project Outcome

Construction of the South Shore Access Project was safely achieved on time and without incident, including no underground conflicts of foundation piling with complex existing infrastructure, and was opened to traffic in December 2023. The road network has been in continuous use since this time, fulfilling its purpose in providing through traffic access to and from terminals on Vancouver's south shore. Its sustainability goals have also been achieved through efficient construction utilizing locally sourced and readily available materials. The improved road is also reducing the carbon footprint of container transport to and from the terminals through the elimination of delays resulting from rail crossings.

Conclusion

The South Shore Access Project re-purposed and extended a 1.95 km long local access road to provide a continuous Port road from Canada Place to Highway 1 with minimal disruption from at-grade crossings, maintain local access to all Port tenants, and improve routing optionality. The project also reduces Port of Vancouver traffic congestion via the construction of a multi-span overpass for truck vehicles that provides a direct access to the Centerm Container Terminal and segregates the major traffic from existing at-grade rail crossings. The design of the local access road overcame numerous site constraints including those imposed by the new overpass and existing infrastructure, especially adjacent the historic Rogers Sugar building.

The Project met all stakeholder, operational and safety requirements by using conventional road design in combination with complex utility and structural engineering detailing to overcome site constraints. The contractor's tried and tested means and methods were able to be utilized, while the completed structure accommodated complex interfaces and satisfied the project intent of improving the transportation network without undue disruption to ongoing terminal and tenant operations. The project has been in continuous use since May 2023, fulfilling its purpose in providing through traffic access to and from terminals on Vancouver's south shore. Its sustainability goals have also been achieved through efficient construction utilizing locally sourced and readily available materials. The overpass is also reducing the carbon footprint of container transport and from the terminals through the elimination of delays resulting from rail crossings.

Figure 11. Prior to Construction

Figure 12. Construction Completed