Centerm Expansion Project

2023 Canadian Consulting Engineering Awards

HATCH

Executive Summary

The Port of Vancouver is the largest port in Canada, and the fourth largest in North America by tonnes of cargo, facilitating trade with more than 170 trading economies around the world. Centerm is a container terminal on the south shore of Vancouver's inner harbour that handles approximately one-fifth of the containerized goods shipped through the Port of Vancouver.

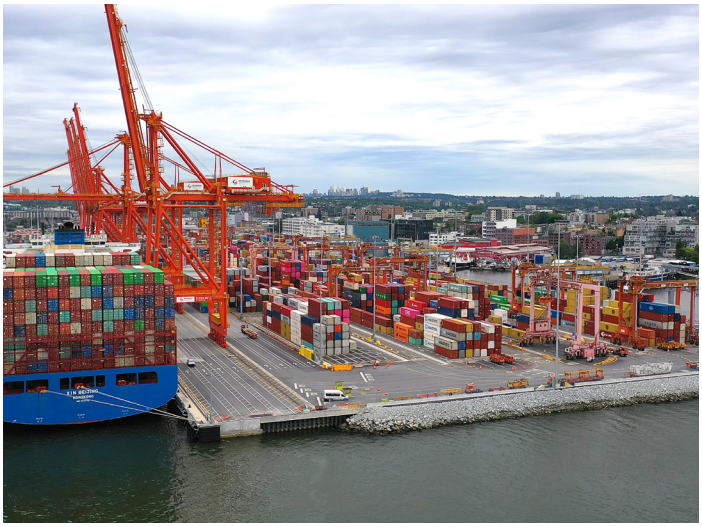
The Centerm Expansion Project is a key component of the Port of Vancouver's mission and vision to enable Canada's increasing trade while becoming the world's most sustainable port. The Project comprises expansion, reconfiguration and additional infrastructure to an operational container terminal in a busy marine environment. Together with enabling off terminal work and combined capital cost exceeding $400 million, these improvements will increase both throughput and sustainability at the terminal.

Hatch was the prime design consultant for Centerm Expansion Partners (CXP), a Dragados led design-build joint venture with their partners Jacob Brothers and Fraser River Pile and Dredge. Hatch worked with subconsultants Moffatt & Nichol for terminal reconfiguration, EXP for geotechnical services, VIA/Perkins Eastman for new buildings scope, and Hemmera/Ausenco, for environmental planning and monitoring.

Project objectives

The Vancouver Fraser Port Authority (VFPA) has completed the Centerm Expansion Project ("the Project"), which involved minor land extensions to the east and west, and on-terminal reconfiguration and upgrades to support greener operation and increased throughput of the existing Centerm container terminal. The completed project helps meet the increasing demand for containers shipped through the Port of Vancouver. The Port of Vancouver is a vital gateway for Canada's international trade economy, acting as a connection hub to over 170 trading economies worldwide and distributing products via vessels, rail, and roads.

In addition to reconfiguring the terminal for more efficient 24/7 operations, upgrades included infrastructure for two additional electric-powered ship-to-shore (STS) cranes, and five new automated electric rail-mounted gantry (RMG) cranes to promote greener operations. The Project also included expanded truck gate entrance and exit facilities, vessel shore power, a new LEED gold (targeted) operations centre, new LED lighting, electric vehicle receptacles, optimized land reclamation for additional real estate, an expanded intermodal yard, and provision of additional refrigerated container (reefer) capacity.



These upgrades are essential to the goal of increasing Centerm's throughput by over 60% to 1.5 million 20-foot equivalent unit containers (TEUs), while only increasing its physical footprint by 15%. Behind each upgrade and expansion related to this Project is the connection to VFPA's vision of a sustainable port and economically thriving community. The VFPA had the objective for the overall Project to obtain an award level of Envision Gold from the Institute of Sustainable Infrastructure (ISI) and a LEED gold certification for the new operations centre. The Project was to also benefit local communities economically. This Project allows the VFPA to ensure that it provides the required future capacity to benefit all Canadians as the global movement of goods through ports will increase significantly resulting in economic prosperity through trade.

Project highlights

- Awarded the Envision Platinum award, the highest rated award from the Institute of Sustainable Infrastructure
- Increased container capacity from 900,000 foot equivalent unit containers (TEUs) to 1.5 million TEUs
- Five new state-of-the art truck gates with automation
- First successful shore power connection at Berth 6
- 2500+ on-terminal and associated logistics jobs created
- Improved connections between the Port of Vancouver, local communities, and worldwide trade

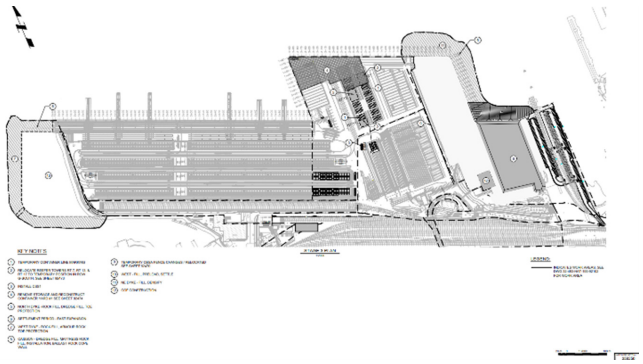
Technical challenges & innovative solutions

Brownfield development in an operating environment

The existing terminal was located on a brownfield site that had undergone decades of prior development and was to remain fully operational throughout the construction of the Project. This entailed extensive reviews of historical records, reconciling against updated surveys, and complex construction staging and sequencing planning involving six major stages and several engineered interim site configurations – particularly for the electrical 12 kV power and fibre optic communications systems – to ensure continuous operating conditions and to suit available work areas and ongoing reconfigurations as the work progressed.

The power distribution system and existing substations underwent several iterative configuration designs at 12 kV, 4 kV, 600 V, 480 V, and 120V to ensure continuous power to terminal operations. Design of redundant fibre optic connections linking the terminal to both the existing and new operations centres to allow a rapid switch over.

The initial configuration of the terminal is shown below.



Terminal reconfiguration phasing plan

Land expansion

The terminal's footprint was expanded by approximately 15% through land reclamation on both its east and west sides. On the east, this involved partial demolition of the Ballantyne Rail Pier, whose concrete was reused as permanent fill, dredging and dyke construction, followed by infilling of the Ballantyne bight. The marine works program was implemented to remediate and protect the marine environment, including:

- Marine Life Salvage Plan - fish salvage and relocation occurred prior to dredging and infilling works
- Autonomous Monitoring System – water quality was monitored to meet the Canadian Council of Ministers of the Environmental Water Quality Guidelines for the Protection of Aquatic Life
- Silt Curtain "Moon Pool" – an apparatus that isolated work areas for sediment control

Slip formed floatable caissons

A 78m extension of the western berth face was constructed from two prefabricated 37.4m x 14.5m, 20m deep concrete caissons that were floated to site under tow and sunk into place on a prepared rock mattress laid on top of densified fill.

Slip forming commenced in the nearby dry dock until freeboard height was attained. The dock was then flooded and concreting continued while moored in open water. Design of these structures was complex and involved extensive coordination with both the owner's engineer and the fabrication contractor, whose specific facilities constraints also had to be accommodated in the design.

Slip formed floatable caissons were designed where no Canadian code requirements have been developed.

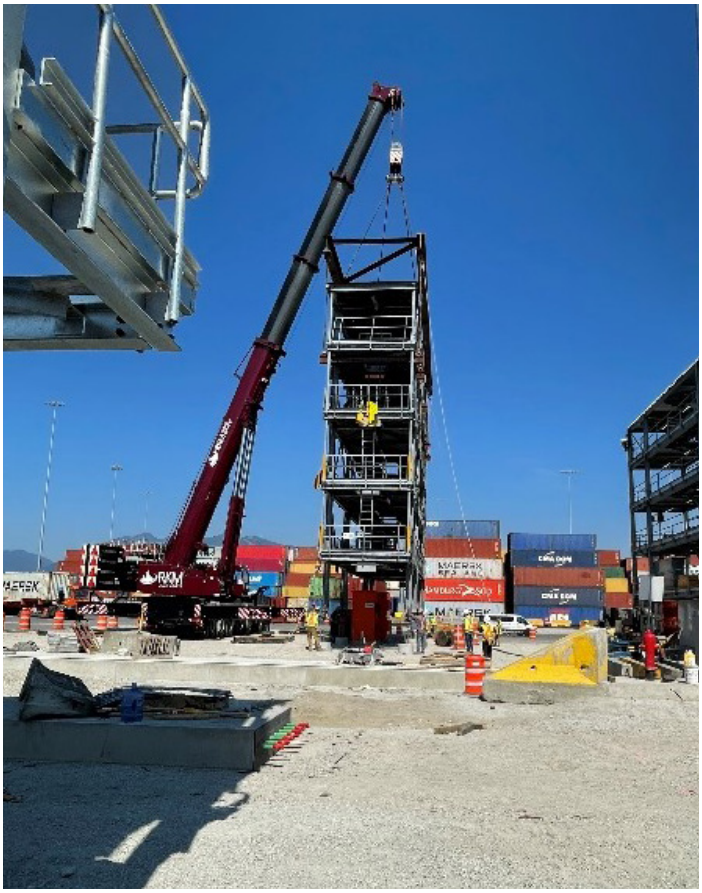
Transformation of a heritage building

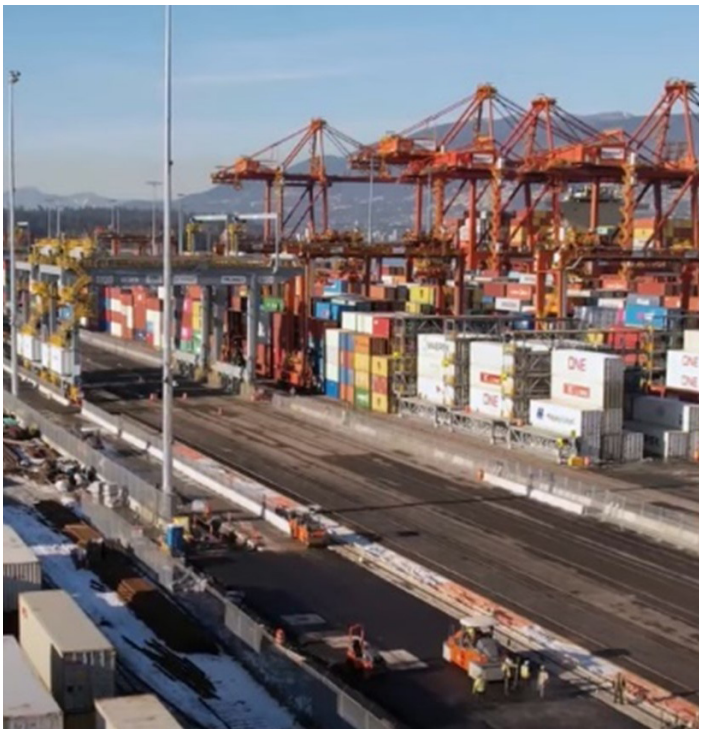
As part of the terminal reconfiguration, the historic Ballantyne Pier Shed 3, originally constructed in the early 1900s, and most recently utilized as part of a cruise ship terminal, was repurposed to become the new Container Operations Facility. This involved architectural reimagining of the building, complete structural upgrades including seismic retrofitting, mechanical and electrical refurbishment, and extensive systems engineering in moving the existing operations centre to the new facilities.

Reuse of existing reefer towers in new locations

The new terminal configuration had to include 12 refrigerated container receptacles on five-story towers, positioned to increase capacity and permit the use of extended gantry RTG crane operations. To save costs, and reduce waste, it was decided to relocate 11 existing four- to five- story reefer towers to these new positions, which in some cases required additional floors to be added to achieve five floors at completion thereby permitting increased capacity. The additional floor structure was added to the base of the structure and seismic upgrading to the existing structure where necessary as found during field inspections. The structures were moved in one piece to the new area and put in place by crane. An additional new tower was also designed and constructed.

Eleven existing four- to five-story reefers were relocated to new locations to save cost and reduce waste.

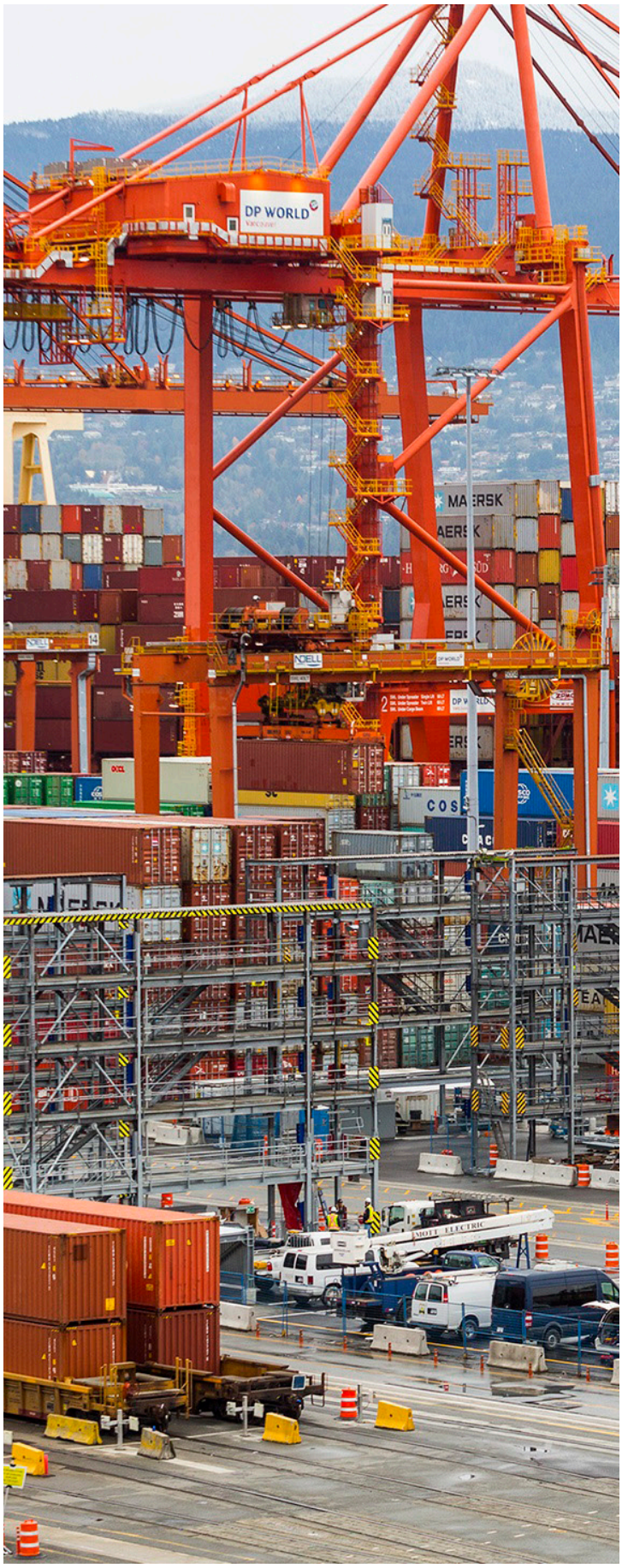




Smart paving

Tying the expanded facilities into the existing terminal while maintaining strict grade control with slopes as little as 0.5% necessary for operations was very challenging and necessitated extensive survey inputs and iterative modelling effort to achieve an effective design. Constructability was achieved by supplying a 3D surface model to the contractor to be programmed into the GPS controlled paving machine, replicating the complex design surface to very tight tolerances in the field.

A Local Positioning System was used on pavers to achieve difficult slope requirements of 0.5%. The system had levelling sensors that helped maintain the desired horizontal and vertical profile when milling, grading, or paving.



Improvements in operational effectiveness and green initiatives

A key project goal was to increase the operational capacity and environmental efficiency of the terminal, which was achieved through its marginally increased footprint and reconfiguration and the deployment of systems such as:

- Design for the reconfiguration of the east side of the terminal to permit extension of rubber tired gantry (RTG) cranes in the yard and access to repositioned reefer towers
- Design of 12 kV feeders and communications for the terminal operator's automated rail mounted gantry (RMG) cranes and two new ship to shore cranes
- Optical readers at truck gates and intermodal rail yard portals, simplifying and accelerating the receipt, handling, and discharge of containers at the terminal
- Updated fuel station for on-site fueling of trucks and container vehicles
- Design of green initiatives such as vessel shore power provided at the expanded western berth, allowing not only larger container vessels to visit the port, but to discharge and load cargo without idling on engine power, electric vehicle connections in parking lots, and LED high mast lighting

- *62 LED high-mast light towers*
- *5 rail-mounted gantry (RMG) cranes*
- *12 refurbished refrigerated container towers*
- *22 electric vehicle stalls at the container operations facility*

Sustainability achievements

LEED Gold for COF

The Canada Green Building Council's LEED certification process guides a building's design, construction and operations processes to achieve high-performing sustainable outcomes.

VFPA targeted the objective of LEED Gold for the new operations facility (COF). The building's design and construction were completed in accordance with the strict criteria required and the operating building is undergoing certification assessment, a significant accomplishment in the repurposing of an over 100-year old building into a comfortable, state-of-the art operations centre.

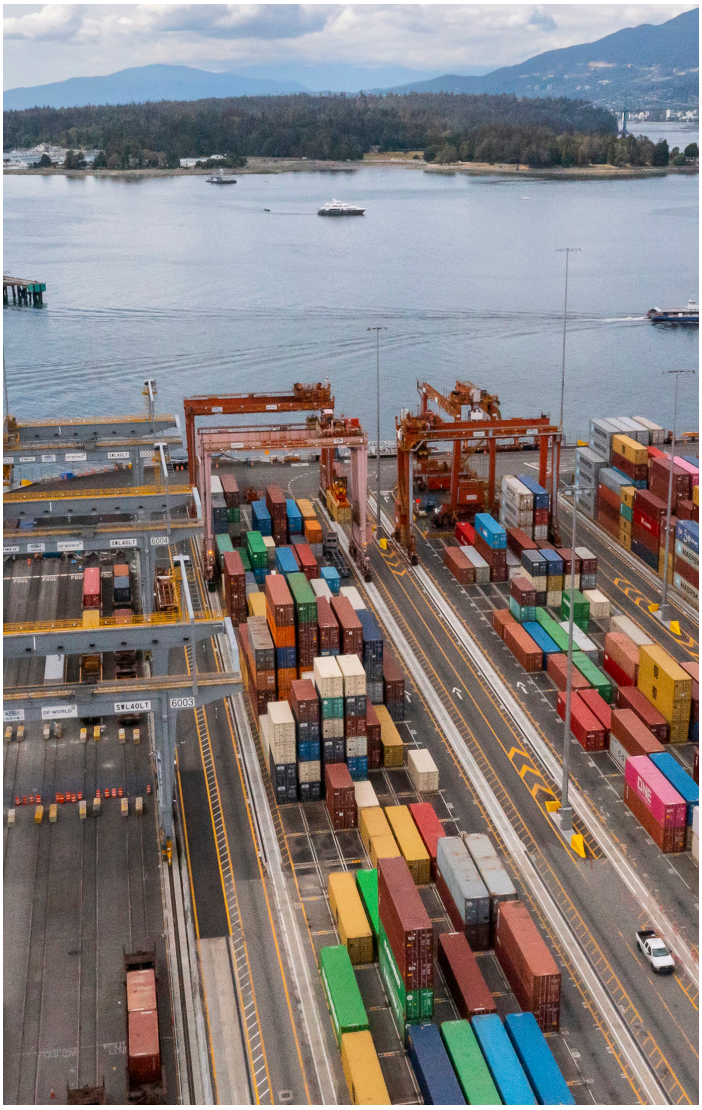
Envision Platinum Award

VFPA achieved its objective of Envision certification from the Institute for Sustainable Infrastructure (ISI), a non-profit organization created to develop and maintain a rating system that recognizes the need for sustainable, resilient, and equitable infrastructure.

The Project's design considerations in this regard included materials sourcing, waste generation and disposal, reducing greenhouse gas and air pollutant emissions, and as well as construction duration and methodology mentioned in previous sections. Overall, the Project also stimulated growth and development in Canada's trade economy while improving socioeconomic conditions locally and regionally through job creation. The successful completion of the expansion within the framework developed is a significant milestone that led the Project to be awarded Envision Platinum – the highest rated award from ISI.

The Centerm Expansion Project created healthy environments and thriving communities by:

- *Creating 2500+ on-terminal and associated logistics jobs*
- *Removing port-related traffic from city roads*
- *Mitigating environmental and construction impacts (noise, traffic, air quality, marine and terrestrial) throughout the Project*
- *Incorporating greenhouse gas and air pollution reduction measures*
- *Providing financial contributions to support the wellbeing of the local community and First Nations*



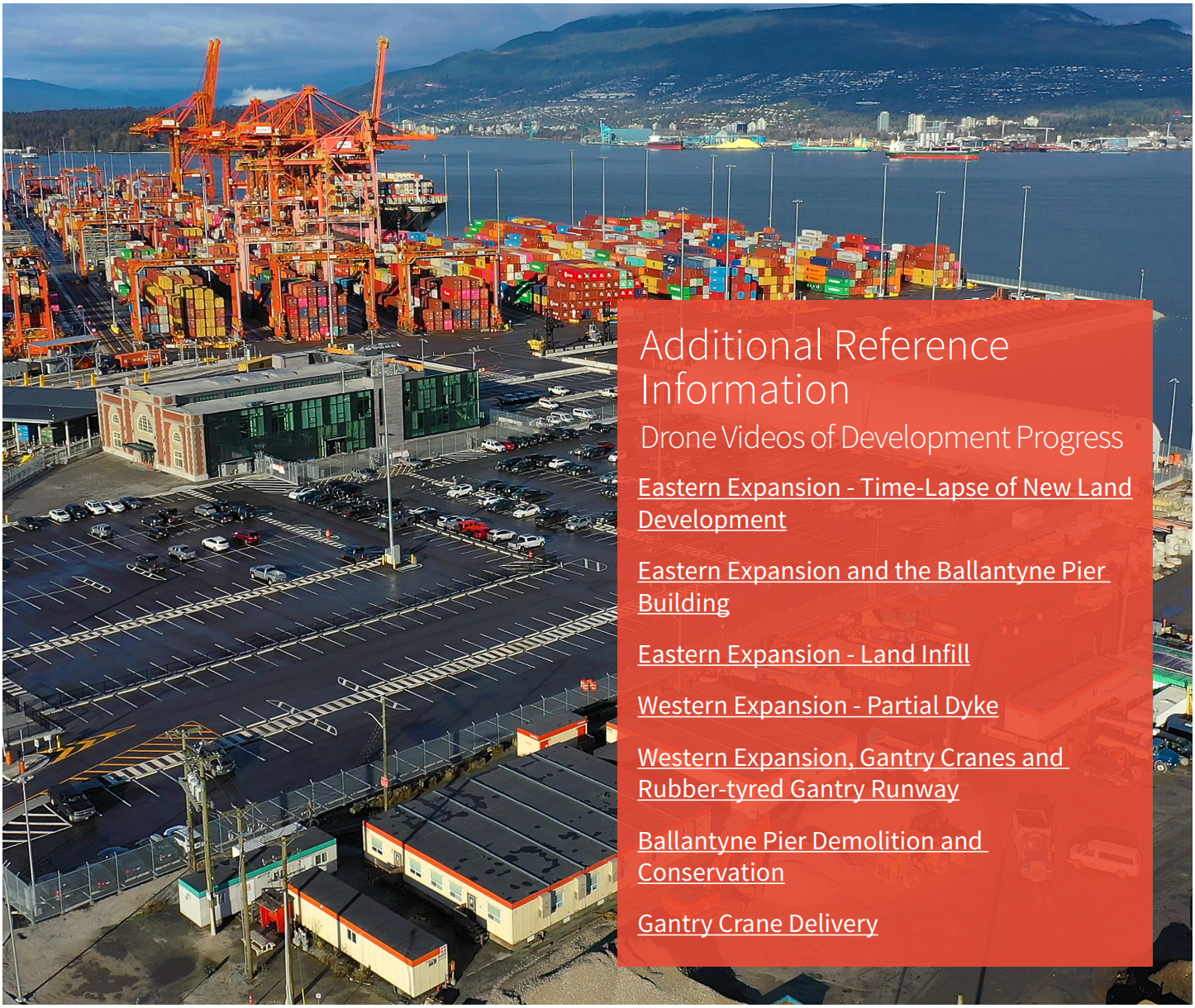
Project outcome and client outlook

All construction of the Centerm Expansion Project was safely achieved on time and without lost time incidents. The Project's sustainability goals were achieved with innovative design solutions.

Economic prosperity was also enhanced by the Project as local jobs were generated within the wider port economy and during construction. The region's major port is now better served for container handling capacity, enhancing Metro Vancouver's ability to manage the enormous increase in Asia-Pacific trade.

"We are very pleased to have achieved such remarkable, independent recognition for our sustainability efforts during planning, design and construction of this critical project for Canada. It was made possible thanks to a concerted team effort and leadership towards our vision."

— Gilles Assier, Project Director, Vancouver Fraser Port Authority



Additional Reference Information

Drone Videos of Development Progress

Eastern Expansion - Time-Lapse of New Land Development

Eastern Expansion and the Ballantyne Pier Building

Eastern Expansion - Land Infill

Western Expansion - Partial Dyke

Western Expansion, Gantry Cranes and Rubber-tyred Gantry Runway

Ballantyne Pier Demolition and Conservation

Gantry Crane Delivery