ConsultingEngineer ASSOCIATION OF CONSULTING ENGINEERING COMPANIES CANADA **McElhanney** UPGRADE PROJECT MILLEN Dra DEL 14m Osh -any u

Firm Name:
McElhanney Ltd.

Location of Project: **Delta, BC** Completed by: 2022 200

Project Category:
B - Transportation



75 WORD PROJECT SUMMARY

PROJECT HIGHLIGHTS

Q1. Innovation	4
Q2. Complexity	5
Q3. Social & Economic Benefits	6
Q4. Environmental Benefits	8
Q5. Meeting Client's Needs	9
Highway 91/17 Upgrade Project Map	10





The Highway 91 / 17 project upgraded the existing Highway 91, 17, and 91 connector corridors to improve travel safety and efficiency. These highways are major trucking routes, connecting the Port of Vancouver's Roberts Bank terminal to key trade and industrial facilities and forming a critical link to national and international markets. This project improves commercial and local travel in the area and reduces conflicts between commercial vehicles and other traffic.

PROJECT HIGHLIGHTS

Innovation

Despite the project right-of-way constraints, McElhanney's design provided four interchanges within 1.2km. This tight spacing constraint for design and construction of four interchanges in an area typically required for one, quoted by Dave Dulay (Design Manager), was "like playing football in a tennis court."

McElhanney rose to the Province's challenge for innovation by developing a pragmatic "one-way-couplet roadway-system" configuration, while retaining the existing bridge and two-lane loop ramp for the Highway 91/91C Interchange, providing for environmentally sustainable design while minimizing impact to historic Burns Bog and Delta Nature Reserve.

The Province's concept consisted of a loop for Nordel Way eastbound (EB) to Highway 91 northbound (NB) movement and a directional ramp for Highway 91 SB/Alex Fraser Bridge to Nordel Way EB movement. Using this configuration, maintaining the existing two-lane loop for southbound (SB) to EB movement was not possible due to the proximity of the proposed Nordel Way EB to Highway 91 NB loop and limited right-of-way. Therefore, a directional ramp was required to accommodate this movement.

McElhanney's innovative design consists of a one-way couplet roadway system, where traffic for the EB and westbound (WB) direction of Nordel Way is completely separated. As such, the design improves the capacity and traffic operation of the Highway 91 SB to Nordel Way EB movement with a two-lane loop ramp, while achieving better operation (merging sequence) than the directional ramp. The two-lane loop design concept for this movement is possible exclusively due to the oneway couplet roadway system, which enables the use of two loops (two-lane SB to EB and one-lane EB to NB) as the traffic movements are coming off individual couplet legs. Therefore, with McElhanney's design, a directional ramp is not required for this SB to EB movement, as the one-way couplet configuration negates it. With the implementation of a one-way couplet system, level of service and safer merge sequence is improved simply because the heaviest traffic volume movement (SB to



Highway 91 / Nordel Way Interchange - Innovative one-way couplet

EB) will not need to merge into the lower traffic volume (Nordel Way EB).

McElhanney's design increases safety and speed management on an exiting ramp with a two-lane loop that provides a better driving transition for motorists coming from a lowspeed freeway (Highway 91 / Alex Fraser Bridge) at 70km/h and entering a 60km/h low speed major arterial road (Nordel Way). The use of loop ramps provides a consistent speed environment and discourages speeding when connecting to Nordel Way east.

Complexity

The project site had numerous complex constraints, especially given its proximity to the environmentally sensitive



Highway 91 Connector / Weigh Scale Interchange - Roundabout Designed to Accommodate Long Combination Vehicles



Complex Major Highway 17 Diversion Detour

Burns Bog and the Delta Nature Reserve. Throughout the construction process, our team was challenged with poor subgrade conditions, inclement weather, and limits such as proximity to gas mains, acidic bog water, and contaminated groundwater. Any issues encountered on-site were reviewed and resolved promptly between the designers, engineering field reviewers, and Pacific Gateway Constructors (PGC) field staff.

To maintain existing/pre-con movement of traffic during construction, complex and strategic construction sequencing was required. Construction staging was a complex planning process and innovative-detours were developed which considered proximity of Burns Bog, environmental sensitiveareas, ground improvements, utilities, structures, and roadworks alongside the traffic-management and project schedule requirements.



Highway 91 / Nordel Way Interchange

Despite these challenges, McElhanney's design prioritized safety by using roundabouts that reduced conflict points and unconsciously prompt safer driving. While safety was paramount, the design also achieved the project's objective of developing sustainable design by retaining the existing Nordel Way bridge, Highway 91 and 17, improving travel time by replacing the existing intersections with free-flow interchanges, and supporting economic-growth.

Subsurface contamination migration was combated by using polyethylene liners in storm trenches and under ditches in areas of high contamination and by constructing a berm adjacent to Burns-Bog. Through several groundwater testing campaigns, the project team determined the expected pH and conductivity of the contaminated groundwater throughout all seasons of the year. This allowed the team to procure materials for the stormwater network that would withstand the conditions anticipated on the site.

Social and/or Economic Benefits

The project presented several employment opportunities to local residents and businesses. Through community engagement via the Community Benefits Program, the project team was able to implement employment and contracting



Highway 17 / River Road Interchange

opportunities to support workforce development with a focus on indigenous peoples, equity groups, and local residents. The team ensured that all interested parties could bid on work packages as they were made available and gave preference to local businesses, when appropriate.

Community outreach was achieved through open houses and engagement sessions that were announced through local and social media. These open houses facilitated opportunities for the project team to share project details and employment opportunities, communicate these opportunities to prospective employees, pre-screen applicants, and initiate the hiring process. The process was summarized into a document called the Community Benefits Plan which outlined the team's local engagement, recruiting, employment, training, and subcontracting strategies which were used to help maximize opportunities for indigenous Peoples, Equity Groups, and Local Residents. The content of the plan was reviewed on an annual basis and amended as necessary to ensure it was effective.

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- Dave Dulay, Design Manager

Highway 91 Connector / Highway 17 Interchange

HIGHWAY 91/17 UPGRADE PROJECT 2023 Canadian Consulting Engineering Awards

Environmental Benefits

SUSTINABILITY

The proximity to Burns Bog necessitated special management to protect environmental and cultural resource values. As Environmental Lead, our team was responsible for the development and revisions of the Construction Environmental Management Plan (CEMP), all associated work plans, securing regulatory permits from federal and provincial regulators, and obtaining fish and wildlife salvage permits for red- and bluelisted species such as the Pacific water shrew and red-legged frogs.

The team dealt with contaminated soils, archaeological challenges, vegetation surveys, wildlife surveys, conducting fish and wildlife salvages, and identifying offset habitats within the project to mitigate environmental impacts. We also developed the environmental enhancement management plan with McElhanney's landscape group, working around Department

Environmentally Sensitive Burns Bog South of the Project Footprint

of Fisheries and Oceans (DFO) compensatory ditches from the South Fraser Perimeter Road.

Our team was responsible for managing contaminated soils and developed a comprehensive plan to prepare and submit BC ENV instruments – Approval in Principle (AiP) and Certificate of Compliance (CoC) – for sections of the site. The instruments included site-specific conditions that allowed work to proceed as the design was approved and construction advanced in a compressed schedule.

CLIMATE CHANGE

Rising sea levels and temperatures paired with changes in precipitation patterns can lead to extreme weather events, such as heat waves and flooding. Due to the site's proximity to Burns Bog, increased runoff caused by climate change was an important consideration for this project. McElhanney prepared a Climate Change Adaptation Report to provide input from the drainage, geotechnical, structural, and traffic disciplines on potential impacts of climate change.



Meeting Client's Needs

Efficient traffic flow along Highway 17, particularly at the Highway 91C intersection, is vital for maintaining the movement of goods and people across the region while reducing truck traffic on municipal corridors in Surrey and Delta. To alleviate congestion and promote free movement of traffic, the Ministry of Transportation and Infrastructure/Province proposed the Highway 91/17 Upgrade Project, consisting of:

- one new interchange at Highway 17/ River Road to remove the existing at-grade railway crossing;
- one free-flow interchange replacing the existing signalized intersection at Highway /Highway 91C;
- one free-flow interchange replacing the existing signalized intersection at Highway 91C/Nordel Way;
- one existing interchange upgraded to a free-flow interchange at Highway 91/Highway 91C; and

• 20 lane-kilometres of upgraded and 15 lane-kilometres of new road infrastructure on Highway 17, 91, and 91C.

Geographical challenges/constraints of the project site included flat (0.5%) terrain gradient, environmentally/archeologically sensitive areas, subsurface contamination, and containing roadway surface runoff away from Burns Bog. Despite these challenges, PGC and McElhanney proposed a design that prioritized safety and comfort for all road users while achieving the project's objectives of developing a sustainable design that preserved important bog and wetland functions in the diverse ecosystem of Burns Bog through construction of a berm and use of a liner and custom weir, protected habitat, and promoted stormwater treatment, improving travel time, safety, and economic growth.

McElhanney achieved the client's goal of creating an environmentally sustainable design by preparing a compact design that covers 100 acres, 45% of which is vegetated, using bioswales and environmental compensation areas.



Highway 91 Connector / Weigh Scale Interchange



Turning movements designed to accommodate long-combination vehicles

River Road

The Hwy 17 / Nordel Way intersection is essential for movement of goods in the region

0.5% site gradient challenged drainage design

Corrugated steel pipe culverts with special coating to protect against corrosion from acidic water from Burns Bog

Constructing over two major fortis transmission gas mains required lightweight fill to avoid differential settlement

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Sustainable design retained existing bridge

Access to the Nordel Weigh Scale was retained throughout construction

Hwy 91 Connector

Proposed drainage and roadworks infrastructure designed to consider climate change based on BC MoTI and EGBC guidelines

Roadworks was designed to manage speeds by introducting electronic signs for tight geometry throughout the site

bog water levels

Highway 91/17 Upgrade Project



Constructibility and traffic staging for Nordel Way / Hwy 91 interchange reduced impact on the diverse ecosystem within Delta Nature Reserve

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Spongy subsurface peat challenged design and construction

Custom weir to control

4. Highway 91 / Nordel Way Interchange