Klohn Crippen Berger

HARVIE PASSAGE REHABILITATION

CALGARY, ALBERTA

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CANADIAN CONSULTING ENGINEERING AWARDS 2020

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PROJECT NAME	Harvie Passage Rehabilitation
LOCATION OF PROJECT	Calgary, Alberta
YEAR COMPLETED	2018
CATEGORY OF ENTRY	C. Water Resources
ROLE IN PROJECT	Prime Consultant
PROJECT OWNER / CLIENT	Alberta Environment and Parks (owner); Alberta Transportation (client)
SUBSCONSULTANTS	SG1 Water Consulting Ltd. O2 Planning + Design Recreational Engineering and Planning Northwest Hydraulic Consultants
GENERAL CONTRACTORS	Bluebird Contracting Services
PROJECT SUMMARY	Klohn Crippen Berger was engaged by Alberta Transportation to plan, design, and administer construction of the rehabilitation of Calgary's Harvie Passage, which was damaged in the unprecedented flood of June 2013. Rehabilitation of Harvie Passage allowed for implementation of "lessons learned" from its design and construction, thereby creating a more robust and sustainable facility with the development of terrestrial and aquatic habitats to create a unique park and recreational amenity in Calgary.


Western headworks at Harvie Passage (photo courtesy of BCS)

INNOVATION

The Western Headworks (WH) was constructed by the Canadian Pacific Railroad in 1908 to divert water from the Bow River to the semi-arid region east of Calgary. The diverted water was, and continues to be, used for agricultural, municipal, and recreational use. It served a pivotal role in the settling of Alberta and the population growth of Calgary and the surrounding area.

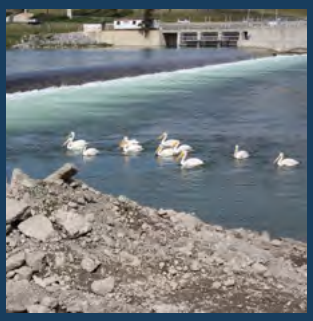
Prior to the original Harvie Passage being built adjacent to Pearce Estate Park in 2011, the WH represented the only barrier to boaters and fish passage in the 100 km section of the Bow River between the Bearspaw Dam at the western limits of Calgary, and the Carseland-Bow River Headworks weir east of Calgary. The weir reduced energy and flow velocities downstream. Unfortunately, more than 20 people perished going over the weir. The purpose of the Harvie Passage Project was to redevelop the weir to eliminate the drowning hazard it created and to enable river and fish passage, while maintaining the WH's function of facilitating diversion from the Bow River to the Western Irrigation District (WID).

The unprecedented flood of 2013 within the Bow and Elbow Rivers resulted in a 1:100-year flood discharge through the Harvie Passage. The discharge and large movement of sediment damaged the channels and abutments. Harvie Passage was closed to river users from 2013 to completion of its rehabilitation in May 2018.

In March 2015, Alberta Transportation retained Klohn Crippen Berger, in association with SG1 Water Consulting, Recreation Engineering and Planning, Northwest Hydraulic Consultants, and O2 Planning + Design to provide engineering and landscape design, recreational hydraulics and environmental services for the preliminary and final design, construction contract administration, post-construction and performance monitoring phases for the rehabilitation of Harvie Passage.

It appears that similar projects in North America were designed and constructed relying on recreational hydraulic specialists' experiences, with sparse supporting documentation and design criteria. Since Harvie Passage is located on the Bow River, one of the largest rivers in North America with a recreational hydraulic facility across its entire width, and because the river is an environmentally sensitive and important fishery, the project team developed design criteria to minimize construction re-work. Criteria developed included minimum pool depths to reduce risk of paddle strikes and improve fish passage, maximum Froude Numbers for boater navigation comfort, and maximum velocities and water depths on constructed beaches to prevent small children from being swept downstream.

Canoe lessons in the LWC



COMPLEXITY

Harvie Passage was a challenging and unusual project when it was completed in 2011, and its rehabilitation in 2017 and 2018 was no different. The rehabilitation spanned the entire width of the Bow River, which presented technical and logistical challenges. Limiting the impact of over 16 months of construction on the aquatic environment was considered extensively in the design, as were the lessons learned after its 2011 completion and the damages that occurred due to the unprecedented 2013 flood.

After the 2013 flood, we learned that the original boulder and concrete structures performed satisfactorily, except where erosion occurred around and beyond the extent of the boulder-armoured areas. For the rehabilitation, we extended the boulders and boulder concrete to reduce potential scour. A portion of the divide island also eroded, so erosion susceptible areas were protected with boulders and boulder concrete and/or vegetated riprap. Less susceptible areas were protected with riparian vegetation. Another "lesson learned" was that sedimentation within Harvie Passage's Low Water Channel (LWC) was significant. Geomorphologic assessments indicated that sedimentation within Harvie Passage during significant future flood events is likely, but is expected to be less in the new LWC as more room is provided for the river. Underwater maintenance roads were incorporated in the design to allow future maintenance. Maintenance access was also incorporated along both sides of the High Water Channel (HWC) and LWC to allow the periodic removal of accumulated sediment and debris.

Harvie Passage prior to the 2013 flood

Harvie Passage after the 2013 flood


LWC (photo courtesy of BCS)

SOCIAL AND/OR ECONOMIC BENEFITS

How Harvie Passage would be used and valued was not fully understood when the original project was completed in 2011. Through site observations by the project team, feedback from river user groups on socialmedia, and anecdotal observations, it became apparent that:

- Calgarians love water and value having access to the Bow River. Providing pedestrian and boater access to the Bow River at Harvie Passage became very popular.
- Harvie Passage has become a recreation destination for Calgarians and tourists alike.
- Recreational boating, particularly river rafting, has exploded in popularity in recent years. Harvie Passage's LWC became a destination for river rafters on hot summer days.

The rehabilitated Harvie Passage is better integrated into Pearce Estate Park, is more multi-use, and is more robust to withstand future floods. There are tree-lined walkways and beach areas for the public to enjoy. The rehabilitation has increased navigability and created more opportunities for recreational boating. It has also improved safety and fish passage and created an amenity for Calgarians and visitors to enjoy. This amenity helps to increase tourism to Calgary and the surrounding area, with associated positive economic impacts to the region.

ENVIRONMENTAL BENEFITS

Like the original Harvie Passage, a key component of the design was to blend the rehabilitation works with the natural surroundings of the Bow River. This required using natural construction materials such as boulders, cobbles, gravels, and riparian vegetation as much as practicable. Conventional hydraulic structure designs normally consist of man-made materials such as reinforced concrete and structural steel.

To better blend into the natural surroundings, some of the design elements were constructed using boulders with the addition of macro-synthetic-fibre-reinforced concrete. The concrete was placed in the voids between the boulders for structural integrity and to reduce the risk of human limb entrapment. Macro-synthetic fibre reinforcement was used to increase the tensile strength of the concrete to reduce thermal cracking and to significantly accelerate construction, thereby reducing temporary impacts on the aquatic environment. Instead of conventional steel fibres, synthetic fibres were used to allow barefoot pedestrian traffic on the boulders and concrete.

The right (Pearce Estate Park) side of the LWC consists of boulders placed in terraces with concrete filling the voids to allow easy river access and provide seating areas for park users. Planting beds and live cutting pits consisting of trees, shrubs, willow, and balsam poplar cuttings are strategically placed within the boulders to provide habitat, shade and improved aesthetics. In areas with lower flow velocities and where space allowed, the left (divide island) side of the LWC is protected with bio-engineering methods (such as vegetated riprap) to provide erosion protection, improved aesthetics, and fish and terrestrial habitat.

LWC landscape design

MEETING CLIENT'S NEEDS

The City of Calgary is planning the creation of a new regional park called Bend in the Bow, which will integrate green spaces along the Bow River and Pearce Estate Park into a cohesive, well-functioning landscape unit to be enjoyed by Calgarians and visitors. O2 Planning + Design was added to the project team to develop the landscape design of the LWC and divide island, in keeping with the City's vision of Bend in the Bow. The new LWC is an integral component of Bend in the Bow and the City's river access strategy, which includes several boat and hand launches throughout Calgary.

The Harvie Passage Rehabilitation project was completed on schedule and under the approved budget. Collaboration with Alberta Transportation, Alberta Environment and Parks, the City of Calgary, regulatory agencies, paddling communities, the construction contractor (Bluebird Contracting Services), and other stakeholders was essential to the successful completion of this project. Their input, guidance, and support are acknowledged and appreciated.

The grand opening of the rehabilitated Harvie Passage on July 12, 2018 was attended by the Minister of Alberta Environment and Parks, City of Calgary councillors, City and provincial government dignitaries, river user groups, and the public. Swimmers, canoeists, kayakers, stand-up paddleboarders, surfers, the City of Calgary Fire Department Aquatic Rescue Team, and others have floated through and played in the new Harvie Passage.

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