Ontario Ministry of Transportation (MTO)

Restoring Fish Passage to a Tributary of the Saugeen River

2017 Transportation Association of Canada

Environmental Achievement Award Nomination Submission

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1.0 Introduction

A concrete open footing culvert located on Ontario Ministry of Transportation (MTO) Highway 21 near Southampton, Ontario, and within the Saugeen First Nation Reserve #29 (see Appendix A), had reached the end of its service life and was in need of replacement. This culvert was perched above the streambed and restricted any upstream fish migration – this has likely been the case since the highway and the culvert were constructed over seventy-five years ago (see Appendix B for pictures of the original culvert). This tributary to the Saugeen River supports a diverse range of coldwater fish species such as Rainbow Trout, and is culturally significant to the community as it is a popular area for fishing. Restoring fish passage upstream of the culvert location was a key objective of this project.

The project team evaluated a number of alternative methods of replacing the culvert. One of the alternatives evaluated required a full closure of the highway to remove the original culvert and place a new culvert in the same location. Closing the two-lane section of road and detouring highway traffic would have had significant negative socio-economic impacts on the First Nation community that relies on Highway 21 as the main road into and out of the Reserve. Through the environmental assessment process it was decided that the original culvert would be left in place, filled in with concrete and capped at both ends. A new culvert would be installed using a ‘jack and bore’ trenchless technology, slightly to the east of the original culvert, allowing the highway above to remain open.

Construction of the new culvert began in summer 2015 and was completed in late fall 2015. A steel pipe culvert was installed beneath the highway, and then a liner with attached fish baffles was slipped inside the pipe. Because the location of the new culvert was shifted slightly to the east of the original culvert, the watercourse at the inlet and outlet of the new culvert required a small shift in alignment. Fish habitat features were then incorporated into the new channel at the inlet and outlet.

2.0 Environmental Protection and Enhancement

As part of the design and Class Environmental Assessment process, fisheries investigations were conducted upstream and downstream of the Highway 21 Craig Street Culvert. Prior to these assessments, little was known about the Saugeen River tributary. Following field investigations, the tributary downstream of the culvert was determined to be highly sensitive, providing diverse habitats which support a wide range of cool and cold water fish species. Access and spawning habitat for Rainbow Trout was evident by the high number of juvenile and young-of-year in the channel immediately downstream of the culvert, as well as a variety of more common species

such as: Creek Chub, Northern Redbelly Dace, Brook Stickleback, Central Mudminnow, Black Bullhead, Bluntnose Minnow, and White Sucker. Upstream of the culvert, the tributary was also found to provide varied riffle/run/pool habitats extending through a well-defined riparian corridor of White Cedar and mixed hardwood vegetation. However, the field investigations did not identify any fish utilizing the upstream reach. The dramatic contrast between fisheries conditions in the tributary downstream and upstream of Highway 21 suggested that the passage and connectivity between the two stream segments was negatively impacted as a result of the original culvert structure. The barriers to fish were threefold: the culvert was perched approximately 1 m above the streambed; a shallow sheet flow of water passed through the culvert, causing a high velocity of water and insufficient depth for fish; and the culvert was located on an approximately 7% slope.

Knowing that the culvert was restricting fish passage in this ecologically sensitive location, restoring fish passage and continuity of the aquatic habitats became a primary objective of the culvert replacement project.

The new culvert was designed to include baffles and graduated pools to increase the potential for the native fish community to migrate to the upper reaches of the watercourse. The baffles were bolted to a corrugated liner that was then slipped inside the steel pipe culvert. The liner and baffles were coated with thermoplastic copolymer to increase their longevity and provide a smooth surface that would not injure fish. The new baffle design promotes slower water speeds with a meandering thalweg throughout the culvert. In addition, to allow upstream migration of smaller fish during periods of lower flows, a ramp/slide was added to the downstream side of each baffle. The corrugations in the liner aid in reducing water velocity and create areas for natural streambed substrates to settle, allowing for naturalization of the culvert channel over time (refer to Appendix C). The areas immediately adjacent to the inlet and the outlet of the culvert were restored with favourable fish habitat features such as fish refuge pools, to provide a resting area for fish after they ascend the culvert.

During post-construction fisheries investigations in Spring and Summer of 2016, Rainbow Trout, White Sucker, and Creek Chub were found upstream of the culvert, confirming that the new culvert provides fish passage. Monitoring will continue in Spring and Summer 2017 to further assess the effectiveness of the culvert and ensure that the fluvial geomorphology of the channel is functioning as intended.

By replacing the original culvert with a structure that eliminates the barriers to fish migration, and incorporating favourable fish habitat features in the tributary both upstream and downstream of the new culvert, fish will now be able to access the upstream segment of the watercourse, similar to the site conditions that existed prior to the construction of Highway 21. Sensitive fish species may now increase their range,

accessing reaches of the stream they have not been able to access for over seventy-five years. This will not only have a positive effect in restoring the ecological connectivity and increasing species diversity throughout the watercourse, but will also serve to expand the habitat of a valuable natural resource to the First Nations community. This project contributes to both the protection and enhancement of the environment and achieves a social and economic benefit, as it improved the quality of the upstream environment and maintained access to the community.

3.0 Innovation

The project team working on this culvert replacement was quite diverse in their backgrounds and experience, and included MTO environmental and engineering staff, MMM Group Ltd. engineering staff, Parsons biologists, Aquafor Beech fluvial geomorphologists, and a representative from the Saugeen Ojibway Nation Environment Office, as well as the designer of the baffles, a modeller, and a representative for the liner constructor. The collaboration among such a diverse project team resulted in an innovative solution to a common problem.

The MTO project team worked directly with the Corrugated Steel Pipe Institute (CSPI) and the designer of the baffles to utilize the Highway 21 site as a pilot project. The main feature of this new culvert is the fish ladder, or series of baffles, that is incorporated within it. The fish ladder is made up of a corrugated steel liner which has baffles bolted to it that are evenly spaced throughout the length of the culvert. The baffles are designed to slow the water flow and create fish refuge areas within the culvert. They also serve to reduce the accumulation of debris within the culvert, which can also act as a barrier to fish. It also includes a ramp/slide which assists the fish in swimming up the culvert from the downstream to the upstream end (refer to Appendix C). The baffle configuration and geometry was designed by Ken Hannaford of the Government of Newfoundland and Labrador, modelled by Jason Duguay of the University of Sherbrooke, and the liner was constructed by Armtec, a member of the Corrugated Steel Pipe Institute. This type of baffle system is an improvement over traditional baffles that have been used to assist fish in ascending sloped culverts, such as the Department of Fisheries and Oceans (DFO) baffle design (shown in Appendix D).

This project site was selected to be a pilot project for the use of this innovative baffle design to solve the environmental issues with the original culvert. One of the challenges of providing for fish passage at this location was that the gradient of the culvert was quite steep at approximately 7%. This makes it difficult for fish to swim upstream due to gravity and the velocity of the water. Extensive modelling was conducted to ensure that the fish liner and baffle system could adequately slow the water such that the targeted

fish species would be able to swim upstream. Photographs of the construction and final results can be seen in Appendix E.

Input from various ministries and agencies was sought throughout the design of the project. Since the most directly affected individuals were those living in the community, consultation with the Saugeen First Nation was done through a representative of the Saugeen Ojibway Nation (SON) Environment Office. MTO developed a positive working relationship with SON and together used innovative methods to communicate information about the project and to provide a contact within the community in case there were any questions or concerns throughout construction. An information brochure was posted on the Saugeen First Nation website with pertinent information about the project and included contact information. A sign was also placed near the culvert location in advance of construction which included a link to the website, directing interested persons to the information brochure (see Appendix E). Additionally, presentations were made to the Saugeen First Nation Council, where Council's input was received and incorporated into the project.

In addition to working closely with SON throughout the design of the culvert and fish ladder, MTO initiated an Aboriginal Procurement Project to hire local SON community members to complete the pre-clearing of trees on-site prior to the start of construction of the culvert. Clearing the trees (in advance of the migratory bird nesting window, which typically begins around April 1st in this area), was required in order to access the site for construction. The pre-clearing work was so successful that MTO is now working towards another Aboriginal Procurement Project for SON community members to complete some of the post-construction landscaping and restoration work at the site, consisting of planting trees, shrubs, and grasses that are native to the area.

4.0 Financial Implications

A 'jack and bore' trenchless method was used to install the new culvert beside the original culvert in order to avoid closing the road, which would have had a negative impact on the First Nations community and the travelling public. This method was estimated to cost approximately 10-15% less than the alternative, which was an open-cut option. It is difficult to quantify the economic impact that a full closure would cause, however, the community relies on Highway 21 for transportation into and out of the Reserve. The closure of Highway 21 would impact residents and business owners, visitors, and anyone using Highway 21 as a through-route to access other communities. The Bruce Peninsula area is a popular summer tourist destination, and a road closure during this time would cause significant delays and increased traffic on the local roads. The Average Annual Daily Traffic using Highway 21 is approximately 4500 vehicles per day. Detour routes for traffic would have to be prepared, and a more extensive public

consultation plan would have to be developed and carried out if a full closure of Highway 21 was required.

Utilizing the baffle system and liner within the culvert was an added expense to the ministry, since the traditional culvert replacement methods would generally not incorporate such a system. However, the benefits provided to the environment and the community for generations to come as a result of incorporating this system more than exceed the costs to install. It should be noted, however, that the CSPI provided the design and evaluation free of charge since this was a pilot project.

5.0 Applicability to Transportation

Given the success experienced with this innovative baffle system, going forward, the ministry may install these baffles instead of the traditional baffle design in culverts with similar challenges and where improving fish passage is a key consideration. The project has garnered attention from other regions, and received an honourable mention from the Ontario Environmental Commissioner's ECO Recognition Award in February 2017.

This successful culvert replacement project proves that outdated infrastructure can be replaced with more environmentally sustainable options, while at the same time reducing the overall cost of construction as compared to traditional methods. It is important that examples such as this are shared with the transportation community so that decision-makers are aware of the benefits that can be realized when an ecosystem-based approach to planning and design is undertaken. It is a common misperception that environmentally-friendly alternatives are more costly, but in the case of long-lasting infrastructure, the benefits must be accounted for over its lifetime. When the environmental, social, and economic benefits that a project such as this provides are accounted for, they far outweigh the costs.

6.0 Conclusion

The unique approach taken to community consultation, design, and construction of this culvert replacement has resulted in an improved outcome for the Ontario Ministry of Transportation. An added benefit resulting from the successful completion of this project is the relationship that the ministry has developed with the Saugeen First Nation and Saugeen Ojibway Nation, through the collaborative approach taken on this project. The knowledge of the local area that was shared was helpful in both the design and construction phases of the project. The project team has benefitted greatly from the knowledge shared amongst team members and experience gained, and will be able to apply this on future, similar projects. Furthermore, the Saugeen First Nation community

will benefit for generations to come, as the tributary to the Saugeen River re-establishes its natural ecosystem, and species diversity and habitat range is expanded.

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APPENDICES

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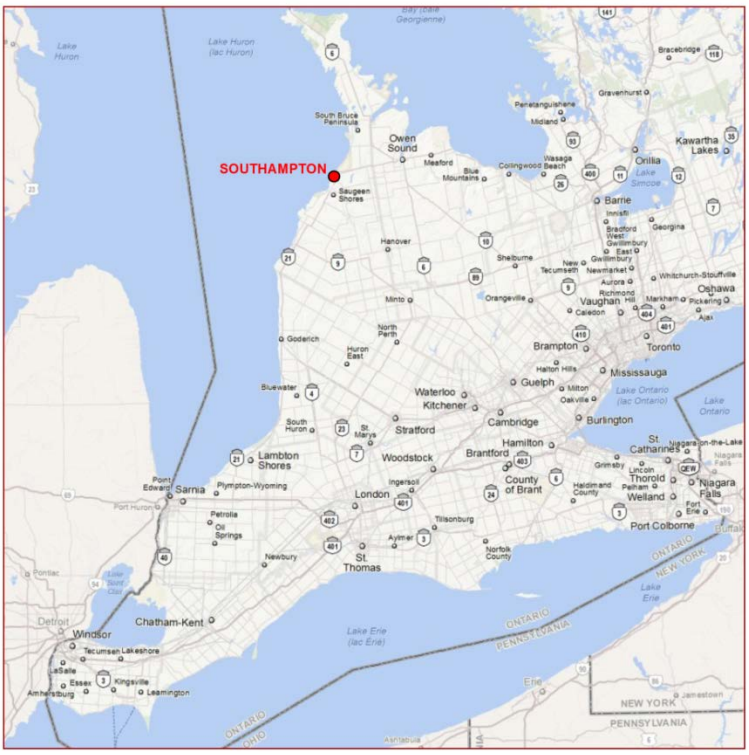
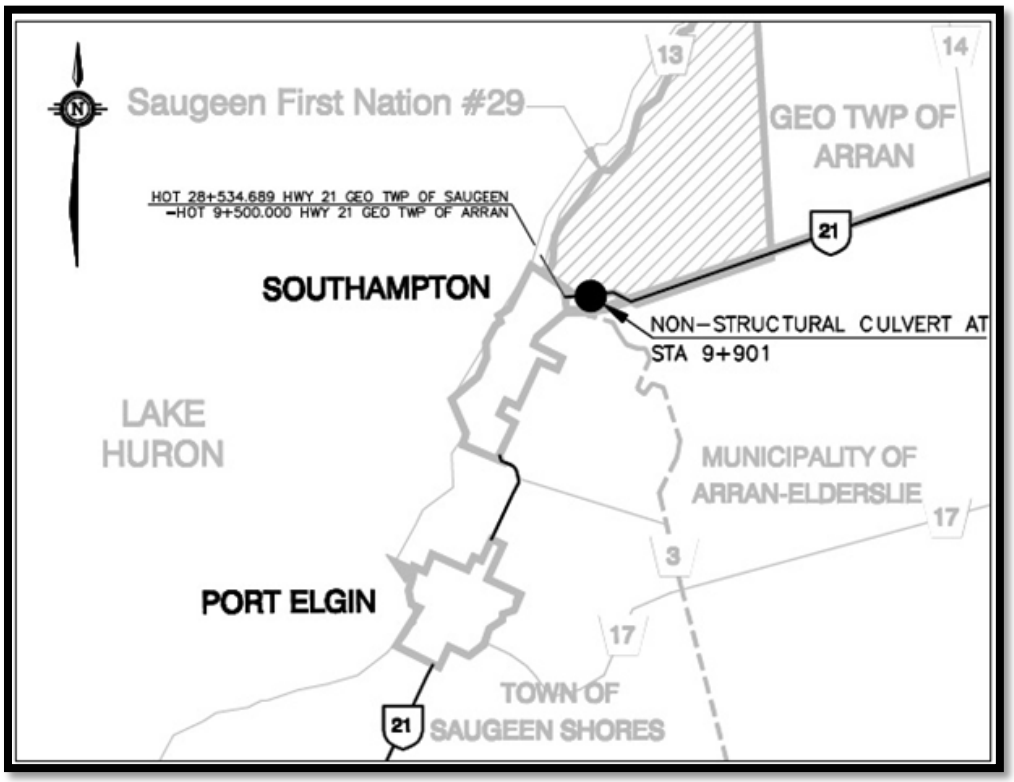
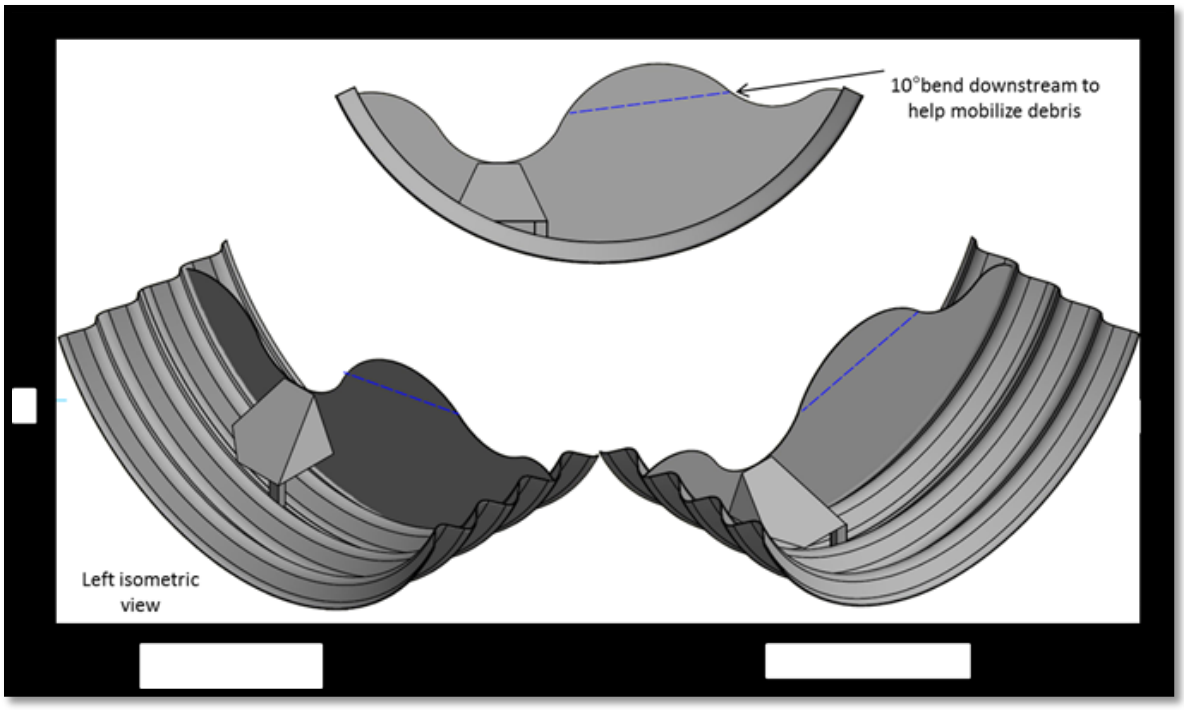
APPENDIX A – Location of the Highway 21 Craig St. Culvert

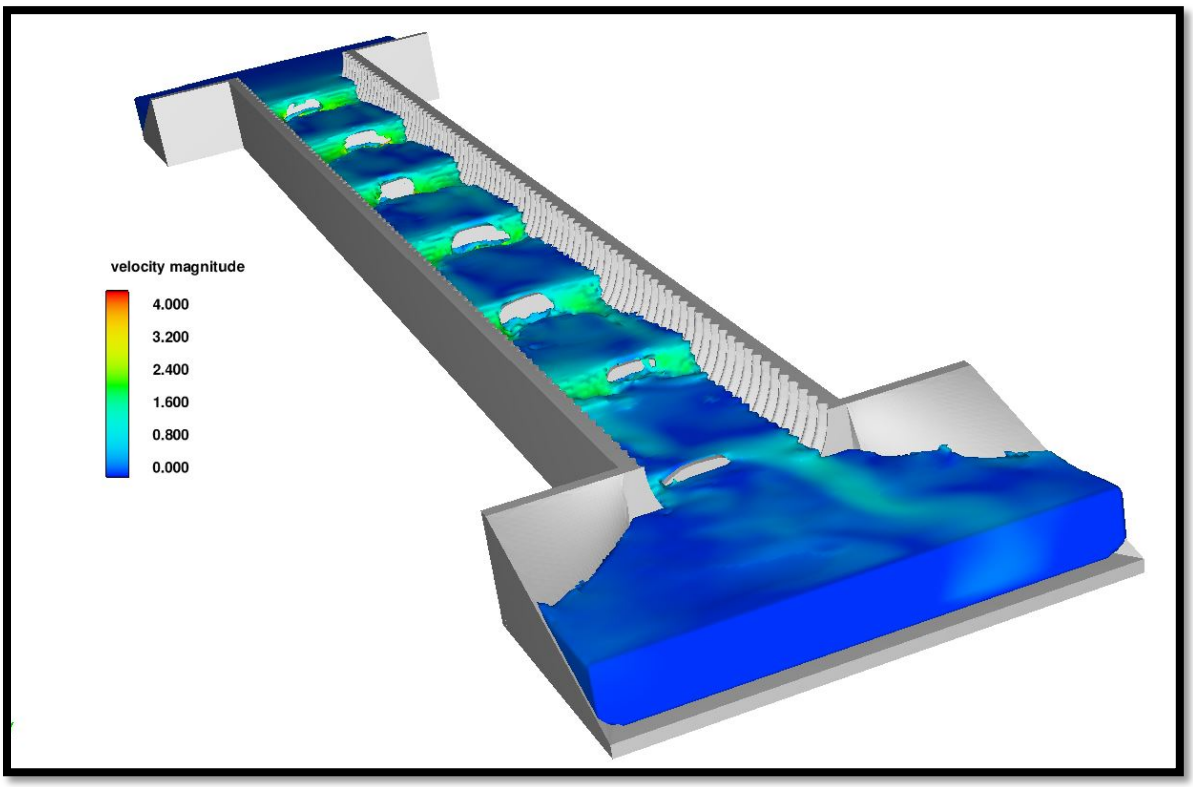




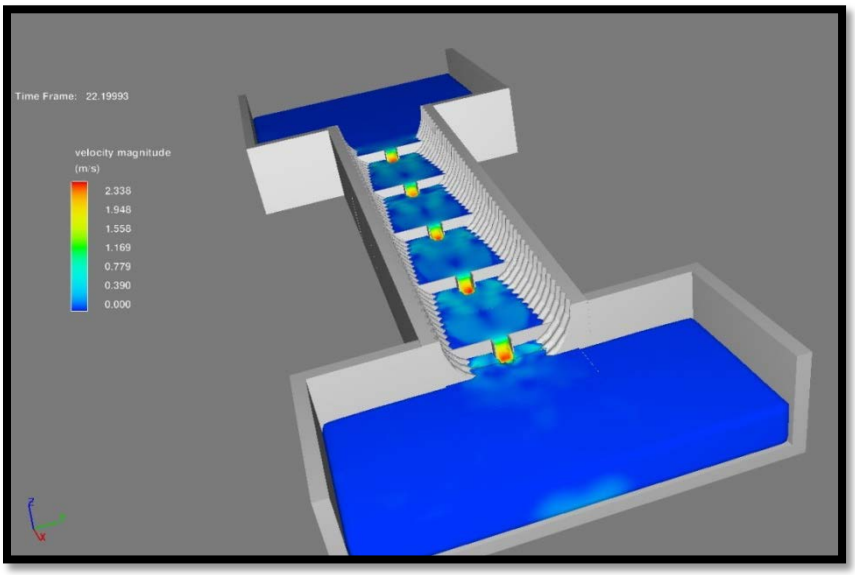
APPENDIX B – Original Culvert

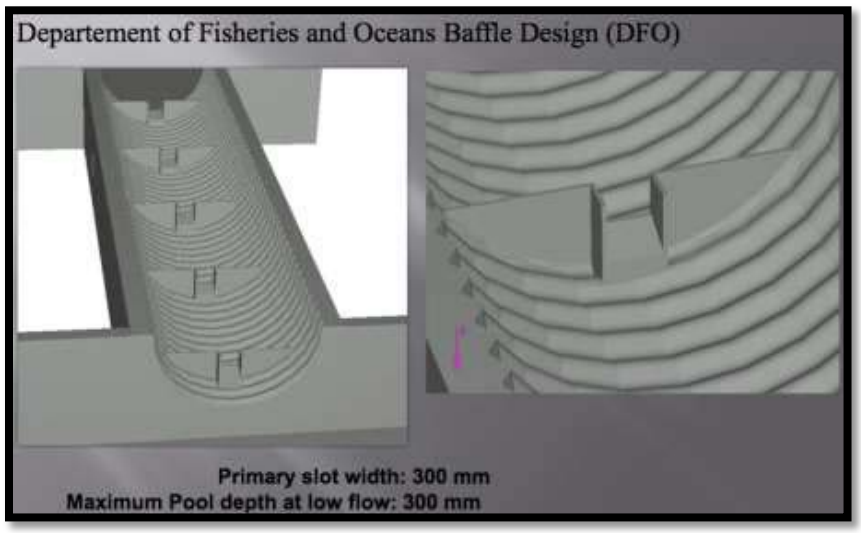
APPENDIX C – Hannaford Baffle Design





APPENDIX D – DFO Fish Baffle Design





APPENDIX E – Construction and Final Results