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MIAMI RIVER PUMP STATION

HARRISON HOT SPRINGS
Naturally Refreshed

CTQ
ENGINEERING PLANNING URBAN DESIGN

MIAMI RIVER PUMP STATION - CTQ CONSULTANTS LTD

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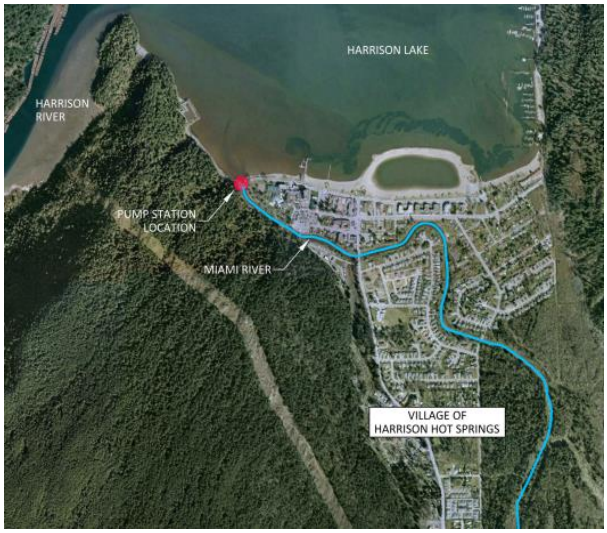
THE SETTING

- Nestled in the Fraser Valley of British Columbia, 60 miles east of Vancouver, the picturesque Village of Harrison Hot Springs, is a small tourist based community with a population of just over 1500 people.
- As a member of the BC Resort Municipality Initiative it is a well-known vacation destination for outdoor enthusiasts that draws extensive visitation on an annual basis and the namesake hot springs are a major attraction for tourists who come to stay in the Village.
- The Village of Harrison Hot Springs has a slogan affixed to its logo...

  "Naturally Refreshed" referring to the recuperative powers of the spring fed waters found in the area.



HARRISON HOT SPRINGS
Naturally Refreshed

THE FLOODS

- The Village of Harrison resides approximately 8.5 meters above sea level. In the late 1940's and early 1950's, the Village experienced significant floods that impacted most of the community. After the floods of the 1950's, the province agreed to contribute to the construction of a dyke to help protect the community. This dyke required the use of a pump to move flowing waters from the Miami River to Harrison Lake in times of high lake levels to mitigate the risk of flooding to the Village.
- Harrison Lake's water source is fed by multiple rivers and the annual snow pack runoff. Certain times of the year, these tributaries cause the lake to rise above the level of the Miami River inlet; causing the risk of flooding of the surrounding area. The existing axial pump had worked as designed for over 65 years; however, due to increased environmental requirements regarding aquatic life and the need to better control the water flow from one source to the other, a new system was required. In 2016, the Canadian Department of Fisheries and Oceans legislated that pumps used in this manner must ensure the fish survival rate in excess of 90%.
- The original pumps required the Village to expend considerable funds for standby pumping in the event of failure. This occurred on a regular basis and precariously placed the Village in jeopardy of flooding.

Harrison Flood 1948

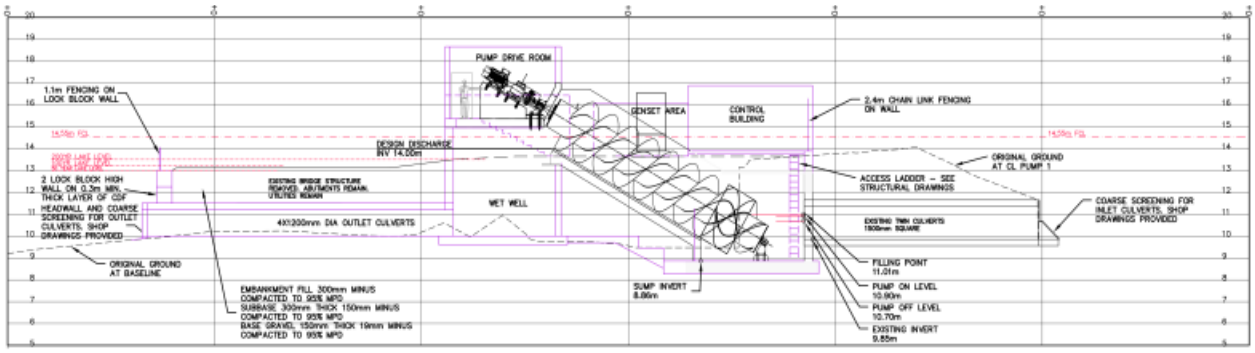

THIS IS AN
EMERGENCY
Disaster Has Struck British Columbia
THOUSANDS ARE HOMELESS...
DWELLINGS WRECKED...
FARMLANDS RUINED...
... The Fruits of Years of Toil Swept Away by Swirling Floods
You may not be able to work on the dykes, but you can help succour the stricken!
$1,000,000
IS NEEDED URGENTLY
for vital emergency relief!
DIG DEEP, BRITISH COLUMBIA — YOU KNOW THE NEED!
Send your Cheque, Money Order or Cash
TODAY . . . NOW!
To Your Local FLOOD EMERGENCY COMMITTEE
Your Newspaper, Bank or Direct to
THE ROYAL TRUST CO.
626 West Pender Street, Vancouver
This advertisement donated by The Vancouver Sun.
Vancouver Sun 1948

- CTQ was commissioned to provide solutions that would replace the existing pump, increase protection from future flooding, as well as satisfy the current environmental legislation.
- With the assistance of CTQ, the Village was able to obtain funding for this project through Provincial and Federal flooding protection programs. The breakdown of funding sources was, one third from the Federal Government, one third from the Provincial Government and the final third was funded locally. With all three parties coming together, the Village could proceed with the project of such significant importance.

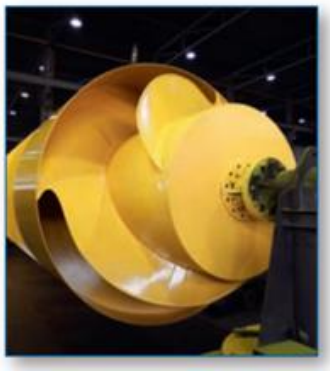
OUR APPROACH

- The existing pump had not been replaced for over 65 years, and there have been significant advances in technology and environmental stewardship. The Harrison situation was initially a challenge as there were no pumps, that we were aware of in North America, which would not jeopardize the lake fish, while providing the necessary extraction of water to keep the region from flooding. We were confident we could find a solution.
- CTQ embraced the design challenge.
- It was both rewarding and amusing to design and install a system, whose classic principles date back to the Greek philosopher Archimedes in the 200's BC, which exceeds the performance standards of today. This is a modern adaptation of ancient technology. The only difference being that today, our pumps are electric but the concept is

exactly the same and so simple to use, that anyone can turn the pumps by hand. The adaption of the Archimedes screw to this application proved both innovative and inventive



- A pump of this magnitude could not be located in North America, and the search turned international. Landustrie, the pump supplier from Holland, created the custom-built pumps to meet Harrison's needs.
- The screw pump has an elevated level of “Fish friendliness” based on the low rotational speed and large openings between the blades, as proven by several scientific tests. In addition, a special wristband around the outside diameter of the screw has been developed by the Landustrie. This “wristband” rotates in the trough with a small clearance. This unique LANDY design prevents damage to fish at the inlet where the blade and trough interface meet. The diameter of the blades increase gradually from the tube towards the outside diameter of the screw pump. The blades will ultimately merge with the “wristband”. A thicker round edge at the beginning of the blades cause pressure waves which are recognized by the fish, leading the fish away from the blades. Resulting in the most fish friendly screw pump available!



Fish friendly “wristband” and rounded edges (red)

- Each of the screw pumps are 2.8 meters in diameter and 9.0 meters in length. The pumps rotate at a rate of 59 RPM and move upwards of 3.0 cubic meters of water per pump per second, This, compared to the original pump which moved the water at a rate of approximately 2.6 cubic meters per second; but, unfortunately had a water life survival rate of 0%.

- CTQ were also cognizant that colour can have an environmental impact, and contacted local fish biologists to find the best “fish-friendly” option. Landustrie pumps have always manufactured their pumps in black, but CTQ research showed that Canary Yellow would be the most fish friendly colour choice. The pump supplier originally questioned the decision to change from their traditional black pumps to yellow, in order to keep the “fish happy”. However, after seeing the result of nearly 100% fish viability after installation, the suppliers were so impressed that they have now decided to offer yellow as a paint choice.

- Site Problems, Scheduling Difficulties or other Elements that were Overcome
    - Liaison with European supplier
    - Coordination with delivering massive pieces of equipment via container ship and truck
    - Very tight tolerances for the construction of the concrete pump housing (+/- 10mm)
    - Working within a sensitive riparian area, and maintaining strict adherence to Environmental Quality control

- Only a 3-month time table was available to the contractor. Construction was fast tracked, working against the threat of early highwater and the need to commission the pump as soon as possible to avoid threatening flood waters.

- Once the size and specifications of the screw pumps were determined, the next step was to design the site plan. Site planning for this project involved placing the key structures to insure minimal impact to the existing dyke structure. An area of the existing flood control system of box culverts, swing gates and open channel was selected as the location of the new screw pump structure. The existing box culverts were trimmed to serve as the inlet to the new facility.

- The open channel and a log bridge spanning the channel were replaced with earth fill over culverts tied to the discharge chamber of the screw pump structure. The discharge culverts were sized to carry the design flow while contained between the remaining concrete abutments.
- Re-grading of the site allowed for improved public use of the scenic setting.

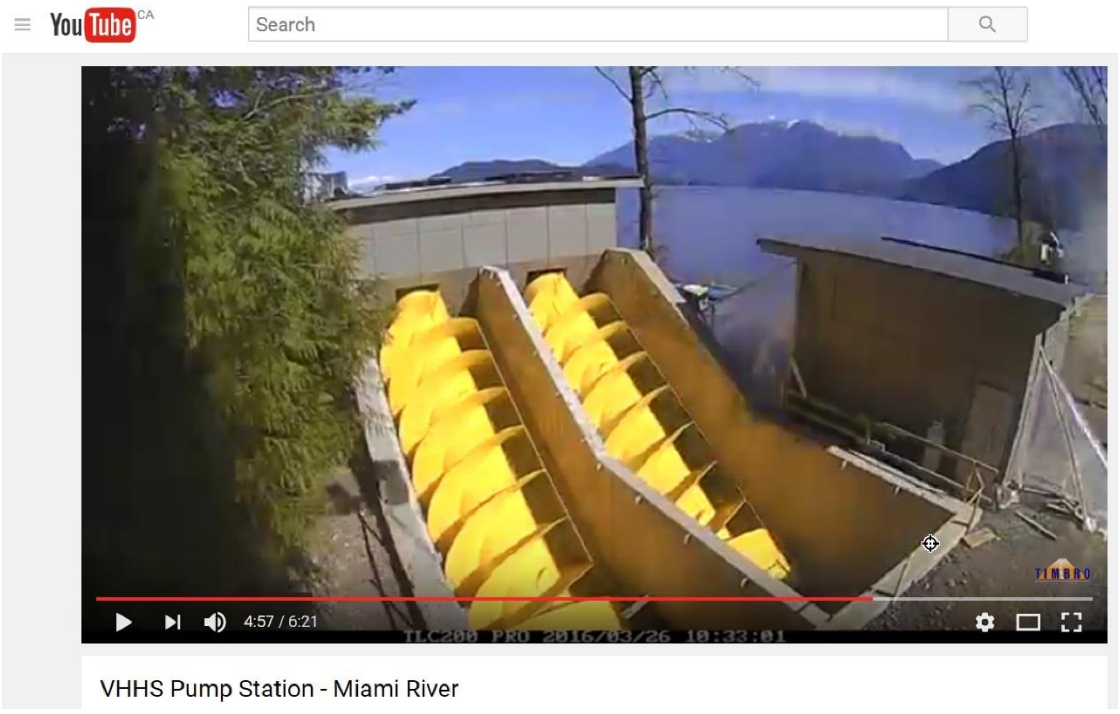
The Beneficial Effects of the Project

- Improved protection of public health and infrastructure;
- Cost effective
- Minimal site impact and increased riparian protection
- Exceeds the minimal standards set for acceptable rates of fish mortality for a pump system of this nature

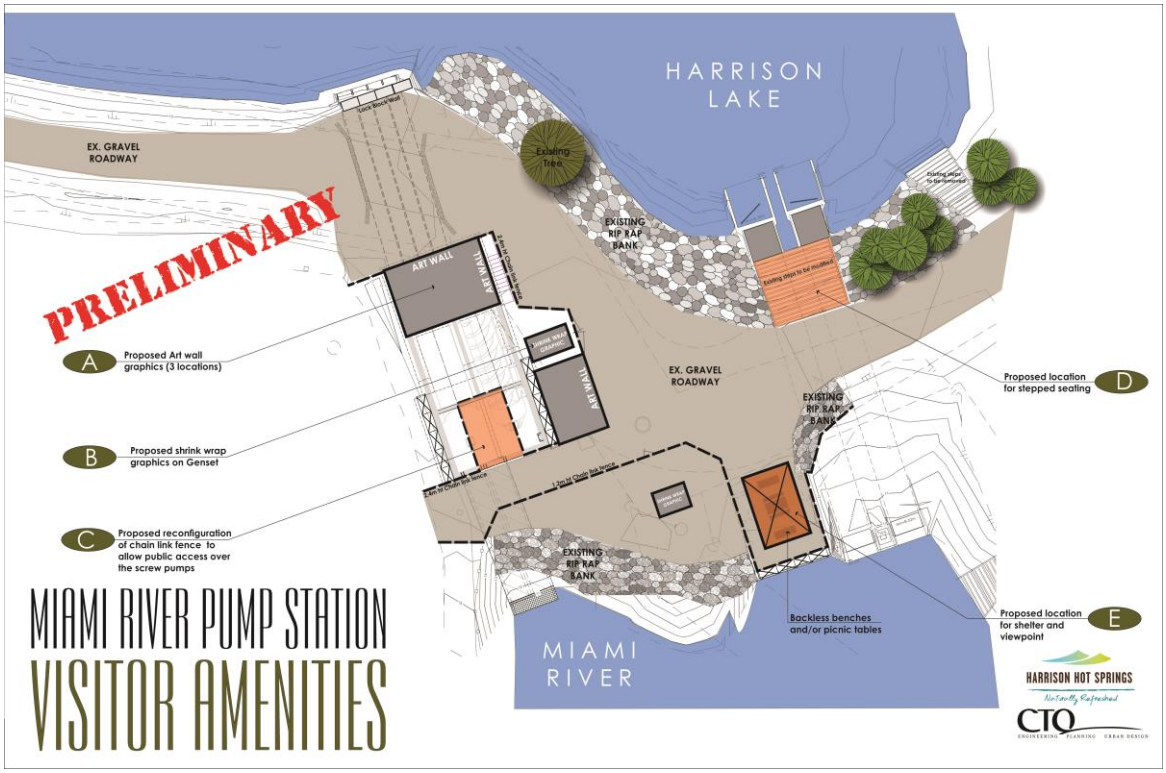
- Replaced an obsolete centrifugal pump which had exceeded its original life expectancy, required significant annual maintenance and which was originally constructed to rudimentary standards
- Protection of public and private property;
- Increased reliability and flexibility of flood protection equipment;
- Emergency redundancy;
- Increased survival of fish and other aquatic inhabitants through provision of a fish-friendly pump and adherence to applicable Best Management Practices (BMPs);
- Decreased operational costs; and
- Reduced risks for economic losses associated with flood events.
- The results of this project are incredible. From the initial design discussions to project completion, the entire process took approximately three years. By creative use of ancient Greek technology to solve a 21st century engineering problem the final product is impressive from many aspects including form and function, economic and social benefits, esthetics, sustainability and minimal environmental impact.

A construction video of the project is included with this binder and can also be found at:

https://www.youtube.com/watch?v=sVoTIz-KwGs&feature=em-share_video_user



MIAMI RIVER PUMP STATION



CTQ also prepared a series of conceptual designs for the Village of Harrison which would introduce an exciting interpretive component for the pump station buildings and the surrounding area

The walls of the buildings presented a blank canvas and an opportunity for artistic creativity to illustrate the variety of fish living in the Harrison Lake and the Miami River ecosystem. Various options were presented as ideas for displaying the information in a colorful and educational format.

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MIAMI RIVER PUMP STATION

C chain link fence reconfigured

VISITOR AMENITIES

The screw pumps are enclosed in a metal mesh and the hope is to allow visitors to stand directly over the pumps and watch the water action directly below their feet.
An interpretive panel would explain the operation of the facility, the influence of the Ancient Greek Archimedes on the design of this 21st century facility, and perhaps child scale working models of the screw pump as another form of teaching and play.

D waterfront seating steps

VISITOR AMENITIES

The lakeshore also offers opportunities to gain direct access to the waters edge and experience the beautiful setting of Harrison Lake.
Steps built into the landscape and or replacing existing steps allows seating and viewing in this unique site context.

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Project Team

The Project Team consisted of the following:

- Ministry of Transportation & Infrastructure Project Manager: - Mona Smith
- Village of Harrison Hot Springs CAO – Madeline MacDonald DFO –Tracey Jones
  Operations Manager – Ian Gardner

Design Team

- Project Lead CTQ Consultants Ltd.
  - Engineer of Record / Contract Administrator – Matt Cameron P.Eng., FEC,
  - Designer – Harry Byl, ASc.T, Site Inspector – Louis Prive,
- Environmental Design and Monitoring – AquaTerra Environmental Ltd.
  - Biologist - Chris Lee, M.Sc., R.P.Bio., QEP, BC-CESCL Site Monitor – Imogen Farren, LLM, B.Sc.
- Geotechnical - Western Geotechnical Consultants Ltd. Geotechnical Engineer - Thanh Le, P.Eng
- Hydraulics - North West Hydraulic Consultants Ltd. Engineer - Joanna Glawdel, M.ASc., P.Eng.
- Architectural – Oasis Design Architectural Designer – James Haasdyk
- Structural – Elbury Consulting Ltd. Design Engineer – Kevin Elbury, M.A.Sc., P.Eng.
  - Seismic Engineer – Andrew Mclellan, M.A.Sc., P.Eng., Struct. Eng., M. I. Struct E., LEED
- Electrical and Controls – Interior Instrumentation and Engineer Services Ltd.
  - Design Engineer - Linda Bie P.Eng.
- Contractors
  - General-Timbro Contracting Ltd
  - Concrete-Mardina Construction Ltd
  - Electrical and Controls-Wynker Electrical and Controls
  -

- CTQ would like to acknowledge the Provincial and Federal funding sources for this project;
  - Building Canada Plan Base Funding Agreement and Flood Protection Program;
  - Building Canada Fund – Communities Component and Flood Protection Program.