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Canadian Consulting Engineering Awards 2011

Duncan-Bateson Pump Station

District of Kent

DISTRICT OF KENT AGASSIZ

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SECTION 1.0 – INTRODUCTION

1.1 Entry Forms

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CANADIAN CONSULTING ENGINEERING AWARDS 2011
DUNCAN-BATESON PUMP STATION

1.2 Project Highlights

The Duncan-Bateson Pump Station is a newly constructed drainage pump station located in Harrison Mills, completed in July 2009, owned and operated by the District of Kent. The station conveys flows from the Duncan-Bateson Slough system, draining a catchment of 590 hectares comprised of forested slopes and hills and low-lying farm lands, to the Harrison River. The Duncan Slough originates as a mountain stream south of the Lougheed Highway with good quality water and flow, and is a salmonoid fish habitat carrying Chinook and Coho fry and smelts. During the annual spring freshet, the water level of the Harrison River is higher than the slough, necessitating for slough flows to be pumped.

The old flood pump station serving this catchment was in deteriorated condition, had insufficient pumping capacity, and lacked mitigation measures for fish protection and transfer. The District required a complete upgrade of the pump station to maintain lower water levels in the sloughs throughout the freshet season while providing a long term, low maintenance method of reducing fish mortality during flood pump operation.

The new pump station which includes two 750 L/s axial flow drainage pumps, increased pumping from 300 to 1,500 L/s, bringing the flood protection of the area up to standard by providing sufficient drainage capacity for a 1 in 10 year, 48 hour summer storm.

Although the primary objective of the project was to protect the low-lying farming community from flooding, achieving this goal, without compromising the viability of the Duncan Slough fish habitat was paramount. The usual approach to accommodating fish passage, when infrastructure acts as a barrier, is through the use of Archimedes screw pumps. As an alternative to screw pumps, the new pump station incorporates a unique means to safe fish transfer by utilizing a submersible-centrifugal hydraulic fish pump typically employed in the aquaculture industry. The centrifugal fish pump design offered a reduction of approximately 50% in cost, allowing the project to fit within the District's budgetary framework. The avoidance of the larger and more demanding screw pumps also allowed for a significant reduction in the station's footprint, minimizing construction impact to the slough and the dike.

Safe fish transfer is achieved by a fish screen, installed on a hinged frame, which protects fish fry from the downstream drainage pumps and provides for easy maintenance as it can be rotated in and out of the inlet channel. The fish pump is mounted integral to the screen and the pump is setup to run automatically prior to flood pump operation. Fish fry are drawn through the low speed impeller and are gently pumped through the dike, and ultimately released into a basin adjacent to the Harrison River.

The design took advantage of the old pump station's 750 mm diameter HDPE discharge pipeline, passing through the dike, by reusing it as a dedicated pipe to convey the discharge from the fish

pump to the Harrison River. The outlet was modified to provide a pool for safe discharge of migrating fish as the river levels dropped. This created significant savings in materials and costs for the project, and reduced the impact of construction on the dike.

During the design, discussions took place with the Department of Fisheries and Oceans (DFO) to ensure their satisfaction with the design approach used for mitigating damage to the slough's fish population and habitat. The fish screen and pump design required that the station inlet approach velocity be sufficiently low to protect fish from becoming impinged on the screen.

To evaluate the new station's functionality, live fish testing was conducted post construction by releasing hatchery fish into the channel inlet. Testing demonstrated a greater than 90% survival rate for transferred fish. This is estimated to have achieved a 90% reduction in fish mortality compared to the previous pump station, providing for safe fish migration during the spring freshet.

Mitigative strategies were established prior to construction to minimize impact to the environmentally sensitive works. A fish salvage was conducted prior to isolating the work area in the Duncan Slough for construction dewatering. Geotechnical and environmental monitoring was conducted throughout the construction of the project to ensure conformance with the best management practices for the Ministry of the Environment, Fisheries and Oceans Canada, and the Diking Authority.

Another environmental feature incorporated into the upgrade to prevent damage to the fish habitat is the use of biodegradable vegetable oil for the hydraulic fluid in the hydraulic pack powering the fish pump. This ensures that if a hydraulic fluid spill occurs it will not negatively impact the slough. As well, an elastomer duckbill type check valve was used instead of a typical flap type check valve on the fish discharge pipe as it provides favourable operation for fish passage. However, beyond the environment, the overall improvement to the fish habitat has far reaching impacts both economically and socially for a sustainable food source such as wild BC salmon.

The upgrade also significantly enhanced the station's accessibility and operation and maintenance. Features include improved truck access, a mechanical room with wash-down station, and a fish screen that can be easily lifted out of the channel. Although function takes precedence over aesthetics in engineering, it is often the physical appearance of a project which garners the most attention. The new pump station is an open concrete channel structure designed with a tiered approach to integrate the works into the natural landscape of dike and minimize visual impact to the surrounding area. Post construction restoration included landscaping the dike banks with naturally occurring grass species indigenous to the area.

The project was completed on schedule and under budget and succeeded in meeting the goals of community and environmental sustainability. The new pump station is entering its third season of operation, alleviating flooding risk in the neighbouring farming lands and improving the viability of the Duncan Slough fish habitat by providing safe fish passage for migrating salmonoids.

SECTION 2.0 – PROJECT DESCRIPTION

2.1 Project Objectives, Solutions, and Achievements

BACKGROUND

The Duncan-Bateson dike is located in Harrison Mills adjacent to the Harrison River. The Duncan and Bateson Sloughs meet and drain into the Harrison River through an existing floodbox culvert. During the annual spring freshet, the water level of the Harrison River is higher than the slough, and the slough flows must be pumped. The old pump station had a capacity of 300 L/s, which was insufficient to protect the low-lying agricultural lands from standard flood risk, and typically ran continuously throughout the freshet period.

The catchment areas for both the Duncan and Bateson sloughs are mostly agricultural, although the Duncan Slough originates as a mountain stream. The upper reaches of the Duncan Slough have been shown to be salmonoid fish habitat and the lower and middle reaches have limited non-salmonoid habitat. During the freshet season – typically from April to August each year - the floodbox is closed and fish migration is obstructed.

The combination of the deteriorated condition of the existing pump station, inadequate pumping capacity, and a lack of mitigation measures for fish protection and transfer dictated the need for a substantial upgrade.

OBJECTIVES

The objectives of the project were as follows:

- Increase the drainage pumping capacity of the Duncan-Bateson Pump Station to prevent and alleviate flooding of the neighbouring farming community;
- Provide a long term, low maintenance method of reducing fish mortality during flood pump operation;
- Protect the physical and aesthetic environment by minimizing impact of the project on the slough system and the dike both during and after construction;
- Improve the accessibility, operation, and maintenance of the Pump Station for District operations staff.

SOLUTIONS

Improving the station's long term drainage capacity to alleviate and prevent flooding of the low-lying agricultural areas of the Duncan and Bateson sloughs catchment was the foremost criteria of this project. A key criteria was to maintain lower water levels in the sloughs throughout the freshet season. Achieving this goal, while not compromising the environmental and economic requirements, necessitated a collaborative approach between the District's Engineering and Operations Departments and the Opus DaytonKnight design team. The design was presented to District staff in a staged review process, during which pump station functionality and operation and maintenance needs were developed and addressed.

During the design, discussions took place with the Department of Fisheries and Oceans (DFO) to ensure their satisfaction with the design approach used for mitigating damage to the slough's fish population and habitat. The fish screen and pump design required that the station inlet approach velocity be sufficiently low to protect fish from becoming impinged on the screen.

The design took advantage of the old pump station's 750 mm diameter HDPE discharge pipeline, passing through the dike, by reusing it as a dedicated pipe to convey the discharge from the fish pump to the Harrison River. The outlet was modified to provide a pool for safe discharge of migrating fish as the river levels dropped. This created significant savings in materials and costs for the project, and reduced the impact of construction on the dyke.

Mitigative strategies were established prior to construction to minimize environmental impact. Throughout the construction of the project Scott Resource Services and Levelton Consultants provided monitoring to ensure conformance with the best management practices for the Ministry of the Environment, Fisheries and Oceans Canada, and the Diking Authority.

Once the new pump station was commissioned, live fish testing was conducted to confirm compliance with Fisheries and Oceans requirements.

ACHIEVEMENTS

The achievements following from the objectives were:

- The new pump station brought the District into compliance with flood protection standards providing sufficient drainage capacity for a 1 in 10 year, 48 hour summer storm.

- Live fish testing results showed greater than 90% of transferred fish were unharmed by pumping.

- Construction of the works was completed with minimal impact on the fisheries resource.

- The upgrade significantly enhanced the station's accessibility and operation and maintenance. Features include improved truck access, a mechanical room with wash-down station, and a fish screen that can be easily lifted out of the channel.

- The project was designed and constructed on schedule and under budget.

- The project was the recipient of the Leadership and Innovation Award for Small Communities at the Union of BC Municipalities Annual Convention in 2010.

2.2 Technical Excellence and Innovation

Fish Pump and Screen

The usual approach to accommodating fish passage, when infrastructure acts as a barrier, is through the use of Archimedes screw pumps. The pump station design implemented a unique alternative to this standard approach to safe fish transfer by utilizing a submersible centrifugal, hydraulic pump typically used in the aquaculture industry. The centrifugal fish pump design offered a reduction of approximately 50% in cost, allowing the project to fit within the District's budgetary framework. The avoidance of the larger and more demanding screw pumps also allowed for a significant reduction in the station's footprint, minimizing construction impact to the slough and the dike.

The fish screen, mounted on a hinged frame, protects fish fry from the downstream drainage pumps and provides for easy maintenance as it can be rotated in and out of the inlet channel. A bar screen at the entrance of the station limits the amount and size of debris that is able to enter the station and protects the pumps and the fish screen from damage. Weights are mounted on to the fish screen to prevent it from lifting off the bottom of the channel floor due to lift and drag forces generated while the flood pumps are running.

The fish pump is mounted integral to the screen and the pump is setup to run automatically prior to flood pump operation. Fish fry are drawn through the low speed impeller and are gently pumped into a section of flexible tubing, through a fish friendly check valve, through the dike via the old pump station's discharge line, and ultimately released into a basin adjacent to the Harrison River.

To evaluate the new station's function, live fish testing was conducted post construction by releasing hatchery fish into the channel inlet. Testing demonstrated a greater than 90% survival rate for transferred fish. This is estimated to have achieved a 90% reduction in fish mortality compared to the previous pump station, providing for safe fish migration during the spring freshet.

2.3 Environmental, Economic and Social Sustainability, and Aesthetic Aspects

Environmental Sustainability – Long term environmental protection was a paramount consideration for the project in order to improve the viability of the Duncan Slough fish habitat by providing safe fish passage through the dike during the spring freshet. Specific features of the project which protect the environment include:

- Biodegradable vegetable oil is used for the hydraulic fluid in the hydraulic pack powering the fish pump. This ensures that if a hydraulic fluid spill occurs it will not negatively impact the slough.
- An elastomer duckbill type check valve was used instead of a typical flap type check valve on the fish discharge pipe as it provides favourable operation for fish passage.
- A fish salvage was conducted during construction, prior to isolating the work area in the Duncan Slough for dewatering.
- Mitigative strategies and best management practices were successfully followed during construction throughout the environmentally sensitive works.

Beyond the environment, the overall improvement to the fish habitat has far reaching impacts both economically and socially for a sustainable food source such as wild BC salmon.

Economic Sustainability – As with all engineering works, costs play a key role often dictating the project's overall viability. The adaptation of the submersible, centrifugal fish pump from the aquaculture harvesting industry to a municipal application significantly lowered the project's construction cost, positively changing its economic feasibility.

Additional cost and material savings were available by reusing the existing station's discharge line through the dike to serve as the new station's dedicated fish pump discharge.

Social Sustainability – The primary goal of the project was to protect the low-lying farming community from flooding. The new pump station which includes two 750 L/s axial flow drainage pumps, increased pumping from 300 to 1,500 L/s, bringing the drainage capacity of the area up to standard.

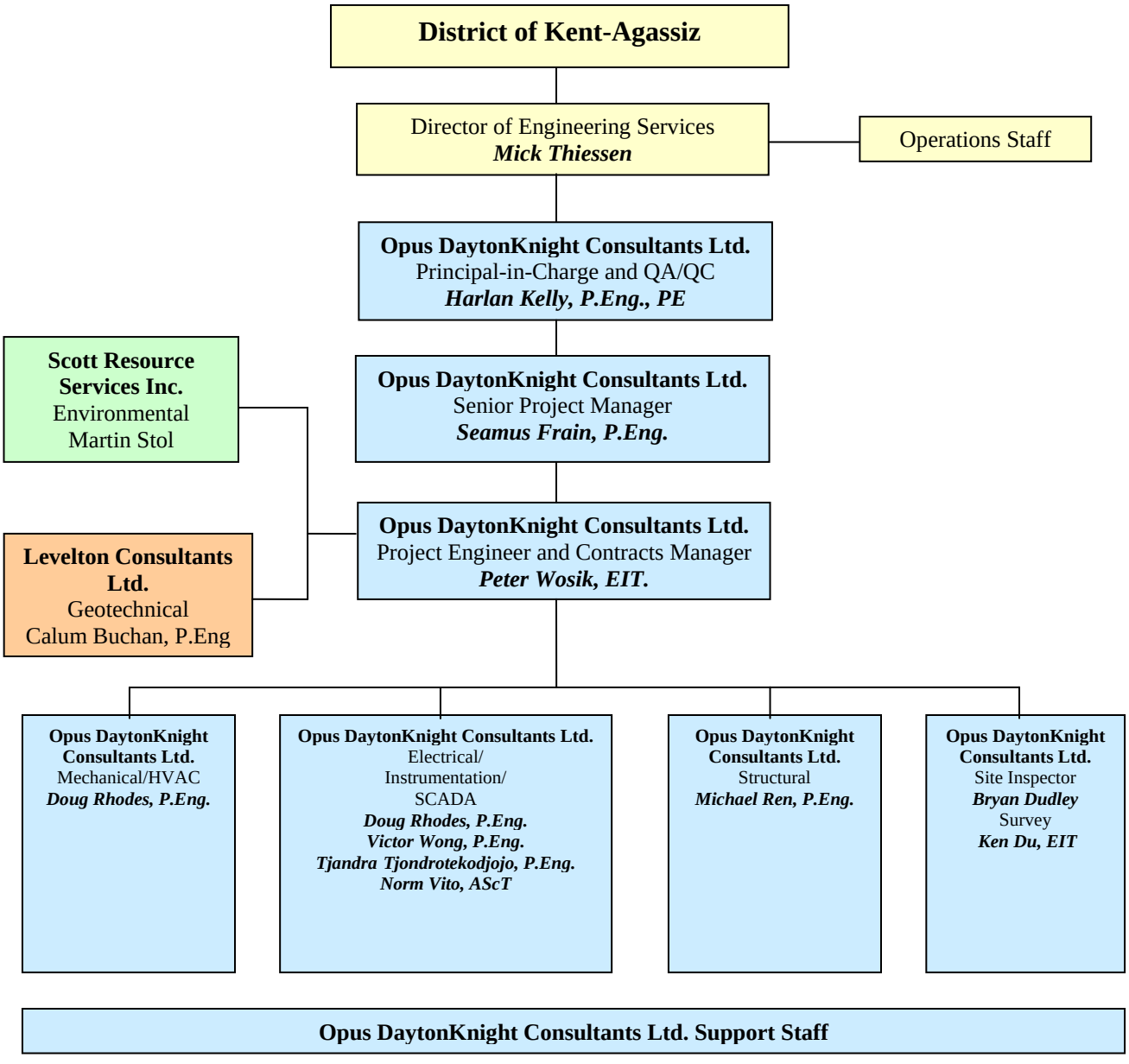
Aesthetic Aspects – Although function takes precedence over aesthetics in engineering, it is often the physical appearance of a project which garners the most attention. The new pump station is an open concrete channel structure designed with a tiered approach to integrate the works into the natural landscape of dike and minimize visual impact to the surrounding area.

Post construction restoration included landscaping the dike banks with naturally occurring grass species indigenous to the area.

SECTION 3.0 – PROJECT ORGINIZATION, DRAWINGS, AND PHOTOS

District of Kent – Agassiz
Duncan-Bateson Flood Pump Station Upgrade

Project Organization Chart



0 2 4 6 8 10 METRES

POND

700ø HDPE DISCHARGE PIPE

EXIST. 750ø HDPE SLOPE 2.04%

BOT. OF DYKE

8.0 9.0 10.0 11.0 12.0 13.0

FISH DISCHARGE CHECK VALVE CHAMBER

EXISTING FLOOD BOX

9.0 8.0

POND

BATESON SLOUGH

200ø FLEX PVC HOSE

10.5

NEW PUMP STATION WITH FISH SCREEN

11.0

NEW KIOSK C/W CONCRETE PAD

13.0 12.0

RETAINING WALL WITH HAND RAIL

SITE PLAN

ELEV. (m)

APPROXIMATE EXISTING GROUND PROFILE

14 12 10 8 6

TRASH RACK

DRAINAGE PUMPS

FISH SCREEN C/W FISH PUMP

RAW WATER PUMP

STATION 0+040 0+030 0+020 0+010 0+000 STATION

PROFILE

PLOT: FULL 1:1 HALF 1:2

FILE: \\Dkfs\dronings\Recdwgs\KENT\370-009-300\GENERAL\370-009-300 G2.dwg Tab G2 11-01-18 vcpdwD

AutoCAD DRAWING

REVISIONS	ISSUE	DATE	DRAWN	CHK'D	APP'D	DESCRIPTION	ISSUE	DATE	DRAWN	CHK'D	APP'D	DESCRIPTION
	A	OCT22/08	KS	PW	SF	ISSUED FOR 90% REVISION	D	JAN22/09	KS	PW	SF	ISSUED FOR CONSTRUCTION
	B	NOV17/08	RB	PW	SF	ISSUED FOR TENDER	E	NOV9/09	KS	PW	SF	RECORD DRAWING
	C	DEC03/08	RB	PW	SF	2 ADDENDUM No.2						

DESIGNED SF/PW
DRAWN KS
CHECKED SF

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DISTRICT OF KENT
DUNCAN–BATESON – FLOOD PUMPING STATION UPGRADE
SITE PLAN AND PROFILE

SCALE: 1:100
DRAWING No. 370.009.300
SHEET No. G2 ISSUE E
THIS DRAWING REDUCED TO HALFSIZE

Old 300 L/s Duncan-Bateson Flood Pump Station prior to demolition.

Installation of the drainage pump discharge columns. Drainage pumping capacity increased to 1,500 L/s.

Installation of new 750 mm diameter HDPE drainage discharge pipes passing through the dike.

Submersible-centrifugal, hydraulic driven, fish-friendly transfer pump and discharge piping mounted integral to the fish screen.

Fish discharge piping passes through a fish-friendly duckbill type check valve.

Dedicated pumped fish pipeline (foreground), and pumped drainage discharge pipes (background), discharging into a basin adjacent to the Harrison River.

Hatchery Chinook and Coho Salmon used for live fish testing. Ninety percent of transferred fish passed without harm.

Overall view of the new pump station at inlet.