QUIDI VIDI CONSULTING

Group 1 : Rattling Brook Hydroelectric Development Work Plan

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January 29, 2010

G. Humby, P.Eng & T. White, P.Eng
Newfoundland Power
PO Box 8910
St. John's, NL
A1B 3P6

Subject: Rattling Brook Hydroelectric Development Work Plan

Dear Mr. Humby & Ms. White,

Quidi Vidi Consulting would like to submit the attached work plan for the engineering design of the new overflow spillway at the Rattling Brook Hydroelectric Development. The plan is a requirement of ENGI 8700 and has been prepared in order to assist us in completing all project requirements within the prescribed deadlines.

The work plan outlines the tasks required for completion of the project and the deadlines we have set for each task. Information on expected deliverables and risks of the project relating to the design are also included.

If there are any questions concerning this report, we would be pleased to discuss them with you.

Yours Sincerely,

Megan Kavanagh
Project Manager
Quidi Vidi Consulting

Attachment: Rattling Brook Hydroelectric Development Work Plan

CC: Dr. S. Bruneau

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1.0 Project Description

The Rattling Brook hydroelectric development began producing electricity in 1958. It is located in the community of Norris Arm South and is the largest hydroelectric plant currently operated by Newfoundland Power. The plant consists of two 7.5 MW generators fed by one steel penstock. Figure 1 shows a map of the hydroelectric development.

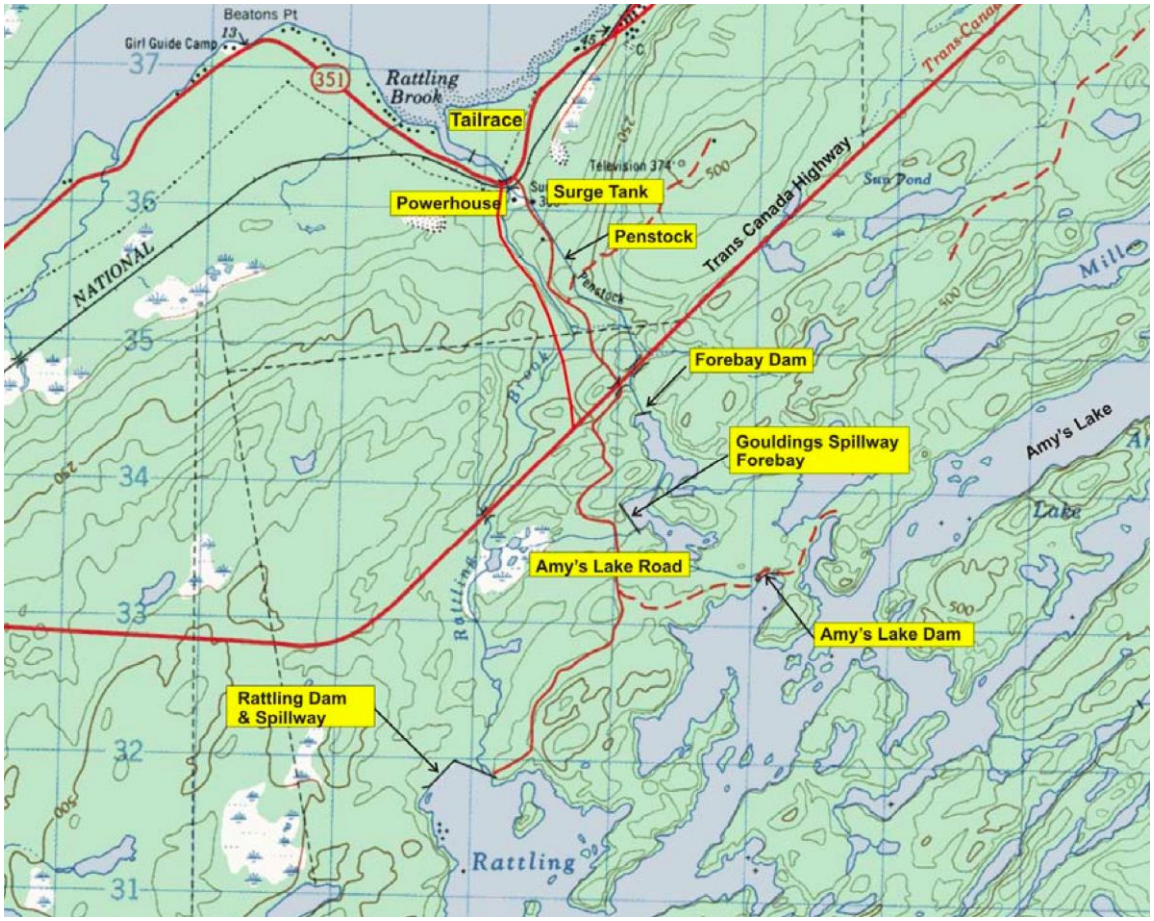


Figure 1 - Rattling Brook Hydroelectric Development

The primary storage reservoir is created by the combination of the former Rattling and Amy's Lakes. The primary overflow spillway is located adjacent to the Rattling Lake Dam and consists of a concrete base with 42 stoplog bays of varying size. Figure 2 shows the current stoplog spillway arrangement.

Figure 2 - Rattling Lake Overflow Spillway

The operation of the spillway in its present configuration leads to reduced hydro plant output as a result of inefficient operation. Because of the freeboard requirements of other dams in the system, the removal of stoplogs is required to safely pass flood flows. Removing stoplogs is very labour intensive and potentially hazardous to employees as manual lift hooks are used to raise excess stoplogs to a platform over the spillway. Flow predictions are required prior to a flood event to ensure a sufficient number of stop logs are removed to accommodate the additional flood flow. Possible dam safety issues are created if an insufficient number of logs are removed. Further dam safety issues result if it becomes impossible to remove lower stoplogs under spill conditions. Water wastage can occur if too many logs are removed and replacing stoplogs under spill conditions is difficult, further increasing the amount of unnecessary spill.

During winter months, the reservoir elevation is lowered to prevent ice loads on the deteriorated structure. By limiting storage capacity of the reservoir to an elevation below full supply level (FSL), some inflow may not be captured or the water may not be used in the most efficient way.

Structural deterioration has been noted in the concrete base as well as the support struts. Due to the operational challenges and structural deficiencies of the structure, Newfoundland Power has decided to replace the overflow spillway. It is presently budgeted for the 2011 construction season.

2.0 Project Requirements

Quidi Vidi Consulting (QVC) is responsible for designing a replacement overflow spillway for the Rattling Brook Hydroelectric Development. QVC will complete a detailed design of the spillway. This will include detailed drawings, calculations and a cost estimate for construction of the new spillway and demolition of the existing spillway. Figure 3 shows the existing layout of the site.

Figure 3 - Existing Site Layout

3.0 Methodology

3.1 Organization

Using the project objectives defined by the client, QVC has identified tasks that are required for completion of the project. While the group will work together on many tasks each person's focus will be as follows:

- Michael Cahill: Design
- Megan Kavanagh: Project Management
- Sara Vaughan: Design and Estimating
- David Ball: Drafting and Design

Group meetings will be held as required to complete the project requirements by the assigned deadlines.

3.2 Client interaction and role

Weekly meetings between the client and QVC will take place during the initial stages of work planning and concept selection. As the design progresses, meetings will be scheduled as needed.

The client's key role will be to provide QVC with the data required to carry out the design and cost estimate for the spillway. The client will also provide high level oversight and guidance of our progress.

3.3 Outcomes

As a group, QVC hopes that taking part in ENGI 8700 will allow us to gain experience in the professional engineering environment. Although we have all taken part in work placements, we now have the opportunity to be responsible for an entire design project from start to finish.

4.0 Tasks for Project Completion

4.1 Re-evaluate past concept

The first task required for the project is to review a report prepared for Newfoundland Power in 2007 by Hatch titled “Rattling Brook Hydroelectric Development – Main Spillway Replacement Study”. The report outlines several options for the spillway replacement and reviews costs and operation of each. Alternatives considered included multiple configurations of gravity spillway, steel gates, rubber dams and stoplogs. The report recommends the use of a labyrinth overflow spillway as the preferred alternative.

The purpose of the review is to ensure that the previously identified alternative is still the most feasible in terms of the cost as well as the operational properties. This stage will involve some conceptual design and preliminary calculations. Important items to consider are the hydrological requirements including spillway flow and required freeboard as well as the associated construction quantities and cost estimation. This step will also require independent research into the many types of spillways that are to be considered.

4.2 Detailed Design

In consultation with the client, Quidi Vidi Consulting will proceed with detailed design of the most desirable option based on cost and the operational properties. Newfoundland Power would prefer the overflow spillway be capable of handling significant flood flows without having to send personnel to the site. To achieve this, the spillway would have to statically handle the flood. Alternatively, any moving parts in the design would be automated and have the ability to be operated remotely.

Because the hydraulic and structural designs are interdependent, design will be an iterative process. We intend to use spreadsheet based calculation tools where possible to ensure iterative calculations are completed in an efficient manner. The structure will be primarily reinforced concrete with the possibility of some structural steel. These structural elements will require detailed design using the applicable codes.

A flow of 416m^3/s will be the 1/10,000 year design flood needed to pass the structure while maintaining a safe freeboard on all reservoirs dams and freeboard dykes. Based on the above mentioned report from Hatch, many of the alternatives suggested require an increase to freeboard on adjacent dams. If any additional work is required on the dams, QVC will be responsible for the design.

Other design considerations are ice loading, erosion and sedimentation. The existing spillway requires that water level during winter months is restricted to below stoplog level to ensure no ice interaction with the stoplogs. The new spillway will have to withstand this ice interaction so that no restriction of water level during the winter months will be required. Flows at the toe of the spillway will be assessed to ensure no undercutting of the dam. Energy dissipaters may

be required. The sedimentation effects need to be assessed to ensure no significant buildups will occur on the spillway.

The client expects that detailed design drawings, calculations and a list of reference material be made available to them at the conclusion of the project. We expect the preparation of detailed design drawings will require significant time resources and are therefore included as a separate task in our schedule.

4.3 Cost estimation

From the design drawings prepared by QVC, a detailed cost estimate will be developed. This estimate must include costs of all materials and labour and take into account the project location. It must also account for the demolition and removal of the existing spillway structure. We plan on using a combination of recent tender cost from our client, supplier quotes and if needed, the current edition of an estimating handbook such as RS Means to complete our estimates accurately. Estimates for both demolition and construction will be prepared to an engineering level (±10%).

4.4 Midterm Report and Presentation

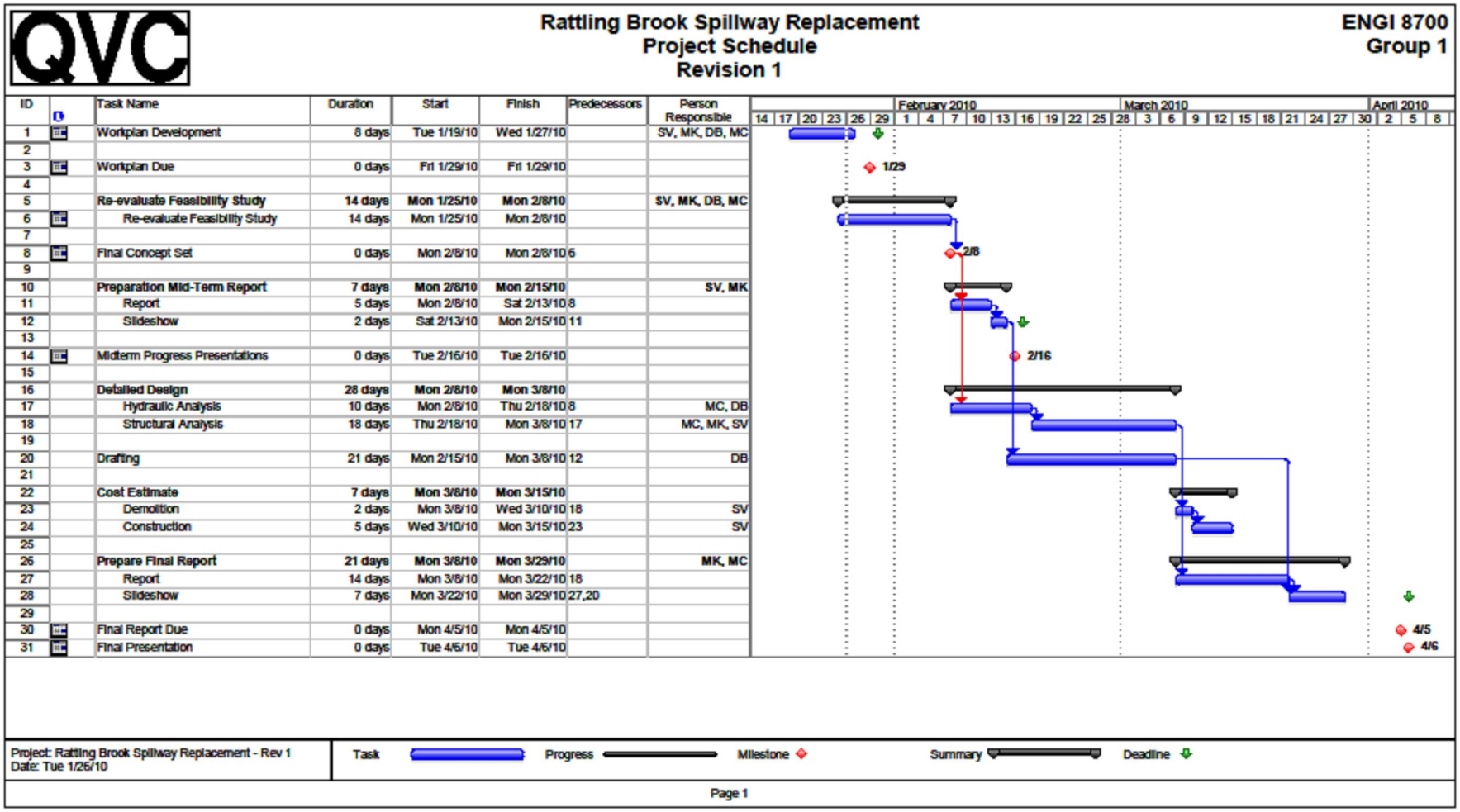
A midterm report and presentation is a requirement of ENGI 8700. The report will review the status of the project tasks and highlight our achievements to date. At that time we will present the final design concept to the client. The content of the report will be summarized and presented to the other members of the class.

4.5 Final Report and Presentation

A final report and presentation is a requirement of ENGI 8700. This report will mark the conclusion of the project. It will present our final design and cost estimate to the client, meeting all requirements set by the client. The report will include all relevant facts, figures and calculations. The final presentation will summarize our report and will be presented to clients, faculty and other students. Significant time and resources have been allotted for this task as it is expected to be a very large document.

5.0 Project Schedule

QVC has developed a project schedule, as outlined in Figure 4. We have estimated the timeframes that will be required to complete the tasks outlined and allotted resources to each task. We have allotted two weeks for all members of the group to review the report prepared by Hatch and to research the concepts presented. The final design will be selected by February 8, 2010. At this point, the group will be split into two subgroups. Megan and Sara will prepare the midterm presentation and report, while David and Michael will begin work on the design of the new spillway. After the midterm presentations are complete, and some of the design work has begun, David will begin drafting while the remaining three members of the group will continue with design of the structure. This is expected to be the most time consuming task and we have allotted four weeks for the detailed design with three weeks of drafting. Once the design is complete, Sara will begin the process of estimating costs for the construction of the new spillway and destruction of the existing one. One week is allotted for estimating the costs associated with the project. Megan and Michael will begin work on the final report on March 8, 2010. The report will not be finalized until design, drafting and cost estimating are completed.



ID	Task Name	Duration	Start	Finish	Predecessors	Person Responsible
1	Workplan Development	8 days	Tue 1/19/10	Wed 1/27/10		SV, MK, DB, MC
2						
3	Workplan Due	0 days	Fri 1/29/10	Fri 1/29/10		
4						
5	**Re-evaluate Feasibility Study**	**14 days**	**Mon 1/25/10**	**Mon 2/8/10**		**SV, MK, DB, MC**
6	Re-evaluate Feasibility Study	14 days	Mon 1/25/10	Mon 2/8/10		
7						
8	Final Concept Set	0 days	Mon 2/8/10	Mon 2/8/10	6	
9						
10	**Preparation Mid-Term Report**	**7 days**	**Mon 2/8/10**	**Mon 2/15/10**		**SV, MK**
11	Report	5 days	Mon 2/8/10	Sat 2/13/10	8	
12	Slideshow	2 days	Sat 2/13/10	Mon 2/15/10	11	
13						
14	Midterm Progress Presentations	0 days	Tue 2/16/10	Tue 2/16/10		
15						
16	**Detailed Design**	**28 days**	**Mon 2/8/10**	**Mon 3/8/10**		
17	Hydraulic Analysis	10 days	Mon 2/8/10	Thu 2/18/10	8	MC, DB
18	Structural Analysis	18 days	Thu 2/18/10	Mon 3/8/10	17	MC, MK, SV
19						
20	Drafting	21 days	Mon 2/15/10	Mon 3/8/10	12	DB
21						
22	**Cost Estimate**	**7 days**	**Mon 3/8/10**	**Mon 3/15/10**		
23	Demolition	2 days	Mon 3/8/10	Wed 3/10/10	18	SV
24	Construction	5 days	Wed 3/10/10	Mon 3/15/10	23	SV
25						
26	**Prepare Final Report**	**21 days**	**Mon 3/8/10**	**Mon 3/29/10**		**MK, MC**
27	Report	14 days	Mon 3/8/10	Mon 3/22/10	18	
28	Slideshow	7 days	Mon 3/22/10	Mon 3/29/10	27,20	
29						
30	Final Report Due	0 days	Mon 4/5/10	Mon 4/5/10		
31	Final Presentation	0 days	Tue 4/6/10	Tue 4/6/10		

Figure 4 - Planned Project Schedule

6.0 Expected Costs

The costs associated with the execution of the project include document preparation, document backup, and site visits to the spillway location. QVC estimates the final total of expenditures to be $100.00. Throughout the term the expenditures will be tallied and divided amongst group members.

7.0 Deliverables

The deliverables to the client for this project will include hard and soft copies of the all reports and presentations as requested. Hard and soft copies of all reports and presentations will be submitted to Dr. Bruneau to complete the requirements of ENGI 8700. The hardcopies will be delivered by hand and the soft copies will be emailed from quidividiconsulting@gmail.com.

The midterm report will be made available during the midterm presentation, scheduled for February 16, 2010. The final report will be available on April 5, 2010. The final presentations to the client, faculty and students will take place on April 6, 2010. Both presentations will take place in the S.J. Carew Building at Memorial University.

8.0 Risks

8.1 Design issues

The selected final concept will impact the level of risk associated with the project. The complexity of the design process, constructability, operability and feasibility of the spillway will all be considered when choosing the final design. This could affect the project schedule as more time will be required to properly address all the details of a more complex structure.

8.2 Weather preventing site visits

QVC hopes to complete a site visit to the Rattling Brook hydroelectric development, to observe site conditions (including the state of the current spillway) and to gauge the scope of the new project. The road is not well maintained during the winter months, so access to the site may be difficult. If the primary site remains inaccessible, the power generation station at Petty Harbour has been designated as a reasonable secondary site to view an operational spillway.

8.3 Insufficient data availability

Reliable data will be required to properly design the new spillway and to carry out cost estimates for construction. Timely data is essential in completing the project on schedule. Insufficient or incorrect data would reduce QVC's confidence in the design.

9.0 References

Smith, Walter. *Rattling Brook Hydroelectric Development Main Spillway Replacement Assessment.* Hatch, 2007

10.0 Appendix – Statement of Qualifications

QUIDI VIDI CONSULTING

Group 1: Statement of Qualifications

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Megan Kavanagh
Sara Vaughan

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Corporate Mission Statement

Quidi Vidi Consulting is committed to presenting our clients with innovative solutions that meet their Civil Engineering requirements. QVC believes in the importance of health, safety, and the environment and will provide quality solutions while mitigating damaging effects to these areas.

Selected Project Involvement

- Electric distribution line design.
- Construction of Kenmount Terrace Subdivision.
- Conceptual Design and drafting, various hydroelectric developments.
- Sanitary Sewer Inflow/Infiltration Study, City of St. John's.
- Rehabilitation of Rocky Pond Hydroelectric Development.
- General Properties 5yr Capital Plan, Newfoundland Power.
- Subsea operation, SeaRose FPSO.
- Turnaround workpacks, Terra Nova FPSO.
- Lift station upgrade study, Town of CBS.
- Storm sewer upgrade study, City of Corner Brook.
- Harbour design and optimization, Nova Scotia.
- Ice-seabed interaction research.
- Construction and upgrading of the Trans-Labrador Highway.
- Construction of the Travespine River Bridge.
- Conceptual structural design, Dry Tree Semi-Submersible.

Megan Kavanagh

Megan Kavanagh is a senior engineering student at Memorial University. Through her work terms, Megan has gained extensive project management experience. Megan also has familiarity in working with clients worldwide, most notably from a work placement in the United Kingdom,

Experience Highlights:
Client/Contractor Communication
Estimating Workscopes
Project and equipment tracking
Material Engineering
Equipment Design, Newfoundland Offshore

Michael Cahill

Michael Cahill is a senior civil engineering student in his 8th and final term at Memorial University of Newfoundland. His areas of experience are focused in the construction and oil and gas engineering industries. Strengths include a wide variety of engineering work experience, a good understanding of structural design principles, and strong project administration skills.

Experience Highlights:
Design and construction of road and bridge infrastructure
Design of structural elements for offshore
Problem solving: Modular construction lifting and transport

David Ball

David Ball is completing his final year of civil engineering at Memorial University. He has gained a broad range of engineering experience through working in the utility sector as well as in municipal consulting. David has become very familiar with the local construction environment. He is a strong communicator and has shown academic aptitude, earning multiple scholarships during his studies at Memorial.

Experience Highlights:
Construction Inspection/Contractor Supervision
Conceptual and detailed design and drafting
Technical report preparation
Advanced Excel based calculation tools and applications

Sara Vaughan

Throughout the course of the Memorial University engineering program Sara has gained valuable experience in various engineering fields including municipal, marine, construction and offshore oil and gas. Sara's organizational skills, work ethic and experience make her a strong asset to Quidi Vidi Consulting.

Experience Highlights:
Engineering Studies
Harbour Design
FEED Developments
Cost Estimation
Project Management

QVC

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