



**STAFF REPORT TO LYALL HARBOUR/BOOT COVE WATER LOCAL SERVICE COMMITTEE
MEETING OF TUESDAY, 25 SEPTEMBER 2007**

SUBJECT **MONEY LAKE DAM REPAIRS AND UPGRADE**

PURPOSE

To obtain the approval of the Lyall Harbour/Boot Cove Water Local Service committee to proceed with remediation works for the Money Lake dam.

BACKGROUND

Very low water levels in Money Lake have been experienced in three of the past six years (2004, 2006, 2007). Active management of losses directly from or under the dam on Money Lake #1 is of critical importance to ensure the primary water supply is protected. At the 2007 Lyall Harbour/Boot Cove Water Local Service committee Annual General Meeting, staff presented information suggesting losses through or under the Money Lake dam have figured prominently in the low water levels and that a preliminary investigation suggested action was needed to reduce losses, or increase lost water capture. A site visit was organized to the dam on the 12 September, 2007 with the committee, local residents involved in the original construction of the earth structure, Capital Regional District (CRD) staff and Thurber Engineering Ltd. This staff report summarizes the work program agreed to in principle by the committee that day which includes as Phase 1, remedial works to the west abutment of the dam, as Phase 2, elimination of valve system which could drain the reservoir, and as Phase 3, optimization of the seepage water recycle system.

Thurber Engineering Ltd. Inspection / Recommendations

Thurber Engineering Ltd. conducted a physical inspection of the dam structure and interviewed Mr. John Money and Mr. Barry Crooks, equipment operators who worked on the dam, to gain insight into likely areas of concern with the structure. The consultant suggested to the committee that given the type of local material used in construction of the dam core, the method of placement and compaction of the material and the location of the show of water downstream of the dam, the most likely area to initiate remedial work would be the west abutment. This area would have received the least compaction owing to the method of material placement, was constructed over the existing Harris roadbed and was unlikely to have been properly keyed into the native rock material. The consultant stressed that without excavation and evaluation of sub surface conditions, it is difficult to confirm whether the west abutment is the primary source of leakage. A program which combines the necessary exploration with a project to upgrade the inner material of the dam in this area is recommended as a first step.

Following the investigative works, Thurber Engineering Ltd. has now completed a short summary report recommending an exploratory approach to mitigate losses through the dam. The work includes excavation of approximately 10 – 15 metres of trench from the west abutment towards the centre of the dam, extending down into the dam as deep as possible, likely four to five metres. The excavated material will be used to increase the height of the dam to meet dam inspection requirements. The trench will be backfilled and compacted with a clay material to full depth. The work will be monitored by Thurber Engineering Ltd. to ensure consistency of placement and compaction. A copy of the report is attached to this staff report.

Other Engineering Upgrades

Although not associated with the dam core construction, CRD engineers drew the committee's attention to an abandoned valving system installed on the intake line which provides a significant risk to draining the reservoir should a failure in the valve system occur. The float valve system, originally installed to permit capture and redirection of drainage water into the supply system, has the potential to still be on line. Isolation and removal of the valving system is recommended to avoid consequence at a later date. To remove the valve system, it will be necessary to bring divers in to disassemble and elevate the intake such that the line downstream can be safely worked on. This work is suggested to be undertaken as Phase 2, as funds are available, following the completion of the investigation and mitigation work on the west dam abutment.

CRD applied for and received approval to store additional water in the lake by increasing the level carried in the lake in the spring. The province, as a condition of the approval, requires certain modifications to be undertaken to the dam structure. These include raising the dam crest level to ensure there is a minimum of one metre freeboard over spillway level, replacement of erosion logs on the dam crest and replacement of boom logs to prevent debris from blocking the spillway. It is anticipated that some of this work can be included in the initial phase of the remedial works, when machinery is available on the site.

The recycle pump system has undergone some significant upgrade this year with replacement of the pump with a larger unit and the installation of some new discharge line. There are however issues with the current system which need to be considered. The recycle system is subject to blockage from fine organic material which is carried into the system from background sources. A means to first settle out this material would enhance the overall operation of the facility. The location of the recycle system was established based on the location of volume of seepage water available. With the remediation of the west abutment, this volume may be reduced significantly, to the point that other locations should be evaluated. The design and implementation of this phase of the works then should be delayed until such time as the west abutment work is completed and the drainage patterns reassessed.

Work Program / Costs

Costs to date include:

\$3,700	Preliminary evaluation work, Thurber Engineering Ltd.
\$2,500	CRD engineering evaluation, drainage system flush and evaluation, overnight leak testing, distribution system, application to dam inspection regarding proposed works.

Phase 1 Cost Estimate:

\$20,000	Access road up North face of dam, excavate trench, transport clay material, place material and compact, install filter fabric, north excavation face, compact excavated material dam crest.
\$5,000	Geotechnical inspection services.
\$3,000	Contingency (remedial / upgrade works as required by dam inspection).
\$34,200	Total cost works to date and estimate phase 1

Phase 2 cost estimate:

\$3,500	Dive team to raise / reinstall and secure intake.
\$3,500	Contractor, excavation, cut main, relay main, replace air valve.
\$2,000	Pipe, valve materials.
\$1,000	CRD costs, oversee works, establish bypass for system supply.
\$10,000	Total cost estimate, phase 2

CONCLUSIONS

To reduce water losses arising from dam leakage and to preserve reservoir volume for use by the water area in future years, steps need to be taken to reduce the migration of water through the dam structure. Thurber Engineering Ltd., geotechnical consultants, has proposed an investigative approach to mitigate losses expected to be flowing through west abutment of the dam. The remediation works are estimated at approximately \$34,200 in total. CRD engineers wish to also address a risk associated with an old valve system used in the early days of the system. The removal and bypass of the valve system can be accomplished for an estimated \$10,000. The dam remediation works and valve system upgrade works would proceed as soon as possible to avoid complications from a filling reservoir. If committee approves the project, work would be scheduled to proceed in the first week of October.

ALTERNATIVES

The works could be postponed until fall 2008; however the community might avoid another dry year if the works are successful this year.


FINANCIAL IMPLICATIONS

The committee, in the 2007 operating budget, raised the annual parcel tax to \$575 from \$295 to set aside additional funds into the capital reserve. With the additional transfer to reserve in 2007 the total reserve funds amount to \$65,736. There are sufficient funds in reserve to complete Phase 1 and Phase 2 works this year however committee will need to approve the project to move forward as soon as possible to ensure the work can be completed prior to a change in weather. Phase 3 works have not been estimated at this time. As funds raised in 2007 were meant to be applied to initiate a capital project to upgrade the water system in concert with a grant from the BC Municipal Rural Infrastructure Grant program, and as the funds are now proposed to be expended for an alternate process, it is recommended the residents and owners of the water district be advised by newsletter of the change in the use of the funds.

RECOMMENDATION

That the Lyall Harbour/Boot Cove Water Local Service committee:

1. direct staff to proceed with Phase 1 works as outlined, for an estimated cost of \$34,000;
2. direct staff to proceed with Phase 2 works as outlined, for an estimated cost of \$10,000; and
3. fund the projects from the reserve fund, in which there exists \$65,736.



Gary Hendren, ASCT
Local Services Engineering Coordinator

GH:ls

Attachments: 2



THURBER ENGINEERING LTD.
GEOTECHNICAL • ENVIRONMENTAL • MATERIALS

September 17, 2007

File: 17-210-102

Capital Regional District
625 Fisgard Street
P.O. Box 1000
Victoria, B.C.
V8W 2S6

Attention: Gary Hendren, A.Sc.T.

**MONEY LAKE DAM, SATURNA ISLAND
SITE INSPECTION OF SEPTEMBER 12, 2007**

Dear Gary:

Our letter of August 23, 2007 provided some preliminary geotechnical comments related to the water losses that you have recorded at the Money Lake Dam on Saturna Island. We were requested to visit the site on September 12 to examine the dam, discuss the construction of the dam with personnel involved with the construction, and to review potential remediation options.

Our comments and discussion on site are summarized below.

Use of this report is subject to the attached Statement of General Conditions.

1. SITE OBSERVATIONS

At the time of our inspection, the water level in the reservoir was about 3 to 4 m below the crest of the dam. There was no evidence of seepage exiting the downslope side of the dam, although water was observed to be flowing in the ditch further downstream of the dam.

A culvert was observed exiting into the channel below the spillway on the east abutment. A small flow of water was noted from the culvert. The location of the inlet of this culvert is unknown.

2. CONSTRUCTION HISTORY

John Money was involved with the raising of the dam and provided some useful insight into the construction. His comments regarding the construction are summarized below:



- Fill used for the dam raising was obtained from a fractured sandstone outcrop located on the east side of the upstream face of the dam.
- The rock was ripped and spread across the dam. Compaction was done by the tracked construction equipment and was concentrated in the area beneath the spillway. The sandstone pieces apparently broke down to small sizes during spreading and compaction.
- Fill placed at the west abutment (above the old roadway) was apparently end dumped by truck without compaction.
- John Money also recollects that a buried log exists in the roadway fill.

3. SITE DISCUSSIONS

Based on the information provided by John Money, the west abutment could be a source of dam leakage. However, we do not have any geotechnical information to confirm actual conditions. Leakage could be occurring at several other locations (as described in our earlier report).

We understand that the community has very limited funds available for investigation and rehabilitation of the dam to mitigate leakage. Given this constraint, we suggested that the following work be carried out to assess conditions at the abutment and to evaluate the potential effectiveness of a cutoff trench:

- Excavate a 10 m to 15 m long trench at the west abutment on the crest of the dam to examine the fill materials. This trench should extend as deep as practical (probably 4 to 5 m) or until seepage is encountered. The trench should be about 1 m wide at the bottom and sloped at an angle of at least 0.5H:1V. Flatter side slopes may be necessary if the sidewalls show a tendency to slough.
- The soils encountered along the trench excavation will be inspected and logged by Thurber.
- Low permeability clay fill (see below) should be used to backfill the trench. This material will have to be placed in thin lifts (approximately 200 mm thick) and thoroughly compacted with a hoe pack. Placement and compaction procedures will be inspected and monitored by Thurber.
- As the soil conditions to be encountered during excavation are unknown, a non-woven geotextile should be placed on the downslope side of the trench to reduce the potential for migration of finer particles.
- Material excavated from the trench can be spread on the crest of the dam to provide the additional freeboard that is required. This fill should be no thicker than 300 mm.
- At the completion of the trench excavation and backfilling, we will prepare a brief report summarizing our observations and inspections.



4. CLAY FILL SOURCES

We obtained two sample of clay fill from John Money's property (Lower Pasture and Swamp). Based on these samples, the clay fill is of medium to high plasticity and should be suitable for backfilling the trench provided the material does not become too wet. Water may need to be added to the fill to achieve compaction, depending on the moisture content of the clay as it comes out of the excavation. Further laboratory testing will be required to check the moisture content of the fill.

5. CLOSURE

Water losses from the dam should be monitored to determine the effectiveness of the limited work carried out at the abutment.

We must re-iterate that the work program suggested in this letter is an investigative program constrained by the limited funding available, and the requirement to complete some work this year while the water level is low. Depending on actual conditions encountered, it is possible that this small cutoff trench may have no significant impact on the losses that are presently occurring.

Should you have any questions concerning the contents of this letter, please contact us.

Yours truly,
Thurber Engineering Ltd.
Stephen Bean, P.Eng.
Review Principal



Kevin Sterne, P.Eng.
Senior Project Engineer

Attachments



STATEMENT OF GENERAL CONDITIONS

1. STANDARD OF CARE

This study and Report have been prepared in accordance with generally accepted engineering or environmental consulting practices in this area. No other warranty, expressed or implied, is made.

2. COMPLETE REPORT

All documents, records, data and files, whether electronic or otherwise, generated as part of this assignment are a part of the Report which is of a summary nature and is not intended to stand alone without reference to the instructions given to us by the Client, communications between us and the Client, and to any other reports, writings, proposals or documents prepared by us for the Client relative to the specific site described herein, all of which constitute the Report.

IN ORDER TO PROPERLY UNDERSTAND THE SUGGESTIONS, RECOMMENDATIONS AND OPINIONS EXPRESSED HEREIN, REFERENCE MUST BE MADE TO THE WHOLE OF THE REPORT. WE CANNOT BE RESPONSIBLE FOR USE BY ANY PARTY OF PORTIONS OF THE REPORT WITHOUT REFERENCE TO THE WHOLE REPORT.

3. BASIS OF REPORT

The Report has been prepared for the specific site, development, design objectives and purposes that were described to us by the Client. The applicability and reliability of any of the findings, recommendations, suggestions, or opinions expressed in the document, subject to the limitations provided herein, are only valid to the extent that this Report expressly addresses proposed development, design objectives and purposes, and then only to the extent there has been no material alteration to or variation from any of the said descriptions provided to us unless we are specifically requested by the Client to review and revise the Report in light of such alteration or variation or to consider such representations, information and instructions.

4. USE OF THE REPORT

The information and opinions expressed in the Report, or any document forming part of the Report, are for the sole benefit of the Client. NO OTHER PARTY MAY USE OR RELY UPON THE REPORT OR ANY PORTION THEREOF WITHOUT OUR WRITTEN CONSENT AND SUCH USE SHALL BE ON SUCH TERMS AND CONDITIONS AS WE MAY EXPRESSLY APPROVE. The contents of the Report remain our copyright property. The Client may not give, lend or, sell the Report, or otherwise make the Report, or any portion thereof, available to any person without our prior written permission. Any use which a third party makes of the Report, are the sole responsibility of such third parties. Unless expressly permitted by us, no person other than the Client is entitled to rely on this Report. We accept no responsibility whatsoever for damages suffered by any third party resulting from use of the Report without our express written permission.

5. INTERPRETATION OF THE REPORT

- a) Nature and Exactness of Soil and Contaminant Description: Classification and identification of soils, rocks, geological units, contaminant materials and quantities have been based on investigations performed in accordance with the standards set out in Paragraph 1. Classification and identification of these factors are judgmental in nature. Comprehensive sampling and testing programs implemented with the appropriate equipment by experienced personnel, may fail to locate some conditions. All investigations utilizing the standards of Paragraph 1 will involve an inherent risk that some conditions will not be detected and all documents or records summarizing such investigations will be based on assumptions of what exists between the actual points sampled. Actual conditions may vary significantly between the points investigated and the Client and all other persons making use of such documents or records with our express written consent should be aware of this risk and this report is delivered on the express condition that such risk is accepted by the Client and such other persons. Some conditions are subject to change over time and those making use of the Report should be aware of this possibility and understand that the Report only presents the conditions at the sampled points at the time of sampling. Where special concerns exist, or the Client has special considerations or requirements, the Client should disclose them so that additional or special investigations may be undertaken which would not otherwise be within the scope of investigations made for the purposes of the Report.
- b) Reliance on Provided Information: The evaluation and conclusions contained in the Report have been prepared on the basis of conditions in evidence at the time of site inspections and on the basis of information provided to us. We have relied in good faith upon representations, information and instructions provided by the Client and others concerning the site. Accordingly, we cannot accept responsibility for any deficiency, misstatement or inaccuracy contained in the Report as a result of misstatements, omissions, misrepresentations, or fraudulent acts of the Client or other persons providing information relied on by us. We are entitled to rely on such representations, information and instructions and are not required to carry out investigations to determine the truth or accuracy of such representations, information and instructions.

(see over)



INTERPRETATION OF THE REPORT *(continued)*

- c) Design Services: The Report may form part of the design and construction documents for information purposes even though it may have been issued prior to the final design being completed. We should be retained to review the final design, project plans and documents prior to construction to confirm that they are consistent with the intent of the Report. Any differences that may exist between the report recommendations and the final design detailed in the contract documents should be reported to us immediately so that we can address potential conflicts.
- d) Construction Services: During construction we must be retained to provide field reviews. Field reviews consist of performing sufficient and timely observations of encountered conditions to confirm and document that the site conditions do not materially differ from those interpreted conditions considered in the preparation of the report. Adequate field reviews are necessary for Thurber to provide letters of assurance, in accordance with the requirements of many regulatory authorities.

6. RISK LIMITATION

Geotechnical engineering and environmental consulting projects often have the potential to encounter pollutants or hazardous substances and the potential to cause an accidental release of those substances. In consideration of the provision of the services by us, which are for the Client's benefit, the Client agrees to hold harmless and to indemnify and defend us and our directors, officers, servants, agents, employees, workmen and contractors (hereinafter referred to as the "Company") from and against any and all claims, losses, damages, demands, disputes, liability and legal investigative costs of defence, whether for personal injury including death, or any other loss whatsoever, regardless of any action or omission on the part of the Company, that result from an accidental release of pollutants or hazardous substances occurring as a result of carrying out this Project. This indemnification shall extend to all Claims brought or threatened against the Company under any federal or provincial statute as a result of conducting work on this Project. In addition to the above indemnification, the Client further agrees not to bring any claims against the Company in connection with any of the aforementioned causes.

7. SERVICES OF SUBCONSULTANTS AND CONTRACTORS

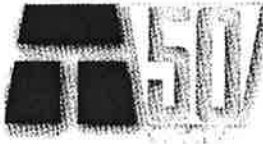
The conduct of engineering and environmental studies frequently requires hiring the services of individuals and companies with special expertise and/or services which we do not provide. We may arrange the hiring of these services as a convenience to our Clients. As these services are for the Client's benefit, the Client agrees to hold the Company harmless and to indemnify and defend us from and against all claims arising through such hirings to the extent that the Client would incur had he hired those services directly. This includes responsibility for payment for services rendered and pursuit of damages for errors, omissions or negligence by those parties in carrying out their work. In particular, these conditions apply to the use of drilling, excavation and laboratory testing services.

8. CONTROL OF WORK AND JOBSITE SAFETY

We are responsible only for the activities of our employees on the jobsite. The presence of our personnel on the site shall not be construed in any way to relieve the Client or any contractors on site from their responsibilities for site safety. The Client acknowledges that he, his representatives, contractors or others retain control of the site and that we never occupy a position of control of the site. The Client undertakes to inform us of all hazardous conditions, or other relevant conditions of which the Client is aware. The Client also recognizes that our activities may uncover previously unknown hazardous conditions or materials and that such a discovery may result in the necessity to undertake emergency procedures to protect our employees as well as the public at large and the environment in general. These procedures may well involve additional costs outside of any budgets previously agreed to. The Client agrees to pay us for any expenses incurred as the result of such discoveries and to compensate us through payment of additional fees and expenses for time spent by us to deal with the consequences of such discoveries. The Client also acknowledges that in some cases the discovery of hazardous conditions and materials will require that certain regulatory bodies be informed and the Client agrees that notification to such bodies by us will not be a cause of action or dispute.

9. INDEPENDENT JUDGEMENTS OF CLIENT

The information, interpretations and conclusions in the Report are based on our interpretation of conditions revealed through limited investigation conducted within a defined scope of services. We cannot accept responsibility for independent conclusions, interpretations, interpolations and/or decisions of the Client, or others who may come into possession of the Report, or any part thereof, which may be based on information contained in the Report. This restriction of liability includes but is not limited to decisions made to develop, purchase or sell land.



MONEY LAKE DAM LEAKAGE Geotechnical Services	MEMORANDUM
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TO: Richard Edwards, P. Eng. (e-mail) DATE: September 18, 2007

COMPANY: Capital Regional District FILE: 17-210-102

ADDRESS: Capital Regional District
625 Fisgard Street
P.O. Box 1000
Victoria, B.C.
V8W 2S6 FROM: Kevin Sterne, P.Eng.
REVIEW: Stephen Bean, P.Eng.

SUBJECT: **Estimated Costs** PAGES: 2

COPIES:

Richard:

As requested, the following provides a summary of costs incurred to date for the geotechnical assessments, and an estimate of cost for the next phase of work (cutoff trench).

- a) The cost for the preliminary geotechnical assessment (our letter of August 23, 2007) is approximately \$800. This work has already been invoiced.
- b) The cost for the site inspection on September 12, 2007 and the subsequent letter summarizing our findings is approximately \$2,600.
- c) The estimated cost for geotechnical inspection services during excavation and backfilling of the cutoff trench will be approximately \$5,000. This is based on 3 days of senior technician time on site and travel disbursements, engineering review, and preparation of a summary report upon completion. It also includes a small allowance for some laboratory testing.

We trust this is satisfactory. If you have any questions, please contact us.

Regards,