City of Saint John

Request for Proposal

2022-091006P

"ENGINEERING SERVICES – MENZIES LAKE DAMS AND ACCESS ROAD DRAINAGE UPGRADES"
SAINT JOHN, NB

Sealed proposals, hand delivered or couriered, addressed to: **Monic MacVicar, CCLP, CPPB,** Procurement Specialist, Supply Chain Management, 175 Rothesay Avenue, 1st Floor, Municipal Operations Complex, Saint John, NB, E2J 2B4 and marked on the envelope:

"PROPOSAL 2022-091006P
ENGINEERING SERVICES - MENZIES LAKE DAMS AND ACCESS ROAD DRAINAGE UPGRADES"

will be received until **4:00:00 pm Local Time**, **Thursday, March 17th, 2022**, for Engineering Design and Construction Management Services for the above noted project, as per the Request for Proposal.

Proposals will be opened in the office of the Purchasing Agent, 175 Rothesay Avenue, 1st Floor, Municipal Operations Complex, immediately following the proposal submission deadline.

The lowest cost or any proposal not necessarily accepted.

Proposals will NOT be opened publicly due to the on-going pandemic.

Monic MacVicar, CCLP, CPPB
Procurement Specialist
Supply Chain Management

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SCOPE OF WORK

Proposal 2022-091006P
Engineering Services - Menzies Lake Dams And Access Road Drainage Upgrades

1. GENERAL

The City of Saint John (City) has prepared this document for Consulting Engineering Firms (Proponents) wishing to provide their services to the City. This request for proposal is to be used as a guide, in combination with good engineering judgment and standard engineering practices and is not intended to be a complete procedural document. It reflects basic standards the Proponent shall adhere to when preparing a proposal or carrying out work for the City.

All engineers working on this project for the City must be a current member, licensee or holder of a certificate of authorization with APEGNB. All consultant engineering firms working on this project for the City must have a current certificate of authorization with APEGNB.

The Consultant shall in all matters act as a faithful advisor to the City. The Consultant shall keep the City informed on all matters related to design, procurement and construction and all other important aspects forming part of the scope of work.

The Consultant must aggressively and proactively manage the project in the best interest of the City of Saint John. The overall project will require one (1) tender. The Consultant will oversee and manage the entire project on behalf of the City. The proposal shall clearly explain the anticipated structure of project management during each phase.

The Consultant shall be aware of and follow any orders, policies, directives, standards, and guidelines issued by any governmental authority, governing all or any part of the work under this RFP.

The Consultant shall ensure that all staff and sub-consultants that will be working on any City jobsite(s) have read and will adhere to the City of Saint John COVID-19 Vaccine and Test Policy. **Within five (5) working days of notification of acceptance of a Proposal, the successful Consultant shall submit to the City, a completed and executed Vaccine or Test Acknowledgement Form. The City's Vaccine and Test Policy may change from time to time. If policy changes the City project manager will supply the updated version to the consultant.**

2. PROJECT DESCRIPTION

The Consultant will carry out preliminary design, detailed design, and provide detailed cost estimates for construction, construction management and inspection services for the project listed below.

Tender documents are to be completed as soon as possible by the Consultant in order for the City to capitalize on competitive bidding from contractors. Final Completion of all work should be planned to be achieved in the 2022 construction season.

The project is generally as follows:

2.1 Menzies Lake Saddle Dykes:

- Menzies Lake Saddle Dyke #1 – upgrade approximately 100 m of dam.
- Menzies Lake Saddle Dyke #2 – upgrade approximately 30 m of dam.
- Menzies Lake Saddle Dyke #3 - upgrade approximately 30 m of dam. The work for all three earthen saddle dykes generally includes cleanup, excavation, backfill with new granular materials, new asphalt, new rip rap, topsoil and vegetation, new signage, miscellaneous restoration and any other items that get included in the final design. The design must address seepage. Improve truck turn around areas for ease of construction and maintenance.

2.2 Menzies Lake Control Structure

- Upgrade and renew worn out items such a grating, timber decking and/or railings,
- The design must address seepage,
- Upgrade safety controls and install barriers as required.
- Make repairs to the concrete walls, slopes, rip rap and the road surface if required.
- Improve truck turn around areas for ease of construction and maintenance if required.
- **Note**: City staff are taking care of replacing the stop logs.

2.3 Storm Sewer upgrades along the access road to Musquash :

- New culverts - approx. 10 locations;
- Improve existing culverts with enhanced headwalls or extra pipe. - approx. 14 locations;
- Upgrade existing ditches as required next to culverts - approx. 15 locations;
- New ditches – two locations and a total of 500 m approx.
- New signage to number the culverts.

See the attached reports and estimates for more details.

3. PROFESSIONAL SERVICES REQUIRED

The professional services required for this project are divided into six (6) parts as follows:

Part A) Site Surveys, Preliminary Investigation and Data Collection

The topographic surveys and the drawings shall use the horizontal control coordinate system NAD83 (CSRS) New Brunswick Double Stereographic Projection and the Canadian Geodetic Vertical Datum of 1928 (CGVD28).

The survey shall include but not be limited to all bridges, structures, buildings, property pins, curb lines, sidewalks, poles, ditches, services, utilities (incl. Saint John Energy, NB Power, Bell Aliant, Rogers, and natural gas, etc.), valves, hydrants, manholes, catch basins, etc. The Consultant shall be responsible for any additional survey information required for a complete design and shall also be responsible to confirm all inverts.

Legal surveys may be required by the Consultant team during design if the works are within 2.0 m of the property lines as shown on the SNB Property Fabric, which are sometimes not accurate to the degree needed. The Consultant shall determine the amount of legal survey required for the project and detail the amount allowed for in the proposal. The topographic survey shall include street rights-of-way, any easements, etc. along the alignment.

It is the responsibility of the Consultant to indicate the extent of the required easements and/or property acquisitions necessary for the construction of the works by submitting to the City a scale drawing (showing only property lines) indicating the exact limits of the property required. The City will have legal surveys prepared for any such acquisitions and City staff will negotiate and obtain any required municipal services easements and/or right to access property within the limits of the contract.

The Consultant and all sub-consultants shall use proper traffic control and warning signage (with approved sign bases) when working or surveying on City streets as per the General Specifications for construction.

Geotechnical investigation and testing, as deemed necessary by the Consultant, shall include all the necessary test pits and boreholes. These test pits and boreholes are to be shown on the project drawings.
All auger probe holes and drilled sample holes must be filled by the same crew who drilled them before they leave the site with appropriate materials. Holes made in asphalt must be finished with asphalt.

NOTE: For this project, new boreholes must be done prior to detailed design.

The Consultant is to advise the City if any of the borehole material that comes to the surface smells of or indicates the presence of petroleum products.

The Consultant shall compile all existing record drawings of the proposed construction work areas. Any topographic survey required, shall pick-up all surface features and buried utilities with a high degree of accuracy obtained from state of the art survey equipment. City crews will excavate and expose pipes at locations requested by the Consultant to gather information during the Consultant's topographic survey, for any critical hookup locations. Plans must note the survey datum and all the monuments used to establish elevations.

No documents (except for the attached Survey Point File) will be made available by the City during the proposal stage. Once the proposal is approved, the City's record drawings and data will be made available to assist in the creation of the new designs and drawings, but no guarantee as to their completeness or accuracy will be made. The Consultant shall send their requests to the City in writing for large amounts of data and allow a reasonable amount of time to retrieve such. The Consultant must contact the Infrastructure Development area directly to gather all pertinent data. The Consultant is expected to meet and be familiar with City staff and their respective roles. The Consultant shall collect record data from all other utilities that have services along the corridor of interest, having them mark out their infrastructure in the field and have the Consultant's survey crew pick up this data.

Pipe Report

The Consultant shall submit a Pipe Report, (two (2) hard copies and one (1) digital copy) to the City for review and acceptance before the design work is started. Pipe reports shall be completed for all projects including street reconstruction projects. The pipe report shall consist of the following steps and deliverables from the Consultant:

1. The Consultant shall: flush and video all storm and sanitary sewers within the project boundaries, and 100 m upstream and downstream as a minimum; Submit the digital copy and the written report; Review Service Cards and all available record information; and compare the service laterals to the information from the sewer videos.

   If the sewers cannot be videoed due to protruding laterals then the Consultant shall provide drawings to the City's Engineer identifying the problem and the location and the City will facilitate the necessary work. and then notify the Consultant when the sewer is available for video.

   In addition to the sewer mains (storm and sanitary) videos, the Consultant shall lateral launch all sewer laterals within the project boundaries and provide the digital copy and the written report.

2. Survey field work shall include opening all chamber and manhole lids, and confirming all necessary invert elevations, survey shots, measurements and photos as required to collect all pertinent information such as pipe material and diameter.

   NOTE: the culverts must all be cleaned and video inspected for this project.

3. Investigate existing infrastructure by reviewing all digital and paper records available from the City or other utilities. Contact all buried infrastructure

owners to confirm what is in the ground, and request field locates as required.

4. Alert the Engineer to conflicting information and contact the appropriate personnel to clarify the ambiguities.

5. Submit full size plans, the same scale as the proposed design drawings, showing only the existing infrastructure including the known water & sewer service laterals and the location and nature of each deficiency noted in the report. All pipes to be clearly labeled with their size and material for review and approval by the City before the design drawings start. Include a cover letter summarizing the findings and highlighting any items that may impact this project.

6. The pipe report may also recommend that more or less pipe or structures should be renewed, under the project. The pipe report must summarize the condition of the existing chambers, structures and pipe work.

Part B) Preliminary Design, Cost Estimates and Design Report

The Consultant must carry out all design in accordance with the latest editions of the following documents:

- City of Saint John - General Specifications;
- City of Saint John - Storm Drainage Design Criteria Manual; **Note: Within the design the consultants must include an allowance for climate change**.
- Atlantic Canada Wastewater Guidelines Manual for Collection, Treatment, and Disposal;
- Atlantic Canada Guidelines for the Supply, Treatment, Storage, Distribution, and Operation of Drinking Water Supply Systems;
- **Climate Change Adaptation Plan** for Saint John, as prepared by ACAP; and
- Canada-wide Strategy for the Management of Municipal Wastewater Effluent endorsed by the Canadian Council of Ministers of the Environment (CCME).

Preliminary design **(40% design drawings)** shall be defined as the following:

- Complete any additional survey required and provide a site plan showing all existing utilities, lot lines and surface features;
- Confirm all invert elevations for the infrastructure;
- Location of works is selected within 600 mm;
- Preliminary design calculations completed;
- Select required capacities, sizes, and design flows;
- Prepare the design report complete with construction cost estimates;
- Identify and locate all major components on the design;
- A drawing set cover sheet and key plan that shows the proposed construction sites; and
- Gantt chart completed showing all major components of the project including the design, tendering, construction phases, testing, disinfection, commissioning, etc. This schedule must be updated at all project milestones.

The Consultant shall speak with the property owners along the route of the project to gather information about water and sewer services, or other matters related to the project. It would be expected that the Consultant's inspector will keep the lines of communication open with the residents and businesses during the course of the work.

The Consultant shall speak with identified businesses to gather information and to understand their requirements during construction. It would be expected that the Consultant will keep the lines of communication open with the businesses during the course of the work (design and construction).

The Consultant should consider the complexities of climate change and anticipate the potential impacts over the projected lifetime of the infrastructure.

Design Report

The Consultant shall present **"The Design Report"** encompassing all aspects of this project to the City's Technical Review Team to discuss findings, solutions, and options. The design report must compare the **flow capacities, velocities, and head loss** of various pipe sizes near the desired range, discuss the pros and cons of various pipe materials and how these options will impact on cost. The report must also compare the different road design cross-section options, discussing the pros and cons of each option and how the cost will be impacted. The Report shall include climate change and include how it has been integrated into the design, operation, maintenance of the infrastructure.

NOTE: For this Dam upgrade project, the following engineering assessments shall be included: dam safety inspection, dam classification, hydrotechnical analysis, stability analysis, seepage investigation and any other dam related work recommended for this type of earthen dykes. The designers are not to rely solely on the old reports and must draw their own conclusions. Consultant must use the most current "Dam Safety Guidelines" and update any of the engineering assessments that are out of date, recalculate as required. The Final version of the Design Report must reflect the upgraded dams after construction is complete. The final Design Report deliverables must include recommendations for operations, maintenance, monitoring and emergency plans for the 3 dams and the control structure. The monitoring program developed by the consultant must include specific monitoring points, and custom forms for the four Menzies structures. Portions of the DR can be provided after construction is complete to reflect the new conditions.

The Consultant shall provide digital files and at least eight (8) hard copies of the final design report and the preliminary design (printed in double sided format). The Consultant shall also provide the digital file of the model(s) used and/or prepared for this project. Hardcopies of all standard modeling reports (energy grade line profile, hydraulic grade line profile, data entry, pipe capacities drainage areas, etc.) must be accompanied with the final design report.

All reports, drawings, and construction specifications must be **signed and stamped** by the Consultant's engineer. All reports and construction specifications submitted to the City shall become the property of the City, which may be used and redistributed as the City sees fit.

After review and acceptance of the report by the City's Technical Review Team, the Consultant may proceed with Part D. Work on Part C, Part E and Part F shall only proceed when written authorization from the City is provided to the Consultant.

Part C) Conduct Public Consultation Process

The City wants to have well-informed citizens, businesses and other stakeholders. As such one (1) of the following options shall be used for public information sessions:

In-Person
The Consultant shall arrange and host two public information sessions on one day (2:00 to 4:00 pm and 6:00 to 8:00 pm) at a location close to the project site. The Consultant shall be responsible for booking and the costs associated with the public meeting venue and the Consultant shall be responsible for translating all material for the public meetings. The Consultant shall have large-scale drawings, project information sheets and handouts detailing limits of work and time frames/work schedules involved, press releases, digital renderings, photos and other visual aids to show the proposed designs to the public and media. All materials for public information shall be presented in both the English and French languages (professional translation required) as per City of Saint John policy. The Consultant shall be available for questions and collect comments from local residents and business owners. The public information sessions shall be advertised on the City's website and project information letters shall be sent by the Consultant to all residents and businesses within the work zones advising them of the information sessions and the upcoming construction work.

Virtual
In the event that in person public information sessions described above are not permitted due to COVID-19 restrictions, the Consultant shall arrange for an on-line/virtual public information session. The session shall run for two (2) consecutive hours with the timing to be confirmed. The Consultant shall have presentation material available to show the proposed design to attendees as well as answer questions and collect comments. The Consultant shall be responsible for registering those that wish to attend and sending out invitations to the meeting. There shall also be the option of recording the public information session so that it may be posted on the City's YouTube channel. The public information session shall be advertised on the City's website and project information letters shall be sent by the Consultant to all residents and businesses within the work zones advising them of the information session and how to register to attend as well as providing information on the upcoming construction work.

For budgeting purposes, the Consultant shall include for the cost of the <u>in-person</u> option in their proposal. The City shall determine which engagement session is to be provided.
Regardless of the format of the Public Information Session, the Consultant shall present a "Report on Part C" to City staff to summarize the concerns and comments and include recommendations on how these concerns and comments can be addressed to meet the needs of the community and the City of Saint John .

<u>NOTE</u>: for this project, the Consultant must communicate with the users of the road that runs over the dams. Signage by (and paid for) the consultant may be required to alert users.
Work on any major streets must have traffic planning and organizing being led by the Consultant with input from the contractor and approved by the City. The Consultant shall notify local residents and businesses of all service disruptions and traffic issues etc. well in advance of construction. The Consultant must also draft media advertisements to notify residents, businesses and commuters of major disruptions in traffic or utility services.

Part D) <u>Detailed Design</u>

The Consultant team shall prepare all detailed design drawings, specifications, and tender documents for the site works and all the other items mentioned in the description of the works.

Detailed design typically involves several iterations and revisions of alignments, profiles and major design elements. The construction cost estimates will require updating in conjunction with the design revisions. For projects involving road reconstruction, cross sections must be included on the drawings at 15 m intervals and at all driveways, doorways, stairs and windows.

The Consultant must look beyond the confines of the immediate project site, and determine what impacts the new works will have on the system as a whole, and propose solutions to avoid possible problems.

The Consultant must review all applicable plans, report(s) and data made available by the City. The Consultant shall review the material in detail, as the Consultant will be responsible for performing any further investigation, data gathering, etc., which may be necessary. The cost of such shall be detailed and included by the Consultant in the proposal. The City will gather new pressure data from fire hydrants at the request of the Consultant, if necessary.
Detailed design shall be defined as the following:

- All items completed from the preliminary design requirements;
- Location of works is selected within 100 mm;
- Detailed design calculations completed;
- A revised and <u>detailed</u> construction cost estimate;
- Complete the 100% design drawings and tender documents reviewed and approved by the City's Technical Review Team; and

- Approvals and permits from all utilities and approval agencies.

Designs must also incorporate planning and sequencing of service disruptions (such as water main shutdowns), testing, disinfection and commissioning. The Consultant will be required to lead the team of sub-consultants, contractors and City staff through these phases.

Work on any street must have traffic planning and organizing being led by the Consultant. Traffic planning must be carried out by the Consultant before tendering to give the City and contractor guidance as to the general scope of the detours, etc. The Consultant may specify in the tender documents that the contractor is to submit traffic detour and work zone safety plans and drawings. The Consultant must review submissions from the contractor and seek approval from the City. Traffic detour and work zone safety plans and drawings must be approved by the City before construction commences. The Consultant may also have to co-ordinate timing of work with other agencies to avoid conflicting traffic detours.

The Consultant shall co-ordinate the design drawings with all the underground utilities before the preparation of the tender documents in order to avoid conflicts with other utilities such as gas, electric, telephone, etc. Underground utility lines must be marked out and picked up during the topographic survey in Part A.

Before detailed designs and related documents are sent to the City for review, the Consultant must have other engineers from their firm review them for errors/omissions to ensure only high quality work is released.

The Consultant must identify in the proposal the peer reviewers. The Consultant's **peer review engineer(s)** must send a memo to the City with the final tender drawings and specifications, stating the outcome of the review.

The construction tender documents shall not indicate that the contractor must supply any design or engineering services, (excluding shoring and dewatering design) except if there is a design/build component or written approval is granted prior to tenders being called.

The Consultant shall be responsible for applying for all of the design approvals and permits necessary from all approval agencies, such as the NBDELG, NBDTI and NBNRED, etc. The Consultant must obtain all permits prior to tendering.

The City's Engineer must approve any variance from these standards in writing before any construction tenders are called.

Part E) Tender Period Services, Materials Testing & Inspection, Red Books and Record Drawings.

1. Tender Period Services

Upon approval of the Consultant's work, City staff will make copies and tender the project, however the Consultant is to be available during the tender period to respond to questions (prepare any addenda, if required) and to perform the tender analysis. The Consultant shall prepare a Tender Summary for each tender. It shall be a digital spreadsheet that compares the Engineer's estimate to all tendered items from all tenders submitted.

2. Materials Testing & Inspection

The **contractor** shall provide quality control (QC) testing for concrete, compaction of soils and for asphalt placement & testing. The **Consultant** shall still provide random quality assurance (QA) tests to confirm that the contractor's tests are in compliance. The **Consultant** shall also make sure that the contractor is completing all his required testing. The **Consultant** shall provide the Quality Assurance (QA) for the Portland cement concrete, granular material and the asphalt concrete. All costs for asphalt, concrete and soil quality assurance testing must be included in Part E of the Consultant's proposal.

The Consultant's minimum requirements for material testing and inspection are as follows:

Asphalt Inspection and Testing

- Full time inspection for asphalt placement by qualified personnel. The inspector assigned to this task shall have a minimum of two (2) years direct related experience with asphalt inspection. The Consultant shall identify in the proposal the qualified personnel they intend to utilize for this task including related experience. If the Consultant does not have the qualified personnel directly on staff then the Consultant must propose to utilize a sub-consultant that has the required expertise in asphalt inspection.
- Measurement of thickness, temperature, etc.
- Signing and collection of weight tickets as they arrive.
- Quality Assurance of asphalt in accordance with Division 27 of the General Specifications.

  NOTE: The City of Saint John requires Certification by the Canadian Council of Independent Laboratories (CCIL) for asphalt testing laboratories. Asphalt laboratories are to have Type "A" Certification – Asphalt Mix Design for Superpave Methods. A copy of the CCIL certification is to be included in the proposal submission.

Concrete Inspection and Testing

- Slump, temperature, air test and compressive strength cylinders shall be considered a "set" of tests.
- Compressive strength testing at CSA standard A283 certified laboratory.
- Check formwork and compaction of base gravels before each pour.
- Check elevations, slopes and grades before every placement.
- Quality Assurance by the Consultant shall consist of random testing.
- Sampling and testing frequency of concrete:
  - The minimum frequency shall be **one (1) set of tests for every ten (10)** done by the contractor.
  - On smaller projects involving only a few loads of concrete, one complete set of tests shall be made.
    - a) Test Samples:
      - i) The test samples shall consist of three (3) concrete cylinders. Compressive strength testing obtained at 7 and 28 days.
    - b) Reporting of field and laboratory testing:
      - i) Field test results obtained shall be recorded on the Form – Concrete Testing Summary and shall be submitted to the City.
      - ii) Compressive strength results shall be submitted to the City on the Consultant's standard reporting form.

NOTE: The City of Saint John requires Certification by the Canadian Council of Independent Laboratories (CCIL) for concrete testing laboratories in accordance with CSA Standard A283 Qualification Code for Concrete Testing Laboratories. A copy of the CCIL certification is to be included in the proposal submission.

Granular Material Supply and Placement (Soils and Gravels) Testing

- Confirming the contractor's test results onsite (QC by contractor)
- Ensuring proper frequency of compaction tests by contractor
- QA by Consultant shall consist of random compaction testing using nuclear density equipment. The minimum frequency shall be one test or every fifteen (15) done by the contractor.
- Enforcement of established rolling pattern
- Approval of material before it arrives onsite (gradation and other properties).
- Checking grades, slopes, thicknesses during fine grading.
- Witness and comment on proof rolling tests.

3. Red Books

It is the responsibility of the Consultant to obtain a copy of the "Standard Format for City of Saint John Red Book Notes" and to maintain a copy on file for all future projects. This format shall be followed by the Consultant when preparing the field notes for the project. The City of Saint John will provide "**Red Book**" field books for the Consultant to fill out and return to City staff at the end of the project.

4. <u>Record Drawings</u>

The Consultant shall submit a set of Record Drawings on paper and in digital formats. The drawings and data shall be in accordance with the Drawing Standards noted below. The Record Drawings will show the actual in-place vertical and horizontal alignments. The finished works shall be **re-surveyed** by the Consultant to establish exact locations and elevations, and the <u>date the site was re-surveyed</u> shall be noted on the signed and sealed **Record Drawings**. The final survey shall also include the pickup of structures (valves, manholes, etc.) that were **not newly installed** during the project, but are along the same section of street or easement. The Consultant shall be responsible for obtaining the data and measurements used in the Record Drawings and shall not rely on the contractor to provide this information. <u>The Consultant shall note on the Record Drawings the number of the Red Book where the project information was recorded.</u> The Record Drawings shall also include the ground water table elevation and geotechnical information, and the names and models of all products used.

All new works specified and incorporated shall have as-built information recorded including electrical, mechanical, structural, etc. All sheets in the set of Record Drawings shall be signed and sealed, including those of sub-consultants.

The digital as-built data submitted to the City shall become the property of the City, which may be used and redistributed as the City sees fit. The Consultant shall not place any disclaimer notes on the Record Drawings.

DIGITAL DRAWING STANDARDS

PURPOSE

The development of Geographic Information Systems (GIS) and computer aided drawing (CAD) has facilitated the method to reduce the time and costs of development processing and land use map updates. Hence, a digital drawing submissions standard has been adopted by the City of Saint John to set the standard and facilitate the transfer process. The intent of this program is to take advantage of new technology, reduce the cost of digital conversion, maintain the mapping and facilitate the efficient transfer of data from private organizations to the City.

The standards and specifications contained within this document shall be used for digital drawing submissions to the Engineer for the purpose of development processing and GIS digital land use map updates.

DIGITAL FORMAT

1. The Consultant shall provide to the Engineer an As-Built record of the project which will include: all required documentation, CAD files and any associated digital files as described below in both ***printed*** and ***digital*** versions.

2. All CAD drawings shall be submitted in AutoCad (.DWG or .DXF) format with all line work complete. Each CAD project shall include all relevant resource files such as line & font resource files and AutoCAD (.shx) resource files. The Consultant also shall provide the **drawings in PDF format.** This shall be a direct conversion, not a scan.

3. The City of Saint John will provide drawing file names for the legend portion of the drawing.

4. Each CAD project shall be accompanied with an ASCII text file of all as-built structure locations as well as any existing underground structure within the limits of the project. This text file is to be used for importing as-built and unknown structure locations into the City's GIS. The text file shall meet the following conditions:

   - ASCII text file will include as-built structure locations such as catch basins, gate valves, manholes, air valves, outfalls, service boxes or any existing underground structure within the limits of the project.

   - ASCII text file shall **only** include all as-built structure locations as well as any existing structures within the limits of the project and shall not contain other coordinated points such as curb shots, utility poles, corners of buildings, etc. This ASCII text file is to be used for importing structure locations into the City's GIS.

All coordinated points for the structures shall be delivered in a single comma-delimited ASCII text file. Each line of the file shall contain coordinate values (NAD83 CSRS Horizontal and HT2 Vertical) for a single point as follows:

Pt Number,Northing,Easting,Elevation,Field Code (Numeric)

1,7362284.223,2533177.653,15.207,3
2,7362028.622,2533004.711,25.695,16
3,7362009.446,2532991.590,25.935,4

The field code in the ASCII text file shall be City of Saint John field codes (i.e. Numeric Field Codes).

City of Saint John Field Codes			
3	CB EXIST CENTER	50	CATCHBASIN MANHOLE
4	CB EXIST EDGE	51	CATCH BASIN PYRD TOP
6	CULVERT	54	DRAIN TILE
14	FIRE HYDRANT	58	MH CP TELEGRAPH
16	GATE VALVE EXISTING	69	UTILITY HYDRO BOX
24	MANHOLE EXIST	70	UTILITY TEL BOX
25	HYDRO MANHOLE	71	UTILITY CABL BOX
26	TELEPHONE MANHOLE	79	NEW SANITARY MANHOLE
27	OTHER	80	NEW STORM MANHOLE
46	WATER TRACE	81	NEW CB EDGE
43	UTILITY BOX	82	NEW CB CENTER
44	SERVICE BOX	83	NEW FIRE HYDRANT
45	VAULT	1205	GATE VALVE NEW

DRAWING DOCUMENTATION

1. The horizontal and vertical datum utilized shall be identified as NOTE 1 on all engineering drawings prepared for the City of Saint John. The horizontal and vertical datum shall be NAD 83 (CSRS) New Brunswick Double Stereographic Projection and the Canadian Geodetic Vertical Datum of 1928 (CGVD28).

2. All as-built drawings are to be marked on the title block in an obvious fashion with the text “Record Drawing” on the CAD files and manual copies of the drawings.

3. Each CAD project shall be accompanied with documentation to indicate CAD layers.

4. All required drawing documentation shall be summarized on a transmittal sheet submitted in both printed and digital versions. The transmittal sheet shall include:
   - Job Title
   - Company/ Firm
   - Contact Person
   - Address
   - Email Address

- Phone
- List of attachments and digital files
- Record Drawings (one (1) set) on High Quality Bond Paper

MEDIA

1. All electronic files shall be delivered on a digital format acceptable to the City.

2. All submitted digital files shall include a transmittal with the project title, contract number, contractor name, consultant name, date of submittal, and list of contents.

3. Plans are to be produced on ISO **A1** paper size no larger than 600 x 900 mm.

Part F) <u>Construction Management</u>

The Consultant must prepare all required documentation for construction management in a formal and standardized format acceptable to the City. The list of documents must include but is not limited to the following: change orders, addenda, progress payments, summary of extras, minutes of meetings, status reports, construction and Consultant budget updates and forecasts, reports to the engineer, meeting agendas, reports on contractor performance, quality control test reports, deficiency lists, letters, memos and so on.

The Consultant is responsible for the **primary** field layout, including marking out property lines for the contractors. This may require the services of a legal surveyor where property pins are not present. The Consultant shall do the **primary** field layout at least once during each phase of the project. If the contractor does not preserve the layout stakes, the Consultant may request a fee from the contractor to replace them. The Consultant shall be responsible for the primary field layout, which consists of the layout of centerline, control points and structures. All other layout will be the responsibility of the contractor. The Consultant shall give the contractor all the information and survey data points required to build the works utilizing the standard City of Saint John field codes from Digital Drawing Standards.

The Consultant must co-ordinate, plan and notify all parties of all service shutdowns, testing, water main pressure testing & disinfection and system commissioning. The Consultant will submit drawings or neat sketches that clearly communicate the proposed activity for the City’s approval. The City will prepare all water service shutdown notices and provide them to the Consultant for distribution. The Consultant must deliver the notices to each home and business affected. The inspector must attempt to talk to someone at each building to explain the shutdown, and leave a notice in an obvious location if nobody is home or at the business. The Consultant must co-ordinate and plan traffic detours, and review proposed work zone safety plans received from the contractor. The City of Saint John staff will translate all routine and standardized public notices during construction.

The Consultant must review and comment on all submissions and correspondence from the contractor, and provide recommendations to the City as to the best course of action.

The Consultant must invite the WorkSafeNB safety inspector to the pre-construction meeting, giving the appropriate officer a minimum of one week's notice.

The Consultant shall immediately notify the Environment and Climate Change Canada's National Environmental Emergencies Centre (NEEC) (1-800-565-1633) until personal contact is made on any sewage overflows discharged to the environment. The Consultant shall provide the location of the discharge, time of discharge, amount of discharge and a detailed description of the event. Consultants are responsible for preparing the detailed emergency report required within five (5) days should sewage overflow occur, with discharge to the environment, as a result of project activities.

The Consultant's field inspector (or resident engineer) assigned to this project shall have significant (minimum four (4) years) related experience with such construction activity. The field inspector shall have a local cellular phone for the duration of the project and the number is to be provided to the City prior to the start of construction.

The Consultant's field inspector shall have a copy of the latest revision of the General Specifications, the contract drawings and specifications and the standard format for Red Book Notes, the pipe report, video report, service cards, any applicable permits or approvals onsite, and be familiar with them. The **principals of the Consulting Firm** must educate and prepare the field inspectors before the start of construction. They must understand the tasks and responsibilities of the position.

The City of Saint John Construction Inspection Guidelines shall be used as a basis for the general requirements for inspecting the construction and installation of municipal infrastructure.

The field inspector shall take pre-construction photographs and shall also take construction photographs for the duration of the project utilizing a digital camera. Each photograph must have the date taken on it and the location labeled. A labeled USB flash drive containing the digital photographs in chronological order shall be provided to the City at the end of the project.

The Consultant shall provide daily inspection 'Field Notes' to detail all work done on the construction site that day. **Daily Field Reports** in the Consultant's standard format shall be completed every day and sent to the City's project engineer once a week (Monday at 4:00 pm) for the preceding week's work. The inspector shall also fill out service cards for each building serviced to detail the water, sanitary and storm services that are installed during the project.

During construction, the Consultant must provide the City with weekly e-mails (by Monday at 4:00 pm) indicating those staff members who worked on the project the previous week, a brief description on their work as well as how many hours each person worked.

The Consultant's field inspector shall be available to work overtime and on weekends (if the contractor is working), without extra charges to the City. The Consultant will provide full time inspection and be on-site at all times, when the contractor is working. The inspector shall advise the City immediately when work on-site starts or stops unexpectedly and of all planned schedule changes and of all changes to the work that may result in extra costs to the City or standby charges.

The Consultant shall review and approve the contractor's work including but not limited to all pipework, excavation, grading, compaction, concrete work and asphalt paving, etc. In addition the Consultant shall verify and provide detail on quantities of excavation and fill material, (measured by the inspector, not the contractor) as well as provide certification of work for progress payments.

The Consultant's field inspector must ensure that the contractor flushes and videos (video camera inspection in colour) all required sewers and drains. The Consultant must review all sewer videos provided by the contractor, report any issues to the City and record them on the deficiency list as required.

4. METHOD OF PAYMENT

Upon award of the contract the City will execute an agreement with the successful engineering firm for the work to be performed. Payment of fees shall be in accordance with the terms of the Request For Proposal at the rates submitted and accepted in the Consultant's proposal, not to exceed the Recommended Minimum Hourly Rates as contained in The Association of Consulting Engineering Companies – New Brunswick fee guideline to a maximum of the upset fee for Parts A, B, C, D, and E as required.

For Part F, payment of fees shall be based on actual time in hours plus reimbursable expenses subject to approval by the City's Engineer.

The Consultant shall invoice the City on a monthly basis for the work performed in accordance with the engineering services agreement. The Consultant shall provide a status report with each invoice outlining in detail the scope of the work completed during that month. Payments will not be processed unless the invoice is signed by an authorized representative of the company, accompanied by a status report in the proper timed based format (hourly rate x hours worked).

Engineering fees are not based on a percentage of the construction costs; therefore, the approved upset fees will not be changed due to the final construction costs being different from the current budget estimate. A change in the fees may be considered only if the scope of the engineering work is changed at the request of the City's Engineer.

Maximum Upset prices (including HST) will be included in the proposal for Part A, Part B, Part C, Part D and Part E of this project beyond which no additional payments will be considered unless first submitted by the Consultant in writing and authorized in writing by the City.

The price submitted for Part F shall be in the format of a budget estimate based on the following estimated construction timeline: = 8 weeks

In Part F, the Consultant's budget should assume a **55 hour work week** for the inspection services as well as **12 hours of project management per week** for the Consultant's Engineer overseeing the project **plus reimbursable expenses**.

The final amount paid to the Consultant for Part F shall be based on actual time in hours to complete Part F plus reimbursable expenses subject to approval by the City's Engineer.

The total price stated, must also include an engineering contingency for unforeseen work as follows: = $7,000 + HST

No part of this contingency shall be expended without the written direction of the City's Engineer, and any part not so expended shall be deducted from the contingency allowance.

Payments for engineering work performed in the preparation of Record Drawings will only be made upon receipt of completed drawings.

5. TERMINATION OF CONTRACT

The City will reserve the right to terminate the contract with the Consultant Engineering Firm after completion of Part A or at any other time during the course of the work. In such an event, payment will be made only for the work completed up to the time of termination.

The City of Saint John does not, by virtue of any proposal request, commit to an award of this bid, nor does it commit to accepting the proposal submitted, but reserves the right to award this proposal in a manner deemed to be in the best interest of the City.

6. CONTENT OF PROPOSAL

The Consultant shall confirm a clear understanding of the work to be undertaken as described in the Scope of Work. The proposal must demonstrate that the Consultant and its team have recent and significant experience with this type of work. When noting examples of experience gained on similar projects, the proposal must also note which current staff members worked on that project and what their role was. The proposal must specifically address all requirements of the work and any matters related to its successful implementation. The proposal must indicate what role each of the Consultant's team will be carrying out for the project. The Consultant may not substitute the project team members noted in the proposal without permission of the City. When proposing a schedule, the Consultant must also indicate that their workload is such that they will have time to complete the project as promised. If the Consultant is very busy, they should either decline the work or propose a longer schedule at the time of the RFP submission.

The proposal shall include the following sections:

A. TECHNICAL PROPOSAL:
- Table of Contents
- Work Plan and Schedule
- Project Team
- Experience with similar projects

B. FINANCIAL PROPOSAL:
- Maximum or Upset Fee(s) for each of parts A, B, C, D and E (for each street).
- Budget Estimate for Part F (for each street).
- All costs are to be subtotaled (including contingency allowance) with the 15% HST component identified separately and added to arrive at a total cost.
- Billing Rate Summary (hourly billing rates for all key personnel).
- The Consultant must submit the cost breakdown in the following matrix format:

Street	Part A	Part B	Part C	Part D	Part E	Part F	Engineering Contingency	Sub-total	HST (15%)	Grand Total (incl. HST)
							$7,000			

The financial proposal shall include separate prices (including reimbursable expenses) for each of Part A, Part B, Part C, Part D, Part E, and Part F.

A further breakdown of Part F is required with the financial proposal to identify all staff participating in Part F, including hourly rates, hours and reimbursable expenses. All sub-consultants such as geotechnical, legal survey, electrical, structural and others shall have their fees identified and included in the appropriate part of the proposal.

7. EVALUATION CRITERIA

For the purposes of this proposal call, submissions will be evaluated on the following criteria:

- *QUALITY AND COMPLETENESS* – Has the proposal addressed all of the needs raised? Is the proposal presented in an organized and professional manner?
(Criteria weight = 10 points)

- *CONSULTANT'S EXPERIENCE* – Has the proposal demonstrated a level of expertise with the requirements of this project? (Include references for projects of a similar nature.)
(Criteria weight = 20 points)

- *EXPERIENCE OF EMPLOYEES / SUB-CONSULTANTS* – Has the proposal demonstrated a level of expertise for the employees of the company and sub-consultants listed? (Include resumes for staff and sub-contractors required)
(Criteria weight = 35 points)

- *METHODOLOGY* – Does the approach to the project outlined in the proposal address, in a realistic sense, attainable goals and is it in keeping with the City's expectations for the project?
(Criteria weight = 75 points)

- *VALUE ADDED* – What additional information, technology, process or options has the consultant included in his proposal? Is there value added to the consultant's response for this additional information?
(Criteria weight = 10 points)

- *COST* – Cost will be a factor, however not the only factor to be considered.
(Criteria weight = 50 points)

Consultants are advised that proposals will be evaluated solely on the basis of information submitted in accordance with the request for proposals. The City reserves the right, if deemed necessary, to short-list the proposals and to request an additional verbal presentation from each short-listed Proponent. The Consultant may supplement their presentation with a summary in written format to clarify points raised during the process.

8. INSURANCE REQUIREMENTS:

The consulting engineering firm shall obtain and keep in force, during the full duration of this contract, an Errors and Omissions Liability policy with a minimum limit of two million dollars **($2,000,000)**, and two million dollars **($2,000,000) per claim**. The policy shall include a clause stating that thirty (30) days-notice of cancellation of this policy will be given to the City of Saint John, by the insurers. The Consultant shall provide evidence of this policy to the City.

The Consultant must provide proof of current coverage from WorkSafeNB prior to the start of the work.

The Consultant shall provide evidence of the following insurance coverage:

General Liability with minimum limits of two million dollars (**$2,000,000**) per occurrence.

The policy shall include:

- Operations of the Consultant in connection with this project;
- Products and completed operations coverage;
- Contractual liability with respect to this project;
- The City of Saint John added as an additional named insured;
- A cross liability clause;
- Non-owned automobile;
- Thirty (30) day's written notice of cancellation of this policy will be given to the City of Saint John, by the insurers; and
- Standard automobile insurance for owned automobiles with at least the minimum limits allowed by law.

9. FORMALITY CLAUSE

In order for the City of Saint John to consider any proposal submission as a legally binding offer, on behalf of the Consultant, it is necessary for the Consultant to communicate this formality to the City in the form of an offer which contains the original signature of the individual or representative of the firm who is authorized to act on behalf of the Consultant.

In order to meet this requirement, all proposal submissions to the City of Saint John must be prefaced with a covering letter which contains an original signature of the individual authorized by the Consultant to submit proposals on their behalf.

The covering letter must be on official company letterhead, be dated and be addressed to the attention of the City of Saint John representative specified in the request for proposal document. Additionally, it must make reference in the body of the letter to the request for proposal number and project title, as well as to the fact that the enclosed documents constitute a formal proposal offer and finally, the letter must contain the original signature as indicated.

Failure to include the required covering letter as a preface with your proposal will be grounds for immediate rejection on the basis that it is not formal.

10. STANDARD TERMS AND CONDITIONS

Addenda

Periodically, the City of Saint John is required to issue notification of changes or corrections to a bid document by way of addenda. Normally these notifications will have direct bearing on the cost of a project and will influence bidding. Therefore, it is important that the City have assurances that bidders have in-fact received the notification(s).

Bidders are responsible for obtaining all addenda issued by the City. Addenda may be obtained from the City's website (www.saintjohn.ca) under the menu option "Tender and Proposals".

Bidders are required to sign and include all addenda with their bid submission.

Failure to include a copy of all signed addenda with the bid submission may result in rejection of the bid regardless of whether or not the changes noted in the addendum are included in the bid submission.

Advisory Notice(s)

Periodically, the City of Saint John is required to issue clarification notices to a bid document in the form of Advisory Notices. Normally these notifications will not have a direct bearing on the cost of a project and will not influence bidding.

Bidders are responsible for obtaining all advisory notice(s) issued by the City. Advisory Notice(s) may be obtained from the City's website (www.saintjohn.ca) under the menu option "Tender and Proposals".

Bidders are instructed to sign the Advisory Notice and return it either by fax to (506) 658-4742 or email to supplychainmanagement@saintjohn.ca prior to the closing date.

Failure to comply with the instructions on an advisory may result in rejection of the bid.

Review of Proposals

The evaluation committee may invite proponents to meet with the review committee to make an oral/visual presentation in support of their proposal. The City will provide the meeting venue at its cost. The Proponent shall bear its own costs related to such meeting.

Additional Information from Proponents

The City of Saint John reserves the right during evaluation of the bids to seek further information from any Proponent and to utilize that information in evaluation and award without becoming obligated to seek further information from any other proponents.

Clarification of Bids

The City of Saint John reserves the right in its sole discretion to clarify any bid after close of bidding without becoming obligated to clarify any other bid.

Negotiation

The City reserves the right in its sole discretion to negotiate the final terms and conditions of the engagement contract with the most probable candidate for award prior to award of the engagement.

Inconsistency between Paper and Electronic Form

If there is any inconsistency between the paper form of a document issued by or on behalf of the City to proponents and the digital, electronic or other computer readable form, the paper form of the document prevails.

Acceptance, Revocation and Rejection of Proposals

The proposal constitutes an offer which shall remain open and irrevocable until ninety (90) days after the date of the proposal opening.

Reserved Rights

The City reserves the right to:

a) Reject an unbalanced Proposal. For the purpose of this section, an unbalanced Proposal is a Proposal containing a unit price which deviates substantially from, or does not fairly represent, reasonable and proper compensation for the unit of work bid or one that contains prices which appear to be so unbalanced as to adversely affect the interests of the City. The City reserves the right to use Proposals submitted in response to other like or similar Requests for Proposals as a guideline in determining if a bid is unbalanced.

b) Amend or modify the scope of a project, and/or cancel or suspend the Bid Solicitation at any time for any reason.

c) Require proponents to provide additional information after the Closing Date for the Bid Solicitation to support or clarify their bids.

d) Not accept any or all bids.
e) Not accept a bid from a bidder who is involved in litigation, arbitration or any other similar proceeding against the City.

f) Reject any or all bids without any obligation, compensation or reimbursement to any bidder or any of its team members.

g) Withdraw a Bid Solicitation and cancel or suspend the Bid Solicitation process.

h) Extend, from time to time, any date, any time period or deadline provided in a Bid Solicitation (including, without limitation, the Bid Solicitation Closing Date), upon written notice to all bidders.

i) Assess and reject a bid on the basis of
   i. information provided by references;
   ii. the bidder's past performance on previous contracts;
   iii. information provided by a bidder pursuant to the City exercising its clarification rights under the Bid Solicitation process;
   iv. the bidder's experience with performing the type and scope of work specified including the bidder's experience;
   v. other relevant information that arises during a Bid Solicitation process.

j) Waive formalities and accept bids which substantially comply with the requirements of the Bid Solicitation.

k) Verify with any bidder or with a third party any information set out in a bid.

l) Disqualify any bidder whose bid contains misrepresentations or any other inaccurate or misleading information.

m) Disqualify any bidder who has engaged in conduct prohibited by the Bid Solicitation documents.

n) Make changes including substantial changes to the bid documents provided that those changes are issued by way of an addendum in the manner set out in the Bid Solicitation documents.

o) Select any bidder other than the bidder whose bid reflects the lowest cost to the City.

p) Cancel a Bid Solicitation process at any stage.

q) Cancel a Bid Solicitation process at any stage and issue a new Bid Solicitation for the same or similar deliverable.

r) Accept any bid in whole or in part.

And these reserved rights are in addition to any other express rights or any other rights which may be implied in the circumstances and the City shall not be liable for any expenses, costs, losses or any direct or indirect damages incurred or suffered by any bidder or any third party resulting from the City exercising any of its express or implied rights under a Bid Solicitation.

Limitation of Liability and Waiver

In every Bid Solicitation, the City shall draft the documents such that each bidder, by submitting a bid, agrees that:

a) Neither the City nor any of its employees, agents, advisers or representatives will be liable, under any circumstances, for any claims arising out of a Bid Solicitation process including but not limited to costs of preparation of the bid, loss of profits, loss of opportunity or any other claim.

b) The bidder waives any claim for any compensation of any kind whatsoever including claims for costs of preparation of the bid, loss of profit or loss of opportunity by reason of the City's decision to not accept the bid submitted by the bidder, to award a contract to any other bidder or to cancel the Bid Solicitation process, and the bidder shall be deemed to have agreed to waive such right or claim.

Proposal Debrief

Immediately following the City's acceptance of a Proposal submitted, the Office of the Purchasing Agent shall send a written notification of award to all unsuccessful proponents disclosing the name of the successful proponent and providing a brief explanation rationalizing the City's selection:

a) For all Requests for Proposals valued at Fifty Thousand Dollars **($50,000) or less**, the written notification of award will be the only form of debriefing offered by the City;

b) In the case of Requests for Proposals valued **in excess** of Fifty Thousand Dollars **($50,000)**, the Purchasing Agent may, in addition to the notification of award and upon written request from any proponent, provide a more detailed oral debriefing either by phone or in person, as required by the proponent. During this debriefing, the Purchasing Agent may disclose information such as the total price of the successful proponent and may discuss an overview of the process as well as the strengths and weaknesses of the requesting proponent's proposal.

c) The written request referred to paragraph (b) shall be submitted to the Office of the Purchasing Agent no later than fifteen (15) business days after the notification of award is issued.

d) The acceptance of the successful Proposal shall not be discussed during a debriefing.

11. SUBMITTALS

When preparing the Agreement for Engineering Services, the Consultant is required to submit a "Business Corporation Act Certificate" to the engineer.

12. ENQUIRIES

All enquiries regarding this request for proposals shall be submitted in writing via email, by **4:00:00 pm Local Time on Tuesday, March 8th, 2022**, only to the attention of:

Monic M^{ac}Vicar, CCLP, CPPB
Procurement Specialist
Supply Chain Management
E-mail: supplychainmanagement@saintjohn.ca

Responses to enquiries will be in writing and distributed by e-mail to all Consultants registered as having received the Terms of Reference as of the date the response is prepared. The source of the question will not be identified in the response. Verbal information shall not be binding upon the City. Enquiries after the above deadline will not receive a response.

13. ATTACHMENTS

- Menzies Lake Dam – Cost Update July 26, 2021
- Menzies Lake Dam Safety Study November 2003
- 2016 Dam Safety Inspections
- Draft Consulting Engineering Agreement
- City of Saint John Vaccine or Test SOP
- City of Saint John Vaccine or Test Acknowledgment Form

14. OTHER RELEVANT DOCUMENTS

- City of Saint John General Specifications, latest revision
- City of Saint John Construction Inspection Guidelines, latest revision
- Standard Format for City of Saint John Red Book Notes, latest revision

15. SUBMISSION OF PROPOSALS

Consultants shall deliver six (6) copies of the Technical Proposal and supporting information and six (6) copies of the Financial Proposal no later than **4:00:00 pm, Local Time, Thursday March 17, 2022**, clearly indicating the Consultant's name and address and marked **"Proposal: 2022-091006P, Engineering Services – Menzies Lake Dams And Access Road Drainage Upgrades"**, to the attention of:

Monic M^{ac}Vicar, CCLP, CPPB
Procurement Specialist, Supply Chain Management
175 Rothesay Avenue, 1st Floor
Saint John, NB E2J 2B4

Please note that:

1. Late proposals or proposals submitted by e-mail will be rejected.

2. The City assumes no responsibility for improperly addressed or delivered proposals.

3. The City of Saint John does not, by virtue of this proposal call, commit to an award of this proposal, nor does it commit to accepting the lowest or any

proposal submitted, but reserves the right to award this proposal in any manner deemed to be in the best interest of the City.

4. The Financial Proposal is to be submitted in the Consultant's package in a separate sealed envelope, clearly marked as **"Financial Proposal: 2022-091006P, Menzies Lake Dams And Access Road Drainage Upgrades"**, with the Consultant's name and address.

5. Consultants must propose on the entire project – incomplete proposals will be rejected.

Immediately following the closing time, proposal packages will be publicly opened in the Office of the Purchasing Agent. Only the names and addresses of the proponents will be made public at this time. No other information about the proposals will be disclosed at that time. Proposals will then be forwarded to an evaluation committee for review and recommendation.

Proposals will **NOT** be opened publicly due to the on-going pandemic.

City of Saint John

Final Report

For

Menzies Lake Dam - Cost Update

H365960-00000-220-230-0001
Rev. 0
July 26, 2021

City of Saint John

Final Report

For

Menzies Lake Dam - Cost Update

H365960-00000-220-230-0001
Rev. 0
July 26, 2021

City of Saint John
Menzies Lake Dam - Cost Update

Final Report

PROVINCE OF NEWFOUNDLAND
PEG Newfoundland and Labrador PROFESSIONAL ENGINEERS AND GEOSCIENTISTS
PERMIT HOLDER
CLASS "A"
This Permit Allows
HATCH LTD.
MIRC #: 02780
To practice Professional Engineering
in Newfoundland and Labrador
Permit No. as issued by PEG-NL D0090
which is valid for the year 2021

REGISTERED PROFESSIONAL ENGINEER
PEG Newfoundland and Labrador PROFESSIONAL ENGINEERS AND GEOSCIENTISTS
ANTHONY CHISLETT
SIGNATURE
2021/07/26
DATE
NEWFOUNDLAND & LABRADOR

Date	Rev.	Status	Prepared By	Checked By	Approved By
2021-07-26	0	Final	M. Morris, A. De Leon	P. Gilks, J. Alarcon	T. Chislett

HATCH

Disclaimer

This report has been prepared by Hatch Ltd ("Hatch") for the sole and exclusive use of the City of Saint John (the "Client") for the purpose of assisting the management of the Client in making decisions with respect to the planned refurbishment of the dam structures at Menzies Lake, and shall not be (a) used for any other purpose, or (b) provided to, relied upon or used by any third party.

This report contains opinions, conclusions and recommendations made by Hatch, using its professional judgment and reasonable care. Any use of or reliance upon this report and estimate by the Client is subject to the following conditions:

(a) the report being read in the context of and subject to the terms of the agreement between Hatch and the Client dated June 7, 2021 (the "Agreement"), including any methodologies, procedures, techniques, assumptions and other relevant terms or conditions that were specified or agreed therein;

(b) the report being read as a whole, with sections or parts hereof read or relied upon in context;

(c) the conditions of the site may change over time (or may have already changed) due to natural forces or human intervention, and Hatch takes no responsibility for the impact that such changes may have on the accuracy or validity of the observations, conclusions and recommendations set out in this report; and

(d) the report is based on information made available to Hatch by the Client or by certain third parties; and unless otherwise stated in the agreement, Hatch has not verified the accuracy, completeness or validity of such information, makes no representation regarding its accuracy and hereby disclaims any liability in connection therewith.

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1. Introduction

In June 2021, The City of Saint John (CSJ) engaged Hatch Ltd. (Hatch) to provide engineering services in support of the planned refurbishment of Menzies Lake dam structures in the Spruce Lake watershed. Previous inspections and assessments have indicated that the dams have various dam safety and maintenance deficiencies which require mitigation. This report provides updated cost estimates for the works.

The scope of work for the current study generally involves the following engineering activities:

- Review of all existing documentation relating to the dams;
- Site reconnaissance to assess the current condition of the structures; and
- Review and update the cost estimates for remedial measures, as per the previous Dam Safety Review report (SGE-Acres, 2003).

2. Site Description

2.1 Spruce Lake Watershed

The City of Saint John's municipal water supply network is serviced by two separate watersheds, the Spruce Lake Watershed and the Loch Lomond Watershed. These watersheds and their structures are operated by Saint John Water (SJW).

The Spruce Lake Watershed includes Ludgate Lake and Menzies Lake. Water is pumped into Menzies Lake, intermittently as required, from East Musquash Reservoir (which is owned by the Province of New Brunswick). Water is gravity fed from Menzies Lake into Spruce Lake and to the treatment and distribution facilities at Spruce Lake. The Spruce Lake Watershed is depicted in **Figure 2-1** and includes the following dam structures:

- Menzies Lake Control Structure and Saddle Dykes 1, 2 and 3; and
- Spruce Lake Dam.

2.2 Menzies Lake Dam Structures

The Menzies Lake dam structures include a concrete control structure and three earth-fill saddle dykes. The control structure was constructed in 1973 and consists of four concrete box culverts fitted with stop logs, with earth abutments and concrete wing walls both upstream and down. The control structure is approximately 4 m high and 14 m long. It replaced an earlier dam which was constructed just upstream of the present location.

The purpose of the dam structures is to block the original flow path via Menzies Stream (main saddle dyke) and control for the level of the water in Menzies Lake (concrete control structure). Menzies Lake provides emergency water supply storage for the west side of Saint John. The lake is generally full, and the stoplogs are rarely removed. Any water pumped from the Musquash system to supplement the supply from the Spruce Lake drainage area is pumped from East Musquash to Menzies Lake and then flows by gravity to Spruce Lake.

Characteristics of the Menzies Lake structures that are included in this report are listed in **Table 2-1**. Additional details of the structures are provided in Appendix A.

Table 2-1: Menzies Lake Structure Inventory

Structure	Type	Length (m)	Max. Height (m)	Crest Elevation(m local datum)	Discharge Facilities	Year Built
Menzies Lake Control Structure	Concrete	13.7 m	4.3 m	76.5 m	4 bay sluiceway	1973
Menzies Lake Saddle Dyke 1	Earth	100 m	5 m	77.25 m	None	1937
Menzies Lake Saddle Dyke 2	Earth	30 m	3.5 m	76.63 m	None	1937
Menzies Lake Saddle Dyke 3	Earth	25 m	1.5 m	77.56 m	None	1937

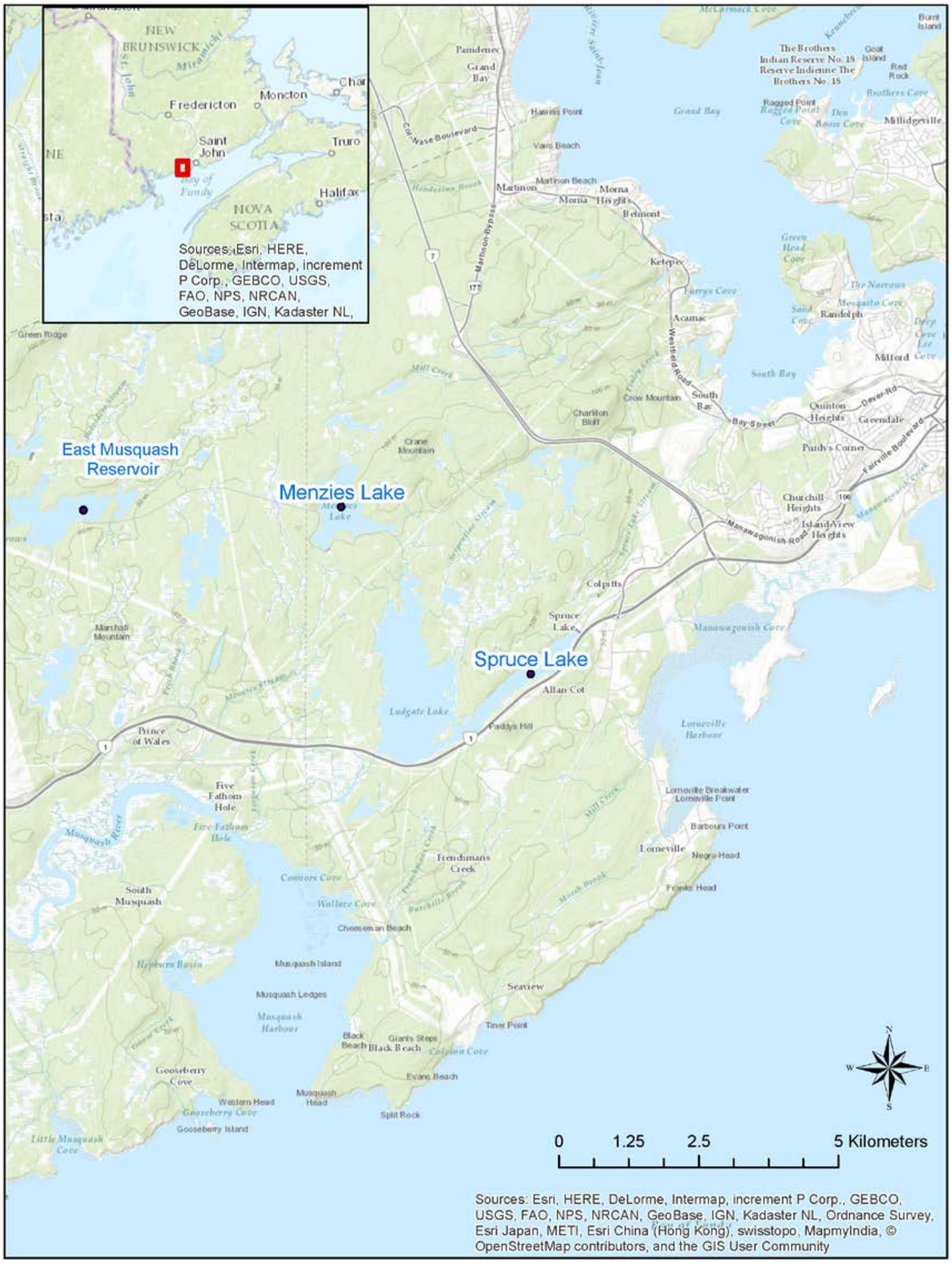

Figure 2-1: Spruce Lake Watershed – Location Plan

3. Site Reconnaissance

A site reconnaissance was undertaken on June 23, 2021 by Phillip Gilks (Hatch senior civil engineer), accompanied by Dean Price (CSJ). The weather was mostly sunny with temperatures around 20°C. The elevation of the lake was 75.45 m at the time of the inspection.

The site reconnaissance generally consisted of a site walkover and visual observations of the structures, in order to verify the observations documented in previous reports and to identify any changed conditions in recent years.

For the purpose of describing the structures in this report, we use the terminology “Left” and “Right” as observed while looking in the downstream direction, as well as the terms “upstream” and “downstream”.

3.1 Menzies Lake Control Structure

The Menzies Lake Control Structure is a concrete structure which consists of a 4-bay sluiceway. The sluiceways are controlled with timber stoplogs. At the time of the site visit, stoplogs were installed to the full height in bays one, three and four with one log removed from the second (from left) bay. During the inspection, an underwater camera was used to examine the upstream face of the structure. No significant deterioration was noted and only limited debris consisting of small sticks was found at the bottom of the walls.

It was not possible to make a close examination of the stoplogs, however there was no evidence of significant deterioration or leakage.

In previous inspection reports some cracking was noted in the downstream wingwalls, and also at the interface between the upstream wing wall and the right abutment. Based on current observations, it does not appear that this condition is worsening and the concrete remains in satisfactory condition.

Seepage noted at the toe of the left abutment in 2003 persists. There is no evidence that this seepage is worsening however a more quantitative monitoring system, such as a measuring weir, is recommended.

The light aluminum grating over the stoplogs was deformed, however it remained adequately anchored and functional. Timber decking was in satisfactory condition. Continued monitoring through regular inspection is recommended.

Generally, the conditions of the Menzies Lake Control Structure appear to be unchanged from the previous inspections and recommendations made in 2003 should be acted upon.

Unrelated to the structural condition of the structure, it was noted during the inspection that the jersey barriers on the downstream side had openings at either end. These provided easy pedestrian access to the toe of the abutment walls, but are located a short distance from the top of the wall. The top of the wall is up to 8 feet above the apron of the spillway and there is no fall protection. Safety barriers are recommended to provide protection against the risk of falls in this area.

3.2 Menzies Lake Saddle Dyke 1

A walkover inspection was carried out on the saddle dykes. No surveys were conducted so it is assumed that the crest of the dykes is the same elevation as in 2003.

As in 2003, the structural condition of Saddle Dyke 1 crest was satisfactory, with no signs of cracking or settlement.

The upstream slope was densely vegetated with brush generally under 50mm diameter. The slope at the top was very steep, more than 1H:1V. It appears that this is because grading operations have pushed material to the side of the road way, resulting in the change in slope at the top of the structure. There were no signs of erosion although this should be re-examined after the vegetation has been removed.

At the left abutment, the seepage noted in 2003 remains. Since this seepage is not measured, it is not possible to determine if it has changed. Flow is evident although there is no signs of turbidity in the water.

The downstream slope is densely vegetated. Most of the vegetation is under 75mm in diameter although there are a number of mature trees that would be up to 400mm in diameter. The slope is steep over the whole structure but increases at the top to steeper than 1V:1H. Like upstream, this is probably a result of grading operations. Because of the vegetation, it was not possible to identify specific seepage areas so it can be assumed that the seepage noted in previous inspections persists.

3.3 Menzies Lake Saddle Dyke 2

Like with Saddle Dyke 1, the slopes of Saddle Dyke 2 are densely vegetated and slopes are steep. There is water present at the toe of the dyke however there was no discernable movement in the water so it was not possible to get a sense for the rate of flow. Along with the clearing of vegetation, ditching of the area downstream is required to ensure water does not pond behind the dam. During the upcoming refurbishment works, it may be found that there is sufficient seepage that a monitoring weir should be installed.

3.4 Menzies Lake Saddle Dyke 3

Saddle Dyke 3 is similar to Saddle Dyke 2. Vegetation removal and ditching is required and water which is forming a pond downstream should be drained to determine if there is sufficient seepage to warrant the installation of a monitoring weir.

3.5 Access Road Culverts

The Acamac Backlands Road runs between the gate at the Martinon Bypass (Route 7) and Lock Alva, passing the Menzies Lake control structure and Saddle Dykes 1-3. During the site reconnaissance, a number of areas of concern were examined along this road. The concerns relate largely to the erosion of the road during periods of heavy rain or ice buildup in winter/spring conditions. A total of 16 culverts were examined, along with five low spots where erosion has occurred in the past or is likely to occur, given the grade of the road. Also, two locations along straight hills were noted, where ice builds up making the road difficult to maintain in winter.

In virtually all cases, it was found that the ditches were over grown with vegetation which restricts the flow of water and makes the ditches and culverts subject to plugging.

While most of the culvert pipes were in satisfactory condition, many required at least some maintenance, especially around the head wall, to ensure proper flow of drainage water into the pipes and reduce plugging.

Existing pipes at 3500 m and 3600 m are in need of replacement and two pipes, located at 8500 m are in questionable condition and must be examined further and repaired or replaced as required.

In many of the low areas, installation of new culvert pipes would reduce the risk of future washouts, however other options could be entertained, including controlled fords. This was noted in six locations.

At the two hills, located at 6100 m and 6500 m, construction of proper ditches on one side of the road is required to prevent ice buildup. This will likely require the installation of a culvert at the transmission line crossing (6500 m).

4. Cost Estimates

4.1 General

The cost estimates provided in this report serve as Level 1 Order of Magnitude estimates based on previous concepts for rehabilitation of the Menzies Lake structures, as presented in the 2003 Dam Safety Review report.

The cost estimates have been developed primarily for the purpose of CSJ's business case development and budget planning process.

The updated cost estimate for the dam remedial works work is $288,700 including contingency. The overall increase in the cost estimate compared to the estimate provided in the 2003 report is generally due to a combination of factors, including; simple price increases in equipment/material/labour, updated quantity estimates, and additional items required to complete the work as per scope.

The estimated cost of the required access road drainage improvements is $96,800 including contingency.

The expected accuracy of the cost estimates at this stage of project pre-planning is in the range of -30% (low) to +50% (high). The accuracy range can be further refined following the completion of additional engineering design activities.

Cost estimates for the various items associated with dam remedial works as listed in Table 7.1 of the 2003 Dam Safety Review report have been updated in this report, as shown in Table 4-1. The cost estimate for access road drainage improvements is provided in Table 4-2.

4.2 Methodology

Cost estimates were developed using a simplified estimating approach and recent benchmark pricing data.

The cost estimates were compiled based on the following parameters:

- An estimate base date of July 2021.
- Civil works estimates based on benchmark pricing data and actual pricing for recently tendered similar projects in Canada – budgetary quotes from contractors were not obtained.
- Estimated quantities for the 2003 budget were not available. Material quantity take-offs (MTOs) were developed, where possible, to estimate the level of effort required for each work item.
- A single general construction contract is assumed, utilizing non-union tradesmen.

4.3 Contingency

A contingency amount is added to allow for uncertainty in project definition, quantities, and pricing, project scope uncertainties, and undefined regulatory requirements. Contingencies reduce the risk that the cost estimates will overrun. The level of contingency included in the overall estimate (30%) is considered appropriate for the relatively low level of engineering definition completed to this point.

4.4 Exclusions

The cost estimates do not include the following:

- Escalation beyond July 2021;
- Harmonized Sales Tax (HST);
- Financing;
- Owner's costs;
- Engineering design;
- Construction management;
- Site resident services during construction;
- Environmental assessment costs (if required); and
- Force majeure (example: COVID-19).

Table 4-1: Cost Estimate – Dam Remedial Works

Item	Structure	Component	Defect / Area of Concern	Cost (2021 $)
1	Dyke 1	U/S Slope	Brush growth and displaced riprap	$ 17,714
2	Dyke 1	D/S Slope	Mature trees on slope	$ 16,460
3	Dyke 1	D/S Slope	Unsuitable material	$ 17,867
4	Dyke 1	D/S Slope	Geotechnical instability	$ 92,730
5	Dyke 1	D/S Slope	Sloughs near toe	$ 0
6	Dyke 1	D/S Slope	General seepage	$ 2,200
7	Dyke 1	Abutment	Concentrated seepage	$ 0
8	Dyke 1	D/S Foundation	Potential for piping failure	$ 0
9	Dyke 2	Crest	Insufficient freeboard	$ 9,537
10	Dyke 2	West of Saddle Dyke	Insufficient freeboard	$ 2,800
11	Dyke 2	U/S & D/S Slope	Brush growth	$ 7,859
12	Dyke 3	U/S & D/S Slope	Brush growth	$ 11,590
13	Control Structure	Downstream Area	Minor cracking in end walls	$ 0
14	Control Structure	Abutment Area	Leakage near d/s wing wall	$ 2,200
15	Control Structure	Abutment Crest	Insufficient freeboard	$ 3,800
16	Control Structure	Upstream Slope	Brush growth and displaced riprap	$ 5,120
17	Control Structure	Downstream Slope	Brush growth	$ 3,200
Total Construction Cost - without Contingency				$ 193,100
Mobilization/Demobilization (15%)				$ 29,00
Subtotal - without Contingency				$ 222,100
Contingency Allowance (30%)				$ 66,600
Total Estimated Cost - with Contingency				$ 288,700

Table 4-2: Cost Estimate – Access Road Drainage Improvements

Item	Structure	Component	Defect / Area of Concern	Cost (2021 $)
1	Access Road	Culverts	Damage/deterioration (new culverts required)	$ 55,000
2	Access Road	Ditches	Deterioration (ditch reinstatement required)	$ 33,000
Total Construction Cost - without Contingency				$ 88,000
Contingency Allowance (10%)				$ 8,800
Total Estimated Cost - with Contingency				$ 96,800

5. Conclusions and Recommendations

The current scope of work was limited to a site reconnaissance, including visual observation of site conditions, and cost estimate updates for remedial works. Site observations are provided in Section 3, and the updated cost estimates are presented in Section 4.

Many of the recommendations as documented in the previous dam safety reports have not been implemented. As stated in the previous reports, the structures are in a neglected state - so CSJ should develop and implement a plan to address these deficiencies.

It is recommended that the structures be inspected by CSJ staff on a regular basis. However, the majority of the structures are heavily overgrown with brush and trees. This prevents a thorough inspection of the structures. The growth of trees on the slopes of earthfill dams or earth abutments can lead to localization of flow and dam failure. The trees and brush should be kept clear and cut brush and debris should be removed from the structures. The vegetation clearing and regular inspections should be given a high priority.

Updated engineering assessments should be undertaken for the structures including, but not limited to; dam classification, hydrotechnical analysis and stability assessments. This will assist in evaluating the design deficiencies and assist with developing rehabilitation plans for the structures.

The updated cost estimate for the dam remedial works is $288,700 including contingency. This estimate is based largely on the conceptual-level designs previously developed in the 2003 Dam Safety Review report. No additional engineering design or advancement of the project definition has been carried out within the current scope. The cost estimate should be further reviewed/revised following the completion of updated engineering assessments as described above.

The estimated cost of the required access road drainage improvements is $96,800 including contingency.

6. References

SGE Acres (2003). Menzies Lake Dam Safety Review. Draft Report. Prepared for City of Saint John.

Hatch (2018). 2016 Dam Safety Inspections. Final Report. Prepared for Saint John Water.

Appendix A
Structure Inventory Sheets

Menzies Lake Control Structure

Date of Construction: 1973
Dam Type: Concrete Gravity
Dam Height: 4.3 m
Dam Length: 13.7 m excluding wing walls
Abutments: Concrete on bedrock
Spillway Type: 4-bay sluiceway
Sluiceway Control: Stoplogs
Sluiceway Length: 13.7m including end walls
Other Outlets: None
Drainage Area: 3.6 km^2
Elevations:
- Top of Dam: 76.5 m (top of roadway)
- Spillway Crest: 76.8 m (top of curb)
- Sluiceway Invert: 73.1 m
- Dam Foundations: 72.8 m (approximately)

Major Repairs: None since construction.
Drawings Available: No. 7006-35 (Box Culvert – Site Plan and Approaches Miscellaneous Details, Eastern Designers and Company Ltd. April 1971)
No. 7006-36 (Box Culvert - Concrete and Reinforcing Details Easter Designers and Company Ltd. April 1971)

Menzie's Lake Saddle Dyke 1

Date of Construction:	1973
Dam Type:	Earth
Drainage Area:	3.6 km^2
Dam Height:	5 m
Dam Length:	100 m
Elevations:	
Top of Dam:	77.25 m (minimum centerline elevation)
Dam Foundations:	72.3 m (approximately)
Major Repairs:	Work done on the saddle dykes in the 1970s and there appears to have been structures at this location since 1937.
Drawings Available:	One drawing from 1937 showing Saddle Dyke 1

Menzie's Lake Saddle Dykes 2 and 3

Saddle Dyke 2

Saddle Dyke 3

Saddle Dyke 2

Dam Height: 3.5 m

Dam Length: 30 m

Elevations:

- Top of Dam: 76.63 m (minimum centerline elevation)
- Dam Foundations: 73.0 m (approximately)

Saddle Dyke 3

Dam Height: 1.5 m

Dam Length: 25 m

Elevations:

- Top of Dam: 77.56 m (minimum centerline elevation)
- Dam Foundations: 76 m (approximately)

Major Repairs: Work done on the saddle dykes in the 1970s and there appears to have been structures at this location since 1937.

Drawings Available: None

Appendix B
Site Assessment of Culverts and Ditches

City of Saint John
Menzies Lake Dam Cost Update

Site Assessment of Culverts and Ditches

Date: June 23, 2021

Time: 10:00 am to 2:00 pm

Participants: Phillip Gilks (Hatch), Dean Price (CSJ), Ed Crowley (CSJ)

Subject: Site Visit Notes

Observations

Note; Location shown in the table below (in meters) is measured from the gate at the Martinon Bypass

Location (m)	Description	Photos	Observations
300	Washout damage in past	IMG_3139.jpg – IMG_3145.jpg	Washout has occurred and been repaired. No culvert. Ditches are shallow and overgrown
700	24" concrete culvert	IMG_3146.jpg – IMG_3153.jpg	Ditches are shall. Culvert could use a headwall. Pipe is good. Fed by small stream.
1000	15" plastic culvert	IMG_3154.jpg – IMG_3158.jpg	Ditches are poorly maintained. Pipe is good
1000+	15" plastic culvert	IMG_3159.jpg – IMG_3163.jpg	Inlet is nearly plugged from grading road. Pipe is in good condition. Fed by a stream in the woods.
1100	24" concrete culvert	IMG_3164.jpg – IMG_3168.jpg	Ditches are poorly maintained. Slight back slope at upstream
1400	24" concrete culvert and 24" plastic culvert	IMG_3169.jpg – IMG_3181.jpg	Two culverts about 20 ft apart. Both fed by the same stream creating a pond at the head of the pipes. Ditches are not well maintained.
1800	24" concrete culvert	IMG_3182.jpg – IMG_3191.jpg	Fred by stream from woods. Ditches both ways need to be cleaned. Inlet is restricted
2200	No culvert	No photos	Low area with no culvert.
2500	24" concrete culvert	IMG_3192.jpg – IMG_3199.jpg	Has flooded before. Good area for beavers. Debris at the inlet.
2600	No culvert	No photos	Low area with no culvert.
2700	No culvert	IMG_3200.jpg – IMG_3207.jpg	Low area that has flooded in the past and will flood again. Culvert or ford is required.
3200	Concrete control structure		Location (chainage) provided for reference purposes only.
3300	16" Concrete Culvert	IMG_3256.jpg – IMG_3259.jpg	Culvert is almost plugged with debris.
3400	12" Concrete culvert	IMG_3260.jpg – IMG_3262.jpg	Culvert is good but needs improvements to ditching and new headwall
3500	16" concrete culvert	IMG_3264.jpg – IMG_3271.jpg	Culvert is heaved in the center with breaks near each end. Needs to be replaced.
3600	10" Iron pipe	IMG_3272.jpg – IMG_3274.jpg	No outlet visible. Set too high

3700	16” Concrete Culvert	IMG_3275.jpg – IMG_3276.jpg	Partly plugged at discharge end
3700	27” plastic culvert	IMG_3278.jpg – IMG_3281.jpg	Good condition. Ditches look OK although vegetation is substantial and should be cleared
3800	No culvert	IMG_3282.jpg	Lo area with no culvert
4000	No culvert	No picture	Low area with no culvert
4500	Saddle Dyke 1		Start of Saddle Dyke 1 (left abutment). Location (chainage) provided for reference purposes only.
4725	Saddle Dyke 2		Location (chainage) provided for reference purposes only.
4875	Saddle Dyke 3		Location (chainage) provided for reference purposes only.
5100	16” Concrete Culvert	IMG_3307.jpg – IMG_3311.jpg	Evidence of beaver activity. Debris in front of pipe
5400	16” plastic culvert	IMG_3312.jpg – IMG_3314.jpg	No issues. Ditches are satisfactory although vegetation is getting dense
6100	Hill	IMG_3317.jpg – IMG_3318.jpg	No ditches so road washes out. Construction of ditches required
6500	Hill	IMG_3319.jpg	No ditches so road washes out. Construction of ditches required. Culvert required at transmission line crossing.
8500	24” steel culvert and 16” concrete culvert	IMG_3321.jpg – IMG_3324.jpg	Water has washed over road in the past. Concrete pipe is over steel pipe. Concrete pipe may be plugged. Evidence of animal activity in pipe. Steel pipe is restricted and water is being held back. Good area for beavers.

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Prepared for

City of Saint John

New Brunswick

Draft Report

Menzies Lake Dam Safety Study

Prepared by

SGE Acres Limited

November 2003

P15039.00

SGE Acres

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Introduction

1 Introduction

1.1 Scope of Work

On December 7, 2001, the City of Saint John first requested Acres International to undertake preliminary investigations for a dam safety review of the earth and concrete structures on Menzies Lake in the Ludgate/Spruce Lake Watershed. The work was ultimately carried out in three phases over a period of approximately 2 years. This report is a compilation of the work undertaken as part of this overall dam safety assessment.

The overall scope of work for such a dam safety review is outlined in Section 2 of the Canadian Dam Association's *Dam Safety Guidelines* (1999) as follows:

The Review shall include the design, operation, maintenance, surveillance and emergency plans, to determine if they are safe in all respects, and, if they are not, to determine required safety improvements.

The Scope of Work for each of the three phases of the assessment is outlined below.

Phase 1

- Visits to the site by the assessment team
- Survey of the fill structures
- Preparation of specifications for the geotechnical investigation program
- Hydrotechnical analysis of spillway capacity and freeboard adequacy

Phase 2

- Inspection of the concrete control structure
- Geotechnical investigations of the saddle dykes and control structure
- Initiate stability analyses for both the earth and concrete structures
- Document potential dam safety concerns for saddle dykes and control structure

Phase 3

- Complete stability analysis for both the earth and concrete structures
- Assess concerns and prepare recommendations
- Compile results of all phases into overall dam safety report

Phase 1 of the study was completed and the draft report was issued in March 2002. Phase 2 of the study was completed in October 2002 with the completion of the site inspection and field investigation.

1.2 System Description and Background Information

Menzies Lake is located near Saint John, New Brunswick. The catchment area draining into the lake is approximately 3.6 km^2 and prior to the construction of the structures the flow was carried in Menzies Stream which ultimately drained into the Musquash River at Prince of Wales. The Menzies Lake structures include a concrete control structure and 3 earth-fill saddle dykes. The control structure was constructed in 1973 and consists of four concrete box culverts fitted with stop logs, with earth abutments and concrete wing walls both upstream and down. The structure is approximately 4 m high and 14 m long. It replaced an earlier dam which was constructed just upstream of the present location.

The Menzies Lake structures are located along the Menzies Lake Road which is accessible from the weigh scale site about 3-4 km northwest of Saint John West, southbound on Highway 7. Menzies Lake Road is a one-lane, all-weather road which passes over the top of the control structure and saddle dykes. As such they are graded yearly, and plowed regularly during the winter months.

The Menzies Lake area is underlain by faintly weathered, strong, Precambrian sedimentary rocks of the Martinon Formation comprising gray to black siltstone and greywacke, minor marble breccia/conglomerate and calcareous quartzite. In the area of the concrete control structure, it appears to be dipping steeply to the southeast. The bedrock appears to control the topography of a rolling and ridged surface. The depressions on the bedrock surface are covered by a veneer or blanket of thin basal till that is generally 0.4-2 m thick.

The purpose of the structures is to block the original flow path via Menzies Stream (main saddle dyke) and control for the level of the water in Menzies Lake (concrete control structure). Menzies Lake provides emergency water supply storage for the west side of Saint John. The lake is generally full, and the stoplogs are rarely removed. Any water pumped from the Musquash system to supplement the supply from the Spruce Lake drainage area is pumped from East Musquash to Menzies Lake and then flows by gravity to Spruce Lake.

Figure 1.1 is a general project location map showing the layout of the drainage system and the structures near Menzies Lake. The arrangement of the saddle dams and control structure is given in the following figures

- Figure 1.2 – Control Structure General Location Plan
- Figure 1.3 - Saddle Dyke General Location Plan
- Figure 1.4 – Saddle Dyke 1 – Plan, Profile and Section
- Figure 1.5 – Saddle Dyke 2 – Plan, Profile and Section
- Figure 1.6 – Saddle Dyke 3 – Plan, Profile and Section

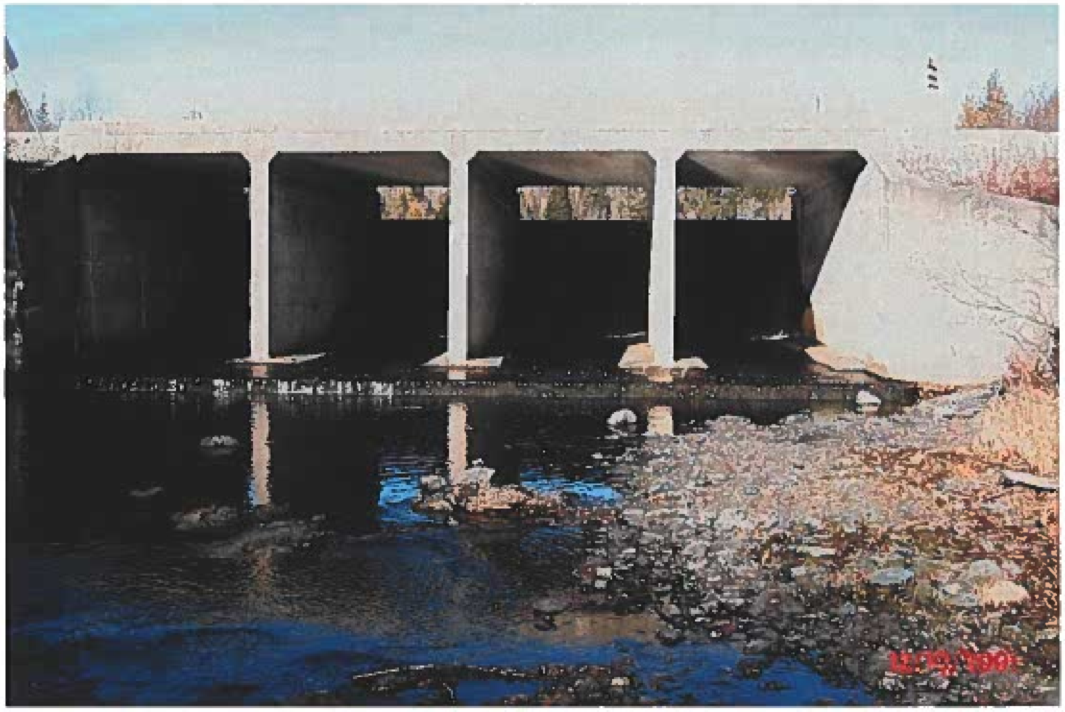
The saddle dykes are located north of the control structure along Menzies Lake Road. The main dyke is approximately 100 m long and a maximum of 6 m high. The other dykes are smaller, with approximate lengths of 30 m and 25 m. For the purposes of this review, the main dyke has been called Saddle Dyke 1, and the others Saddle Dyke 2 and Saddle Dyke 3, as shown on Figure 1.2. Although work was done on the saddle dykes in the 1970s, it appears that there have been structures at those locations since 1937. The concrete control structure is approximately 14 m in length excluding the wing walls.

1.3 Structure Inventory

The basic information of the Menzies Lake structure including a photograph and a summary of relevant information is given in the following inventory sheets.

Menzies Lake Dam Inventory

Concrete Control Structure



Menzies Lake Control Structure Looking from Downstream

Date of Construction:	1973
Dam Type:	Concrete gravity
Dam Height:	4.3 m (14 ft)
Dam Length:	13.7 m (45 ft) excluding wing walls
Abutments:	Concrete on bedrock
Spillway type:	4-bay sluiceway
Sluiceway Control:	Stoplogs
Sluiceway Length:	13.7 m (45 ft) including end walls
Other Outlets:	None
Drainage Area:	3.6 km^2
Elevations:	
Top of Dam:	76.5 m (251 ft) Top of roadway
Top of Dam:	76.8 m (252 ft) Top of curb
Sluiceway Invert:	73.1 m (239.8 ft)
Dam Foundations:	72.8 m (238.8 ft) approximately

Concrete Control Structure (continued)

Major Works:	No major repairs since construction
Drawings Available:	No. 7006-35 (Box Culvert – Site Plan and Approaches Miscellaneous Details, Eastern Designers and Company Ltd. April 1971) No. 7006-36 (Box Culvert – Concrete and Reinforcing Details Eastern Designers and Company Ltd. April 1971)

Saddle Dykes

Saddle Dyke 1

Date of Construction: 1973
Drainage Area: 3.6 km^2

Saddle Dyke 1

Dam Type: Homogenous Earthfill
Dam Height: 5 m (16.4 ft)
Dam Length: 100 m (328 ft)
Elevations:
- Top of Dam: 77.25 m (253.4 ft) minimum centreline elevation
- Dam Foundations: 72.3 m (237.2 ft) approximately

Saddle Dykes (continued)

Saddle Dyke 2

Dam Type:	Homogenous Earthfill
Dam Height:	3.5 m (11.5 ft)
Dam Length:	30 m (98.4 ft)
Elevations:	
Top of Dam:	76.63 m (251.4 ft) minimum centreline elevation
Dam Foundations:	73 m (239.5 ft) approximately

Saddle Dyke 3

Dam Type:	Homogenous Earthfill
Dam Height:	1.5 m (5 ft)
Dam Length:	25 m (82 ft)
Elevations:	
Top of Dam:	77.56 m (254.5 ft) minimum centreline elevation
Dam Foundations:	76 m (249 ft) approximately

Major Works:	Work was done on the saddle dykes in the 1970s and there appears to have been structures at this location since 1937
Drawings Available:	One drawing from 1937 showing Saddle Dyke 1

NOTES

1. TOPOGRAPHICAL SOURCE MAP IS MUSQUASH NTS 21G/1, ENERGY MINES AND RESOURCES CANADA, 4th. EDITION.
2. MODIFICATIONS TO THE ROADS AND HIGHWAYS SINCE 1989 ARE NOT SHOWN.

0 1 2 3 4 5 Km

Scale : N.T.S.

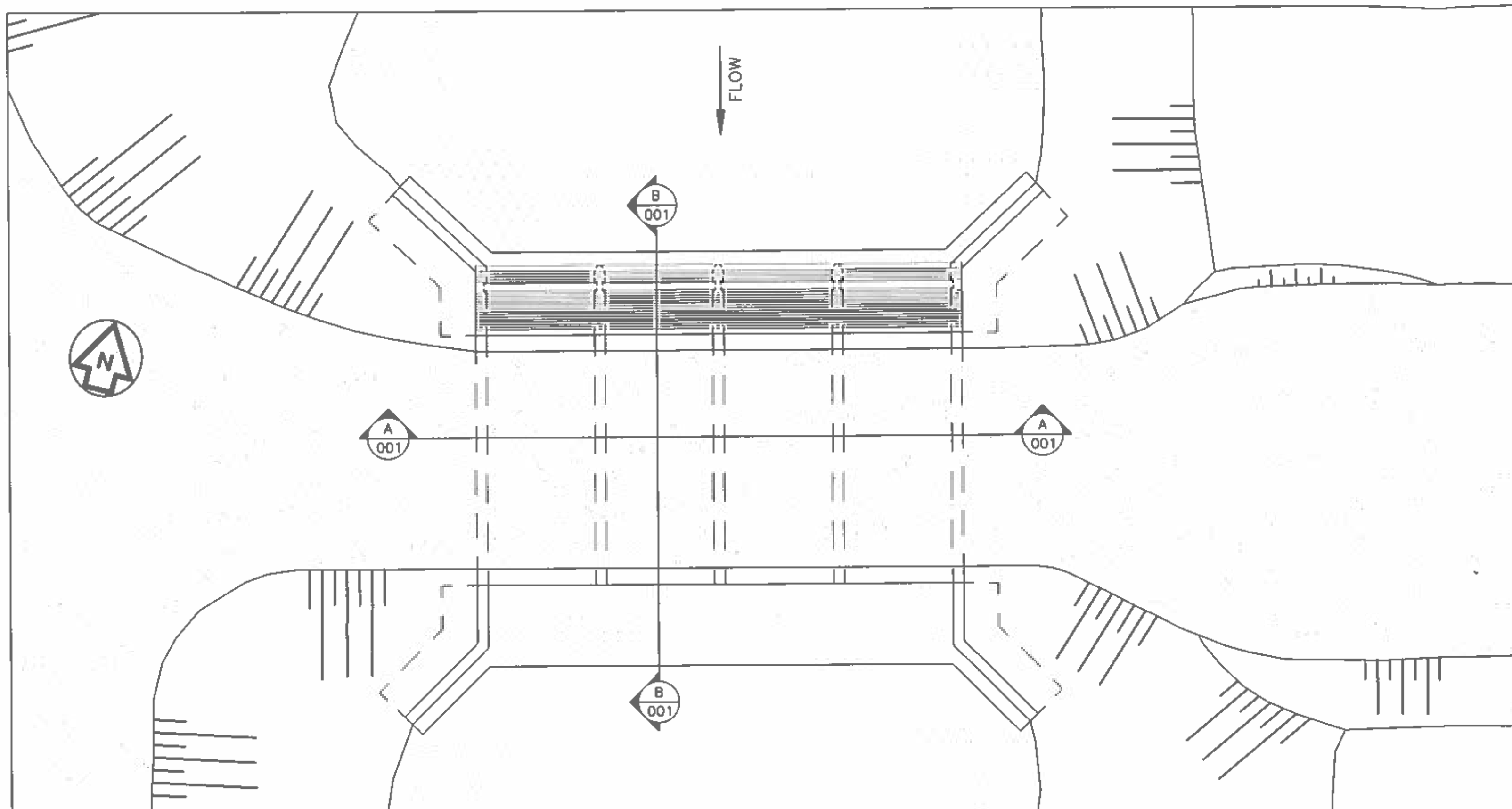
FIG 1.1

SGE Acres

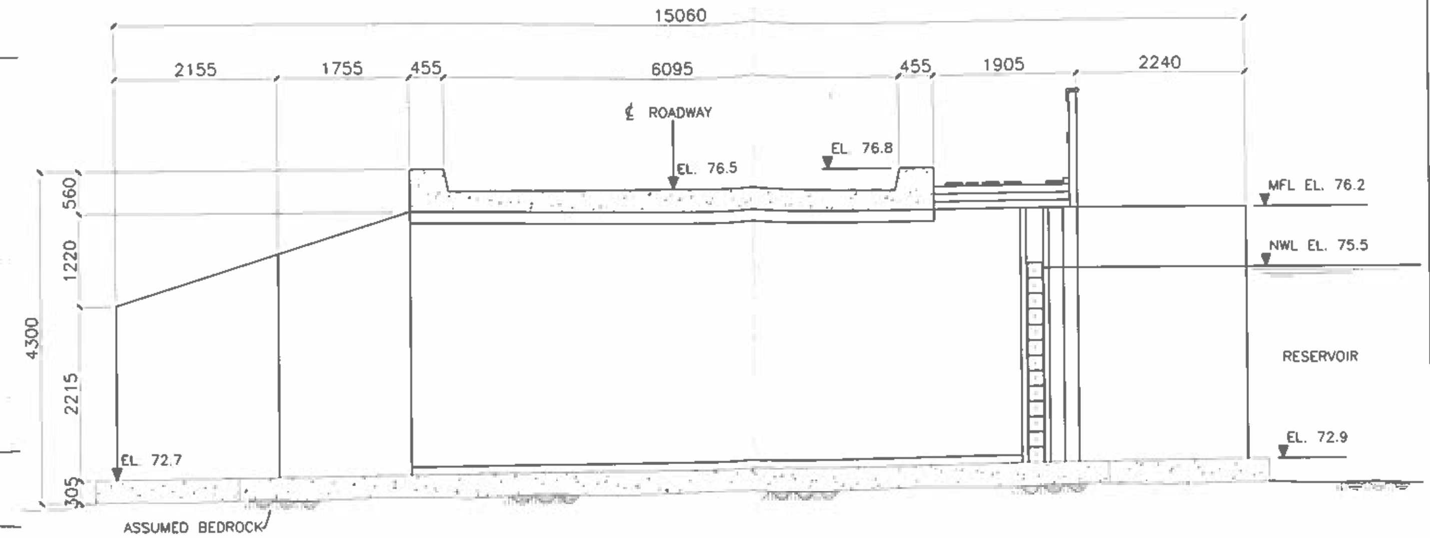
CITY OF SAINT JOHN

MENZIES LAKE DAM SAFETY REVIEW

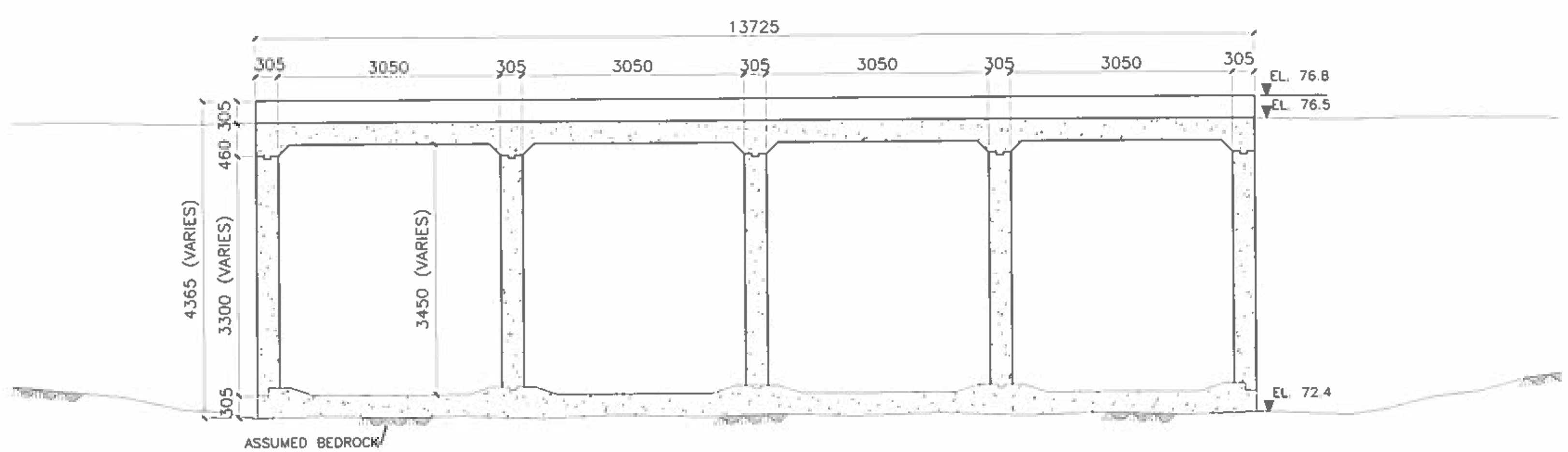
MENZIES LAKE GENERAL LAYOUT



PLAN
SCALE 1:200



B SECTION 001
SCALE 1:100



A SECTION – LOOKING UPSTREAM 001
SCALE 1:100

LEGEND:

NWL	NORMAL WATER LEVEL
MFL	MAXIMUM FLOOD LEVEL
	ASSUMED BEDROCK SURFACE
	WATER
	ROADWAY

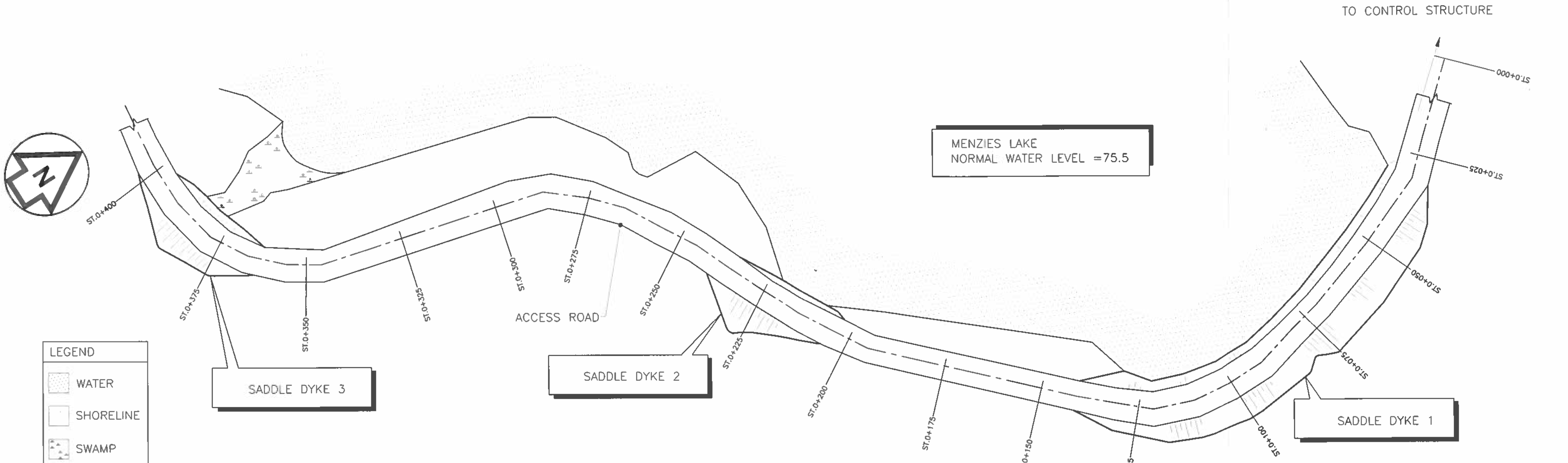
NOTE:

1. ALL ELEVATIONS ARE IN METRES AND DISTANCES IN MILLIMETRES.

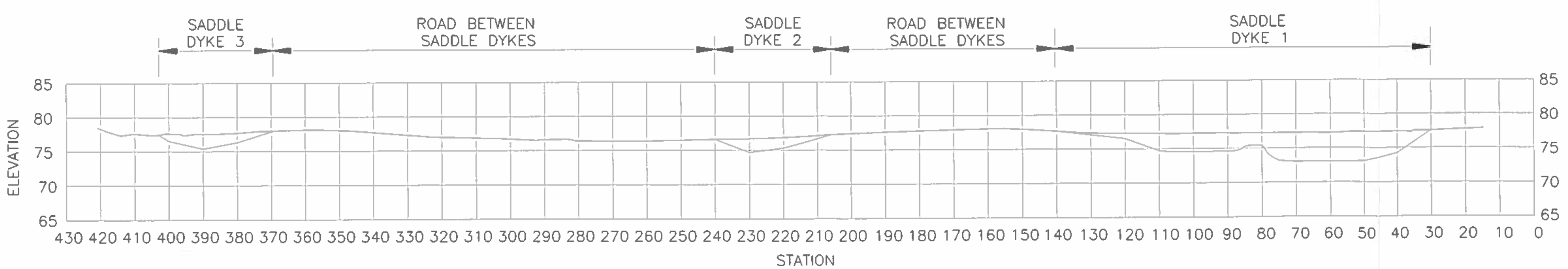
CITY OF SAINT JOHN
MENZIES LAKE DAM SAFETY REVIEW
CONCRETE STRUCTURE GENERAL LOCATION

FIG 1.2

SGE Acres



PLAN—GENERAL LOCATION
SCALE 1:1000



CENTRELINE PROFILE
SCALE H = 1500
V = 750

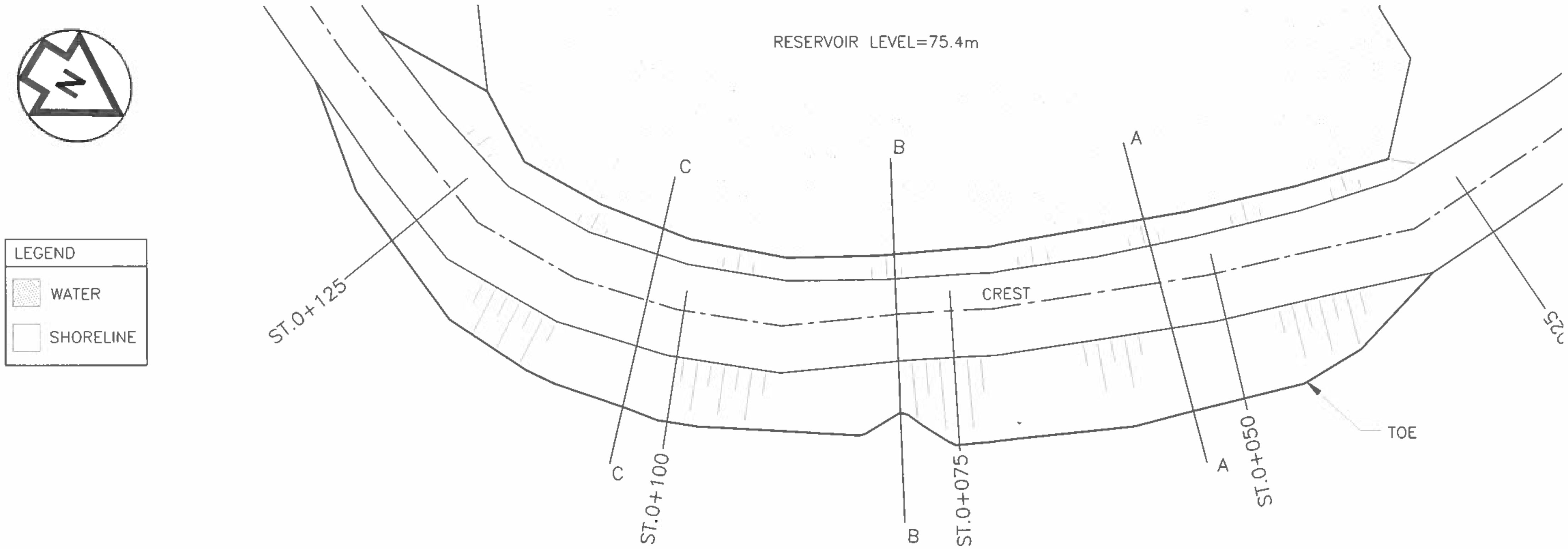
NOTE:

1. ALL ELEVATIONS AND STATIONS MEASURED IN METRES.

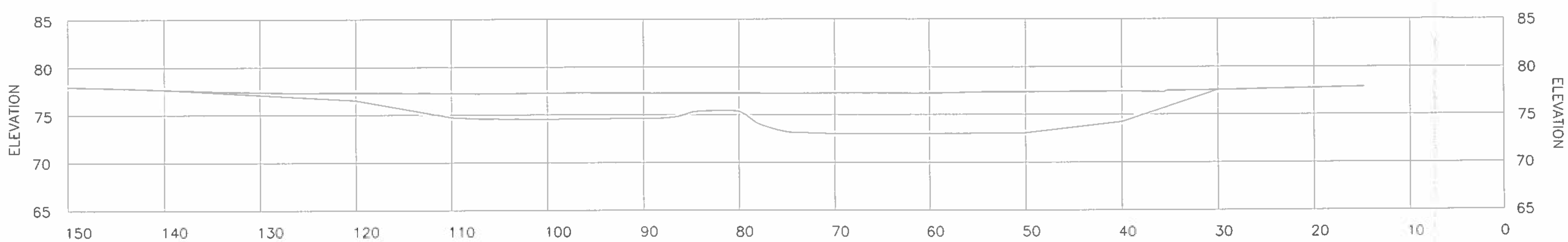
FIG 1.3

CITY OF SAINT JOHN
MENZIES LAKE DAM SAFETY REVIEW
SADDLE DYKE GENERAL LOCATION

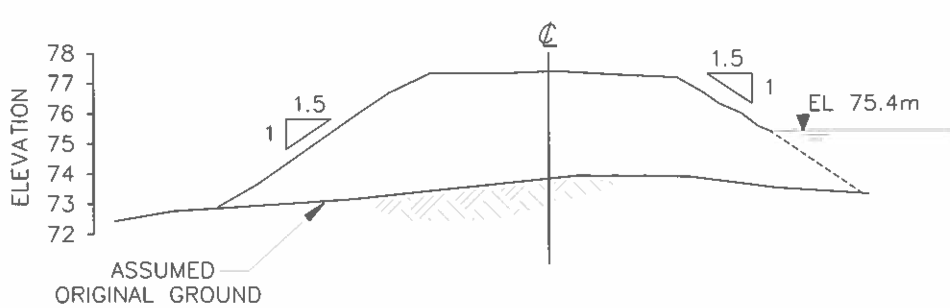
SGE Acres



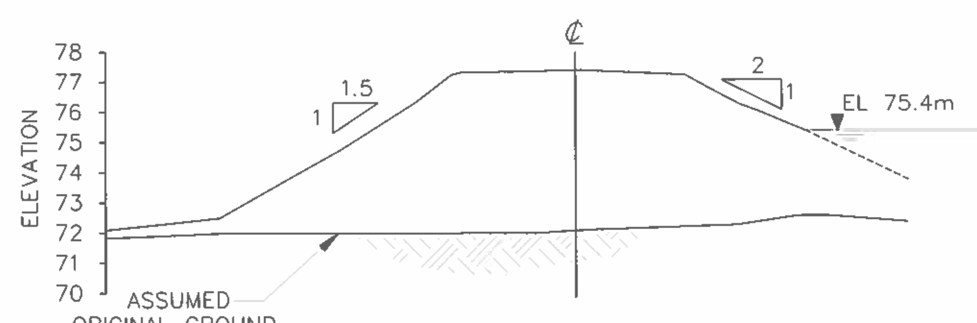
PLAN VIEW
SCALE 1:500



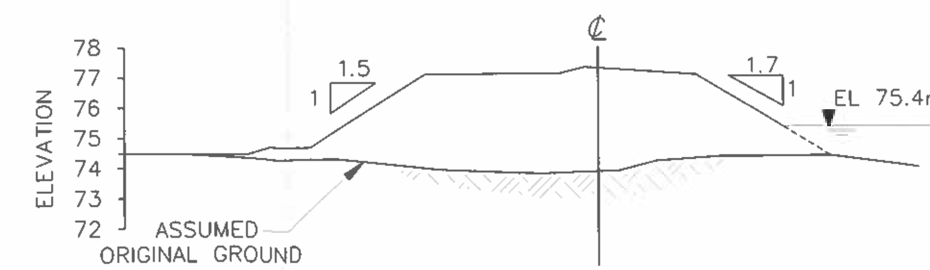
LONGITUDINAL PROFILE
SCALE 1:500



SECTION A
SCALE 1:250



SECTION B
SCALE 1:250



SECTION C
SCALE 1:250

TABLE OF ELEVATIONS
SADDLE DYKE 1 CENTRELINE

STATION (m)	ELEVATION (m)
0+030	77.56
0+040	77.43
0+050	77.38
0+060	77.25
0+070	77.26
0+080	77.27
0+090	77.29
0+100	77.28
0+110	77.27
0+120	77.34
0+130	77.39
0+140	77.69

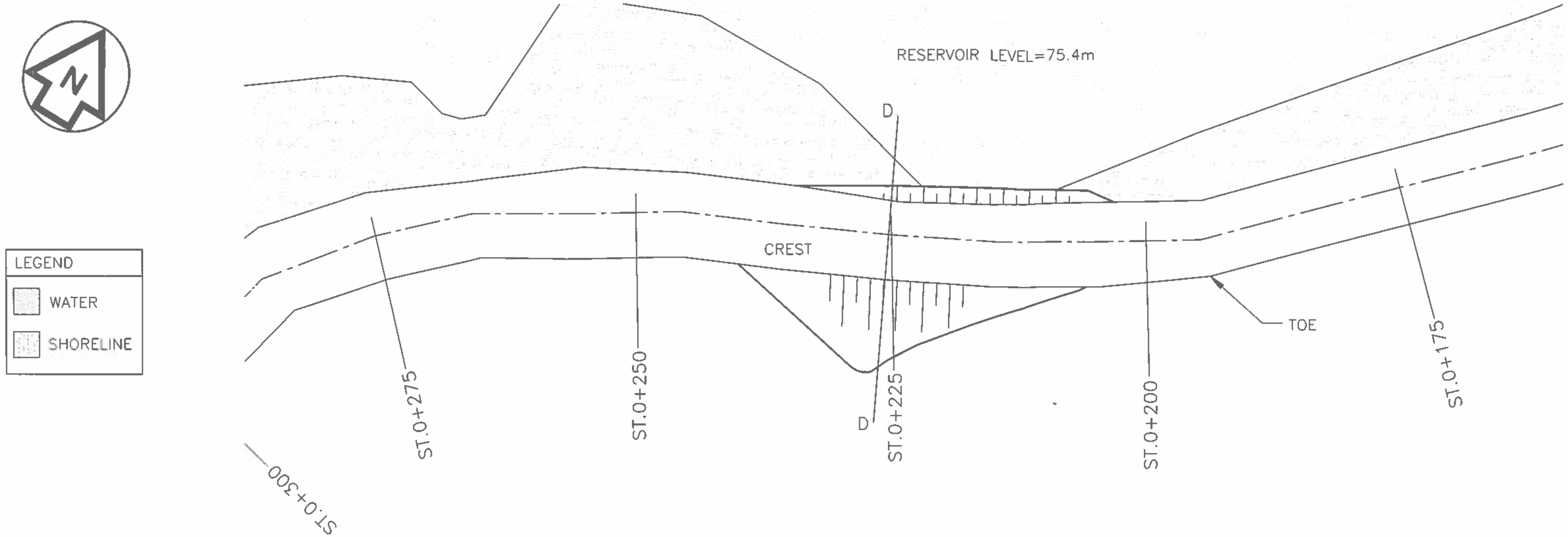
NOTE:

1. ALL ELEVATIONS AND STATIONS MEASURED IN METRES.

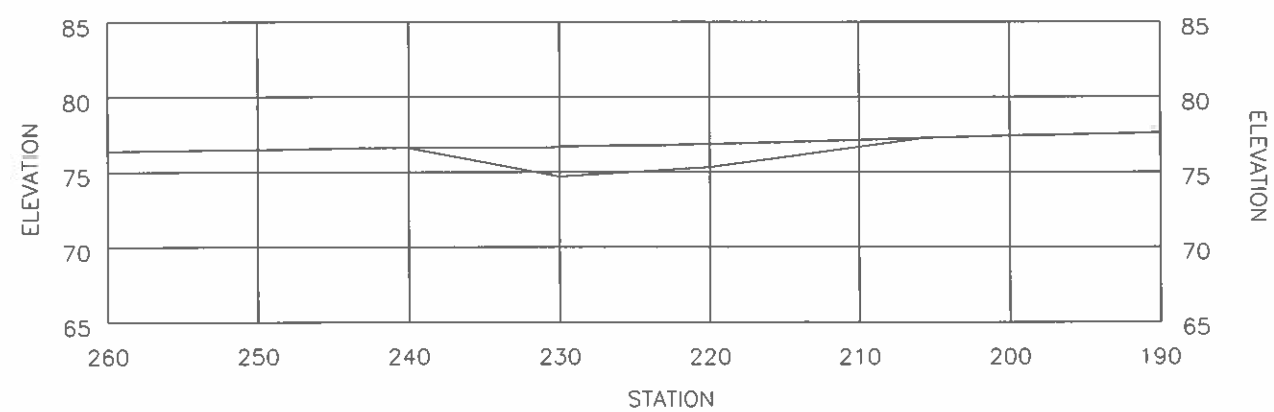
FIG 1.4

CITY OF SAINT JOHN
MENZIES LAKE DAM SAFETY REVIEW
SADDLE DYKE 1

SGE Acres

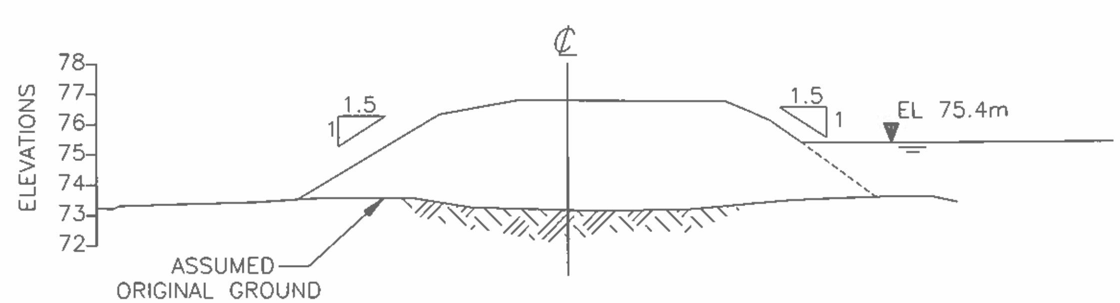


PLAN VIEW
SCALE 1:500



LONGITUDINAL PROFILE
SCALE 1:500

TABLE OF ELEVATIONS SADDLE DYKE 2 CENTRELINE	
STATION (m)	ELEVATION (m)
0+210	77.14
0+220	76.87
0+230	76.70
0+240	76.63



SECTION D
SCALE 1:250

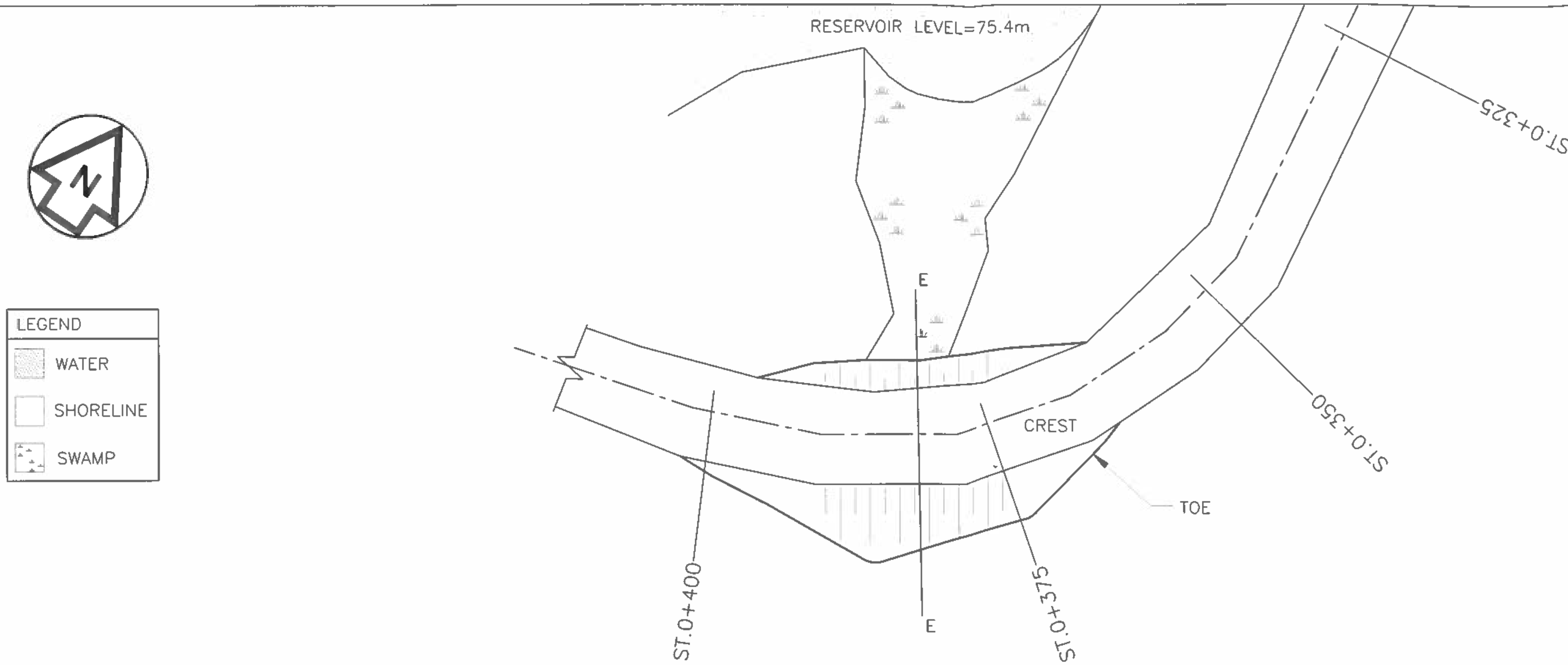
NOTE:

1. ALL ELEVATIONS AND STATIONS MEASURED IN METRES.

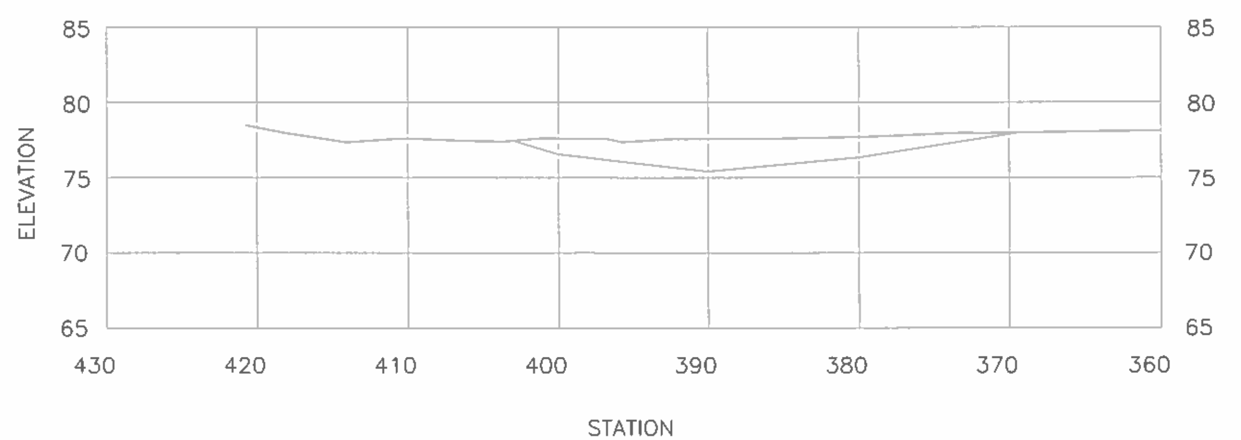
CITY OF SAINT JOHN
MENZIES LAKE DAM SAFETY REVIEW
SADDLE DYKE 2

FIG 1.5

SGE Acres

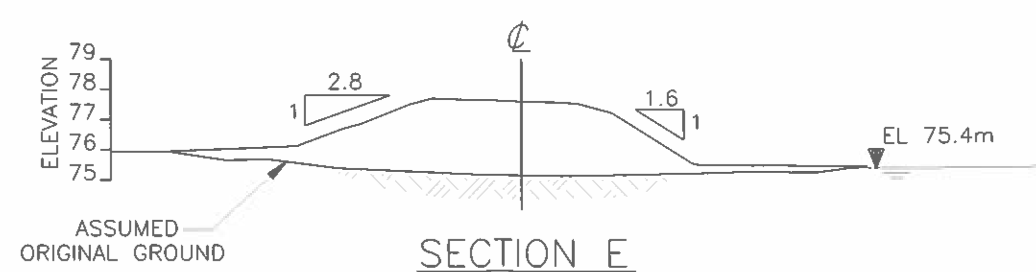


PLAN VIEW
SCALE 1:500



LONGITUDINAL PROFILE
SCALE 1:500

TABLE OF ELEVATIONS SADDLE DYKE 3 CENTRELINE	
STATION (m)	ELEVATION (m)
0+375	77.89
0+380	77.70
0+390	77.56
0+400	77.60
0+410	77.58
0+415	77.48



SECTION E
SCALE 1:250

NOTE:

1. ALL ELEVATIONS AND STATIONS MEASURED IN METRES.

CITY OF SAINT JOHN
MENZIES LAKE DAM SAFETY REVIEW
SADDLE DYKE 3

FIG 1.6

SGE Acres

Site Visit and Investigations

2 Site Visit and Investigations

2.1 Site Inspection

The dam and its surroundings were inspected on October 12, 2001 by Ms Joanna Barnard, Mr Greg Snyder and Mr. Sean Hinchberger. Copies of the site photographs can be found in Appendix A.

The water level in the reservoir during the inspection was approximately 1.8 m below the top Saddle Dyke 1 which translates into an elevation of 75.4 m approximately.

The inspection of the saddle dykes concentrated on Saddle Dyke 1 since it is of a significant height and length. The crest and upstream face of this dyke was found to be in reasonable condition but the downstream face was in relatively poor condition. Concentrated seepages were noticed at several locations at the toe of the dyke with a total volume of 5 to 10 l/s. Saddle Dykes 2 and 3 are low (< 3 m) and appear to be in relatively good condition with no signs of instability or significant seepage.

The concrete control structure was visually inspected as part of this site visit and the civil inspection report is given in Appendix B. A separate underwater inspection of the upstream area and a geotechnical investigations of the deck and abutments were also undertaken at this structure. Overall, the structure was found to be in good condition, as discussed in Section 3.

2.2 Underwater Inspection

An underwater inspection of the Menzies Lake control structure was performed on October 30, 2002 by JorDive Limited of Rothesay under the direction of SGE Acres. The inspection was conducted using a video camera attached to a pole of sufficient length to reach the apron level of the structure (about 5 m); the output was connected to a video tape recorder and was monitored on a TV screen during the inspection.

The inspection proceeded from the end of the right wing wall to the end of the left wing wall, including the apron, stoplogs, stoplog gains and pier noses. Results of the inspection are discussed in Section 3.

2.3 Surveys

A topographic survey of the Menzies saddle dykes was carried out on December 10 and 11, 2001. The survey was required to determine the crest heights and layouts of the structures and to provide information for preparing preliminary drawings since there were no current drawings available of the saddle dykes.

The survey used water level transfer to tie the elevations into the datum used at the concrete discharge structure. The water level at the time of the survey was 75.4 m (247.3 ft), as indicated on the water level gauge at the discharge structure.

Preliminary sketches were developed from the survey data as shown in Figures 1.2 to 1.6.

2.4 Site Investigation

Site investigations were carried out at the earth and concrete structures on Menzies Lake in the Ludgate/Spruce Lake Watershed as part of Phase 2 of the current study.

The main objective of the investigations was to obtain information required for the dam safety assessment. The scope of the investigations included:

- geotechnical investigations at the earth saddle dykes
- geotechnical investigation of the earth fill abutments to the concrete control structure and
- coring of the concrete control structure

The site investigations of the Saddle Dykes 1, 2, and 3 took place in September, 2002. These investigations were supervised by SGE Acres Limited and consisted of the following:

- test pits at Saddle Dyke 1 in search of the 1 m wide core wall indicated on the 1937 drawing.
- drilling of boreholes in Saddle Dykes 1 and 2
- installation of standpipe piezometers in the boreholes and subsequent monitoring of the water level

- variable hydraulic head testing in several piezometers
- drilling of probe holes at each of the saddle dykes
- measurement of the standing water level in each of the probe holes
- laboratory testing of the overburden samples

The site investigations of the Concrete Control Structure took place in September and October, 2002. These investigations were supervised by SGE Acres and consisted of the following:

- test pits at each abutment to expose and inspect the concrete surface of the structure
- drilling of probe holes at each abutment
- measurement of the standing water level in each of the probe holes
- taking concrete core samples of the concrete structure
- inspection of the concrete structure, both upstream and downstream.

Location and elevation of test pits, boreholes, and probe holes were surveyed by Desaulniers Surveys Inc. of Grand Bay – Westfield, New Brunswick.

Appendix B provides details on the scope of the site investigations. Photographs taken during the site investigations are included in Appendix A. Section 6 presents a preliminary engineering evaluation of the earth fill dykes and abutments based on this information from the site investigation.

Condition Assessment

3 Condition Assessment

Reference should be made to Appendix A for a set of photographs taken during the site visits.

3.1 Control Structure

The concrete control structure was found to be in good condition overall with some cracking on the downstream side. The condition of the concrete was found to be generally good with surface roughened in areas exposed to flowing water. There was some minor leakage through the stop logs. The abutment fill on both sides of the dam exhibited leakage at the toe adjacent to the downstream wing walls.

In general, the structure appears to be without any obvious signs of instability or relative displacement of individual components.

3.1.1 Upstream Area

The dive inspection found that there was debris, consisting of sand, gravel, sticks and some cobbles on the bottom against the structure, which made viewing of the bottom interface difficult. Algal growth was present over most of the concrete and the stoplog gains, this made viewing of finer details difficult.

The concrete generally appeared smooth and free of defects. There was no cracking or spalling apparent. Construction joints were observed to be tight and in good condition. The upstream edge of the apron was sharp for the whole length, with no apparent damage. The bottom interface upstream of the apron was not visible due to debris. The vertical upstream face of the apron was visible to a depth of 300 mm below the edge and was in good condition. There was no undercutting or concrete damage visible.

The stoplog gains in all bays appeared to be in good condition. Corrosion of the steel gains was visible, but this was not excessive. The bottom of the sill could not be inspected due to presence of debris – mostly sticks and twigs. This layer appeared to be about 100 mm thick.

The concrete of the pier noses and wing wall also appeared to be in good condition, all joints were tight, and there was no observable damage, cracking or spalling. At the waterline, the concrete surface was roughened with the aggregate being exposed. There was no evidence of freeze-thaw damage at the waterline.

3.1.2 Downstream Area

The concrete of the downstream area of the control structure, including the deck, slab, wing walls, piers and end walls all appeared to be in good overall condition.

All construction joints were observed to be tight with no sign of damage or displacement. The concrete was generally smooth, with minor roughening of the surface in area of flowage. The roughening was observed close to the stoplogs, and on the base slab, most noticeably in the area downstream of the piers. The roughening would be caused by freeze-thaw and erosion from the flowing water. It is not excessive and therefore not a concern.

There has been some minor cracking in end walls downstream of the stop log and on the downstream wing walls. These cracks exhibit calcite deposits but they are all tight, with no displacement across the cracks apparent, and are therefore not a concern at this time. The cracks should be monitored on an annual basis and any changes to their condition noted. These cracks can be seen in the photographs in Appendix A.

As part of the geotechnical investigations, three concrete cores were taken on the concrete deck of the control structure. At that time, the fill was removed from the deck to allow inspection of the surface. The surface appeared smooth and sound, with no signs of damage. The cores taken showed the concrete to be in good condition for the full height of the core, with no signs of interior cracking or deterioration.

3.1.3 Abutment Area

The earth abutments of the concrete control structure are part of the Menzies Lake access road which crosses the concrete structure at this point. The earthfill is retained by wing walls, and protected by riprap on the upstream side. The abutments are approximately 9 m (30 ft) long with a maximum height of 3.7 m (12 ft) adjacent to the control structure end walls.

The crest width of the abutments is approximately 7 m (23 ft) and was observed to be in good condition, with no indications of cracking or settlement. The upstream and downstream slopes of the abutments have gradients of approximately 2H:1V and were observed to be in relatively good condition, but are heavily vegetated with bushes and trees. This made observation of the downstream toe area difficult.

Leakage was observed at the downstream of both the left and right abutment in the area of the interface with the downstream wing walls. The leakage was relatively concentrated and appeared to be in the order of 1 l/s. There was no evidence of material being carried by this flow.

3.2 Saddle Dyke 1

The main dyke is an earth- and rock-fill embankment with a maximum height of about 6 m and a length of about 100 m. The structure is a saddle dyke for Menzies Lake and also serves as a road embankment for Menzies Lake Road. An old drawing shows a 1 m core wall, but the nature and condition of the core-wall are unknown. Testpits dug in the crest as part of the geotechnical investigations failed to find evidence of the core wall. Bedrock outcrops form both left and right abutments. The structure straddles two topographic lows (or saddles) located at about Station 0+065 m and 0+095 m. The saddles are separated by a topographic high at Station 0+080 m where the embankment is about 2.5 m high.

3.2.1 Crest

As noted above, the crest of the dykes comprises Menzies Lake Road. The crest is well maintained and free of significant settlement and rutting. Crest alignment was found to be satisfactory and there is no evidence of longitudinal or transverse cracking.

3.2.2 Upstream Slope

At the time of the site inspection, the reservoir level was about 1.8 m below the top of the dyke. As such, detailed inspection of the upstream slope was not possible since most of the slope was below water. However, the upper portion of the slope was found to be in relatively good condition with a slope gradient of between 1.5H:1V and 2.5H:1V.

The slope above the waterline has significant growth of brush in the rip rap, and the rip rap appears to be covered with material from road grading in places. This made detailed observation of the rip rap condition difficult, but it appears that there is some rip rap displacement which will require redressing. This area should be inspected again once the area has been cleared of vegetation. The observable portions of the rip rap just at the water line appeared to be in good condition.

3.2.3 Abutment Areas

The abutments comprise bedrock out-crops located at either end of the structure. The downstream right abutment groin was generally dry and there was no evidence of significant end-run leakage at this end of the structure. On the left end of the structure, a concentrated seep was observed issuing from the downstream abutment groin near the toe of the dyke. The seepage was clear with some evidence of iron deposition just downstream of the dyke groin. Seepage from the lower left abutment was in the order of 1 to 2 l/s.

In general, the abutment areas are in good condition.

3.2.4 Downstream Slope

The downstream slope of the main dyke is covered with relatively mature trees. The trees vary in height from about 3 to 6 m. The growth of mature trees on the downstream slope of earth-fill dykes can lead to localization of flow and dam failure.

The downstream slope of the structure is in fair to poor condition. There were several small sloughs found near the toe of the slope. In particular, there is sloughing at the toe of the dyke between Station 0+042 and 0+045. Between Stations 0+45 and 0+70, the downstream slope gradient is variable. The average slope is about 2H:1V; however, there are numerous areas with a slope gradient of about 1.5H:1V to 1.8H:1V. The local variations of slope may be due to erosion or sloughing. The tree cover appears to be improving surficial and local stability.

The upper portion of the downstream slope is relatively steep in the order of 1.2H:1V to 1.5H:1V. Overall, the downstream slope exhibits some signs of minor surficial instability due to the steep slope angle and the occasional concentrated seep discussed below.

3.2.5 Seepage

At the time of inspection, there were several concentrated seeps issuing from the downstream toe of the dyke between Station 0+045 and 0+070. At Station 0+045, seepage was observed issuing from a spring at the toe of the dyke at a rate of about 1 l/s. As noted above, there is a small slough at the downstream toe between Station 0+042 and 0+045. The toe of the dyke was very wet between Station 0+045 and 0+056 m and between Station 0+064 and 0+070 m. Drainage from these areas is poor and the depth of freestanding water is 0.3 to 0.6 m. There were four to five concentrated seeps or springs observed between Stations 0+064 and 0+070 m. Total flow from the springs was in the order of 2 l/s. From Station 0+073 m to 0+110 m, the toe of the dyke was found to be dry to damp with no signs of significant leakage from the reservoir.

Overall leakage from the structure is moderate with several zones of concentrated seeps or springs. The cumulative leakage is roughly estimated at between 5 to 10 l/s.

3.3 Saddle Dyke 2 and 3

The secondary saddle dykes are generally less than 3 m in height. Both structures appear to be in relatively good condition and there is no sign of significant instability or seepage. As noted above, the crest of the dykes comprises Menzies Lake Road. The crest is well maintained and free of significant settlement and rutting, with no evidence of longitudinal or transverse cracking.

Both dykes are vegetated with brush on both the upstream and downstream slopes. Detailed observation of the condition of the slopes was therefore difficult. Minor seepage was observed at both structures near the centre of the dykes, with some dampness in the area immediately downstream of the toes.

The rip rap on the upstream slope was vegetated, and the upper portions were choked with material from road grading. The observable rip rap at the water line appeared to be in good condition. The reservoir area just upstream of these dykes is very shallow and it is not known if this is from accumulation of material, or related to the original construction.

3.4 Summary of Concerns

The concrete control structure appears to be in satisfactory conditions with minor cracks in the end walls but some concentrated leakage was observed near the downstream wing walls. There has been no monitoring of the structure and therefore no historical information on volume of leakage. Riprap on the abutments should be examined after removal of brush.

Overall, the three Menzies Lake saddle dykes appear to be in satisfactory condition. Mature trees on the downstream slope of the main dyke and the moderate rate of leakage is cause for some concern. It is understood that the structures have performed well since construction. However, there is no monitoring data for the dykes and consequently, it is not possible to determine if the leakage has been stable since construction or if the leakage is caused by degradation of the structure.

The downstream slope of the main dyke is steeper than desired for a water retention dyke. The crest, however, is relatively wide and the overall embankment is fairly massive given the operating head. Instability of the downstream slope is not likely to cause loss of reservoir due to the relative size of the embankment and its dual use as a roadway. The main geotechnical risk is associated with the foundation leakage and potential piping of foundation materials which may lead to dam failure.

Hydrotechnical Analysis

4 Hydrotechnical Analysis

4.1 Preliminary Consequence Assessment and Inflow Design Flood

4.1.1 Background

The CDA Dam Safety Guidelines are consequence based, i.e., the criteria to use in designing or assessing a dam are dependent on the consequences of failure of the structure. Two types of consequences are considered:

- life safety consequences,
- socioeconomic, financial and environmental consequences.

The latter include losses due to physical damage to structures but also less tangible losses including reduced property values, loss of fish habitat, and loss of recreational opportunities in the watershed. The level of consequences determines what inflow design flood (IDF) and other design events are used for analysis of the structure.

The CDA Guidelines also state that the evaluation of consequences should include inundation studies and should consider existing and anticipated future land use downstream of the dam. It should be noted that the consequence classification is generally independent of the condition of the dam. The consequences are assessed based on what would happen if the dam failed, however improbable that event may be.

The classification system considers only incremental consequences, i.e. only those directly relating to the loss of the dam in question. Damages that would have occurred as a result of a flood event without dam failure are not included in the assessment. Table 1-1 of the CDA Guidelines, which defines the classification system, is included as Appendix C.

A simplified and conservative analysis can be done to make a preliminary assessment. If this analysis demonstrates a potential hazard, a more sophisticated analysis should be undertaken, such as a dam breach analysis that incorporates hydraulic modeling. For the purpose of this study, a simplified assessment was carried out to arrive at a preliminary consequence category and a preliminary selection of the IDF.

4.1.2 Consequence of Failure

A review of the likely consequences of failure of any of the structures at Menzies Lake was undertaken in order to select appropriate design floods for the hydrotechnical analysis.

If the control structure breached, Menzies Lake would be released into Ludgate/Spruce Lake. The channel between the two lakes is only 500 m long, and the area is uninhabited so loss of life is unlikely. The flood would cause damage to the dirt road that crosses the control structure and could damage the transmission line that crosses the channel about 250 m downstream of the dam. As discussed in a later section, the volume of live storage in Menzies Lake is not precisely known but is estimated at 1.5 million m^3, which is unlikely to raise the level of Spruce Lake sufficiently to cause a cascade failure. Spruce Lake Dam is rated as a Low Consequence Category structure.

If one or more of the earth saddle dykes were to fail, the reservoir volume would be released to the original discharge channel, Menzies Stream. The flood path would cross transmission line routes from Coleson Cove several times and would cross Highway 1 just upstream of the towns of Prince of Wales and Five Fathom Hole. About 2 km downstream of the dam the flood plain widens out considerably, which would lead to attenuation of the flood wave. Loss of life in either of the communities is unlikely.

4.1.3 Consequence Categories

Loss of the reservoir would have some socioeconomic, financial and environmental consequences, including the loss of the emergency water supply for Saint John and the financial costs to rebuild. Menzies Lake, therefore, has been tentatively categorized as a Low Consequence structure, but design criteria at the upper end of the range given in the Dam Safety Guidelines for Low Consequence structures were considered for design and dam safety evaluations, as they were for Spruce Lake Dam.

4.1.4 Selection of Inflow Design Flood

Under the CDA Guidelines, the criteria for a Low Consequence Category dams is an IDF in the range of 1/100 to 1/1000 annual exceedance probability (AEP). An IDF with an AEP 1/1000 event was selected as this is at the upper end of the range suggested by CDA.

4.2 Estimates of Design Floods

4.2.1 Flood Peak Estimates

Data from an Environment Canada hydrometric gauge on the Lepreau River at Lepreau (#01AQ001) were used as a basis for estimating approximate inflows into Menzies Lake for various return periods. Data from Lepreau River was previously used for the Musquash studies for DNRE and for Spruce Lake studies for the City of Saint John, therefore some of the analysis was already available. A comparison of the Lepreau River record and the short term record on the Little Lepreau River showed that the magnitude of the floods relative to basin size were similar, so prorating flood peaks from the Lepreau River based on drainage area is considered to be sufficiently accurate for this type of study.

Frequency analyses to develop estimates of floods with annual exceedance probabilities between 1/2 and 1/10 000 for the Lepreau River were done for the Musquash System. Table 4.1 shows the results. These values were prorated by drainage area to estimate potential flood magnitudes at Menzies Lake.

Table 4.1
Flood Frequency Analysis

Flood Annual Exceedance Probability	Lepreau River Annual Flood Peak (m^3/s)	Equivalent Menzies Lake Annual Flood Peak (m^3/s)
1/2	78	1
1/5	119	2
1/10	157	2
1/50	290	4
1/100	376	5
1/200	486	7
1/1 000	884	12
1/10 000	2078	28

4.2.2 Development of Flood Hydrograph

The shape of the flood hydrograph was also obtained from data on the Lepreau River. Hourly data were obtained for several of the largest floods on record, for both spring (snowmelt) and fall floods, and the hydrographs were plotted. It was found that the hydrograph shape was similar for all events and was independent of the time of year so an average shape was selected. A non-dimensional version of the hydrograph shape is plotted in Figure 4.1.

4.3 Flood Routing Analysis

A spreadsheet routing model was prepared to estimate the reservoir levels that would occur during flood events. Menzies Lake is a simple system with only local inflows and one release facility, so a more complex routing model was not considered to be necessary. Since the model was required to look at flood routing only, consideration of the pumped inflow from the Musquash System was not required.

In addition to the IDF discussed in the previous section, the following information was required to carryout the flood routing:

- reservoir characteristics (operating range and storage curve);
- structure characteristics (dam crest elevations, control structure rating curve);
- operating procedures; and
- operating constraints.

The following sections describe these various elements and of the Menzies Lake flood routing model.

4.3.1 Storage Volume-Elevation Curves

A volume-elevation curve provides information regarding how much water is in storage when the reservoir is at different water levels. A volume-elevation curve was not available for Menzies Lake so one was derived from available data.

There is very little bathymetric information available for Menzies Lake. A drawing from 1970 shows depths across the lake between the location of the inflow from the Musquash System and the control structure. The maximum depth appears to be approximately 8 m. The inlet of the control structure, however is at el.72.8 m, so only the top 3 m of storage are useable for water supply.

An indication of potential storage at or above the full supply level is given by contouring on the Province of New Brunswick orthophoto maps for the area. The areas of the lake, and the area of the next highest contour were planimetered to estimate the storage volume, and that data was extrapolated to derive the volume-elevation information presented in Table 4.2. These values suggest a live storage volume of Menzies Lake of approximately 1.5 million m^3.

The City of Saint John use a "rule of thumb" that Menzies Lake holds about 3-days of water supply for the city in case of an emergency. It would appear from our analysis that the storage is actually much higher than this.

Table 4.2
Menzies Lake Estimated Volume-Elevation Data

Reservoir Level, m	Reservoir Storage, million m^3
72.8 (control structure invert)	0
74.5	0.71
75.5 (top of stoplogs)	1.48
76.5	2.51

4.3.2 Spillway Discharge Capacity

The control structure is used to release flow for water supply purposes and it is not normal operating procedure to remove the stoplogs during the spring runoff. Therefore it cannot be assumed in practice that the full discharge capacity of the structure will be available. In addition, the stoplogs must be removed manually, which is time-consuming and may be difficult or impractical in high flow situations.

A rating curve was not available for the Menzies Lake Control Structure and therefore the discharge capacities were estimated using the standard weir equation, $Q = CLH^{1.5}$. The weir coefficient C was estimated from comparison with data in a standard hydraulic reference text. Effective length L was taken as the total overflow length of the stoplog bays with adjustments for pier and abutment contractions. Table 4.3 provides an estimate of the release capacity with all 13 stoplogs in place.

Table 4.3
Rating Curve for Control Structure

Water Level, m	Discharge, m^3/s All stoplogs in place (crest elevation 75.5 m)
75.2	0.0
75.6	0.4
76.0	6.7

4.3.3 Routing Results

The time step used in the routing model was 1 hour, and the overall duration of the flood hydrograph was 72 hours. The starting reservoir level was assumed to be El. 75.5 m, the top of the stoplogs, which is somewhat conservative since leakage and evaporation usually result in the water level being slightly below the top of the stoplogs.

The flood routing was done using an IDF defined by 1/1000 AEP flood event as described in Section 4.2. This is the upper end of the range suggested by CDA for Low Consequence Category dams. The peak of the IDF is approximately 11.8 m^3/s.

Routing the IDF under the conditions described above led to a maximum flood level of el. 76.2 m, and a maximum hourly spill of 10.4 m^3/s. Figure 4.2 shows the reservoir level and discharge from the lake during the event.

4.4 Freeboard Analysis

4.4.1 Methodology

The standards followed for the analysis of freeboard for Menzies Lake were those given in the *Dam Safety Guidelines.*

The Guidelines include the following requirements.

Sufficient freeboard shall be provided so that under all operating conditions, including those during extreme floods or extreme wind conditions ... the percentage of waves that could overtop the dam is limited to an amount that would not lead to dam failure.

The maximum reservoir level shall be at or below the top of the impervious core for embankment dams.

The Guidelines go on to say that:

For embankment dams, the freeboard should generally be sufficient to avoid dam overtopping for 95% of the waves created under the specified wind conditions . . . The dam crest is normally set at the level which satisfies all of the following conditions:

- *Wave conditions and set-up due to wind with a 1/1000 Annual Exceedance Probability (AEP) with the reservoir at its maximum normal level*
- *Wave conditions and set-up due to the most severe reasonable wind conditions for the reservoir at its maximum extreme level based on the selected IDF. For small reservoirs and/or small basins, the 1/100 AEP maximum annual wind is normally used. For large reservoirs and/or large basins, the mean maximum annual wind is normally used.*

The resistance of concrete dams to overtopping may be considered for overtopping design with due consideration of abutments and ancillary structure vulnerability and other downstream consequences.

The amount of freeboard required at a particular dam is defined by the wind set-up plus wave runup and is dependent on the following factors

- the design wind speed and direction;
- the upstream slope of the dam and the roughness of any upstream protection;
- both effective and maximum fetch (the distance the wind blows over the water upstream of the structure); and
- depth of water upstream of the dam.

Freeboard calculations for Menzies Lake were based on calculations undertaken by Acres in 2000 for the New Brunswick Department of Natural Resources for the Musquash system.

4.4.2 Wind Analysis

Frequency analyses were undertaken to calculate winds with AEPs of 1/1000 for combination with average flows and 1/100 for combination with flood flows. Maximum hourly wind speeds for eight points on the compass were obtained from Environment Canada for the station at Saint John Airport for each month of the 48 years of record.

To avoid being overly conservative, direction as well as season were considered in the wind analysis for freeboard. It is unlikely that all maximum winds will impinge directly on the dam.

Frequency analyses were carried out for wind speeds during the spring snowmelt period (February through June), to use in analyzing required freeboard during the freshet period, and for the full years. Frequency analyses were done for each of the eight points of the compass, but using winds from +/- one compass point to each side, e.g. the wind analysis for the northerly direction included the maximums from northeasterly, northerly and northwesterly directions. This was to account for wind / waves at the dams coming from a 90 degree radius. In each case, the distribution that gave the best fit was adopted, and the results are given in Table 4.4.

Table 4.4
Frequency Analysis of Saint John Wind Speeds

Wind Direction	Spring (Feb through Jun) Maxima (km/hr)				Annual Maxima (km/hr)			
	Mean Annual Max	Historic Max	1/100 AEP	1/1000 AEP	Mean Annual Max	Historic Max	1/100 AEP	1/1000 AEP
North	54	85	78	89	60	89	86	101
Northeast	56	85	84	97	62	89	88	99
East	53	74	78	85	60	80	87	99
Southeast	57	80	80	87	68	100	107	129
South	56	80	79	89	69	111	119	163
Southwest	56	80	78	87	69	111	119	164
West	54	70	71	78	64	111	102	133
Northwest	55	85	79	90	62	89	88	102

Maximum overtopping by waves will occur when the wind direction is perpendicular to the dam. Table 4.5 shows the orientation of the various structures at Menzies Lake, and the critical wind direction.

Table 4.5
Menzies Lake Wind Characteristics

Structure	Structure Orientation	Critical Wind Direction	Wind over Water Adjustment
Control Structure	Southwest to northeast	Northwest	1.05
Saddle Dyke 1	South to north	West	1.07
Saddle Dyke 2	Southwest to northeast	Northwest	1.07
Saddle Dyke 3	West to East	North	1.07

For given meteorological conditions, wind velocities over water tend to be higher than wind velocities over land. Saville et al (1962) provides tabulated adjustment factors as a function of fetch. For the size of Menzies Lake, values between 1.05 to 1.07 were selected for the various structures, as listed in Table 4.5.

4.4.3 Reservoir / Structure Characteristics

Dyke Slopes

The concrete portion of the control structure has a vertical upstream face. The earth saddle dykes have upstream slopes of between 1.5H:1V and 2H:1V. The values used are summarized in Table 4.6.

In the procedure for calculating runup, an adjustment is made to take into account the roughness of the upstream slope. The rougher the slope, the lower the runup. For this study, a relatively conservative adjustment of 0.7 was applied for the earth dykes, because of the uncertain condition of the erosion protection.

Fetch
The effective fetch for the Menzies Lake structures was calculated according to Saville et al's methodology. The calculation of set-up uses maximum, rather than effective fetch. The maximum fetch for each structure was measured from the available mapping. Table 4.6 lists the values used.

Table 4.6
Reservoir / Structure Characteristics

Structure	Upstream Slope	Effective Fetch, m	Maximum Fetch, m
Control Structure	Vertical	110	200
Saddle Dyke 1	1.5H:1V 1.7 H:1V 2H:1V	500	1240
Saddle Dyke 2	1.5H:1V	630	1460
Saddle Dyke 3	1.6H:1V	690	1570

Reservoir Depth
The reservoir depths at the dams were estimated from the survey. There is very little bathymetry available for estimation of the average reservoir depth. The deepest surveyed point from a 1970 drawing is at el. 68 m. An average depth of 5 m was used in the freeboard calculations. The freeboard calculations are not highly sensitive to reservoir depth so this approximate value is sufficient.

4.4.4 Freeboard Requirements

The freeboard calculations are summarized in Table 4.7. The freeboard required above the IDF flood is 0.4 m for the vertically faced portion of the control structure, and between 1.0 m or 1.1 m for the earth dykes. In non-flood conditions, the freeboard required above maximum normal level is again 0.4 m on the vertical face and is 1.3 m on the earth dykes.

Table 4.7
Freeboard Requirements

Structure	Wind, AEP	U/S Slope *	Wave Runup, m	Wind Setup, m	Total Freeboard Required, m
Control Structure	1/100	vert.	0.35	0.01	0.4
	1/1000	vert.	0.41	0.01	0.4
Control Structure Abutments	1/100	3:1			1.0**
	1/1000	3:1			1.0**
Saddle Dyke 1	1/100	1.5:1	1.09	0.05	1.1
	1/100	2:1	0.91	0.05	1.0
	1/1000	1.5:1	1.45	0.08	1.5
	1/1000	2:1	1.20	0.08	1.3
Saddle Dyke 2	1/100	1.5:1	1.05	0.04	1.1
	1/1000	1.5:1	1.23	0.06	1.3
Saddle Dyke 3	1/100	1.5:1	1.07	0.04	1.1
	1/1000	1.5:1	1.27	0.06	1.3

* Upstream slopes were rounded to the nearest 0.5 to match available lookup tables.

** Calculated values replaced with minimum acceptable freeboard.

The earth abutments of the control structure have slopes of approximately 3H:1V. The limited fetch at the control structure would lead to a limited wave height and runup at the abutments. However, it is recommended that a minimum of 1 m of freeboard be maintained above the IDF for earth structures.

4.5 Flood Handling Assessment

There are two criteria which apply to determining the minimum allowable crest elevation; freeboard for waves resulting from 1/1000 AEP winds on the maximum normal level (el. 75.5 m) and freeboard for waves resulting from 1/100 AEP winds on the maximum flood level (el. 76.2 m). Table 4.8 shows the comparison of the two requirements.

The requirement for freeboard above maximum flood level governs for all three saddle dykes. The following conclusions are made from the analysis:

- Saddle Dyke 1 has adequate freeboard.
- Saddle Dyke 2 requires an additional 0.7 m of freeboard.
- Saddle Dyke 3 has adequate freeboard.

Saddle Dyke 2 is lower than the other two dykes. During a design flood event, with the dyke at its current elevation, the water level in the lake would come to within 0.1 m of the crest, and waves would overtop the crest. This would lead to erosion and probable failure of the dyke.

Saddle Dyke 2 should be raised to prevent wave overtopping of the crest. Until the raising can be carried out, the reservoir should be operated at a lower level so that the design flood can be handled without encroaching on the required freeboard.

The concrete control structure has adequate freeboard for the vertical faces of the main structure. The abutments, however, do not meet the minimum recommended freeboard requirements and will require to be raised by 0.7 m.

Table 4.8
Dam Crest Elevation Requirements

Structure	Normal Conditions Water Level 75.5 m		Flood Conditions Water Level 76.2 m		Current Low Point m	Crest Raising Require m
	Freeboard Required	Crest Required m	Freeboard Required	Crest Required m		
Concrete Control Structure	0.4	75.9	0.4	76.8	76.8	--
Control Structure Abutments	1.0	76.5	1.0	77.2	76.5	0.7
Saddle Dyke 1*	1.5	77.0	1.1	77.3	77.3	--
Saddle Dyke 2	1.3	76.8	1.1	77.3	76.6**	0.7
Saddle Dyke 3	1.3	76.8	1.1	77.3	77.5	--

* Steeper dykes require the most freeboard, so the result from the 1.5H:1V portion of the main dyke are included here.

** There is a low point to the west of Saddle Dyke 2 which is 0.3 m lower than the lowest portion of the dyke. This section of the embankment is also at risk from overtopping.

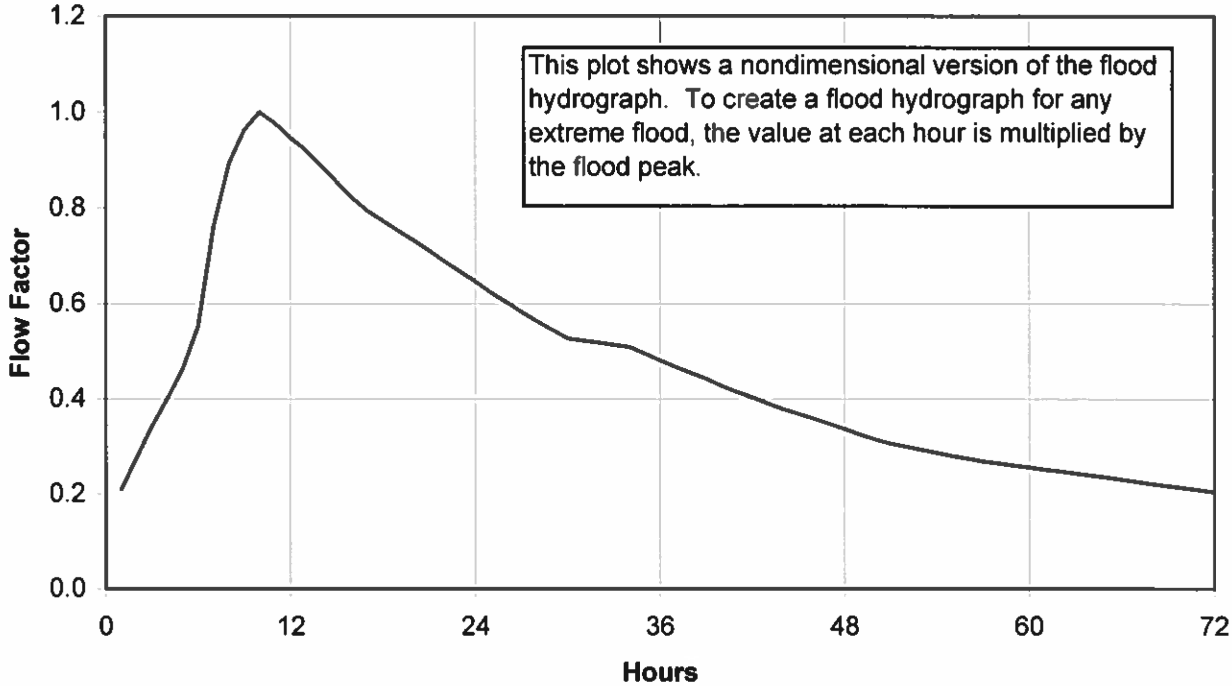


Fig. 4.1

City of Saint John

Menzies Lake Dam Safety Assessment

Flood Hydrograph Shape

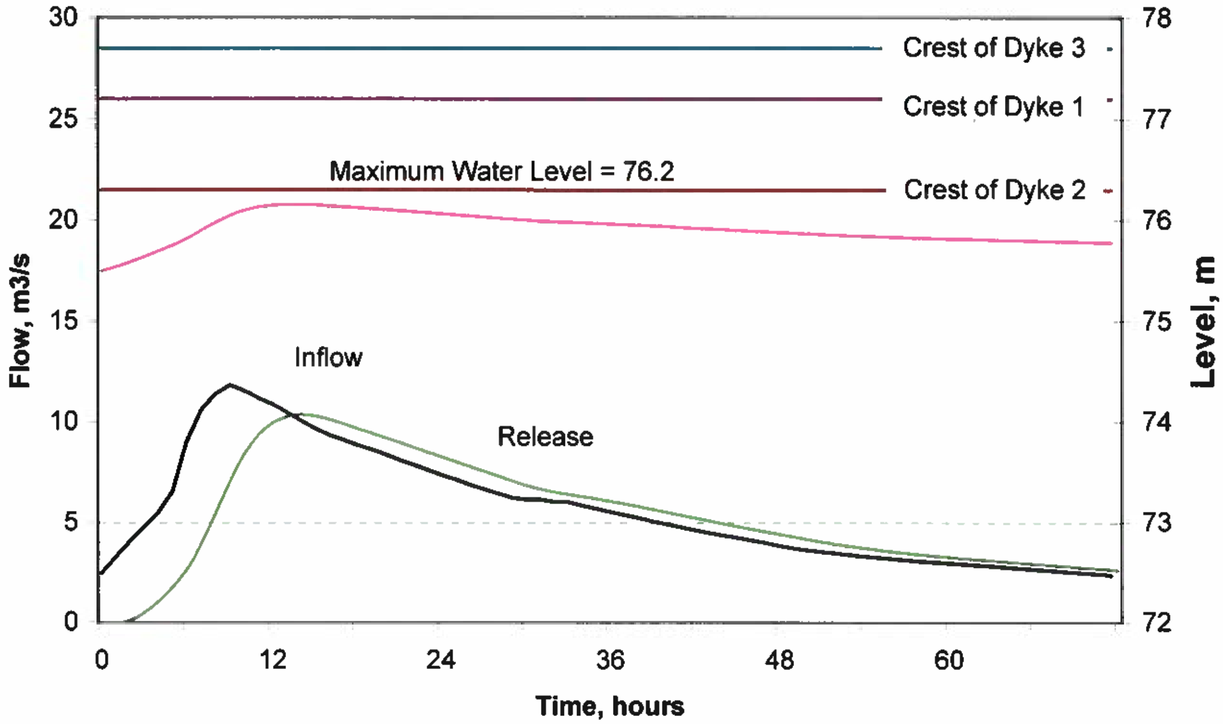


Fig. 4.2

City of Saint John

Menzies Lake Dam Safety Assessment

Flood Routing

Stability Analysis of Control Structure

5 Stability Analysis of Control Structure

5.1 Methodology

Stability analysis of the Menzies Lake control structure was performed in accordance with the CDA Guidelines. The drawing available from the City of Saint John shows the arrangement of the structure, stoplog bays, sluiceways and various details. Field visits / survey were carried out in October and December 2002 to provide additional information on the abutments and locate the boreholes etc. The results of the survey supplemented by visual and underwater inspection provided the data for the stability analysis.

The stability analysis was completed using an in-house spreadsheet program. This was based on rigid body equilibrium analysis to determine the structural behaviour of the dam for various loading conditions. For this analysis, uplift pressures, crack propagation and shear strength (peak and residual) were calculated in accordance with the CDA Guidelines as outlined below.

5.2 Stability Criteria

This section sets forth the general criteria and loading conditions for the stability analysis calculated in accordance with the CDA Guidelines.

Loads and Forces

The structures were analyzed for combinations of the following loads. The load combinations are outlined in Section 5.3.

- Dead Loads (D)
- Hydrostatic Loads (H)
- Silt Loads (S)
- Uplift Hydrostatic Pressure (U)
- Ice Loads (I)
- Earthquake Loads (Q)
- Hydrodynamic Loads (V_e)

Figure 5.1 shows the manner in which the hydrostatic and ice loads are applied to a typical concrete structure.

Dead Loads

The vertical gravity loads, i.e. dead loads, of all permanent structures and equipment were considered in the stability analysis of the dam structures. The following unit weights were assumed for the calculation of the dead loads.

mass concrete	23.5 kN/m^3
water	9.81 kN/m^3
soil (dry)	21.2 kN/m^3 (applied vertically only)

Hydrostatic and Silt Loads

The silt loads and hydrostatic loads are assumed to be triangular pressure loads varying linearly from zero at the top to a maximum pressure P_0 at the base, as calculated below. The resultant force from the pressure distribution is assumed to act at H/3 above the point of maximum pressure.

$$P_0 = K_0 \gamma H$$

Where:

K_0 = pressure coefficient (1 for hydrostatic, 1-sin(Ø) for silt load)
Ø = assume internal angle of friction = 12 degrees for silt
γ = unit weight, buoyant weight for earth pressure
H = depth of water or silt

Silt loads were assumed to be negligible since the underwater inspection showed no significant accumulation of silt upstream of the structure.

Uplift Hydrostatic Pressure

The uplift force due to hydrostatic pressure is assumed to act, under normal operating conditions, as a trapezoidal distribution from the heel to the toe of the dam over the full area of the base. The uplift pressure under the heel is equivalent to the hydrostatic pressure at the upstream face of the dam due to the headwater, calculated from gH_1. Similarly, the uplift pressure under the toe will equal the hydrostatic pressure at the downstream face of the dam due to the tailwater. If there is no tailwater, the uplift pressure at the toe is assumed to be zero.

For cases where the resultant is outside the middle third, there will be additional uplift forces due to the initiation and propagation of a crack at the heel of the dam.

Because the resultant is outside of the middle third, the entire base is no longer in compression against the foundation. It is then assumed that the maximum hydrostatic pressure will act uniformly over the cracking area which is not in compression with the foundation, and the uplift pressure will then be reduced linearly from the point where compression on the foundation begins. This will cause an increase in the uplift forces, thereby propagating the crack. For a stable structure under usual loading conditions, this crack will not be initiated. However, under unusual and extreme conditions, the crack is permitted but, if the structure is stable, the propagation of the crack will terminate as the forces come into equilibrium.

Ice Load

Ice loading is one of the major loads on a dam in northern climate, and perhaps the most variable. Ice loading for concrete structures has traditionally been assumed to be 145 kN/m for rigid structures, and 73 kN/m for flexible structures for certain ice thickness. Recent work in the area of ice loading has prompted SGE Acres to review theses traditional assumptions and reduce ice loads for certain structures. . An ice load of 29.2 kN/m resulting from expansion of a 0.6 m thick ice sheet at the water surface is considered applicable for this concrete structure, taking into account the presence of stoplogs and the geometry of the structure. The load is assumed to be a line load acting at the middle of the sheet, or approximately 0.3 m below the water surface.

Earthquake

Concrete structures such as dams and spillways are not classified as building structures and as such do not fit into any of the classification systems found in the latest edition of the National Building Code of Canada (NBCC). Instead, common practice is to use the peak horizontal ground acceleration (PHGA) method. The earthquake load is assumed to be a horizontal pseudostatic load equal to the PHGA times the weight of the structure and is assumed to act at the center of gravity of the structure. For the location of Menzies Lake Control Structure, the PHGA is 0.12 g.

Hydrodynamic

In addition to the PHGA method described above, an earthquake will also cause an increase in the hydrostatic force on the dam. The additional horizontal pressure of water at the dam base is noted as P_e. It is calculated using Zangar's method as follows.

$$P_e = PHGA \times \gamma_w \times C \times H$$

Where:

PHGA = peak horizontal ground acceleration = 0.12g for the Menzies Lake Control Structure

C = maximum pressure coefficient = 0.73 for vertical faced dams

H = full depth of water

The total horizontal force per metre above the base, termed the hydrodynamic force and noted by V_e, and the resulting overturning moment M_e, due to the hydrodynamic force are

$$V_e = 0.726 \times P_e \times H \quad \text{(applied at a height of 0.41H)}$$
$$M_e = 0.299 \times P_e \times H^2$$

Resisting Forces

The overturning resistance is due to the dead weight of the permanent structures and equipment. The sliding resistance is due to the friction of base joint of rock/concrete interface, or of the construction joints of concrete/concrete as appropriate. The sliding resistance is calculated using the following formula.

$$R = V \tan \text{Ø}$$

Where:

R = sliding Resistance

V = net vertical force

Ø = angle of friction

The Barton-Bandis approach was used to arrive at an estimate of the angle of friction. The Base Friction Angle of wet Siltstone which is the rock in this area is about 31 degrees. Assuming that the rock/concrete interface is "smooth natural" and that the height of concrete structure is slightly less than 5.0 m, the Roughness Component is about 11 degrees. Therefore the rock/concrete interface friction angle was estimated as approximately 42 degrees. The friction angle of the construction joints was assumed to be 55 degrees in accordance with the CDA guidelines.

5.3 Load Combinations

The following load combinations were considered for the stability analysis.

Combination 1: Usual (Summer):
- Dead Loads
  - Reservoir levels at full supply level (FSL)
  - Negligible tailwater level
  - Silt Loads (assumed negligible)
- Uplift Hydrostatic Pressure

Combination 2: Usual (Winter):
- Dead Loads
  - Reservoir levels at FSL
  - Negligible tailwater level
  - Ice loading
  - Silt Loads (assumed negligible)
- Uplift Hydrostatic Pressure

Combination 3: Unusual (Inflow Design Flood (IDF)):
- Dead Loads
  - Reservoir levels at IDF level
  - Negligible tailwater level
  - Silt Loads (assumed negligible)
- Uplift Hydrostatic Pressure

Combination 4: Extreme (Maximum Design Earthquake):
- Dead Loads
  - Reservoir levels at FSL
  - Negligible tailwater level
  - Silt Loads (assumed negligible)
- Uplift Hydrostatic Pressure
- Earthquake load

Acceptance Criteria

The following criteria are evaluated at the foundation level of each structure to ensure adequate stability within the limiting values outlined in Table 5.1.

- Sliding Factor of Safety
- Location of Resultant Force
- Effective Base Width
- Maximum Base Pressures

Table 5.1
Stability Analysis Acceptance Criteria

Description	Usual	Usual + Ice	Unusual	Extreme
Sliding Factor of Safety	1.5	1.5	1.3	1.0
Location of Resultant*	within mid-third	within mid-third	within mid-half	within mid-half
Effective Base	100%	100%	>75%	>75%
Max. base pressure	Qall	Qall	Qall	Qall
Max. Tension at Conc/Rock Interface, Crack Width	none	none	self-limiting crack	self-limiting crack

Qall = Allowable bearing capacity of bedrock or concrete, whichever is less.

*Applies to slices of structure with rectangular footprint only

5.4 Stability Results

A summary of results of the stability analyses are presented in Table 5.2. Two sections of the dam have been analyzed.

- Spillway section consisting of an intermediate pier plus half of the base slab on both sides of the pier
- End spillway section consisting of an end pier and half of the adjacent base slab on one side of the pier only

Table 5.1
Stability Analysis Results

Description	Usual	Usual + Ice	Unusual	Extreme
Sliding Factor of Safety	2.5	1.35 *	3.7	1.4
Location of Resultant	7.4 m	8.3 m	1.8 m	8.0 m
Effective Base	100%	100%	100%	100%
Max. base pressure	11.1	12.7	35.3	12.2
Max. Tension at Conc/Rock Interface, Crack Width	0 mm	0 mm	0 mm	0 mm

* below acceptance criteria Factor of Safety of 1.5

The analysis shows that the structure has an acceptable factor of safety for all load cases except for the normal winter (usual plus ice) load case. The CDA guidelines recommend that for low consequence structures, lower factors of safety may be acceptable provided a review and inspection has been carried which shows that the structure appears safe and shown no signs of problems since construction. Therefore, no action to address the lower factor of safety is recommended at this time.

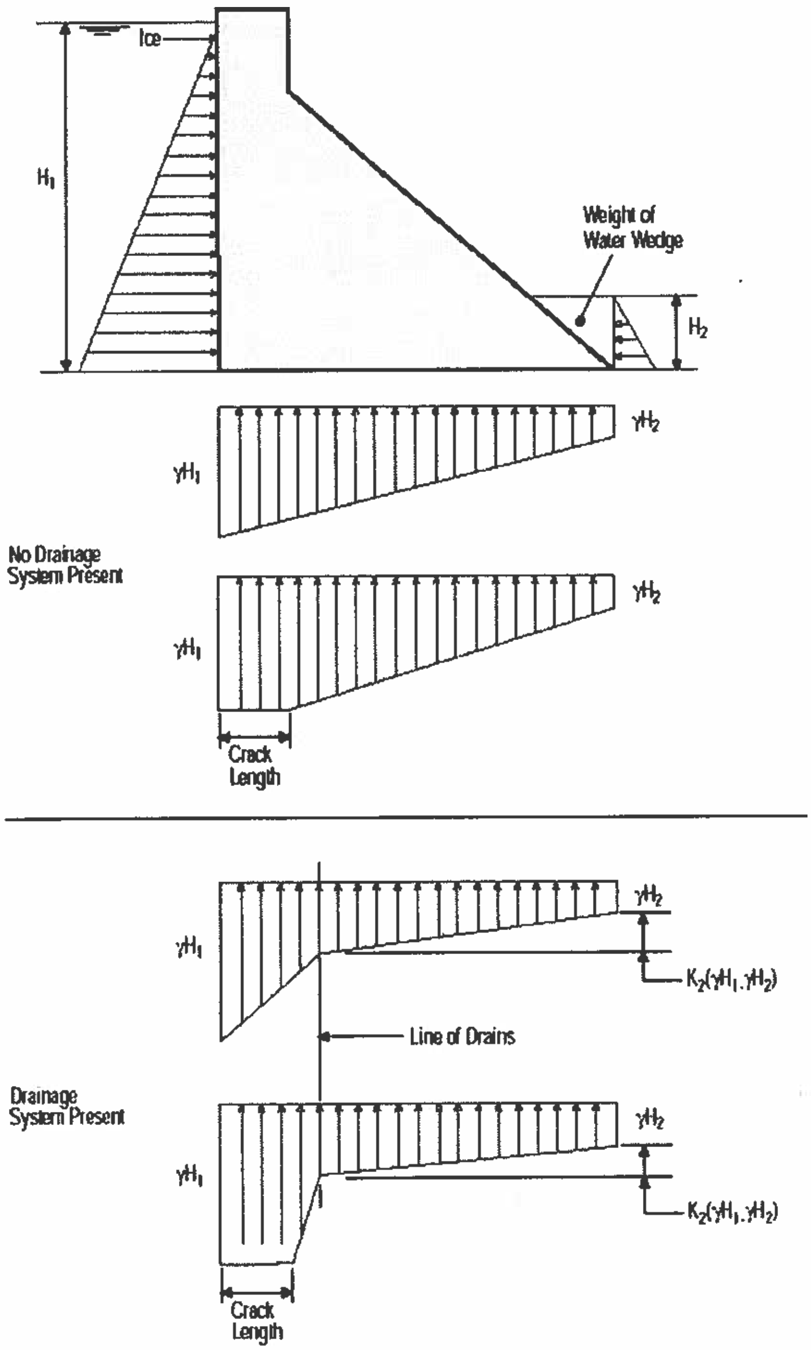


Figure 5.1 – Typical Load Conditions for Concrete Dams

Stability Analysis of Saddle Dykes

6 Stability Analysis of Saddle Dykes

Other than the concrete control structure, Saddle Dyke 1 is the primary water retaining structure since it effectively blocks the flow from going down the original drainage path and has the greatest overall height. For this reason the stability and seepage analyses described in this section was limited to the examination of Saddle Dyke 1. The geotechnical condition of all three dykes is considered to be similar. The evaluation of only Saddle Dyke 1 was deemed conservative since it has the highest section. The results of the analysis were therefore used in doing a qualitative assessment of Saddle Dykes 2 and 3.

Cross-section of Saddle Dyke 1 as it exists are shown in Figure 1.4. For the stability analysis a homogeneous earthfill embankment with 1.5H:1V upstream and downstream slopes has been assumed. The existing crest has been taken as el. 77.3 m and the original ground elevation has been assumed as el. 72.3 m.

The structure comprises sand and gravel with some silt and the embankment fill is compact in-situ. According to the drill logs, there is a silt and sand layer present underneath the embankment fill, which contains organic material. It appears therefore that at the time of the dam construction, the organic topsoil layer had not been removed. It can be assumed that a continuous layer of organic silt exists underneath the entire embankment footprint. This layer overlies a glacial till foundation. Details of the site investigation for the saddle dyke dams are presented in Appendix B.

The grain size distributions for the samples tested for the project indicate that the embankment fill and the till foundation material are basically the same material comprising sand and gravel with some silt.

As noted in Section 4 the normal water level (NWL) is el. 75.5 m while the maximum level associated with an IDF is expected to be el. 76.2 m.

Saddle Dyke 1 has been assessed against the current Canadian Dam Association (CDA) Guidelines through

- a seepage analysis
- a slope stability analysis (static and with earthquake loading)

6.1 Seepage Analysis

Seepage analyses were carried out for Saddle Dyke 1 to establish the anticipated location of the phreatic surface and the pore pressures within the dyke and foundation material. Seepage analyses were performed by applying the SEEP/W program to model two dimensional water movement and pore-water pressure distribution within porous materials. A steady state groundwater flow assessment was undertaken in the seepage analyses.

The coefficient of permeability (hydraulic conductivity) of these materials was derived from the results of variable head permeability tests carried out. Appendix B gives the results of these tests. Table 6.1 summarizes the hydraulic conductivity values selected for use in the seepage analyses.

Table 6.1
Material Hydraulic Conductivity

Material	Coefficient of Permeability (cm/s)
Existing dam fill	1×10^{-3}
Organic Silt	5×10^{-5}
Gravel / Till (Foundation)	5×10^{-4} and 0.01

The results of the seepage analysis using these parameters gave a phreatic surface which slopes gradually from the static water level of el 75.5 m to daylight at the toe. This does not conform to the majority of the piezometer readings, which showed the surface to be low, approaching the original ground surface.

Therefore a second seepage analysis was performed with only two materials, an embankment fill on a highly pervious foundation (0.01 cm/s). This lowers the phreatic surface but it still was higher than was observed in the piezometers. This discrepancy was attributed to the highly pervious layer noted near the original ground surface which was observed in some of the bore holes. An alternative explanation could be the presence of a core wall in the fill. Field investigations did not find the core wall although drawings from 1937 indicate the presence of such a wall in one of the original structures. Therefore, a phreatic surface conforming to piezometer readings was assumed to be representative of the dam condition and appropriate for use in the stability calculations.

6.2 Slope Stability Analysis

The slope stability of Saddle Dyke 1 was performed using SLOPE/W software. Input parameters for this analysis are provided in the following sections.

6.2.1 Stability Criteria

Material Properties

Table 6.2 shows the material properties selected for use in the stability analyses.

Table 6.2
Material Properties

Material	SPT	Material Properties		
	Min. "N"	ϕ ' (°)	c ' (kPa)	γ (kN/m^3)
Existing dam fill	3 to 8	32	0	18
Organic Silt	6	28	0	18
Gravel / Till (Foundation)	9	34	0	19

Seismic Coefficient for Musquash Embankments

Table 6.3 shows the Peak Horizontal Ground Acceleration (PHGA) for a nearby site (Musquash, New Brunswick). This table is based on data received from the Geological Survey of Canada.

Table 6.3
Musquash Horizontal Ground Acceleration

Probability of Exceedance per Annum	Peak Horizontal Ground Acceleration (PHGA)	Design Horizontal Ground Acceleration (2/3 of PHGA)
1/1000	0.12 g	0.08 g

In terms of the classification of dams based on the consequences of failure, Saddle Dyke 1 has been designated as a low consequence category structure (See Section 4). Therefore according to CDA guidelines a design earthquake with an annual probability of exceedance of between 1/100 and 1/1 000 should be considered. In this case a 1/1 000 annual exceedance probability event was selected for consideration.

The stability of the dam slopes under seismic loading was studied using the pseudo-static method of analysis. A pseudo-static coefficient corresponding to 2/3 of the peak ground acceleration was used. Table 6.3 shows the value used in the analyses.

6.2.2 Method of Analysis and Load Cases

Stability analyses were performed according to the limit equilibrium method of slope analysis utilizing the SLOPE/W slope stability program. All calculations were based on the effective strength method. An appropriate factor of safety is obtained from a slope stability method that satisfies both force and moment equilibrium. The analysis was performed according to the Morgenstern-Price method of slices with a half-sine function selected for the interslice force function, which satisfy both moment and force equilibrium.

Four load cases were considered in the assessment as summarized in Table 6.4. The required factors of safety are based on current CDA Guidelines.

Table 6.4
Slope Stability Load Cases

Load Case	Required Factor of Safety (Canadian Dam Association Guidelines)
Normal Water Level, NWL	1.5
Inflow Design Flood Level	1.3
NWL + Earthquake	1.1
Rapid Drawdown	1.1

6.2.3 Stability Analysis Results

Table 6.5 summarizes the calculated factors of safety. Individual results of the stability analyses can be seen in Appendix D.

Table 6.5
Calculated Factors of Safety

Load Case	Calculated FOS*	
	Downstream	Upstream
NWL (Reservoir at el. 75.5 m)	1.13	1.15
MFL (Reservoir at el. 76.2 m)	1.12	1.23
NWL + EQ	0.97	0.90
Drawdown	NA	1.09

Note: * - The calculated FOS is based on estimated phreatic surface. The use of phreatic surface from seepage analysis will result in lower FOS.

It is seen that the calculated factors of safety are low for all loading conditions, and that is based on the assumption that the phreatic surface is low as indicated by piezometric measurements. Even under these conditions the CDA Guidelines are not met under all conditions examined.

6.3 Remedial Measures

Remedial measures are required in order to meet current Canadian Dam Association Guidelines. This comprises the addition of a 3 m wide 2 m high berm at the downstream toe. A conservative estimate for the volume of materials required to construct this berm for Saddle Dyke 1 is about 780 m^3. The overall slope of the downstream side with the addition of the berm is 2.25H:1V. Observations made during the visit also suggest that improvements are required on the upstream side, including stabilization and possibly improvements to erosion protection measures.

Figure 6.1 shows a typical fill section for Saddle Dyke 1 with flattened downstream slopes and or a toe berm.

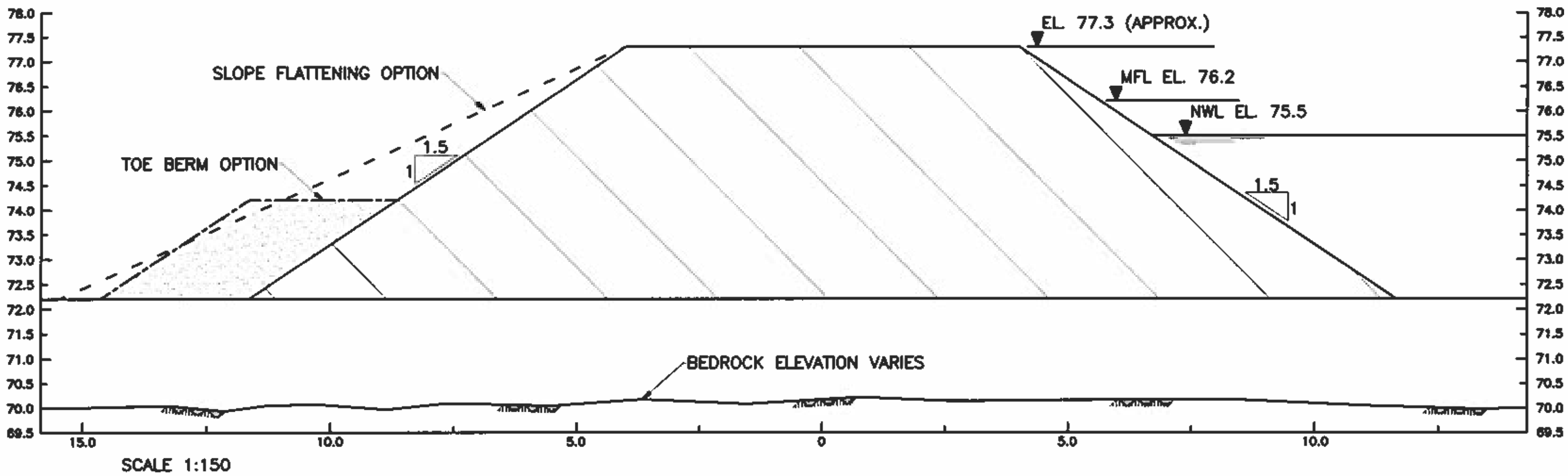


Figure 6.1 Typical Saddle Dyke Section With Potential Remedial Measures.

Remedial Works and Construction Cost Estimate

7 Remedial Works and Construction Cost Estimate

The dam safety inspections and analysis has identified dam safety and maintenance concerns for the Menzies Lake structures. This section presents a review of the items identified, and provides a recommended rehabilitation program to address these. Preliminary cost estimates are provided for the required work.

7.1 Classification

During the course of this study, a distinction was made between the measures required to enhance the safety of the structures and maintenance items. For the purposes of this study, the following guidelines have been used.

Dam Safety Items
Issues needed to address potential structural instability which, if not addressed, could cause the loss of the reservoir.

Maintenance Items
Work necessary to restore and maintain the integrity of the structure or prevent further deterioration.

Obviously, dam safety items have been given a high priority. Certain major maintenance items, if not attended to in the near future, could cause excessive deterioration of the structure and possibly create concern for the integrity of the structure. These maintenance items have also been given a high priority.

A priority system using five levels has been used. This is as follows.

Priority	Description
1	Immediate - action required prior to 2004 spring freshet
2	Very High - action required prior to 2005 spring freshet
3	High - action required within 3 years
4	Medium - action required within 5 years
5	Low - action required within 10 years

Each level reflects the relative importance or urgency associated with taking some form of action. In cases in which the defects were observed and the causes easily identifiable, action means actual construction. In other cases, action means the investigation of the defect and its causes.

7.2 Significant Safety Issues

The evaluation found that there are potential dam safety concerns associated with both the concrete control structure and the saddle dykes. The specific concerns may require further study to further quantify issues affecting the safety of the structures. In addition there are maintenance items which should be addressed so that they do not develop into dam safety concerns.

Improving Stability

The analyses undertaken showed that Saddle Dyke 1 has insufficient stability under the load cases considered. Improvement to the stability of this structure is therefore required. This can be achieved by addition of a downstream toe berm, or by flattening the downstream slope.

!

error

Saddle Dykes 3 and 2, and the Concrete Control Structure were found to have adequate stability.

Adding Freeboard

Freeboard is added to structures to prevent overtopping of a structure by the inflow design flood by increasing the structure height to give additional flood storage. Freeboard is also required to prevent overtopping by waves. This is particularly important with earthfill dams or earth abutments, which cannot accommodate overtopping of any kind.

Additional freeboard is required at Saddle Dyke 2. This structure is at risk of overtopping. Raising the crest of this dyke by 0.7 m to elevation 77.3 m is required.

Until the raising of Saddle Dyke 2 can be carried out, the reservoir should be operated at a lower level so that the design flood can be handled without encroaching on the required freeboard.

Raising of the crest of the abutments to the concrete control structure is also required. This area needs to be raised to elevation 77.2 to meet the minimum freeboard requirements.

Other Significant Issues
The growth of trees on the slopes of earthfill dams or earth abutments can lead to localization of flow and dam failure. The downstream slopes of the saddle dykes are covered with relatively mature trees and is cause for some concern. The trees and brush should be cleared in conjunction with the required remedial work on the dykes to improve stability.

There are risks associated with foundation leakage and potential piping of foundation materials which could lead to dam failure. At Saddle Dyke 1 there are several concentrated seeps and springs issuing from the downstream toe of the dyke. Some sloughs of material are also present. The overall leakage at Saddle Dyke 1 is moderate and occurs near the left abutment and the deepest sections. The required remedial work on the dykes to improve stability will incorporate filter material at the downstream toe to control the leakage and prevent piping failure.

7.3 Remedial Works

Table 7.1 shows the recommended repairs to the structures. The preventative maintenance measures recommended are also shown in Table 7.1. The actions shown in this table have been prioritized in keeping with the system described above. There were no low priority items found; all remedial work on the dam should take place within the next 5 years.

Repairs to Saddle Dyke 1 in terms of effectively flattening the downstream slope and implementing measures to control the leakage of water coming form some area of the structure will stabilize the structure. Raising of the crest of Saddle Dyke 2 and the abutments to the control structure will also provide for consistent protection against the design flood.

Table 7.1
Remedial Measures

Item No.	Structure	Component	Defect/ Area of Concern	Repair	Repair Type	Estimated Cost (2003 $)	Priority	Remarks
1	Saddle Dyke 1	Upstream Slope	Brush growth and displaced riprap	Remove brush and redress riprap	Maintenance	$18,000	2	High levels and brush made inspection difficult, scope is subject to review
2	Saddle Dyke 1	Downstream Slope	Mature trees on slope	Remove trees	Dam Safety	$9,000	2	This will probably require the removal of up to 1 m of material
3	Saddle Dyke 1	Downstream Slope	Unsuitable material	Remove material	Dam Safety	$5,063	2	This will probably require the removal of up to 1 m of material
4	Saddle Dyke 1	Downstream Slope	Geotechnical instability	Flatten slope & hydroseed	Dam Safety	$47,250	2	A toe berm is also a possible alternative
5	Saddle Dyke 1	Downstream Slope	Sloughs near toe	Flatten slope	Dam Safety	Included in above item	2	A toe berm is also a possible alternative
6	Saddle Dyke 1	Downstream Slope	General seepage	Monitor	Maintenance	$500	3	Install monitoring weir as part of repair
7	Saddle Dyke 1	Abutment	Concentrated seepage	Monitor	Maintenance	$500	3	After slope repair, leakage should be monitored
8	Saddle Dyke 1	D/S Foundation	Potential for piping failure	Add filter to control seepage	Dam Safety	$5,625	2	Repair to control potential for piping will go with slope flattening
9	Saddle Dyke 2	Crest	Insufficient freeboard	Raise crest level by 0.7 m	Dam Safety	$4,200	1	Water level should be maintained low until repair can be implemented
10	Saddle Dyke 2	West of Saddle Dyke	Insufficient freeboard	Raise section of road	Dam Safety	$1,800	1	Low point is 0.3 m below Saddle Dyke 2 crest
11	Saddle Dyke 2	U/S & D/S Slope	Brush growth	Remove brush	Maintenance	$450	2	Remove brush and examine riprap
12	Saddle Dyke 3	U/S & D/S Slope	Brush growth	Remove brush	Maintenance	$375	2	Remove brush and examine riprap
13	Control Structure	Downstream Area	Minor cracking in end walls	Monitor	Maintenance	$500	4	Monitor for significant movement
14	Control Structure	Abutment Area	Leakage near d/s wing wall	Monitor	Maintenance	$500	3	Monitor for significant increase in leakage
15	Control Structure	Abutment Crest	Insufficient freeboard	Install curbes	Dam Safety	$2,400	1	
16	Control Structure	Upstream Slope	Brush growth and displaced riprap	Remove brush and redress riprap	Maintenance	$3,600	2	
17	Control Structure	Downstream Slope	Brush growth	Remove brush	Maintenance	$360	2	Remove brush and inspect riprap & fill

Notes: 1. Cost estimates do not include costs for contractor mobilization/demobilization, dewatering, contingency, engineering design or site supervision.

7.4 Monitoring Program

A monitoring program is required so that any changes in the structure condition will be noted, and a direct comparison can be made to previous observations. The program will need to be designed and set up, and then can be carried on by City of Saint John personnel. The monitoring results should be reviewed on a periodic basis, or brought to our immediate attention should there be any significant or unexplained changes.

The monitoring program will monitor:

- condition of the structure
- existing and new cracks in the control structure - width, length, location
- indications of structure movement e.g. sloughing of slope or concrete displacement
- leakage flow quantity in the Saddle Dyke and Control Structure

To initiate the program, monitoring points and location will have to be set up, and a series of reporting forms developed. This will allow consistency in the measurements and reported data, so that direct comparisons can be made to previous observations. It is important that efforts be made to use the same personnel in conducting the observations and in the review of the results. Photographs should be taken from consistent observation points, and surveys should use the same section locations and measurement points.

7.5 Conceptual Designs and Construction Costs

This section provides a discussion of the conceptual designs for the rehabilitation of the Menzies Lake structures and presents a preliminary cost estimate. At this conceptual stage there has been no actual design work. Rather, an assessment of the possible needs for the work has been made based on the stability assessment for the structures and similar repairs to similar structures.

Cost estimates which have been developed are for budget purposes only and should not be used for final determination of cost of individual items. The level of accuracy which can be expected at this stage for the costs will generally be within +/- 25%. Mobilization/demobilization costs associated with the work have not been included but could be in the order of 15% due to the good access to the site.

The estimates do not include an allowance for engineering design and construction management, which would be in the range of 15% to 20% of the construction costs. The accuracy of the estimates will vary depending on the nature of the work required and the amount of information available for each item.

The estimated cost for this work, which addresses all the priority 2 items, is shown in Table 7.2. Engineering design and site supervision have not been included in this estimate.

Table 7.2
Remedial Measures Cost Estimate

Priority	1	2	3	4	5	Total
Mobilization/Demobilization - 15%	$1,300	$13,500	$200	$100	$0	$15,100
Construction Costs	$8,400	$89,700	$1,500	$500	$0	$100,100
Subtotal	**$9,700**	**$103,200**	**$1,700**	**$600**	**$0**	**$115,200**
Contingency - 25%	$2,400	$25,800	$400	$200	$0	$28,800
Total Estimated Construction Costs	**$12,100**	**$129,000**	**$2,100**	**$800**	**$0**	**$144,000**

Note: Mob/Demob on small jobs may exceed the 15% assumed here.

Conclusions and Recommendations

8 Conclusions and Recommendations

8.1 Conclusions

The condition assessment and dam safety evaluation of the Menzies Lake Structures has been undertaken with the following conclusions.

1. The concrete control structure is in reasonably good condition with some minor cracking in the end walls with no apparent displacement. The structure is sound, and showing limited signs of deterioration.

2. Saddle Dyke 1 is the highest of the three dykes and is a significant water retaining structure. It is exhibiting some leakage which is probably originating from a silty sandy layer of material on or near the original ground level. This leakage should be controlled as part of increasing the overall stability of the structure as discussed later in this section.

3. The evaluation consequences of failure of the structure found that there is a low risk to life in the reach between the Menzies Lake and Spruce Lake and the failure of Menzies Lake is unlikely to cause a cascade failure of the Spruce Lake dam. The Menzies Lake structures have therefore been classified as low consequence structures.

4. The control structure will not be overtopped in the design flood even if the stoplogs are not removed in the IDF. The channel approaching the control structure is relatively short and narrow and there is not a high risk of wave action. The approach fills are composed of earth but they are not high enough and could be adversely affected by a design flood event.

5. Saddle Dyke 1 and 3 are high enough that they will not be overtopped by a design event. Saddle Dyke 2 however is lower and therefore it is at risk of being overtopped in a design event if it is not raised by 0.7 m.

6. It does not appear that logs and floating debris jamming in the stoplog bays has been a problem. Since boating is not allowed on Menzies Lake a debris and / or safety boom would not appear to be necessary.

7. The stability of Saddle Dyke 1 does not meet the CDA stability criteria under most of the load cases examined, and will require measures to increase the factors of safety. A toe berm or flattening of the downstream slope of the structure are two measures to be considered to increase the stability.

8. The stability of the concrete control structure was reviewed and it was found that the structure meets the CDA stability criteria in all load cases reviewed except for the "usual + ice" case, which is slightly below the required value. Since this is a low consequence structure, no action to increase stability is recommended at this time.

9. Concrete cores were taken at various locations on the concrete structure deck and they indicate that concrete condition is good condition.

10. There is significant leakage adjacent to both the left and right wing walls of the control structure. The leakage does not appear to be a problem at this time, but measurements of the flow should be taken as part of a monitoring program. The leakage should be reviewed on a regular basis, and if it increases, or shows signs of carrying sediment, then remedial measures will be required to control the leakage.

8.2 Recommendations

8.2.1 Repairs and Rehabilitation

The recommended repairs and required rehabilitation have been discussed above, and are listed in Table 7.1. It is recommended that this program be implemented to address the items identified in this report. This section provides a brief summary of the work required.

The downstream slope of Saddle Dyke 1 should be flattened or a toe berm with approximately dimensions of 3 m wide and 2 m high should be added. Trees and brush should also be removed and current seepage should be controlled and monitored.

Saddle Dyke 2 and an area west of this saddle dyke will be overtopped in a design flood event and should be raised by approximately 0.7 m. Brush should also be removed from Saddle Dykes 1 and 2.

The earth abutments of the control structure will also be overtopped by waves in the design flood event and required raising by 0.7 m to prevent this. An alternative of using concrete barriers is recommended for the control structure, which will be easier to implement. Brush should be removed from the approach fills and rip rap added to the upstream slopes. A program to monitor the localized seepage at the downstream ends of the wingwalls should be implemented. The cracks in the end walls should also be monitored and any signs of displacement or other changes noted.

8.2.2 Dam Safety Program

A dam safety program should be implemented for the Menzies Lake structures based on the requirements of the Canadian Dam Association's Dam Safety Guidelines. Regular inspections should be implemented and documented and a monitoring program developed.

The Canadian Dam Association's *Dam Safety Guidelines* (1999) state that:

An Emergency Preparedness Plan (EPP) shall be prepared, tested, issued and maintained for any dam ..... whose failure could be expected to result in loss of life as well as for any dam for which advanced warning would reduce upstream or downstream damage.

Since the failure of the Menzies Lake structures is unlikely to lead to loss of life or significant damage which could be avoided with a warning system, an EPP is not a requirement for these structures.

Appendix A
Site Photographs

Menzies Lake Dam Site Photographs – Concrete Control Structure

Photo 1 – View from downstream

Photo 2 – Looking downstream

Photo 3 – Control structure deck

Photo 4 – Left endwall

Photo 5 – Bay 1 - Stoplogs.

Photo 6 – Bay 2 – Underside of stoplog deck.

Menzies Lake Dam Site Photographs – Concrete Control Structure


Photo 7 – End of pier 2


Photo 8 – End of piers and slab extension


Photo 9 – Stop log and slot

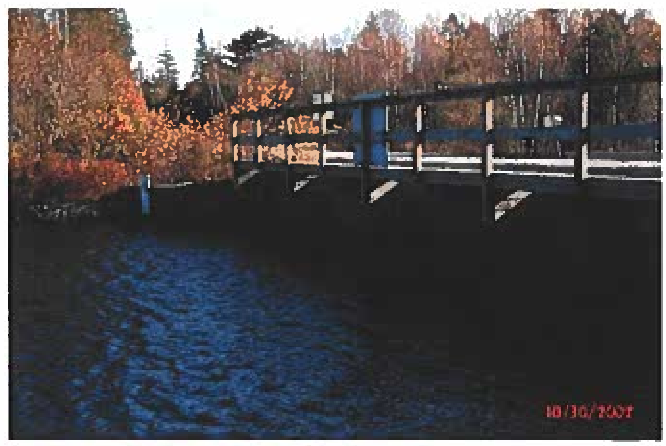


Photo 10 – Left upstream wingwall

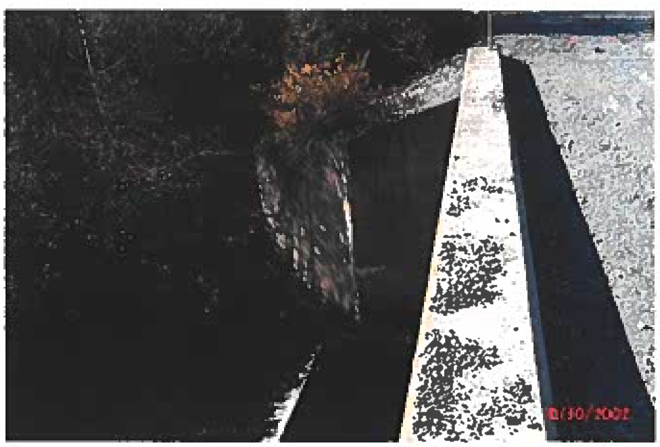


Photo 11 – Right downstream wingwall


Photo 12 – Left downstream wingwall

Menzies Lake Dam Site Photographs – Concrete Control Structure

Photo 13 – Underside of concrete deck

Photo 14 – Pier nose

Photo 15 – Leakage at left downstream wingwall

Photo 16 – Test pit in right abutment

Photo 17 – Deck and test pit in left abutment

Menzies Lake Dam Site Photographs – Saddle Dykes

Photo 1 – Saddle Dyke 1 from Upstream Right

Photo 2 – Saddle Dyke 1 - Downstream Crest

Photo 3 – Saddle Dyke 1 showing slope protection.

Photo 4 – Saddle Dyke 1 – wet area at downstream toe

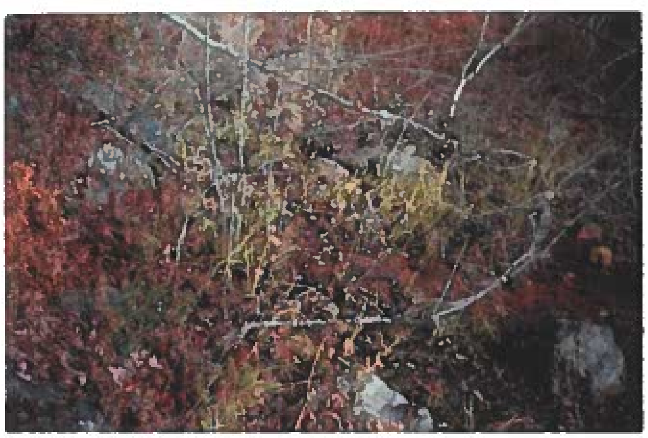


Photo 5 – Saddle Dyke 1 – Seepage at left abutment toe.

Photo 6 – Saddle Dyke 1 – Seepage at left abutment toe and trees on slope.

Menzies Lake Dam Site Photographs – Saddle Dykes

Photo 7 – Saddle Dyke 1 – tree growth on slope looking left from centre of dam

Photo 8 – Saddle Dyke 1 – tree growth on slope

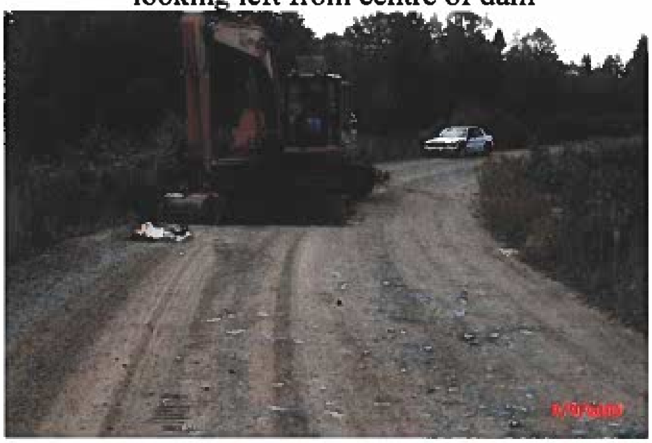


Photo 9 – Saddle Dyke 1 – Test pit on crest

Photo 10 – Saddle Dyke 1 – Probe holes on crest

Photo 11 – Saddle Dyke 2 – Probe hole on crest

Photo 12 – Saddle Dyke 3 – Probe hole on crest

Appendix B
Site Investigation Results

B Site Investigations

This Appendix presents the site investigation reports for the civil and geotechnical site visits and investigations.

The civil investigations of the Concrete Control Structure were initially conducted in October 2001 as part of the Phase 1 investigations. Civil inspection report notes from the Phase 1 investigations are included in Annex B-1. These investigations were supplemented with additional visits in the fall of 2002 as part of Phase 2 of this study, during which core samples of the concrete were taken and an underwater inspection of the upstream portion of the structure was undertaken.

The geotechnical site investigations of the Control Structure abutments and Saddle Dykes 1, 2, and 3 took place in September, 2002. These investigations were supervised SGE Acres Limited and consisted of the following

- test pits at Saddle Dyke 1 in search of a 1 m wide core wall
- drilling of boreholes in Saddle Dykes 1 and 2
- installation of standpipe piezometers in the boreholes and subsequent monitoring of the water level
- variable hydraulic head testing in the piezometers
- drilling of probe holes at each of the saddle dykes
- drilling of probe holes at the control structure abutments
- measurement of the standing water level in each of the probe holes
- test pits at the control structure abutments to expose and inspect the concrete surface of the structure
- laboratory testing of the overburden samples

Photographs taken during the site investigations are included in Appendix A.

B-1 Geotechnical Site Investigations

B-1.1 Test Pits

Five test pits numbered TP1 to TP5 were excavated at the Concrete Control Structure and Saddle Dyke 1 on September 9, 2002. Test pits were excavated using a Cat 315L excavator operated by Maguire Excavating Ltd. of Saint John, New Brunswick. The test pits were inspected and logged by Bethanie Bourque of SGE Acres Limited. Information from the test pits is given in the Test Pit Reports in Annex B-2. On completion of excavation, the test pits were backfilled.

Test pits TP1 and TP2 were in the right and left abutments of the control structure respectively. These test pits were excavated to depths of 1.37 m and 1.52 m respectively and were excavated to expose the surface of the concrete structure at the abutments and to identify the abutment fill material.

Test pits TP3, 4, and 5 were located at the crest of Saddle Dyke 1. These test pits were excavated to search for the 1 m wide impermeable core identified on an old drawing. The 1 m wide impermeable core was not found. The test pitting was limited in both depth and width in order to maintain the stability of the structure during excavation. The depth of the test pits ranged from 1.75 m to 2.9 m.

The test pits are summarized in Table B-1.1 and the locations are shown on Figures B-1.1 and B-1.2.

Table B-1.1 Summary of Test Pit Data

Test Pit	Coordinates		Ground Elevation (m)	Bottom of Test Pit	
	Northing (m)	Easting (m)		Elevation (m)	Depth* (m)
Concrete Control Structure					
TP 1	7359356	2522068	76.53	75.16	1.37
TP 2	7359361	2522084	76.49	74.97	1.52
Saddle Dyke 1					
TP 3	7359092	2520853	77.25	75.25	2.00
TP 4	7359101	2520868	77.28	75.53	1.75
TP 5	7359116	2520886	77.24	74.34	2.9

Notes
All elevations are geodetic
* - depth measured from ground surface

B-1.2 Boreholes

Five boreholes numbered BH3 to BH7 were drilled at Saddle Dykes 1 and 2 on September 11, 2002 and September 17 to 19, 2002. Drilling was performed by Boart Longyear Inc. using a CME 55 track mounted drilling rig. The boreholes were inspected and logged by Bethanie Bourque of SGE Acres Limited. Samples were obtained with a standard 50 mm ID split spoon sampler used in conjunction with standard penetration tests. A list of abbreviations and terms used in the drilling and probe hole reports are included as Annex B-3. The Drilling Reports are included in Annex B-4.

The boreholes were drilled to depths ranging from 1.22 m to 6.78 m. Core samples into bedrock were not taken.

The boreholes are summarized in Table B-1.2 and the locations are shown in Figure B-1.2.

Table B-1.2 Summary of Borehole Data

Borehole	Coordinates		Ground Elevation (m)	Bottom of Borehole		Bedrock Elevation (m)	Piezometer Installed
	Northing (m)	Easting (m)		Elevation (m)	Depth* (m)		
Saddle Dyke 1							
BH 1	same location as BH 3		~72.3	~69.71	2.59	~69.71**	No
BH 2	same location as BH 3		~72.3	~71.08	1.22	NE	No
BH 3	7359110	2520899	72.27	69.55	2.72	69.55**	Yes
BH 4	7359091	2520856	77.23	73.17	4.06	73.17**	Yes
BH 5	7359117	2520893	77.13	70.35	6.78	70.35**	Yes
BH 7	7359117	2520892	77.14	73.94	3.20	NE	Yes
Saddle Dyke 2							
BH 6	7359134	2520737	76.60	73.37	3.23	73.37**	Yes

Notes:
All elevations are geodetic
* - depth measured from ground surface
** - bedrock surface assumed
NE - not encountered

B-1.3 Installation of Piezometers

A total of five standpipe piezometers were installed during the investigations. The details of each installation are provided in the Drilling Reports in Annex B-4 and are summarized in Table B-1.3.

Table B-1.3 Summary of Piezometer Installation Details

Piezometer	Ground Elevation (m)	Elevation of Riser Tube (m)	Depth* of Piezometer Screen		Depth* of Silica Sand	
			From (m)	To (m)	From (m)	To (m)
BH 3	72.27	73.64	1.68	2.29	1.68	2.29
BH 4	77.23	77.16	2.31	3.23	2.13	3.30
BH 5	77.13	77.09	4.47	6.07	3.66	6.78
BH 6	76.60	76.53	1.52	2.29	1.30	2.74
BH 7	77.14	77.03	2.20	3.12	1.88	3.18

Notes:
All elevations are geodetic
* - depth measured from ground surface

The piezometers consist of 50-mm ID PVC casing and slotted screen, or variable length, depending on the borehole geology. The screen and solid casing are of the same diameter and attached by flush threaded couplings.

A typical installation procedure for a piezometer involved backfilling the borehole with sand or common fill to a desired depth below the slotted screen of the piezometer. A bentonite seal, if required, was placed, followed by about 150 mm of coarse silica sand. The slotted screen and riser pipe were then set in the borehole and the slotted screen was packed by backfilling to about 200 mm above the screening with coarse silica sand. The top of the sand pack was then sealed with a thick cap of bentonite chips or bentonite slurry grout. The balance of the borehole, if not already sealed to the surface, was backfilled with cuttings or sand.

Difficulty was experienced on occasion during backfilling with sand or bentonite due to sloughing of the soil.

Water level measurements are summarized in the drilling reports contained in Annex B-4.

B-1.4 Permeability Testing

Permeability testing was carried out in the piezometers using the rising head and falling head method. The rising head test was performed on most of the piezometers by removing water by hand pumping the standpipe using a Terrapump.

The results of the variable head tests are given in Table B-1.4, and the coefficient of permeability values have been calculated following the method of Hvorslev. Permeability Calculations are provided in Annex B-5.

Table B-1.4 Summary of Variable Head Test Results

Piezometer	Depth of Water (m)	Depth* of Silica Sand From (m)	Depth* of Silica Sand To (m)	Type of Test	Coefficient of Permeability (m/s)	Strata Tested
BH3	@ Surface	1.68	2.29	Rising Head - 1	1.5×10^{-5}	Glacial Till
				Rising Head - 2	3.5×10^{-5}	
BH4	2.44	2.13	3.30	Rising Head	3.6×10^{-7}	Gravelly Silt
BH5	3.89	3.66	6.78	Rising Head - 1	8.4×10^{-6}	Gravel
				Falling Head - 2	5.2×10^{-6}	
BH6	1.72	1.30	2.74	Rising Head	7.4×10^{-6}	Embankment Fill / Silt / Gravel / Glacial Till
BH7	Dry	1.88	3.18	Falling Head - 1	8.5×10^{-6}	Embankment Fill / Gravel & Sand
				Falling Head - 2	7.0×10^{-6}	

Notes:
All elevations are geodetic
* - depth measured from ground surface

B-1.5 Probe Holes

A total of eighteen probe holes were advanced at the Menzies Lake structures on September 16, 2002 and September 18 to 20, 2002. Drilling of the probe holes was performed by Boart Longyear Inc. using a CME 55 track mounted drilling rig. The probe holes were inspected and logged by Bethanie Bourque of SGE Acres Limited. Some samples were obtained with a standard 50 mm ID split spoon sampler used in conjunction with standard penetration tests. A list of abbreviations and terms used in the drilling and probe hole reports are included as Annex B-3. The Probe Hole Reports are included in Annex B-6.

The probe holes were drilled to depths ranging from 1.73 m to 6.43 m. The probe holes were drilled at the abutments of the Control Structure, Saddle Dyke 1, and Saddle Dyke 2, as well as at the deepest section of Saddle Dyke 3 in order to determine the depth to bedrock. The standing water level (the stabilized water level in the open hole) was measured in each probe hole.

The probe holes are summarized in Table B-1.5 and the locations are shown on Figures B-1.1 and B-1.2.

Table B-1.5 Summary of Probe Hole Data

Probe Hole	Coordinates		Ground Elevation (m)	Bottom of Probe Hole		Bedrock Elevation (m)	Water Elevation (m)
	Northing (m)	Easting (m)		Elevation (m)	Depth* (m)		
PH 1	7359149	2520915	77.74	74.49	3.25	76.39	76.45
PH 2	7359138	2520908	77.50	75.77	1.73	75.77**	NE
PH 3	7359130	2520903	77.39	70.96	6.43	70.96**	73.26
PH 4	7359098	2520866	77.31	73.50	3.81	73.50**	NE
PH 5	7359096	2520862	77.31	73.80	3.51	73.80**	74.97
PH 6	7359088	2520834	77.35	75.24	2.11	75.24**	NE
PH 7	7359130	2520742	76.69	71.20	5.49	71.20**	74.80
PH 8	7359126	2520747	76.86	67.11	9.75	67.11**	74.82
PH 9	7359141	2520731	76.49	71.00	5.49	NE	75.16
PH 10	7359157	2520711	76.11	72.30	3.81	72.30**	74.80
PH 11	7359170	2520601	77.54	73.12	4.42	73.12**	75.62
PH 12	7359288	2520537	77.56	73.75	3.81	73.75**	75.60
PH 13	7359357	2522068	76.55	72.16	4.39	72.16**	74.41
PH 14	7359356	2522063	76.57	73.93	2.64	73.93**	75.30
PH 15	7359355	2522058	76.58	74.60	1.98	74.60**	75.21
PH 16	7359360	2522084	76.49	72.35	4.14	72.35**	74.50
PH 17	7359361	2522089	76.54	73.64	2.90	73.64**	74.96
PH 18	7359362	2522093	76.54	73.03	3.51	73.03**	73.66

Notes:
All elevations are geodetic
Water Elevation is stabilized water level
* - depth measured from ground surface
** - bedrock surface assumed
NE - not encountered

B-1.6 Concrete Coring

A total of three core samples were taken from the deck of the concrete control structure. These samples were taken on September 19, 2002. The depth of the cores ranged from 0.15 m (6 inches) to 0.33 m (13 inches). The concrete core samples are summarized in Table B-1.6 and the locations are shown in Figure B-1.1. The concrete was found to be sound, showing no signs of deterioration for the length of the cores.

Table B-1.6 Summary of Concrete Core Samples

Borehole	Coordinates		Ground Elevation (m)	Bottom of Borehole	
	Northing (m)	Easting (m)		Depth (m)	Depth (inches)
Core 1	7359359	2522079	76.52	0.33	13
Core 2	7359364	2522078	76.52	0.15	6
Core 3	7359357	2522072	76.52	0.23	9

Note: All elevations are geodetic

B-1.7 Laboratory Testing

The laboratory testing of samples was performed by Acres International Limited at the Geotechnical Lab Section in Niagara Falls, Ontario. The testing consisted of grain size analysis, hydrometer, and moisture content tests in accordance with the testing procedures described by ASTM standards.

Laboratory test results are included in Annex B-7.

B-1.8 Survey

Location and elevation of test pits, boreholes, and probe holes were surveyed by Desaulniers Surveys Inc. of Grand Bay – Westfield, New Brunswick.

Annex B1
Civil Inspection Report

Civil Inspection Report
Small Concrete Dams

1	**Identification**
1.1	Name: *Menzies Lake Concrete Control Structure*
1.2	Location: *N 7359359, W 2522079*
1.3	Year constructed: *1973*
2	**Inspection:**
2.1	Inspector(s): G. Snyder, J. Barnard
2.2	Date: *Oct 12, 2001*
2.3	Time: *9:30am – 11:30 am*
2.4	Weather: *Sunny, cold approx -5 C*
3	**Water Levels**
3.1	Upstream: *247.4 ft (75.4 m)*
3.2	Reference for measurement: *Water level board on left wingwall.*
3.3	Downstream: *Sill level for stop logs*
3.4	Reference for measurement: *Stop log bay sill*
4	**Graphic records and reports:**
4.1	Previous photographs of the dam
4.1.1	Available – yes □ or no X
4.1.2	Attached – yes □ or no X
4.2	Previous drawings of the dam
4.2.1	Available – yes X or no □
4.2.2	Attached – yes □ or no X
4.3	Previous reports on the dam
4.3.1	Available – yes □ or no X
4.3.2	Attached – yes □ or no X
4.4	Photographs taken during this inspection
4.4.1	Taken – yes X or no □
4.4.2	Attached – yes X or no □
4.5	Sketches made during this inspection
4.5.1	Made – yes X or no □
4.5.2	Attached – yes X or no □

Note: Sketches were developed as part of this study.

5 Abutments – Earth fill X or Concrete □

5.1 Left Abutment (looking downstream)

5.1.1 Defects in upstream face: *vegetated.*
5.1.2 Defects in crest: *graded road surface. Good condition*
5.1.3 Defects in downstream face: *vegetated.*

Note: leakage at downstream toe at concrete wingwall

5.2 Right Abutment (looking downstream)

5.2.1 Defects in upstream face: *vegetated*
5.2.2 Defects in crest: *graded road surface. Good condition*
5.1.3 Defects in downstream face: *vegetated.*

Note: leakage at downstream toe at concrete wingwall

6 Gated spillway bays:

6.1 General Description

6.1.1 Total number of bays: *Four*
6.1.2 Bay numbers/opening widths/gate types/number of logs: *All 10'+/- wide*
6.1.3 Depth from water surface to sill:
6.1.4 Identify bays which were spilling: *none*
6.1.5 Bay numbers/gate positions or stop logs in place: *all logs in place*

6.2 Gate(s) and stop logs

6.2.1 Type and proportions of gate(s): *None*
6.2.2 Condition of gate(s):
6.2.3 Type of hoist(s):
6.2.4 Condition of hoist(s):
6.2.5 Type and proportions of stop logs: *10" x 10" Timber*
6.2.6 Condition of stop logs: *Excellent*
6.2.7 Type of hoist(s): *none*
6.2.8 Condition of hoist(s):

6.3 End walls and Wingwalls (looking downstream)

6.3.1 Left end wall

6.3.1.1 Condition of steel in gate slots: *Not* applicable
6.3.1.2 Condition of steel in stop log slots: *Good*

6.3.1.3 Defects upstream of stop log slots: *none*
6.3.1.4 Defects between stop log and gate slots:
6.3.1.5 Defects downstream of gate slots: *minor cracks and calcite, no displacement*

note: leakage observed at downstream end of wingwall at earth fill interface.

6.3.2 Right end wall
6.3.2.1 Condition of steel in gate slots: *Not applicable*
6.3.2.2 Condition of steel in stop log slots: *Good*
6.3.2.3 Defects upstream of stop log slots: *none*
6.3.2.4 Defects between stop log slots and gate slots:
6.3.2.5 Defects downstream of gate slots: *minor cracks and calcite, no displacement*

note: leakage observed at downstream end of wingwall at earth fill interface.

6.4 Piers (looking downstream)

6.4.1 Pier No. 1
6.4.1.1 Right Side
6.4.1.1.1 Condition of steel in gate slot: *Not applicable*
6.4.1.1.2 Condition of steel in stop log slot: *Good*
6.4.1.1.3 Defects upstream of stop log slot: *none*
6.4.1.1.4 Defects between stop log and gate slot:
6.4.1.1.5 Defects downstream of gate slot: *minor surficial erosion near stoplogs*

6.4.1.2 Left side
6.4.1.2.1 Condition of steel in gate slot: *Not applicable*
6.4.1.2.2 Condition of steel in stop log slot: *Good*
6.4.1.2.3 Defects upstream of stop log slot: *none*
6.4.1.2.4 Defects between stop log and gate slot:
6.4.1.2.5 Defects downstream of gate slot: *minor surficial erosion near stoplogs*

6.4.2 Pier No. 2
6.4.2.1 Right Side
6.4.2.1.1 Condition of steel in gate slot: *Not applicable*
6.4.2.1.2 Condition of steel in stop log slot: *Good*
6.4.2.1.3 Defects upstream of stop log slot: *none*
6.4.2.1.4 Defects between stop log and gate slot:
6.4.2.1.5 Defects downstream of gate slot: *minor surficial erosion near stoplogs*

6.4.2.2 Left side
6.4.2.2.1 Condition of steel in gate slot: *Not applicable*
6.4.2.2.2 Condition of steel in stop log slot: *Good*
6.4.2.2.3 Defects upstream of stop log slot: *none*
6.4.2.2.4 Defects between stop log and gate slot:
6.4.2.2.5 Defects downstream of gate slot: *minor surficial erosion near stoplogs*

6.4.3 Pier No. 3
6.4.3.1 Right Side
6.4.3.1.1 Condition of steel in gate slot: *Not applicable*
6.4.3.1.2 Condition of steel in stop log slot: *Good*
6.4.3.1.3 Defects upstream of stop log slot: *none*
6.4.3.1.4 Defects between stop log and gate slot:
6.4.3.1.5 Defects downstream of gate slot: *minor surficial erosion near stoplogs*
6.4.3.2 Left side
6.4.3.2.1 Condition of steel in gate slot: *Not applicable*
6.4.3.2.2 Condition of steel in stop log slot: *Good*
6.4.3.2.3 Defects upstream of stop log slot: *none*
6.4.3.2.4 Defects between stop log and gate slot:
6.4.3.2.5 Defects downstream of gate slot: *minor surficial erosion near stoplogs*

6.5 Rollways or sluice slabs between abutments/piers

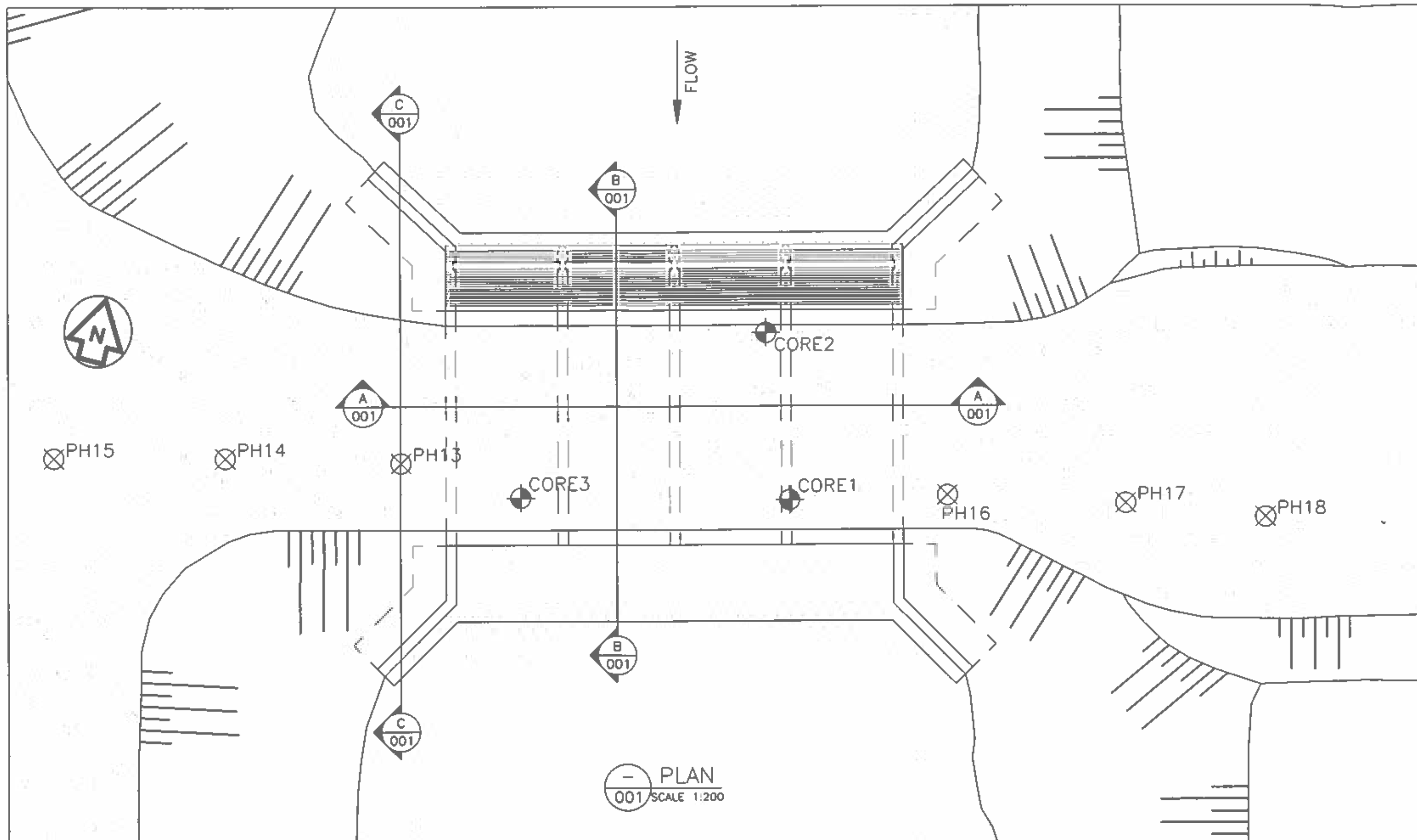
6.5.1 Bay No.1
6.5.1.1 Condition upstream of crest:
6.5.1.2 Condition of crest:
6.5.1.3 Condition downstream of crest: *minor surficial erosion in main flow areas*
6.5.1.4 Leakage observed: *minor leakage of stoplogs at slots*
6.5.1.5 Condition of vertical joints:
6.5.1.6 Condition of horizontal joints:
6.5.1.7 Condition of foundation downstream: *good, no undercutting observed*
6.5.2 Bay No.2
6.5.2.1 Condition upstream of crest:
6.5.2.2 Condition of crest:
6.5.2.3 Condition downstream of crest: *minor surficial erosion in main flow areas*
6.5.2.4 Leakage observed: *minor leakage of stoplogs at slots*
6.5.2.5 Condition of vertical joints:
6.5.2.6 Condition of horizontal joints:

6.5.2.7 Condition of foundation downstream: *good, no undercutting observed*
6.5.3 Bay No.3
6.5.3.1 Condition upstream of crest:
6.5.3.2 Condition of crest:
6.5.3.3 Condition downstream of crest: *minor surficial erosion in main flow areas*
6.5.3.4 Leakage observed: *minor leakage of stoplogs at slots*
6.5.3.5 Condition of vertical joints:
6.5.3.6 Condition of horizontal joints:
6.5.3.7 Condition of foundation downstream: *good, no undercutting observed*
6.5.4 Bay No.4
6.5.4.1 Condition upstream of crest:
6.5.4.2 Condition of crest:
6.5.4.3 Condition downstream of crest: *minor surficial erosion in main flow areas*
6.5.4.4 Leakage observed: *minor leakage of stoplogs at slots*
6.5.4.5 Condition of vertical joints:
6.5.4.6 Condition of horizontal joints:
6.5.4.7 Condition of foundation downstream: *good, no undercutting observed*

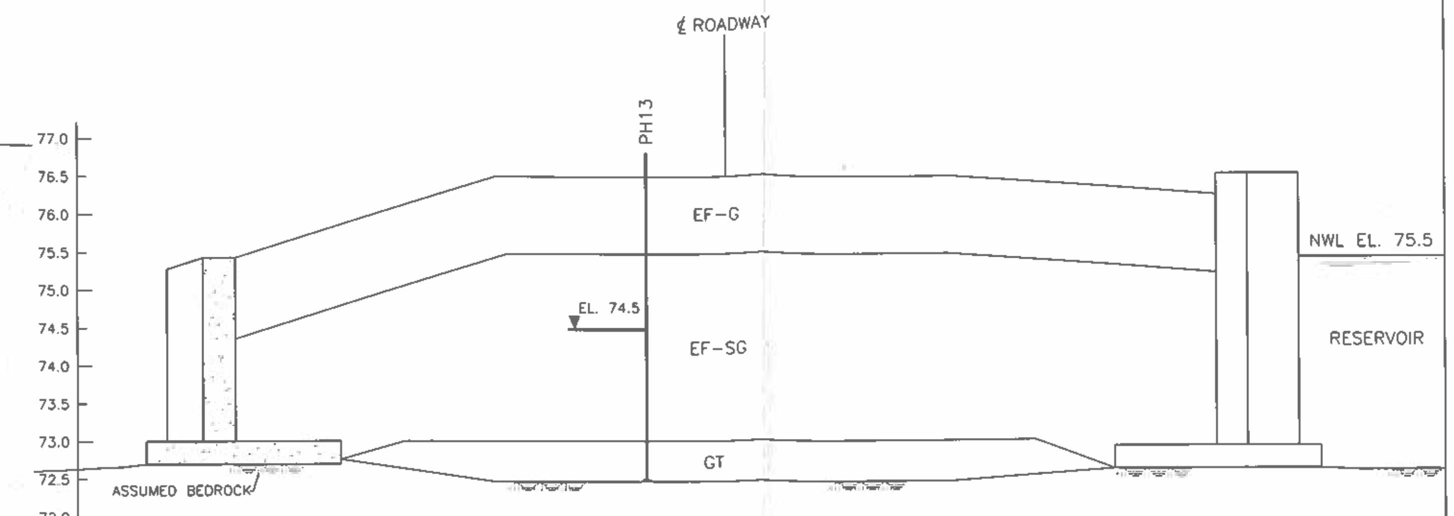
6.6 Deck spans – Concrete X Steel □ Wood □

6.6.1 Concrete Decks
6.6.1.1 Bay No. 1
6.6.1.1.1 Underside defects: *none*
6.6.1.1.2 Topside defects: *none*
6.6.1.1.3 Condition of upstream edge: *good*
6.6.1.1.4 Condition of downstream edge: *good*
6.6.1.1.5 Type of railing:
6.6.1.1.5.1 Condition of upstream railing: *wooden railing at stoplogs - good*
6.6.1.1.5.2 Condition of downstream railing: *none*
6.6.1.1.6 Gate slot covers:
6.6.1.1.6.1 Type of cover: *wooden*
6.6.1.1.6.2 Condition of cover: *good*
6.6.1.1.7 Condition of up-stand
6.6.1.2 Bay No.2
6.6.1.2.1 Underside defects: *none*
6.6.1.2.2 Topside defects: *none*
6.6.1.2.3 Condition of upstream edge: *good*
6.6.1.2.4 Condition of downstream edge: *good*
6.6.1.2.5 Type of railing:

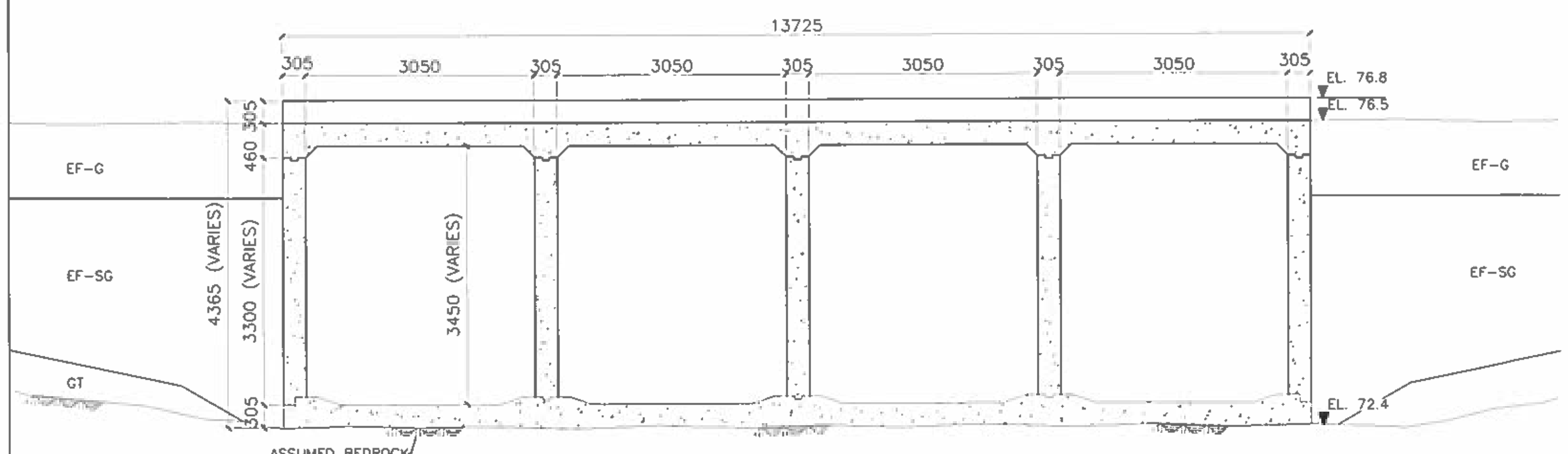
6.6.1.2.5.1 Condition of upstream railing: *wooden railing at stoplogs - good*
6.6.1.2.5.2 Condition of downstream railing: *none*
6.6.1.2.6 Gate slot covers:
6.6.1.2.6.1 Type of cover:
6.6.1.2.6.2 Condition of cover:
6.6.1.2.7 Condition of up-stand:
6.6.1.3 Bay No.3
6.6.1.3.1 Underside defects: *none*
6.6.1.3.2 Topside defects: *none*
6.6.1.3.3 Condition of upstream edge: *good*
6.6.1.3.4 Condition of downstream edge: *good*
6.6.1.3.5 Type of railing:
6.6.1.3.5.1 Condition of upstream railing: *wooden railing at stoplogs - good*
6.6.1.3.5.2 Condition of downstream railing: *none*
6.6.1.3.6 Gate slot covers:
6.6.1.3.6.1 Type of cover: *wooden*
6.6.1.3.6.2 Condition of cover: *good*
6.6.1.3.7 Condition of up-stand:
6.6.1.4 Bay No.4
6.6.1.4.1 Underside defects: *none*
6.6.1.4.2 Topside defects: *none*
6.6.1.4.3 Condition of upstream edge: *good*
6.6.1.4.4 Condition of downstream edge: *good*
6.6.1.4.5 Type of railing:
6.6.1.4.5.1 Condition of upstream railing: *wooden railing at stoplogs - good*
6.6.1.4.5.2 Condition of downstream railing: *none*
6.6.1.4.6 Gate slot covers:
6.6.1.4.6.1 Type of cover: *wooden*
6.6.1.4.6.2 Condition of cover: *good*
6.6.1.4.7 Condition of up-stand:



PLAN
SCALE 1:200



B 001 SECTION
SCALE 1:100



A 001 SECTION – LOOKING UPSTREAM
SCALE 1:100

LEGEND:

EF-G	EMBANKMENT FILL, GRAVEL
EF-SG	EMBANKMENT FILL, SAND AND GRAVEL
GT	GLACIAL TILL
NWL	NORMAL WATER LEVEL
MFL	MAXIMUM FLOOD LEVEL
	ASSUMED BEDROCK SURFACE
	WATER
	ROADWAY

NOTE:

1. ALL ELEVATIONS ARE IN METRES AND DISTANCES IN MILLIMETRES.

PROBEHOLE LOCATIONS/ELEVATIONS

PROBE HOLE	ELEVATION (m)	REGION
13	76.55	ROAD
14	76.57	ROAD
15	76.58	ROAD
16	76.49	ROAD
17	76.54	ROAD
18	76.54	ROAD

CORE LOCATIONS/ELEVATIONS

CORE	ELEVATION (m)	REGION
1	76.52	CONCRETE STRUCTURE
2	76.52	CONCRETE STRUCTURE
3	76.52	CONCRETE STRUCTURE

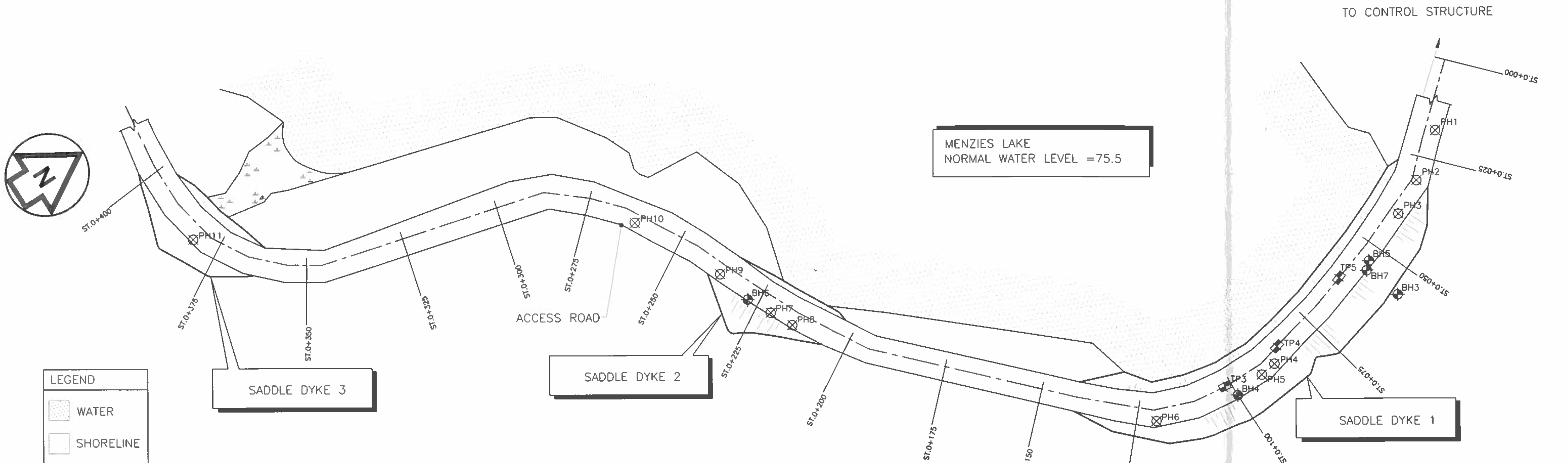
TESTPIT LOCATIONS/ELEVATIONS

TEST PIT	ELEVATION (m)	REGION
1	76.53	ROAD
2	76.49	ROAD

FIG B-1.1

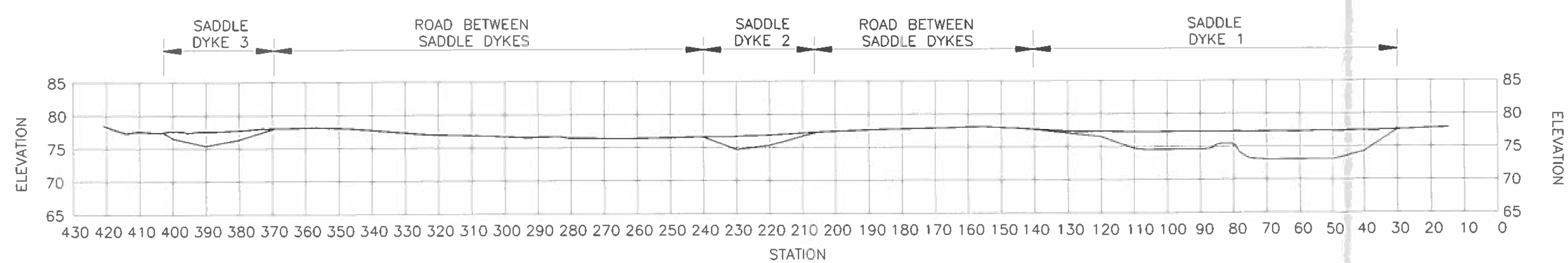
CITY OF SAINT JOHN
MENZIES LAKE DAM SAFETY REVIEW
CONCRETE STRUCTURE GENERAL LOCATION

SGE Acres



PLAN—GENERAL LOCATION

SCALE 1:1000



CENTRELINE PROFILE

SCALE H = 1500
V = 750

PROBEHOLE LOCATIONS/ELEVATIONS					
PROBE HOLE	ELEVATION (m)	REGION	PROBE HOLE	ELEVATION (m)	REGION
1	77.74	ROAD	7	76.70	SADDLE DYKE 2
2	77.50	SADDLE DYKE 1	8	76.87	SADDLE DYKE 2
3	77.39	SADDLE DYKE 1	9	76.49	SADDLE DYKE 2
4	77.31	SADDLE DYKE 1	10	76.11	ROAD
5	77.31	SADDLE DYKE 1	11	77.54	SADDLE DYKE 3
6	77.35	SADDLE DYKE 1	12	77.56	ROAD

BOREHOLE LOCATIONS/ELEVATIONS		
BOREHOLE	ELEVATION (m)	REGION
3	72.27	SADDLE DYKE 1
4	77.23	SADDLE DYKE 1
5	77.13	SADDLE DYKE 1
6	76.60	SADDLE DYKE 2
7	77.14	SADDLE DYKE 1

TESTPIT LOCATIONS/ELEVATIONS		
TEST PIT	ELEVATION (m)	REGION
3	77.25	SADDLE DYKE 1
4	77.28	SADDLE DYKE 1
5	77.24	SADDLE DYKE 1

NOTE:

1. ALL ELEVATIONS AND STATIONS MEASURED IN METRES.

FIG B–1.2

CITY OF SAINT JOHN
MENZIES LAKE DAM SAFETY REVIEW
SADDLE DYKES GENERAL LOCATION

SGE Acres

Annex B2
Test Pit Reports

TEST PIT REPORT

ACRES

CLIENT: City of Saint John
PROJECT: Menzies Lake Dam Safety Study

PIT NO: TP 1
PAGE: 1 **OF:** 1

SITE: Control Structure, right abutment, N7359356 E2522068

COORDINATES:

CONTRACTOR: Maguire Excavating Ltd.
EXCAVATION METHOD Cat 315L

STARTED: 09 Sept, 2002
FINISHED: 09 Sept, 2002
INSPECTOR: B.Bourque

LENGTH: 3.35
WIDTH: 1.83
DEPTH 1.37

ELEVATIONS (m)
DATUM: Geodetic
GROUND: 76.531
BOTTOM OF PIT: 75.16

WATER: 1.01
WEATHER: sunny/cloudy periods, warm

See end page for detailed groundwater measurements

ELEV. / DEPTH (m)	DESCRIPTION	SAMPLE DEPTH	SAMPLE TYPE/NUMBER	SAMPLE SIZE	DEPTH (m)	SHEAR STRENGTH (kPa) ☐ UNCONFINED ■ QUICK TRIAXIAL ✖ FIELD VANE ✚ LAB VANE ✦ POCKET PEN. 40 80 120 160	WATER CONTENT & ATTERBERG LIMITS 10 20 30 (%)	BULK DENSITY (kg/m3)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
76.531 / 0.0	road topping - gravel								Reservoir Level: 248.55 ft (09/09/2002 8:45 AM)
76.281 / .25	gravel, some sand, average size 150 mm minus, max size 300 mm, trace silt	0.76 – 0.96	GS1						inspect concrete surface - concrete surface is in good condition (photos 3684 to 3686) GS1 taken approx 2 m from edge of concrete water flows in at 1.01 m End of test pit at 1.37 m
75.161 / 1.37	BOTTOM OF TEST PIT								Note: material content has more fines away from the structure (see photos 3687 to 3689)

SAMPLING METHOD AND SHIPPING CONTAINER

G- Shovel	R - Cloth Bag
L- Block Sample	S - Plastic Bag
P - Water Content Tin	U - Wooden Box
Q - Jar	Z - Discarded

LOGGED BY: B.Bourque
REVIEWED BY:
DATE

Project: **P14127.00**

TEST PIT REPORT

ACRES

CLIENT: City of Saint John
PROJECT: Menzies Lake Dam Safety Study

PIT NO: TP 2
PAGE: 1 **OF:** 1

SITE: Control Structure, left abutment, N7359361 E2522084

COORDINATES:

CONTRACTOR: Maguire Excavating Ltd.
EXCAVATION METHOD Cat 315L

STARTED: 09 Sept, 2002
FINISHED: 09 Sept, 2002
INSPECTOR: B.Bourque

LENGTH: 3.05
WIDTH: 1.83
DEPTH 1.52

ELEVATIONS (m)
DATUM: Geodetic
GROUND: 76.493
BOTTOM OF PIT: 74.97

WATER: 1.27
WEATHER: sunny/cloudy periods, warm

ELEV. DEPTH (m)	DESCRIPTION	SAMPLE DEPTH	SAMPLE TYPE/NUMBER	SAMPLE SIZE	DEPTH (m)	SHEAR STRENGTH (kPa) ☐ UNCONFINED ■ QUICK TRIAXIAL ✖ FIELD VANE ✚ LAB VANE ✥ POCKET PEN. 40 80 120 160	WATER CONTENT & ATTERBERG LIMITS 10 20 30 (%)	BULK DENSITY (kg/m3)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
76.493									
76.468 .025	road topping - gravel								Reservoir Level: 248.55 ft (09/09/2002 8:45 AM)
	gravel, trace sand, average size 102 mm, angular, some boulders - max size 460 mm								inspect concrete surface - concrete surface is in good condition water is at elevation 1.22 m End of test pit at 1.52 m
74.973 1.52	BOTTOM OF TEST PIT								leakage at left abutment turns brown when backfill the test pit (photo 3700), once backfilled to 0.61 m below ground surface leakage is almost clear again

SAMPLING METHOD AND SHIPPING CONTAINER

G- Shovel
L- Block Sample
P - Water Content Tin
Q - Jar

R - Cloth Bag
S - Plastic Bag
U - Wooden Box
Z - Discarded

LOGGED BY: B.Bourque
REVIEWED BY:
DATE

TEST PIT REPORT

ACRES

CLIENT: City of Saint John | **PIT NO:** TP 3

PROJECT: Menzies Lake Dam Safety Study | **PAGE:** 1 **OF:** 1

SITE: Saddle Dyke 1, crest of dam, N7359092 E2520853

COORDINATES:

CONTRACTOR: Maguire Excavating Ltd.
EXCAVATION METHOD Cat 315L

STARTED: 09 Sept, 2002
FINISHED: 09 Sept, 2002
INSPECTOR: B.Bourque

LENGTH: 4.5
WIDTH: 4.3
DEPTH 2

ELEVATIONS (m)
DATUM: Geodetic
GROUND: 77.248
BOTTOM OF PIT: 75.25

WATER: 1.75
WEATHER: sunny/cloudy periods, warm

ELEV. / DEPTH (m)	DESCRIPTION	SAMPLE DEPTH	SAMPLE TYPE/NUMBER	SAMPLE SIZE	DEPTH (m)	SHEAR STRENGTH (kPa) (☐ UNCONFINED ■ QUICK TRIAXIAL ✖ FIELD VANE ◆ LAB VANE ◆ POCKET PEN.) 40 80 120 160	WATER CONTENT & ATTERBERG LIMITS 10 20 30 (%)	BULK DENSITY (kg/m3)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
77.248 0.0	road topping - gravel								Reservoir Level: 248.55 ft (09/09/2002 8:45 AM)
77.048 0.2	sand and gravel, some cobbles, brown, gravel is grey-blue, angular to subrounded, max size 200 mm								upstream edge of testpit is approx 3.5 m from upstream edge of dam
76.148 1.1	red cobbles, some fines (clay) - clay is like mortar amongst the red rock, trace sand and gravel, angular to subrounded, max size 150 mm								drawing shows a 1 m wide corewall, however no corewall encountered during test pit excavation
75.848 1.4	organic silt, some rock, trace sand, tree stumps up to 200 mm diameter								End of test pit at 2.0 m
75.248 2	BOTTOM OF TEST PIT								Water encountered at 1.75 m below ground surface. Water enters from upstream side of test pit.

SAMPLING METHOD AND SHIPPING CONTAINER

G- Shovel	R - Cloth Bag
L- Block Sample	S - Plastic Bag
P - Water Content Tin	U - Wooden Box
Q - Jar	Z - Discarded

LOGGED BY: B.Bourque
REVIEWED BY:
DATE

TEST PIT REPORT

ACRES

CLIENT: City of Saint John | **PIT NO:** TP 4
PROJECT: Menzies Lake Dam Safety Study | **PAGE:** 1 **OF:** 1

SITE: Saddle Dyke 1, crest of dam, N7359101 E2520868

COORDINATES:

CONTRACTOR: Maguire Excavating Ltd.
EXCAVATION METHOD Cat 315L

STARTED: 09 Sept, 2002
FINISHED: 09 Sept, 2002
INSPECTOR: B.Bourque

LENGTH: 4.9
WIDTH: 3.7
DEPTH 1.75

ELEVATIONS (m)
DATUM: Geodetic
GROUND: 77.281
BOTTOM OF PIT: 75.53

WATER: NE
WEATHER: sunny/cloudy periods, warm

ELEV. DEPTH (m)	DESCRIPTION	SAMPLE DEPTH	SAMPLE TYPE/NUMBER	SAMPLE SIZE	DEPTH (m)	SHEAR STRENGTH (kPa) (□ UNCONFINED, ■ QUICK TRIAXIAL, ✖ FIELD VANE, ✚ LAB VANE, ✜ POCKET PEN.) 40 80 120 160	WATER CONTENT & ATTERBERG LIMITS 10 20 30 (%)	BULK DENSITY (kg/m3)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
77.281 0.0	road topping - compact sand and gravel, brown, max size 150 mm								Reservoir Level: 248.55 ft (09/09/2002 8:45 AM)
76.981 0.3	fine sand, gravelly, brown, angular, max size 100 mm	0.6 0.8	GS1						upstream edge of testpit is approx 1.5 m from upstream edge of dam
76.181 76.131 1.15	50 mm thick red silt seam, dry (not plastic), gravelly								drawing shows a 1 m wide corewall, however no corewall encountered during test pit excavation
	gravel, and silt, and sand, brown, max size 300 mm, trace organics (roots, twigs up to 10 mm diameter)	1.3 1.5	GS2						end of test pit at 1.75 m
75.531 1.75	**BOTTOM OF TEST PIT**								NO WATER ENCOUNTERED

SAMPLING METHOD AND SHIPPING CONTAINER

G- Shovel	R - Cloth Bag
L- Block Sample	S - Plastic Bag
P - Water Content Tin	U - Wooden Box
Q - Jar	Z - Discarded

LOGGED BY: B.Bourque
REVIEWED BY:
DATE

TEST PIT REPORT

ACRES

CLIENT: City of Saint John

PROJECT: Menzies Lake Dam Safety Study

PIT NO: TP 5

PAGE: 1 **OF:** 1

SITE: Saddle Dyke 1, crest of dam, N7359116 E2520886

COORDINATES:

CONTRACTOR: Maguire Excavating Ltd.
EXCAVATION METHOD Cat 315L

STARTED: 09 Sept, 2002
FINISHED: 09 Sept, 2002
INSPECTOR: B.Bourque

LENGTH: 4.88
WIDTH: 2.44
DEPTH 2.9

WATER: NE
WEATHER: sunny/cloudy periods, warm

ELEVATIONS (m)
DATUM: Geodetic
GROUND: 77.241
BOTTOM OF PIT: 74.34

ELEV. / DEPTH (m)	DESCRIPTION	SAMPLE: DEPTH	SAMPLE: TYPE/NUMBER	SAMPLE: SIZE	DEPTH (m)	SHEAR STRENGTH (kPa) ☐ UNCONFINED ■ QUICK TRIAXIAL ✖ FIELD VANE ✚ LAB VANE ✜ POCKET PEN. 40 80 120 160	WATER CONTENT & ATTERBERG LIMITS 10 20 30 (%)	BULK DENSITY (kg/m3)	REMARKS AND GRAIN SIZE DISTRIBUTION (%) GR SA SI CL
77.241 / 0.0	sand and gravel, max size 70 mm								Reservoir Level: 248.55 ft (09/09/2002 8:45 AM) upstream edge of test pit is approx 3.3 m from upstream edge of dam drawing shows a 1 m wide corewall, however no corewall encountered during test pit excavation
76.041 / 1.2	gravel and silt, and sand, brown, trace organics (fine roots)								end of test pit at 2.90 m
74.341 / 2.9	BOTTOM OF TEST PIT								NO WATER ENCOUNTERED

SAMPLING METHOD AND SHIPPING CONTAINER

G- Shovel	R - Cloth Bag
L- Block Sample	S - Plastic Bag
P - Water Content Tin	U - Wooden Box
Q - Jar	Z - Discarded

LOGGED BY: B.Bourque
REVIEWED BY:
DATE

Annex B3
Abbreviations and Terms Used in Drilling and Probe Hole Reports

List of Abbreviations and Terms used in the Borehole Reports

(Sheet 1)

SGE Acres

General

Elevations

Refer to datum indicated on drilling report.

Depth

All depths are given in metres measured from the ground surface unless otherwise noted.

Sample Type

The first letter describes the sampling method and the second, the shipping container.

Sampling Method

A - Split Tube	E - Auger
B - Thin Wall Tube	F - Wash
C - Piston Sampler	G - Shovel Grab Sample
D - Core Barrel	K - Slotted Sampler

Shipping Container

N - Insert	S - Plastic Bag
O - Tube	U - Wooden Box
P - Water Content Tin	Y - Core Box
Q - Jar	Z - Discarded
R - Cloth Bag	

Sample No.

Samples are numbered consecutively in the order in which they were obtained in the borehole.

Sample Size

Dimension is in millimetres and refers to the nominal diameter of the sampler.

Sample Retained

Indicates the length in millimetres of sample retained in the sampler.

Abbreviations

N/A - Not applicable
N/E - Not encountered
N/O - Not observed

Permeability

Degree of Permeability	*k (cm/s)*
Very high	$>10^{-1}$
High	10^{-1} to 10^{-3}
Medium	10^{-3} to 10^{-5}
Low	10^{-5} to 10^{-7}
Practically impermeable	$<10^{-7}$

Soil

Standard Penetration Test (SPT)

The test is carried out in accordance with ASTM D-1586 and the 'N' value corresponds to the sum of the number of blows required by a 63.5-kg hammer, dropped 760 mm, to drive a 50-mm diameter split tube sampler the second and third 150 mm of penetration.

Grain Size

Clay	<0.002 mm
Silt	0.002 - 0.075 mm
Sand	0.075 - 4.75 mm
Gravel	4.75 - 75 mm
Cobbles	75 - 200 mm
Boulder	>200 mm

Soil Description

Term	*Example*	*(%)*
Trace	Trace sand	1 - 10
Some	Some sand	10 - 20
Adjective	Sandy	20 - 35
And	And sand	>35
Noun	Sand	>50

Relative Density (Granular Soils)

	N (SPT)
Very loose	0 - 4
Loose	4 - 10
Compact	10 - 30
Dense	30 - 50
Very dense	>50

Consistency (Cohesive Soils)

	N (SPT)	*Undrained Shear Strength kPa*	*psf*
Very soft	<2	0 - 12	0 - 250
Soft	2 - 4	12 - 25	250 - 500
Firm	4 - 8	25 - 50	500 - 1000
Stiff	8 - 15	50 - 100	1000 - 2000
Very stiff	15 - 30	100 - 200	2000 - 4000
Hard	>30	>200	>4000

Plasticity/Compressibility

		Liquid Limit (%)
Low plasticity clays	Low compressibility silts	<30
Medium plasticity clays	Medium compressibility silts	30 - 50
High plasticity clays	High compressibility silts	>50

Dilatancy

None - No visible change.

Slow - Water appears slowly on surface of specimen during shaking and does not disappear or disappears slowly upon squeezing.

Rapid - Water appears quickly on the surface of specimen during shaking and disappears quickly upon squeezing.

Sensitivity

Insensitive	< 2
Low	2 - 4
Medium	4 - 8
High	8 - 16
Quick	> 16

List of Abbreviations and Terms used in the Borehole Reports
(Sheet 2)

SGE Acres

Rock

Core Recovery

Sum of lengths of rock core recovered from a core run, divided by the length of the core run and expressed as a percentage.

RQD (Rock Quality Designation)

Sum of lengths of hard, sound pieces of rock core equal to or greater than 100 mm from a core run, divided by the length of the core run and expressed as a percentage. Measured along centerline of core. Core fractured by drilling is considered intact. RQD normally quoted for N-size core.

RQD (%)	*Rock Quality*
90 - 100	Excellent
75 - 90	Good
50 - 75	Fair
25 - 50	Poor
0 - 25	Very poor

Grain Size

Term	*Grain Size*
Very coarse-grained	>60 mm
Coarse-grained	2 mm - 60 mm
Medium-grained	60 µm - 2 mm
Fine-grained	2 µm - 60 µm
Very fine-grained	<2 µm

Bedding

Term	*Bed Thickness*	
Very thickly bedded	>2 m	>6.50 ft
Thickly bedded	600 mm - 2 m	2.00 - 6.50 ft
Medium bedded	200 mm - 600 mm	0.65 - 2.00 ft
Thinly bedded	60 mm - 200 mm	0.20 - 0.65 ft
Very thinly bedded	20 mm - 60 mm	0.06 - 0.20 ft
Laminated	6 mm - 20 mm	0.02 - 0.06 ft
Thinly laminated	<6 mm	<0.02 ft

Discontinuity Frequency

Expressed as the number of discontinuities per metre or discontinuities per foot. Excludes drill-induced fractures and fragmented zones.

Discontinuity Spacing

Term	*Average Spacing*	
Extremely widely spaced	>6 m	>20.00 ft
Very widely spaced	2 m - 6 m	6.50 - 20.00 ft
Widely spaced	600 mm - 2 m	2.00 - 6.50 ft
Moderately spaced	200 mm - 600 mm	0.65 - 2.00 ft
Closely spaced	60 mm - 200 mm	0.20 - 0.65 ft
Very closely spaced	20 mm - 60 mm	0.06 - 0.20 ft
Extremely closely spaced	<20 mm	<0.06 ft

Note: Excludes drill-induced fractures and fragmented rock.

Broken Zone

Zone of full diameter core of very low RQD which may include some drill-induced fractures.

Fragmented Zone

Zone where core is less than full diameter and RQD = 0.

Strength

Term	*Description*	*Unconfined Compressive Strength* (MPa)	(psi)
Extremely weak rock	Indented by thumbnail	0.25-1.0	36-145
Very weak rock	Crumbles under firm blows with point of geological hammer, can be peeled by a pocket knife	1.0-5.0	145-725
Weak rock	Can be peeled by a pocket knife with difficulty, shallow indentations made by firm blow with point of geological hammer	5.0-25	725-3625
Medium strong rock	Cannot be scraped or peeled with a pocket knife, specimen can be fractured with single firm blow of geological hammer to fracture it	25-50	3625-7250
Strong rock	Specimen requires more than one blow of geological hammer to fracture it	50-100	7250-14500
Very strong rock	Specimen requires many blows of geological hammer to fracture it	100-250	14500-36250
Extremely strong rock	Specimen can only be chipped with geological hammer	>250	>36250

Weathering

Term	*Description*
Fresh	No visible sign of rock material weathering.
Faintly weathered	Discoloration on major discontinuity surfaces.
Slightly weathered	Discoloration indicates weathering of rock material and discontinuity surfaces. All the rock material may be discolored by weathering and may be somewhat weaker than in its fresh condition.
Moderately weathered	Less than half of the rock material is decomposed and/or disintegrated to a soil. Fresh or discolored rock is present either as a continuous framework or as corestones.
Highly weathered	More than half of the rock material is decom posed and/or disintegrated to a soil. Fresh or discolored rock is present either as a discontinuous framework or as corestones.
Completely weathered	All rock material is decomposed and/or disintegrated to a soil. The original mass structure is still largely intact.
Residual soil	All rock material is converted to soil. The mass structure and material fabic are destroyed. There is a large change in volume,but the soil has not been significantly transported.

Annex B4
Drilling Reports

DRILLING REPORT

ACRES

CLIENT: City of Saint John

PROJECT: Menzies Lake Dam Safety Study

HOLE: BH 1

PAGE: 1 **OF:** 1

SITE: Saddle Dyke 1, d/s toe (in the vicinity of BH 3)

DIP DIRECTION:
DIP: 90
ELEVATIONS (m)
DATUM: Geodetic
PLATFORM:
GROUND:
END OF HOLE:

CONTRACTOR: Boart-Longyear Inc.
DRILL TYPE: CME 55, track mounted
METHOD SOIL: Std. auger, 115 mm OD
ROCK:
CASING:
CORE:

STARTED: 11 Sept, 2002
FINISHED: 11 Sept, 2002
INSPECTOR: B.Bourque
LOGGED BY: B.Bourque

SCALE (m)	DEPTH (m)	DESCRIPTION	SAMPLE DEPTH (m)	TYPE/ NUMBER	SIZE (mm)	RECY (mm)	RETD (mm)	BLOW COUNTS	REMARKS
	0.0	Organics, wet	0 0.61	A1	50	0		0 0 1 3	
	.61 .66	Peat - Organics, brown to black, wet Glacial Till - Gravel, some silt, some sand, grey to brown, angular to subrounded, max size 40 mm	0.61 1.22	AQ2	50	305		6 14 19 21	
	1.22		1.22 1.83	AQ3	50	0		11 16 16 19	
									advance augers to 1.83 m (6 ft) - boulder at 6 ft advance augers to 2.59 m (8.5 ft) resistant stratum at 2.59 m
	2.59		END OF BOREHOLE						

SAMPLING METHOD

A - Split Tube
B - Thin Wall Tube
C - Piston Sample
D - Core Barrel
E - Auger
F - Wash
G - Shovel Grab
K - Slotted

SHIPPING CONTAINER

N - Insert
O - Tube
P - Water Content Tin
Q - Jar
R - Cloth Bag
S - Plastic Bag
U - Wooden Box
Y - Core Box
Z - Discarded

Approved ____________________

Date ____________________

Project: P14127.00

DRILLING REPORT

ACRES

CLIENT: City of Saint John
PROJECT: Menzies Lake Dam Safety Study

HOLE: BH 2
PAGE: 1 **OF:** 1

SITE: Saddle Dyke 1, d/s toe (in the vicinity of BH 3)

DIP DIRECTION:
DIP: 90

ELEVATIONS (m)
DATUM: Geodetic
PLATFORM:
GROUND:

END OF HOLE:

CONTRACTOR: Boart-Longyear Inc.
DRILL TYPE: CME 55, track mounted
METHOD SOIL: Std. auger, 115 mm OD
ROCK:
CASING:

CORE:

STARTED: 11 Sept, 2002
FINISHED: 11 Sept, 2002
INSPECTOR: B.Bourque
LOGGED BY: B.Bourque

SCALE (m)	DEPTH (m)	DESCRIPTION	SAMPLE DEPTH (m)	TYPE/ NUMBER	SIZE (mm)	RECY (mm)	RET'D (mm)	BLOW COUNTS	REMARKS
	0.0								
		Organics - dark brown to black, gravelly, very wet	0.61					3	
	.71	Glacial Till - Gravel, some sand, some silt, grey, angular to subrounded, max size 30 mm		AQ1	50	330		19 46 27	advance augers to 0.91m (3 ft) could not advance augers past 3 ft - kicking out on a boulder
			1.22						
	1.22	END OF BOREHOLE							

SAMPLING METHOD

A - Split Tube
B - Thin Wall Tube
C - Piston Sample
D - Core Barrel
E - Auger
F - Wash
G - Shovel Grab
K - Slotted

SHIPPING CONTAINER

N - Insert
O - Tube
P - Water Content Tin
Q - Jar
R - Cloth Bag
S - Plastic Bag
U - Wooden Box
Y - Core Box
Z - Discarded

Approved ____________________

Date ____________________

DRILLING REPORT

ACRES

CLIENT: City of Saint John
PROJECT: Menzies Lake Dam Safety Study

HOLE: BH 3

SITE: Saddle Dyke 1, d/s toe, N7359110 E2520899

DIP DIRECTION:
DIP: 90
ELEVATIONS (m)
DATUM: Geodetic
PLATFORM:
GROUND: 72.267
END OF HOLE:

CONTRACTOR: Boart-Longyear Inc.
DRILL TYPE: CME 55, track mounted
METHOD SOIL: Std. auger, 115 mm OD
ROCK:
CASING:
CORE:

STARTED: 11 Sept, 2002
FINISHED: 11 Sept, 2002
INSPECTOR: B.Bourque
LOGGED BY: B.Bourque

See end page for detailed groundwater measurements

SCALE (m)	DEPTH (m)	DESCRIPTION	SAMPLE DEPTH (m)	TYPE/ NUMBER	SIZE (mm)	RECY (mm)	RETD (mm)	BLOW COUNTS	REMARKS
	0.0	Organics, wet							borehole location is approximately 8 ft from downstream toe of dam to avoid boulders
	0.7	Glacial Till - gravel with some silt and some sand, and sand with some gravel and some silt, grey, angular to subrounded, max size 50 mm	1.22–1.83	AQ1	50	229		14 14 20 14	
			1.83–2.44	AQ2	50	203		9 15 13 24	advance augers to 2.62 m, resistant stratum (could be a boulder), chain broke inside drill - cannot advance augers
			2.44–2.72	AQ3	50	254		32 70	
	2.72	END OF BOREHOLE							return drill rig to Moncton, NB to be repaired

SAMPLING METHOD

A - Split Tube
B - Thin Wall Tube
C - Piston Sample
D - Core Barrel
E - Auger
F - Wash
G - Shovel Grab
K - Slotted

SHIPPING CONTAINER

N - Insert
O - Tube
P - Water Content Tin
Q - Jar
R - Cloth Bag
S - Plastic Bag
U - Wooden Box
Y - Core Box
Z - Discarded

Approved ____________________

Date ____________________

BOREHOLE REPORT

ACRES

CLIENT: City of Saint John
PROJECT: Menzies Lake Dam Safety Study

HOLE: BH 3
PAGE: 2 **OF:** 2

WATERLEVEL READINGS

9/11/2002 12:00:00 PM
water is at ground level
(prior to well install)
9/11/2002 1:30:00 PM 3.435
(after well install)
9/11/2002 1:40:00 PM after
flushing out the well,
water level is at 1.40
(50 mm above ground
level)
9/17/2002 12:21:00 PM 1.48
9/22/2002 12:03:00 PM
1.534

NOTES/COMMENTS

1 Water Level Measurements

All water level measurements are referenced to top of riser and are measured in metres. Top of riser is 1450 mm above original ground.
After well was installed it was flushed out by pumping water into well. During flushing the water was bubling up approximately 1 ft from well. When removed pump water immediately dropped to just above ground level.

2 Reservoir Levels

09/09/2002 8:45 AM 248.55 ft
09/11/2002
09/16/2002 4:50 PM 248.55 ft
09/17/2002 7:40 AM 248.55 ft, 6:15 PM 248.5 ft
09/18/2002 7:30 AM 248.3 ft, 6:30 PM 248.2 ft
09/19/2002 7:30 AM 248.1 ft, 12:42 PM 248.1 ft, 5:27 PM 248.05 ft
09/20/2002 7:35 AM 248.0 ft, 11:00 AM 248.0 ft
09/22/2002 1:35 PM 247.9 ft

3 Piezometer Installation

ground surface to 0.9 m - bentonite chips
0.9 m to 1.68 m - silica sand and sloughed material
1.68 m to 2.29 m - slotted screen, 50 mm ID, silica sand and sloughed material
2.29 m to 2.62 m - sloughed material

Note: riser pipe consists of 50 mm ID flush coupled PVC

DRILLING REPORT

ACRES

CLIENT: City of Saint John

PROJECT: Menzies Lake Dam Safety Study

HOLE: BH 4

PAGE: 1 **OF:** 2

SITE: Saddle Dyke 1, crest, N7359091 E2520856

DIP DIRECTION:
DIP: 90

ELEVATIONS (m)
DATUM: Geodetic
PLATFORM:
GROUND: 77.231

END OF HOLE: 73.17

CONTRACTOR: Boart-Longyear Inc.
DRILL TYPE: CME 55, track mounted
METHOD SOIL: HW casing
ROCK: NA
CASING: HW

CORE:

STARTED: 17 Sept, 2002
FINISHED: 17 Sept, 2002
INSPECTOR: B.Bourque
LOGGED BY: B.Bourque

See end page for detailed groundwater measurements

SCALE (m)	DEPTH (m)	DESCRIPTION	SAMPLE DEPTH (m)	TYPE/ NUMBER	SIZE (mm)	RECY (mm)	RET'D (mm)	BLOW COUNTS	REMARKS
	0.0	Embankment Fill - sand, gravelly, some silt, brown, angular to subrounded, max size 50 mm moist at about 0.91 to 1.22 m	0 0.61	AQ1	50	152		2 7 12 10	
			0.61 1.22	AQ2	50	229		8 16 9 7	
	1.42	Original ground surface - Organics, black, woody, roots, max 10mm dia, trace gravel	1.22 1.83	AQ3	50	229		23 12 4 3	
	1.83	gravel, sandy, silty, brown, some organics (woody material, brown and black, max size 8mm dia), angular to subrounded, max size 30 mm wet from 3.05 to 3.25 m	1.83 2.44	AQ4	50	203		4 3 3 14	1.83 m (6ft) to 2.29 m (7.5ft) - advance with HQ starting barrell through a possible boulder, water return is cloudy grey, stop at 2.29 m (7.5ft) when water return changes color to dark brown
			2.44 3.05	AQ5	50	51		13 12 5 3	2.74 m (9ft) to 3.66 m (12ft) - advance with HQ starting barrell, water return is dark grey-brown
	3.25	Glacial Till - gravel, sandy, some silt, grey, angular to subrounded, max size 50 mm	3.05 3.66	AQ6	50	356		8 36 60 49	
			3.66 4.06	AQ7	50	203		16 45 50	
	4.06	END OF BOREHOLE							

SAMPLING METHOD

A - Split Tube
B - Thin Wall Tube
C - Piston Sample
D - Core Barrel
E - Auger
F - Wash
G - Shovel Grab
K - Slotted

4.0

SHIPPING CONTAINER

N - Insert
O - Tube
P - Water Content Tin
Q - Jar
R - Cloth Bag
S - Plastic Bag
U - Wooden Box
Y - Core Box
Z - Discarded

Approved ____________

Date ____________

BOREHOLE REPORT

ACRES

CLIENT: City of Saint John

PROJECT: Menzies Lake Dam Safety Study

HOLE: BH 4

WATERLEVEL READINGS

9/17/2002 5:55:00 PM 1.73
9/22/2002 10:40:00 AM 2.438

NOTES/COMMENTS

1 Water Level Measurements

All water level measurements are referenced to top of riser and are measured in metres. Top of riser is at elevation 77.162 m (69mm below ground surface)

2 Reservoir Levels

09/09/2002 8:45 AM 248.55 ft
09/11/2002
09/16/2002 4:50 PM 248.55 ft
09/17/2002 7:40 AM 248.55 ft, 6:15 PM 248.5 ft
09/18/2002 7:30 AM 248.3 ft, 6:30 PM 248.2 ft
09/19/2002 7:30 AM 248.1 ft, 12:42 PM 248.1 ft, 5:27 PM 248.05 ft
09/20/2002 7:35 AM 248.0 ft, 11:00 AM 248.0 ft
09/22/2002 1:35 PM 247.9 ft

3 Piezometer Installation

ground surface to 2.03 m - tremie grout
2.03 m to 2.13 m - bentonite chips
2.13 m to 2.31 m - silica sand
2.31 m to 3.23 m - slotted screen, 50 mm ID, silica sand
3.23 m to 3.30 m - silica sand
3.30 m to 3.66 m - sloughed material

Note: riser pipe consists of 50 mm ID flush coupled PVC

DRILLING REPORT

ACRES

CLIENT: City of Saint John

PROJECT: Menzies Lake Dam Safety Study

HOLE: BH 5

SITE: Saddle Dyke 1, crest, N7359117 E2520893

DIP DIRECTION:		**CONTRACTOR:**	Boart-Longyear Inc.	**STARTED:**	17 Sept, 2002
DIP:	90	**DRILL TYPE:**	CME 55, track mounted	**FINISHED:**	17 Sept, 2002
ELEVATIONS (m)		**METHOD SOIL:**	Std. auger - 115 OD, HW casing	**INSPECTOR:**	B.Bourque
DATUM:	Geodetic	**ROCK:**	NA	**LOGGED BY:**	B.Bourque
PLATFORM:		**CASING:**	HW		
GROUND:	77.130				
END OF HOLE:	70.35	**CORE:**			

See end page for detailed groundwater measurements

SCALE (m)	DEPTH (m)	DESCRIPTION	SAMPLE DEPTH (m)	TYPE/ NUMBER	SIZE (mm)	REC'Y (mm)	RET'D (mm)	BLOW COUNTS	REMARKS
	0.0	Embankment Fill - sand and gravel, trace silt, brown, angular to rounded, max size 30 mm	0 – 0.61	AQ1	50	51		2 1 4 5	Standard augers from 0 to 1.22 m; HW casing from 1.22 m to 3.66 m; HQ starter barrell from 3.66 m to 6.55 m
			0.61 – 1.22	AQ2	50	178		9 11 4 2	
	.76	Embankment Fill - gravel, sandy, silty, brown, angular to subrounded, max size 40 mm Moist from 2.44 m to 3.05 m Wet from 3.05 m to 3.66 m							
			1.22 – 1.83	AQ3	50	279		4 4 4 7	
			1.83 – 2.44	AQ4	50	229		8 14 13 6	
			2.44 – 3.05	AQ5	50	127		7 5 4 3	
			3.05 – 3.66	AQ6	50	203		5 4 7 3	
	3.66	Original ground surface - Gravel and sand, brown, trace silt, trace woody organics, angular to subrounded, max size 40 mm Wet from about 4 m to 4.3 m	3.66 – 4.27	AQ7	50	102		17 3 5 7	AQ 7 - not much sample return because pushing gravel and cobbles Advance starter barrell - comes up with large woody fragments (approximately 50 mm diameter)
	4.3	Gravel, silty, grey-brown, trace sand, angular to subrounded, max size 50 mm Wet bouncing on rock at 4.57 m	4.27 – 4.57	AQ8	50	152		10 5	
	4.57	Gravel, trace silt, trace sand, angular, max size 50 mm Wet							spoon is bouncing on rock at 4.57 m

SAMPLING METHOD

A - Split Tube
B - Thin Wall Tube
C - Piston Sample
D - Core Barrel
E - Auger
F - Wash
G - Shovel Grab
K - Slotted

SHIPPING CONTAINER

N - Insert
O - Tube
P - Water Content Tin
Q - Jar
R - Cloth Bag
S - Plastic Bag
U - Wooden Box
Y - Core Box
Z - Discarded

Approved ______________

Date ______________

4.0

DRILLING REPORT

ACRES

CLIENT: City of Saint John

PROJECT: Menzies Lake Dam Safety Study

HOLE: BH 5

SCALE (m)	DEPTH (m)	DESCRIPTION	SAMPLE DEPTH (m)	TYPE/ NUMBER	SIZE (mm)	RECY (mm)	RET'D (mm)	BLOW COUNTS	REMARKS
			5.03 5.64	AQ9	50	0		4 1 1 1	Advance starter barrell from 4.27 m to 5.03 m - very hard although softer at 5.03 m. No water return AQ 9 - no sample return - pushing a rock which was stuck in the end of the spoon
									Advance starter barrell from 5.03 m to 5.94 m - no water return
			5.94	AQ10	50	203		14 20 25 11	Advance starter barrell to 6.55 m, material is 152 mm up into barrell (ie. AQ 11 starts at 6.40 m)
	6.40	Glacial Till - gravel, sandy, some silt, grey, angular to subrounded, maz size 30 mm	6.4 6.55 6.78	AQ11	50			12 40 50	
	6.78	END OF BOREHOLE							

SAMPLING METHOD

A - Split Tube
B - Thin Wall Tube
C - Piston Sample
D - Core Barrel
E - Auger
F - Wash
G - Shovel Grab
K - Slotted

SHIPPING CONTAINER

N - Insert
O - Tube
P - Water Content Tin
Q - Jar
R - Cloth Bag
S - Plastic Bag
U - Wooden Box
Y - Core Box
Z - Discarded

Approved ____________________

Date ____________________

BORHOLE REPORT

CLIENT: City of Saint John

PROJECT: Menzies Lake Dam Safety Study

HOLE: BH 5

WATERLEVEL READINGS

9/17/2002 4:45:00 PM 3.96 m from ground surface
9/17/2002 6:00:00 PM 3.842
9/19/2002 10:53:00 AM 3.88
9/19/2002 12:11:00 PM 3.88
9/22/2002 11:56:00 AM 3.895
9/22/2002 12:24:00 PM 3.895

NOTES/COMMENTS

1 Water Level Measurements

All water level measurements are referenced to top of riser and are measured in metres. Top of riser is at elevation 77.091 m (39mm below ground surface)

.

2 Reservoir Levels

09/09/2002 8:45 AM 248.55 ft
09/11/2002
09/16/2002 4:50 PM 248.55 ft
09/17/2002 7:40 AM 248.55 ft, 6:15 PM 248.5 ft
09/18/2002 7:30 AM 248.3 ft, 6:30 PM 248.2 ft
09/19/2002 7:30 AM 248.1 ft, 12:42 PM 248.1 ft, 5:27 PM 248.05 ft
09/20/2002 7:35 AM 248.0 ft, 11:00 AM 248.0 ft
09/22/2002 1:35 PM 247.9 ft

.

3 Piezometer Installation

ground surface to 1.22 m - drill cuttings
1.22 m to 3.66 m - bentonite chips
3.66 m to 4.47 m - silica sand
4.47 m to 6.07 m - slotted screen, 50 mm ID, silica sand
6.07 m to 6.78 m - silica sand

Note: riser pipe consists of 50 mm ID flush coupled PVC

DRILLING REPORT

ACRES

CLIENT: City of Saint John
PROJECT: Menzies Lake Dam Safety Study

HOLE: BH 6
PAGE: 1 **OF:** 2

SITE: Saddle Dyke 2, crest, N7359134 E2520737

DIP DIRECTION:
DIP: 90
ELEVATIONS (m)
DATUM: Geodetic
PLATFORM:
GROUND: 76.597
END OF HOLE: 73.37

CONTRACTOR: Boart-Longyear Inc.
DRILL TYPE: CME 55, track mounted
METHOD SOIL: Std. auger - 115 OD, HW casing
ROCK: NA
CASING: HW
CORE:

STARTED: 18 Sept, 2002
FINISHED: 18 Sept, 2002
INSPECTOR: B.Bourque
LOGGED BY: B.Bourque

See end page for detailed groundwater measurements

SCALE (m)	DEPTH (m)	DESCRIPTION	SAMPLE DEPTH (m)	TYPE/ NUMBER	SIZE (mm)	REC'Y (mm)	RET'D (mm)	BLOW COUNTS	REMARKS
	0.0	Embankment Fill - sand and gravel, brown, trace silt, angular to rounded, max size 40 mm	0 – 0.61	AQ1	50	127		4 7 7 6	standard auger from 0 to 1.83 m HW casing from 1.83 m to 2.9 m
			0.61 – 1.22	AQ2	50	102		5 2 2 1	piece of gravel stuck in spoon tip
			1.22 – 1.83	AQ3	50	102		5 2 1 1	piece of gravel stuck in spoon tip
	1.90	Original surface - silt (organic), sandy, trace gravel, light brown and dark brown, trace woody fragments Moist	1.83 – 2.44	AQ4	50	508		2 2 9 12	
	2.03	sand, gravelly, silty, brown to grey, angular to subrounded, max size 40 mm Moist to Wet							
	2.44	Glacial Till - gravel, sandy, some silt, grey, angular to subrounded, max size 30 mm very dense Moist	2.44 – 2.9	AQ5	50	229		12 26 40 57	advance starter barrell 2.44 m to 2.90 m advance casing to 2.9 m
			~~2.9~~ 3.05 – 3.23	~~AQ6~~	~~50~~	~~178~~		27 ~~25~~ 54	
	3.23		END OF BOREHOLE						

SAMPLING METHOD

A - Split Tube
B - Thin Wall Tube
C - Piston Sample
D - Core Barrel
E - Auger
F - Wash
G - Shovel Grab
K - Slotted

SHIPPING CONTAINER

N - Insert
O - Tube
P - Water Content Tin
Q - Jar
R - Cloth Bag
S - Plastic Bag
U - Wooden Box
Y - Core Box
Z - Discarded

Approved ______________

Date ______________

BOREHOLE REPORT

ACRES

CLIENT: City of Saint John | **HOLE:** BH 6

PROJECT: Menzies Lake Dam Safety Study | **PAGE:** 2 **OF:** 2

WATERLEVEL READINGS

9/18/2002 1:44:00 PM
during drilling wl 1.88 m
from ground surface
9/18/2002 3:58:00 PM 1.595
9/22/2002 9:53:00 AM 1.72

NOTES/COMMENTS

1 Water Level Measurements

All water level measurements are referenced to top of riser and are measured in metres. Top of riser is at elevation 76.534 m (63mm below ground surface)

.
2 Reservoir Levels

09/09/2002 8:45 AM 248.55 ft
09/11/2002
09/16/2002 4:50 PM 248.55 ft
09/17/2002 7:40 AM 248.55 ft, 6:15 PM 248.5 ft
09/18/2002 7:30 AM 248.3 ft, 6:30 PM 248.2 ft
09/19/2002 7:30 AM 248.1 ft, 12:42 PM 248.1 ft, 5:27 PM 248.05 ft
09/20/2002 7:35 AM 248.0 ft, 11:00 AM 248.0 ft
09/22/2002 1:35 PM 247.9 ft

.
3 Piezometer Installation

ground surface to 0.46 m - drill cuttings
0.46 m to 1.30 m - bentonite chips
1.30 m to 1.52 m - silica sand
1.52 m to 2.29 m - slotted screen, 50 mm ID, silica sand
2.29 m to 2.74 m - silica sand
2.74 m to 3.05 m - bentonite chips

Note: riser pipe consists of 50 mm ID flush coupled PVC

DRILLING REPORT

ACRES

CLIENT: City of Saint John
PROJECT: Menzies Lake Dam Safety Study

HOLE: BH 7
PAGE: 1 **OF:** 2

SITE: Saddle Dyke 1, crest, N7359117 E2520892

DIP DIRECTION:
DIP: 90
ELEVATIONS (m)
DATUM: Geodetic
PLATFORM:
GROUND: 77.142
END OF HOLE: 73.94

CONTRACTOR: Boart-Longyear Inc.
DRILL TYPE: CME 55, track mounted
METHOD SOIL: Hollow stem auger, 115 mm ID
ROCK: NA
CASING:
CORE:

STARTED: 19 Sept, 2002
FINISHED: 19 Sept, 2002
INSPECTOR: B.Bourque
LOGGED BY: B.Bourque

See end page for detailed groundwater measurements

SCALE (m)	DEPTH (m)	DESCRIPTION	SAMPLE DEPTH (m)	TYPE/ NUMBER	SIZE (mm)	RECY (mm)	RET'D (mm)	BLOW COUNTS	REMARKS
	0.0	Embankment Fill - sand and gravel, trace silt, brown							Advance augers to 3.2 m Samples were not taken. This borehole is 1.5 m from BH5. Lithology is taken from BH5.
	.76	Embankment Fill - gravel, sandy, silty, brown							End of Borehole at 3.2 m
	3.2	END OF BOREHOLE							

SAMPLING METHOD

A - Split Tube
B - Thin Wall Tube
C - Piston Sample
D - Core Barrel
E - Auger
F - Wash
G - Shovel Grab
K - Slotted

SHIPPING CONTAINER

N - Insert
O - Tube
P - Water Content Tin
Q - Jar
R - Cloth Bag
S - Plastic Bag
U - Wooden Box
Y - Core Box
Z - Discarded

Approved ____________________

Date ____________________

BOREHOLE REPORT

CLIENT: City of Saint John **HOLE:** BH 7

PROJECT: Menzies Lake Dam Safety Study

WATERLEVEL READINGS

9/19/2002 12:10:00 PM no water on waterlevel meter, however the tip of the meter is wet.
9/22/2002 12:47:00 PM no water
9/22/2002 12:48:00 PM add 11 L of water
9/22/2002 12:51:00 PM no water
9/22/2002 12:54:00 PM add 13 L of water
9/22/2002 12:59:00 PM no water

NOTES/COMMENTS

1 Water Level Measurements

All water level measurements are referenced to top of riser and are measured in metres. Top of riser is at elevation 77.030 m (112mm below ground surface)

.

2 Reservoir Levels

09/09/2002 8:45 AM 248.55 ft
09/11/2002
09/16/2002 4:50 PM 248.55 ft
09/17/2002 7:40 AM 248.55 ft, 6:15 PM 248.5 ft
09/18/2002 7:30 AM 248.3 ft, 6:30 PM 248.2 ft
09/19/2002 7:30 AM 248.1 ft, 12:42 PM 248.1 ft, 5:27 PM 248.05 ft
09/20/2002 7:35 AM 248.0 ft, 11:00 AM 248.0 ft
09/22/2002 1:35 PM 247.9 ft

.

3 Piezometer Installation

ground surface to 0.91 m - drill cuttings
0.91 m to 1.88 m - bentonite chips
1.88 m to 2.20 m - silica sand
2.20 m to 3.12 m - slotted screen, 50 mm ID, silica sand
3.12 m to 3.18 m - silica sand

Note: riser pipe consists of 50 mm ID flush coupled PVC

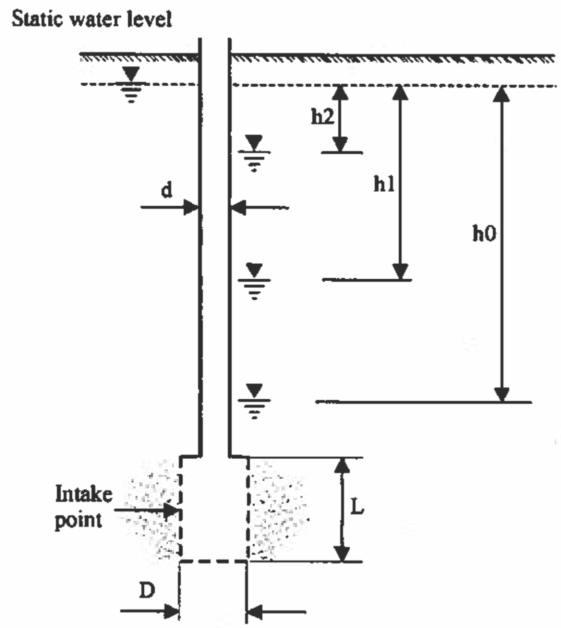
Annex B5
Permeability Calculations

Project
Rising Head Test in Piezometer

Borehole No. BH3 **Test 1**

static water level =	1.480	m
ho =	0.130	m
L=	0.61	m
D (intake point)	20.30	cm
d (riser pipe)	5	cm

t (min)	Readings (h) (m)	Δh	$h_t = h_o - \Delta h$	h_t/ho head ratio
0	1.610	0.000	0.130	1.000
0.25	1.575	0.035	0.095	0.731
0.5	1.560	0.050	0.080	0.615
1	1.556	0.054	0.076	0.585
1.5	1.554	0.056	0.074	0.569
2	1.552	0.058	0.072	0.554
2.5	1.551	0.059	0.071	0.546
3	1.550	0.060	0.070	0.538
3.5	1.550	0.060	0.070	0.538
4	1.549	0.061	0.069	0.531
4.5	1.549	0.061	0.069	0.531
5	1.548	0.062	0.068	0.523
5.5	1.548	0.062	0.068	0.523
6	1.547	0.063	0.067	0.515
7	1.547	0.063	0.067	0.515
8	1.547	0.063	0.067	0.515
9	1.547	0.063	0.067	0.515
10	1.546	0.064	0.066	0.508
11	1.546	0.064	0.066	0.508
32	1.537	0.073	0.057	0.438
40	1.537	0.073	0.057	0.438
135	1.528	0.082	0.048	0.369
235	1.525	0.085	0.045	0.346



Permeability calculation:

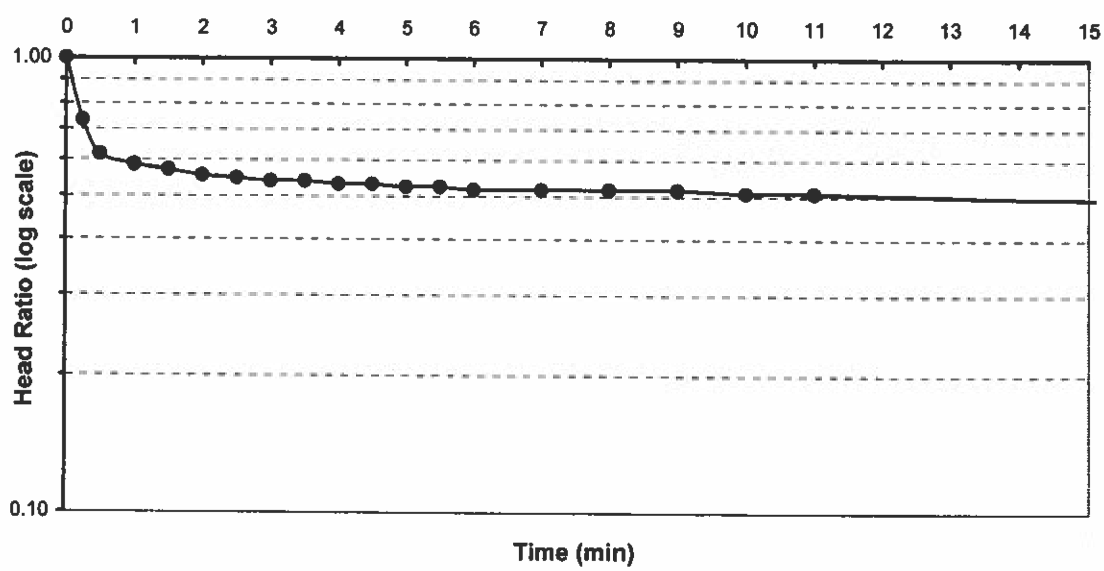
h1 = 0.13   t1 = 0.0
h2 = 0.08   t2 = 0.5

$$K = \frac{d^2 \ln\left(\frac{2mL}{D}\right)}{8\,L(t_2 - t_1)} \ln\left(\frac{h_1}{h_2}\right)$$

m = transformation ratio, assumed 1

K = 1.5E-05 m/sec

Head Ratio vs Time



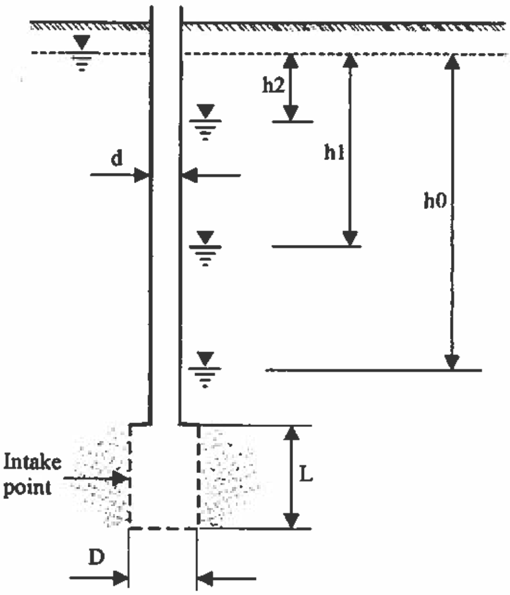
Project
Rising Head Test in Piezometer

Borehole No. BH3 **Test 2**

static water level =	1.534	m
ho =	0.051	m
L=	0.61	m
D (intake point)	20.30	cm
d (riser pipe)	5	cm

t (min)	Readings (h) (m)	Δh	$h_t = h_o - \Delta h$	h_t/ho head ratio
0	1.585	0.000	0.051	1.000
0.25	1.549	0.036	0.015	0.294
0.5	1.541	0.044	0.007	0.137
0.75	1.539	0.046	0.005	0.098
1	1.538	0.047	0.004	0.078
1.25	1.537	0.048	0.003	0.059
1.5	1.537	0.048	0.003	0.059
1.75	1.537	0.048	0.003	0.059
2	1.536	0.049	0.002	0.039
2.25	1.536	0.049	0.002	0.039
2.5	1.536	0.049	0.002	0.039
2.75	1.536	0.049	0.002	0.039
3	1.536	0.049	0.002	0.039
3.25	1.536	0.049	0.002	0.039
3.5	1.536	0.049	0.002	0.039
3.75	1.536	0.049	0.002	0.039
4	1.535	0.050	0.001	0.020
4.25	1.535	0.050	0.001	0.020
4.5	1.535	0.050	0.001	0.020
4.75	1.535	0.050	0.001	0.020
5	1.535	0.050	0.001	0.020
6	1.535	0.050	0.001	0.020
7	1.535	0.050	0.001	0.020
8	1.535	0.050	0.001	0.020
9	1.535	0.050	0.001	0.020
10	1.535	0.050	0.001	0.020

Static water level



Permeability calculation:

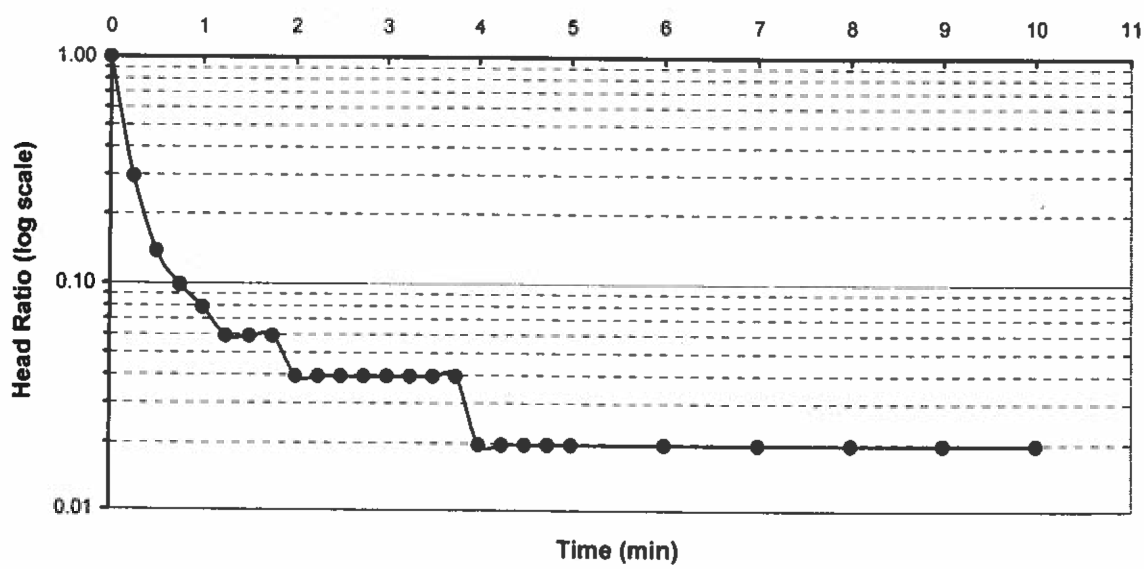
h1 = 0.051 t1 = 0.0
h2 = 0.003 t2 = 1.25

$$K = \frac{d^2 \ln\left(\frac{2mL}{D}\right)}{8L(t_2 - t_1)} \ln\left(\frac{h_1}{h_2}\right)$$

m = transformation ratio, assumed 1

K = 3.5E-05 m/sec

Head Ratio vs Time

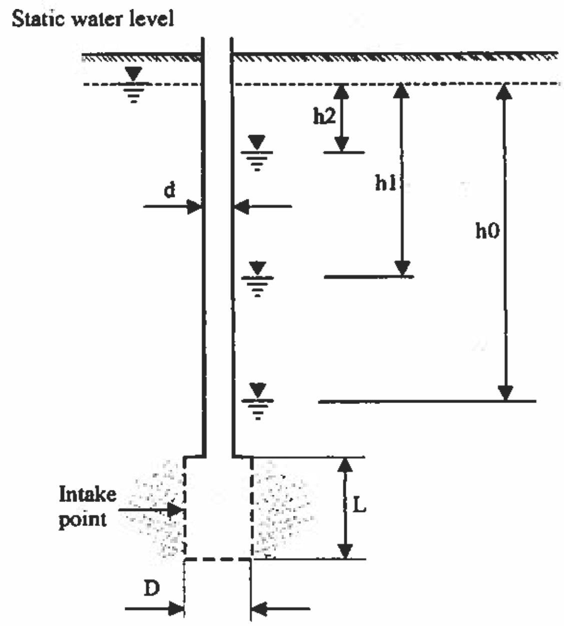


Project
Rising Head Test in Piezometer

Borehole No. BH4

static water level =	2.438	m
ho =	0.342	m
L=	1.17	m
D (intake point)	20.30	cm
d (riser pipe)	5	cm

t (min)	Readings (h) (m)	Δh	$h_t = h_o - \Delta h$	h_t/h_o head ratio
0	2.780	0.000	0.342	1.000
0.25	2.770	0.010	0.332	0.971
0.5	2.760	0.020	0.322	0.942
1	2.745	0.035	0.307	0.898
1.5	2.735	0.045	0.297	0.868
2	2.722	0.058	0.284	0.830
2.5	2.710	0.070	0.272	0.795
3	2.700	0.080	0.262	0.766
3.5	2.692	0.088	0.254	0.743
4	2.684	0.096	0.246	0.719
4.5	2.678	0.102	0.240	0.702
5	2.671	0.109	0.233	0.681
5.5	2.663	0.117	0.225	0.658
6	2.659	0.121	0.221	0.646
6.5	2.653	0.127	0.215	0.629
7	2.650	0.130	0.212	0.620
8	2.642	0.138	0.204	0.596
9	2.634	0.146	0.196	0.573
10	2.628	0.152	0.190	0.556
11	2.621	0.159	0.183	0.535
12	2.616	0.164	0.178	0.520
13	2.609	0.171	0.171	0.500
14	2.602	0.178	0.164	0.480
15	2.598	0.182	0.160	0.468
16	2.595	0.185	0.157	0.459
17	2.591	0.189	0.153	0.447
18	2.587	0.193	0.149	0.436
19	2.583	0.197	0.145	0.424
20	2.580	0.200	0.142	0.415
22	2.571	0.209	0.133	0.389
24	2.567	0.213	0.129	0.377
26	2.561	0.219	0.123	0.360
28	2.557	0.223	0.119	0.348
30	2.553	0.227	0.115	0.336
32	2.549	0.231	0.111	0.325
40	2.538	0.242	0.100	0.292
42	2.538	0.242	0.100	0.292
44	2.536	0.244	0.098	0.287
46	2.534	0.246	0.096	0.281
58	2.526	0.252	0.090	0.263
155	2.515	0.265	0.077	0.225



Permeability calculation:

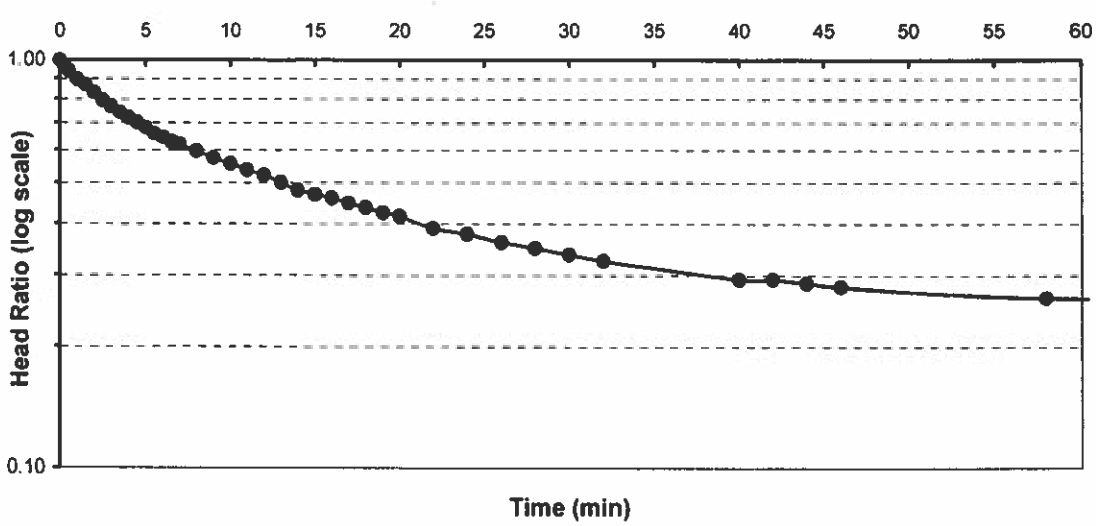
h1 = 0.233 t1 = 5.0
h2 = 0.133 t2 = 22.0

$$K = \frac{d^2 \ln\left(\frac{2mL}{D}\right)}{8\,L\,(t_2 - t_1)} \ln\left(\frac{h_1}{h_2}\right)$$

m = transformation ratio, assumed 1

K = 3.6E-07 m/sec

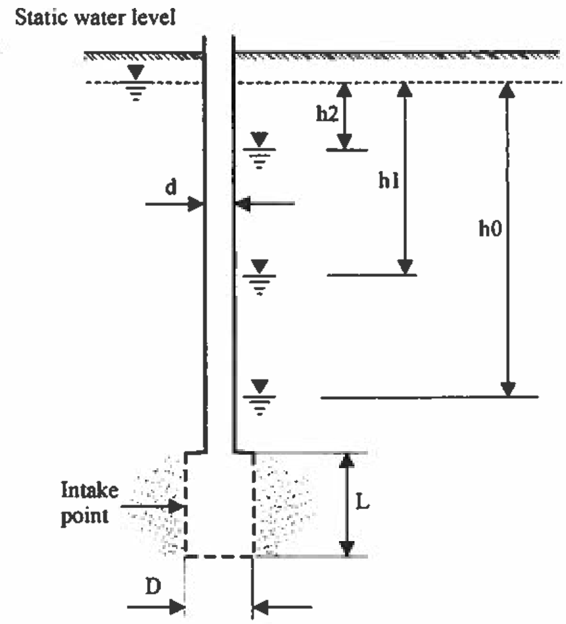
Head Ratio vs Time



Project
Rising Head Test in Piezometer

Borehole No. BH5

static water level =	3.895	m
ho =	0.025	m
L=	3.12	m
D (intake point)	20.30	cm
d (riser pipe)	5	cm



t (min)	Readings (h) (m)	Δh	$h_t = h_o - \Delta h$	h_t/h_o head ratio
0	3.920	0.000	0.025	1.000
0.25	3.908	0.012	0.013	0.520
0.5	3.903	0.017	0.008	0.320
0.75	3.900	0.020	0.005	0.200
1	3.899	0.021	0.004	0.160
1.25	3.898	0.022	0.003	0.120
1.5	3.897	0.023	0.002	0.080
1.75	3.897	0.023	0.002	0.080
2	3.896	0.024	0.001	0.040
2.25	3.896	0.024	0.001	0.040
2.5	3.896	0.024	0.001	0.040
2.75	3.896	0.024	0.001	0.040
3	3.895	0.025	0.000	0.000
3.25	3.895	0.025	0.000	0.000
3.5	3.895	0.025	0.000	0.000
3.75	3.895	0.025	0.000	0.000

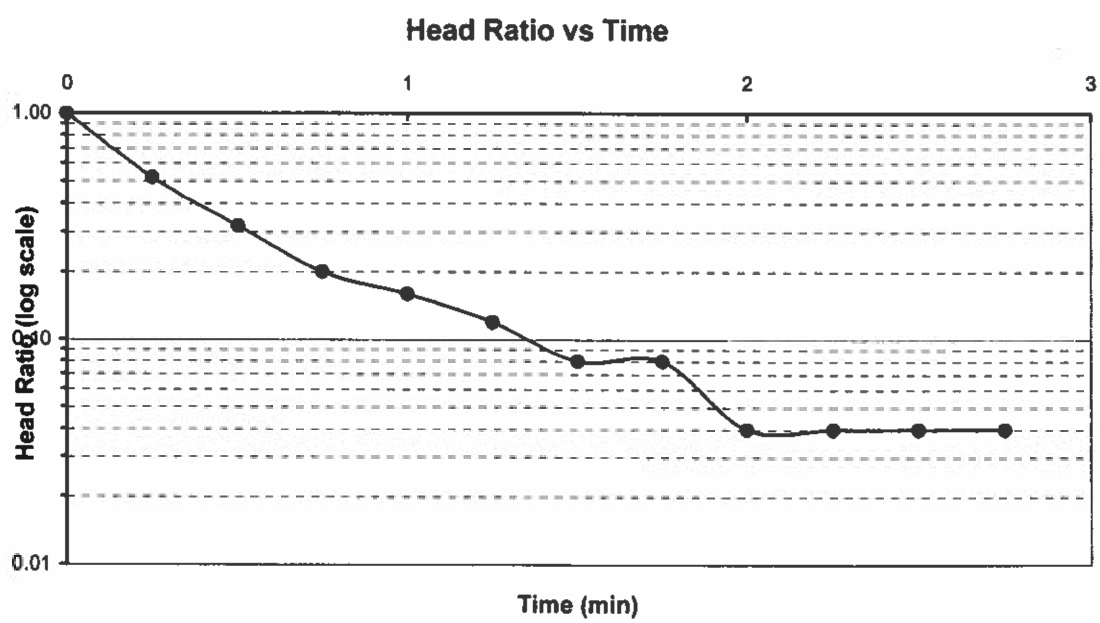
Permeability calculation:

h1 = 0.013 t1 = 0.25
h2 = 0.003 t2 = 1.25

$$K = \frac{d^2 \ln\left(\frac{2mL}{D}\right)}{8\,L(t_2 - t_1)} \ln\left(\frac{h_1}{h_2}\right)$$

m = transformation ratio, assumed 1

K = 8.4E-06 m/sec

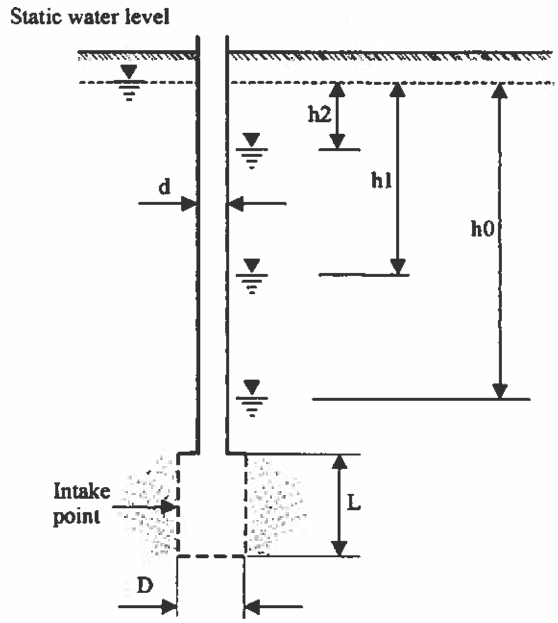


Project
Falling Head Test in Piezometer

Borehole No. BH5

static water level = 3.894 m
ho = 0.059 m

L= 3.12 m
D (intake point) 20.30 cm
d (riser pipe) 5 cm



t (min)	Readings (h) (m)	Δh	$h_t = h_o - \Delta h$	h_t/h_o head ratio
0	3.835	0.000	0.059	1.000
0.25	3.857	0.022	0.037	0.627
0.75	3.872	0.037	0.022	0.373
1.25	3.877	0.042	0.017	0.288
1.5	3.880	0.045	0.014	0.237
1.75	3.884	0.049	0.010	0.169
2.5	3.888	0.053	0.006	0.102
2.75	3.888	0.053	0.006	0.102
3.25	3.889	0.054	0.005	0.085
3.5	3.889	0.054	0.005	0.085
3.75	3.889	0.054	0.005	0.085
4.25	3.890	0.055	0.004	0.068
5.25	3.890	0.055	0.004	0.068
6.25	3.890	0.055	0.004	0.068
7.25	3.891	0.056	0.003	0.051
12.25	3.892	0.057	0.002	0.034

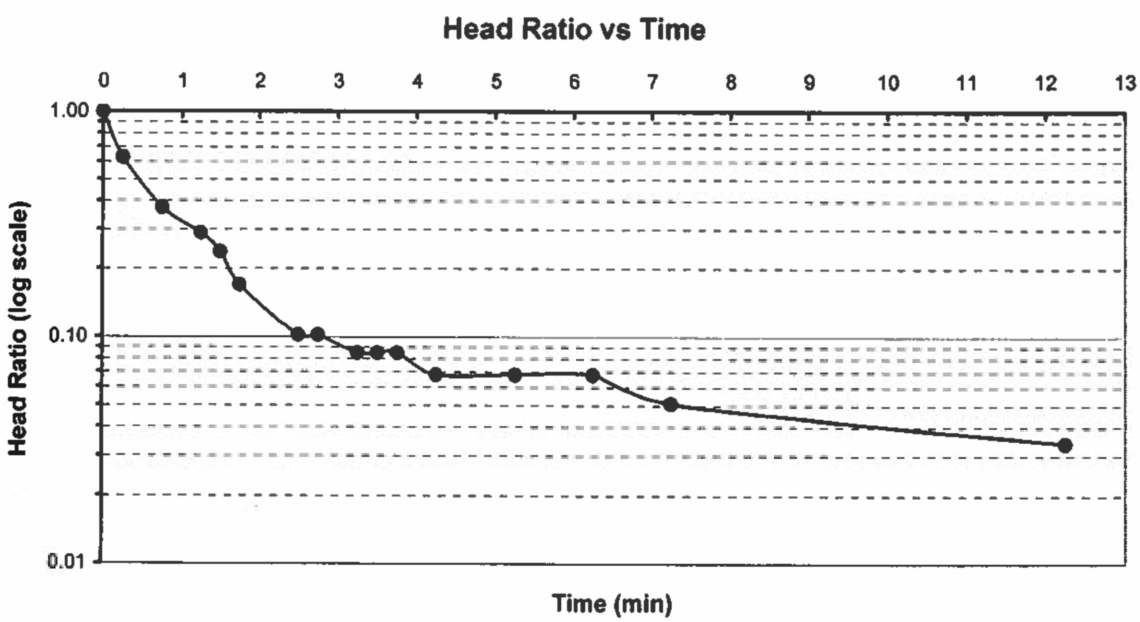
Permeability calculation:

h1 = 0.059 t1 = 0.0
h2 = 0.006 t2 = 2.5

$$K = \frac{d^2 \ln\left(\frac{2mL}{D}\right)}{8L(t_2 - t_1)} \ln\left(\frac{h_1}{h_2}\right)$$

m = transformation ratio, assumed 1

K = 5.2E-06 m/sec

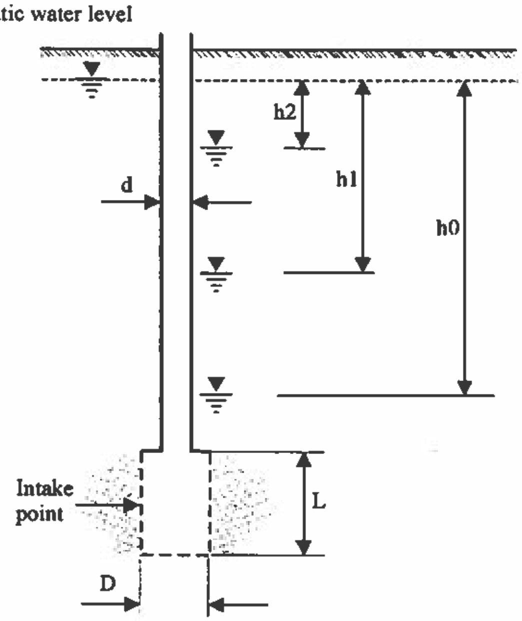


Project
Rising Head Test in Piezometer

Borehole No. BH6

static water level =	1.720	m
ho =	0.090	m
L=	1.44	m
D (intake point)	20.30	cm
d (riser pipe)	5	cm

t (min)	Readings (h) (m)	Δh	$h_t = h_o - \Delta h$	h_t/ho head ratio
0	1.810	0.000	0.090	1.000
0.083	1.800	0.010	0.080	0.889
0.25	1.790	0.020	0.070	0.778
0.5	1.770	0.040	0.050	0.556
0.75	1.762	0.048	0.042	0.467
1	1.755	0.055	0.035	0.389
1.25	1.750	0.060	0.030	0.333
1.5	1.745	0.065	0.025	0.278
1.75	1.741	0.069	0.021	0.233
2	1.738	0.072	0.018	0.200
2.25	1.736	0.074	0.016	0.178
2.5	1.736	0.074	0.016	0.178
2.75	1.735	0.075	0.015	0.167
3	1.733	0.077	0.013	0.144
3.25	1.731	0.079	0.011	0.122
3.5	1.731	0.079	0.011	0.122
3.75	1.730	0.080	0.010	0.111
4	1.730	0.080	0.010	0.111
4.25	1.729	0.081	0.009	0.100
4.5	1.729	0.081	0.009	0.100
4.75	1.728	0.082	0.008	0.089
5	1.728	0.082	0.008	0.089
5.25	1.728	0.082	0.008	0.089
5.5	1.728	0.082	0.008	0.089
5.75	1.727	0.083	0.007	0.078
6	1.727	0.083	0.007	0.078
6.25	1.727	0.083	0.007	0.078
6.5	1.726	0.084	0.006	0.067
6.75	1.726	0.084	0.006	0.067
7	1.726	0.084	0.006	0.067
7.25	1.725	0.085	0.005	0.056
7.5	1.725	0.085	0.005	0.056
7.75	1.725	0.085	0.005	0.056
8	1.725	0.085	0.005	0.056
8.25	1.725	0.085	0.005	0.056
8.5	1.725	0.085	0.005	0.056
8.75	1.725	0.085	0.005	0.056
9	1.725	0.085	0.005	0.056
9.25	1.725	0.085	0.005	0.056
9.5	1.725	0.085	0.005	0.056



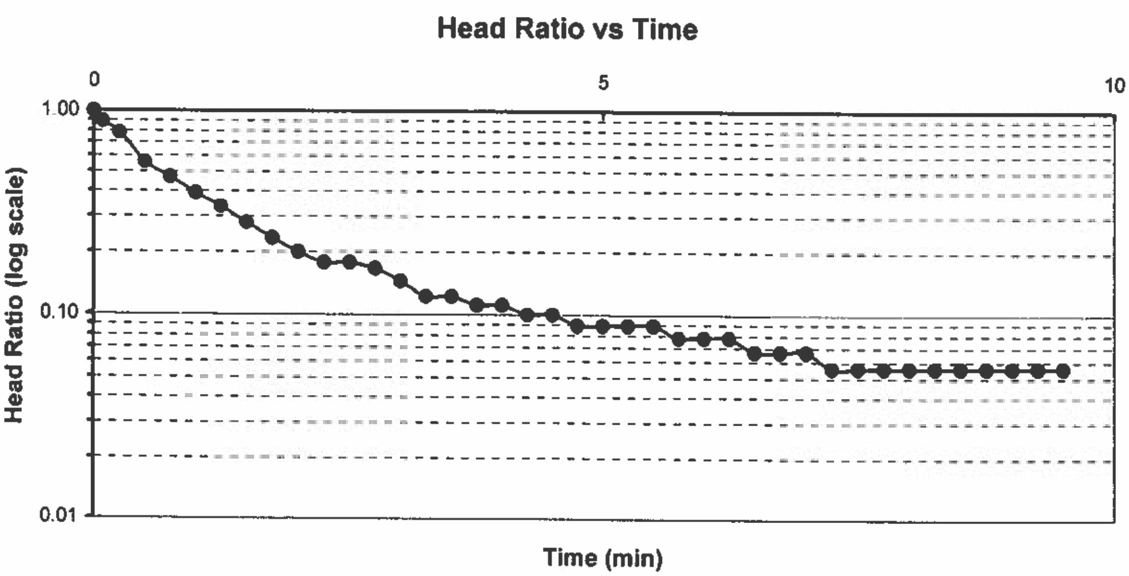
Permeability calculation:

h1 = 0.09 t1 = 0.00
h2 = 0.016 t2 = 2.25

$$K = \frac{d^2 \ln\left(\frac{2mL}{D}\right)}{8\,L\,(t_2 - t_1)} \ln\left(\frac{h_1}{h_2}\right)$$

m = transformation ratio, assumed 1

K = 7.4E-06 m/sec

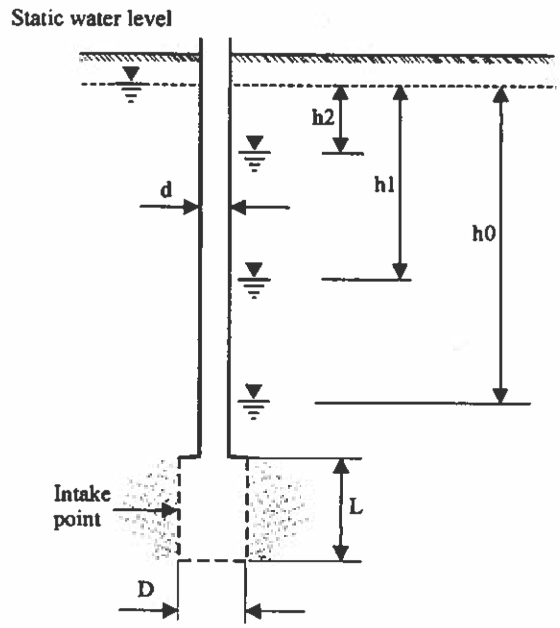


Project
Falling Head Test in Piezometer

Borehole No. BH7

static water level = 2.950 m
ho = 0.340 m

L= 1.30 m
D (intake point) 20.30 cm
d (riser pipe) 5 cm



	t (min)	Readings (h) (m)	Δh	$h_t = h_o - \Delta h$	h_t/ho head ratio
Test 1	0	2.610	0.000	0.340	1.000
	0.25	2.675	0.065	0.275	0.809
	0.5	2.730	0.120	0.220	0.647
	0.75	2.750	0.140	0.200	0.588
	1	2.795	0.185	0.155	0.456
	1.25	2.820	0.210	0.130	0.382
	1.5	2.845	0.235	0.105	0.309
	1.75	2.865	0.255	0.085	0.250
	2	2.885	0.275	0.065	0.191
	2.25	2.895	0.285	0.055	0.162
	2.5	2.900	0.290	0.050	0.147
Test 2	0	2.440	0.000	0.510	1.000
	0.25	2.530	0.090	0.420	0.824
	0.5	2.570	0.130	0.380	0.745
	0.75	2.645	0.205	0.305	0.598
	1	2.685	0.245	0.265	0.520
	1.25	2.725	0.285	0.225	0.441
	1.5	2.750	0.310	0.200	0.392
	1.75	2.780	0.340	0.170	0.333
	2	2.815	0.375	0.135	0.265
	2.25	2.840	0.400	0.110	0.216
	2.5	2.855	0.415	0.095	0.186
	2.75	2.870	0.430	0.080	0.157
	3	2.885	0.445	0.065	0.127
	3.25	2.900	0.460	0.050	0.098

Permeability calculation:

Test 1
h1 = 0.34 t1 = 0.0
h2 = 0.065 t2 = 2.0

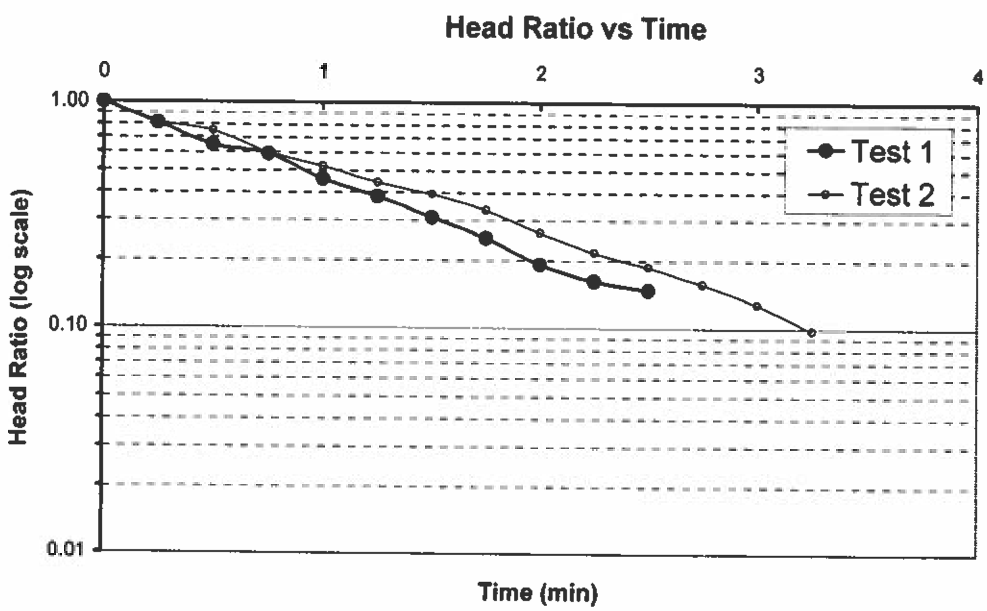
K = 8.5E-06 m/sec

Test 2
h1 = 0.51 t1 = 0.0
h2 = 0.065 t2 = 3.0

K = 7.0E-06 m/sec

$$K = \frac{d^2 \ln\left(\frac{2mL}{D}\right)}{8\,L(t_2 - t_1)} \ln\left(\frac{h_1}{h_2}\right)$$

m = transformation ratio, assumed 1



Annex B6
Probe Hole Reports

PROBE HOLE REPORT

ACRES

CLIENT: City of Saint John

PROJECT: Menzies Lake Dam Safety Study

HOLE: PH 1

PAGE: 1 **OF:** 1

SITE: Saddle Dyke 1, left abutment, N7359149 E2520915

DIP DIRECTION:
DIP: 90

ELEVATIONS (m)
DATUM: Geodetic
PLATFORM:
GROUND: 77.739

END OF HOLE: 74.49

CONTRACTOR: Boart-Longyear Inc.
DRILL TYPE: CME 55, track mounted
METHOD SOIL: Std. auger - 115 OD, HQ coring

STARTED: 16 Sept, 2002
FINISHED: 16 Sept, 2002
INSPECTOR: B.Bourque
LOGGED BY: B.Bourque

SCALE (m)	DEPTH (m)	DESCRIPTION	SAMPLE DEPTH (m)	TYPE/ NUMBER	SIZE (mm)	REC'Y (mm)	RET'D (mm)	BLOW COUNTS	REMARKS
	0.0	Cuttings are gravel, some sand, some silt	0 1.35						Reservoir Level: 248.55 ft (09/16/2002 4:50 PM) Standard augers from 0 to 1.35 m HQ coring from 1.35 m to 3.25 m
	1.35	Run 1 - core sample is rock fragments	1.35 2.01	RUN 1					resistant stratum at 1.22 m (grind with augers to 1.35 m) 1.35 m to 1.73 m water return is cloudy brown-grey 1.73 m to 1.90 m water return is cloudy grey
	2.01	Run 2 - core sample is well fractured and weathered bedrock	2.01 2.49	RUN 2					1.90 m to 1.96 m water return is cloudy brown-grey 2.01 m - barrell is blocked, remove core sample
	2.49	Run 3 - core sample is fractured bedrock	2.49 3.25	RUN 3					2.01 m to 2.49 m water return is cloudy grey 2.49 m to 3.25 m water return is cloudy grey End of probe hole at 3.25 m
	3.25	**END OF PROBE HOLE**							WATERLEVEL STABILIZED IN HOLE AT 1.29 m BELOW GROUND SURFACE (09/16/2002 4:02 PM)

SAMPLING METHOD

A - Split Tube
B - Thin Wall Tube
C - Piston Sample
D - Core Barrel
E - Auger
F - Wash
G - Shovel Grab
K - Slotted

SHIPPING CONTAINER

N - Insert
O - Tube
P - Water Content Tin
Q - Jar
R - Cloth Bag
S - Plastic Bag
U - Wooden Box
Y - Core Box
Z - Discarded

Approved ____________________

Date ____________________

PROBE HOLE REPORT

ACRES

CLIENT: City of Saint John

PROJECT: Menzies Lake Dam Safety Study

HOLE: PH 2

PAGE: 1 **OF:** 1

SITE: Saddle Dyke 1, left abutment, N7359138 E2520908

DIP DIRECTION:
DIP: 90

ELEVATIONS (m)
DATUM: Geodetic
PLATFORM:
GROUND: 77.502

END OF HOLE: 75.77

CONTRACTOR: Boart-Longyear Inc.
DRILL TYPE: CME 55, track mounted
METHOD SOIL: Std. auger - 115 OD

STARTED: 16 Sept, 2002
FINISHED: 16 Sept, 2002
INSPECTOR: B.Bourque
LOGGED BY: B.Bourque

SCALE (m)	DEPTH (m)	DESCRIPTION	SAMPLE DEPTH (m)	TYPE/ NUMBER	SIZE (mm)	RECY (mm)	RETD (mm)	BLOW COUNTS	REMARKS
	0.0	Sandy gravel, some silt	0						Reservoir Level: 248.55 ft (09/16/2002 4:50 PM) Advance augers to 1.73 m (bouldery, grinding) Auger refusal at 1.73 m
			1.73						
	1.73		END OF PROBE HOLE						NO WATER ENCOUNTERED

SAMPLING METHOD

A - Split Tube
B - Thin Wall Tube
C - Piston Sample
D - Core Barrel
E - Auger
F - Wash
G - Shovel Grab
K - Slotted

SHIPPING CONTAINER

N - Insert
O - Tube
P - Water Content Tin
Q - Jar
R - Cloth Bag
S - Plastic Bag
U - Wooden Box
Y - Core Box
Z - Discarded

Approved ____________________

Date ____________________

PROBE HOLE REPORT

ACRES

CLIENT: City of Saint John
PROJECT: Menzies Lake Dam Safety Study

HOLE: PH 3
PAGE: 1 **OF:** 1

SITE: Saddle Dyke 1, left abutment, N7359130 E2520903

DIP DIRECTION:
DIP: 90
ELEVATIONS (m)
DATUM: Geodetic
PLATFORM:
GROUND: 77.387
END OF HOLE: 70.96

CONTRACTOR: Boart-Longyear Inc.
DRILL TYPE: CME 55, track mounted
METHOD SOIL: Std. auger - 115 OD

STARTED: 16 Sept, 2002
FINISHED: 16 Sept, 2002
INSPECTOR: B.Bourque
LOGGED BY: B.Bourque

SCALE (m)	DEPTH (m)	DESCRIPTION	SAMPLE DEPTH (m)	TYPE/ NUMBER	SIZE (mm)	RECY (mm)	RETD (mm)	BLOW COUNTS	REMARKS
	0.0	Auger cuttings are gravel and sand, brown	0						Reservoir Level: 248.55 ft (09/16/2002 4:50 PM) Advance augers to 6.43 m
			1.68						0 to 2.74 m auger advance is bouldery and grinding
	3.2	Auger cuttings are gravel, some silt, some sand Moist	3.2						3.20 m to 4.72 m very easy auger advance, very soft, augers were almost pushed
	4.72		4.72						
			5.49						5.49 m to 6.43 m auger advance is bouldery and grinding Auger refusal at 6.43 m
	6.43		6.43						

END OF PROBE HOLE

WATERLEVEL STABILIZED IN HOLE AT 4.125 m BELOW GROUND SURFACE (09/16/2002 3:42 PM)

SAMPLING METHOD

A - Split Tube
B - Thin Wall Tube
C - Piston Sample
D - Core Barrel
E - Auger
F - Wash
G - Shovel Grab
K - Slotted

SHIPPING CONTAINER

N - Insert
O - Tube
P - Water Content Tin
Q - Jar
R - Cloth Bag
S - Plastic Bag
U - Wooden Box
Y - Core Box
Z - Discarded

Approved ____________________

Date ____________________

PROBE HOLE REPORT

ACRES

CLIENT: City of Saint John
PROJECT: Menzies Lake Dam Safety Study

HOLE: PH 4
PAGE: 1 **OF:** 1

SITE: Saddle Dyke 1, right abutment, N7359098 E2520866

DIP DIRECTION:
DIP: 90

ELEVATIONS (m)
DATUM: Geodetic
PLATFORM:
GROUND: 77.309

END OF HOLE: 73.50

CONTRACTOR: Boart-Longyear Inc.
DRILL TYPE: CME 55, track mounted
METHOD SOIL: Std. auger - 115 OD

STARTED: 16 Sept, 2002
FINISHED: 16 Sept, 2002
INSPECTOR: B.Bourque
LOGGED BY: B.Bourque

SCALE (m)	DEPTH (m)	DESCRIPTION	SAMPLE DEPTH (m)	TYPE/ NUMBER	SIZE (mm)	REC'Y (mm)	RET'D (mm)	BLOW COUNTS	REMARKS
	0.0		0						Reservoir Level: 248.55 ft (09/16/2002 4:50 PM) Advance augers to 3.81 m Grinding on a boulder at 3.81 m, auger refusal at 3.81 m
	3.81		3.81						

END OF PROBE HOLE

NO WATER ENCOUNTERED

SAMPLING METHOD

A - Split Tube
B - Thin Wall Tube
C - Piston Sample
D - Core Barrel
E - Auger
F - Wash
G - Shovel Grab
K - Slotted

SHIPPING CONTAINER

N - Insert
O - Tube
P - Water Content Tin
Q - Jar
R - Cloth Bag
S - Plastic Bag
U - Wooden Box
Y - Core Box
Z - Discarded

Approved ____________________

Date ____________________

PROBE HOLE REPORT

ACRES

CLIENT: City of Saint John
PROJECT: Menzies Lake Dam Safety Study

HOLE: PH 5
PAGE: 1 **OF:** 1

SITE: Saddle Dyke 1, right abutment, N7359096 E2520862

DIP DIRECTION:		**CONTRACTOR:**	Boart-Longyear Inc.	**STARTED:**	16 Sept, 2002
DIP:	90	**DRILL TYPE:**	CME 55, track mounted	**FINISHED:**	16 Sept, 2002
ELEVATIONS (m)		**METHOD SOIL:**	Std. auger - 115 OD	**INSPECTOR:**	B.Bourque
DATUM:	Geodetic			**LOGGED BY:**	B.Bourque
PLATFORM:					
GROUND:	77.309				
END OF HOLE:	73.80				

SCALE (m)	DEPTH (m)	DESCRIPTION	SAMPLE DEPTH (m)	TYPE/ NUMBER	SIZE (mm)	REC'Y (mm)	RET'D (mm)	BLOW COUNTS	REMARKS
	0.0	Auger cuttings are gravel, sand, trace silt	0						Reservoir Level: 248.55 ft (09/16/2002 4:50 PM) Advance augers to 3.51 m (bouldery)
			3.51						Resistant stratum at 3.51 m
	3.51		**END OF PROBE HOLE**						WATERLEVEL STABILIZED IN HOLE AT 2.335 m BELOW GROUND SURFACE (09/16/2002 4:17:30 PM)

SAMPLING METHOD

A - Split Tube
B - Thin Wall Tube
C - Piston Sample
D - Core Barrel
E - Auger
F - Wash
G - Shovel Grab
K - Slotted

SHIPPING CONTAINER

N - Insert
O - Tube
P - Water Content Tin
Q - Jar
R - Cloth Bag
S - Plastic Bag
U - Wooden Box
Y - Core Box
Z - Discarded

Approved ______________________

Date ______________________

Project: **P14127.00**

PROBE HOLE REPORT

ACRES

CLIENT: City of Saint John
PROJECT: Menzies Lake Dam Safety Study

HOLE: PH 6
PAGE: 1 **OF:** 1

SITE: Saddle Dyke 1, right abutment, N7359088 E2520834

DIP DIRECTION:
DIP: 90
ELEVATIONS (m)
DATUM: Geodetic
PLATFORM:
GROUND: 77.351
END OF HOLE: 75.24

CONTRACTOR: Boart-Longyear Inc.
DRILL TYPE: CME 55, track mounted
METHOD SOIL: Std. auger - 115 OD

STARTED: 16 Sept, 2002
FINISHED: 16 Sept, 2002
INSPECTOR: B.Bourque
LOGGED BY: B.Bourque

SCALE (m)	DEPTH (m)	DESCRIPTION	SAMPLE DEPTH (m)	TYPE/ NUMBER	SIZE (mm)	REC'Y (mm)	RET'D (mm)	BLOW COUNTS	REMARKS
	0.0	Auger cuttings are gravel, some sand, trace silt	0						Reservoir Level: 248.55 ft (09/16/2002 4:50 PM) Advance augers to 2.11 m Resistant stratum at 2.11 m - broke a tooth off auger bit and one auger broken (sheared just below joint at top)
	2.11		2.11						

END OF PROBE HOLE

NO WATER ENCOUNTERED

SAMPLING METHOD

A - Split Tube
B - Thin Wall Tube
C - Piston Sample
D - Core Barrel
E - Auger
F - Wash
G - Shovel Grab
K - Slotted

SHIPPING CONTAINER

N - Insert
O - Tube
P - Water Content Tin
Q - Jar
R - Cloth Bag
S - Plastic Bag
U - Wooden Box
Y - Core Box
Z - Discarded

Approved ______________

Date ______________

Project: **P14127.00**

PROBE HOLE REPORT

ACRES

CLIENT: City of Saint John
PROJECT: Menzies Lake Dam Safety Study

HOLE: PH 7
PAGE: 1 **OF:** 1

SITE: Saddle Dyke 2, left abutment, N7359130 E2520742

DIP DIRECTION:
DIP: 90
ELEVATIONS (m)
DATUM: Geodetic
PLATFORM:
GROUND: 76.692
END OF HOLE: 71.20

CONTRACTOR: Boart-Longyear Inc.
DRILL TYPE: CME 55, track mounted
METHOD SOIL: Std. auger - 115 OD

STARTED: 18 Sept, 2002
FINISHED: 18 Sept, 2002
INSPECTOR: B.Bourque
LOGGED BY: B.Bourque

SCALE (m)	DEPTH (m)	DESCRIPTION	SAMPLE DEPTH (m)	TYPE/NUMBER	SIZE (mm)	RECY (mm)	RET'D (mm)	BLOW COUNTS	REMARKS
	0.0	Auger cuttings are sand and gravel, trace silt	0 1.52						Reservoir Level: 248.3 ft (09/18/2002 7:30 AM) Reservoir Level: 248.2 ft (09/18/2002 6:30 PM) Advance augers to 5.49 m (bouldery)
	1.52	Auger cuttings are sand and gravel, silty Moist from 1.52 m to 3.05 m	1.52 3.04						
									Auger refusal at 5.49 m
	5.49	**END OF PROBE HOLE**							WATERLEVEL STABILIZED IN HOLE AT 1.89 m FROM GROUND SURFACE (09/18/2002 4:04 PM)

SAMPLING METHOD

A - Split Tube
B - Thin Wall Tube
C - Piston Sample
D - Core Barrel
E - Auger
F - Wash
G - Shovel Grab
K - Slotted

SHIPPING CONTAINER

N - Insert
O - Tube
P - Water Content Tin
Q - Jar
R - Cloth Bag
S - Plastic Bag
U - Wooden Box
Y - Core Box
Z - Discarded

Approved ____________________

Date ____________________

PROBE HOLE REPORT

ACRES

CLIENT: City of Saint John
PROJECT: Menzies Lake Dam Safety Study

HOLE: PH 8
PAGE: 1 **OF:** 1

SITE: Saddle Dyke 2, left abutment, N7359126 E2520747

DIP DIRECTION:
DIP: 90
ELEVATIONS (m)
DATUM: Geodetic
PLATFORM:
GROUND: 76.864

END OF HOLE: 67.11

CONTRACTOR: Boart-Longyear Inc.
DRILL TYPE: CME 55, track mounted
METHOD SOIL: Std. auger - 115 OD

STARTED: 18 Sept, 2002
FINISHED: 18 Sept, 2002
INSPECTOR: B.Bourque
LOGGED BY: B.Bourque

SCALE (m)	DEPTH (m)	DESCRIPTION	SAMPLE DEPTH (m)	TYPE/ NUMBER	SIZE (mm)	REC'Y (mm)	RET'D (mm)	BLOW COUNTS	REMARKS
	0.0	Auger cuttings are gravel and sand	0 2.74						Reservoir Level: 248.3 ft (09/18/2002 7:30 AM) Reservoir Level: 248.2 ft (09/18/2002 6:30 PM) Advance augers to 9.75 m Auger advance is bouldery from 0 to 2.74 m
	2.74	Auger cuttings are gravel, and sand, some silt Wet	2.74 3.04 7.62						Easy augering from 2.74 m to 3.66 m Auger advance is bouldery from 3.66 m to 5.49 m Easy augering from 5.49 m to 6.10 m Auger advance is bouldery from 6.10 m to 6.55 m Easy augering from 6.55 m to 7.32 m
	7.62	Auger cuttings are grey brown silt Wet, looks almost like grout	7.62						Auger advance is bouldery from 7.32 m to 9.75 m Auger refusal at 9.75 m
	9.75	END OF PROBE HOLE							WATERLEVEL STABILIZED IN HOLE AT 2.04 m FROM GROUND SURFACE (09/18/2002 4:05 PM)

SAMPLING METHOD

A - Split Tube
B - Thin Wall Tube
C - Piston Sample
D - Core Barrel
E - Auger
F - Wash
G - Shovel Grab
K - Slotted

SHIPPING CONTAINER

N - Insert
O - Tube
P - Water Content Tin
Q - Jar
R - Cloth Bag
S - Plastic Bag
U - Wooden Box
Y - Core Box
Z - Discarded

Approved ____________________

Date ____________________

PROBE HOLE REPORT

ACRES

CLIENT: City of Saint John
PROJECT: Menzies Lake Dam Safety Study

HOLE: PH 9
PAGE: 1 **OF:** 1

SITE: Saddle Dyke 2, right abutment, N7359141 E2520731

DIP DIRECTION:
DIP: 90
ELEVATIONS (m)
DATUM: Geodetic
PLATFORM:
GROUND: 76.489

END OF HOLE: 71.00

CONTRACTOR: Boart-Longyear Inc.
DRILL TYPE: CME 55, track mounted
METHOD SOIL: Std. auger - 115 OD

STARTED: 18 Sept, 2002
FINISHED: 18 Sept, 2002
INSPECTOR: B.Bourque
LOGGED BY: B.Bourque

SCALE (m)	DEPTH (m)	DESCRIPTION	SAMPLE DEPTH (m)	TYPE/ NUMBER	SIZE (mm)	RECY (mm)	RET'D (mm)	BLOW COUNTS	REMARKS
	0.0	Auger cuttings are gravel and sand, trace silt, brown Wet from 3.05 m to 5.49 m	0						Reservoir Level: 248.3 ft (09/18/2002 7:30 AM) Reservoir Level: 248.2 ft (09/18/2002 6:30 PM) Advance augers to 5.49 m
			3.05 3.05						
			5.49						Auger advance is difficult at 5.49 m, bottom auger broke off and was left in the hole End of probe hole at 5.49 m
	5.49		END OF PROBE HOLE						WATERLEVEL STABILIZED IN HOLE AT 1.325 m FROM GROUND SURFACE (09/18/2002 4:17 PM)

SAMPLING METHOD

A - Split Tube
B - Thin Wall Tube
C - Piston Sample
D - Core Barrel
E - Auger
F - Wash
G - Shovel Grab
K - Slotted

SHIPPING CONTAINER

N - Insert
O - Tube
P - Water Content Tin
Q - Jar
R - Cloth Bag
S - Plastic Bag
U - Wooden Box
Y - Core Box
Z - Discarded

Approved ______________________

Date ______________________

PROBE HOLE REPORT

ACRES

CLIENT: City of Saint John
PROJECT: Menzies Lake Dam Safety Study
HOLE: PH 10
PAGE: 1 **OF:** 1

SITE: Saddle Dyke 2, right abutment, N7359157 E2520711

DIP DIRECTION:		**CONTRACTOR:**	Boart-Longyear Inc.	**STARTED:**	18 Sept, 2002
DIP:	90	**DRILL TYPE:**	CME 55, track mounted	**FINISHED:**	18 Sept, 2002
ELEVATIONS (m)		**METHOD SOIL:**	Std. auger - 115 OD	**INSPECTOR:**	B.Bourque
DATUM:	Geodetic			**LOGGED BY:**	B.Bourque
PLATFORM:					
GROUND:	76.111				
END OF HOLE:	72.30				

SCALE (m)	DEPTH (m)	DESCRIPTION	SAMPLE DEPTH (m)	TYPE/ NUMBER	SIZE (mm)	REC'Y (mm)	RET'D (mm)	BLOW COUNTS	REMARKS
	0.0	Auger cuttings are sand and gravel, trace silt wet from 1.52 m to 3.81 m	0						Reservoir Level: 248.3 ft (09/18/2002 7:30 AM) Reservoir Level: 248.2 ft (09/18/2002 6:30 PM) Advance augers to 3.81 m
			1.52						
			1.52						Auger advance is bouldery from 1.52 m to 3.81 m
			3.81						Auger refusal at 3.81 m
	3.81								

END OF PROBE HOLE

WATERLEVEL STABILIZED IN HOLE AT 1.31 m FROM GROUND SURFACE (09/18/2002 4:23 PM)

SAMPLING METHOD

A - Split Tube
B - Thin Wall Tube
C - Piston Sample
D - Core Barrel
E - Auger
F - Wash
G - Shovel Grab
K - Slotted

SHIPPING CONTAINER

N - Insert
O - Tube
P - Water Content Tin
Q - Jar
R - Cloth Bag
S - Plastic Bag
U - Wooden Box
Y - Core Box
Z - Discarded

Approved ____________________

Date ____________________

PROBE HOLE REPORT

ACRES

CLIENT: City of Saint John

PROJECT: Menzies Lake Dam Safety Study

HOLE: PH 11

PAGE: 1 **OF:** 1

SITE: Saddle Dyke 3, centre of dyke at downstream crest, N7359170 E2520601

DIP DIRECTION:
DIP: 90

ELEVATIONS (m)
DATUM: Geodetic
PLATFORM:
GROUND: 77.540

END OF HOLE: 73.12

CONTRACTOR: Boart-Longyear Inc.
DRILL TYPE: CME 55, track mounted
METHOD SOIL: Std. auger - 115 OD

STARTED: 18 Sept, 2002
FINISHED: 18 Sept, 2002
INSPECTOR: B.Bourque
LOGGED BY: B.Bourque

SCALE (m)	DEPTH (m)	DESCRIPTION	SAMPLE DEPTH (m)	TYPE/ NUMBER	SIZE (mm)	REC'Y (mm)	RET'D (mm)	BLOW COUNTS	REMARKS
	0.0	Gravel and sand, grey brown, max size 50 mm, rounded to angular	0 0.61	AQ1	50	178		5 9 9 16	Reservoir Level: 248.3 ft (09/18/2002 7:30 AM) Reservoir Level: 248.2 ft (09/18/2002 6:30 PM) Standard augers
	.61	Embankment Fill - gravel and sand, some silt, brown, max size 30 mm, rounded to angular	0.61 1.22	AQ2	50	203		7 13 11 5	
									Advance standard auger to 1.52 m because of gravel and cobbles
			1.52 2.13	AQ3	50	51		3 1 1 1	
	2.13	Gravel and sand, some silt, trace woody fragments, brown, max size 20 mm, angular to rounded wet	2.13 2.74	AQ4	50	152		6 4 6 13	
	2.74	Gravel and sand, trace to some silt, trace organics, grey gravel and brown silt, max size 60 mm, angular to subrounded	2.74 3.15	AQ5	50	305		32 38 50	
	3.15								Auger advance is cobbles and bouldery from 3.05 m to 4.42 m Auger refusal at 4.42 m
	4.42	END OF PROBE HOLE							WATERLEVEL STABILIZED IN HOLE AT 1.92 m FROM GROUND SURFACE (09/18/2002 4:23 PM)

SAMPLING METHOD

A - Split Tube
B - Thin Wall Tube
C - Piston Sample
D - Core Barrel
E - Auger
F - Wash
G - Shovel Grab
K - Slotted

4.0

SHIPPING CONTAINER

N - Insert
O - Tube
P - Water Content Tin
Q - Jar
R - Cloth Bag
S - Plastic Bag
U - Wooden Box
Y - Core Box
Z - Discarded

Approved ____________________

Date ____________________

Project: **P14127.00**

PROBE HOLE REPORT

ACRES

CLIENT: City of Saint John **HOLE:** PH 12

PROJECT: Menzies Lake Dam Safety Study **PAGE:** 1 **OF:** 1

SITE: Approximately 140 m past Saddle Dyke 3 where water is on both sides of road, at downstream crest, N7359288 E2520537

DIP DIRECTION:
DIP: 90

ELEVATIONS (m)
DATUM: Geodetic
PLATFORM:
GROUND: 77.557

END OF HOLE: 73.75

CONTRACTOR: Boart-Longyear Inc.
DRILL TYPE: CME 55, track mounted
METHOD SOIL: Std. auger - 115 OD, Hollow stem auger

STARTED: 19 Sept, 2002
FINISHED: 19 Sept, 2002
INSPECTOR: B.Bourque
LOGGED BY: B.Bourque

SCALE (m)	DEPTH (m)	DESCRIPTION	SAMPLE DEPTH (m)	TYPE/ NUMBER	SIZE (mm)	RECY (mm)	RET'D (mm)	BLOW COUNTS	REMARKS
	0.0	Road Fill - gravel, silty, trace sand, brown, max size 30 mm, rounded to angular Moist at about 1 m	0 – 0.61	AQ1	50	178		2 4 6 14	Reservoir Level: 248.1 ft (09/19/2002 12:42 PM) Reservoir Level: 248.05 ft (09/19/2002 5:27 PM) Standard augers from 0 to 2.44 m Hollow stem augers from 2.44 m to 3.66 m
			0.61 – 1.22	AQ2	50	178		11 12 11 25	
	1.22	Dark brown silt, gravelly, trace sand, trace woody and black organics, max size 40 mm, angular to subrounded	1.22 – 1.83	AQ3	50	229		4 6 6 5	
	1.83	Gravel and silt, trace to some sand, brown, max size 50 mm, angular to rounded Wet	1.83 – 2.44	AQ4	50	76		5 4 2 5	
			2.44 – 3.05	AQ5	50	305		16 15 10 10	
	2.74	Silt, some gravel, trace sand, brown, max size 50 mm, angular to subrounded Wet							
			3.05 – 3.66	AQ6	50	457		24 40 43 38	
	3.35	Sand and gravel, trace to some silt, grey, max size 50 mm, angular to subrounded Moist							
			3.66 – 3.81	AQ7	50	15		70	end of probehole at 3.81 m
	3.81								

END OF PROBE HOLE

WATERLEVEL STABILIZED IN HOLE AT 1.96 m BELOW GROUND SURFACE (09/19/2002 9:40 AM)

SAMPLING METHOD

A - Split Tube
B - Thin Wall Tube
C - Piston Sample
D - Core Barrel
E - Auger
F - Wash
G - Shovel Grab
K - Slotted

SHIPPING CONTAINER

N - Insert
O - Tube
P - Water Content Tin
Q - Jar
R - Cloth Bag
S - Plastic Bag
U - Wooden Box
Y - Core Box
Z - Discarded

Approved ______________

Date ______________

PROBE HOLE REPORT

ACRES

CLIENT: City of Saint John **HOLE:** PH 13
PROJECT: Menzies Lake Dam Safety Study **PAGE:** 1 **OF:** 1

SITE: Control Structure, right abutment, N7359357 E2522068

DIP DIRECTION:
DIP: 90
ELEVATIONS (m)
DATUM: Geodetic
PLATFORM:
GROUND: 76.547
END OF HOLE: 72.16

CONTRACTOR: Boart-Longyear Inc.
DRILL TYPE: CME 55, track mounted
METHOD SOIL: Std. auger - 115 OD, NW casing

STARTED: 19 Sept, 2002
FINISHED: 19 Sept, 2002
INSPECTOR: B.Bourque
LOGGED BY: B.Bourque

SCALE (m)	DEPTH (m)	DESCRIPTION	SAMPLE DEPTH (m)	TYPE/ NUMBER	SIZE (mm)	RECY (mm)	RET'D (mm)	BLOW COUNTS	REMARKS
	0.0	Gravel, sandy, brown to grey, trace silt, angular to subrounded, max size 40 mm Wet from 0.66 to 1.22 m	0 – 0.61	AQ1	50	127		3 3 5 6	Reservoir Level: 248.1 ft (09/19/2002 12:42 PM) Reservoir Level: 248.05 ft (09/19/2002 5:27 PM) Standard augers from 0 to 1.52 m NW casing from 1.53 m to 3.96 m
			0.61 – 1.22	AQ2	50	127		8 8 8 11	0.91 m to 1.52 m auger advance through possible cobbles
	1.22	Sand and gravel, some silt, brown, angular to subrounded, max size 50 mm	1.52 – 2.13	AQ3	50	254		1 1 1 1	
			2.13 – 2.74	AQ4	50	76		1 1 1 2	AQ 4 - pushing a piece of gravel which was stuck in end of spoon
			2.74 – 3.35	AQ5	50	0		2 3 3 6	AQ 5 - no sample recovery - pushing a piece of gravel
	3.35	Sand, some gravel, trace silt, brown, angular to subrounded, max size 20 mm	3.35 – 3.93	AQ6	50	203		10 7 13 50	AQ 6 - pushing a piece of gravel which was stuck in the end of the spoon Advance casing from 3.35 m to 3.96 m - no water at surface, water just downstream of structure is brown during drilling
	3.51	Glacial Till - gravel, trace silt to silty, trace sand, grey, angular to subrounded, max size 50 mm	3.96 – 4.39	AQ7	50	127		33 41 50	End of probe hole at 4.39 m
	4.39								

END OF PROBE HOLE

WATERLEVEL STABILIZED IN HOLE AT 2.14 m BELOW GROUND SURFACE (09/19/2002 5:45 PM)

SAMPLING METHOD

A - Split Tube
B - Thin Wall Tube
C - Piston Sample
D - Core Barrel
E - Auger
F - Wash
G - Shovel Grab
K - Slotted

SHIPPING CONTAINER

N - Insert
O - Tube
P - Water Content Tin
Q - Jar
R - Cloth Bag
S - Plastic Bag
U - Wooden Box
Y - Core Box
Z - Discarded

Approved ____________________

Date ____________________

PROBE HOLE REPORT

ACRES

CLIENT: City of Saint John
PROJECT: Menzies Lake Dam Safety Study

HOLE: PH 14
PAGE: 1 **OF:** 1

SITE: Control Structure, right abutment, N7359356 E2522063

DIP DIRECTION:
DIP: 90
ELEVATIONS (m)
DATUM: Geodetic
PLATFORM:
GROUND: 76.571
END OF HOLE: 73.93

CONTRACTOR: Boart-Longyear Inc.
DRILL TYPE: CME 55, track mounted
METHOD SOIL: Std. auger - 115 OD, NW casing

STARTED: 19 Sept, 2002
FINISHED: 19 Sept, 2002
INSPECTOR: B.Bourque
LOGGED BY: B.Bourque

SCALE (m)	DEPTH (m)	DESCRIPTION	SAMPLE DEPTH (m)	TYPE/ NUMBER	SIZE (mm)	REC'Y (mm)	RET'D (mm)	BLOW COUNTS	REMARKS
	0.0	Gravel, sandy, brown, trace silt, angular to subrounded, max size 40 mm	0 – 0.61	AQ1	50	102		8, 13, 25, 19	Reservoir Level: 248.1 ft (09/19/2002 12:42 PM) Reservoir Level: 248.05 ft (09/19/2002 5:27 PM) Standard augers from 0 to 1.52 m NW casing from 1.52 m to 2.44 m
			0.61 – 1.22	AQ2	50	51		7, 9, 8, 6	AQ 2 - pushing a piece of rock which was stuck in spoon tip
	1.22	Sand and gravel, some silt, brown, angular to subrounded, max size 20 mm Moist	1.22 – 1.83	AQ3	50	102		6, 2, 1, 1	AQ 3 - pushing a piece of rock which was stuck in spoon tip waterlevel is 1.28 m below ground surface during drilling
	1.83	Original surface - gravel, some silt, some sand, brown, trace woody organics (fine), trace black organics, angular to subrounded, max size 40 mm Wet	1.83 – 2.44	AQ4	50	279		3, 5, 20, 40	
	2.06	Gravel and sand, grey, angular to subrounded, max size 20 mm Wet							
	2.44	Glacial Till - gravel, trace to some sand, trace to some silt, brown to dark grey, angular to subrounded, max size 30 mm	2.44 – 2.64	AQ5	50	102		12, 50	End of probe hole at 2.64 m
	2.64								

END OF PROBE HOLE

WATERLEVEL STABILIZED IN HOLE AT 1.27 m BELOW GROUND SURFACE (09/19/2002 5:41 PM)

SAMPLING METHOD

A - Split Tube
B - Thin Wall Tube
C - Piston Sample
D - Core Barrel
E - Auger
F - Wash
G - Shovel Grab
K - Slotted

SHIPPING CONTAINER

N - Insert
O - Tube
P - Water Content Tin
Q - Jar
R - Cloth Bag
S - Plastic Bag
U - Wooden Box
Y - Core Box
Z - Discarded

Approved ______________________

Date ______________________

PROBE HOLE REPORT

ACRES

CLIENT: City of Saint John
PROJECT: Menzies Lake Dam Safety Study

HOLE: PH 15
PAGE: 1 **OF:** 1

SITE: Control Structure, right abutment, N7359355 E2522058

DIP DIRECTION:
DIP: 90
ELEVATIONS (m)
DATUM: Geodetic
PLATFORM:
GROUND: 76.585

END OF HOLE: 74.61

CONTRACTOR: Boart-Longyear Inc.
DRILL TYPE: CME 55, track mounted
METHOD SOIL: Std. auger - 115 OD

STARTED: 19 Sept, 2002
FINISHED: 19 Sept, 2002
INSPECTOR: B.Bourque
LOGGED BY: B.Bourque

SCALE (m)	DEPTH (m)	DESCRIPTION	SAMPLE DEPTH (m)	TYPE/ NUMBER	SIZE (mm)	REC'Y (mm)	RET'D (mm)	BLOW COUNTS	REMARKS
	0.0	Auger cuttings are cobbles, gravel and sand, brown grey	0 1.22						Reservoir Level: 248.1 ft (09/19/2002 12:42 PM) Reservoir Level: 248.05 ft (09/19/2002 5:27 PM) Advance augers to 1.98 m Augers grinding on cobbles from 0 to 1.22 m
	1.22	Auger cuttings are gravel, silty, brown	1.22 1.68						Auger refusal at 1.98 m
	1.98		END OF PROBE HOLE						WATERLEVEL STABILIZED IN HOLE AT 1.375 m FROM GROUND SURFACE (09/19/2002 5:23 PM)

SAMPLING METHOD

A - Split Tube
B - Thin Wall Tube
C - Piston Sample
D - Core Barrel
E - Auger
F - Wash
G - Shovel Grab
K - Slotted

SHIPPING CONTAINER

N - Insert
O - Tube
P - Water Content Tin
Q - Jar
R - Cloth Bag
S - Plastic Bag
U - Wooden Box
Y - Core Box
Z - Discarded

Approved ____________________

Date ____________________

PROBE HOLE REPORT

ACRES

CLIENT: City of Saint John
PROJECT: Menzies Lake Dam Safety Study

HOLE: PH 16
PAGE: 1 **OF:** 1

SITE: Control Structure, left abutment, N7359360 E2522084

DIP DIRECTION:
DIP: 90
ELEVATIONS (m)
DATUM: Geodetic
PLATFORM:
GROUND: 76.495
END OF HOLE: 72.36

CONTRACTOR: Boart-Longyear Inc.
DRILL TYPE: CME 55, track mounted
METHOD SOIL: Std. auger - 115 OD, NW casing

STARTED: 20 Sept, 2002
FINISHED: 20 Sept, 2002
INSPECTOR: B.Bourque
LOGGED BY: B.Bourque

SCALE (m)	DEPTH (m)	DESCRIPTION	SAMPLE DEPTH (m)	TYPE/ NUMBER	SIZE (mm)	REC'Y (mm)	RET'D (mm)	BLOW COUNTS	REMARKS
	0.0	Auger cuttings are gravel and sand	0 1.52						Reservoir Level: 248.0 ft (09/20/2002 7:35 AM) Reservoir Level: 248.0 ft (09/20/2002 11:00 AM) Standard augers from 0 to 4.11 m NW casing from 4.11 m to 4.14 m
	1.52	Auger cuttings are gravel, some silt, some sand, brown	1.52 3.04						The visible leakage through the left abutment did not change color during augering Casing was advanced once the augers were removed to keep the hole open in order to measure the standing water level, the visible leakage through abutment became slightly discolored during advancement of casing Boulder or cobbles at about 4 m End of probe hole at 4.14 m
	4.14		END OF PROBE HOLE						WATERLEVEL STABILIZED IN HOLE AT 1.99 m BELOW GROUND SURFACE (09/20/2002 10:58 AM)

SAMPLING METHOD

A - Split Tube
B - Thin Wall Tube
C - Piston Sample
D - Core Barrel
E - Auger
F - Wash
G - Shovel Grab
K - Slotted

4.0

SHIPPING CONTAINER

N - Insert
O - Tube
P - Water Content Tin
Q - Jar
R - Cloth Bag
S - Plastic Bag
U - Wooden Box
Y - Core Box
Z - Discarded

Approved ______________________

Date ______________________

PROBE HOLE REPORT

ACRES

CLIENT: City of Saint John
PROJECT: Menzies Lake Dam Safety Study

HOLE: PH 17
PAGE: 1 **OF:** 1

SITE: Control Structure, left abutment, N7359361 E2522089

DIP DIRECTION:
DIP: 90
ELEVATIONS (m)
DATUM: Geodetic
PLATFORM:
GROUND: 76.539
END OF HOLE: 73.64

CONTRACTOR: Boart-Longyear Inc.
DRILL TYPE: CME 55, track mounted
METHOD SOIL: Std. auger - 115 OD

STARTED: 20 Sept, 2002
FINISHED: 20 Sept, 2002
INSPECTOR: B.Bourque
LOGGED BY: B.Bourque

SCALE (m)	DEPTH (m)	DESCRIPTION	SAMPLE DEPTH (m)	TYPE/ NUMBER	SIZE (mm)	REC'Y (mm)	RET'D (mm)	BLOW COUNTS	REMARKS
	0.0		0						Reservoir Level: 248.0 ft (09/20/2002 7:35 AM) Reservoir Level: 248.0 ft (09/20/2002 11:00 AM) Advance augers from 0 to 2.90 m Auger advance is cobbles and bouldery from 0.76 m to 0.91 m During advancing from 0.91 m to 1.52 m the leakage at left abutment is very brown Easy augering from 1.52 m to 2.13 m Auger advance is cobbles and bouldery from 2.13 m to 2.74 m During advancing from 1.52 m to 2.74 m the leakage at left abutment color is not as bad Augers grinding at 2.74 m, auger refusal at 2.90 m
	2.90		2.9						

END OF PROBE HOLE

WATERLEVEL STABILIZED IN HOLE AT 1.58 m BELOW GROUND SURFACE (09/20/2002 11:10 AM)

SAMPLING METHOD

A - Split Tube
B - Thin Wall Tube
C - Piston Sample
D - Core Barrel
E - Auger
F - Wash
G - Shovel Grab
K - Slotted

SHIPPING CONTAINER

N - Insert
O - Tube
P - Water Content Tin
Q - Jar
R - Cloth Bag
S - Plastic Bag
U - Wooden Box
Y - Core Box
Z - Discarded

Approved ________________

Date ________________

PROBE HOLE REPORT

ACRES

CLIENT: City of Saint John
PROJECT: Menzies Lake Dam Safety Study

HOLE: PH 18
PAGE: 1 **OF:** 1

SITE: Control Structure, left abutment, N7359362 E2522093

DIP DIRECTION:
DIP: 90

ELEVATIONS (m)
DATUM: Geodetic
PLATFORM:
GROUND: 76.540

END OF HOLE: 73.03

CONTRACTOR: Boart-Longyear Inc.
DRILL TYPE: CME 55, track mounted
METHOD SOIL: Std. auger - 115 OD

STARTED: 20 Sept, 2002
FINISHED: 20 Sept, 2002
INSPECTOR: B.Bourque
LOGGED BY: B.Bourque

SCALE (m)	DEPTH (m)	DESCRIPTION	SAMPLE DEPTH (m)	TYPE/ NUMBER	SIZE (mm)	RECY (mm)	RET'D (mm)	BLOW COUNTS	REMARKS
	0.0	Auger cuttings are cobbles, gravel, trace sand, grey brown	0 0.91						Reservoir Level: 248.0 ft (09/20/2002 7:35 AM) Reservoir Level: 248.0 ft (09/20/2002 11:00 AM) Advance augers to 3.51 m
	.91	Auger cuttings are gravel, silty, trace sand, brown Moist from 1.52 m to 2.44 m	0.91 1.52						Auger advance is cobbles and bouldery from 0 m to 1.07 m
			1.52 2.44						Leakage at abutment does not change color during drilling Easy augering from 1.07 m to 3.05 m
	2.44	Auger cuttings are gravel, silty, trace sand, grey Moist	2.44 3.51						Augers are grinding at 3.35 m Auger refusal at 3.51 m
	3.51		END OF PROBE HOLE						WATERLEVEL STABILIZED IN HOLE AT 2.885 m BELOW GROUND SURFACE (09/20/2002 11:10 AM)

SAMPLING METHOD

A - Split Tube
B - Thin Wall Tube
C - Piston Sample
D - Core Barrel
E - Auger
F - Wash
G - Shovel Grab
K - Slotted

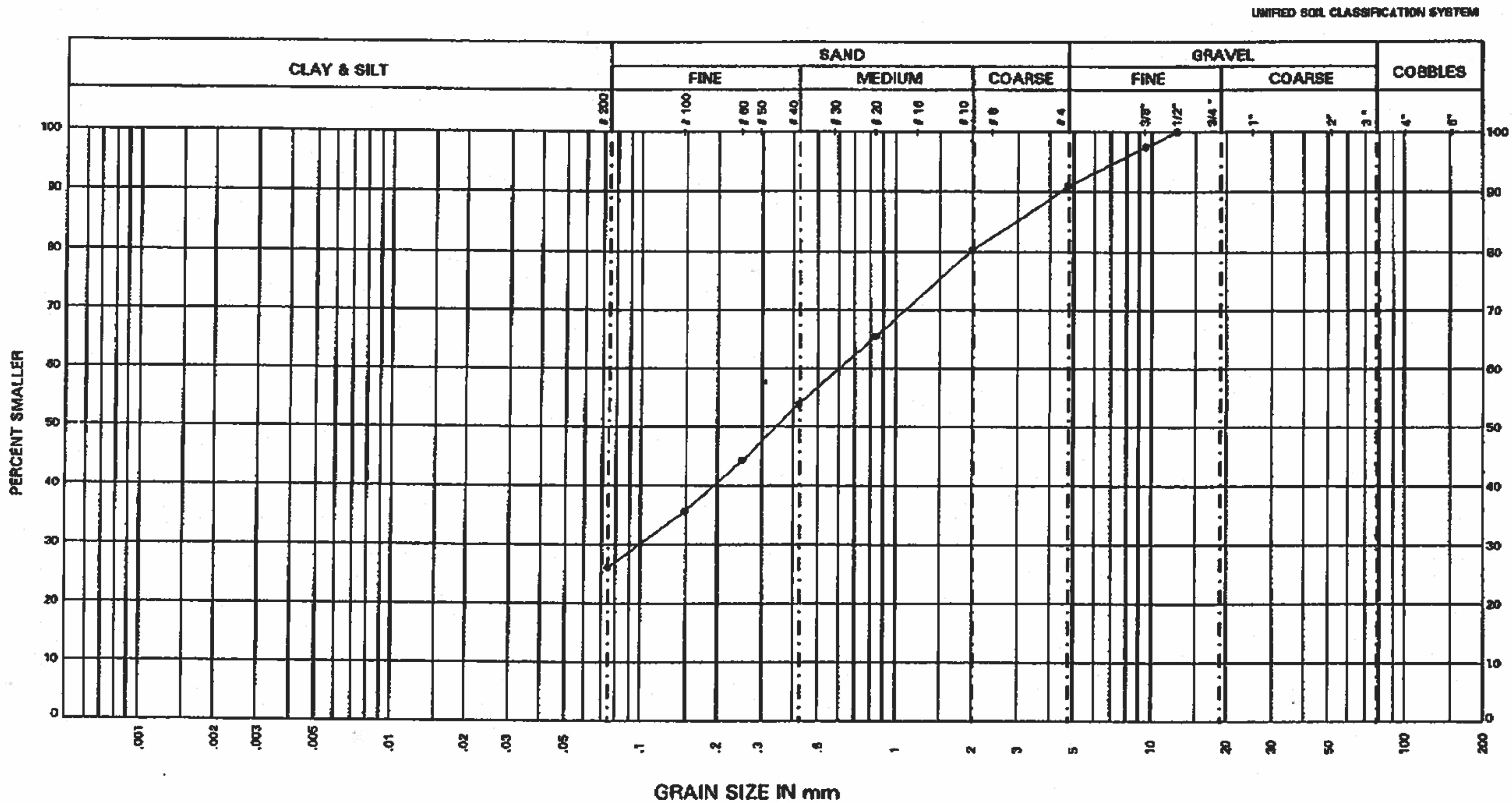
SHIPPING CONTAINER

N - Insert
O - Tube
P - Water Content Tin
Q - Jar
R - Cloth Bag
S - Plastic Bag
U - Wooden Box
Y - Core Box
Z - Discarded

Approved ____________________

Date ____________________

Annex B7
Lab Test Results



LAB SAMPLE NO.

LAB TEST NO.

DATE June 25 2003

TESTED BY RS

CHECKED BY AT

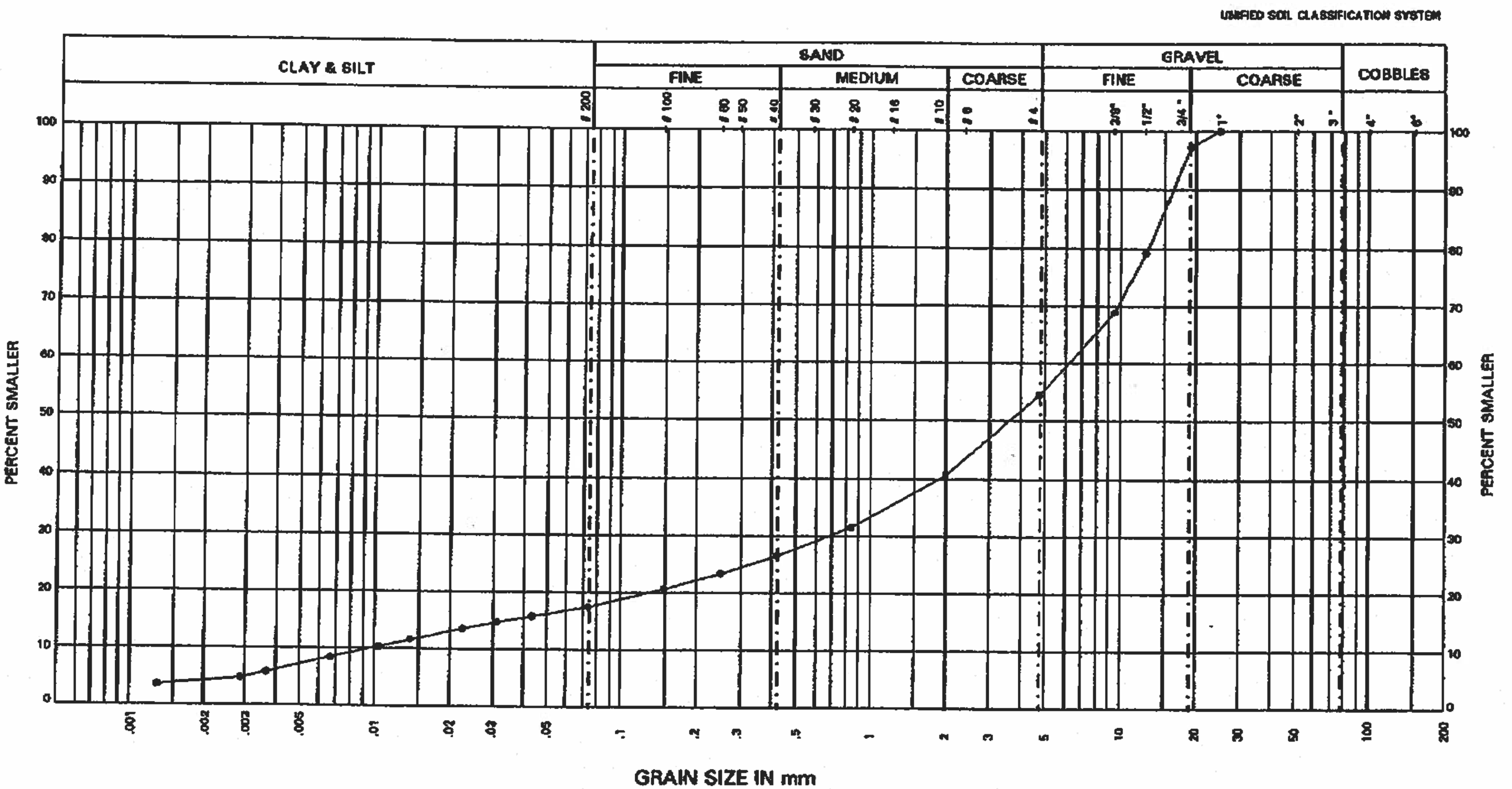
APPROVED BY

REMARKS: MENZIES LAKE DAM

GRAIN SIZE DISTRIBUTION

DEPTH	SAMPLE NO.	HOLE NO.	JOB NO.
1.83-2.44 m	AQ2	BH3	P15068.00

ACRES



LAB SAMPLE NO.

LAB TEST NO.

DATE June 25 2003

TESTED BY RS

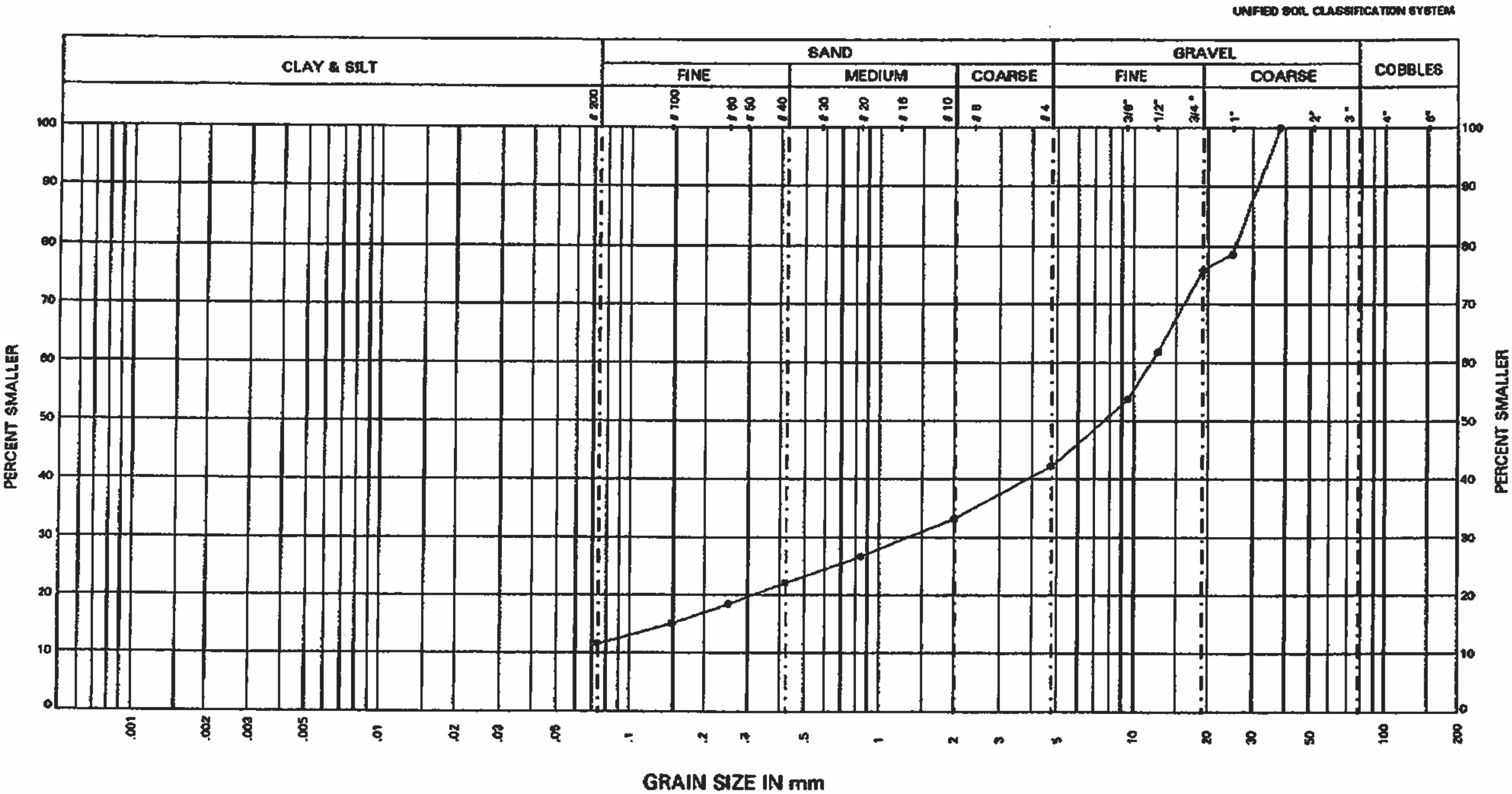
CHECKED BY AT

APPROVED BY

REMARKS: MENZIES LAKE DAM

GRAIN SIZE DISTRIBUTION

DEPTH	SAMPLE NO.	HOLE NO.	JOB NO.
2.44-3.05 m	A03	BH3	P15069.00



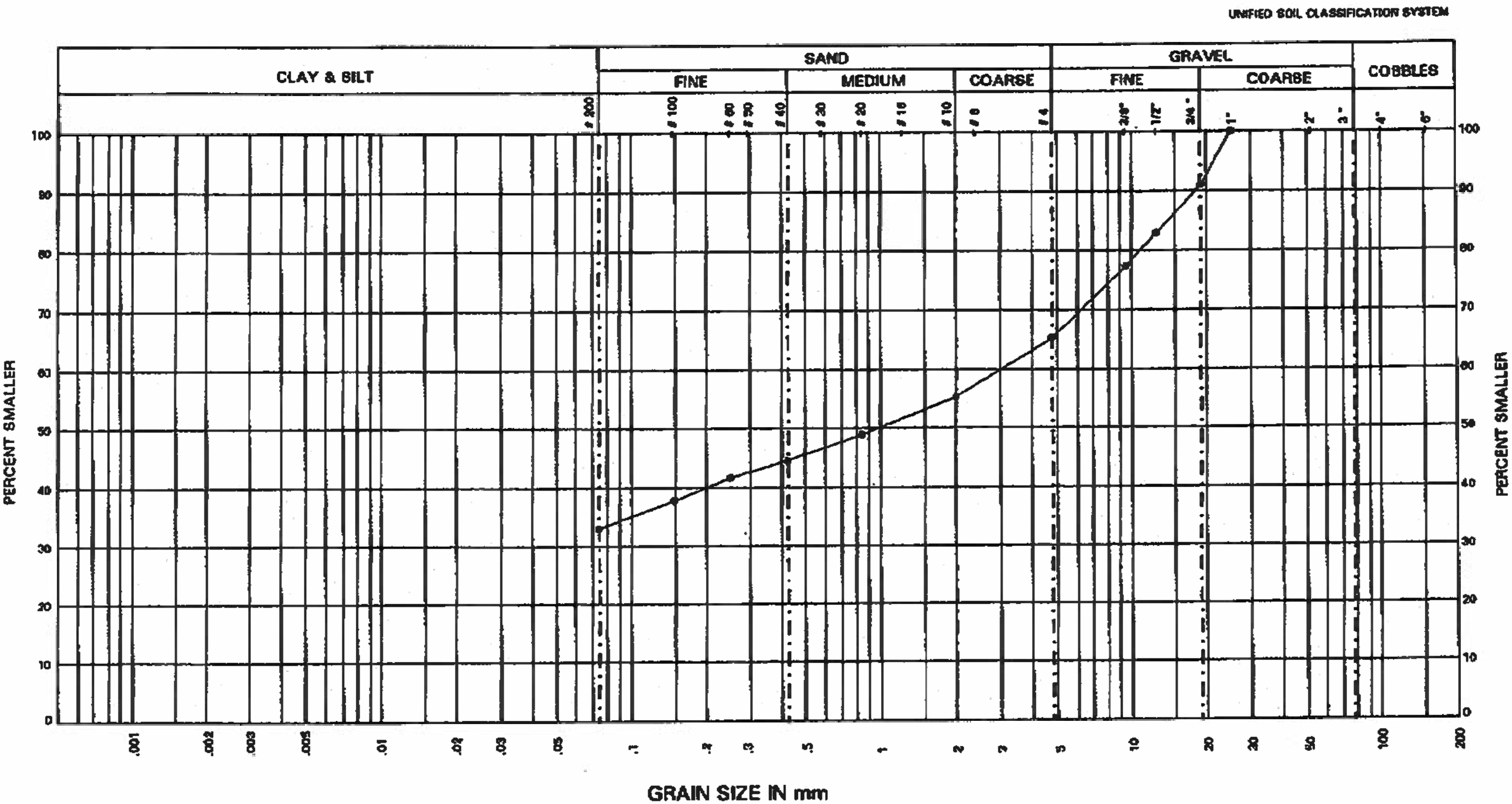
REMARKS: MENZIES LAKE DAM

LAB SAMPLE NO.	
LAB TEST NO.	
DATE	June 25 2003
TESTED BY	RS
CHECKED BY	AT
APPROVED BY	

GRAIN SIZE DISTRIBUTION

DEPTH	SAMPLE NO.	HOLE NO.	JOB NO.
0.61-1.22 m	AQ2	BH4	P15069.00

ACRES



REMARKS: MENZIES LAKE DAM

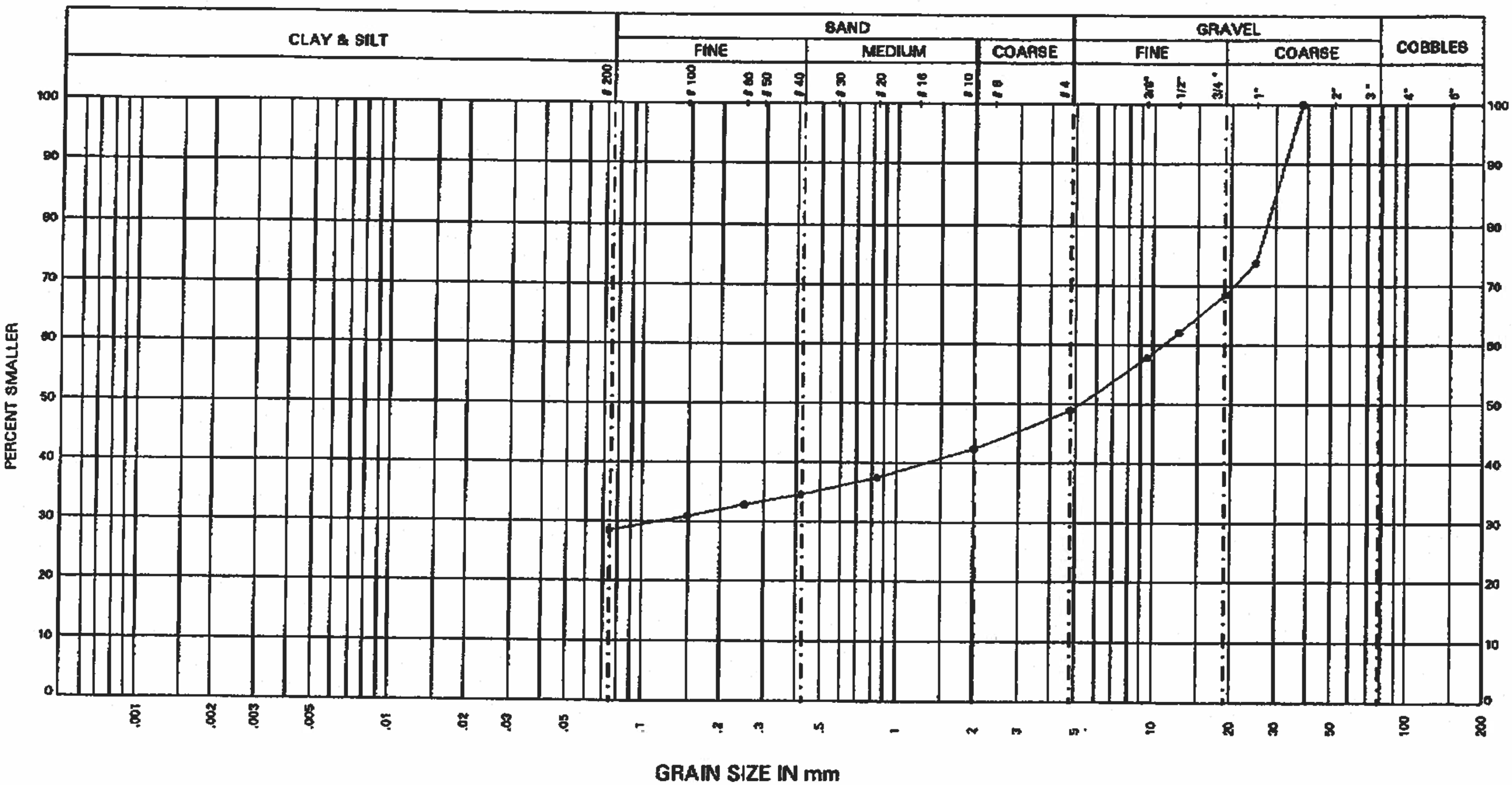
LAB SAMPLE NO.	
LAB TEST NO.	
DATE	June 25 2003
TESTED BY	RS
CHECKED BY	AT
APPROVED BY	

GRAIN SIZE DISTRIBUTION

DEPTH	SAMPLE NO.	HOLE NO.	JOB NO.
1.83-2.44 m	AQ4	BH4	P15069.00

ACRES

UNIFIED SOIL CLASSIFICATION SYSTEM



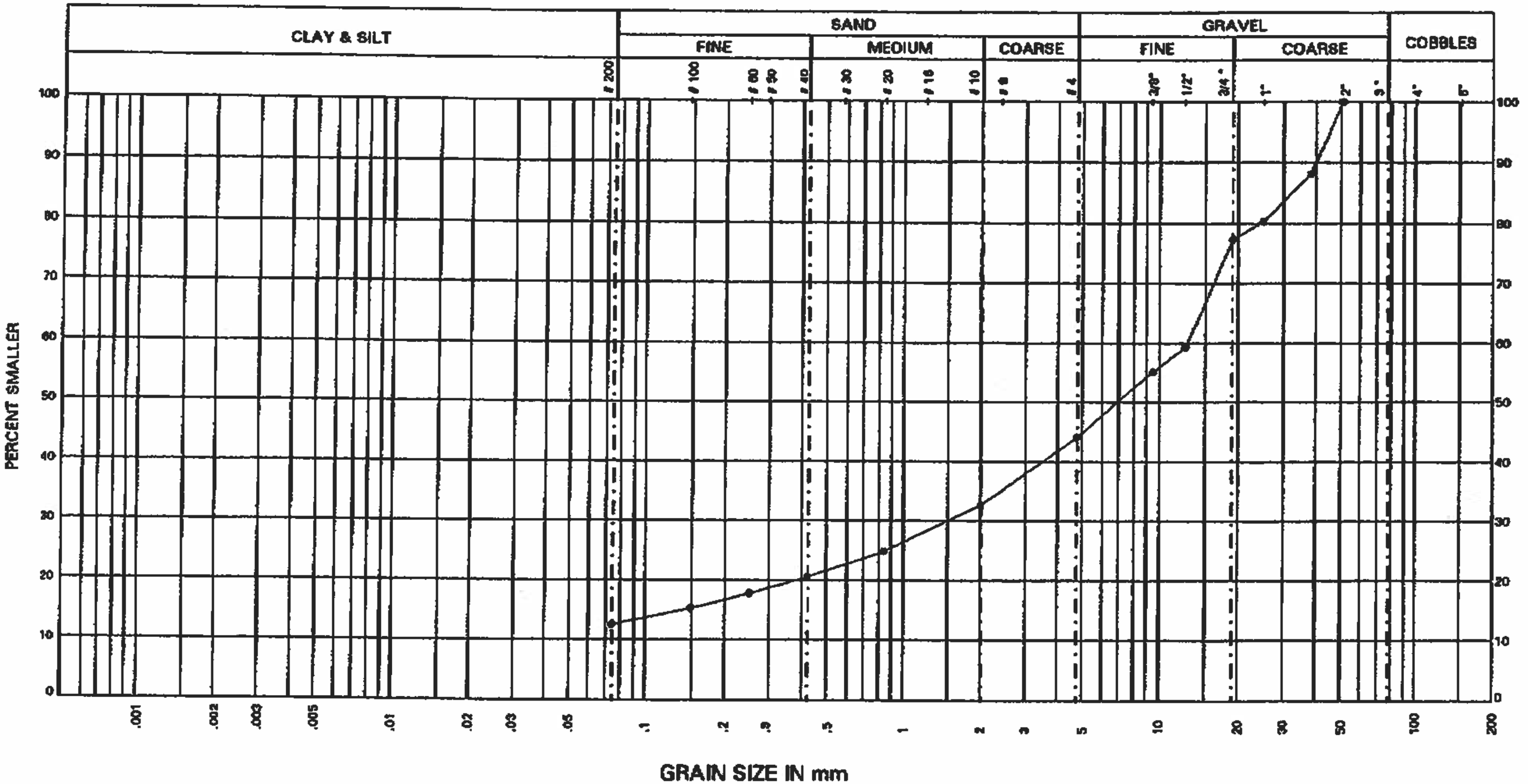
LAB SAMPLE NO.
LAB TEST NO.
DATE June 25 2003
TESTED BY RS
CHECKED BY AT
APPROVED BY

REMARKS: MENZIES LAKE DAM

GRAIN SIZE DISTRIBUTION

DEPTH	SAMPLE NO.	HOLE NO.	JOB NO.
3.05-3.25 m	AQ6	BH4	P15069.00

ACRES



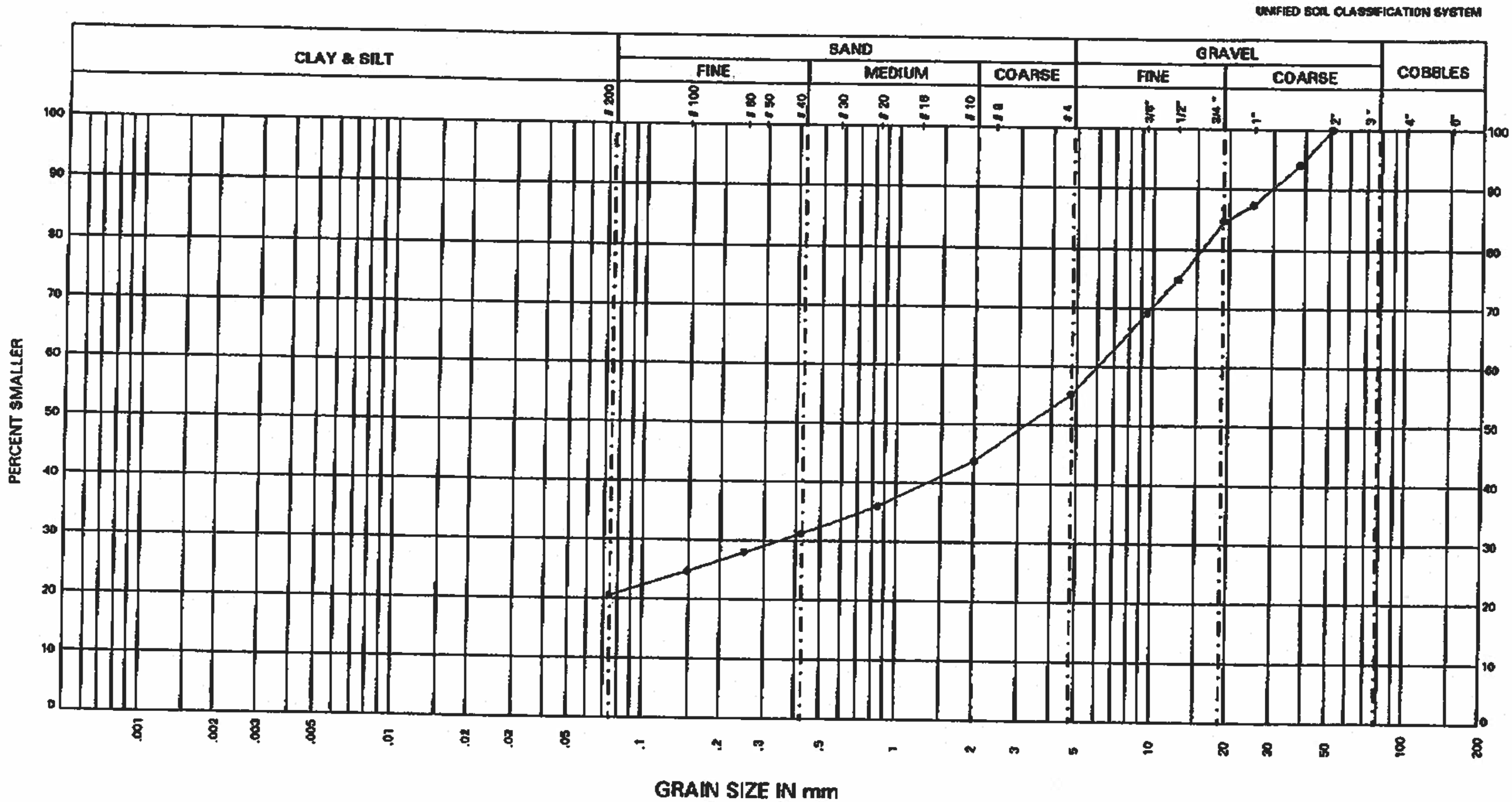
REMARKS: MENZIES LAKE DAM

LAB SAMPLE NO.
LAB TEST NO.
DATE June 25 2003
TESTED BY RS
CHECKED BY AT
APPROVED BY

GRAIN SIZE DISTRIBUTION

DEPTH	SAMPLE NO.	HOLE NO.	JOB NO.
3.25-3.40 m	AQ6	BH4	P15069.00

ACRES



LAB SAMPLE NO.

LAB TEST NO.

DATE June 25 2003

TESTED BY RS

CHECKED BY AT

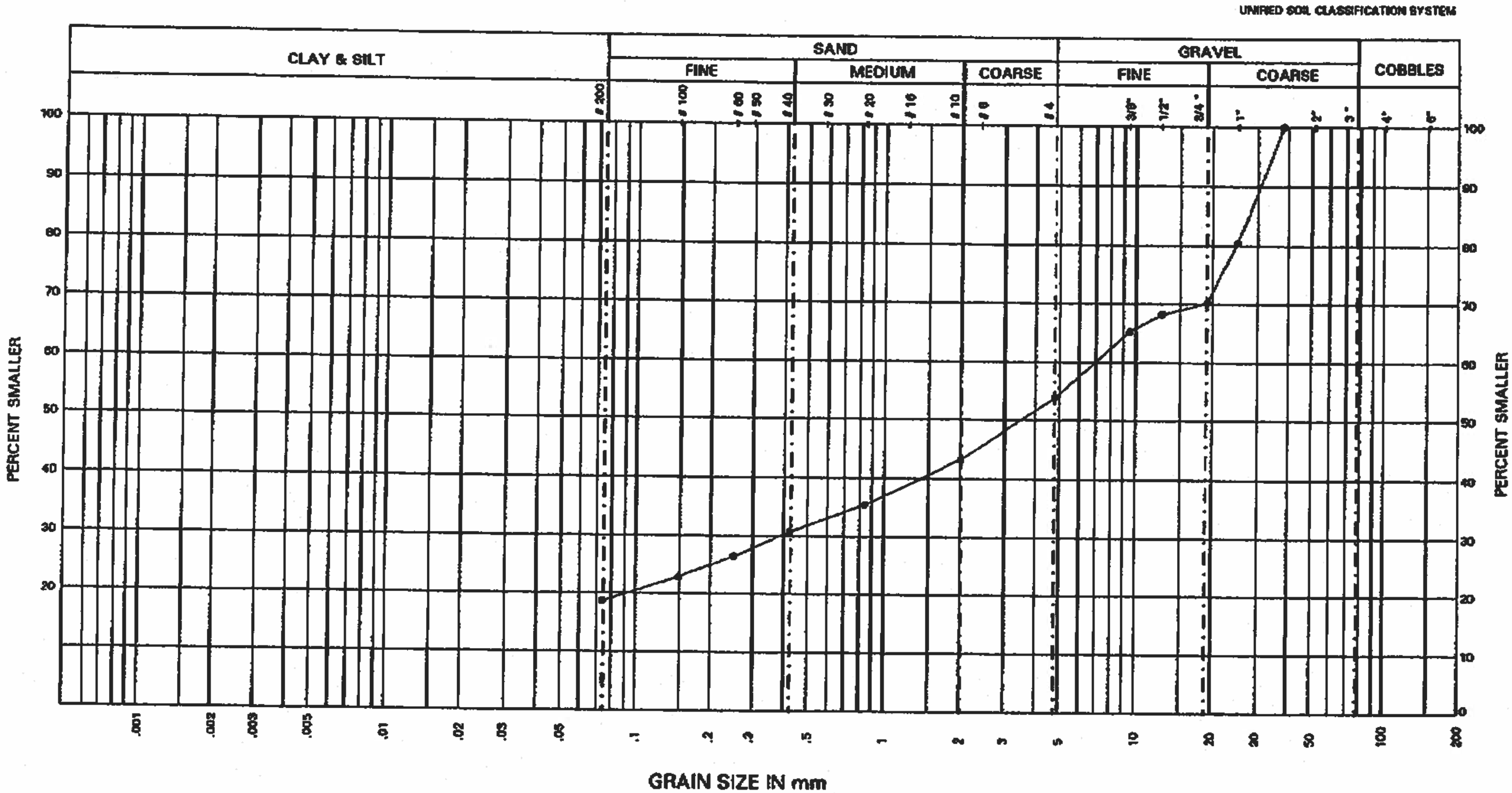
APPROVED BY

REMARKS: MENZIES LAKE DAM

GRAIN SIZE DISTRIBUTION

DEPTH	SAMPLE NO.	HOLE NO.	JOB NO.
1.21-1.83 m	AO3	BH5	P15068.00

ACRES



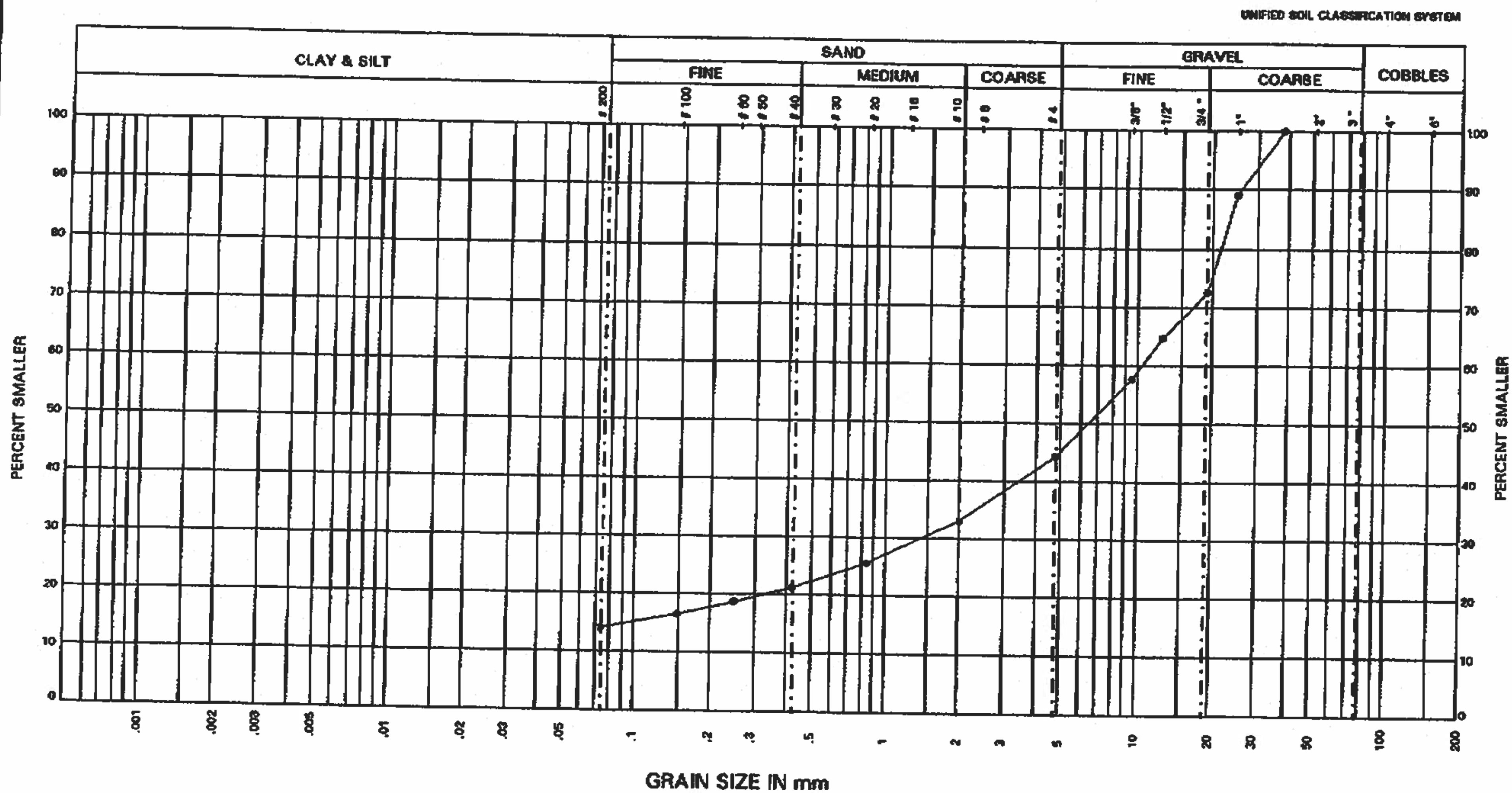
LAB SAMPLE NO.
LAB TEST NO.
DATE June 25 2003
TESTED BY RS
CHECKED BY AT
APPROVED BY

REMARKS: MENZIES LAKE DAM

GRAIN SIZE DISTRIBUTION

DEPTH	SAMPLE NO.	HOLE NO.	JOB NO.
1.83-2.44 m	AG4	BH5	P15069.00

ACRES



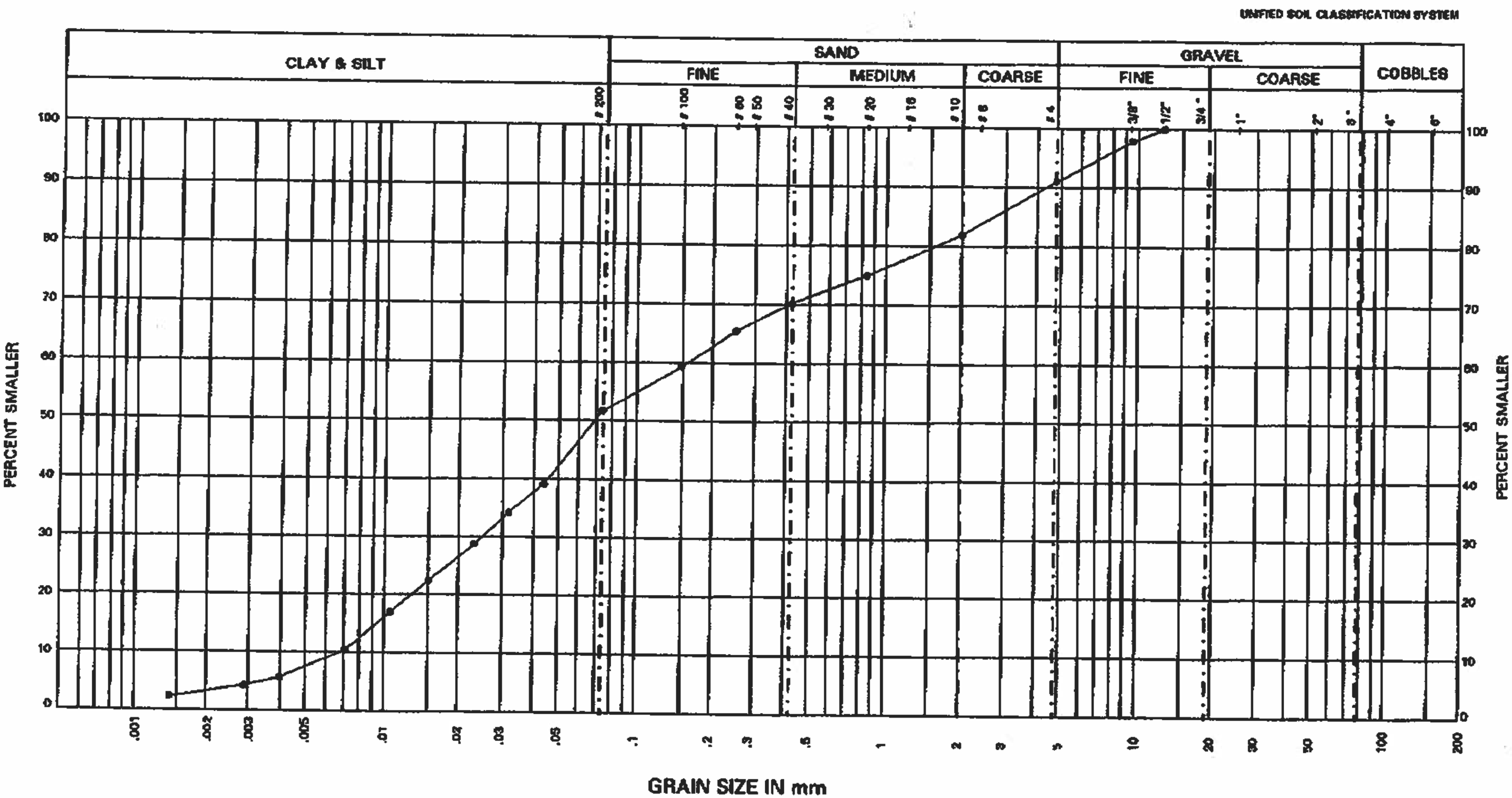
REMARKS: MENZIES LAKE DAM

LAB SAMPLE NO.	
LAB TEST NO.	
DATE	June 25 2003
TESTED BY	RS
CHECKED BY	AT
APPROVED BY	

GRAIN SIZE DISTRIBUTION

DEPTH	SAMPLE NO.	HOLE NO.	JOB NO.
6.40-6.78 m	AQ11	BH5	P15069.00

ACRES



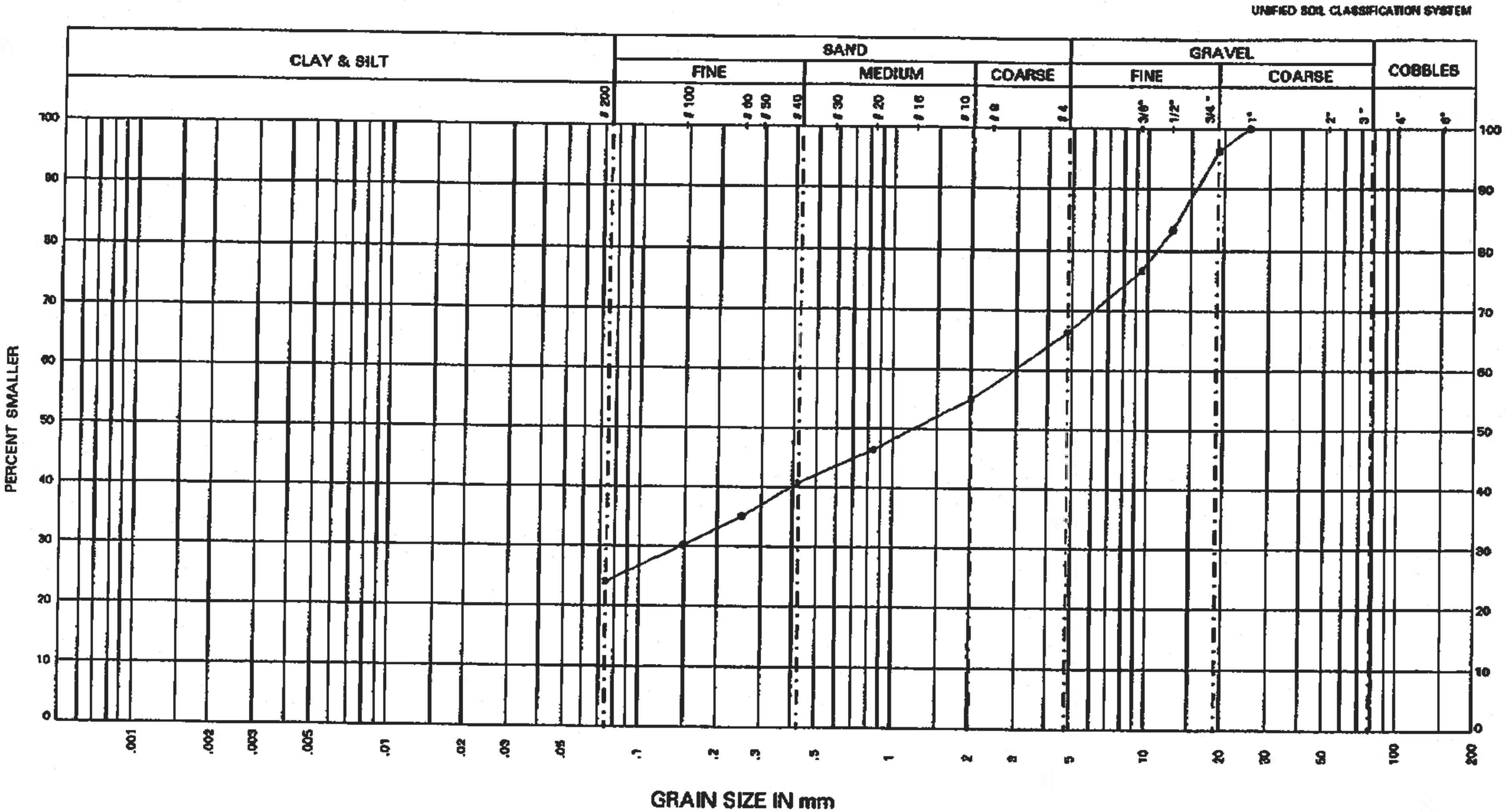
REMARKS: MENZIES LAKE DAM

LAB SAMPLE NO.
LAB TEST NO.
DATE June 25 2003
TESTED BY RS
CHECKED BY AT
APPROVED BY

GRAIN SIZE DISTRIBUTION

DEPTH	SAMPLE NO.	HOLE NO.	JOB NO.
1.90-2.03 m	AQ4	BH6	P15069.00

AGRES



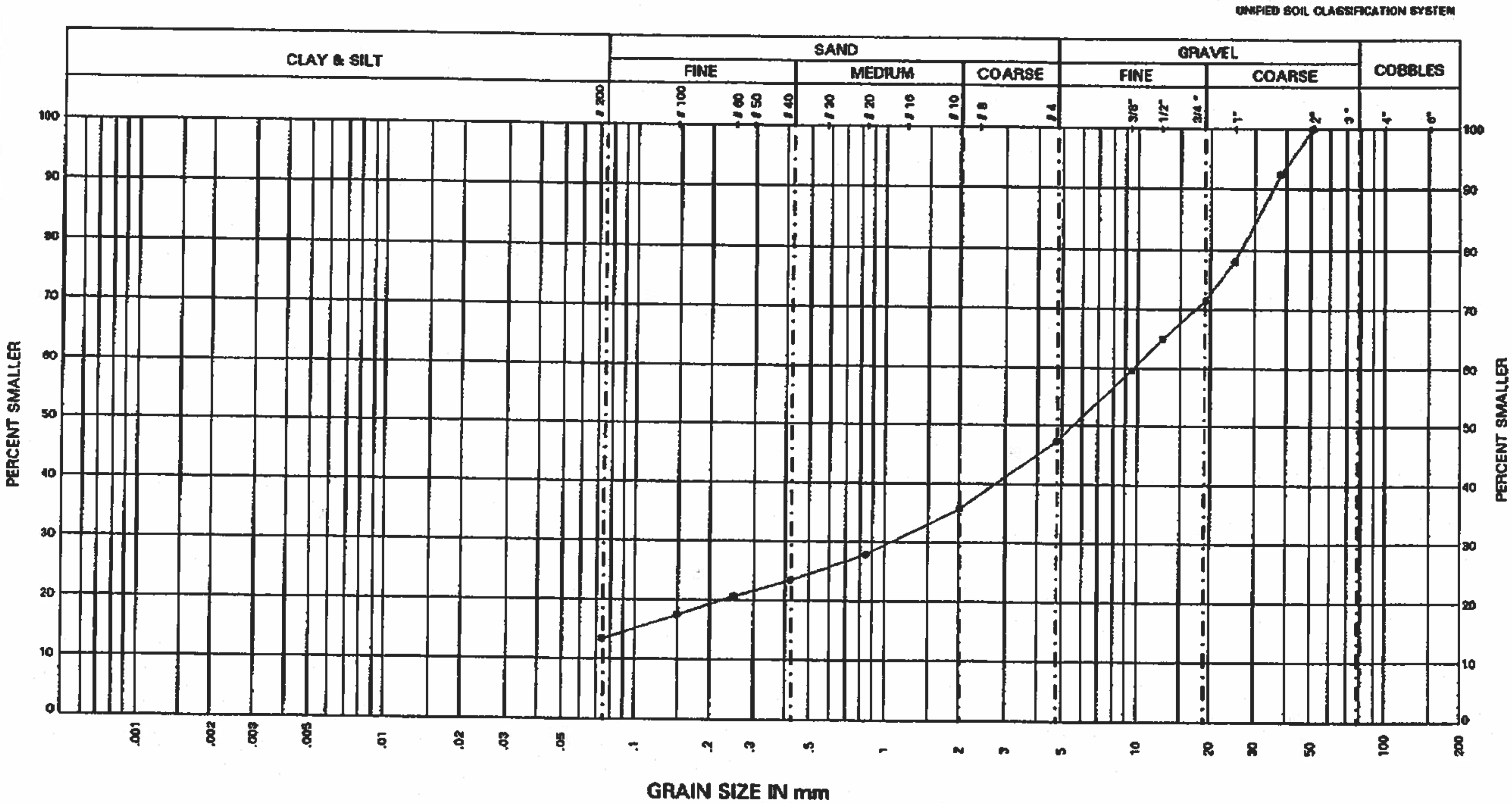
LAB SAMPLE NO.
LAB TEST NO.
DATE June 25 2003
TESTED BY RS
CHECKED BY AT
APPROVED BY

REMARKS: MENZIES LAKE DAM

GRAIN SIZE DISTRIBUTION

DEPTH	SAMPLE NO.	HOLE NO.	JOB NO.
2.18-2.33 m	AO4	BH6	P15069.00

ACRES



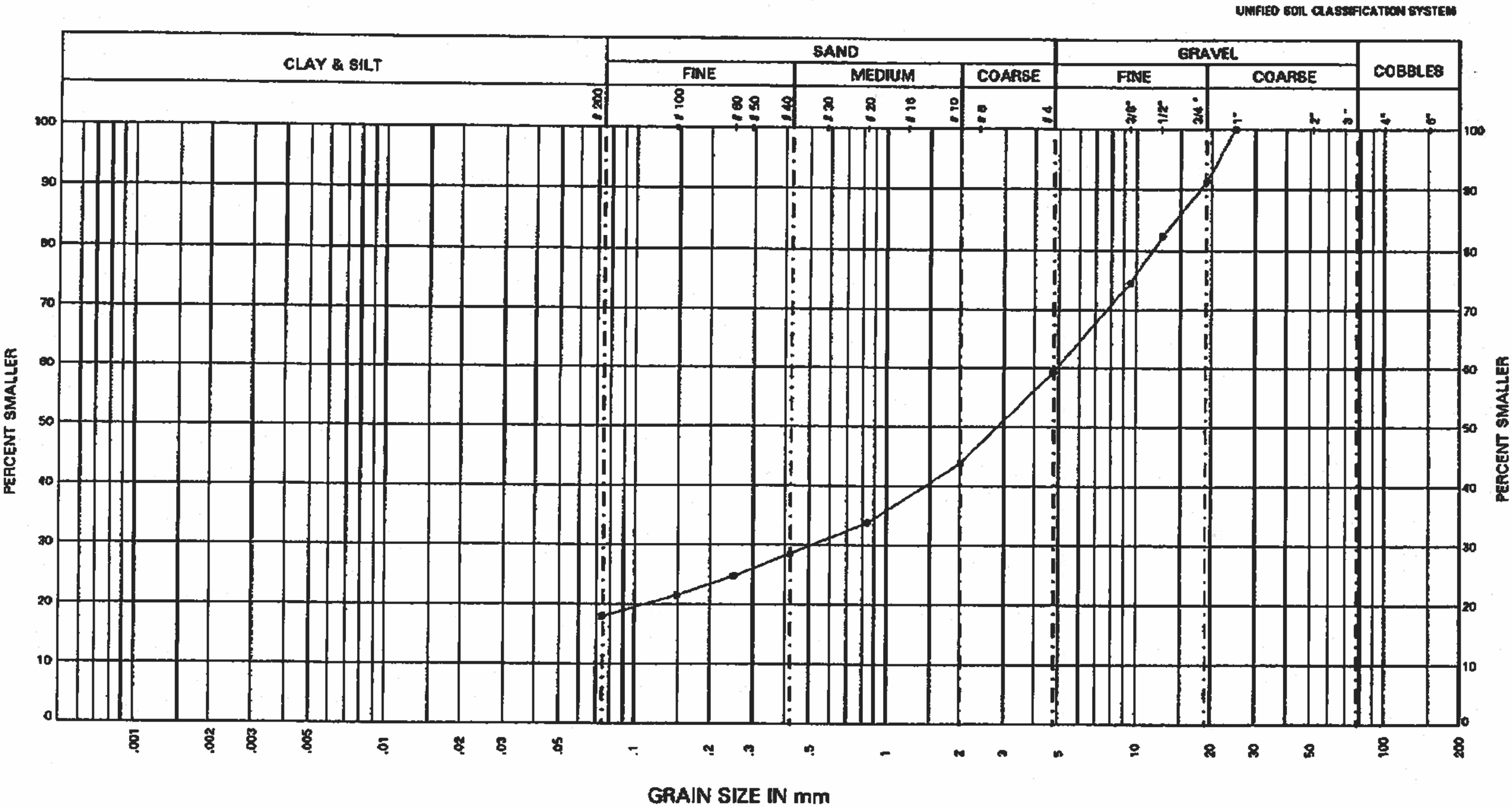
REMARKS: MENZIES LAKE DAM

LAB SAMPLE NO.
LAB TEST NO.
DATE June 25 2003
TESTED BY RS
CHECKED BY AT
APPROVED BY

GRAIN SIZE DISTRIBUTION

DEPTH	SAMPLE NO.	HOLE NO.	JOB NO.
2.44-3.05 m	AQ5	BH6	P15069.00

ACRES



LAB SAMPLE NO.

LAB TEST NO.

DATE June 25 2003

TESTED BY RS

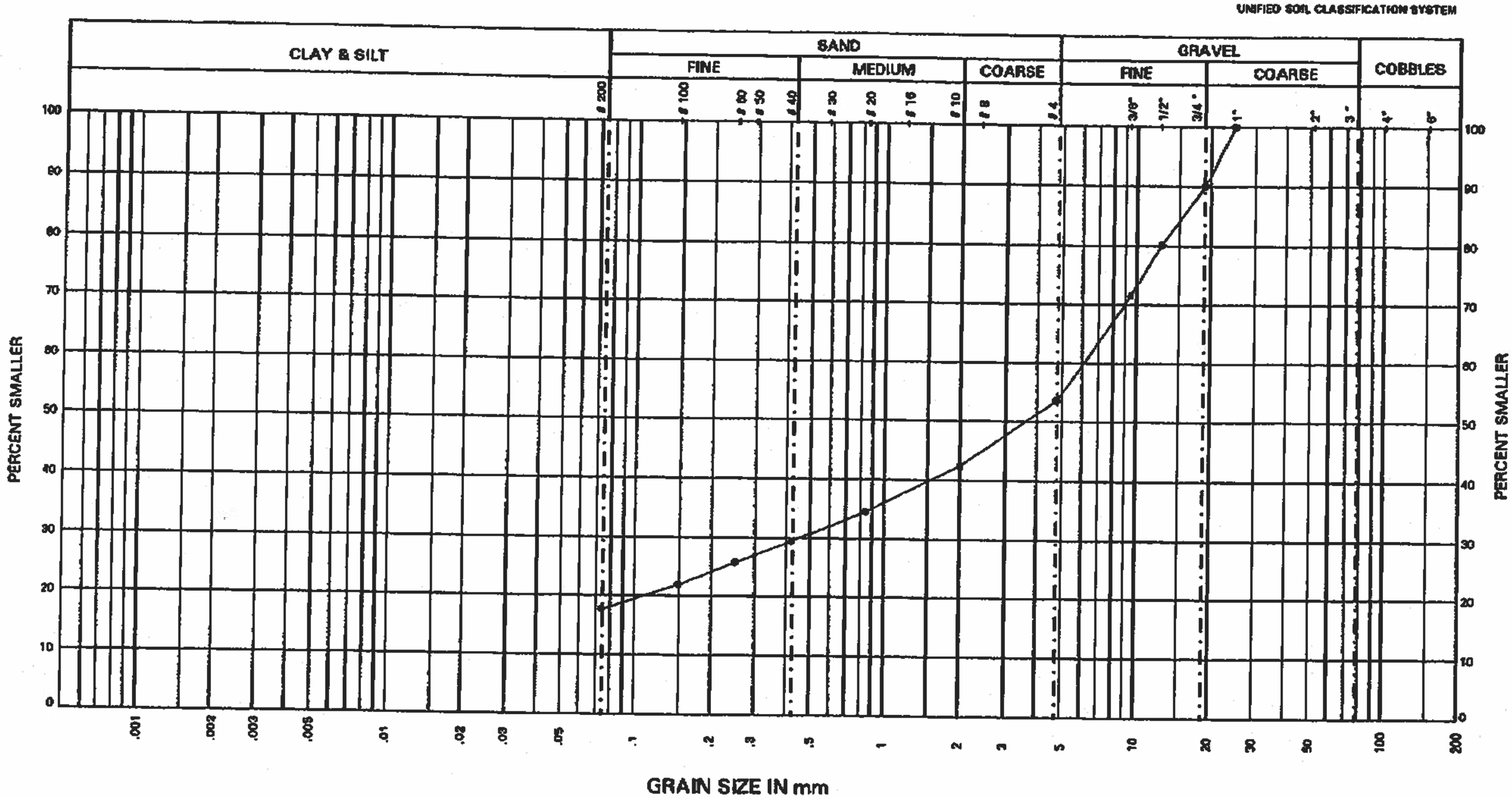
CHECKED BY AT

APPROVED BY

REMARKS: MENZIES LAKE DAM

GRAIN SIZE DISTRIBUTION

DEPTH	SAMPLE NO.	HOLE NO.	JOB NO.
0.61-1.22 m	AQ2	PH11	P15069.00



LAB SAMPLE NO.

LAB TEST NO.

DATE June 25 2003

TESTED BY RS

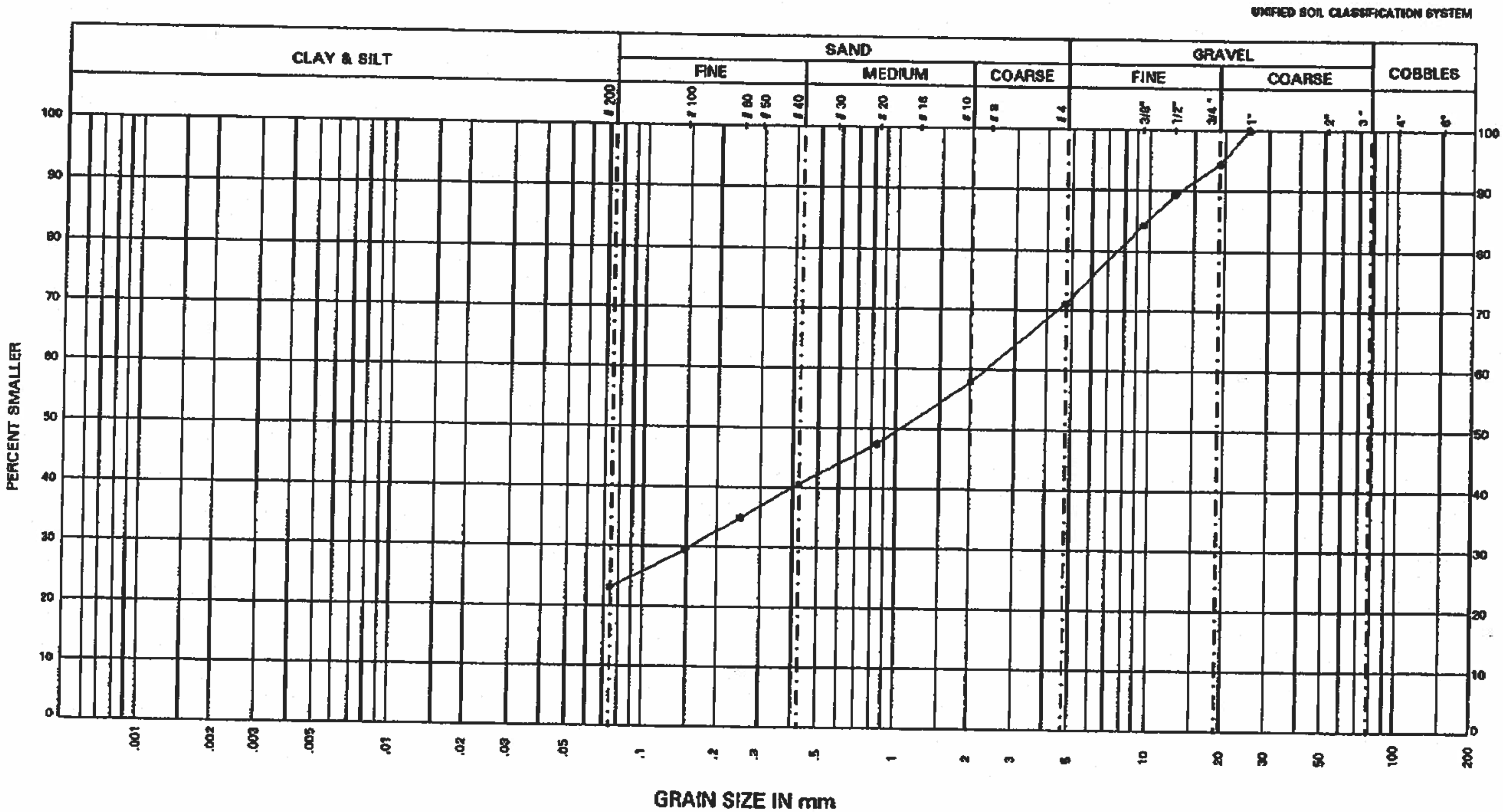
CHECKED BY AT

APPROVED BY

REMARKS: MENZIES LAKE DAM

GRAIN SIZE DISTRIBUTION

DEPTH	SAMPLE NO.	HOLE NO.	JOB NO.
2.13-2.74 m	AO4	PH11	P15069.00

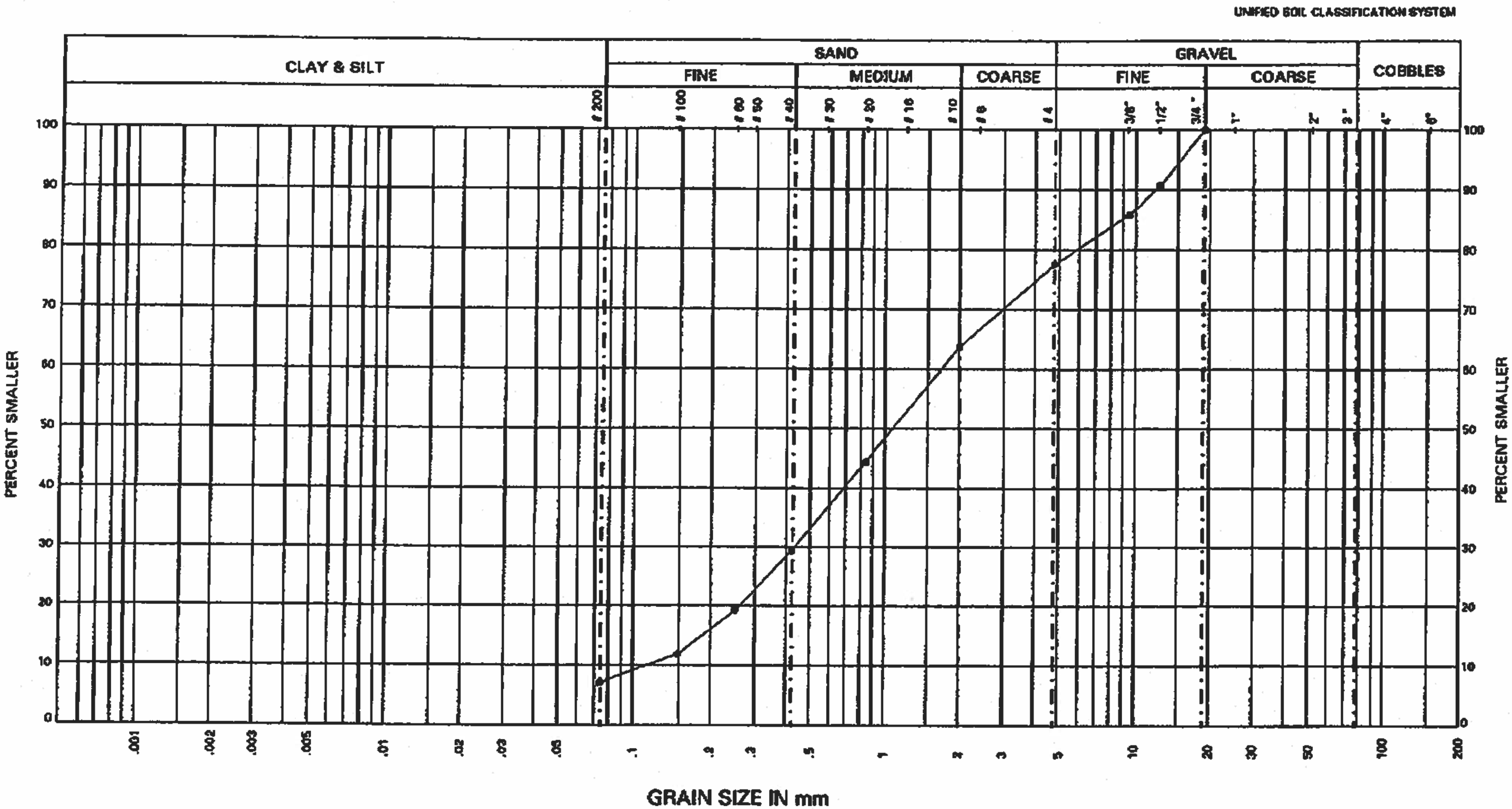


LAB SAMPLE NO.
LAB TEST NO.
DATE June 25 2003
TESTED BY RS
CHECKED BY AT
APPROVED BY

REMARKS: MENZIES LAKE DAM

GRAIN SIZE DISTRIBUTION

DEPTH	SAMPLE NO.	HOLE NO.	JOB NO.
1.52-2.13 m	AQ3	PH13	P15069.00



LAB SAMPLE NO.

LAB TEST NO.

DATE June 25 2003

TESTED BY RS

CHECKED BY AT

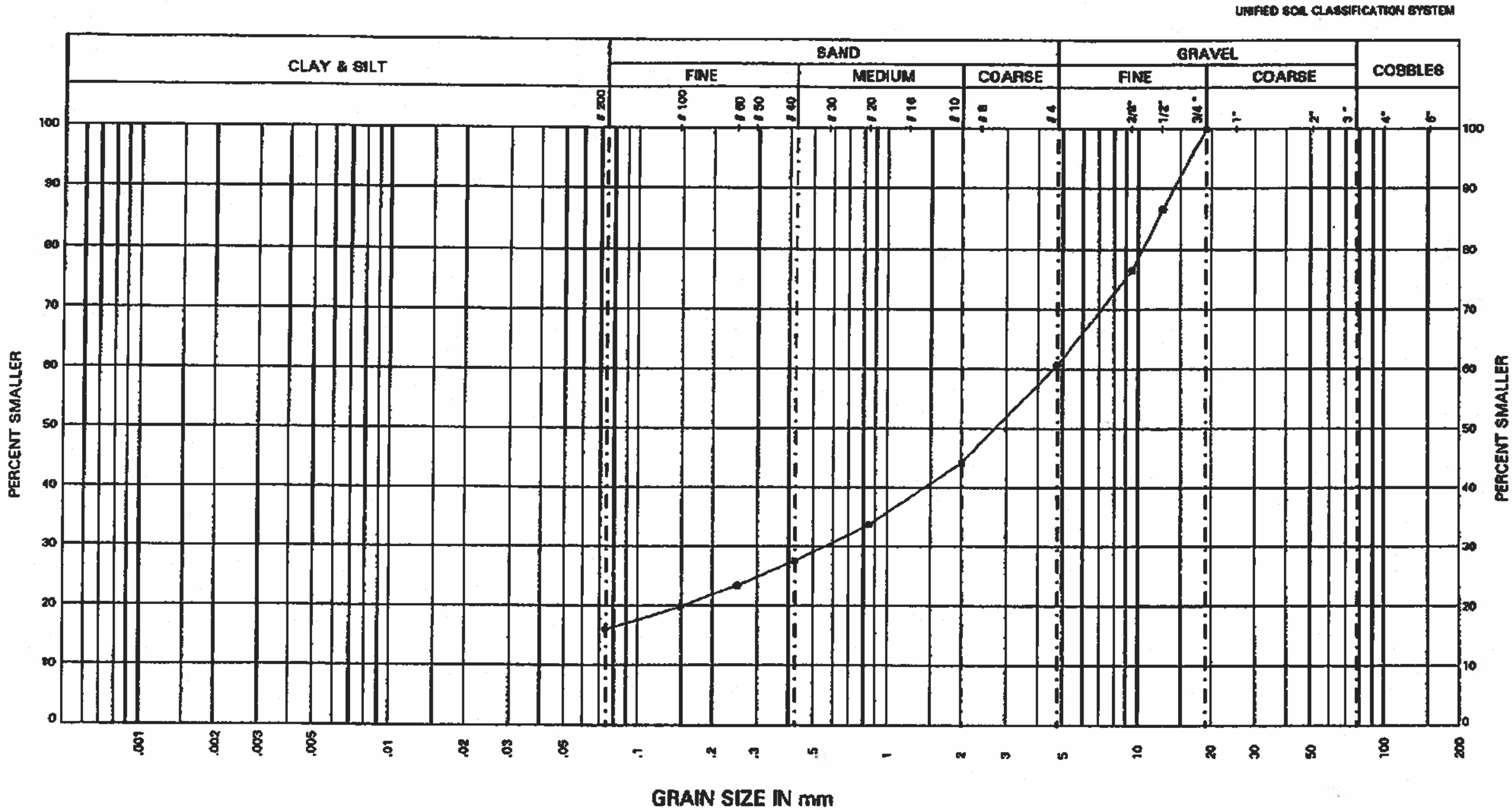
APPROVED BY

REMARKS: MENZIES LAKE DAM

GRAIN SIZE DISTRIBUTION

DEPTH	SAMPLE NO.	HOLE NO.	JOB NO.
3.35-3.50 m	AQ6	PH13	P15069.00

ACRES



LAB SAMPLE NO.

LAB TEST NO.

DATE June 25 2003

TESTED BY RS

CHECKED BY AT

APPROVED BY

REMARKS: MENZIES LAKE DAM

GRAIN SIZE DISTRIBUTION

DEPTH	SAMPLE NO.	HOLE NO.	JOB NO.
1.22-1.83 m	AQ3	PH14	P15069.00

Appendix C
Table 1-1 of the Canadian Dam Association's Dam Safety Guidelines

TABLE 1-1
CLASSIFICATION OF DAMS
IN TERMS OF CONSEQUENCES OF FAILURE

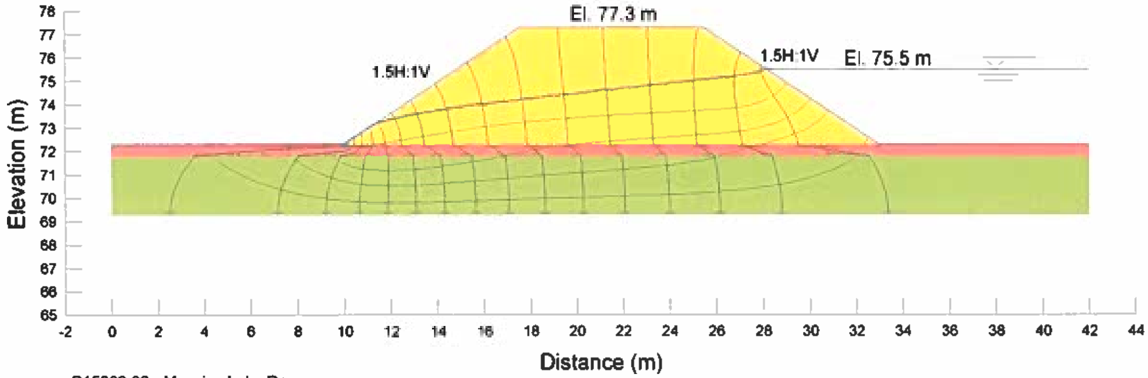
CONSEQUENCE CATEGORY	POTENTIAL INCREMENTAL CONSEQUENCES OF FAILURE [a]	
	LIFE SAFETY [b]	SOCIOECONOMIC FINANCIAL & ENVIRONMENTAL [b] [c]
VERY HIGH	Large number of fatalities	Extreme damages
HIGH	Some fatalities	Large damages
LOW	No fatalities anticipated	Moderate damages
VERY LOW	No fatalities	Minor damages beyond owner's property

[a] Incremental to the impacts which would occur under the same natural conditions (flood, earthquake or other event) but without failure of the dam. The consequence (i.e. loss of life or economic losses) with the higher rating determines which category is assigned to the structure. In the case of tailings dams, consequence categories should be assigned for each stage in the life cycle of the dam.

[b] The criteria which define the Consequence Categories should be established between the Owner and regulator authorities, consistent with societal expectations. Where regulatory authorities do not exist, or do not provide guidance, the criteria should be set by the Owner to be consistent with societal expectations. The criteria may be based on levels of risk which are acceptable or tolerable to society.

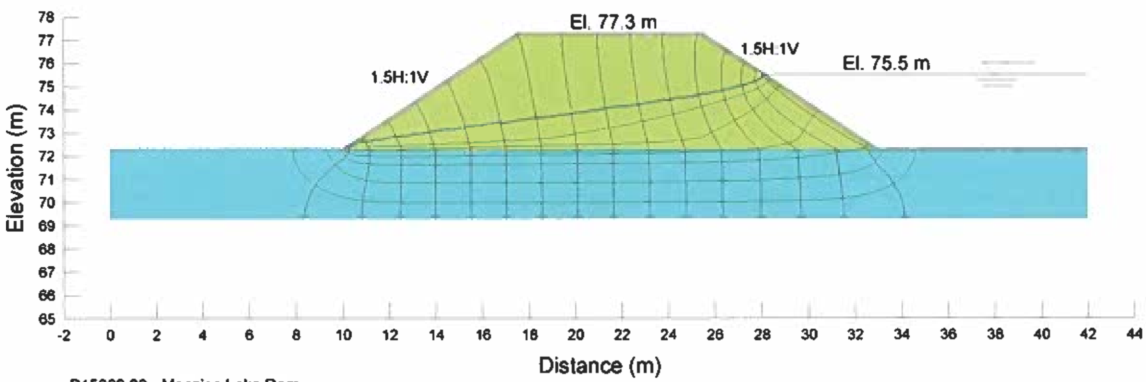
[c] The Owner may which to establish separate corporate financial criteria which reflect their ability to absorb or otherwise manage the direct financial loss to their business and their liability for damage to others.

Appendix D
Stability Analyses Results



P15069.00 - Menzies Lake Dam
Seepage Analysis
File Name: Dyke1-101.sez
Last Saved Date: 7/18/2003
Analysis Type: Steady-State

Figure D-1
Simplified Analysis Model – Saddle Dyke 1



P15069.00 - Menzies Lake Dam
Seepage Analysis
File Name: Dyke1-102.sez
Last Saved Date: 7/18/2003
Analysis Type: Steady-State

Figure D-2
Modified Analysis Model – Saddle Dyke 1

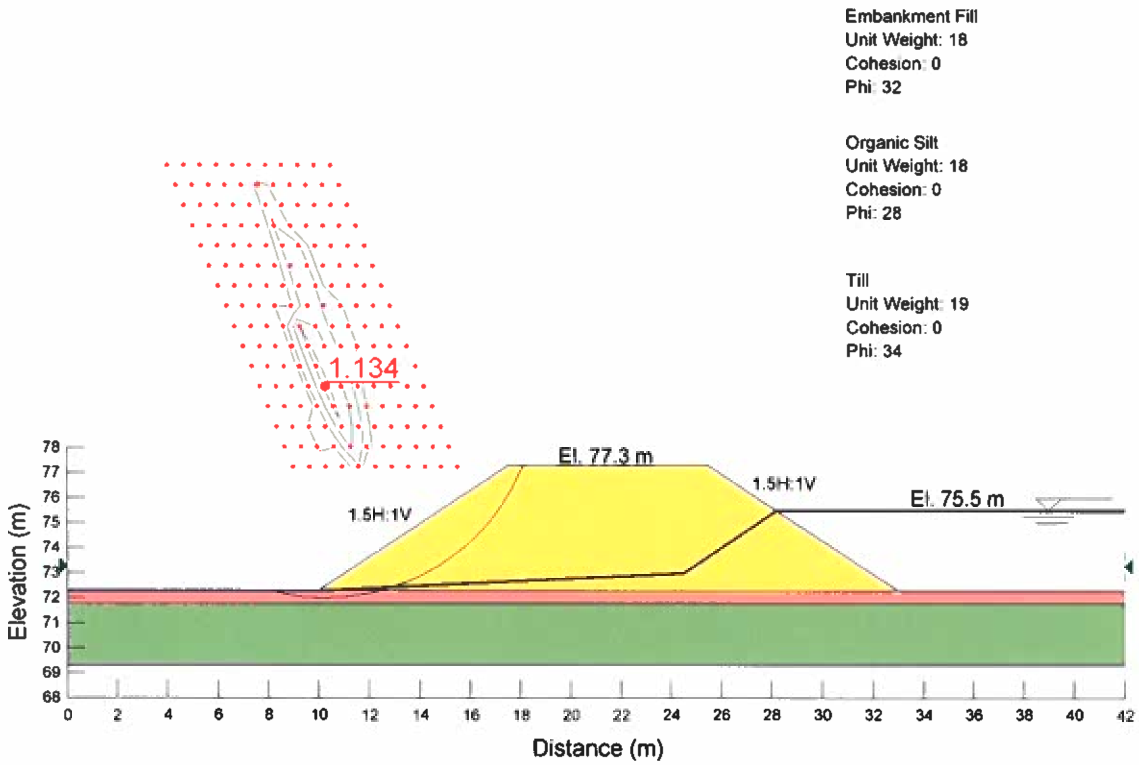


Figure D-3 Stability Analysis Results – Saddle Dyke 1
Normal Water Level – Downstream Stability

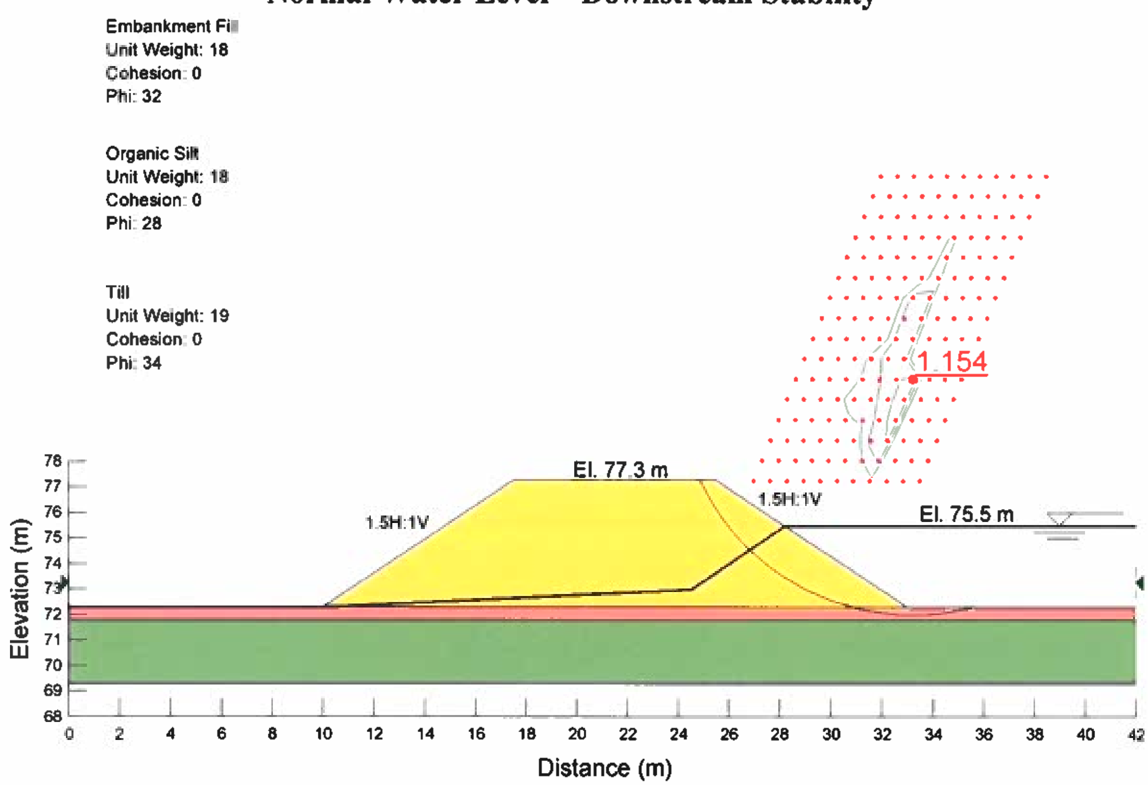


Figure D-4 Stability Analysis Results – Saddle Dyke 1
Normal Water Level – Upstream Stability

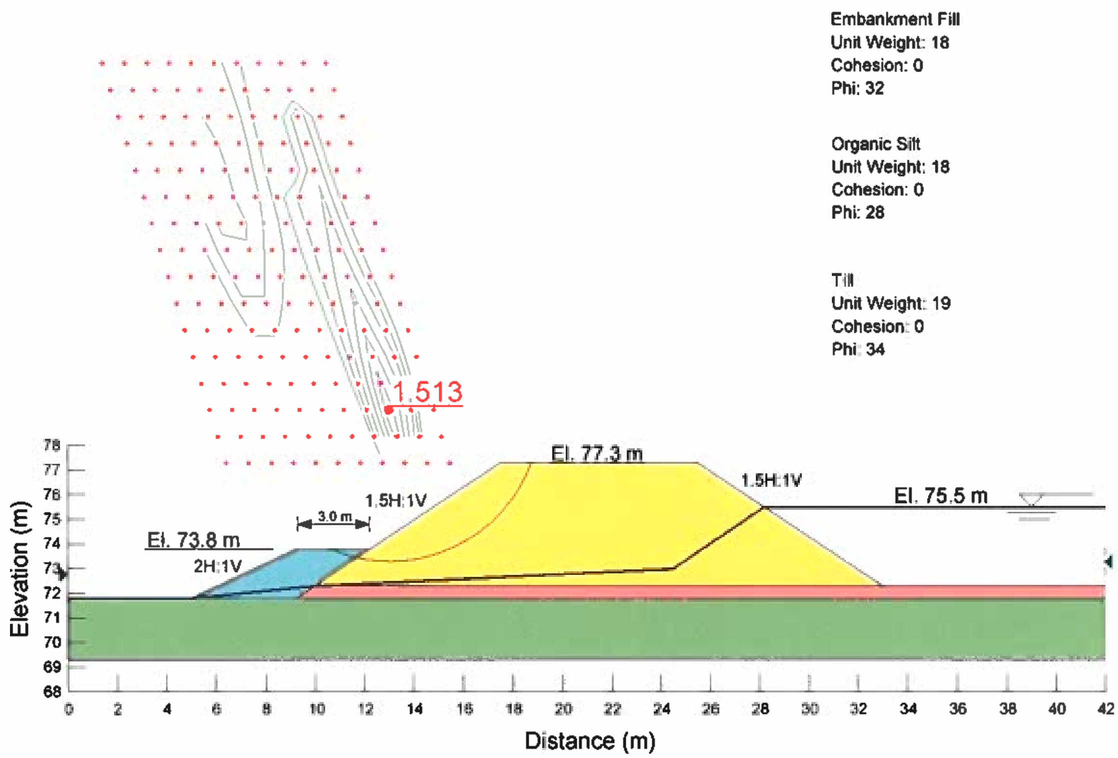


Figure D-5 Stability Analysis Results – Saddle Dyke 1 Remediation Normal Water Level – Upstream Stability

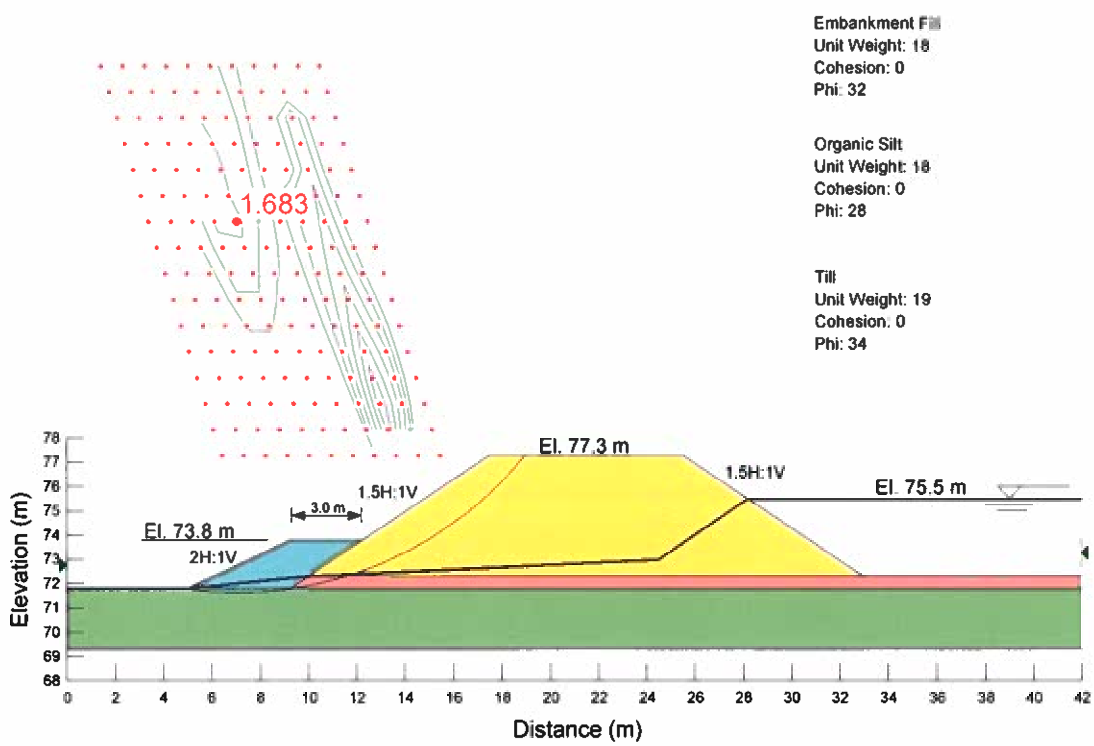


Figure D-6 Stability Analysis Results – Saddle Dyke 1 Remediation Normal Water Level – Upstream Stability

Saint John Water

Final Report

For

2016 Dam Safety Inspections

H353029-00000-200-230-0001
Rev. 0
February 28, 2018

Saint John Water

Final Report

For

2016 Dam Safety Inspections

H353029-00000-200-230-0001
Rev. 0
February 28, 2018

Saint John Water
2016 Dam Safety Inspections
H353029

2016 Dam Safety Inspections

H353029-00000-200-230-0001

LICENCED
PROFESSIONAL ENGINEER
Province of New Brunswick
L4346 2018
Anthony E. Chislett
T. Chislett
Signature
28-FEB-2018
Date
INGÉNIEUR TITULAIRE DE PERMIS
Province du Nouveau-Brunswick

				T. Chislett	T. Chislett
2018-02-28	0	Final	B. Parker	T. Chislett	T. Chislett
DATE	REV.	STATUS	PREPARED BY	CHECKED BY	APPROVED BY

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1. The report is intended for the exclusive use of the Client and it may not be used or relied upon in any manner or for any purpose whatsoever by any other party.
2. The report is 2016 Dam Safety Inspections (the "Project"). Data required to support detailed engineering assessments have not always been available and in such cases engineering judgments have been made which may subsequently turn out to be inaccurate. There are, therefore, risks inherent in the Project which are outlined in the report. The CONSULTANT accepts no liability beyond using reasonable diligence, professional skill and care in preparing the report in accordance with the standard of care, skill, and diligence expected of professional engineering firms performing substantially similar work at the time such work is performed, based on the circumstances the CONSULTANT knew or ought to have known based on the information it had at the date the report was written and after due inquiry based on that information.
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4. The investigation described in the report is based solely upon site visits carried out on November 22 and 23, 2016 by the CONSULTANT, and the information received from the Client.
5. The report speaks only as of its date and to conditions observed at that time, which conditions may change (or may have changed) by virtue of the passage of time or due to direct or indirect human intervention causing any one or more changes in plans or procedures or due to other factors.
6. The report does not extend to any latent defect or other deficiency in the Project which could not have been reasonably discoverable or discovered by such observation, with the exception of any latent defect or other such deficiency of which the CONSULTANT had actual knowledge.
7. The report is to be read in conjunction with all other data and information received and referenced throughout the report, and all correspondence between the Client and the CONSULTANT. Except as stated in the report, the CONSULTANT has not made any independent verification of such data and information and does not have responsibility for the accuracy or completeness thereof.

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1. Introduction

The City of Saint John's municipal water supply network is serviced by two separate watersheds, the Spruce Lake Watershed and the Loch Lomond Watershed. These watersheds and their structures are operated by Saint John Water (SJW). In October 2016, SJW engaged Hatch to perform a Dam Safety Inspection (DSI) of all dams owned/operated by SJW, with the exception of the Robertson Dam and Latimer Lake Main Dam and South Dam (which were reviewed as part of a separate project).

The primary objective of the DSI is to carry out an engineering inspection and condition assessment of the dams. The inspection report prepared by Hatch will serve as a reference for future in-house dam safety inspections by SJW. The findings of the report will provide the basis for establishing maintenance, rehabilitation works, and capital upgrades.

2. System Description

2.1 Spruce Lake Watershed

The Spruce Lake Watershed includes Ludgate Lake and Menzies Lake. Water is pumped into Menzie's Lake, intermittently as required, from East Musquash Reservoir (which is owned by the Province of New Brunswick). Water is gravity fed from Menzie's Lake into Spruce Lake and to the treatment and distribution facilities at Spruce Lake. The Spruce Lake Watershed is depicted in Figure 2-1 and includes the following dam structures:

- Menzie's Lake Control Structure and Saddle Dykes 1, 2 and 3
- Spruce Lake Dam

Characteristics of the Spruce Lake Watershed structures that are included in this DSI are listed in Table 2-1. Additional details of the structures are provided in Appendix A.

Table 2-1: Spruce Lake Watershed Structure Inventory

Structure	Type	Length (m)	Max. Height (m)	Crest Elevation (m local datum)	Discharge Facilities	Year Built
Menzies Lake Control Structure	Concrete	13.7 m	4.3 m	76.5 m	4 bay sluiceway	1973
Menzies Lake Saddle Dyke 1	Earth	100 m	5 m	77.25 m	None	1973
Menzies Lake Saddle Dyke 2	Earth	30 m	3.5 m	76.63 m	None	1973
Menzies Lake Saddle Dyke 3	Earth	25 m	1.5 m	77.56 m	None	1973
Spruce Lake Dam	Concrete Spillway Earth Embankments	237 m	7 m	64.0 m	Overflow spillway, gated low level outlet, water supply intake pipe through earth embankment	Reconstruction 2002 (originally constructed ca. 1898)

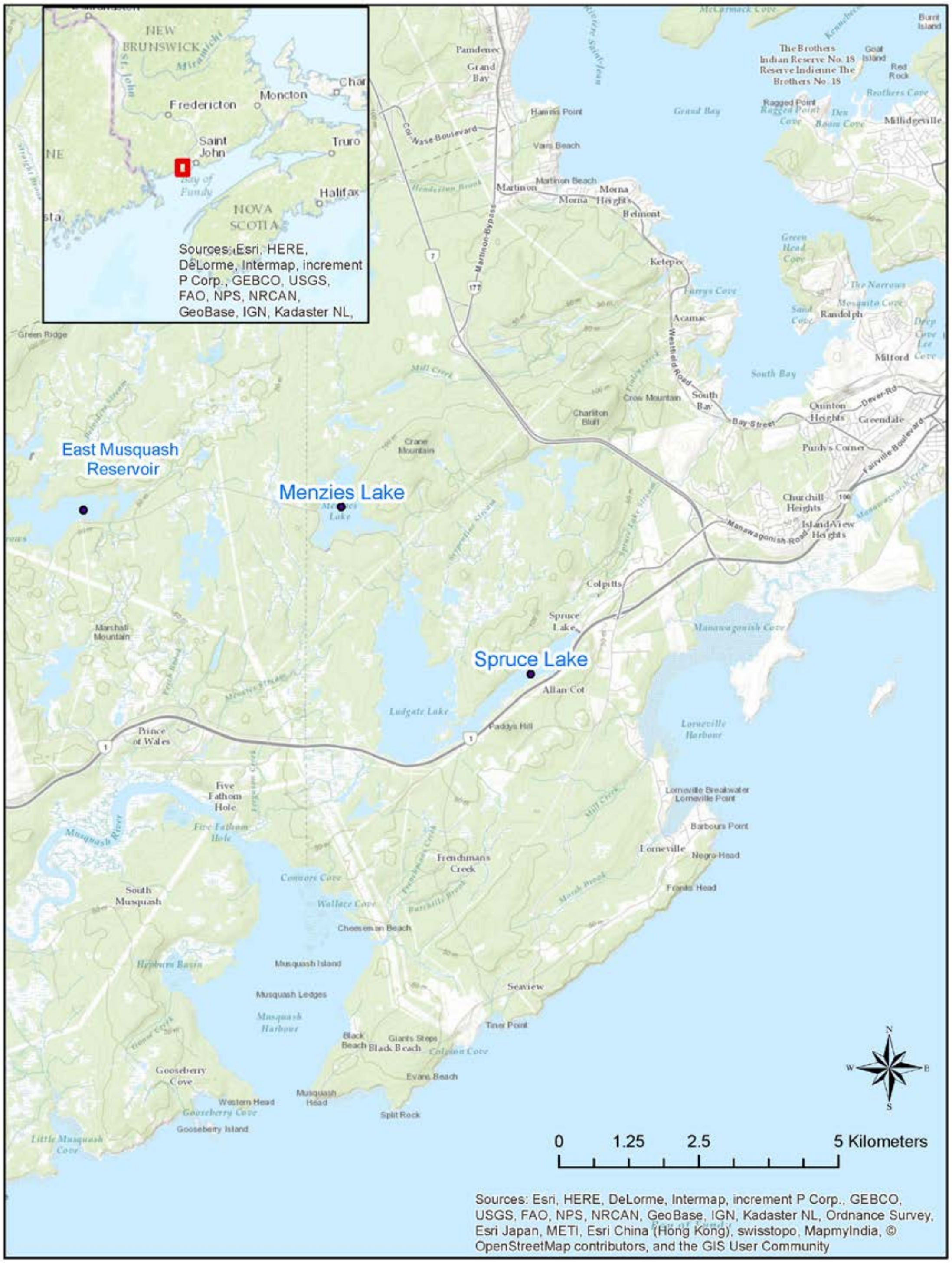

Figure 2-1: Spruce Lake Watershed – Location Plan

2.2 Loch Lomond Watershed

The Loch Lomond Watershed includes a system of dams and reservoirs: Loch Lomond is the largest reservoir. Water is fed from Loch Lomond via the Robertson Lake Dam to the treatment and distribution facilities located on Latimer Lake. Reservoirs Hunter Lake, McBrien Lake, and Terreo Lake feed into Loch Lomond reservoir and serve to provide additional water storage. Two other reservoirs, Taylor Lake and Otter Lake also provided additional water storage in the past but are no longer providing storage as the structure at Otter has been removed. The Loch Lomond Watershed is depicted in Figure 2-2 and includes the following dam structures:

- Hunter Lake Dam
- McBrien Lake Southwest Dam and Southeast Dam
- Terreo Lake Dam
- Taylor Lake Dam
- Otter Lake Dam (currently breached and not in service)
- Robertson Dam
- Latimer Lake Main Dam and South Dam

Robertson Dam and Latimer Main Dam and South Dam have been studied separately (Hatch 2016) and are not included in the current DSI. Characteristics of the Loch Lomond Watershed structures that are included in this DSI are listed below in Table 2-2. Additional details of the structures are provided in Appendix A.

Table 2-2: Loch Lomond Watershed Structure Inventory

Structure	Type	Length (m)	Max. Height (m)	Crest Elevation (m local datum)	Discharge Facilities	Year Built
Hunter Lake Dam	Concrete w/earth abutments	10.5 m	2.2 m	123 m	Overflow spillway, stoplog gate and fish ladder	2000 (originally constructed in 1961)
McBrien Lake Southwest Dam	Earth Embankment	182.9 m	4.9 m	109.4 m	Concrete decant structure connected to an outlet pipe (not in service). Uncontrolled discharge at the northwest (right) end of the dam	1964
McBrien Lake Southeast Dam	Earth Embankment	91.4 m	4.3 m	109.4 m	None	1964
Terreo Lake Dam	Timber Crib (assumed) w/earth abutments	24 m	1.0 m	Unknown	The timber crib structure no longer exists (uncontrolled discharge at this location)	1880's
Taylor Lake Dam	Earth w/buried concrete control structure	9 m	3.3 m	Unknown	None	Structure backfilled late 1990's (originally constructed ca. 1961)
Otter Lake Dam	Earth embankment	24 m	3.3 m	Unknown	Structure is breached	1961, now breached

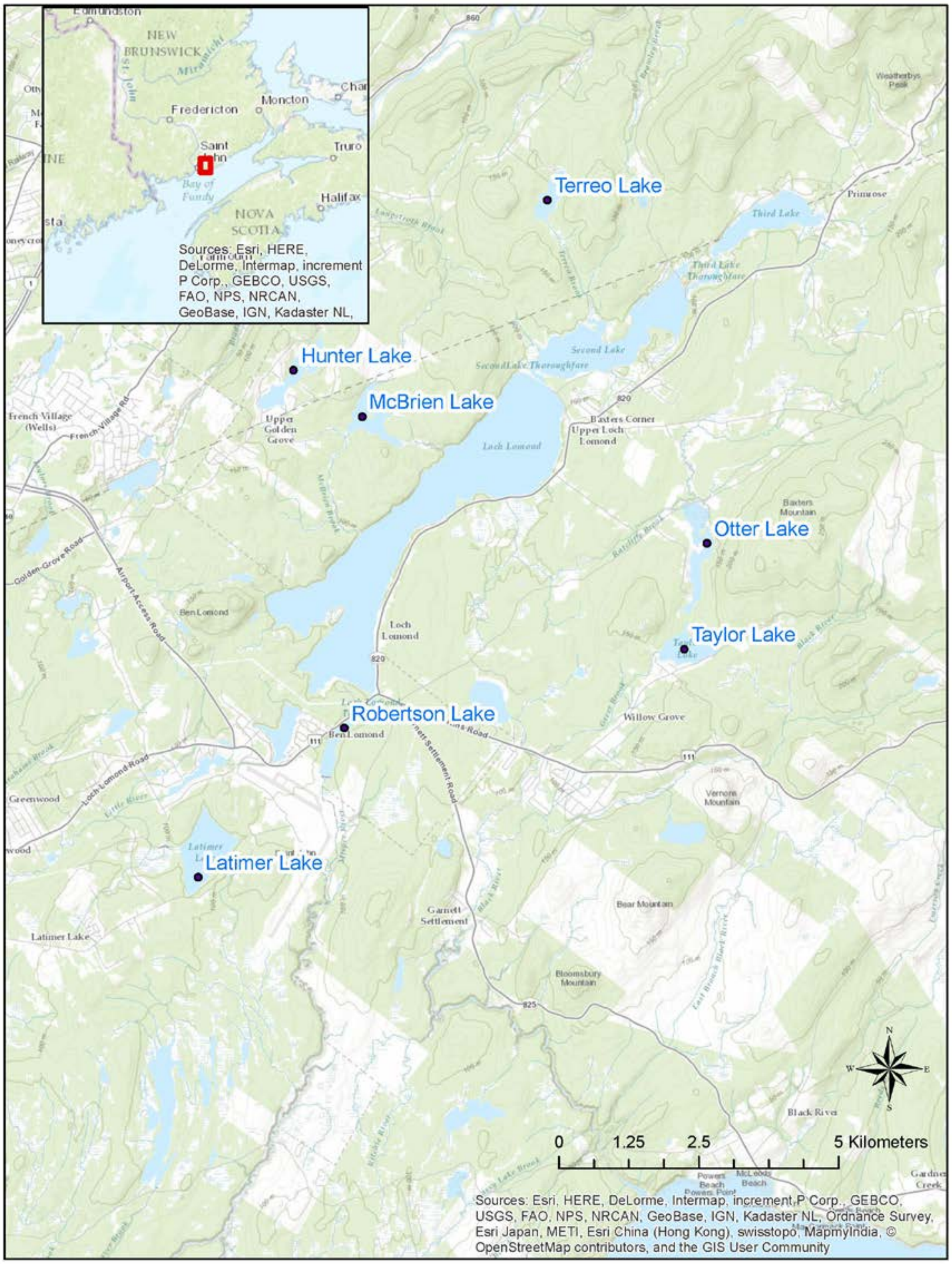

Figure 2-2: Loch Lomond Watershed – Location Plan

3. Site Inspection and Condition Assessment

Site inspections of the structures were conducted on November 22 and 23, 2016. Members of the Hatch inspection team were Tony Chislett, Bethanie Parker, and Manuel Malenfant (November 23rd only). They were accompanied on the inspection by James Margaris and LeRoy Graham of SJW on November 22nd and by James Margaris, Ed Crowley, and Rod Comeau of SJW on November 23rd. The weather was mostly overcast with temperatures around 0°C.

The purpose of the visit was to carry out a visual inspection of the various dams, addressing present conditions, observed deficiencies, operational observations pertinent to dam safety, and any potential or immediate concerns. Photographs of the structures are included in Appendix B.

For the purpose of describing the structures and sites in this report, we use the terminology “Left” and “Right” as observed while looking in the downstream direction, as well as the terms “upstream” and “downstream”.

3.1 Spruce Lake Watershed

3.1.1 Menzies Lake Control Structure

The Menzies Lake Control Structure is a concrete structure which consists of a 4-bay sluiceway. The sluiceways are controlled with stoplogs. The structure is approximately 13.7 m long and 4.3 m high. The waterlevel at the time of the inspection was 75.45 m - approximately 0.05 m below the Full Supply Level (FSL).

The upstream of the wing walls and piers showed surface weathering of concrete with exposed aggregate along the waterline. There was no rockfill bank protection adjacent to the upstream wing walls and some settlement/erosion of the fill was noted in this area.

The downstream wingwalls showed some cracking with efflorescence however there were no signs of movement.

Water was spilling over the stoplogs at the time of the inspection in 2 of the bays. Leakage was noted through the stoplogs in the other two bays. The downstream apron and stilling basin at the toe was not visible due to the flow of water.

Minor cracking at the interface between the upstream wing wall and the right abutment was noted however there were no signs of movement.

No leakage was observed at the abutments (around the wing walls).

3.1.2 Menzies Lake Saddle Dyke 1

Saddle Dyke 1 is a homogeneous earthfill embankment and is approximately 100 m long and 5 m high.

The upstream slope of the structure is steep and brush covered, which made it difficult to inspect. Some rock was visible at the upstream toe; however no riprap protection on the slope was visible.

The downstream slope is also steep and is grass and brush covered with small trees. Large tree stumps were also noted and cut trees and brush was left on the downstream slope and at the toe of the structure. The condition and steepness of the downstream slope made the structure difficult to inspect however some unevenness of the slope was noted. The downstream toe of the structure was wet and there is a wetland type area downstream. Seepage at the toe was visible during the inspection but was not measured. It was noted by SJW that seepage at this structure has increased in the last decade.

The crest of the structure is a gravel roadway and is sloped towards the upstream shoulder. Large rocks were noted in the crest. Windrows at the upstream and downstream crest of the slopes were noted; this structure is plowed regularly during the winter because it forms part of the access road to SJW's pumping station. There were two traffic signs on the crest (to act as a warning to drivers of the downstream edge of the crest) and additional damaged signs were noted on the downstream slope which appeared to have been previously installed on the crest.

Other debris noted on the structure was two propane tanks at the crest and an animal carcass on the downstream slope.

3.1.3 Menzies Lake Saddle Dyke 2

Saddle Dyke 2 is a homogeneous earthfill embankment and is approximately 30 m long and 3.5 m high.

The upstream and downstream slopes are heavily brush covered. Large trees were also noted. Erosion and beaching at the upstream toe was noted. Ponded water was noted at the downstream toe however no seepage was visible. There is a wetland type area downstream of the dyke.

The crest of the structure is a gravel roadway which forms part of the access road to the City's pumping station. There is high ground at both ends of the dyke and the road continues.

3.1.4 Menzies Lake Saddle Dyke 3

Saddle Dyke 3 is a homogeneous earthfill embankment and is approximately 25 m long and 1.5 m high.

The upstream and downstream slopes are heavily brush covered. Large trees were also noted. The crest of the structure is a gravel roadway which forms part of the access road to the City's pumping station. There is high ground at both ends of the dyke and the road continues.

Ponded water was noted at the downstream toe however this appears to be from poor drainage of local runoff.

3.1.5 Spruce Lake Dam

Concrete Spillway

The concrete spillway was constructed in 2002, just downstream from the previous structure. It is a concrete gravity structure with an 18 m wide overflow spillway, with a 914 mm diameter low level gate. The waterlevel at the time of the inspection was at elevation 61.15 m (0.85 m below the crest of the spillway)

The visible portion of the upstream face of the spillway showed minor surface erosion of concrete with exposed aggregates near the low level gate.

The downstream face of the structure is generally in good condition. Some minor leakage was evident at two locations on the downstream face. No unusual cracking was evident.

The crest of the structure showed no signs of cracks or other unusual conditions.

The upstream wing walls are in good condition. Some slight joint separation was observed at the interface between the abutments and the upstream wing walls (at both left and right wing walls).

The low level outlet was not operated during the inspection.

The side slopes of the outlet channel appear stable. Some alder growth in the downstream discharge channel (downstream of precast concrete arch culvert) was noted.

Left Embankment

The left embankment was constructed in 2002 and is a homogeneous earthfill embankment with upstream riprap protection and is approximately 34 m long and up to approximately 6 m high.

The upstream slope is protected with riprap and appears in good condition. Four trees were noted on the slope. The downstream slope is grassed. Signs of past settlement/rutting were noted however the slope appears stable. An animal hole was noted near the crest. A small area of soil (granular) appears to be dumped on the slope.

The crest is granular with trace grass. Minor settlement of the crest was noted.

The left abutment is a roadway to the intake and storage building. The elevation of the roadway appears slightly lower than the embankment crest however this area would not be exposed to the wind and wave action of the reservoir. The right abutment is the left wingwall of the spillway.

Right Embankment

The right embankment is an earthfill embankment with a concrete core and upstream riprap protection. It is approximately 185 m long and up to approximately 6 m high. The original structure was a concrete gravity section which was later buried upstream and downstream. In

2002 the concrete core was raised and granular fill was placed upstream and downstream of the core with a crest width of 4 m.

The upstream slope is protected with riprap and appears in good condition. Driftwood and debris was noted to approximately 1 m above the current water level.

The downstream slope is grassed (thick grass, short cut). Trace settlement of the slope was evident. While the settlement was not visible due to the thick grass, the slope felt slightly uneven when walking on. In an area near the right abutment, there is some damage at the downstream toe of the structure where a construction vehicle drove on the toe (see photos).

There was wetness at the downstream toe and flow was visible at one location. This appears to be consistent with previous reports.

The crest is sloped towards the upstream and varies in width from approximately 3.5 m to over 4 m (near the abutment with the spillway).

At the left abutment (abutment with the spillway) the crest material is migrating into the riprap where the riprap wraps around the wing wall. The right end of the embankment abuts with the NB trail and here is a ditch and highway beyond the trail. The internal geometry of the embankment changes as it approaches the right abutment (there is no concrete core here). Trace settlement of the crest was noted in the transition area.

3.2 Loch Lomond Watershed

3.2.1 Hunter Lake Dam

Hunter Lake Dam was reconstructed in 2000. It is a 4.2 m wide concrete over flow spillway structure with a stoplog bay and a steel fishway located within the spillway. The abutments are designed as earth embankments with concrete cores. The structure is approximately 2.2 m high. The waterlevel at the time of the inspection was approximately 5 cm above the top of the stoplogs (with 5 stoplogs in place) which is about 0.47 m below the spillway crest elevation. SJW reported that the stoplogs are not typically operated throughout the year.

While the dam reportedly has a height of 2.2 m, sediment in the water was visible at approximately 1.2 m from the crest (indicating up to 1 m of siltation upstream of the dam). Due to the waterlevel, a detailed inspection of the upstream face of the structure could not be undertaken.

The downstream face of the structure appeared in good condition. No unusual cracking was noted. The only seepage that was noted was at the caulking of the fishway.

No seepage was observed at the abutments at the time of the inspection. The right abutment appeared to be as shown on drawings and in good condition. The left abutment is not as shown on the as-built drawings and is not adequate. The end of the concrete core is exposed and is not currently tied into high ground. The elevation of the fill at the end of the core wall is approximately 0.7 m below the crest of the corewall. This fill is at an elevation of 0.4 m below the crest of the spillway if all stoplogs were in place.

There was no debris or obstructions to flow visible in the channel downstream of the structure and the channel side slopes appeared to be stable.

3.2.2 McBrien Southwest Dam

McBrien Southwest Dam is an earthfill embankment which is L-shaped in plan and is approximately 183 m long and up to approximately 4.9 m high. At one time there was a concrete decant structure connected to an outlet pipe, however it is no longer in service.

There is no spillway for this reservoir, however water discharges through an open section of the dam at the northwest (right) end of the embankment. The purpose of this open section is unclear. There is no erosion protection for the embankment dam at this location.

The upstream slope has significant vegetative growth of brush and alders. There was no upstream riprap protection visible and erosion of the slope was evident.

The downstream slope also has significant vegetative growth of brush and alders. Large tree stumps were also noted and cut trees and brush was left at the toe of the structure. The condition of the downstream slope made the structure difficult to inspect. In the area of the decant structure there is a pipe which exists at the toe of the dam into a wetland type area. The water in this area was murky but no flow was visible. The decant structure (located in the reservoir) is no longer in service and is leaning on its side. It is unclear what is keeping water from flowing through the pipe. There was evidence of beavers in the area. The downstream toe at other locations had some areas of ponded water however at these locations it appeared to be poor runoff of local drainage.

The crest of the structure is uneven and rutted and the crest elevation varies.

3.2.3 McBrien Southeast Dam

McBrien Southeast Dam is an earthfill embankment which is approximately 91 m long and up to 4.3 m high.

The upstream slope was heavily overgrown with brush which made the structure difficult to inspect. No riprap protection was evident on the upstream slope.

The crest and downstream slope were overgrown with brush and large trees. The crest appeared to be somewhat irregular. No seepage was visible and there were no signs of the structure being overtopped. There was a wet area at a fair distance downstream, however this appeared to be local runoff from poor drainage.

3.2.4 Terreo Lake Dam

Terreo Lake Dam is an earthfill embankment which is approximately 24 m long and up to 1 m high. There is an opening which appears to be a location where a timber crib flow control structure may have previously existed. Uncontrolled discharges currently flow through this opening.

The embankment has significant alder growth and irregular slopes and ATV tracks were visible at the crest. No upstream riprap protection was visible. Just upstream of the dam opening area is the remains of a beaver dam. Evidence of beaver work is was also evident in the downstream area.

3.2.5 Taylor Lake Dam

Taylor Lake dam is an earthfill embankment with a buried concrete control structure. The concrete structure was reportedly backfilled in the late 1990's. It is approximately 9 m long and 3.3 m high.

The structure has significant tree growth. No riprap protection was visible on the upstream slope and shoreline erosion was visible. Some settlement of the crest and slopes was evident (unevenness). There was no other evidence of movement of the downstream slope and the slope appeared stable. No seepage was observed.

3.2.6 Otter Lake Dam

The control structure at Otter Lake has been removed. The site is free-flowing with no hydraulic control.

4. Conclusions and Recommendations

The current scope of work was limited to a condition assessment of the structures. Condition assessment details are provided in Section 3. This section provides general conclusions and recommendations as well as site specific recommendations.

4.1 General Conclusions and Recommendations

The site inspection found that a number of the structures are in a neglected state, which has the potential to lead to future problems. However they currently show no obvious signs of instability or unusual stress conditions. It is recommended that the structures be inspected by operations staff on a regular basis. Sample checklists that operations staff can use during their periodic inspections are provided in Appendix C.

The majority of the structures are heavily overgrown with brush and trees. This prevents a thorough inspection of the structures. The growth of trees on the slopes of earthfill dams or earth abutments can lead to localization of flow and dam failure. The trees and brush should be kept clear and cut brush and debris should be removed from the structures.

A vegetation removal program should be implemented as part of a regular maintenance program. The trees and brush should be kept clear and cut brush and debris should be removed from the structures.

A detailed engineering assessment should be undertaken for some of the structures including, but not limited to; hydrotechnical analysis and stability assessments. This will assist in evaluating other dam safety concerns (e.g. design deficiencies) and assist with developing rehabilitation plans for the structures.

4.2 Site Specific Recommendations

Menzies Lake Control Structure

Add rockfill protection to the bank adjacent to the upstream wing walls to prevent erosion of the earthfill.

Menzies Lake Saddle Dyke 1

Vegetation removal and control is recommended. Given the mature tree stumps visible, it is assumed that removal of some embankment material will be required in order to properly address the vegetation issue.

The seepage should be monitored and addressed as required.

The previous report (SGE Acres) indicates that stability requirements are not met. An updated detailed engineering assessment and overall rehabilitation of the structure is recommended.

Menzies Lake Saddle Dykes 2 and 3

Vegetation removal and control is recommended. Erosion at the upstream slope of Saddle Dyke 2 should be repaired.

Spruce Lake Dam

Vegetation control at the structure should continue to be maintained. The four trees noted on the slope of the left embankment should be removed. Any driftwood and debris should be removed from the slopes.

The animal hole noted near the crest of the left embankment which should be filled in.

The damage at the downstream toe of the right embankment (near the right abutment) where a vehicle drove on the toe should be repaired.

The wetness and seepage at the downstream toe of the right embankment should continue to be monitored.

At the abutment of the right embankment with the spillway, the crest material is migrating into the riprap where the riprap wraps around the wing wall. This area should be monitored for additional movement.

Hunter Lake Dam

Reinstatement/rehabilitation of the left abutment is required.

The upstream face of the structure should be re-assessed at a time when the reservoir level is low.

Seepage at the caulking of the fishway should be repaired.

McBrien Southwest Dam

In addition to vegetation removal and control, improvements to the upstream slope of McBrien Southwest Dam are recommended. Improvements to the crest are also recommended. Given the mature trees and cut trees visible on the downstream slope, it is assumed that removal of some embankment material will also be required in order to properly address the vegetation issue.

It is recommended that the condition of the structure be reassessed once the vegetation is removed. A geotechnical program and topographic survey will likely be required in order to determine the extent of the rehabilitation work.

The decant structure is no longer operational and the condition is unknown. At the northwest (right) end of the embankment there is water discharging through an open section of the dam. There is currently no controlled outlet. It is recommended that a control structure be incorporated as part of the rehabilitation work for this dam.

McBrien Southeast Dam

Vegetation removal and control is recommended. It is recommended that the condition of the structure be reassessed once the vegetation is removed. Given the mature trees visible it is assumed that removal of some embankment material will also be required in order to properly address the vegetation issue.

Terreo Lake Dam

Vegetation removal and control is recommended. It is recommended that the condition of the structure be reassessed once the vegetation is removed to determine the extent of additional dam rehabilitation requirements.

Uncontrolled discharges currently flow through an opening in the dam where it is assumed there was previously a timber crib flow control structure. Reinstatement of a control structure is recommended.

Taylor Lake Dam

In addition to the vegetation removal and control, it is recommended that upstream slope protection be added.

5. References

Acres International (2001). Spruce Lake Dam Reconstruction. Final Report. Prepared for City of Saint John.

SGE Acres (2008). Loch Lomond Watershed Structures Evaluation and Design. Final Report. Prepared for City of Saint John.

SGE Acres (2003). Menzies Lake Dam Safety Review. Draft Report. Prepared for City of Saint John.

Appendix A
Structure Inventory Sheets

Menzies Lake Control Structure

Date of Construction:	1973
Dam Type:	Concrete Gravity
Dam Height:	4.3 m
Dam Length:	13.7 m excluding wing walls
Abutments:	Concrete on bedrock
Spillway Type:	4-bay sluiceway
Sluiceway Control:	Stoplogs
Sluiceway Length:	13.7m including end walls
Other Outlets:	None
Drainage Area:	3.6 km^2
Elevations:	
Top of Dam:	76.5 m (top of roadway)
Spillway Crest:	76.8 m (top of curb)
Sluiceway Invert:	73.1 m
Dam Foundations:	72.8 m (approximately)
Major Repairs:	None since construction.
Drawings Available:	No. 7006-35 (Box Culvert – Site Plan and Approaches Miscellaneous Details, Eastern Designers and Company Ltd. April 1971) No. 7006-36 (Box Culvert - Concrete and Reinforcing Details Easter Designers and Company Ltd. April 1971)

Menzie's Lake Saddle Dyke 1

Date of Construction:	1973
Dam Type:	Earth
Drainage Area:	3.6 km^2
Dam Height:	5 m
Dam Length:	100 m
Elevations:	
Top of Dam:	77.25 m (minimum centerline elevation)
Dam Foundations:	72.3 m (approximately)
Major Repairs:	Work done on the saddle dykes in the 1970s and there appears to have been structures at this location since 1937.
Drawings Available:	One drawing from 1937 showing Saddle Dyke 1

Menzie's Lake Saddle Dykes 2 and 3


Saddle Dyke 2


Saddle Dyke 3

Saddle Dyke 2

Dam Height: 3.5 m
Dam Length: 30 m
Elevations:
  Top of Dam: 76.63 m (minimum centerline elevation)
  Dam Foundations: 73.0 m (approximately)

Saddle Dyke 3

Dam Height: 1.5 m
Dam Length: 25 m
Elevations:
  Top of Dam: 77.56 m (minimum centerline elevation)
  Dam Foundations: 76 m (approximately)

Major Repairs: Work done on the saddle dykes in the 1970s and there appears to have been structures at this location since 1937.
Drawings Available: None

Spruce Lake Dam

Date of Construction:	Reconstructed 2002, originally constructed1898 (approximately),
Dam Type:	Concrete structure with earth embankments
Drainage Area:	20.4 km^2
Dam Height (max):	7 m
Dam Length:	237 m
Abutments:	Left: Homogeneous Earth embankment Right: Earth embankment with concrete core
Spillway Type:	Concrete overflow spillway
Spillway Length:	18 m
Other Outlets:	914 mm diameter low level gate
Elevations:	
Top of Dam:	64.0 m
Spillway Crest:	62.0 m
Low Level Gate:	59.5 m (springline)
Dam Foundations:	57 m approximately
Major Repairs:	Reconstructed in 2002
Drawings Available:	S167-001 Spruce Lake Dam Reconstruction, Record Set Drawings Dated March 2003, Sheets 1 of 7 to 7 of 7

Hunter Lake Dam

Date of Construction:	Reconstructed in 2000, originally constructed during 1961
Dam Type:	Concrete structure with earth embankments
Dam Height (max):	2.2 m
Dam Length:	10.5 m
Abutments:	Earth embankments with concrete cores
Spillway Type:	Concrete overflow spillway
Spillway Length:	4.2 m
Other Outlets:	1.2 m x 1.2 m stoplog bay located in spillway 6.1m long stainless steel fish ladder
Elevations:	
Top of Dam:	122.53 m (402.0 ft local datum)
Overflow Spillway:	122.22 m (401.0 ft local datum)
Major Repairs:	Reconstructed in 2000
Drawings Available:	H-082-002 Hunter Lake Control Dam – Plan, Sections, and Details As Built, Dated Sept. 2000 – Sheet 1 of 2 H-082-002 Hunter Lake Control Dam – Fish Ladder Details As Built, Dated Sept. 2000 – Sheet 2 of 2 H-082-004 Hunter Lake Control Dam – Plan, Sections, and Details Issued For Tender, Dated May 2000 – Sheet 1 of 2 H-082-004 Hunter Lake Control Dam – Fish Ladder Details Issued For Construction, Dated May 2000 – Sheet 2 of 2 H-082-001 Hunter Lake Dam – Existing Conditions Dated Aug. 18, 1998 – Sheet 1 of 1 H-082-003 Hunter Lake Control Dam – Existing Plan, Profile and Section - Dated 1961

McBrien Lake Southwest Dam

Date of Construction:	1964
Dam Type:	Earth Embankment
Dam Height (max):	4.9 m
Dam Length:	182.9 m
Abutments:	Earth Embankments
Spillway Type:	None. An opening exists at the northwest (right) end of the dam
Other Outlets	Concrete decant structure connected to an outlet pipe
Elevations:	Top of Dam 109.42 m (359.0 ft local datum)
Operating Levels:	Normal Operation 108.20 m (355.0 ft local datum)
Major Repairs:	No record of any repairs
Drawings Available:	None

McBrien Southeast Dam

Date of Construction:	1964
Dam Type:	Earth Embankment
Dam Height (max):	4.3 m
Dam Length:	91.4 m
Abutments:	Earth Embankments
Spillway Type:	None
Other Outlets:	None
Elevations:	Top of Dam 109.42 m (359.0 ft local datum)
Operating Levels:	Normal Operation 108.20 m (355.0 ft local datum)
Major Repairs:	Unknown
Drawings Available:	Lake South Dam Site – Plan, Profile, and Cross Sections Dwg I-621, Dated April 14, 1964

Terreo Lake Dam

Date of Construction:	1880s
Dam Type:	Earth Embankment
Dam Height (max):	1.0 m
Dam Length:	24 m
Abutments:	Earth
Spillway Type:	Timber Crib (no longer exists)
Other Outlets:	None
Elevations:	Top of dam elevation unknown
Operating Levels:	Unknown
Major Repairs:	Unknown
Drawings Available:	None available, A sketch of possible dam replacement is available

Taylor Lake Dam

Date of construction:	ca 1990s structure backfilled. Original construction ca. 1961
Dam Type:	Earth embankment (buried concrete control structure)
Dam Height (max):	3.3 m
Dam Length:	9 m
Abutments:	Earth
Spillway Type:	None
Other Outlets:	None
Elevations:	Top of dam elevation unknown
Operating Levels:	Normal operating levels unknown
Major Repairs:	Unknown
Drawings Available:	None available

Otter Lake Dam

Date of construction:	1961
Dam Type:	Breached earth embankment (the site is free flowing)
Dam Height (max):	3.3 m
Dam Length:	24 m
Abutments:	Earth
Spillway Type:	None. The control structure at Otter Lake has been removed
Other Outlets	None
Elevations:	Top of dam elevation unknown
Operating Levels:	Natural levels
Major Repairs:	Unknown
Drawings Available:	Sketch of Otter lake Timber Crib dam

Appendix B
Site Photographs

Spruce Lake Watershed

Photo 1: Menzies Lake Control Structure
View from upstream of left abutment

Photo 2: Menzies Lake Control Structure
View from upstream of right abutment

Photo 3: Menzies Lake Control Structure
Looking upstream from the right abutment of the structure

Photo 4: Menzies Lake Control Structure
Looking downstream from the structure

Photo 5: Menzies Lake Control Structure
Upstream piers

Photo 6: Menzies Lake Control Structure
Looking at the crest from the right abutment of the structure

Photo 7: Menzies Lake Control Structure
Left downstream wingwall

Photo 8: Menzies Lake Control Structure
Left downstream wingwall

Photo 9: Menzies Lake Control Structure
Right downstream wingwall

Photo 10: Menzies Lake Control Structure
View of structure from downstream left wingwall

Photo 11: Menzies Lake Control Structure
Leakage through stoplogs

Photo 12: Menzies Lake Control Structure
Flow over stoplogs

Photo 13: Menzies Lake Saddle Dyke 1
Crest of dam, from left abutment looking West

Photo 14: Menzies Lake Saddle Dyke 1
Downstream slope and wetland type area downstream.

Photo 15: Menzies Lake **Saddle Dyke1**
Upstream slope

Photo 16: Menzies Lake Saddle Dyke 2
View from left abutment looking West

Photo 17: Menzies Lake Saddle Dyke 2
Trees and brush on downstream slope

Photo 18: Menzies Lake Saddle Dyke 2
Erosion/beaching at upstream waterline

Photo 19: Menzies Lake Saddle Dyke 3
View from crest looking upstream

Photo 20: Menzies Lake Saddle Dyke 3
At left abutment crest looking North

Photo 21: Menzies Lake Saddle Dyke 3
Upstream slope

Photo 22: Menzies Lake Saddle Dyke 3
Downstream slope and ponded water downstream

Photo 23: Spruce Lake Dam – Concrete Spillway
View from upstream toe of left wingwall

Photo 24: Spruce Lake Dam – Concrete Spillway
Downstream face of spillway

Photo 25: Spruce Lake Dam – Concrete Spillway
Downstream face of spillway structure and retaining walls

Photo 26: Spruce Lake Dam – Concrete Spillway
View of downstream slope and crest

Photo 27: Spruce Lake Dam – Concrete Spillway
Joint of right abutment wall and wing wall

Photo 28: Spruce Lake Dam – Concrete Spillway
Joint of right abutment wall and wing wall

Photo 29: Spruce Lake Dam – Concrete Spillway
Joint of left abutment wall and wing wall

Photo 30: Spruce Lake Dam – Concrete Spillway
Downstream retaining walls of discharge channel and precast concrete arch culvert

Photo 31: Spruce Lake Dam – Concrete Spillway
Discharge channel downstream of precast concrete arch culvert

Photo 32: Spruce Lake Dam – Left Embankment
View from left abutment

Photo 33: Spruce Lake Dam – Left Embankment
Upstream riprap protection

Photo 34: Spruce Lake Dam – Left Embankment
Animal hole on downstream slope near crest

Photo 35: Spruce Lake Dam – Left Embankment
Area of granular material on downstream slope (appeared to be dumped)

Photo 36: Spruce Lake Dam – Left Embankment
Downstream slope, access road and storage facility beyond abutment

Photo 37: Spruce Lake Dam – Right Embankment
View from abutment with spillway

Photo 38: Spruce Lake Dam – Right Embankment
Upstream riprap protection and driftwood debris

Photo 39: Spruce Lake Dam – Right Embankment
Downstream slope, note thick grass and damage at downstream toe

Photo 40: Spruce Lake Dam – Right Embankment
Wetness (from seepage) beyond downstream toe

Photo 41: Spruce Lake Dam – Right Embankment
Crest material migrating into riprap at abutment of spillway wing wall

Loch Lomond Watershed

Photo 42: Hunter Lake Dam
View of upstream face of structure

Photo 43: Hunter Lake Dam
Sedimentation in reservoir upstream of the dam

Photo 44: Hunter Lake Dam
Downstream face of the dam

Photo 45: Hunter Lake Dam
Stoplogs in place to 0.52 m below top of spillway

Photo 46: Hunter Lake Dam
Left abutment, corewall is not backfilled and water can go around the dam

Photo 47: McBrien Southwest Dam
View from beyond the breach at right abutment

Photo 48: McBrien Southwest Dam
View of breach near right abutment

Photo 49: McBrien Southwest Dam
Crest, upstream, and downstream slope, looking towards right abutment

Photo 50: McBrien Southwest Dam
Displaced decant structure

Photo 51: McBrien Southwest Dam

Outlet pipe downstream of displaced decant structure, murky water but no flow visible

Photo 52: McBrien Southwest Dam

Erosion of upstream slope

Photo 53: McBrien Southwest Dam

Vegetative growth on downstream slope

Photo 54: McBrien Southeast Dam
Trees and vegetative growth on crest and upstream slope

Photo 55: McBrien Southeast Dam

Looking upstream

Photo 56: Terreo Lake Dam
Crest looking towards left abutment, note breached area and beaverdam upstream

Photo 57: Terreo Lake Dam
Crest looking towards right abutment

Photo 58: Terreo Lake Dam
Crest and downstream slope

Photo 59: Terreo Lake Dam
Looking downstream at breached area

Photo 60: Taylor Lake Dam
Looking at crest towards downstream slope (person at toe visible)

Photo 61: Taylor Lake Dam
Upstream slope

Photo 62: Taylor Lake Dam
Looking upstream from dam

Photo 63: Taylor Lake Dam
Looking towards downstream face of dam

Photo 64: Otter Lake Dam
Breach at Otter Lake Dam

Photo 65: Otter Lake Dam
Breach at Otter Lake Dam

Appendix C
Sample Inspection Checklists

CONCRETE DAM/SPILLWAY – Inspection Checklist

Structure: ______________________________ Date: ______________________________

Inspector: ______________________________ Time: ______________________________

Water Level: ______________________________ Weather/Temp: ______________________________

Item Inspected	Condition	Comments
A. Upstream Face (waterside) *Cracks, Joint offsets, Unusual conditions*		
B. Downstream Face/Apron *Cracks, Joint offsets, Seepage on d/s face*		
C. Downstream Toe/Stilling Basin *Cracks, Undercutting from erosion, Debris in basin, Walls movement*		
D. Crest *Roadway, Walks, Parapet wall, Lighting, Flashboards condition and operation*		
E. Concrete Abutments *Condition, Seepage around dam – location/amount*		
F. Gates and Controls *Type of gate, General condition, Leakage, Operation of gate/lift*		
G. Approach Channel *Debris, Slides over channel, Channel side slope stability, Slope protection*		
H. Walkway *Condition of piers, Condition of decking and beams, Condition of rails*		
I. Outlet Channel *Slope Protection, Stability of slopes, Vegetation and other obstructions*		
Additional Comments and Actions Required:		

Condition: NI = Not Inspected

NC = No Change since last inspection

CC = Condition Changed (enter comments)

EMBANKMENT DAM – Inspection Checklist

Structure: ______________________ Date: ______________________

Inspector: ______________________ Time: ______________________

Water Level: ______________________ Weather/Temp: ______________________

Item Inspected	Condition	Comments
A. Upstream Face (waterside) *Slide movements, Slope protection, Erosion–beaching, Cracks, Sinkholes, Settlement, Displacement, Debris, Unusual conditions*		
B. Downstream Face *Slide movements, Signs of movement, Cracks, Seepage or wet areas, Unusual conditions*		
C. Crest *Surface cracking, Settlement, Lateral movement, Camber*		
D. Left Abutment *Seepage, Cracks/joints/bedding planes, Slides, Signs of movement*		
E. Right Abutment *Seepage, Cracks/joints/bedding planes, Slides, Signs of movement*		
F. Seepage and Drainage *Locations(s)* *Estimated flow(s)* *Color (staining)*		
G. Outlet Works *Approach & Discharge channels, Structure/Abutments, Leakage, Operation of Gate/Lift*		
Additional Comments and Actions Required:		

Condition: NI = Not Inspected
NC = No Change since last inspection
CC = Condition Changed (enter comments)

231 Regent Street, Suite 302
Fredericton, New Brunswick Canada E3B 3W8
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231 Regent Street, Suite 302
Fredericton, New Brunswick Canada E3B 3W8
Tel: +1 (506) 450 4170

THIS ***CONSULTING ENGINEERING AGREEMENT*** made in triplicate this _____ day of February, 2022 (the "Effective Date").

BETWEEN:

THE CITY OF SAINT JOHN, having its offices at the City Hall Building at 15 Market Square, Saint John, New Brunswick, a body corporate by Royal Charter, confirmed and amended by Acts of the Legislative Assembly of the Province of New Brunswick, hereinafter called the "City",

OF THE FIRST PART

- and -

DOG CORP., an extra-provincial corporation registered under the Business Corporations Act, having its head office in the City of Laval, Province of Quebec, hereinafter called the "Consultant",

OF THE SECOND PART

WHEREAS, the City issued a Request for Proposal 2022-091006P for Engineering Services – Menzies Lake Dams and Access Road Drainage Upgrades [hereinafter referred to as "Request for Proposal"] attached hereto as Schedule "A";

WHEREAS, the Consultant submitted a Proposal with respect to the Request for Proposal on March 17, 2022 [hereinafter referred to as the "Proposal"] which proposal the City has accepted and attached hereto as Schedule "B";

WHEREAS, the purpose of this Agreement is for the services of Engineering Services – Menzies Lake Dams and Access Road Drainage Upgrades;

WHEREAS, the Common Council on February 7th, 2022 resolved that:

(a) The proposal from dog Corp., for engineering design and construction management services for Engineering Services – Menzies Lake Dams and Access Road Drainage Upgrades in the amount of $9,528,300.82 including HST be accepted; and

(b) That the Mayor and City Clerk be authorized to execute the appropriate documentation in that regard.

NOW THEREFORE THIS AGREEMENT WITNESSETH that in consideration of the mutual covenants and agreements herein and subject to the terms and conditions set out in this Agreement, the parties agree as follows:

1. Definitions

The terms defined in this clause shall for all purposes of this Agreement have the meanings specified unless the context otherwise specifies or requires:

1(1) **City Manager** means the city manager of the City or his designate appointed by resolution of Common Council.

1(2) **Claims** means any actual or threatened loss, liability, cost, charge, interest, claim, demand, allegation, action, cause of action, proceeding, suit, assessment, reassessment, proposed assessment or reassessment, damage, demand, expense, levy, tax, duty, judgment, award, fine, charge, deficiency, penalty, court proceeding or hearing cost, amount paid in settlement, encumbrance, and/or tangible and intangible property right (including all costs and expenses relating to the foregoing, including legal and other professional adviser and expert fees and expenses), and whether arising by contract, at common or statute law, in tort (including negligence and strict liability), in equity, in property or otherwise of any kind or character howsoever, and howsoever arising; and **Claim** means any one of them.

1(3) **Common Council** means the elected municipal council of the City.

1(4) **Confidential Information** means information disclosed to or obtained by the Consultant in connection with the fulfillment of the terms of this Agreement and which has been identified by Municipal Operations as information which should be treated as confidential and shall be as defined in section 9.

1(5) **Consultant** means the consulting engineering firm who is currently licensed to practice within the Province of New Brunswick to carry out engineering services required to complete the Project and referred to as dogo Corp. in this Agreement.

1(6) **Consultant Representative** means the person designated by the Consultant with duly vested authority to act on behalf of the Consultant.

1(7) **Dispute** means any dispute, controversy, Claim, disagreement or failure to agree arising out of, in connection with, or relating to the interpretation, performance or application of the Agreement; and **Disputes** has a corresponding meaning.

1(8) **Information** means all data, site surveys, preliminary investigations, preliminary designs, design reports with cost estimates, detailed designs, record drawings in digital and hard copy format, plans in digital and hard copy format, public consultation process data or reports, construction management and inspection services data or reports, and other materials developed in pursuance of the Project.

1(9) **Municipal Operations** means the Transportation and Environment Service of the City of Saint John.

1(10) **Parties** means the City and the Consultant, respectively; and **Party** means individually the City and the Consultant.

1(11) **Project** means the engineering design and construction management services for the Menzies Lake Dams and Access Road Drainage Upgrades.

1(12) **Proposal** means the proposal submitted by the Consultant entitled Request for *Proposal* 2022-091006P for Engineering Services – Menzies Lake Dams and Access Road Drainage Upgrades dated January 13, 2022 and letter of clarification dated January 28, 2022 attached as Schedule "B".

1(13) **Services** means those design and construction management services as set out in the Request for Proposal and the Proposal and as set forth in this Agreement.

1(14) **Work** means the scope of the Consultant's services.

2. General

2(1) The City hereby agrees to retain the Consultant to provide the City with the Services and the Consultant hereby agrees to provide the Services to the City, all in accordance with the provisions of this Agreement.

2(2) The Consultant shall carry out the work in accordance with the Request for Proposal and the Proposal and any other written clarification(s) or addendum(s) thereof that has or have been requested and, provided and agreed to by the parties to this Agreement.

3. <u>Term</u>

3(1) The term of this Agreement commences on the Effective Date and construction of the Project is to proceed as outlined in the Request for Proposal.

4. <u>Scope of Services and Responsibilities</u>

4(1) The Consultant shall perform the Services as set out in the Request for Proposal and the Proposal and any other written clarification(s) or addendum(s) thereof that has or have been requested, provided and agreed to by the Parties to this Agreement, and these Services shall include:

(a) Site surveys, preliminary investigation and data collection;

(b) Preliminary design, cost estimates and design report;

(c) Public Information;

(d) Detailed design;

(e) Tender period services, Material Testing & Inspection, Redbook Notes and Record Drawings; and

(f) Construction Management.

4(2) The Consultant shall perform these Services under the general direction and control of Municipal Operations and with all due and reasonable diligence, professional skills and competence.

5. <u>Fees</u>

5(1) The City shall pay to the Consultant the fees in accordance with the Proposal and the provisions of the Request for Proposal including any other written clarification(s) or addendum(s) thereof that has or have been requested and provided and agreed to by the Parties to this Agreement.

5(2) Municipal Operations will review each invoice submitted by the Consultant within five (5) days after receipt and the City shall pay any undisputed amount thereunder within forty-five (45) days of the date of submission of such invoice by the Consultant.

5(3) The fees to be paid by the City for the Services performed hereunder shall be inclusive of any applicable sales taxes.

5(4) With respect to any invoice submitted by the Consultant, the City may, without triggering a default under this Agreement, withhold from any payment otherwise due:

(a) any amount incorrectly invoiced, provided that Municipal Operations or the City timely informs the Consultant of the amounts alleged to be incorrectly invoiced and the basis for any such assertion for review, resolution and rebilling purposes; or

(b) any amount in dispute.

6. Records and Audit

6(1) In order to provide data to support the invoice for fees, the Consultant shall keep a detailed record of hours worked and the billing rate for all staff performing work on the Project. The Consultant agrees that the City may inspect these time records at any reasonable time.

6(2) The Consultant, when requested by the City, shall provide copies of receipts in respect to any disbursements for which the Consultant claims payment.

7. Failure to Perform

7(1) Should the Consultant fail for any cause whatever to perform the Work provided for by this Agreement, or fail to perform the Work in a manner satisfactory to the City, then, in either case, all payments by the City to the Consultant shall cease as of the date of such failure, and the City may appoint its officials, or any other person or persons in the place instead of the Consultant to perform the Work and the Consultant shall have no Claim against the City except for the Work which has been performed by the Consultant under this Agreement up to the time of such failure, without further liability, penalty or obligation to the City under this

Agreement, and subject to any amounts that have already been paid to the Consultant.

8. Dismissal and Termination

8(1) In the event that the City, acting reasonably, is dissatisfied with the Work performance by the Consultant or that the Consultant fail to comply with the specifications and the terms and conditions of this Agreement, the Parties agree that the City may dismiss the Consultant at any time on thirty (30) days' prior written notice. The Consultant will accept payment for Work performed to the date of dismissal on a pro-rated basis in accordance with the provisions of this Agreement, in full satisfaction of any and all Claims under this Agreement, without further liability, penalty or obligation to the City under this Agreement, and subject to any amounts that have already been paid to the Consultant.

8(2) This Agreement may be terminated, without cause, by the City upon thirty (30) days' written notice to the Consultant of the City's intention to terminate same.

8(3) In the event of termination of this Agreement by the City, it shall within forty-five (45) calendar days of termination pay the Consultant, for all services rendered and all reimbursable costs incurred by the Consultant up to the date of termination, in accordance with the payment provisions set out in this Agreement, without further liability, penalty or obligation to the City under this Agreement, and subject to any amounts that have already been paid to the Consultant.

8(4) Upon early termination of this Agreement and settlement of accounts, or upon completion of the Consultant's obligations under this Agreement, all information, data, material, sketches, plans, notes, documents, memoranda, specifications or other paper writing belonging to the City and gathered or assembled by the Consultant or their agents, whether in paper or electronic format or otherwise for the purpose of this Agreement, shall forthwith be delivered to the City by the Consultant.

9. Confidential Information

9(1) The Consultant will, both during and following the term of this Agreement, treat as confidential and safeguard any information or document concerning the affairs of the City of which the Consultant acquires knowledge or that comes into its possession by reason of the Work for the City under this Agreement and will not disclose either directly or indirectly any such information or documents to any person, firm or corporation without first obtaining the written permission by the City, except any information or documents as the Consultant determines in its professional judgment should be disclosed to a third party.

9(2) Without limiting the generality of paragraph 9(1):

(a) The Consultant will not use any information acquired through the performance of this Agreement (herein referred to as "findings") to gain advantage in any other project or undertaking irrespective of the topic, scale, or scope of such project or undertaking;

(b) The Consultant will not disclose any findings during or after the performance of this Agreement;

(c) The Consultant will not respond to any inquiries pertaining to any findings and agrees to refer all such inquiries to the City;

(d) The Consultant will not disclose or use any information that Municipal Operations cannot or may not wish to disclose;

(e) The Consultant shall hold all Confidential Information obtained in trust and confidence for Municipal Operations or the City and shall not disclose, except as required by law, any such Confidential Information, by publication or other means, to any person, company or other government agency nor use same for any other project other than for the benefit of the City as may be authorized by the City in writing; and

Any request for such approval by the City shall specifically state the benefit to the City of the disclosure of the Confidential Information.

10. <u>Liability Insurance</u>

10(1) The Consultant, at no expense to the City, shall obtain and maintain in full force and effect during the term of this Agreement, a policy or policies of insurance with the following minimum limits of liability:

(a) Professional Errors and Omissions Liability Insurance

The Insurance Coverage shall be in the amount of Two Million Dollars ($2,000,000.00) per claim and in the aggregate. When requested, the Consultant shall provide the City proof of Professional Errors and Omissions Liability Insurance carried by the Consultant and in accordance with the *Engineering and Geoscience Professions Act*, S.N.B. 2015, c. 9, and amendments thereto.

(b) Comprehensive General Liability and Automobile Insurance

The Insurance Coverage shall be of not less than Two Million Dollars ($2,000,000.00) per occurrence and in the aggregate for general liability and Two Million Dollars ($2,000,000.00) for automobile insurance. When requested, the Consultant shall provide the City with proof of Comprehensive General Liability and Automobile Insurance (Inclusive Limits) for both owned and non-owned vehicles.

10(2) The policies of insurance required in paragraphs 10(1)(a) & 10(1)(b) must provide that the coverage shall stay in force and not be amended, cancelled or allowed to lapse without thirty (30) days prior written notice being given to the City. The Consultant agrees to furnish to the City a renewal certificate at least ten (10) calendar days prior to the expiration of the policy.

10(3) The policy of insurance required in paragraph 10(1)(b) shall name the City as an additional insured and shall contain a cross-liability clause.

10(4) The Consultant shall obtain and maintain in full force and effect during the term of this Agreement, coverage from WorkSafeNB.

10(5) The Consultant shall submit to the City satisfactory evidence of having obtained the insurance coverage required and shall submit certificates of such coverage as well as current coverage from the WorkSafeNB forthwith to the City upon execution of this Agreement.

10(6) Nothing in this section 10 shall be construed as limiting in any way, the indemnification provision contained in this Agreement, or the extent to which the Consultant may be held responsible for payments of damages to persons or property.

11. <u>Project Managers</u>

11(1) The City shall designate a project manager to work directly with the Consultant in the performance of this Agreement.

11(2) The Consultant shall designate a Consultant Representative who shall represent it and be its agent in all consultations with the City during the term of this Agreement. The Consultant or its Consultant Representative shall attend and assist in all coordination meetings called by the City.

12. Responsibility for Errors

12(1) The Consultant shall be responsible for its work and results under this Agreement. The Consultant, when requested, shall furnish clarification and/or explanation as may be required by the City's representative, regarding any services rendered under this Agreement at no additional cost to the City.

12(2) In the event that an error or omission attributable to the Consultant's negligence, then the Consultant shall, at no cost to the City, provide all necessary design drawings, estimates and other Consultant professional services necessary to rectify and correct the error or omission to the sole satisfaction of the City, acting reasonably, and to participate in any meeting required with regard to the correction.

13. Remedies

13(1) Subject to sections 18 and 19 hereof, upon default by either Party under any terms and conditions of this Agreement, and at any time after the default, either Party shall have all rights and remedies provided by law and by this Agreement.

13(2) No delay or omission by the Parties in exercising any right or remedy shall operate as a waiver of them or of any other right or remedy, and no single or partial exercise of a right or remedy shall preclude any other or further exercise of them or the exercise of any other right or remedy. Furthermore, any Parties may remedy any default by the other Party in any reasonable manner without waiving the default remedied and without waiving any other prior or subsequent default by the defaulting party. All rights and remedies of each Party granted or recognized in this Agreement are cumulative and may be exercised at any time and from time to time independently or in combination.

14. Indemnification

14(1) Subject to subsection 14(2) hereof, but notwithstanding any other clauses herein, the Consultant shall indemnify and save harmless the City from all Claims, or other proceedings by whomsoever claimed, made, brought or prosecuted in any manner and whether in respect of property owned by others or in respect of damage sustained by others based upon or arising out of or in connection with the performance of this Agreement or anything done or purported to be done in any manner hereunder, but only to the extent that such Claims, or other proceedings are attributable to and caused by the Consultant's negligence, errors or omissions.

14(2) In no event shall the Consultant be obligated to indemnify the City in any manner whatsoever in respect of any Claims, or other proceedings caused by the negligence of the City, or any person for whom the City is responsible.

15. Contract Assignment

15(1) This Agreement cannot be assigned by the Consultant to any other service provider without the express written approval of the City.

16. Performance

16(1) All Parties agree to do everything reasonably necessary to ensure that the terms of this Agreement are met.

17. Non-Performance

17(1) The failure on the part of any Parties to exercise or enforce any right conferred upon it under this Agreement shall not be deemed to be a waiver of any such right or operate to bar the exercise or enforcement thereof at any time or times thereafter.

18. Dispute Resolution

A. Referral to Senior Management

18(1) All Disputes arising out of, or in connection with, this Agreement, or in respect of any legal relationship associated with or derived from this Agreement shall within two (2) Business Days be referred for resolution to the City Manager and the Consultant Representative.

18(2) If the City Manager and Consultant Representative are not able to resolve the Dispute referred to them under this section 18 within seven (7) Business Days following such referral, the matter shall be referred for resolution by way of mediation upon the willingness of the Parties.

B. Mediation

18(3) Despite an agreement to mediate, a Party may apply to a court of competent jurisdiction or other competent authority for interim measures of protection at any time.

18(4) If the Parties resolve to mediate the Dispute referred to them under subsection 18(2), the Parties shall invoke the following mediation process:

(a) Either Party shall immediately declare an impasse and provide written notice to the other within seven (7) Business Days thereof (or such other period as the Parties mutually prescribe) declaring that such party wishes to proceed to mediation and setting out in reasonable detail the issue(s) to be resolved, the proposed time and a list of at least three (3) and not more than five (5) proposed mediators. Each of the proposed mediators shall be an individual:

(i) with at least three (3) years' experience working in an executive capacity or representing clients in the area of public disputes, and

(ii) unless otherwise agreed by the Parties, with no prior connection, affiliation or other formal relationship with either Party.

(b) Upon receipt of such notice, the notified party shall have two (2) Business Days to select one (1) of the proposed mediators as the mediator, failing which the Party providing notice shall select one (1) of its proposed mediators as the mediator. Within seven (7) Business Days following selection of the mediator the matter shall be heard by the mediator.

(c) The mediator shall be entitled to establish his or her own practices and procedures. Each Party shall co-operate fully with the mediator and shall present its case to the mediator orally and/or in writing within (10) Business Days following the mediator's appointment. The mediation shall not be in the nature of arbitration as contemplated by the *Arbitration Act* and the mediator's decision shall not be binding upon the Parties, but shall be considered as a bona fide attempt by the mediator to judiciously resolve the Dispute. The decision of the mediator shall be rendered in a written report, not to exceed two (2) pages in length, delivered to the Parties within (10) Business Days following the last of such presentations. The fees of the mediator shall be shared equally by the Parties.

18(5) The mediation shall be terminated:

(a) By the execution of a settlement agreement by the Parties; or

(b) By a written declaration of one or more parties that the mediation is terminated; or

(c) By a written declaration by the mediator that further efforts at mediation would not be useful.

18(6) The place of mediation shall be the City of Saint John and Province of New Brunswick.

C. <u>Arbitration</u>

18(7) In the event that the Parties are unwilling to mediate their Dispute or that the Dispute between the Parties remain unresolved after mediation has been attempted in good faith, then either the City or the Consultant, upon written notice to the other, may refer the Dispute for determination to a Board of Arbitration consisting of three (3) persons, one (1) chosen by and on behalf of the City, one (1) chosen by and on behalf of the Consultant and the third chosen by these two.

18(8) In case of failure of the two arbitrators appointed by the Parties hereto to agree upon a third arbitrator, such third arbitrator shall be appointed by a Judge of the Court of Queen's Bench of New Brunswick.

18(9) No one shall be appointed or act as arbitrator who is in any way interested, financially or otherwise, in the conduct of the work or in the business or other affairs of either Party.

18(10) Notwithstanding the provisions of the *Arbitration Act*, the Board of Arbitration, upon such terms and conditions as are deemed by it to be appropriate, may allow a Party to amend or supplement its claim, defence or reply at any time prior to the date at which the Parties have been notified of the arbitration hearing date, unless the Board of Arbitration considers the delay in amending or supplementing such statements to be prejudicial to a Party. The Board of Arbitration will not permit a Party to amend or supplement its claim, defence or reply once the arbitration hearing has been scheduled.

18(11) The Board of Arbitration may encourage settlement of the Dispute and, with the written agreement of the Parties, may order that mediation, conciliation or other procedures be used by the Parties at any time during the arbitration proceedings to encourage settlement.

18(12) If, during the arbitration proceedings, the Parties settle the Dispute, the Board of Arbitration shall, upon receiving confirmation of the settlement or determining that there is settlement, terminate the proceedings and, if requested by the Parties, record the settlement in the form of an arbitration award on agreed terms.

18(13) Subject to subsection 18(14), any determination made by the Board of Arbitration shall be final and binding upon the Parties and the cost of such determination shall be apportioned as the Board of Arbitration may decide.

18(14) Either Party may appeal an arbitration decision to The Court of Queen's Bench of New Brunswick: (i) on a question of law; or (ii) on a question of fact; or (iii) on a question of mixed fact and law.

18(15) The place of arbitration shall be the City of Saint John and Province of New Brunswick and the provisions of the *Arbitration Act,* R.S.N.B. 2014, c. 100, shall apply to the arbitration.

D. Retention of Rights

18(16) It is agreed that no act by either Party shall be construed as a renunciation or waiver of any rights or recourses provided the Party has given the notices required under section 18 and has carried out the instructions as provided in section A of this Part.

18(17) Nothing in section 18 shall be construed in any way to limit a Party from asserting any statutory right to a lien under applicable lien legislation of the jurisdiction of New Brunswick and the assertion of such right by initiating judicial proceedings is not to be construed as a waiver of any right that Party may have under section B of this Part to proceed by way of arbitration to adjudicate the merits of the claim upon which such a lien is based.

19. Force Majeure

19(1) It is agreed between all Parties that neither Parties shall be held responsible for damages caused by delay or failure to perform his undertakings under the terms and conditions of this Agreement when the delay or failure is due to strikes, labour disputes, riots, fires, explosions, war, floods, acts of God, lawful acts of public authorities, or delays or defaults caused by common carriers, which cannot be reasonably foreseen or provided against. After ninety (90) consecutive or cumulative days of the suspension of Party's obligations due to force majeure, the other Party may terminate the Agreement.

20. Time

20(1) This Agreement shall not be enforced or bind any of the Parties, until executed by all the Parties named in it.

21. Notices

21(1) Any notice under this Agreement shall be sufficiently given by personal delivery or by registered letter, postage prepaid, mailed in a Canadian post office and prepaid courier, addressed, in the case of notice to:

The City:	**CONSULTANT:**
Municipal Operations City of Saint John 175 Rothesay Avenue Saint John, NB E2J 2B4	dogo Corp. cat Street, Suite 007 Saint John, NB E2L 2B5
Telephone: 506-658-4455	Telephone: 506-693-5893

or to any other address as may be designated in writing by the Parties and the date of receipt of any notice by mailing shall be deemed conclusively to be five (5) calendar days after the mailing.

22. Reference to Prior Agreement

22(1) This Agreement supersedes and takes the place of all prior agreements entered into by the Parties with respect to the consulting engineering services for design and construction management of the Charlotte Street (St. James Street to Lower Cove Loop) and St. James Street (Germain Street to Charlotte Street) – Street Reconstruction.

23. Amendments

23(1) No change or modification of this Agreement shall be valid unless it is in writing and signed by the Parties.

24. Acknowledgment of Terms and of Entirety

24(1) It is agreed that this written instrument embodies the entire agreement of the Parties with regard to the matters dealt with in it, and that no understandings or agreements, verbal or otherwise, exist between the Parties except as expressly set out in this instrument or as set out in the Request for Proposal or the Proposal or any written clarification(s) or addendum(s) that are included as part of this Agreement.

25. Further Documents

25(1) The Parties agree that each of them shall, upon reasonable request of the other, do or cause to be done all further lawful acts, deeds and assurances whatever for the better performance of the terms and conditions of this Agreement.

26. Validity and Interpretation

26(1) Paragraph headings are inserted solely for convenience of reference, do not form part of this Agreement, and are not to be used as an aid in the interpretation of this Agreement.

26(2) The failure of the Parties to insist upon strict adherence to any term or condition of this Agreement on any occasion shall not be considered a waiver of any right thereafter to insist upon strict adherence to that term or condition or any other term or condition of this Agreement.

26(3) The Schedules to the Agreement form part of and are incorporated into the Agreement as fully and effectively as if they were set forth in the Agreement.

27. Governing Law

27(1) This Agreement shall be governed by and construed in accordance with the laws of the Province of New Brunswick and the federal laws of Canada applicable therein.

28. Successors, Assigns

28(1) This Agreement shall enure to the benefit of and be binding on the successors and assigns of the City and on the successors and permitted assigns of the Consultant.

29. Severability

29(1) It is intended that all provisions of this Agreement shall be fully binding and effective between the Parties, but in the event that any particular provision or provisions or part of one is found to be void, voidable or unenforceable for any reason whatsoever, then the particular provision or provisions or part of the provision shall be deemed severed from the remainder of this Agreement and all other provisions shall remain in full force.

30. Independent Legal Advice

30(1) The Parties acknowledge having obtained their own independent legal advice with respect to the terms of this Agreement prior to its execution.

31. Acknowledgment of Receipt of Copy

31(1) Each Parties acknowledge receipt of a true copy of this Agreement.

IN WITNESS WHEREOF dogoe Corp. has caused this Agreement to be executed in its corporate name, and on its behalf, by its President of Operations, Atlantic Canada, and The City of Saint John has caused this Agreement to be executed in its corporate name in the manner prescribed by the *Local Governance Act*, S.N.B. 2017, c 18, and amendments thereto.

SIGNED, SEALED & DELIVERED In the presence of:	**dogE CORP.** Per: ______________________________ bow wow, President of Operations, I have authority to bind the Consultant **THE CITY OF SAINT JOHN** ______________________________ Donna Noade Reardon, Mayor ______________________________ Jonathan Taylor, City Clerk Common Council Resolution: February 7th, 2022

PROVINCE OF NEW BRUNSWICK

I, **wweewweewee**, of the City of Saint John and Province of New Brunswick, **MAKE OATH AND SAY**:

1. That I am Pwewewewe weewe, the President of Operations, Atlantic Canada of ded Corp., a Consultant named in the foregoing instrument and have custody of the corporate seal of the said company and am duly authorized to make this affidavit.

2. That the corporate seal affixed to the foregoing agreement and purporting to be the corporate seal of dede Corp., is the corporate seal of dede Corp., a Consultant named in the foregoing instrument and it was affixed by the officers authorized to so affix the seal.

3. That the signature of "weer frby", is my signature, and as the President of Operations, Atlantic Canada of deded Corp., I am duly authorized to execute the said instrument.

4. THAT the said document was executed as aforesaid at the City of Saint John in the Province of New Brunswick on the ________ day of February, 2022.

SWORN TO before me at	)	
Saint John, in the Province of	)	
New Brunswick	)	
the ______ day of February,	)	
2022	)	________________________________
	)	weded grgrby
	)	
__________________________	)	
Commissioner of Oaths,	)	
	)	

SAINT JOHN

COVID-19 Vaccine or Test Policy

Subject: COVID-19 Vaccine and Test Policy Version 3	Category: Policy
Policy No.:	M&C Report No.: 2021-248
Effective Date: February 3, 2022	Next Review Date: TBD
Area(s) this policy applies to: All Employees/ Council Members attending City Workplaces	Office Responsible for Review of this Policy: Human Resources
Related Instruments:	Policy Sponsor: City Manager
	Document Pages: 8

Revision History:

City Clerk's Annotation for Official Record

I certify that the Vaccine or Test Policy Statement was adopted by resolution of Common Council on September 7, 2021

I certify that the Vaccine or Test Policy was approved by the City Manager on February 3, 2022

Feb 10, 2022

Contact: Human Resources
Telephone: 506-658-2866
Email: humanresources@saintjohn.ca

1.0 Policy Statement

In the context of the COVID-19 pandemic, the City of Saint John will adopt a Vaccine or Test policy requiring that current employees and members of Common Council who attend the workplace either show proof of full vaccination, or wear masks and regularly undergo COVID-19 testing.

Current employees are defined as any employee who is employed by the City of Saint John prior to February 3, 2022.

Effective February 3, 2022, all new employees hired on or after this date must provide proof of full vaccination as a condition of employment.

In the context of this Policy, the definition of "full vaccination" is the definition adopted by the Government of New Brunswick as amended from time to time.

2.0 Purpose and General Requirement

The City of Saint John must provide a safe work environment. Implementing this policy helps protect employees, members of Common Council, third parties who work at City buildings and, generally, the community we serve from infection, serious illness, hospitalization, and death associated with the COVID-19 pandemic.

Current employees and members of Common Council who attend the workplace shall either provide proof of full vaccination or wear a mask and regularly undergo COVID-19 testing. Participation in the Vaccine or Test program is mandatory. The program shall remain in force pending advice to Council by the City Manager that it is no longer required, and the subsequent rescinding of the policy statement by Council.

As directed through amendment of the Policy by Council, new employees hired as of February 3, 2022, or later must provide proof of full vaccination as a condition of employment.

3.0 Context and Scope

Federal and Provincial Governments and Public Health have urged all eligible residents to receive the COVID-19 vaccination. They have also made public statements regarding the effectiveness of the vaccine in preventing the spread of COVID-19. Evidence has shown that the vaccine protects individuals, their families and their communities against severe illness, hospitalization and even death from COVID-19. This policy is a condition of access to the City of Saint John workplaces for its employees, members of Council and third parties to ensure that the City provides a safe work environment for its workforce and those it serves during the COVID-19 pandemic.

This policy applies to all City of Saint John employees, members of Common Council, contractors, on-site vendors, suppliers, and volunteers who attend City workplaces.

Contingent upon the availability of the vaccine, and unless medically unable to receive the vaccine or subject to accommodation on Human Rights grounds, it is expected that all City of Saint John employees, members of Common Council, contractors, on-site vendors, suppliers, and volunteers who attend City workplaces will be fully vaccinated against COVID-19 **or** wear a mask at all times when at work, indoors and outdoors, unless consuming food or drink, and undergo COVID-19 testing, as directed.

Employees who do not comply with this policy will be subject to the disciplinary process, up to and including dismissal. They will be sent home on leave without pay pending investigation and necessary disciplinary action.

In the event of an outbreak in a workplace, the testing requirements may be temporarily modified (including for fully vaccinated employees) based on Public Health guidance.

Vaccination appointments may be made by visiting the following site:

https://www2.gnb.ca/content/gnb/en/corporate/promo/covid-19.html

4.0 LEGISLATION AND STANDARDS

The New Brunswick *Occupational Health and Safety Act* (NBOHSA) requires that employers take every reasonable precaution to ensure the health and safety of their employees. In addition, the City of Saint John Safety Policy amplifies the City's obligation of due diligence in representing the health and safety of its employees as a central obligation of the City of Saint John.

5.0 IMPLEMENTATION

Employees and Members of Council

Employees and members of Council have until Monday, September 20, 2021, or if absent, until their return to work, to provide proof of full vaccination. Employees will provide proof to their managers of such vaccination. Members of Council are requested to provide proof to the City Clerk. Departments will not keep a copy of their employee (or member of Council) vaccination records. They will simply maintain a list of who has provided proof of vaccination. Managers will provide this list to Human Resources in a format to be announced by Human Resources.

Employees and members of Council who do not provide proof of vaccination by September 20, 2021, must always wear a mask in the workplace.

For consumption of food and drink, employees who are required to wear a mask may remove the mask if they are isolated from all others, sanitize their area after use, and are located in an area where incidental or accidental close contact (within 2 meters) is not possible. Those who are required to wear a mask must immediately re-mask after completion of the consumption of food or drink.

In addition to the mask requirement, current employees and members of Common Council who do not provide proof of vaccination will be required to complete a COVID-19 point of care test (POCT) consent form and they must follow the COVID-19 testing requirements until such time that they provide proof of full vaccination.

Employees and members of Council who provide an approved certificate of a medical exemption to the vaccine or to wearing a mask will be managed on a case-by-case basis. Employees and members of Council who believe they meet this requirement must contact Human Resources for a review and possible exemption. Medical documentation will be required.

New Employees

New employees hired on February 3, 2022, or later, must provide proof of full vaccination as a condition of their employment.

Contractors and On-site Vendors, Suppliers and Volunteers

Anyone who regularly works at City workplaces shall comply with this policy. City representatives within the department responsible for the contractors, suppliers or volunteers are responsible to inform those impacted by this policy and enforce this policy.

Accommodation on Human Rights Grounds

The City will accommodate employees and members of Council who cannot get vaccinated or wear a mask and undergo testing on Human Rights Grounds. Each situation will be managed on a case-by-case basis.

Members of the Public

Direction related to members of the public entering City facilities will be developed and modified as necessary based on guidance and direction from Public Health and the Government of New Brunswick.

As of 22 September, the Province did impose requirements for access to select public spaces. These requirements are likely to be fluid and change as the situation warrants. Therefore, access by members of the public to city facilities will not form part of this Policy but will be communicated to employees and our community through other mediums and products, on an "as required" basis.

Additional detail will follow, when provided by the Province.

6.0 COLLECTION AND TREATMENT OF INFORMATION

The City will review the proof of vaccination and test results of those to whom this policy applies but will not retain copies of such documentation. Instead, it will keep a list of employees and members of Council who have produced this information.

Access to proof of vaccination and test results will be limited to management who are administering the policy. Proof of vaccination and test results will be protected against unauthorized access and kept separate from employees' Human Resources files.

The information collected under the authority of this policy will be collected and used only for the purpose for which it is collected and will be destroyed when no longer required.

7.0 ROLES AND RESPONSIBILITIES

Employees and Members of Common Council

Employees and Members of Common Council are responsible for:

- Reading and understanding this policy and their responsibilities under it.
- Maintaining mutual respect and dignity in all workplace relations.
- If not already done, scheduling and receiving vaccinations if they choose to show proof of vaccination.
- Providing proof of COVID-19 vaccine status. Employees are to provide proof to their manager, members of Council to the City Clerk.
- If not providing proof of vaccination, completing COVID-19 POCT consent form (applicable to current employees and members of Common Council).
- If not providing proof of vaccination, completing the consent form, completing a POCT test and providing result on a twice-weekly basis in compliance with this policy (applicable to current employees and members of Common Council).
- If required to test, reviewing, and following testing instructions.
- If not fully vaccinated, always wear a mask in the workplace except when isolated for the consumption of food or drink. See Section 5 for further clarification.
- If applicable, providing an approved certificate of medical exemption to Human Resources.

- Responsible for requesting additional testing kits (if applicable).

Management

Management is responsible for:

- Reading and understanding this policy and their responsibilities under it.
- Maintaining a current list of employees within their work units with the employees' vaccination status; the format of which list will be provided by the Human Resources Department.
- Providing updates to Human Resources on employees' vaccination status when changes occur.
- Ensuring the appropriate level of privacy is in place.
- Providing employees proper testing instructions.
- Ensuring proper protocols are followed if an employee has a positive COVID-19 test result.
- Providing a copy of the policy to on-site vendors, suppliers, contractors, and volunteers and ensuring they read and abide by the policy.

Human Resources

Human Resources is responsible for:

- Verify proof of full vaccination with all new employees hired on or after February 3, 2022.
- Maintaining a master list of employees' vaccination status.
- Providing managers the format for employee vaccination list.
- Ensuring the appropriate level of privacy is in place.
- Ensuring POCT consent form is in place (if applicable).
- Ensuring the proper protocols are in place so testing is performed correctly, safely, and effectively.
- Ensuring that weekly test results are provided to the Province of New Brunswick as required.
- Ensuring testing products are available and correctly distributed and monitored.
- Ensuring protocols are in place if a positive test result is identified.
- Preparing the necessary instructions for testing and providing them to managers for onward briefing to employees.

On-site Vendors, Suppliers, Contractors and Volunteers

On-site vendors, suppliers, contractors, and volunteers shall:

- Read and understand this policy and their responsibilities under it.

- Provide proof of COVID-19 vaccine status or a negative COVID-19 test result on a twice-weekly basis.
- If not fully vaccinated, always wear a mask in the City of Saint John workplaces.
- Those who provide an approved certificate of a medical exemption to the vaccine will be required to wear a mask and will be required to follow the testing requirements. Each such exemption will be reviewed on a case-by-case basis.

8.0 Monitor and Review

This policy will be reviewed as needed by the City Manager. As the COVID-19 pandemic unfolds, if the policy statement must change, the City Manager will take any proposed change to the policy statement to Common Council for approval.

9.0 Authorization

This Policy is authorized by the City Manager pursuant to a resolution of Common Council approved on September 7, 2021.

10.0 Resources

Government of New Brunswick: https://www2.gnb.ca/content/gnb/en/corporate/promo/covid-19.html

WorkSafe NB: https://www.worksafenb.ca/

New Brunswick Public Health: https://www2.gnb.ca/content/gnb/en/corporate/promo/covid-19/about-covid-19/testing-tracing.html#7

11.0 Procedures

Testing Requirements

A current employee or member of Council who chose not to provide proof of their vaccination status shall complete a POCT two (2) times per week. These tests are to be performed three (3) days apart. The City will provide the POCT kits. Current employees and members of Council will begin the testing as soon as the City provides the kits and will provide the results of each test to their manager in accordance with the instructions provided by their manager. The POCT test can be taken at home, prior to the start of the workday. Any fraudulent testing is grounds for disciplinary action up to and including dismissal.

A POCT takes approximately 15 minutes to complete. To learn more about the POCT test and how to use it, view: https://www.youtube.com/watch?v=EbVEQfnXwyU

If Positive POCT Result

Current Employees and members of Council are encouraged to schedule a polymerase chain reaction (PCR) test immediately if they get a positive POCT test result or have two or more symptoms, if eligible. Employees and members of Council will not attend the workplace until they have met all conditions for ending isolation in accordance with New Brunswick Public Health guidance. If all New Brunswick Public Health conditions have been met, they shall return to work. Employees can register for a PCR test online at www2.gnb.ca (Get Tested) or by calling 811, if eligible.

If Negative POCT Result

Employees and members of Council will be able to attend workplace and will be required to continue with the required masking protocols and current employees will be required to resume testing until proof of full vaccination is provided.

12.0 Glossary

Point of care testing (POCT) - diagnostic tests performed at or near the place where a specimen is collected. They provide results within minutes rather than hours. These may be NAAT, antigen, or antibody tests.

Polymerase chain reaction (PCR) - a test to detect genetic material from a specific organism such as a virus. The test detects the presence of a virus if you have the virus at the time of the test. The test could also detect fragments of the virus even after you are no longer infected.

13.0 Inquiries

Inquiries regarding this Policy can be addressed to the City of Saint John's Human Resources Department.

14.0 Appendices

N/A

15.0 Approval

Recommended	Title	Signature	Date
Stephanie Hossack	Commissioner, Human Resources	S Hossack S.Hossack (Feb 9, 2022 16:19 AST)	Feb 9, 2022
John Collin	City Manager	JC Collin JC Collin (Feb 10, 2022 08:33 AST)	Feb 10, 2022

SAINT JOHN

CITY OF SAINT JOHN

CONTRACTOR: VACCINE OR TEST ACKNOWLEDGEMENT FORM

CONTRACTOR INFORMATION

Company name:

Name of company representative:

Title of company representative:

Phone number:

Email:

Date or range of dates when contractor activities are to be carried out:

ACKNOWLEDGEMENT

This is to acknowledge and agree that, as of DATE, all employees and sub-contractors of COMPANY NAME that have been or are being deployed to do work for the City of Saint John by COMPANY NAME must and do comply with all the following:

- Have received, reviewed, and understand the City of Saint John Vaccine or Test Policy (the “Policy”), as amended from time to time
- Have either provided proof of COVID-19 vaccine status or a negative COVID-19 test result on a twice weekly basis to COMPANY NAME in full compliance with the Policy
- If not fully vaccinated, know always to wear and do wear a mask in the City of Saint John workplaces.

I acknowledge and agree that employees/subcontractors of _________________________ will either be fully vaccinated and will provide proof of their vaccination status, if requested, in full compliance with the Policy, as amended from time to time. If the employees/subcontractors are not vaccinated, I acknowledge and agree they will obtain COVID19 test twice weekly, with demonstrated negative results, and wear a mask as required. If testing is required, it will be ___________________________ responsibility to ensure it is completed as required. I further acknowledge and agree that any fines, charges, or damages resulting from failure to comply with the Policy and the foregoing will be the sole responsibility of ___________________________.

SIGNATURE: **DATE:**