

2023 Waterbury Dam Interim Risk Reduction Project

Release Date: June 28, 2023

Proposals Due: July 11, 2023

Contact for Proposals: Rebecca Griggs, ANR, Department of Environmental Conservation,
Financial Operations (802) 522-0312, rebecca.griggs@vermont.gov

THE STATE WILL MAKE NO ATTEMPT TO CONTACT VENDORS WITH UPDATED INFORMATION. IT IS THE RESPONSIBILITY OF EACH VENDOR TO PERIODICALLY CHECK <http://www.vermontbidsystem.com> FOR ANY AND ALL NOTIFICATIONS, RELEASES AND AMENDMENTS ASSOCIATED WITH THE RFP.

If you speak a language not listed or require additional help, we offer free language assistance services. Please reach out to ANR at 802-636-7266 and we can support getting you access to the State of Vermont's free language services. The State of Vermont contracts with several Translation Services organizations, and you can visit this page for more information. <https://anr.vermont.gov/special-topics/equity-and-accessibility/language-services>. If you require assistance with technology, access, or have other issues with being able to fill out this form please contact Rebecca Griggs, rebecca.griggs@vermont.gov, and via telephone (802)522-0312.

Introduction and Purpose

The Department of Environmental Conservation (DEC) Dam Safety Program (DSP) is seeking proposals from qualified contractors to assist with emergency preconstruction and construction activities associated with temporary and high priority bridge and flood gate strut arm reinforcing at the Waterbury Dam located in Waterbury, Vermont. The project requires immediate on site availability for preconstruction and construction services at the Waterbury Dam. The design engineer of record and construction phase engineering services for the project is GEI Consultants, Inc.

In accordance with Executive Order No. 02-22, signed on March 3, 2022, by Governor Phil Scott, the State is required to secure your certification that no Russian-sourced goods or services provided or produced by Russian entities will be provided to the State of Vermont under this proposal. In submitting this proposal, you are providing this certification to the State.

Scope of Work

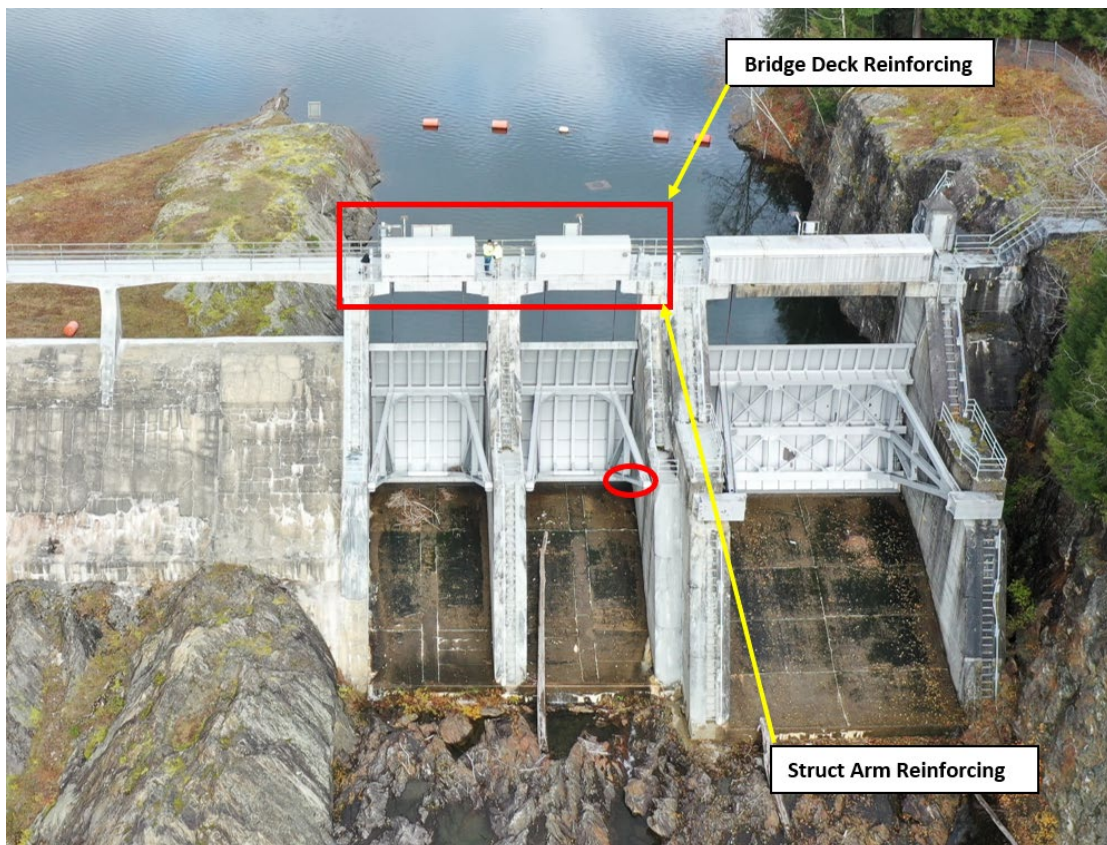
The State of Vermont is the owner/operator of Waterbury Dam, a 187-foot high, 2,000-foot long, HIGH hazard potential earth embankment flood control dam designed and constructed by the US Army Corps of Engineers (USACE) in the late 1930s. At the eastern (left) end of the dam is the spillway system that consists of a gated section with three steel radial arm flood (Tainter) gates and an uncontrolled section consisting of a concrete fixed crest ogee-style weir. The spillways are founded on bedrock. Atop both sections of the spillway is a

reinforced concrete access bridge that also supports the gate hoist equipment. Attached are select 1937 and 1957 drawings that show plans of the bridge and gate sections.

As part of the study/exploratory work of a larger project to rehabilitate/replace the spillway and flood gate systems, the following deficiencies were identified that require immediate repair to allow for continued safe and reliable performance until a more extensive spillway bridge and gate rehabilitation/replacement project can be designed, permitted, and constructed in the 2027 timeframe:

- Overstressing of the bridge deck over two of the Tainter gates requires temporary reinforcing consisting of two top side beams connected to the underside of the reinforced concrete bridge deck to strengthen it and provide a stable, composite structure.
- Overstressing of the lower left strut arm of the center radial arm flood gate requiring limited paint removal, reinforcing with two flange plates fillet welded to W-beam strut and recoated with epoxy primer and paint to achieve a coating of 8 to 10 mils thick.
- Contractors should proceed as though Lead Paint is present on painted structures for the site and use appropriate safety precautions.

GEI Consultants, Inc. (GEI) has previously provided an assessment report with 10% repair design (attached) and has been retained to provide final analysis, design, and construction monitoring services for the two temporary reinforcing measures. Given the risk to safe and reliable flood control operations, implementation of the temporary measures is time sensitive, with a goal to have all Work completed by November 30, 2023. Accordingly, the State is looking to retain a Contractor for both pre-construction and construction activities through project completion. The specific scope of work (SOW) is outlined below.



Waterbury Dam Spillway – Gated Section – Radial Arm Flood Gates, Hoists, and Access Bridge

It is anticipated that Task 1: Preconstruction will represent a smaller portion of the total project compared to Task 2: Construction. For bidding purposes, the Contractor should provide a time and materials cost for Task 1. For Task 2, the Contractor should provide a proposed budget based on the scope requirements below and the GEI Report with 10% design information. At the completion of Task 1, the Contractor will provide a bid on Task 2 based on 60% and 100% project design drawings with specifications presented on the drawings. If the bid provided by the Contractor at the completion of Task 1 is accepted, the contract amount for Task 2 will be amended accordingly and the project will proceed to construction. If the bid provided by the Contractor at the completion of Task 1 is rejected, the contract will be terminated and the Contractor will be compensated for Task 1: Preconstruction work, only.

Task 1: Preconstruction Tasks: The following tasks shall be completed during the design phase of the project.

- Receive and review 60% GEI project design drawings and specifications. Attend onsite and online plan review meetings of 60% proposed design. Provide constructability and material availability comments in writing to GEI for review and incorporation in the 100% design package.
- Receive and review 100% GEI project design drawings and specifications. Develop Construction Bid Budget for implementation of the 100% Design and present Budget to GEI and the State. The bid budget will be evaluated by GEI and the Owner (State of VT) and compared to the Engineer's Estimated construction cost. The State reserves the right to negotiate the Bid with the Contractor, after which the Bid will either be accepted or rejected as outlined, above. Once this process of 100% bid review and negotiation is complete, GEI will issue 100% Drawings Issued for Construction.

Task 2: Construction: The following tasks shall be completed during the construction phase of the project.

- Develop shop drawings for materials for engineer/owner review and approval.
- Purchase materials for the project based on approved shop drawings.
- Develop a brief material transport, handling, and construction access and logistics plan for the project.
- Develop a plan that outlines how construction activities will occur during inclement weather or flood conditions.
- Maintain access to the Engineer and Owner to operate the gates at any time required with commitment to move scaffolding, barges and boats out of the spillway forebay channel and secure (safe harbor) the barges and boats at the west (right) dam abutment.
- Means and methods to drill or core the bridge deck to avoid cutting rebar steel. We expect rebar locating/Ground Penetrating Radar (GPR) equipment will be available on-site to scan concrete.
- Construction administration and billing. An office trailer may be used at the site by the contractor subject to the approval of the State.
- Mobilize to the site and set up necessary protections, safety controls, shoring, rigging, environmental controls, etc.
- Transport materials, equipment, and personnel to the site.
- Perform installation of bridge and gate reinforcing measures.
- Attend/participate in kickoff, weekly project progress meetings, final punch list, and completion meeting.
- Restore site and demobilize.
- All onsite work is to be performed under a qualified, full-time site supervisor with more than 5years' experience who will coordinate construction activities and communicate with the Engineer and Owner. A copy of the supervisor's resume shall be provided

CONTRACTOR WARRANTY

The contractor shall provide a 1-year warranty on materials and workmanship starting immediately after final completion/Owner acceptance of Task 2.

BONDING

The Contractor will furnish a Performance Bond for Task 2: Construction in the amount of 100% of the contract price. The Contractor should carry the estimated cost of bonding in their proposal for this project as well as in bidding. All bonds are to be executed according to applicable instructions.

See Deliverables Table in **Deadlines and Content of Proposals** section for all deliverables that must be included in the proposal.

Funding and Method of Payment

Funding for this project is available from DEC through General and Capitol Funds up to \$350,000.00.. Payment is contingent upon available funding. All payments will be made after satisfactory completion of each deliverable as outlined in an agreement between the State and the selected entity.

Project Timeline

All work is to be completed between/by July 21, 2023, and December 31, 2023. Specific deliverable deadlines are indicated in the sample deliverables table below.

A mandatory Prebid site visit is being held on July 5, 2023 at the Waterbury Dam in Waterbury, Vermont at 1:00 PM. The meeting will start at western end of the dam adjacent to the State Boat Ramp at 2792 Little River Road. Registration is required via email to Rebecca Griggs, rebecca.griggs@vermont.gov by July 5 at 9:00 AM. General questions and questions following the site visit may be submitted up to July 6, 2023 at 11 AM. It is anticipated that responses to all questions will be provided by July 7, 2023.

Procurement

Awardees must maintain written procedures for procurement transactions. Any equipment, supplies, and/or services procured outside of an awardee's organization will need to be obtained per the awardee's procurement or purchasing policy.

Deadlines and Content of Proposals

Questions: Questions must be submitted electronically via email to Rebecca Griggs at Rebecca.griggs@vermont.gov by **July 6, 2023, 11:00 am EST** using the subject line "*Waterbury Dam Risk Reduction Project RFP.*"

Submittal: All proposals must be submitted electronically via email to Rebecca Griggs at Rebecca.griggs@vermont.gov by **July 11, 2023, 4:00 pm EST** using the subject line "*Waterbury Dam Risk Reduction Project RFP.*"

Bid opening: Proposals are anticipated to be opened **July 12, at 9:00 am EDST.**

Notification: Proposal preliminarily accepted by DEC is anticipated to be notified no later than **July 30, 2023.**

All proposals must include the following information:

- A detailed scope of work describing how the deliverables will be met.

- Experience with pre-construction, design review, value engineering, design-built style projects, structure reinforcing, work on/near water, work on time sensitive critical infrastructure projects, etc.
- Resumes of key personnel including the onsite Project Superintendent.
- Identification and examples of successfully collaboration with the subcontractor used for engineering support, design of temporary construction systems, etc.
- Worker Safety approach and capabilities. Experience Modification Rating (EMR), if available.
- A general narrative providing some insight to the contractor’s potential approach to access the bridge/get materials in place.
- This is a time sensitive project on critical, high hazard potential flood control infrastructure. Preference will be given to contractors that can display a history of quality, efficient workmanship as well as flexible and creative technical and schedule approaches.
- A statement identifying individuals who were involved in the preparation of the proposal as well as a single point of contact.
- A certificate of insurance, indicating that the entity or entities have met the insurance requirements listed in Attachment C.
- Disclosure of the bidders contact with DEC employees about the RFP and the subject matter of the scope of work. The specifics of the contact to include type, method, reason for, and date and time. Failure to disclose contact with DEC employees shall result in the disqualification of the bidder, (potential contractor) from participation in the RFP
- A complete and detailed deliverables table. An example of a deliverables table is included below.

Deliverables table that must be included in the proposal:

Description	Deliverables	*Cost
Task 1: Preconstruction	<ul style="list-style-type: none"> • Start on July 21, 2023 • 60% Design, Drawing and Specification Review Memorandum by or before within ten (10) business days of receipt. • Construction Bid based on 100% Design and Specifications • Provide written comment(s) and bid to State and GEI, Inc. contact within ten (10) business days. 	Est. Hours: _____ Hourly Rate: _____ Not-to-Exceed: _____ Timeline: _____
Task 2: Construction*	Completed Construction Project and 1-year warranty on materials and workmanship, field activities complete on or before November 30, 2023. Complete project closeout by December 31, 2023.	Est. Price: _____ Timeline: _____

*Estimated/placeholder cost based on review of currently available information. To be replaced with negotiated bid price from Task 1, above.

Selection Criteria

Proposals will be reviewed and evaluated by three or more DEC staff members. Selection will be based on the following criteria:

1. 35 Points - Qualifications/Prior Experience with this type of work
2. 35 Points - Ability to meet completion dates in proposed project schedule
3. 30 Points – Value, (Cost- to include a detailed breakdown of time and materials in electronic format)

Eligibility

A current Vermont state employee responding to this RFP as a sole proprietor or owner of other form of business must obtain a waiver from the Vermont Department of Human Resources prior to entering into contract with the State.

Reservation of State's Rights

The State reserves the right:

- to accept or reject any and all bids, in whole or in part, with or without cause in the best interest of the State;
- waive technicalities in submissions; (A technicality is a minor deviation from the requirements of an RFP that does not impact the substantive terms of the bid/RFP and can be considered without a material impact on the RFP process, etc.). If uncertain of whether a condition qualifies as a technicality, consult with the OPC or AGO for clarification. For example, a late bid is NOT considered a technicality;
- to make purchases outside of the awarded contracts where it is deemed in the best interest of the State; and
- to obtain clarification or additional information.

Insurance

Respondents to this RFP should be aware that they will need to agree to the State of Vermont Customary Contract Provisions (Attachment C,) in addition to all Attachments in order to execute an agreement for this project.

Special care should be paid to Workers' Compensation coverage for out-of-state Vendors. Vermont statute requires insurance carriers be specifically licensed to write Workers' Compensation coverage in Vermont. Out-of-state Vendors may have Workers' Compensation coverage valid in their home state, but their carrier may not be licensed to cover workers' compensation for work actually performed by their employees in Vermont.

Confidentiality

After conclusion of the contracting process, Proposals are a matter of public record. If an application includes material considered by the applicant to be proprietary and confidential under 1 V.S.A., Chapter 5, the application shall clearly designate the material as such and explain why such material should be considered confidential. The Vendor must identify each page or section of the Proposal that it believes is proprietary and confidential with sufficient grounds to justify each exemption from release, including the prospective harm to the competitive position of the applicant if the identified material were to be released.

Under no circumstances shall the entire Proposal be designated as proprietary or confidential. If the Vendor marks portions of the Proposal confidential, the Vendor shall provide a redacted version of the Proposal for release to the public. Notwithstanding the above, the Secretary has an independent obligation under Vermont law to determine whether any proposal material is subject to public inspection and copying upon request, which may include material that has otherwise been designated as proprietary and confidential by the Vendor. The Vendor's designation of material as proprietary and confidential, and submission of a redacted Proposal, are provided to the Secretary for informational purposes in the event the Agency receives a public records request and will not result in withholding of materials by the Secretary unless expressly supported by Vermont law.

Attachments

- SFA – Standard Contract for Services (template)
- Attachment C – Standard State Provisions for Contracts and Grants, Revised December 15, 2017
- Attachment D – Other Contract Provisions
- Attachment E - SECTION 103 – TAXES AND INSURANCE
- Attachment F - Select Project Drawings and GEI Report

SFA - STANDARD CONTRACT FOR SERVICES

1. **Parties:** This is a contract for services between the State of Vermont, Department of Environmental Conservation (hereinafter called “State”), and _____ with principal place of business at _____ (hereinafter called “Contractor). Contractor’s form of business organization is _____. It is the Contractor’s responsibility to contact the Vermont Department of Taxes to determine if, by law, the Contractor is required to have a Vermont Department of Taxes Business Account Number.
2. **Subject Matter:** The subject matter of this contract is personal services generally on the subject of _____. Detailed services to be provided by the contractor are described in Attachment A.
3. **Maximum Amount:** In consideration of the services to be performed by Contractor, the State agrees to pay Contractor, in accordance with the payment provisions specified in Attachment B, a sum not to exceed \$ _____. This contract cannot be used as match for the purpose of obtaining additional federal funds by the contractor without the written approval of the State.
4. **Subcontracting:** Contractor shall not assign labor duties to a subcontractor without the prior written approval of the State. Written approval is obtained by completing the Request for Approval to Subcontract form.
5. **Ownership and Disposition of Equipment:** Any equipment purchased or furnished to the Contractor by the State under this Agreement is provided on a loan basis only and remains the property of the State. Contractor must submit a written request to retain the equipment at the end of agreement term for the same use and intended purpose as outlined in this agreement. The written request should include: description of equipment, date of purchase, original cost and estimated current market value.
6. **Contract Term:** The period of contractor’s performance shall on _____ and end on _____. This contract may be renewed for up to 2 additional one year periods upon written agreement by the State and the Contractor.
7. **Source of Funds:** State funds
8. **Amendment:** No changes, modifications, or amendments in the terms and conditions of this Grant Agreement shall be effective unless reduced to writing, numbered, and signed by the duly authorized representative of the State and Grantee. No amendment will be considered without a detailed justification to support the amendment request. Failure to provide an adequate justification may result in the denial of the request. Any request for an amendment to this agreement must be made in writing at least 30 days prior to the end date of this agreement or the request may be denied.
9. **Cancellation:** This contract may be canceled by either party by giving written notice at least _____ days in advance.
10. **Fiscal Year:** The contractor’s fiscal year starts _____ and ends _____.
11. **Work product ownership:** Upon full payment by the State, all products of the Contractor’s work, including outlines, reports, charts, sketches, drawings, art work, plans, photographs, specifications, estimates, computer programs, or similar documents, become the sole property of the State of Vermont and may not be copyrighted or resold by Contractor.
12. **Attachments** This contract consists of the following attachments which are incorporated herein:

Attachment A - Specifications of Work to be Performed
Attachment B - Payment Provisions
Attachment C - Customary State Contract Provisions
Request for Approval to Subcontract

13. Order of Precedence: Any ambiguity, conflict or inconsistency between the documents comprising this contract shall be resolved according to the following order of precedence:
- a. Standard Contract
 - b. Attachment C (Standard Contract Provisions for Contracts and Grants)
 - c. Attachment A
 - d. Attachment B

**ATTACHMENT C: STANDARD STATE PROVISIONS
FOR CONTRACTS AND GRANTS
REVISED DECEMBER 15, 2017**

1. Definitions: For purposes of this Attachment, “Party” shall mean the Contractor, Grantee or Subrecipient, with whom the State of Vermont is executing this Agreement and consistent with the form of the Agreement. “Agreement” shall mean the specific contract or grant to which this form is attached.

2. Entire Agreement: This Agreement, whether in the form of a contract, State-funded grant, or Federally-funded grant, represents the entire agreement between the parties on the subject matter. All prior agreements, representations, statements, negotiations, and understandings shall have no effect.

3. Governing Law, Jurisdiction and Venue; No Waiver of Jury Trial: This Agreement will be governed by the laws of the State of Vermont. Any action or proceeding brought by either the State or the Party in connection with this Agreement shall be brought and enforced in the Superior Court of the State of Vermont, Civil Division, Washington Unit. The Party irrevocably submits to the jurisdiction of this court for any action or proceeding regarding this Agreement. The Party agrees that it must first exhaust any applicable administrative remedies with respect to any cause of action that it may have against the State with regard to its performance under this Agreement. Party agrees that the State shall not be required to submit to binding arbitration or waive its right to a jury trial.

4. Sovereign Immunity: The State reserves all immunities, defenses, rights or actions arising out of the State’s sovereign status or under the Eleventh Amendment to the United States Constitution. No waiver of the State’s immunities, defenses, rights or actions shall be implied or otherwise deemed to exist by reason of the State’s entry into this Agreement.

5. No Employee Benefits For Party: The Party understands that the State will not provide any individual retirement benefits, group life insurance, group health and dental insurance, vacation or sick leave, workers compensation or other benefits or services available to State employees, nor will the State withhold any state or Federal taxes except as required under applicable tax laws, which shall be determined in advance of execution of the Agreement. The Party understands that all tax returns required by the Internal Revenue Code and the State of Vermont, including but not limited to income, withholding, sales and use, and rooms and meals, must be filed by the Party, and information as to Agreement income will be provided by the State of Vermont to the Internal Revenue Service and the Vermont Department of Taxes.

6. Independence: The Party will act in an independent capacity and not as officers or employees of the State.

7. Defense and Indemnity: The Party shall defend the State and its officers and employees against all third party claims or suits arising in whole or in part from any act or omission of the Party or of any agent of the Party in connection with the performance of this Agreement. The State shall notify the Party in the event of any such claim or suit, and the Party shall immediately retain counsel and otherwise provide a complete defense against the entire claim or suit. The State retains the right to participate at its own expense in the defense of any claim. The State shall have the right to approve all proposed settlements of such claims or suits.

After a final judgment or settlement, the Party may request recoupment of specific defense costs and may file suit in Washington Superior Court requesting recoupment. The Party shall be entitled to recoup costs only

upon a showing that such costs were entirely unrelated to the defense of any claim arising from an act or omission of the Party in connection with the performance of this Agreement.

The Party shall indemnify the State and its officers and employees if the State, its officers or employees become legally obligated to pay any damages or losses arising from any act or omission of the Party or an agent of the Party in connection with the performance of this Agreement.

Notwithstanding any contrary language anywhere, in no event shall the terms of this Agreement or any document furnished by the Party in connection with its performance under this Agreement obligate the State to (1) defend or indemnify the Party or any third party, or (2) otherwise be liable for the expenses or reimbursement, including attorneys' fees, collection costs or other costs of the Party or any third party.

8. Insurance: Before commencing work on this Agreement the Party must provide certificates of insurance to show that the following minimum coverages are in effect. It is the responsibility of the Party to maintain current certificates of insurance on file with the State through the term of this Agreement. No warranty is made that the coverages and limits listed herein are adequate to cover and protect the interests of the Party for the Party's operations. These are solely minimums that have been established to protect the interests of the State.

Workers Compensation: With respect to all operations performed, the Party shall carry workers' compensation insurance in accordance with the laws of the State of Vermont. Vermont will accept an out-of-state employer's workers' compensation coverage while operating in Vermont provided that the insurance carrier is licensed to write insurance in Vermont and an amendatory endorsement is added to the policy adding Vermont for coverage purposes. Otherwise, the party shall secure a Vermont workers' compensation policy, if necessary to comply with Vermont law.

General Liability and Property Damage: With respect to all operations performed under this Agreement, the Party shall carry general liability insurance having all major divisions of coverage including, but not limited to:

- Premises - Operations
- Products and Completed Operations
- Personal Injury Liability
- Contractual Liability

The policy shall be on an occurrence form and limits shall not be less than:

- \$1,000,000 Each Occurrence
- \$2,000,000 General Aggregate
- \$1,000,000 Products/Completed Operations Aggregate
- \$1,000,000 Personal & Advertising Injury

Automotive Liability: The Party shall carry automotive liability insurance covering all motor vehicles, including hired and non-owned coverage, used in connection with the Agreement. Limits of coverage shall not be less than \$500,000 combined single limit. If performance of this Agreement involves construction, or the transport of persons or hazardous materials, limits of coverage shall not be less than \$1,000,000 combined single limit.

Additional Insured. The General Liability and Property Damage coverages required for performance of this Agreement shall include the State of Vermont and its agencies, departments, officers and employees as Additional Insureds. If performance of this Agreement involves construction, or the transport of persons or hazardous materials, then the required Automotive Liability coverage shall include the State of Vermont and its agencies, departments, officers and employees as Additional Insureds. Coverage shall be primary and non-contributory with any other insurance and self-insurance.

Notice of Cancellation or Change. There shall be no cancellation, change, potential exhaustion of aggregate limits or non-renewal of insurance coverage(s) without thirty (30) days written prior written notice to the State.

9. Reliance by the State on Representations: All payments by the State under this Agreement will be made in reliance upon the accuracy of all representations made by the Party in accordance with this Agreement, including but not limited to bills, invoices, progress reports and other proofs of work.

10. False Claims Act: The Party acknowledges that it is subject to the Vermont False Claims Act as set forth in 32 V.S.A. § 630 *et seq.* If the Party violates the Vermont False Claims Act it shall be liable to the State for civil penalties, treble damages and the costs of the investigation and prosecution of such violation, including attorney's fees, except as the same may be reduced by a court of competent jurisdiction. The Party's liability to the State under the False Claims Act shall not be limited notwithstanding any agreement of the State to otherwise limit Party's liability.

11. Whistleblower Protections: The Party shall not discriminate or retaliate against one of its employees or agents for disclosing information concerning a violation of law, fraud, waste, abuse of authority or acts threatening health or safety, including but not limited to allegations concerning the False Claims Act. Further, the Party shall not require such employees or agents to forego monetary awards as a result of such disclosures, nor should they be required to report misconduct to the Party or its agents prior to reporting to any governmental entity and/or the public.

12. Location of State Data: No State data received, obtained, or generated by the Party in connection with performance under this Agreement shall be processed, transmitted, stored, or transferred by any means outside the continental United States, except with the express written permission of the State.

13. Records Available for Audit: The Party shall maintain all records pertaining to performance under this agreement. "Records" means any written or recorded information, regardless of physical form or characteristics, which is produced or acquired by the Party in the performance of this agreement. Records produced or acquired in a machine readable electronic format shall be maintained in that format. The records described shall be made available at reasonable times during the period of the Agreement and for three years thereafter or for any period required by law for inspection by any authorized representatives of the State or Federal Government. If any litigation, claim, or audit is started before the expiration of the three-year period, the records shall be retained until all litigation, claims or audit findings involving the records have been resolved.

14. Fair Employment Practices and Americans with Disabilities Act: Party agrees to comply with the requirement of 21 V.S.A. Chapter 5, Subchapter 6, relating to fair employment practices, to the full extent applicable. Party shall also ensure, to the full extent required by the Americans with Disabilities Act of 1990, as amended, that qualified individuals with disabilities receive equitable access to the services, programs, and activities provided by the Party under this Agreement.

15. Set Off: The State may set off any sums which the Party owes the State against any sums due the Party under this Agreement; provided, however, that any set off of amounts due the State of Vermont as taxes shall be in accordance with the procedures more specifically provided hereinafter.

16. Taxes Due to the State:

- A. Party understands and acknowledges responsibility, if applicable, for compliance with State tax laws, including income tax withholding for employees performing services within the State, payment of

use tax on property used within the State, corporate and/or personal income tax on income earned within the State.

- B.** Party certifies under the pains and penalties of perjury that, as of the date this Agreement is signed, the Party is in good standing with respect to, or in full compliance with, a plan to pay any and all taxes due the State of Vermont.
- C.** Party understands that final payment under this Agreement may be withheld if the Commissioner of Taxes determines that the Party is not in good standing with respect to or in full compliance with a plan to pay any and all taxes due to the State of Vermont.
- D.** Party also understands the State may set off taxes (and related penalties, interest and fees) due to the State of Vermont, but only if the Party has failed to make an appeal within the time allowed by law, or an appeal has been taken and finally determined and the Party has no further legal recourse to contest the amounts due.

17. Taxation of Purchases: All State purchases must be invoiced tax free. An exemption certificate will be furnished upon request with respect to otherwise taxable items.

18. Child Support: (Only applicable if the Party is a natural person, not a corporation or partnership.) Party states that, as of the date this Agreement is signed, he/she:

- A.** is not under any obligation to pay child support; or
- B.** is under such an obligation and is in good standing with respect to that obligation; or
- C.** has agreed to a payment plan with the Vermont Office of Child Support Services and is in full compliance with that plan.

Party makes this statement with regard to support owed to any and all children residing in Vermont. In addition, if the Party is a resident of Vermont, Party makes this statement with regard to support owed to any and all children residing in any other state or territory of the United States.

19. Sub-Agreements: Party shall not assign, subcontract or subgrant the performance of this Agreement or any portion thereof to any other Party without the prior written approval of the State. Party shall be responsible and liable to the State for all acts or omissions of subcontractors and any other person performing work under this Agreement pursuant to an agreement with Party or any subcontractor.

In the case this Agreement is a contract with a total cost in excess of \$250,000, the Party shall provide to the State a list of all proposed subcontractors and subcontractors' subcontractors, together with the identity of those subcontractors' workers compensation insurance providers, and additional required or requested information, as applicable, in accordance with Section 32 of The Vermont Recovery and Reinvestment Act of 2009 (Act No. 54).

Party shall include the following provisions of this Attachment C in all subcontracts for work performed solely for the State of Vermont and subcontracts for work performed in the State of Vermont: Section 10 ("False Claims Act"); Section 11 ("Whistleblower Protections"); Section 12 ("Location of State Data"); Section 14 ("Fair Employment Practices and Americans with Disabilities Act"); Section 16 ("Taxes Due the State"); Section 18 ("Child Support"); Section 20 ("No Gifts or Gratuities"); Section 22 ("Certification Regarding Debarment"); Section 30 ("State Facilities"); and Section 32.A ("Certification Regarding Use of State Funds").

20. No Gifts or Gratuities: Party shall not give title or possession of anything of substantial value (including property, currency, travel and/or education programs) to any officer or employee of the State during the term of this Agreement.

21. Copies: Party shall use reasonable best efforts to ensure that all written reports prepared under this Agreement are printed using both sides of the paper.

22. Certification Regarding Debarment: Party certifies under pains and penalties of perjury that, as of the date that this Agreement is signed, neither Party nor Party's principals (officers, directors, owners, or partners) are presently debarred, suspended, proposed for debarment, declared ineligible or excluded from participation in Federal programs, or programs supported in whole or in part by Federal funds.

Party further certifies under pains and penalties of perjury that, as of the date that this Agreement is signed, Party is not presently debarred, suspended, nor named on the State's debarment list at: <http://bgs.vermont.gov/purchasing/debarment>

23. Conflict of Interest: Party shall fully disclose, in writing, any conflicts of interest or potential conflicts of interest.

24. Confidentiality: Party acknowledges and agrees that this Agreement and any and all information obtained by the State from the Party in connection with this Agreement are subject to the State of Vermont Access to Public Records Act, 1 V.S.A. § 315 et seq.

25. Force Majeure: Neither the State nor the Party shall be liable to the other for any failure or delay of performance of any obligations under this Agreement to the extent such failure or delay shall have been wholly or principally caused by acts or events beyond its reasonable control rendering performance illegal or impossible (excluding strikes or lock-outs) ("Force Majeure"). Where Force Majeure is asserted, the nonperforming party must prove that it made all reasonable efforts to remove, eliminate or minimize such cause of delay or damages, diligently pursued performance of its obligations under this Agreement, substantially fulfilled all non-excused obligations, and timely notified the other party of the likelihood or actual occurrence of an event described in this paragraph.

26. Marketing: Party shall not refer to the State in any publicity materials, information pamphlets, press releases, research reports, advertising, sales promotions, trade shows, or marketing materials or similar communications to third parties except with the prior written consent of the State.

27. Termination:

A. Non-Appropriation: If this Agreement extends into more than one fiscal year of the State (July 1 to June 30), and if appropriations are insufficient to support this Agreement, the State may cancel at the end of the fiscal year, or otherwise upon the expiration of existing appropriation authority. In the case that this Agreement is a Grant that is funded in whole or in part by Federal funds, and in the event Federal funds become unavailable or reduced, the State may suspend or cancel this Grant immediately, and the State shall have no obligation to pay Subrecipient from State revenues.

B. Termination for Cause: Either party may terminate this Agreement if a party materially breaches its obligations under this Agreement, and such breach is not cured within thirty (30) days after delivery of the non-breaching party's notice or such longer time as the non-breaching party may specify in the notice.

C. Termination Assistance: Upon nearing the end of the final term or termination of this Agreement, without respect to cause, the Party shall take all reasonable and prudent measures to facilitate any transition required by the State. All State property, tangible and intangible, shall be returned to the State upon demand at no additional cost to the State in a format acceptable to the State.

28. Continuity of Performance: In the event of a dispute between the Party and the State, each party will continue to perform its obligations under this Agreement during the resolution of the dispute until this Agreement is terminated in accordance with its terms.

29. No Implied Waiver of Remedies: Either party's delay or failure to exercise any right, power or remedy under this Agreement shall not impair any such right, power or remedy, or be construed as a waiver of any such right, power or remedy. All waivers must be in writing.

30. State Facilities: If the State makes space available to the Party in any State facility during the term of this Agreement for purposes of the Party's performance under this Agreement, the Party shall only use the space in accordance with all policies and procedures governing access to and use of State facilities which shall be made available upon request. State facilities will be made available to Party on an "AS IS, WHERE IS" basis, with no warranties whatsoever.

31. Requirements Pertaining Only to Federal Grants and Subrecipient Agreements: If this Agreement is a grant that is funded in whole or in part by Federal funds:

A. Requirement to Have a Single Audit: The Subrecipient will complete the Subrecipient Annual Report annually within 45 days after its fiscal year end, informing the State of Vermont whether or not a Single Audit is required for the prior fiscal year. If a Single Audit is required, the Subrecipient will submit a copy of the audit report to the granting Party within 9 months. If a single audit is not required, only the Subrecipient Annual Report is required.

For fiscal years ending before December 25, 2015, a Single Audit is required if the subrecipient expends \$500,000 or more in Federal assistance during its fiscal year and must be conducted in accordance with OMB Circular A-133. For fiscal years ending on or after December 25, 2015, a Single Audit is required if the subrecipient expends \$750,000 or more in Federal assistance during its fiscal year and must be conducted in accordance with 2 CFR Chapter I, Chapter II, Part 200, Subpart F. The Subrecipient Annual Report is required to be submitted within 45 days, whether or not a Single Audit is required.

B. Internal Controls: In accordance with 2 CFR Part II, §200.303, the Party must establish and maintain effective internal control over the Federal award to provide reasonable assurance that the Party is managing the Federal award in compliance with Federal statutes, regulations, and the terms and conditions of the award. These internal controls should be in compliance with guidance in "Standards for Internal Control in the Federal Government" issued by the Comptroller General of the United States and the "Internal Control Integrated Framework", issued by the Committee of Sponsoring Organizations of the Treadway Commission (COSO).

C. Mandatory Disclosures: In accordance with 2 CFR Part II, §200.113, Party must disclose, in a timely manner, in writing to the State, all violations of Federal criminal law involving fraud, bribery, or gratuity violations potentially affecting the Federal award. Failure to make required disclosures may result in the imposition of sanctions which may include disallowance of costs incurred, withholding of payments, termination of the Agreement, suspension/debarment, etc.

32. Requirements Pertaining Only to State-Funded Grants:

A. Certification Regarding Use of State Funds: If Party is an employer and this Agreement is a State-funded grant in excess of \$1,001, Party certifies that none of these State funds will be used to interfere with or restrain the exercise of Party's employee's rights with respect to unionization.

B. Good Standing Certification (Act 154 of 2016): If this Agreement is a State-funded grant, Party hereby represents: (i) that it has signed and provided to the State the form prescribed by the Secretary

of Administration for purposes of certifying that it is in good standing (as provided in Section 13(a)(2) of Act 154) with the Agency of Natural Resources and the Agency of Agriculture, Food and Markets, or otherwise explaining the circumstances surrounding the inability to so certify, and (ii) that it will comply with the requirements stated therein.

(End of Standard Provisions)

**ATTACHMENT D:
OTHER CONTRACT PROVISIONS**

- 1. Professional liability insurance:** Before commencing work on this contract and throughout the term of this contract, contractor shall procure and maintain professional liability insurance for any and all services performed under this contract, with minimum coverage of \$ aggregate/\$ per occurrence.

ATTACHMENT E
SECTION 103 – TAXES AND INSURANCE

103

SECTION 103 – TAXES AND INSURANCE

103.01 CONSTRUCTION EQUIPMENT TAX. The Contractor shall pay all construction equipment tax assessed under [32 V.S.A. § 3603](#) for machinery and other personal estate.

103.02 WITHHOLDING OF TAXES. The Contractor shall comply with the requirements of [32 V.S.A., Chapter 151, Subchapter 4](#) relating to the withholding of taxes from employees, and all taxes withheld pursuant to [32 V.S.A., Chapter 151, Subchapter 4](#) shall be reported and paid to the Commissioner of the Vermont Department of Taxes.

103.03 STATE SALES TAX. Contractors are not required to pay the Vermont sales tax for materials incorporated into a state funded project completed on property owned or held in trust for the benefit of any governmental body or agency and used exclusively for public purposes, or owned or held in trust for the benefit of any organization holding a valid exemption certificate and used exclusively in the conduct of its business or purpose, or for materials incorporated in a rail line in connection with the construction, maintenance, repair, improvement, or reconstruction of the rail line (see [32 V.S.A. § 9743\(4\)](#), [32 V.S.A. § 9741\(30\)](#), [32 V.S.A. § 9741\(44\)](#), the [Vermont Sales and Use Tax Regulations, Reg. § 1.9741\(34\)-5](#), and the [Vermont Sales and Use Tax Regulations, Reg. § 1.9743](#)).

Therefore, no sales tax shall be included in the cost of these materials.

Contractors are responsible for maintaining records sufficient to justify eligibility for sales tax exemption. Forms for maintaining these records are available from the Vermont Department of Taxes.

103.04 INSURANCE REQUIREMENTS. Insurance obtained by the Contractor to cover the below-listed requirements shall be procured from an insurance company with an A.M Best Rating of A- or better and which is registered and licensed to do business in Vermont. Before the Contract is executed, the Contractor shall file with the Agency a certificate of insurance, executed by an insurance company or its licensed agents, on a form satisfactory to the Agency, stating that with respect to the Contract awarded, the Contractor carries insurance in accordance with the following requirements. Renewal certificates for keeping the required insurance in force for the duration of the Contract shall also be filed as specified above.

No warranty is made that the coverages and limits listed herein are adequate to cover and protect the interests of the Contractor and any subcontractor for the Contractor's and subcontractor's operations. These are solely minimums that have been established to protect the interests of the state.

(a) Workers' Compensation Insurance. With respect to all operations performed the Contractor shall

carry workers' compensation insurance in accordance with [21 V.S.A., Chapter 9](#). The Contractor shall also ensure that all subcontractors carry workers' compensation insurance in accordance with [21 V.S.A., Chapter 9](#) for all work performed by them.

1-25

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(b) Commercial General Liability Insurance. With respect to all operations performed by the Contractor and subcontractors, the Contractor shall carry commercial general liability insurance on an occurrence form providing all major divisions of coverage, including but not limited to:

- (1) Premises – operations
- (2) Independent contractors
- (3) Products and completed operations continuously in effect for three years past the acceptance date
- (4) Personal injury liability
- (5) Contractual liability applying to the Contractor's obligations under [Subsection 107.15](#), broad form property damage
- (6) Dam Downstream liability
- (7) Limits of coverage shall be not less than:

\$10,000,000 Each occurrence.

\$10,000,000 General aggregate with a per project aggregate. In cases of Contracts with multiple projects, the per project aggregate applies to the entire Contract.

\$10,000,000 Products/completed operations.

- (c) Automobile Liability Insurance. The Contractor shall carry automobile liability insurance covering all motor vehicles including owned, hired, borrowed, and non-owned vehicles, used in connection with the project.
- (1) Combined single limit for bodily injury and property damage shall not be less than \$2,000,000.
 - (2) If performance of the Contract involves the transport of hazardous materials, the policy shall include the *MCS-90* endorsement.
- (d) Railroad Protective Liability Insurance. When the Contract involves work on, over, or under the right-of-way of any railroad, the Contractor shall carry, with respect to operations performed by the Contractor or by the Contractor's subcontractors, railroad protective liability insurance in a form and amount as required by the Operating Railroad and as specified in *23 C.F.R. § 646.107*. If not available from insurance companies registered and licensed to do business in Vermont, this insurance may be procured from Eligible Surplus Lines companies approved by the Vermont Department of Financial Regulation.

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Upon request by the Agency the Contractor shall provide a copy of the railroad protective liability policy within 24 hours.

The Contractor shall defend, indemnify, and save harmless the Operating Railroad and all of its officers, employees, and agents against any claim or liability arising from or based on any delay to the Contractor as a result of railroad construction or maintenance, whether by the Operating Railroad, its employees, or agents.

- (e) Contractor Pollution Legal Liability Insurance. With respect to all operations performed by the Contractor and subcontractors, the Contractor and, if applicable, its subcontractors, shall maintain a policy covering third-party injury and property damage, contractual liability, and claims arising from owned and non-owned disposal sites utilized. Coverage will also include clean-up costs as a result of pollution conditions arising from the Contractor's operations and completed operations.

Limits of coverage shall not be less than \$2,000,000 per occurrence or claim and \$2,000,000 in the aggregate. The Contractor is responsible for reporting all pollution incidences in accordance with federal and state laws, regulations, and applicable insurance policy reporting deadlines.

- (f) General Insurance Conditions. All applicable insurance coverages shall be maintained until the acceptance date. Completed operations coverage under Subsection 103.04(b) and all

coverage under [Subsection 103.04\(e\)](#) shall be maintained continuously in effect for three years past the acceptance date.

Under [Subsection 103.04\(d\)](#), the liability protective policy shall remain in force until all work required to be performed on railroad property is completed to the satisfaction of the Operating Railroad and of the authorized representative of the Agency.

The contractual liability insurance requirements detailed in the Contract, including [Subsection 107.15](#), are to indemnify, defend, and hold harmless the municipalities, the state, the Agency, and Operating Railroads, as applicable, and their officers, agents, representatives, and employees, with respect to any and all claims, causes of actions, losses, expenses, or damages that arise out of, relate to, or are in any manner connected with the Contractor's work or the supervision of the Contractor's work on the project.

Each policy, except the workers' compensation policy, shall name the municipalities, the state, the Agency, and Operating Railroads, as additional insureds for actions, losses, expenses, or damages that arise out of, relate to, or are in any manner connected with the Contractor's work or the supervision of the Contractor's work on the project. The additional insured endorsements under [Subsection 103.04\(b\)](#) and [Subsection 103.04\(e\)](#) shall use Insurance Services Office form [CG 20 10](#) and form [CG 20 37](#) or its equivalent and will be on a primary, noncontributory basis.

1-27

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All policies shall include a waiver of subrogation in favor of the state of Vermont.

Umbrella or excess liability policies may be used in conjunction with primary automobile liability and commercial general liability policies only to comply with any of the limit requirements specified above.

Claims-made coverage forms are not acceptable without the prior written consent of the Agency.

The Contractor or the insurance company shall investigate and shall either adjust or defend all claims against the insured for damages covered, even if groundless.

Each policy furnished shall contain a rider or non-cancellation clause reading in substance as follows:

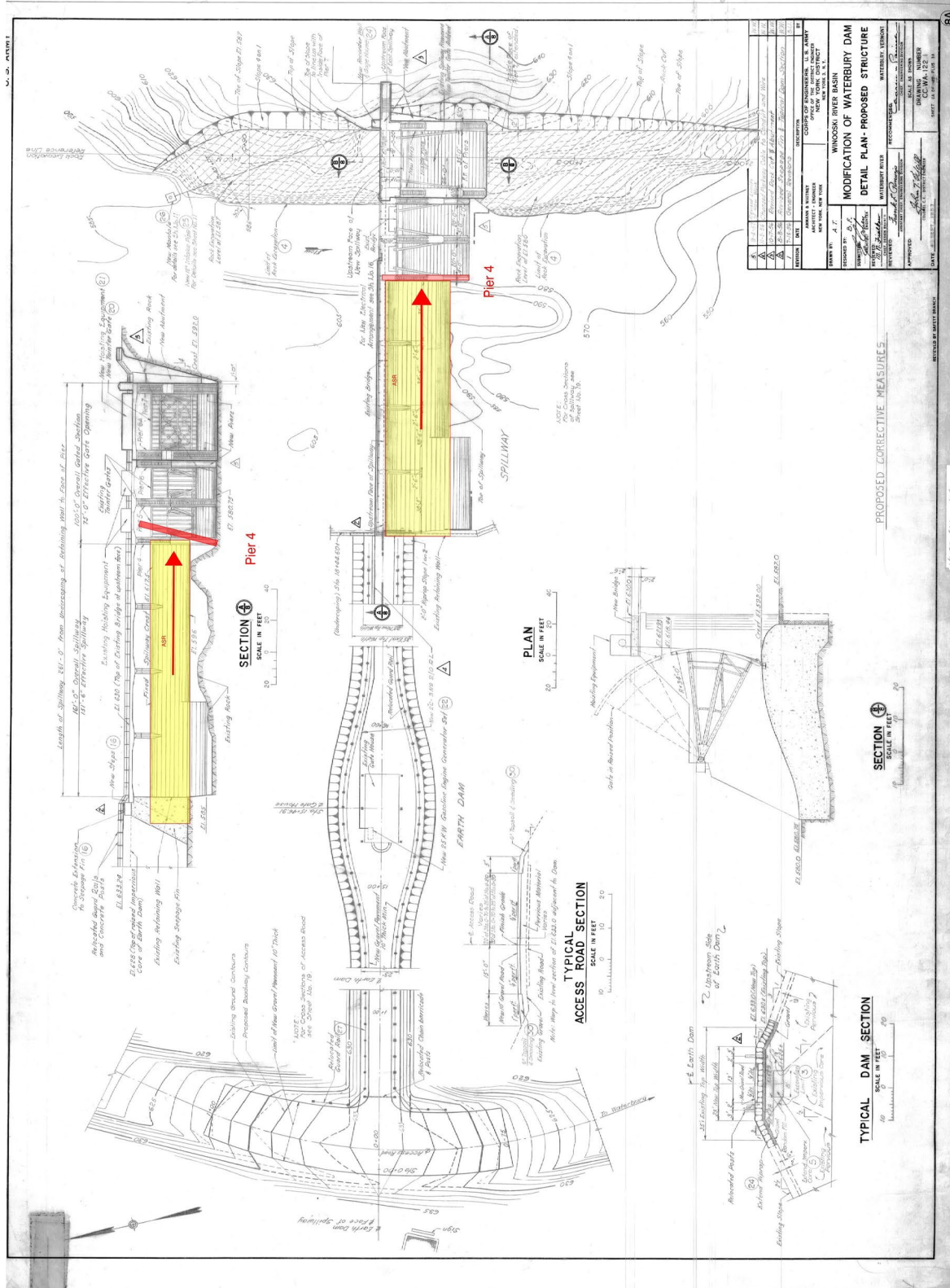
There shall be no cancellation or non-renewal of insurance coverages without 30 calendar days' written prior notice to the state, except for non-payment of premium, which will require 15 calendar days' written prior notice to the state.

There shall be no directed compensation allowed the Contractor on account of any premium or other charge necessary to take out and keep in effect such insurance or bond. The cost of any premium or other charge shall be considered included in the general cost of the work.

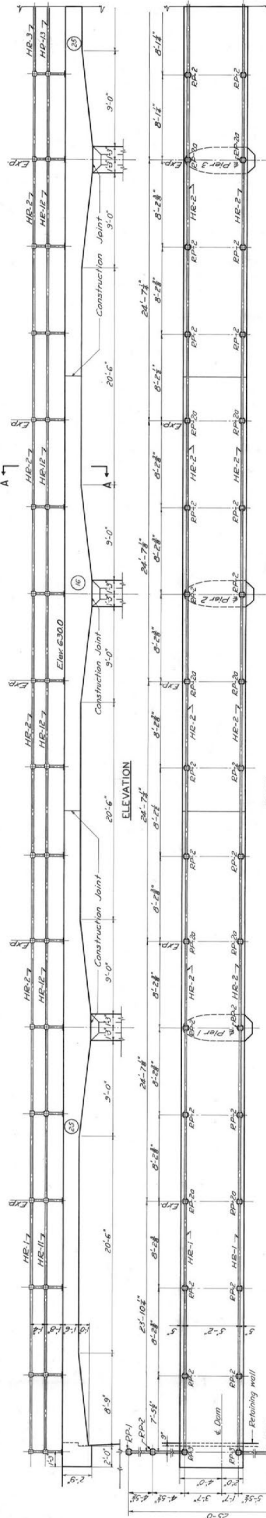
- (g) Contract Insurance Requirements. In cases that a discrepancy between the stated insurance requirements of *Bulletin 3.5 Attachment C: Standard State Provisions for Contracts and Grants* and this section occurs, the higher limit shall govern.

1-27

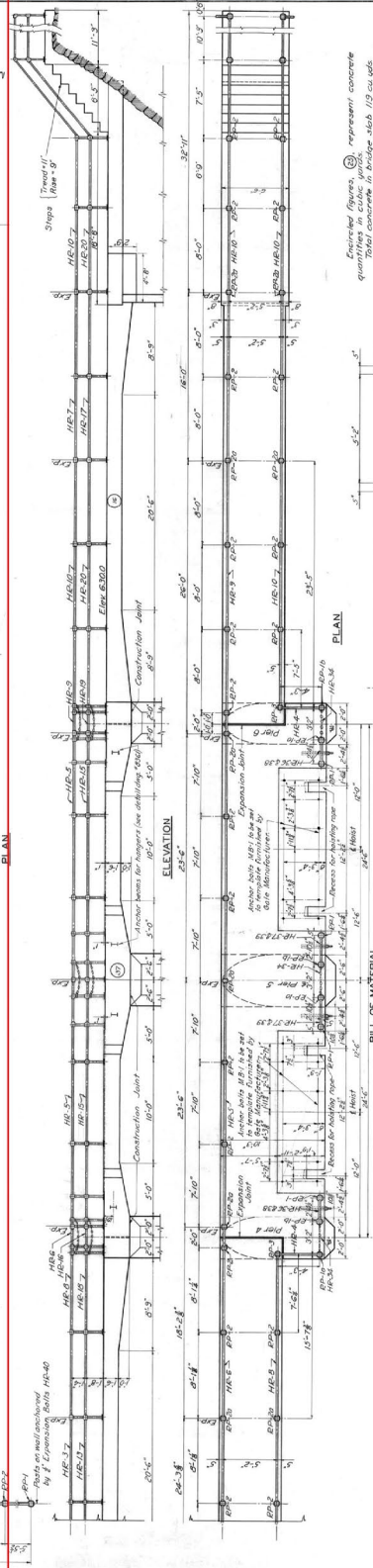
Attachment F: Technical Specifications and Memo



DESIGNED BY: A.J.T.	WINOCKS RIVER BASIN	CORPS OF ENGINEERS, U.S. ARMY
DRAWN BY: A.J.T.	NEW YORK DISTRICT	NEW YORK OFFICE
CHECKED BY: J.P.H.	MODIFICATION OF WATERBURY DAM	RECOMMENDED BY: WATERBURY DAM
APPROVED BY: J.P.H.	DETAIL PLAN - PROPOSED STRUCTURE	RECOMMENDED BY: WATERBURY DAM
DATE: 12/15/11		SCALE: AS SHOWN
		DATE: 12/15/11



ELEVATION



PLAN

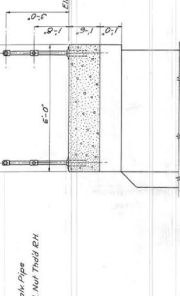
Reinforced concrete quantities in cubic feet. Total concrete in bridge slab 119 cu yds. concrete shall be placed in adjacent work.

NOTE: ALL WORK SHOWN ON THIS DRAWING SHOULD BE DONE IN ACCORDANCE WITH SPECIFICATIONS FOR BRIDGE AND STRUCTURES, U. S. ARMY, APRIL 16, 1937, OR LATER. REVISIONS ARE IN PENCIL AND REFER TO THE PLAN OF REVISIONS LIST AT BACK OF THIS DRAWING.

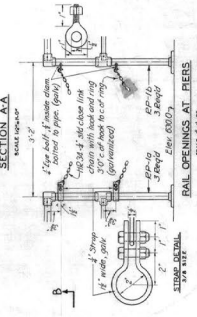
NO.	DATE	REVISIONS
1	10/21/37	Added rail on retaining wall
2	1/20/38	Added location anchor bolts

WINOOSKI RIVER, VT.
FLOOD CONTROL PROJECT
WATERBURY DAM
CONCRETING SCHEME OF BRIDGE AND HAND RAILING

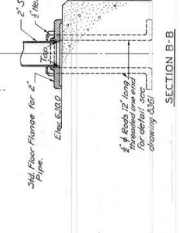
UNITED STATES ENGINEERING OFFICE NEW YORK DISTRICT NEW YORK, N. Y.
 Scale 1/4" = 1' - 0" EXCEPT AS NOTED
 H. C. ...
 R. ...
 ...



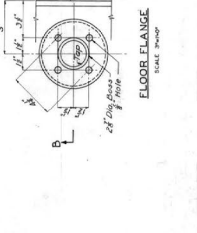
SECTION A-A
SCALE 3/4" = 1'-0"



RAIL OPENINGS AT PIERS
SCALE 1/2" = 1'-0"

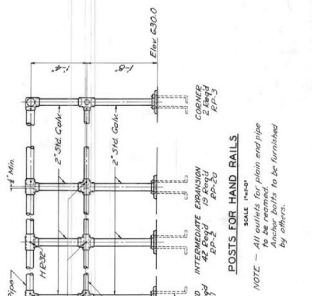


SECTION B-B
SCALE 1/2" = 1'-0"

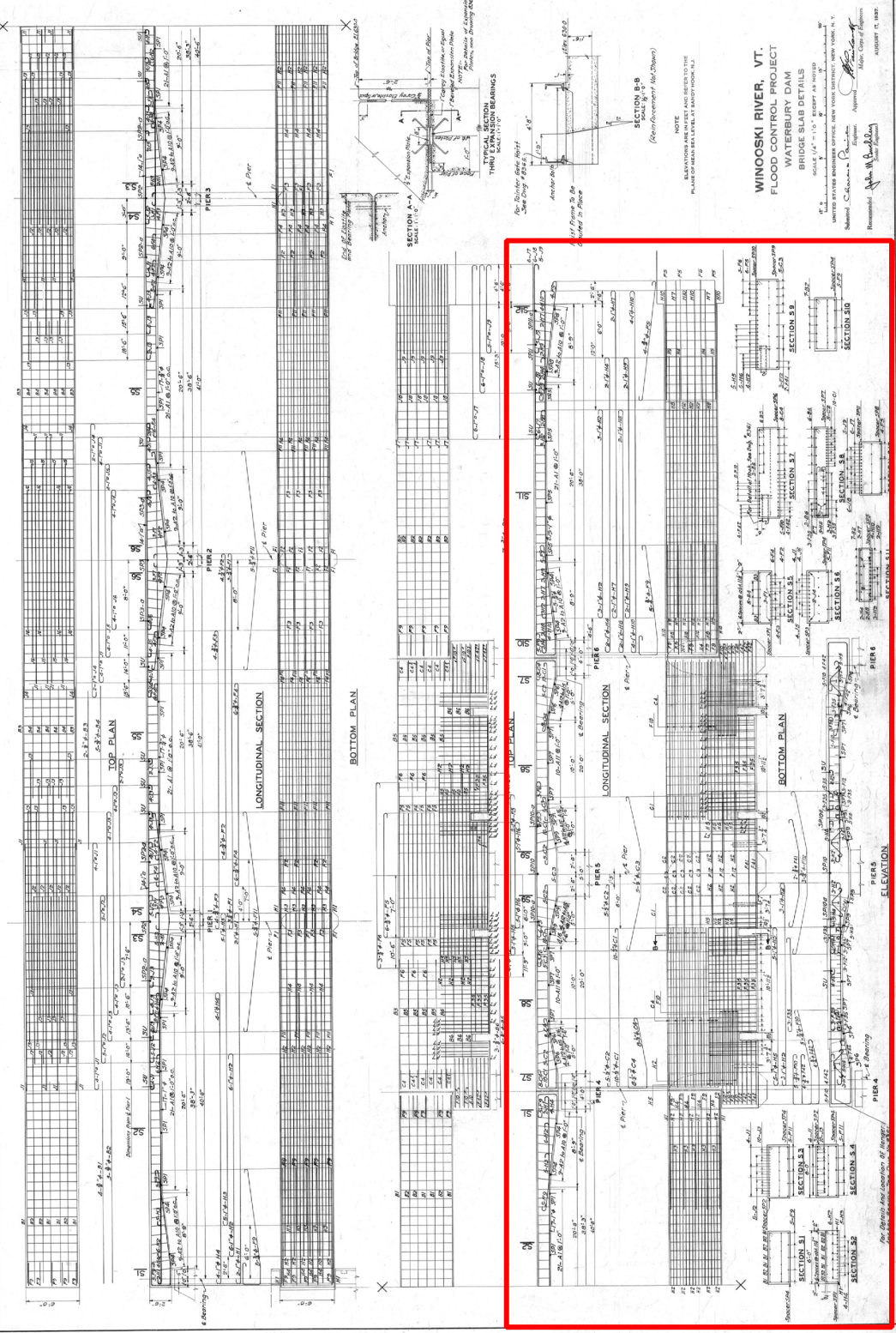


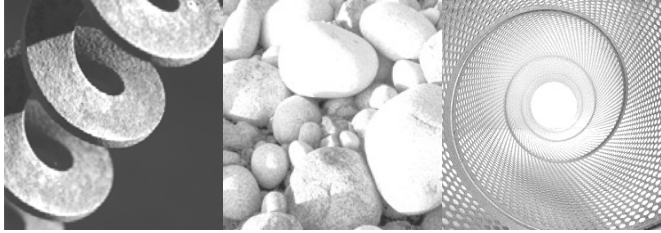
FLOOR FLANGE
SCALE 1/2" = 1'-0"

NO.	DESCRIPTION	REMARKS
1	1/2" x 1/2" x 1/2" Galv. Iron Floor Flange Ends	
2	1/2" x 1/2" x 1/2" Galv. Iron Floor Flange Ends	
3	1/2" x 1/2" x 1/2" Galv. Iron Floor Flange Ends	
4	1/2" x 1/2" x 1/2" Galv. Iron Floor Flange Ends	
5	1/2" x 1/2" x 1/2" Galv. Iron Floor Flange Ends	
6	1/2" x 1/2" x 1/2" Galv. Iron Floor Flange Ends	
7	1/2" x 1/2" x 1/2" Galv. Iron Floor Flange Ends	
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11	1/2" x 1/2" x 1/2" Galv. Iron Floor Flange Ends	
12	1/2" x 1/2" x 1/2" Galv. Iron Floor Flange Ends	
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14	1/2" x 1/2" x 1/2" Galv. Iron Floor Flange Ends	
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28	1/2" x 1/2" x 1/2" Galv. Iron Floor Flange Ends	
29	1/2" x 1/2" x 1/2" Galv. Iron Floor Flange Ends	
30	1/2" x 1/2" x 1/2" Galv. Iron Floor Flange Ends	



POSTS FOR HAND RAILS
NOTE: All details for main and pipe Anchor bolts to be furnished by others.





Consulting
Engineers and
Scientists

Final Report

Interim Measures to Reduce Downstream Flood and Improved Dam Safety

Waterbury Dam, Waterbury Vermont

Submitted to:

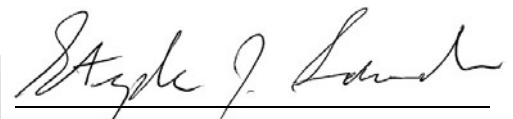
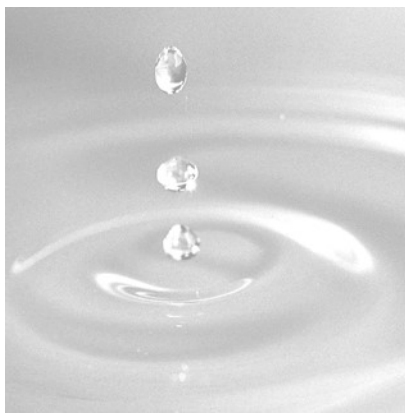
State of Vermont Department of Environmental Conservation

1 National Life Drive, Davis 3
Montpelier, VT 05620-3510

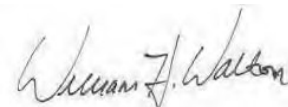
Submitted by:

GEI Consultants, Inc.
400 Unicorn Park Drive
Woburn, MA 01801
781-721-4000

May 31, 2023
Project 2301089



Stephen Sarandis, P.E.
Project Manager



William Walton, P.E. (VT), S.E.,
Senior Vice President

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Waterbury Dam, Waterbury Vermont	
May 31, 2023	
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Plates

1. Site Location Map
2. Spillway Monolith, Pier, and Gate Numbering Plan
3. Photograph of Tainter Gates

Appendices

- A. Structural Capacity Calculation of Existing Bridge
- B. March 2022 USACE Bridge Analysis
- C. Bridge Improvement Presentation

AMJ/SJS/MG/WHW:jam

B:\Working\VERMONT DEC\2301089 Waterbury Dam Interim Flood Operation Study 2023\08_Reports and Memos\Final Report\Interim Measures Final Report_2023-05-31.docx

Executive Summary

This report presents the results of our engineering analyses and our recommendations for interim repair measures to the hoistway bridge and lower left strut arm of Gate 2 at the Waterbury Dam in Waterbury, Vermont.

Background

Ongoing alkali-silica reaction (ASR) has caused lateral expansion of the non-gated spillway ogee weir causing Pier 4 to tilt and negatively impact the hoistway bridge that supports Gates 1 and 2. The two-span hoistway bridge is overstressed in flexure and has locked in compression stresses due to Pier 4 moving under the bridge deck by 2.5 inches. The overstressing has also caused the two 0.75-inch expansion joints to close tight. The computed Pier 4 left movement is 0.05 inches per year (50 mils/year).

In February 2023, VT DEC surveys identified that the left trunnion pin for Gate 2 is not perpendicular (square) with the pier and the gate arm casting. The measured skew is approximately 1-degree downward and upstream (e.g., tilted to 7:30 as a clock analogy, looking east). This skew has yielded a higher measured coefficient of friction (COF) in the left gate casting that rotates around the trunnion pin.

Engineering Analyses

Due to ASR expansion and distress on the gated and non-gated spillway sections and the skewed left trunnion pin on Pier 6, for Gate 2, our analyses indicate the hoistway bridge and lower left strut arm of Gate 2 will be overstressed if the gate is operated with the pool above El. 608.4 (NGVD 29). This is 2.4 ft below the required ponding pool elevation behind closed gates during a flood condition (El. 610.8 (NGVD 29)) as prescribed in the *2005 Revised Waterbury Dam and Reservoir Regulation Manual (RRM)*.

Recommendations

To avoid operational uncertainty and early flood flow releases at Gate 2, we recommend interim stabilization and strengthening work be done in 2023. This work includes:

1. Adding two steel beams over the Gate 1 and 2 hoistway bridge deck to make the steel beams and concrete slabs an integral/composite element.
2. Adding flange plates to the 14-foot-long lower left cord of Gate 2 where it connects to the trunnion hub casting at the left trunnion pin. Consider loosening the trunnion casting around left pin.

Final Report
Interim Measures to Reduce Downstream Flood and
Improved Dam Safety
Waterbury Dam, Waterbury Vermont
May 31, 2023

3. Epoxy grouting or sealing the open horizontal cracks in non-gated spillway monoliths M1 and M2 to reduce water infiltration during surcharge pools.
4. Measuring movements of the piers and bridge deck on a semi-annual basis using total station on established of pier displacement monitoring survey points (DMPs), and with electronic bi-axial tiltmeters installed on Pier 4.

Performing these interim remedial measures will enable the State of Vermont to continue to use the operating guidelines in the *2005 Waterbury Dam and Reservoir Regulation Manual*. This interim bridge and gate work should be done as soon as practical (before the winter of 2023/2024), as the spillway replacement work pertaining to the gates, piers, hoists, and bridge will likely not start until 2027.

1. Introduction

1.1 Purpose

This report presents the results of our engineering analyses and our recommendations for interim repair measures to the hoistway bridge and lower left strut arm of Gate 2 of the Waterbury Dam in Waterbury, Vermont.

1.2 Authorization

Mr. John Beling Commissioner of the State of Vermont Department of Environmental Conservation (VT DEC) authorized GEI Consultants, Inc. (GEI) work on this assignment by a signed Contract #45415 on March 22, 2023.

1.3 Scope of Work

Our scope of work included:

- Reviewed and evaluated provided historical project documentation, including reports and plan sets on reservoir regulation manual, standard operating procedures, basis of design documentation, load ratings, hydrologic and hydraulic (H&H) and structural analyses, gate testing, and recent VT DEC spillway surveys.
- Reviewed existing H&H model and operating rule curve and collaborated with the Dam Safety Program on observed operating conditions. Evaluated need to develop a new interim operating rule curve given the existing gate operating restrictions and dam safety risks.
- Developed a structural model of Tainter Gate 2 (and consequently identical Gate 1) in STAAD, a finite element computer program. Analyzed the Tainter gate member stresses under various operating load cases (different reservoir levels) and various coefficient of friction values for the trunnion pins (based on results of recently completed dry lift testing on all three instrumented gates by BDI Inc.).
- Performed independent structural calculations of the hoistway bridge capacity to compare to the US Army Corps of Engineers (USACE) May 2022 load rating calculation.
- Provided recommendations on interim remedial measures to structurally support the hoistway bridge deck and gate structural members and develop interim operating rules curves.

1.4 Project Description

Waterbury Dam and Reservoir are in the Town of Waterbury, Vermont on the Little River, a tributary of the Winooski River system. The dam is located approximately 2.5 miles above the Little River's confluence with the Winooski River (Plate 1).

The dam is used as a multipurpose facility for flood control, power, and recreation, and was designed and built between 1935 and 1938 by the U.S. Army Corps of Engineers (USACE). Currently, the dam is owned and operated by the State of Vermont and is primarily responsible for flood works. Green Mountain Power (GMP) Corporation operates the hydropower station and is responsible for maintaining normal water levels and bypass flows.

The dam includes an embankment dam, gate house, and gated outlet works, and a concrete spillway with an uncontrolled ogee weir and three Tainter gates.

The non-gated (uncontrolled) spillway monolith section consists of a mass concrete ogee weir on the downstream side and vertical walls on the upstream side. As shown in Plate 2, the non-gated spillway is bounded by the right training wall and Pier 4 (which serves as the right wall for Gate 1). The non-gated spillway consists of four piers that support the hoistway bridge. The non-gated spillway is identified by five monoliths which are designated by vertical construction joints. The monoliths are identified as monoliths M1 thru M5, numbered from left to right relative to looking downstream (Plate 2).

The three gated spillway bays are identified in this report as Gate 1 (right), Gate 2 (center) and Gate 3 (left), when looking downstream (Plate 2 and 3). All references to left and right radial gates, gate components, pier seal plates, etc. are made relative to looking downstream. The gated spillway section consists of five piers (4, 5, 6, 6a, and 7) numbered from right to left relative to looking downstream (Plate 2 and 3).

1.5 Background

The USACE retained GEI Consultants, Inc. (GEI) to perform a field and laboratory testing program to assess the extent of damage caused by alkali silica reaction (ASR) in the concrete spillway structures, and to provide recommendations for remediation and future investigations. As part of that work the following reports were prepared:

1. Concrete Non-Destructive Testing (NDT) Field Summary Report, Atlantic Testing Laboratories, Limited, November 3, 2022. Report summarizes the results of NDT testing, performed by Atlantic, prior to performing the concrete coring to reduce the potential of encountering reinforcing steel in the concrete cores.
2. Trunnion Friction Evaluation Report, Dry Lift Testing of Waterbury Dam, Gates 1, 2, & 3, BDI Inc., January 19th, 2023. Report provides the results of instrumentation

and testing program on Gates 1, 2, and 3 at Waterbury Dam. The goal of the tests was to record the gates' structural responses during a series of lift tests and use the data to evaluate the friction behavior of each trunnion pin.

3. Final Report of Explorations, Structural Concrete and Bedrock Coring at Waterbury Dam, GEI Consultants, Inc., February 17, 2023. This report presents the results of the structural and geotechnical explorations of the existing spillway at Waterbury Dam. GEI was the prime Architect/Engineer (A/E) contractor for the U.S. Army Corps of Engineers, New England District (USACE-NAE). GEI subcontracted the concrete and bedrock drilling work to Atlantic Testing Laboratories (ATL) of Canton, New York. Laboratory testing for concrete cores and bedrock testing was subcontracted to Advance Testing Company, Inc. (ATC) of Campbell Hall, New York and GeoTesting Express of Acton, Massachusetts, respectively.
4. Engineering Report, Assessment of ASR, Engineering Evaluation, and Recommendations, GEI Consultants, Inc., April 28, 2023. This report presents the engineering assessment of field and laboratory data collected as part of the structural and geotechnical explorations of the existing spillway at Waterbury Dam. This report addresses the extent of damage caused by alkali silica reaction (ASR) expansion in the concrete spillway structures and provides recommendations for remediation and future investigations.

Additionally, VT DEC (in coordination with GEI) performed a February 2023 total station survey of points set on Piers 4, 5 and 6, hoists and hoistway bridge deck to measure displacement (VT DEC, 2023). The previous survey of the pier and bridge deck displacement was performed in 2002 by URS Corporation (URS, 2002). VT DEC also performed detailed measurements of the forge steel gate arm trunnion casting to quantify whether the trunnion pins were square with 2-part forged steel trunnion casting.

As a result of the recent explorations, testing and studies above, ongoing alkali-silica reaction (ASR) has caused lateral expansion of the non-gated spillway ogee weir causing Pier 4 to tilt and negatively impact the hoistway bridge that supports Gates 1 and 2. The two-span hoistway bridge is overstressed in flexure and has locked in compression stresses due to Pier 4 moving under the hoistway bridge by 2.5 inches. The overstressing has also caused the two 0.75-inch expansion joints to close tight. The computed Pier 4 left movement is 0.05 inches per year (50 mils/year).

As a result of the work described above, we prepared the attached PowerPoint presentations showing closed expansion joint (EJ), distressed hoistway bridge supporting Gate 1 and 2 hoists and a summary of our structural and hydraulic analyses presented below (Appendix C).

1.6 Elevation and Horizontal Datums

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Historical “As Built” plans of Waterbury Dam appear to report elevations referenced to National Geodetic Vertical Datum of 1929 (NGVD 29). Elevations in this report are reported in feet using NGVD 29, to be consistent with elevations cited in the *2005 Waterbury Dam and Reservoir Regulation Manual*.

The elevations used by the USACE in their Waterbury Dam Staged Flood Frequency Curves included in the draft version of the Quantified Risk Assessment (QRA) are referenced to NAVD 88.

The conversion factor from NGVD 29 to the North American Vertical Datum of 1988 (NAVD 88) for Waterbury, Vermont was obtained from the National Oceanic and Atmospheric Administration (NOAA) Vertical Datum Transformation tool (Vdatum), and is provided below:

$$NGVD29 \text{ El. (feet)} - 0.249 \text{ feet} = NAVD88 \text{ El. (feet)}$$

2. Existing Conditions

2.1 Gate 1 and 2 Spillway Concrete Condition

Harmful reactive siliceous aggregate, cracking, and ASR gel production was observed in the petrographic analyses on all the concrete core samples collected from the non-gated spillway, hoistway bridge deck, and Piers 4, 5 and 6 as part of GEI's 2022 exploration program. The absorption of water by ASR gel induces internal pressure, expansion, and cracking of the aggregate and surrounding paste. ASR is a continuous cycle; gel dries, water infiltrates, gel swells up, produces more cracking and it repeats.

Since the original construction in 1937, lateral expansion of the non-gated spillway monoliths has caused Pier 4 to slid under the Gate 1 and 2 hoistway bridge a total of 2.52 inches and close two 0.75-inch expansion joints (1.5 inches of closure) with apparent slab crushing at the end of bridge over Pier 6. Therefore, the expansion rate of the non-gated spillway monolith M1 through M5 onto Pier 4 is estimated to be 0.05 inches (50 mils) per year or 1.2 mm per year.

Fig. 2-1 below illustrates the overhang measurements in inches over the years since original construction at Pier 4, and the photo in Fig. 2-2 visually shows the current (2022) hoistway bridge deck/pier junction.

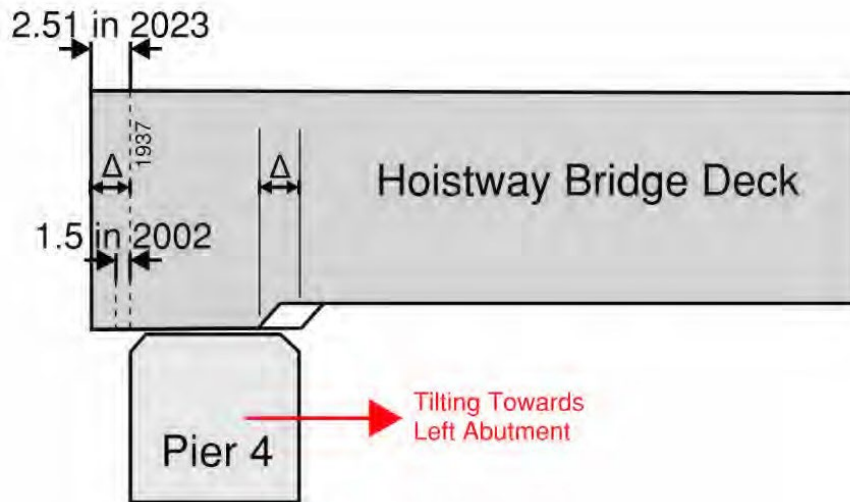


Fig. 2-1. Displacement at the Pier 4 – Hoistway Bridge Junction per 2002 and 2023 Surveys (looking upstream)



Fig. 2-2. Pier 4 – Hoistway Bridge Junction in 2022

2.2 Hoistway Bridge Condition and Structural Analysis

The hoistway bridge deck spanning Piers 4 through 6 has heaved and cracked extensively. Adverse ASR expansion in the non-gated spillway has manifested as open diagonal tension cracks on the upstream vertical face of Monoliths M1 and M2.

A March 21, 2022, USACE structural analysis computed the two-span reinforced concrete bridge for Gates 1 and 2 to have a Load Rating Factor (RF) of 0.6 (USACE, 2022). This RF is well below the USACE and AASHTO standard RF of 1.0 (unity). The USACE bridge analysis assumed Gate 1 and 2 hoists weigh 40 kips each, however, there are references in USACE (2022) that state the hoists could weigh up to 80 kips. Therefore, if a hoist weight of 80 kips is used in the computations, the resulting RF will be lower.

Furthermore, the designed strength of 1937 and 1957 reinforced concrete assumed by USACE (2002) was 3,000 psi. We also adopted USACE (2023) that the 1937 concrete had rebar meeting ASTM A15 for a bar yield strength of 40 ksi. The average concrete compressive strength for 2022 cores in the hoistway bridge deck yielded a concrete strength of 3,330 psi (GEI, 2023). This is significantly less than pier concrete that had 2022 compressive strengths ranging from 4,000 to 8,000 psi, after 86 years of curing.

The hoistway bridge deck structural deficiencies include insufficient top and bottom longitudinal reinforcement which are meant to resist flexural moments at mid-spans and over Pier 5. The USACE structural analysis did not address locked-in compression in the twospan slab. The combination of unmeasured ASR induced compression stress with excessive

flexural stress in the bridge slab, is likely a stability concern any time the gates are operated, as described in Section 3 below.

2.3 Trunnion Pin Condition

The 2023 VT DEC surveys identified that the left trunnion pin for Gate 2 is not perpendicular (square) with the pier and the gate arm casting. The measured skew is 1-degree downward and upstream (e.g., tilted to 7:30 as a clock analogy, looking east). The trunnion pins were relatively square to the piers and the gate arm castings at Gates 1 and 3.

BDI (2023) computed the coefficient of friction (COF) at the left trunnion pin in Pier 6 for Gate 2 to be higher (2x to 3x) than right trunnion for Gate 2, which is square to Pier 5. The industry standard upper limit for COF in USACE or USBR industry standards is 0.3. BDI (2023) stated, “Based on the measured stress levels, most of the friction coefficients associated with maximum moment-to-thrust ratios are considered unreasonably high”.

BDI (2023) further stated, “the lower bound friction results, associated with the minimum moment-to-thrust values, appear to be more reasonable and generally occurred with a greater thrust value”. In our analyses described in Section 3, we used a COF of 1.0 for the skewed left trunnion pin at Gate 2 and the right pin at Gate 2 was assigned a COF of 0.3. We ran multiple cases using a COF of 5 for sensitivity analysis and to understand the potential impact to the lifting.

3. Engineering Analyses

3.1 Gate Analyses

GEI reviewed the 1937 construction drawings, the USACE (2005) gate analysis and the BDI (2023) finite element model (FEM) field strain measurements and computed trunnion pin COF values. We built a three-dimensional (3D) model of Gate 2 (and consequently identical Gate 1) using STAAD Pro, a FEM computer program. The FEM was created using the geometry and section sizes provided in the 1937 construction drawings. Gate steel material (ASTM A7 or A9), with a yield strength of 33 ksi and ultimate strength of 60 ksi, was assumed based on the age of the structure. Gate steel material was assumed per “Evaluation of Existing Structures” article by Steelwise, dated February 2007. We calibrated our STAAD Pro model to previous USACE (2005) and BDI (2023) studies.

Load cases were developed using USACE EM 1110-2-2107 “Design of Hydraulic Steel Structures” dated August 2022. Loads consisted of gate self-weight, side seal friction, trunnion pin friction and chain contact forces.

The objective of the structural analysis performed for Gate 2 was to understand how variations in trunnion pin friction and pool elevation affect the operation of the gate. Previous testing and analysis by BDI (2023) indicated the COF at the left trunnion pin may be as high as 5.0. This would be considered extreme compared to the recommended value of 0.3. The higher friction value may cause excessive stress on the gate arms. We varied the pool elevation from ‘no pool on the gate’ to ‘a pool at the top of the gate,’ and varied COF for the left trunnion pin for values of 0.3, 1, 2 and 5. The right trunnion pin COF was held constant at 0.3.

Table 1 shows the FEM analysis results performed on Gate 2. We compared stresses to allowable stresses in compression, flexure, combined tension and compression and tensile stress listed on the 1937 construction drawings and the latest AISC and USACE guidelines.

Fig. 3-1 shows the STAAD Pro model of Gate 2 as an isometric with demand to capacity (d/c) ratio listed for a sample load case. A d/c ratio of 1.0 and above indicates the member is overstressed per USACE guidelines (EM-1110-2-2107), as the demand is larger than the capacity. The USACE guidelines further require a gate of this type to have a d/c ratio of less than 0.9 to meet a ‘performance factor.’

The red highlighted values, of maximum d/c ratio, in Table 1 indicate cases where the gate arm member is overstressed ($d/c > 1$). The yellow highlighted values indicate cases approaching the d/c safety factor, which consequently aligns with the ‘performance factor’ of

0.9 or strength reduction limit on the allowable d/c ratio required on old gates, as outlined by the USACE.

The first load case presented in Table 1, shows a calibration run we performed with no load on the gate to obtain the unfactored chain forces required to lift the gate. The results indicated a pickup load of 15.1 kips on each chain is required to lift the gate with no pool loading on the gate, even with a high COF. The pickup load of 15.1 kips was then used in the bridge analysis presented in Section 3.2.

Table 1. Gate 2 Structural Analysis Results

Input into STAAD Model	Output from STAAD Model
------------------------	-------------------------

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Description of Load Case	Water Elevation, ft (NGVD 29)	Water Head on Gate ¹ , ft	Left Trunnion Coefficient of Friction ² (COF)	Max. Demand to Capacity Ratio (d/c) in Gate Arm	Controlling Member (highest d/c)	Unfactored Right Chain Force ³ , kip	Unfactored Left Chain Force ³ , kip
No Pool on Gate	582.94	0	1	Calibration Run ⁴ d/c < 0.5		15.1	15.1
			5	Calibration Run ⁴ d/c < 0.5		15.1	15.3
Intermediate Pool Condition	598.37	6.43	5	0.61	Bottom Left Arm	15.1	16.3
Intermediate Pool Condition	601.79	9.85	2	0.58	Bottom Left Arm	--	--
			5	1.37	Bottom Left Arm	--	--
100-year Flood	608.44	16.50	1	0.88	Bottom Left Arm	15.7	16.9
Intermediate Pool Condition	609.27	17.33	1	0.95	Bottom Left Arm	15.7	16.9
			2	1.61	Bottom Left Arm	--	--
Safety Operated Max. Pool	610.80	18.86	0.3	0.65	Bottom Left Arm	--	--
			1	1.12	Bottom Left Arm	--	--
Pool at Top of Gate	618.44	26.50	0.3	0.98	Bottom Right Arm	17.0	17.0

Notes:

1. Top of Gate 2 sill is El. 591.94 (NGVD) and top of the gate is El. 618.44 (NGVD).
2. Coefficient of friction for right trunnion held constant at 0.3.
3. Chain force is the tension in both hoist lifting cables used in structural capacity calculation of bridge.
4. Calibration run to obtain unfactored chain forces required to lift gate without a pool loading the gate.

- Typical graphical results for Demand/Capacity ratio output from STAAD Pro
- Results shown are from model with pool El = 608.44' and left trunnion COF = 1.0 and right trunnion COF = 0.3

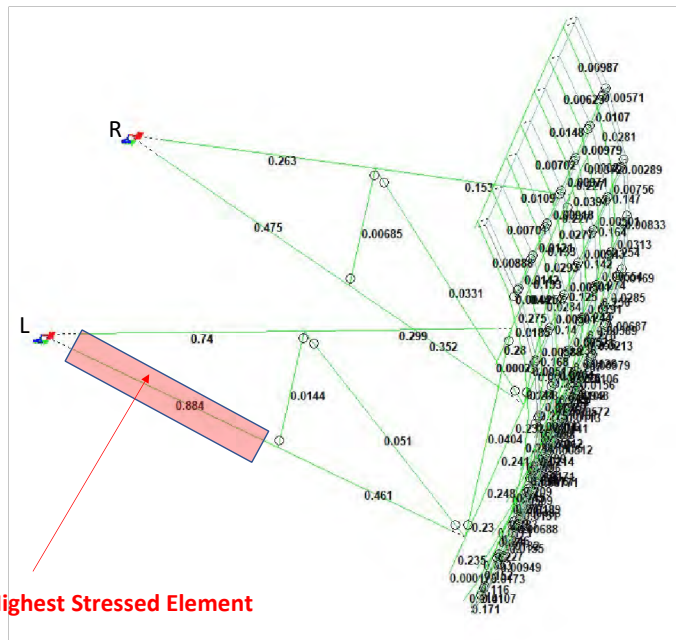


Fig. 3-1. Sample Gate 2 STAAD Pro Model Results

3.2 Bridge Analyses

We reviewed the USACE March 2022 bridge analysis and computed the RF for a 40-kip hoist. We performed a simple two-span concrete bridge analysis using fixity over Pier 5 and steel skid or slide plates (i.e., rollers) over Piers 4 and 6 using bridge dead loads, distributed gate hoist load of 40 and 80 kips (as different scenarios), and two wire rope forces ranging from 14 to 15 kips per rope for a maximum 18.8 ft of water on the gate. The 1937 construction drawings indicate the wire ropes must carry 23.4 kips each to lift a gate with an El. 617.5 pool against the gate.

Based on our attached computations, we concur with the USACE analysis that the bridge is overstressed for 40- and 80-kip hoist weights (Appendix B). Using an ACI 318 (2014) dead load factor of 1.2 for bridge and hoist, and a live load factor of 1.6 for wire rope forces we compute unacceptable factored positive μ (demand) versus ϕM_n (capacity) for short-term loading conditions assuming an 80-kip hoist over the next four years. Using USACE EM 1110-2-2107 dead and live load factor of 2.2 we compute the unacceptable factored positive and negative μ (demand) versus ϕM_n (capacity) for both 40 and 80-kip hoists. Based on the results of our analyses, we recommend the bridge be stabilized soon, until it can be replaced.

These analyses do not include a check if there are induced compression loads in the hoist bridge deck. The potential for the bridge deck to be negatively impacted by combined compression and flexure is likely to reduce capacity of the bridge further. Currently the compression force in the deck is indeterminate. However, the compression force was sufficient to have caused closure of the two (2) $\frac{3}{4}$ -inch thick EJ's which has caused the slab above Pier 6 deck to heave and be crushed. The top of Pier 4 has tilted 2.5 inches left and the expansion joint closure is 1.5 inches.

3.3 Hydraulic Discussion

Fig. 3-2 from the USACE's draft version of the Quantified Risk Assessment (QRA) study, shows the Waterbury Dam Staged Flood Frequency Curve for pool elevations in NAVD 88. The latest USACE Waterbury Dam DSMS Stage-Frequency estimates approx. El. 608.2 (NAVD 88) [608.44 NGVD 29] for 100-year flood and approx. El. 610.6 (NAVD 88) [610.80 NGVD 29] for a 300-year return period flood. When reservoir inflow reaches 31,200 cubic feet per second (cfs), the three gates will be fully opened.

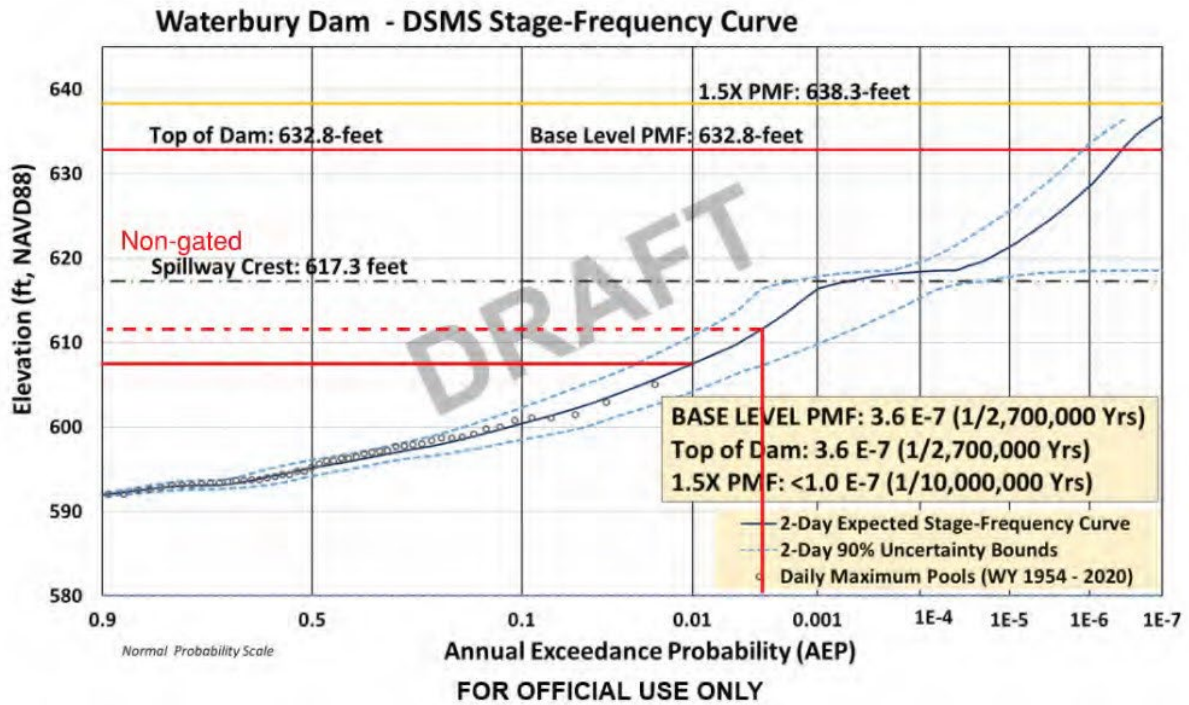


Fig. 3-2. Waterbury Dam Stage-Frequency Curve (USACE, 2023)

We understand during a flood condition VT DEC has a post-storm total discharge limit of 2,000 cfs, using the gated spillway, cone valve and Green Mountain Power (GMP) turbine plus bypass unit, which corresponds to flows associated with a bank full condition in the Little River downstream of the dam. Green Mountain Power (GMP) has no limits during a flood event and can operate the single turbine plus bypass unit to reportedly pass up to 600 to 700 cfs, depending on headwater pool elevation.

For example, a 2.4 ft of opening differential between Gate 2 and Gates 1 and 3 resulting from the early lifting of Gate 2, yields increased Gate 2 outflows by 900 cfs to 1,200 cfs. This exceeds the *2005 Reservoir Regulation Manual*. This release is greater than the 600 to 700 cfs for the GMP turbine/generator unit, discussed above, that is allowed during operate during a flood event.

In collaboration with the State of Vermont Dam Safety Program, we concluded the H&H conditions are representative of the observed conditions and the current *2005 Revised Reservoir Regulation Manual* is sufficient. Therefore, we recommend not developing an interim operating rule curve, but rather maintain the existing operating procedure and provide interim structural stabilization and remediation to hoistway bridge and strut arms before the end of 2023. See Section 4.2 for justification.

4. Recommendations

The current condition of the gated spillway, including Tainter gates, hoists, piers, hoistway bridge are considered structurally deficient due to the ASR expansion and distress and high gate stresses per modern guidelines. In the interim period (to a reported 2027) where these gates are routinely operated, GEI recommends reinforcing the left gate strut (Gate 2), strengthening the two-span bridge (above Gates 1 and 2), and sealing open tension cracks in the upstream face of the non-gated spillway monoliths M1 and M2.

Furthermore, the piers of the gated spillway should be surveyed routinely (seasonally every May and October) using the established DMPs or permanent prisms. These measures are expected to increase the short-term stability and reliability of the bridge and dam structures. However, these are interim measures are not designed to be permanent and are not expected to increase the longevity of the structure more than four to five years. GEI is of the opinion that the existing Tainter gates, hoists, piers, and bridge should be replaced and rehabilitated using contemporary design requirements/guidelines within the next five (5) years.

To avoid operational uncertainties in the bridge and hoist weight and early flood flow releases at Gate 2, we recommend interim bridge and Gate 2 stabilization and strengthening work be done in 2023. This work includes:

1. Adding two beams over the Gate 1 and 2 hoistway bridge deck to make the steel beams and concrete slabs an integral/composite element.
2. Adding flange plates to the 14-foot-long lower left cord of Gate 2 where it connects to the trunnion hub casting at the left trunnion pin. Consider loosening the trunnion casting around left pin.
3. Epoxy grouting or sealing the open horizontal cracks in non-gated spillway monoliths M1 and M2 to reduce water infiltration during surcharge pools.
4. Measuring movements of the piers and bridge deck on a semi-annual basis with total station survey of established displacement monitoring survey points (DMPs - could add prisms) and electronic bi-axial tiltmeters installed on Pier 4.

This interim bridge and gate work should be done as soon as practical, as the replacement work pertaining to the gates, piers, hoists, and bridge will likely not start until 2027.

Before this recommended work is done later this year, we recommend the following flood control operating approach be implemented immediately until the 2023 interim work can be completed, to prevent early flood flow releases at Gate 2:

- In the event a flood event occurs, all three Tainter gates remain closed and the VT DEC cone valve be opened, and hopefully GMP operates the turbine plus bypass unit, to discharge water in accordance with the *2005 Reservoir Regulation Manual (RRM)*.

- If during the flood period the reservoir level rises to El. 610.8 (NGVD 29), the maximum safely operated pool per the RRM, Gate 3 could be opened first, followed by Gate 1 to discharge water. Gate 2 would only be operated in an emergency in which case the Emergency Action Plan (EAP) for Waterbury Dam would be activated. Gates 1 and 3 could remain open until the pool decreases or the pool rises to El. 617.5 in which Gate 2 would have to be operated and all gates would remain open.

Permanent rehabilitation work tentatively scheduled starting in 2027 should include:

1. Replace existing bridge from the embankment dam wing wall to the left rock abutment.
2. Strengthen or replace existing Tainter gates.
3. Replace or upgrade hoists. This could include automated gate hoist.
4. Address ASR concrete and sealing concrete cracks.

4.1 2023 Interim (Short-Term) Recommendations

1. We recommend the hoistway bridge be reinforced with two (2) top side beams (double back-to-back channels with flange plates). The beams will connect through the concrete slab with tie rods and plates along the underside of the hoistway bridge slab to strengthen the concrete slab and provide a stable composite structure. These beams will be low profile to allow gate hoist doors to open, as illustrated in Fig 4-1 below.

2 Beam
 Option
 (preferred)

20k/1.4= 14.3K increases to 15K

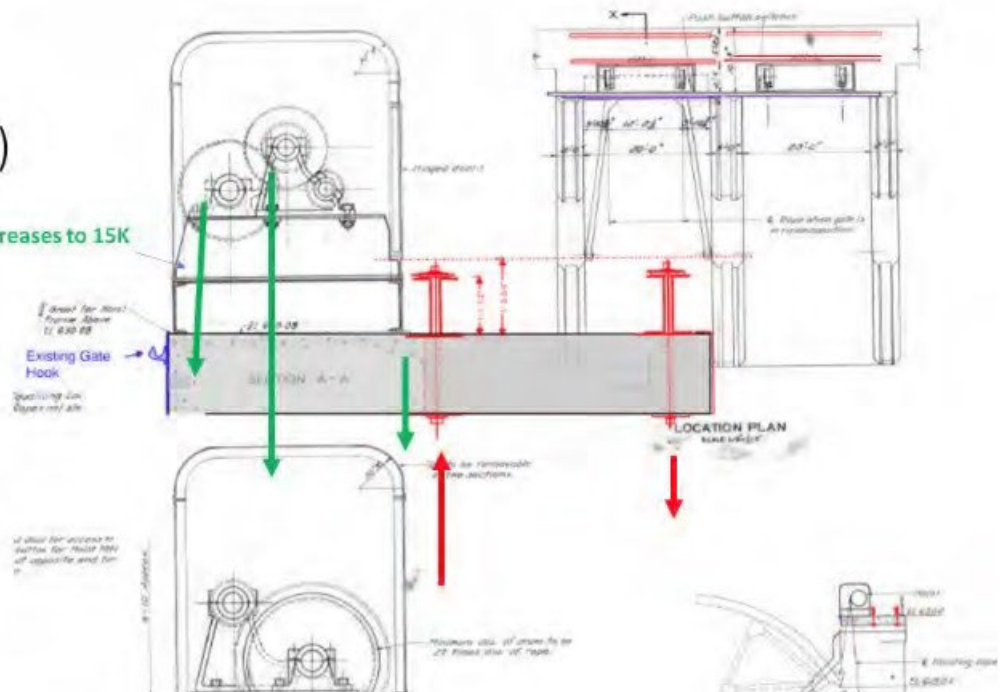


Fig. 4-1. Two Low Profile Beam Reinforcing Option

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2. Due to the skewed left trunnion pin in Pier 6, for Gate 2, the lower strut arm could be overstressed if the pool rises to El. 608.4 (NGVD 29) (16.5 above the gate sill at El. 591.94); this is 2.4 ft less than the maximum ponding pool behind closed gates that can be safely operated as prescribed in the *2005 Revised Waterbury Dam and Reservoir Regulation Manual*; until the reservoir reaches El. 610.8 (NGVD 29) (18.8 ft above the gate sill). We recommend the lower left strut arm be reinforced with two symmetric vertical flange plates welded to W-beam bottom strut closest to the left (east) Gate 2 trunnion pin to reduce the beam-column stresses, as shown in Fig 4-2. In addition, the four bolts of the trunnion casting around the skewed left trunnion pin could be loosened to reduce gate binding.

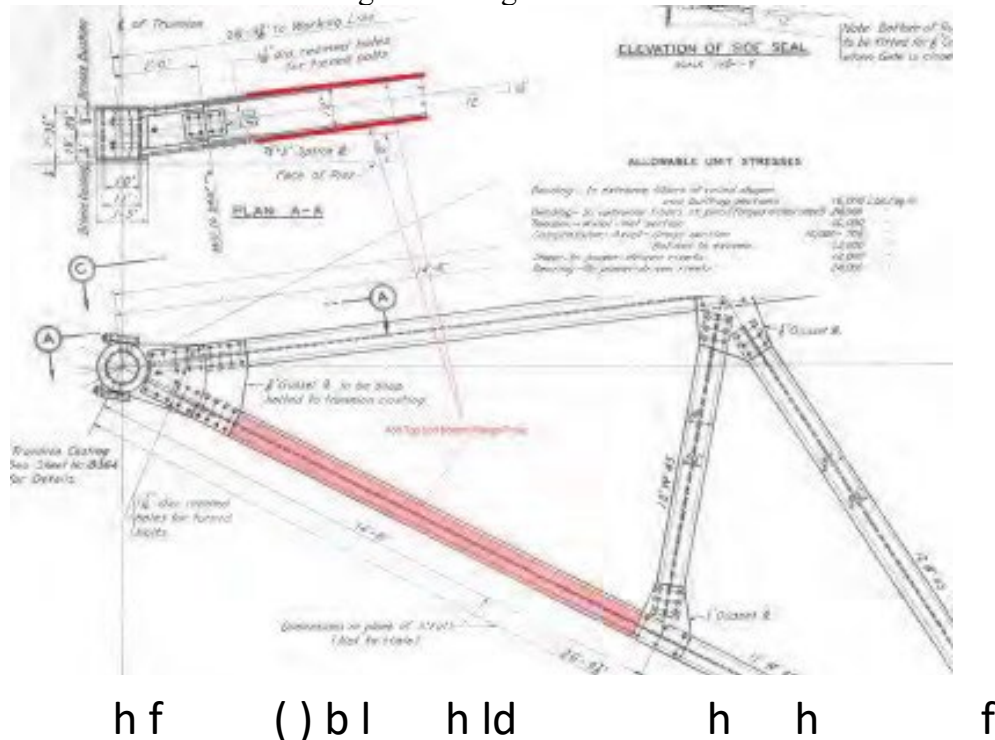


Fig. 4-2. Gate 2 Arm Improvements

3. Epoxy grout or seal the upstream open tension cracks on non-gated spillway Monoliths M1 and M2 to reduce water infiltration during surcharge pools. Fig. 4-3 and 4-4 show photographs of the cracks, taken in 2022.



Fig. 4-3. Cracks on Upstream Side of Monolith M1 and M2



Fig. 4-4. Close-up of cracks on Upstream Side of Monolith M1 and M2

Our recommendations presented above to stabilize the hoistway bridge and reinforce the Gate 2 strut arm assume maintaining the current operating guidelines under the existing operating rule curves. This work should be completed before the end of 2023. One option we evaluated was to update the *2005 Waterbury Dam and Reservoir Regulation Manual* (RRM) for an interim period before permanent repairs can be made. In our opinion, developing a new interim operating rule curve would require extensive changes to the operating guidelines that would have impacts to both the hydropower operations and the recreational use of the reservoir, in addition to the impacts of the restricted operation of Gate 2, because of the BDI (2023) findings.

Our structural analyses concluded by reinforcing the Gate 2 strut arm and hoistway bridge, the State of Vermont can continue to operate the gated spillway in accordance with the existing *2005 Reservoir Regulation Manual* until final bridge and gate improvements are completed.

Performing the recommended 2023 interim measures will accomplish the following:

- The State of Vermont will be able to continue to operate the dam safely and confidently under the current operating RRM procedures.
- Does not require changing the *2005 Reservoir Regulation Manual* and helps to prevent the real or perceived risk of discharging more or a different flood flow regime, which might cause downstream impacts and possibly violate the “Do No Harm” concepts to life, property, lifeline, and the environment.
- Increases the confidence in the bridge/hoist, gate, and reliable operations, avoids the need to consider alternatives like a lower normal pool over the summer etc.

In addition, by also reinforcing the hoistway bridge this approach increases the confidence in the hoistway bridge and provides a safer working deck for operators to perform reliable gate operations until a permanent gate rehabilitation and bridge replacement is performed starting in 2027.

If the interim structural improvements are not performed, the early flood flow releases of Gate 2 could have the following negative impacts:

- Real or perceived downstream impacts that could affect loss of life, property, lifelines, and environment including flood protection. The State of Vermont as the owner of Waterbury Dam could be liable if changes are made to the RRM.
- Potentially violates ‘Do No Harm’ principle.
- Lower normal pool, which would negatively impact hydropower operations and the recreational use of the reservoir, as well as environment and water quality issues.

Our recommended option to stabilize the hoistway bridge and strengthening the left Gate 2 strut arm reduces both upstream and downstream impacts, improves confidence and

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reliability of operating the gates, improves dam safety, and improves operator safety on the distressed concrete bridge.

5. Suggested Path Forward

1. Stage 1 – Interim Analysis Under Current 2023 Contact
 - a. Issue Technical Memo May 4, 2023, emphasizing Gate 1 and 2 bridge weakness and Gate 2 left lower strut arm overstress.
 - b. VT DEC to brief USACE on the States goal to operate safely during interim from now to 2027.
 - c. GEI Issue this Final Report by June 1, 2023.
2. Stage 2 – 2023 Design Effort
 - a. Procurement - Prepare budget for engineering (biddable drawings and specifications) for Gate 1 and 2 hoistway bridge improvements, and Gate 2 left strut arm strengthening.
 - b. Analysis and design.
 - c. Prepare and Issue IFB drawings and specifications.
3. Stage 3 – 2023 Construction
 - a. Procurement
 - b. Construction
 - c. As-built Documentation
4. Stage 4 – 2024 – 2027 Continue Monitoring Piers using DMP and Tiltmeters
5. Stage 5 – 2027 VT DEC and USACE begin permanent bridge, gate improvements, and mitigate ASR

6. References

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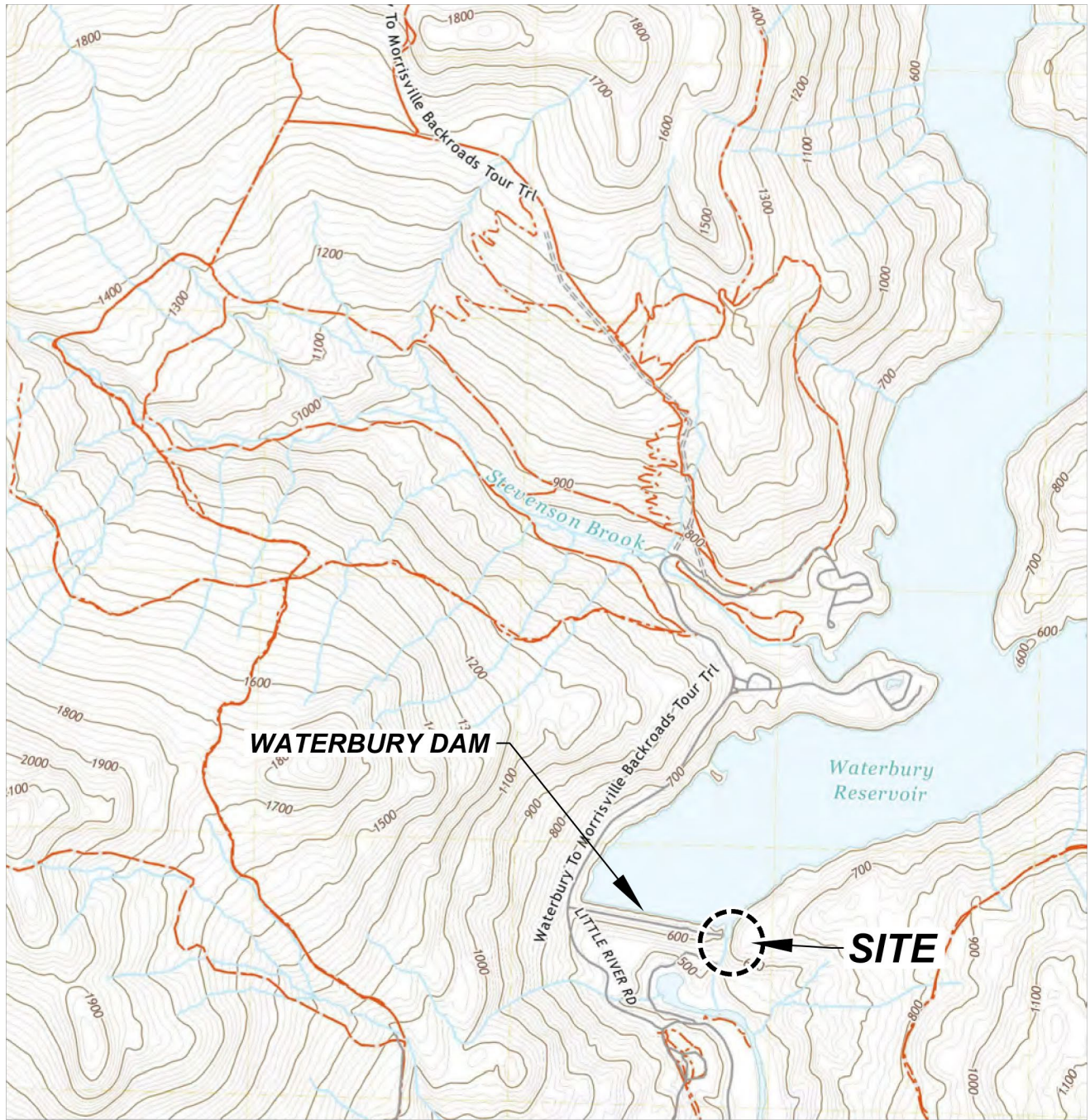
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Plates

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This Image is from U.S.G.S. Topographic 7.5 Minute Series
Bolton Mountain, VT Quadrangle, 2021.
Datum is North American Vertical Datum of 1988 (NAVD88).
Contour Interval is 20 Feet.



Waterbury Dam
Waterbury, Vermont



SITE LOCATION MAP

Vermont Department of Environmental Conservation
Montpelier, Vermont

Project 2301089

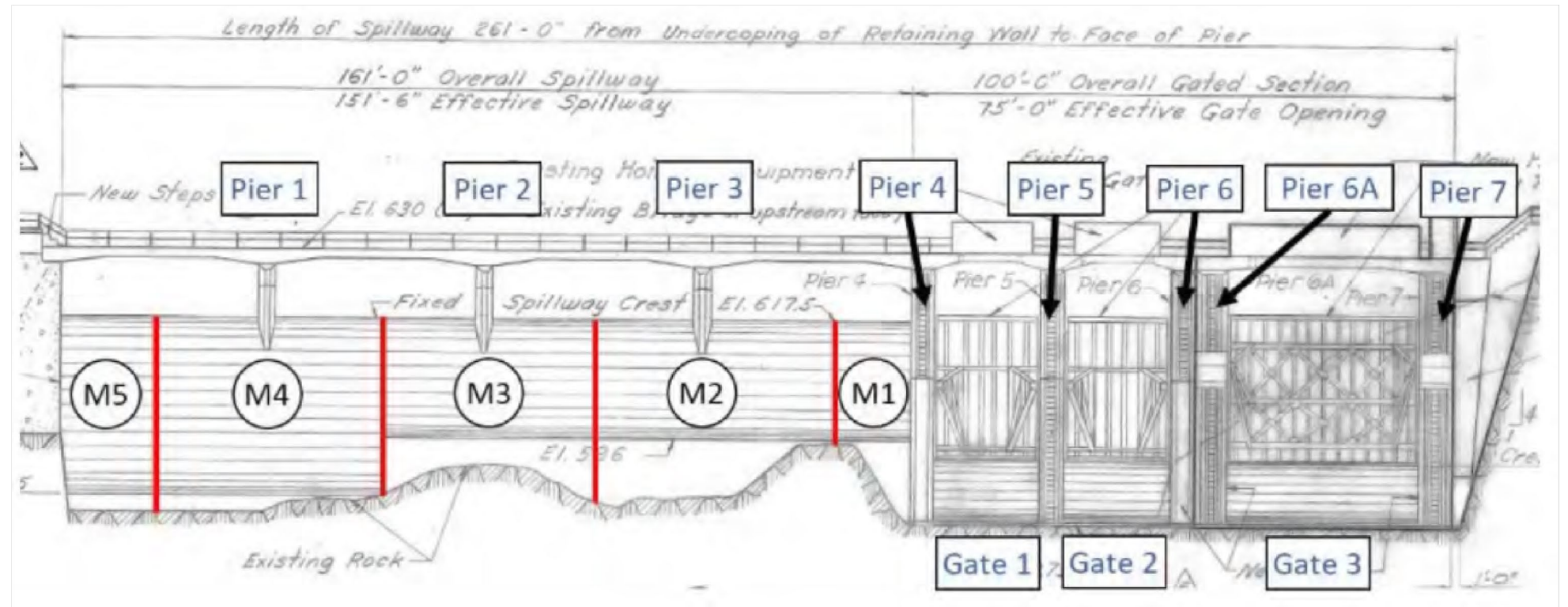
May 2023


Plate 1

B:\Working\VERMONT DEC\2301089 Waterbury Dam Interim Flood Operation Study
2023\00_CAD\Figures\2301089-01



LOCUS
1" = 500'




<p>Waterbury Dam Waterbury, Vermont</p>		<p>SPILLWAY MONOLITH, PIER, AND GATE NUMBERING PLAN</p>
<p>Vermont Department of Environmental Conservation Montpelier, Vermont</p>	<p>Project 2301089</p>	<p>May 2023 Plate 2</p>



NOTES:

1. PHOTOGRAPH TAKEN IN OCTOBER 2022.


<p>Waterbury Dam Waterbury, Vermont</p>		<p>PHOTOGRAPH OF TAINTER GATES</p>
<p>Vermont Department of Environmental Conservation Montpelier, Vermont</p>	<p>Project 2301089</p>	<p>May 2023 Plate 3</p>

Final Report
Interim Measures to Reduce Downstream Flood and
Improved Dam Safety
Waterbury Dam, Waterbury Vermont May
31, 2023

Appendix A

Structural Capacity Calculation of Existing Bridge

GEI Consultants, Inc.

	Client	VT DEC Project: Mathcad Template Project No.: 00000-0			Page	1 of 22
	Project	Waterbury Dam Interim Flood Study			Pg. Rev.	
	By	M. Carden	Chk.	M. Guirguis	App.	B. Walton
	Date	5/23/2023	Date	2/24/2023	Date	5/26/2023
Project No.	2301089	Document No.	N/A			
Subject	Existing Bridge Capacity					

Background

Waterbury Dam is a State of Vermont owned and operated dam with a pedestrian bridge over the concrete spillway and Tainter gates.

Material and Section Properties

Material properties assumed based on date of construction.

Concrete

Compressive Strength: $f'_c := 3000\text{psi}$

Modulus: $E_c := 57000\sqrt{f'_c}\text{psi} = 3122\text{ksi}$

Steel Reinforcement

Yield Strength: $f_y := 40\text{ksi}$ ASTM A15

Modulus: $E_s := 29000\text{ksi}$


Material Density

Concrete: $c := 145\text{pcf}$ From 2022 Unit Weight Test Data

Water: $y_{\text{water}} := 62.4\text{pcf}$

Rebar Sizes

No.	Diameter	Area	No.	Diameter	Area
3	$d_3 := 0.375\text{in}$	$A_3 := 0.11\text{in}^2$	7	$d_7 := 0.875\text{in}$	$A_7 := 0.60\text{in}^2$
4	$d_4 := 0.5\text{in}$	$A_4 := 0.20\text{in}^2$	8	$d_8 := 1\text{in}$	$A_8 := 0.79\text{in}^2$
5	$d_5 := 0.625\text{in}$	$A_5 := 0.31\text{in}^2$	9	$d_9 := 1.128\text{in}$	$A_9 := 1.0\text{in}^2$
6	$d_6 := 0.75\text{in}$	$A_6 := 0.44\text{in}^2$	10	$d_{10} := 1.27\text{in}$	$A_{10} := 1.27\text{in}^2$


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	Date	5/23/2023	Date	2/24/2023	Date	5/26/2023

Project No.	2301089	Document No.	N/A
Subject	Existing Bridge Capacity		
Bridge Data			
Bridge is a pedestrian bridge with mechanical hoists to lift Tainter gates.			
Restricted Pool Elevation:	ELpool := 610.8ft		
End Sill Elevation:	ELSill := 592.0ft		
Head of Water on Gate:	Hwater.gate := ELpool – ELSill = 18.80 ft		
Pier Spacing - 5 to 6:	Spier := 24.5ft		
<i>Hoist</i>			
Hoist Weight:	Whoist.40 := 40kip	Whoist.80 := 80kip	
Hoist Width:	Bhoist := 15ft		
Load Location:	aHoist := 5ft	bHoist := 4.5ft	
<i>Wire Rope</i>			
Force:	P := 15kip		
Load Location:	a	bP := 5.9ft	
	P := 6.4ft		
<i>Bridge Deck</i>			
Thickness of Deck at Center:	t	deck.center := 1.5ft	
Thickness of Deck at Edge:	tdeck.edge := 2.5ft		
Average Thickness of Deck:	$t_{deck.av} := \frac{t_{deck.center} + t_{deck.edge}}{2} = 2.00 \text{ ft}$		
Width of Deck:	center := 10ft		
	b bthick :=		
	5ft		
	bpier5 := 2.5ft	bpier6 := 2ft	
Out to Out Width of Deck:	bout := 10.25ft		

Client: GEI Consultants, Inc.

Width Beam: bbeam := 5.58ft

Width Rest: brest := 2.92ft

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Project No.	2301089	Document No.	N/A
Subject	Existing Bridge Capacity		

Load Cases

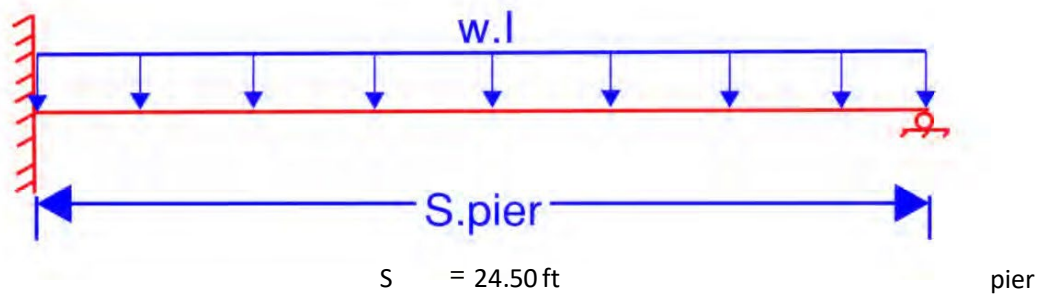
Load Case I

Concrete Slab Weight:

$$w_l := \frac{b_{\text{pier5}} \cdot t_{\text{deck.edge}} + 2 \cdot b_{\text{thick}} \cdot t_{\text{deck.av}} + b_{\text{center}} \cdot t_{\text{deck.center}}}{b_{\text{pier6}} \cdot t_{\text{deck.edge}} + b_{\text{out}} \cdot y_c} \cdot \text{Spier}$$

$$w_l = 2.81 \frac{\text{kip}}{\text{ft}} \quad w_{l.\text{tot}} :=$$

$$w_l \cdot \text{Spier} = 68.74 \text{ kip}$$

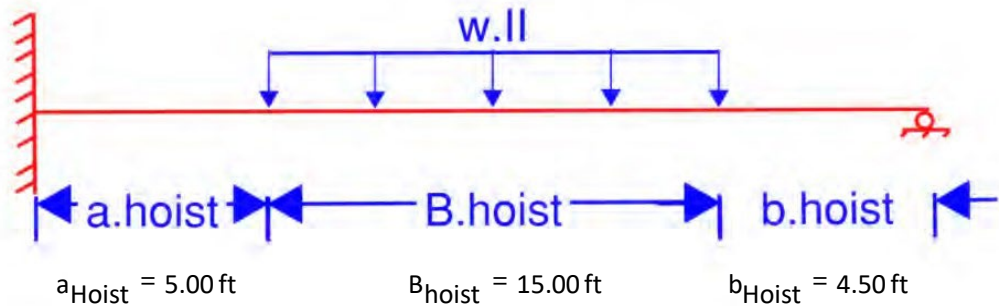


Load Case II


Hoist Weight:

$$w_{II.40} := \frac{W_{\text{hoist.40}}}{B_{\text{hoist}}} = 2.67 \frac{\text{kip}}{\text{ft}}$$

$$w_{II.80} := \frac{W_{\text{hoist.80}}}{B_{\text{hoist}}} = 5.33 \frac{\text{kip}}{\text{ft}}$$



Client: GEI Consultants, Inc.

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Project No.	2301089	Document No.	N/A			
Subject	Existing Bridge Capacity					

Load Case III

Wire Rope:

$P = 15 \square \text{kip}$



Load and Resistance Factors

References:

ACI 318-14

USACE EM 1110-2-2014 (2016)

Load Factors - ACI318-14


Dead Load Factor:	LF :=	DL 1.2	Hoist & Bridge Deck
Live Load Factor:	LF :=	LL 1.6	Wire Rope

Load Factors - USACE EM 1110-2-2014 (2016)

Dead Load Factor:	LFDL.U := 2.2	Hoist & Bridge Deck
Live Load Factor:	LFL.L.U := 2.2	Wire Rope

Resistance Factors

Concrete Flexure:	$\phi_{flex} := 0.9$
Concrete Shear:	$\phi_{shear} := 0.75$

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Project No.	2301089	Document No.	N/A
Subject	Existing Bridge Capacity		

Shear and Moments

Loading was input into ENERCLAC, see attached outputs for shear and moment diagrams, loading is summarized below.

80 kip Hoist - ACI

Reactions: $R_a_{80} := \text{LFDL} \cdot 96 \text{kip} + \text{LFLL} \cdot 20 \text{kip} = 147.20 \text{kip}$

$R_b_{80} := \text{LFDL} \cdot 54 \text{kip} + \text{LFLL} \cdot 11 \text{kip} = 82.40 \text{kip}$

Max Shear: $V_{\text{max}_{80}} := 146 \text{kip}$

Positive Moment: $M_{\text{pos}_{80}} := 466 \text{kip ft}$

Negative Moment: $M_{\text{neg}_{80}} := 803 \text{kip ft}$

40 kip Hoist - ACI

Reactions: $R_a_{40} := \text{LFDL} \cdot 70 \text{kip} + \text{LFLL} \cdot 20 \text{kip} = 116.00 \text{kip}$

$R_b_{40} := \text{LFDL} \cdot 40 \text{kip} + \text{LFLL} \cdot 11 \text{kip} = 65.60 \text{kip}$

Max Shear: $V_{\text{max}_{40}} := 115 \text{kip}$

Positive Moment: $M_{\text{pos}_{40}} := 350 \text{kip ft}$

Negative Moment: $M_{\text{neg}_{40}} := 612 \text{kip ft}$

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Project No.	2301089	Document No.	N/A
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Subject	Existing Bridge Capacity
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80 kip Hoist - USACE

Reactions: $R_a_{80U} := \text{LFDL.U} \cdot 96\text{kip} + \text{LFLL.U} \cdot 20\text{kip} = 255.20\text{kip}$

$R_b_{80U} := \text{LFDL.U} \cdot 54\text{kip} + \text{LFLL.U} \cdot 11\text{kip} = 143.00\text{kip}$

Max Shear: $V_{\text{max}_80U} := 253\text{kip}$

Positive Moment: $M_{\text{pos}_80U} := 813\text{kip ft}$

Negative Moment: $M_{\text{neg}_80U} := 1396\text{kip ft}$

40 kip Hoist - USACE

Reactions: $R_a_{40U} := \text{LFDL.U} \cdot 70\text{kip} + \text{LFLL.U} \cdot 20\text{kip} = 198.00\text{kip}$


$R_b_{40U} := \text{LFDL.U} \cdot 40\text{kip} + \text{LFLL.U} \cdot 11\text{kip} = 112.20\text{kip}$

Max Shear: $V_{\text{max}_40U} := 196\text{kip}$

Positive Moment: $M_{\text{pos}_40U} := 599\text{kip ft}$

Negative Moment: $M_{\text{neg}_40U} := 1045\text{kip ft}$

Client: GEI Consultants, Inc.

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Subject	Existing Bridge Capacity					

Flexural Resistance of Concrete

Deck is reinforced with (8) #8 in the boBom and (9) #8 in the top under the hoist and the remainder is reinforced with (15) #4 in the boBom and (9) #6 in the top.

Area of Steel on Deck BoBom: $A_{s_deck_bot} := 8 \square A8 + 15 \square A4 = 9.32 \square in^2$

Area of Steel on the Deck Top: $A_{s_deck_top} := 9A8 + 9A6 = 11.07 \square in^2$

Check Moment Capacity

Stress Block Factor - 5.6.2.2 $\alpha := \frac{1}{0.85}$

$$a_{bot.hoist} := \frac{A_{s_deck_bot} \square f_y}{0.85 \square f'_c \square (b_{rest} + b_{beam})} = 1.43 \square in$$

$$a_{top.hoist} := \frac{A_{s_deck_top} \square f_y}{0.85 \square f'_c \square (b_{rest} + b_{beam})} = 1.70 \square in$$

Clear Cover: $c_{ct} := 2.0in \quad c_{cb} := 2.0in$

Effective Depth BoBom: $d_{e_bot} := t_{deck.center} - \frac{c_{cb}}{2} - \frac{d8}{2} = 15.50 \square in$

Deck Positive Moment Capacity:

$$\phi M_n.pos.hoist := \phi flex \square A_{s_deck_bot} \square f_y \square d_{e_bot} - \frac{a_{bot.hoist} \square A_{s_deck_bot} \square f_y \square d_{e_bot}^2}{2} \square \square = 413.34 \square kip \square ft$$


Effective Depth Top: $d_{e_top} := t_{deck.edge} - \frac{c_{ct}}{2} - \frac{d8}{2} = 27.50 \square in$

Deck Negative Moment Capacity:

$$\square \square \square a_{top.hoist} \square$$

885.01 kip ft

$\phi M_n \text{ neg. hoist} := \phi \text{ flex } \square \text{ As_deck_top } \square \text{ fy } \square \square \square \text{ de_top} - \text{ } \square \square =$

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Subject	Existing Bridge Capacity		

Shear Resistance of Concrete

Assume no shear reinforcement.

Concrete Factor - Normal Weight - 5.4.2.8-2:

$$\lambda_{con} := 1.0$$

$$\lambda_s := \sqrt{1 + \frac{2}{\frac{d_{e_top}}{10in}}} = 0.73$$

$$\beta := 2.0$$

Shear Capacity:

$$\phi V_{c1} := \phi_{shear} \lambda_s \lambda_{con} \sqrt{f'_c} \psi_i d_{e_top} (b_{rest} + b_{beam}) = 336.60 \text{ kip}$$

$$\phi V_{c2} := \phi_{shear} \left[\sqrt{c_2} + \beta \lambda_s \lambda_{con} \sqrt{f'_c} \psi_i d_{e_top} \right] (b_{rest} + b_{beam}) = 336.60 \text{ kip}$$

$$\phi V_{c3} := \phi_{shear} \left[\sqrt{c_2} + \lambda_s \lambda_{con} \sqrt{f'_c} \psi_i d_{e_top} \right] (b_{rest} + b_{beam}) = 187.58 \text{ kip}$$

$$\phi V_n := \min(\phi V_{c1}, \phi V_{c2}, \phi V_{c3}) = 188 \text{ kip}$$

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Project No.	2301089	Document No.	N/A
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Subject	Existing Bridge Capacity
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Capacity Checks - ACI

LRFD Capacity

Factored Load

1.2DL+1.6LL

80 kip Hoist

Moment Posi\$ve:

$\phi M_n.pos.hoist = 413.34 \text{ kip ft} < M_{pos_80} = 466 \text{ kip ft} \quad \text{NG}$

Moment Nega\$ve:

$\phi M_n.neg.hoist = 885.01 \text{ kip ft} > M_{neg_80} = 803 \text{ kip ft} \quad \text{OK}$

Shear:

$\phi V_n = 187.58 \text{ kip} > V_{max_80} = 146 \text{ kip} \quad \text{OK}$

40 kip Hoist

Moment Posi\$ve:

$\phi M_n.pos.hoist = 413.34 \text{ kip ft} > M_{pos_40} = 350 \text{ kip ft} \quad \text{OK}$


Moment Nega\$ve:

$\phi M_n.neg.hoist = 885.01 \text{ kip ft} > M_{neg_40} = 612 \text{ kip ft} \quad \text{OK}$

Shear:

$\phi V_n = 187.58 \text{ kip} > V_{max_40} = 115 \text{ kip} \quad \text{OK}$


Client: GEI Consultants, Inc.

	Client	VT DEC Project: Mathcad Template Project No.: 00000-0			Page	10 of 22
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	By	M. Carden	Chk.	M. Guirguis	App.	B. Walton
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Project No.	2301089	Document No.	N/A			
Subject	Existing Bridge Capacity					

Capacity Checks - USACE



	LRFD Capacity		Factored Load	
			2.2DL+2.2LL	
<i>80 kip Hoist</i>				
Moment Posi%ve:	$\phi M_n.pos.hoist = 413.34 \cdot kip \cdot ft$	<	$M_{pos_80U} = 813 \cdot kip \cdot ft$	NG
Moment Nega%ve:	$\phi M_n.neg.hoist = 885.01 \cdot kip \cdot ft$	<	$M_{neg_80U} = 1396 \cdot kip \cdot ft$	NG
Shear:	$\phi V_n = 187.58 \cdot kip$	<	$V_{max_80U} = 253 \cdot kip$	NG
<i>40 kip Hoist</i>				
Moment Posi%ve:	$\phi M_n.pos.hoist = 413.34 \cdot kip \cdot ft$	<	$M_{pos_40U} = 599 \cdot kip \cdot ft$	NG
Moment Nega%ve:	$\phi M_n.neg.hoist = 885.01 \cdot kip \cdot ft$	<	$M_{neg_40U} = 1045 \cdot kip \cdot ft$	NG
Shear:	$\phi V_n = 187.58 \cdot kip$	<	$V_{max_40U} = 196 \cdot kip$	NG

These analyses do not include a compression check if there are induced loads in the hoistway bridge deck. The potential for the bridge to be impacted by combined compression and factor is a real concern. However, the compression force caused closure of the two (2) 3/4-inch EJ's which has caused the slab above Pier 6 deck to crush.

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	Date	5/23/2023	Date	2/24/2023	Date	5/26/2023

Client: GEI Consultants, Inc.

Project No.	2301089	Document No.	N/A
Subject	Existing Bridge Capacity		
80 kip Hoist - ENERCALC ACI			

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Project No.	2301089	Document No.	N/A				
Subject	Existing Bridge Capacity						

General Beam Analysis

Project File: Beam Loading.ec6

LIC#: KW-06014034, Build:20.22.3.16

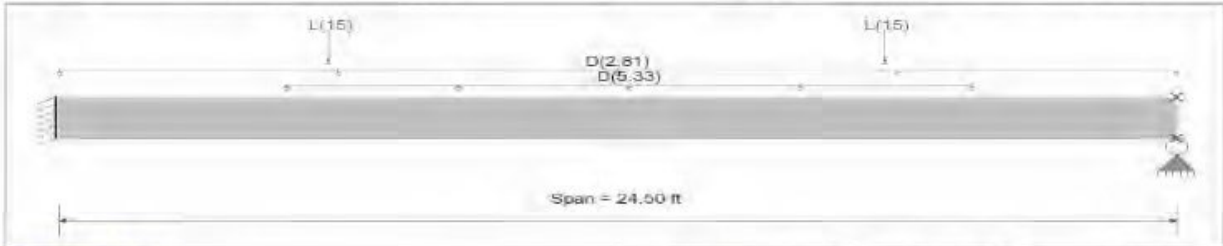
GEI CONSULTANTS INC.

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DESCRIPTION: All Loads - 80 Kip Hoist - ACI

General Beam Properties

Elastic Modulus = 3,122.0 ksi
 Span #1 Span Length = 24.50 ft Area = 204.0 in² Moment of Inertia = 272.0 in⁴



Applied Loads

Service loads entered. Load Factors will be applied for calculations

- Load for Span Number 1
 - Uniform Load : D = 5.330 k/ft, Extent = 5.0 --> 20.0 ft, Tributary Width = 1.0 ft, (Hoist)
 - Uniform Load : D = 2.810 k/ft, Tributary Width = 1.0 ft, (Deck)
 - Point Load : L = 15.0 k @ 5.90 ft, (Wire Rope)
 - Point Load : L = 15.0 k @ 18.10 ft, (Wire Rope)

DESIGN SUMMARY


Maximum Bending =	802.721 k-ft	Maximum Shear =	145.552 k
Load Combination	+1.20D+1.60L	Load Combination	+1.20D+1.60L
Span # where maximum occurs	Span # 1	Span # where maximum occurs	Span # 1
Location of maximum on span	0.000 ft	Location of maximum on span	0.000 ft
Maximum Deflection			
Max Downward Transient Deflection	5.239 in		56
Max Upward Transient Deflection	0.003 in		93815
Max Downward Total Deflection	34.512 in		8
Max Upward Total Deflection	0.010 in		30583

Maximum Forces & Stresses for Load Combinations

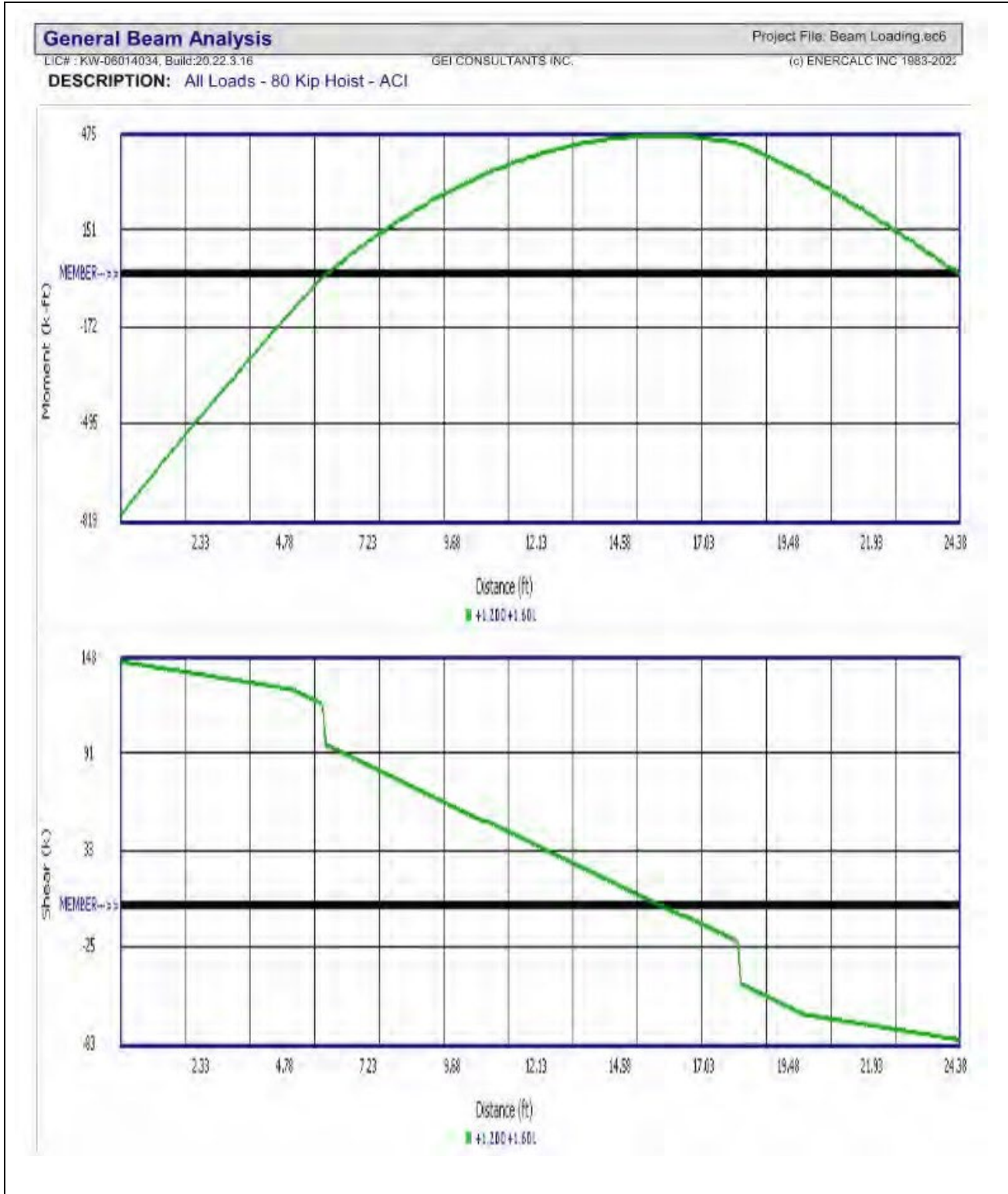
Load Combination	Segment Length	Span #	Max Stress Ratios		Summary of Moment Values (k-ft)					Shear Values (k)		
			M	V	Mmax +	Mmax -	Ma -	Max	Mrx	Mrx/Omega Cb	Rm	Va Max
Overall MAXimum Envelope	Dsgn. L = 24.50 ft	1			465.52	-802.72	802.72					145.55
+1.20D+1.60L	Dsgn. L = 24.50 ft	1			465.52	-802.72	802.72					145.55


Vertical Reactions

Load Combination	Support notation : Far left is #		Values in KIPS	
	Support 1	Support 2		
Overall MAXimum	114.779	64.016		
Overall MINimum				
D Only	95.235	53.560		
+D+L	114.779	64.016		
+D+0.750L	109.893	61.402		
+0.60D	57.141	32.136		
L Only	19.544	10.456		



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Subject	Existing Bridge Capacity						



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80 kip Hoist - ENERCALC USACE

 GEI <small>cor</small>		Client	VT DEC	Page	15 of 2215
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		By	M. Carden	Chk.	M. Guirguis	App.	B. Walton
		Date	5/23/2023	Date	2/24/2023	Date	5/26/2023
Project No.	2301089	Document No.	N/A				
Subject	Existing Bridge Capacity						

General Beam Analysis

LIC#: KW-06014034, Build: 20.22.3.16

DESCRIPTION: All Loads - 80 Kip Hoist - USACE

Project File: Beam Loading.eob

GEI CONSULTANTS INC. (c) ENERCALC INC 1983-2022

General Beam Properties

Elastic Modulus	3,122.0 ksi			
Span #1	Span Length =	24.50 ft	Area =	204.0 in ²
			Moment of Inertia =	272.0 in ⁴

Span = 24.50 ft

Applied Loads

Service loads entered. Load Factors will be applied for calculations

Load for Span Number 1

Uniform Load : D = 5.330 k/ft, Extent = 5.0 --> 20.0 ft, Tributary Width = 1.0 ft, (Hoist)

Uniform Load : D = 2.810 k/ft, Tributary Width = 1.0 ft. (Deck)

Point Load : L = 15.0 k @ 5.90 ft, (Wire Rope)

Point Load : L = 15.0 k @ 18.10 ft, (Wire Rope)

DESIGN SUMMARY

Maximum Bending =	1,395.519 k-ft	Maximum Shear =	252.513 k
Load Combination	+2.20D+2.20L	Load Combination	+2.20D+2.20L
Span # where maximum occurs	Span # 1	Span # where maximum occurs	Span # 1
Location of maximum on span	0.000 ft	Location of maximum on span	0.000 ft
Maximum Deflection			
Max Downward Transient Deflection	5.239 in		56
Max Upward Transient Deflection	0.003 in		93815
Max Downward Total Deflection	34.512 in		8
Max Upward Total Deflection	0.010 in		30583

Maximum Forces & Stresses for Load Combinations

Load Combination	Segment Length	Span #	Max Stress Ratios		Summary of Moment Values (k-ft)					Shear Values (k)		
			M	V	Mmax +	Mmax -	Ma - Max	Mnx	Mnx/Omega Cb	Rm	Va Max	Vnx/Vnx/Omega
Overall MAXimum Envelope	Dsgn. L = 24.50 ft	1			812.63	-1,395.52	1,395.52					252.51
+2.20D+2.20L	Dsgn. L = 24.50 ft	1			812.63	-1,395.52	1,395.52					252.51

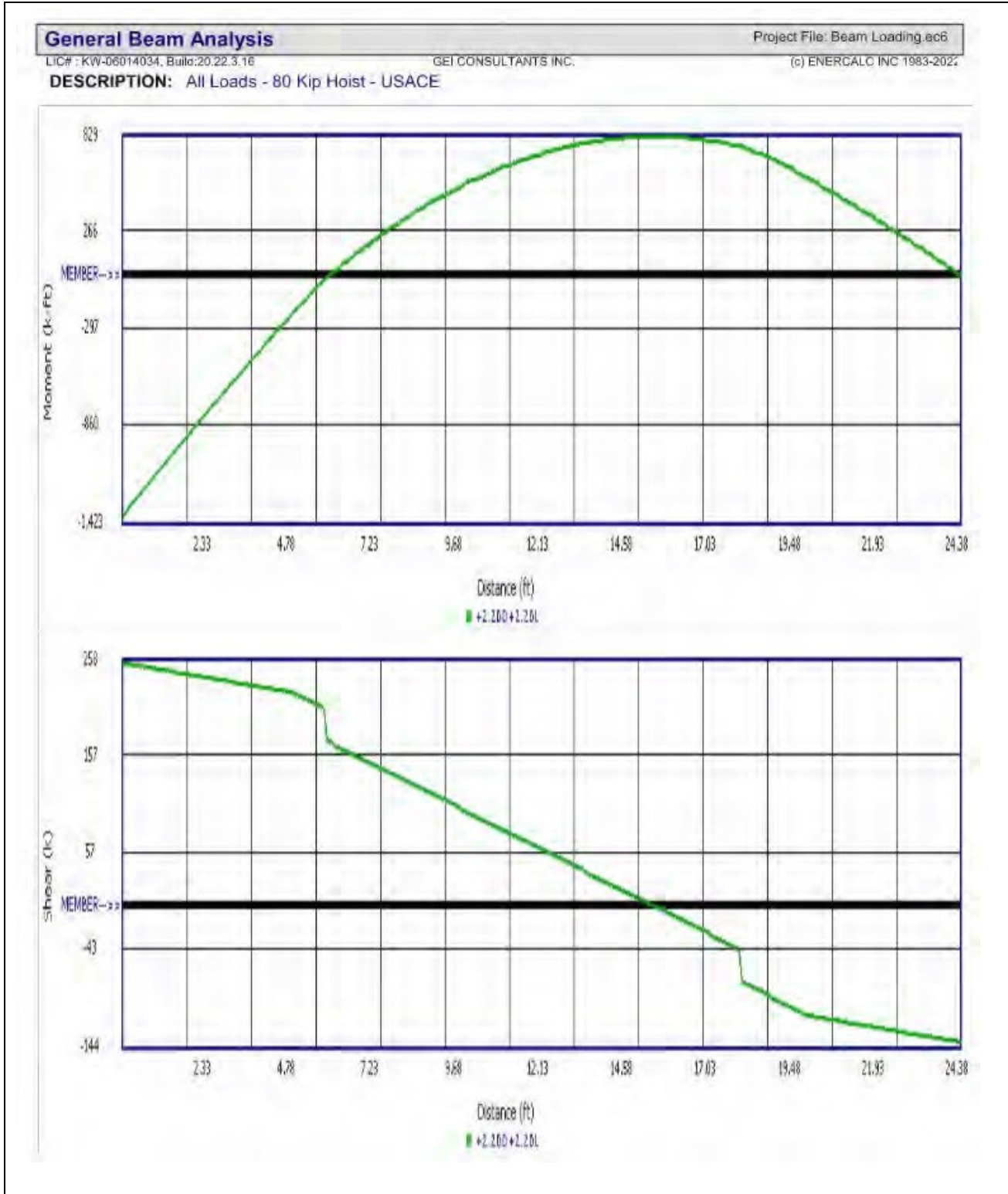
Vertical Reactions

Support notation : Far left is # Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	114.779	64.016
Overall MINimum		
D Only	95.235	53.560
+D+L	114.779	64.016
+D+0.750L	109.893	61.402
+0.60D	57.141	32.136
L Only	19.544	10.456


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		By	M. Carden	Chk.	M. Guirguis	App.	B. Walton
		Date	5/23/2023	Date	2/24/2023	Date	5/26/2023
Project No.	2301089	Document No.	N/A				
Subject	Existing Bridge Capacity						




Client: GEI Consultants, Inc.

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	Project	Waterbury Dam Interim Flood Study			Pg. Rev.	
	By	M. Carden	Chk.	M. Guirguis	App.	B. Walton
	Date	5/23/2023	Date	2/24/2023	Date	5/26/2023
Project No.	2301089	Document No.	N/A			
Subject	Existing Bridge Capacity					

40 kip Hoist - ENERCALC ACI

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		By	M. Carden	Chk.	M. Guirguis	App.	B. Walton
		Date	5/23/2023	Date	2/24/2023	Date	5/26/2023
Project No.	2301089	Document No.	N/A				
Subject	Existing Bridge Capacity						

General Beam Analysis

Project File: Beam Loading.ec6

LIC# : KW-08014034, Build:20.22.3.16

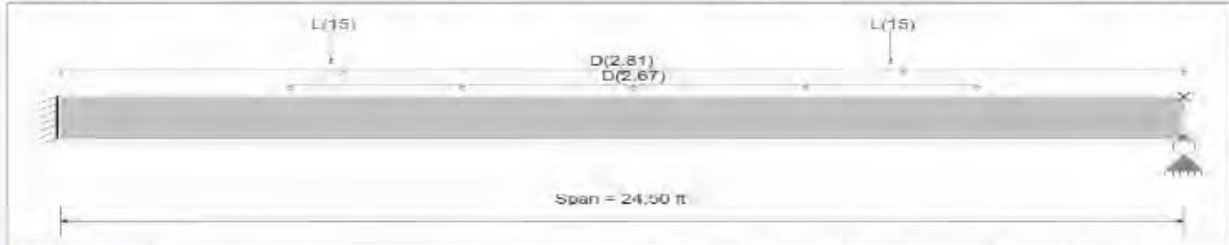
GEI CONSULTANTS INC.

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DESCRIPTION: All Loads - 40 Kip Hoist - ACI

General Beam Properties

Elastic Modulus = 3,122.0 ksi
Span #1 Span Length = 24.50 ft Area = 204.0 in² Moment of Inertia = 272.0 in⁴



Applied Loads

Service loads entered. Load Factors will be applied for calculations

Load for Span Number 1

Uniform Load : D = 2.670 k/ft, Extent = 5.0 --> 20.0 ft, Tributary Width = 1.0 ft, (Hoist)

Uniform Load : D = 2.810 k/ft, Tributary Width = 1.0 ft, (Deck)

Point Load : L = 15.0 k @ 5.90 ft, (Wire Rope)

Point Load : L = 15.0 k @ 18.10 ft, (Wire Rope)

DESIGN SUMMARY

Maximum Bending =	611.281 k-ft	Maximum Shear =	114.287 k
Load Combination	+1.20D+1.60L	Load Combination	+1.20D+1.60L
Span # where maximum occurs	Span # 1	Span # where maximum occurs	Span # 1
Location of maximum on span	0.000 ft	Location of maximum on span	0.000 ft
Maximum Deflection			
Max Downward Transient Deflection	5.239 in	56	
Max Upward Transient Deflection	0.003 in	93815	
Max Downward Total Deflection	25.466 in	11	
Max Upward Total Deflection	0.007 in	43753	

Maximum Forces & Stresses for Load Combinations


Load Combination	Segment Length	Span #	Max Stress Ratios		Summary of Moment Values (k-ft)					Shear Values (k)		
			M	V	Mmax +	Mmax -	Ma - Max	Mnx	Mnx/Omega Cb	Rm	Va Max	Vnx/Vnx/Omega
Overall MAXimum Envelope												
Dsgn. L = 24.50 ft		1			349.54	-611.28	611.28					114.29
+1.20D+1.60L												
Dsgn. L = 24.50 ft		1			349.54	-611.28	611.28					114.29

Vertical Reactions

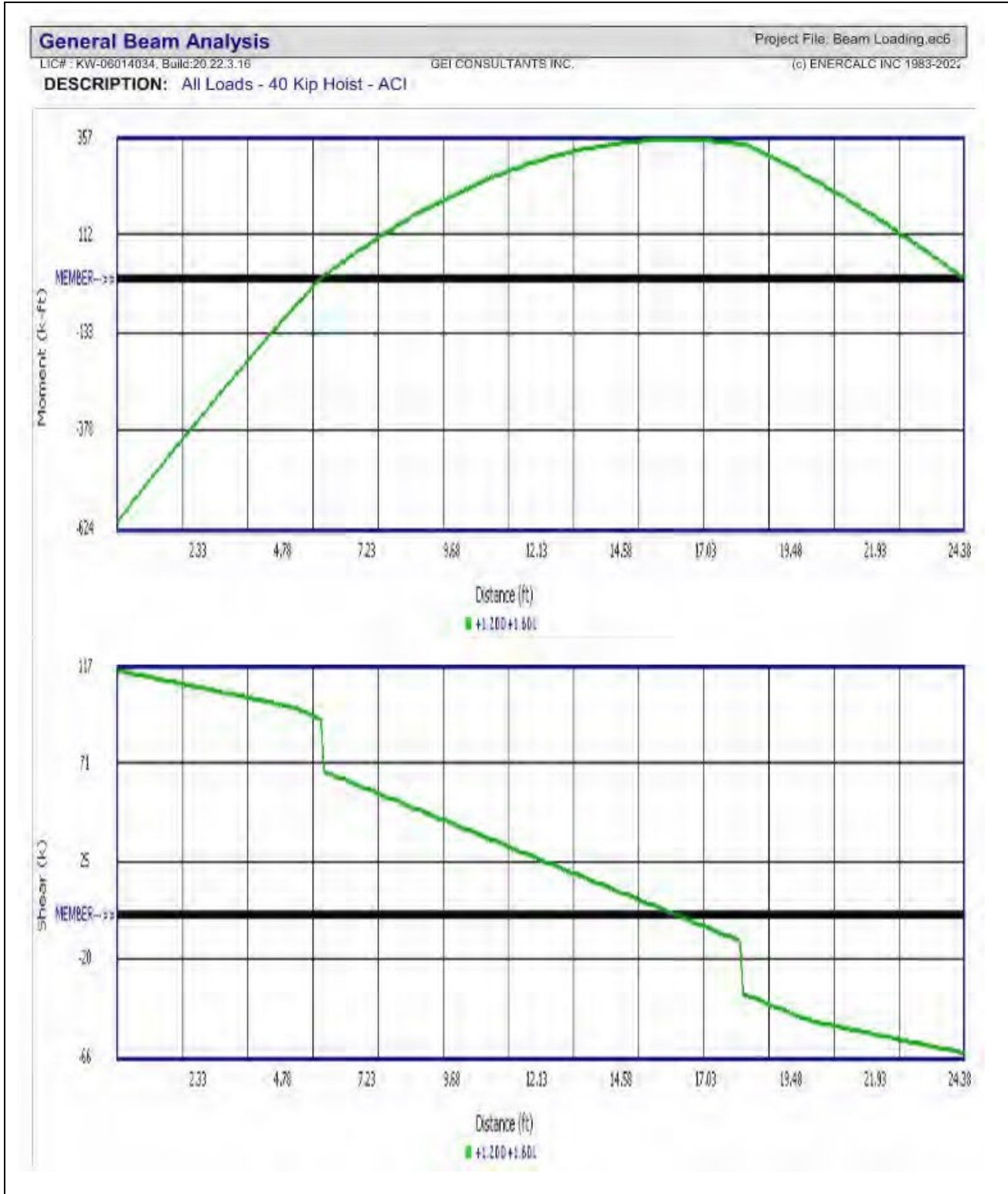
Support notation : Far left is #

Values in KIPS


Load Combination	Support 1	Support 2
Overall MAXimum	88.724	50.171
Overall MINimum		
D Only	69.181	39.714
+D+L	88.724	50.171
+D+0.750L	83.838	47.557
+0.60D	41.508	23.829
L Only	19.544	10.456


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		By	M. Carden	Chk.	M. Guirguis	App.	B. Walton
		Date	5/23/2023	Date	2/24/2023	Date	5/26/2023
Project No.	2301089	Document No.	N/A				
Subject	Existing Bridge Capacity						




Client: GEI Consultants, Inc.

	Client	VT DEC Project: Mathcad Template	Page
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	Project	Waterbury Dam Interim Flood Study			Pg. Rev.	
	By	M. Carden	Chk.	M. Guirguis	App.	B. Walton
	Date	5/23/2023	Date	2/24/2023	Date	5/26/2023
Project No.	2301089	Document No.	N/A			
Subject	Existing Bridge Capacity					

40 kip Hoist - ENERCALC USACE

 GEI <small>cor</small>	Client	VT DEC	Page	21 of 221
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		By	M. Carden	Chk.	M. Guirguis	App.	B. Walton
		Date	5/23/2023	Date	2/24/2023	Date	5/26/2023
Project No.	2301089	Document No.	N/A				
Subject	Existing Bridge Capacity						

General Beam Analysis

Project File: Beam Loading.ec6

LIC#: KW-06014034, Build:20.22.3.16

GEI CONSULTANTS INC.

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DESCRIPTION: All Loads - 40 Kip Hoist - USACE

General Beam Properties

Elastic Modulus	3,122.0 ksi			
Span #1	Span Length = 24.50 ft	Area = 204.0 in ²	Moment of Inertia = 272.0 in ⁴	

Applied Loads Service loads entered. Load Factors will be applied for calculations

Load for Span Number 1

- Uniform Load : D = 2.670 k/ft, Extent = 5.0 --> 20.0 ft, Tributary Width = 1.0 ft, (Hoist)
- Uniform Load : D = 2.810 k/ft, Tributary Width = 1.0 ft, (Deck)
- Point Load : L = 15.0 k @ 5.90 ft, (Wire Rope)
- Point Load : L = 15.0 k @ 18.10 ft, (Wire Rope)

DESIGN SUMMARY

Maximum Bending =	1,044.546 k-ft	Maximum Shear =	195.193 k
Load Combination	+2.20D+2.20L	Load Combination	+2.20D+2.20L
Span # where maximum occurs	Span # 1	Span # where maximum occurs	Span # 1
Location of maximum on span	0.000 ft	Location of maximum on span	0.000 ft
Maximum Deflection			
Max Downward Transient Deflection	5.239 in		56
Max Upward Transient Deflection	0.003 in		93815
Max Downward Total Deflection	25.466 in		11
Max Upward Total Deflection	0.007 in		43753

Maximum Forces & Stresses for Load Combinations

Load Combination	Segment Length	Span #	Max Stress Ratios		Summary of Moment Values (k-ft)				Shear Values (k)		
			M	V	Mmax +	Mmax -	Ma - Max	Mnx	Mnx/Omega Cb	Rm	Va Max
Overall MAXimum Envelope											
Dsgn. L = 24.50 ft		1			598.64	-1,044.55	1,044.55				195.19
+2.20D+2.20L											
Dsgn. L = 24.50 ft		1			598.64	-1,044.55	1,044.55				195.19

Vertical Reactions Support rotation : Far left is # Values in KIPS

Load Combination	Support 1	Support 2
Overall MAXimum	88.724	50.171
Overall MINimum		
D Only	69.181	39.714
+D+L	88.724	50.171
+D+0.750L	83.838	47.557
+0.60D	41.508	23.829
L Only	19.544	10.456

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		By	M. Carden	Chk.	M. Guirguis	App.	B. Walton
		Date	5/23/2023	Date	2/24/2023	Date	5/26/2023
Project No.	2301089	Document No.	N/A				
Subject	Existing Bridge Capacity						

General Beam Analysis

Project File: Beam Loading.ec6

LIC# : KW-08014034, Build:20.22.3.16

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DESCRIPTION: All Loads - 40 Kip Hoist - USACE

