CONSTRUCTION COMPLETION REPORT
SQUANNACOOK RIVER DAM
NID # MA00442
GROTON, MASSACHUSETTS

by

Haley & Aldrich, Inc.
Boston, Massachusetts

for

Groton Highway Department
Groton, Massachusetts

File No. 35078-003
10 January 2014

HALEY & ALDRICH

Haley & Aldrich, Inc.
465 Medford St.
Suite 2200
Boston, MA 02129-1400

Tel: 617.886.7400
Fax: 617.886.7600
HaleyAldrich.com

10 January 2014
File No. 35078-003

Mark Geib, P.E.
Dam Safety Engineer
Office of Dam Safety
Department of Conservation and Recreation
251 Causeway Street, Suite 600
Boston, MA 02114-2119

Subject: Construction Completion Report
Squannacook River Dam
NID # MA00442
State Dam ID No. 4-9-115-1
Groton, Massachusetts

Dear Mr. Geib:

On behalf of our client, the Town of Groton, we are submitting this Construction Completion Report in accordance with the Chapter 253 Dam Safety Permit issued to the project.

A Dam Safety Permit was issued under M.G.L. Chapter 253 to complete repairs to Squannacook River Dam, NID #MA00442, in Groton, Massachusetts by the Massachusetts Office of Dam Safety on 24 March 2008. This permit expired 24 March 2010; however, the proposed work was delayed due to project funding issues and the permit was renewed by the Massachusetts Office of Dam Safety on 22 March 2013. This report summarizes and documents completion of the work and requests a Certificate of Compliance be issued by the Office of Dam Safety for the Dam.

Summary of Repairs

The repairs include chipping and removal of deteriorated concrete, doweling steel reinforcing bars into the remaining concrete and placement of concrete for sluiceway and portions of the spillway.

Repairs of the Squannacook River Dam were completed in accordance with the Construction Documents for the project and the attached documents included in this report.

Haley & Aldrich, Inc. reviewed field reports completed by Mr. Lynwood V. Prest, P.E. of Groton Engineering, LLC. Mr. Prest was on-site part time during construction to document compliance with the contract documents and generated the attached field reports for the project.

In our opinion, the work described in field reports by Mr. Prest, P.E. was conducted in accordance with acceptable dam construction practices and requirements of the Massachusetts Dam Safety Regulations, Chapter 253.

Closure

Please feel free to contact the undersigned at 617-886-7343 if you wish to discuss the enclosed information or have additional questions.

Sincerely yours,
HALEY & ALDRICH, INC.

Denis J. Bell, P.E.
Senior Engineer

Attachments:

Appendix A	M.G.L. Chapter 253 Dam Safety Permit
Appendix B	Dam Safety Certificate of Completion
Appendix C	Record Drawings
Appendix D	Construction Field Reports
Appendix E	Photographs
Appendix F	Phase I Dam Safety Inspection/ Evaluation

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APPENDIX A

M.G.L. Chapter 253 Dam Safety Permit

dcr
Massachusetts

M.G.L. Chapter 253
Dam Safety Permit

Applicant

Mr. R. Thomas Delaney, Jr.
Highway Director
600 Cow Pond Brook Rd.
Groton, MA 01450

Re: Groton
Squannacook River Dam Repairs
State Dam ID No. 4-9-115-1
National Dam ID No. MA00442

Date: March 24, 2008

Dear Mr. Delaney,

Reference is made to the completed application and supporting data submitted for Department of Conservation and Recreation (DCR) regulatory review of the above-referenced dam safety improvements.

Approval is hereby granted under M.G.L. Chapter 253, as amended, to perform the work indicated on the drawings and supporting documentation titled: **"Squannacook River Dam Repairs"** as prepared by Haley & Aldrich, Inc. and dated February , 2008.

Permission is granted subject to the following conditions:

Department of Conservation and Recreation
Office of Dam Safety
John Augustus Hall
180 Beaman Street
West Boylston, MA 01583
508-792-7716 508-792-78718 FAX
www.mass.gov/dcr

Required:

(a) At least 21 days before the start of construction, **DAM SAFETY IMPROVEMENTS – NOTICE OF CONSTRUCTION** (form attached) with attached construction schedule to the DCR/ODS - Permits Section.

(b) Notification of any design change from the original due to regulatory requirements, change in field conditions, or any other unanticipated occurrence.

(c) **DAM SAFETY CERTIFICATE OF COMPLETION** (form attached) and two (2) sets of final "as built" plans signed and stamped by a registered professional civil engineer with contractor's signature attesting that the work was performed according to the plans and specifications.

(d) Digital color photos of construction phases and appurtenant installations. Photos numbers, location and direction in which each photo was taken must be identified.

Elective requirements:

(a) An evaluation report of repairs within four (4) months of completion and/or after the impoundment is raised to the highest adjusted water elevation. Yes() No(x)

(b) Weekly() or bi-monthly() reports signed by a registered professional civil engineer during periods of construction. Yes() No(x)

(c) Part-time field engineering services paid by the DCR. Weekly() or bi-monthly() reports signed by inspecting engineer. Reports to include date, timetable and type of service(s) performed. Yes() No(x)

(d) Full-time field engineering services paid by the DCR. Weekly() or bi-monthly() reports signed by inspecting engineer. Reports to include date, timetable and type of service(s) performed. Yes() No(x)

(e) Construction water control plan and warning procedure are to be approved by the design engineer before the start of construction. Yes(x) No()

(f) As specified: Yes(x) No()

The applicant shall invite ODS to the preconstruction meeting, another project meeting at 50% completion and the final inspection meeting. ODS reserves the right to make site visits and inspections at any time during the permit period.

Any permit issued by DCR shall be subject to revocation by order of the Commissioner if the permitted fails to conform to 302 CMR 10.00, Dam Safety Rules and Regulations, provisions of this permit, or any other applicable laws and regulations.

This permit does not release the applicant from the requirements of any other regulatory authority. Such authorizations and/or notifications include, but are not limited to:

Local Conservation Commission
Massachusetts Department of Environmental Protection (DEP)
Massachusetts Department of Fish and Game (DFG)
Massachusetts Executive Office of Environmental Affairs (EOEA), MEPA Unit.
U.S. Army Corps of Engineers.

This permit must be recorded by the applicant at the Registry of Deeds in the county where the dam lies. Recording must be done prior to the commencement of construction and a copy of the recorded permit filed with the Office of Dam Safety.

This permit remains valid for two (2) years from the date of issue: **March 24, 2008**

Permit expiration date: **March 24, 2010**

Jerzy Pietrzak, P.E., Permit Engineer
DCR, Office of Dam Safety

c: Denis J. Bell, P.E., Haley & Aldrich, Inc., 465 Medford St., Boston MA 02129

Attachments: Dam Safety Improvements – Notice of Construction form
Dam Safety Certificate of Completion form

Informational (NOT TO BE RECORDED AT REGISTRY OF DEEDS)

Excerpts from Dam Safety Rules Regulations

302 CMR 10.09(5): Recording a Chapter 253 Permit.

A permit to construct, drawdown, repair, alter, breach or remove a dam shall be recorded at the Registry of Deeds in the county where the dam lies. Recording must be done prior to the commencement of construction and a copy of the recorded permit filed with the Commissioner.

APPENDIX B

Dam Safety Certificate of Completion

To: DCR, Office of Dam Safety – Permits Section
180 Beaman Street
West Boylston, MA 01583

DAM SAFETY CERTIFICATE OF COMPLETION

Dam Owner/Applicant

Name:	Town of Groton, Massachusetts
Representative:	R. Thomas Delaney, Jr., Highway Director
Address:	600 Cow Pond Brook Road, Groton, Massachusetts 01450
Phone:	(978) 448-1162
Fax:	
Email Address:	highway@townofgroton.org

Project

Project location Town/City:	Groton, Massachusetts
Dam name:	Squannacook River Dam
National Dam ID Number:	MA00442
State Dam ID Number:	4-9-115-1
Nature of Dam Safety Improvements:	Re-Build Spillway and Sluiceway
Chapter 253 Permit date of issue:	24 March 2008
Chapter 253 Permit expiration date:	24 March 2010
Chapter 253 Permit Renewed:	22 March 2013

Permit Recorded at Middlesex South Registry of Deeds

Dam Parcel Registry of Deeds Book/Page Numbers:	35669/ 569
Registered Permit Registry of Deeds Book Number:	58860
Registered Permit Registry of Deeds Page Number:	133
Project completion date:	December 2013

Engineer

Company Name:	Haley & Aldrich, Inc.
Representative:	Denis J. Bell, P.E.
Address:	465 Medford Street, Suite 2200, Boston, Massachusetts
Phone:	617-886-7343
Fax:	617-886-7643
Email Address:	DBell@HaleyAldrich.com

Contractor

Company Name:	T. Ford Company, Inc.
Representative:	Dan Galante
Address:	118 Tenney Street, Georgetown, MA 01833
Phone:	(978) 352-5606
Fax:	
Email Address:	dan@TFORD.COM

Brief description of project and dates of construction:

Construction began September 2013 and included temporary cofferdam and water diversion, chipping of deteriorated concrete walls, doweling, and placement of new concrete for penstock walls and portion of spillway
Construction was completed by December 2013.

Statement of project completion in accordance with plans, specifications, dam safety permit conditions and standard construction practices:

By Contractor

Print name and title: Daniel Galante, Vice President

Signature and date: 1/7/13

By Engineer

Print name, title and PE stamp here: Denis J. Bell, P.E. MA Reg No. 46241

Signature and date: 1/7/2014

By Dam Owner/Applicant

Print name and title: Robert T Delaney Jr DPW Director

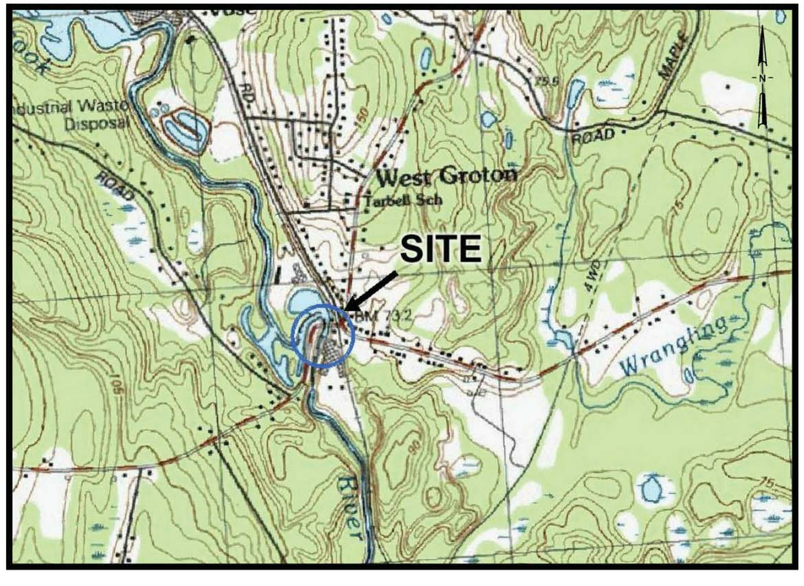
Signature and date:

APPENDIX C

Record Drawings

Contract Drawings
Squannacook River Dam
Town of Groton Phase

Groton, Massachusetts
1 February 2013



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APPROXIMATE SCALE IN FEET

Index of Drawings		
Drawing	**Drawing No.**	**Drawing Title**
C-1	1	Cover Sheet and Index
C-2	2	Existing Conditions Plan
C-3	3	Erosion Control and Site Layout Plan
C-4	4	Proposed Conditions Plan
C-5	5	Sections and Details

HALEY & ALDRICH
465 Medford Street, Suite 2200
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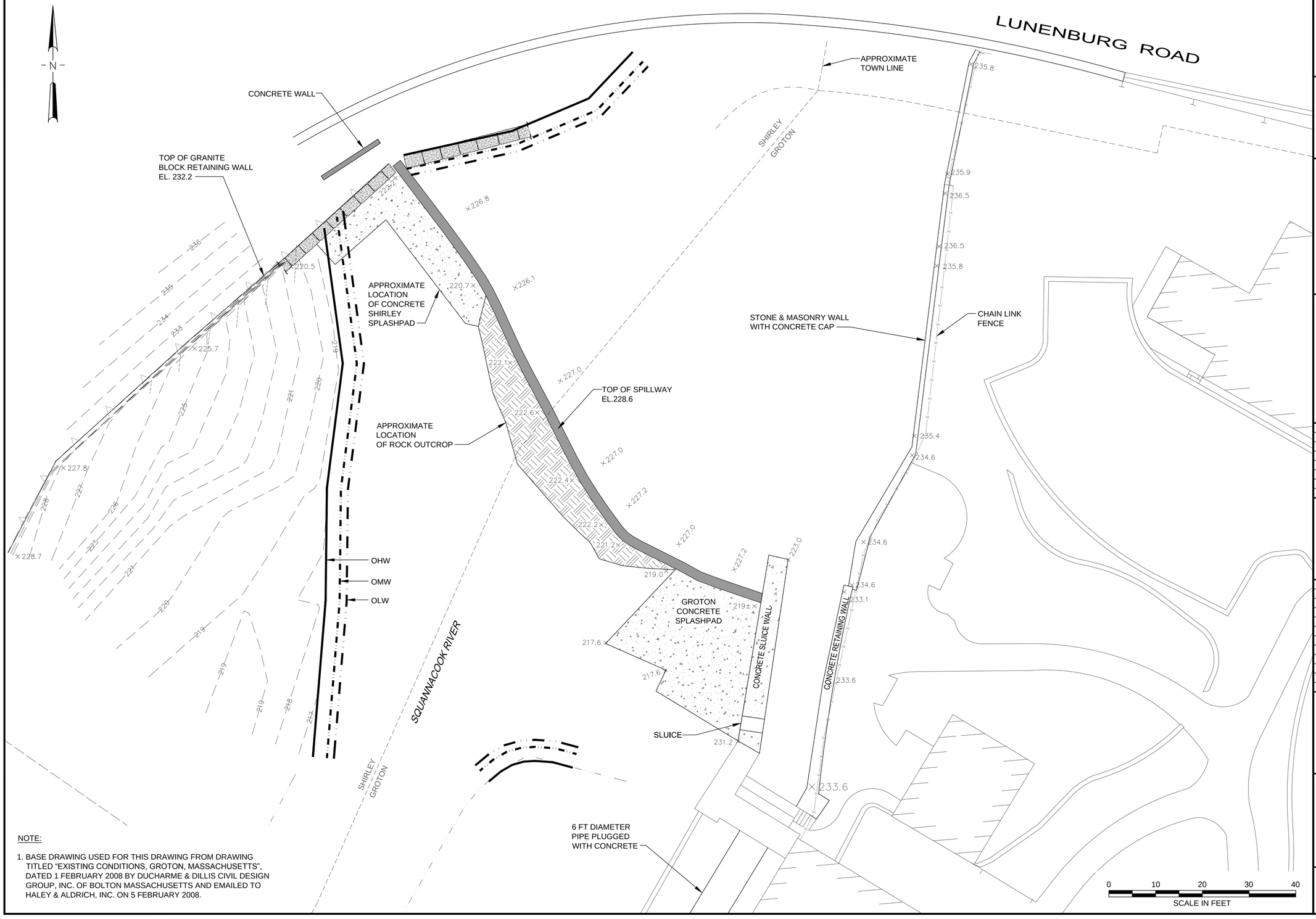
Fax: 617.886.7600
Web site: www.HaleyAldrich.com

COMMONWEALTH OF MASSACHUSETTS
DENIS J. BELL
CIVIL
No. 46241
REGISTERED PROFESSIONAL ENGINEER

J:\GRAPHICS\35078\35078-000-D021.DWG



NOTE:

1. BASE DRAWING USED FOR THIS DRAWING FROM DRAWING TITLED "EXISTING CONDITIONS, GROTON, MASSACHUSETTS", DATED 1 FEBRUARY 2008 BY DUCHARME & DILLIS CIVIL DESIGN GROUP, INC. OF BOLTON MASSACHUSETTS AND EMAILED TO HALEY & ALDRICH, INC. ON 5 FEBRUARY 2008.

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HALEY & ALDRICH
465 Medford Street, Suite 2200
Boston, Massachusetts
Tel: 617.886.7400
Fax: 617.886.7600
Website: www.HaleyAldrich.com

Project No.:	35094-000
Scale:	AS SHOWN
Date:	29 FEBRUARY 2008
Autocad File:	35078-000-D017.DWG
Drawn By:	BV
Designed By:	BV
Checked By:	DJB
Approved By:	DJB

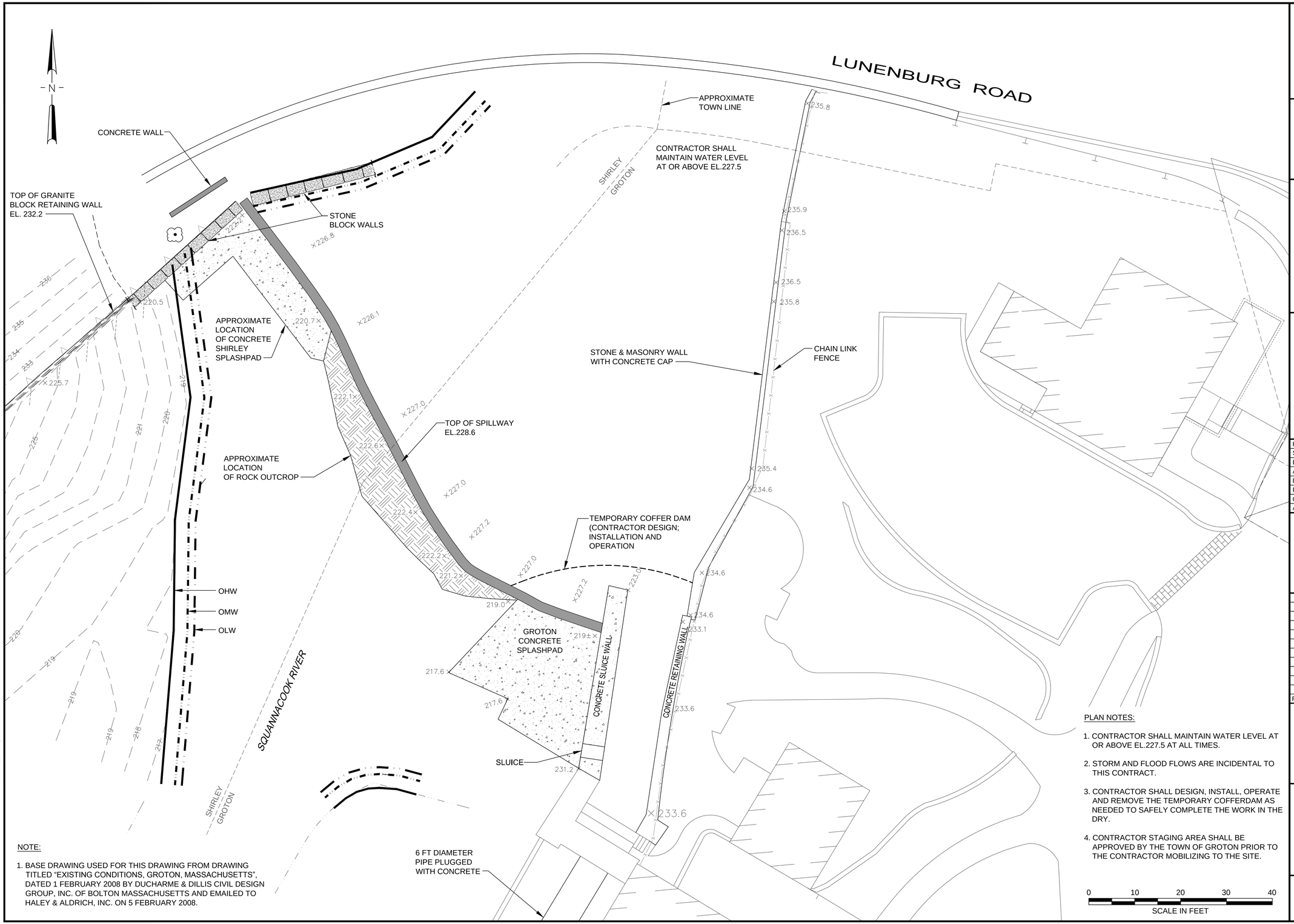
Rev.	Description	By	Date
3	CONTRACT DRAWINGS	DJB	2/1/2013
2	GROTON PHASE	DJB	9/17/12
1	FOR REVIEW	DJB	8/8/12

SQUANNACOOK RIVER DAM

Groton, Massachusetts

EXISTING CONDITIONS PLAN

C-2



NOTE:

1. BASE DRAWING USED FOR THIS DRAWING FROM DRAWING TITLED “EXISTING CONDITIONS, GROTON, MASSACHUSETTS”, DATED 1 FEBRUARY 2008 BY DUCHARME & DILLIS CIVIL DESIGN GROUP, INC. OF BOLTON MASSACHUSETTS AND EMAILED TO HALEY & ADLDRICH, INC. ON 5 FEBRUARY 2008.

PLAN NOTES:

1. CONTRACTOR SHALL MAINTAIN WATER LEVEL AT OR ABOVE EL.227.5 AT ALL TIMES.
2. STORM AND FLOOD FLOWS ARE INCIDENTAL TO THIS CONTRACT.
3. CONTRACTOR SHALL DESIGN, INSTALL, OPERATE AND REMOVE THE TEMPORARY COFFERDAM AS NEEDED TO SAFELY COMPLETE THE WORK IN THE DRY.
4. CONTRACTOR STAGING AREA SHALL BE APPROVED BY THE TOWN OF GROTON PRIOR TO THE CONTRACTOR MOBILIZING TO THE SITE.

0 10 20 30 40
SCALE IN FEET

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Boston, Massachusetts
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Website: www.HaleyAldrich.com

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Date:	29 FEBRUARY 2008
Autocad File:	35078-000-D017.DWG
Drawn By:	BV
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Rev.	Description	By	Date
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1	FOR REVIEW	DJB	8/8/12

SQUANNACOOK RIVER DAM

Groton, Massachusetts

EROSION CONTROL AND SITE LAYOUT PLAN

C-3

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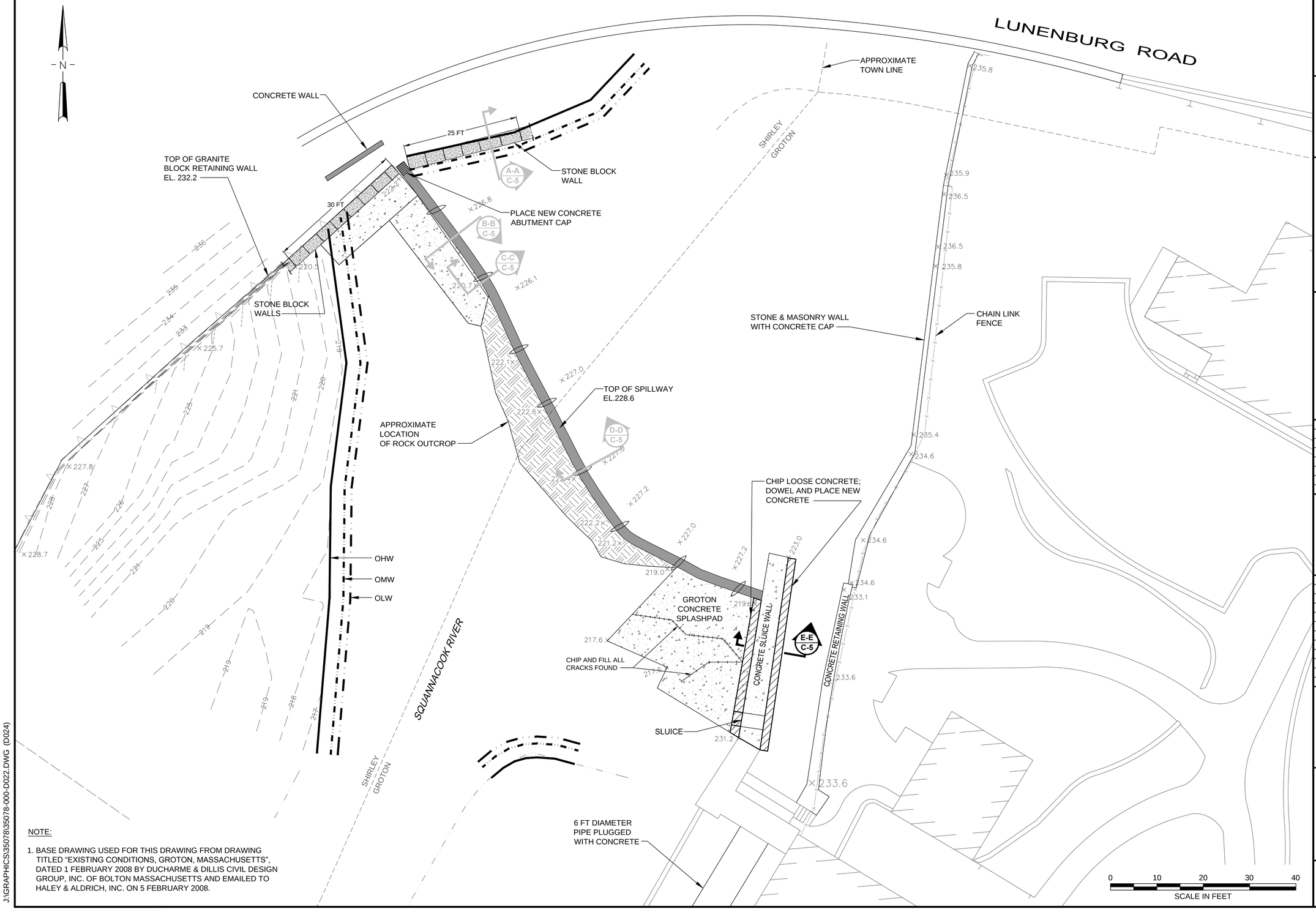

NOTE:

1. BASE DRAWING USED FOR THIS DRAWING FROM DRAWING TITLED "EXISTING CONDITIONS, GROTON, MASSACHUSETTS", DATED 1 FEBRUARY 2008 BY DUCHARME & DILLIS CIVIL DESIGN GROUP, INC. OF BOLTON MASSACHUSETTS AND EMAILED TO HALEY & ALDRICH, INC. ON 5 FEBRUARY 2008.

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HALEY & ALDRICH
465 Medford Street, Suite 2200
Boston, Massachusetts
Tel: 617.886.7400
Fax: 617.886.7600
Website: www.HaleyAldrich.com

Project No.:	35094-000
Scale:	AS SHOWN
Date:	29 FEBRUARY 2008
Autocad File:	35078-000-D017.DWG
Drawn By:	BV
Designed By:	BV
Checked By:	DJB
Approved By:	DJB

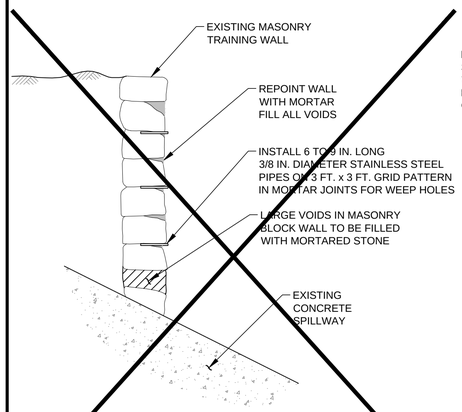
Rev.	Description	By	Date
3	CONTRACT DRAWINGS	DJB	2/1/2013
2	GROTON PHASE	DJB	9/17/12
1	FOR REVIEW	DJB	8/8/12

SQUANNACOOK RIVER DAM

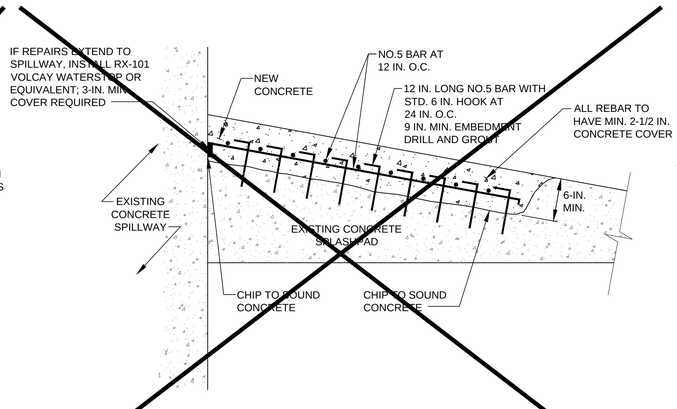
Groton, Massachusetts

PROPOSED CONDITIONS PLAN

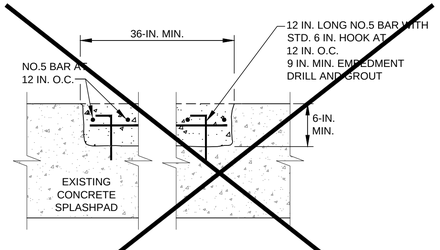
C-4



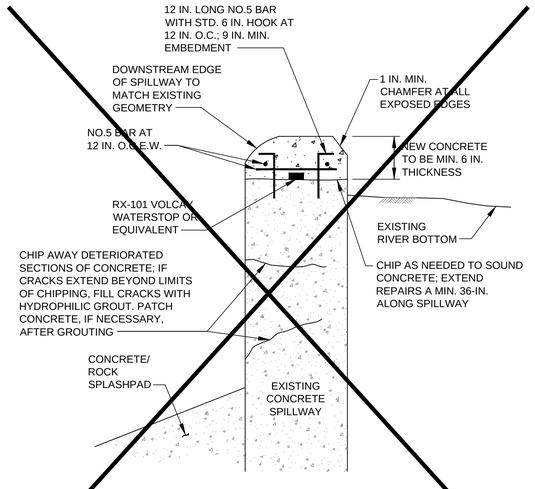
PROPOSED REPAIRS TO STONE MASONRY TRAINING WALL SECTION VIEW A-A C-4
NOT TO SCALE



PROPOSED REPAIRS TO SPLASHPAD SECTION VIEW B-B C-4
NOT TO SCALE

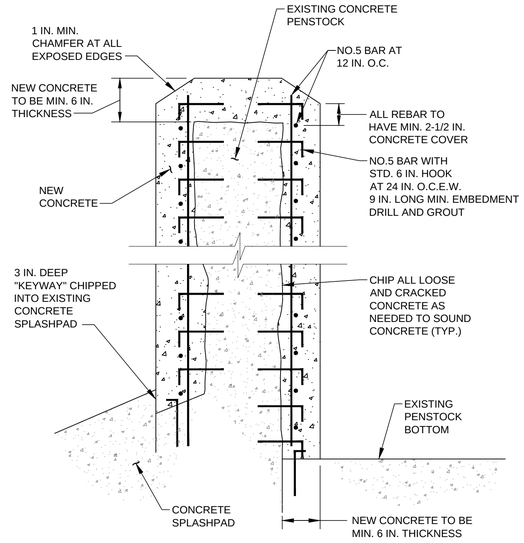


PROPOSED REPAIRS TO SHIRLEY SPLASHPAD ELEVATION VIEW C-C C-4
NOT TO SCALE

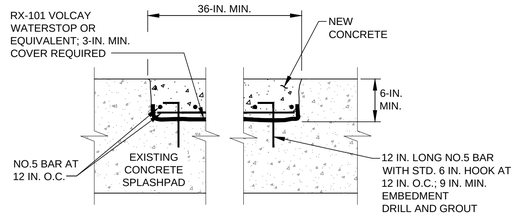


PROPOSED REPAIRS TO CONCRETE SPILLWAY SECTION VIEW D-D C-4
NOT TO SCALE

NOTE: SECTIONS A-A, B-B, C-C, AND D-D ARE NOT IN GROTON PHASE CONTRACT



PROPOSED REPAIRS TO PENSTOCK WALL SECTION VIEW E-E C-4
NOT TO SCALE



PROPOSED REPAIRS TO CRACKS IN GROTON CONCRETE SPLASH PAD ELEVATION VIEW
NOT TO SCALE

NOTES FOR CONCRETE REPAIRS

1. DETERIORATED PORTIONS OF EXISTING CONCRETE TO BE CHIPPED DOWN TO SOUND CONCRETE. THE SURFACE OF THE CHIPPED AREA SHALL BE THOROUGHLY CLEANED AND FREE OF DUST AND DEBRIS PRIOR TO PLACING NEW CONCRETE. ALL SURFACES TO RECEIVE CONCRETE TO BE POWER-WASHED WITH HIGH PRESSURE WATER AND THEN CLEANED WITH COMPRESSED AIR PRIOR TO PLACING CONCRETE.
2. PRIOR TO PLACING CONCRETE AND REINFORCING STEEL ADJACENT TO A PREVIOUSLY POURED SECTION, ALL JOINTS SHALL BE THOROUGHLY CLEANED TO CREATE A WATERTIGHT BOND.
3. ALL CRACKS GREATER THAN 4 INCHES DEEP OBSERVED ALONG THE CHIPPED AND CLEANED CONCRETE SURFACE SHALL BE FILLED WITH A HYDROPHILIC GROUT.
4. REINFORCING STEEL SHALL BE STANDARD DEFORMED STEEL REINFORCING BARS CONFORMING TO THE REQUIREMENTS OF ASTM A615, GRADE 60. BARS SHALL BE EPOXY COATED.
5. REINFORCING BARS SHALL BE DRILLED AND GROUTED A MINIMUM OF 9 IN. IN TO THE FACE OF THE EXISTING CONCRETE SURFACE, FOLLOWING CHIPPING.
6. TESTING AND INSPECTION OF CONCRETE SHALL BE BY APPROVED TESTING AGENCY CONTRACTED TO CONTRACTOR. CONCRETE SHALL BE COLLECTED IN ACCORDANCE WITH ASTM C172. THE TESTING AGENCY WILL CONFORM TO ASTM C31. THE CONCRETE SHALL CONSIST OF TYPE II PORTLAND CEMENT 3/4 IN. MAX. AGGREGATE WITH A MINIMUM 28-DAY COMPRESSIVE STRENGTH OF 4,000 PSI.
7. CONTRACTOR SHALL PROVIDE LATERAL SUPPORT OF THE SPILLWAY AND PENSTOCK WALLS, AS NECESSARY, DURING ALL CONCRETE REPAIRS.

HALEY & ALDRICH
465 Medford Street, Suite 2200
Boston, Massachusetts
Tel: 617.886.7400
Fax: 617.886.7600
Website: www.HaleyAldrich.com

Project No.:	35078-000
Scale:	AS SHOWN
Date:	JANUARY 2012
Autocad File:	35078-000-D020.DWG
Drawn By:	DTE
Designed By:	LSV
Checked By:	DJB
Approved By:	DJB

Rev.	Description	By	Date
3	CONTRACT DRAWINGS	DJB	2/1/2013
2	GROTON PHASE	DJB	9/17/12
1	FOR REVIEW	DJB	8/8/12

SQUANNACOOK RIVER DAM
Groton, Massachusetts

SECTIONS AND DETAILS

C-5

5 OF 5

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APPENDIX D

Construction Field Reports

GROTON ENGINEERING, LLC
11 Highland Road
Groton, MA 01450
Ph: 978 - 448-3863
Email: grotoneng@gmail.com

ENGINEER'S STRUCTURAL FIELD REPORT

JOB NO.: 2013-043 FIELD REPORT NO.: 1
PROJECT: Squannacook River Dam Repair
CLIENT: DPW, Town of Groton, MA

DATE: 9-12-2013 TIME: 7 AM WEATHER: Cloudy TEMP.: 71 F

EST. % OF COMPLETION: 0.0%	CONFORMANCE WITH SCHEDULE:
WORK IN PROGRESS: Starting to install staging for chipping off old and deteriorated concrete.	PRESENT AT SITE: Tom Delaney, DPW Manager, Town of Groton Daniel Galante, V.P., T-Ford Construction Val Prest, S.E. representing the Town of Groton

OBSERVATIONS:
Water has been drawn down to expose sides and bottom of spillway. A lot of mud, logs, fallen concrete and other debris must be removed from the spillway. Both sides of the inner spillway wall are severely damaged from the flowing water and probably recurring ice during winters. Concrete apron on downstream discharge sides of the spillway and main dam has numerous cracks that will be part of the repair program.

ITEMS TO VERIFY: The 3/4" stone aggregate for the concrete is too large for ease of getting concrete into and around reinforcing in the proposed 6" thick capping wall. Mr. Galante and I suggested 1/4" peastone and will request the SER review that.

I also suggest that the new concrete be coated with an epoxy suitable for resistance to scouring and penetration of flowing water. In lieu of that consider some SIKA admixtures that reduce permeability and increase resistance to scouring.

INFORMATION or ACTION REQUIRED: Find some SIKA products suitable to the purpose.

ATTACHMENTS: None

REPORT BY: Lynwood V. Prest, P.E., S.E.
President of Groton Engineering

GROTON ENGINEERING, LLC
11 Highland Road
Groton, MA 01450
Ph: 978-448-3863
Email: grotoneng@gmail.com

ENGINEER'S STRUCTURAL FIELD REPORT

JOB NO.: 2013-043 FIELD REPORT NO.: 2
PROJECT: Squannacook River Dam Repair
CLIENT: DPW, Town of Groton, MA

DATE: 9-26-2013 TIME: 11 AM WEATHER: Clear & sunny TEMP.: 65 F

EST. % OF COMPLETION: 10.0%	CONFORMANCE WITH SCHEDULE:
WORK IN PROGRESS: Chipping off old and deteriorated concrete on east side of sluiceway wall. Reinforcement already in place on the west side.	PRESENT AT SITE: Construction crew Val Prest, S.E. representing the Town of Groton

OBSERVATIONS:
Removal of damaged concrete is ongoing on east side of sluiceway wall. Reinforcing layer and anchors already in place on west side wall. Nothing touched on apron.

ITEMS TO VERIFY:

INFORMATION or ACTION REQUIRED:

ATTACHMENTS: Photos

REPORT BY: Lynwood V. Prest, P.E., S.E.
President of Groton Engineering

West face – Sept 26, 2013

Top of east side – Sept. 26, 2013

GROTON ENGINEERING, LLC
11 Highland Road
Groton, MA 01450
Ph: 978-448-3863
Email: grotoneng@gmail.com

ENGINEER'S STRUCTURAL FIELD REPORT

JOB NO.: 2013-043 FIELD REPORT NO.: 3
PROJECT: Squannacook River Dam Repair
CLIENT: DPW, Town of Groton, MA

DATE: 10-03-2013	TIME: 3 PM	WEATHER: Clear & sunny	TEMP.: 71 F

EST. % OF COMPLETION: 15.0%

CONFORMANCE WITH SCHEDULE:

WORK IN PROGRESS:
Continuation of chipping off old and deteriorated concrete on east side of sluiceway wall. They have opened up and removed a great deal of deteriorated concrete thus creating large cavities as visible in the attached photo.

PRESENT AT SITE:
Construction crew
Val Prest, S.E. representing the Town of Groton

OBSERVATIONS:
Removal of damaged concrete is ongoing on east side of sluiceway wall. Reinforcing layer and anchors already in place on west side wall. Nothing touched on apron.

ITEMS TO VERIFY: Concrete mix design

INFORMATION or ACTION REQUIRED: Changes in concrete mix design.

ATTACHMENTS: Photos

REPORT BY: Lynwood V. Prest, P.E., S.E.
President of Groton Engineering

Ongoing chipping on east side of wall

Concrete support for gearbox needs repair.

GROTON ENGINEERING, LLC
11 Highland Road
Groton, MA 01450
Ph: 978-448-3863
Email: grotoneng@gmail.com

ENGINEER'S STRUCTURAL FIELD REPORT

JOB NO.: 2013-043 FIELD REPORT NO.: 4
PROJECT: Squannacook River Dam Repair
CLIENT: DPW, Town of Groton, MA

DATE: 10-24-2013	TIME: 10:30 AM	WEATHER: Clear & sunny	TEMP.: 45 F

EST. % OF COMPLETION: 40.0 %

CONFORMANCE WITH SCHEDULE:

WORK IN PROGRESS:
Formwork for side walls completed. Top of wall chipped down 6". Still have top-of-wall reinforcing to install

PRESENT AT SITE:
Construction crew
Val Prest, S.E. representing the Town of Groton

OBSERVATIONS:
Chipping and preparation of existing concrete wall for new concrete has been done well as has the installation of reinforcing. Formwork has been installed on both sides of sluiceway wall and was also done very well. The west-side formwork is visible in the attached photo. Reinforcing across the top of the wall is yet to be installed. The lower levels of the wall formwork have been built such that the contractor, T Ford Company, Inc., can place concrete down low and get the pencil vibrators in at those levels for consolidating the placements.

The top-of-wall concrete was not shown in Rev. 2 of the drawings for construction but did appear in Rev. 3. A change order was issued for its inclusion in the scope of work along with changes in the concrete mix design.

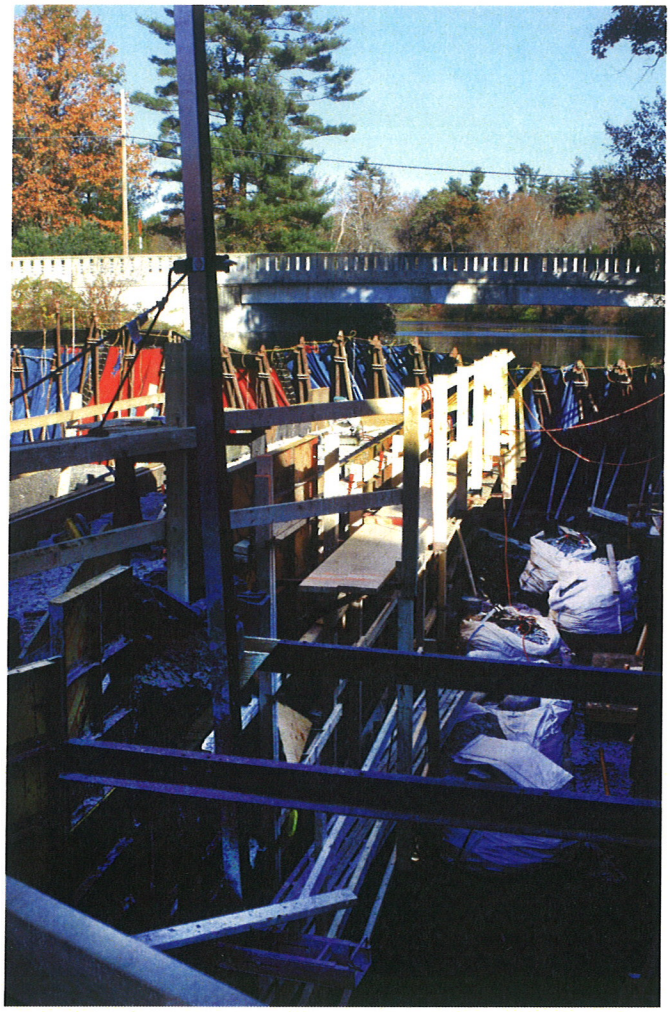
The concrete mix has been modified and approved for using smaller, 3/8", stone aggregate and microsilica to increase density of the concrete for better resistance to intrusion of and abrasion by the flowing river water.

ITEMS TO VERIFY:

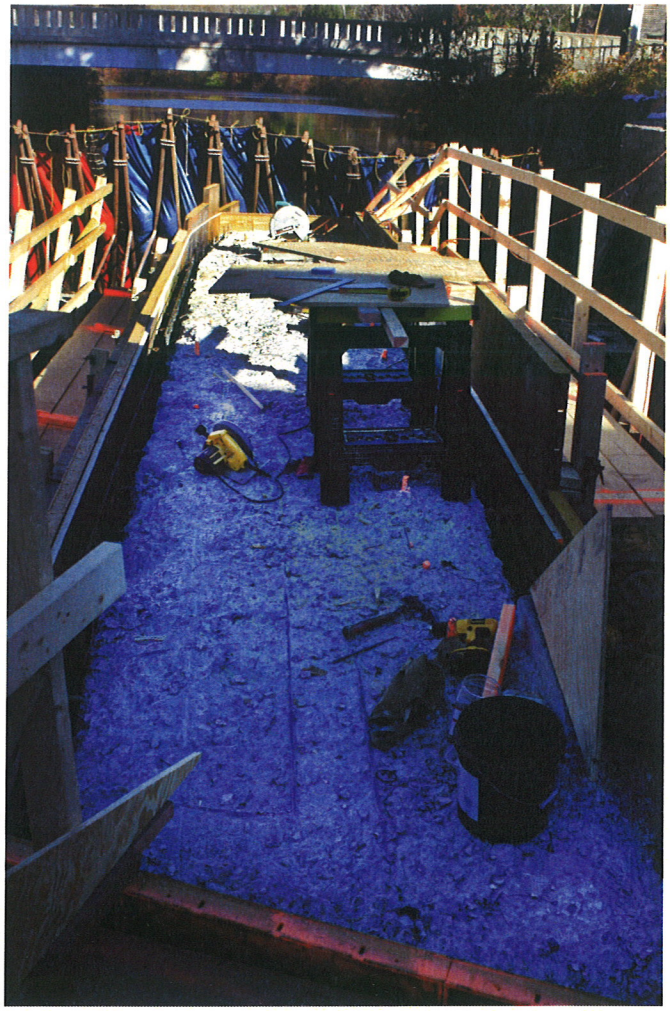
INFORMATION or ACTION REQUIRED: The placement of concrete for the sides and top of the wall is scheduled for tomorrow, Friday, October 25, 2013.

ATTACHMENTS: Photos

REPORT BY: Lynwood V. Prest, P.E., S.E.
President of Groton Engineering



West Side Formwork in place.



Top of Wall Prepped and Ready for Reinforcing

APPENDIX E

Photographs

Squannacook River Dam

Squannacook River Dam

Squannacook River Dam

Squannacook River Dam

APPENDIX F

Phase I Dam Safety Inspection/ Evaluation

SQUANNACOOK RIVER DAM
PHASE I INSPECTION / EVALUATION

Dam Name:	Squannacook River Dam
State ID #:	4-9-115-1
NID ID#:	MA00442
Owner:	Town of Groton
Owner Type:	Municipal
Town:	Groton
Consultant:	Haley & Aldrich, Inc.
Date of Inspection:	December 10, 2013

HALEY & ALDRICH

EXECUTIVE SUMMARY

The Squannacook River Dam is a run-of-the-river concrete structure with stone masonry training walls, approximately 150 ft long and 18 ft high. The dam includes a concrete spillway, which extends from a 10-ft-high masonry training wall on the right abutment to a concrete outlet works structure at the left abutment. A stone masonry training wall extends from the grassed embankment slope at the upstream West Groton Road bridge abutment to the outlet works structure.

The dam is located immediately upstream of a former Mill Building which has been redeveloped into the River Court Residences, an assisted and independent living facility. Due to the downstream development, the dam is classified as a High hazard dam.

The size and hazard classifications for the Squannacook River Dam were determined in accordance with 302 CMR 10.06. Squannacook River Dam has a maximum height of approximately 18 ft and a maximum storage capacity of 110 acre-feet. The dam is classified as an **Intermediate** size dam. Failure of the dam could lead to property damage and potential loss of life; accordingly, the dam is classified as a **High Hazard** dam.

A Phase I inspection was last completed at the site in August 2011 and concluded that the dam was in poor condition. In the Fall of 2013, repairs to the Groton side (East, or Left, side) of the dam were completed including chipping loose and deteriorated concrete and placement of reinforced concrete. Repairs to the Shirley (West, or Right) side are still needed to maintain the structure. The overall physical condition of the dam is now judged to be in FAIR condition due to the needed repairs in the Shirley side of the dam.

Dam Evaluation Summary Detail Sheet

1. NID ID:	**MA00442**	**4. Inspection Date:**	**December 10, 2013**
2. Dam Name:	**Squannacook River Dam**	**5. Last Insp. Date:**	**August 25, 2011**
3. Dam Location:	**Groton, MA**	**6. Next Inspection:**	**December 10, 2015**
7. Inspector:	**Denis J. Bell, P.E.**		
8. Consultant:	**Haley & Aldrich, Inc.**		
9. Hazard Code:	**High**	**9a. Is Hazard Code Change Requested?:**	**No**
10. Insp. Frequency:	**2 Years**	**11. Overall Physical Condition of Dam:**	**FAIR**
12. Spillway Capacity (% SDF)	**>100% SDF w/ no actions by Caretaker**		

E1. Design Methodology:	**1**	**E7. Low-Level Discharge Capacity:**	**3**
E2. Level of Maintenance:	**3**	**E8. Low-Level Outlet Physical Condition:**	**3**
E3. Emergency Action Plan:	**2**	**E9. Spillway Design Flood Capacity:**	**5**
E4. Embankment Seepage:	**4**	**E10. Overall Physical Condition of the Dam:**	**3**
E5. Embankment Condition:	**2**	**E11. Estimated Repair Cost:**	**$200,000**
E6. Concrete Condition:	**3**		

Evaluation Description

E1: DESIGN METHODOLOGY
1. Unknown Design – no design records available
2. No design or post-design analyses
3. No analyses, but dam features appear suitable
4. Design or post design analysis show dam meets most criteria
5. State of the art design – design records available & dam meets all criteria

E2: LEVEL OF MAINTENANCE
1. Dam in disrepair, no evidence of maintenance, no O&M manual
2. Dam in poor level of upkeep, very little maintenance, no O&M manual
3. Dam in fair level of upkeep, some maintenance and standard procedures
4. Adequate level of maintenance and standard procedures
5. Dam well maintained, detailed maintenance plan that is executed

E3: EMERGENCY ACTION PLAN
1. No plan or idea of what to do in the event of an emergency
2. Some idea but no written plan
3. No formal plan but well thought out
4. Available written plan that needs updating
5. Detailed, updated written plan available and filed with MADCR, annual training

E4: SEEPAGE (Embankments, Foundations, & Abutments)
1. Severe piping and/or seepage with no monitoring
2. Evidence of monitored piping and seepage
3. No piping but uncontrolled seepage
4 Minor seepage or high volumes of seepage with filtered collection
5. No seepage or minor seepage with filtered collection

E5: EMBANKMENT CONDITION (See Note 1)
1. Severe erosion and/or large trees
2. Significant erosion or significant woody vegetation
3. Brush and exposed embankment soils, or moderate erosion
4. Unmaintained grass, rodent activity and maintainable erosion
5. Well maintained healthy uniform grass cover

E6: CONCRETE CONDITION (See Note 2)
1. Major cracks, misalignment, discontinuities causing leaks, seepage or stability concerns
2. Cracks with misalignment inclusive of transverse cracks with no misalignment but with potential for significant structural degradation
3. Significant longitudinal cracking and minor transverse cracking
4. Spalling and minor surface cracking
5. No apparent deficiencies

E7: LOW-LEVEL OUTLET DISCHARGE CAPACITY
1. No low level outlet, no provisions (e.g. pumps, siphons) for emptying pond
2. No operable outlet, plans for emptying pond, but no equipment
3. Outlet with insufficient drawdown capacity, pumping equipment available
4. Operable gate with sufficient drawdown capacity
5. Operable gate with capacity greater than necessary

E8: LOW-LEVEL OUTLET PHYSICAL CONDITION
1. Outlet inoperative needs replacement, non-existent or inaccessible
2. Outlet inoperative needs repair
3. Outlet operable but needs repair
4. Outlet operable but needs maintenance
5. Outlet and operator operable and well maintained

E9: SPILLWAY DESIGN FLOOD CAPACITY
1. 0 - 50% of the SDF or unknown
2. 50-90% of the SDF
3. 90 - 100% of the SDF
4. >100% of the SDF with actions required by caretaker (e.g. open outlet)
5. >100% of the SDF with no actions required by caretaker

E10: OVERALL PHYSICAL CONDITION OF DAM
1. UNSAFE – Major structural, operational, and maintenance deficiencies exist under normal operating conditions
2. POOR - Significant structural, operation and maintenance deficiencies are clearly recognized under normal loading conditions
3. FAIR - Significant operational and maintenance deficiencies, no structural deficiencies. Potential deficiencies exist under unusual loading conditions that may realistically occur. Can be used when uncertainties exist as to critical parameters
4. SATISFACTORY - Minor operational and maintenance deficiencies. Infrequent hydrologic events would probably result In deficiencies.
5. GOOD - No existing or potential deficiencies recognized. Safe performance is expected under all loading including SDF

E11: ESTIMATED REPAIR COST
Estimation of the total cost to address all identified structural, operational, maintenance deficiencies. Cost shall be developed utilizing standard estimating guides and procedures

Changes/Deviations to Database Information since Last Inspection

PREFACE

The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation and analyses involving topographic mapping, subsurface investigations, testing and detailed computational evaluations are beyond the scope of this report.

In reviewing this report, it should be realized that the described condition of the dam is based on observations of field conditions at the time of inspection, along with other data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions that might otherwise be detectable if inspected under normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions will be detected.

Signed: Denis J Bell
Consulting Engineer

Print Name: Denis J. Bell
Massachusetts License No.: 46241
Title: Senior Engineer
Company: Haley & Aldrich, Inc.

Professional Engineer's Seal:

TABLE OF CONTENTS

TABLE OF CONTENTS

1.0 DESCRIPTION OF PROJECT

1.1 General

1.1.1 Authority

Haley & Aldrich, Inc. has been retained by the Town of Groton to perform a visual inspection and develop a report of conditions for the Squannacook River Dam in Groton, Massachusetts. This inspection and report were performed in accordance with Chapter 253, Sections 44-50 of the Massachusetts General Laws.

1.1.2 Purpose of Work

The purpose of this investigation is to inspect and evaluate the present condition of the dam and appurtenant structures. More specifically, it is to compare the existing structural and hydraulic conditions of the dam to the conditions reported during previous inspections, and to re-evaluate hazard and size classifications as they relate to present Massachusetts 302 CMR 10.00 Dam Safety Rules and Regulations.

The investigation is divided into four parts: 1) obtain and review readily available reports, investigations, and data pertaining to the dam and appurtenant structures; 2) perform a visual inspection of the site; 3) evaluate the status, and need for an emergency action plan for the site; and 4) prepare and submit a final report presenting the evaluation of the retention structure, including recommendations, remedial actions and associated costs.

1.1.3 Definitions

To provide the reader a better understanding of the report, definitions of commonly used terms associated with dams are provided in Appendix D. Many of these terms may be included in this report. The terms are presented under common categories associated with dams which include: 1) orientation; 2) dam components; 3) size classification; 4) hazard classification; and 5) miscellaneous.

1.2 Description of Project

1.2.1 Location

Squannacook River Dam is located on the Squannacook River in the Town of Groton in Middlesex County, Massachusetts. As shown on Figure 1, the coordinates of the dam are 42E 36’ 09” north latitude and 71E 37’ 41” west longitude.

1.2.2 Owner/Operator

Squannacook River Dam is owned by the Town of Groton with Mr. Thomas Delaney, Highway Director as the primary caretaker of the dam.

	Dam Owner	Dam Caretaker
Name	Town of Groton	Thomas Delaney, Jr., Highway Director
Mailing Address	173 Main Street	600 Cow Pond Brook Road PO Box 1111
Town	Groton, MA 01450	Groton, MA 01450
Daytime Phone	978-448-1111	(978) 448-1162
Emergency Phone	911	911
Email Address	selectmen@ci.groton.ma.us	highway@townofgroton.org

1.2.3 Purpose of Dam

Squannacook River Dam was formerly used to generate power for the mill located adjacent to the dam. The current use of the dam is for recreation (isolated canoeing upstream) and as a scenic area adjacent to the housing development and roadway. A 6-ft diameter pipe located downstream of the penstock area has been plugged with concrete and is no longer in service.

1.2.4 Description of the Dam and Appurtenances

The dam is a run-of-the-river stone masonry and concrete structure, approximately 150 ft long and 18 ft high. The crest of the dam was submerged below about 6 inches of water at the time of the inspection and was not fully observable. The dam includes a cut stone masonry and concrete spillway, which extends from a 10-ft-high masonry training wall on the right abutment to concrete outlet works structure at the left abutment. A stone masonry training wall extends from the grassed embankment slope at the upstream West Groton Road bridge abutment to the outlet works structure.

A refurbished brick mill building is located downstream of the dam starting at the left abutment. The building has been converted into an assisted and independent living facility, and is currently occupied. A 6-ft diameter penstock starts at a concrete headwall at the outlet works structure and discharges within the mill building. The outlet pipe was plugged with concrete sometime between 1999 and 2006 and is no longer in service.

The general layout of the dam is shown on the plan view, Figure 2, and reference documents used for the preparation of this report are referenced in Appendix C.

1.2.5 Operation and Maintenance

There are no formal operating procedures at the Squannacook River Dam. The outlet for the penstock consists of three outlets. One outlet, a 6-ft diameter pipe downstream of the penstock area which leads into the mill building, has been plugged with concrete and is no longer active. The second outlet, a notch in the concrete with stoplog grooves in the concrete is able to be

fitted with stoplogs. The third outlet is a low level outlet from the penstock and is set open a few inches.

1.2.6 DCR Size Classification

Storage volume at the top of Squannacook River Dam is estimated to be about 110 acre-ft. The dam has a maximum structural height of about 18 ft. Based on this information and according to the criteria in 302 CMR 10.00, the dam is classified as an INTERMEDIATE dam.

1.2.7 DCR Hazard Classification

Based on the inspection and a review of topographic maps, the downstream area consists of farmland and swamps with little development downstream of the dam, however the mill building adjacent to the left abutment which was previously unoccupied, is now occupied. Accordingly, failure of the dam may cause loss of life and temporary flooding to the lowest level of the mill building. Based on the criteria in 302 CMR 10.00, the dam is classified as HIGH hazard.

1.3 Engineering Dam

Information on the dam is presented below in Table 1.1.

1.3.1 Drainage Area

The dam is a run of the river dam and is in series with the privately owned Hollingsworth & Vose Co. dam upstream of the Squannacook River Dam, thus the drainage area was evaluated as the drainage area for the river below the upstream dam, approximately 780 acres (1.2 square miles). The normal surface area of the river impounded by the dam below the upstream dam is about 28 acres (0.04 square miles), about 4% of the drainage area. The topography of the area is mostly wooded with some hills. There are also residential areas within the drainage area.

1.3.2 Reservoir

1.3.2.1 Length

Below the Hollingsworth & Vose Co. dam and above the Squannacook River Dam, the Squannacook River is approximately 0.8 miles long. In general, the banks of the river are wooded and gently sloped.

1.3.2.2 Surface Area

The normal surface area for the portion of the Squannacook River upstream of the Squannacook River Dam and downstream of the Hollingsworth & Vose Co. dam is about 28 acres.

1.3.2.3 Storage Area

Based on a review of existing data for the dam, the normal storage capacity of the Squannacook River Dam is about 75 acre-ft. Its maximum capacity is estimated to be about 110 acre-ft.

1.3.3 Discharges at the Dam Site

The design flood for the Squannacook River Dam is the 100-year flood. The inflow to the dam is significantly governed by the upstream control (Hollingsworth & Vose Co. dam).

1.3.4 General Elevations

All elevations are based on the National Geodetic Vertical Datum (NGVD). Based on a review of topographic maps, the elevation of the top of the dam was approximately El. 242.75.

1.3.5 Overflow Spillway

The elevation of the top of the spillway was approximately 2.75 ft below the top of the dam (El. 240).

1.3.6 Outlet Structure

The low level outlet structure consists of a square wooded gate measuring about 40 inches square. The mechanism is exercised once each year or so and is typically left open a few inches.

1.3.7 Design and Construction Records

No construction records are available however the year 1926 is imprinted in the concrete of the dam. It is not known if this year is the original construction or a major reconstruction.

In the Fall of 2013, the Groton side of the dam, the left side, was repaired and the design drawings are available.

1.3.8 Operating Records

No operational records are available and reportedly, no operation records are maintained.

1.1 Summary Data Table

Required Phase I Report Data	Data Provided by the Inspecting Engineer
National ID #	MA00442
Dam Name	Squannacook River Dam
Dam Name (Alternate)	NA
River Name	Squannacook River
Impoundment Name	Squannacook River
Hazard Class	High
Size Class	Intermediate
Dam Type	Concrete; Run of the River
Dam Purpose	Former Mill Dam; Recreational
Structural Height of Dam (feet)	18
Hydraulic Height of Dam (feet)	18
Drainage Area (sq. mi.)	1.2
Reservoir Surface Area (acres)	20
Normal Impoundment Volume (acre-feet)	75
Max Impoundment Volume ((top of dam) acre-feet)	110
SDF Impoundment Volume* (acre-feet)	110
Spillway Type	Concrete; Run of the River
Spillway Length (feet)	150
Freeboard at Normal Pool (feet)	5
Principal Spillway Capacity* (cfs)	1400
Auxiliary Spillway Capacity* (cfs)	50
Low-Level Outlet Capacity* (cfs)	50
Spillway Design Flood* (flow rate - cfs)	100yr/ 720 cfs
Winter Drawdown (feet below normal pool)	None
Drawdown Impoundment Vol. (acre-feet)	Not Applicable
Latitude	42o 36.1'
Longitude	71o 37.4'
City/Town	Groton
County Name	Middlesex
Public Road on Crest	No
Public Bridge over Spillway	Upstream
EAP Date (if applicable)	None
Owner Name	Town of Groton
Owner Address	173 Main Street
Owner Town	Groton, MA 01450
Owner Phone	978-448-1111
Owner Emergency Phone	(978) 852-6545
Owner Type	Municipality or Political subdivision
Caretaker Name	Thomas Delaney
Caretaker Address	600 Cow Pond Brook Road
Caretaker Town	Groton, MA 01450
Caretaker Phone	978-448-1162
Caretaker Emergency Phone	(978) 852-6545
Date of Field Inspection	12/10/2013
Consultant Firm Name	Haley & Aldrich, Inc.
Inspecting Engineer	Denis J. Bell, P.E.
Engineer Phone Number	617-886-7343

2.0 INSPECTION

2.1 Visual Inspection

2.1.1 General Findings

On 10 December 2013, Haley & Aldrich, Inc. completed a visual inspection of the Squannacook River Dam. The reservoir level at the time of the site visit was at the top of spillway. Based on that inspection, the dam and spillway were found to be in FAIR condition. Previously, the dam was found to be in Poor condition. The change in the condition of the dam was a result of the recent repairs to the Groton side of the Dam. The following paragraphs describe the conditions of the dam observed during the inspection. Refer to the photographs included as Appendix A and checklist forms included in Appendix B for additional comments.

2.1.2 Dam

The Squannacook River Dam is a run of the river, concrete structure approximately 150 ft long and 18 ft high. The dam spillway could not be directly observed since the spillway was submerged. Bedrock was exposed below the dam in the central portion of the spillway and is abutted on both sides with an inclined concrete spillway slab where bedrock outcrops are not present.

The overall crest alignment appeared satisfactory, however, mortar was observed missing at some of the joints. The concrete spillway on the Groton side of the dam was recently chipped and loose concrete removed. Repairs consisting of reinforced concrete placement were completed.

Repairs the Shirley side of the dam, the right side, were not completed. The right side of the dam is in need of repairs.

2.1.3 Appurtenant Structures

Along the left side of the dam, a stone masonry training wall extends from the bridge abutment upstream to the concrete outlet works structure. Downstream of the dam the abandoned mill building extends along the vegetated river bank. A cut stone masonry wall extends from the dam downstream along the right abutment.

The 6-ft-diameter above ground pipe that exits the concrete headwall structure and runs along the side of the mill building for approximately 100 to 150 ft has reportedly been plugged with concrete sometime between 1999 and 2006.

The mill building immediately downstream of the left end of the spillway is occupied by an independent and assisted living facility.

2.1.4 Downstream Area

Slope protection consisting of large stones was observed below the dam along the river banks. Brush and trees were observed growing in the slope protection. At the time of the inspection, water was flowing over the spillway and much of the discharge channel was underwater.

2.1.5 Reservoir Area

The banks of the river are wooded with mild slopes. Immediately upstream of the spillway, the reservoir is silted up to about 1 in. below the top of the spillway. Vegetation including grasses and light bushes was observed growing immediately upstream of the spillway.

2.2 Caretaker Interview

Mr. Tom Delaney, Groton Highway Department was interviewed concerning the operation and maintenance of the dam and the following is a summary of the interview:

Mr. Delaney stated that town personnel visit the dam site every few days and more often during high water events to observe the conditions. During this site visit, it had been about 3-4 days since Mr. Delaney observed the dam and spillway.

2.3 Operation and Maintenance Procedures

2.3.1 Operational Procedures

There are no formal operation or maintenance procedures, nor operating records for the dam.

2.3.2 Maintenance of Dam and Operating Facilities

The Town of Groton monitors the dam periodically and controls the access to the dam by locking the gate at the outlet works structure. The outlet for the 6 ft diameter pipe has been plugged with concrete sometime between 1999 and 2006. The low level outlet is reportedly kept open a few inches and is exercised about once each year or two.

2.4 Emergency Warning System

There is no emergency warning system for the Squannacook River Dam.

2.5 Hydraulic/Hydrologic Data

Based on the DEM size and hazard classification system, the selected test flood for Squannacook River Dam is the 100 year flood. Upstream of the dam is the privately owned dam Hollingsworth & Vose Co. dam. Due to the proximity of the dams, the dams are considered in series. Since the Squannacook River Dam is the lower dam in a series, hydraulic/hydrologic calculations are based on only the flow from the drainage area between the upstream dam and the Squannacook River Dam. Accordingly, the calculated 100 year flood inflow is 720 cfs. Based on a review of the existing information, the spillway capacity is 1400 cfs, which is greater than the 100 year flood overflow. The height of water passing the spillway would be about 2 ft.

2.6 Structural Stability/Overtopping Potential

2.6.1 Structural Stability

The concrete spillway was dewatered during the recent construction and found to be in fair condition. Previously cracked and spauling concrete locations on the Groton side of the dam were chipped and repaired with reinforced concrete.

The Shirley side of the dam was not repaired during the recent work and this area of the dam is in need of repairs to maintain the structure.

2.6.2 Overtopping Potential

Assuming no upstream control, during the 100 year flood the water level on the dam should not overtop the dam during the design storm event. The height of water passing the spillway would be about 2.0 ft.

3.0 ASSESSMENT AND RECOMMENDATIONS

3.1 Assessments

The condition of the Squannacook River Dam observed during the most recent site inspection is judged to be FAIR. Recent repairs to the dam on the Groton side of the dam resulted in a change from the previously reported poor condition in 2011. Repairs to the Shirley side of the dam are needed to maintain the structure.

3.2 Studies and Analyses

- An Emergency Action Plan (EAP) should be prepared for the dam.
- A detailed hydrologic/ hydraulic study should be completed for the dam taking into account the series of dams including the Hollingsworth & Vose Co. dam upstream of the Squannacook River Dam.

3.3 Yearly Recommendations

The condition of the spillway and dam should be monitored several times per year. The low level outlet gate should be exercised several times per year.

3.4 Recommendations, Maintenance, and Minor Repairs

The following recommendations for improvement at the dam include

- Implement remedial measures developed for the Shirley Side of the dam.
- Conduct a hydraulic/hydrologic study, including the effect of the upstream dam on the flow over the Squannacook River Dam, for the dam configuration after implementation of the remedial measures
- Prepare an emergency action plan
- Repair the training wall on the Shirley side of the dam.
- Remove vegetation and debris from downstream areas, auxiliary spillway, and along crest.

3.5 Remedial Measures

In order for Squannacook Dam to be in compliance with Massachusetts General Law 253, Section 44, Chapter 302 CMR 10.00, the owner must upgrade the condition of the dam by performing the remedial measures shown below. These remedial measures require the owner to hire a qualified engineer to prepare documents prior to implementing the remedial measures. This work may require state, local or government permits that should be investigated prior to starting work.

Remedial measures requiring assistance from a qualified engineer:

- Implement remedial measures developed for the Shirley side of the dam.

- Conduct a hydraulic/hydrologic study, including the effect of the upstream dam on the flow over the Squannacook River Dam, for the dam configuration after implementation of the remedial measures.

- Prepare an emergency action plan.

- Repair the training wall on the Shirley side of the dam.

- Remove vegetation and debris from downstream areas, auxiliary spillway, and along crest.

3.6 Alternatives

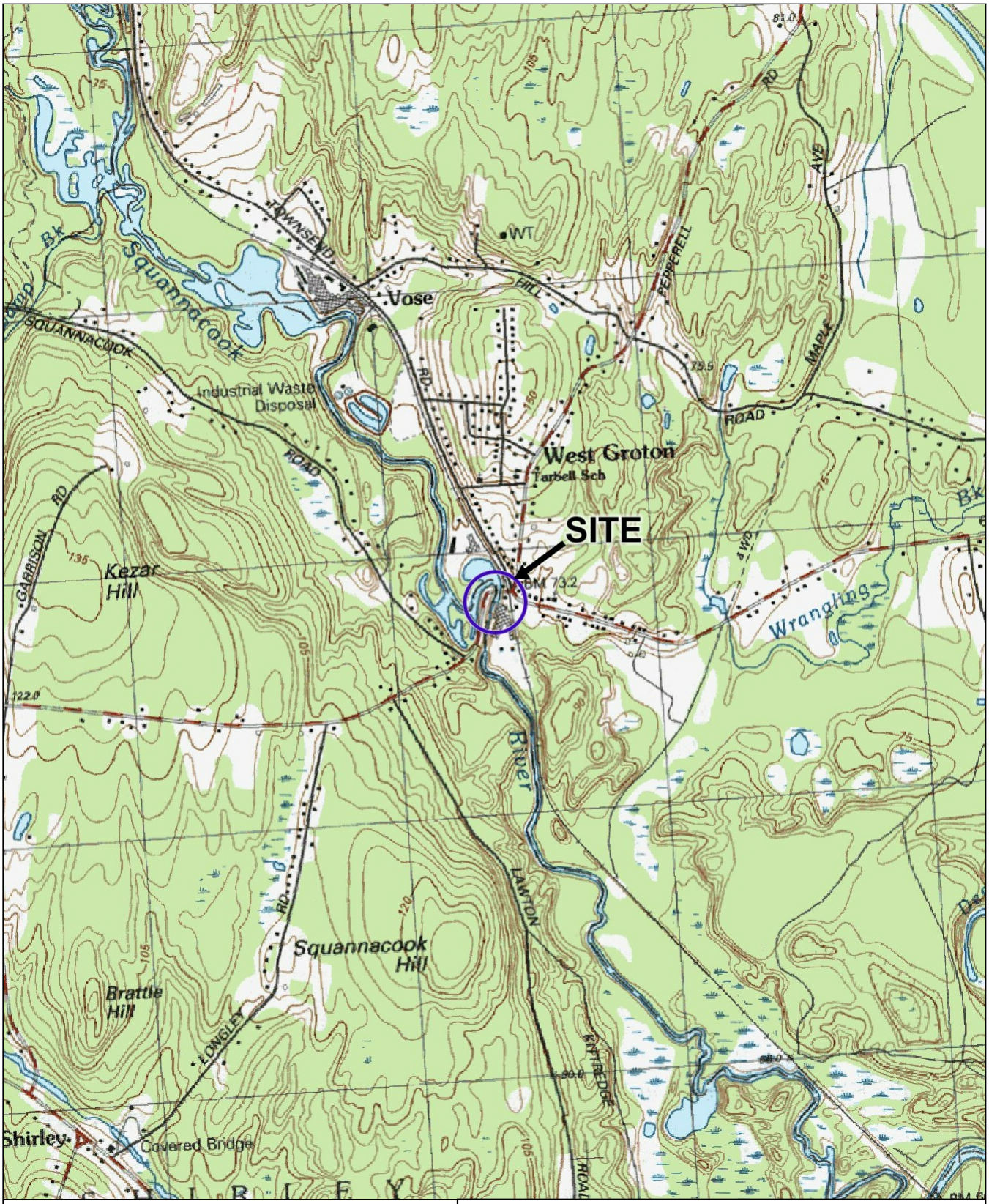
An alternative to repairing the dam is to take the dam out of service and remove the structure.

3.7 Opinion of Probable Construction Cost

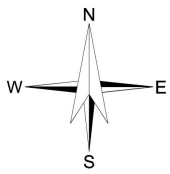
The opinion of probable costs is given below. These design and construction costs, including estimated labor and material costs, are based on limited investigations and are provided only for general information and relative cost of individual items. No detailed quantity measurements; nor time and equipment calculations were completed. Estimates were based on engineering judgment, interpretation of site conditions, and general comparison with other similar repair work where appropriate. Actual construction costs can vary significantly from these estimates; budgeting requests or other financial decisions should not be submitted based on these estimates. A detailed project specific estimate should be completed for those purposes.

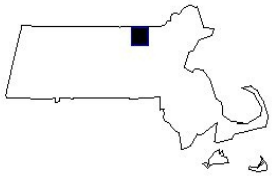
RECOMMENDATIONS/REMEDIAL MEASURES	ESTIMATED COST
Repair Shirley training wall	$60,000
Conduct hydraulic/hydrologic evaluation	$20,000
Prepare Emergency Action Plan	$15,000
Repair Splashpad on Shirley side	$25,000
Remove vegetation at downstream area and crest	$16,000
Re-Point Upstream Walls (w/ water diversion)	$30,000
Subtotal	$166,000
Engineering and Construction Contingencies (20%)	$34,000
Total	$200,000

Total estimated repair cost for Squannacook River Dam is approximately $200,000.



SITE COORDINATES:42°36'9"N 71°37'40"W





U.S.G.S. QUADRANGLE: SHIRLEY, MA

HALEY & ALDRICH

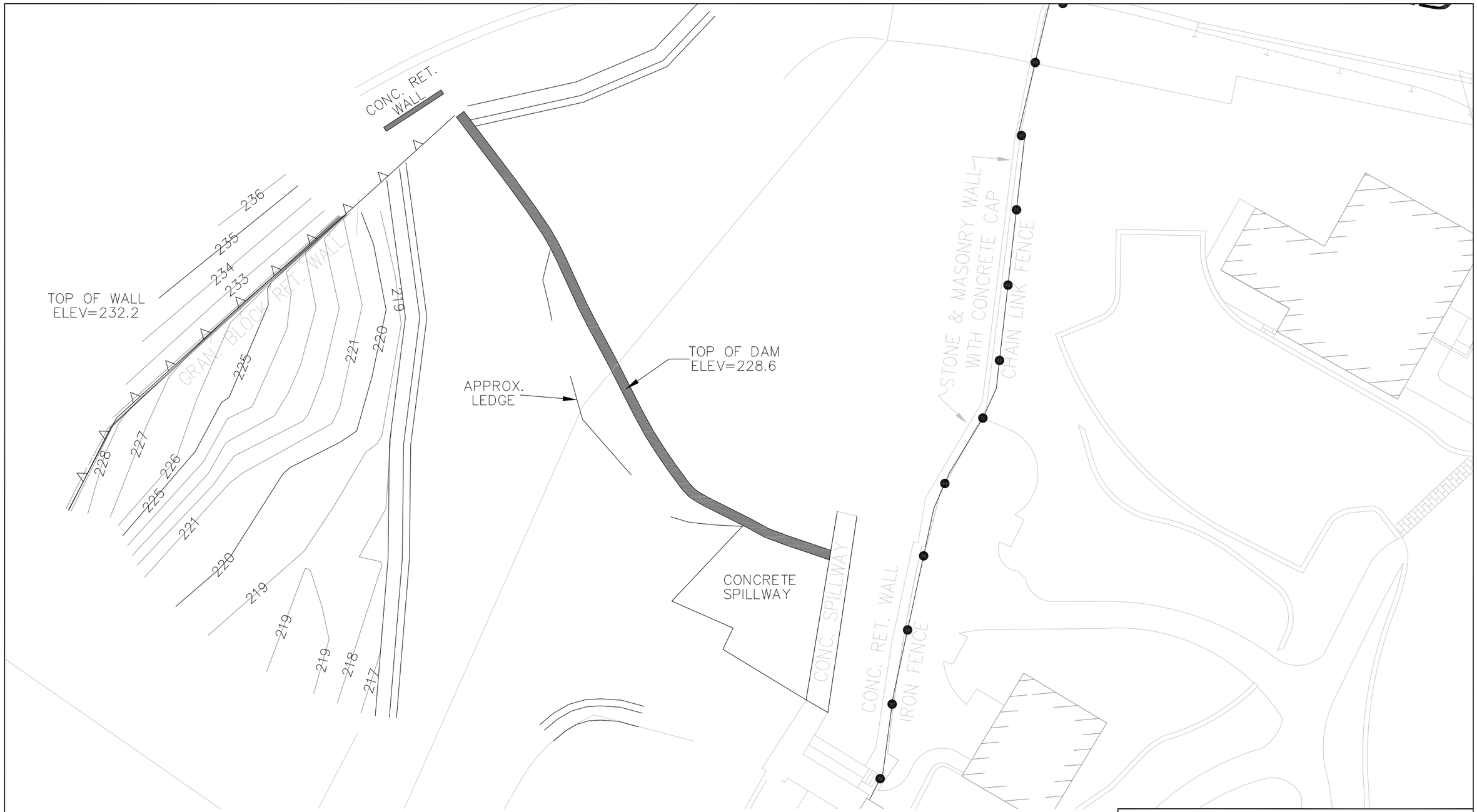
SQUANNACOOK RIVER DAM
PHASE I INSPECTION/EVALUATION
GROTON, MASSACHUSETTS

PROJECT LOCUS

SCALE: 1:24,000
SEPTEMBER 2011

FIGURE 1

35078-002 1.PDF



NOTES:

1. BASE PLAN TAKEN FROM PLAN TITLED "EXISTING CONDITIONS" PREPARED BY DUCHARME AND DILLIS CIVIL DESIGN GROUP, INC. DATED 1 FEBRUARY 2008.

2. ELEVATIONS ARE IN FEET AND REFERENCE THE NATIONAL GEODETIC VERTICAL DATUM (NGVD) OF 1929

LEGEND:

APPROXIMATE DESIGNATION AND ORIENTATION OF PHOTOGRAPH

HALEY & ALDRICH

SQUANNACOOK RIVER DAM
GROTON, MASSACHUSETTS

EXISTING CONDITIONS PLAN

SCALE: AS SHOWN
AUGUST 2011

FIGURE 2

G:\35078\002-2011-PHI\SQUANACOOK-01.DWG

APPENDIX A

Photographs

Squannacook River Dam

Squannacook River Dam

Squannacook River Dam

Squannacook River Dam

APPENDIX B

Inspection Checklist

DAM SAFETY INSPECTION CHECKLIST

NAME OF DAM: Squannacook River Dam

STATE ID #: 4-9-115-1

REGISTERED: ☑ YES ☐ NO

NID ID #: MA00442

STATE SIZE CLASSIFICATION: Intermediate

STATE HAZARD CLASSIFICATION: High

CHANGE IN HAZARD CLASSIFICATION REQUESTED?: No

DAM LOCATION INFORMATION

CITY/TOWN: Groton

COUNTY: Middlesex

DAM LOCATION: West Main Street (Route 225)
(street address if known)

ALTERNATE DAM NAME: NA

USGS QUAD.: Shirley, MA

LAT.: 42° 36.1'

LONG.: 71° 37.4'

DRAINAGE BASIN: Merrimack

RIVER: Squannacook River

IMPOUNDMENT NAME(S): Squannacook River

GENERAL DAM INFORMATION

TYPE OF DAM: Concrete; Run of the River

OVERALL LENGTH (FT): 150

PURPOSE OF DAM: Former Mill Dam; Recreational

NORMAL POOL STORAGE (ACRE-FT): 75

YEAR BUILT: Concrete Imprint indictaes 1926; exact date unknown

MAXIMUM POOL STORAGE (ACRE-FT): 110

STRUCTURAL HEIGHT (FT): 18

EL. NORMAL POOL (FT): 240.0

HYDRAULIC HEIGHT (FT): 18

EL. MAXIMUM POOL (FT): 242.0

FOR INTERNAL MADCR USE ONLY

FOLLOW-UP INSPECTION REQUIRED: ☐ YES ☐ NO

CONDITIONAL LETTER: ☐ YES ☐ NO

NAME OF DAM: Squannacook River Dam | STATE ID #: 4-9-115-1

INSPECTION DATE: December 10, 2013 | NID ID #: MA00442

INSPECTION SUMMARY

DATE OF INSPECTION: December 10, 2013 | DATE OF PREVIOUS INSPECTION: August 25, 2011

TEMPERATURE/WEATHER: Cloudy, 30s | ARMY CORPS PHASE I: ☐ YES ☑ NO | If YES, date

CONSULTANT: Haley & Aldrich, Inc. | PREVIOUS DCR PHASE I: ☑ YES ☐ NO | If YES, date 25-Aug-11

BENCHMARK/DATUM: NGVD 1929

OVERALL PHYSICAL CONDITION OF DAM: FAIR | DATE OF LAST REHABILITATION: 2013

SPILLWAY CAPACITY: >100% SDF w/ no actions by Caretaker

EL. POOL DURING INSP.: 240 | EL. TAILWATER DURING INSP.: 222

PERSONS PRESENT AT INSPECTION

NAME	TITLE/POSITION	REPRESENTING
Denis J. Bell, P.E.	Senior Engineer	Haley & Aldrich, Inc.

EVALUATION INFORMATION

		Click on box to select E-code
E1)	TYPE OF DESIGN	1
E2)	LEVEL OF MAINTENANCE	3
E3)	EMERGENCY ACTION PLAN	2
E4)	EMBANKMENT SEEPAGE	4
E5)	EMBANKMENT CONDITION	2
E6)	CONCRETE CONDITION	3
E7)	LOW-LEVEL OUTLET CAPACITY	3
E8)	LOW-LEVEL OUTLET CONDITION	3
E9)	SPILLWAY DESIGN FLOOD CAPACITY	5
E10)	OVERALL PHYSICAL CONDITION	3
E11)	ESTIMATED REPAIR COST	$200,000
	ROADWAY OVER CREST	NO
	BRIDGE NEAR DAM	YES

NAME OF INSPECTING ENGINEER: Denis J. Bell, P.E. | SIGNATURE: Denis J Bell

NAME OF DAM:	Squannacook River Dam	STATE ID #:	4-9-115-1
INSPECTION DATE:	December 10, 2013	NID ID #:	MA00442

OWNER:	ORGANIZATION	Town of Groton	CARETAKER:	ORGANIZATION	Groton Highway Department
	NAME/TITLE	Selectmen		NAME/TITLE	Thomas Delaney
	STREET	173 Main Street		STREET	600 Cow Pond Brook Road
	TOWN, STATE, ZIP	Groton, MA 01450		TOWN, STATE, ZIP	Groton, MA 01450
	PHONE	978-448-1111		PHONE	978-448-1162
	EMERGENCY PH. #	(978) 852-6545		EMERGENCY PH. #	(978) 852-6545
	FAX			FAX	
	EMAIL	highway@townofgroton.org		EMAIL	highway@townofgroton.org
	OWNER TYPE	Municipality or Political subdivision			

PRIMARY SPILLWAY TYPE	Concrete; Run of the River		
SPILLWAY LENGTH (FT)	150	SPILLWAY CAPACITY (CFS)	1,400
AUXILIARY SPILLWAY TYPE	Stoplog Weir	AUX. SPILLWAY CAPACITY (CFS)	50
NUMBER OF OUTLETS	1	OUTLET(S) CAPACITY (CFS)	50
TYPE OF OUTLETS	Low Level Concrete Outlet	TOTAL DISCHARGE CAPACITY (CFS)	1,500
DRAINAGE AREA (SQ MI)	1.2	SPILLWAY DESIGN FLOOD (PERIOD/CFS)	100yr/ 720 cfs

HAS DAM BEEN BREACHED OR OVERTOPPED ☐ YES ☑ NO IF YES, PROVIDE DATE(S)

FISH LADDER (LIST TYPE IF PRESENT) No

DOES CREST SUPPORT PUBLIC ROAD? ☐ YES ☑ NO IF YES, ROAD NAME:

PUBLIC BRIDGE WITHIN 50' OF DAM? ☑ YES ☐ NO IF YES, ROAD/BRIDGE NAME: West Main Street (Rt 225) Upstream

MHD BRIDGE NO. (IF APPLICABLE)

NAME OF DAM: Squannacook River Dam STATE ID #: 4-9-115-1

INSPECTION DATE: December 10, 2013 NID ID #: MA00442

EMBANKMENT (CREST)

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
CREST	1. SURFACE TYPE	Not Applicable			
	2. SURFACE CRACKING	Not Applicable			
	3. SINKHOLES, ANIMAL BURROWS	Not Applicable			
	4. VERTICAL ALIGNMENT (DEPRESSIONS)	Not Applicable			
	5. HORIZONTAL ALIGNMENT	Not Applicable			
	6. RUTS AND/OR PUDDLES	Not Applicable			
	7. VEGETATION (PRESENCE/CONDITION)	Not Applicable			
	8. ABUTMENT CONTACT	Not Applicable			

ADDITIONAL COMMENTS:

NAME OF DAM: Squannacook River Dam STATE ID #: 4-9-115-1

INSPECTION DATE: December 10, 2013 NID ID #: MA00442

EMBANKMENT (D/S SLOPE)

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
D/S SLOPE	1. WET AREAS (NO FLOW)	Not Applicable			
	2. SEEPAGE	Not Applicable			
	3. SLIDE, SLOUGH, SCARP	Not Applicable			
	4. EMB.-ABUTMENT CONTACT	Not Applicable			
	5. SINKHOLE/ANIMAL BURROWS	Not Applicable			
	6. EROSION	Not Applicable			
	7. UNUSUAL MOVEMENT	Not Applicable			
	8. VEGETATION (PRESENCE/CONDITION)	Not Applicable			

ADDITIONAL COMMENTS:

NAME OF DAM: Squannacook River Dam STATE ID #: 4-9-115-1

INSPECTION DATE: December 10, 2013 NID ID #: MA00442

EMBANKMENT (U/S SLOPE)

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
U/S SLOPE	1. SLIDE, SLOUGH, SCARP	Not Applicable			
	2. SLOPE PROTECTION TYPE AND COND.	Not Applicable			
	3. SINKHOLE/ANIMAL BURROWS	Not Applicable			
	4. EMB.-ABUTMENT CONTACT	Not Applicable			
	5. EROSION	Not Applicable			
	6. UNUSUAL MOVEMENT	Not Applicable			
	7. VEGETATION (PRESENCE/CONDITION)	Not Applicable			

ADDITIONAL COMMENTS:

NAME OF DAM: Squannacook River Dam STATE ID #: 4-9-115-1

INSPECTION DATE: December 10, 2013 NID ID #: MA00442

INSTRUMENTATION

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
INSTR.	1. PIEZOMETERS	None			
	2. OBSERVATION WELLS	None			
	3. STAFF GAGE AND RECORDER	None			
	4. WEIRS	None for Instrumentation; inlet weir			
	5. INCLINOMETERS	None			
	6. SURVEY MONUMENTS	None			
	7. DRAINS	None			
	8. FREQUENCY OF READINGS	None			
	9. LOCATION OF READINGS	None			

ADDITIONAL COMMENTS:

NAME OF DAM: Squannacook River Dam STATE ID #: 4-9-115-1

INSPECTION DATE: December 10, 2013 NID ID #: MA00442

DOWNSTREAM MASONRY WALLS

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
D/S WALLS	1. WALL TYPE	Stone Block with Mortar and Concrete			x
	2. WALL ALIGNMENT	Fair; Some Block Misalignment			x
	3. WALL CONDITION	Fiar to Poor; Mortar missing, block rotation and spauling of concrete			x
	4. HEIGHT: TOP OF WALL TO MUDLINE	min: max: avg: 10 ft			
	5. SEEPAGE OR LEAKAGE	Not Applicable			
	6. ABUTMENT CONTACT	Fair; Some Vegetation			x
	7. EROSION/SINKHOLES BEHIND WALL	Stone Blocks misaligned			x
	8. ANIMAL BURROWS	None Noted		x	
	9. UNUSUAL MOVEMENT	Stone wall in Fair to Poor Condition			x
	10. WET AREAS AT TOE OF WALL	Yes; bottom 3 ft			x

ADDITIONAL COMMENTS:

NAME OF DAM: Squannacook River Dam STATE ID #: 4-9-115-1

INSPECTION DATE: December 10, 2013 NID ID #: MA00442

UPSTREAM MASONRY WALLS

AREA INSPECTED	CONDITION	OBSERVATIONS			NO ACTION	MONITOR	REPAIR
U/S WALLS	1. WALL TYPE	Stone Block Wall					x
	2. WALL ALIGNMENT	Some Misalignment					x
	3. WALL CONDITION	Fair					x
	4. HEIGHT: TOP OF WALL TO MUDLINE	min:	max:	avg: 10 ft		x	
	5. ABUTMENT CONTACT	Vegetation					x
	6. EROSION/SINKHOLES BEHIND WALL	None Noted				x	
	7. ANIMAL BURROWS	None Noted				x	
	8. UNUSUAL MOVEMENT	Block Misalignment					x

ADDITIONAL COMMENTS:

NAME OF DAM: Squannacook River Dam STATE ID #: 4-9-115-1

INSPECTION DATE: December 10, 2013 NID ID #: MA00442

DOWNSTREAM AREA

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
D/S AREA	1. ABUTMENT LEAKAGE	None Observed	x		
	2. FOUNDATION SEEPAGE	None Observed	x		
	3. SLIDE, SLOUGH, SCARP	None Observed	x		
	4. WEIRS	None Observed	x		
	5. DRAINAGE SYSTEM	None	x		
	6. INSTRUMENTATION	None	x		
	7. VEGETATION	Grass; brush and small trees			x
	8. ACCESSIBILITY	Through Woods off Road	x		
	9. DOWNSTREAM HAZARD DESCRIPTION	Wooded River Banks; Senior Housing in Old Mill Complex			
	10. DATE OF LAST EAP UPDATE	None			

ADDITIONAL COMMENTS:

NAME OF DAM: Squannacook River Dam STATE ID #: 4-9-115-1

INSPECTION DATE: December 10, 2013 NID ID #: MA00442

MISCELLANEOUS

AREA INSPECTED	CONDITION	OBSERVATIONS
MISC.	1. RESERVOIR DEPTH (AVG)	3 to 8 ft
	2. RESERVOIR SHORELINE	Mostly wooded riverbanks and residential building
	3. RESERVOIR SLOPES	Shallow slopes, mostly wooded
	4. ACCESS ROADS	None Obsereved
	5. SECURITY DEVICES	Closed gate at fenceline
	6. VANDALISM OR TRESPASS	☐ YES ☑ NO WHAT:
	7. AVAILABILITY OF PLANS	☐ YES ☑ NO DATE:
	8. AVAILABILITY OF DESIGN CALCS	☐ YES ☑ NO DATE:
	9. AVAILABILITY OF EAP/LAST UPDATE	☐ YES ☑ NO DATE: None
	10. AVAILABILITY OF O&M MANUAL	☐ YES ☑ NO DATE:
	11. CARETAKER/OWNER AVAILABLE	☑ YES ☐ NO DATE: December 10, 2013
	12. CONFINED SPACE ENTRY REQUIRED	☐ YES ☑ NO PURPOSE:

ADDITIONAL COMMENTS:

NAME OF DAM: Squannacook River Dam STATE ID #: 4-9-115-1

INSPECTION DATE: December 10, 2013 NID ID #: MA00442

PRIMARY SPILLWAY

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
SPILLWAY	SPILLWAY TYPE	Concrete		x	
	WEIR TYPE	Uncontrolled		x	
	SPILLWAY CONDITION	Fair		x	
	TRAINING WALLS	Left Wall in Fair Condition; Right Wall in Poor Condition		x	
	SPILLWAY CONTROLS AND CONDITION	Fair		x	
	UNUSUAL MOVEMENT	None Observed		x	
	APPROACH AREA	Debris build up upstream of spillway		x	
	DISCHARGE AREA	Bedrock outcrop and clear; discharge channel is wooded		x	
	DEBRIS	Debris build up on upstream side of spillway		x	
	WATER LEVEL AT TIME OF INSPECTION	240		x	

ADDITIONAL COMMENTS:

NAME OF DAM: Squannacook River Dam STATE ID #: 4-9-115-1

INSPECTION DATE: December 10, 2013 NID ID #: MA00442

AUXILIARY SPILLWAY

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
SPILLWAY	SPILLWAY TYPE	Concrete with Stoplog groves		x	
	WEIR TYPE	Stoplogs		x	
	SPILLWAY CONDITION	Satisfactory; reapired concrete 2013		x	
	TRAINING WALLS	Concrete		x	
	SPILLWAY CONTROLS AND CONDITION	Stoplogs; Satisfactory		x	
	UNUSUAL MOVEMENT	None		x	
	APPROACH AREA	Penstock; Concrete		x	
	DISCHARGE AREA	Splashpad; fair		x	
	DEBRIS	None; construction in Fall 2013 removed debris		x	
	WATER LEVEL AT TIME OF INSPECTION	240		x	

ADDITIONAL COMMENTS:

NAME OF DAM: Squannacook River Dam STATE ID #: 4-9-115-1

INSPECTION DATE: December 10, 2013 NID ID #: MA00442

OUTLET WORKS

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
OUTLET WORKS	TYPE	Low Level outlet consists of Concrete Culvert; Fair Condition		x	
	INTAKE STRUCTURE	Concrete Culvert		x	
	TRASHRACK	None		x	
	PRIMARY CLOSURE	Wooden Gate		x	
	SECONDARY CLOSURE	None		x	
	CONDUIT	Concrete Culvert		x	
	OUTLET STRUCTURE/HEADWALL	Stone and Concrete Culvert		x	
	EROSION ALONG TOE OF DAM	None		x	
	SEEPAGE/LEAKAGE	Gate remains 1 to 2 in. open for flow		x	
	DEBRIS/BLOCKAGE	None after Fall 2013 Construction		x	
	UNUSUAL MOVEMENT	None		x	
	DOWNSTREAM AREA	Splashpad		x	
	MISCELLANEOUS	Wooden Gate in Satisfactory condition; gate operator support in fair condition		x	

ADDITIONAL COMMENTS:

NAME OF DAM: Squannacook River Dam STATE ID #: 4-9-115-1

INSPECTION DATE: December 10, 2013 NID ID #: MA00442

CONCRETE/MASONRY DAMS

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
GENERAL	TYPE	Uncontrolled Concrete/ Stone Masonry Run of the River Dam			
	AVAILABILITY OF PLANS	None; plans available for 2013 repair work			
	AVAILABILITY OF DESIGN CALCS	Not Available			
	PIEZOMETERS	None Obsereved			
	OBSERVATION WELLS	None Obsereved			
	INCLINOMETERS	None Obsereved			
	SEEPAGE GALLERY	None Obsereved			
	UNUSUAL MOVEMENT	None Obsereved			

ADDITIONAL COMMENTS:

NAME OF DAM: Squannacook River Dam STATE ID #: 4-9-115-1

INSPECTION DATE: December 10, 2013 NID ID #: MA00442

CONCRETE/MASONRY DAMS (CREST)

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
CREST	TYPE	Concrete Uncontroled Spillway		x	
	SURFACE CONDITIONS	Fair		x	
	CONDITIONS OF JOINTS	Fair		x	
	UNUSUAL MOVEMENT	None		x	
	HORIZONTAL ALIGNMENT	Satisfactory		x	
	VERTICAL ALIGNMENT	Satisfactory		x	

ADDITIONAL COMMENTS:

NAME OF DAM: Squannacook River Dam STATE ID #: 4-9-115-1

INSPECTION DATE: December 10, 2013 NID ID #: MA00442

CONCRETE/MASONRY DAMS (DOWNSTREAM FACE)

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
D/S FACE	TYPE	Concrete Face		x	
	SURFACE CONDITIONS	Fair		x	
	CONDITIONS OF JOINTS	Fair		x	
	UNUSUAL MOVEMENT	None Observed		x	
	ABUTMENT CONTACT	Fair		x	
	LEAKAGE	None Observed		x	

ADDITIONAL COMMENTS:

NAME OF DAM: Squannacook River Dam STATE ID #: 4-9-115-1

INSPECTION DATE: December 10, 2013 NID ID #: MA00442

CONCRETE/MASONRY DAMS (UPSTREAM FACE)

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
U/S FACE	TYPE	Sloping Concrete		x	
	SURFACE CONDITIONS	Fair		x	
	CONDITIONS OF JOINTS	Fair		x	
	UNUSUAL MOVEMENT	None Observed		x	
	ABUTMENT CONTACTS	None Observed		x	

ADDITIONAL COMMENTS:

APPENDIX C

Previous Reports and References

APPENDIX D

Definitions

COMMON DAM SAFETY DEFINITIONS

For a comprehensive list of dam engineering terminology and definitions refer to 302 CMR10.00 Dam Safety, or other reference published by FERC, Dept. of the Interior Bureau of Reclamation, or FEMA. Please note should discrepancies between definitions exits, those definitions included within 302 CMR 10.00 govern for dams located within the Commonwealth of Massachusetts.

Orientation

Upstream – Shall mean the side of the dam that borders the impoundment.

Downstream – Shall mean the high side of the dam, the side opposite the upstream side.

Right – Shall mean the area to the right when looking in the downstream direction.

Left – Shall mean the area to the left when looking in the downstream direction.

Dam Components

Dam – Shall mean any artificial barrier, including appurtenant works, which impounds or diverts water.

Embankment – Shall mean the fill material, usually earth or rock, placed with sloping sides, such that it forms a permanent barrier that impounds water.

Crest – Shall mean the top of the dam, usually provides a road or path across the dam.

Abutment – Shall mean that part of a valley side against which a dam is constructed. An artificial abutment is sometimes constructed as a concrete gravity section, to take the thrust of an arch dam where there is no suitable natural abutment.

Appurtenant Works – Shall mean structures, either in dams or separate there from including but not be limited to spillways; reservoirs and their rims; low level outlet works; and water conduits including tunnels, pipelines, or penstocks, either through the dams or their abutments.

Spillway – Shall mean a structure over or through which water flows are discharged. If the flow is controlled by gates or boards, it is a controlled spillway; if the fixed elevation of the spillway crest controls the level of the impoundment, it is an uncontrolled spillway.

Size Classification

(as listed in Commonwealth of Massachusetts, 302 CMR 10.00 Dam Safety)

Large – structure with a height greater than 40 feet or a storage capacity greater than 1,000 acre-feet.

Intermediate – structure with a height between 15 and 40 feet or a storage capacity of 50 to 1,000 acre-feet.

Small – structure with a height between 6 and 15 feet and a storage capacity of 15 to 50 acre-feet.

Non-Jurisdictional – structure less than 6 feet in height and having a storage capacity of less than 15 acre-feet.

Hazard Classification

(as listed in Commonwealth of Massachusetts, 302 CMR 10.00 Dam Safety)

High Hazard (Class I) – Shall mean dams located where failure will likely cause loss of life and serious damage to home(s), industrial or commercial facilities, important public utilities, main highway(s) or railroad(s).

Significant Hazard (Class II) – Shall mean dams located where failure may cause loss of life and damage to home(s), industrial or commercial facilities, secondary highway(s) or railroad(s), or cause the interruption of the use or service of relatively important facilities.

Low Hazard (Class III) – Dams located where failure may cause minimal property damage to others. Loss of life is not expected.

General

EAP – Emergency Action Plan - Shall mean a predetermined plan of action to be taken to reduce the potential for property damage and/or loss of life in an area affected by an impending dam break.

O&M Manual – Operations and Maintenance Manual; Document identifying routine maintenance and operational procedures under normal and storm conditions.

Normal Pool – Shall mean the elevation of the impoundment during normal operating conditions.

Acre-foot – Shall mean a unit of volumetric measure that would cover one acre to a depth of one foot. It is equal to 43,560 cubic feet. On million U.S. gallons = 3.068 acre feet

Height of Dam – Shall mean the vertical distance from the lowest portion of the natural ground, including any stream channel, along the downstream toe of the dam to the crest of the dam.

Spillway Design Flood (SDF) – Shall mean the flood used in the design of a dam and its appurtenant works particularly for sizing the spillway and outlet works, and for determining maximum temporary storage and height of dam requirements.

Condition Rating

Unsafe - Major structural, operational, and maintenance deficiencies exist under normal operating conditions.

Poor - Significant structural, operation and maintenance deficiencies are clearly recognized for normal loading conditions.

Fair - Significant operational and maintenance deficiencies, no structural deficiencies. Potential deficiencies exist under unusual loading conditions that may realistically occur. Can be used when uncertainties exist as to critical parameters.

Satisfactory - Minor operational and maintenance deficiencies. Infrequent hydrologic events would probably result in deficiencies.

Good - No existing or potential deficiencies recognized. Safe performance is expected under all loading including SDF.