Notice of Intent and Application for Permit
Waite Pond Dam Repairs

Leicester, Massachusetts

Town of Leicester

November 1, 2017

FUSS & O'NEILL

146 Hartford Road
Manchester, CT 06040

FUSS & O'NEILL

Table of Contents

Notice of Intent
Waite Pond Dam Repairs

WPA Form 3 – Notice of Intent

Town of Leicester Application for Permit

FUSS & O'NEILL

Table of Contents

Notice of Intent
Waite Pond Dam Repairs

FUSS & O'NEILL

WPA Form 3 – Notice of Intent

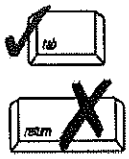
Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands

WPA Form 3 – Notice of Intent

Massachusetts Wetlands Protection Act M.G.L. c. 131, §40

Provided by MassDEP:
MassDEP File Number
Document Transaction Number
Leicester
City/Town

Important: When filling out forms on the computer, use only the tab key to move your cursor - do not use the return key.



Note: Before completing this form consult your local Conservation Commission regarding any municipal bylaw or ordinance.

A. General Information

1. Project Location (**Note:** electronic filers will click on button to locate project site):

a. Street Address | Leicester b. City/Town | 01524 c. Zip Code

Latitude and Longitude: 42.24900 d. Latitude | -71.88708 e. Longitude

f. Assessors Map/Plat Number | g. Parcel /Lot Number

2. Applicant:

a. First Name | b. Last Name

Town of Leicester
c. Organization

3 Washburn Square
d. Street Address

Leicester e. City/Town | MA f. State | 01524 g. Zip Code

h. Phone Number | i. Fax Number | j. Email Address

3. Property owner (required if different from applicant): ☐ Check if more than one owner

a. First Name | b. Last Name

c. Organization

d. Street Address

e. City/Town | f. State | g. Zip Code

h. Phone Number | i. Fax Number | j. Email address

4. Representative (if any):

Kevin a. First Name | Mizikar b. Last Name

Town Administrator, Town of Leicester
c. Company

3 Washburn Square
d. Street Address

Leicester e. City/Town | MA f. State | 01524 g. Zip Code

508-892-7000 h. Phone Number | i. Fax Number | mizikark@leicesterma.org j. Email address

5. Total WPA Fee Paid (from NOI Wetland Fee Transmittal Form):

a. Total Fee Paid | b. State Fee Paid | c. City/Town Fee Paid

A. General Information (continued)

6. General Project Description:

Proposed Waite Pond Dam repairs include replacement of retaining walls and embankments, creation of a downstream plunge pool energy dissipation basin, removal of the existing gatehouse and replacement of the low-level CMP outlet pipe, and tree/stump removal.

7a. Project Type Checklist: (Limited Project Types see Section A. 7b.)

1. ☐ Single Family Home
2. ☐ Residential Subdivision
3. ☐ Commercial/Industrial
4. ☐ Dock/Pier
5. ☐ Utilities
6. ☐ Coastal engineering Structure
7. ☐ Agriculture (e.g., cranberries, forestry)
8. ☐ Transportation
9. ☒ Other

7b. Is any portion of the proposed activity eligible to be treated as a limited project (including Ecological Restoration Limited Project) subject to 310 CMR 10.24 (coastal) or 310 CMR 10.53 (inland)?

1. ☐ Yes ☒ No

If yes, describe which limited project applies to this project. (See 310 CMR 10.24 and 10.53 for a complete list and description of limited project types)

2. Limited Project Type

If the proposed activity is eligible to be treated as an Ecological Restoration Limited Project (310 CMR10.24(8), 310 CMR 10.53(4)), complete and attach Appendix A: Ecological Restoration Limited Project Checklist and Signed Certification.

8. Property recorded at the Registry of Deeds for:

a. County
b. Certificate # (if registered land)
c. Book
d. Page Number

B. Buffer Zone & Resource Area Impacts (temporary & permanent)

1. ☐ Buffer Zone Only – Check if the project is located only in the Buffer Zone of a Bordering Vegetated Wetland, Inland Bank, or Coastal Resource Area.
2. ☒ Inland Resource Areas (see 310 CMR 10.54-10.58; if not applicable, go to Section B.3, Coastal Resource Areas).

Check all that apply below. Attach narrative and any supporting documentation describing how the project will meet all performance standards for each of the resource areas altered, including standards requiring consideration of alternative project design or location.

B. Buffer Zone & Resource Area Impacts (temporary & permanent) (cont'd)

For all projects affecting other Resource Areas, please attach a narrative explaining how the resource area was delineated.

Resource Area	Size of Proposed Alteration	Proposed Replacement (if any)
a. ☒ Bank	300 (1. linear feet)	(2. linear feet)
b. ☐ Bordering Vegetated Wetland	(1. square feet)	(2. square feet)
c. ☒ Land Under Waterbodies and Waterways	4,027 (1. square feet); (3. cubic yards dredged)	(2. square feet)

Resource Area	Size of Proposed Alteration	Proposed Replacement (if any)
d. ☐ Bordering Land Subject to Flooding	(1. square feet); (3. cubic feet of flood storage lost)	(2. square feet); (4. cubic feet replaced)
e. ☐ Isolated Land Subject to Flooding	(1. square feet); (2. cubic feet of flood storage lost)	(3. cubic feet replaced)
f. ☒ Riverfront Area	Kettle Brook - inland (1. Name of Waterway (if available) - **specify coastal or inland**)	

2. Width of Riverfront Area (check one):

☐ 25 ft. - Designated Densely Developed Areas only

☐ 100 ft. - New agricultural projects only

☒ 200 ft. - All other projects

3. Total area of Riverfront Area on the site of the proposed project: 7,900 square feet

4. Proposed alteration of the Riverfront Area:

a. total square feet	b. square feet within 100 ft.	c. square feet between 100 ft. and 200 ft.
200	200	0

5. Has an alternatives analysis been done and is it attached to this NOI? ☒ Yes ☐ No

6. Was the lot where the activity is proposed created prior to August 1, 1996? ☒ Yes ☐ No

3. ☐ Coastal Resource Areas: (See 310 CMR 10.25-10.35)

Note: for coastal riverfront areas, please complete **Section B.2.f.** above.

B. Buffer Zone & Resource Area Impacts (temporary & permanent) (cont'd)

Check all that apply below. Attach narrative and supporting documentation describing how the project will meet all performance standards for each of the resource areas altered, including standards requiring consideration of alternative project design or location.

Online Users: Include your document transaction number (provided on your receipt page) with all supplementary information you submit to the Department.

Resource Area	Size of Proposed Alteration	Proposed Replacement (if any)
a. ☐ Designated Port Areas	Indicate size under Land Under the Ocean, below	
b. ☐ Land Under the Ocean	1. square feet 2. cubic yards dredged	
c. ☐ Barrier Beach	Indicate size under Coastal Beaches and/or Coastal Dunes below	
d. ☐ Coastal Beaches	1. square feet	2. cubic yards beach nourishment
e. ☐ Coastal Dunes	1. square feet	2. cubic yards dune nourishment

Resource Area	Size of Proposed Alteration	Proposed Replacement (if any)
f. ☐ Coastal Banks	1. linear feet	
g. ☐ Rocky Intertidal Shores	1. square feet	
h. ☐ Salt Marshes	1. square feet	2. sq ft restoration, rehab., creation
i. ☐ Land Under Salt Ponds	1. square feet 2. cubic yards dredged	
j. ☐ Land Containing Shellfish	1. square feet	
k. ☐ Fish Runs	Indicate size under Coastal Banks, inland Bank, Land Under the Ocean, and/or inland Land Under Waterbodies and Waterways, above 1. cubic yards dredged	
l. ☐ Land Subject to Coastal Storm Flowage	1. square feet	

4. ☐ Restoration/Enhancement
If the project is for the purpose of restoring or enhancing a wetland resource area in addition to the square footage that has been entered in Section B.2.b or B.3.h above, please enter the additional amount here.

a. square feet of BVW _____ b. square feet of Salt Marsh _____

5. ☐ Project Involves Stream Crossings

a. number of new stream crossings _____ b. number of replacement stream crossings _____

C. Other Applicable Standards and Requirements

☐ This is a proposal for an Ecological Restoration Limited Project. Skip Section C and complete Appendix A: Ecological Restoration Notice of Intent – Required Actions (310 CMR 10.11).

Streamlined Massachusetts Endangered Species Act/Wetlands Protection Act Review

1. Is any portion of the proposed project located in **Estimated Habitat of Rare Wildlife** as indicated on the most recent Estimated Habitat Map of State-Listed Rare Wetland Wildlife published by the Natural Heritage and Endangered Species Program (NHESP)? To view habitat maps, see the *Massachusetts Natural Heritage Atlas* or go to http://maps.massgis.state.ma.us/PRI_EST_HAB/viewer.htm.

   a. ☐ Yes ☒ No **If yes, include proof of mailing or hand delivery of NOI to:**

   Natural Heritage and Endangered Species Program
   Division of Fisheries and Wildlife
   1 Rabbit Hill Road
   Westborough, MA 01581

   b. Date of map

   If *yes*, the project is also subject to Massachusetts Endangered Species Act (MESA) review (321 CMR 10.18). To qualify for a streamlined, 30-day, MESA/Wetlands Protection Act review, please complete Section C.1.c, and include requested materials with this Notice of Intent (NOI); *OR* complete Section C.2.f, if applicable. *If MESA supplemental information is not included with the NOI, by completing Section 1 of this form, the NHESP will require a separate MESA filing which may take up to 90 days to review (unless noted exceptions in Section 2 apply, see below).*

   c. Submit Supplemental Information for Endangered Species Review*

      1. ☐ Percentage/acreage of property to be altered:

         (a) within wetland Resource Area _____ percentage/acreage

         (b) outside Resource Area _____ percentage/acreage

      2. ☐ Assessor's Map or right-of-way plan of site

2. ☒ Project plans for entire project site, including wetland resource areas and areas outside of wetlands jurisdiction, showing existing and proposed conditions, existing and proposed tree/vegetation clearing line, and clearly demarcated limits of work **

   (a) ☐ Project description (including description of impacts outside of wetland resource area & buffer zone)

   (b) ☐ Photographs representative of the site

* Some projects **not** in Estimated Habitat may be located in Priority Habitat, and require NHESP review (see http://www.mass.gov/eea/agencies/dfg/dfw/natural-heritage/regulatory-review/). Priority Habitat includes habitat for state-listed plants and strictly upland species not protected by the Wetlands Protection Act.

** MESA projects may not be segmented (321 CMR 10.16). The applicant must disclose full development plans even if such plans are not required as part of the Notice of Intent process.

C. Other Applicable Standards and Requirements (cont'd)

(c) ☐ MESA filing fee (fee information available at http://www.mass.gov/dfwele/dfw/nhesp/regulatory_review/mesa/mesa_fee_schedule.htm). Make check payable to "Commonwealth of Massachusetts - NHESP" and ***mail to NHESP*** at above address

*Projects altering **10 or more acres** of land, also submit:*

(d) ☐ Vegetation cover type map of site

(e) ☐ Project plans showing Priority & Estimated Habitat boundaries

(f) OR Check One of the Following

1. ☐ Project is exempt from MESA review.
Attach applicant letter indicating which MESA exemption applies. (See 321 CMR 10.14, http://www.mass.gov/dfwele/dfw/nhesp/regulatory_review/mesa/mesa_exemptions.htm; the NOI must still be sent to NHESP if the project is within estimated habitat pursuant to 310 CMR 10.37 and 10.59.)

2. ☐ Separate MESA review ongoing. a. NHESP Tracking # b. Date submitted to NHESP

3. ☐ Separate MESA review completed.
Include copy of NHESP "no Take" determination or valid Conservation & Management Permit with approved plan.

3. For coastal projects only, is any portion of the proposed project located below the mean high water line or in a fish run?

a. ☒ Not applicable – project is in inland resource area only b. ☐ Yes ☐ No

If yes, include proof of mailing, hand delivery, or electronic delivery of NOI to either:

South Shore - Cohasset to Rhode Island border, and the Cape & Islands:

Division of Marine Fisheries -
Southeast Marine Fisheries Station
Attn: Environmental Reviewer
1213 Purchase Street – 3rd Floor
New Bedford, MA 02740-6694
Email: DMF.EnvReview-South@state.ma.us

North Shore - Hull to New Hampshire border:

Division of Marine Fisheries -
North Shore Office
Attn: Environmental Reviewer
30 Emerson Avenue
Gloucester, MA 01930
Email: DMF.EnvReview-North@state.ma.us

Also if yes, the project may require a Chapter 91 license. For coastal towns in the Northeast Region, please contact MassDEP's Boston Office. For coastal towns in the Southeast Region, please contact MassDEP's Southeast Regional Office.

C. Other Applicable Standards and Requirements (cont'd)

Online Users: Include your document transaction number (provided on your receipt page) with all supplementary information you submit to the Department.

4. Is any portion of the proposed project within an Area of Critical Environmental Concern (ACEC)?

   a. ☐ Yes ☒ No If yes, provide name of ACEC (see instructions to WPA Form 3 or MassDEP Website for ACEC locations). **Note:** electronic filers click on Website.

   b. ACEC

5. Is any portion of the proposed project within an area designated as an Outstanding Resource Water (ORW) as designated in the Massachusetts Surface Water Quality Standards, 314 CMR 4.00?

   a. ☐ Yes ☒ No

6. Is any portion of the site subject to a Wetlands Restriction Order under the Inland Wetlands Restriction Act (M.G.L. c. 131, § 40A) or the Coastal Wetlands Restriction Act (M.G.L. c. 130, § 105)?

   a. ☐ Yes ☒ No

7. Is this project subject to provisions of the MassDEP Stormwater Management Standards?

   a. ☐ Yes. Attach a copy of the Stormwater Report as required by the Stormwater Management Standards per 310 CMR 10.05(6)(k)-(q) and check if:

      1. ☐ Applying for Low Impact Development (LID) site design credits (as described in Stormwater Management Handbook Vol. 2, Chapter 3)

      2. ☐ A portion of the site constitutes redevelopment

      3. ☐ Proprietary BMPs are included in the Stormwater Management System.

   b. ☐ No. Check why the project is exempt:

      1. ☐ Single-family house

      2. ☐ Emergency road repair

      3. ☐ Small Residential Subdivision (less than or equal to 4 single-family houses or less than or equal to 4 units in multi-family housing project) with no discharge to Critical Areas.

D. Additional Information

☐ This is a proposal for an Ecological Restoration Limited Project. Skip Section D and complete Appendix A: Ecological Restoration Notice of Intent – Minimum Required Documents (310 CMR 10.12).

Applicants must include the following with this Notice of Intent (NOI). See instructions for details.

Online Users: Attach the document transaction number (provided on your receipt page) for any of the following information you submit to the Department.

1. ☐ USGS or other map of the area (along with a narrative description, if necessary) containing sufficient information for the Conservation Commission and the Department to locate the site. (Electronic filers may omit this item.)

2. ☐ Plans identifying the location of proposed activities (including activities proposed to serve as a Bordering Vegetated Wetland [BVW] replication area or other mitigating measure) relative to the boundaries of each affected resource area.

D. Additional Information (cont'd)

3. ☐ Identify the method for BVW and other resource area boundary delineations (MassDEP BVW Field Data Form(s), Determination of Applicability, Order of Resource Area Delineation, etc.), and attach documentation of the methodology.

4. ☐ List the titles and dates for all plans and other materials submitted with this NOI.

a. Plan Title

b. Prepared By

c. Signed and Stamped by

d. Final Revision Date

e. Scale

f. Additional Plan or Document Title

g. Date

5. ☐ If there is more than one property owner, please attach a list of these property owners not listed on this form.

6. ☐ Attach proof of mailing for Natural Heritage and Endangered Species Program, if needed.

7. ☐ Attach proof of mailing for Massachusetts Division of Marine Fisheries, if needed.

8. ☐ Attach NOI Wetland Fee Transmittal Form

9. ☐ Attach Stormwater Report, if needed.

E. Fees

1. ☐ Fee Exempt: No filing fee shall be assessed for projects of any city, town, county, or district of the Commonwealth, federally recognized Indian tribe housing authority, municipal housing authority, or the Massachusetts Bay Transportation Authority.

Applicants must submit the following information (in addition to pages 1 and 2 of the NOI Wetland Fee Transmittal Form) to confirm fee payment:

2. Municipal Check Number

3. Check date

4. State Check Number

5. Check date

6. Payor name on check: First Name

7. Payor name on check: Last Name

F. Signatures and Submittal Requirements

I hereby certify under the penalties of perjury that the foregoing Notice of Intent and accompanying plans, documents, and supporting data are true and complete to the best of my knowledge. I understand that the Conservation Commission will place notification of this Notice in a local newspaper at the expense of the applicant in accordance with the wetlands regulations, 310 CMR 10.05(5)(a).

I further certify under penalties of perjury that all abutters were notified of this application, pursuant to the requirements of M.G.L. c. 131, § 40. Notice must be made by Certificate of Mailing or in writing by hand delivery or certified mail (return receipt requested) to all abutters within 100 feet of the property line of the project location.

1. Signature of Applicant — Town Administrator
2. Date: 5/30/17

3. Signature of Property Owner (if different)
4. Date

5. Signature of Representative (if any)
6. Date: 11/1/2017

For Conservation Commission:
Two copies of the completed Notice of Intent (Form 3), including supporting plans and documents, two copies of the NOI Wetland Fee Transmittal Form, and the city/town fee payment, to the Conservation Commission by certified mail or hand delivery.

For MassDEP:
One copy of the completed Notice of Intent (Form 3), including supporting plans and documents, one copy of the NOI Wetland Fee Transmittal Form, and a **copy** of the state fee payment to the MassDEP Regional Office (see Instructions) by certified mail or hand delivery.

Other:
If the applicant has checked the "yes" box in any part of Section C, Item 3, above, refer to that section and the Instructions for additional submittal requirements.

The original and copies must be sent simultaneously. Failure by the applicant to send copies in a timely manner may result in dismissal of the Notice of Intent.

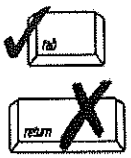
Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands

NOI Wetland Fee Transmittal Form

Massachusetts Wetlands Protection Act M.G.L. c. 131, §40

A. Applicant Information

Important: When filling out forms on the computer, use only the tab key to move your cursor - do not use the return key.



1. Location of Project:

Waite Pond Dam — a. Street Address
Leicester — b. City/Town
c. Check number
d. Fee amount

2. Applicant Mailing Address:

Kevin — a. First Name
Mizikar — b. Last Name
Town Administrator, Town of Leicester — c. Organization
3 Washburn Square — d. Mailing Address
Leicester — e. City/Town
MA — f. State
01524 — g. Zip Code
508-892-7000 — h. Phone Number
i. Fax Number
mizikark@leicesterma.org — j. Email Address

3. Property Owner (if different):

a. First Name
b. Last Name
c. Organization
d. Mailing Address
e. City/Town
f. State
g. Zip Code
h. Phone Number
i. Fax Number
j. Email Address

B. Fees

To calculate filing fees, refer to the category fee list and examples in the instructions for filling out WPA Form 3 (Notice of Intent).

Fee should be calculated using the following process & worksheet. ***Please see Instructions before filling out worksheet.***

Step 1/Type of Activity: Describe each type of activity that will occur in wetland resource area and buffer zone.

Step 2/Number of Activities: Identify the number of each type of activity.

Step 3/Individual Activity Fee: Identify each activity fee from the six project categories listed in the instructions.

Step 4/Subtotal Activity Fee: Multiply the number of activities (identified in Step 2) times the fee per category (identified in Step 3) to reach a subtotal fee amount. Note: If any of these activities are in a Riverfront Area in addition to another Resource Area or the Buffer Zone, the fee per activity should be multiplied by 1.5 and then added to the subtotal amount.

Step 5/Total Project Fee: Determine the total project fee by adding the subtotal amounts from Step **4**.

Step 6/Fee Payments: To calculate the state share of the fee, divide the total fee in half and subtract $12.50. To calculate the city/town share of the fee, divide the total fee in half and add $12.50.

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands

NOI Wetland Fee Transmittal Form

Massachusetts Wetlands Protection Act M.G.L. c. 131, §40

B. Fees (continued)

Step 1/Type of Activity	Step 2/Number of Activities	Step 3/Individual Activity Fee	Step 4/Subtotal Activity Fee
Category 4b - Dam Work	1.5	$1,450.00	$2,175.00

Step 5/Total Project Fee: $2,175.00

Step 6/Fee Payments:

Total Project Fee:	Exempt a. Total Fee from Step 5
State share of filing Fee:	N/A b. 1/2 Total Fee **less** $12.50
City/Town share of filling Fee:	N/A c. 1/2 Total Fee **plus** $12.50

C. Submittal Requirements

a.) Complete pages 1 and 2 and send with a check or money order for the state share of the fee, payable to the Commonwealth of Massachusetts.

Department of Environmental Protection
Box 4062
Boston, MA 02211

b.) **To the Conservation Commission:** Send the Notice of Intent or Abbreviated Notice of Intent; a **copy** of this form; and the city/town fee payment.

To MassDEP Regional Office (see Instructions): Send a copy of the Notice of Intent or Abbreviated Notice of Intent; a **copy** of this form; and a **copy** of the state fee payment. (E-filers of Notices of Intent may submit these electronically.)

FUSS & O'NEILL

Town of Leicester Application for Permit

1 Introduction

Pursuant to the Massachusetts Wetlands Protection Act (WPA), M.G.L. c. 131 40, 310 CMR §10.00, this Notice of Intent (NOI) describes work proposed by the Massachusetts Department of Conservation and Recreation associated with repairs to Waite Pond Dam. The project involves the demolition of the existing spillway and training walls, the demolition of the upstream and downstream concrete and masonry walls, the rehabilitation of the dam crest, including leveling of the dam crest, removal of woody vegetation and trees within 20 feet of the dam and abutments, and restoration of existing parking, the construction of a new concrete spillway and energy dissipation basin, the construction of a riprap lined downstream channel, the construction and installation of a low-level outlet structure, grading and armoring of slopes, and other minor repairs.

The location of the dam site in Leicester, Massachusetts is shown on the Project Location Map, *Figure 1*, and the Project Vicinity Map, *Figure 2*. The existing and proposed conditions are shown on the Site Plans provided in *Appendix A*. Construction is anticipated to begin in September 2018 and be completed by February 2019.

Pursuant to 310 CMR 10.02 (2), filing of a WPA Form 3 Notice of Intent permit application in accordance with the Massachusetts Wetlands Protection Act is required because of proposed alterations within Bordering Vegetated Wetland, Land Under Water Bodies and Waterways, Bank, Bordering Land Subject to Flooding, and Riverfront Area. In addition to an Order of Conditions from the Leicester Conservation Commission, a U.S. Army Corps of Engineers (USACE) Pre-Construction Notification under the Section 404 of the Clean Water Act and a Dam Safety Chapter 253 Permit are required for this project.

2 Project Description

2.1 Existing Conditions

The dam is located at latitude 42.24900 North and longitude 71.88708 West on Kettle Brook in Worcester County. The dam sits at the east end of Waite Pond at the intersection of Chapel Street and Waite Street in Leicester, Massachusetts. The project is located on the Town of Leicester parcel number 49.

Waite Pond Dam consists of a 118-foot long earth/masonry composite embankment supported by vertical upstream and downstream concrete and masonry walls. The structural height is 11 feet, and the hydraulic height at normal pool is 8 feet. The crest is grassed and approximately 20 feet wide. The spillway is a 41-foot long stone masonry weir. Weir boards are normally installed to the normal pond level at elevation 819.24 feet. The left and right training walls are constructed of concrete over masonry. Flow through the spillway falls onto a stepped stone and concrete energy dissipation basin, and then into Kettle Brook.

A 24-inch corrugated metal pipe (CMP) low level outlet is present on-site. Existing conditions plans are included in *Appendix A*. Existing site photographs are included in *Appendix B*.

The following are basic dam characteristics and elevations:

Dam Name:	Waite Pond Dam
Nat. ID Number:	MA00987
State ID Number:	3-14-151-21
Town	Leicester
Dam Owner:	Town of Leicester 3 Washburn Square, Leicester, MA 01524
Dam Caretaker:	Town of Leicester 3 Washburn Square, Leicester, MA 01524
Hazard Potential:	Significant
Size Classification:	Intermediate
Location of Dam (town):	Leicester
Coordinate location (lat, long):	42.24900, -71.88708
Street Address:	West of Chapel/Waite Street Intersection
Purpose of the Dam:	Current: Recreation Historical: Originally to power a small mill of which there are no longer any traces
Length:	120 feet
Structural Height:	11 feet
Hydraulic Height:	8 feet
Type of Dam:	Earth/masonry composite Low-Level Outlet: 24-inch CMP

To reach the dam from Exit 10 of the Massachusetts Turnpike, merge onto Route 12 south for 0.2 miles. Turn right onto Waterman Road for 0.5 miles. Turn right onto Bryn Mawr Avenue for 0.6 miles and turn left onto Leicester Street for 1.1 miles. Turn left onto Rochdale Street for 72 feet, turn right onto Leicester Street for 0.9 miles, and continue onto Auburn Street for 0.3 miles. Turn right onto Stafford Street, turn left onto Auburn Street, and then a slight left onto Main Street. Turn right onto Chapel Street for 0.6 miles. The parking area adjacent to the dam will be on the left after crossing over Kettle Brook.

2.2 Project Purpose & Need

Fuss & O'Neill has performed a Phase I Dam Inspection, Follow up Inspections, and a Phase II Investigation. During the Phase I inspection and the follow-up inspections, the dam was found to be in Poor condition. The primary deficiencies identified during these inspections include:

- **Upstream Face:** Severe erosion, cracking, and undermining of both of the concrete retaining walls observed. The left retaining wall is leaning towards the impoundment.
- **Embankment Crest:** The crest of the dam consists of vegetated earth. Subsidence/depressions were observed on the right and left crests. Dense small woody vegetation and tree root encroachment were also observed on the left crest.

- **Primary Spillway:** The concrete training walls on both sides of the spillway are cracked and eroded. The stilling basin consists of stone rubble covered with concrete that spills overflow to the channel below. The concrete is breaking into fragments.
- **Low Level Outlet:** No functioning low level outlet. Low level outlet structure leaning out of plumb, concrete deteriorated, foundation undermined, and no roof. The low level outlet pipe is 50% full of sediment and its operability unknown.
- **Vegetation:** Dense woody vegetation is present on the right embankment crest and along the toe of the downstream retaining wall.
- **Primary Spillway Training Walls:** Downstream left masonry channel wall is collapsing.
- **Downstream Area and Abutments:** Trees and brush within 20 feet of the dam and abutments.

2.3 Proposed Conditions

The following repairs are proposed, as depicted in the Site Plans:

1. **Remove gate house** Backfill existing low level outlet pipe with grout and abandon in place.
2. **Remove upstream concrete/masonry walls.**
3. **Replace concrete training walls.** The training walls will be replaced with up to one foot thick reinforced concrete along both training walls and will be set to a top elevation of 824.0'.
4. **Construct energy dissipation basin with low flow notch.** The wall to be constructed at the end of the energy dissipation basin will be 42' long at an elevation of 814.3' with a 4' long low flow notch in the center of the wall set to an elevation of 810.3'.
5. **Construct concrete gravity retaining wall along the left side of the downstream channel.** Crest elevation of the wall will vary from 823.5' at the intersection of the left training wall to 815.5' where the wall ends downstream.
6. **Replace concrete spillway crest.** The proposed crest will consist of a 42'-long gravity wall and set to the existing spillway crest elevation (not including weir boards) of 819.24'.
7. **Remove trees and stumps from within 20 feet of the dam and abutments.** Restore area disturbed by tree and vegetation removal to original condition.
8. **Construct low level outlet and gate valve chamber.** Install low-level outlet pipe at 1% slope, concrete cradle, thrust block, and gate valve chamber. Construct concrete headwall with trash rack at upstream end of outlet pipe.
9. **Construct armored upstream embankment slope.**

Construction-period mitigation for sedimentation and erosion controls includes the following, as shown on the Site Plans:

- Adequate sedimentation and erosion control management measures, practices and devices shall be installed and properly maintained to reduce erosion and retain sediment on-site during and after construction, such as
    - phased construction;
    - installation of sediment control barriers including a perimeter silt fence barrier around the project site, floating silt curtain in the river downstream of the stilling basin and upstream of undisturbed wetlands, and the temporary stockpile areas will be surrounded by silt fence; and

  - application of temporary mulching during construction, and permanent seeding and stabilization.
- Temporary sediment control barriers will be removed upon completion of work but not until all disturbed areas are permanently stabilized. The sediment collected by these sediment barriers shall be removed and placed at an upland location and stabilized to prevent its subsequent erosion into a waterway or wetland.
- All exposed soil and other fills shall be permanently stabilized at the earliest practicable date.

Temporary water controls are required to dewater the work area and to convey base flows through the dam. The water controls may consist of water level draw down in the pond, cofferdamming around the work area, or a combination of both. If the pond is not drawn down, the water controls will consist of upstream cofferdams that have a top elevation of a minimum of 822.3 feet to dewater a portion of Waite Pond. The cofferdams will be installed to allow water to flow over a portion of the spillway during certain portions of the work, assuming the training walls will be isolated one side at a time. The pond may be drawn down by up to 8 feet to allow for shorter cofferdams to be installed.

Under any water control plan, base flows will be conveyed around the dam during construction through siphons or pumping when necessary. Water from within the cofferdammed areas will be pumped into a dewatering basin for sedimentation prior to discharging to the Kettle Brook just downstream of the dam. The dewatering basin will serve to minimize turbidity and high velocity flows from entering the river. Any contractor-proposed water control scheme will be subject to review and approval by the engineer and dam owner.

2.3.1 Construction Sequencing

All work described in this section will be conducted in accordance with the Site Plans and as described in detail in other sections of this report. Flow in the existing stream will be maintained throughout construction using a pump and settling basin combination described in *Section 2.3*. The construction sequence will consist of the following general steps:

1. Site Preparation
    a. Install sediment and erosion controls
    b. Install temporary coffer dams and dewater work area
2. Demolition
    a. Remove upstream concrete embankment walls, training walls, spillway wall, downstream left channel wall, and all additional concrete walls.
    b. Remove existing concrete slab in stilling basin immediately downstream of the weir.
    c. Remove marked woody vegetation, saplings, and trees in the project area,
    d. Remove gatehouse. Backfill existing low-level outlet pipe with grout and abandon in place.
3. Site Work
    a. Construct concrete spillway training walls.
    b. Construct energy dissipation basin.
    c. Construct downstream left concrete retaining wall.
    d. Construct low-level outlet pipe and concrete headwall.
    e. Perform grading as indicated upstream of the left and right embankment crests and armor the grading area. Grade the downstream embankment left of the new spillway training wall.
    f. Topsoil, seed and mulch all disturbed areas.
4. Site Closure
    a. Remove coffer dams
    b. Remove all construction equipment
    c. Once vegetation has established, remove E&S controls with the approval of the Leicester Conservation Commission and restore area disturbed by tree and vegetation removal to original condition.

2.3.2 Project Abutters

In accordance with 310 CMR 10.05, concurrent with the filing of the Notice of Intent, the applicant shall provide notification to all Abutters. A "Request for Abutters List" was submitted to the Leicester Board of Assessors and the official provided list will be used to send Certified Mail notices of the project. The list of abutters is included in *Appendix C*. The return receipts will be provided to the Conservation Commission at the Hearing.

3 Alternatives Analysis

Alternatives were evaluated for the repair of Waite Pond Dam to address the existing structural deficiencies, ensure that the dam can safely pass the spillway design flood (SDF), and otherwise bring the dam into compliance with Office of Dam Safety design regulations and dam safety design practice. Alternatives considered for Waite Pond Dam are described in *Section* 2.2 and documented in the Phase II Investigation included in *Appendix D*.

The recommended repairs, associated permitting requirements, and estimated costs are also discussed. The opinion of cost is of order of magnitude accuracy. Order of Magnitude accuracy cost estimates are generally accurate within a range of -30% to +50%.

Dam removal is often also considered as an option, as its advantages and disadvantages are important to consider. This is not deemed a viable alternative, however, because the impoundment is actively used for recreation and is surrounded by privately owned residential properties.

4 Hydrology and Hydraulic Analysis

4.1 Drainage Basin Description

Waite Pond is fed primarily by Kettle Brook and an unnamed stream from the west. The drainage area is approximately 4.92 square miles and extends into the Town of Paxton. The majority of land use consists of undeveloped wooded areas, but includes pastures and residential developments throughout the basin. The drainage area, shown in *Figure 3*, was delineated using USGS topographic mapping. It is long and narrow, with a total length of 6.1 miles and an average width of 0.95 miles.

The surface area of Waite Pond is approximately 53.9 acres at the normal water surface elevation. The dominant hydrologic feature of the drainage basin is flood storage provided Waite Pond and upstream impoundments, which include Kettle Brook Reservoirs No. 1, No. 2, No. 3, and No. 4.

4.2 Model Description

A hydrologic and hydraulic model was prepared using the HydroCAD software to assess the peak flood discharges and spillway capacity at Waite Pond Dam. HydroCAD incorporates the TR-55 rainfall/runoff routing method, which was used for this project. Flood attenuation in Waite Pond and Kettle Brook Reservoir No. 1, No. 2, No. 3, and No. 4 was modeled in the analyses using level-pool routing. The 4.9 square mile drainage basin was divided into ten sub-basins. Two sub-basins were assigned to each impoundment; one for direct precipitation onto the water surface of the impoundments and the one for overland runoff.

The hydrologic properties of the drainage basin were determined from available topographic, land use, soils, and hydrography data. A composite curve number for each of five sub-basins representing overland runoff to the impoundments were determined from land use and hydrologic soils group and range from 64 to 70. A curve number of 98 was assigned to represent inflow volume to the impoundments via direct precipitation.

Storm hyetographs were based on the Soil Conservation Service Type III storm events, with storm depths determined from TP-40. The model elements and hydraulic and hydrologic parameters used in the HydroCad (TR-20) model are provided in *Appendix G*.

4.3 Spillway Design Flood Capacity Assessment

The significant hazard class and intermediate size of Waite Pond Dam dictate that the spillway must safely pass the 100-year storm (the Spillway Design Flood, or SDF) per 302 CMR 10.00. Adequate freeboard is generally preferred between the peak water surface elevation and the top of the dam such that waves do not cause overtopping. For a relatively small impoundment such as Waite Pond, adequate freeboard is generally considered to be one foot.

From the National Weather Bureau Technical Paper 40 (TP-40) (Hershfield 1961), the 100-year storm consists of 6.5 inches of precipitation in 24 hours. This rainfall was routed through the pond as described in *Section 4.2* to assess the spillway capacity. Separate analyses were performed for the existing dam with the weir boards removed and with them installed.

The results of the analysis indicate that with the weir boards removed the spillway has adequate capacity to safely convey the SDF. The maximum water surface elevation for the 100-year flood is shown to be 822.0 feet, which is 1.0 foot below the left embankment crest and 1.5 feet below the right embankment crest. With the weir boards installed, however, the results of the analysis indicate a maximum WSE of 823.1 feet, which will overtop the left embankment by 0.1± feet. This is a minor depth of overtopping, and small variations in the design of the structure could be effective in allowing the dam to safely pass the SDF.

By raising the crest of the left embankment 0.5 feet to EL 823.5 feet (equal to the right embankment crest), 0.4 feet of freeboard will be provided with the weir boards installed and 1.5 feet of freeboard will be provided with them removed. It is assumed that the weir boards will be removed prior to the start of runoff when heavy precipitation is predicted; therefore, 1.5 feet of freeboard is the design capacity and 0.4 feet is for conservatism the worst case scenario.

4.4 Hazard Class Assessment

Chapel Street, a secondary road, runs parallel to the southeastern shore of Waite Pond and forms the left abutment of the dam. Kettle Brook is conveyed beneath Chapel, via a box culvert, approximately 150 feet downstream of the dam and continues flowing in the southeast direction for another 1,500 feet until it passes under a second bridge crossing on Chapel Street and enters City Pond. It appears that a failure of the dam at maximum pool may cause damage to the downstream bridge/culvert crossings. A failure of the dam could also result in damage to Chapel Street at the left abutment of the structure.

Therefore, in accordance with Department of Conservation and Recreation classification procedures, under Commonwealth of Massachusetts dam safety rules and regulations stated in 302 CMR 10.00 as amended by Chapter 330 of the Acts of 2002, Waite Pond Dam is classified as a **Significant** hazard potential dam.

5 Wetland Resource Area Impacts and Mitigation

Wetland boundary delineations were performed by Sara Fusco, PWS, then of Fuss & O'Neill, Inc., within 100 feet of proposed work areas on September 17, 2013. The purpose of the delineation was to locate the jurisdictional limits of areas regulated under the Wetland Protection Act (M.G.L. c. 131 sec. 40) and the associated Wetland Protection regulations (310 CMR 10) using methodology presented in the Massachusetts DEP Handbook: Delineating Bordering Vegetated Wetlands, March 1995, the 1987 ACOE Wetland Delineation Manual, and the Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Northcentral and Northeast Region, January 2012. A Wetland Delineation Report is included as *Appendix E*. Inland wetland resource areas identified in the area of interest during the field inspection included Bordering Vegetated Wetlands (BVW), Land Under Water Bodies and Waterways (LUWW), Bank, Bordering Land Subject to Flooding (BLSF), and Riverfront Area (RA). The surveyed wetland boundaries are shown on the Site Plans.

Proposed project activities consist of alterations to LUWW, Bank, and RA. No alterations to BVW are proposed. A summary of the wetland resource area impacts and proposed replication is included in *Table 2*. The General Performance Standards associated with the impact and replication areas for the resource areas are included in *Section 6*.

Table 2. Wetland Resource Area Impact Summary

Resource Area	Length/Area of Alteration	Associated Work	Proposed Resource Restoration
LUWW	4,096 sf	Rip rap, dewatering/cofferdam area, gatehouse removal, and tree clearing	sf
Bank	300 lf	Equipment and water controls, Grading	lf
RA	7,666 sf within project area; 200 sf of permanent alteration	Rip rap, piping, and tree clearing	Exempt pursuant to 310 CMR 10.58(6)(a)

5.1 Stormwater Management

In accordance with 310 CMR 10.05(6)(k)-(q), the Massachusetts Stormwater Standards must be adhered to with stormwater best management practices to attenuate pollutants and to provide a setback from the receiving waters and wetlands.

The Stormwater Management Standards apply to stormwater runoff from all industrial, commercial, institutional, office, residential and transportation projects that are subject to regulation under M.G.L. c.

131, § 40 including site preparation, construction, and redevelopment and all point source stormwater discharges from said projects within an Area Subject to Protection under M.G.L. c. 131, § 40 or within the Buffer Zone.

Since this project is not an industrial, commercial, institutional, office, residential or transportation project, the standards are not applicable. Therefore, the Stormwater Checklist and Stormwater Report are not included.

6 Post-Construction Wetland Performance Standards

This project is a **Limited Project** as defined under 310 CMR 10.53 (3)(i) "for the maintenance, repair and improvement (but not substantial enlargement…) of structures, including dams and reservoirs and appurtenant works to such dams and reservoirs… which existed on the effective date of 310 CMR 10.51 through 10.60 (April 1, 1983)."

Following the repairs, the water level will return to the pre-construction level. The project will not have an adverse effect on specified habitat sites of Rare Species as described in *Section 7*. Reasonable alternatives to the proposed activity are described in *Section 3*. The minimization of adverse impacts, including mitigation measures are described in this section.

6.1 Bordering Vegetated Wetlands

Bordering Vegetated Wetlands identified on the site will not be altered during dam repair construction. Therefore, no mitigation or replication is necessary.

6.2 Land Under Water Bodies and Waterways

The alteration of 4,096 sf of LUWW is proposed. Although not required for a Limited Project, the following General Performance Standards of 310 CMR 10.56(4) will be considered to the extent feasible.

6.3 Bank

Approximately 300 linear feet (lf) of Bank associated with construction will be temporarily altered. Although not required for a Limited Project, the Bank will be replicated in-situ in accordance with the General Performance Standards of 310 CMR 10.54(4).

6.4 Riverfront Area

There are a total of 7,666 sf of RA located within the project area. The proposed project involves alteration of 200 sf of RA associated with Kettle Brook located within a previously developed area associated with tree clearing and rip rap installation.

The project consists of maintenance of a structure (not enlargement) in existence on August 7, 1996, and therefore it qualifies for an exemption from the requirements for Riverfront Area [310 CMR 10.58(1) through (5)] pursuant to 310 CMR 10.58(6)(a). As such, the requirement for the Evaluation of Alternatives and the adherence to the Massachusetts Stormwater Management Standards under this section do not apply. Nevertheless, the proposed work will result in no significant changes over existing conditions of the capacity of the RA to protect the interests identified in M.G.L. c. 131 § 40.

6.5 Bordering Land Subject to Flooding

The general performance standards under the WPA for Bordering Land Subject to Flooding include providing compensatory storage for all flood storage volume that will be lost as the result of a proposed project within BLSF, when said loss will cause an increase or will contribute incrementally to an increase in the horizontal extent and level of flood waters during peak flows.

No loss of floodplain is anticipated due to dam repair construction activities.

7 Threatened and Endangered Species

7.1 Federal Endangered Species

The U.S Fish & Wildlife Service (USFWS) enacted a final rule that identifies Endangered Species Act protections for the northern long-eared bat (NLEB). The final 4(d) rule, published in the Federal Register on January 14, 2016, identifies prohibitions that focus on protecting the bat's sensitive life stages in areas affected by white-nose syndrome. The project site is located within Worcester County, which is located within the White Nose Syndrome (NWS) Zone *(Appendix F1)*. The "Biological Opinion on Final 4(d) Rule for the Northern Long-Eared Bat and activities Excepted from Take Prohibitions for Regions 2, 3, 4, 5, and 6"[1], which was prepared by USFWS and issued January 5, 2016, stated that the following activities are prohibited under 4(d), and would require a project-specific Section 7 consultation:

1. Activities resulting in the disruption of NLEB in their hibernacula
2. Activities resulting in physical alteration of a hibernaculum's entrance or environment at any time of year
3. Tree clearing within 0.25 miles of a known NLEB hibernaculum
4. Tree clearing that results in cutting or destroying known, occupied maternity roost trees or any other trees within a 150-foot radius around the roost tree during pup season (June 1 – July 31).

NLEB are known to roost in cavities, under bark, crevices, or hollows of live and dead trees or snags greater than 3 inches diameter at breast height (dbh). NLEB have also been known to roost in buildings, under bridges, and in bat houses. There are no known hibernacula located within Leicester according to

[1] The 13 northeastern states are Region 5

the Massachusetts Natural Heritage & Endangered Species Program (NHESP) Massachusetts Endangered Species Act (MESA) -listed species ohservations in the Commonwealth, dated March 24, 2016 *(Appendix F2 and F3).*

Since the activity will take place at least 0.25 miles outside of a known NLEB hibernaculum, no permit/consultation should be necessary. In addition, tree removal will not occur between June 1 and July 31.

7.2 State-listed Species

The project area is not located within any areas of Natural Heritage and Endangered Species Program (NHESP) Priority Habitat of Rare Species ("Priority Habitat") or Estimated Habitat of Rare Wildlife ("Estimated Habitat"). Therefore, coordination with NHESP is not required in accordance with Massachusetts Endangered Species Act (MESA) Regulations at 321 CMR 10.

WAITE POND DAM REPAIRS

PERMITTING PLAN SET

MA00987 · CHAPEL STREET · LEICESTER · MASSACHUSETTS

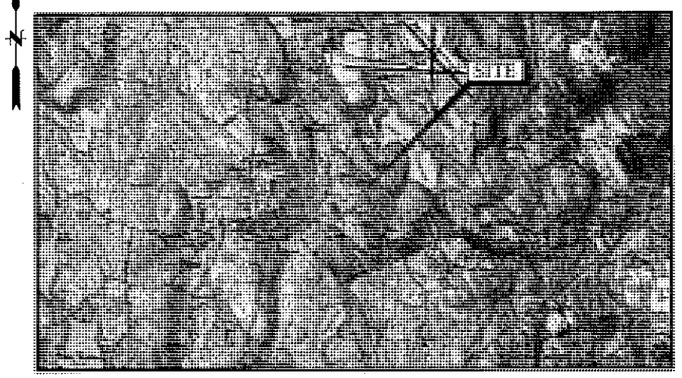
SEPTEMBER 20, 2017

PREPARED FOR

TOWN OF LEICESTER
3 WASHBURN SQUARE
LEICESTER, MA 01524

PREPARED BY

FUSS & O'NEILL
78 INTERSTATE DRIVE
WEST SPRINGFIELD, MA 01089
413.452.0445
www.fando.com



LOCATION MAP
SCALE: 1" = 2000'

SHEET INDEX

COMMONWEALTH OF MASSACHUSETTS
PHILIP W. MORESCHI
CIVIL
No. 32051
REGISTERED PROFESSIONAL ENGINEER

PHILIP W. MORESCHI — MA PE LICENSE No. 32051

PROJ. No.: 20081206.A70
DATE: SEPTEMBER 2017

GI-001

File Path: J:\CIVIL\P\20081206\Design\70C-HPlan\20081206A70L_C01V01.dwg, Layout: GI-001, Plotted: Wednesday, September 20, 2017, User: dang, Plotter: DWG TO PDF.PC3 CTB File: FO.STB

CIVIL GENERAL NOTES

GENERAL NOTES

1. SYMBOLS AND LEGENDS OF PROJECT FEATURES ARE GRAPHIC REPRESENTATIONS AND ARE NOT NECESSARILY SHOWN ON THE DRAWINGS TO SCALE OR TO THEIR ACTUAL DIMENSION OR LOCATION. COORDINATE DETAIL SHEET DIMENSIONS, MANUFACTURERS' LITERATURE, SHOP DRAWINGS AND FIELD MEASUREMENTS OF SUPPLIED PRODUCTS FOR LAYOUT OF THE PROJECT FEATURES.
2. DO NOT RELY SOLELY ON ELECTRONIC VERSIONS OF DRAWINGS, SPECIFICATIONS, AND DATA FILES THAT ARE PROVIDED BY THE ENGINEER. FIELD VERIFY LOCATION OF PROJECT FEATURES.
3. PERFORM NECESSARY CONSTRUCTION NOTIFICATIONS, APPLY FOR AND OBTAIN NECESSARY PERMITS, PAY FEES, AND POST BONDS ASSOCIATED WITH THE WORK AS REQUIRED BY THE CONTRACT DOCUMENTS.
4. BASE PLAN: THE TOPOGRAPHY AND PHYSICAL FEATURES ARE BASED ON FIELD SURVEY PERFORMED BY SHERMAN & FRYDRYK LAND SURVEYING & ENGINEERING (PALMER, MA) ON 09/26/13.
5. TOPOGRAPHIC ELEVATIONS ARE BASED ON NAVD88 DATUM.
6. WETLANDS WERE DELINEATED BY FUSS & O'NEILL ON 09/17/13.
7. DEVIATIONS OR CHANGES FROM THESE PLANS WILL NOT BE ALLOWED UNLESS APPROVED BY THE ENGINEER AND DAM OWNER.
8. THE CONTRACTOR SHALL BE RESPONSIBLE FOR REPLACING, WITH MATCHING MATERIALS, ANY PAVEMENT, WALKS, CURBS, ETC., THAT MUST BE CUT OR THAT ARE DAMAGED DURING CONSTRUCTION.
9. AN APPROVED SET OF PLANS AND ALL APPLICABLE PERMITS MUST BE AVAILABLE AT THE SITE THROUGH THE ENTIRE PERIOD OF CONSTRUCTION WHEN WORK IS ACTIVELY OCCURRING.
10. CONTRACTOR AGREES THAT HE/SHE SHALL ASSUME SOLE AND COMPLETE RESPONSIBILITY FOR JOB SITE CONDITIONS DURING THE COURSE OF CONSTRUCTION OF THIS PROJECT, INCLUDING SAFETY OF ALL PERSONS AND PROPERTY; THAT THIS REQUIREMENT SHALL APPLY CONTINUOUSLY AND NOT BE LIMITED TO NORMAL WORKING HOURS; AND THAT THE CONTRACTOR SHALL DEFEND, INDEMNIFY AND HOLD THE CONTRACT OWNER, PROPERTY OWNER (TOWN OF LEICESTER) AND THE ENGINEER HARMLESS FROM ANY AND ALL LIABILITY, REAL AND ALLEGED, IN CONNECTION WITH THE PERFORMANCE OF WORK ON THIS PROJECT, EXCEPTING FOR LIABILITY ARISING FROM "THE SOLE NEGLIGENCE OF THE CONTRACT OWNER, PROPERTY OWNER OR THE ENGINEER."
11. PHOTOGRAPHS AND SKETCHES (AS NECESSARY) MUST BE TAKEN OF ADJOINING CONSTRUCTION AND SITE IMPROVEMENTS WITHIN 200 FEET OF EXCAVATION LIMITS ASSOCIATED WITH THE DAM IMPROVEMENTS PRIOR TO EXCAVATION AND THE INSTALLATION OF EXCAVATION SUPPORT SYSTEMS. SUCH DOCUMENTATION SHALL ILLUSTRATE EXISTING SURFACES THAT MAY BE MISCONSTRUED AS DAMAGE CAUSED BY THE PROJECT CONSTRUCTION OPERATIONS.
12. ACCESS, STAGING, AND TEMPORARY SEDIMENT STOCKPILING AREAS NOT INDICATED ON THE PLANS SHALL BE DELINEATED BY THE CONTRACTOR FOR APPROVAL PRIOR TO PROJECT INITIATION.
13. VEHICLE STORAGE AND FUELING SHALL BE PERFORMED AT LEAST 50' OUTSIDE OF THE POND AND DOWNSTREAM CHANNEL AND ONLY IN DESIGNATED AREAS SUCH THAT THERE WILL BE NO CONTAMINATION OF SOIL, GROUNDWATER, OR SURFACE WATER FROM SPILLS OR LEAKS.

WATER CONTROL NOTES

1. THE TEMPORARY COFFERDAM SYSTEM MUST BE MAINTAINED TO ALLOW A DEWATERED CONDITION (NO SEDIMENT PLUME) IN THE WATERCOURSE. SOIL DISTURBANCE WITHIN THE WATERCOURSE MUST TEMPORARILY CEASE IN THE EVENT OF ANY ABNORMALLY HIGH STORMWATER RUNOFF EVEN IF A DRY WORKING CONDITION CANNOT BE MAINTAINED WITH THE USE OF WATER PUMPS OR OTHER MEANS.
2. THE CONTRACTOR SHALL PROTECT CONSTRUCTED WORK AND ADJACENT PROPERTIES POTENTIALLY AFFECTED BY FLOW DIVERSIONS RESULTING FROM COFFERDAMS AND BYPASS CONVEYANCES DURING FLOOD EVENTS.
3. TEMPORARY COFFERDAMS AND WATER DIVERSION STRUCTURE(S) ARE TO BE CONSTRUCTED OF MATERIALS THAT CAN BE COMPLETELY REMOVED FROM WATERCOURSE UPON COMPLETION OF CONSTRUCTION. REMOVAL OF THE TEMPORARY COFFERDAMS SHALL BE CONDUCTED IN A CONTROLLED MANNER.
4. THE CONTRACTOR SHALL SUBMIT A WATER CONTROL PLAN FOR REVIEW AND APPROVAL BY THE ENGINEER A MINIMUM OF TWO WEEKS PRIOR TO THE START OF CONSTRUCTION.

WORK RESTRICTIONS & REGULATORY REQUIREMENTS

1. DO NOT CLOSE OR OBSTRUCT ROADWAYS, SIDEWALKS, FIRE HYDRANTS, AND UTILITIES WITHOUT APPROPRIATE PERMITS.
2. WITHIN LOCAL RIGHTS-OF-WAY, PERFORM THE WORK IN ACCORDANCE WITH LOCAL MUNICIPAL STANDARDS.
3. PROVIDE TRAFFIC SIGNAGE AND PAVEMENT MARKINGS IN CONFORMANCE WITH THE LATEST EDITION OF THE MANUAL OF UNIFORM TRAFFIC CONTROL DEVICES.
4. BE RESPONSIBLE FOR SITE SECURITY AND JOB SAFETY. PERFORM CONSTRUCTION ACTIVITIES IN ACCORDANCE WITH OSHA STANDARDS AND LOCAL REQUIREMENTS.
5. DISPOSE OF DEMOLITION DEBRIS IN ACCORDANCE WITH APPLICABLE FEDERAL, STATE AND LOCAL REGULATIONS, ORDINANCES AND STATUTES.

EROSION AND SEDIMENT CONTROL NOTES

1. INSTALL EROSION CONTROL MEASURES PRIOR TO STARTING ANY WORK ON THE SITE.
2. IMPLEMENT ALL NECESSARY MEASURES REQUIRED TO CONTROL STORMWATER RUNOFF, DUST, SEDIMENT, AND DEBRIS FROM EXITING THE SITE. PERFORM CORRECTIVE ACTION AS NEEDED FOR EROSION CLEANUP AND REPAIRS TO OFF SITE AREAS, IF ANY, AT NO COST TO OWNER.
3. INSPECT AND MAINTAIN EROSION CONTROL MEASURES PER THE SCHEDULE IN THE EROSION AND SEDIMENT CONTROL DRAWINGS. DISPOSE OF SEDIMENT IN AN UPLAND AREA. DO NOT ENCUMBER OTHER DRAINAGE STRUCTURES AND PROTECTED AREAS.
4. PERFORM CONSTRUCTION SEQUENCING IN SUCH A MANNER TO CONTROL EROSION AND TO MINIMIZE THE TIME THAT EARTH MATERIALS ARE EXPOSED BEFORE THEY ARE COVERED, SEEDED, OR OTHERWISE STABILIZED.
5. UPON COMPLETION OF CONSTRUCTION AND ESTABLISHMENT OF PERMANENT GROUND COVER, REMOVE AND DISPOSE OF TEMPORARY EROSION CONTROL MEASURES. CLEAN SEDIMENT AND DEBRIS FROM TEMPORARY MEASURES AND FROM PERMANENT STORM DRAIN AND SANITARY SEWER SYSTEMS.

DEMOLITION & CONSTRUCTION LAYOUT NOTES

1. PROVIDE PROPER TRANSITIONS BETWEEN EXISTING AND PROPOSED SITE IMPROVEMENTS. FIELD VERIFY EXISTING PAVEMENT AND GROUND ELEVATIONS AT THE INTERFACE WITH PROPOSED PAVEMENTS AND DRAINAGE STRUCTURES BEFORE START OF CONSTRUCTION.
2. PRIOR TO ORDERING MATERIALS AND BEGINNING CONSTRUCTION, FIELD VERIFY PROPOSED UTILITY ROUTES AND IDENTIFY ANY INTERFERENCES OR OBSTRUCTIONS WITH EXISTING UTILITIES OR PUBLIC RIGHTS-OF-WAY.
3. IMMEDIATELY INFORM THE ENGINEER IN WRITING IF EXISTING UTILITY CONDITIONS CONFLICT OR DIFFER FROM THAT INDICATED AND IF THE WORK CANNOT BE COMPLETED AS INDICATED.
4. DIMENSIONS ARE FROM FACE OF CURB, FACE OF BUILDING, FACE OF WALL, AND CENTER LINE OF PAVEMENT MARKINGS, UNLESS NOTED OTHERWISE.
5. BOUNDS OR MONUMENTATION DISTURBED DURING CONSTRUCTION SHALL BE SET OR RESET BY A PROFESSIONAL LICENSED SURVEYOR.

EARTHWORK NOTES

1. NOTIFY UTILITY LOCATOR SERVICE AT LEAST 72 HOURS BEFORE STARTING EXCAVATION.
   CALL MA "DIG SAFE" AT 1-888-344-7233
2. STOP WORK IN THE VICINITY OF SUSPECTED CONTAMINATED SOIL, GROUNDWATER OR OTHER MEDIA. IMMEDIATELY NOTIFY THE OWNER SO THAT APPROPRIATE TESTING AND SUBSEQUENT ACTION CAN BE TAKEN. RESUME WORK IN THE IMMEDIATE VICINITY ONLY UPON DIRECTION BY THE OWNER.
3. WITHIN THE LIMITS OF THE DAM FOOTPRINT, PERFORM EARTHWORK OPERATIONS TO SUBGRADE ELEVATIONS. SEE DRAWINGS BY OTHERS FOR WORK ABOVE SUBGRADE.

UTILITY NOTES

1. TERMINATE EXISTING UTILITIES IN CONFORMANCE WITH LOCAL, STATE AND INDIVIDUAL UTILITY COMPANY STANDARD SPECIFICATIONS AND DETAILS. COORDINATE UTILITY SERVICE DISCONNECTS WITH UTILITY REPRESENTATIVES.
2. THE TYPE, SIZE AND LOCATION OF DEPICTED UNDERGROUND UTILITIES ARE APPROXIMATE REPRESENTATIONS OF INFORMATION OBTAINED FROM FIELD LOCATIONS OF VISIBLE FEATURES, EXISTING MAPS AND PLANS OF RECORD, UTILITY MAPPING, AND OTHER SOURCES OF INFORMATION OBTAINED BY THE ENGINEER. ASSUME NO GUARANTEE AS TO THE COMPLETENESS, SERVICEABILITY, EXISTENCE, OR ACCURACY OF UNDERGROUND FACILITIES. FIELD VERIFY THE EXACT LOCATIONS, SIZES, AND ELEVATIONS OF THE POINTS OF CONNECTIONS TO EXISTING UTILITIES.
3. PAY ALL FEES AND COSTS ASSOCIATED WITH UTILITY MODIFICATIONS AND CONNECTIONS, REGARDLESS OF THE ENTITY THAT PERFORMS THE WORK.
4. COORDINATE THE WORK AND WORK SCHEDULE WITH UTILITY COMPANIES. PROVIDE ADEQUATE NOTICE TO UTILITIES TO PREVENT DELAYS IN CONSTRUCTION.

SITE RESTORATION NOTES

1. PROVIDE 6 INCHES OF TOPSOIL AND SEED TO AREAS DISTURBED DURING CONSTRUCTION AND NOT DESIGNATED TO BE RESTORED WITH IMPERVIOUS SURFACES (BUILDINGS, PAVEMENTS, WALKS, ETC.) UNLESS OTHERWISE NOTED.
2. REPAIR DAMAGES RESULTING FROM CONSTRUCTION LOADS, AT NO ADDITIONAL COST TO OWNER.
3. RESTORE AREAS DISTURBED BY CONSTRUCTION OPERATIONS TO THEIR ORIGINAL CONDITION OR BETTER, AT NO ADDITIONAL COST TO OWNER.

File Path: ...\DWG\P2008\1286A70\Civil\Plan\20081286A70_CGN01.dwg Layout: GI-002 Plotted: Wed, September 20, 2017 - 3:38 PM User: aking
MG VIEW: LAYER STATE: Plotter: DWG TO PDF.PC3 CTB File: FO.STB

No.	DATE	DESCRIPTION	DESIGNER	REVIEWER
1.				

COMMONWEALTH OF MASSACHUSETTS
PHILIP W. MORRISSEY
CIVIL
No. 49091
REGISTERED PROFESSIONAL ENGINEER

SEAL

SCALE:
HORZ.:
VERT.:
DATUM:
HORZ.:
VERT.:
0
GRAPHIC SCALE

FUSS & O'NEILL
78 INTERSTATE DRIVE
WEST SPRINGFIELD, MA 01089
413.452.0445
www.fando.com

TOWN OF LEICESTER

GENERAL NOTES & INFORMATION

WAITE POND DAM REPAIRS

CHAPEL STREET, LEICESTER MASSACHUSETTS

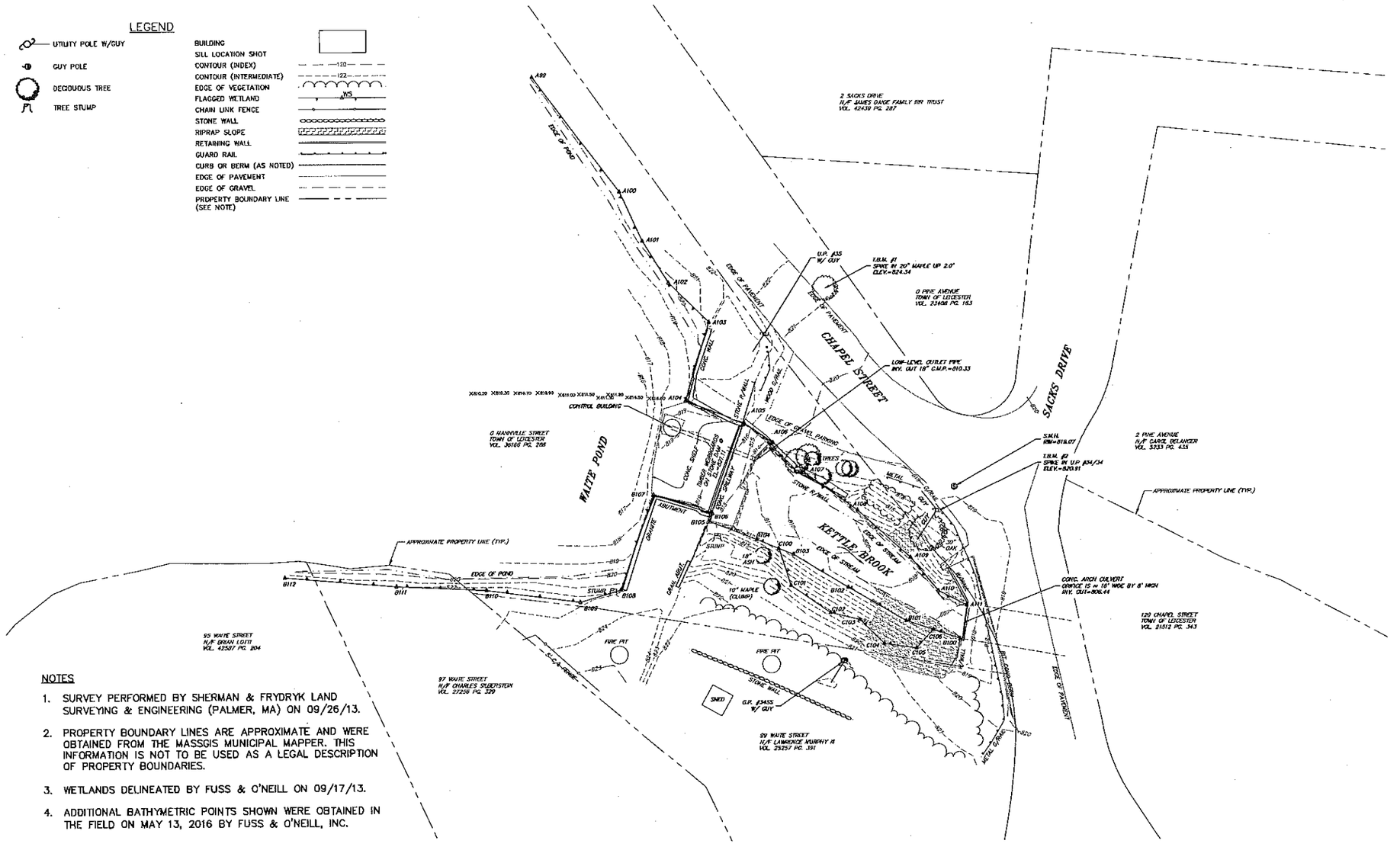
PROJ. No.: 20081286.A70
DATE: 9/20/2017

GI-002

LEGEND

- UTILITY POLE W/GUY
- GUY POLE
- DECIDUOUS TREE
- TREE STUMP

- BUILDING
- SILL LOCATION SHOT
- CONTOUR (INDEX) — 120 —
- CONTOUR (INTERMEDIATE) — 122 —
- EDGE OF VEGETATION
- FLAGGED WETLAND — WS —
- CHAIN LINK FENCE
- STONE WALL
- RIPRAP SLOPE
- RETAINING WALL
- GUARD RAIL
- CURB OR BERM (AS NOTED)
- EDGE OF PAVEMENT
- EDGE OF GRAVEL
- PROPERTY BOUNDARY LINE (SEE NOTE)



NOTES

1. SURVEY PERFORMED BY SHERMAN & FRYDRYK LAND SURVEYING & ENGINEERING (PALMER, MA) ON 09/26/13.
2. PROPERTY BOUNDARY LINES ARE APPROXIMATE AND WERE OBTAINED FROM THE MASSGIS MUNICIPAL MAPPER. THIS INFORMATION IS NOT TO BE USED AS A LEGAL DESCRIPTION OF PROPERTY BOUNDARIES.
3. WETLANDS DELINEATED BY FUSS & O'NEILL ON 09/17/13.
4. ADDITIONAL BATHYMETRIC POINTS SHOWN WERE OBTAINED IN THE FIELD ON MAY 13, 2016 BY FUSS & O'NEILL, INC.

File Path: J:\DWG\P2006\12861286A70\CAD\Plan\20061286A70_EX001.dwg Layout: RC-101 Plotted: Wed, September 20, 2017 - 3:35 PM User: dking
Plotter: DWG TO PDF.PC3 CTB File: FO.STB
LAYER STATE:
XAS VIEW:

No.	DATE	DESCRIPTION	DESIGNER	REVIEWER
1.				

COMMONWEALTH OF MASSACHUSETTS
PHILIP W. MORESCHI
CIVIL
No. 32261
REGISTERED PROFESSIONAL ENGINEER

SEAL

SCALE:
HORZ.: 1" = 20'
VERT.:
DATUM:
HORZ.: NAD 83
VERT.: NAVD 88
20 10 0 20
GRAPHIC SCALE

FUSS & O'NEILL
78 INTERSTATE DRIVE
WEST SPRINGFIELD, MA 01089
413.452.0445
www.fando.com

TOWN OF LEICESTER

EXISTING CONDITIONS PLAN

WAITE POND DAM REPAIRS

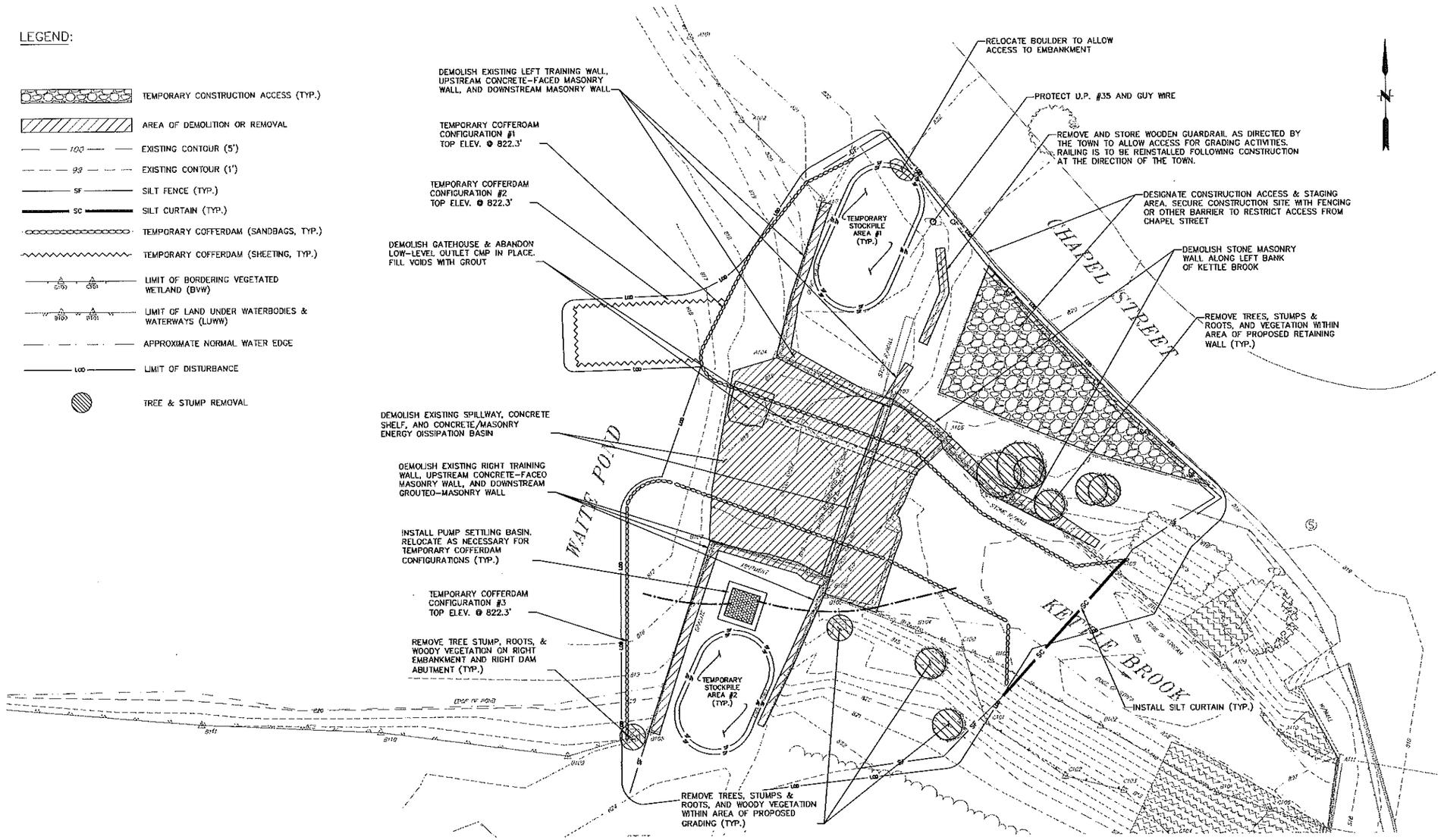
CHAPEL STREET, LEICESTER — MASSACHUSETTS

PROJ. No.: 20061286.A70
DATE: 9/20/2017

RC-101

LEGEND:

- TEMPORARY CONSTRUCTION ACCESS (TYP.)
- AREA OF DEMOLITION OR REMOVAL
- 103 EXISTING CONTOUR (5')
- 93 EXISTING CONTOUR (1')
- SF SILT FENCE (TYP.)
- SC SILT CURTAIN (TYP.)
- TEMPORARY COFFERDAM (SANDBAGS, TYP.)
- TEMPORARY COFFERDAM (SHEETING, TYP.)
- LIMIT OF BORDERING VEGETATED WETLAND (BVW)
- LIMIT OF LAND UNDER WATERBODIES & WATERWAYS (LUWW)
- APPROXIMATE NORMAL WATER EDGE
- LOD LIMIT OF DISTURBANCE
- TREE & STUMP REMOVAL



No.	DATE	DESCRIPTION	DESIGNER	REVIEWER
1.				

PHILIP W. MORESCHI CIVIL No. 33041 REGISTERED PROFESSIONAL ENGINEER

SEAL

SCALE:
HORZ.: 1" = 10'
VERT.:
DATUM:
HORZ.: NAVD83
VERT.: NAVD88
10 5 0 10
GRAPHIC SCALE

FUSS & O'NEILL
78 INTERSTATE DRIVE
WEST SPRINGFIELD, MA 01089
413.452.0445
www.fando.com

TOWN OF LEICESTER
SITE PREPARATION, DEMOLITION & WATER CONTROL PLAN
WAITE POND DAM REPAIRS
CHAPEL STREET, LEICESTER MASSACHUSETTS

PROJ. No.: 20081286.A70
DATE: 9/28/2017

CE-101

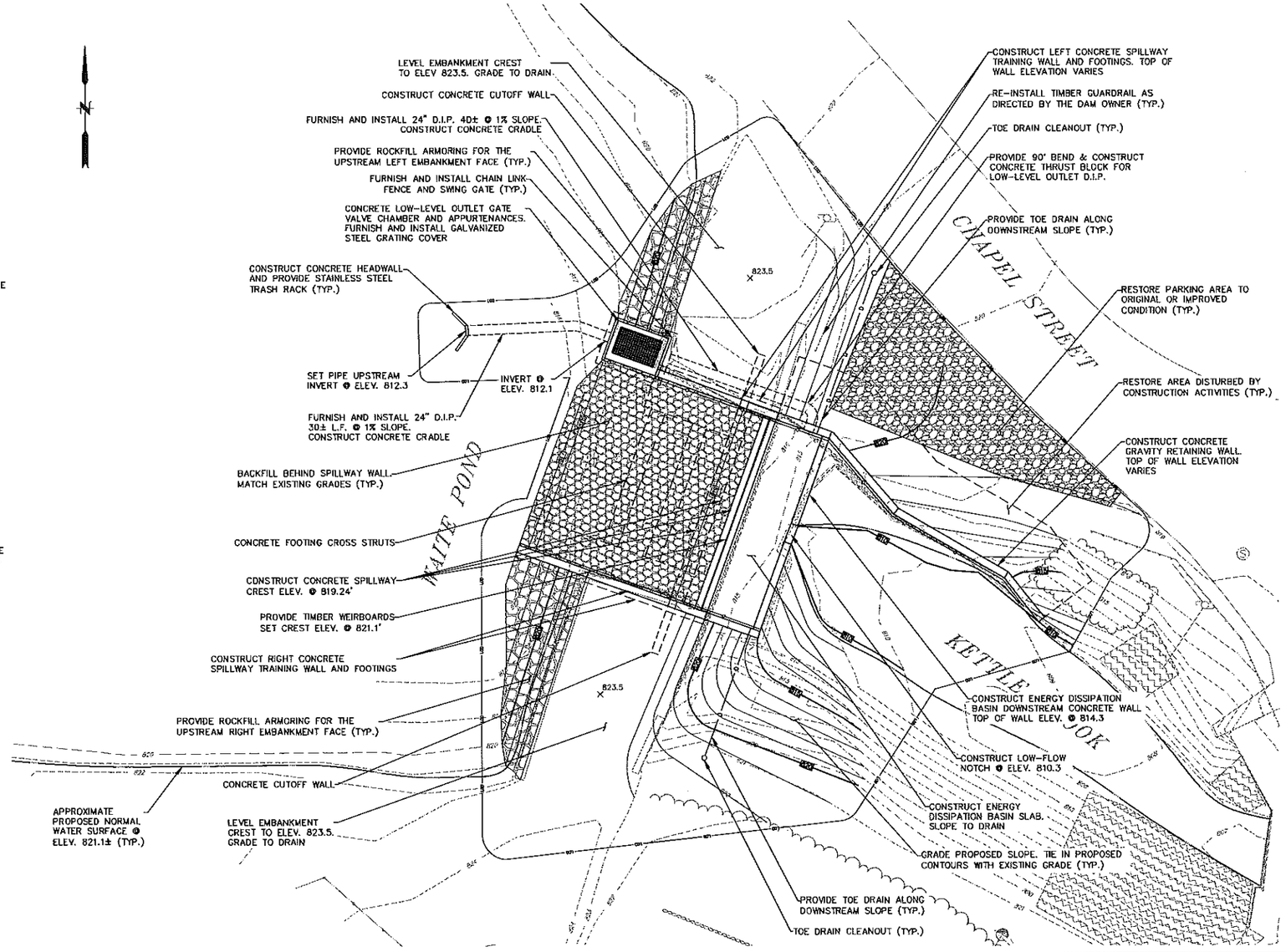
File Path: J:\CIVIL\P2008\1286.A70\CIVIL\Plan\20081286A70_GRA01.dwg Layout: CE-101 Plotted: Wed, September 20, 2017 - 3:26 PM User: ebing
Plotter: DWG To PDF.PC3 CTB File: FO.STB
LATER STATE:
MS VIEW:

GENERAL CONSTRUCTION SEQUENCE:

1. CALL MA "DIG SAFE" A MINIMUM OF 72 HOURS PRIOR TO THE START OF EXCAVATION ACTIVITIES
2. MOBILIZE TO CONSTRUCTION SITE
3. INSTALL CONSTRUCTION ENTRANCE AND SECURE CONSTRUCTION SITE AS INDICATED ON CE-101
4. DESIGNATE TEMPORARY STOCKPILING AND STAGING AREAS
5. INSTALL EROSION & SEDIMENTATION CONTROL MEASURES
6. INSTALL WATER CONTROL MEASURES AS INDICATED ON CE-101. WATER CONTROL MEASURES WILL BE DESIGNED TO ACCOMMODATE FLOOD FLOWS UP TO ELEVATION 822.3.
7. DEMOLISH UPSTREAM CONCRETE AND STONE MASONRY WALLS
8. DEMOLISH CONCRETE SPILLWAY TRAINING WALLS AND CONCRETE-CAPPED STONE MASONRY SPILLWAY WALL
9. DEMOLISH COLLAPSED CONCRETE AND STONE ENERGY DISSIPATION BASIN AND DOWNSTREAM RIGHT STONE MASONRY WALLS AS INDICATED ON CE-101
10. DEMOLISH GATEHOUSE. ABANDON LOW-LEVEL OUTLET DISCHARGE PIPE IN PLACE AND GROUT INTERIOR OF PIPE
11. REMOVE WOODY VEGETATION, SAPLINGS, AND TREES IN THE AREAS INDICATED ON THE PLANS
12. CONSTRUCT LEFT CONCRETE TRAINING WALL AND LEFT CONCRETE RETAINING WALL. BACKFILL TO PROPOSED GRADE. SEE SHEETS STR-01 THROUGH STR-03 FOR DETAILS
13. CONSTRUCT LOW-LEVEL OUTLET STRUCTURE, INCLUDING THE GATE VALVE CHAMBER & APPURTENANCES, 24" DUCTILE IRON PIPE & BENDS, CONCRETE HEADWALL & STAINLESS STEEL TRASH RACK, CONCRETE CRADLE, AND CONCRETE THRUST BLOCK.
14. CONSTRUCT RIGHT CONCRETE TRAINING WALLS
15. CONSTRUCT CONCRETE SPILLWAY GRAVITY WALL, CONCRETE ENERGY DISSIPATION BASIN, AND LOW-FLOW NOTCH
16. BACKFILL AND GRADE AREA BEHIND SPILLWAY WALL TO THE APPROXIMATE GRADE OF ORIGINAL SURFACE
17. FURNISH AND INSTALL TIMBER WEIR BOARDS ON THE SPILLWAY CREST TO EL. 821.1
18. PROVIDE ROCKFILL ARMORING FOR THE UPSTREAM FACE OF THE DAM AS INDICATED ON THE PLANS. SEE CD-501 FOR DETAILS
19. GRADE THE DOWNSTREAM DAM FACE AND INSTALL TOE DRAIN ALONG DOWNSTREAM SLOPE AS INDICATED ON THE PLAN
20. RE-INSTALL TIMBER GUARDRAIL AS DIRECTED BY THE DAM OWNER (TYP.)
21. RESTORE AREAS DISTURBED BY CONSTRUCTION ACTIVITIES TO ORIGINAL OR IMPROVED CONDITION
22. REMOVE WATER CONTROL AND EROSION AND SEDIMENTATION CONTROL MEASURES ONCE VEGETATION HAS REESTABLISHED
23. DEMOBILIZE FROM CONSTRUCTION SITE

LEGEND:

- GRAVEL PARKING AREA (TYP.)
- ROCKFILL ARMORING (TYP.)
- 100 — EXISTING CONTOUR (5')
- 99 — EXISTING CONTOUR (1')
- 100 — PROPOSED CONTOUR (5')
- PROPOSED CONTOUR (1')
- TOE DRAIN (TYP.)
- LIMIT OF DISTURBANCE
- PROPOSED WATER EDGE (TYP.)



No.	DATE	DESCRIPTION	DESIGNER	REVIEWER
1.				

COMMONWEALTH OF MASSACHUSETTS
PHILIP W. MOREDICH
CIVIL
No. 33041
REGISTERED PROFESSIONAL ENGINEER

SEAL

SCALE:
HORZ.: 1" = 10'
VERT.:
DATUM:
HORZ.: NAVD83
VERT.: NAVD88
10 5 0 10
GRAPHIC SCALE

FUSS & O'NEILL
78 INTERSTATE DRIVE
WEST SPRINGFIELD, MA 01089
413.452.0445
www.fando.com

TOWN OF LEICESTER

PROPOSED CONDITIONS PLAN

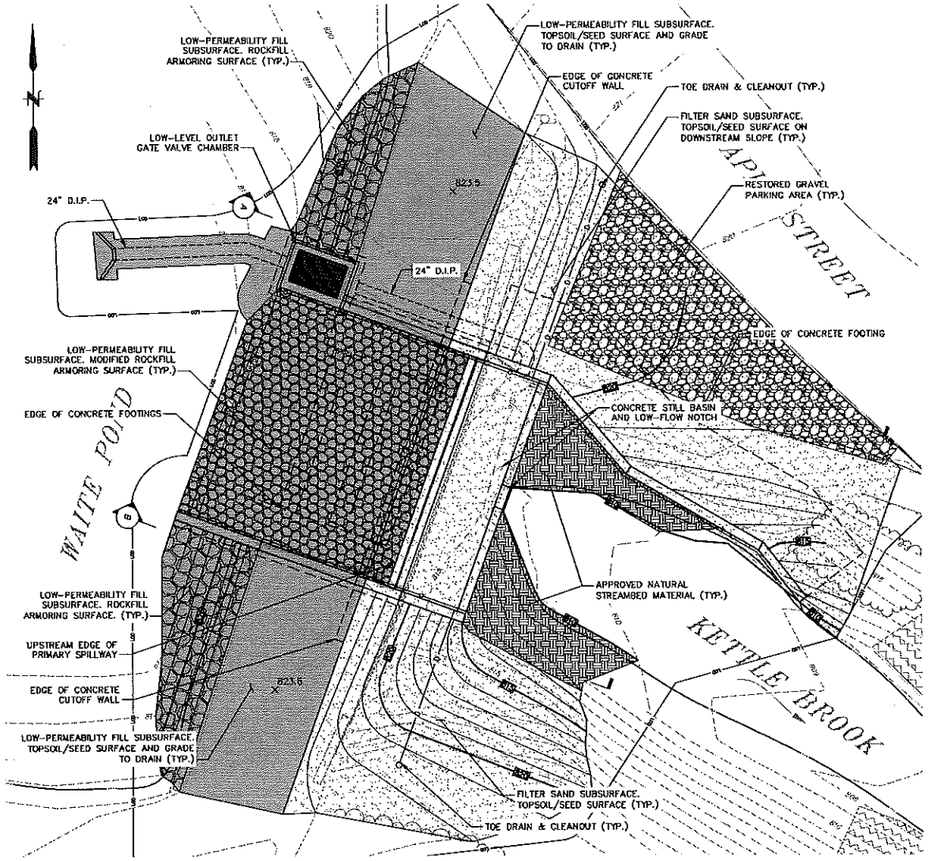
WAITE POND DAM REPAIRS

CHAPEL STREET, LEICESTER MASSACHUSETTS

PROJ. No.: 20061286.A70
DATE: 9/20/2017

CS-101

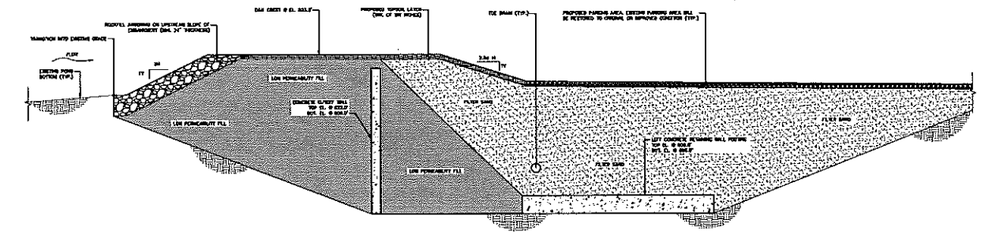
File Path: J:\DWGP\2006\1286\A70\DWP\Plan\20061286A70_STP01.dwg Layout: CS-101 Plotted: Wed, September 20, 2017 - 3:21 PM User: sking
Plotter: DWG TO PDF.PC3 CTB File: FO.STB
LAYER STATE:
MS VIEW:



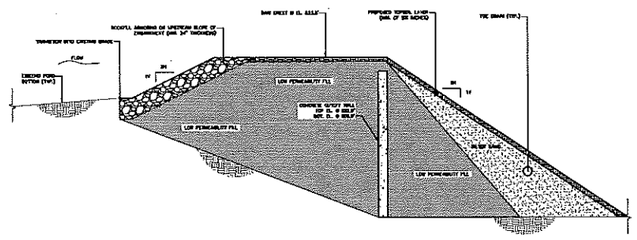
PLAN VIEW
SCALE: 1" = 10'

LEGEND:

- MODIFIED ROCKFILL ARMORING
- ROCKFILL ARMORING
- LOW-PERMEABILITY FILL
- FILTER SAND
- APPROVED NATURAL MATERIAL
- GRAVEL PARKING SURFACE
- EXISTING CONTOUR (5')
- EXISTING CONTOUR (1')
- PROPOSED CONTOUR (5')
- PROPOSED CONTOUR (1')
- TOE DRAIN (TYP.)
- LIMIT OF DISTURBANCE
- PROPOSED WATER EDGE (TYP.)



A TYPICAL DAM EMBANKMENT SECTION (LEFT)
SCALE: N.T.S.



B TYPICAL DAM EMBANKMENT SECTION (RIGHT)
SCALE: N.T.S.

File Path: J:\DWG\P2008\1286\A70\Civil\Plan\20081286A70_STP01.dwg Layout: CG-101 Plotted: Wed, September 20, 2017 - 3:21 PM User: sking
Plotter: DWG TO PDF.PC3 CTB File: FO.STB
LAYER STATE:
MS VIEW:

No.	DATE	DESCRIPTION	DESIGNER	REVIEWER
1.				

PHILIP W. MORESCHI CIVIL No. 33051 REGISTERED PROFESSIONAL ENGINEER

SEAL

SCALE:
HORZ.: 1" = 10'
VERT.:
DATUM:
HORZ.: NAVD83
VERT.: NAVD88
10 5 0 10
GRAPHIC SCALE

FUSS & O'NEILL
78 INTERSTATE DRIVE
WEST SPRINGFIELD, MA 01089
413.452.0445
www.fando.com

TOWN OF LEICESTER

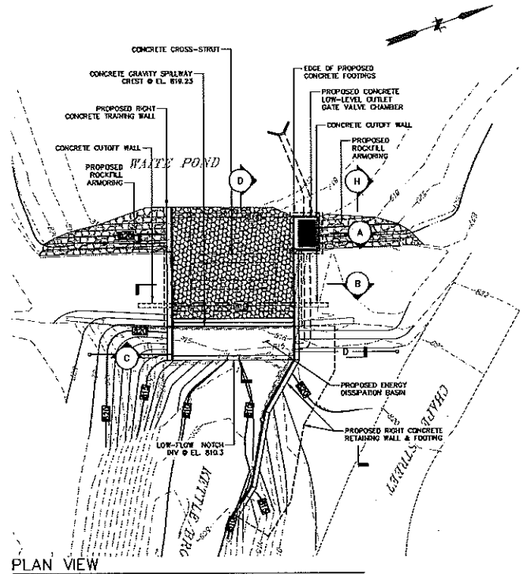
FILL MATERIAL PLACEMENT PLAN

WAITE POND DAM REPAIRS

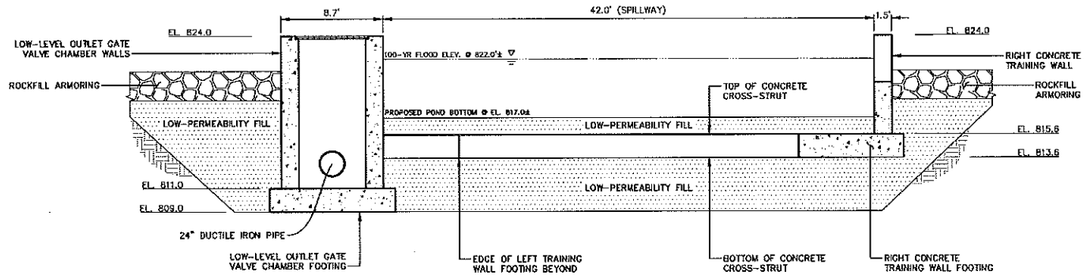
CHAPEL STREET, LEICESTER MASSACHUSETTS

PROJ. No.: 20081286.A70
DATE: 9/20/2017

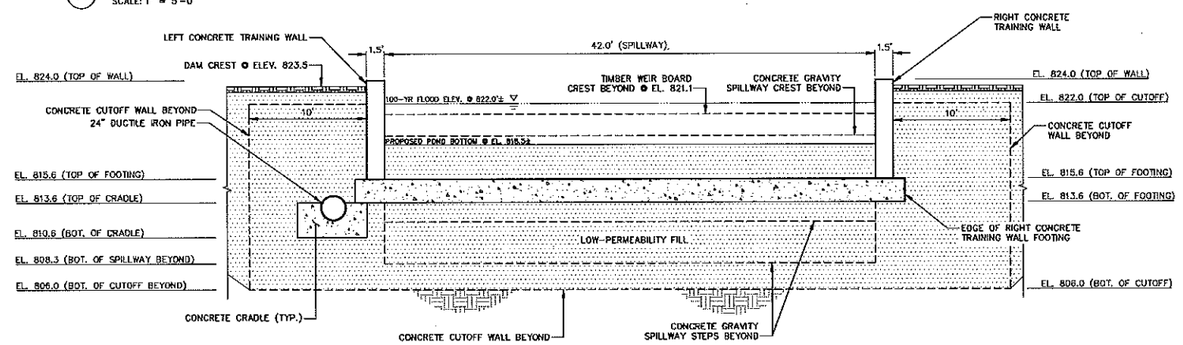
CG-101



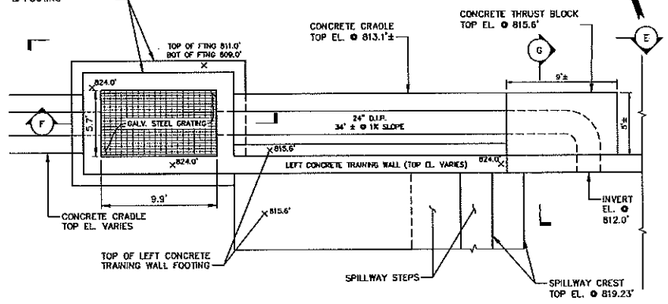
PLAN VIEW
SCALE: 1"=20'



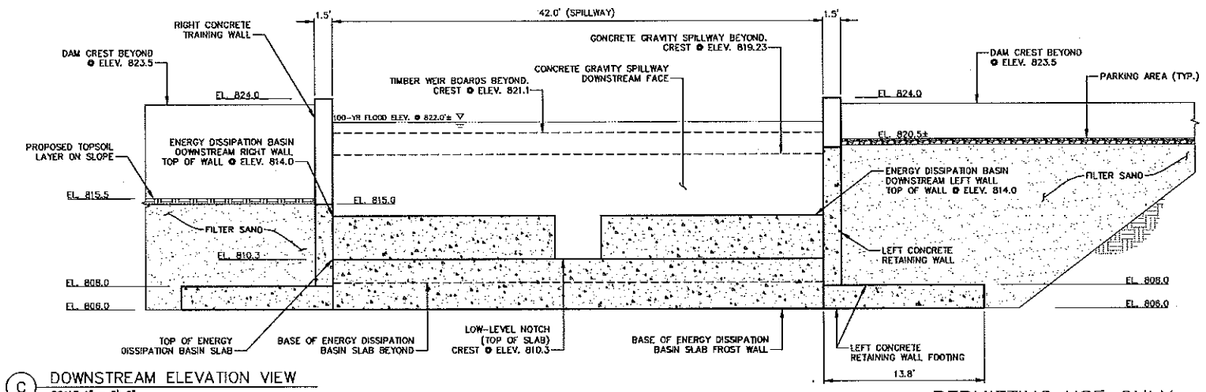
A UPSTREAM ELEVATION VIEW
SCALE: 1" = 5'-0"



B DAM SECTION THROUGH CROSS STRUT – FACING DOWNSTREAM
SCALE: 1" = 5'-0"



LOW-LEVEL OUTLET STRUCTURE PLAN
SCALE: 1" = 5'-0"



C DOWNSTREAM ELEVATION VIEW
SCALE: 1" = 5'-0"

PERMITTING USE ONLY

No.	DATE	DESCRIPTION	DESIGNER	REVIEWER
1.				

PHILIP W. MORESCHI CIVIL No. 30061 REGISTERED PROFESSIONAL ENGINEER
COMMONWEALTH OF MASSACHUSETTS

SEAL

SCALE:
HORZ.: AS SHOWN
VERT.:
DATUM:
HORZ.:
VERT.:
0
GRAPHIC SCALE

FUSS & O'NEILL
78 INTERSTATE DRIVE
WEST SPRINGFIELD, MA 01089
413.452.0445
www.fando.com

TOWN OF LEICESTER

STRUCTURAL REPAIR PLAN & DETAILS

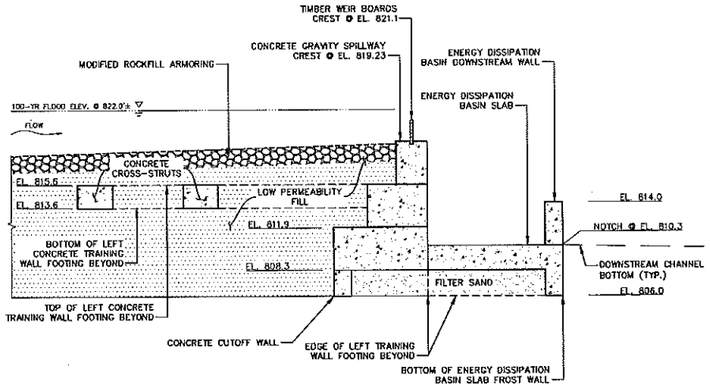
WAITE POND DAM REPAIRS

CHAPEL STREET, LEICESTER MASSACHUSETTS

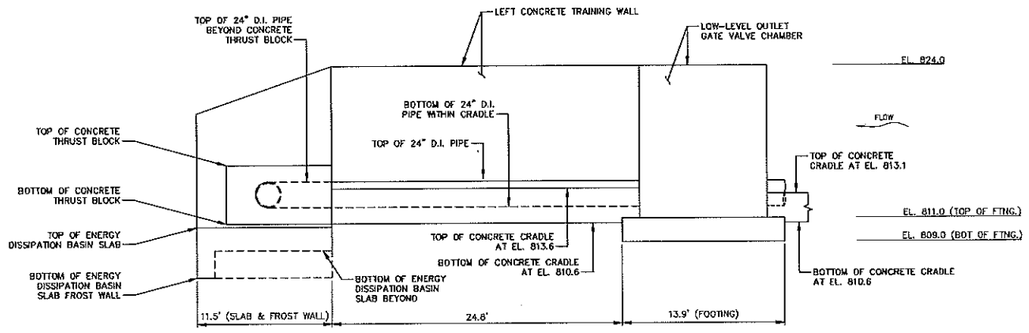
PROJ. No.: 20081286.A70
DATE: 9/20/2017

STR-01

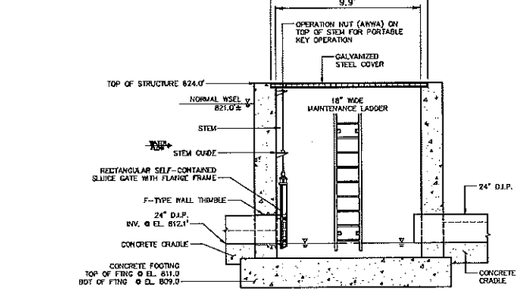
File Path: J:\DWG\P2008\1286A70\CivilPlan\20081286A70_STR01.dwg Layout: STR-01 Plotted: Wed, September 20, 2017 - 3:28 PM User: ekling
MS VIEW: Plotter: DWG TO PDF.PC3 CTB File: FO.STB
LAYER STATE:



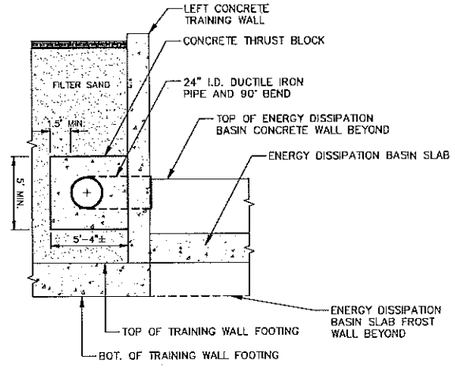
D SPILLWAY SECTION – FACING LEFT TRAINING WALL
SCALE: 1" = 5'-0"



E LOW-LEVEL OUTLET STRUCTURE PROFILE
SCALE: 1" = 5'-0"



F LOW-LEVEL OUTLET – GATE VALVE CHAMBER SECTION
SCALE: N.T.S.



G CONCRETE THRUST BLOCK DETAILS
SCALE: N.T.S.

PERMITTING USE ONLY

No.	DATE	DESCRIPTION	DESIGNER	REVIEWER
1.				

PHILIP W. MORSCHE CIVIL No. 53061 REGISTERED PROFESSIONAL ENGINEER

SEAL

SCALE:
HORZ.: AS SHOWN
VERT.:
DATUM:
HORZ.:
VERT.:
0
GRAPHIC SCALE

FUSS & O'NEILL
75 INTERSTATE DRIVE
WEST SPRINGFIELD, MA 01089
413-452-0445
www.fando.com

TOWN OF LEICESTER

STRUCTURAL REPAIR DETAILS

WAITE POND DAM REPAIRS

CHAPEL STREET, LEICESTER MASSACHUSETTS

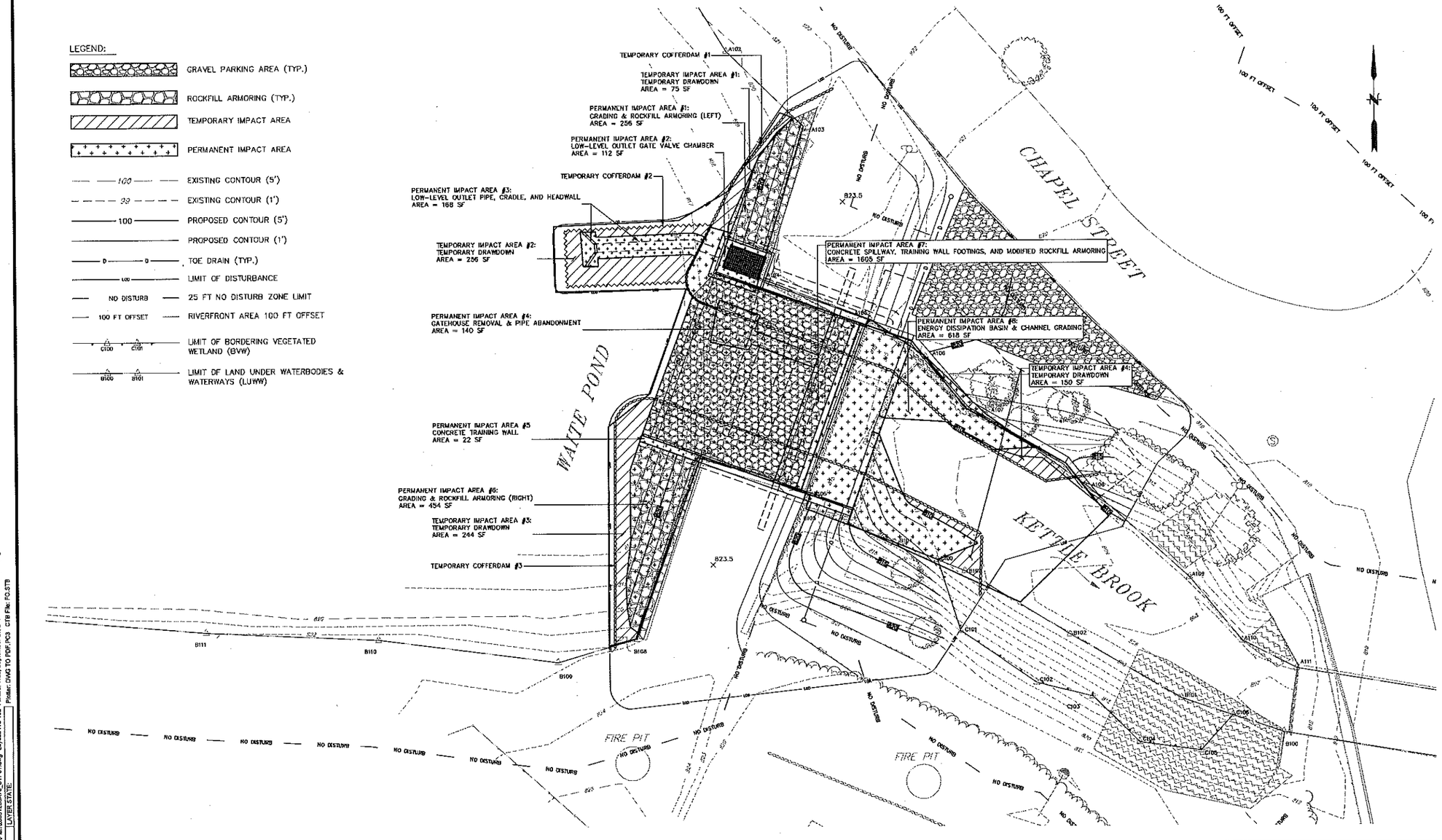
PROJ. No.: 20081288.A70
DATE: 9/20/2017

STR-02

File Path: J:\DWG\P20081\288\A70\Civil\Plan\20081288A70_STR01.dwg Layout: STR-02 Plotted: Thu, September 28, 2017 - 11:23 AM User: sking
Plotter: DWG TO PDF.PC3 CTB File: FO.STB
LAYER STATE:
MS VIEW:

LEGEND:

- GRAVEL PARKING AREA (TYP.)
- ROCKFILL ARMORING (TYP.)
- TEMPORARY IMPACT AREA
- PERMANENT IMPACT AREA
- 100 — EXISTING CONTOUR (5')
- 99 — EXISTING CONTOUR (1')
- 100 — PROPOSED CONTOUR (5')
- PROPOSED CONTOUR (1')
- D — D — TOE DRAIN (TYP.)
- LOD — LIMIT OF DISTURBANCE
- NO DISTURB — 25 FT NO DISTURB ZONE LIMIT
- 100 FT OFFSET — RIVERFRONT AREA 100 FT OFFSET
- C100 / C101 — LIMIT OF BORDERING VEGETATED WETLAND (BVW)
- B100 / B101 — LIMIT OF LAND UNDER WATERBODIES & WATERWAYS (LUWW)



No.	DATE	DESCRIPTION	DESIGNER	REVIEWER
1.				

COMMONWEALTH OF MASSACHUSETTS — PHILIP W. MOREDOCK — CIVIL — No. 32061 — REGISTERED PROFESSIONAL ENGINEER

SEAL

SCALE:
HORZ.: 1" = 10'
VERT.:
DATUM:
HORZ.: NAVD83
VERT.: NAVD88
10 5 0 10
GRAPHIC SCALE

FUSS & O'NEILL
78 INTERSTATE DRIVE
WEST SPRINGFIELD, MA 01089
413.452.0445
www.fando.com

TOWN OF LEICESTER

WETLAND IMPACT AREA PLAN

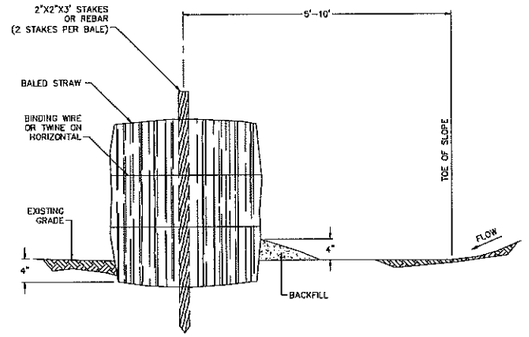
WAITE POND DAM REPAIRS

CHAPEL STREET, LEICESTER — MASSACHUSETTS

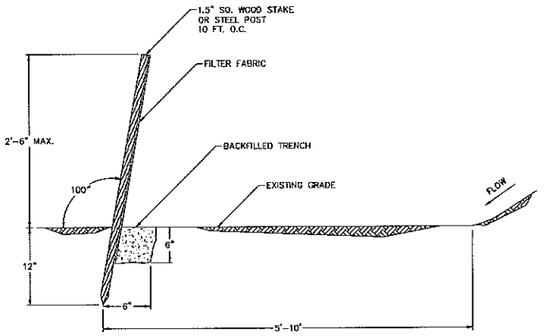
PROJ. No.: 20061285.A70
DATE: 9/20/2017

RC-102

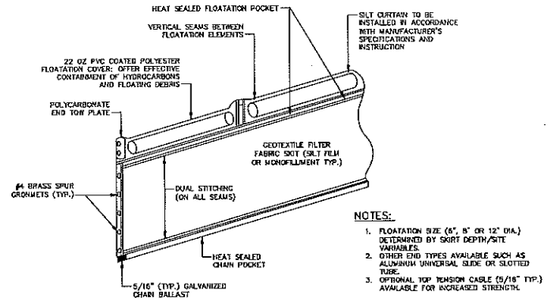
File Path: J:\DWG\P2006\12\85A70\Civil\Plan\20061285A70_STP01.dwg Layout: RC-102 Plotted: Wed, September 20, 2017 - 3:23 PM User: ebing
Plotter: DWG TO PDF.PC3 CTB File: FO-STB
LAYER STATE:
MS VIEW:



1 STRAWBALE BARRIER
SCALE: NTS

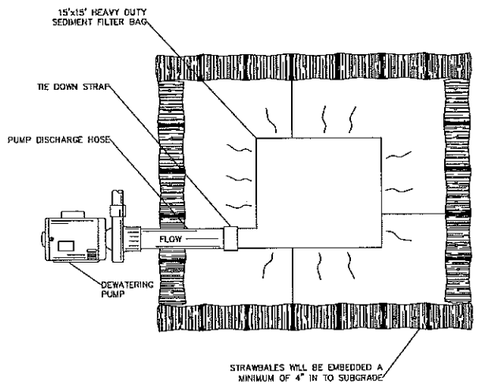


2 SILT FENCE
SCALE: NTS

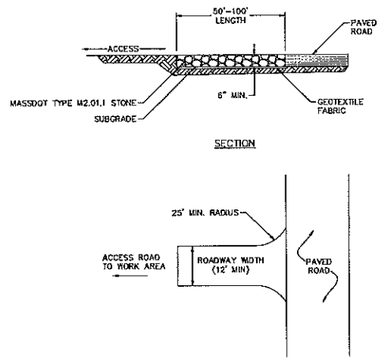


NOTES:
1. FLOATATION SIZE (6", 8" OR 12" DIA.) DETERMINED BY SKIRT DEPTH/SITE VARIABLES.
2. OTHER END TYPES AVAILABLE SUCH AS ALUMINUM UNIVERSAL SLIDE OR SLOTTED TUBE.
3. OPTIONAL TOP TENSION CABLE (5/16" TYP.) AVAILABLE FOR INCREASED STRENGTH.

3 SILT CURTAIN
SCALE: NTS



4 PUMPING SETTLING BASIN
SCALE: NTS



5 CONSTRUCTION ENTRANCE
SCALE: NTS

File Path: J:\DWG\P2006\1286\70\CAD\Details\2286470_DET01.dwg Layout: CD-501 Plotted: Wed, September 20, 2017 - 3:59 PM User: alling
Plotter: DWG TO PDF.PC3 CTB File: FO.CTB
LAYER STATE:
MS VIEW:

No.	DATE	DESCRIPTION	DESIGNER	REVIEWER
1.				

COMMONWEALTH OF MASSACHUSETTS
PHILIP W. MOREECHI
CIVIL
No. 32251
REGISTERED PROFESSIONAL ENGINEER

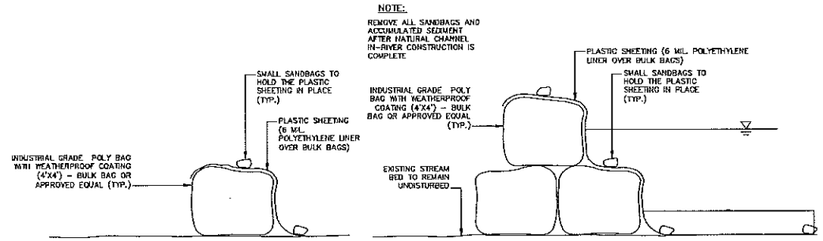
SEAL

SCALE:
HORZ.: AS SHOWN
VERT.:
DATUM:
HORZ.:
VERT.:
0
GRAPHIC SCALE

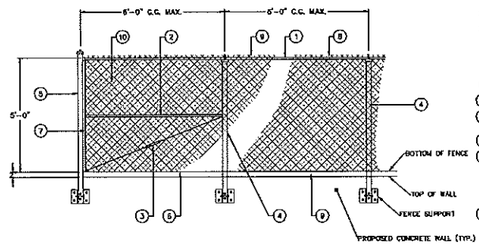
FUSS & O'NEILL
78 INTERSTATE DRIVE
WEST SPRINGFIELD, MA 01089
413.452.0445
www.fando.com

TOWN OF LEICESTER
EROSION & SEDIMENTATION CONTROL DETAILS
WAITE POND DAM REPAIRS
CHAPEL STREET, LEICESTER MASSACHUSETTS

PROJ. No.: 2006120LA70
DATE: 9/20/2017
CD-501



6 TEMPORARY SANDBAG COFFERDAM
SCALE: NTS



NOTES
1. FENCE SUPPORT DESIGN TO BE CHECKED BY AN ENGINEER.
2. STRAIGHT RUNS BETWEEN BRACED POSTS SHALL NOT EXCEED 500 FT.
3. FENCE DETAILS ARE INTENDED AS A GUIDE ONLY. ALL FENCE MATERIALS AND CONSTRUCTION METHODS SHALL BE APPROVED BY THE ENGINEER AND FENCE MANUFACTURER.

CHAIN LINK FENCE LEGEND
1. 1 5/8" O.D. TOP RAIL ATTACH FABRIC WITH 9 GAUGE WIRE CLIP EVERY 24"
2. 1 5/8" O.D. BRACE FOR RAIL FENCES OVER 6 FEET HIGH AND ALL FENCES WITHOUT TOP RAIL
3. 5/16" TRUSS ROD AND TURNBUCKLE
4. INTERMEDIATE POST

FENCE HEIGHT	SQUARE POST	ROUND POST
6 FEET AND LESS	1 7/8"	2"
OVER 6 FEET	2 1/4"	2 1/2"

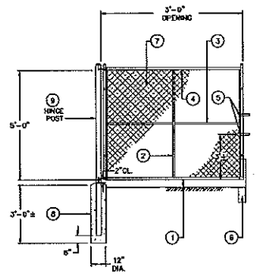
ATTACH TO C.L. FABRIC WITH CLIPS EVERY 15"

5. END OR CORNER POST

FENCE HEIGHT	SQUARE POST	ROUND POST
6 FEET AND LESS	3"	2 1/2"
OVER 6 FEET	2 1/2"	3"

6. 6 GAUGE BOTTOM TENSION WIRE ATTACH TO FABRIC WITH HOG RING AT 24" O.C.
7. TENSION ROD ATTACHED TO END OR CORNER POST
8. 6 GAUGE TENSION WIRE WHEN TOP RAIL IS NOT USED.
9. FABRIC SELVAGE:
UNDER 6 FEET SHALL BE KNUCKLED TOP AND BOTTOM
6 FEET AND OVER SHALL BE KNUCKLED BOTTOM AND TWISTED ON THE TOP
RECREATIONAL FENCING, REGARDLESS OF HEIGHT, SHALL BE KNUCKLED TOP AND BOTTOM
10. 9 GAUGE 2" WIRE MESH FABRIC (COMMERCIAL) BLACK VINYL COATED.

7 CHAIN LINK FENCE
SCALE: NTS

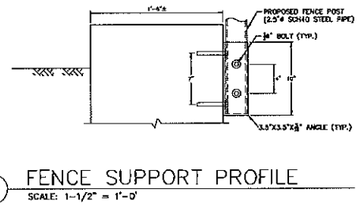


CHAIN LINK SWING GATE LEGEND
1. 2" SQUARE FRAME WELDED TO FORM FOUR SIDES OF LEAF
2. 1 1/4" SQUARE UPRIGHT BRACING WELDED TO FRAME
3. 1 1/4" SQUARE HORIZONTAL BRACING WELDED TO FRAME
4. TENSION BAR ATTACHED TO FRAME ON ALL FOUR SIDES WITH HOOK BOLTS
5. PADLOCK AND LATCH DEVICE
6. 12" DIA. x 12" DEEP CONC. COLLAR WITH STEEL PIPE FOR SET PIN. COLLAR AND PIPE SET FLUSH WITH GROUND SURFACE. PIPE TO DRAIN INTO GRAVEL BASE.
7. 9 GAUGE 2" WIRE MESH FABRIC (COMMERCIAL) BLACK VINYL COATED.
8. HINGE POST FOOTING SHALL BE 3000 PSI CONCRETE. DIAMETER SHALL BE 4 TIMES POST WIDTH (MIN.)
9. SEE GATE TABLE

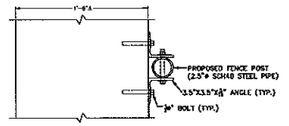
GATE TABLE

OPENING	HINGE POST
3'-0"	2 1/2" SQUARE
8'-0" – 12'-0"	2 1/2" SQUARE
26'-0" – 36'-0"	6" SQUARE
38'-0" – 40'-0"	8" SQUARE

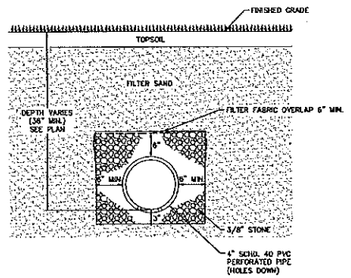
10 SINGLE-LEAF CHAIN LINK SWING GATE
SCALE: NTS



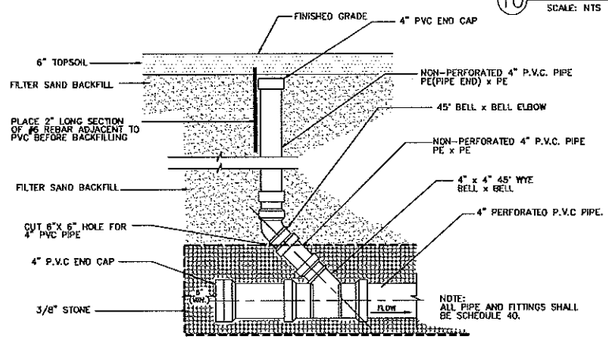
8 FENCE SUPPORT PROFILE
SCALE: 1-1/2" = 1'-0"



9 FENCE SUPPORT SECTION
SCALE: 1-1/2" = 1'-0"



TOE DRAIN
NOT TO SCALE



TOE DRAIN CLEANOUT
NOT TO SCALE

No.	DATE	DESCRIPTION	DESIGNER	REVIEWER
1.				

PHILIP W. MORESCHI CIVIL No. 32061 REGISTERED PROFESSIONAL ENGINEER

SEAL

SCALE:
HORZ.: AS SHOWN
VERT.:
DATUM:
HORZ.:
VERT.:
0
GRAPHIC SCALE

FUSS & O'NEILL
78 INTERSTATE DRIVE
WEST SPRINGFIELD, MA 01089
413.452.0445
www.fando.com

TOWN OF LEICESTER
CIVIL DETAILS
WAITE POND DAM REPAIRS
CHAPEL STREET, LEICESTER MASSACHUSETTS

PROJ. No.: 20081280.A70
DATE: 9/29/2017
CD-502

File Path: J:\DWG\P2008\20081280\A70\CAD\Data\20081280A70_DET01.dwg Layout: CD-502 Plotted: Wed, September 20, 2017 - 3:39 PM User: eking
Plotter: DWG TO PDF.PC3 CTB File: FO.STB
LAYER STATE:
MS VIEW:

-- *Waite Pond Dam* --
PHASE II
INVESTIGATIONS REPORT

Dam Name:	Waite Pond Dam
State Dam ID#:	3-14-151-21
NID#:	MA00987
Owner:	Town of Leicester
Owner Type:	Municipal
Town:	Leicester
Consultant:	Fuss & O'Neill, Inc.
Date of Completion:	August 4, 2014

FUSS & O'NEILL

Table of Contents

Waite Pond Dam Phase II Investigations Report
Town of Leicester

Table of Contents

Waite Pond Dam Phase II Investigations Report
Town of Leicester

Figures

Appendices

FUSS & O'NEILL

1 Description of Project

1.1 Introduction

Fuss & O'Neill, Inc. has been retained by the Town of Leicester to perform a Phase II Inspection and Investigation of the dam at Waite Pond in Leicester, Massachusetts in accordance With a Dam Safety Order issued by the Massachusetts Department of Conservation and recreation Office of Dam Safety (ODS) dated February 22, 2008. In0 addition to performance of the Phase II Dam Inspection and Investigation, the order required the Town to perform Follow up inspections to be completed at 6-month intervals until adequate repairs are made to the dam.

Typically, the Phase II Investigation presents alternatives for disposition of the dam. These alternatives can include various types of repair, replacement, removal, and partial removal, among others. However, in the case of Waite Pond Dam, the pond is used by residences for recreational purposes. Therefore, it was decided by the Town to proceed with the understanding that the dam would be repaired, maintaining the current pond level and spillway geometry.

1.2 Purpose of this Report

The purpose of this investigation is to assess the current condition of the dam, the options available for its repair or removal, a preliminary/conceptual design of proposed repairs, an opinion of the costs for those repairs, the approach to bringing it into compliance, and the permitting that is likely to be necessary. The findings will be used by the Town of Leicester to meet the conditions for submission of a Phase II Inspection and Investigation report set forth by the Office of Dam Safety in the previously mentioned dam safety order.

1.3 Dam Data

Dam Name:	Waite Pond Dam
AKA Name:	Not applicable
Nat. ID Number:	MA00987
State ID Number:	3-14-151-21
Town	Leicester
Dam Owner/Caretaker:	Town of Leicester 3 Washburn Square, Leicester, MA 01524 Contact: Kevin Mizikar
Hazard Potential:	Significant
Size Classification:	Intermediate
Location of Dam (town):	Leicester
Coordinate location (lat, long):	42.24900, -71.88708
Street Address/Nearest Intersection:	Sacks Drive & Chapel Street
Purpose of the Dam:	Current: Recreation and Conservation Historical: Early industrial hydropower
Constructed:	Unknown

Length:	134 feet
Structural Height:	11 feet
Hydraulic Height:	8 feet
Type of Dam:	Earth embankment supported by stone masonry & concrete walls
Low-Level Outlet:	Hand-operated 24 inch diameter outlet

1.4 Description of Dam

Waite Pond Dam consists of an earth core supported by upstream and downstream masonry and concrete walls. The structural height is 11 feet, and the hydraulic height at normal pool is 8 feet. The spillway is located in the approximate center of the dam. The right embankment has an average elevation of 823.5 feet (NAVD 88); the left embankment is slightly lower, with an average elevation of 823.0 feet.

The spillway is a 42-foot wide earth/stone lined broad crested weir supported by a concrete capped stone masonry retaining wall at the downstream face of the dam. The left and right training walls are constructed of concrete. Timber weir boards, supported by steel dowels anchored into the concrete cap, are installed to a height of 2± feet above the spillway crest. The elevation of the spillway crest is 819.24 feet, which provides a maximum flow depth of 3.8 feet measured from the left abutment. With the weir boards installed, the maximum flow depth is reduced to 1.9 feet. A grouted stone splash pad/stilling basin is located downstream of the spillway.

There is a 24-inch diameter CMP low-level outlet with a slide gate located in a circular, roofless masonry structure that is located in the upstream end of the spillway channel. The outlet pipe discharges approximately 10 feet downstream of the spillway, at the base of the stilling basin.

The upstream face of the dam is supported by concrete retaining walls. The downstream right face of the dam consists of a vertical dry-laid masonry wall. The downstream left embankment consists of a relatively flat earthen area used for parking, supported along the stream by a vertical masonry wall that has partially collapsed. The left dam crest is isolated from the parking area by a timber post and rail fence. An existing conditions plan is provided as *Figure 4*.

1.5 Summary of Deficiencies

Recent visual inspections of Waite Pond Dam include a Phase I inspection performed by Fuss & O'Neill on August 8, 2012, a follow-up inspection performed by Fuss & O'Neill on January 23, 2013, and a follow-up inspection performed by Fuss & O'Neill on July 31, 2014. A copy of the most recent inspection report is provided in *Appendix A*. Previous inspections were performed in 1986, 1998, 2009, 2010, and 2011.

During the Phase I inspection and the follow-up inspections, the dam was found to be in **Poor** condition. The primary deficiencies identified during these inspections include:

- **Upstream Face:** Severe erosion, cracking, and undermining of both of the concrete retaining walls were observed. The left retaining wall is leaning towards the impoundment.
- **Embankment Crest:** The crest of the dam consists of vegetated earth. Depressions were observed on the right and left crests. Dense small woody vegetation and tree root encroachment were also observed on the left crest.
- **Downstream Face:** The right downstream face consists of vertical dry-laid stone masonry wall. The wall appears to be slightly leaning out of plumb and some stones are missing. The left downstream area consists of a gravel parking area supported by a vertical masonry wall parallel to the brook channel; a portion of this wall has collapsed.
- **Primary Spillway:** The concrete training walls on both sides of the spillway are cracked and eroded. The stilling basin consists of stone rubble covered with concrete that spills overflow to the channel below. The concrete is breaking into fragments.
- **Low Level Outlet:** The 24-inch CMP low level outlet is rusted and appears to be approximately ½ full of sediment; however, water was observed to be discharging from the pipe during the July 31, 2014 inspection. It is not known if this is due to leakage past the gate, or the gate having been recently opened. Sediment was not observed in the water discharging from the outlet pipe. The position/height of the gate operator stem observed during the inspection appeared to have changed relative to the previous inspection (based on photographs). It was also noted that a series of stones had been placed in the spillway channel between the left training wall and the door in the gate house, presumably for access to the gate operator.
- **Gate House:** The gate operator is located in a circular structure in the upstream end of the spillway channel. The structure has no roof, the walls are leaning out of plumb, and the concrete foundation is severely deteriorated. There is currently no access to the structure except by wading or boat.
- **Vegetation:** Large trees are present within 20 feet of the downstream toe of the right embankment at both abutments.

2 Site Resources Areas

Resource areas were delineated in the field on September 17, 2013. A copy of the *Site Investigation & Inland Resource Area Delineation Report* is provided in *Appendix E*. The delineated wetland boundaries are shown on the existing conditions survey plan (*Figure 4*). Regulated resource areas associated with this location include the following:

- Bank
- Land Under Water Bodies & Waterways
- Riverfront Area
- Buffer Zone
- Bordering Vegetated Wetland

3 Hydrologic & Hydraulic Assessments

3.1 Drainage Basin Description

Waite Pond is fed primarily by Kettle Brook and an unnamed stream from the west. The drainage area is approximately 4.92 square miles and extends into the Town of Paxton. The majority of land use consists of undeveloped wooded areas, but includes pastures and residential developments throughout the basin. The drainage area, shown in *Figure 3*, was delineated using USGS topographic mapping. It is long and narrow, with a total length of 6.1 miles and an average width of 0.95 miles.

The surface area of Waite Pond is approximately 53.9 acres at the normal water surface elevation. The dominant hydrologic feature of the drainage basin is flood storage provided Waite Pond and upstream impoundments, which include Kettle Brook Reservoir No. 1, No. 2, No. 3, and No. 4.

3.2 Model Description

A hydrologic and hydraulic model was prepared using the HydroCAD software to assess the peak flood discharges and spillway capacity at Waite Pond Dam. HydroCAD incorporates the TR-55 rainfall/runoff routing method, which was used for this project. Flood attenuation in Waite Pond and Kettle Brook Reservoir No. 1, No. 2, No. 3, and No. 4 was modeled in the analyses using level-pool routing. The 4.9 square mile drainage basin was divided into ten sub-basins. Two sub-basins were assigned to each impoundment; one for direct precipitation onto the water surface of the impoundments and the one for overland runoff.

The hydrologic properties of the drainage basin were determined from available topographic, land use, soils, and hydrography data. A composite curve number for each of five sub-basins representing overland runoff to the impoundments were determined from land use and hydrologic soils group and range from 64 to 70. A curve number of 98 was assigned to represent inflow volume to the impoundments via direct precipitation.

Storm hyetographs were based on the Soil Conservation Service Type III storm events, with storm depths determined from TP-40. The model elements and hydraulic and hydrologic parameters used in the HydroCad (TR-20) model are provided in *Appendix B*.

3.3 Spillway Design Flood Capacity Assessment

The significant hazard class and intermediate size of Waite Pond Dam dictate that the spillway must safely pass the 100-year storm (the Spillway Design Flood, or SDF) per 302 CMR 10.00. Adequate freeboard is generally preferred between the peak water surface elevation and the top of the dam such that waves do not cause overtopping. For a relatively small impoundment such as Waite Pond, adequate freeboard is generally considered to be one foot.

From the National Weather Bureau Technical Paper 40 (TP-40) (Hershfield 1961), the 100-year storm consists of 6.5 inches of precipitation in 24 hours. This rainfall was routed through the pond

as described in *Section 3.2* to assess the spillway capacity. Separate analyses were performed for the existing dam with the weir boards removed and with them installed.

The results of the analysis indicate that with the weir boards removed the spillway has adequate capacity to safely convey the SDF. The maximum water surface elevation for the 100-year flood is shown to be 822.0 feet, which is 1.0 foot below the left embankment crest and 1.5 feet below the right embankment crest. With the weir boards installed, however, the results of the analysis indicate a maximum WSE of 823.1 feet, which will overtop the left embankment by 0.1± feet. This is a minor depth of overtopping, and small variations in the design of the structure could be effective in allowing the dam to safely pass the SDF.

By raising the crest of the left embankment 0.5 feet to EL 823.5 feet (equal to the right embankment crest), 0.4 feet of freeboard will be provided with the weir boards installed and 1.5 feet of freeboard will be provided with them removed. It is assumed that the weir boards will be removed prior to the start of runoff when heavy precipitation is predicted; therefore, 1.5 feet of freeboard is the design capacity and 0.4 feet is for conservatism in the worst case scenario. This is discussed in greater detail under the assessment of alternatives in *Section 5.0*.

3.4 Hazard Class Assessment

Chapel Street, a secondary road, runs parallel to the southeastern shore of Waite Pond and forms the left abutment of the dam. Kettle Brook is conveyed beneath Chapel, via a box culvert, approximately 150 feet downstream of the dam and continues flowing in the southeast direction for another 1,500 feet until it passes under a second bridge crossing on Chapel Street and enters City Pond. It appears that a failure of the dam at maximum pool may cause damage to the downstream bridge/culvert crossings. A failure of the dam could also result in damage to Chapel Street at the left abutment of the structure.

Therefore, in accordance with Department of Conservation and Recreation classification procedures, under Commonwealth of Massachusetts dam safety rules and regulations stated in 302 CMR 10.00 as amended by Chapter 330 of the Acts of 2002, Waite Pond Dam is classified as a **Significant** hazard potential dam.

4 Geotechnical Assessment

4.1 General

No seepage has been observed at Waite Pond Dam, but visual inspection reveals the vertical masonry and concrete walls have moved and are therefore not stable, indicating remedial measures are necessary. A soil boring program was implemented to provide the necessary data for design of repairs to the dam.

4.2 Subsurface Explorations

Fuss & O'Neill retained the services of Martin Geo-Environmental drilling contractors of Belchertown, Massachusetts to drill test borings at the site. The borings were drilled on January 13, 2014 using a truck mounted drill rig, using standard hollow stem auger techniques. Two borings were drilled; borehole B-2 on the left dam crest and B-1 in front of the crest by the side of the adjacent road. A bedrock core was performed in boring B-1 to confirm the depth to bedrock and to assess the quality of the rock. The rock core was advanced 5 feet into bedrock. Refer to *Appendix A* for a boring location plan.

The borings were advanced using hollow stem augers. Soil samples were obtained at 5-foot intervals using a standard split spoon sampler driven 24 inches with a 140-pound weight falling 30 inches. The number of blows required to drive the sampler from 6 to 18 inches was recorded as the Standard Penetration Resistance (N-value), which is a standard test used to estimate the in situ soil density. Samples obtained from each soil boring were logged by a Fuss &O'Neill engineer. Refer to the *Appendix B* for the boring logs.

The bedrock cores advanced in boring B-1 used an NQ core barrel with water-cooled diamond bit. The resulting core (2.16-inch diameter) was measured to determine the Rock Quality Designation (RQD), a measure of the relative amount of fracturing and general quality of the rock. The locations are indicated on *Figure 4*, labeled borings B-1 and B-2.

4.3 Subsurface Conditions

Subsurface conditions in the dam crest generally consist of 5 feet of dense gravelly sand overlying a 7-foot thick layer of medium dense to dense natural sand. Auger refusal was encountered at a depth of 12 feet in boring B-1 and rock fragments and split spoon refusal were encountered at a depth of 12 feet in boring B-2. Augering continued in the rock for an additional foot in boring B-2 before the augers encountered refusal. Rock coring was performed in boring B-1 and a rock sample was collected between 12 feet and 17 feet deep. The rock consisted of granite with a recovery of 100 percent and a measured RQD of 83 percent, which indicates the rock is of high quality with little fracturing. Groundwater was encountered at a depth of 9 feet below the ground surface in boring B-1 and 6 feet below ground surface in boring B-2.

4.4 Stability Analysis

Visual observation indicates the dam embankment walls are failing likely do to a combination of soil pressures and frost heave. We were unable to determine the depth of the wall footings, if any exist, so a conventional sliding/overturning wall analysis was not possible. However, the stability is obviously compromised and needs to be corrected. We performed embankment stability analysis for the apparent most critical section of wall, which is the downstream right embankment wall immediately adjacent to the spillway. Embankment stability analysis was performed using Galena Version 4.0 software and Spencer's methodology with circular failure surfaces. The resulting slope stability analysis indicated the existing factor of safety against failure is just above 1.0, assuming the existing masonry wall does not extend vertically very deeply into the downstream embankment. The new spillway will need to incorporate downstream training walls to allow fill to be placed against the downstream face of the dam to increase stability. When preliminary design is performed, both retaining wall and dam stability analyses will be included to assure the proposed design is stable.

The subgrade soil is suitably coarse and dense to support a new or reconstructed dam and spillway without any special soil improvement considerations.

4.5 Seepage Analysis

Since the dam embankment and walls will be reconstructed, no seepage analysis was performed of the existing conditions. As mentioned above, boring data was obtained for use in design of future embankment slopes and/or walls. Seepage analysis will be performed for proposed conditions when preliminary repair design is performed.

4.6 Conclusions

Stability of the dam is inadequate in its present condition. Even though the dam has not suffered catastrophic failure, it does not meet dam safety requirements for stability. The repair construction will require removal of most of the dam embankment to correct the deficiencies identified visually. Therefore, the dam will be effectively rebuilt and the issue of the current instability is not a factor.

5 Evaluation of Repair Alternatives

Alternatives were evaluated for the repair of Waite Pond Dam to address the existing structural deficiencies, ensure that the dam can safely pass the SDF, and otherwise bring the dam into compliance with Office of Dam Safety design regulations and dam safety design practice. We determined that repairs can be made the dam to meet these requirements while maintaining the existing configuration of the structure, with minimal modification.

The recommended repairs, associated permitting requirements, and estimated costs are discussed in *Section 5.1* and *Section 8.0*. The opinion of cost is of order of magnitude accuracy based on the information available for the writing of this report. Order of Magnitude accuracy cost estimates are generally accurate within a range of -30% to +50%.

Dam removal is often also considered as an option, as its advantages and disadvantages are important to consider. This is not deemed a viable alternative, however, because the impoundment is actively used for recreation and is surrounded by privately owned residential properties.

5.1 Required Repairs

The flowing deficiencies need to be addressed in the repair design:

- Depressions observed on the right and left embankment crests.
- The stone masonry wall on the downstream face of the right abutment leaning out of plumb and missing stones.
- The upstream concrete retaining walls are severely deteriorated; the left retaining wall is leaning toward the impoundment.
- The stone masonry retaining wall along the left bank of the downstream channel has collapsed. This wall partially supports the downstream face of the left embankment and the left spillway training wall. Additional deterioration could destabilize those portions of the dam.
- The training walls at the spillway are severely deteriorated. Portions of the grouted stone splash pad/stilling basin are breaking into fragments.
- The gatehouse and the discharge conduit on the low-level outlet are deteriorated. The 24-inch CMP is rusted and appears to be approximately ½ full of sediment. The gatehouse has no roof, the walls are leaning out of plumb, and the concrete foundation is severely deteriorated.
- Trees and woody vegetation are present within 20 feet of the downstream toe of the right embankment at both abutments.

To correct these deficiencies, Fuss & O'Neill recommends the following repairs:

- Replace the existing stone masonry retaining wall at the downstream face of the right embankment with a concrete gravity wall. A concrete buttress is proposed for added stability of the retaining wall. As shown in *Figure 5*, the buttress would be located adjacent to

the spillway and integral with the energy dissipation basin (discussed below). The use of a sloped earth embankment instead of a retaining wall was also considered as a means of reducing construction cost. That approach, however, would require a retaining wall to be constructed along the right bank of the downstream channel.

- Earth slopes, graded into the impoundment, are recommended at the upstream face of the left and right embankments. This approach will be less expensive than reconstruction of the existing concrete retaining walls.
- Replace the existing stone masonry wall at the downstream face of the spillway and the left and right concrete training walls with concrete gravity walls. The training walls extend into the impoundment to accommodate the proposed earth slopes at the upstream face. The elevation of the spillway crest, as proposed, matches the existing condition. Structural supports for weir boards can be cast into and/or attached to the retaining wall at the downstream face of the spillway.
- A plunge pool type energy dissipation basin is proposed downstream of the spillway. This will serve to dissipate the energy from flow over the spillway crest and from the low-level outlet.
- Remove the existing gatehouse and low-level CMP outlet pipe. A new low-level outlet is proposed to be installed through the left embankment and will discharge into the proposed energy dissipation basin. A valve chamber, consisting of a 6-foot diameter manhole, is proposed to be located in the embankment.
- Raise left embankment crest to EL 823.5 feet. Level the right embankment crest and remove vegetation.
- Remove trees greater than 6 inches in diameter within 20 feet of the dam.

The attached plan of the dam (*Figure 5*) and immediate surrounding area indicates the locations of the repairs.

6 Construction Methods

This section presents general guidelines for materials and methods of major components of the project that may occur under the proposed repairs described in this report.

6.1 Reconstruction of Downstream Stone Masonry Wall

The downstream masonry wall would be reconstructed by a mason, who would most likely disassemble the wall, regrade and recompact the foundation, cut away a small portion of the dam embankment behind it, and rebuild it completely. The space between the replaced stones and the embankment soils would be filled with freely draining sand to ensure that and groundwater pressure is relieved. The reconstructed wall would remain unmortared to allow for free drainage.

A graded filter drain would be necessary to prevent the sand and embankment materials from migrating through the wall. These drains consist of layers of uniformly-graded soils that gradually increase in grain size to prevent embankment soils from being carried by groundwater through voids

between stones in the larger adjacent layer. Alternatively, a properly-selected filter fabric could be used for this purpose.

6.2 Embankment Buttressing

Rather than being reconstructed, the downstream stone masonry wall could be buttressed with dumped stone to resist the forces of frost heaving, water, and erosion that may have caused the existing damage to the wall, and prevent the wall from toppling under applied loading conditions. It is important to note, however, that this approach would require a retaining wall to be constructed along the right bank of downstream channel. Without the retaining wall, the volume of buttress stone that could be placed would be limited by the angle of repose of the material.

The area would be filled with a well-graded fill material that includes larger gravel and cobble-sized particles, such as a crusher-run stone, to a level approximately 1 foot below finished grade. Riprap slope protection with an average stone diameter of four to five inches, with little fine material, would be installed on top. The riprap slope protection will provide adequate resistance to erosion without grass cover. Additionally, if undesired vegetation growth begins, it could be easily hand pulled or cut with a string trimmer.

6.3 Cast-in-Place Concrete

Cast-in-place concrete walls are proposed to be used for the retaining walls at the downstream face of the dam and along the left bank of the downstream channel, the right and left spillway training walls, the bottom slab and walls of the energy dissipation basin, and the buttress at the downstream face. Construction requires demolition of the existing walls, excavation of the material supported by them, and preparation of a base for the footings. The cast-in-place concrete would be formed in place to the required dimensions and poured on site.

6.4 Low Level Outlet Pipe

The low-level outlet pipe is proposed to be ductile iron and lined with cement to resist internal corrosion. The pipe would connect to the valve thimble at the proposed outlet structure, and then be installed in sections into the impoundment to the desired length. In the impoundment sediment would be excavated to the desired installation depth, and then replaced after the pipe is positioned.

A trash rack would be constructed for the end using a flange attached to the end of the pipe with threaded rod bolted to it and projecting out beyond the pipe's end. A blank flange would be bolted to the threaded rod on the opposite end.

High density polyethylene (HDPE) pipe could also be used for this application. The Federal Emergency Management Agency (FEMA) provides guidance for the use of plastic pipe in dams in

the following document: *Technical Manual: Plastic Pipe Used in Embankment Dams*, dated November 2007.

6.5 Tree Removal

Removing trees from a dam embankment must be undertaken carefully to ensure proper strength following completion, and would ideally be performed with the impoundment drawn down since excavating the embankment reduces its factor of safety against instability. Trees should be removed by cutting, followed by grinding of the stumps and removal by excavation of any roots greater in diameter than ½ inch. Any unsuitable material should then be removed from the resulting void, including organic soil, and replaced with suitable, impervious fill that is compacted in place.

7 Anticipated Permits Required for Construction

The permits presented in this section are anticipated to be necessary for implementation of the repairs discussed above.

7.1 Local Permits

7.1.1 Leicester Conservation Commission

An Order of Conditions will be necessary from the Town of Leicester Conservation Commission.

7.2 State Permits

7.2.1 MGL Chapter 253 - Dam Safety Permit

This permit is required for the construction, repair, material alterations, breach, or removal of a dam, and would be required for this project.

7.2.2 Clean Water Act Section 401 Water Quality Certification

This permit is required for projects that involve more than 100 cubic yards of dredging and management and disposal of dredged materials, for disturbance of more than 5,000 square feet of BVW or LUW, and for state review of an activity that requires a permit from the Army Corps of Engineers related to wetlands and waterways. Other thresholds exist which may require a permit application when exceeded. We do not believe this project will require a Section 401 permit since less than 100 cubic yards of material will be dredged and less than 5,000 square feet of wetlands will be disturbed.

7.2.3 Massachusetts Environmental Policy Act Environmental Notification Form

This review process must be undertaken for projects that involve alteration of more than 5,000 square feet of bordering or isolated vegetated wetlands. We do not anticipate that this permit will be necessary for this project.

7.2.4 MESA Notification

A notification of the project will need to be sent to MESA. A review of the most current mapping of the Natural Heritage Endangered Species Program (NHESP) Estimated Habitats of Rare Wildlife and Priority Habitats of Rare Species indicates no such habitats are listed in the Waite Pond area. This mapping is expected to be updated soon, but presently it appears no requirements will be necessary that would affect the permitting or construction of the dam repairs. This mapping should be checked again prior to preparing permit applications.

7.2.5 Mass. Historical Commission

A Section 106 notification form with appropriate attachments will need to be sent to the Massachusetts Historical Commission (MHC) describing the project.

7.3 Federal Permits

7.3.1 Clean Water Act Section 404

Compliance with this permitting program administered by the Army Corps of Engineers is required for excavation and dredging in wetlands and waterways. The category of permit will depend on quantity of disturbance. Several of the alternatives proposed as part of this project might qualify for Category 1 of coverage under the Programmatic General Permit (PGP), which is non-reporting, whereas the removal alternatives may require an individual permit. This permitting program is closely associated with the 401 Water Quality Certification program.

As part of the Clean Water Act Section 404 requirements, Native American Tribal Authorities representative of this area will be notified of the project for their review and comment.

8 Opinion of Total Project Costs

Fuss & O'Neill prepared an Order of Magnitude Opinion of Construction cost based on the level of effort for a Phase II Investigation, which does not involve preparing detailed permit or construction drawings and specifications. Where possible, unit costs were obtained from recent experience with similar projects, as well as use of cost estimating guides such as RS Means Heavy Construction guide. These costs will be able to be more accurately estimated when more accurate quantities and material types required for preparation of preliminary design plans and technical specifications are determined. We have also provided estimates of the costs for engineering services based upon our extensive experience with design and permitting of water resources projects in Massachusetts. The opinion of construction cost and engineering costs will total to provide the opinion of total project costs. This however does not include any costs that may be incurred for acquisition of property rights if required or the costs for other professional services such as legal fees or Town staff time.

Order of Magnitude opinions of cost are typically accurate to within -30% to +50%. The attached Opinion of Cost spreadsheet indicates a cost of $808,000, which includes engineering and permitting costs, plus a 20% contingency. Using the stated range for Order of Magnitude estimates, the expected total cost could range from as little as $565,000 to as much as $1,212,000. It should be noted that Fuss & O'Neill are not professional cost estimators, and costs can vary considerably due to conditions over which Fuss & O'Neill has no control, such as the economic climate at the time of bidding. The costs included here should only be used for planning purposes, and not for bidding purposes. The basis for this cost estimate is included in the attached Cost Estimation Spreadsheet located in *Appendix D.*

9 References

9.1 Documents and Reports

Fay, William K. (November 1986). *Dam Inspection, Safety & Repair Report.* Prepared for the Worcester Spinning & Finishing Company.

Fuss & O'Neill (June 2009). *Poor Condition Follow-up Inspection Report.* Prepared for the Town of Leicester.

Fuss & O'Neill (February 2010). *Poor Condition Follow-up Inspection Report.* Prepared for the Town of Leicester.

Fuss & O'Neill (June 2010). *Poor Condition Follow-up Inspection Report.* Prepared for the Town of Leicester.

Fuss & O'Neill (January 2011). *Poor Condition Follow-up Inspection Report.* Prepared for the Town of Leicester.

Fuss & O'Neill (July 2011). *Poor Condition Follow-up Inspection Report.* Prepared for the Town of Leicester.

Fuss & O'Neill (January 2012). *Poor Condition Follow-up Inspection Report.* Prepared for the Town of Leicester.

Fuss & O'Neill (August 2012). *Phase I Inspection Report.* Prepared for the Town of Leicester.

Fuss & O'Neill (January 2013). *Poor Condition Follow-up Inspection Report.* Prepared for the Town of Leicester.

Fuss & O'Neill (July 2014). *Poor Condition Follow-up Inspection Report.* Prepared for the Town of Leicester.

Haley & Aldrich (March 2008). *Phase I Inspection Report.* Prepared for the Massachusetts Department of Environmental Management.

Hershfield, David M. (May 1961) *Rainfall Frequency Atlas of the United States.* National Weather Bureau Technical Paper 40. Prepared for Engineering Division, Soil Conservation Service.

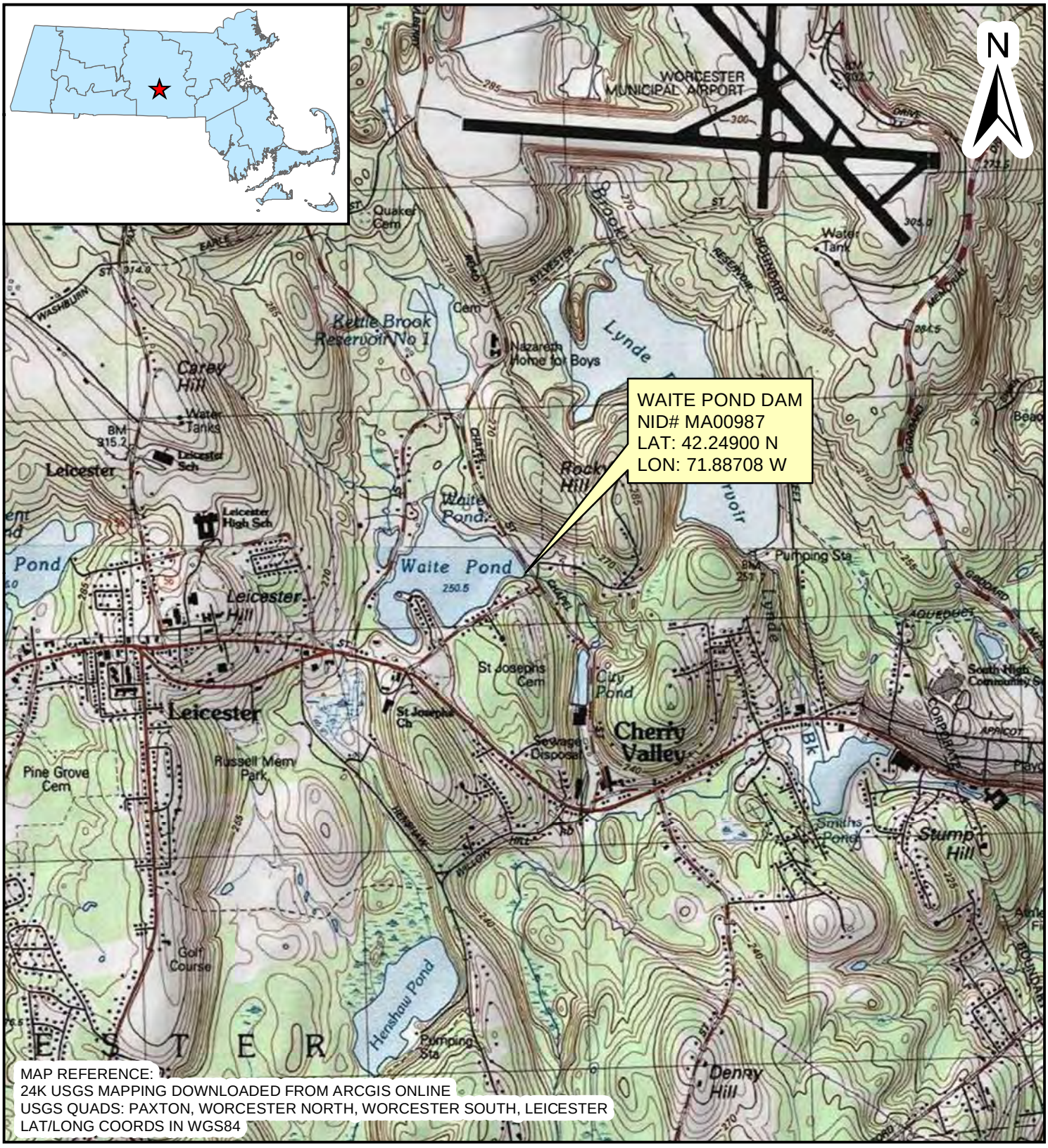
NRCS (June 1986). *Urban Hydrology for Small Watersheds.* Natural Resources Conservation Service Technical Release 55.

9.2 Regulations

MA Department of Conservation and Recreation Dam Safety Regulations, 302 CMR 10.00.

FUSS & O'NEILL

Figures



AUGUST 2012

FIGURE 1

2,000 1,000 0 2,000 Feet

TOWN OF LEICESTER

LOCUS MAP

WAITE POND DAM (MA00987)

LEICESTER, MASSACHUSETTS

SCALE
HORZ: 1 INCH = 2,000 FEET
VERT:
DATUM
HORZ:
VERT: NGVD29 (3-METER CONTOURS)

FUSS & O'NEILL

K:\GIS\P2008\1286\A50\MA00987_WaitePondDam\MXD\Fig1_Locus.mxd

AUGUST 2012

FIGURE 2

200 100 0 200 Feet

TOWN OF LEICESTER

AERIAL PHOTOGRAPH

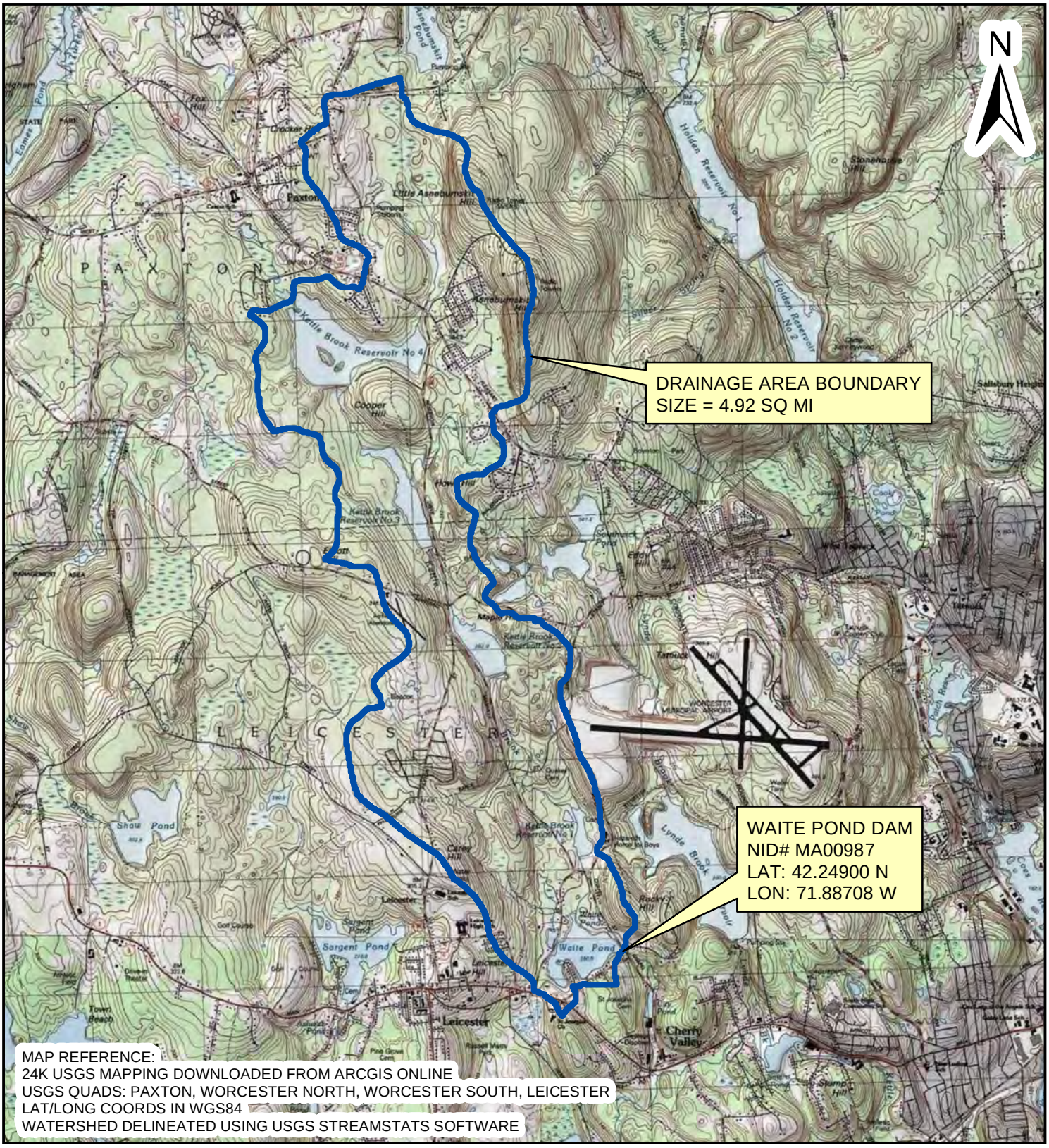
WAITE POND DAM (MA00987)

LEICESTER, MASSACHUSETTS

SCALE
HORZ: 1 INCH = 200 FEET
VERT:
DATUM
HORZ:
VERT:

FUSS & O'NEILL

K:\GIS\P2008\1286\A50\MA00987_WaitePondDam\MXD\Fig2_Aerial.mxd



AUGUST 2012

FIGURE 3

4,000 2,000 0 4,000 Feet

TOWN OF LEICESTER

DRAINAGE AREA

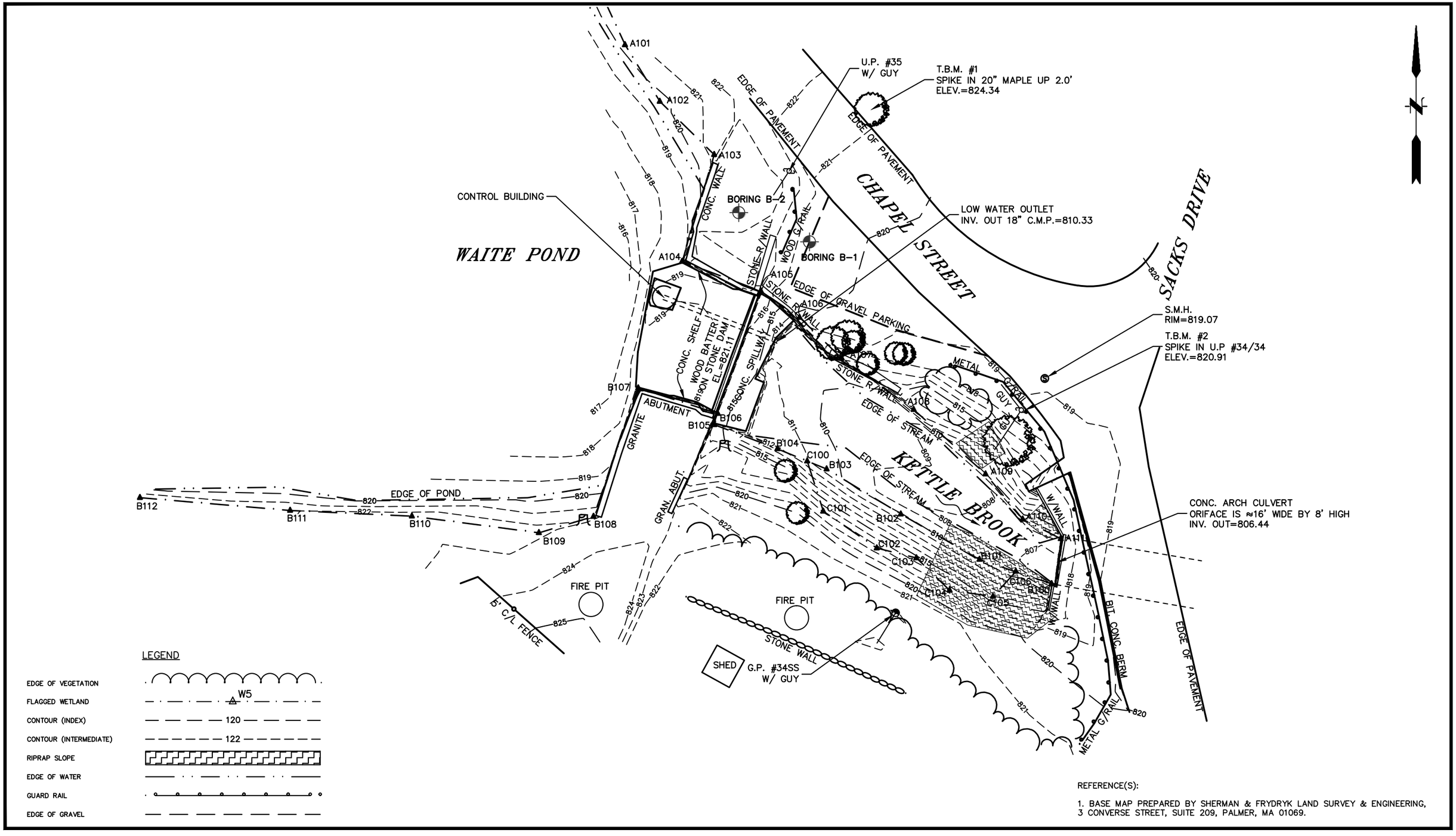
WAITE POND DAM (MA00987)

LEICESTER, MASSACHUSETTS

SCALE
HORZ: 1 INCH = 4,000 FEET
VERT:
DATUM
HORZ:
VERT: NGVD29 (3-METER CONTOURS)

FUSS & O'NEILL

K:\GIS\P2008\1286\A50\MA00987_WaitePondDam\MXD\Fig3_DrainageArea.mxd



LEGEND

- EDGE OF VEGETATION
- FLAGGED WETLAND — W5
- CONTOUR (INDEX) — 120
- CONTOUR (INTERMEDIATE) — 122
- RIPRAP SLOPE
- EDGE OF WATER
- GUARD RAIL
- EDGE OF GRAVEL

REFERENCE(S):

1. BASE MAP PREPARED BY SHERMAN & FRYDRYK LAND SURVEY & ENGINEERING, 3 CONVERSE STREET, SUITE 209, PALMER, MA 01069.

No.	DATE	DESCRIPTION	DESIGNER	REVIEWER

SCALE:
HORZ.: 1" = 30'
VERT.:
DATUM:
HORZ.:
VERT.: NAVD 1988
0 15 30
GRAPHIC SCALE

FUSS & O'NEILL
146 HARTFORD ROAD
MANCHESTER, CONNECTICUT 06040
860.646.2469
www.fando.com

TOWN OF LEICESTER

EXISTING CONDITIONS PLAN

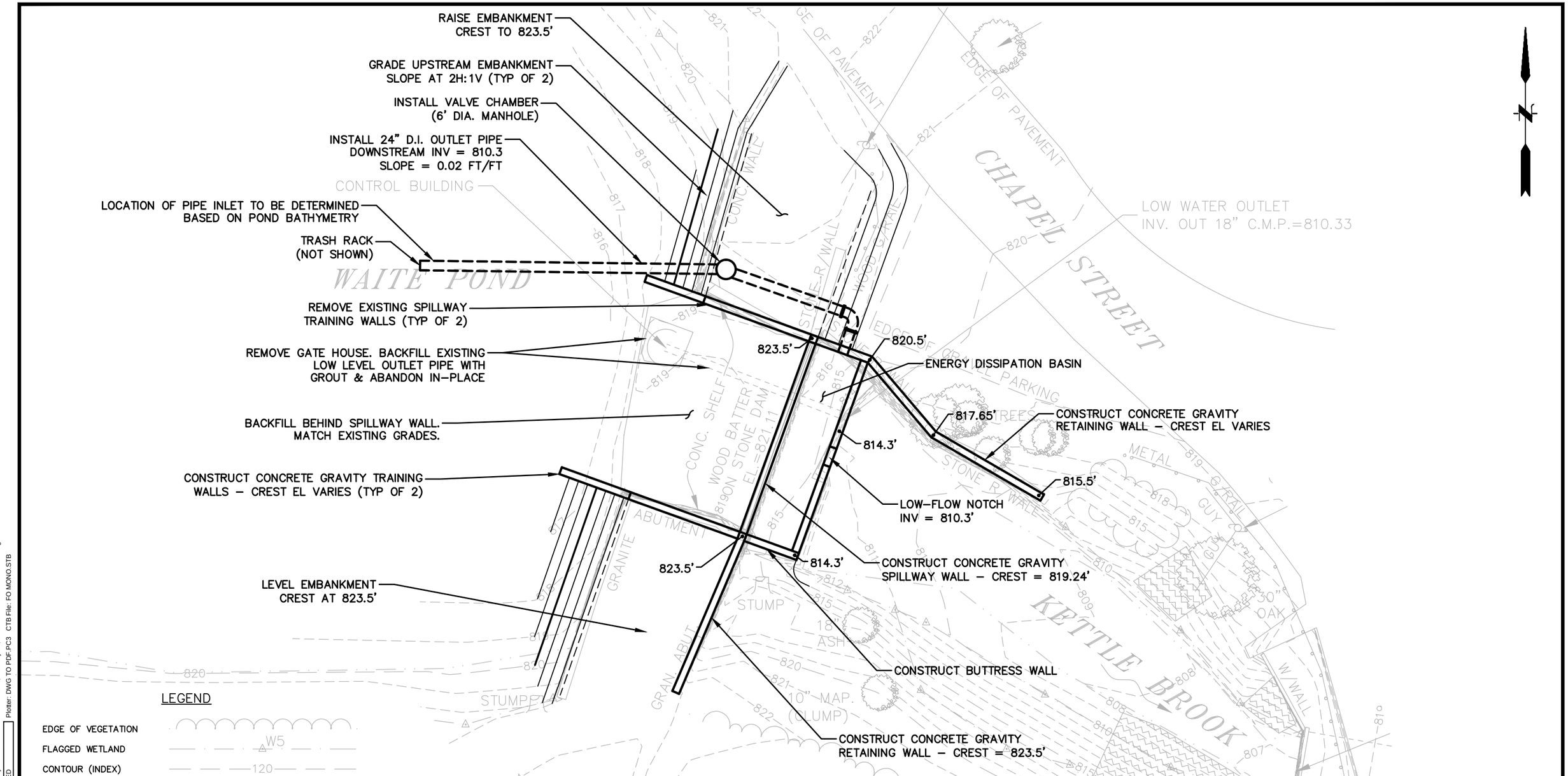
WAITE POND DAM

LEICESTER MASSACHUSETTS

PROJ. No.: 20081286.A60
DATE: SEPTEMBER 2014

FIG 4

File Path: J:\DWG\P2008\1286\A60\Civil\Plan\081286A60_STP01.dwg Layout: EXISTING Plotted: Wed, January 21, 2015 - 1:58 PM User: kmikolinski
MS VIEW: LAYER STATE: EXISTING Plotter: DWG TO PDF.PC3 CTB File: FO MONO.STB



REFERENCE(S):

1. BASE MAP PREPARED BY SHERMAN & FRYDRYK LAND SURVEY & ENGINEERING, 3 CONVERSE STREET, SUITE 209, PALMER, MA 01069.

No.	DATE	DESCRIPTION	DESIGNER	REVIEWER

SCALE:
HORZ.: 1" = 20'
VERT.:
DATUM:
HORZ.:
VERT.: NAVD 1988
0 10 20
GRAPHIC SCALE

FUSS & O'NEILL
146 HARTFORD ROAD
MANCHESTER, CONNECTICUT 06040
860.646.2469
www.fando.com

TOWN OF LEICESTER

CONCEPTUAL DAM REPAIRS

WAITE POND DAM

LEICESTER MASSACHUSETTS

PROJ. No.: 20081286.A60
DATE: SEPTEMBER 2014

FIG 5

File Path: J:\DWG\P2008\81286\A60\Civil\Plan\081286A60_STP01.dwg Layout: PROPOSED Plotted: Fri, January 23, 2015 - 11:37 AM User: ksullenger
Plotter: DWG TO PDF.PC3 CTB File: FO MONO.STB
LAYER STATE: PROPOSED
MS VIEW:

Appendix A

Visual Inspection Update

--*WAITE POND DAM*--

PHASE I

INSPECTION / EVALUATION REPORT

Dam Name:	**Waite Pond Dam**
State Dam ID#:	**3-14-151-21**
NID ID#:	**MA00987**
Owner:	**Town of Leicester**
Owner Type:	**Municipality**
Town:	**Leicester**
Consultant:	**Fuss & O'Neill, Inc.**
Date of Inspection:	**August 8, 2012**

FUSS & O'NEILL

EXECUTIVE SUMMARY

Waite Pond Dam is located in Leicester, MA. This dam was inspected on August 8, 2012 by Fuss & O'Neill, Inc. The structure is classified as an Intermediate size, Significant (Class II) hazard potential dam. The dam was found to be in **Poor** condition.

The deficiencies noted during this inspection are:

1. Deteriorating and undermined concrete training walls and embankment walls.
2. Upstream left embankment wall leaning toward impoundment.
3. Downstream right masonry embankment wall overhanging out of plumb and missing stones.
4. Downstream left masonry channel wall collapsing
5. Tree root penetration into embankment.
6. Subsidence/depressions in right crest of dam.
7. Low level outlet structure leaning out of plumb, concrete deteriorated, foundation undermined, no roof.
8. Low level outlet pipe operator inoperability unknown.
9. Low level outlet pipe 50 percent full of sediment.

The Town is initiating a Phase II Investigation for Waite Pond Dam, which will consist of survey, wetland delineation, drilling, performance of hydraulic and hydrologic analyses, and performance of stability analyses. Recommendations for dam repair and associated cost estimates for completing the repairs will be made as part of the Phase II Investigation.

Dam Evaluation Summary Detail Sheet

1. NID ID:	**MA00987**	**4. Inspection Date:**	**August 8, 2012**
2. Dam Name:	**Waite Pond Dam**	**5. Last Insp. Date:**	**March 10, 1998**
3. Dam Location:	**Leicester, MA**	**6. Next Inspection:**	**August 8, 2017**
7. Inspector:	**Christopher J. Cullen, P.E.**		
8. Consultant:	**Fuss & O'Neill, Inc.**		
9. Hazard Code:	**Significant**	**9a. Is Hazard Code Change Requested?:**	**No**
10. Insp. Frequency:	**5 Years**	**11. Overall Physical Condition of Dam:**	**POOR**
12. Spillway Capacity (% SDF)	**>100% SDF w/ no actions by Caretaker**		

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

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 reported herein was based upon available data and visual inspections. Detailed investigations and analyses involving topographic mapping, subsurface investigations, testing and detailed computational evaluations were beyond the scope of this report unless reported otherwise.

In reviewing this report, it should be realized that the reported condition of the dam was based on observations of field conditions at the time of inspection, along with data available to the inspection team.

It is critical to note that the condition of the dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the reported 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 be detected.

Licensed Professional's Signature

Christopher J. Cullen, P.E.
Massachusetts License No.: 47018
License Type: Civil

Project Manager
Fuss & O'Neill, Inc.

TABLE OF CONTENTS

SECTION **PAGE**

TABLES **FOLLOWING PAGE**

FIGURES **END OF REPORT**

APPENDICES

SECTION 1

1.0 DESCRIPTION OF PROJECT

1.1 General

1.1.1 Authority

The Town of Leicester has retained Fuss & O'Neill, Inc. to perform a visual inspection and develop a report of conditions for the dam at Waite Pond along Kettle Brook in Leicester, Massachusetts. This inspection and report were performed in accordance with MGL Chapter 253, Sections 44-50 of the Massachusetts General Laws as amended by Chapter 330 of the Acts of 2002.

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 in accordance with 302 CMR10.07 to provide information that will assist in both prioritizing dam repair needs and planning/conducting maintenance and operation.

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

1.1.3 Definitions

To provide the reader with 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

The dam is located on Chapel Road north of the center Leicester, approximately 50 feet north of Waite Street. The dam location is latitude 42.2490 degrees and 71.8871 degrees longitude (WGS84). From the center of Leicester, travel west on Route 9 for 0.8 miles. Turn left onto Waite Street and continue for 0.5 miles to the end. Turn left onto Chapel Street. The dam is 200 feet on the left. A locus map is provided as Figure 1.

1.2.2 Owner/Caretaker

See Table 1.1 for current owner and caretaker data (names and contact information).

1.2.3 Purpose of the Dam

The purpose of the dam is for recreation. Presumably, the dam was originally constructed to power a small mill, of which there are no longer any traces.

1.2.4 Description of the Dam and Appurtenances

The dam consists of an earth core with upstream and downstream masonry walls. The structural height is 11 feet, and the hydraulic height at normal pool is 8 feet.The spillway is a concrete broad crested weir structure with 2 feet of wood weir boards supported by steel dowels. The spillway is 41 feet long and 5 feet high from the concrete spillway invert (3 feet from the top of the sharp-crested weir boards) to the dam crest. There is a 24-inch diameter CMP low level outlet with a slide gate located in a circular, roofless masonry structure approximately 10 feet from the upstream edge of the spillway. The outlet pipe exits to the stream at the base of the stilling basin approximately 10 feet downstream of the spillway. The upstream face of the dam consists of deteriorating concrete walls. The downstream right face of the dam consists of a vertical dry-laid masonry wall. The downstream left embankment consists of a relatively flat earthen area used for parking, supported along the stream by a vertical masonry wall that has partially collapsed. The left dam crest is isolated from the parking area by a timber post and rail fence.

1.2.5 Operations and Maintenance

Operation and maintenance of the dam is the responsibility of the Town of Leicester. Flow can be controlled through placement and removal of the weir boards, which are always left in place. The low level outlet was partially flowing during our inspection, but the gate operators are not used. Normal pool of the pond is maintained by leaving the weir boards in place. The crest vegetation is periodically mowed by the Town, and some tree cutting has been performed to keep the dam clear.

1.2.6 DCR Size Classification

Waite Pond Dam has a maximum structural height of approximately 14 feet and a maximum storage capacity of approximately 350 acre-feet. Therefore, in accordance with Department of Conservation and Recreation Office of Dam Safety classification, under Commonwealth of Massachusetts dam safety rules and regulations stated in 302 CMR 10.00 as amended by Chapter 330 of the Acts of 2002, Waite Pond Dam is an **Intermediate** size structure.

1.2.7 DCR Hazard Classification

Waite Pond is located approximately 200 feet upstream of Chapel Street, a secondary road. The stream passes under Waite Street through a box culvert, and again under Chapel Street approximately 2,000 feet down gradient before entering City Pond. It appears that a failure of the dam at maximum pool may cause damage to the road it supports and secondary highway(s).

Therefore, in accordance with Department of Conservation and Recreation classification procedures, under Commonwealth of Massachusetts dam safety rules and regulations stated in 302 CMR 10.00 as amended by Chapter 330 of the Acts of 2002, Waite Pond Dam is classified as a **Significant** hazard potential dam.

1.3 Pertinent Engineering Data

1.3.1 Drainage Area

The drainage area for Waite Pond is approximately 4.92 square miles and extends through the Town of Leicester. The drainage area was determined using the USGS StreamStats software for Massachusetts.

1.3.2 Reservoir

See data below for normal, maximum, and spillway design flood (SDF) pools. These data were calculated based on USGS topographic mapping.

1.3.3 Discharges at the Dam Site

There are no formal records of historic flow volumes at the dam site.

1.3.4 General Elevations (feet):

Elevations are based on USGS Topographic mapping. The spillway concrete invert was estimated to be at elevation 821.9.

A.	Top of Dam	826.9
B.	Spillway Design Flood Pool	Unknown
C.	Normal Pool (with weir boards)	823.9
D.	Spillway Crest (without weir boards)	821.9
E.	Top of Stop Logs	823.9
F.	Upstream Water at Time of Inspection	821.9
G.	Streambed at Toe of the Dam	816.0
H.	Low Point along Toe of the Dam	816.0

1.3.5 Main Spillway

A.	Type	Concrete with weir boards
B.	Length	41 feet
C.	Invert Elevation	823.9
D.	Upstream Channel	NA
E.	Downstream Channel	816.0
F.	Downstream Water	816.5

1.3.6 Additional Information and Elevations

A.	Low level outlet pipe invert	816.0

1.3.7 Design and Construction Records

MADCR dam records indicate the dam was constructed in 1898. No design or construction records were available.

1.3.8 Operating Records

There are no operating records available at this date for Waite Pond Dam.

1.4 Summary Data Table

1.1 Summary Data Table

Required Phase I Report Data	Data Provided by the Inspecting Engineer
National ID #	MA00987
Dam Name	Waite Pond Dam
Dam Name (Alternate)	
River Name	Kettle Brook
Impoundment Name	Waite Pond
Hazard Class	Significant
Size Class	Intermediate
Dam Type	Earth/ masonry composite
Dam Purpose	Recreation
Structural Height of Dam (feet)	11
Hydraulic Height of Dam (feet)	8
Drainage Area (sq. mi.)	4.92
Reservoir Surface Area (sq. mi.)	0.0125
Normal Impoundment Volume (acre-feet)	230
Max Impoundment Volume ((top of dam) acre-feet)	350
SDF Impoundment Volume* (acre-feet)	NO H&H
Spillway Type	Broad crest concrete weir with wood weir boards
Spillway Length (feet)	41
Freeboard at Normal Pool (feet)	3
Principal Spillway Capacity* (cfs)	709
Auxiliary Spillway Capacity* (cfs)	NA
Low-Level Outlet Capacity* (cfs)	0
Spillway Design Flood* (flow rate - cfs)	100 yr./343
Winter Drawdown (feet below normal pool)	N/A
Drawdown Impoundment Vol. (acre-feet)	N/A
Latitude	42.249
Longitude	-71.88708
City/Town	Leicester
County Name	Worcester
Public Road on Crest	No
Public Bridge over Spillway	No
EAP Date (if applicable)	NA
Owner Name	Town of Leicester
Owner Address	3 Washburn Square
Owner Town	Leicester, MA 01524-1333
Owner Phone	(508) 892-7000
Owner Emergency Phone	(508) 892-7000
Owner Type	Municipality or Political subdivision
Caretaker Name	Town of Leicester
Caretaker Address	3 Washburn Square
Caretaker Town	Leicester, MA 01524-1333
Caretaker Phone	(508) 892-7000
Caretaker Emergency Phone	(508) 892-7000
Date of Field Inspection	8/8/2012
Consultant Firm Name	Fuss & O'Neill, Inc.
Inspecting Engineer	Christopher J. Cullen, P.E.
Engineer Phone Number	800-286-2469

*In the event a hydraulic and hydrologic analysis has not been completed for the dam, indicate "No H&H" in this table, recommendation section shall include specific recommendation to hire a qualified dam engineering consultant to conduct analysis to determine spillway adequacy in conformance with 302 CMR 10.00.

SECTION 2

2.0 INSPECTION

2.1 Visual Inspection

Waite Pond Dam was inspected on August 8, 2012. At the time of the inspection, the weather was clear with temperatures in the 80s. No significant storm event occurred immediately prior to our inspection. Flow at the time of our inspection appeared to relatively low flow conditions. Flow was limited to leakage through the weir boards at the base of the concrete portion of the spillway. Photographs to document the current conditions of the dam were taken during the inspection and are included in Appendix A. The elevation of the impoundment was approximately two feet lower than the normal pool elevation, barely seeping over the concrete spillway. Underwater areas were not inspected. A copy of the inspection checklist is included in Appendix B.

2.1.1 General Findings

In general**,** Waite Pond Dam was found to be in Poor condition with several deficiencies noted**.** The specific concerns are identified in more detail in the sections below:

2.1.2 Dam

- ***Abutments*** Abutments to the dam appeared to be in good condition and in good contact with the earthen and stone portions of the dam.
- ***Upstream Face*** Severe erosion, cracking and undermining of the concrete covered masonry walls were observed. (See Photos 21 and 23)
- ***Crest*** The crest of the dam consists of vegetated earth. Depressions were observed on the right crest. Sparse vegetation and tree root encroachment were observed on the left crest. (See Photo 20)
- ***Downstream Face*** The right downstream face consists of vertical dry-laid stone masonry wall. The wall appeared to be slightly overhanging and some stones appeared to be missing. The left downstream area consists of a gravel parking area supported by a vertical masonry wall parallel to the brook channel. The wall has partially collapsed. (See Photo 22)
- ***Drains*** No drains were observed.
- ***Instrumentation*** There is no permanent instrumentation at the dam.
- ***Access Roads and Gates*** Access to the dam is possible from the parking area on the downstream left side, and from private residences on the right side. There are no gates.

2.1.3 Appurtenant Structures

- Primary Spillway

The spillway consists of a concrete slab with 2 feet of wooden weir boards. The side walls of the spillway are cracked and eroded. The stilling basin consists of stone rubble covered with concrete that spills overflow to the channel below. The concrete

is breaking into fragments but seems to be functioning satisfactorily. (See Photo 14) Weir boards were in place during our inspection and appeared to be in satisfactory condition, with minor leakage through the boards. (See Photo 13)

- Low Level Outlet

The 24-inch CMP low level outlet was rusted and appeared to be approximately ½ full of sediment, but was flowing (See Photo 18). The operator is located in a circular structure in the impoundment. There is currently no access to the structure except by wading or boat. There is no roof on the structure, which is leaning over (See Photo 16). The concrete foundation is severely eroded. It is not known if the gate operator is functional.

- Auxiliary/Emergency Spillway

There is no emergency spillway associated with this dam.

- Dikes

There are no dikes associated with this dam.

2.1.4 Downstream Area

The downstream area is wooded. The stream channel consists of boulders, cobbles and gravel. The left channel embankment consists of a vertical stone masonry wall extending approximately 70 feet downstream from the dam, and has partially collapsed. Approximately 200 feet downstream, the stream passes beneath Chapel Street through a concrete box culvert.

2.1.5 Reservoir Area

The impoundment is approximately 1,700 feet long by 1,500 feet wide. The impoundment is bounded by residential development and wooded areas. Reservoir slopes appeared to be stable. (See Photo 19)

2.2 Caretaker Interview

The Town of Leicester is responsible for maintenance of Waite Pond Dam, although there are volunteers from the residences on the pond that contribute to maintenance of the dam. The dam is inspected as needed and following storms. According to Mr. Robert Reed, Town Administrator, debris is removed from the dam spillway on an as-needed basis and the weir boards replaced as needed.

2.3 Operation and Maintenance Procedures

There is no Operation & Maintenance (O&M) manual for this dam. An Operating Plan was prepared by the Waite Pond Association in 2010 outlining future steps to be taken to rehabilitate the dam.

2.3.1 Operational Procedures

Operation of the dam is limited to making sure weir boards are in place to maintain the pond water level. Normal operation of the dam includes leaving all the stop logs installed.

2.3.2 Maintenance of Dam and Operating Facilities

Maintenance of the dam consists of occasional mowing and replacement of weir boards when needed. Some tree clearing has been performed in the past to keep the dam crest clear of woody vegetation.

2.4 Emergency Warning System

There is no Emergency Action Plan for this dam.

2.5 Hydrologic/Hydraulic Data

Hydrologic/Hydraulic analyses were found during our file review in a 1986 dam inspection report. According to the 1986 report, the peak discharge capacity of the 41-foot by 3-foot sharp crest spillway is approximately 709 cfs with the weir boards in place.

A. Spillway Design Flood (SDF) Return Period	100 years
B. SDF Inflow (CFS)	343 cfs
C. SDF Outflow (CFS)	343 cfs
D. Spillway Capacity (CFS) (with weir boards installed)	709 cfs
E. Depth of Overtopping (FT) (with weir boards installed)	none

2.6 Structural and Seepage Stability

2.6.1 Embankment Structural Stability

The embankments are not in danger of immediate collapse, but the upstream and downstream walls all show signs of movement. It is not clear what has caused the movement, but scour and undermining, combined with frost action are likely.

2.6.2 Structural Stability of Non-Embankment Structures

Non-embankment structures include the circular low level outlet gate structure. The structure's concrete base is severely eroded and the structure is no longer plumb, possibly due to scour action.

2.6.3 Seepage Stability

No visual evidence of seepage was observed. No evidence of erosion or piping was observed.

SECTION 3

3.0 ASSESSMENTS AND RECOMMENDATIONS

3.1 Assessments

In general, the overall condition of Waite Pond Dam is Poor. The dam was found to have structural deficiencies during our August 8, 2012 inspection. The dam was found to have the following deficiencies:

1. Deteriorating and undermined concrete training walls and embankment walls.
2. Upstream left embankment wall leaning toward impoundment.
3. Downstream right masonry embankment wall overhanging out of plumb and missing stones.
4. Downstream left masonry channel wall collapsing
5. Tree root penetration into embankment.
6. Subsidence/depressions in right crest of dam.
7. Low level outlet structure leaning out of plumb, concrete deteriorated, foundation undermined, no roof.
8. Low level outlet pipe operator inoperability unknown.
9. Low level outlet pipe 50 percent full of sediment.

The following recommendations and remedial measures generally describe the recommended approach to address current minor deficiencies at the dam. Prior to undertaking recommended maintenance, repairs and remedial measure, the applicability of environmental permits needs to be determined prior to undertaking activities that may occur within resource areas under the jurisdiction of local conservation commissions, MADEP, or other regulatory agencies.

3.2 Studies and Analyses

The Town has been ordered to perform a Phase II Dam Investigation, which will include hydraulic, hydrologic and stability analyses.

3.3 Recurrent Maintenance Recommendations

The activities presented below should be undertaken on a regular or yearly basis by the dam owner/caretaker to improve the safety, maintenance, and operation of the dam. Typically these activities do not require engineering design.

Regularly remove small diameter (<6 inches) trees, brush, and woody vegetation from the dam embankment and within 20 feet of the downstream toe.

Monitor and repair as needed minor erosion, fill animal burrows, and remove woody vegetation growth.

3.4 Minor Repair Recommendations

The following recommendations are intended to improve the overall condition of the dam but do not alter the current design of the dam. The recommendations will probably require assistance by a professional engineer and construction by a contractor experienced in dam construction or repair. A Chapter 253 permit may be required.

- Clear large trees from the dam for a distance of 20 feet beyond the toe and abutments of the dam. The Conservation Commission should be consulted regarding the need for a permit to cut trees near the dam, and Part A of the Dam Safety Permit Application form should be completed and submitted to the MADCR.

3.5 Remedial Modifications Recommendations

Remedial modifications are those that alter the current configuration or design of the dam that are necessary to meet stability, seepage or safety concerns as well as comply with current state requirements. These recommendations will require design by a professional engineer and construction by a contractor experienced in dam repair. A Chapter 253 permit will likely be required.

No remedial recommendations are being made at this time. As part of the Phase II Investigation, remedial measures and options for dam repair will be recommended.

3.6 Alternatives

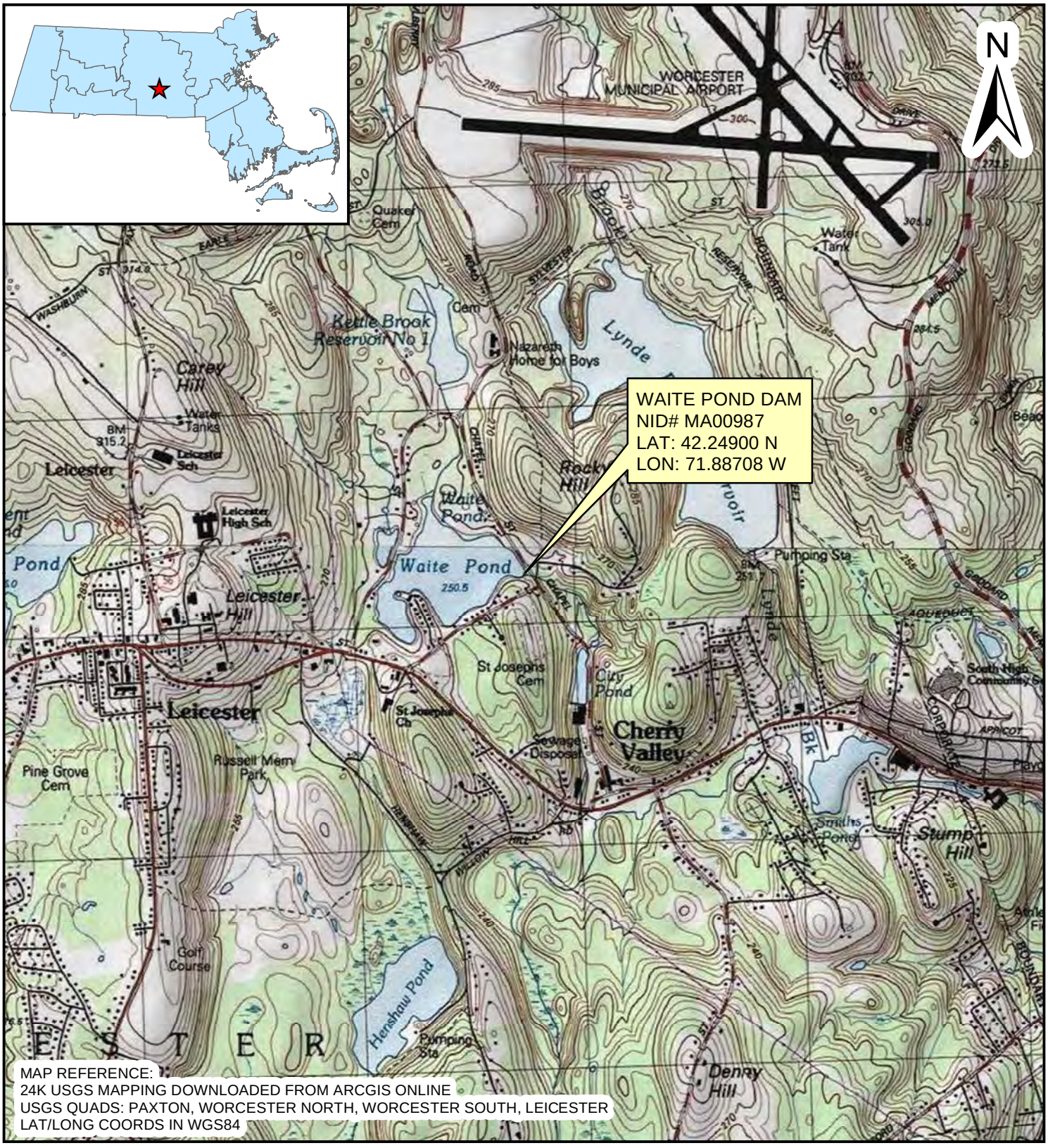
No alternatives are presented based upon the condition and current use of the pond and dam.

3.7 Opinion of Probable Construction Costs

The Phase II Investigation will include construction cost estimates for various repair options for the dam.

Prior to commencing construction of repairs or maintenance activity, the owner/caretaker should contact the Office of Dam Safety and the local Conservation Commission to determine whether a permit is required. Consultation with a professional engineer familiar with the dam safety regulatory process is recommended to determine which other federal, state, and local permits may apply.

FIGURES



AUGUST 2012

FIGURE 1

2,000 1,000 0 2,000 Feet

TOWN OF LEICESTER

LOCUS MAP

WAITE POND DAM (MA00987)

LEICESTER, MASSACHUSETTS

SCALE
HORZ: 1 INCH = 2,000 FEET
VERT:
DATUM
HORZ:
VERT: NGVD29 (3-METER CONTOURS)

FUSS & O'NEILL

K:\GIS\P2008\1286\A50\MA00987_WaitePondDam\MXD\Fig1_Locus.mxd

AUGUST 2012

FIGURE 2

200 100 0 200 Feet

TOWN OF LEICESTER

AERIAL PHOTOGRAPH

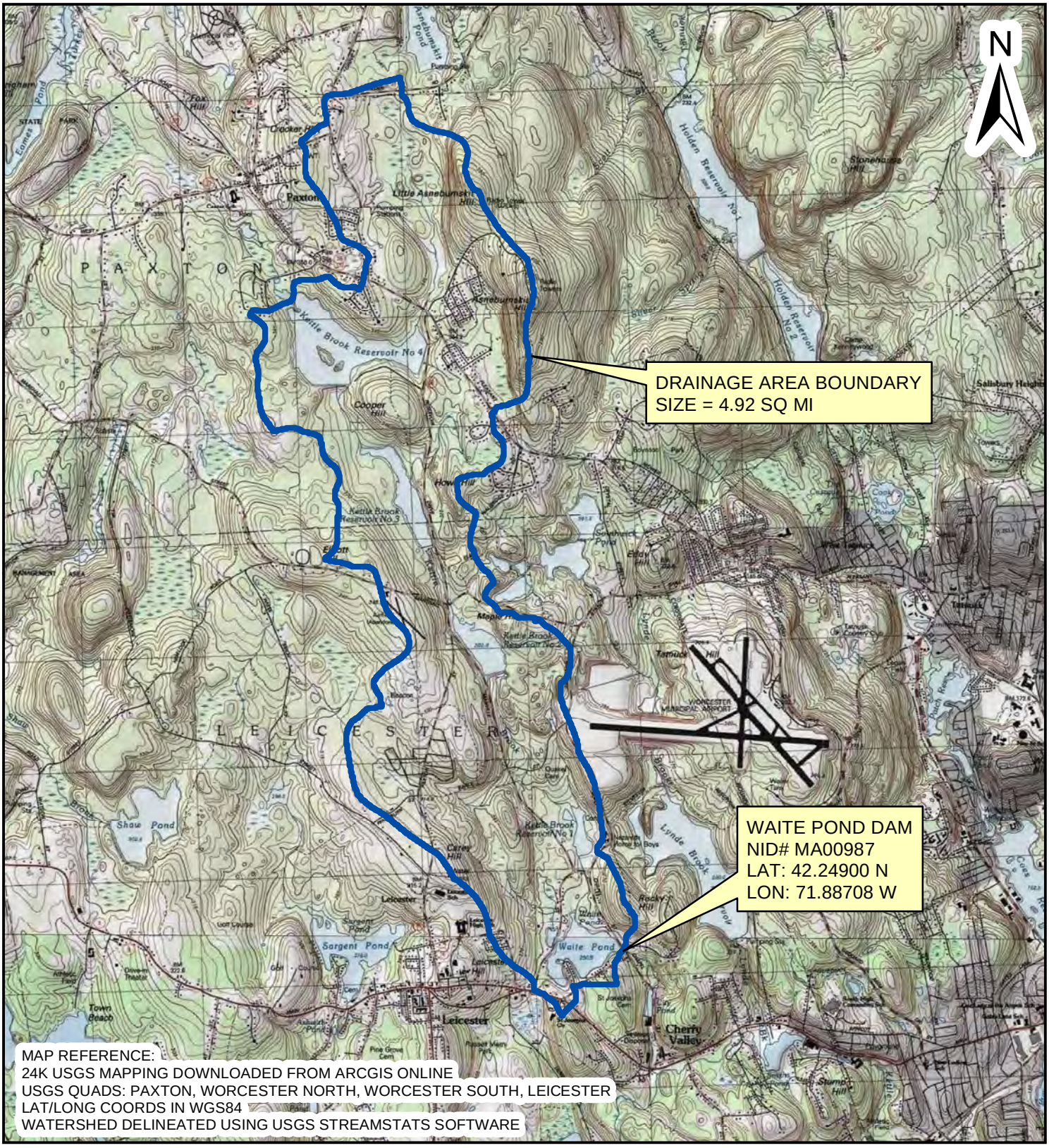
WAITE POND DAM (MA00987)

LEICESTER, MASSACHUSETTS

SCALE
HORZ: 1 INCH = 200 FEET
VERT:
DATUM
HORZ:
VERT:

FUSS & O'NEILL

K:\GIS\P2008\1286\A50\MA00987_WaitePondDam\MXD\Fig2_Aerial.mxd



AUGUST 2012

FIGURE 3

4,000 2,000 0 4,000 Feet

TOWN OF LEICESTER

DRAINAGE AREA

WAITE POND DAM (MA00987)

LEICESTER, MASSACHUSETTS

SCALE
HORZ: 1 INCH = 4,000 FEET
VERT:
DATUM
HORZ:
VERT: NGVD29 (3-METER CONTOURS)

FUSS & O'NEILL

K:\GIS\P2008\1286\A50\MA00987_WaitePondDam\MXD\Fig3_DrainageArea.mxd

AUGUST 2012

FIGURE 4

2,000 1,000 0 2,000 Feet

TOWN OF LEICESTER

DOWNSTREAM AREA

WAITE POND DAM (MA00987)

LEICESTER, MASSACHUSETTS

SCALE
HORZ: 1 INCH = 2,000 FEET
VERT:
DATUM
HORZ:
VERT: NGVD29 (3-METER CONTOURS)

FUSS & O'NEILL

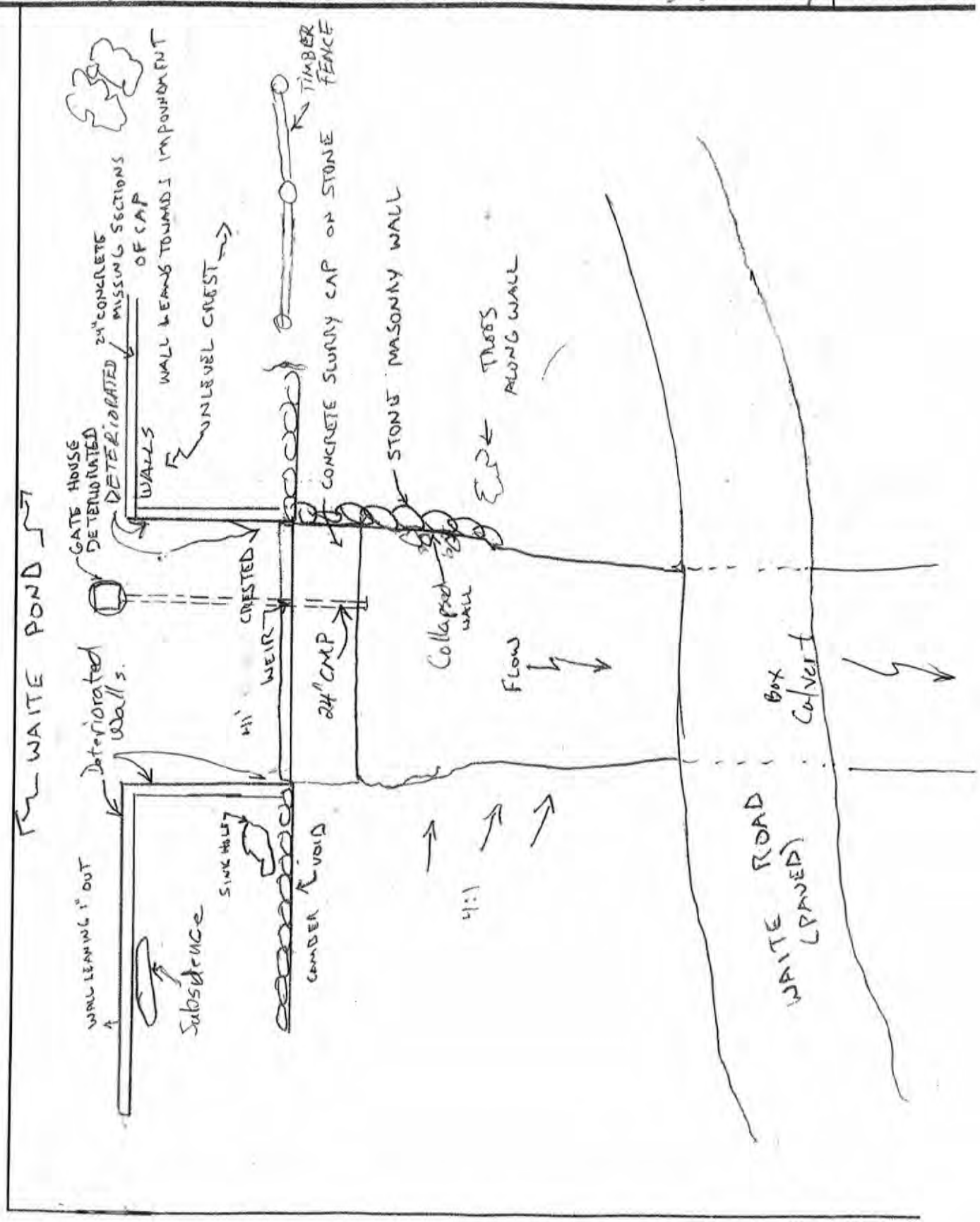
K:\GIS\P2008\1286\A50\MA00987_WaitePondDam\MXD\Fig4_DownstreamArea.mxd

FUSS & O'NEILL
Disciplines to Deliver

PREPARED BY	DATE	CHECKED BY	DATE	PROJECT NO.
CJC	8/7/12			20081286.A50

SHEET NO. 1 of 1

WAITE POND - FIELD SKETCH-MA00987



APPENDIX A

Photographs

FUSS & O'NEILL
Disciplines to Deliver

PREPARED BY	DATE	CHECKED BY	DATE	PROJECT NO.
CJC	8/7/12			20081286.A50

WAITE POND - FIELD SKETCH-MA00987

SHEET NO. 1 of 1

Photo Locations

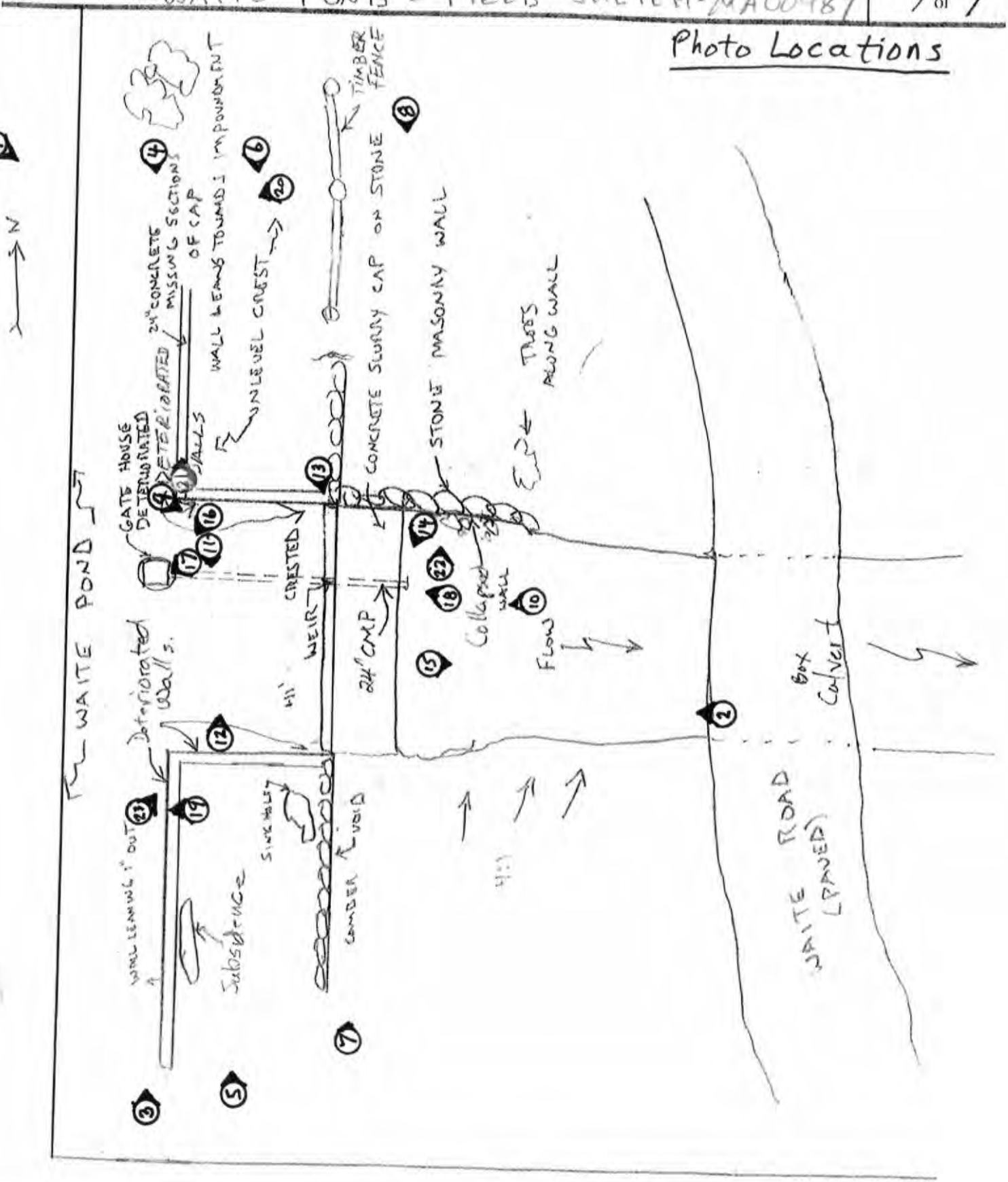


Photo 1: Overview of dam from upstream

Photo 2: Overview of dam from downstream

Photo 3: Overview of upstream face from right abutment

Photo 4: Overview of upstream face from left abutment

Photo 5: Overview of dam crest from right abutment

Photo 6: Overview of dam crest from left abutment

Photo 7: Overview of downstream face from right abutment

Photo 8: Overview of downstream face from left abutment

Photo 9: Overview of spillway from upstream

Photo 10: Overview of spillway from downstream (tailrace or channel area)

Photo 11: Overview of right training wall

Photo 12: Overview of left training wall

Photo 13: Overview of weir

Photo 14: Overview of stilling basin

Photo 15: Overview of downstream channel

Photo 16: Overview of gatehouse exterior

Photo 17: Overview of gatehouse interior & operator

Photo 18: Low level outlet – 24" CMP

Photo 19: Overview of reservoir

Photo 20: Areas of specific deficiencies-tree roots, sparse vegetative cover

Photo 21: Areas of specific deficiencies-deteriorating concrete, leaning wall

Photo 22: Areas of specific deficiencies-collapsed masonry wall

Photo 23: Areas of specific deficiencies-undermined cracked wall

APPENDIX B

Inspection Checklist

DAM SAFETY INSPECTION CHECKLIST

NAME OF DAM: Waite Pond Dam

STATE ID #: 3-14-151-21

REGISTERED: ☑ YES ☐ NO

NID ID #: MA00987

STATE SIZE CLASSIFICATION: Intermediate

STATE HAZARD CLASSIFICATION: Significant

CHANGE IN HAZARD CLASSIFICATION REQUESTED?: No

DAM LOCATION INFORMATION

CITY/TOWN: Leicester

COUNTY: Worcester

DAM LOCATION: West of Chapel/Waite St. intersection
(street address if known)

ALTERNATE DAM NAME:

USGS QUAD.: Paxton and Leicester

LAT.: 42.24900 LONG.: -71.88708

DRAINAGE BASIN: Blackstone

RIVER: Kettle Brook

IMPOUNDMENT NAME(S): Waite Pond

GENERAL DAM INFORMATION

TYPE OF DAM: Earth/ masonry composite

OVERALL LENGTH (FT): 118

PURPOSE OF DAM: Recreation

NORMAL POOL STORAGE (ACRE-FT): 230

YEAR BUILT: 1898

MAXIMUM POOL STORAGE (ACRE-FT): 350

STRUCTURAL HEIGHT (FT): 11

EL. NORMAL POOL (FT): 823.9

HYDRAULIC HEIGHT (FT): 8

EL. MAXIMUM POOL (FT): 826.9

FOR INTERNAL MADCR USE ONLY

FOLLOW-UP INSPECTION REQUIRED: ☐ YES ☐ NO

CONDITIONAL LETTER: ☐ YES ☐ NO

NAME OF DAM: Waite Pond Dam | STATE ID #: 3-14-151-21

INSPECTION DATE: August 8, 2012 | NID ID #: MA00987

INSPECTION SUMMARY

DATE OF INSPECTION: August 8, 2012 | DATE OF PREVIOUS INSPECTION: March 10, 1998

TEMPERATURE/WEATHER: Sunny 84°F | ARMY CORPS PHASE I: ☐ YES ☑ NO | If YES, date

CONSULTANT: Fuss & O'Neill, Inc. | PREVIOUS DCR PHASE I: ☑ YES ☐ NO | If YES, date March 10, 1998

BENCHMARK/DATUM: NGVD27

OVERALL PHYSICAL CONDITION OF DAM: POOR | DATE OF LAST REHABILITATION: 1986

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

EL. POOL DURING INSP.: 821.9 | EL. TAILWATER DURING INSP.: 816.5

PERSONS PRESENT AT INSPECTION

NAME	TITLE/POSITION	REPRESENTING
Christopher J. Cullen, P.E.	Project Manager	Fuss & O'Neill, Inc.

EVALUATION INFORMATION

	Click on box to select E-code		Click on box to select E-code
E1) TYPE OF DESIGN	1	E8) LOW-LEVEL OUTLET CONDITION	2
E2) LEVEL OF MAINTENANCE	2	E9) SPILLWAY DESIGN FLOOD CAPACITY	5
E3) EMERGENCY ACTION PLAN	1	E10) OVERALL PHYSICAL CONDITION	2
E4) EMBANKMENT SEEPAGE	5	E11) ESTIMATED REPAIR COST	NA
E5) EMBANKMENT CONDITION	3	ROADWAY OVER CREST	
E6) CONCRETE CONDITION	1	BRIDGE NEAR DAM	
E7) LOW-LEVEL OUTLET CAPACITY	2		

NAME OF INSPECTING ENGINEER: Christopher J. Cullen, P.E. | SIGNATURE: Chris Cullen

NAME OF DAM:	Waite Pond Dam	STATE ID #:	3-14-151-21
INSPECTION DATE:	August 8, 2012	NID ID #:	MA00987

OWNER:	ORGANIZATION	Town of Leicester	CARETAKER:	ORGANIZATION	Town of Leicester
	NAME/TITLE	Town of Leicester		NAME/TITLE	Town of Leicester
	STREET	3 Washburn Square		STREET	3 Washburn Square
	TOWN, STATE, ZIP	Leicester, MA 01524-1333		TOWN, STATE, ZIP	Leicester, MA 01524-1333
	PHONE	(508) 892-7000		PHONE	(508) 892-7000
	EMERGENCY PH. #	(508) 892-7000		EMERGENCY PH. #	(508) 892-7000
	FAX	(508) 892-7070		FAX	(508) 892-7070
	EMAIL	reedb@leicesterma.org		EMAIL	
	OWNER TYPE	Municipality or Political subdivision			

PRIMARY SPILLWAY TYPE	Broad crest concrete weir with wood weir boards		
SPILLWAY LENGTH (FT)	41	SPILLWAY CAPACITY (CFS)	709
AUXILIARY SPILLWAY TYPE	NA	AUX. SPILLWAY CAPACITY (CFS)	NA
NUMBER OF OUTLETS	1	OUTLET(S) CAPACITY (CFS)	0
TYPE OF OUTLETS	24-inch CMP	TOTAL DISCHARGE CAPACITY (CFS)	709
DRAINAGE AREA (SQ MI)	4.92	SPILLWAY DESIGN FLOOD (PERIOD/CFS)	100 yr./343
HAS DAM BEEN BREACHED OR OVERTOPPED	☐ YES ☑ NO	IF YES, PROVIDE DATE(S)	
FISH LADDER (LIST TYPE IF PRESENT)	N/A		
DOES CREST SUPPORT PUBLIC ROAD?	☐ YES ☑ NO	IF YES, ROAD NAME:	
PUBLIC BRIDGE WITHIN 50' OF DAM?	☐ YES ☑ NO	IF YES, ROAD/BRIDGE NAME:	
		MHD BRIDGE NO. (IF APPLICABLE)	

NAME OF DAM: Waite Pond Dam STATE ID #: 3-14-151-21

INSPECTION DATE: August 8, 2012 NID ID #: MA00987

EMBANKMENT (CREST)

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
CREST	1. SURFACE TYPE	Earth	X		
	2. SURFACE CRACKING	NA	X		
	3. SINKHOLES, ANIMAL BURROWS	Depressions on right crest			X
	4. VERTICAL ALIGNMENT (DEPRESSIONS)	Depressions in crest			X
	5. HORIZONTAL ALIGNMENT	Satisfactory	X		
	6. RUTS AND/OR PUDDLES	Settlement in isolated locations on crest			X
	7. VEGETATION (PRESENCE/CONDITION)	Very sparse vegetation, tree roots on left crest			X
	8. ABUTMENT CONTACT	Good	X		

ADDITIONAL COMMENTS:

NAME OF DAM: Waite Pond Dam STATE ID #: 3-14-151-21

INSPECTION DATE: August 8, 2012 NID ID #: MA00987

EMBANKMENT (D/S SLOPE)

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
D/S SLOPE	1. WET AREAS (NO FLOW)	None observed	X		
	2. SEEPAGE	None observed	X		
	3. SLIDE, SLOUGH, SCARP	None observed	X		
	4. EMB.-ABUTMENT CONTACT	Good	X		
	5. SINKHOLE/ANIMAL BURROWS	None observed	X		
	6. EROSION	None observed	X		
	7. UNUSUAL MOVEMENT	None observed	X		
	8. VEGETATION (PRESENCE/CONDITION)	Right side gravel parking area		X	

ADDITIONAL COMMENTS:

NAME OF DAM: Waite Pond Dam STATE ID #: 3-14-151-21

INSPECTION DATE: August 8, 2012 NID ID #: MA00987

EMBANKMENT (U/S SLOPE)

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
U/S SLOPE	1. SLIDE, SLOUGH, SCARP	NA			
	2. SLOPE PROTECTION TYPE AND COND.	NA			
	3. SINKHOLE/ANIMAL BURROWS	NA			
	4. EMB.-ABUTMENT CONTACT	NA			
	5. EROSION	NA			
	6. UNUSUAL MOVEMENT	NA			
	7. VEGETATION (PRESENCE/CONDITION)	NA			

ADDITIONAL COMMENTS:

NAME OF DAM: Waite Pond Dam STATE ID #: 3-14-151-21

INSPECTION DATE: August 8, 2012 NID ID #: MA00987

INSTRUMENTATION - N/A

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
INSTR.	1. PIEZOMETERS				
	2. OBSERVATION WELLS				
	3. STAFF GAGE AND RECORDER				
	4. WEIRS				
	5. INCLINOMETERS				
	6. SURVEY MONUMENTS				
	7. DRAINS				
	8. FREQUENCY OF READINGS				
	9. LOCATION OF READINGS				

ADDITIONAL COMMENTS:

NAME OF DAM: Waite Pond Dam STATE ID #: 3-14-151-21

INSPECTION DATE: August 8, 2012 NID ID #: MA00987

DOWNSTREAM MASONRY WALLS

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
D/S WALLS	1. WALL TYPE	Dry laid stone right side and left channel wall	X		
	2. WALL ALIGNMENT	Right wall leaning overhanging			X
	3. WALL CONDITION	Right wall leaning slightly, missing stones; left channel wall partially collapsed			X
	4. HEIGHT: TOP OF WALL TO MUDLINE	min: 1' max: 6' avg: 3'	X		
	5. SEEPAGE OR LEAKAGE	None observed	X		
	6. ABUTMENT CONTACT	Satisfactory	X		
	7. EROSION/SINKHOLES BEHIND WALL	Depressions on crest			X
	8. ANIMAL BURROWS	None observed	X		
	9. UNUSUAL MOVEMENT	Right wall leaning outward; left channel wall collapsing			X
	10. WET AREAS AT TOE OF WALL	None observed	X		

ADDITIONAL COMMENTS:

NAME OF DAM: Waite Pond Dam STATE ID #: 3-14-151-21

INSPECTION DATE: August 8, 2012 NID ID #: MA00987

UPSTREAM MASONRY WALLS

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
U/S WALLS	1. WALL TYPE	Concrete covered masonry			
	2. WALL ALIGNMENT	Poor-walls leaning outward toward impoundment			X
	3. WALL CONDITION	Poor- severe undermining, cracking, erosion			X
	4. HEIGHT: TOP OF WALL TO MUDLINE	min: 5' max: 5' avg: 5'	X		
	5. ABUTMENT CONTACT	Satisfactory		X	
	6. EROSION/SINKHOLES BEHIND WALL	Depressions in crest			X
	7. ANIMAL BURROWS	None observed	X		
	8. UNUSUAL MOVEMENT	Walls leaning outward toward the impoundment			X

ADDITIONAL COMMENTS:

NAME OF DAM: Waite Pond Dam STATE ID #: 3-14-151-21

INSPECTION DATE: August 8, 2012 NID ID #: MA00987

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	NA	X		
	5. DRAINAGE SYSTEM	NA	X		
	6. INSTRUMENTATION	NA	X		
	7. VEGETATION	Wooded	X		
	8. ACCESSIBILITY	By foot	X		
	9. DOWNSTREAM HAZARD DESCRIPTION	Wooded downsteam. Box culvert under Chapel Street ~200' downstream	X		
	10. DATE OF LAST EAP UPDATE	NA	X		

ADDITIONAL COMMENTS:

NAME OF DAM: Waite Pond Dam STATE ID #: 3-14-151-21

INSPECTION DATE: August 8, 2012 NID ID #: MA00987

MISCELLANEOUS

AREA INSPECTED	CONDITION	OBSERVATIONS		
MISC.	1. RESERVOIR DEPTH (AVG)	5'		
	2. RESERVOIR SHORELINE	Residential and wooded areas		
	3. RESERVOIR SLOPES	Moderate		
	4. ACCESS ROADS	Dam is located on puiblic road, Chapel Street		
	5. SECURITY DEVICES	None		
	6. VANDALISM OR TRESPASS	☐ YES	☑ NO	WHAT: N/A
	7. AVAILABILITY OF PLANS	☐ YES	☑ NO	DATE: N/A
	8. AVAILABILITY OF DESIGN CALCS	☐ YES	☑ NO	DATE: N/A
	9. AVAILABILITY OF EAP/LAST UPDATE	☐ YES	☑ NO	DATE: N/A
	10. AVAILABILITY OF O&M MANUAL	☐ YES	☑ NO	DATE: N/A
	11. CARETAKER/OWNER AVAILABLE	☑ YES	☐ NO	DATE: 10-Jul-12
	12. CONFINED SPACE ENTRY REQUIRED	☐ YES	☑ NO	PURPOSE: N/A

ADDITIONAL COMMENTS:

NAME OF DAM: Waite Pond Dam STATE ID #: 3-14-151-21

INSPECTION DATE: August 8, 2012 NID ID #: MA00987

PRIMARY SPILLWAY

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
SPILLWAY	SPILLWAY TYPE	Concrete with wood weir boards	X		
	WEIR TYPE	Sharp Crest	X		
	SPILLWAY CONDITION	Fair	X		
	TRAINING WALLS	Concrete - cracked and eroded			X
	SPILLWAY CONTROLS AND CONDITION	Weir boards-satisfactory condition		X	
	UNUSUAL MOVEMENT	None observed	X		
	APPROACH AREA	Clear	X		
	DISCHARGE AREA	Concrete and masonry rubble; concrete breaking up; vegetation growing in channel		X	
	DEBRIS	None observed	X		
	WATER LEVEL AT TIME OF INSPECTION	Approx. 2 feet below top of weir boards	X		

ADDITIONAL COMMENTS:

NAME OF DAM: Waite Pond Dam STATE ID #: 3-14-151-21

INSPECTION DATE: August 8, 2012 NID ID #: MA00987

AUXILIARY SPILLWAY

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
SPILLWAY	SPILLWAY TYPE		X		
	WEIR TYPE		X		
	SPILLWAY CONDITION		X		
	TRAINING WALLS		X		
	SPILLWAY CONTROLS AND CONDITION		X		
	UNUSUAL MOVEMENT		X		
	APPROACH AREA		X		
	DISCHARGE AREA		X		
	DEBRIS		X		
	WATER LEVEL AT TIME OF INSPECTION		X		

ADDITIONAL COMMENTS:

NAME OF DAM: Waite Pond Dam STATE ID #: 3-14-151-21

INSPECTION DATE: August 8, 2012 NID ID #: MA00987

OUTLET WORKS

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
OUTLET WORKS	TYPE	24-inch CMP	X		
	INTAKE STRUCTURE	Masonry structure-leaning, undermined			X
	TRASHRACK	Unknown		X	
	PRIMARY CLOSURE	Slide gate- operability unknown			X
	SECONDARY CLOSURE	NA	X		
	CONDUIT	24-inch CMP	X		
	OUTLET STRUCTURE/HEADWALL	Emerges through rubble in stilling basin		X	
	EROSION ALONG TOE OF DAM	Minimal	X		
	SEEPAGE/LEAKAGE	None observed		X	
	DEBRIS/BLOCKAGE	Outlet pipe 50% sedimented			X
	UNUSUAL MOVEMENT	Gate structure notceably out of plumb			X
	DOWNSTREAM AREA	Stable; some vegetation growing in channel		X	
	MISCELLANEOUS				

ADDITIONAL COMMENTS:

NAME OF DAM: Waite Pond Dam STATE ID #: 3-14-151-21

INSPECTION DATE: August 8, 2012 NID ID #: MA00987

CONCRETE/MASONRY DAMS - N/A

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
GENERAL	TYPE				
	AVAILABILITY OF PLANS				
	AVAILABILITY OF DESIGN CALCS				
	PIEZOMETERS				
	OBSERVATION WELLS				
	INCLINOMETERS				
	SEEPAGE GALLERY				
	UNUSUAL MOVEMENT				

ADDITIONAL COMMENTS:

NAME OF DAM: Waite Pond Dam STATE ID #: 3-14-151-21

INSPECTION DATE: August 8, 2012 NID ID #: MA00987

CONCRETE/MASONRY DAMS (CREST) - N/A

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
CREST	TYPE				
	SURFACE CONDITIONS				
	CONDITIONS OF JOINTS				
	UNUSUAL MOVEMENT				
	HORIZONTAL ALIGNMENT				
	VERTICAL ALIGNMENT				

ADDITIONAL COMMENTS:

NAME OF DAM: Waite Pond Dam STATE ID #: 3-14-151-21

INSPECTION DATE: August 8, 2012 NID ID #: MA00987

CONCRETE/MASONRY DAMS (DOWNSTREAM FACE) - N/A

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
D/S FACE	TYPE				
	SURFACE CONDITIONS				
	CONDITIONS OF JOINTS				
	UNUSUAL MOVEMENT				
	ABUTMENT CONTACT				
	LEAKAGE				

ADDITIONAL COMMENTS:

NAME OF DAM: Waite Pond Dam STATE ID #: 3-14-151-21

INSPECTION DATE: August 8, 2012 NID ID #: MA00987

CONCRETE/MASONRY DAMS (UPSTREAM FACE) - N/A

AREA INSPECTED	CONDITION	OBSERVATIONS	NO ACTION	MONITOR	REPAIR
U/S FACE	TYPE				
	SURFACE CONDITIONS				
	CONDITIONS OF JOINTS				
	UNUSUAL MOVEMENT				
	ABUTMENT CONTACTS				

ADDITIONAL COMMENTS:

APPENDIX C

Previous Reports and References

PREVIOUS REPORTS AND REFERENCES

The following is a list of reports that were located during the file review, or were referenced in previous reports.

1. Waite Pond Dam, Follow-up Inspection reports prepared by Fuss & O'Neill, Inc., dated June, 2009, February 2010, July 2010, January 2011, July 2011, and January 2012.

2. "Phase I Inspection/Evaluation, Waite Pond Dam," performed by Haley & Aldrich, March 10, 1998.

3. "Dam Inspection, Safety, and Repair Report, Waite's Pond Dam," prepared by William F. Fay, P.E., dated November 1986.

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 exist, 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 therefrom, 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 or 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 (and properly documented) 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 failure.

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. One million U.S. gallons = 3.068 acre feet.

Height of Dam (Structural Height) – 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 lowest point on the crest of the dam.

Hydraulic Height – means the height to which water rises behind a dam and the difference between the lowest point in the original streambed at the axis of the dam and the maximum controllable water surface.

Maximum Water Storage Elevation – means the maximum elevation of water surface which can be contained by the dam without overtopping the embankment section.

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.

Maximum Storage Capacity – The volume of water contained in the impoundment at maximum water storage elevation.

Normal Storage Capacity – The volume of water contained in the impoundment at normal water storage elevation.

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.

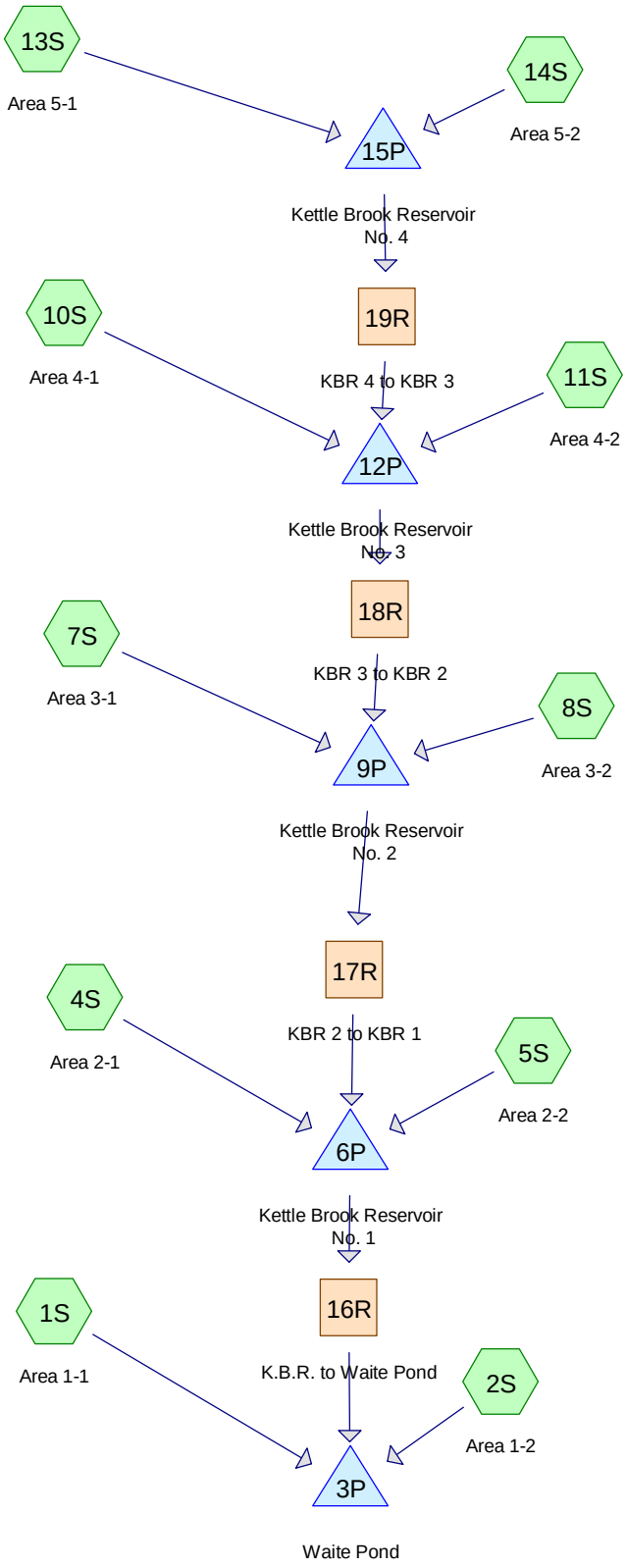
* Structural deficiencies include but are not limited to the following:

- Excessive uncontrolled seepage (e.g., upwelling of water, evidence of fines movement, flowing water, erosion, etc.)
- Missing riprap with resulting erosion of slope
- Sinkholes, particularly behind retaining walls and above outlet pipes, possibly indicating loss of soil due to piping, rather than animal burrows
- Excessive vegetation and tree growth, particularly if it obscures features of the dam and the dam cannot be fully inspected
- Deterioration of concrete structures (e.g., exposed rebar, tilted walls, large cracks with or without seepage, excessive spalling, etc.)
- Inoperable outlets (gates and valves that have not been operated for many years or are broken)

FUSS & O'NEILL

Appendix B

H&H Model Report



Scenario: Weir Boards Installed in Spillway

Subcat Reach Pond Link

Routing Diagram for Waite Pond Dam-Proposed-Weir Boards Installed
Prepared by Fuss & O'Neill, Printed 1/21/2015

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
59.231	68	1 acre lots, 20% imp, HSG B (1S, 13S)
325.752	79	1 acre lots, 20% imp, HSG C (1S, 4S, 7S, 10S, 13S)
39.442	61	Pasture/grassland/range, Good, HSG B (1S, 4S, 7S)
143.407	74	Pasture/grassland/range, Good, HSG C (1S, 4S, 7S, 10S, 13S)
0.937	80	Pasture/grassland/range, Good, HSG D (4S)
53.901	98	Water Surface, 0% imp, HSG C (2S)
209.378	98	Water Surface, HSG C (4S, 5S, 8S, 11S, 14S)
521.770	55	Woods, Good, HSG B (1S, 4S, 7S, 10S, 13S)
1,619.398	70	Woods, Good, HSG C (1S, 4S, 7S, 10S, 13S)
154.550	77	Woods, Good, HSG D (1S, 4S, 7S, 10S, 13S)
3,127.766	**71**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
620.443	HSG B	1S, 4S, 7S, 10S, 13S
2,351.836	HSG C	1S, 2S, 4S, 5S, 7S, 8S, 10S, 11S, 13S, 14S
155.487	HSG D	1S, 4S, 7S, 10S, 13S
0.000	Other	
3,127.766		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	59.231	325.752	0.000	0.000	384.983	1 acre lots, 20% imp	1S, 4S, 7S, 10S, 13S
0.000	39.442	143.407	0.937	0.000	183.786	Pasture/grassland/range, Good	1S, 4S, 7S, 10S, 13S
0.000	0.000	209.378	0.000	0.000	209.378	Water Surface	4S, 5S, 8S, 11S, 14S
0.000	0.000	53.901	0.000	0.000	53.901	Water Surface, 0% imp	2S
0.000	521.770	1,619.398	154.550	0.000	2,295.718	Woods, Good	1S, 4S, 7S, 10S, 13S
0.000	**620.443**	**2,351.836**	**155.487**	**0.000**	**3,127.766**	**TOTAL AREA**	

Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Area 1-1 Runoff Area=411.454 ac 5.72% Impervious Runoff Depth>3.06"
Flow Length=4,785' Slope=0.0525 '/' Tc=66.5 min CN=69 Runoff=551.38 cfs 104.898 af

Subcatchment 2S: Area 1-2 Runoff Area=53.901 ac 0.00% Impervious Runoff Depth>6.26"
Flow Length=2,500' Tc=3.3 min CN=98 Runoff=378.29 cfs 28.113 af

Subcatchment 4S: Area 2-1 Runoff Area=667.890 ac 0.63% Impervious Runoff Depth>2.84"
Flow Length=6,024' Slope=0.0383 '/' Tc=98.7 min CN=67 Runoff=637.60 cfs 158.068 af

Subcatchment 5S: Area 2-2 Runoff Area=11.658 ac 100.00% Impervious Runoff Depth>6.26"
Flow Length=1,540' Tc=2.0 min CN=98 Runoff=85.72 cfs 6.082 af

Subcatchment 7S: Area 3-1 Runoff Area=286.135 ac 0.35% Impervious Runoff Depth>2.57"
Flow Length=4,084' Slope=0.0394 '/' Tc=77.1 min CN=64 Runoff=288.43 cfs 61.364 af

Subcatchment 8S: Area 3-2 Runoff Area=31.267 ac 100.00% Impervious Runoff Depth>6.26"
Flow Length=2,160' Tc=2.8 min CN=98 Runoff=223.51 cfs 16.309 af

Subcatchment 10S: Area 4-1 Runoff Area=459.666 ac 0.86% Impervious Runoff Depth>3.06"
Flow Length=3,334' Slope=0.0280 '/' Tc=68.2 min CN=69 Runoff=606.08 cfs 117.138 af

Subcatchment 11S: Area 4-2 Runoff Area=39.207 ac 100.00% Impervious Runoff Depth>6.26"
Flow Length=3,700' Tc=4.9 min CN=98 Runoff=259.79 cfs 20.445 af

Subcatchment 13S: Area 5-1 Runoff Area=1,042.248 ac 4.53% Impervious Runoff Depth>3.01"
Flow Length=8,740' Slope=0.0118 '/' Tc=221.2 min CN=70 Runoff=629.06 cfs 261.248 af

Subcatchment 14S: Area 5-2 Runoff Area=124.340 ac 100.00% Impervious Runoff Depth>6.26"
Flow Length=4,326' Tc=5.7 min CN=98 Runoff=801.12 cfs 64.830 af

Reach 16R: K.B.R. to Waite Pond Avg. Flow Depth=3.53' Max Vel=3.44 fps Inflow=614.30 cfs 367.453 af
n=0.070 L=1,620.0' S=0.0100 '/' Capacity=3,087.40 cfs Outflow=612.16 cfs 360.683 af

Reach 17R: KBR 2 to KBR 1 Avg. Flow Depth=2.07' Max Vel=5.45 fps Inflow=276.29 cfs 232.803 af
n=0.050 L=5,320.0' S=0.0240 '/' Capacity=11,169.75 cfs Outflow=275.93 cfs 221.898 af

Reach 18R: KBR 3 to KBR 2 Avg. Flow Depth=2.43' Max Vel=4.22 fps Inflow=227.49 cfs 202.299 af
n=0.050 L=2,060.0' S=0.0113 '/' Capacity=5,794.51 cfs Outflow=227.48 cfs 197.546 af

Reach 19R: KBR 4 to KBR 3 Inflow=189.32 cfs 134.029 af
Outflow=189.32 cfs 134.029 af

Pond 3P: Waite Pond Peak Elev=823.11' Storage=214.749 af Inflow=811.80 cfs 493.694 af
Outflow=438.70 cfs 296.465 af

Pond 6P: Kettle Brook Reservoir No. 1 Peak Elev=852.95' Storage=34.232 af Inflow=721.36 cfs 386.048 af
Outflow=614.30 cfs 367.453 af

Pond 9P: Kettle Brook Reservoir No. 2 Peak Elev=996.46' Storage=47.203 af Inflow=397.49 cfs 275.218 af
Outflow=276.29 cfs 232.803 af

Pond 12P: Kettle Brook Reservoir No. 3 Peak Elev=1,041.75' Storage=73.767 af Inflow=648.86 cfs 271.612 af
Outflow=227.49 cfs 202.299 af

Pond 15P: Kettle Brook Reservoir No. 4 Peak Elev=1,088.80' Storage=213.882 af Inflow=830.65 cfs 326.079 af
Outflow=189.32 cfs 134.029 af

Total Runoff Area = 3,127.766 ac Runoff Volume = 838.494 af Average Runoff Depth = 3.22"
90.84% Pervious = 2,841.391 ac 9.16% Impervious = 286.375 ac

Summary for Subcatchment 1S: Area 1-1

Overland runoff to Waite Pond.

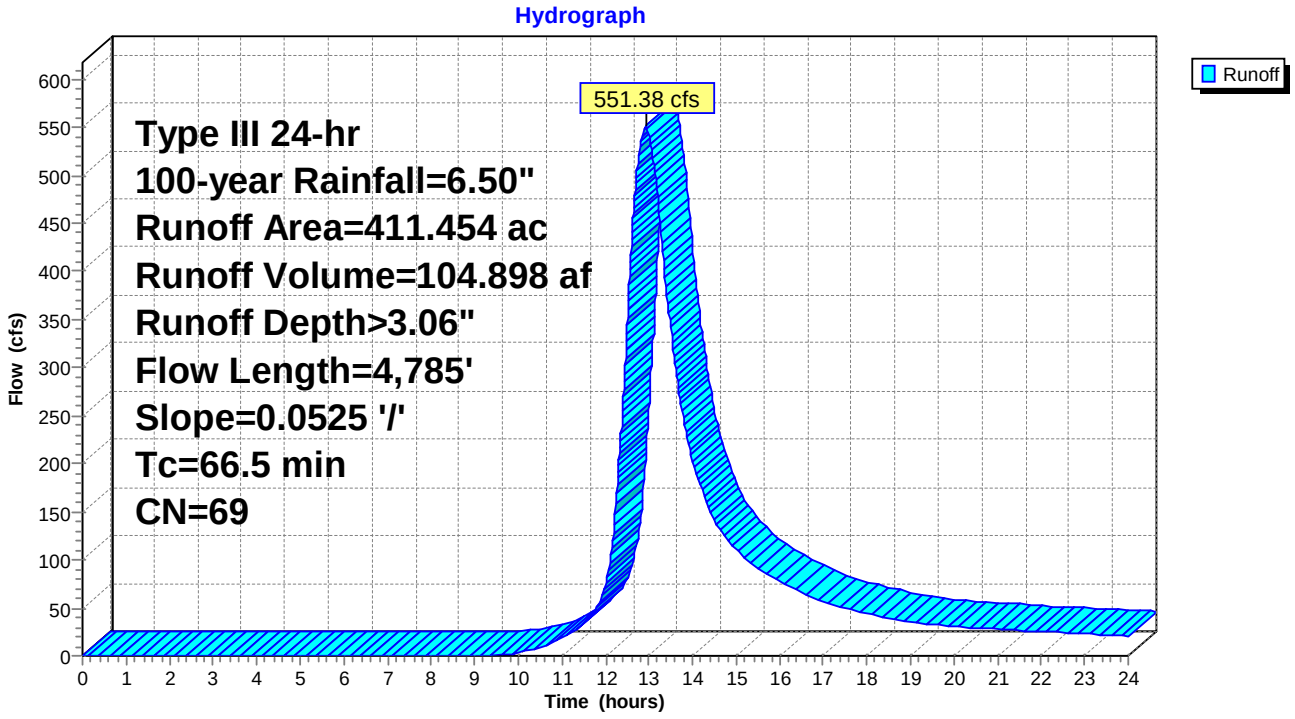
Runoff = 551.38 cfs @ 12.93 hrs, Volume= 104.898 af, Depth> 3.06"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year Rainfall=6.50"

Area (ac)	CN	Description
49.447	68	1 acre lots, 20% imp, HSG B
13.446	61	Pasture/grassland/range, Good, HSG B
70.642	55	Woods, Good, HSG B
68.149	79	1 acre lots, 20% imp, HSG C
4.689	74	Pasture/grassland/range, Good, HSG C
170.963	70	Woods, Good, HSG C
34.118	77	Woods, Good, HSG D
411.454	69	Weighted Average
387.935		94.28% Pervious Area
23.519		5.72% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
66.5	4,785	0.0525	1.20		**Lag/CN Method,**

Subcatchment 1S: Area 1-1



Summary for Subcatchment 2S: Area 1-2

Direct precipitation to Waite Pond.

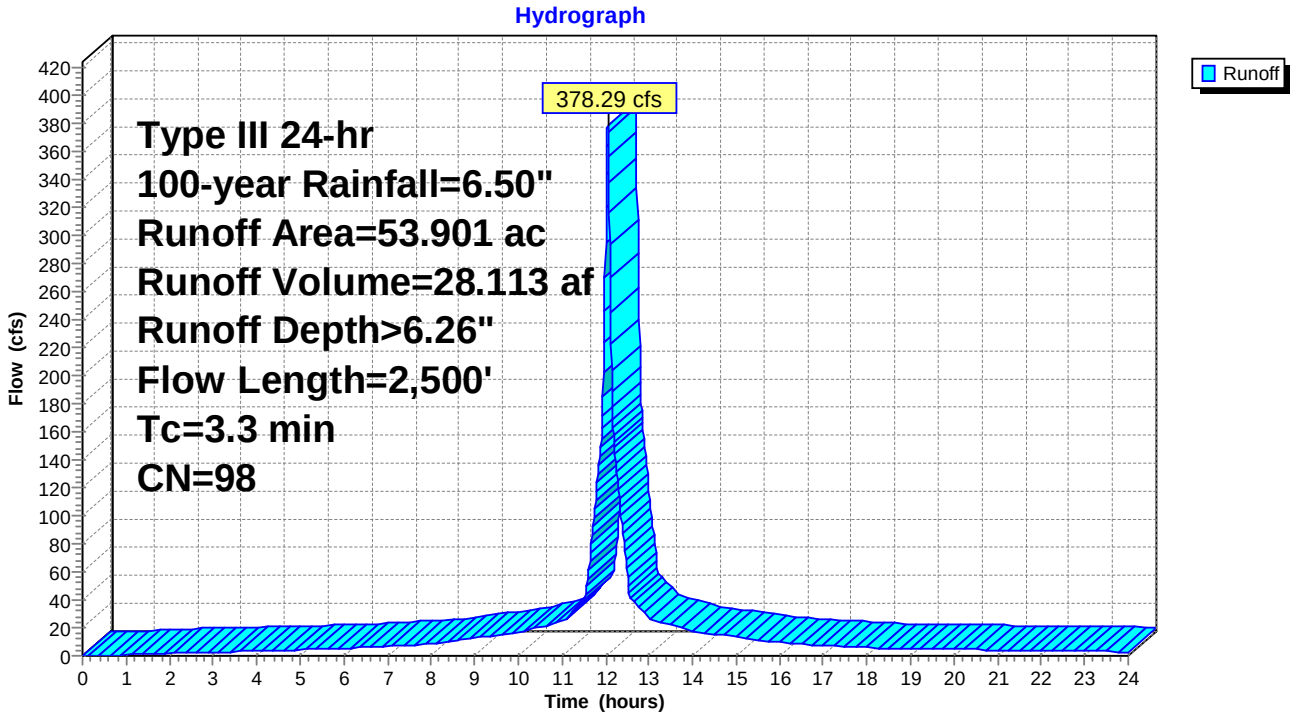
Runoff = 378.29 cfs @ 12.05 hrs, Volume= 28.113 af, Depth> 6.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year Rainfall=6.50"

Area (ac)	CN	Description
53.901	98	Water Surface, 0% imp, HSG C
53.901		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.3	2,500		12.69		**Lake or Reservoir, Estimated travel time through Waite Pond.** Mean Depth= 5.00'

Subcatchment 2S: Area 1-2



Summary for Subcatchment 4S: Area 2-1

Overland runoff to Kettle Brook Reservoir No. 1.

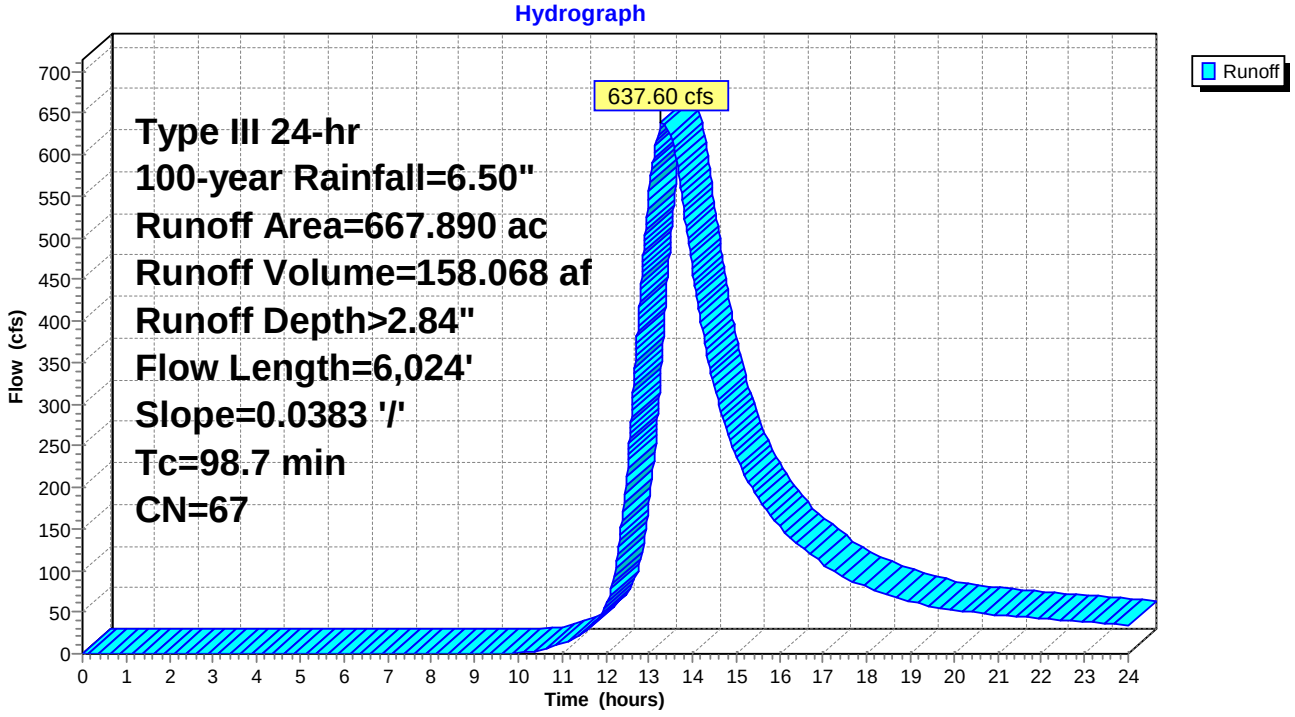
Runoff = 637.60 cfs @ 13.28 hrs, Volume= 158.068 af, Depth> 2.84"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year Rainfall=6.50"

Area (ac)	CN	Description
6.557	79	1 acre lots, 20% imp, HSG C
23.867	61	Pasture/grassland/range, Good, HSG B
95.923	74	Pasture/grassland/range, Good, HSG C
0.937	80	Pasture/grassland/range, Good, HSG D
152.437	55	Woods, Good, HSG B
348.095	70	Woods, Good, HSG C
37.168	77	Woods, Good, HSG D
2.906	98	Water Surface, HSG C
667.890	67	Weighted Average
663.673		99.37% Pervious Area
4.217		0.63% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
98.7	6,024	0.0383	1.02		**Lag/CN Method,**

Subcatchment 4S: Area 2-1



Summary for Subcatchment 5S: Area 2-2

Direct precipitation to Kettle Brook Reservoir No. 1.

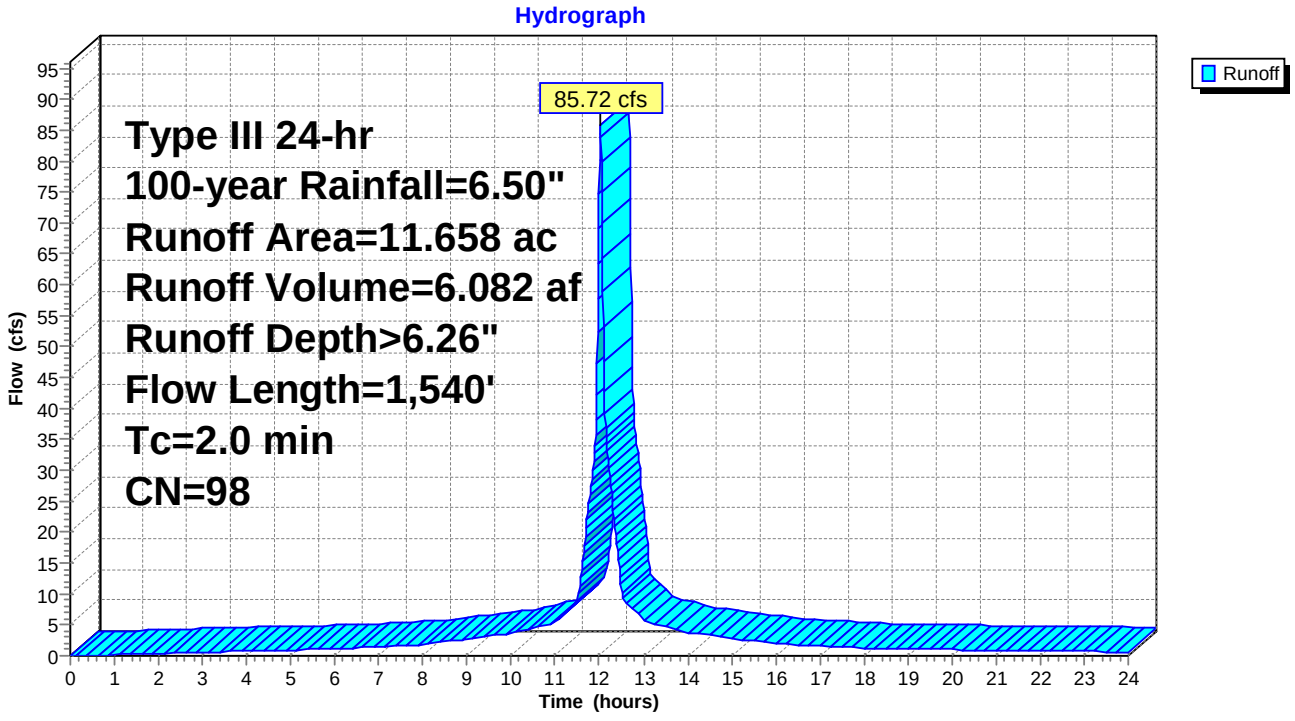
Runoff = 85.72 cfs @ 12.03 hrs, Volume= 6.082 af, Depth> 6.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year Rainfall=6.50"

Area (ac)	CN	Description
11.658	98	Water Surface, HSG C
11.658		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.0	1,540		12.69		**Lake or Reservoir,** Mean Depth= 5.00'

Subcatchment 5S: Area 2-2



Summary for Subcatchment 7S: Area 3-1

Overland runoff to Kettle Brook Reservoir No. 2.

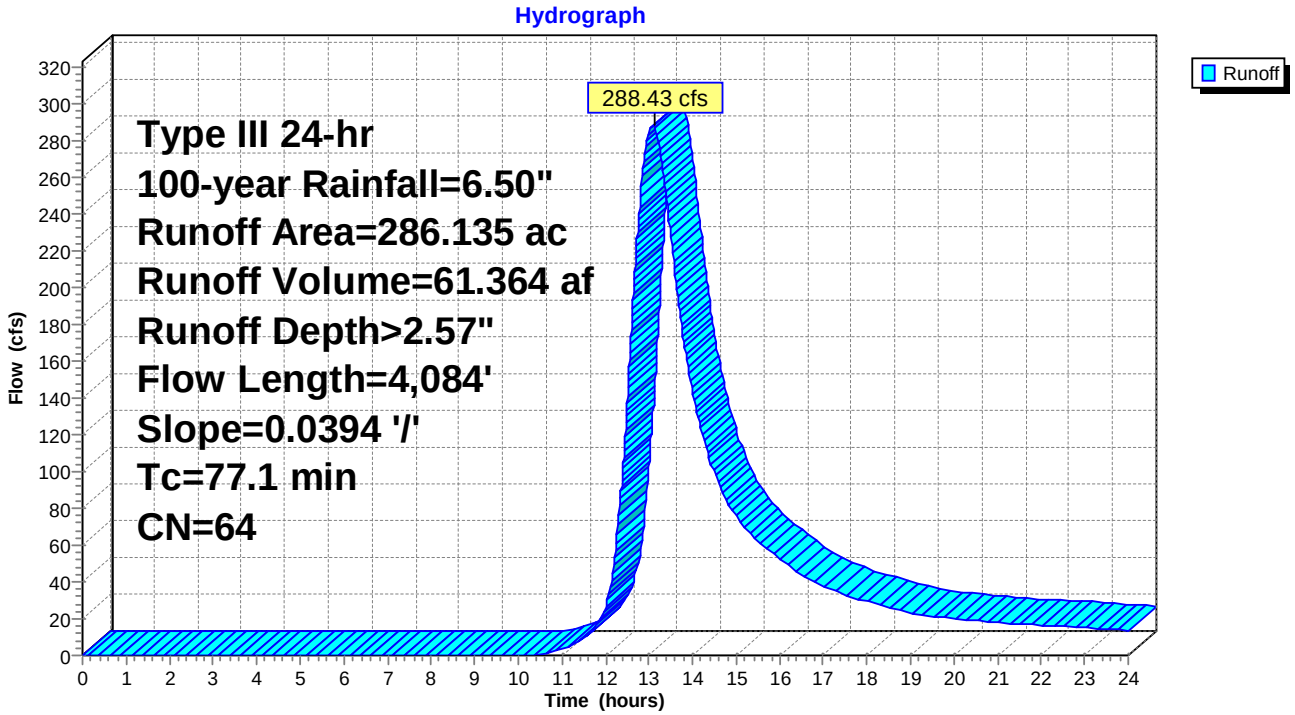
Runoff = 288.43 cfs @ 13.10 hrs, Volume= 61.364 af, Depth> 2.57"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year Rainfall=6.50"

Area (ac)	CN	Description
5.050	79	1 acre lots, 20% imp, HSG C
2.129	61	Pasture/grassland/range, Good, HSG B
14.941	74	Pasture/grassland/range, Good, HSG C
115.991	55	Woods, Good, HSG B
139.035	70	Woods, Good, HSG C
8.989	77	Woods, Good, HSG D
286.135	64	Weighted Average
285.125		99.65% Pervious Area
1.010		0.35% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
77.1	4,084	0.0394	0.88		**Lag/CN Method,**

Subcatchment 7S: Area 3-1



Summary for Subcatchment 8S: Area 3-2

Direct precipitation to Kettle Brook Reservoir No. 2.

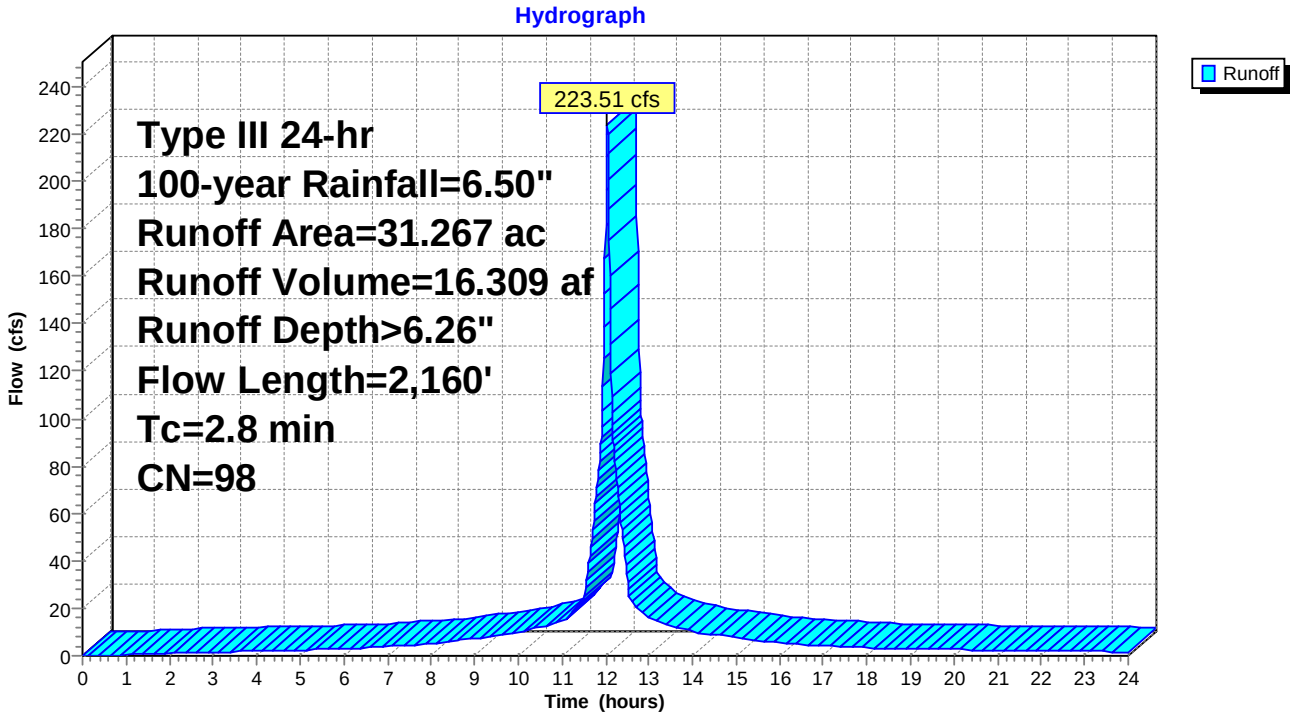
Runoff = 223.51 cfs @ 12.04 hrs, Volume= 16.309 af, Depth> 6.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year Rainfall=6.50"

Area (ac)	CN	Description
31.267	98	Water Surface, HSG C
31.267		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.8	2,160		12.69		**Lake or Reservoir,** Mean Depth= 5.00'

Subcatchment 8S: Area 3-2



Summary for Subcatchment 10S: Area 4-1

Overland runoff to Kettle Brook Reservoir No. 3.

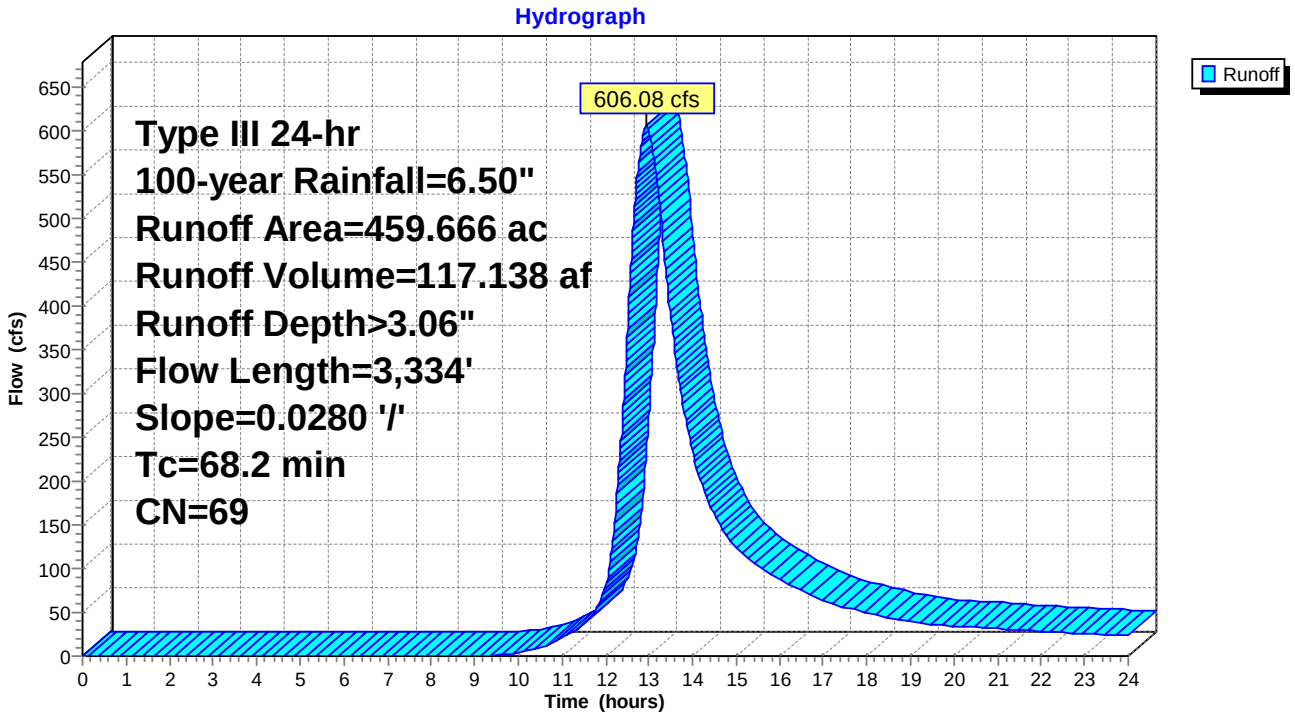
Runoff = 606.08 cfs @ 12.96 hrs, Volume= 117.138 af, Depth> 3.06"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year Rainfall=6.50"

Area (ac)	CN	Description
19.759	79	1 acre lots, 20% imp, HSG C
7.916	74	Pasture/grassland/range, Good, HSG C
48.751	55	Woods, Good, HSG B
367.701	70	Woods, Good, HSG C
15.539	77	Woods, Good, HSG D
459.666	69	Weighted Average
455.714		99.14% Pervious Area
3.952		0.86% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
68.2	3,334	0.0280	0.81		**Lag/CN Method,**

Subcatchment 10S: Area 4-1



Summary for Subcatchment 11S: Area 4-2

Direct precipitation to Kettle Brook Reservoir No. 3.

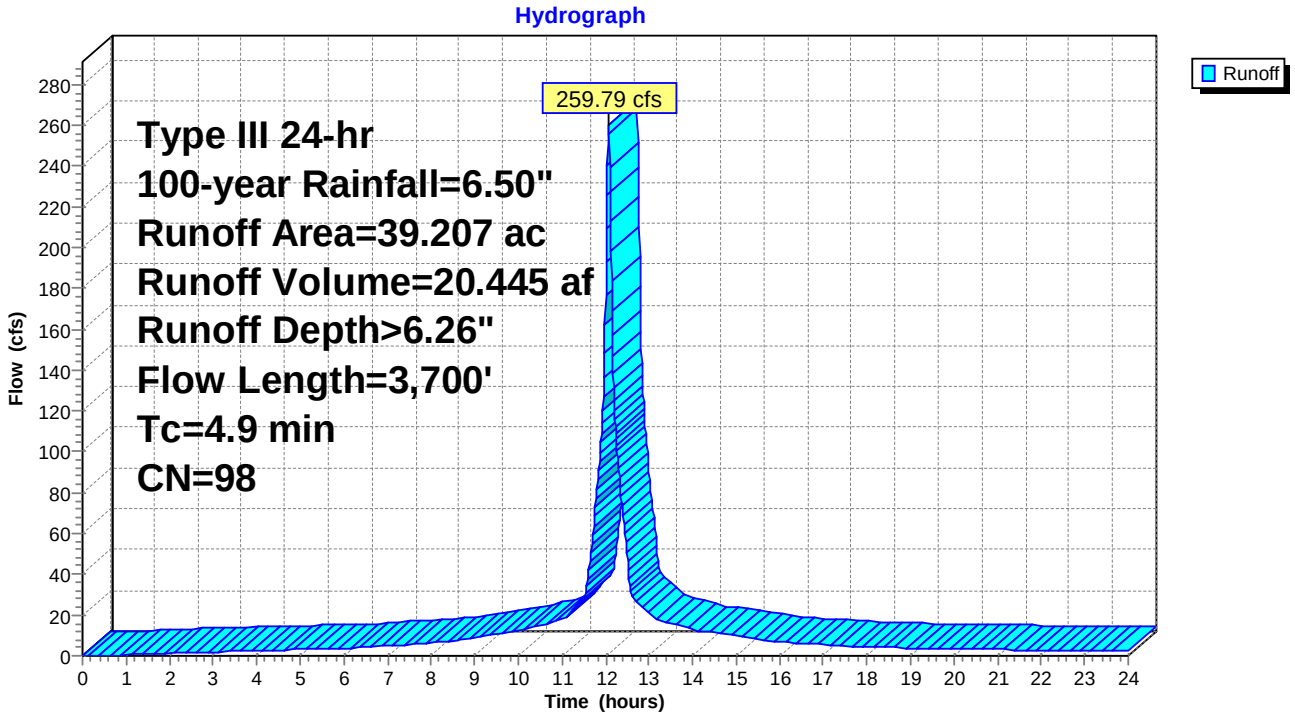
Runoff = 259.79 cfs @ 12.07 hrs, Volume= 20.445 af, Depth> 6.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year Rainfall=6.50"

Area (ac)	CN	Description
39.207	98	Water Surface, HSG C
39.207		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.9	3,700		12.69		**Lake or Reservoir,** Mean Depth= 5.00'

Subcatchment 11S: Area 4-2



Summary for Subcatchment 13S: Area 5-1

Overland runoff to Kettle Brook Reservoir No. 4.

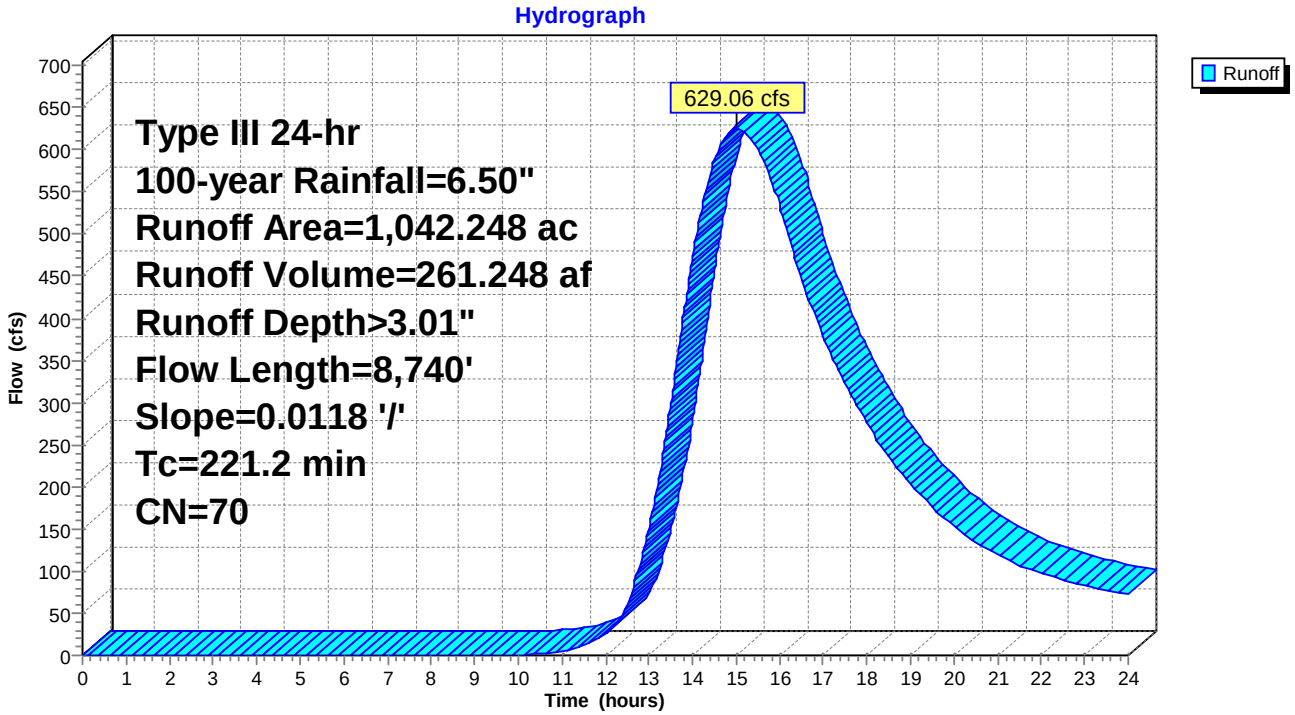
Runoff = 629.06 cfs @ 14.99 hrs, Volume= 261.248 af, Depth> 3.01"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year Rainfall=6.50"

Area (ac)	CN	Description
9.784	68	1 acre lots, 20% imp, HSG B
226.237	79	1 acre lots, 20% imp, HSG C
19.938	74	Pasture/grassland/range, Good, HSG C
133.949	55	Woods, Good, HSG B
593.604	70	Woods, Good, HSG C
58.736	77	Woods, Good, HSG D
1,042.248	70	Weighted Average
995.044		95.47% Pervious Area
47.204		4.53% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
221.2	8,740	0.0118	0.66		**Lag/CN Method,**

Subcatchment 13S: Area 5-1



Summary for Subcatchment 14S: Area 5-2

Direct precipitation to Kettle Brook Reservoir No. 4.

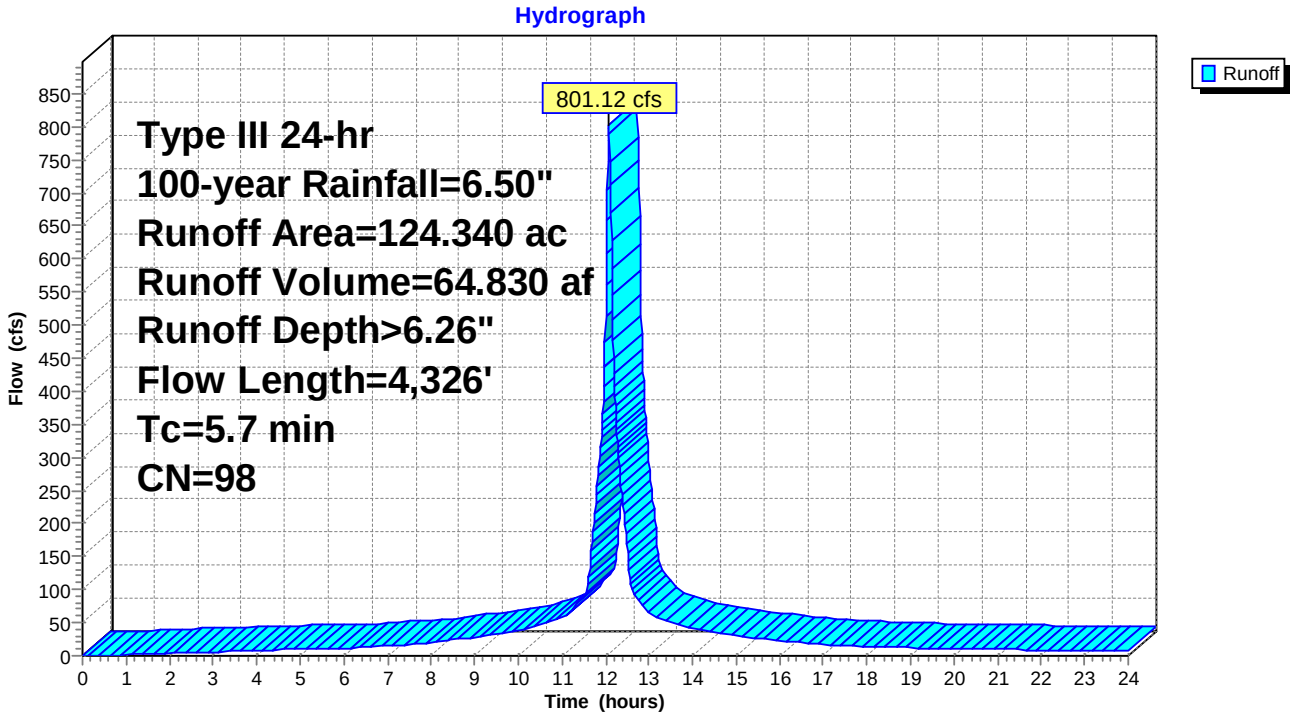
Runoff = 801.12 cfs @ 12.08 hrs, Volume= 64.830 af, Depth> 6.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year Rainfall=6.50"

Area (ac)	CN	Description
124.340	98	Water Surface, HSG C
124.340		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.7	4,326		12.69		**Lake or Reservoir,** Mean Depth= 5.00'

Subcatchment 14S: Area 5-2



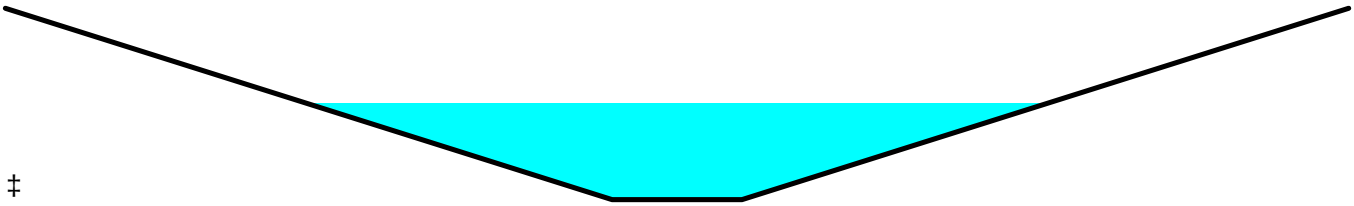
Summary for Reach 16R: K.B.R. to Waite Pond

Inflow Area = 2,662.411 ac, 9.87% Impervious, Inflow Depth > 1.66" for 100-year event
Inflow = 614.30 cfs @ 14.06 hrs, Volume= 367.453 af
Outflow = 612.16 cfs @ 14.30 hrs, Volume= 360.683 af, Atten= 0%, Lag= 14.5 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.44 fps, Min. Travel Time= 7.8 min
Avg. Velocity = 1.81 fps, Avg. Travel Time= 14.9 min

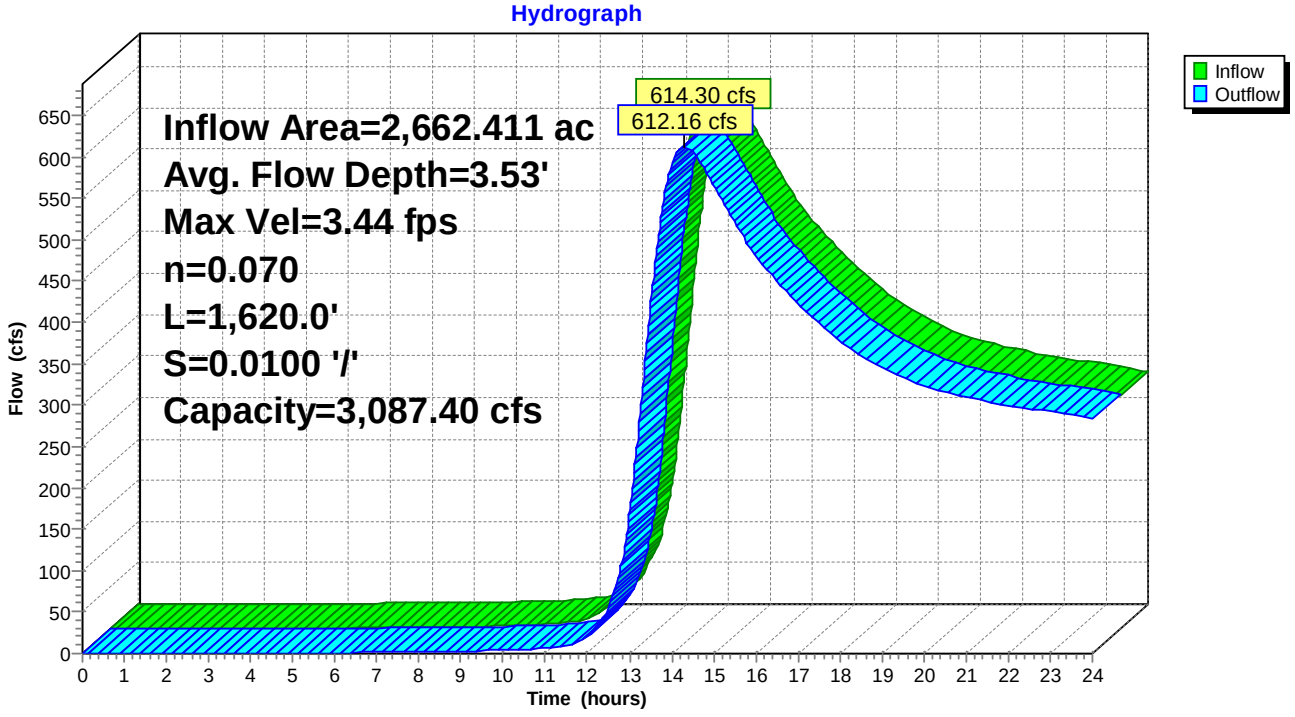
Peak Storage= 287,899 cf @ 14.17 hrs
Average Depth at Peak Storage= 3.53'
Bank-Full Depth= 7.00' Flow Area= 595.0 sf, Capacity= 3,087.40 cfs

15.00' x 7.00' deep channel, n= 0.070 Sluggish weedy reaches w/pools
Side Slope Z-value= 10.0 '/' Top Width= 155.00'
Length= 1,620.0' Slope= 0.0100 '/'
Inlet Invert= 838.00', Outlet Invert= 821.80'



‡

Reach 16R: K.B.R. to Waite Pond



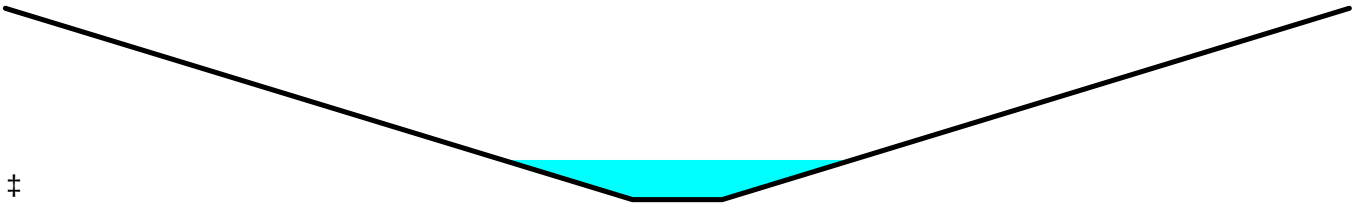
Summary for Reach 17R: KBR 2 to KBR 1

Inflow Area = 1,982.863 ac, 12.46% Impervious, Inflow Depth > 1.41" for 100-year event
Inflow = 276.29 cfs @ 15.85 hrs, Volume= 232.803 af
Outflow = 275.93 cfs @ 16.35 hrs, Volume= 221.898 af, Atten= 0%, Lag= 30.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Max. Velocity= 5.45 fps, Min. Travel Time= 16.3 min
Avg. Velocity = 3.22 fps, Avg. Travel Time= 27.6 min

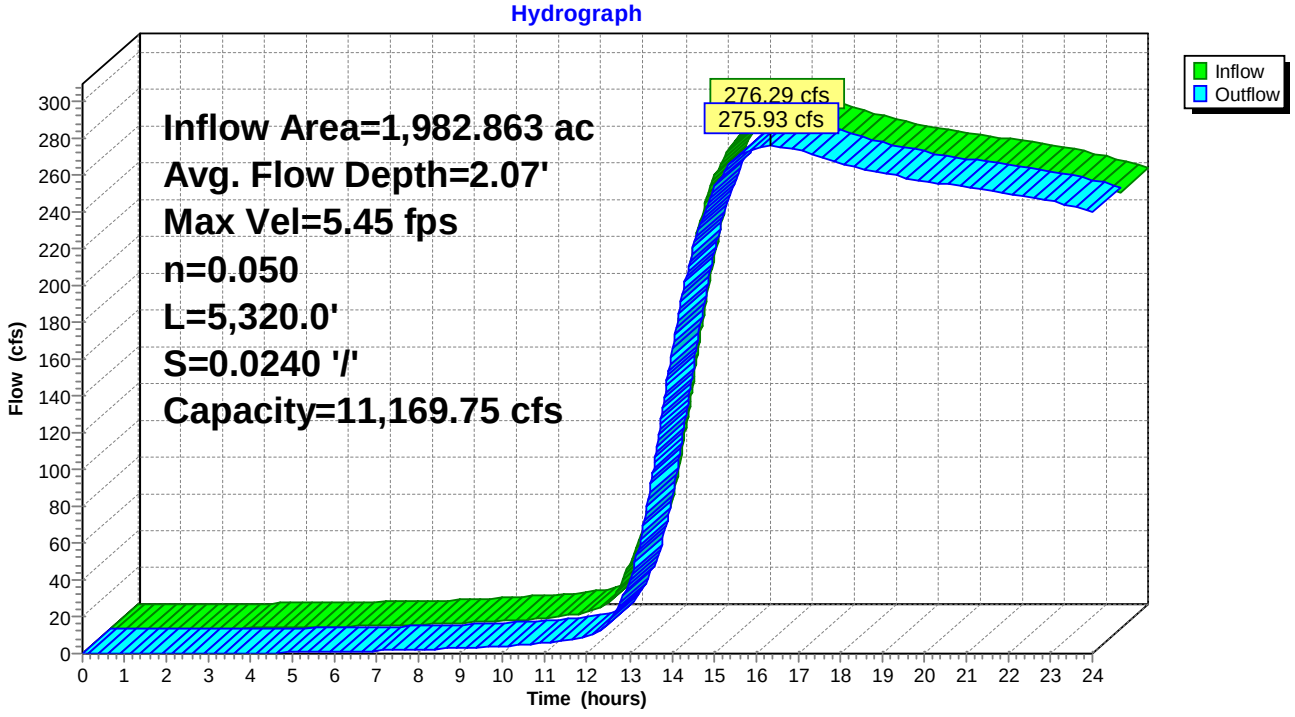
Peak Storage= 269,143 cf @ 16.08 hrs
Average Depth at Peak Storage= 2.07'
Bank-Full Depth= 10.00' Flow Area= 800.0 sf, Capacity= 11,169.75 cfs

10.00' x 10.00' deep channel, n= 0.050
Side Slope Z-value= 7.0 '/' Top Width= 150.00'
Length= 5,320.0' Slope= 0.0240 '/'
Inlet Invert= 979.00', Outlet Invert= 851.40'



‡

Reach 17R: KBR 2 to KBR 1



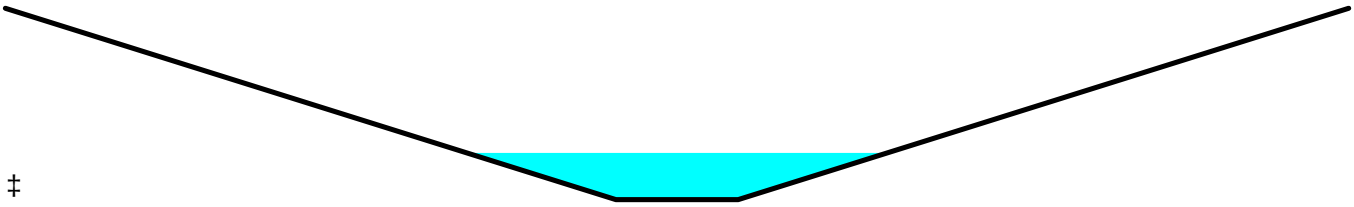
Summary for Reach 18R: KBR 3 to KBR 2

Inflow Area = 1,665.461 ac, 12.89% Impervious, Inflow Depth > 1.46" for 100-year event
Inflow = 227.49 cfs @ 19.87 hrs, Volume= 202.299 af
Outflow = 227.48 cfs @ 20.11 hrs, Volume= 197.546 af, Atten= 0%, Lag= 14.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Max. Velocity= 4.22 fps, Min. Travel Time= 8.1 min
Avg. Velocity = 2.50 fps, Avg. Travel Time= 13.7 min

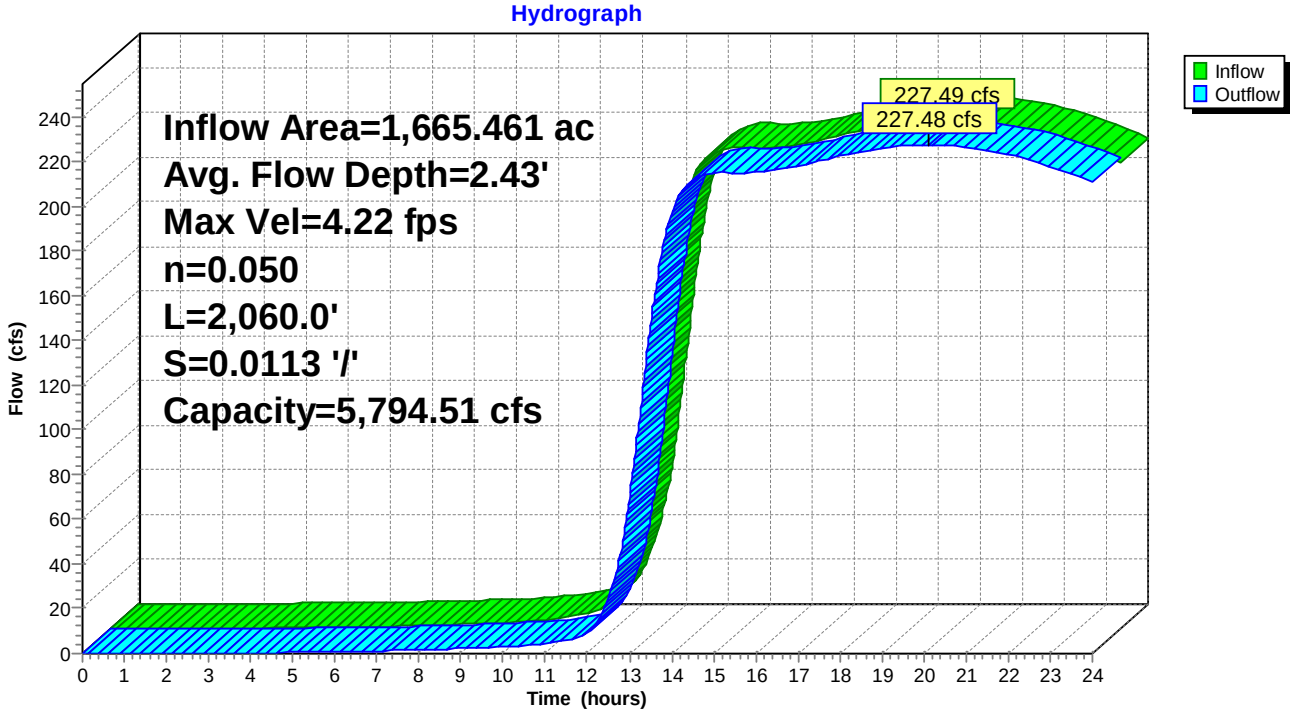
Peak Storage= 110,991 cf @ 19.97 hrs
Average Depth at Peak Storage= 2.43'
Bank-Full Depth= 10.00' Flow Area= 600.0 sf, Capacity= 5,794.51 cfs

10.00' x 10.00' deep channel, n= 0.050
Side Slope Z-value= 5.0 '/' Top Width= 110.00'
Length= 2,060.0' Slope= 0.0113 '/'
Inlet Invert= 1,014.00', Outlet Invert= 990.80'



‡

Reach 18R: KBR 3 to KBR 2



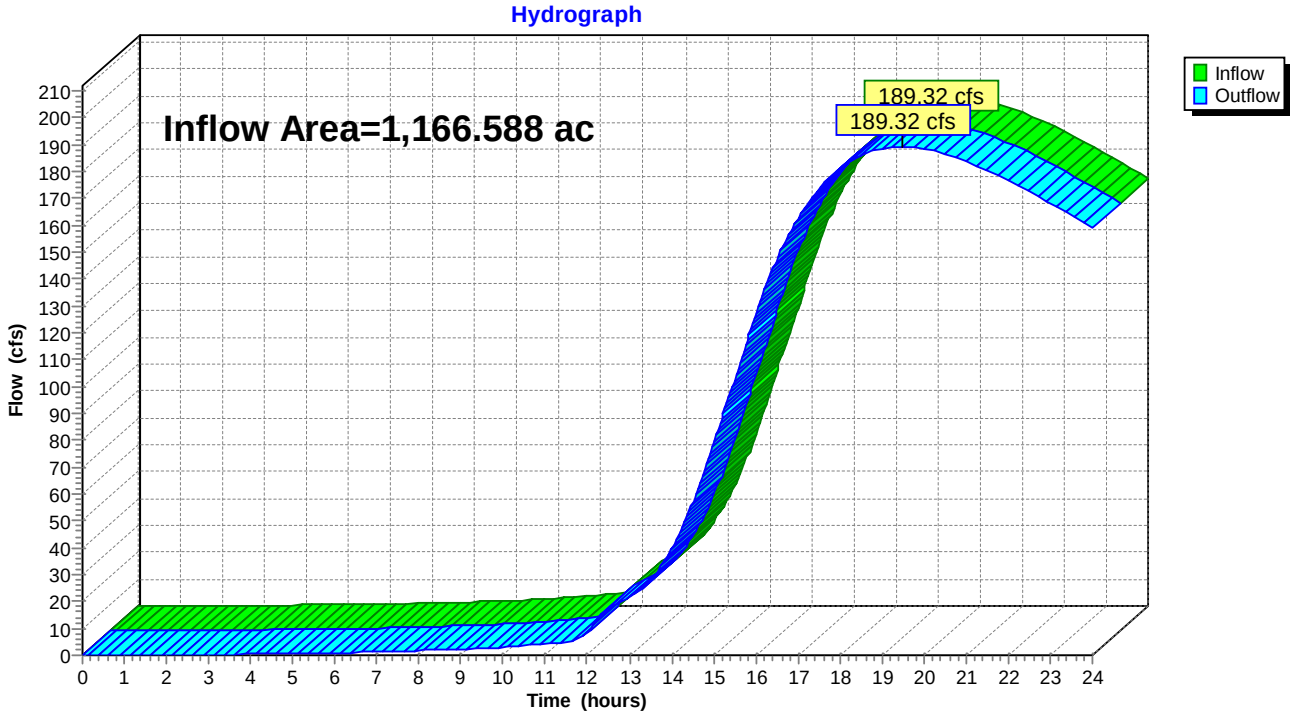
Summary for Reach 19R: KBR 4 to KBR 3

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 1,166.588 ac, 14.70% Impervious, Inflow Depth > 1.38" for 100-year event
Inflow = 189.32 cfs @ 19.47 hrs, Volume= 134.029 af
Outflow = 189.32 cfs @ 19.47 hrs, Volume= 134.029 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Reach 19R: KBR 4 to KBR 3



Summary for Pond 3P: Waite Pond

[61] Hint: Exceeded Reach 16R outlet invert by 1.31' @ 17.79 hrs

Inflow Area = 3,127.766 ac, 9.16% Impervious, Inflow Depth > 1.89" for 100-year event
Inflow = 811.80 cfs @ 13.95 hrs, Volume= 493.694 af
Outflow = 438.70 cfs @ 17.79 hrs, Volume= 296.465 af, Atten= 46%, Lag= 230.4 min
Primary = 438.70 cfs @ 17.79 hrs, Volume= 296.465 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 823.11' @ 17.79 hrs Surf.Area= 56.860 ac Storage= 214.749 af

Plug-Flow detention time= 296.5 min calculated for 296.465 af (60% of inflow)
Center-of-Mass det. time= 149.6 min (1,156.7 - 1,007.1)

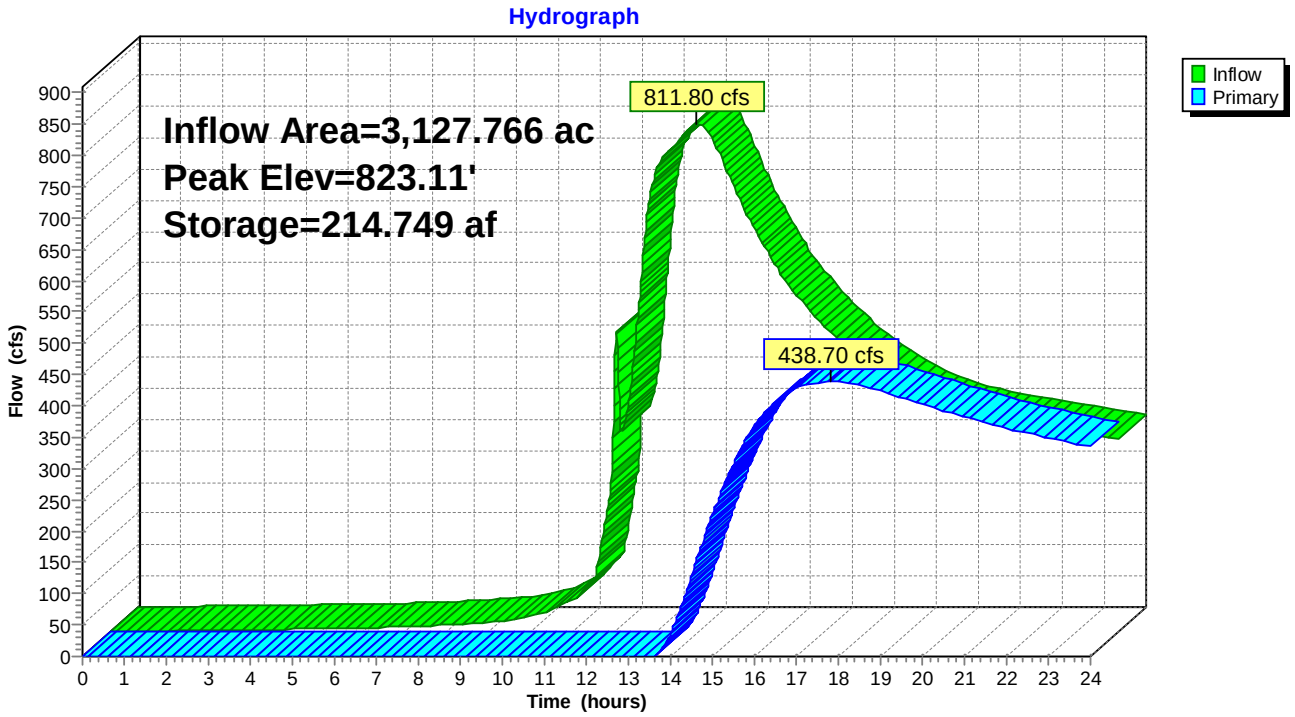
Volume	Invert	Avail.Storage	Storage Description
#1	819.23'	2,648.447 af	**Custom Stage Data (Conic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)	Wet.Area (acres)
819.23	53.901	0.000	0.000	53.901
826.80	59.750	429.979	429.979	59.830
836.60	115.614	844.361	1,274.340	115.715
846.40	166.350	1,374.107	2,648.447	166.489

Device	Routing	Invert	Outlet Devices
#1	Primary	821.11'	**42.0' long Primary Spillway w/ Weir Boards** 0 End Contraction(s) 1.9' Crest Height
#2	Primary	823.50'	**44.0' long x 25.0' breadth Right Embankment Crest** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63
#3	Primary	823.50'	**36.0' long x 25.0' breadth Left Embankment Crest** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=437.83 cfs @ 17.79 hrs HW=823.11' (Free Discharge)
- **1=Primary Spillway w/ Weir Boards** (Weir Controls 437.83 cfs @ 5.22 fps)
- **2=Right Embankment Crest** (Controls 0.00 cfs)
- **3=Left Embankment Crest** (Controls 0.00 cfs)

Pond 3P: Waite Pond



Summary for Pond 6P: Kettle Brook Reservoir No. 1

[61] Hint: Exceeded Reach 17R outlet invert by 1.55' @ 14.06 hrs

Inflow Area = 2,662.411 ac, 9.87% Impervious, Inflow Depth > 1.74" for 100-year event
Inflow = 721.36 cfs @ 13.49 hrs, Volume= 386.048 af
Outflow = 614.30 cfs @ 14.06 hrs, Volume= 367.453 af, Atten= 15%, Lag= 34.5 min
Primary = 614.30 cfs @ 14.06 hrs, Volume= 367.453 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 852.95' @ 14.06 hrs Surf.Area= 17.746 ac Storage= 34.232 af

Plug-Flow detention time= 44.0 min calculated for 367.453 af (95% of inflow)
Center-of-Mass det. time= 24.5 min (1,054.2 - 1,029.7)

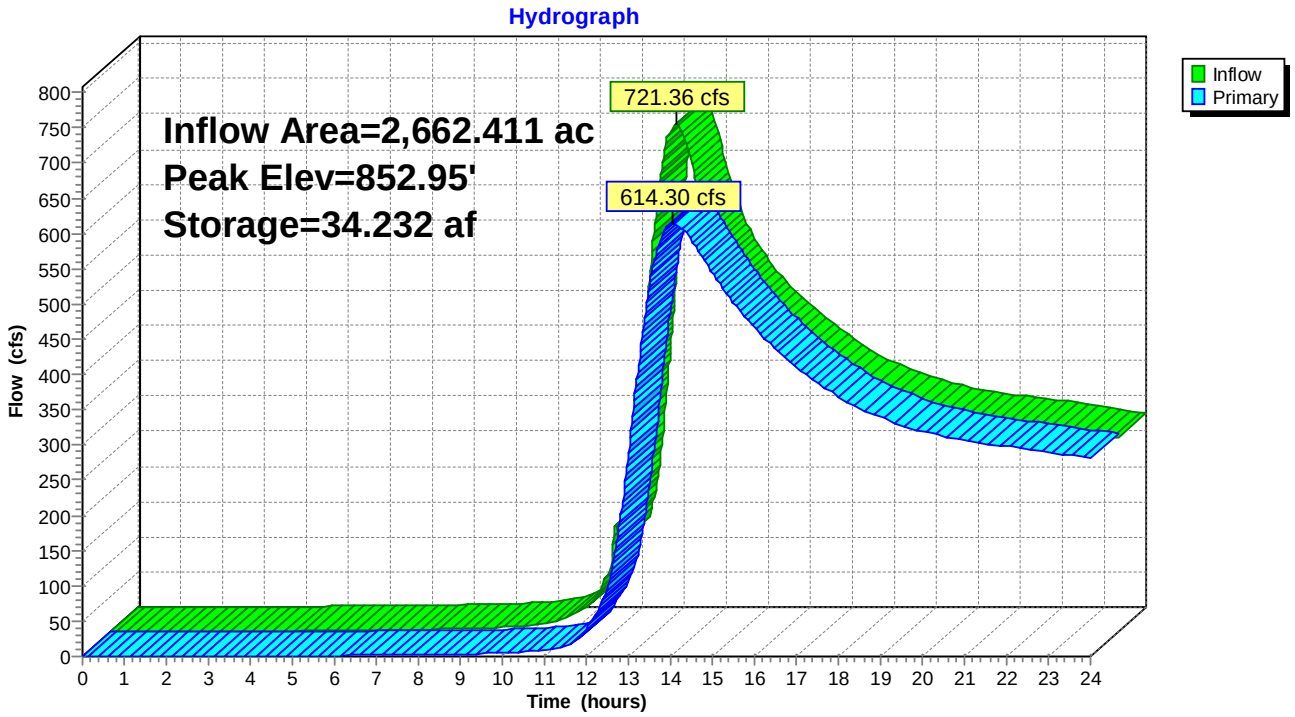
Volume	Invert	Avail.Storage	Storage Description
#1	850.60'	476.839 af	**Custom Stage Data (Conic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)	Wet.Area (acres)
850.60	11.658	0.000	0.000	11.658
856.30	28.670	111.359	111.359	28.675
866.10	46.643	365.480	476.839	46.677

Device	Routing	Invert	Outlet Devices
#1	Primary	850.60'	**45.0' long x 2.0' breadth Primary Spillway** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 Coef. (English) 3.80 3.80 3.80 3.80 3.80 3.80 3.80 3.80 3.80 3.80 3.80 3.80 3.80
#2	Primary	855.00'	**580.0' long x 25.0' breadth Dam Embankment Crest** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=614.18 cfs @ 14.06 hrs HW=852.95' (Free Discharge)
└**1=Primary Spillway** (Weir Controls 614.18 cfs @ 5.82 fps)
└**2=Dam Embankment Crest** (Controls 0.00 cfs)

Pond 6P: Kettle Brook Reservoir No. 1



Summary for Pond 9P: Kettle Brook Reservoir No. 2

[62] Hint: Exceeded Reach 18R OUTLET depth by 4.20' @ 1.03 hrs

Inflow Area = 1,982.863 ac, 12.46% Impervious, Inflow Depth > 1.67" for 100-year event
Inflow = 397.49 cfs @ 13.28 hrs, Volume= 275.218 af
Outflow = 276.29 cfs @ 15.85 hrs, Volume= 232.803 af, Atten= 30%, Lag= 154.0 min
Primary = 276.29 cfs @ 15.85 hrs, Volume= 232.803 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 996.46' @ 15.85 hrs Surf.Area= 33.243 ac Storage= 47.203 af

Plug-Flow detention time= 118.9 min calculated for 232.706 af (85% of inflow)
Center-of-Mass det. time= 58.9 min (1,103.6 - 1,044.7)

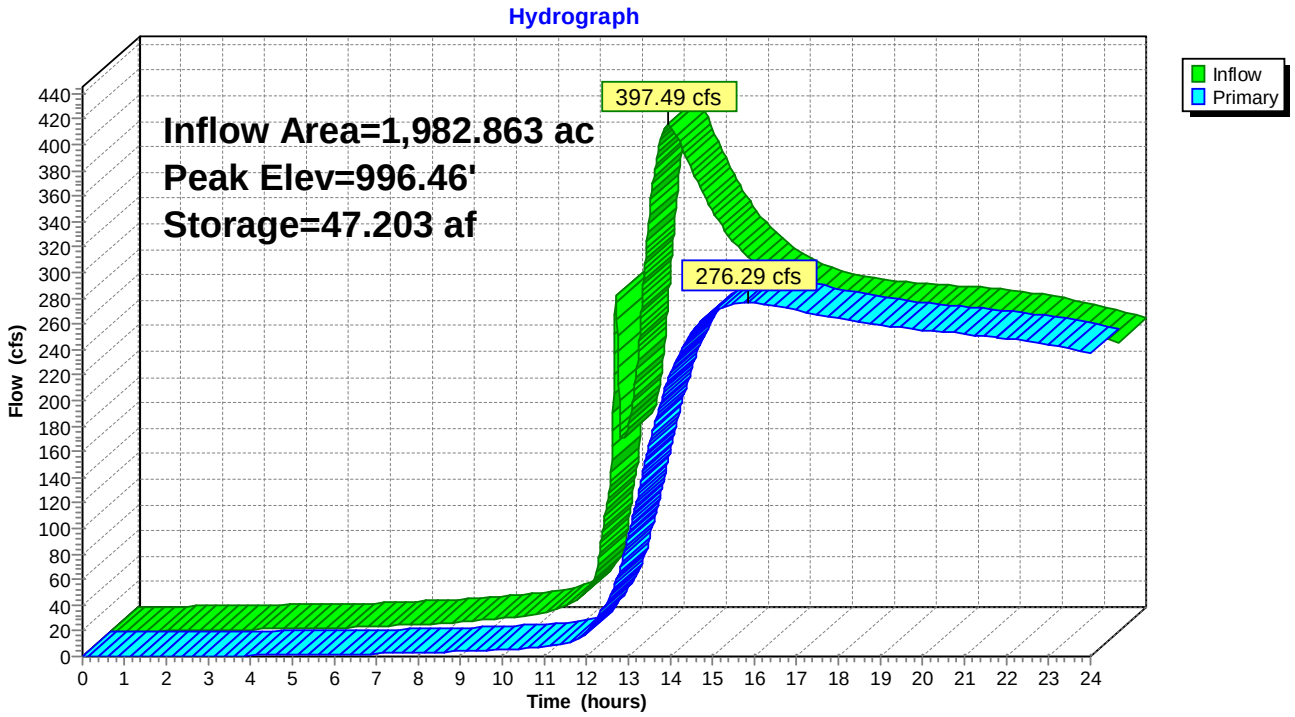
Volume	Invert	Avail.Storage	Storage Description
#1	995.00'	1,660.546 af	**Custom Stage Data (Conic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)	Wet.Area (acres)
995.00	31.267	0.000	0.000	31.267
1,003.90	44.217	334.244	334.244	44.250
1,013.80	68.192	552.157	886.401	68.258
1,023.60	90.314	774.146	1,660.546	90.429

Device	Routing	Invert	Outlet Devices
#1	Primary	995.00'	**41.0' long x 2.0' breadth Primary Spillway** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 Coef. (English) 3.80 3.80 3.80 3.80 3.80 3.80 3.80 3.80 3.80 3.80 3.80 3.80 3.80
#2	Primary	1,000.00'	**600.0' long x 15.0' breadth Dam Embankment Crest** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=275.89 cfs @ 15.85 hrs HW=996.46' (Free Discharge)
└**1=Primary Spillway** (Weir Controls 275.89 cfs @ 4.60 fps)
└**2=Dam Embankment Crest** (Controls 0.00 cfs)

Pond 9P: Kettle Brook Reservoir No. 2



Summary for Pond 12P: Kettle Brook Reservoir No. 3

Inflow Area = 1,665.461 ac, 12.89% Impervious, Inflow Depth > 1.96" for 100-year event
Inflow = 648.86 cfs @ 12.96 hrs, Volume= 271.612 af
Outflow = 227.49 cfs @ 19.87 hrs, Volume= 202.299 af, Atten= 65%, Lag= 414.8 min
Primary = 227.49 cfs @ 19.87 hrs, Volume= 202.299 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 1,041.75' @ 19.87 hrs Surf.Area= 45.036 ac Storage= 73.767 af

Plug-Flow detention time= 203.0 min calculated for 202.299 af (74% of inflow)
Center-of-Mass det. time= 97.8 min (1,105.3 - 1,007.6)

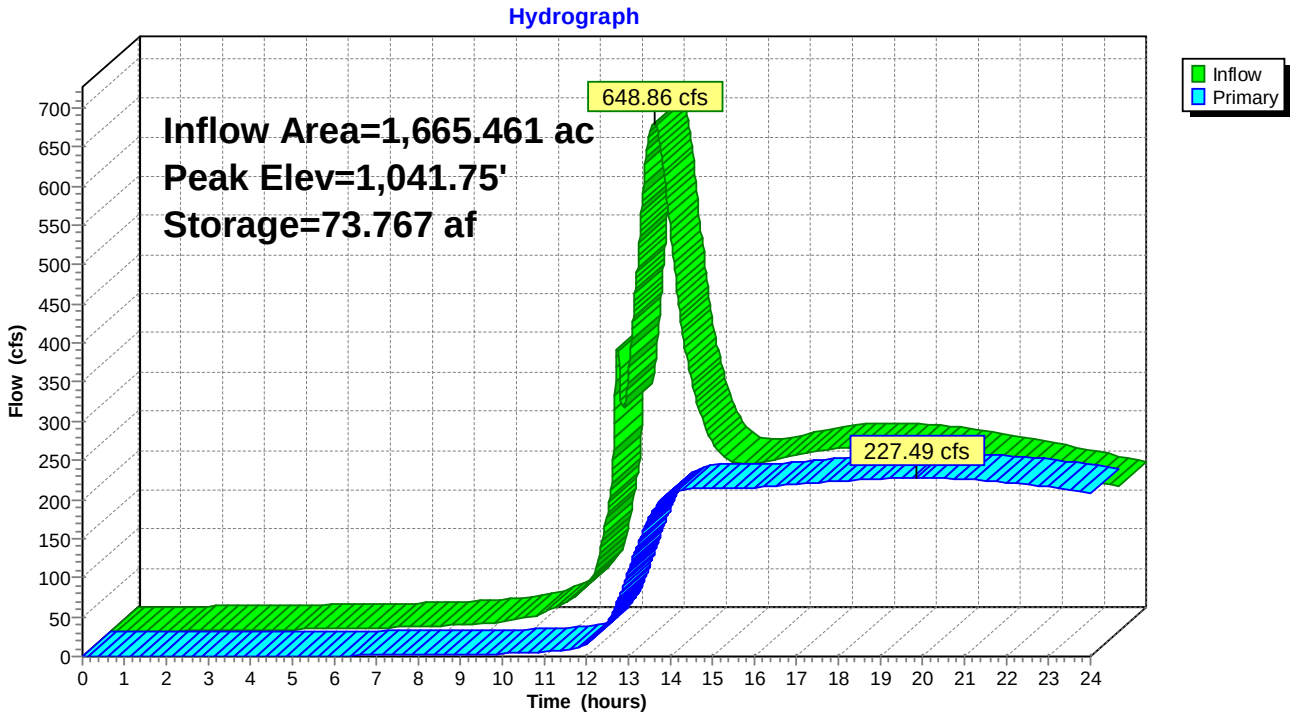
Volume	Invert	Avail.Storage	Storage Description
#1	1,040.00'	2,031.123 af	**Custom Stage Data (Conic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)	Wet.Area (acres)
1,040.00	39.207	0.000	0.000	39.207
1,043.30	50.517	147.651	147.651	50.523
1,053.10	97.200	711.448	859.099	97.228
1,063.00	140.922	1,172.024	2,031.123	140.988

Device	Routing	Invert	Outlet Devices
#1	Primary	1,040.00'	**34.0' long x 2.0' breadth Primary Spillway** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 Coef. (English) 2.54 2.61 2.61 2.60 2.66 2.70 2.77 2.89 2.88 2.85 3.07 3.20 3.32
#2	Primary	1,044.60'	**329.0' long x 15.0' breadth Dam Embankment Crest** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=227.40 cfs @ 19.87 hrs HW=1,041.75' (Free Discharge)
└**1=Primary Spillway** (Weir Controls 227.40 cfs @ 3.82 fps)
└**2=Dam Embankment Crest** (Controls 0.00 cfs)

Pond 12P: Kettle Brook Reservoir No. 3



Summary for Pond 15P: Kettle Brook Reservoir No. 4

Inflow Area = 1,166.588 ac, 14.70% Impervious, Inflow Depth > 3.35" for 100-year event
Inflow = 830.65 cfs @ 12.08 hrs, Volume= 326.079 af
Outflow = 189.32 cfs @ 19.47 hrs, Volume= 134.029 af, Atten= 77%, Lag= 443.2 min
Primary = 189.32 cfs @ 19.47 hrs, Volume= 134.029 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 1,088.80' @ 19.47 hrs Surf.Area= 128.987 ac Storage= 213.882 af

Plug-Flow detention time= 380.8 min calculated for 133.973 af (41% of inflow)
Center-of-Mass det. time= 207.0 min (1,155.3 - 948.3)

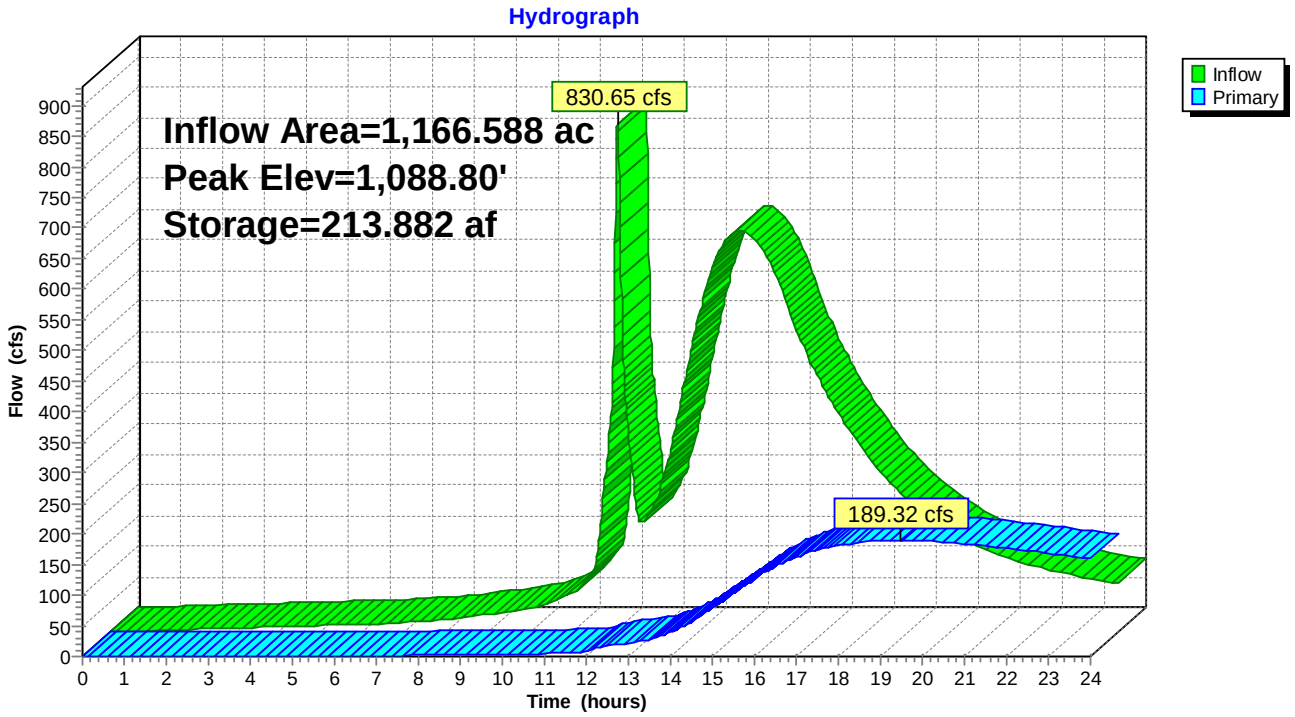
Volume	Invert	Avail.Storage	Storage Description
#1	1,087.11'	4,375.774 af	**Custom Stage Data (Conic)** Listed below (Recalc)

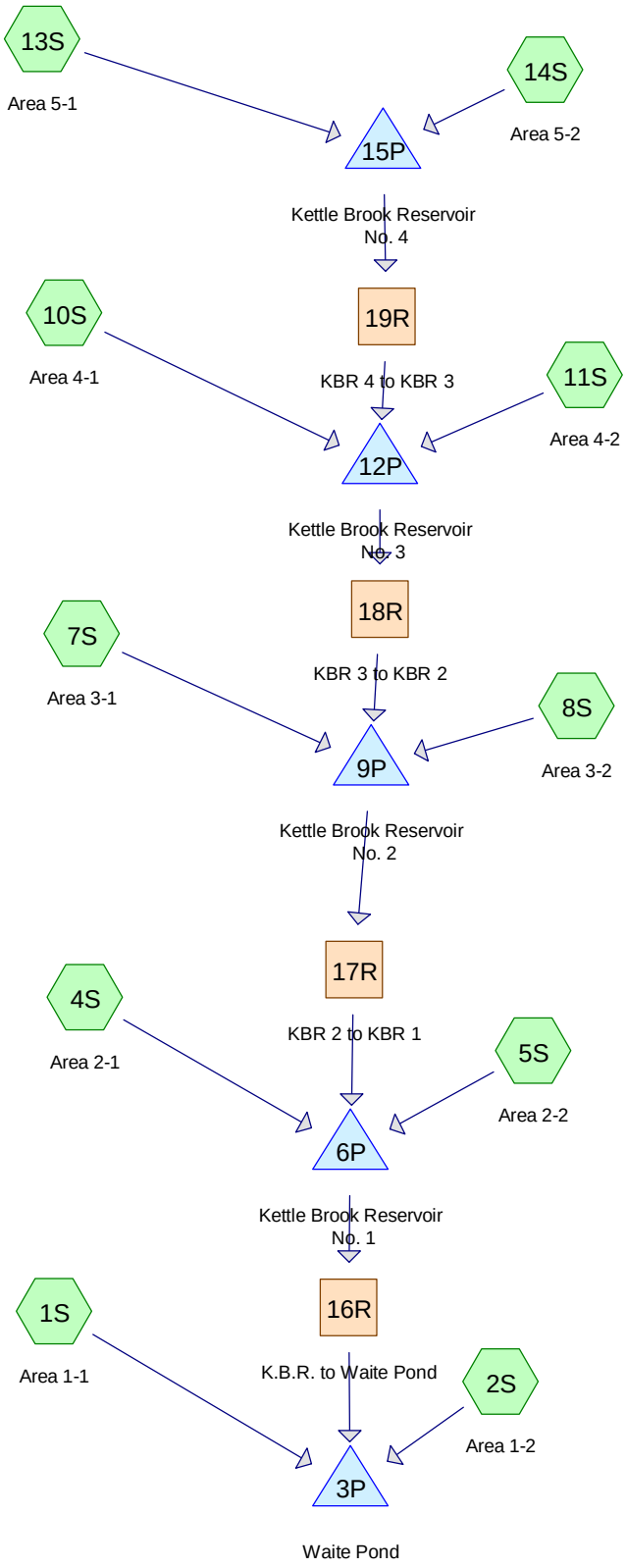
Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)	Wet.Area (acres)
1,087.11	124.340	0.000	0.000	124.340
1,092.50	139.470	710.578	710.578	139.506
1,102.30	181.000	1,565.889	2,276.467	181.090
1,112.20	244.700	2,099.307	4,375.774	244.837

Device	Routing	Invert	Outlet Devices
#1	Primary	1,087.11'	**30.0' long x 2.0' breadth Primary Spillway** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 Coef. (English) 2.54 2.61 2.61 2.60 2.66 2.70 2.77 2.89 2.88 2.85 3.07 3.20 3.32
#2	Primary	1,091.12'	**1,100.0' long x 15.0' breadth Dam Embankment Crest** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=189.96 cfs @ 19.47 hrs HW=1,088.80' (Free Discharge)
1=Primary Spillway (Weir Controls 189.96 cfs @ 3.75 fps)
2=Dam Embankment Crest (Controls 0.00 cfs)

Pond 15P: Kettle Brook Reservoir No. 4





Scenario: Weir Boards Removed from Spillway

Subcat Reach Pond Link

Routing Diagram for Waite Pond Dam-Proposed-No Weir Boards
Prepared by Fuss & O'Neill, Printed 1/21/2015

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
59.231	68	1 acre lots, 20% imp, HSG B (1S, 13S)
325.752	79	1 acre lots, 20% imp, HSG C (1S, 4S, 7S, 10S, 13S)
39.442	61	Pasture/grassland/range, Good, HSG B (1S, 4S, 7S)
143.407	74	Pasture/grassland/range, Good, HSG C (1S, 4S, 7S, 10S, 13S)
0.937	80	Pasture/grassland/range, Good, HSG D (4S)
53.901	98	Water Surface, 0% imp, HSG C (2S)
209.378	98	Water Surface, HSG C (4S, 5S, 8S, 11S, 14S)
521.770	55	Woods, Good, HSG B (1S, 4S, 7S, 10S, 13S)
1,619.398	70	Woods, Good, HSG C (1S, 4S, 7S, 10S, 13S)
154.550	77	Woods, Good, HSG D (1S, 4S, 7S, 10S, 13S)
3,127.766	**71**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
620.443	HSG B	1S, 4S, 7S, 10S, 13S
2,351.836	HSG C	1S, 2S, 4S, 5S, 7S, 8S, 10S, 11S, 13S, 14S
155.487	HSG D	1S, 4S, 7S, 10S, 13S
0.000	Other	
3,127.766		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	59.231	325.752	0.000	0.000	384.983	1 acre lots, 20% imp	1S, 4S, 7S, 10S, 13S
0.000	39.442	143.407	0.937	0.000	183.786	Pasture/grassland/range, Good	1S, 4S, 7S, 10S, 13S
0.000	0.000	209.378	0.000	0.000	209.378	Water Surface	4S, 5S, 8S, 11S, 14S
0.000	0.000	53.901	0.000	0.000	53.901	Water Surface, 0% imp	2S
0.000	521.770	1,619.398	154.550	0.000	2,295.718	Woods, Good	1S, 4S, 7S, 10S, 13S
0.000	**620.443**	**2,351.836**	**155.487**	**0.000**	**3,127.766**	**TOTAL AREA**	

Time span=0.00-24.00 hrs, dt=0.01 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Area 1-1 Runoff Area=411.454 ac 5.72% Impervious Runoff Depth>3.06"
Flow Length=4,785' Slope=0.0525 '/' Tc=66.5 min CN=69 Runoff=551.38 cfs 104.898 af

Subcatchment 2S: Area 1-2 Runoff Area=53.901 ac 0.00% Impervious Runoff Depth>6.26"
Flow Length=2,500' Tc=3.3 min CN=98 Runoff=378.29 cfs 28.113 af

Subcatchment 4S: Area 2-1 Runoff Area=667.890 ac 0.63% Impervious Runoff Depth>2.84"
Flow Length=6,024' Slope=0.0383 '/' Tc=98.7 min CN=67 Runoff=637.60 cfs 158.068 af

Subcatchment 5S: Area 2-2 Runoff Area=11.658 ac 100.00% Impervious Runoff Depth>6.26"
Flow Length=1,540' Tc=2.0 min CN=98 Runoff=85.72 cfs 6.082 af

Subcatchment 7S: Area 3-1 Runoff Area=286.135 ac 0.35% Impervious Runoff Depth>2.57"
Flow Length=4,084' Slope=0.0394 '/' Tc=77.1 min CN=64 Runoff=288.43 cfs 61.364 af

Subcatchment 8S: Area 3-2 Runoff Area=31.267 ac 100.00% Impervious Runoff Depth>6.26"
Flow Length=2,160' Tc=2.8 min CN=98 Runoff=223.51 cfs 16.309 af

Subcatchment 10S: Area 4-1 Runoff Area=459.666 ac 0.86% Impervious Runoff Depth>3.06"
Flow Length=3,334' Slope=0.0280 '/' Tc=68.2 min CN=69 Runoff=606.08 cfs 117.138 af

Subcatchment 11S: Area 4-2 Runoff Area=39.207 ac 100.00% Impervious Runoff Depth>6.26"
Flow Length=3,700' Tc=4.9 min CN=98 Runoff=259.79 cfs 20.445 af

Subcatchment 13S: Area 5-1 Runoff Area=1,042.248 ac 4.53% Impervious Runoff Depth>3.01"
Flow Length=8,740' Slope=0.0118 '/' Tc=221.2 min CN=70 Runoff=629.06 cfs 261.248 af

Subcatchment 14S: Area 5-2 Runoff Area=124.340 ac 100.00% Impervious Runoff Depth>6.26"
Flow Length=4,326' Tc=5.7 min CN=98 Runoff=801.12 cfs 64.830 af

Reach 16R: K.B.R. to Waite Pond Avg. Flow Depth=3.53' Max Vel=3.44 fps Inflow=614.30 cfs 367.453 af
n=0.070 L=1,620.0' S=0.0100 '/' Capacity=3,087.40 cfs Outflow=612.16 cfs 360.683 af

Reach 17R: KBR 2 to KBR 1 Avg. Flow Depth=2.07' Max Vel=5.45 fps Inflow=276.29 cfs 232.803 af
n=0.050 L=5,320.0' S=0.0240 '/' Capacity=11,169.75 cfs Outflow=275.93 cfs 221.898 af

Reach 18R: KBR 3 to KBR 2 Avg. Flow Depth=2.43' Max Vel=4.22 fps Inflow=227.49 cfs 202.299 af
n=0.050 L=2,060.0' S=0.0113 '/' Capacity=5,794.51 cfs Outflow=227.48 cfs 197.546 af

Reach 19R: KBR 4 to KBR 3 Inflow=189.32 cfs 134.029 af
Outflow=189.32 cfs 134.029 af

Pond 3P: Waite Pond Peak Elev=821.97' Storage=150.533 af Inflow=811.80 cfs 493.694 af
Outflow=501.14 cfs 376.051 af

Pond 6P: Kettle Brook Reservoir No. 1 Peak Elev=852.95' Storage=34.232 af Inflow=721.36 cfs 386.048 af
Outflow=614.30 cfs 367.453 af

Pond 9P: Kettle Brook Reservoir No. 2 Peak Elev=996.46' Storage=47.203 af Inflow=397.49 cfs 275.218 af
Outflow=276.29 cfs 232.803 af

Pond 12P: Kettle Brook Reservoir No. 3 Peak Elev=1,041.75' Storage=73.767 af Inflow=648.86 cfs 271.612 af
Outflow=227.49 cfs 202.299 af

Pond 15P: Kettle Brook Reservoir No. 4 Peak Elev=1,088.80' Storage=213.882 af Inflow=830.65 cfs 326.079 af
Outflow=189.32 cfs 134.029 af

Total Runoff Area = 3,127.766 ac Runoff Volume = 838.494 af Average Runoff Depth = 3.22"
90.84% Pervious = 2,841.391 ac 9.16% Impervious = 286.375 ac

Summary for Subcatchment 1S: Area 1-1

Overland runoff to Waite Pond.

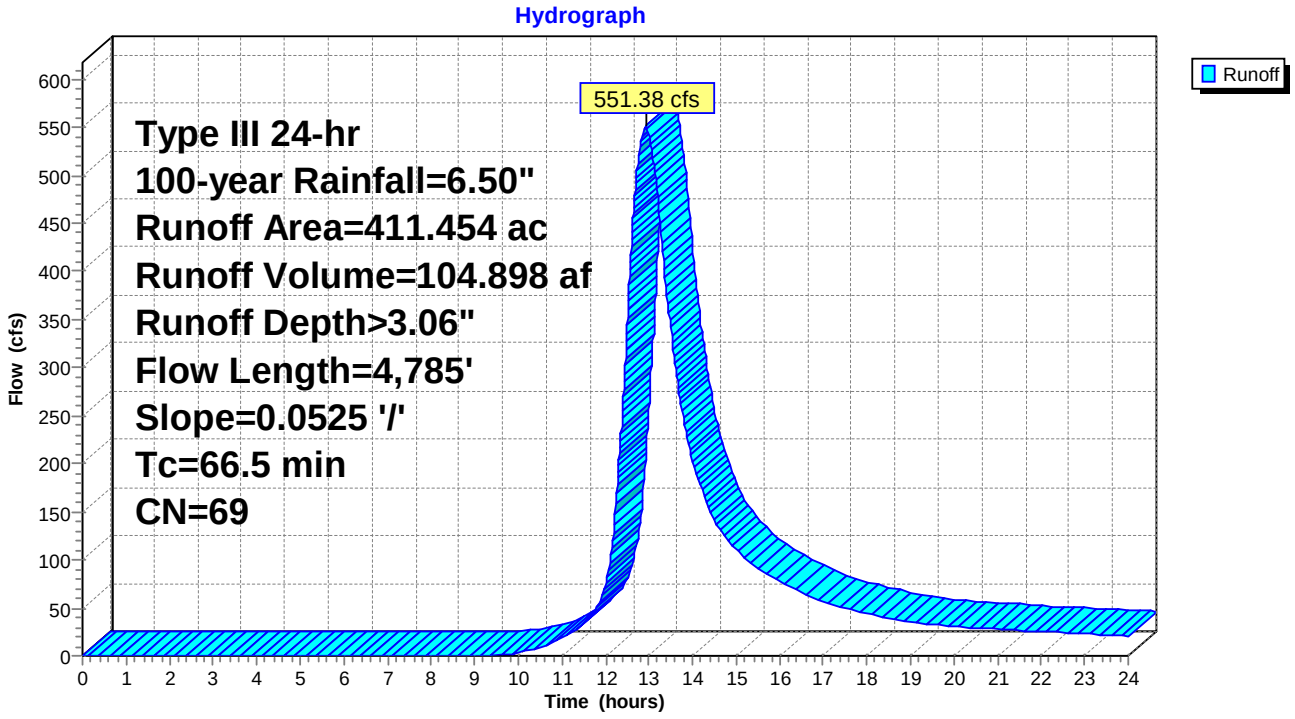
Runoff = 551.38 cfs @ 12.93 hrs, Volume= 104.898 af, Depth> 3.06"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year Rainfall=6.50"

Area (ac)	CN	Description
49.447	68	1 acre lots, 20% imp, HSG B
13.446	61	Pasture/grassland/range, Good, HSG B
70.642	55	Woods, Good, HSG B
68.149	79	1 acre lots, 20% imp, HSG C
4.689	74	Pasture/grassland/range, Good, HSG C
170.963	70	Woods, Good, HSG C
34.118	77	Woods, Good, HSG D
411.454	69	Weighted Average
387.935		94.28% Pervious Area
23.519		5.72% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
66.5	4,785	0.0525	1.20		**Lag/CN Method,**

Subcatchment 1S: Area 1-1



Summary for Subcatchment 2S: Area 1-2

Direct precipitation to Waite Pond.

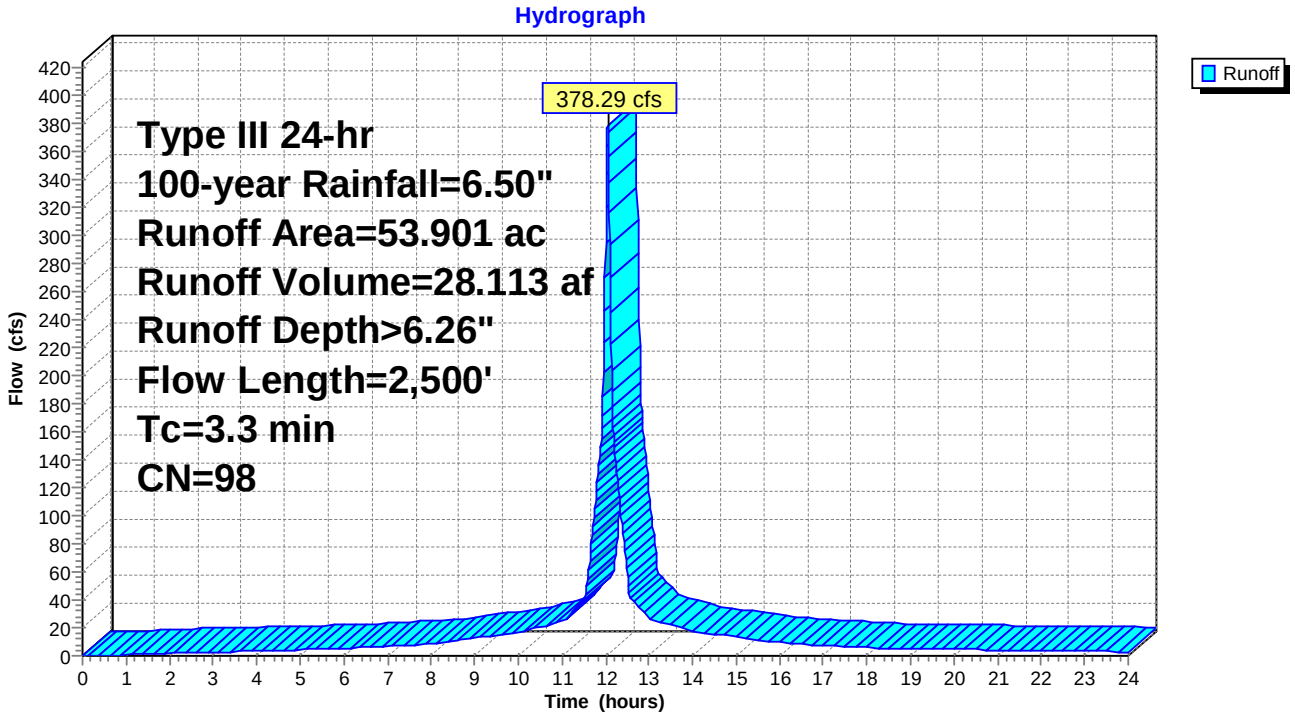
Runoff = 378.29 cfs @ 12.05 hrs, Volume= 28.113 af, Depth> 6.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year Rainfall=6.50"

Area (ac)	CN	Description
53.901	98	Water Surface, 0% imp, HSG C
53.901		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.3	2,500		12.69		**Lake or Reservoir, Estimated travel time through Waite Pond.** Mean Depth= 5.00'

Subcatchment 2S: Area 1-2



Summary for Subcatchment 4S: Area 2-1

Overland runoff to Kettle Brook Reservoir No. 1.

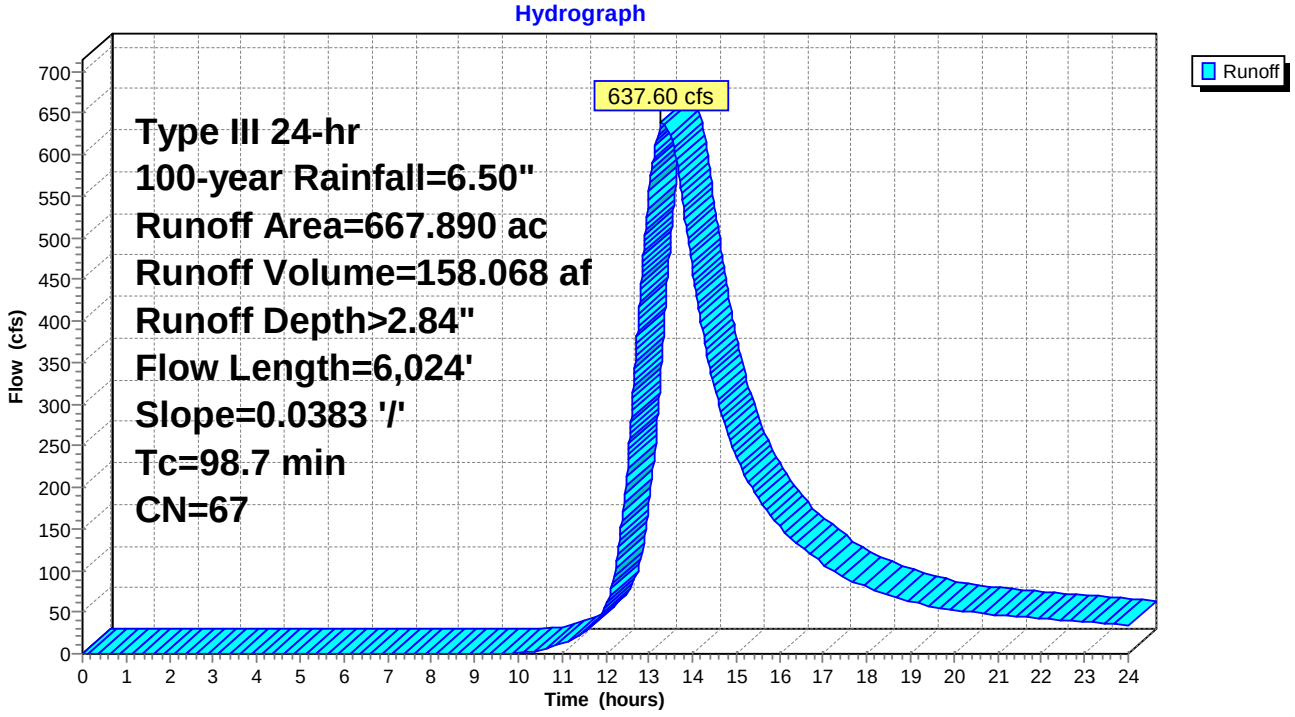
Runoff = 637.60 cfs @ 13.28 hrs, Volume= 158.068 af, Depth> 2.84"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year Rainfall=6.50"

Area (ac)	CN	Description
6.557	79	1 acre lots, 20% imp, HSG C
23.867	61	Pasture/grassland/range, Good, HSG B
95.923	74	Pasture/grassland/range, Good, HSG C
0.937	80	Pasture/grassland/range, Good, HSG D
152.437	55	Woods, Good, HSG B
348.095	70	Woods, Good, HSG C
37.168	77	Woods, Good, HSG D
2.906	98	Water Surface, HSG C
667.890	67	Weighted Average
663.673		99.37% Pervious Area
4.217		0.63% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
98.7	6,024	0.0383	1.02		**Lag/CN Method,**

Subcatchment 4S: Area 2-1



Summary for Subcatchment 5S: Area 2-2

Direct precipitation to Kettle Brook Reservoir No. 1.

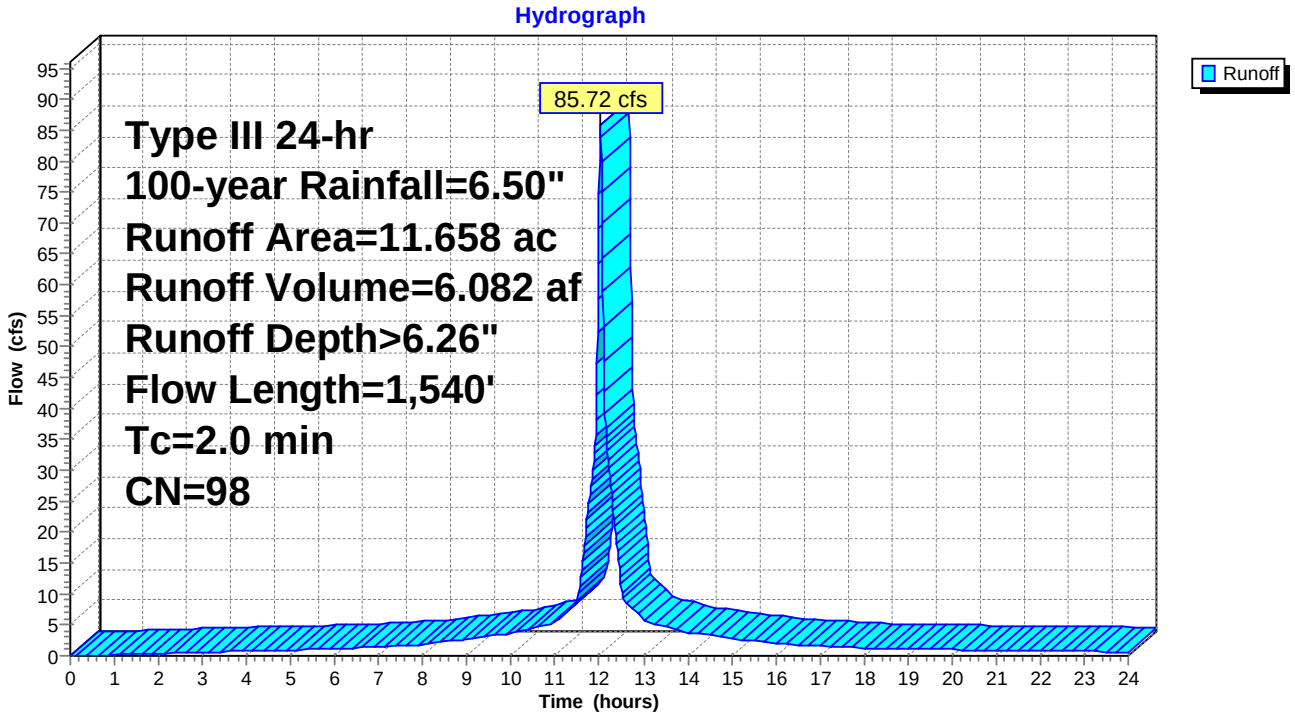
Runoff = 85.72 cfs @ 12.03 hrs, Volume= 6.082 af, Depth> 6.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year Rainfall=6.50"

Area (ac)	CN	Description
11.658	98	Water Surface, HSG C
11.658		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.0	1,540		12.69		**Lake or Reservoir,** Mean Depth= 5.00'

Subcatchment 5S: Area 2-2



Summary for Subcatchment 7S: Area 3-1

Overland runoff to Kettle Brook Reservoir No. 2.

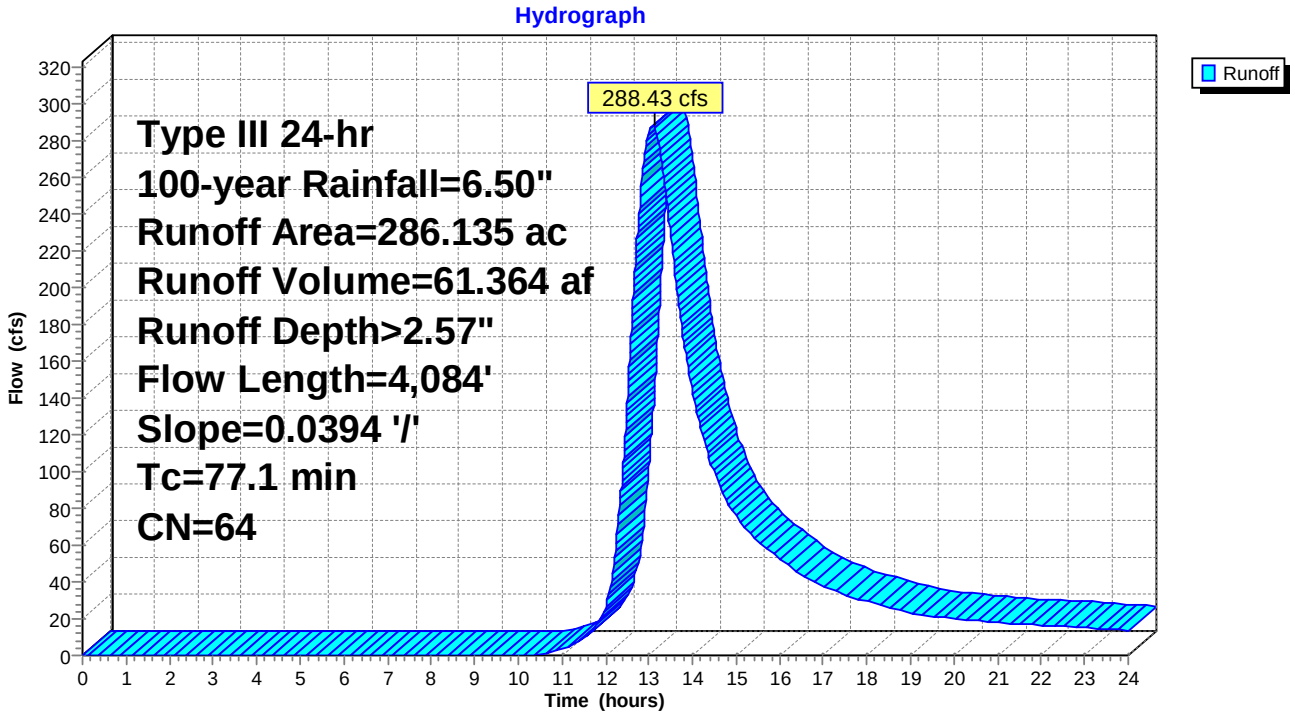
Runoff = 288.43 cfs @ 13.10 hrs, Volume= 61.364 af, Depth> 2.57"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year Rainfall=6.50"

Area (ac)	CN	Description
5.050	79	1 acre lots, 20% imp, HSG C
2.129	61	Pasture/grassland/range, Good, HSG B
14.941	74	Pasture/grassland/range, Good, HSG C
115.991	55	Woods, Good, HSG B
139.035	70	Woods, Good, HSG C
8.989	77	Woods, Good, HSG D
286.135	64	Weighted Average
285.125		99.65% Pervious Area
1.010		0.35% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
77.1	4,084	0.0394	0.88		**Lag/CN Method,**

Subcatchment 7S: Area 3-1



Summary for Subcatchment 8S: Area 3-2

Direct precipitation to Kettle Brook Reservoir No. 2.

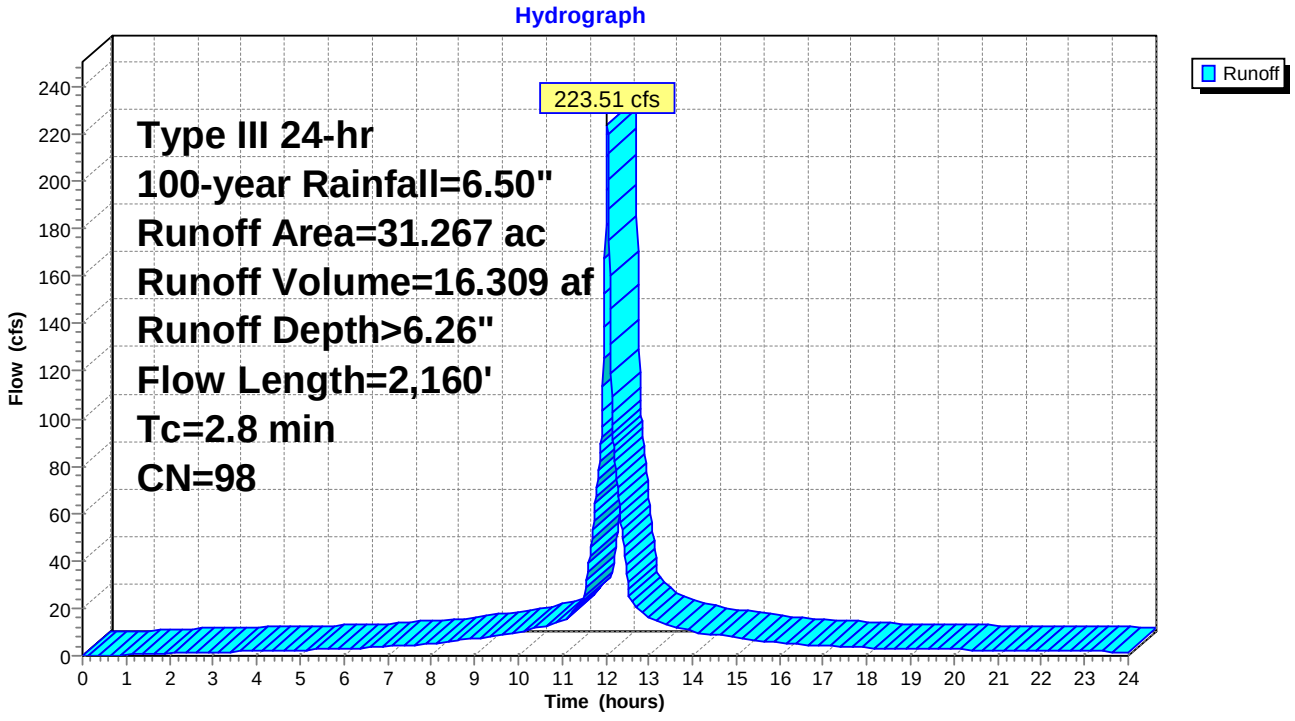
Runoff = 223.51 cfs @ 12.04 hrs, Volume= 16.309 af, Depth> 6.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year Rainfall=6.50"

Area (ac)	CN	Description
31.267	98	Water Surface, HSG C
31.267		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.8	2,160		12.69		**Lake or Reservoir,** Mean Depth= 5.00'

Subcatchment 8S: Area 3-2



Summary for Subcatchment 10S: Area 4-1

Overland runoff to Kettle Brook Reservoir No. 3.

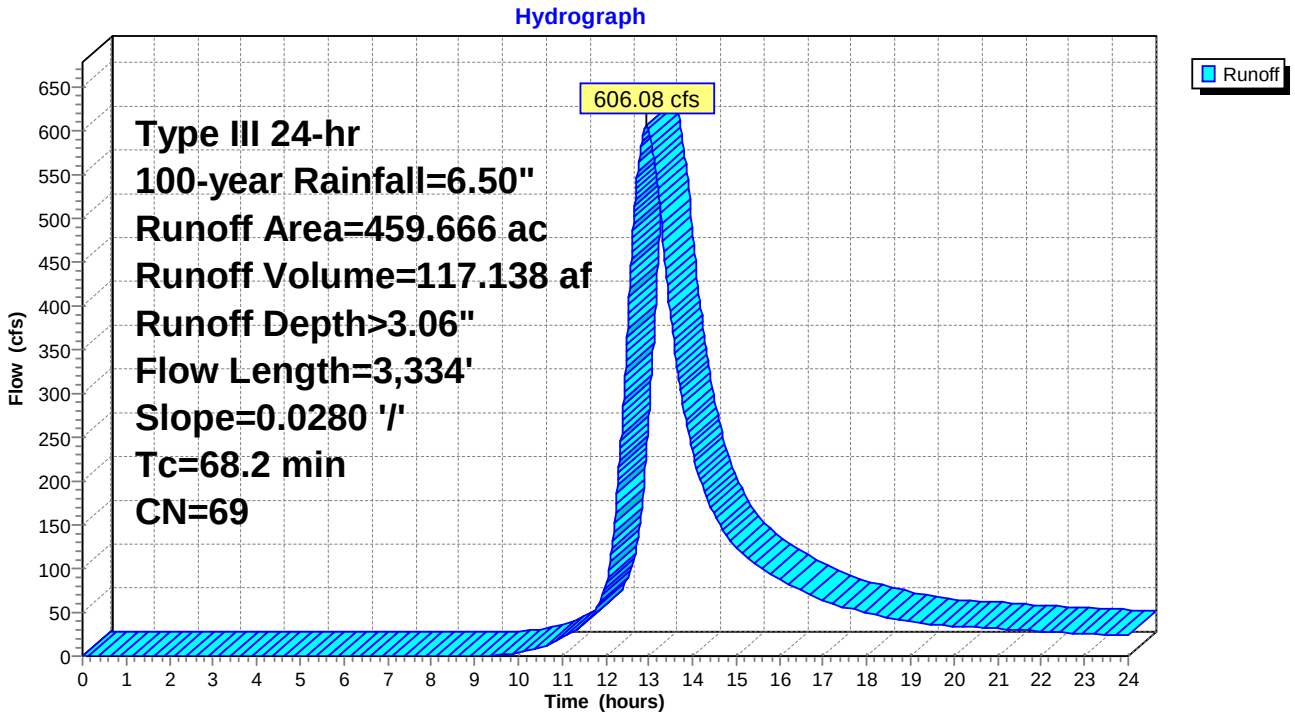
Runoff = 606.08 cfs @ 12.96 hrs, Volume= 117.138 af, Depth> 3.06"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year Rainfall=6.50"

Area (ac)	CN	Description
19.759	79	1 acre lots, 20% imp, HSG C
7.916	74	Pasture/grassland/range, Good, HSG C
48.751	55	Woods, Good, HSG B
367.701	70	Woods, Good, HSG C
15.539	77	Woods, Good, HSG D
459.666	69	Weighted Average
455.714		99.14% Pervious Area
3.952		0.86% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
68.2	3,334	0.0280	0.81		**Lag/CN Method,**

Subcatchment 10S: Area 4-1



Summary for Subcatchment 11S: Area 4-2

Direct precipitation to Kettle Brook Reservoir No. 3.

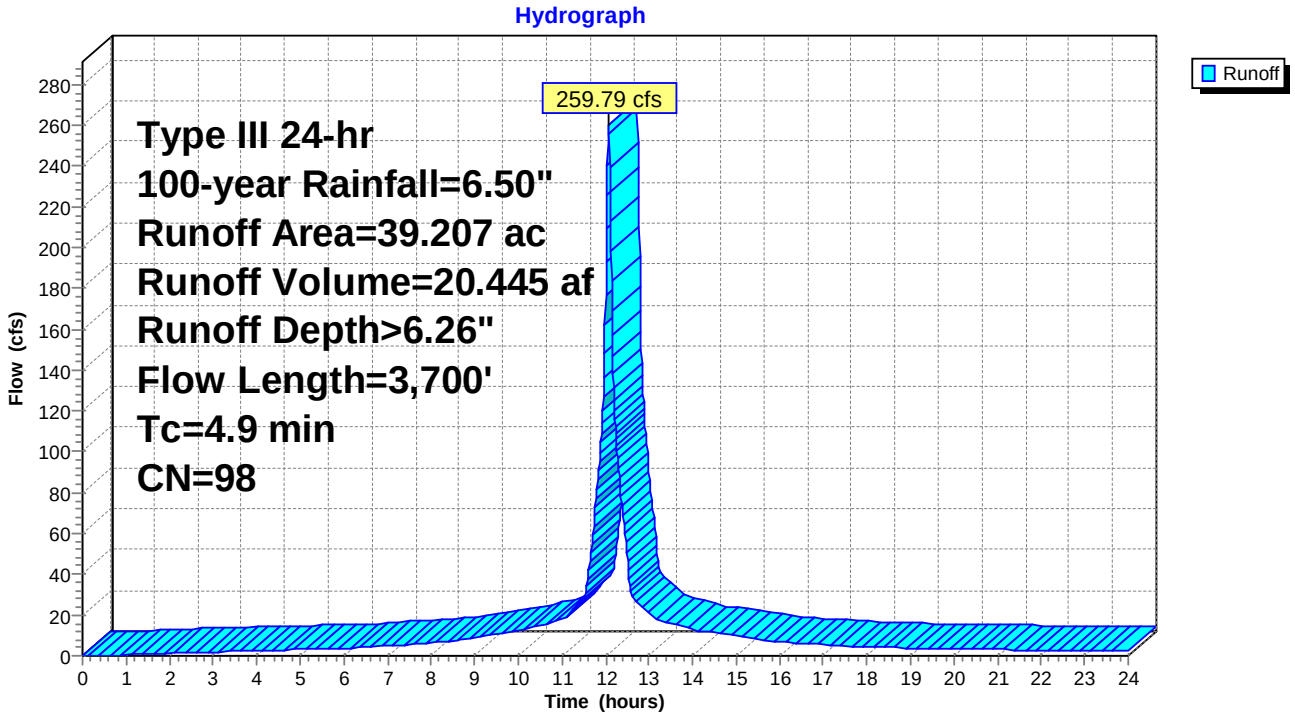
Runoff = 259.79 cfs @ 12.07 hrs, Volume= 20.445 af, Depth> 6.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year Rainfall=6.50"

Area (ac)	CN	Description
39.207	98	Water Surface, HSG C
39.207		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.9	3,700		12.69		**Lake or Reservoir,** Mean Depth= 5.00'

Subcatchment 11S: Area 4-2



Summary for Subcatchment 13S: Area 5-1

Overland runoff to Kettle Brook Reservoir No. 4.

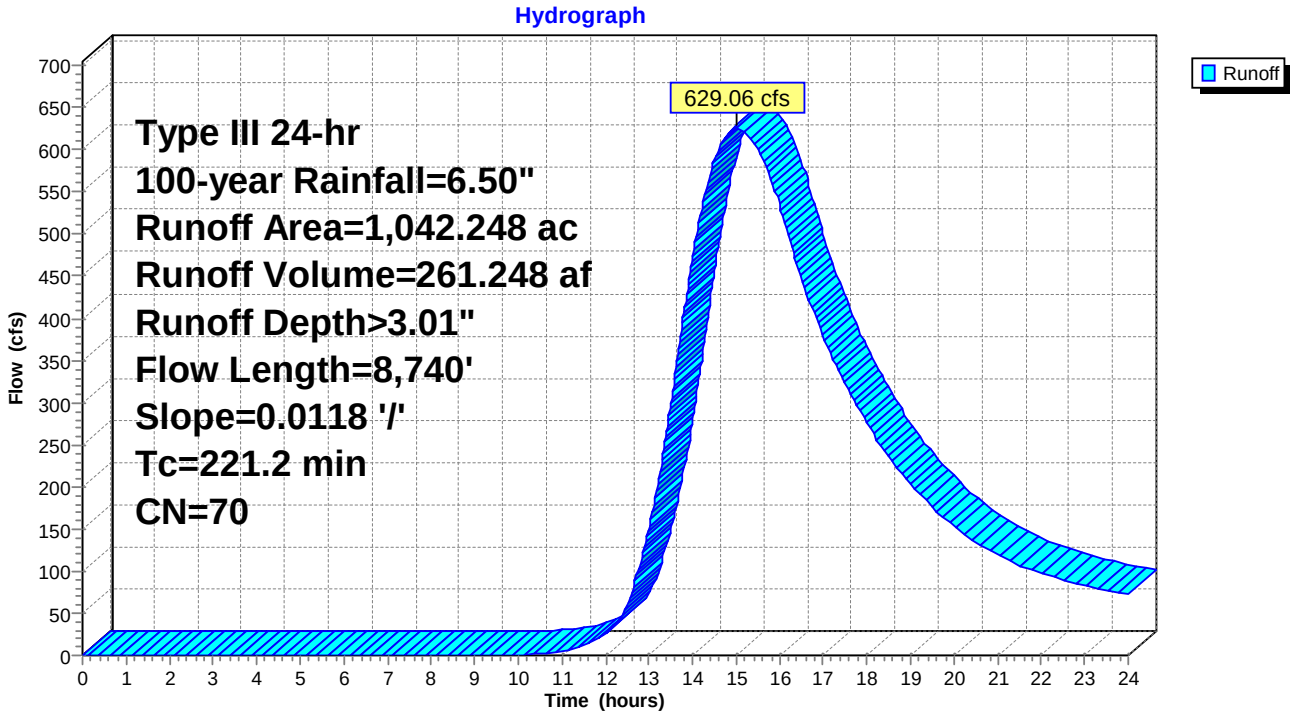
Runoff = 629.06 cfs @ 14.99 hrs, Volume= 261.248 af, Depth> 3.01"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year Rainfall=6.50"

Area (ac)	CN	Description
9.784	68	1 acre lots, 20% imp, HSG B
226.237	79	1 acre lots, 20% imp, HSG C
19.938	74	Pasture/grassland/range, Good, HSG C
133.949	55	Woods, Good, HSG B
593.604	70	Woods, Good, HSG C
58.736	77	Woods, Good, HSG D
1,042.248	70	Weighted Average
995.044		95.47% Pervious Area
47.204		4.53% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
221.2	8,740	0.0118	0.66		**Lag/CN Method,**

Subcatchment 13S: Area 5-1



Summary for Subcatchment 14S: Area 5-2

Direct precipitation to Kettle Brook Reservoir No. 4.

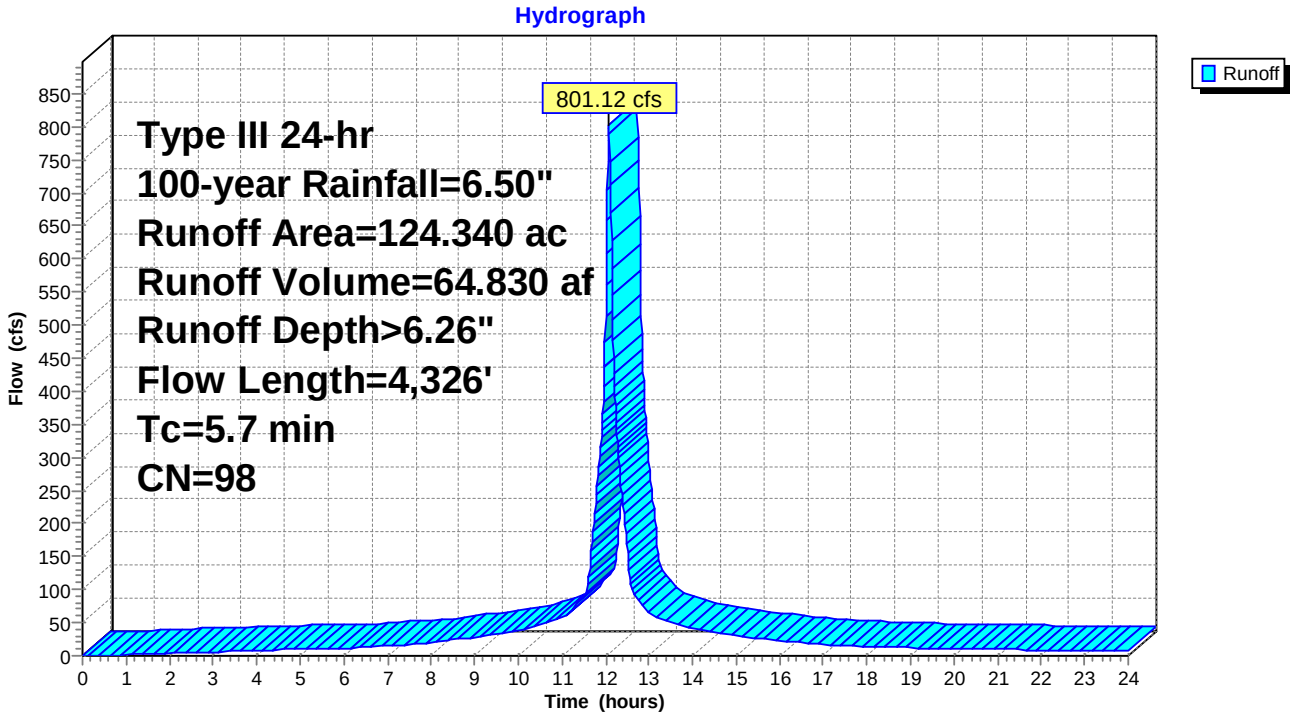
Runoff = 801.12 cfs @ 12.08 hrs, Volume= 64.830 af, Depth> 6.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-year Rainfall=6.50"

Area (ac)	CN	Description
124.340	98	Water Surface, HSG C
124.340		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.7	4,326		12.69		**Lake or Reservoir,** Mean Depth= 5.00'

Subcatchment 14S: Area 5-2



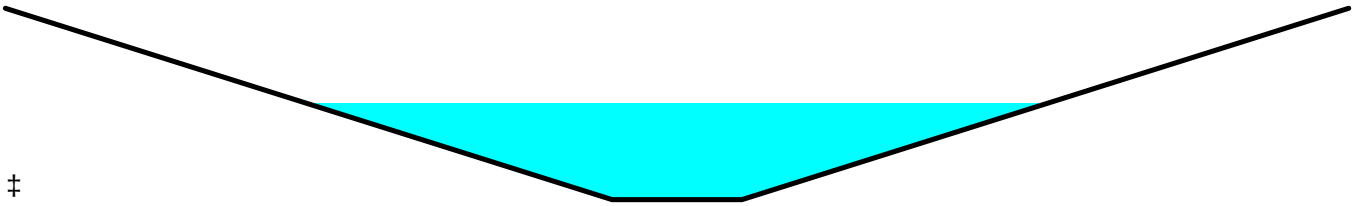
Summary for Reach 16R: K.B.R. to Waite Pond

Inflow Area = 2,662.411 ac, 9.87% Impervious, Inflow Depth > 1.66" for 100-year event
Inflow = 614.30 cfs @ 14.06 hrs, Volume= 367.453 af
Outflow = 612.16 cfs @ 14.30 hrs, Volume= 360.683 af, Atten= 0%, Lag= 14.5 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.44 fps, Min. Travel Time= 7.8 min
Avg. Velocity = 1.81 fps, Avg. Travel Time= 14.9 min

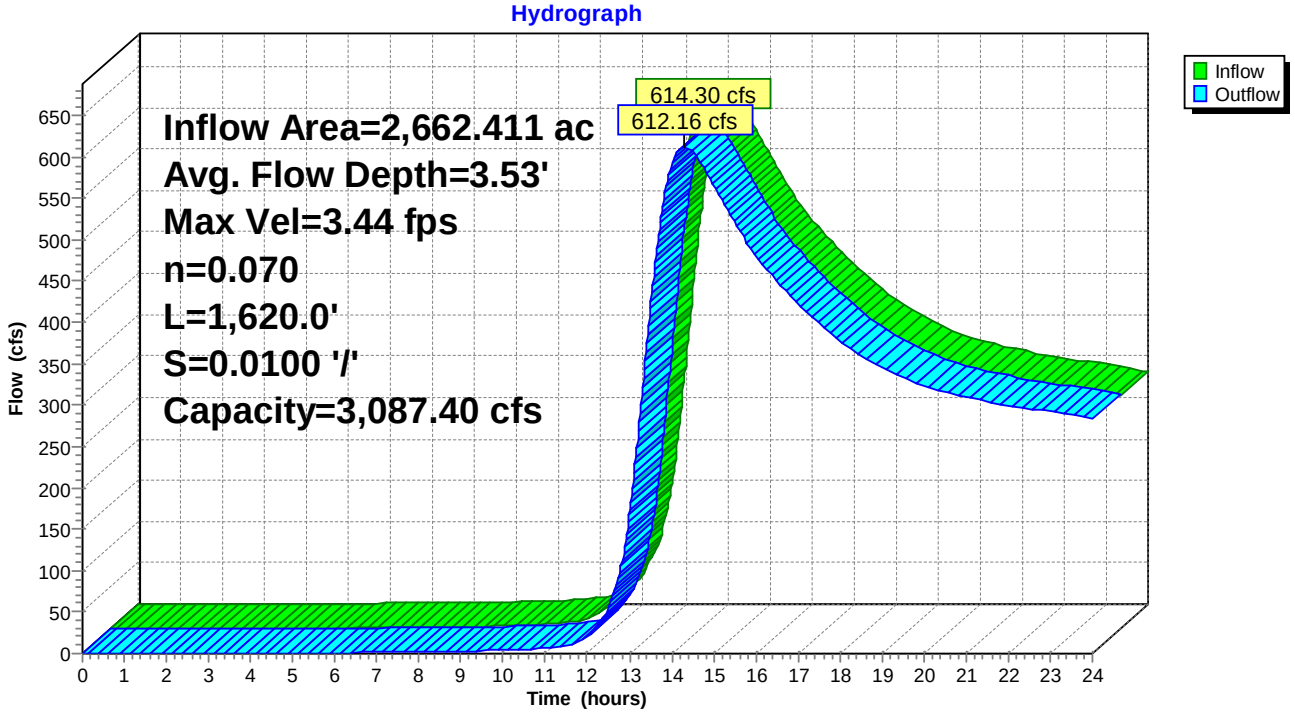
Peak Storage= 287,899 cf @ 14.17 hrs
Average Depth at Peak Storage= 3.53'
Bank-Full Depth= 7.00' Flow Area= 595.0 sf, Capacity= 3,087.40 cfs

15.00' x 7.00' deep channel, n= 0.070 Sluggish weedy reaches w/pools
Side Slope Z-value= 10.0 '/' Top Width= 155.00'
Length= 1,620.0' Slope= 0.0100 '/'
Inlet Invert= 838.00', Outlet Invert= 821.80'



‡

Reach 16R: K.B.R. to Waite Pond



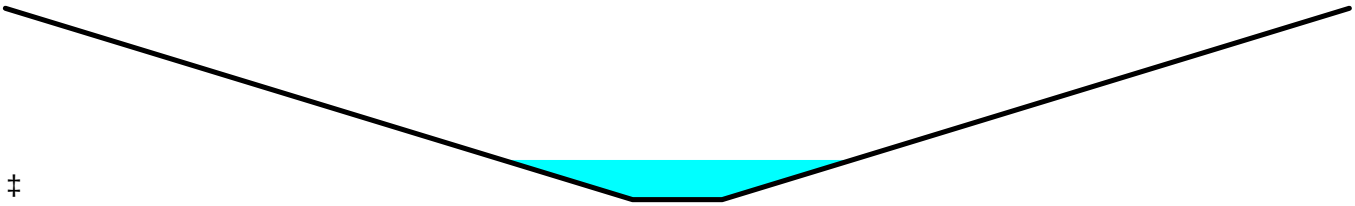
Summary for Reach 17R: KBR 2 to KBR 1

Inflow Area = 1,982.863 ac, 12.46% Impervious, Inflow Depth > 1.41" for 100-year event
Inflow = 276.29 cfs @ 15.85 hrs, Volume= 232.803 af
Outflow = 275.93 cfs @ 16.35 hrs, Volume= 221.898 af, Atten= 0%, Lag= 30.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Max. Velocity= 5.45 fps, Min. Travel Time= 16.3 min
Avg. Velocity = 3.22 fps, Avg. Travel Time= 27.6 min

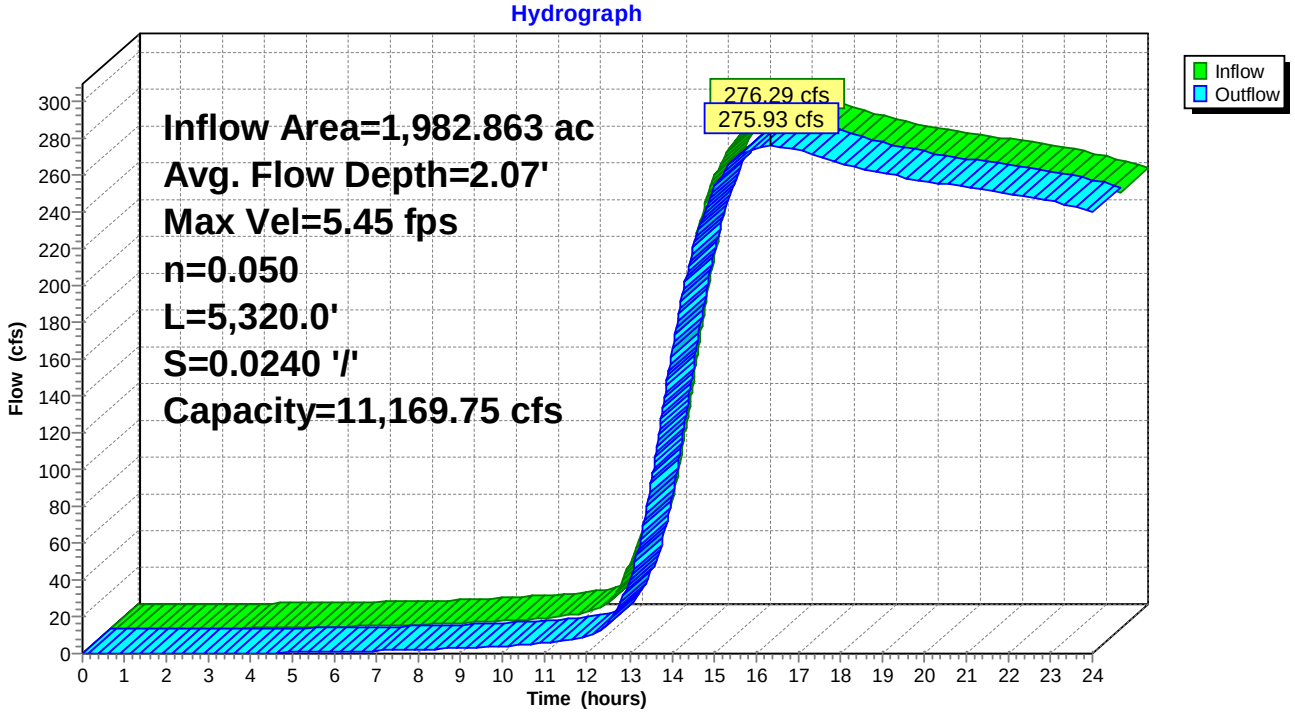
Peak Storage= 269,143 cf @ 16.08 hrs
Average Depth at Peak Storage= 2.07'
Bank-Full Depth= 10.00' Flow Area= 800.0 sf, Capacity= 11,169.75 cfs

10.00' x 10.00' deep channel, n= 0.050
Side Slope Z-value= 7.0 '/' Top Width= 150.00'
Length= 5,320.0' Slope= 0.0240 '/'
Inlet Invert= 979.00', Outlet Invert= 851.40'



‡

Reach 17R: KBR 2 to KBR 1



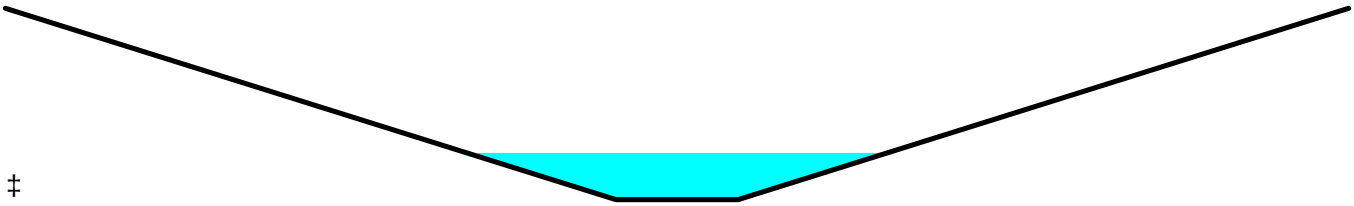
Summary for Reach 18R: KBR 3 to KBR 2

Inflow Area = 1,665.461 ac, 12.89% Impervious, Inflow Depth > 1.46" for 100-year event
Inflow = 227.49 cfs @ 19.87 hrs, Volume= 202.299 af
Outflow = 227.48 cfs @ 20.11 hrs, Volume= 197.546 af, Atten= 0%, Lag= 14.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Max. Velocity= 4.22 fps, Min. Travel Time= 8.1 min
Avg. Velocity = 2.50 fps, Avg. Travel Time= 13.7 min

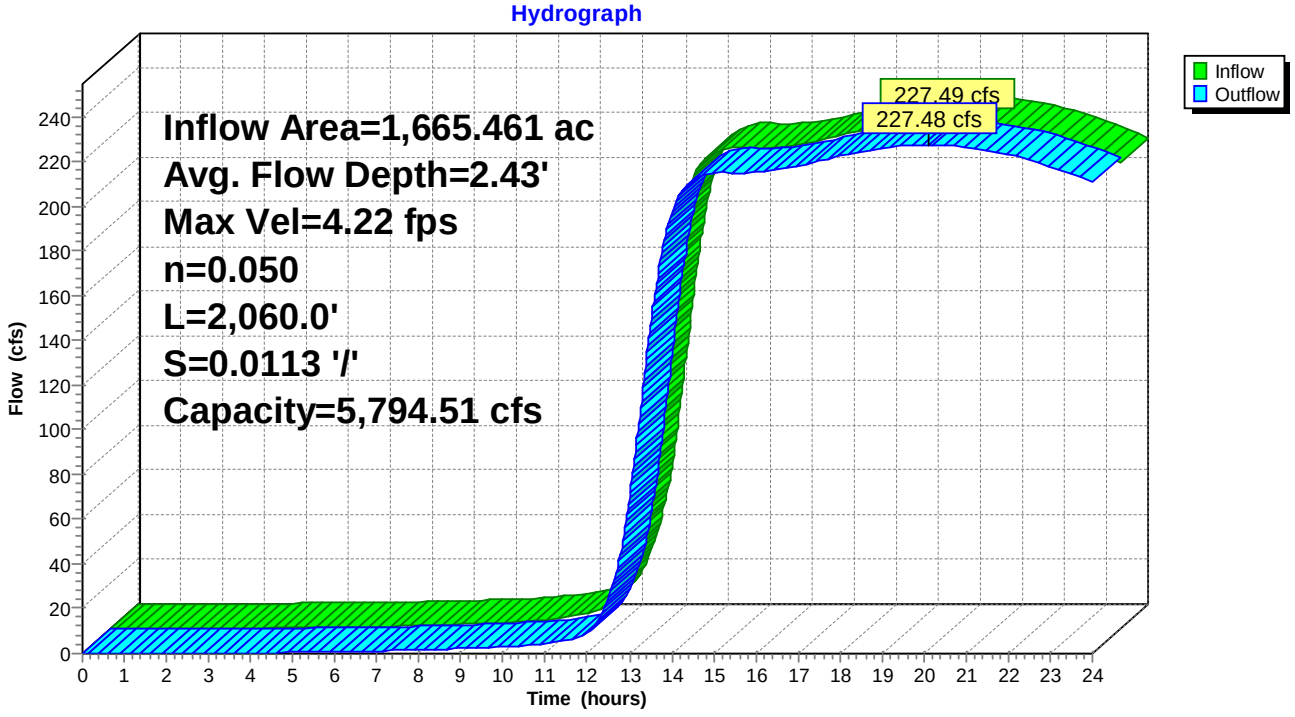
Peak Storage= 110,991 cf @ 19.97 hrs
Average Depth at Peak Storage= 2.43'
Bank-Full Depth= 10.00' Flow Area= 600.0 sf, Capacity= 5,794.51 cfs

10.00' x 10.00' deep channel, n= 0.050
Side Slope Z-value= 5.0 '/' Top Width= 110.00'
Length= 2,060.0' Slope= 0.0113 '/'
Inlet Invert= 1,014.00', Outlet Invert= 990.80'



‡

Reach 18R: KBR 3 to KBR 2



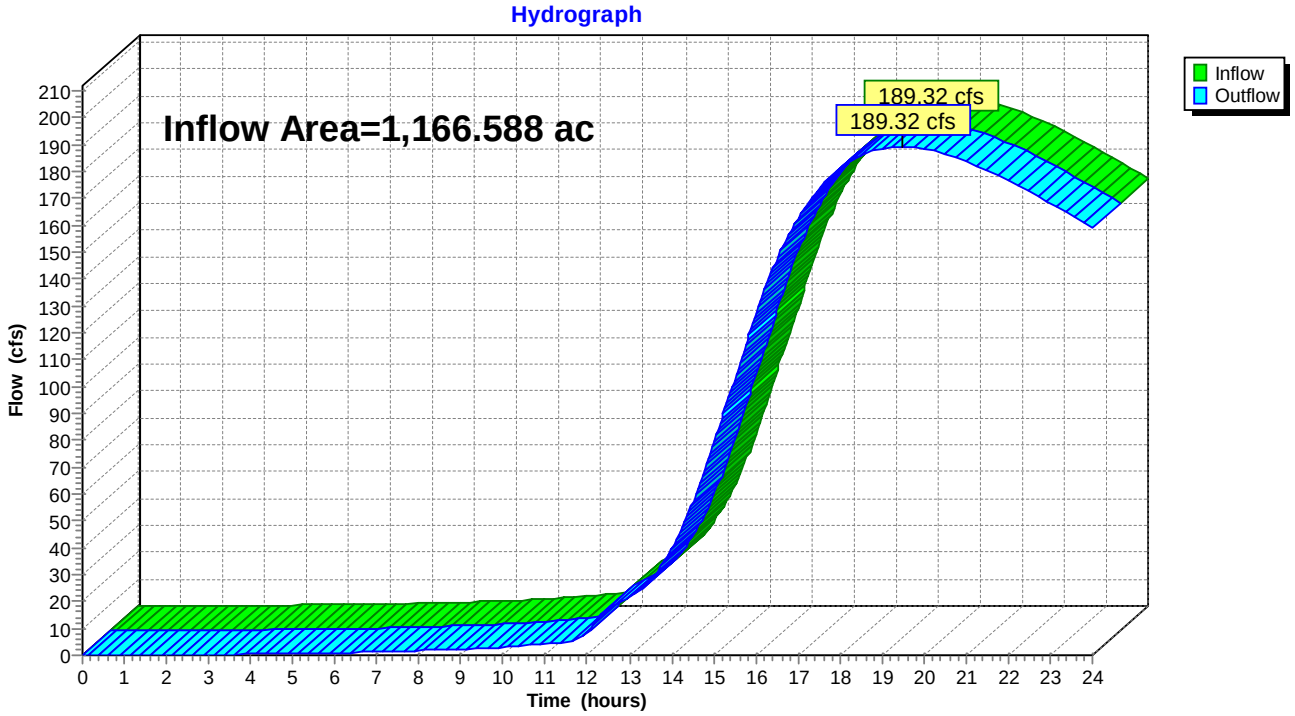
Summary for Reach 19R: KBR 4 to KBR 3

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 1,166.588 ac, 14.70% Impervious, Inflow Depth > 1.38" for 100-year event
Inflow = 189.32 cfs @ 19.47 hrs, Volume= 134.029 af
Outflow = 189.32 cfs @ 19.47 hrs, Volume= 134.029 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs

Reach 19R: KBR 4 to KBR 3



Summary for Pond 3P: Waite Pond

[61] Hint: Exceeded Reach 16R outlet invert by 0.17' @ 16.80 hrs

Inflow Area = 3,127.766 ac, 9.16% Impervious, Inflow Depth > 1.89" for 100-year event
Inflow = 811.80 cfs @ 13.95 hrs, Volume= 493.694 af
Outflow = 501.14 cfs @ 16.80 hrs, Volume= 376.051 af, Atten= 38%, Lag= 171.1 min
Primary = 501.14 cfs @ 16.80 hrs, Volume= 376.051 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 821.97' @ 16.80 hrs Surf.Area= 55.983 ac Storage= 150.533 af

Plug-Flow detention time= 195.8 min calculated for 376.051 af (76% of inflow)
Center-of-Mass det. time= 101.6 min (1,108.7 - 1,007.1)

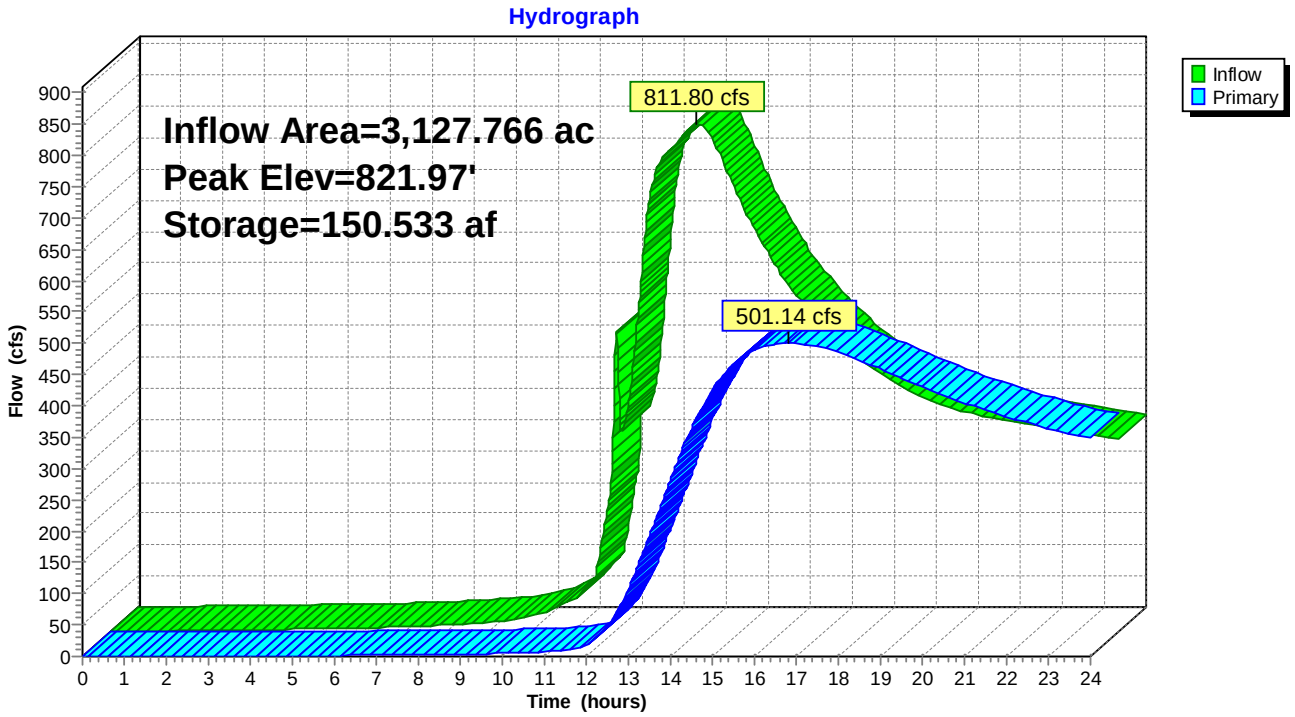
Volume	Invert	Avail.Storage	Storage Description
#1	819.23'	2,648.447 af	**Custom Stage Data (Conic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)	Wet.Area (acres)
819.23	53.901	0.000	0.000	53.901
826.80	59.750	429.979	429.979	59.830
836.60	115.614	844.361	1,274.340	115.715
846.40	166.350	1,374.107	2,648.447	166.489

Device	Routing	Invert	Outlet Devices
#1	Primary	819.23'	**42.0' long x 32.0' breadth Primary Spillway**
			Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60
			Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63
#2	Primary	823.50'	**44.0' long x 25.0' breadth Right Embankment Crest**
			Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60
			Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63
#3	Primary	823.50'	**36.0' long x 25.0' breadth Left Embankment Crest**
			Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60
			Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=501.00 cfs @ 16.80 hrs HW=821.97' (Free Discharge)
- **1=Primary Spillway** (Weir Controls 501.00 cfs @ 4.35 fps)
- **2=Right Embankment Crest** (Controls 0.00 cfs)
- **3=Left Embankment Crest** (Controls 0.00 cfs)

Pond 3P: Waite Pond



Summary for Pond 6P: Kettle Brook Reservoir No. 1

[61] Hint: Exceeded Reach 17R outlet invert by 1.55' @ 14.06 hrs

Inflow Area = 2,662.411 ac, 9.87% Impervious, Inflow Depth > 1.74" for 100-year event
Inflow = 721.36 cfs @ 13.49 hrs, Volume= 386.048 af
Outflow = 614.30 cfs @ 14.06 hrs, Volume= 367.453 af, Atten= 15%, Lag= 34.5 min
Primary = 614.30 cfs @ 14.06 hrs, Volume= 367.453 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 852.95' @ 14.06 hrs Surf.Area= 17.746 ac Storage= 34.232 af

Plug-Flow detention time= 44.0 min calculated for 367.453 af (95% of inflow)
Center-of-Mass det. time= 24.5 min (1,054.2 - 1,029.7)

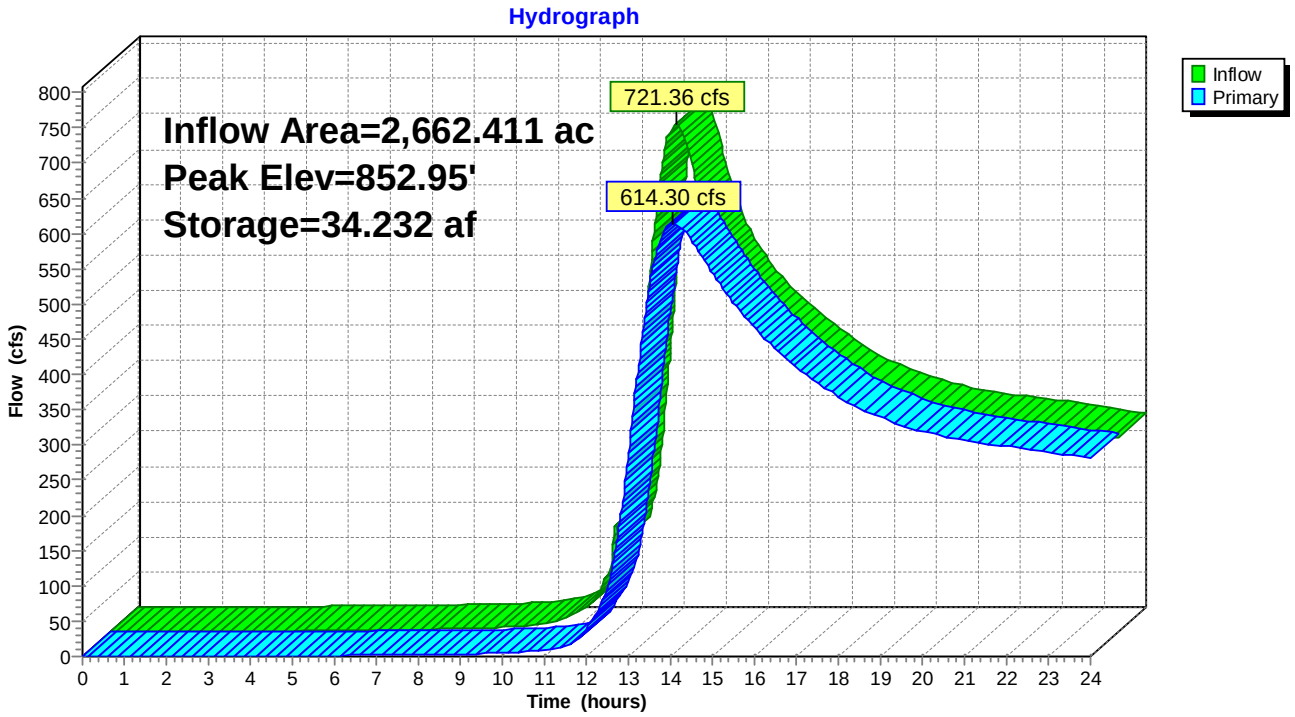
Volume	Invert	Avail.Storage	Storage Description
#1	850.60'	476.839 af	**Custom Stage Data (Conic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)	Wet.Area (acres)
850.60	11.658	0.000	0.000	11.658
856.30	28.670	111.359	111.359	28.675
866.10	46.643	365.480	476.839	46.677

Device	Routing	Invert	Outlet Devices
#1	Primary	850.60'	**45.0' long x 2.0' breadth Primary Spillway** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 Coef. (English) 3.80 3.80 3.80 3.80 3.80 3.80 3.80 3.80 3.80 3.80 3.80 3.80 3.80
#2	Primary	855.00'	**580.0' long x 25.0' breadth Dam Embankment Crest** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=614.18 cfs @ 14.06 hrs HW=852.95' (Free Discharge)
└**1=Primary Spillway** (Weir Controls 614.18 cfs @ 5.82 fps)
└**2=Dam Embankment Crest** (Controls 0.00 cfs)

Pond 6P: Kettle Brook Reservoir No. 1



Summary for Pond 9P: Kettle Brook Reservoir No. 2

[62] Hint: Exceeded Reach 18R OUTLET depth by 4.20' @ 1.03 hrs

Inflow Area = 1,982.863 ac, 12.46% Impervious, Inflow Depth > 1.67" for 100-year event
Inflow = 397.49 cfs @ 13.28 hrs, Volume= 275.218 af
Outflow = 276.29 cfs @ 15.85 hrs, Volume= 232.803 af, Atten= 30%, Lag= 154.0 min
Primary = 276.29 cfs @ 15.85 hrs, Volume= 232.803 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 996.46' @ 15.85 hrs Surf.Area= 33.243 ac Storage= 47.203 af

Plug-Flow detention time= 118.9 min calculated for 232.706 af (85% of inflow)
Center-of-Mass det. time= 58.9 min (1,103.6 - 1,044.7)

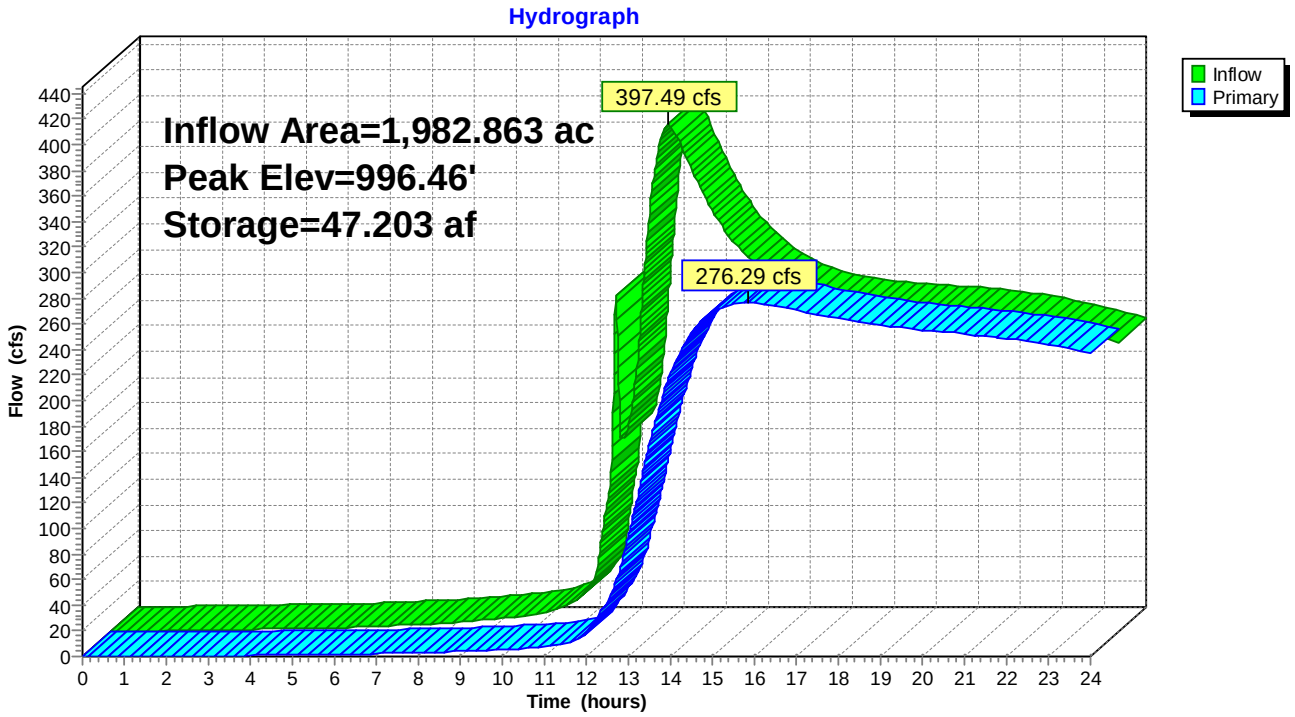
Volume	Invert	Avail.Storage	Storage Description
#1	995.00'	1,660.546 af	**Custom Stage Data (Conic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)	Wet.Area (acres)
995.00	31.267	0.000	0.000	31.267
1,003.90	44.217	334.244	334.244	44.250
1,013.80	68.192	552.157	886.401	68.258
1,023.60	90.314	774.146	1,660.546	90.429

Device	Routing	Invert	Outlet Devices
#1	Primary	995.00'	**41.0' long x 2.0' breadth Primary Spillway** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 Coef. (English) 3.80 3.80 3.80 3.80 3.80 3.80 3.80 3.80 3.80 3.80 3.80 3.80 3.80
#2	Primary	1,000.00'	**600.0' long x 15.0' breadth Dam Embankment Crest** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=275.89 cfs @ 15.85 hrs HW=996.46' (Free Discharge)
└**1=Primary Spillway** (Weir Controls 275.89 cfs @ 4.60 fps)
└**2=Dam Embankment Crest** (Controls 0.00 cfs)

Pond 9P: Kettle Brook Reservoir No. 2



Summary for Pond 12P: Kettle Brook Reservoir No. 3

Inflow Area = 1,665.461 ac, 12.89% Impervious, Inflow Depth > 1.96" for 100-year event
Inflow = 648.86 cfs @ 12.96 hrs, Volume= 271.612 af
Outflow = 227.49 cfs @ 19.87 hrs, Volume= 202.299 af, Atten= 65%, Lag= 414.8 min
Primary = 227.49 cfs @ 19.87 hrs, Volume= 202.299 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 1,041.75' @ 19.87 hrs Surf.Area= 45.036 ac Storage= 73.767 af

Plug-Flow detention time= 203.0 min calculated for 202.299 af (74% of inflow)
Center-of-Mass det. time= 97.8 min (1,105.3 - 1,007.6)

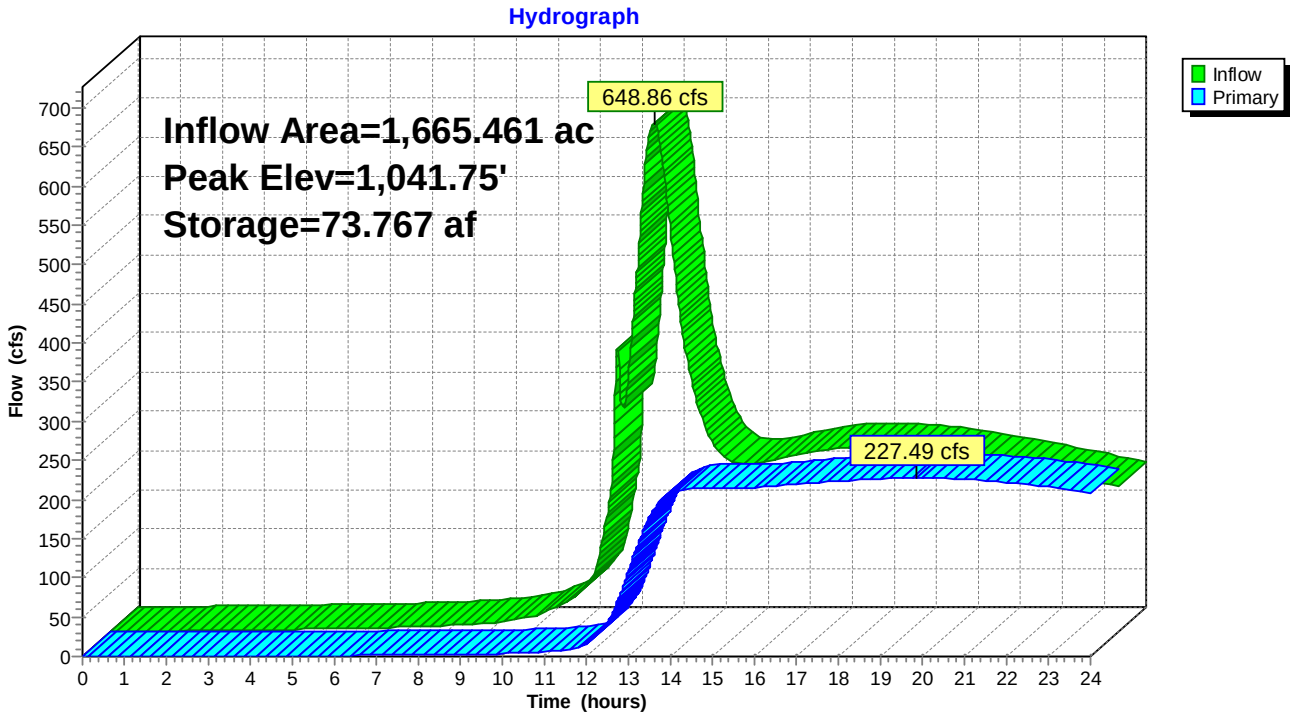
Volume	Invert	Avail.Storage	Storage Description
#1	1,040.00'	2,031.123 af	**Custom Stage Data (Conic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)	Wet.Area (acres)
1,040.00	39.207	0.000	0.000	39.207
1,043.30	50.517	147.651	147.651	50.523
1,053.10	97.200	711.448	859.099	97.228
1,063.00	140.922	1,172.024	2,031.123	140.988

Device	Routing	Invert	Outlet Devices
#1	Primary	1,040.00'	**34.0' long x 2.0' breadth Primary Spillway** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 Coef. (English) 2.54 2.61 2.61 2.60 2.66 2.70 2.77 2.89 2.88 2.85 3.07 3.20 3.32
#2	Primary	1,044.60'	**329.0' long x 15.0' breadth Dam Embankment Crest** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=227.40 cfs @ 19.87 hrs HW=1,041.75' (Free Discharge)
└**1=Primary Spillway** (Weir Controls 227.40 cfs @ 3.82 fps)
└**2=Dam Embankment Crest** (Controls 0.00 cfs)

Pond 12P: Kettle Brook Reservoir No. 3



Summary for Pond 15P: Kettle Brook Reservoir No. 4

Inflow Area = 1,166.588 ac, 14.70% Impervious, Inflow Depth > 3.35" for 100-year event
Inflow = 830.65 cfs @ 12.08 hrs, Volume= 326.079 af
Outflow = 189.32 cfs @ 19.47 hrs, Volume= 134.029 af, Atten= 77%, Lag= 443.2 min
Primary = 189.32 cfs @ 19.47 hrs, Volume= 134.029 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.01 hrs
Peak Elev= 1,088.80' @ 19.47 hrs Surf.Area= 128.987 ac Storage= 213.882 af

Plug-Flow detention time= 380.8 min calculated for 133.973 af (41% of inflow)
Center-of-Mass det. time= 207.0 min (1,155.3 - 948.3)

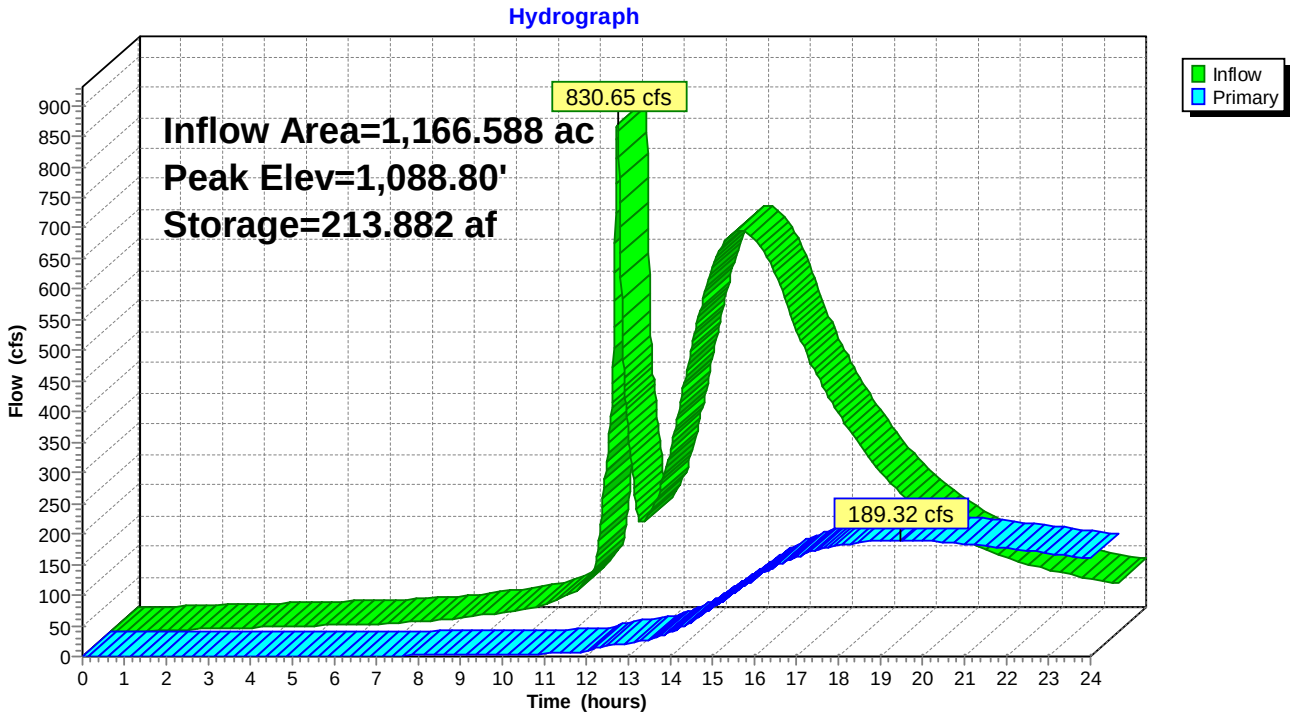
Volume	Invert	Avail.Storage	Storage Description
#1	1,087.11'	4,375.774 af	**Custom Stage Data (Conic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)	Wet.Area (acres)
1,087.11	124.340	0.000	0.000	124.340
1,092.50	139.470	710.578	710.578	139.506
1,102.30	181.000	1,565.889	2,276.467	181.090
1,112.20	244.700	2,099.307	4,375.774	244.837

Device	Routing	Invert	Outlet Devices
#1	Primary	1,087.11'	**30.0' long x 2.0' breadth Primary Spillway** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 Coef. (English) 2.54 2.61 2.61 2.60 2.66 2.70 2.77 2.89 2.88 2.85 3.07 3.20 3.32
#2	Primary	1,091.12'	**1,100.0' long x 15.0' breadth Dam Embankment Crest** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.68 2.70 2.70 2.64 2.63 2.64 2.64 2.63

Primary OutFlow Max=189.96 cfs @ 19.47 hrs HW=1,088.80' (Free Discharge)
1=Primary Spillway (Weir Controls 189.96 cfs @ 3.75 fps)
2=Dam Embankment Crest (Controls 0.00 cfs)

Pond 15P: Kettle Brook Reservoir No. 4



Appendix C

Soil Boring Logs

FUSS & O'NEILL, INC. CONSULTING ENGINEERS MANCHESTER, CT	**BORING LOG** **Project: Waite Pond Dam** **Location: Leicester, MA**	**Boring ID: B-1** **Sheet 1 of 1** **Project No.:20081286.A10**

Contractor: Martin Geo Environmental
Operator: Jeremy Martin, Derrick Murphy
F&O Rep.: Manju Sharma
Drilling Method: Hollow Stem Auger
Sampling Method: Split Spoon (2" OD)
Hammer Wt.: 140 lbs Hammer Fall (in.): 30
Boring Location: See Plan
Ground Elevation:
Date Start: 1/14/2014 Date Finish: 1/14/2014

Water Level Measurements

Date	Ref. Pt.	Depth	Time

Depth (ft)	Sample No.	Sample Depth (ft)	Rec/ Pen	Blows/ 6"	Sample Description	Strata Change	USCS Class.	Remarks
0								
1	S-1	0-2	9/24	17-30 35-15	Very dense, yellow-brown fine to medium SAND,trace Silt, trace Gravel.Dry		SP	
2								
3								
4								
5								
6	S-2	5-7	20/24	6-11 15-25	Medium dense yellow-brown fine to medium SAND, some Silt. Moist.	Sand	SM	
7								1
8								
9								2
10								
11	S-3	10-10.4	5/5	100/5"	Very dense yellow-brown fine to medium SAND, some Silt.Wet.		SM	
12								3
13					Rock core from 12' and 17' Recovery = 100%; RQD = 83%			
14					Granite	Bed Rock		
15								
16					Boring terminated at 17'			

MINOR CONSTITUENT PROPORTIONS:

Trace	**0 to 10%**	**Some**	**20 to 35%**
Little	**10 to 20%**	**And**	**35 to 50%**

REMARKS:
1. Difficult augering between 7' and 10'.
2. Ground water encountered at 9 feet.
3.Auger refusal at 12 feet.

FUSS & O'NEILL, INC. CONSULTING ENGINEERS MANCHESTER, CT	**BORING LOG** **Project: Waite Pond Dam** **Location: Leicester, MA**	**Boring ID: B-2** **Sheet 1 of 1** **Project No.:20081286.A10**

Contractor: Martin Geo Environmental
Operator: Jeremy Martin, Derrick Murphy
F&O Rep.: Manju Sharma
Drilling Method: Hollow Stem Auger
Sampling Method: Split Spoon (2" OD)
Hammer Wt.: 140 lbs Hammer Fall (in.): 30
Boring Location: See Plan
Ground Elevation:
Date Start: 1/14/2014 Date Finish: 1/14/2014

Water Level Measurements

Date	Ref. Pt.	Depth	Time

Depth (ft)	Sample No.	Sample Depth (ft)	Rec/ Pen	Blows/ 6"	Sample Description	Strata Change	USCS Class.	Remarks
0								
1	S-1	0-2	9/24	5-28 17-4	Dense, brown fine to medium SAND,little Gravel, trace Silt. Dry		SP	
2								
3								
4								
5								
6	S-2	5-7	4/24	1-3 2-2	Loose dark grey fine to medium SAND, some Silt. Wet	Sand	SM	1
7								
8								
9								
10								
11	S-3	10-11.91	23/23	68-50 68-100/5"	Very dense grey fine to medium SAND,little Gravel. Wet		SP	2
12								
13					Auger refusal at 13 feet			3
14						Rock		
15								
16								

MINOR CONSTITUENT PROPORTIONS:

Trace	**0 to 10%**	**Some**	**20 to 35%**
Little	**10 to 20%**	**And**	**35 to 50%**

REMARKS:
1. Ground water encountered at approximately 6 feet.
2. Rock fragments in split spoon.
3. Auger refusal at 13 feet.

Appendix D

Opinion of Construction Cost Worksheet

FUSS & O'NEILL, INC.

146 Hartford Road
Manchester, CT 06040

OPINION OF COST Order of Magnitude Level		DATE PREPARED : 01/16/15	SHEET 1 OF 1
PROJECT :	Waite Pond Dam	BASIS : Previous Experience	
LOCATION :	Leicester, MA		
DESCRIPTION:	Dam repair and improvements		
DRAWING NO. :		ESTIMATOR : KCM	CHECKED BY :

Since Fuss & O'Neill has no control over the cost of labor, materials, equipment or services furnished by others, or over the Contractor(s)' methods of determining prices, or over competitive bidding or market conditions, Fuss & O'Neill's opinion of probable Total Project Costs and Construction Cost are made on the basis of Fuss & O'Neill's experience and qualifications and represent Fuss & O'Neill's best judgment as an experienced and qualified professional engineer, familiar with the construction industry; but Fuss & O'Neill cannot and does not guarantee that proposals, bids or actual Total Project or Construction Costs will not vary from opinions of probable cost prepared by Fuss & O'Neill. If prior to the bidding or negotiating Phase the Owner wishes greater assurance as to Total Project or Construction Costs, the Owner shall employ an independent cost estimator.

ITEM NO.	ITEM DESCRIPTION	UNIT MEAS.	NO. UNITS	PER UNIT	TOTAL COST
SITE PREPARATION					
	Tree and Stump Removal	L.S.	1	$ 3,000.00	$ 3,000.00
	Clearing and Grubbing	AC	0.2	$ 7,000.00	$ 1,400.00
WATER CONTROL					
	Coffer Dam, Pump Systems, Bypass Pipes	L.S.	1	$ 75,000.00	$ 75,000.00
DEMOLITION					
	Concrete Walls	L.F.	130	$ 300.00	$ 39,000.00
	Concrete/Stone Stilling Basin	L.F.	42	$ 200.00	$ 8,400.00
	Stone Masonry Walls	L.F.	140	$ 100.00	$ 14,000.00
	Low-Level Outlet Pipe	L.F.	90	$ 25.00	$ 2,250.00
	Gate House, Foundation, Gate, Hardware	L.S.	1	$ 5,000.00	$ 5,000.00
EROSION AND SEDIMENT CONTROL					
	Slit Fence & Maintenance	L.F.	120	$ 7.50	$ 900.00
	Anti-Tracking Apron	L.S.	1	$ 2,000.00	$ 2,000.00
	Pumping Settling Basin & Maintenance	E.A.	1	$ 3,500.00	$ 3,500.00
LOW-LEVEL OUTLET & VALVE CHAMBER					
	Cement Lined D.I. Pipe (24" diameter)	L.F.	95	$ 130.00	$ 12,350.00
	Concrete Encasement - Class C	C.Y.	45	$ 400.00	$ 18,000.00
	Gate Valve	E.A.	1	$ 5,000.00	$ 5,000.00
	Trash Rack	E.A.	1	$ 1,200.00	$ 1,200.00
	Valve Chamber (4' diameter manhole)	E.A.	1	$ 10,000.00	$ 10,000.00
SPILLWAY & RETAINING WALL REPLACEMENT					
	Excavation	C.Y.	4,500	$ 20.00	$ 90,000.00
	Soil Stockpiling	L.S	1	$ 20,000.00	$ 20,000.00
	Concrete - Class F	C.Y.	280	$ 620.00	$ 173,600.00
SITE STABILIZATION WORK					
	Topsoil, Seed, Mulch, Fertilize	S.Y.	970	$ 4.25	$ 4,122.50
	SUBTOTAL OPINION OF CONSTRUCTION COST				**$ 488,722.50**
ENGINEERING/ PERMITTING					
	Engineering and Permitting	LS	1	$ 80,000.00	$ 80,000.00
	Survey/As-Built Mapping	LS	1	$ 5,000.00	$ 5,000.00
	Construction Administration	LS	1	$ 50,000.00	$ 50,000.00
	Mobilization & Demobilization	LS	1	$ 20,000.00	$ 20,000.00
	Testing Laboratory- Concrete	LS	1	$ 5,000.00	$ 5,000.00
	Insurance and Bonds	LS	1	$ 25,000.00	$ 25,000.00
	Escalation/Inflation	%	1	3%/year	
	TOTAL OPINION OF CONSTRUCTION COST				**$ 673,722.50**
	CONTINGENCY (20%)				**$ 134,744.50**
	TOTAL OPINION OF COST (ROUNDED TO NEAREST $1,000)				**$ 808,000.00**

Appendix E

Inland Resource Area Delineation Report

FUSS & O'NEILL

Site Investigation and Inland Resource Area Delineation Report

Report Date: October 30, 2013

Prepared For: Robert T. Reed
Town Administrator
Town of Leicester
3 Washburn Square
Leicester, Massachusetts 01524

Site Location: Waite Pond Dam, Leicester, MA

Inspection Date: September 17, 2013

Regulated Inland Wetland Resource Areas:

- ☒ Bank
- ☒ Land Under Water Bodies and Waterways
- ☒ Riverfront Area
- ☒ Buffer Zone
- ☐ Vernal Pool
- ☒ Bordering Vegetated Wetland (BVW)
- ☒ Land Subject to Flooding (BLSF/ILSF)
- ☐ Isolated Vegetated Wetland
- ☐ Estimated Habitats of Rare Wildlife

Delineated Resource Area Field Numbering Sequence *[as depicted on the attached Resource Map]***:**

Bank/LUWW: A099 to A111; B100 to B112 **BVW:** C100 to C106

Wetland and watercourse resource areas were delineated in accordance with applicable local, state and federal statutes, as detailed within the Resource Area Description attachment. This delineation does not constitute an official wetland boundary until such time as it is accepted and approved by local, state or federal regulatory agencies.

The wetlands delineation was conducted by:

Sara S. Fusco, CPESC
Wetland Scientist/Soil Scientist

att

146 Hartford Road
Manchester, CT
06040
t 860.646.2469
800.286.2469
f 860.533.5143

www.fando.com

Connecticut
Massachusetts
Rhode Island
South Carolina

FUSS & O'NEILL

ATTACHMENTS

- Resource Area Description
- DEP Bordering Vegetated Wetland (310 CMR 10.55) Delineation Field Forms
- NRCS Soil Map and Soil Report
- Resource Area Sketch Map
- MassGIS: OLIVER generated FEMA Map

Fuss & O'Neill Inc. performed a wetland resource area field inspection and delineation within 100 feet of Waite Pond Dam in Leicester, Massachusetts on September 17, 2013. The purpose of the delineation was to locate the jurisdictional limits of areas regulated under the Wetland Protection Act (M.G.L. c. 131 sec. 40) and the associated Wetland Protection regulations (310 CMR 10). The extent of the resource area determination is referred to herein as "the area of interest" and depicted on the attached Wetland Sketch Map. Inland wetland resource areas identified in the area of interest during the field inspection include: Bordering Vegetated Wetlands (BVW), Bank, Land Under Water Bodies and Waterways (LUWW), Riverfront Area, and Buffer Zone. MA Natural Heritage Endangered Species Program (NHESP) Priority Habitat for Rare Species and Estimated Habitat for Rare Wildlife are not depicted within the area of interest on maps retrieved from MassGIS.

Resource Area Descriptions

Bordering Vegetated Wetlands (BVW): Regulatory Framework and Delineation Methodology

As stated in 310 CMR (2)(a), "*Bordering Vegetated Wetlands are freshwater wetlands which border on creeks, rivers, streams, ponds and lakes. The types of freshwater wetlands are wet meadows, marshes, swamps and bogs. Bordering Vegetated Wetlands are areas where the soils are saturated and/or inundated such that they support a predominance of wetland indicator plants. The ground and surface water regime and the vegetation community which occur in each type of freshwater wetland are specified in M.G.L. c 131 sec. 40*."

Fuss & O'Neill Inc. delineated bordering vegetated wetlands within 100 feet of Waite Pond Dam in accordance with methodology provided in the Massachusetts DEP handbook, Delineating Bordering Vegetated Wetlands under the Massachusetts Wetlands Protection Act, dated March 1995, the 1987 Corps of Engineers Wetlands Delineation Manual, and the Regional Supplement to the Corps of Engineers Wetlands Delineation Manual: Northcentral and Northeast Region, dated 2012. Consecutively numbered flags were placed in the field to demarcate the wetland boundary and data regarding vegetation, soils, and hydrology was gathered to complete the required MassDEP BVW delineation field forms, attached. Wetlands were categorized in accordance with Classification of Wetlands and Deepwater Habitats of the United States, Cowardin et.al. 1979.

Hydric soil determinations were made in accordance with Field Indicators for Identifying Hydric Soils in New England (NEIWPCC, 2004). The Wetland Indicator Status for plant species was ascertained using the USACE Northcentral and Northeast 2013 Regional Wetland Plant List. The Wetland Indicator Status is used to designate a plant species' preference for growth in a wetland or upland habitat as follows:

- Obligate Wetland (OBL): Hydrophyte, almost always occur in wetlands
- Facultative Wetland (FACW): Hydrophyte, usually occur in wetlands, but may occur in non-wetlands
- Facultative (FAC): Hydrophyte, occur in wetlands and non-wetlands

- Facultative Upland (FACU): nonhydrophyte, usually occur in non-wetlands, but may occur in wetlands
- Upland (UPL): Nonhydrophyte, almost never occur in wetlands

BVW: Resource Area Description

Vegetation

The BVW within the area of interest is a palustrine emergent groundwater seep. It is located on a concave hillslope east of the dam and south of Kettle Brook (wetland flags: C100 to C106). Common vegetation identified within the hillside seep included: arrow-wood, *Viburnum dentatum* (FAC); jewelweed, *Impatiens capensis* (FACW); Jack-in-the-pulpit, *Arisaema triphyllum* (FAC); cinnamon fern, *Osmundastrum cinnamomeum* (FACW); and, royal fern, *Osmunda regalis* (OBL).

Hydrology

The delineated BVW is hydrologically connected to Kettle Brook, which flows southeast from Waite Pond. Groundwater was observed seeping from the hillside during the investigation.

Soils

The Natural Resource Conservation Service (NRCS) mapped soil types adjacent to the dam include: well drained Paxton, fine sandy loam; and, very poorly drained Whitman, sandy loam. Detailed information regarding each of these soil series is included within the NRCS Soil Map and Soil Report attachment. Results of the detailed field analyses of soils within the area of interest were generally consistent with the published NRCS soil mapping. The area north of Kettle Brook is mapped as Whitman sandy loam but was found to consist of rip rap, stone retaining walls and well drained human transported material (HTM). These materials are present due to historic disturbances associated with the channelization of the watercourse and construction of the parking area adjacent to Chapel Street.

Bank: Regulatory Framework and Delineation Methodology

Bank is defined under 310 CMR 10.54(2)(c) as "*the portion of the land surface which normally abuts and confines a water body. It occurs between a water body and a vegetated bordering wetland and adjacent flood plain, or, in the absence of these, it occurs between a water body and an upland*." Fuss & O'Neill Inc. performed a delineation of Bank within the area of interest using consecutively numbered flags placed in the field to demarcate the Bank of a perennial stream (Kettle Brook) as well as the Banks of Waite Pond in the vicinity of the dam.

Bank: Resource Description

Bank along the perennial watercourse (Kettle Brook) coincided with the Mean Annual High-Water Line (MAHWL)/bankfull, as defined under 310 CMR 10.58 (2)(a)(2). Bank along Waite Pond is located between the surrounding upland and the water body. Bank was located in the field by the first observable break in topography (flags: A099 to A111 and B100 to B112).

Riverfront Area: Regulatory Framework and Delineation Methodology

Riverfront Area is defined under 310 CMR 10.58(2)(a) as "*the area of land between a river's mean annual high water line and a parallel line measured horizontally*." 310 CMR 10.58(2)(a)(1) defines rivers as, "*any natural flowing body of water that empties to any ocean, lake, pond or other river and which flows throughout the year. Rivers include streams (see 310 CMR 10.04: Stream) that are perennial because surface water flows within them throughout the year. Intermittent streams are not rivers as defined herein because surface water does not flow within them throughout the year*." 310 CMR 10.58(2)(a)(2) further specifies that "*The Riverfront Area is the area of land between a river's mean annual high-water line measured horizontally outward from the river and a parallel line located 200 feet away, …*" continuing with exceptions that are not applicable to the area of interest.

The extent of the Riverfront Area adjacent to Waite Pond dam is determined by measuring a horizontal line 200 feet from the delineated mean annual high-water line of the perennial watercourse, Kettle Brook. As previously detailed, the mean annual high water line of the brook coincides with the delineated Bank resource.

Riverfront Area: Resource Area Description

The Riverfront Area within the area of interest includes the following regulated resource areas: Bordering Land Subject to Flooding (BLSF), BVW, Bank, Land Under Water Bodies and Waterways, and Buffer. No vernal pools, isolated vegetated wetlands, or Natural Heritage Endangered Species Program habitats of rare species or rare wildlife are located within the Riverfront Area in the area of interest. The Riverfront Area within the area of interest also includes roadways and private residential properties. Evidence of wildlife usage within the Riverfront Area was limited to sightings of common songbirds.

Land Under Water Bodies and Waterways (LUWW)

LUWW is defined under 310 CMR 10.56 (2)(a) as "*the land beneath any creek, river, stream, pond or lake. Said land may be composed of organic muck or peat, fine sediments, rocks or bedrock.*" The boundary of LUWW is defined as the mean annual low water level (310 CMR 10.56 (2)(c). LUWW was not specifically field delineated. For the intents and purposes of this resource area delineation, the delineated Banks of the perennial stream and Waite Pond are analogous to the limits of LUWW.

Land Subject to Flooding (LSF)

Bordering Land Subject to Flooding (BLSF) is defined in 310 CMR 10.57 (2)(a)(1) as "*an area with low, flat topography adjacent to and inundated by flood waters rising from creeks, rivers, streams, ponds or lakes. It extends from the banks of these waterways and water bodies; where a bordering vegetated wetland occurs, it extends from said wetlands*." 310 CMR (2)(a)(3) further states that the boundary of BLSF "*is the estimated maximum lateral extent of flood water which will theoretically result from the statistical 100-year frequency storm*." The BLSF boundary within the area of interest was determined through use of the MassGIS's Online Mapping Tool (OLIVER), attached. The National Flood Hazard Layer is provided by the Federal Emergency Management Agency (FEMA). Information provided by FEMA is generally consistent with observed field conditions.

Buffer Zone

Buffer Zone is defined in 310 CRM 10.04 as "that area of land extending 100 feet horizontally outward from the boundary of any area specified in 310 CMR 10.02(1)(a). Buffer Zone within the area of interest is associated with BVW and Bank. The buffer zone in the area of interest contains roadways and private residential properties, including wooded areas and mown lawns. Common vegetation occurring within the Buffer in the area of interest includes: sugar maple, *Acer saccharum* (FACU); pignut hickory, *Carya glabra* (FACU); eastern white pine, *Pinus strubus* (FACU); red maple, *Acer rubrum* (FAC); gray birch, *Betula populifolia* (FAC); beech, *Fagus grandifolia* (FACU); staghorn sumac, *Rhyus hirta*; (not classified); Virginia creeper, *Parthenocissus quinquefolia* (FACU); bittersweet, *Celastrus orbiculatus* (not classified); tatarian honeysuckle, *Lonicera tatarica* (FACU); brambles, *rubus spp.*; Canada mayflower, *Maianthemum canadense* (FACU), and mown lawn.

- Observation Plot: 1W; Transect: 1
- Observation Plot: 2U; Transect: 1

MassDEP Bordering Vegetated Wetland (310 CMR 10.55) Delineation Field Data Form

Applicant: Town of Leicester Prepared by: Sara Fusco Project location: Waite Pond Dam DEP File #: _____

Check all that apply:

- ☐ Vegetation alone presumed adequate to delineate BVW boundary: fill out Section I only
- ☑ Vegetation and other indicators of hydrology usedto delineateBVW boundary: fill out Sections I and II
- ☐ Method other than dominance test used (attach additional information)

Section I.

Vegetation	Observation Plot Number: 1W		Transect Number: 1	Date of Delineation: 9/17/2013
A. Sample Layer & Plant Species (by common/scientific name)	B. Percent Cover (or basal Area)	C. Percent Dominance	D. Dominant Plant (yes or no)	E. Wetland Indicator Category*
Shrubs				
Arrow-wood (Viburnum dentatum)	8%	10.0%	yes	FAC *
Herb				
jewelweed (Impatiens capensis)	20%	25%	yes	FACW *
Jack-in-the-pulpit (Arisaema triphyllum)	5%	6.25%	No	FAC *
Cinnamon fern osmondastrum cinnamomeum)	30%	37.5%	yes	FACW *
royal fern (osmonda regalis)	25%	31.25%	yes	OBL *

* *Use an asterisk to mark wetland indicator plants: plant species listed in the Wetlands Protection Act (MGL c.131, s.40); plants in the genus Sphagnum; plants listed as FAC, FAC+, FACW-, FACW, FACW+, or OBL; or plants with physiological or morphological adaptations. If any plants are identified as wetland indicator plants due to physiological or morphological adaptations, describe the adaptation next to the asterisk.*

Vegetation conclusion:

Number of dominant wetland indicator plants: 4 Number of dominant non-wetland indicator plants: 0

Is the number of dominant wetland plants equal to or greater than the number of dominant non-wetland plants? (yes) no

If vegetation alone is presumed adequate to delineate the BVW boundary, submit this form with the Request for Determination of Applicability or Notice of Intent

Section II. Indicators of Hydrology

Hydric Soil Interpretation

1. Soil Survey

Is there a published soil survey for this site? yes no
title/date:
map number: NRCS Web Soil
soil type mapped:
hydric soil inclusions: Survey.

Are field observations consistent with soil survey? yes no
Remarks:
General consistent with the exception of disturbed areas north of Kettle Brook.

2. Soil Description

Horizon	Depth	Matrix Color	Mottles Color
Ap	8"	10YR 4/1	
Bg	—	7.5YR 2/1	2.5YR 5/4

Remarks:
Very rocky ≥ 20%; could not dig below +/- 12"

3. Other:
Ground water observed in test hole
Conclusion: Is soil hydric? yes no

Other Indicators of Hydrology: (check all that apply & describe)

- ☐ Site Inundated: _____
- ☑ Depth to free water in observation hole: +/- 4"
- ☑ Depth to soil saturation in observation hole: a surface
- ☑ Water marks: _____
- ☐ Drift lines: _____
- ☐ Sediment Deposits: _____
- ☐ Drainage patterns in BVW: _____
- ☐ Oxidized rhizospheres: _____
- ☑ Water-stained leaves: _____
- ☐ Recorded Data (streams, lake, or tidal gauge; aerial photo; other): _____
- ☐ Other: _____

Vegetation and Hydrology Conclusion

	Yes	No
Number of wetland indicator plants ≥ # of non-wetland indicator plants	✓	
Wetland hydrology present:		
Hydric soil present	✓	
Other indicators of hydrology present	✓	
Sample location is in a BVW	✓	

Submit this form with the Request for Determination of Applicability or Notice of Intent.

MassDEP Bordering Vegetated Wetland (310 CMR 10.55) Delineation Field Data Form

Applicant: Town of Leicester Prepared by: Sara Fusco Project location: Waite Pond Dam DEP File #: _____

Check all that apply:

- ☑ Vegetation alone presumed adequate to delineate BVW boundary: fill out Section I only
- ☐ Vegetation and other indicators of hydrology usedto delineateBVW boundary: fill out Sections I and II
- ☐ Method other than dominance test used (attach additional information)

Section I.

Vegetation	Observation Plot Number: 2W		Transect Number: 1	Date of Delineation: 9/17/2013
A. Sample Layer & Plant Species (by common/scientific name)	B. Percent Cover (or basal Area)	C. Percent Dominance	D. Dominant Plant (yes or no)	E. Wetland Indicator Category*
Tree				
Sugar Maple (Acer saccharum)	30%	60%	yes	~~FA~~ FACU
Pignut Hickory (Carya glabra)	20%	40%	yes	FACU
Liana				
V. creeper (Parthenocissus quinquefolia)	10%	55.5%	yes	FACU
Bittersweet (Celastrus orbiculatus)	8%	44.6%	yes	Not classified
shrub				
Staghorn sumac (Rhus hirta)	18%	100%	yes	Not classified.
Herb				
NY Fern (Parathelypteris noveboracensis)	10%	14.2%	NO	FAC.
Mown Lawn	60%	85.7%	yes	

* *Use an asterisk to mark wetland indicator plants: plant species listed in the Wetlands Protection Act (MGL c.131, s.40); plants in the genus Sphagnum; plants listed as FAC, FAC+, FACW-, FACW, FACW+, or OBL; or plants with physiological or morphological adaptations. If any plants are identified as wetland indicator plants due to physiological or morphological adaptations, describe the adaptation next to the asterisk.*

Vegetation conclusion:

Number of dominant wetland indicator plants: 0 Number of dominant non-wetland indicator plants: 3

Is the number of dominant wetland plants equal to or greater than the number of dominant non-wetland plants? yes (no)

If vegetation alone is presumed adequate to delineate the BVW boundary, submit this form with the Request for Determination of Applicability or Notice of Intent

NRCS Soil Map and Soil Report

Soil Map—Worcester County, Massachusetts, Southern Part
(Waite Pond)

Map Scale: 1:1,100 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 15 30 60 90

Feet: 0 50 100 200 300

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 19N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:25,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Worcester County, Massachusetts, Southern Part
Survey Area Data: Version 5, Jan 30, 2007

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Mar 30, 2011—May 1, 2011

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Worcester County, Massachusetts, Southern Part (MA615)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
1	Water	1.2	23.2%
73A	Whitman sandy loam, 0 to 3 percent slopes, extremely stony	0.9	16.9%
305C	Paxton fine sandy loam, 8 to 15 percent slopes	3.1	59.8%
Totals for Area of Interest		**5.1**	**100.0%**

Map Unit Description (Brief, Generated)

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions in this report, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

The Map Unit Description (Brief, Generated) report displays a generated description of the major soils that occur in a map unit. Descriptions of non-soil (miscellaneous areas) and minor map unit components are not included. This description is generated from the underlying soil attribute data.

Additional information about the map units described in this report is available in other Soil Data Mart reports, which give properties of the soils and the limitations, capabilities, and potentials for many uses. Also, the narratives that accompany the Soil Data Mart reports define some of the properties included in the map unit descriptions.

Report—Map Unit Description (Brief, Generated)

Worcester County, Massachusetts, Southern Part

Map Unit: 1—Water

Component: Water (100%)

Generated brief soil descriptions are created for major soil components. The Water is a miscellaneous area.

Map Unit: 73A—Whitman sandy loam, 0 to 3 percent slopes, extremely stony

Component: Whitman (70%)

The Whitman component makes up 70 percent of the map unit. Slopes are 0 to 3 percent. This component is on depressions on till plains. The parent material consists of friable coarse-loamy eolian deposits over dense coarse-loamy lodgment till derived from metamorphic rock. Depth to a root restrictive layer, densic material, is 12 to 30 inches. The natural drainage class is very poorly drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches is low. Shrink-swell potential is low. This soil is not flooded. It is frequently ponded. A seasonal zone of water saturation is at 0 inches during January, February, March, April, May, June, September, October, November, December. Organic matter content in the surface horizon is about 74 percent. Nonirrigated land capability classification is 7s. This soil meets hydric criteria.

Component: RIDGEBURY (10%)

Generated brief soil descriptions are created for major components. The RIDGEBURY soil is a minor component.

Component: SWANSEA (10%)

Generated brief soil descriptions are created for major components. The SWANSEA soil is a minor component.

Component: other soils (10%)

Generated brief soil descriptions are created for major components. The other soils soil is a minor component.

Map Unit: 305C—Paxton fine sandy loam, 8 to 15 percent slopes

Component: Paxton (75%)

The Paxton component makes up 75 percent of the map unit. Slopes are 8 to 15 percent. This component is on drumlins on uplands, drumlinoid ridges on uplands. The parent material consists of friable coarse-loamy eolian deposits over dense coarse-loamy lodgment till derived from schist. Depth to a root restrictive layer, densic material, is 18 to 38 inches. The natural drainage class is well drained. Water movement in the most restrictive layer is moderately high. Available water to a depth of 60 inches is low. Shrink-swell potential is low. This soil is not flooded. It is not ponded. A seasonal zone of water saturation is at 24 inches during February, March, April. Organic matter content in the surface horizon is about 4 percent. Nonirrigated land capability classification is 3e. This soil does not meet hydric criteria.

Component: CHARLTON (10%)

Generated brief soil descriptions are created for major components. The CHARLTON soil is a minor component.

Component: CANTON (8%)

Generated brief soil descriptions are created for major components. The CANTON soil is a minor component.

Component: WOODBRIDGE (5%)

Generated brief soil descriptions are created for major components. The WOODBRIDGE soil is a minor component.

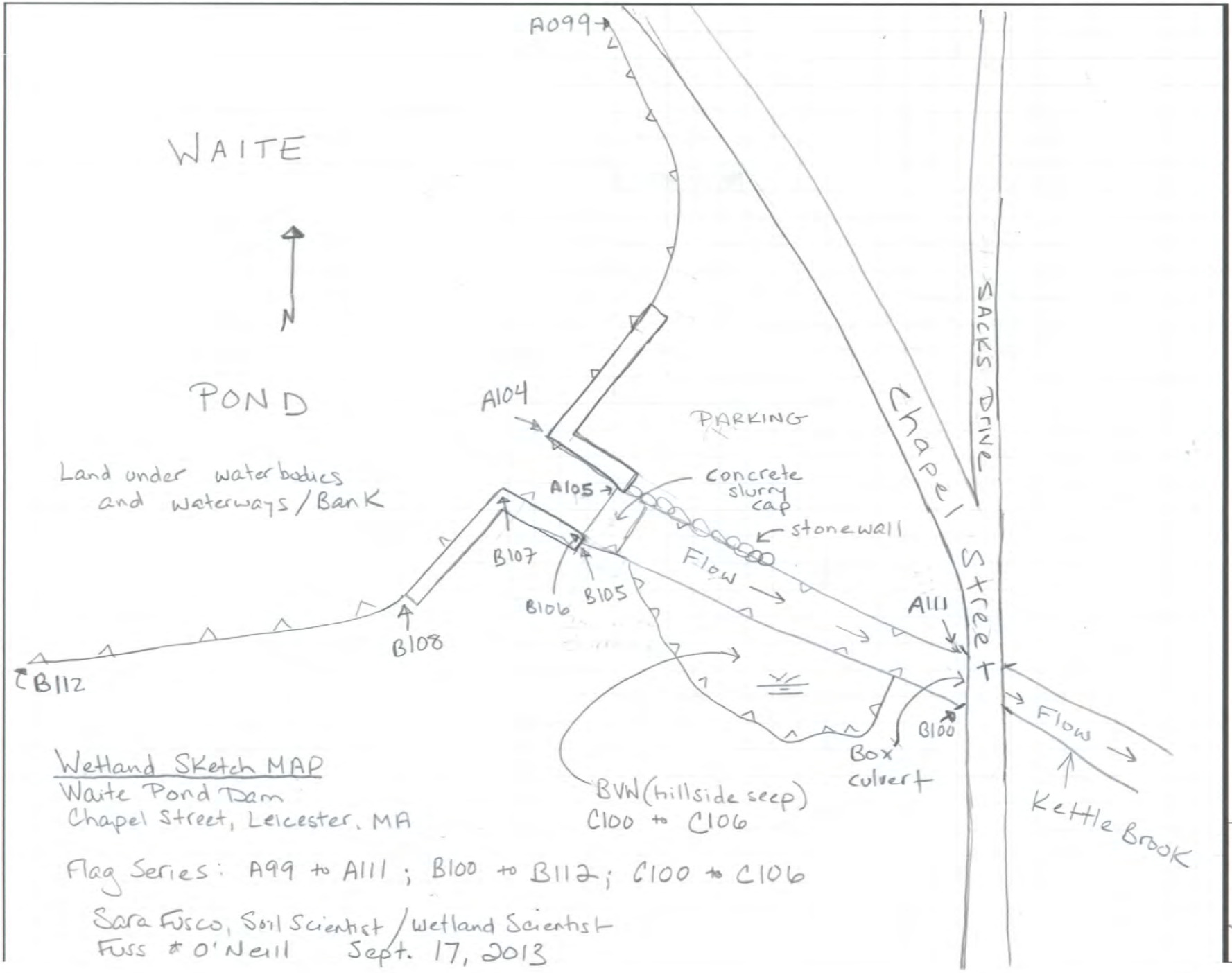
Component: RIDGEBURY (2%)

Generated brief soil descriptions are created for major components. The RIDGEBURY soil is a minor component.

Data Source Information

Soil Survey Area: Worcester County, Massachusetts, Southern Part
Survey Area Data: Version 5, Jan 30, 2007

Wetland Sketch Map



Wetland Sketch MAP
Waite Pond Dam
Chapel Street, Leicester, MA

Flag Series: A99 to A111 ; B100 to B112; C100 to C106

Sara Fusco, Soil Scientist / Wetland Scientist
Fuss & O'Neill Sept. 17, 2013

FUSS&O'NEILL

Prepared By	Date	Checked By	Date	Project No
SSF	9/17/13			20081886.A10

Sheet No 1 of 1

MassGIS: Oliver Generated FEMA Map