Draft Supplemental Watershed Plan No. 2 and Environmental Assessment for the Rehabilitation of Powdermill Dam of the Powdermill Brook Watershed Hampden and Hampshire Counties, Massachusetts

PREPARED BY
USDA Natural Resources Conservation Service

IN COOPERATION WITH

City of Westfield
Hampden Hampshire Conservation District

September 2023

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DRAFT Supplemental Watershed Plan No. 2 and Environmental Assessment for the Rehabilitation of Powdermill Dam of the Powdermill Brook Watershed Hampden and Hampshire Counties, Massachusetts

Prepared By:
USDA – Natural Resources Conservation Service

In Cooperation With:
City of Westfield
Hampden Hampshire Conservation District

AUTHORITY

The original watershed work plan was prepared, and the works of improvement were installed under the authority of the Watershed Protection and Flood Prevention Act of 1954. The rehabilitation of Powdermill Dam is authorized by Section 14 of the Watershed Protection and Flood Prevention Act (Public Law 83-566) as enacted by Section 313 of Public Law 106-472, otherwise known as "The Small Watershed Rehabilitation Amendments of 2000."

ABSTRACT

The Powdermill Dam is classified as a high hazard dam that does not presently meet Massachusetts Department of Conservation and Recreation (DCR) and USDA Natural Resources Conservation Service (NRCS) current dam safety and performance standards. The Powdermill Dam would be overtopped during the Probable Maximum Flood (PMF) for both current and future buildout conditions and models predict the auxiliary spillway would breach during the design storm. The Sponsors have chosen to rehabilitate the dam to address the identified safety deficiencies. The preferred alternative involves the following modifications to the structure: raise the top of dam an average of 2 feet to level it to elevation 205; armor the auxiliary spillway (ASW) with a 4-cycle, 106-ft-wide labyrinth weir at the existing ASW crest elevation; construct the chute of the labyrinth weir with roller compacted concrete (RCC) and reinforced concrete sidewalls; construct an RCC stilling basin with riprap outlet protection at the toe of the chute; regrout the principal spillway conduit and apply a concrete sealant; install a filter diaphragm near the downstream end of the existing principal spillway conduit; install new plastic pipe toe drains and filter trench, and fill the existing toe drains with grout; and remove the existing pond drain gate to allow Powdermill Brook to naturally re-establish through the floodpool. There will be no change in the current levels of flood protection downstream as a result of project activity. Project installation cost is estimated to be $7,734,800 of which $5,599,800 will be paid from the Small Watershed Rehabilitation funds and $2,135,000 from local funds.

COMMENTS AND INQUIRIES

Comments and inquiries must be received by November 20, 2023. Submit comments and inquiries to Daniel Wright, State Conservationist, USDA – Natural Resources Conservation Service, 451 West Street, Amherst MA 01002; Phone: (413) 253-4350.

Non-Discrimination Statement

In accordance with Federal civil rights law and U.S. Department of Agriculture (USDA) civil rights regulations and policies, the USDA, its Agencies, offices, and employees, and institutions participating in or administering USDA programs are prohibited from discriminating based on race, color, national origin, religion, sex, gender identity (including gender expression), sexual orientation, disability, age, marital status, family/parental status, income derived from a public assistance program, political beliefs, or reprisal or retaliation for prior civil rights activity, in any program or activity conducted or funded by USDA (not all bases apply to all programs). Remedies and complaint filing deadlines vary by program or incident.

Persons with disabilities who require alternative means of communication for program information (e.g., Braille, large print, audiotape, American Sign Language, etc.) should contact the responsible Agency or USDA's TARGET Center at (202) 720-2600 (voice and TTY) or contact USDA through the Federal Relay Service at (800) 877-8339. Additionally, program information may be made available in languages other than English.

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POWDERMILL BROOK WATERSHED AGREEMENT

Supplemental Watershed Plan Agreement
(Supplement No. 2)

Between the

City of Westfield
Hampden Hampshire Conservation District
(Referred to herein as "Sponsors")

and the

UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
Formerly the Soil Conservation Service (SCS)
(Referred to herein as NRCS)

Whereas, the original Watershed Plan Agreement for the Powdermill Brook Watershed, State of Massachusetts, executed by the Sponsors named therein and NRCS, became effective on the 16th day of November 1961; and

Whereas, a Supplemental Watershed Plan Agreement No.1 for the Powdermill Brook Watershed, State of Massachusetts, executed by the Sponsors named therein and NRCS, became effective on the __ day of ___ 20__; and

Whereas, application has heretofore been made to the Secretary of Agriculture by the Sponsors for assistance in preparing a plan for works of improvement for Powdermill Dam in the Powdermill Brook Watershed, State of Massachusetts, under the authority of the Watershed Protection and Flood Prevention Act, as amended (16 U.S.C. Sections 1001 to 1008, 1010, and 1012); and

Whereas, the responsibility for administration of the Watershed Protection and Flood Prevention Act, has been assigned by the Secretary of Agriculture to NRCS; and

Whereas, there has been developed through the cooperative efforts of the Sponsors and NRCS a Watershed Work Plan – Environmental Assessment for works of improvement for the rehabilitation of Powdermill Dam, Powdermill Brook Watershed, State of Massachusetts, hereinafter referred to as the Plan-EA or plan, which plan is annexed to and made a part of this agreement;

Now, therefore, in view of the foregoing considerations, the Secretary of Agriculture, through NRCS, and the Sponsors hereby agree on this watershed project plan and that the works of improvement for this project will be installed, operated, and maintained in accordance with the terms, conditions, and stipulations provided for in this plan and including the following:

1. **Term.** The term of this agreement is for the installation period and evaluated life of the project (79 years) and does not commit NRCS to assistance of any kind beyond the end of the evaluated life.

2. **Costs.** The costs shown in this plan are preliminary estimates. Final costs to be borne by the parties hereto will be the actual costs incurred in the installation of works of improvement.

3. **Real property.** The City of Westfield will acquire such real property as will be needed in connection with the works of improvement according to NRCS minimum land rights' policy, which is to the existing crest of the auxiliary spillway elevation of 196.3 feet, a level below top of dam elevation. The City of Westfield accepts this level of easement and its associated risk for potential damages. They also recognize that the land rights must include a prohibition on future construction of habitable dwellings upstream from the dam below the elevation of the top of the dam. The amounts and percentages of the real property acquisition costs to be borne by the Sponsors and NRCS are as shown in the cost-share table in Section 5 hereof.

   The sponsors agree that all land acquired for measures, other than land treatment practices, with financial or credit assistance under this agreement will not be sold or otherwise disposed of for the evaluated life of the project except to a public agency which will continue to maintain and operate the development in accordance with the operation and maintenance agreement.

4. **Uniform Relocation Assistance and Real Property Acquisition Policies Act.** The sponsors hereby agree to comply with all of the policies and procedures of the Uniform Relocation Assistance and Real Property Acquisition Policies Act (42 U.S.C. Section 4601 et seq. as further implemented through regulations in 49 CFR Part 24 and 7 CFR Part 21) when acquiring real property interests for this federally assisted project. If the sponsors are legally unable to comply with the real property acquisition requirements, they agree that, before any Federal financial assistance is furnished, they will provide a statement to that effect, supported by an opinion of the chief legal officer of the state containing a full discussion of the facts and law involved. This statement may be accepted as constituting compliance.

5. **Cost-share for Watershed Project Plans.** The following table will be used to show cost-share percentages and amounts for watershed project plan implementation.

Works of Improvement	NRCS		Sponsors		Total
Cost-Sharable Items 1/	**%**	**Cost**	**%**	**Cost**	**Cost**
Rehabilitation of dam (Construction Costs)	65.7%	$3,954,800	34.3%	$2,068,200	$6,023,000
Sponsors' Project Administration 1/	0%	$0	100%	$12,000	$12,000
Sponsors' Engineering	0%	$0	100%	$30,000	$30,000
Land Rights Acquisition	0%	$0	100%	$19,300	$19,300
Subtotal: Cost-Sharable Costs	**65%**	**$3,954,800**	**35%**	**$2,129,500**	**$6,084,300**
Non Cost-Sharable Items 2/					
NRCS Technical Assistance/Engineering	100%	$1,585,000	0%	$0	$1,585,000
Project Administration 1/	100%	$60,000	0%	$0	$60,000
Federal, State and Local Permits	0%	$0	100%	$5,500	$5,500
Real Property Rights	0%	$0	0%	$0	$0
Subtotal: Non Cost-Share Costs	**99.7%**	**$1,645,000**	**0.3%**	**$5,500**	**$1,650,500**
TOTAL:	**-**	**$5,599,800**	**-**	**$2,135,000**	**$7,734,800**

1/ The sponsors and NRCS will each bear the costs of project administration that each incurs.
2/ If actual non-cost-sharable item expenditures vary from these figures, the responsible party will bear the change.

6. **Land treatment agreements.** The sponsors will obtain agreements from owners of not less than 50 percent of the land above each multiple-purpose and floodwater-retarding structure. These agreements must provide that the owners will carry out farm or ranch conservation plans on their land. The sponsors will ensure that 50 percent of the land upstream of any retention reservoir site is adequately protected before construction of the

dam. The sponsors will provide assistance to landowners and operators to ensure the installation of the land treatment measures shown in the watershed project plan. The sponsors will encourage landowners and operators to continue to operate and maintain the land treatment measures after the long-term contracts expire, for the protection and improvement of the watershed.

7. **Floodplain Management.** Before construction of any project for flood prevention, the sponsors must agree to participate in and comply with applicable Federal floodplain management and flood insurance programs. The sponsor is required to have development controls in place below low and significant hazard dams prior to NRCS or the sponsor entering into a construction contract.

8. **Water and mineral rights.** The sponsors will acquire or provide assurance that landowners or resource users have acquired such water, mineral, or other natural resources rights pursuant to State law as may be needed in the installation and operation of the works of improvement. Any costs incurred must be borne by the sponsors and these costs are not eligible as part of the sponsors' cost-share.

9. **Permits.** The sponsors will obtain and bear the cost for all necessary Federal, State, and local permits required by law, ordinance, or regulation for installation of the works of improvement. These costs are not eligible as part of the sponsors' cost-share.

10. **NRCS assistance.** This agreement is not a fund-obligating document. Financial and other assistance to be furnished by NRCS in carrying out the plan is contingent upon the fulfillment of applicable laws and regulations and the availability of appropriations for this purpose.

11. **Additional agreements**. A separate agreement will be entered into between NRCS and the sponsors before either party initiates work involving funds of the other party. Such agreements will set forth in detail the financial and working arrangements and other conditions that are applicable to the specific works of improvement.

12. **Amendments.** This plan may be amended or revised only by mutual agreement of the parties hereto, except that NRCS may deauthorize or terminate funding at any time it determines that the sponsors have failed to comply with the conditions of this agreement or when the program funding or authority expires. In this case, NRCS must promptly notify the sponsors in writing of the determination and the reasons for the deauthorization of project funding, together with the effective date. Payments made to the sponsors or recoveries by NRCS must be in accordance with the legal rights and liabilities of the parties when project funding has been deauthorized. An amendment to incorporate changes affecting a specific measure may be made by mutual agreement between NRCS and the sponsors having specific responsibilities for the measure involved.

13. **Prohibitions.** No member of or delegate to Congress, or resident commissioner, may be admitted to any share or part of this plan, or to any benefit that may arise therefrom; but

this provision may not be construed to extend to this agreement if made with a corporation for its general benefit.

14. **Operation and Maintenance (O&M).** The sponsors will be responsible for the operation, maintenance, and any needed replacement of the works of improvement by actually performing the work or arranging for such work, in accordance with an O&M agreement. An O&M agreement will be entered into before Federal funds are obligated and will continue for the project life (75 years from completion of construction). Although the sponsors' responsibility to the Federal Government for O&M ends when the O&M agreement expires upon completion of the evaluated life of measures covered by the agreement, the sponsors acknowledge that continued liabilities and responsibilities associated with works of improvement may exist beyond the evaluated life.

15. **Emergency Action Plan.** Prior to construction, the sponsors must prepare an Emergency Action Plan (EAP) for each dam or similar structure where failure may cause loss of life or as required by state and local regulations. The EAP must meet the minimum content specified in the NRCS Title 180, National Operation and Maintenance Manual (NOMM), Part 500, Subpart F, Section 500.52, and meet applicable State agency dam safety requirements. The NRCS will determine that an EAP is prepared prior to the execution of fund obligating documents for construction of the structure. EAPs must be reviewed and updated by the sponsors annually.

16. **Nondiscrimination Provisions**. In accordance with Federal civil rights law and U.S. Department of Agriculture (USDA) civil rights regulations and policies, the USDA, its Agencies, offices, and employees, and institutions participating in or administering USDA programs are prohibited from discriminating based on race, color, national origin, religion, sex, gender identity (including gender expression), sexual orientation, disability, age, marital status, family/parental status, income derived from a public assistance program, political beliefs, or reprisal or retaliation for prior civil rights activity, in any program or activity conducted or funded by USDA (not all bases apply to all programs). Remedies and complaint filing deadlines vary by program or incident.

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Rights, 1400 Independence Avenue, SW, Washington, D.C. 20250-9410; (2) fax: (202) 690-7442; or (3) email: program.intake@usda.gov.

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By signing this agreement, the recipient assures the Department of Agriculture that the program or activities provided for under this agreement will be conducted in compliance with all applicable Federal civil rights laws, rules, regulations, and policies.

17. **Certification Regarding Drug-Free Workplace Requirements** (7 CFR Part 3021). By signing this Watershed Agreement, the sponsors are providing the certification set out below. If it is later determined that the sponsors knowingly rendered a false certification, or otherwise violated the requirements of the Drug-Free Workplace Act, the NRCS, in addition to any other remedies available to the Federal Government, may take action authorized under the Drug-Free Workplace Act.

    Controlled substance means a controlled substance in Schedules I through V of the Controlled Substances Act (21 U.S.C. Section 812) and as further defined by regulation (21 CFR Sections 1308.11 through 1308.15);

    Conviction means a finding of guilt (including a plea of nolo contendere) or imposition of sentence, or both, by any judicial body charged with the responsibility to determine violations of the Federal or State criminal drug statutes;

    Criminal drug statute means a Federal or non-Federal criminal statute involving the manufacturing, distribution, dispensing, use, or possession of any controlled substance;

    Employee means the employee of a grantee directly engaged in the performance of work under a grant, including: (i) all direct charge employees; (ii) all indirect charge employees unless their impact or involvement is insignificant to the performance of the grant; and (iii) temporary personnel and consultants who are directly engaged in the performance of work under the grant and who are on the grantee's payroll. This definition does not include workers not on the payroll of the grantee (e.g., volunteers, even if used to meet a matching requirement; consultants or independent contractors not on the grantees' payroll; or employees of subrecipients or subcontractors in covered workplaces).

Certification:

A. The sponsors certify that they will or will continue to provide a drug-free workplace by—

    1. Publishing a statement notifying employees that the unlawful manufacture, distribution, dispensing, possession, or use of a controlled substance is prohibited in the grantee's workplace and specifying the actions that will be taken against employees for violation of such prohibition.

2. Establishing an ongoing drug-free awareness program to inform employees about—
    a. The danger of drug abuse in the workplace;
    b. The grantee's policy of maintaining a drug-free workplace;
    c. Any available drug counseling, rehabilitation, and employee assistance programs; and
    d. The penalties that may be imposed upon employees for drug abuse violations occurring in the workplace.

3. Making it a requirement that each employee to be engaged in the performance of the grant be given a copy of the statement required by paragraph (1).

4. Notifying the employee in the statement required by paragraph (1) that, as a condition of employment under the grant, the employee must—
    a. Abide by the terms of the statement; and
    b. Notify the employer in writing of his or her conviction for a violation of a criminal drug statute occurring in the workplace no later than five calendar days after such conviction.

5. Notifying the NRCS in writing, within 10 calendar days after receiving notice under paragraph (4)(b) from an employee or otherwise receiving actual notice of such conviction. Employers of convicted employees must provide notice, including position title, to every grant officer or other designee on whose grant activity the convicted employee was working, unless the Federal agency has designated a central point for the receipt of such notices. Notice must include the identification numbers of each affected grant.

6. Taking one of the following actions, within 30 calendar days of receiving notice under paragraph (4) (b), with respect to any employee who is so convicted—
    a. Taking appropriate personnel action against such an employee, up to and including termination, consistent with the requirements of the Rehabilitation Act of 1973, as amended; or
    b. Requiring such employee to participate satisfactorily in a drug abuse assistance or rehabilitation program approved for such purposes by a Federal, State, or local health, law enforcement, or other appropriate agency.
7. Making a good faith effort to continue to maintain a drug-free workplace through implementation of paragraphs (1), (2), (3), (4), (5), and (6).

B. The sponsors may provide a list of the sites for the performance of work done in connection with a specific project or other agreement.

C. Agencies will keep the original of all disclosure reports in the official files of the agency.

18. **Certification Regarding Lobbying** (7 CFR Part 3018) (for projects > $100,000)

A. The sponsors certify to the best of their knowledge and belief, that:

1. No Federal appropriated funds have been paid or will be paid, by or on behalf of the sponsors, to any person for influencing or attempting to influence an officer or employee of an agency, Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.

2. If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned must complete and submit Standard Form LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions.

3. The sponsors must require that the language of this certification be included in the award documents for all subawards at all tiers (including subcontracts, subgrants, and contracts under grants, loans, and cooperative agreements) and that all subrecipients must certify and disclose accordingly.

B. This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by U.S. Code, Title 31, Section 1352. Any person who fails to file the required certification shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such failure.

19**. Certification Regarding Debarment, Suspension, and Other Responsibility Matters—Primary Covered Transactions (7 CFR Part 3017).**

A. The sponsors certify to the best of their knowledge and belief, that they and their principals:

1. Are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal department or agency;

2. Have not within a 3-year period preceding this proposal been convicted of or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public

(Federal, State, or local) transaction or contract under a public transaction; violation of Federal or State antitrust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property;

3. Are not presently indicted for or otherwise criminally or civilly charged by a governmental entity (Federal, State, or local) with commission of any of the offenses enumerated in paragraph A(2) of this certification; and

4. Have not within a 3-year period preceding this application/proposal had one or more public transactions (Federal, State, or local) terminated for cause or default.

B. Where the primary sponsors are unable to certify to any of the statements in this certification, such prospective participant must attach an explanation to this agreement.

20**. Clean Air and Water Certification.**

A. The project sponsoring organizations signatory to this agreement certify as follows:

1. Any facility to be utilized in the performance of this proposed agreement is (____), is not (X) listed on the Environmental Protection Agency List of Violating Facilities.

2. To promptly notify the NRCS-State administrative officer prior to the signing of this agreement by NRCS, of the receipt of any communication from the Director, Office of Federal Activities, U.S. Environmental Protection Agency, indicating that any facility which is proposed for use under this agreement is under consideration to be listed on the Environmental Protection Agency List of Violating Facilities.
3. To include substantially this certification, including this subparagraph, in every nonexempt sub-agreement.

B. The project sponsoring organizations signatory to this agreement agrees as follows:

1. To comply with all the requirements of section 114 of the Clean Air Act as amended (42 U.S.C. Section 7414) and section 308 of the Federal Water Pollution Control Act (33 U.S.C. Section 1318), respectively, relating to inspection, monitoring, entry, reports, and information, as well as other requirements specified in section 114 and section 308 of the Air Act and the Water Act, issued there under before the signing of this agreement by NRCS.

2. That no portion of the work required by this agreement will be performed in facilities listed on the EPA List of Violating Facilities on the date when this agreement was signed by NRCS unless and until the EPA eliminates the name of such facility or facilities from such listing.

3. To use their best efforts to comply with clean air standards and clean water standards at the facilities in which the agreement is being performed.

4. To insert the substance of the provisions of this clause in any nonexempt subagreement.

C. The terms used in this clause have the following meanings:

1. The term "Air Act" means the Clean Air Act, as amended (42 U.S.C. Section 7401 et seq.).

2. The term "Water Act" means Federal Water Pollution Control Act, as amended (33 U.S.C. Section 1251 et seq.).

3. The term "clean air standards" means any enforceable rules, regulations, guidelines, standards, limitations, orders, controls, prohibitions, or other requirements which are contained in, issued under, or otherwise adopted pursuant to the Air Act or Executive Order 11738, an applicable implementation plan as described in section 110 of the Air Act (42 U.S.C. Section 7414) or an approved implementation procedure under section 112 of the Air Act (42 U.S.C. Section 7412).

4. The term "clean water standards" means any enforceable limitation, control, condition, prohibition, standards, or other requirement which is promulgated pursuant to the Water Act or contained in a permit issued to a discharger by the Environmental Protection Agency or by a State under an approved program, as authorized by section 402 of the Water Act (33 U.S.C. Section 1342), or by a local government to assure compliance with pretreatment regulations as required by section 307 of the Water Act (33 U.S.C. Section 1317).

5. The term "facility" means any building, plant, installation, structure, mine, vessel, or other floating craft, location or site of operations, owned, leased, or supervised by a sponsor, to be utilized in the performance of an agreement or subagreement. Where a location or site of operations contains or includes more than one building, plant, installation, or structure, the entire location will be deemed to be a facility except where the Director, Office of Federal Activities, Environmental Protection Agency, determines that independent facilities are collocated in one geographical area.

21. **Assurances and Compliance.** As a condition of the grant or cooperative agreement, the sponsors assures and certifies that it is in compliance with and will comply in the course of the agreement with all applicable laws, regulations, Executive orders and other generally applicable requirements, including those set out below which are hereby incorporated in this agreement by reference, and such other statutory provisions as a specifically set forth herein.

State, Local, and Indian Tribal Governments: OMB Circular Nos. A-87, A-102, A-129, and A-133; and 7 CFR Parts 3015, 3016, 3017, 3018, 3021, and 3052.

Nonprofit Organizations, Hospitals, Institutions of Higher Learning: OMB Circular Nos. A-110, A-122, A-129, and A-133; and 7 CFR Parts 3015, 3017, 3018, 3019, 3021 and 3052.

22. **Examination of Records.** The sponsors must give the NRCS or the Comptroller General, through any authorized representative, access to and the right to examine all records, books, papers, or documents related to this agreement, and retain all records related to this agreement for a period of three years after completion of the terms of this agreement in accordance with the applicable OMB Circular.

23. **Signatures.**

The Sponsors and NRCS further agree to all other terms, conditions, and stipulations of said watershed agreement not modified herein.

CITY OF WESTFIELD
City Hall – Room 202
59 Court Street
Westfield, MA 01085

By:_____
Michael A. McCabe

Title: Mayor

Date: _____

The signing of this plan was authorized by a resolution by the City of Westfield and adopted at an official meeting held on_____.

_____
Secretary or Notary Public

City Hall – Room 202
59 Court Street
Westfield, MA 01085

Date: _____

24. **Signatures (cont.)**

The Sponsors and NRCS further agree to all other terms, conditions, and stipulations of said watershed agreement not modified herein.

Hampden Hampshire Conservation District
195 Russell Street, Suite B6
Hadley, MA 01035

By:_____
LEON RIPLEY

Title: Chairman

Date: _____

The signing of this plan was authorized by a resolution by the Hampden Hampshire Conservation District and adopted at an official meeting held on _____.

_____
Secretary or Notary Public

195 Russell Street, Suite B6
Hadley, MA 01035

Date: _____

NATURAL RESOURCES CONSERVATION SERVICE
U.S. DEPARTMENT OF AGRICULTURE

Approved by:

_____
DANIEL WRIGHT
State Conservationist
Massachusetts

Date:_____

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

SUMMARY OMB FACT SHEET

SUMMARY OF SUPPLEMENTAL WATERSHED PLAN NO. 102 AND ENVIRONMENTAL ASSESSMENT FOR THE REHABILITATION OF POWDERMILL BROOK WATERSHED DAM HAMPDEN AND HAMPSHIRE COUNTIES, MASSACHUSETTS 1ST CONGRESSIONAL DISTRICT

Prepared by: United States Department of Agriculture, Natural Resources Conservation Service (NRCS).

Authorization: The original work plan was prepared, and the works of improvement were installed, under the authority of the Watershed Protection and Flood Prevention Act (Public Law 83-566), as amended (16 U.S.C. Section 1001 et seq.), 1954. The rehabilitation of Powdermill Dam is authorized under Public Law 83-566 (as amended), and as further amended by Section 313 of Public Law 106-472.

Sponsors: City of Westfield and Hampden Hampshire Conservation District

Proposed Action: Raise the top of dam to level it to EL 205 and construct a 106-ft-wide, 4-cycle reinforced concrete labyrinth weir along with an earthen berm at the level control section of the existing auxiliary spillway. Armor the chute of the labyrinth with roller compacted concrete (RCC) with reinforced concrete sidewalls and construct an RCC stilling basin with riprap outlet protection at the toe of the chute. Re-grout the pipe joints in the existing 48-inch diameter reinforced concrete principal spillway conduit and apply a concrete sealant to the worn surfaces. In addition, install a filter diaphragm around the existing principal spillway conduit near the downstream slope and install new plastic pipe toe drains and a filter trench closer to the toe of the dam slope. Grout closed the existing toe drain pipes. Localized sediment will be removed adjacent to the existing principal spillway riser and the existing pond drain gate will be removed to allow Powdermill Brook to naturally re-establish through the floodpool.

Federal Objective: Investments in this proposed action reflect national priorities, encourage economic development, and protect the environment by:

(1) seeking to maximize sustainable economic development;

(2) seeking to avoid the unwise use of floodplains and flood-prone areas and minimizing adverse impacts and vulnerabilities in any case in which a floodplain or flood-prone area must be used; and

(3) protecting and restoring the functions of natural systems and mitigating any unavoidable damage to natural systems.

Purpose and Need for Action

Purpose: Provide the originally planned level of flood protection to the watershed for the next 50-100 years while minimizing environmental, economic, and social impacts.

Need: The present dam structure does not meet current safety and performance standards. Action is needed to reduce the risk of loss of life due to an overtopping breach of the existing dam or breach of the auxiliary spillway as a result of headcut erosion as well as to reduce the risk of flood damage to homes, commercial facilities, and an expanded infrastructure. .

There is a potential for loss of life from a catastrophic overtopping dam failure due to the existence of one stream crossing (bridge) and 19 roadways downstream of this structure within the breach inundation zone. In addition, people living and/or working in 363 residences, 82 apartments, 45 commercial buildings, and 2 public properties would be at risk from a catastrophic dam failure. The dam currently retains flood events up to a magnitude of the 100-year flood (auxiliary spillway crest elevation). The continuation of flood damage reduction is needed to protect downstream properties and infrastructure from flooding from the 100-year and smaller floods, while not increasing flooding upstream of the dam. The Sponsors want to continue to provide flood protection in a manner that reduces risk of loss of human life and is both cost effective and environmentally acceptable.

Landrights currently exist for the construction, operation, and maintenance of the dam and the storage of water based on the original easements procured for the project. The Sponsors currently hold the original flood easements below the auxiliary spillway crest elevation. Additional landrights will need to be procured to meet minimum NRCS landrights policy. The elevation of the top of dam will be raised about 2 feet to 205.0 for implementation of the recommended alternative.

Description of The Preferred Alternative: The selected plan is to rehabilitate Powdermill Dam in order to eliminate the threat to loss of life and property from a breach.

Resource Information:

Location: Latitude: 42.1451 degrees; Longitude: -72.7462 degrees

8-Digit Hydrologic Unit Number: 01080206

Watershed Size: Drainage Area = 2,851 acres (4.45 square miles)

Land Ownership: Town = 53.75%; State = 6.25%; Private= 40.0%; Federal = N/A

Climate and Topography: Massachusetts is influenced by wet, dry, hot, and cold airstreams, causing daily weather to be highly variable. The region has a humid continental climate with four distinct seasons. Summers are typically hot and humid, and winters are cold and snowy. Western Massachusetts can experience nor'easters in the winter months, which often cause several feet of snow accumulation. The topography of central Massachusetts consists of rolling hills, small

mountains, and rocky outcroppings. General characteristic topography and land features surrounding the project area consists of rolling hills but there are mountains located to the east and west of the dam.

Land Use: Cultivated Crops, 46.3 acres, 1.6%
Grassland/Pasture, 161.3 acres, 5.7%
Urban Open Space, 330.3 acres, 11.6%
Urban Low Intensity, 317.8 acres, 11.1%
Urban Medium Intensity, 168.9 acres, 5.9%
Urban High Intensity, 86.0 acres, 3.0%
Barren Land, 46.5 acres, 1.6%
Deciduous Forest, 794.2 acres, 27.9%
Coniferous Forest, 177.7 acres, 6.2%
Mixed Forest, 454.8 acres, 16.0%
Shrub, 27.0 acres, 0.9%
Woody Wetlands, 177.5 acres, 6.2%
Emergent Wetlands, 9.8 acres, 0.3%
Water, 52.7 acres, 1.8%

Population and Demographics: The estimated population of the area within the breach inundation zone floodplain (affected area) is 2,290 and the number of households is 888 according to the U.S. Census Bureau projections (American Community Survey 5-year Estimates for 2013-2017). According to the U.S. Census Bureau, Westfield's population was 40,072 in 2000; 41,092 in 2010; and 41,680 in 2018, indicating a steady increase over the last few decades. It is estimated that the affected area has seen similar growth during the same time period. Minority population by race is much higher in the affected area (23.0%) compared to Westfield (7.0%), but comparable to Hampden County (19.6%) and the State of Massachusetts (21.1%). Ethnicity (Hispanic or Latino) in the affected area (16.0%) is nearly double than Westfield (8.3%) and somewhat higher than the State of Massachusetts (11.2%), but lower than Hampden County (23.9%).

About 74.0% of the people living within the affected area are 18 years old and above, which is about the same for the City, County, and State. However, those age 65 years and older make up only 9% of the population in the affected area, which is lower than Westfield (15.9%), Hampden County (15.7%) and the State of Massachusetts (15.5%). It was noted during the field review of the affected area that there were many rental properties (duplexes, apartments, etc.) containing young people and/or young families. Westfield State University, a four-year public school university with over 6,000 total enrollment, is located not far from the affected area, which might help to explain the relatively younger population within the affected area as compared to the other three entities.

Using the *American Community Survey 5-year Estimates for 2013-2017*, 68.0% of the population in the affected area were in the labor force. The percentage of civilian unemployed in the labor force was 4.0%. Figures for the other entities were 65.4% in the labor force and 6.3% unemployed for Westfield, 62.0% in the labor force and 8.0% unemployment (Hampden County), and 67.3% and 6.0% (State of Massachusetts), respectively. According to the *U.S. Bureau of Labor Statistics*, recent unemployment rates are as follows: Westfield (October 2019 – 2.9%), Hampden County

(3.2%) and State of Massachusetts (4.0%), both November 2019. Unemployment data was not available for the affected area but given that the recent figures for the other three entities are within the small range of 2.9 – 4.0%, it is within reason that the affected area's unemployment rate is comparable, also.

The affected area's per capita income ($20,454) is much lower than Westfield, Hampden County, and the State of Massachusetts per capita incomes of $29,092, $28,072, and $39,913, respectively. Interestingly, when looking at median household incomes though, the affected area's is 107% of that of Westfield, 128% of Hampden County, but only 90% of the State of Massachusetts.

The percentage of high school graduates or higher in the affected area is much lower than Westfield, Hampden County, and the State of Massachusetts – 74.0% compared to 92.1%, 87.1%, and 90.3%, respectively. Again, this seems to be inconsistent with some of the other statistics, especially those related to income. About 28.0% of residents in the affected area have a bachelor's degree or higher compared to 32.0%, 28.7%, and 42.1% for the other three entities, respectively.

The population living below the poverty level for the affected area (7.6%) is a little lower than Westfield (8.5%) but much lower than Hampden County (17.2%) and the State of Massachusetts (11.1%).

Less than half of the population in the affected area are homeowners (48.0%); whereas the other three entities all exceed 60% home ownership.

In summary, the demographics of the affected area as compared to Westfield, Hampden County, and the State of Massachusetts overall reflects evidence of lower per capita income but higher median household income, low poverty levels, and the presence of a minority population. Although some statistics point towards the presence of disadvantaged communities, the poverty and median income levels reflect otherwise. Regardless, efforts were made to involve all interested parties in the planning process.

Based on a 2019 average daily traffic count from the Massachusetts Department of Transportation (MassDOT), approximately 29,200 motorists could be traveling on one stream crossing (bridge) and 19 roadways downstream of this structure within the breach inundation zone. In addition, 363 residences, 82 apartments, 45 commercial buildings, and 2 public properties would be at risk from a catastrophic dam failure. The potential for loss of human life would be significant.

Resource Concerns/Ecosystem Services Identified Through Scoping

Item/Concern	Relevant to the Proposed Action		Rationale
	Yes	**No**	
SOILS			
Prime and Unique Farmland and Farmland of Statewide Importance	X		Several acres of prime and unique farmland and farmland of statewide importance will be impacted by project activities.
WATER			
Water Quality	X		Environmental Law – may be a TMDL. Possible blue-green algae in area.
Floodplain Management	X		Executive Order 11988 directs federal agencies to evaluate impacts to floodplain management which this project involves.
Streams, Lakes and Wetlands	X		Executive Order 11990 directs federal agencies to evaluate impacts to wetlands which this project has in the adjacent streams, impoundment and wetlands.
Wild and Scenic Rivers	X		Evaluation completed, but none located on Powdermill Brook.
AIR			
Clean Air Act	X		Project activities may impact air quality near the site.
PLANTS			
Endangered and Threatened Species	X		Environmental Law – but no known plant species in area.
Invasive Species	X		Lots of Phragmites in project area.
Riparian Areas	X		NRCS Policy – potential impacts with decommissioning alternative.
ANIMALS			
Fish and Wildlife	X		Brook trout in lake and upstream. Fisher Cat in area.
Endangered and Threatened Species	X		Northern long-eared bat habitat potential.
Invasive Species	X		Evaluate for potential presence of, and impacts to, invasive species.

Item/Concern	Relevant to the Proposed Action		Rationale
	Yes	**No**	
Migratory Birds/Bald Eagles/Golden Eagles	X		Bald eagles are present in area.
HUMAN			
Public Health and Safety	X		Concern for public safety due to breach of the dam.
Scenic Beauty	X		A few homes could negatively be affected by the project.
Social / Cultural Issues	X		Concern for protection of social and cultural values associated with the project.
Historic Properties	X		The Phase 1A Report did not recommend any additional testing due to prior disturbance and Architectural Historian's report evaluated the dam as not eligible for listing in the National Register of Historic Places.
Environmental Justice and Civil Rights	X		Executive Order requires an evaluation of EJ and Civil Rights.
Recreation	X		Ecosystem services for recreation may be impacted.
Park Lands	X		Opportunity for trail/bike path on dam.

ECOSYSTEM SERVICES	Relevant to the proposed action?		RATIONALE
	YES	**NO**	
Regulating (maintain world in which it is possible for people to live, providing critical benefits that buffer against environmental catastrophe)			
Flood and Disease Control	X		This was a purpose for the structure being studied.
Supporting (underlying processes maintaining conditions for life on Earth)			
Nutrient Cycling	X		Some soil disturbance likely.
Soil Formation	X		Some soil disturbance likely.

Cultural (make the world a place in which people want to live)			
Recreational Use	X		Project area is used for recreation.
Aesthetic Viewsheds	X		The area is enjoyed by area visitors.

Alternative Plans Considered: Four plans were considered and evaluated in detail.

1. Future Without Federal Investment or FWOFI (Sponsors' Rehabilitation) – The Sponsors have indicated that without federal assistance, they would rehabilitate the dam according to Massachusetts Department of Conservation and Recreation (DCR) standards. The FWOFI alternative (Sponsor's Rehabilitation) would rehabilitate the dam to State of Massachusetts standards (½ PMF), which would involve armoring of the auxiliary spillway crest with articulated concrete blocks.

2. Structural Rehabilitation with Federal Assistance – Construct a 158-ft-wide, 6-cycle reinforced concrete labyrinth, the existing ASW will be decommissioned by installing an earthen berm at the existing ASW crest, a RCC stepped spillway with RCC stilling basin and reinforced concrete walls. The dam crest will be leveled at EL 203 and depressions along the crest will be filled in. The pipe joints in the existing 48-inch diameter reinforced concrete principal spillway conduit will be re-grouted and a concrete sealant will be applied to the worn surfaces. In addition, a filter diaphragm will be constructed around the existing principal spillway conduit near the downstream slope. The existing bituminous coated corrugated metal pipe toe drains will be left in-place and filled with grout. New plastic pipe toe drains and a filter trench will be installed closer to the toe of the dam slope. Some sediment will be removed in the vicinity of the existing principal spillway riser along with removing the existing pond drain gate to allow Powdermill Brook to naturally re-establish through the floodpool. There will be no change in the current levels of flood protection downstream as a result of project activity.

3. Structural Rehabilitation with Federal Assistance (Preferred Alternative) – Construct a 106-ft-wide, 4-cycle reinforced concrete labyrinth, the existing ASW will be decommissioned by installing an earthen berm at the existing ASW crest elevation, a RCC stepped spillway with RCC stilling basin and reinforced concrete walls. The dam crest will be raised to EL 205. The pipe joints in the existing 48-inch diameter reinforced concrete principal spillway conduit will be re-grouted and a concrete sealant will be applied to the worn surfaces. In addition, a filter diaphragm will be constructed around the existing principal spillway conduit near the downstream slope. The existing bituminous coated corrugated metal pipe toe drains will be left in-place and filled with grout. New plastic pipe toe drains and a filter trench will be installed closer to the toe of the dam slope. Some sediment will be removed in the vicinity of the existing principal spillway riser along with removing the existing pond drain gate to allow Powdermill Brook to naturally re-establish through the floodpool. There will be no change in the current levels of flood protection downstream as a result of project activity.

4. Structural Rehabilitation with Federal Assistance – Construct a 265-ft-wide level control section (reinforced concrete broad crested weir), the existing ASW will be decommissioned by installing an earthen berm at the existing ASW crest a RCC stepped spillway with RCC stepped side slopes, and an RCC stilling basin. The dam crest will be raised to EL 205. The pipe joints in the existing 48-inch diameter reinforced concrete principal spillway conduit will be re-grouted and a concrete sealant will be applied to the worn surfaces. In addition, a filter diaphragm will be constructed around the existing principal spillway conduit near the downstream slope. The existing bituminous coated corrugated metal pipe toe drains will be left in-place and filled with grout. New plastic pipe toe drains and a filter trench will be installed closer to the toe of the dam slope. Some sediment will be removed in the vicinity of the existing principal spillway riser along with removing the existing pond drain gate to allow Powdermill Brook to naturally re-establish through the floodpool. There will be no change in the current levels of flood protection downstream as a result of project activity.

Alternatives Considered but Eliminated From Detailed Study

Some of the alternatives considered in the planning process were eliminated from detailed consideration because these alternatives either did not meet the proposed purpose or need for federal action, they were exorbitantly expensive, or they were logistically impractical to implement.

Decommission Dam: Decommissioning is mandatory based on law (PL 83-566, Section 14, A1e) and NRCS policy. This option describes an alternative which requires removing the flood detention capacity of the dam by cutting a notch in the existing embankment and re-connecting and restoring the stream channel and 100-year floodplain upstream and downstream of the dam in a non-erosive manner. However, this would cause downstream structures, roadways, and crossings to be subject to pre-project flood conditions. Alleviating the additional flooding would require either relocating or floodproofing the structures and modifying the affected roadways and crossings. Due to the exorbitant cost, this alternative was not studied in detail.

Non-Structural – Relocate, Elevate, or Floodproof Structures: This alternative involves upgrading the dam to meet significant hazard dam criteria; elevating, floodproofing, or relocating all structures within the dam breach inundation area, purchasing deed restrictions to prevent future development in the dam breach inundation area, and modification or relocation of roadways and stream crossings within the breach inundation area. Because of the exorbitant costs of such activities, this alternative was not studied in detail and eliminated from further study.

For all four alternatives studied in detail, there will be no change in the 100-year and 500-year levels of flood protection downstream. The preferred alternative maximizes public benefits and is the rehabilitation alternative preferred by the Sponsors.

Project Costs (Dollars) 1/

	PL-83-566 Funds		Other Funds		Total	
Category	**Dollars**	**%**	**Dollars**	**%**	**Dollars**	**%**
Construction	$3,954,800	65.7%	$2,068,200	34.3%	$6,023,000	100%
Engineering	$1,500,000	98.0%	$30,000	2.0%	$1,530,000	100%
Geotechnical Investigation	$85,000	100%	$0	0%	$85,000	100%
Relocation	n/a	n/a	n/a	n/a	n/a	n/a
Real Property Rights	$0	0%	$19,300	100%	$19,300	n/a
Project Administration	$60,000	83.3%	$12,000	16.7%	$72,000	100%
Permits	n/a	n/a	$5,500	100%	$5,500	100%
TOTAL COSTS	**$5,599,800**	**72.4%**	**$2,135,000**	**27.6%**	**$7,734,800**	**100%**
Annual O&M (non-Federal)	n/a	n/a	$13,500	100%	$13,500	100%

1/ Price base: 2020

Project Benefits: The planning policy used for this plan/environmental document (Principles, Requirements, and Guidelines or PR&G) state that Federal investments in water resources as a whole should strive to maximize public benefits, with appropriate consideration of costs. Public benefits (i.e., positive ecosystem services) encompass environmental, economic, and social goals; include monetary and non-monetary effects; and allow for the consideration of both quantified and unquantified measures. The preferred alternative will allow the Sponsors to comply with applicable dam safety and performance standards, to reduce the potential for loss of life, and to continue protection of existing property and infrastructure downstream of the dam. The preferred alternative maximizes public benefits. For economics, average annual monetary benefits are estimated to be $390,700, which includes $195,400 flood damage reduction benefits and $195,300 cost avoidance benefits. Average annual cost is estimated at $238,900 resulting in net benefits of $151,800. The Probable Maximum Precipitation (PMP) storm event will be retained, thus reducing the threat of a catastrophic dam failure (breach), and incidental recreation after construction will continue. Environmentally adverse impacts will be minimized during construction. Long-term there would be adverse, although negligible, environmental impacts.

Number of Direct Beneficiaries/Population at Risk: 1,352

Other beneficial effects:

- Reduces the threat to loss of life to approximately 1,352 people who live and/or work in the breach zone.
- Protects 363 residences, 82 apartments, 45 commercial structures, 2 public properties, numerous outbuildings (sheds, barns, etc.), 1 stream crossing (bridge), and 19 roadways downstream within the breach inundation zone.
- Provides protection for over 14,600 vehicles and their occupants who utilize the roads downstream of Powdermill Dam daily (using an average of 2 people per vehicle results in about 29,200 motorists).

- Reduces the threat of loss of access and loss of emergency services for downstream properties and property owners.
- Provides downstream flood protection for the residents in the area, as well as those working, recreating, or traversing within the downstream floodplains, for an additional 75 years.
- Eliminates the liability associated with continuing to operate a dam that does not meet current Massachusetts and NRC safety and performance standards.
- Retains the existing aquatic and terrestrial habitat in and around the dam.
- Leverages federal resources to install the planned works of improvement.
- Will meet current Massachusetts and NRCS safety and performance standards for a high hazard potential dam.

Benefit to Cost Ratio (current rate): 1.6 to 1.0

Net beneficial effects (National Economic Efficiency (NEE)) effects): $151,800

Funding Schedule: The most likely scenario is for the project to be implemented over four years including the design and construction.

Federal funds: Year 1 – $556,000 for engineering services, $85,000 for geo-technical services, and $20,000 for project administration; **Year 2** – $264,000 for engineering services, and $20,000 for project administration; **Year 3** - $340,000 for construction supervision, $14,000 for project administration, and $1,977,400 for construction; **Year 4** - $340,000 for construction supervision, $6,000 for project administration, and $1,977,400 for construction.

Non-Federal funds: Year 1 – $2,000 for project administration, $10,000 for engineering services, $19,300 for land rights, and $5,500 for permits; **Year 2** – $3,000 for project administration and $10,000 for engineering services; **Year 3** - $7,000 for engineering services, $3,000 for project administration, and $1,034,100 for construction; **Year 4** - $3,000 for engineering services, $4,000 for project administration, and $1,034,100 for construction.

Period of Analysis: 79 years (includes 2 years for design and 2 years for construction)

Project Life: 75 years

Ecosystem Services and Environmental Effects/Impacts:

Resource	Impact
Air Quality	Temporary increase in particulate matter on-site during construction. Short-term – direct, negligible, and adverse impacts. No long-term effects.

Resource	Impact
Land Use Changes	Up to 4.0 acres of trees and brush within the LOD will be cleared for staging of equipment and materials. Area will be reseeded to grass and trees after construction. At the proposed top of dam elevation (205.0), there would be 10.1 acres of additional easements secured by the City of Westfield. However, the land use in these easement acres is not expected to change.
Floodplains	Current 100-year and 500-year floodplains will be maintained. Short-term – direct, minor and adverse impacts to floodplains. Long-term – direct, moderate, and beneficial effects to floodplains.
Soils	Short-term, minor, adverse impacts to 4.44 acres Prime and Unique Farmland Soils and 8.63 acres of Farmland Soils of Statewide Importance due to compaction by equipment, and grading and shaping of the project area.
Water Quality	Short-term, negligible adverse and long-term, negligible adverse impacts to water quality. Construction will impact water quality by increasing the total suspended solid loads and turbidity of the 303(d) impaired waters, Powdermill Brook, and the pool during construction. These water quality impacts will be mitigated through implementation of practices like soil stabilization and sediment and erosion controls and are not expected to have lasting effects.
Water Quantity	Short- and long-term moderate effects to water quantity. The 0.27-acre artificial impoundment will be lost once the dam is converted back to a dry dam.
Wetlands	Short-term direct, minor and adverse and long-term direct, negligible and adverse impacts to wetlands. Up to 0.28 acre of forested wetlands and up to 1.89 acres of freshwater emergent wetlands will be temporarily impacted. Long-term impacts to 0.11 acre of freshwater wetlands from construction of RCC apron and riprap on southern end of the ASW. About 0.13 acre of freshwater emergent wetlands will be created, mitigating long-term effects to wetlands downstream. Permanent impacts to 0.27 acre of pond wetlands upstream of dam after it reestablishes to a dry dam. The 0.27 acre of freshwater pond wetlands in current impoundment will be converted to 0.27 acre of freshwater emergent wetlands once the gate valve is removed. These wetlands may be impacted by adjacent Common Reed without routine treatment or removal of adjacent common reed. An overall net increase of 0.29 acre of freshwater emergent wetlands will result from the project.

Resource	Impact
Fish and Wildlife	Short-term – direct, minor, and adverse impacts to fish and wildlife. Long-term – direct, negligible and adverse impacts to fish and wildlife.
Invasive Species	Short-term, direct, minor, adverse impacts to Common Reed; These impacts are anticipated to be beneficial long-term to Common Reed, but adverse long-term for the wetlands created on site, if Common Reed is not maintained to reduce its spread into newly created wetland areas; BMPs identified through consultation with the City, MA DEP, and USACE during permitting will be implemented to prevent the spread of invasive species and treat or remove invasive species within the LOD in accordance with Local, State, and Federal recommendations and requirements. No effect for invasive animal species, as none have been identified on site.
Cultural Resources	No effects.
Threatened/ Endangered Species	No impacts to special status plant species. Negligible impacts to northern long-eared bat habitat. Time of year restrictions on tree cutting will minimize potential impacts.
Riparian Areas	Short-term – direct, minor and adverse impacts during construction. Long-term – direct, negligible and beneficial impacts from the impoundment pool being removed but reverted back to a stream. About 45 feet of additional riparian area will be created when impoundment area is re-established as natural stream channel.
Mitigation	No compensatory mitigation is anticipated. This will be confirmed during the USACE CWA Section 404 permitting and CWA Section 401 Water Quality Certification processes, as well as state and local regulatory agencies
Public Health & Safety	Under the preferred alternative, the dam would be structurally rehabilitated to NRCS standards (full PMF). Continued flood protection for 75 years would be provided after the rehabilitation project is complete. The downstream flooding level would be the same for the 100-year and 500-year flood events. The threat to loss of life from failure of the dam would be greatly reduced. Conservative estimates indicate that at least 1,352 people living/working/driving downstream of the dam would be protected. Catastrophic damages to buildings, roadways, bridges, and utilities would also be avoided. Access to the site will be restricted during construction.

Resource	Impact
Environmental Justice/Civil Rights	There are no Tribal Communities or other Environmental Justice groups in the project area. No disparate treatment.
Ecosystem Services	Regulating: Long-term, direct, and beneficial. Supporting: Short-term, direct, negligible, adverse; Long-term, direct, negligible, adverse Cultural: Short-term, direct, moderate, adverse; Long-term, direct, negligible, adverse and beneficial

Major Conclusions: Rehabilitation is necessary to address an existing dam that does not meet NRCS and DCR standards for its current high hazard classification and to continue flood protection to downstream houses, commercial, and public properties as well as infrastructure that would be flooded by a one-percent annual-chance (100-year) flood event without the dam or other flood control measures in place. The preferred alternative would structurally rehabilitate the existing dam to meet high hazard design standards and continue to provide a level of flood control up to the one-percent annual chance (100-year) flood event. Unavoidable adverse effects would result from implementation of the proposed action. These effects will be short-term and minor overall. The adverse impacts identified in the plan-environmental assessment are not considered significant and can be mitigated with the use of best management practices during the construction process.

Areas of Controversy: None

Issues to be Resolved: None

Evidence of Unusual Congressional or Local Interest: No

Is this report in compliance with executive orders, public laws, and other statutes governing the formulation of water resource projects? Yes X No ___

CHANGES REQUIRING PREPARATION OF A SUPPLEMENT

There was one single purpose floodwater retarding dam and one multi-purpose dam, and some land treatment conservation practices installed as part of the original construction in the Powdermill Brook Watershed project. This supplement addresses only Powdermill Dam. The Powdermill Dam was constructed in 1965 as a high hazard dam. The DCR and the NRCS both concur with the high hazard classification of the dam based on current criteria. Based on the SITES analysis results, the dam does not meet Technical Release No. 210-60, Earth Dams and Reservoirs (TR 210-60) design criteria for auxiliary spillway stability and integrity, as well as auxiliary spillway capacity. Based on the analysis, the dam would be overtopped during the critical PMP event (the 6-hour freeboard hydrograph), and the auxiliary spillway would breach during this event. Therefore, the dam does not meet the objectives of the City of Westfield or the Hampden Hampshire Conservation District (herein referred to as Sponsors), which are to address deficiencies with the existing dam that are not compliant with current high-hazard dam standards, continue to provide needed flood damage reduction for downstream properties, and reduce the risk of loss of human life. Dams classified as high hazard are those which upon failure could cause loss of life or serious damage to homes, commercial and public buildings, important public utilities, and roadways. There are 363 residences, 82 apartments, 45 commercial buildings, and two public buildings, numerous outbuildings and sheds, plus one stream crossing and 19 roadways at risk downstream of the dam if a catastrophic breach of the structure were to occur.

This supplemental Plan-EA documents the planning process by which NRCS provided technical assistance to the Sponsors and the public in addressing resource issues and concerns within the Powdermill Brook Watershed and complied with the requirements of the National Environmental Policy Act (NEPA). In accordance with NRCS NEPA Policy, an Environmental Evaluation Worksheet, NRCS-CPA-52 form, was completed for the Powdermill Dam rehabilitation project to determine the requisite level of NEPA documentation to support the proposed action. The NRCS-CPA-52 resulted in a determination that an Environmental Assessment (EA) was required.

FEDERAL OBJECTIVE

The investments in this proposed action reflect national priorities, encourage economic development, and protect the environment by:

(1) seeking to maximize sustainable economic development;

(2) seeking to avoid the unwise use of floodplains and flood-prone areas and minimizing adverse impacts and vulnerabilities in any case in which a floodplain or flood-prone area must be used; and

(3) protecting and restoring the functions of natural systems and mitigating any unavoidable damage to natural systems.

PURPOSE AND NEED FOR ACTION

Purpose: Provide the originally planned level of flood protection to the watershed for the next 50-100 years while minimizing environmental, economic, and social impacts.

Need: Action is needed because the present dam structure does not meet current safety and performance standards. To reduce the risk of flood damage to homes, commercial facilities, and an expanded infrastructure due to an overtopping breach of the dam or a breach of the auxiliary spillway and the associated risk of loss of life, action is necessary.

There is a potential for loss of life from a catastrophic dam failure due to the existence of one stream crossing (bridge) and 19 roadways downstream of this structure within the breach inundation zone. In addition, people living and/or working in 363 residences, 82 apartments, 45 commercial buildings, and 2 public properties would be at risk from a catastrophic dam failure. NOTE: In order to estimate population at risk (PAR) from a catastrophic dam failure for residents of apartment complexes, PAR within each affected apartment was estimated. For floodwater damage reduction, impacts to apartment buildings were estimated. Thus, "apartments" is associated only with PAR and "apartment buildings" is associated only with monetary value.

The dam currently provides floodwater damage reduction for flood events up to a magnitude of the 500-year flood for 118 residences, 29 apartment buildings, 30 commercial properties, 3 public properties, 3 stream crossings, 26 roadways, and a cargo railroad line.

The continuation of flood damage reduction is needed to protect the downstream properties and infrastructure. The Sponsors want to continue to provide flood protection in a manner that reduces risk of loss of human life and is both cost effective and environmentally acceptable. Federal action is required to assist the Sponsors and to assure that the Federal government's interest is protected.

SCOPE OF THE ENVIRONMENTAL ASSESSMENT

A scoping process was used to identify issues of economic, environmental, cultural, and social importance in the watershed. Watershed concerns of Sponsors, technical agencies, and local citizens were expressed in the scoping meeting and in other planning and public meetings. Factors that would affect soil, water, air, plant, animals, human resources, and ecosystem services were identified by an interdisciplinary planning team composed of the following areas of expertise: engineering, biology, economics, resource conservation, water quality, soils, archaeology, and geology. NRCS conservation practice physical effects network effects diagrams were used during the process to identify ecosystem flows that potentially would be affected. The practice network effects diagrams used were for a Dam (402), and Critical Area Planting (342).

On November 13, 2019, a Scoping Meeting was held in the Westfield City Hall in Westfield, Massachusetts, with 17 people attending. Table A lists the specific concerns and their relevance to the proposed action to the decision-making process.

Various alternative measures to address the deficiencies of the dam were mentioned during the scoping meeting. The specific measures discussed fall into the following four categories:

1. No Action – the action that would be taken in the absence of federal funds for dam rehabilitation, known as the Future Without Federal Investment (FWOFI)
2. Decommissioning – removal of a dam while providing flood protection
    a. Relocation of structures
    b. Floodproofing
3. Rehabilitation – Structural rehabilitation
    a. Roller-compacted concrete in the existing auxiliary spillway location
    b. Roller-compacted concrete over the top of the dam to harden it
    c. Armoring the spillway with articulated concrete block to allow for higher flows
4. Non-structural –
    a. Relocation of structures potentially impacted from a Probable Maximum -Flood
    b. Floodproofing (including elevating buildings)

The NRCS conservation measure physical effects network diagrams for "Dam" and "Critical Area Seeding" were used during scoping. These diagrams identify ecosystem flows that potentially would be affected by project action. They also identified potential cumulative effects which provided an initial starting point for cumulative effects analysis.

Table A below, summarizes the concerns felt to be relevant to decision-making related to the project. Those resource issues and ecosystem services not marked with an "X" fall under one of the following categories:

a) Not likely to be impacted by the alternatives evaluated in this plan.
b) Not required by NRCS policy to evaluate.
c) Not required by Executive Order or Environmental Law to evaluate.

Those resource items and ecosystem services marked with an "X" fall under one of the following categories:

a) Likely to be impacted by the alternatives evaluated in this plan.
b) Required by NRCS policy to evaluate.
c) Required by Executive Order or Environmental Law to evaluate.

Table A – Scoping Results for Rehabilitation of Powdermill Dam
Hampden County, Massachusetts

ITEM/ CONCERN	Relevant to the proposed action?		RATIONALE
	YES	**NO**	
SOILS			
Land use		X	
Soil Resources		X	
Prime and Unique Farmland and Farmland of Statewide Importance	X		NRCS policy requires analysis of impacts to this resource. Several acres of prime and unique farmland and farmland of statewide importance will be impacted by project activities.
WATER			
Sole Source Aquifers		X	None known for potable use.
Water Resources		X	
Water Quality	X		Environmental Law - may be a TMDL on Powdermill Brook. Possible Blue-Green algae in area.
Regional Water Mgt. Plans (including Coastal Zone Mgt. Areas)		X	
Floodplain Management	X		Executive Order11988 directs federal agencies to evaluate impacts to floodplain management which this project involves.
Streams, Lakes and Wetlands	X		Executive Order 11990 directs federal agencies to evaluate impacts to wetlands which this project has in the adjacent streams, impoundment and wetlands.

Wild and Scenic Rivers	X		Evaluation completed, but none located on Powdermill Brook.
ITEM/ CONCERN	Relevant to the proposed action?		**RATIONALE**
	YES	**NO**	
AIR			
Air Quality		X	
Clean Air Act	X		Project activities may impact air quality near the site.
PLANTS			
Forest Resources		X	Nothing significant.
Natural Areas		X	None at this site.
Ecologically Critical Areas		X	None present in the project area.
Endangered and Threatened Species	X		Environmental Law – but no known plant species at this site.
Invasive Species	X		Lots of phragmites in the area.
Riparian Areas	X		Potential impacts with decommissioning alternative.
ANIMALS			
Fish and Wildlife	X		Brook trout in lake and upstream. Fisher Cat in area.
Essential Fish Habitat		X	
Coral Reefs		X	
Endangered and Threatened Species	X		Northern long-eared bat habitat potential.

Invasive Species	X		Evaluate for potential presence of, and impacts to, invasive species.
Migratory Birds/Bald Eagles/Golden Eagles	X		Bald eagles are present in area.
ITEM/ CONCERN	Relevant to the proposed action?		**RATIONALE**
	YES	**NO**	
HUMANS			
Public Health and Safety	X		Concern for public safety due to breach of the dam.
Scenic Beauty	X		A few homes could negatively be affected by the project.
Scientific Resources		X	
Social / Cultural Issues	X		Concern for protection of social and cultural values associated with the project.
Historic Properties	X		The Phase 1A archaeological investigation did not recommend any additional testing due to prior disturbance. The architectural historian's report evaluated the dam as not eligible for listing in the National Register of Historic Places. No TCP where brought to the attention of NRCS during the consultation with six federally recognized Indian Tribes.
Environmental Justice and Civil Rights	X		Executive Order requires an evaluation of EJ and Civil Rights.
Local and Regional Economy		X	
Recreation	X		Ecosystem services for recreation may be impacted.
Park Lands	X		Opportunity for trail/bike path on dam.

ECOSYSTEM SERVICES	Relevant to the proposed action?		**RATIONALE**
	YES	**NO**	
Provisioning (tangible goods provided for direct human use and consumption)			
Food		X	Not a significant food production area.
Fiber		X	Not a cropland watershed.
Water		X	Not a water supply.
Timber		X	No timber industry present.
Biomass		X	No significant forage production.
Regulating (maintain world in which it is possible for people to live, providing critical benefits that buffer against environmental catastrophe)			
Flood and Disease Control	X		This was a purpose for the structure being studied.
Water Filtration		X	Not a groundwater aquifer area.
Climate Stabilization		X	Not a significant greenhouse gas production area.
Crop Pollination		X	Not a cropland watershed.
Supporting (underlying processes maintaining conditions for life on Earth)			
Nutrient Cycling	X		Some soil disturbance likely.
Soil Formation	X		Some soil disturbance likely.
Primary Production		X	Not a significant green plant production area.
Cultural (make the world a place in which people want to live)			
Recreational Use	X		Project area is used for recreation.
Spiritual		X	No spiritually used areas present.
Aesthetic Viewsheds	X		The area is enjoyed by area visitors.
Tribal Values		X	No Tribal values identified.

AFFECTED ENVIRONMENT

This section of the plan describes the elements of the natural, social, and economic environments within the project area that might be affected by the rehabilitation alternatives. Emphasis is placed on the current status of each element and any trends that may be evident both upstream and downstream of the alternatives. The project area is approximately 180 acres and encompasses land upstream and downstream of the dam anticipated to be impacted by project action (Figure C-2). The project area includes the limit of disturbance, which was used to evaluate environmental impacts in the Environmental Consequences section.

Physical Environment

Project Location: The Powdermill Brook Watershed is located in Hampden and Hampshire Counties, Massachusetts. The Powdermill Dam is located on Powdermill Brook in the City of Westfield approximately three miles upstream of the confluence with the Westfield River. It has approximate coordinates of North 42-14'-51" latitude and West 72-74'-62" longitude. It is in the 8-digit hydrologic unit number 01080206 and U.S. Congressional District No. 1 in Massachusetts.

Topography: The topography of central Massachusetts consists of rolling hills, small mountains, and rocky outcroppings. Topography surrounding the project area consists of gently rolling hills but there are mountains located to the east and west of the dam. A general description of local topography is described in the original Watershed Work Plan for Powdermill Brook Watershed.

Climate: Massachusetts is influenced by wet, dry, hot, and cold airstreams, causing daily weather to be highly variable. Central Massachusetts has low lying areas as well as mountainous topography. The region has a humid continental climate with four distinct seasons. Summers are typically hot and humid, and winters are cold and snowy. Massachusetts can experience nor'easters in the winter months, which often cause several feet of snow accumulation.

Climate change research such as the Fourth National Climate Assessment (NCA4) Volume II, indicates that future changes will likely include the following:

- More intense, longer duration precipitation events
- Increased frequency of flood events
- There may be more incidence of drought

Population: According to the City of Westfield's Open Space and Recreation Plan, 2018 Update, the population of Westfield is projected to increase from 42,251 in 2020 to 43,260 in 2035, a modest 1.02% increase.

Geology: The dam is located in the western portion of the Connecticut Valley Lowland physiographic region, which extends from northern Massachusetts to southern Connecticut and contains the southern section of the Connecticut River. The U.S. Geological Survey (USGS) Surficial Materials Quadrangle Maps of Massachusetts (Stone, 2018) show the surficial material at the site to consist of lake-bottom fine deposits including very fine sand, silt, and clay occurring as well-sorted, thin layers of alternating silt and clay varves typically underlying fine sand deposits. Additional surficial materials include flood-plain alluvium (sand, gravel, and silt deposits in stream flood plains) and stream-terrace deposits (sand, gravel, and silt deposits from glacial meltwater

sediments along rivers and streams) particularly denoted where overlying glaciolacustrine deposits (lake-bottom fine deposits). The site lies near the approximate western edge of historical glacial Lake Hitchcock. USGS data accessed via the MassGIS OLIVER website show the site to consist of thin till overlain by glaciolacustrine fine deposits underneath stream terrace deposits and alluvium.

According to the USGS Bedrock Geologic Map of Massachusetts (USGS, 1983), the site is underlain by Mesozoic Basin Sedimentary Rock, specifically comprising New Haven Arkose, a coarse-grained conglomeritic arkose (feldspar-rich sandstone) of Upper Triassic geologic age interbedded with shaley siltstone and fine grained arkosic sandstone.

The original watershed work plan for Powdermill Brook Watershed describes thick layers of glacial deposits (till) overlaying the watershed area.

Seismology: The primary causes of seismic events in New England include crustal rupture (breakage) and sliding of crustal rock segments past one another (faulting). However, according to recent USGS maps, no surficial faults within Massachusetts have been identified as active or capable during the Quaternary Period within a 100-km radius around the project site. A review of the Central and Eastern United States (CEUS) Seismic Source Characterization Model earthquake catalog and the New England Seismic Network performed to identify regional seismicity found that two historical earthquakes with magnitude 4 or greater have occurred within a 100-km radius of the site. These include an M4.4 in 1791 in Moodus, Connecticut and an M4.9 in 1568 in Haddam, Connecticut. These earthquakes occurred before the creation of the modern-day seismic network; therefore, there is a great degree of uncertainty associated with their location and magnitude. Additionally, the reported body wave magnitudes for these events were estimated from the intensity of shaking that was reported in the area.

Land Use and Zoning: Powdermill Dam is located in an area zoned as residence A and residence B (western side of project area), industrial (eastern side of project area), and rural residential (center of project area) by the City of Westfield. Land Cover types in the project area are described in Table B. A description of each zoning designation is provided in Table BC. A zoning map is shown in Appendix C.

Table B - Land Cover in Project Area

Vegetation Community	Acres in Project Area	Description
Bare land	2.8	Contains areas of bedrock, desert pavement, scarps, talus, slides, volcanic material, glacial debris, sand dunes, strip mines, gravel pits, and other accumulations of earth material. Generally, vegetation accounts for less than 10% of total cover.

Vegetation Community	Acres in Project Area	Description
Deciduous forest	50	Contains areas dominated by trees generally greater than 5 meters tall and greater than 20% of total vegetation cover. More than 75% of the tree species shed foliage simultaneously in response to seasonal change.
Developed open space vegetation	35	Contains areas with a mixture of some constructed materials but mostly managed grasses or low-lying vegetation planted in developed areas for recreation, erosion control, or aesthetic purposes. These areas are maintained by human activity such as fertilization and irrigation, are distinguished by enhanced biomass productivity, and can be recognized through vegetative indices based on spectral characteristics. Constructed surfaces account for less than 20% of land cover.
Evergreen forest	20.6	Contains areas dominated by trees generally greater than 5 meters tall and greater than 20% total vegetation cover. More than 75% of the tree species maintain their leaves all year. Canopy is never without green foliage.
Grassland	21	Contains areas dominated by grammanoid or herbaceous vegetation, generally greater than 80% of total vegetation. These areas are not subject to intensive management as tilling but can be utilized for grazing.
Impervious	18	Anthropogenic features such as buildings, parking lots, and roads developed from asphalt, concrete, or other constructed surfaces that do not allow infiltration from precipitation.
Palustrine emergent wetland	4	Includes tidal and nontidal wetlands dominated by persistent emergent vascular plants, emergent mosses or lichens, and all such wetlands that occur in tidal areas in which salinity due to ocean-derived salts is below 0.5%. Total vegetation cover is greater than 80%.
Palustrine forested wetland	13.5	Includes tidal and nontidal wetlands dominated by woody vegetation greater than or equal to 5 meters in height, and all such wetlands that occur in tidal areas in which salinity due to ocean-derived salts is below 0.5%. Total vegetation coverage is greater than 2%.

Vegetation Community	Acres in Project Area	Description
Palustrine shrub/scrub wetland	6	Includes tidal and nontidal wetlands dominated by woody vegetation less than 5 meters in height, and all such wetlands that occur in tidal areas in which salinity due to ocean-derived salts is below 0.5%. Total vegetation coverage is greater than 20%.
Pasture/hay	8	Contains areas of grasses, legumes, or grass-legume mixtures planted for livestock grazing or the production of seed or hay crops, typically on a perennial cycle and not tilled. Pasture/hay vegetation accounts for greater than 20% of total vegetation.
Scrub/shrub	1.2	Contains areas dominated by shrubs less than 5 meters tall with shrub canopy typically greater than 20% of total vegetation. Includes tree shrubs, young trees in an early successional stage, or trees stunted from environmental conditions.
Water	0.2	Includes areas of open water, generally with less than 25% cover of vegetation or soil.

Table C – Land Use (Zoning Ordinances) in Project Area

Zoning District	Acres in Project Area	Description
Industrial A	62.5	Make provisions for a wide range of industrial and business uses. However, special review and approval is required in the case of certain potentially hazardous or obnoxious uses or uses of significant impact.
Residence A	57	Intended to accommodate single family detached dwellings at a higher density than the agriculture district.
Residence B	1.5	Intended to accommodate single family, detached, semi-detached, and two-family dwellings of medium densities.
Rural Residential	58.3	Intended to accommodate agriculture, horticulture, or floriculture as well as single family detached dwellings at low densities plus other land uses which minimally impact the aquifer and preserve or respect the city's open space.
N/A	1	Not zoned

Below is the land use in the drainage area upstream of the dam.

Table D – Land Use

Land Cover Type	Drainage Area (ac.)	Drainage Area (sq. mi.)	Percent of Total
Water	52.7	0.08	1.8%
Urban Open	330.3	0.52	11.6%
Urban Low	317.8	0.50	11.1%
Urban Med.	168.9	0.26	5.9%
Urban High	86.0	0.13	3.0%
Barren	46.5	0.07	1.6%
Forest Deciduous	794.2	1.24	27.9%
Forest Coniferous	177.7	0.28	6.2%
Forest Mixed	454.8	0.71	16.0%
Shrub	27.0	0.04	0.9%
Grassland	19.6	0.03	0.7%
Pasture	141.7	0.22	5.0%
Cultivated	46.3	0.07	1.6%
Woody Wetlands	177.5	0.28	6.2%
Emergent Wetlands	9.8	0.02	0.3%
Totals	**2,850.8**	**4.45**	**100.0%**

Biological/Ecological Environment

Soils

Prime and unique farmlands, and farmland of statewide importance: Prime Farmland is identified at locations to the northeast and south of Powdermill Dam where Enfield silt loam, Sudbury fine sandy loam, and Podunk fine sandy loam are present. Areas classified as Prime Farmland cover approximately 32 acres within the project area and are primarily covered by wetland plants, trees, and grass based on a review of the NRCS Web Soil Survey.

Farmland soils of statewide importance are identified at locations to the east and south of Powdermill Dam where Hinckley Loamy Sand (0-3% and 3-8% slopes), Merrimac sandy loam, and Windsor loamy sand are present. These soils cover approximately 76 acres within the project area and are primarily forested.

Soil suitability and limitations that are relevant to the rehabilitation of Powdermill Dam include:

- corrosion of concrete – risk rated as "low," "moderate," or "high" and is based primarily on the sulfate and sodium content, texture, moisture content, and acidity of the soil.
- corrosion of steel – risk rated as "low," "moderate," or "high" and is based primarily on soil moisture, particle-size distribution, acidity, and electrical conductivity of the soil.
- shallow excavations – listed as any trenches or holes dug to a maximum depth of 5-6 feet, and their ratings are based on soil properties that influence the ease of digging and the resistance to sloughing. Some specific characteristics that factor into this rating include depth to bedrock, hardness of bedrock, number of large stones, soil texture, depth to water table, and linear extensibility.

There is no highly erodible cropland in the project area.

Powdermill Dam is located immediately downslope of a landfill, transfer station, and the City of Westfield Recycling Center. There is potential that the sediment within the pool may be contaminated, based on proximity to the landfill and transfer station.

Water

Water Resources: Within the project area there is one freshwater reservoir (the dam impoundment), one stream channel (Powdermill Brook), and multiple freshwater wetlands. Powdermill Dam is located on the southern side of Powdermill Brook Reservoir, which formed as a result of the installation of Powdermill Dam. Powdermill Brook is a tributary of the Westfield River, and the Brook meets the Westfield River approximately 3 miles southeast of the dam. Refer to the original Watershed Work Plan for Powdermill Brook Watershed for a complete description of water resources in the area.

Floodplains: Powdermill Dam is located within a Federal Emergency Management Agency (FEMA) 100-year floodplain zone and is considered to be in a special flood hazard area. There have been occurrences of flooding in the areas along the Westfield River particularly near Westgate Plaza, approximately 2.5 miles downstream of Powdermill Dam, especially during hurricanes.

Based on review of the FEMA flood insurance map for the study area (panel 25013C0190F) effective September 2014 (Appendix C), the project area is located in Zone A, a special flood hazard area. The area is subject to inundation by a 1%-annual-chance flood event; however, no base flood elevations for the area have been determined yet because no hydraulic analyses have been performed. Powdermill Dam was constructed to protect the watershed and prevent flooding in the surrounding areas.

Water Quality: The Commonwealth of Massachusetts surface water quality standards are defined under 314 Code of Massachusetts Regulations 4.0, and the Commonwealth of Massachusetts classifies certain waters as "surface water supply protection areas". There are no Massachusetts surface water supply protection areas within the project area.

The Clean Water Act requires states to assess the quality of their waterbodies and to identify specific waterbodies where water quality is impaired or threatened by pollutants. Powdermill

Brook Reservoir and Powdermill Brook are classified as an impaired waterbody and impaired stream, respectively. Powdermill Brook is impaired for algae, E. coli, sedimentation/siltation, and turbidity. Powdermill Brook Reservoir is impaired for E. coli.

Water Quantity: Powdermill Dam has a normal pool storage capacity of 58 acre-feet and a flood control storage capacity of 955 acre-feet. A small 0.27-acre artificial pool of water was created about 20 years ago when the drain gate valve was closed. The dam was originally built as a dry structure.

Hydrology: Powdermill Dam is a flood control structure located on Powdermill Brook, a tributary of the Westfield River. The total watershed of Powdermill Dam is approximately 4.5 square miles and drains into the larger Westfield River Watershed, which has a total area of 528 square miles.

Powdermill Dam has an estimated 896 acre-feet pool storage capacity to the elevation of the auxiliary spillway. There are no other dams along Powdermill Brook. The completion of construction of Powdermill Dam in 1965 formed Powdermill Brook Reservoir.

Several hundred feet of the outlet channel downstream of the principal spillway outlet were modified as part of the original dam plan. The outlet channel was lined with 12 inches of riprap stone. The average bottom width and average depth of the channel are 20 feet and 3 feet, respectively.

Wild and Scenic Rivers: There are no wild and scenic rivers or Nationwide Rivers Inventory-listed segments present in or near the project area.

Waters of the U. S., including Wetlands: Powdermill Brook and Powdermill Brook Reservoir are considered as a Waters of the United States. Powdermill Brook Reservoir is a freshwater reservoir approximately 0.27 acre in size and Powdermill Brook is an approximately 7-mile-long stream, which connects to the Westfield River.

Wetlands and Vernal Pools: There are approximately 0.28 acres of freshwater forested wetlands 2.06 acres of freshwater emergent wetlands, and 0.27 acres of freshwater pond wetlands in the LOD. These wetlands were delineated in August 2020 using USACE wetland delineation guidelines. The descriptions of the wetland types below in Table E are based on general descriptions of wetlands types.

Table E - Wetlands Communities in the LOD

Wetlands Type	Acres in Project Area	Description
Freshwater Forested	0.28	Woody wetlands, forested swamp, shrub bog
Freshwater Emergent	2.06	Herbaceous marsh, fen, swale, or wet meadow. Characterized by erect, rooted, herbaceous hydrophytes. Usually dominated by perennial plants.
Freshwater Pond	0.27	Pond.

Vernal pools provide unique wildlife habitats for various species of amphibians and invertebrate to live and breed. Within the project area, there is one Massachusetts Wildlife Natural Heritage and Endangered Species Program (NHESP) certified vernal pool, located northwest of the Dam on the slope of the adjacent landfill.

Coastal Zone Management Act: The project area is not located within the Massachusetts coastal zone.

Air

Air Quality: National Ambient Air Quality Standards pollutants include carbon monoxide, nitrogen dioxide, ozone, particulate matter, sulfur dioxide, and lead. As all concentrations in the area are below the standards of these six criteria pollutants, Powdermill Dam is located in an attainment area.

Greenhouse Gases: Data regarding greenhouse gases (GHGs), regulations, and emissions sources are summarized from the EPA website. GHGs include carbon dioxide, methane, nitrous oxide, and fluorinated gases such as hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride.

GHGs are introduced into the atmosphere by a variety of sources including production of electricity, private and commercial transportation, industry practices, commercial and residential practices, agriculture, land use, and logging. Except for routine maintenance at the dam site, including grass mowing, there are no emissions sources of GHGs at the dam site.

Plants

Vegetation communities are groups of plants sharing a common environment that interact with one another, animal populations, and the physical environment. Vegetation communities within the LOD were classified by land cover types using GIS data from MassDEP and were mapped by MassGIS. Twelve discrete land cover types occur within the Powdermill Dam LOD. Descriptions of the various land cover types and vegetation communities within the LOD are provided in Table F.

Vegetation in freshwater forested/shrub wetlands in Massachusetts is typically comprised shrubs such as mountain laurel (*Kalmia latifolia*), winterberry (*Ilex verticillata*), highbush blueberry (*Vaccinium corymbosum*) and trees such as red maple (*Acer rubrum*), Eastern hemlock (*Tsuga canadensis*) and Northern red oak (*Quercus rubra*).

Trees and plants observed in the upland of the project area during the site visit include white birch (*Betula papyrifera*), white pine (*Quercus alba*), red oak (*Quercus rubra*), black spruce (*Picea mariana*), and willow (*Salix*). Cattails (*Typha*) and common reed (*Phragmites australis*) were observed in the wetland areas and standing water.

Table F - Vegetation Communities in the Limit of Disturbance (LOD)

Land Cover/ Vegetation Type	Description	Acres in LOD
Deciduous forest	Contains areas dominated by trees generally greater than 5 meters tall and greater than 20% of total vegetation cover. More than 75% of the tree species shed foliage simultaneously in response to seasonal change.	3.42
Developed open space	Contains areas with a mixture of some constructed materials but mostly managed grasses or low-lying vegetation planted in developed areas for recreation, erosion control, or aesthetic purposes. These areas are maintained by human activity such as fertilization and irrigation, are distinguished by enhanced biomass productivity, and can be recognized through vegetative indices based on spectral characteristics. Constructed surfaces account for less than 20% of land cover.	1.39
Evergreen forest	Contains areas dominated by trees generally greater than 5 meters tall and greater than 20% total vegetation cover. More than 75% of the tree species maintain their leaves all year. Canopy is never without green foliage.	6.51
Grassland	Contains areas dominated by graminoid or herbaceous vegetation, generally greater than 80% of total vegetation. These areas are not subject to intensive management as tilling but can be utilized for grazing.	0.05
Palustrine emergent wetland	Includes tidal and nontidal wetlands dominated by persistent emergent vascular plants, emergent mosses or lichens, and all such wetlands that occur in tidal areas in which salinity due to ocean-derived salts is below 0.5%. Total vegetation cover is greater than 80%.	0.32
Palustrine shrub/scrub wetland	Includes tidal and nontidal wetlands dominated by woody vegetation less than 5 meters in height, and all such wetlands that occur in tidal areas in which salinity due to ocean-derived salts is below 0.5%. Total vegetation coverage is greater than 20%.	1.44
Pasture/hay	Contains areas of grasses, legumes, or grass-legume mixtures planted for livestock grazing or the production of seed or hay crops, typically on a perennial cycle and not tilled. Pasture/hay vegetation accounts for greater than 20% of total vegetation.	8.05
Scrub/shrub	Contains areas dominated by shrubs less than 5 meters tall with shrub canopy typically greater than 20% of total vegetation. Includes tree shrubs, young trees in an early successional stage, or trees stunted from environmental conditions.	0.79
Water	Includes areas of open water, generally with less than 25% cover of vegetation or soil.	0.18

Special Status Plant Species: A USFWS Information for Planning and Consultation (IPaC) report has been generated for the project. The IPaC system is used to help identify federally-protected plant and animal species which may be potentially impacted by a project. The report did not identify any federally threatened or endangered plant species in the project area. Formal consultation with USFWS and MassWildlife NHESP regarding federally-protected plant species was initiated in December 2021 and again in October 2022. A response from the USFWS was received on 30 November 2022. The USFWS did not comment on the presence of phragmites in the project area. No response was received from MassWildlife NHESP.

Massachusetts Wildlife's NHESP lists threatened, endangered, and special concern plant species for the Commonwealth, protected under the Massachusetts Endangered Species Act. Fourteen of these species have been observed, either historically or recently, within the City of Westfield. Six are considered species of special concern, 2 have a status of threatened, and 6 have a status of endangered. No surveys have been conducted to determine whether these species are present within the project area. Formal consultation with Massachusetts Wildlife's NHESP was initiated in November 2020 and completed in January 2021. No response was received. The full list of Massachusetts special status plant species observed (historically or recently) in Westfield is included in Table G.

Table G - NHESP State Listed Plant Species in Westfield

City	Taxonomic Group	Scientific Name	Common Name	MESA Status	Most Recent Observation	County
Westfield	Vascular Plant	*Calystegia spithamaea*	Low bindweed	E	1934	Hampden
Westfield	Vascular Plant	*Carex polymorpha*	Variable sedge	E	Historic	Hampden
Westfield	Vascular Plant	*Cyperus houghtonii*	Houghton's glatsedge	E	1973	Hampden
Westfield	Vascular Plant	*Elymus villosus*	Hairy wild rye	E	1913	Hampden
Westfield	Vascular Plant	*Houstonia longifolia*	Long-leaved bluet	E	1914	Hampden
Westfield	Vascular Plant	*Hypericum ascyron*	Giant St. John's-wort	E	1858	Hampden
Westfield	Vascular Plant	*Adlumia fungosa*	Climbing fumitory	SC	1988	Hampden
Westfield	Vascular Plant	*Boechera laevigata*	Smooth rock-cress	SC	2007	Hampden
Westfield	Vascular Plant	*Clematis occidentalis*	Purple clematis	SC	2009	Hampden
Westfield	Vascular Plant	*Liatris scariosa var. novae-angliae*	New England blazing star	SC	2010	Hampden
Westfield	Vascular Plant	*Moneses uniflora*	One-flowered pyrola	SC	1974	Hampden
Westfield	Vascular Plant	*Ranunculus pensylvanicus*	Bristly buttercup	SC	2010	Hampden
Westfield	Vascular Plant	*Aristida purpurascens*	Purple needlegrass	T	1858	Hampden
Westfield	Vascular Plant	*Sphenopholis nitida*	Shining wedgegrass	T	2016	Hampden

City	Taxonomic Group	Scientific Name	Common Name	MESA Status	Most Recent Observation	County
NOTES: MESA = Massachusetts Endangered Species Act. Status: E = Endangered; SC = Special Concern; T = Threatened.						

Noxious Weed and Invasive Plant Species: Massachusetts Department of Agricultural Resources maintains a list of approximately 150 prohibited plant species for Massachusetts. Common reed (*Phragmites australis)* which is included on the list and is also a federally listed invasive species, was observed in abundance in the freshwater emergent wetlands and the freshwater forested/shrub wetlands upstream of the dam.

Common reed, which is included on the list and is also a federally listed invasive species, was observed in abundance in the freshwater emergent wetlands both upstream and downstream of the dam within the LOD. The freshwater emergent wetlands upstream of the dam, which occupies 0.61 acre in the LOD, was comprised almost entirely of common reed. The freshwater emergent wetlands downstream of the dam, which occupies 1.36 acres in the LOD, was comprised of approximately 50% common reed.

Riparian Areas: Riparian habitat exists in transitional areas between uplands and watercourses adjacent to Powdermill Brook and Powdermill Brook Reservoir. Vegetation cover in the riparian corridor of the project area is categorized as palustrine emergent wetlands, palustrine scrub/shrub wetlands, palustrine forested wetlands, and some deciduous forested land.

Animals

Fish Habitat and Species: Fish data were obtained for Powdermill Brook from the Massachusetts Division of Fisheries and Wildlife. The data was from stream surveys they conducted in 2001, 2006, and 2011 using the backpack electroshock method, which identified several common freshwater fish species in Powdermill Brook, both upstream and downstream of the Dam.

Fish species identified upstream of the dam include: blacknose dace (*Rhinichthys atratulus*), creek chub (*Semotilus atromaculatus*), common shiner (*Luxilus cornutus*), and white sucker (*Catostomus commersonii*).

Fish species identified downstream of the dam include American eel (*Anguilla rostrata*), blacknose dace (*Rhinichthys atratulus*), brown trout (*Salmo trutta*), brook trout (*Salvelinus fontinalis*), common shiner (*Luxilus cornutus*), longnose dace (*Rhinichthys cataractae*), pumpkinseed (*Lepomis gibbosus*), sea lamprey (*Petromyzon marinus*), tessellated darter (*Etheostoma olmstedi*), and white sucker (*Catostomus commersonii*).

Brook Trout are stocked in Powdermill Brook during the spring season approximately 0.5 miles downstream of the dam site at the confluence of Powdermill Brook and Arm Brook.

Coral Reefs: There are no coral reefs present within the project area or near the project site.

Wildlife Habitat and Species: The area around Powdermill Dam is located just off a major Massachusetts transportation corridor (Massachusetts Turnpike also known as Interstate 90), though the area is comprised of a suburban setting with residential homes. Wildlife species that typically inhabit these areas include a variety of birds, migratory birds (seasonal), mammals, amphibians, and reptiles. Potential habitat for these species is provided by the many diverse habitats within the project area, which includes water, grassland, palustrine emergent, forested, and scrub/shrub wetlands, deciduous and evergreen forests, and pasture/hay.

iNaturalist is a nonprofit citizen science website that maintains a record of citizens record observations of plant and animal species. iNaturalist had recorded observations of various wildlife and plant species in the project area and surrounding the dam. There were documented observations of the eastern cottontail (*Sylvilagus floridanus*), eastern gray squirrel (*Scirus carolinensis*), gray tree frog (*Hyla versicolor*), spring peeper (*Pseudacris crucifer*), red-winged blackbird (*Agelaius phoeniceus*), cedar waxwing (*Bombycilla cedrorum*), mourning dove (*Zenaida macroura*), turkey vulture (*Cathartes aura*), red bellied woodpecker (*Melanerpes carolines),* and yellow warbler (*Setophaga petechia*) (iNaturalist 2019).

Additional wildlife species that typically inhabit areas similar to the environment of the project area include groundhog (*Marmota monax*), racoon (*Procyon lotor*), red fox (*Vulpes vulpes*), and opossum (*Didelphimorphia*). Evidence of white-tailed deer (*Odocoileus virginianus*), including tracks and tree markings from antler rubbing, was observed in the project area during a site visit.

Endangered and Threatened Species and State Species of Concern

Federally Listed Species: A USFWS IPaC search was completed for the project site and one federally-threatened mammal species was found to be potentially present in the project area: the northern long-eared bat (NLEB).

Formal consultation with USFWS for Section 7 regarding federally listed animal species was initiated in December 2021 and again in October 2022. A response from USFWS was received on 30 November 2022, in which USFWS recommended implementing a seasonal cutting restriction from 1 April to 31 October during NLEB active season. The USFWS also indicated that the NLEB will be reclassified from threatened to endangered effective 30 January 2023.

Northern Long-Eared Bat (*Myotis septentrionalis*)

During summer, NLEB roost singly or in colonies underneath bark, in cavities, or in crevices of both live trees and snags (dead trees). NLEB are flexible in selecting roosts, choosing roost trees based on suitability to retain bark or provide cavities or crevices. Breeding begins in late summer or early fall when males begin to swarm near hibernacula, the caves or mines where NLEB will hibernate during the winter. USFWS has classified the area surrounding the dam to be suitable habitat for the NLEB. However, no known surveys have ever been conducted on the site. The Massachusetts Wildlife NHESP has developed maps of known NLEB roosting trees and NLEB winter hibernacula. The closest mapped occurrence of a known NLEB site is 16 miles west of the Dam in the Town of Chester, Massachusetts.

State Species of Concern: Massachusetts categorizes species protected under the Massachusetts Endangered Species Act as either "endangered," "threatened," or "special concern." "Endangered" species are species that are in danger of extinction throughout all or a significant portion of their range or in danger of extirpation as documented by biological research and inventory. "Threatened" species are species that are likely to become endangered species within the foreseeable future throughout all or a significant portion of their range and any species that is likely to become endangered determined by biological research and inventory. Species of "special concern" are species that have been documented by biological research and inventory to have suffered decline that could threaten the species if allowed to continue unchecked or species that occur in such small numbers or with such restricted distribution or specialized habitat requirement that it could easily become threatened within Massachusetts.

A Massachusetts State Listed Animals Species list was accessed through Massachusetts Wildlife's NHESP. The list includes three endangered species, four threatened species, and ten species of special concern present within the City of Westfield. The full list of Massachusetts special status animal species in Westfield is included in Table H below.

Table H - NHESP State Listed Animal Species in Westfield

City	Taxonomic Group	Scientific Name	Common Name	MESA Status	Most Recent Observation	County
Westfield	Amphibian	*Ambystoma jeffersonianum*	Jefferson salamander	SC	2018	Hampden
Westfield	Amphibian	*Ambystoma opacum*	Marbled salamander	T	1982	Hampden
Westfield	Amphibian	*Scaphiopus holbrookii*	Eastern spadefoot	T	2018	Hampden
Westfield	Bird	*Bartramia longicauda*	Upland sandpiper	E	2014	Hampden
Westfield	Bird	*Vermivora chrysoptera*	Golden-winged warbler	E	1992	Hampden
Westfield	Bird	*Caprimulgus vociferous*	Eastern whip-poor-will	SC	2017	Hampden
Westfield	Bird	*Ammodramus savannarum*	Grasshopper sparrow	T	2014	Hampden
Westfield	Bird	*Pooecetes gramineus*	Vesper sparrow	T	2011	Hampden
Westfield	Butterfly/ Moth	*Apodrepanulatrix liberaria*	New Jersey tea inchworm	E	1999	Hampden
Westfield	Butterfly/ Moth	*Callophrys irus*	Frosted elfin	SC	2010	Hampden
Westfield	Butterfly/ Moth	*Speranza exonerata*	Pine barrens speranza	SC	1999	Hampden
Westfield	Butterfly/ Moth	*Zanclognatha martha*	Pine barrens zanclognatha	SC	1999	Hampden
Westfield	Crustacean	*Limnadia lenticularis*	American clam shrimp	SC	2018	Hampden
Westfield	Fish	*Notropis bifrenatus*	Bridle shiner	SC	1944	Hampden
Westfield	Mussel	*Strophitus undulatus*	Creeper	SC	2010	Hampden
Westfield	Reptile	*Glyptemys insculpta*	Wood turtle	SC	2013	Hampden

City	Taxonomic Group	Scientific Name	Common Name	MESA Status	Most Recent Observation	County
Westfield	Reptile	*Terrapene carolina*	Eastern box turtle	SC	2018	Hampden

Status: E = Endangered.
SC = Special Concern.
T = Threatened.

An area of land about 1 mile northeast of the dam site has been designated as "Estimated Habitats of Rare Wildlife" by the Massachusetts NHESP. This habitat covers approximately 4 acres within the project area. However, the habit is not adjacent to the dam and will not be impacted by any rehabilitation alternatives.

Formal consultation with Massachusetts Wildlife's NHESP was initiated in December 2021 and again in October 2022. No response was received from MassWildlife NHESP during the 30-day response period.

Invasive Fish and Wildlife Species: There are no known occurrences of invasive fish or wildlife within the project area or near the project site.

Migratory Birds/Bald and Golden Eagles: Bald eagles have occasionally been observed in the project area. However, no nesting eagles have been observed. It is anticipated that the occasional eagle observation can be attributed to eagles utilizing the reservoir and surrounding habitats while searching or foraging for food. Birds are likely attracted to the impoundment and the natural areas surrounding the dam.

The USFWS IPaC report for the project area identified migratory birds that could potentially utilize the Powdermill Brook Reservoir impoundment or the surrounding project area. These species include bald eagle (Haliaeetus leucocephalus), black-billed cuckoo (Coccyzus erythropthalmus), bobolink (Dolichonx oryzivorus), Canada warbler (Cardellina canadensis), Eastern whip-poor-will (Antrostomus vociferus), evening grosbeak (Coccothraustes vespertinus), prairie warbler (Dendroica discolor), rusty blackbird (Euphagus carolinus), and wood thrush (Hylocichla mustelina).

Human

Cultural Resources / Historic Properties: The cultural resources Area of Potential Effect consists of the limit of disturbance, staging area, access roads, borrow areas, the flood pool, the viewshed, and takes into account incidental disturbance that may occur during project installation.

A review of the Massachusetts Cultural Resources Inventory System (MACRIS) was conducted and the nearest recorded precontact site is 19-HD-286 which is located approximately 2,500 feet east of the APE and is described as a lithic workshop site. There are seven additional recorded precontact Native American archaeological sites and one historic period archeological sites located within a mile of the project area and an additional twenty-four precontact sites located within 2 miles of the project area. These include nineteen camp sites, one isolated find, one fort, one flake scatter, one village site, one burial site, one petroglyph site, and one lithic workshop /habitation site. No information other than location information was provide in MACRIS for the remaining

sites located within 2 miles of the APE. There are also more than 100 historic properties located within 2.5 miles of the APE. All of these properties are located within the Westfield Center Historic District located approximately 2 miles south of the project location.

The Phase 1A Archaeological investigation of the limit of disturbance and the staging area revealed no previously undisturbed locations of archeological sensitivity within the limit of disturbance and staging area. The architectural historian's report evaluated the dam structure as not eligible for listing in the National Register of Historic Places under any criteria. Returning the dam back to a functioning dry dam will reduce impacts within the existing flood pool by allowing Powdermill Brook to naturally reestablish through this location. Impacts on the viewshed will be negligible based on the minor change to the height of the dam. The surrounding landscape consists of a solar farm, a recycling center, industrial areas, a public school with recreational fields, and suburban housing. None of these areas are located within a National Register or State Register listed historic district and none of the buildings are listed on the National Register or State Register of Historic Places.

NRCS has been in ongoing consultation with six federally recognized Indian Tribes who have expressed an interest in Hampden County Massachusetts. These consultation efforts are detailed in Appendix A. Most recently, on July 21, 2023, a copy of the Phase 1A Report and Architectural Historian's Report prepared by SEARCH were submitted to the Delaware Tribe of Indians, the Mashpee Wampanoag Tribe, the Mohegan tribe of Indians of Connecticut, the Narragansett Indian Tribe, the Stockbridge-Munsee Community Band of Mohican Indians, and the Wampanoag Tribe of Gay Head (Aquinnah) Tribal Historic Preservation Officers on with a determination of No Historic Properties Affected. NRCS received concurrence from the Stockbridge-Munsee Community THPO on August 9, 2023. No comments were received from the Delaware Tribe of Indians, the Mashpee Wampanoag Tribe, the Mohegan tribe of Indians of Connecticut, the Narragansett Indian Tribe, and the Wampanoag Tribe of Gay Head (Aquinnah) Tribal Historic Preservation Officers during this most recent consultation effort. Nor were any comments received following our February 9, 2023, consultation efforts. Hard copies of the Phase 1A and Architectural Historians report were submitted to the Massachusetts SHPO on July 31, 2023, via certified mail and were received by SHPO staff on August 4, 2023. SHPO staff responded and reiterated that they have no concerns with the project and that the area of potential effect is not sensitive for containing historic or archaeological resources.

NRCS received no information regarding Traditional Cultural Properties within or near the APE that would be impacted by this project.

Recreation and Parklands: The project area is predominantly grassed and wooded land with some developed, suburban areas surrounding Powdermill Brook. The Westfield High School Athletic Fields fall within the project area, just west of the dam site. The area includes a baseball field, football field, and other grassed land. Powdermill Brook, both upstream and downstream of the Dam and Reservoir, is used by residents for recreational fishing and hunting.

Natural Areas: Natural areas within the project area are comprised of water, pasture/hay, various forest types, and various wetland types. The dam, spillway, and access road are actively maintained by the City of Westfield.

Visual/Aesthetics and Scenic Beauty: Scenic beauty takes into consideration landforms, water, vegetation, and structures, some of which are present within the project area. The landforms in the project area include small hills and other small geologic formations. There is one small, shallow water body, about 0.27 acre in size, which was formed by the construction of Powdermill Dam, and is used by residents for fishing. There are a variety of vegetation communities in the project area.

Powdermill Dam is located in a primarily residential area of Westfield. The land can be seen from 2 residential properties adjacent to the dam. The natural vista of the dam area is generally valued by the local residents.

Environmental Justice: Table I depicts the results of utilizing EPA's EJSCREEN regarding the demographics and socio-economics of the affected population compared to the City of Westfield, Hampden County and the State of Massachusetts. See *Economic Conditions* later in this section for an explanation of the presence or non-presence of EJ communities within the affected area.

Ecosystem Health

The structure of the ecosystems associated with the Powdermill Dam has similar characteristics. The ecosystem structure surrounding the dam consist of mixed forest, riverine creek habitat, a maintained grass covered auxiliary spillway, maintained grass covered earthen dam area and an impounded water area upstream of the dam.

During the site visit to the dam site, the entire extent of the existing structure and adjacent land areas was walked and visually assessed. The areas adjacent to the dam and spillway were primarily made up of mixed forest with native shrubs and grass. The vegetation and habitat appeared healthy, and the site and adjacent land areas did not exhibit signs of obvious ecological degradation (i.e., severe erosion gullies, runnels, patches of dead vegetation, etc.). Evidence of natural succession was present in areas adjacent to the dam. Turbidity was not identified as a concern in the stream feeding the impoundment or in the impoundment itself. Based on these observed conditions it was determined that the ecosystem functions were being performed adequately and the system was stable and in good health which provides evidence of the resiliency of the site related to flooding.

Ecosystem Services

The following ecosystem service investigation approach is based on Departmental Regulation 9500-013 guidance. It utilizes additional guidance in 40 CFR 1502.15, National Watershed Program Manual (NWPM) (501.38 A. (1), and in Departmental Manual 9500-013 (pgs. 17, 31, 38) which states the intensity of planning is dependent on the potential significance of the project action. It has particular application to the development of Supplemental Watershed Plans where conservation measures have previously been installed, e.g. Dam Rehabilitation Projects.

To understand ecosystem flows related to project action, the NRCS Conservation Practice Physical Effects (CPPE) network diagrams were employed. The specific diagrams for practices anticipated to be implemented were reviewed. Linkages were defined between the network diagram direct

effects and the 16 ecosystem services to be considered in project planning. The direct effect was used as the surrogate measure for impacts to a related ecosystem service. This conceptual model connection was presented during scoping to identify the ecosystem services that would be relevant to decision making. The analysis indicated that three categories of ecosystem services would likely be impacted. These categories include, Regulating, Supporting, and Cultural services. These categories are discussed in more detail below as well as the specific services in each "Service Category" that are anticipated to be impacted by project action. The associated metrics used to evaluate service impacts are also discussed in the following paragraphs.

Regulating Services Category

Regulating ecosystem services are services which help maintain a world in which it is possible for people to live, providing critical benefits that buffer against environmental catastrophe. These benefits are obtained through moderation or control of ecosystem processes, including regulation of local climate, air, or soil quality; carbon sequestration; flood, erosion, or disease control; and pollination. There is inherent uncertainty when trying to predict impacts on regulating ecosystem services, given that most ideas of climate change and potential environmental catastrophes are based on models and simulations.

Flood and Disease Control – Service (DM 9500-013, P. 31)

Powdermill Dam was constructed for the purpose of flood control to protect the City of Westfield and its downstream residents from flooding events. The creation of the dam has limited the frequency and extent of flooding events, and as a result, the risk of pathogens, harmful bacteria i.e., fecal coliform etc., and vector borne disease spreading through contaminated flood waters is believed to be decreased. Disease control is not used as a metric for this service, it is only noted as a likely associated benefit. The continuing functionality of the dam ensures public health and safety to downstream residents.

<u>Surrogate Metric for Flood and Disease Control</u>
The key metrics which were used as the surrogate measures of the flood control service (and by default disease control) were the acres of undeveloped land, and the number of structures (i.e., bridges and buildings) located within the FEMA 100-year flood zone and the hypothetical breach zone downstream of the dam. The residents and businesses within these zones will be directly impacted by changes in flood control. The number of structures impacted will be used as an ecosystem service metric. This is because the inundation and destruction of structures are more likely to impact human lives than the inundation of floodplain acres. As such, the final metric which will be carried forward and included in the summary of project alternatives and associated ecosystem services in the Final Plan-EA is the number of structures impacted under existing conditions as compared to each Alternative. This is because reducing flood damages and the potential loss of life is a critical ecosystem service for the project area. A secondary surrogate metric to measure flood control is the composition of vegetation within the 100-year flood zone. The vegetation has adapted to the current flood regime and changes, or elimination of vegetation has the potential to affect flood control. Flood zone vegetation will be examined before and after project action to determine if the dominant vegetation communities have significantly changed.

Based on 100-year inundation maps, there are a total of 126 buildings that flood under current conditions (existing conditions with dam-in-place). The types of buildings are 91 houses, 18 apartment buildings, 16 commercial businesses, and 1 public building. There are also 8 acres of undeveloped land in the 100-year inundation zone. This vegetation is 2 acres of pasture/brush and 5 acres of trees.

Supporting Services Category

Supporting services refer to the underlying processes maintaining conditions for life on Earth, including nutrient cycling, soil formation, and primary production. There is inherent uncertainty when trying to determine impacts of the project on supporting ecosystem services since there are many factors unrelated to the project that can affect processes such as nutrient cycling and soil formation.

Nutrient Cycling – Service

Nutrient cycling in ecosystems is the exchange of organic and inorganic material back into the production of energy and matter. The nutrient cycle involves animals, plants, bacteria, fungi, as well as mineral components of the soil.

Surrogate Metric for Nutrient Cycling
The key surrogate metric which will be used to represent nutrient cycling will be vegetation. The addition or removal of vegetation will have an impact on nutrient cycling. The change in the extent of vegetation in the Limits of Disturbance (LOD) for each alternative will be analyzed.

There are currently 69.7 acres of established vegetation in the project area, of which 41.3 acres are trees.

Soil Formation – Service

Factors that affect soil formation include parent material, climate, topography, biological factors, and time.

Surrogate Metric for Soil Formation
The key surrogate metric which will be used to represent impacts to soil formation will be the extent and magnitude of the change of perviousness in the LOD.

There are 81.4 acres of semi-pervious surface and 0.9 acre of impervious surface (existing conditions with dam-in-place).

Cultural Services Category

Cultural services make the world a place in which people want to live. These services are the non-material benefits that ecosystems provide to human societies and culture, including opportunities for recreation, tourism, aesthetic or artistic appreciation, and spirituality. Uncertainty within cultural ecosystem services lies within society's restructuring of what is deemed culturally important as well as future management actions outside the realm of this project.

Recreational Use – Service

The project area is predominantly grassed and wooded land with suburban areas surrounding the dam site. There are several designated recreational areas in the upstream and downstream areas surrounding Powdermill Dam.

Surrogate Metric for Recreational Use
The key surrogate metrics used to represent recreational use will be the impoundment size and feet of trails within the project area.

Existing Conditions for Recreational Use

- Surface Area of the Pond = 0.27 acre
- Feet of Pedestrian Trails in LOD is 605

Aesthetic Viewsheds – Service

Scenic beauty takes into consideration landforms, water, vegetation, and structures, some of which are present within the project area. The landforms in the project area include small hills and other small geologic formations.

Surrogate Metric for Viewsheds
The key surrogate metric which will be used to represent the viewshed will be the percentage of green landscape within the project area. A secondary metric that will be used is the number of residences and businesses which have a direct line of sight or view of the project area.

There is 81.4 acres of green landscape in the project area and 2 residents have homes with a viewshed of the dam in the existing condition with the dam-in-place.

Economic Conditions

Employment/Unemployment: Using the Census data available at the time of the study, 68.0% of the population in the affected area were in the labor force. The percentage of civilian unemployed in the labor force was 4.0%. Figures for the other entities were 65.4% in the labor force and 6.3% unemployed for Westfield, 62.0% in the labor force and 8.0% unemployment (Hampden County), and 67.3% and 6.0% (State of Massachusetts), respectively. According to the U.S. Bureau of Labor Statistics, recent unemployment rates are as follows: Westfield (October 2019 – 2.9%), Hampden County (3.2%) and State of Massachusetts (4.0%), both November 2019. Unemployment data was not available for the affected area but given that the recent figures for the other three entities are within the small range of 2.9 – 4.0%, it is within reason that the affected area's unemployment rate is comparable.

Income/Education: The affected area's per capita income ($20,454) is much lower than Westfield, Hampden County, and the State of Massachusetts per capita incomes of $29,092, $28,072, and $39,913, respectively. When looking at median household incomes though, the affected area's is 107% of that of Westfield, 128% of Hampden County, but only 90% of the State of Massachusetts.

The affected area's median household income is $66,619, higher than Westfield and Hampden County. But only 46% of the households in the affected area have incomes greater than $50,000. This compares to Westfield of about 60%, Hampden County of 52%, and the State of Massachusetts of nearly 65%. For the other income breakdown categories, the affected area has more population with income less than $25,000 than the other three entities (which would make sense given the school associated high rental rate). But more of the area's population falls within the $25,000 - $50,000 category than do the other three entities.

The percentage of high school graduates or higher in the affected area is much lower than Westfield, Hampden County, and the State of Massachusetts – 74.0% compared to 92.1%, 87.1%, and 90.3%, respectively. About 28.0% of residents in the affected area have a bachelor's degree or higher compared to 32.0%, 28.7%, and 42.1% for the other three entities, respectively.

Poverty: Statistics in Table I show that population living below the poverty level for the affected area (7.6%) is a little lower than Westfield (8.5%) but much lower than Hampden County (17.2%) and the State of Massachusetts (11.1%).

Housing: As Table I reflects, less than half of the population in the affected area are homeowners (48.0%); whereas the other three entities all exceed 60% home ownership. The high rental rate within the affected area (52.0%) supports the earlier assumption of college-age residents.

Table I – Demographics and Socio-Economics of Breach Inundation Zone, City of Westfield, Hampden County, and Massachusetts [1/]

Category	Affected Population [2/]	City of Westfield	Hampden County	Massachusetts
Total Persons	2,290	89,708	469,188	6,789,319
Persons Below Poverty Level	7.6%	8.5%	17.2%	11.1%
Households in Area (#)	888	15,276	178,931	2,585,715
Race				
White	77.0%	93.0%	80.4%	78.9%
African American	0.0%	1.6%	8.7%	7.4%
American Indian and Alaska Native	0.0%	0.1%	0.3%	0.2%
Asian	9.5%	2.2%	2.2%	6.3%
Native Hawaiian and Other Pacific Islander	0.0%	0.1%	0.0%	0.0%
Other Race	9.5%	1.7%	5.6%	4.1%
Multiracial	4.0%	1.3%	2.7%	3.1%
Ethnicity				

Category	Affected Population 2/	City of Westfield	Hampden County	Massachusetts
Hispanic or Latino	16.0%	8.3%	23.9%	11.2%
Not Hispanic or Latino	84.0%	91.7%	76.1%	88.8%
Age Breakdown				
Age 0 - 18 years old	26.0%	25.5%	25.3%	23.5%
Age 18+	74.0%	74.5%	74.7%	76.5%
Age 65 years and older	9.0%	15.9%	15.7%	15.5%
Gender				
Males	47.0%	48.9%	48.3%	48.5%
Females	53.0%	51.1%	51.7%	51.5%
Education Level (age 25 and over)				
Less than 9th grade	12.0%	3.1%	6.1%	4.6%
9th - 12th grade	14.0%	4.8%	8.5%	5.1%
High School Diploma	25.0%	30.9%	30.2%	24.7%
Some College, no degree	22.0%	18.8%	19.0%	15.8%
Associate Degree	6.0%	10.4%	9.8%	7.7%
Percent High School Graduate or Higher	74.0%	92.1%	857.4%	90.3%
Percent Bachelor's Degree or Higher	28.0%	32.0%	28.7%	42.1%
Language Spoken at Home				
English Only	75.0%	NA	79.9%	88.7%
Language Other Than English	25.0%	NA	20.1%	11.3%
Income Breakdown (Households)				
Less than $15,000	9.0%	6.6%	14.6%	10.4%
$15,000 - $25,000	18.0%	8.3%	11.2%	7.9%
$25,000 - $50,000	27.0%	24.9%	22.2%	17.1%
$50,000 - $75,000	26.0%	19.9%	16.4%	15.1%
$75,000+	20.0%	40.3%	35.6%	49.5%
Median Household Income	$66,619	$62,212	$52,205	$74,167

Category	Affected Population 2/	City of Westfield	Hampden County	Massachusetts
Per Capita Income				
Total Population	$20,454	$29,092	$28,072	$39,913
Occupied Housing Units by Tenure				
Owner Occupied	48.0%	68.6%	61.2%	62.4%
Renter Occupied	52.0%	31.4%	38.8%	37.6%
Employed Population Age 16+ Years				
In Labor Force	68.0%	65.4%	62.0%	67.3%
Civilian Unemployed in Labor Force	4.0%	6.3%	8.0%	6.0%

[1/] American Community Survey 5-year Estimates for 2013-2017

[2/] Data represents population within breach inundation zone downstream of dam.

Summary:

In summary, the demographics of the affected area as compared to Westfield, Hampden County, and the State of Massachusetts overall reflects evidence of lower per capita income but higher median household income (except for State of Massachusetts), low poverty levels, and the presence of a minority population.

In Massachusetts, a neighborhood is defined as an Environmental Justice (EJ) population if any of the following are true:

- Block group whose annual median household income is equal to or less than 65 percent of the statewide median ($62,072 in 2010); or
- 25% or more of the residents identify as a race other than white; or
- 25% or more of households have no one over the age of 14 who speaks English only or very well - English Isolation

Source: *Environmental Justice Populations in Massachusetts, Environmental Justice (EJ) Population Data from 2010 Census based upon demographic criteria developed by the Massachusetts Executive Office of Energy and Environmental Affairs* (https://www.mass.gov/info-details/environmental-justice-populations-in-massachusetts).

The affected area does not meet the minimum threshold of the above criteria for an EJ community. Median household income in the affected area is $66,619. This is greater than 65% of the statewide median of $62,072 in 2010. Twenty-three percent of the population in the affected area is non-white, which is 2% lower than the threshold of 25%. And according to EJSCREEN, 75% of the population in the affected area speak only English and 25% speak non-English at home. Of the 25%, 10% speak English "very well", 7% speak English "well", 1% speak English "not well", and

7% speak English "not at all". This, too, does not meet the language threshold for an EJ community. Regardless, efforts were made to involve all interested parties in the planning process.

Social Environment

Population and Race: The estimated population of the affected area is 2,290 and the number of households is about 900 according to the U.S. Census Bureau projections (American Community Survey 5-year Estimates for 2013-2017). According to the U.S. Census Bureau, Westfield's population was 40,072 in 2000; 41,092 in 2010; and 41,680 in 2018, indicating a steady increase over the last few decades. It is estimated that the affected area has seen similar growth during the same time period. Minority population by race is much higher in the affected area (23.0%) compared to Westfield (7.0%), but comparable to Hampden County (19.6%) and the State of Massachusetts (21.1%). Ethnicity (Hispanic or Latino) in the affected area (16.0%) is nearly double than Westfield (8.3%) and somewhat higher than the State of Massachusetts (11.2%), but much lower than Hampden County (23.9%).

Age: About 74.0% of the people living within the affected area are 18 years old and above, which is about the same for the other three entities. However, those age 65 years and older make up only 9% of the population in the affected area, which is much lower than Westfield (15.9%), Hampden County (15.7%) and the State of Massachusetts (15.5%). It was noted during the field review of the affected area that there were many rental properties (duplexes, apartments, etc.) containing young people and/or young families. Westfield State University, a four-year public university with over 6,000 total enrollment, is located not far from the affected area, which might help explain the relatively younger population within the affected area as compared to the other three entities.

Status of Operation and Maintenance

Operation and maintenance of the Powdermill Dam are the responsibility of the City of Westfield, and they have operated and maintained the dam in accordance with the operation and maintenance agreement. This has been verified through inspection reports. The last full O&M inspection was conducted in December 2022.

Sedimentation

The major land uses in the watershed above the dam are 55% Forest, 36% Urban, 5% Pasture, 2% Grassland, and 2% Cultivated Land. Based on the zoning restrictions, the projected land uses are 46% Forest, 41% Urban, 10% Pasture, and 4% Grassland. However, future sediment accumulation rate is not expected to exceed the historical rate since many of the past sources of significant sediment yield (such as the Westfield City landfill, logging site above Russellville Road, and erosion associated with new development) have been eliminated. The total annual sediment accumulation rate based on the sediment survey was estimated to be 0.29 ac-ft per year (0.25 ac-ft/year of submerged sediment and 0.18 ac-ft/year of aerated sediment) . The remaining submerged sediment storage of acre-feet does not satisfy the minimum requirement of 50 years of sediment storage. However, Powdermill Dam was originally planned and designed as a dry dam with the high stage set an elevation to provide to provide for the storage of sediment accumulated over the

period of 50 years. The rehabilitation plan is to re-establish the "dry condition" and, therefore, projected sediment deposited behind the dam was assumed to have aerated sediment characteristics and the total aerated sediment volume was accounted for in the stage-storage curve. Given the uncertainty associated with aerated sediment deposition behind the dam, the historical total sediment accumulation rate of 0.29 ac-ft/year was used to project future aerated sediment accumulation. Based on this annual sedimentation rate, it is estimated that 33,800 tons of sediment with a volume weight of 90 lbs/cu ft (clay-silt-sand mixtures) would result in deposition of approximately 17.2 ac-ft of aerated sediment behind the dam during the 79-year period of analysis (a design and installation period of four years and an expected useful life of 75 years).

Breach Analysis and Hazard Classification

To estimate the downstream inundation zone resulting from a dam breach, a breach analysis was performed for the static (sunny-day) breach, the hydrologic (PMF), and the seismic breach scenarios and breach inundation maps for these conditions were prepared.

The WinDAM C computer program was used to generate the breach hydrographs, which were manually entered into the HEC-RAS hydraulic model. For the static (sunny-day) and seismic breach scenarios no inflow hydrographs were required since the dam breach was initiated at the auxiliary spillway crest and normal elevations, respectively. For the hydrologic (PMF) dam breach scenario, the inflow hydrograph was developed in SITES. Table D-9 in Appendix D describes the key inputs for WinDAM C, including soil parameters, which were based on the geotechnical exploration performed as part of this project.

The static (sunny-day) dam breach scenario, with pool elevation at the auxiliary spillway crest and with non-storm conditions downstream, was considered the limiting case for determination of hazard classification. Based on the results of the dam breach analysis, there is no justification to lower the hazard classification of Powdermill Dam. The breach inundation maps for both static (sunny-day) and hydrologic dam breach scenarios are located in Appendix C. The breach inundation maps for the static dam breach scenario were not included since they do not show any impacts due to the minimal storage behind the dam at normal pool.

The Emergency Action Plan prepared for the Sponsors and dated December 2006 contains a ½ PMF breach inundation zone map that complies with DCR dam safety requirements for existing High Hazard dams.

Table J - As-Built and Existing Structural Data for Powdermill Dam

	As-Built	**Existing**
Local Name	Powdermill Dam	Powdermill Dam
Site Number	N/A	N/A
Year Completed	1965	1965
Cost		
Purpose	Flood control	Flood control
Drainage Area, mi^2	4.6	4.5
Dam Height, feet[1/]	53	52.5 – 55.7
Dam Type	Earthen	Earthen

	As-Built	Existing
Dam Volume, yds[3]	160,000	160,000
Dam Crest Length, feet	640	620
Total Capacity, acre-feet [2/]	970	906.1
Submerged Sediment, acre-feet	N/A	0.8
Aerated Sediment, acre-feet	15	N/A
Beneficial Use , acre-feet	N/A	N/A
Floodwater Retarding, acre-feet	955	896.1
Surface Area (Sediment Pool), acre	5	0.3
Principal Spillway		
Type	Reinforced Concrete	Reinforced Concrete
Riser Height, feet[3/]	7.2	7.2
Conduit Size, inches (I.D.)	48	48
Stages, number	2	2
Elevation Crest Low Stage Inlet	156.8	Not Measured
Elevation Crest High Stage Inlet	162.3	162.3
Capacity, cubic feet per second[4/]	342	328
Energy Dissipater	Rip Rap Stilling Basin	Rip Rap Stilling Basin
Auxiliary Spillway		
Type	Vegetated Earth	Vegetated Earth
Crest Elevation	196.3	196.3
Width, feet	260	260
Capacity, % of PMF[5/]	100	41
Sediment Pool Elevation	162.3	162.3
Floodpool Elevation	N/A	N/A
Top of Dam Elevation	201.3 (settled)	200.8 -204.0
Datum	NAVD 88	NAVD 88

[1/] Dam Height measured from top of dam to plunge pool bottom of channel vertical curve.
[2/] Total storage capacity at crest of auxiliary spillway.
[3/] Riser Height measured from invert to riser platform.
[4/] Measured as principal spillway conduit capacity at top of dam elevation.
[5/] Based on discharge rate during passage of FBH (7900 cfs) from Table 3 of Powdermill Work Plan compared to peak discharge during the 6-hr FBH (19318) from the existing SITES model.

Unilateral Climate Change Resilience Facets of Alternatives

To address climate change each construction alternative includes steps to build ecological resiliency. A level of resiliency will be accomplished by recommending the use of grass species that are more drought and flood tolerant during revegetation of the construction site.

Evaluation of Potential Failure Modes

Dams are built for the conditions that existed or could reasonably be anticipated during the time of design. Sometimes these conditions change, resulting in dam failure. Several potential modes of failure were evaluated for Powdermill Dam.

Slope Stability

The upstream slope of the dam meets the required factors of safety for the Normal Pool Steady Seepage, Flood Surcharge FBH Event, and Normal Pool Rapid Drawdown conditions. The potential for a failure due to slope stability on the upstream slope is low.

The downstream slope of the embankment meets the required factors of safety for Normal Pool Steady Seepage and Flood Surcharge FBH Event conditions. The potential for a failure due to slope stability on the downstream slope is low.

Hydrologic Capacity and Spillway Integrity

Hydrologic failure of a dam occurs when the auxiliary spillway is breached or when the dam is overtopped and fails. Under current NRCS criteria for high hazard potential dams, the auxiliary spillway must have sufficient integrity and capacity to completely pass the full PMF event. The auxiliary spillway does not have sufficient capacity to prevent overtopping, and based on the WinDAM C model results, the dam would breach due to the overtopping. Furthermore, the auxiliary spillway does not have sufficient integrity to withstand the flows from the PMF event and, based on the SITES integrity analysis, would breach due to headcut development. For these reasons, the overall potential for hydrologic failure of the Powdermill Dam is high.

Seepage

Embankment and foundation seepage can contribute to failure of an embankment by removing (piping) soil material through the embankment or foundation. As the soil material is removed, the voids created allow even more water flow through the embankment or foundation, until the dam collapses due to the internal erosion. Seepage that increases with a rise in pool elevation is an indication of a potential problem, as is stained or muddy water or "sand boils" (the up-welling of sediment transported by water through voided areas). Foundation and embankment drainage systems can alleviate the seepage problem by removing the water without allowing soil particles to be transported away from the dam. The existing bituminous coated corrugated metal pipe (BCCMP) within the foundation trench drain is beyond its design life and, if corroded or collapsed, could create an unfiltered outlet, potentially resulting in internal erosion of the filter material and foundation soils. The outlets to the BCCMP trench drain could not be located during the field inspection and the outlets are assumed to be buried by rip rap and submerged under normal tailwater conditions in the stilling basin.

The as-built drawings show that the filter materials were placed along the right and left sides of the downstream section of the spillway conduit, but not above or below the conduit such that the conduit does not have a filter diaphragm as required by TR210-60 and 210-NEH-628, Chapter 45, "Filter Diaphragms."

Although the seepage gradients are low, the potential for a seepage failure is moderate.

Seismic

The structural integrity of an earthen embankment is typically dependent upon the presence of a stable foundation. Foundation movement through consolidation, compression, or lateral movement can cause the creation of voids or cracks within an embankment, separation of the

principal spillway conduit joints, or, in extreme cases, complete collapse of the embankment. The Powdermill Dam Watershed is located within an area of moderate seismic hazard.

The results of the geotechnical investigation, testing, and analyses indicate the dam embankment and foundation soils are not susceptible to liquefaction due to ground motions resulting from design-level earthquake loading. The analyses indicate that the yield accelerations of the upstream and downstream slopes are greater than the minimum design such that the embankment is unlikely to deform during the design-level seismic event. The potential for failure of the dam embankment due to seismic loading is low.

The Powdermill Dam spillway riser structure meets current criteria for seismic stability. The potential for a seismic failure of the riser is low.

Material Deterioration

The materials used in the principal spillway system, the embankment drains, and the pool drainage system are subject to weathering and chemical reactions due to natural elements within the soil, water, and atmosphere. Concrete risers and conduits can deteriorate and crack, metal components can rust and corrode, and leaks can develop. Embankment failure can occur from internal erosion caused by these leaks. An inspection of the principal spillway pipe was conducted in 2020. Visible portions of the spillway riser and pipe appeared to be in generally good condition, although the joints along the interior of the conduit require grouting and a large spall was observed at one joint. The low-stage slide gate on the upstream face of the spillway riser is partially buried in sediment and is non-functional. There is a reasonable expectation that it will continue to function as planned for the next 75 years, with the understanding that repairs and corrective actions to the low-stage slide gate and spillway conduit will be made during the dam rehabilitation. Therefore, there is low potential for failure due to material deterioration of the principal spillway system. The bituminous-coated corrugated metal pipe in the toe drain is beyond its service life based on expected metal loss over time. The corrosion of the pipe could potentially allow adjacent soil and filter material to backward erode into the remaining pipe and discharge through an unfiltered exit. Although the seepage gradients at the dam are low, the potential for failure of the embankment due to a collapse of the toe drain is considered moderate since the drains cannot be monitored. The existing toe drain pipes should be grouted-in-place and replaced with a new filtered toe drain with plastic piping as part of the dam rehabilitation.

Conclusion

At the present time, the most likely means of failure for the Powdermill Dam are caused by an extreme event such as the Probable Maximum Precipitation (PMP). The PMP would result in overtopping of the dam and breaching of the dam and the auxiliary spillway. The original BCCMP trench drain is beyond its service life and could create an unfiltered exit allowing backward erosion to occur. Additionally, there is no filter diaphragm fully encircling the spillway conduit potentially allowing for unfiltered seepage and backward erosion to occur along the conduit. These types of failures could occur at any time during the remaining life of the structure. The dam does not have adequate submerged sediment capacity to extend its service life; however, the intent is to restore the dam as “dry” for which the dam has adequate aerated sediment capacity.

Identified Deficiencies: Below is a summary of deficiencies associated with the dam.

Filter Diaphragm – There is no filter diaphragm around the existing principal spillway conduit. A compliant filter diaphragm should be installed around the conduit.

Existing Foundation Drains - The condition of the existing foundation drains is unknown. The original pipes were bituminous-coated corrugated metal pipes which have exceeded their life expectancy. They should be removed or abandoned (grouted) and replaced with a new foundation toe drain and filter system.

Erosion on Embankment – There is significant erosion, rutting and uneven surfaces on the embankment, abutments, and auxiliary spillway that were caused by unauthorized offroad vehicles. These areas need to be graded, shaped and seeded with an acceptable vegetative cover.

Hydrology and Hydraulic – Based on the SITES analysis results, Powdermill Dam does not meet the TR 210-60 design criteria for auxiliary spillway capacity and the dam is overtopped during both the short and long duration PMP events (6-hour and 24-hour freeboard hydrographs). As a result, structural rehabilitation options will need to consider increasing the auxiliary spillway capacity and/or raising the dam crest. The results indicate the top of dam would have to be raised to EL 204.87 if the hydraulic capacity of the auxiliary spillway were not increased.

Auxiliary Spillway Stability and Integrity – Based on the SITES analysis results, the auxiliary spillway would not meet stability criteria during passage of the Spillway Design Hydrograph (SDH), and the Freeboard Hydrograph (FBH) results in breaching of the existing vegetated auxiliary spillway by headcutting. To meet NRCS criteria, armoring of the spillway will be required to safely pass the FBH.

Consequences of Dam Failure

The effect of a dam failure was measured as the net impact between a PMP storm event with no breach compared to a PMP storm event with a breach. Under the PMP without a breach scenario, many properties would be impacted by flooding. Thus, these properties were not accounted for under the PMP with a breach scenario. The properties and infrastructure potentially affected by the incremental effect of overtopping breach of the Powdermill Dam include: 363 residences, 82 apartments, 45 commercial structures, 2 public properties, numerous outbuildings (sheds, barns, etc.), 1 stream crossing (bridge), and 19 roadways downstream within the breach inundation zone. In addition, the cargo railroad than runs along the eastern boundary of the site (Holyoke Branch) and continues to the south (New Haven and Hampton Railroad) would be affected by both the overtopping and static breaches. The incremental effects of the overtopping dam breach when compared to the non-breach scenario would mostly affect the Holyoke Branch section of the railroad for approximately 800 feet north of Notre Dame Street. The breach would result in inundation depths of up to 6 ft and velocities of up to 7 ft/sec. The railroad would be flooded for up to 1.5 hours.

Due to the nature of the at-risk properties downstream, it is difficult to predict population at risk (PAR) (i.e., individuals subject to injury or even death due to a catastrophic breach of Powdermill

Dam). Therefore, the NRCS publication Guidance for Completion of "Evaluation of Potential Rehabilitation Projects" was utilized to estimate PAR. Regarding urban structures, there are 363 residences, 82 apartments, 45 commercial businesses, and 2 public properties that would be impacted by a dam failure. Using an average of 3 residents per home and 1.5 people per apartment, it was estimated that 1,212 residents would be at risk during a breach. Based upon the NRCS guidance for commercial and public properties (the estimated number of people at these facilities under normal conditions, not peak capacity), it was determined that 96 people would be at risk from a breach.

As mentioned earlier, the impact of a PMP storm event with no breach was compared to that of a PMP storm event with a breach. Therefore, the depths of flooding stated in this section constitute net depths, the difference between the two events. The stream crossing at North Elm Street would be impacted by a dam breach resulting in 2.2 feet depth of overflow. Roadways approaching either side of this crossing would also be affected, plus multiple roadways downstream of the dam. According to MassDOT 2019 average daily traffic counts, over 14,600 vehicles utilize the roads downstream of Powdermill Dam daily (using an average of two people per vehicle results in about 29,200 motorists). Even though MassDOT did not have average daily traffic counts for all of the downstream roads, it is conceivable that motorists on these roads during a breach of Powdermill Dam could be at risk. Two of the roads are four-lane and would be flooded at depths of 1.8 feet and 2.2 feet resulting in four vehicles being at risk from a breach. Eighteen of the roadways downstream flood at depths ranging from just over 1 foot to nearly 3.5 feet. Because these are local streets and based on current NRCS guidance for estimating PAR, it was estimated that about 18 vehicles would be in harm's way. Adding the vehicles from the four-lane roads with the ones from the local roads total 22 vehicles. Considering an average of 2 occupants per vehicle, a total of 44 motorists would be exposed to risk. Vehicles on the roads would be washed downstream, and the road surfaces would be damaged and impassable. Traffic would be disrupted for an extended time while the crossings/roadways are being repaired. Including the PAR estimated above for buildings and the PAR estimated for stream crossings/roadways, total PAR from a breach of Powdermill Dam would be 1,352.

The environmental damages from a dam failure would be significant. In addition to the damage caused by the water, the sediment stored in the pool area would be flushed downstream in the event of a catastrophic breach. Based on the flow velocities during the breach, significant scouring of the stream channel would occur downstream. Sediment would be deposited in the floodplain. This would constrict the floodplain and cause additional flooding in subsequent storm events. Deposition of sediment in the floodplain would also restrict normal use of the land which may cause water quality problems in the future. It is unlikely that a catastrophic breach would remove all the fill material used to build the dam. Some of the embankment material remaining after a breach would also eventually erode into the stream, contributing to the downstream sediment deposition. Over time, the sediment could migrate downstream into the Westfield River.

ALTERNATIVES

Rationale for Alternative Formulation

Several deficiencies were identified for this dam during the inventory and data collection phase of the planning effort. When the deficiencies of the dam were considered along with the Purpose and Need Statement, it was apparent that various alternatives should be evaluated in order to bring the dam into compliance with current Massachusetts and NRCS dam safety and performance standards. Under the Watershed Rehabilitation Provisions of the Watershed Protection and Flood Prevention Act, NRCS is required to consider the technical, social, and economic feasibility of the locally preferred solution and other alternatives identified through the planning process. In addition, NEPA and the National Watershed Program Manual require the consideration of all reasonable alternatives to the proposed federal action.

Formulation Process

The process begins with identifying alternatives that meet the Purpose and Need statement goals. This "Statement" requires that alternatives meet current safety and performance standards and provide the current level of flood protection. A suite of alternatives was developed to meet the "Statement."

The following alternatives were included based on NRCS policy:

1. No Federal Action
2. Decommissioning (removal)
3. Nonstructural Alternatives (elevation, relocation, zoning, etc.)
4. Structural Rehabilitation to current criteria

All initial alternatives undergo a screening evaluation involving the "Four Tests" of Completeness, Effectiveness, Efficiency, and Acceptability that are presented in the following text as well as the criteria provided in Departmental Manual 9500-013 which states "Alternatives that may at first appear reasonable but clearly become unreasonable because of cost, logistics, existing technology, social, or environmental reasons may also be eliminated from further analysis."

The alternatives which were not eliminated during initial screening then were carried through to the detailed evaluation phase. This phase required alternatives to be evaluated against additional criteria which are shown below:

- PR&G – Federal Objective
- PR&G – General Requirements
- PR&G – Guiding Principles
- PR&G – "Four Tests" of Completeness, Effectiveness, Efficiency, and Acceptability

After this part of the evaluation was complete, an alternative was identified as the National Economic Efficiency (NEE) alternative. The alternatives that met the above criteria were then compared to the Future Without Federal Investment (FWOFI) alternative in three areas:

1. Effects on environmental resources and ecosystem services
2. Economic contribution

3. Social contribution

The tradeoffs related to the alternatives were defined during the comparison process. At the end of the process, a Recommended Alternative was identified. The sponsors then selected their "Locally Preferred" alternative from the final suite of alternatives.

This process follows procedures set forth in the NRCS National Watershed Program Manual and other guidance referenced below:

- The Principles and Requirements for Federal Investments in Water Resources, dated March 2013
- USDA Departmental Regulation 9500-013
- USDA Departmental Manual 9500-013
- Interagency Guidelines (promulgated by Public Law 110-114)
- NRCS Economics Handbook, Part II for Water Resources

Alternatives Considered but Eliminated From Detailed Study

Some of the alternatives considered in the planning process were eliminated from detailed consideration because these alternatives either did not meet the proposed purpose or need for federal action, they were exorbitantly expensive, or they were logistically impractical to implement.

Decommission Dam: Consideration of a decommissioning alternative is mandatory based on law (PL 83-566, Section 14, A1e) and NRCS policy. This option describes an alternative which requires removing the flood detention capacity of the dam by cutting a notch in the existing embankment and re-connecting and restoring the stream channel and 100-year floodplain upstream and downstream of the dam in a non-erosive manner. If the dam were removed, the 363 homes, 82 apartments, 45 business structures, and 2 public buildings in the breach zone (total of 492 buildings) would no longer be at risk from flooding caused by a breach of the dam. However, federal policy requires that this alternative address the purpose and need for flood protection. With this alternative 118 homes, 29 apartment buildings, 30 business structures, and 3 public buildings would be subjected to increases in flooding for storms up to and including the 500-year flood.

Table K reflects the extent of flood events without the dam.

Table K - Flooding Depths at Buildings Without the Dam

Building	Without the Dam Flood Event		
	500-year	100-year	50-year
	Depths Above First Floor Elevation (feet) *		
118 Residential Houses	0.0 - 2.0	0.0 - 1.0	0.0 - 0.9
29 Apartment Buildings	0.0 - 0.7	0.0 - 0.2	0.0 - 0.1
30 Commercial Buildings	0.0 - 9.9	0.0 - 8.3	0.0 - 7.5
3 Public Buildings	0.1 - 0.7	0.1 - 0.4	0.1 - 0.3

* Depths of 0.0 feet indicate the presence of basements, which would flood at depths below first floor elevation. The public buildings do not have basements.

In addition, three bridges (Lower Sandy Hill Road, North Elm Street, and Union Street) and 10 roadways that currently do not flood would need to be upgraded. Additionally, utilities would need to be protected.

Since the regulatory floodplain (100-year) was established assuming the dam is in place, structures in the downstream flood zone would need to be relocated or floodproofed. Downstream flooding conditions would be similar to those that existed prior to construction of the dam. Therefore, all properties within the 100-year floodplain would need to be protected. A cost of $95 - $100 million was estimated that would include the relocation of the affected properties (118 residences, 29 apartment buildings, 30 businesses, and 3 public properties). Since relocating so many buildings was not only very expensive but also impractical, another effort was made to estimate the cost of floodproofing the affected buildings. This, too, proved very expensive - estimated at $15 - $20 million. Along with addressing the flooding of the buildings, this alternative would also require modifying 10 roadways and 3 stream crossings that do not flood with the dam but would under decommissioning so that flooding would not impact vehicles as they traveled along these roads. And, at a minimum, partial removal of the dam's embankment would need to be completed so as to safely pass the 100-year, 24-hour frequency flood event, thus eliminating the structure's ability to store water. NOTE: Estimated cost only reflects cost to floodproof and/or relocate affected properties. Estimate does not include costs to decommission the dam and upgrade stream crossings/roadways. Due to the exorbitant cost of relocating or floodproofing structures, this alternative was not studied in detail and eliminated from further study.

Non-Structural – Relocate, Elevate, or Floodproof Structures: This alternative involves upgrading the dam to meet significant hazard dam criteria; elevating, floodproofing, or relocating all structures within the dam breach inundation area, and modification or relocation of roadways and stream crossings within the breach inundation area. There are 492 buildings to elevate, floodproof and/or relocate downstream of the dam, and 20 roadways/stream crossings would need to be elevated/modified. The estimated cost of this alternative was estimated at $210 - $220 million dollars. NOTE: Estimated cost only reflects cost to floodproof and/or relocate affected properties. Estimate does not include costs to purchase deed restrictions and modify stream crossings/roadways. Because of exorbitant costs of relocating or floodproofing structures, this alternative was not studied in detail and eliminated from further study.

Structural Rehabilitation – Articulated Concrete Block (ACB) Auxiliary Spillway: Based on the maximum velocities and shear stress during the controlling FBH event obtained from the hydraulic model, the ACBs are not considered a suitable method for armoring the auxiliary spillway against breach during the design event (FBH) because they do not meet the required factor of safety criteria.

Description of Alternative Plans Considered

The alternatives presented in the following will not change the hazard class of the structure. It will remain High Hazard based on the potential loss of life and property damage if the dam were to breach. All of the alternatives presented, with the exception of the FWOFI, will meet NRCS current safety and performance standards if implemented. Therefore, there is very little hazard for storms defined as the 100-year, 24-hour event because they will not flow through the auxiliary spillway. The dam will not overtop under any of the proposed alternatives, which meets NRCS

standards. This same criterion ensures that the proposed alternatives will not fail with respect to the typical modes of failure. Risk of property damage and loss of life increases for storms of a greater magnitude. The frequency of storm events as they relate to climate change are unknown.

Future Without Federal Investment (FWOFI)

One of the alternatives that must be included in the plan is the FWOFI alternative. For the purposes of the rehabilitation program, the FWOFI alternative describes the action that the Sponsors will take if no federal funds are provided for implementation. The Sponsors would be responsible for the total cost of rehabilitation or removal of the dam. The potential for an uncontrolled breach and resulting damages is present and will continue until the existing dam safety issues are addressed and resolved.

FWOFI (Sponsor's Rehabilitation): The Powdermill Dam is classified as a high hazard dam that does not presently meet DCR and NRCS current dam safety and performance standards. The hazard class is based on the potential loss of life and property damage if the dam were to breach. The Powdermill Dam is overtopped during the PMF for both current and future buildout conditions and models predict the auxiliary spillway would breach during the design storm. DCR standards are contained in 302 CMR 10.00: Dam Safety. DCR criteria require existing dam's spillway system to have the capacity to pass at least a flow resulting from ½ PMF. The ½ PMF does not overtop the Powdermill Brook Dam, but models predict the auxiliary spillway would breach during this flood event.

The Future Without Federal Investment (FWOFI) alternative would rehabilitate the dam to DCR standards (½ PMF). The FWOFI alternative involves stabilizing the 260-ft-wide existing auxiliary spillway using articulated concrete blocks (ACBs) and constructing a concrete cutoff wall at the downstream toe of the spillway. An ACB stilling basin with riprap outlet protection will also be constructed at the end of the auxiliary spillway. The dam crest will be leveled at existing EL 203 and existing depressions filled in. The pipe joints in the existing 48-inch diameter reinforced concrete principal spillway conduit will be re-grouted and a concrete sealant will be applied to the worn surfaces. In addition, a filter diaphragm will be constructed near the downstream slope around the existing principal spillway conduit. The existing bituminous-coated corrugated metal pipe toe drains will be left in-place and filled with grout. New plastic pipe toe drains and a filter trench will be installed closer to the toe of the dam slope. Some sediment will be removed immediately adjacent to the existing principal spillway riser along with removing the existing pond drain gate to allow Powdermill Brook to naturally re-establish through the floodpool. Storms which exceed the ½ PMF criteria could overtop and breach the dam and cause property damage downstream of the structure. There will be no change in the current levels of flood protection downstream as a result of project activity.

The estimated construction cost to rehabilitate the dam to Massachusetts DCR Office of Dam Safety design and performance standards, which is to stabilize the ASW using articulated concrete blocks, is $4,555,000. Additional costs of $1,681,500 (engineering, permits, and project administration) would result in a total cost estimate of $6,236,500.

Alternatives with Federal Assistance

The proposed structural alternatives with federal assistance address all the deficiencies identified during planning.

Alternative No. 1

Alternative No. 1 involves leveling the top of dam at EL 203 and constructing a 158-ft-wide, 6-cycle reinforced concrete labyrinth weir along with an earthen berm at the level control section of the existing auxiliary spillway. The chute of the labyrinth weir will be constructed of roller compacted concrete (RCC) with reinforced concrete sidewalls. An RCC stilling basin with riprap outlet protection will also be constructed at the toe of the chute. The dam crest will be leveled at existing EL 203 and existing depressions filled in. The pipe joints in the existing 48-inch diameter reinforced concrete principal spillway conduit will be re-grouted and a concrete sealant will be applied to the worn surfaces. In addition, a filter diaphragm will be constructed around the existing principal spillway conduit near the downstream slope. The existing bituminous-coated corrugated metal pipe toe drains will be left in-place and filled with grout. New plastic pipe toe drains and a filter trench will be installed closer to the toe of the dam slope. Some sediment will be removed immediately adjacent to the existing principal spillway riser along with removing the existing pond drain gate to allow Powdermill Brook to naturally re-establish through the floodpool. There will be no change in the current levels of flood protection downstream as a result of project activity for any of the flood recurrence intervals that were evaluated.

The estimated construction cost for the 158-ft-wide, 6-cycle reinforced concrete labyrinth weir is $7,283,000. Additional costs of $1,733,800 (engineering, real property rights, permits, and project administration) would result in a total cost estimate of $9,016,800.

Alternative No. 2 – the National Economic Efficiency (NEE) Alternative

Alternative No. 2 involves raising the top of dam to EL 205 and constructing a 106-ft-wide, 4-cycle reinforced concrete labyrinth weir along with an earthen berm at the level control section of the existing auxiliary spillway. The chute of the labyrinth weir will be constructed of roller compacted concrete (RCC) with reinforced concrete sidewalls. An RCC stilling basin with riprap outlet protection will also be constructed at the toe of the chute. The pipe joints in the existing 48-inch diameter reinforced concrete principal spillway conduit will be re-grouted and a concrete sealant will be applied to the worn surfaces. In addition, a filter diaphragm will be constructed around the existing principal spillway conduit near the downstream slope. The existing bituminous-coated corrugated metal pipe toe drains will be left in-place and filled with grout. New plastic pipe toe drains and a filter trench will be installed closer to the toe of the dam slope. Some sediment will be removed immediately adjacent to the existing principal spillway riser along with removing the existing pond drain gate to allow Powdermill Brook to naturally re-establish through the floodpool. There will be no change in the current levels of flood protection downstream as a result of project activity for any of the flood recurrence intervals that were evaluated.

The estimated construction cost for the raising the top of dam elevation to EL 205 and constructing a 106-ft-wide, 4-cycle reinforced concrete labyrinth weir is $6,023,000. Additional costs of $1,711,800 (engineering, real property rights, permits, and project administration) would result in a total cost estimate of $7,734,800.

As the NEE alternative, Alternative 2 is also the Federally Recommended alternative. For purposes of the rehabilitation program, the NEE alternative is defined as the federally assisted alternative with the greatest public benefits, with appropriate consideration of costs. Public benefits (i.e., positive ecosystem services) encompass environmental, economic, and social goals; include monetary and non-monetary effects; and allow for the consideration of both quantified and unquantified measures. The NEE alternative (also The Preferred Alternative or Sponsors' Alternative) will allow the Sponsors to comply with applicable dam safety and performance standards, reduce the potential for loss of life, and continue protection of existing property and infrastructure downstream of the dam. For economics, average annual monetary benefits are estimated to be $390,700, which includes $195,400 flood damage reduction benefits and $195,300 cost avoidance benefits. Average annual cost is estimated at $238,900 resulting in net benefits of $151,800. Socially, the PMP storm event will be retained, thus minimizing the threat of a catastrophic dam failure (breach), and incidental recreation after construction will continue. And environmentally, adverse impacts will be minimized during construction. Long-term there would be adverse, although negligible, impacts.

Alternative No. 3

Alternative No. 3 involves raising the top of dam elevation to EL 205 and constructing a 265-ft-wide level control section (reinforced concrete broad crested weir) along with an earthen berm at the level control section of the existing auxiliary spillway. An exit chute will be constructed of roller compacted concrete (RCC) with reinforced concrete sidewalls. An RCC stilling basin with riprap outlet protection will also be constructed at the toe of the RCC chute. The pipe joints in the existing 48-inch diameter reinforced concrete principal spillway conduit will be re-grouted and a concrete sealant will be applied to the worn surfaces. In addition, a filter diaphragm will be constructed around the existing principal spillway conduit near the downstream slope. The

existing bituminous coated corrugated metal pipe toe drains will be left in-place and filled with grout. New plastic pipe toe drains and a filter trench will be installed closer to the toe of the dam slope. Some sediment will be removed immediately adjacent to the existing principal spillway riser along with removing the existing pond drain gate to allow Powdermill Brook to naturally re-establish through the floodpool. There will be no change in the current levels of flood protection downstream as a result of project activity for any of the flood recurrence intervals that were evaluated.

The estimated construction cost for raising the top of dam elevation to EL 205 and constructing a 265-ft-wide level control section (reinforced concrete broad crested weir) is $8,473,000. Additional costs of $1,443,800 (engineering, real property rights, permits, and project administration) would result in a total cost estimate of $9,916,800.

Figure 1 - Example of a 5-Cycle Labyrinth Weir in an Embankment

Figure 2 - Example of a Roller-Compacted Concrete Auxiliary Spillway

Summary and Comparison of Alternative Plans

Table L summarizes the effects of each alternative considered. Refer to the Environmental Consequences section for additional information.

Table L – Summary and Comparison of Alternative Plans

Item or Concern	Future Without Federal Investment No Federal Action – Sponsors' Rehabilitation [1/]	Alternative 1 – Labyrinth Weir in existing ASW location (158-ft-wide with 6 cycles) at existing ASW crest elevation	Alternative 2 – Labyrinth Weir in existing ASW location (106-ft-wide with 4-cycles) with dam raise	Alternative 3 - Roller-compacted concrete in existing ASW location (265-ft-wide) with dam raise
Structural	Upgrade dam to meet dam safety criteria.	Upgrade dam to meet dam safety criteria.	Upgrade dam to meet dam safety criteria.	Upgrade dam to meet dam safety criteria.
Total Project Investment Powdermill Dam	$6,236,500	$9,016,800	$7,734,800	$9,916,800
Total Beneficial Annualized	$195,400	$390,700	$390,700	$390,700
Total Adverse Annualized	$195,300	$276,400	$238,900	$302,600
Net Beneficial	$100	$114,300	$151,800	$88,100
Benefit/Cost Ratio	1.0 to 1.0	1.4 to 1.0	1.6 to 1.0	1.3 to 1.0
Estimated OM&R[2/]	$13,500	$13,600	$13,500	$13,600
Soils	About 4.44 acres of Prime Farmland and 8.63 acres of Farmland of Statewide Importance would be impacted.	About 4.44 acres of Prime Farmland and 8.63 acres of Farmland of Statewide Importance would be impacted.	About 4.44 acres of Prime Farmland and 8.63 acres of Farmland of Statewide Importance would be impacted.	About 4.44 acres of Prime Farmland and 8.63 acres of Farmland of Statewide Importance would be impacted.

Item or Concern	Future Without Federal Investment No Federal Action – Sponsors' Rehabilitation [1/]	Alternative 1 – Labyrinth Weir in existing ASW location (158-ft-wide with 6 cycles) at existing ASW crest elevation	Alternative 2 – Labyrinth Weir in existing ASW location (106-ft-wide with 4-cycles) with dam raise	Alternative 3 - Roller-compacted concrete in existing ASW location (265-ft-wide) with dam raise
Water Quality and Water Quantity	***Water Quality:*** Short-term: direct, negligible, adverse; long-term: direct, negligible, adverse ***Water Quantity:*** Short-term: direct, moderate; long-term: direct, negligible	***Water Quality:*** Short-term: direct, negligible, adverse; long-term: direct, negligible, adverse ***Water Quantity:*** Short-term: direct, moderate; long-term: direct, negligible	***Water Quality:*** Short-term: direct, negligible, adverse; long-term: direct, negligible, adverse ***Water Quantity:*** Short-term: direct, moderate; long-term: direct, negligible	***Water Quality:*** Short-term: direct, negligible, adverse; long-term: direct, negligible, adverse ***Water Quantity:*** Short-term: direct, moderate; long-term: direct, negligible

Item or Concern	Future Without Federal Investment No Federal Action – Sponsors' Rehabilitation [1/]	Alternative 1 – Labyrinth Weir in existing ASW location (158-ft-wide with 6 cycles) at existing ASW crest elevation	Alternative 2 – Labyrinth Weir in existing ASW location (106-ft-wide with 4-cycles) with dam raise	Alternative 3 - Roller-compacted concrete in existing ASW location (265-ft-wide) with dam raise
Wetlands	Short-term: direct, minor, adverse; long-term: direct, negligible, adverse. Up to 0.28 ac. of forested wetlands and up to 1.89 ac. of freshwater emergent wetlands will be temporarily impacted. Long-term impacts to 0.13 ac. of freshwater wetlands. Permanent impacts to 0.27 acre of pond wetlands upstream of dam after it returns to a dry dam. The 0.27 acre of freshwater pond wetlands in the impoundment will be converted to 0.27 acre of freshwater emergent wetlands. A net increase of 0.29 acre of freshwater emergent wetlands.	Short-term: direct, minor, adverse; long-term: direct, negligible, adverse. Up to 0.28 ac. of forested wetlands and up to 1.89 ac. of freshwater emergent wetlands will be temporarily impacted. Long-term impacts to 0.17 ac. of freshwater wetlands. About 0.20 ac. of freshwater emergent wetlands will be created. Permanent impacts to 0.27 acre of pond wetlands upstream of dam after it returns to a dry dam. The 0.27 acre of freshwater pond wetlands in the impoundment will be converted to 0.27 acre of freshwater emergent wetlands. A net increase of 0.30 acre of freshwater emergent wetlands.	Short-term; direct, minor, adverse; long-term: direct, negligible, adverse. Up to 0.28 ac. of forested wetlands and up to 1.89 ac. of freshwater emergent wetlands will be temporarily impacted. Long-term impacts to 0.11 ac. of freshwater wetlands. About 0.13 ac. of freshwater emergent wetlands will be created. Permanent impacts to 0.27 acre of pond wetlands upstream of dam after it returns to a dry dam. The 0.27 acre of freshwater pond wetlands in the impoundment will be converted to 0.27 acre of freshwater emergent wetlands. A net increase of 0.29 acre of freshwater emergent wetlands.	Short-term: direct, minor, adverse; long-term: direct, negligible, adverse. Up to 0.28 ac. of forested wetlands and up to 1.89 ac. of freshwater emergent wetlands will be temporarily impacted. Long-term impacts to 0.28 ac. of freshwater wetlands and 0.02 acre of forested wetlands. About 0.28 ac. of freshwater emergent wetlands will be created. Permanent impacts to 0.27 acre of pond wetlands upstream of dam after it returns to a dry dam. The 0.27 acre of freshwater pond wetlands in the impoundment will be converted to 0.27 acre of freshwater emergent wetlands. A net increase of 0.27 acre of freshwater emergent wetlands.

Item or Concern	Future Without Federal Investment No Federal Action – Sponsors' Rehabilitation [1/]	Alternative 1 – Labyrinth Weir in existing ASW location (158-ft-wide with 6 cycles) at existing ASW crest elevation	Alternative 2 – Labyrinth Weir in existing ASW location (106-ft-wide with 4-cycles) with dam raise	Alternative 3 - Roller-compacted concrete in existing ASW location (265-ft-wide) with dam raise
Floodplain Management	Short-term: direct, minor, adverse; long-term: direct, negligible, adverse. No change in the 100-year floodplain upstream or downstream of the dam	Short-term: direct, minor, adverse; long-term: direct, negligible, adverse. No change in the 100-year floodplain upstream of downstream or the dam.	Short-term: direct, minor, adverse; long-term: direct, negligible, adverse. No change in the 100-year floodplain upstream of downstream or the dam.	Short-term: direct, minor, adverse; long-term: direct, negligible, adverse. No change in the 100-year floodplain upstream of downstream or the dam.
Air Quality and Greenhouse Gases	Short-term: direct, negligible, adverse; no long-term effects	Short-term: direct, negligible, adverse; no long-term effects	Short-term: direct, negligible, adverse; no long-term effects	Short-term: direct, negligible, adverse; no long-term effects
Endangered and Threatened Species	Minor impacts to northern long-eared bat habitat. Time of year restrictions on tree cutting will minimize potential impacts on NLEB.	Minor impacts to northern long-eared bat habitat. Time of year restrictions on tree cutting will minimize potential impacts on NLEB.	Minor impacts to northern long-eared bat habitat. Time of year restrictions on tree cutting will minimize potential impacts on NLEB.	Minor impacts to northern long-eared bat habitat. Time of year restrictions on tree cutting will minimize potential impacts on NLEB.
Land Use Changes	0.27 acre of open water will be converted to riparian area or wetlands. Up to 4.0 acres of trees from a previously disturbed area may be removed. Disturbed areas will be planted to grass or trees.	0.27 acre of open water will be converted to riparian area or wetlands. Up to 4.0 acres of trees from a previously disturbed area may be removed. Disturbed areas will be planted to grass or trees.	0.27 acre of open water will be converted to riparian area or wetlands. Up to 4.0 acres of trees from a previously disturbed area may be removed. Disturbed areas will be planted to grass or trees.	0.27 acre of open water will be converted to riparian area or wetlands. Up to 4.0 acres of trees from a previously disturbed area may be removed. Disturbed areas will be planted to grass or trees.

Item or Concern	Future Without Federal Investment No Federal Action – Sponsors' Rehabilitation [1/]	Alternative 1 – Labyrinth Weir in existing ASW location (158-ft-wide with 6 cycles) at existing ASW crest elevation	Alternative 2 – Labyrinth Weir in existing ASW location (106-ft-wide with 4-cycles) with dam raise	Alternative 3 - Roller-compacted concrete in existing ASW location (265-ft-wide) with dam raise
Invasive Plant Species	Short-term: direct, minor, adverse impacts to Common Reed; These impacts are anticipated to be beneficial long-term to Common Reed, but adverse long-term for the wetlands created on-site, if Common Reed is not maintained to reduce its spread into newly created wetland areas	Short-term: direct, minor, adverse impacts to Common Reed; These impacts are anticipated to be beneficial long-term to Common Reed, but adverse long-term for the wetlands created on-site, if Common Reed is not maintained to reduce its spread into newly created wetland areas	Short-term: direct, minor, adverse impacts to Common Reed; These impacts are anticipated to be beneficial long-term to Common Reed, but adverse long-term for the wetlands created on-site, if Common Reed is not maintained to reduce its spread into newly created wetland areas	Short-term: direct, minor, adverse impacts to Common Reed; These impacts are anticipated to be beneficial long-term to Common Reed, but adverse long-term for the wetlands created on-site, if Common Reed is not maintained to reduce its spread into newly created wetland areas

Item or Concern	Future Without Federal Investment No Federal Action – Sponsors' Rehabilitation [1/]	Alternative 1 – Labyrinth Weir in existing ASW location (158-ft-wide with 6 cycles) at existing ASW crest elevation	Alternative 2 – Labyrinth Weir in existing ASW location (106-ft-wide with 4-cycles) with dam raise	Alternative 3 - Roller-compacted concrete in existing ASW location (265-ft-wide) with dam raise
Riparian Areas and Vegetation Communities	Short-term: direct, minor and adverse impacts. Long-term: direct, minor and adverse impacts. About 45 feet of riparian area will be restored when impoundment is returned to a dry dam. Up to 4 acres of tree clearing is possible and will be based on site access and staging requirements. Areas cleared will be replanted and restored post construction.	Short-term: direct, minor and adverse impacts. Long-term: direct, minor and adverse impacts. About 45 feet of riparian area will be restored when impoundment is returned to a dry dam. Up to 4 acres of tree clearing is possible and will be based on site access and staging requirements. Areas cleared will be replanted and restored post construction.	Short-term: direct, minor and adverse impacts. Long-term: direct, minor and adverse impacts. About 45 feet of riparian area will be restored when impoundment is returned to a dry dam. Up to 4 acres of tree clearing is possible and will be based on site access and staging requirements. Areas cleared will be replanted and restored post construction.	Short-term: direct, minor and adverse impacts. Long-term: direct, minor and adverse impacts. About 45 feet of riparian area will be restored when impoundment is returned to a dry dam. Up to 4 acres of tree clearing is possible and will be based on site access and staging requirements. Areas cleared will be replanted and restored post construction.
Local and Regional Economy	Temporary positive effect on local and/or regional construction companies. Temporary negative effect due to loss of existing access to the lake during construction.	Temporary positive effect on local and/or regional construction companies. Temporary negative effect due to loss of existing access to the lake during construction.	Temporary positive effect on local and/or regional construction companies. Temporary negative effect due to loss of existing access to the lake during construction.	Temporary positive effect on local and/or regional construction companies. Temporary negative effect due to loss of existing access to the lake during construction.

Item or Concern	Future Without Federal Investment No Federal Action – Sponsors' Rehabilitation [1/]	Alternative 1 – Labyrinth Weir in existing ASW location (158-ft-wide with 6 cycles) at existing ASW crest elevation	Alternative 2 – Labyrinth Weir in existing ASW location (106-ft-wide with 4-cycles) with dam raise	Alternative 3 - Roller-compacted concrete in existing ASW location (265-ft-wide) with dam raise
Public Health and Safety	Decrease potential for loss of life from a dam breach. Provide flood protection downstream. Safety and noise concerns will be addressed during construction.	Decrease potential for loss of life from a dam breach. Provide flood protection downstream. Safety and noise concerns will be addressed during construction.	Decrease potential for loss of life from a dam breach. Provide flood protection downstream. Safety and noise concerns will be addressed during construction.	Decrease potential for loss of life from a dam breach. Provide flood protection downstream. Safety and noise concerns will be addressed during construction.
Fish and Wildlife	***Fish:*** Short-term: direct, minor, adverse; long-term: direct, negligible, adverse ***Wildlife:*** Short-term: direct, minor, adverse; long-term: direct, negligible, adverse ***Invasive Fish and Wildlife Species:*** No effect	***Fish:*** Short-term: direct, minor, adverse; long-term: direct, negligible, adverse ***Wildlife:*** Short-term: direct, minor, adverse; long-term: direct, negligible, adverse ***Invasive Fish and Wildlife Species:*** No effect	***Fish:*** Short-term: direct, minor, adverse; long-term: direct, negligible, adverse ***Wildlife:*** Short-term: direct, minor, adverse; long-term: direct, negligible, adverse ***Invasive Fish and Wildlife Species:*** No effect	***Fish:*** Short-term: direct, minor, adverse; long-term: direct, negligible, adverse ***Wildlife:*** Short-term: direct, minor, adverse; long-term: direct, negligible, adverse ***Invasive Fish and Wildlife Species:*** No effect
Incidental Recreation	Short-term – direct, minor and adverse impacts to hiking and fishing during construction. No long-term effects.	Short-term – direct, minor and adverse impacts to hiking and fishing during construction. No long-term effects.	Short-term – direct, minor and adverse impacts to hiking and fishing during construction. No long-term effects.	Short-term – direct, minor and adverse impacts to hiking and fishing during construction. No long-term effects.
Cultural Resources	No effect	No effect	No effect	No effect

Item or Concern	Future Without Federal Investment No Federal Action – Sponsors' Rehabilitation [1/]	Alternative 1 – Labyrinth Weir in existing ASW location (158-ft-wide with 6 cycles) at existing ASW crest elevation	Alternative 2 – Labyrinth Weir in existing ASW location (106-ft-wide with 4-cycles) with dam raise	Alternative 3 - Roller-compacted concrete in existing ASW location (265-ft-wide) with dam raise
Environmental Justice and Civil Rights	Consultation occurred with six federally recognized Indian Tribes, NRCS received concurrence from the Stockbridge-Munsee Community on August 9, 2023. No comments were received from the Delaware Tribe of Indians, the Mashpee Wampanoag Tribe, the Mohegan tribe of Indians of Connecticut, the Narragansett Indian Tribe, and the Wampanoag Tribe of Gay Head (Aquinnah) Tribal Historic Preservation Officers during this most recent consultation effort. Nor were any comments received following our February 9, 2023, consultation efforts. NRCS has assumed concurrence.	Consultation occurred with six federally recognized Indian Tribes, NRCS received concurrence from the Stockbridge-Munsee Community on August 9, 2023. No comments were received from the Delaware Tribe of Indians, the Mashpee Wampanoag Tribe, the Mohegan tribe of Indians of Connecticut, the Narragansett Indian Tribe, and the Wampanoag Tribe of Gay Head (Aquinnah) Tribal Historic Preservation Officers during this most recent consultation effort. Nor were any comments received following our February 9, 2023, consultation efforts. NRCS has assumed concurrence.	Consultation occurred with six federally recognized Indian Tribes, NRCS received concurrence from the Stockbridge-Munsee Community on August 9, 2023. No comments were received from the Delaware Tribe of Indians, the Mashpee Wampanoag Tribe, the Mohegan tribe of Indians of Connecticut, the Narragansett Indian Tribe, and the Wampanoag Tribe of Gay Head (Aquinnah) Tribal Historic Preservation Officers during this most recent consultation effort. Nor were any comments received following our February 9, 2023, consultation efforts. NRCS has assumed concurrence.	Consultation occurred with six federally recognized Indian Tribes, NRCS received concurrence from the Stockbridge-Munsee Community on August 9, 2023. No comments were received from the Delaware Tribe of Indians, the Mashpee Wampanoag Tribe, the Mohegan tribe of Indians of Connecticut, the Narragansett Indian Tribe, and the Wampanoag Tribe of Gay Head (Aquinnah) Tribal Historic Preservation Officers during this most recent consultation effort. Nor were any comments received following our February 9, 2023, consultation efforts. NRCS has assumed concurrence.

[1/] The FWOFI alternative represents the Sponsor's choice in the event federal assistance is not available. Costs will be 100% borne by the Sponsor.

[2/] "Estimated OM&R" stands for Operation, Maintenance and Replacement Costs.

Table M - Alternatives and Associated Ecosystem Services

Alternatives				
	No Action (FWOFI)	Alternative 1	Alternative 2	Alternative 3
Alternatives				
The Preferred			X	
National Economic Efficiency (NEE)			X	
Brief Description of Major Project Features	Stabilize the 260-ft-wide existing auxiliary spillway (ASW) using articulated concrete blocks (ACBs) and construct a concrete cutoff wall at the downstream toe of the spillway.	Construct a 158-ft-wide, 6-cycle reinforced concrete labyrinth weir along with an earthen berm at the level control section of the existing ASW.	Raise the top of dam (TOD) elevation by 2 feet to EL 205 ft and construct a 106-ft-wide, 4-cycle reinforced concrete labyrinth weir along with an earthen berm at the level control section of the existing ASW.	Raise the TOD by 2 feet to EL 205 and construct a 265-ft-wide, 4-cycle level control section (reinforced concrete broad crested weir) along with an earthen berm at the level control section of the existing ASW.
Total Project Investment	$6,236,500	$9,016,800	$7,734,800	$9,916,800
Monetized Net Benefits	$100	$114,300	$151,800	$88,100
Provisioning Services	NA	NA	NA	NA
Regulating Services				
Flood and Disease Control	Retains one-half PMF: maintains current flood protection. 126 structures and 32 ac. in 100-yr. flood zone	Retains full PMF: maintains current flood protection. 126 structures and 32 ac. in 100-yr. flood zone	Retains full PMF: maintains current flood protection. 126 structures and 32 ac. in 100-yr. flood zone	Retains PMF: maintains current flood protection. 126 structures and 32 ac. in 100-yr. flood zone
Cultural Services				
Recreational Use	Hiking Trail extended 355 ft; 0.27 ac. pond lost	Hiking Trail extended 355 ft; 0.27 ac. pond lost	Hiking Trail extended 355 ft; 0.27 ac. pond lost	Hiking Trail extended 355 ft. 0.27 ac. pond lost
Aesthetic Viewsheds	Green landscape decreases by 1.5 ac.	Green landscape decreases by 1.05 ac.	Green landscape decreases by 2.4 ac.	Green landscape decreases by 1.15 ac.
Supporting Services				
Nutrient Cycling	Vegetative landscape decreases by 1.5 ac.	Vegetative landscape decreases by 1.05 ac.	Vegetative landscape decreases by 2.4 ac.	Vegetative landscape decreases by 1.15 ac.
Soil Formation	1.15 ac increase in impervious surface in LOD	1.5 ac. increase in impervious surface in LOD	1.05 ac. increase in impervious surface in LOD	2.4 ac. increase in impervious surface in LOD

Table N - Consideration of PR&G Guiding Principles
(an "X" indicates the criteria is met to the greatest extent)

PR&G Guiding Principles	No Action (FWOFI)	Alternative 1	Alternative 2	Alternative 3
Healthy and Resilient Ecosystem			X	
Sustainable Economic Development			X	
Floodplains			X	
Public Safety			X	
Environmental Justice			X	
Watershed Approach			X	

Table O - Consideration of PR&G Federal Objective

Components	No Action (FWOFI)	Alternative 1	Alternative 2	Alternative 3
Maximize Sustainable Economic Development			X	
Avoid Unwise Use of Floodplains			X	
Protect & Restore Functions of Natural Systems			X	

ENVIRONMENTAL CONSEQUENCES

Alternative plans of action can result in a multitude of potential effects on resources upstream and downstream of the dam. This section describes anticipated effects on resource and ecosystem services concerns identified by the Sponsors, the public, and agency personnel in the Scoping meeting and the public meetings. Topics are listed in the same categories as listed in Table A. The six Guiding Principles of the Principles and Requirements were used in the alternative evaluations. Although the project area was used in the Affected Environment section to present environmental resource information, the LOD was used to evaluate impacts in the Environmental Consequences Section (Figure C-1).

Four alternative plans were considered and evaluated in detail.

1. Future Without Federal Investment (FWOFI) (Sponsor's Rehabilitation)
2. Rehabilitate Dam with a 158-ft Wide Labyrinth Weir in the Existing Auxiliary Spillway
3. Rehabilitate Dam with a 106-ft Wide Labyrinth Weir in the Existing Auxiliary Spillway
4. Rehabilitate Dam with Roller Compacted Concrete in the Existing Auxiliary Spillway

The Sponsors have indicated that without federal assistance, they would rehabilitate the dam to DCR standards (½ PMF).

Healthy and Resilient Ecosystems
The composition and structure of the ecosystem is not expected to be significantly impacted by any of the proposed alternatives.

Sustainable Economic Development

Economic – Installation of any of the proposed alternatives will not alter current economic conditions (i.e., personal income and distribution, education, job growth opportunities, etc.) within the area of potential effect (APE) downstream of the dam.

Social - Installation of any of the proposed alternatives will not alter current social conditions (i.e., poverty, unemployment, etc.) within the APE downstream of the dam. However, it would diminish the possibility of a dam failure, thus providing more protection to the population located within the APE downstream.

Environmental - The alternatives proposed in this project will not have an impact on the potable water supply. There will be a loss of a 0.27-ac. ponded waterbody. The natural stream flows will improve due to the elimination of the pond. The water quality of the tributary waterbody will not change in terms of contaminants. These effects indicate no significant change in the sustainability of the ecosystem or associated economy.

Floodplains - There will be no change in the current levels of flood protection downstream as a result of implementation of any of the alternatives analyzed in detail. There are anticipated to be minor impacts to the floodplain, both upstream and downstream within the limits of disturbance (LOD) (see map in Appendix C), during construction work; however long-term impacts are expected to be negligible.

Public Safety – The implementation of any of the proposed alternatives will result in long-term beneficial impacts to population downstream because it will allow water to pass more efficiently and safely through the auxiliary spillway in the event a storm event of such magnitude causes it to function. The auxiliary spillway will not be susceptible to erosion, headcutting, or breaching. There are no critical facilities (e.g., hospitals, fire/police stations, nursing homes, etc.) located downstream within the APE. Also, there is not a population upstream of the dam below the PMP floodpool elevation.

Environmental Justice - The demographics of the affected area as compared to Westfield, Hampden County, and the State of Massachusetts overall reflects evidence of lower per capita income but higher median household income (except for the State of Massachusetts), low poverty levels, and the presence of a minority population. Although some statistics point towards the presence of disadvantaged communities, the poverty and median income levels reflect otherwise. There are no Environmental Justice groups in the area of potential effect of the dam rehabilitation project.

Watershed Approach - In conducting the effects analysis for each of the analyzed alternatives, both upstream and downstream project impacts were evaluated. A conscious effort was made to investigate both direct and indirect effects.

Physical Environment

Land Use

Existing Conditions: Based on aerial observations and NLCD data, the area around the dam is identified as pasture/hay with several residences in the developed open space around the dam site. Grassland and deciduous and evergreen forests are present further from the dam.

Powdermill Dam is located in an area zoned as residence A (center of LOD), industrial (eastern side of LOD), and rural residential (western side of LOD) by the City of Westfield.

Future Without Federal Investment (Sponsors' Rehabilitation): Impacts to land use are expected to be similar to Alternative 1 because both involve the same LOD and similar construction activities.

Alternative 1 - Rehabilitation with Labyrinth Weir ASW (158-ft wide with 6 cycles) at Existing ASW Crest Elevation: Alternative 1 will result in short-term, moderate, adverse impacts to land use within the vicinity of the project associated with the active construction zone in the LOD. The short-term impacts to land use are considered moderate because the site will be inaccessible during construction (approximately 24 months total). Long-term impacts to land use are expected to be negligible given that the only permanent change will be the loss of the artificial impoundment. The residential and industrial zoned land surrounding the LOD is not expected to be impacted.

The staging area comprises a total of 10.5 acres, with approximately 6.45 acres of trees/forest. Of this 6.45 acres of forested area, it is anticipated that a maximum of only 4 acres will be cleared for staging and stockpiling, only as necessary. Historical aerial photographs indicate that portions of

this staging area were previously cleared and likely used for agriculture in 1957, 1966, and 1971, and then reverted back to early successional habitat around the mid-1990s. It is now presently in a state of early forest habitat. Based on a comparison of historical aerials from 1957 and 1966, it appears that part of the area proposed for staging was wholly or partially used during the original dam construction. Based on that, the impacts from the clearing of trees within this area is anticipated to be minor. During construction, emphasis will be placed on prioritizing previously or existing cleared locations to minimize impacts and number of trees cleared. This area will also be reseeded after construction, and trees may be part of the replanting in this area.

Alternative 2 - Rehabilitation with Labyrinth Weir ASW (106-ft-wide with 4 cycles) with Dam Raise (NEE Alternative): Impacts to land use are expected to be similar to Alternative 1 because both involve the same LOD and similar construction activities.

Alternative 3 - Rehabilitation with RCC Concrete ASW (265-ft-wide) with Dam Raise: Impacts to land use are expected to be similar to Alternative 1 because both involve the same LOD and similar construction activities.

Biological/Ecological Environment

Soils

Prime and Unique Farmland and Farmland of Statewide Importance

Existing Conditions: Prime Farmland is identified in the northern and southern portions of the LOD where Sudbury fine sandy loam and Podunk fine sandy loam are present. Areas classified as Prime Farmland cover approximately 4.44 acres within the LOD and are primarily covered by wetland plants, shrubs, and grass.

Farmland soils of statewide importance are identified along the eastern edge of the LOD and the western portion of the LOD and in the staging area where Hinckley Loamy Sand (0-3% and 3-8% slopes) are present. These soils cover approximately 8.63 acres within the LOD (staging area) and are primarily forested.

Future Without Federal Investment (Sponsors' Rehabilitation): Soil impacts from the No Action Alternative are expected to be similar to those of Alternative 1 because both involve the same LOD and similar construction activities. However, slightly more impacts to Sudbury fine sandy loam are expected from the No Action Alternative because the ACB exit channel footprint will be slightly larger than the footprint of the RCC chute, resulting in more soil excavation and compaction.

Alternative 1 - Rehabilitation with Labyrinth Weir ASW (158-ft-wide with 6 cycles) at Existing ASW Crest Elevation: Short-term, minor, adverse impacts to 4.44 acres of Prime and Unique Farmland and 8.63 acres of Farmland of Statewide Importance. Short-term adverse effects to soils may include temporary compaction and disturbance from heavy construction equipment and staging/stockpiling of materials. This disturbance has the potential to increase the risk of soil erosion which are anticipated to be mitigated using standard sediment and erosion control BMPs Many of the soils in the LOD had been previously compacted during construction of the original dam and therefore compaction impacts are expected to be negligible.

Soils within the staging and stockpiling area may experience additional compaction due to the concrete batch plant and multiple concrete trucks accessing the site daily during RCC and drainfill construction work (maximum 18 trucks per day). Portions of the staging area are believed to have been used during construction of the original dam. Therefore, impacts to these soils are only anticipated to be short-term and negligible.

Direct impacts to Prime and Unique Farmland and Farmland of Statewide Importance are considered negligible and there are no anticipated indirect or cumulative effects to this resource.

Alternative 2 - Rehabilitation with Labyrinth Weir ASW (106-ft-wide with 4 cycles) with Dam Raise (NEE Alternative): Soil impacts from Alternative 2 are expected to be similar to those of Alternative 1 because both involve the same LOD and similar construction activities. However, slightly fewer impacts to Sudbury fine sandy loam are expected from Alternative 2 because the RCC chute footprint will be smaller, resulting in fewer excavated soils and compaction. There also may be more compaction to the soils along the top of the dam because of the additional soil fill material to raise the top of dam elevation.

Alternative 3 - Rehabilitation with RCC Concrete ASW (265-ft-wide) with Dam Raise: Soil impacts from Alternative 3 are expected to be similar to those of Alternative 1 because both involve the same LOD and similar construction activities. However, slightly more impacts to Sudbury fine sandy loam are expected from Alternative 3 because the RCC ASW footprint will be larger, resulting in more soil excavation and compaction. There also may be more compaction to the soils along the top of the dam because of the additional soil fill material to raise the top of dam elevation.

Water

Water Resources (including Water Quality, Quantity, and Use/Efficiency)

Existing Conditions: Within the project area there is one freshwater reservoir (the dam impoundment of about 0.27 acre), one stream channel (Powdermill Brook), and multiple freshwater wetlands. Powdermill Dam is located on the southern side of Powdermill Brook Reservoir, which formed as a result of the installation of Powdermill Dam. Powdermill Brook is a tributary of the Westfield River, and the Brook meets the Westfield River approximately 3 miles southeast of the dam. Refer to the original Watershed Work Plan for Powdermill Brook Watershed for a complete description of water resources in the area.

Powdermill Brook and Powdermill Brook Pool are considered Waters of the United States.

Powdermill Dam is a flood control structure located on Powdermill Brook. The total watershed of Powdermill Dam is approximately 4.5 square miles, and the entire watershed of Powdermill Brook is 20 square miles.

Powdermill Dam has an estimated 955 acre-feet pool storage capacity to the elevation of the low-level spillway. There are no other dams along Powdermill Brook. Powdermill Dam's drain gate was closed more than 20 years ago and is now covered with sediment. The closing of this gate caused the formation of a small impoundment upstream of the dam.

There are no Massachusetts surface water supply protection areas within the LOD or in the vicinity of the dam.

Powdermill Brook and the pool are classified as impaired waterbodies for algae, E. coli, sedimentation/siltation, and turbidity.

Future Without Federal Investment (Sponsors' Rehabilitation): Impacts to water resources from the No Action Alternative are expected to be similar to those of Alternative 1 because both involve the same LOD.

Alternative 1 - Rehabilitation with Labyrinth Weir ASW (158-ft-wide with 6 cycles) at Existing ASW Crest Elevation: Alternative 1 will revert the dam back to its original purpose as a dry dam and allow Powdermill Brook to naturally re-establish through the floodpool. The current impoundment area will then likely revert to a freshwater emergent wetland.

Short- and long-term moderate effects to water quantity are anticipated from Alternative 1. This resource will be impacted once Powdermill Brook re-establishes through the floodpool after the dam is converted back to a dry dam and the impoundment is eliminated. However, this was a 0.27-acre artificial impoundment created by the inoperable condition of the gate valve and therefore effects on water quantity are anticipated to be moderate. The water quantity impact relates to the loss of the ponded water which existed upstream of the dam.

Alternative 1 is anticipated to result in short-term, negligible adverse and long-term, negligible adverse impacts to water quality. Construction work may impact water quality by increasing the total suspended solid loads and turbidity of the 303(d) impaired waters, Powdermill Brook, and the pool, during construction. However, these impacts are anticipated to be mitigated through the implementation of practices such as soil stabilization and sediment and erosion controls (turbidity curtain) and are not expected to have lasting effects on water quality. There is the potential for contamination in sediments to become suspended during construction and carried downstream. It is recommended that the City of Westfield test the sediments prior to beginning onsite construction to determine if additional best management practices (BMPs) are necessary to mitigate this potential impact.

Alternative 2 - Rehabilitation with Labyrinth Weir ASW (106-ft-wide with 4 cycles) with Dam Raise (NEE Alternative): Impacts to water resources from Alternative 2 are expected to be similar to those of Alternative 1 because both involve the same LOD and similar construction activities.

Alternative 3 - Rehabilitation with RCC Concrete ASW (265-ft-wide) with Dam Raise: Impacts to water resources from Alternative 3 are expected to be similar to those of Alternative 1 because both involve the same LOD and similar construction activities.

Floodplain Management

Existing Conditions: Powdermill Dam is located within a FEMA 100-year flood zone and is considered to be in a special flood hazard area. There have been occurrences of flooding in the areas along the Westfield River particularly near Westgate Plaza, approximately 2.5 miles downstream of Powdermill Dam, especially during hurricanes.

Based on review of the FEMA flood insurance map for the study area, Powdermill Dam and surrounding areas are located in Zone A, a special flood hazard area. The area is subject to inundation by a 1%-annual-chance flood event. Powdermill Dam was constructed to protect the downstream floodplain and prevent flooding in the surrounding areas.

Future Without Federal Investment (Sponsors' Rehabilitation): Similar to Alternative 1.

Alternative 1 - Rehabilitation with Labyrinth Weir ASW (158-ft-wide with 6 cycles) at Existing ASW Crest Elevation: There will be no change in the current levels of flood protection downstream as a result of project activity. There are anticipated to be minor impacts to the floodplain, both upstream and downstream within the LOD, during construction work; however long-term impacts are expected to be negligible.

This alternative will result in long-term beneficial impacts to downstream floodplains because it will allow water to pass more efficiently and safely around the dam in the event the auxiliary spillway is utilized.

Alternative 2 - Rehabilitation with Labyrinth Weir ASW (106-ft-wide with 4 cycles) with Dam Raise (NEE Alternative): Similar to Alternative 1.

Alternative 3 - Rehabilitation with RCC Concrete ASW (265-ft-wide) with Dam Raise: Similar to Alternative 1.

Streams, Lakes, and Wetlands

Existing Conditions: The Powdermill Brook, the impoundment, and associated wetlands are Waters of the United States. Wetlands present in the LOD include approximately 0.28 acre of freshwater forested wetlands, 2.06 acres of freshwater emergent wetlands, and 0.27 acre of freshwater pond wetlands.

Future Without Federal Investment (Sponsors' Rehabilitation): Impacts to water resources from the No Action Alternative are expected to be similar to those of Alternative 1 because both involve the same LOD. However, the No Action Alternative will entail only 0.13 acre of permanent freshwater emergent wetlands impacts based on the positioning of the articulated concrete block exit channel. New wetlands will not be inserted downstream with this alternative; therefore, the net increase in freshwater emergent wetlands is expected to be 0.14 acre from the addition of the wetlands in the location of the impoundment.

Alternative 1 - Rehabilitation with Labyrinth Weir ASW (158-ft-wide with 6 cycles) at Existing ASW Crest Elevation: The existing impoundment will be drained as a result of restoration of the design "dry" dam condition. Powdermill Brook will be allowed to re-establish within the existing reservoir. After construction, disturbed areas will be restored to pre-construction conditions. The landscape around the dam will be graded to match existing grade where possible; and all the disturbed areas will be seeded. Wetland areas will be seeded with an appropriate wetlands seed mix approved by DEP.

Alternative 1 is anticipated to result in both short-term and long-term direct adverse (temporary and permanent) impacts to wetlands. Freshwater wetlands, both upstream and downstream of the dam, will be temporarily impacted by the general construction work associated with the project. Up to 0.28 acre of forested wetlands and up to 1.89 acres of freshwater emergent wetlands will be temporarily impacted by project work. Long-term impacts to the freshwater wetlands downstream of the dam are expected to occur from the construction of the RCC apron and riprap along the southern end of the ASW. The installation of the apron and riprap will permanently impact 0.17 acre of freshwater emergent wetlands. However, the stilling basin of the ASW will be filled with wetland soils and revegetated with native wetland plants, which would create 0.20 acre of freshwater emergent wetlands, mitigating the majority of the potential long-term effects to wetlands downstream of the dam. Additionally, there will be permanent impacts to wetlands upstream of the dam after the dam reestablishes to a dry dam. It is expected that the 0.27 acre of freshwater pond wetlands that make up the current impoundment will be converted to approximately 0.27 acre of freshwater emergent wetlands once the original gate valve on the primary spillway is removed. There will be a net increase of 0.30 acre of freshwater emergent wetlands as a result of Alternative 1. No indirect effects were identified during analysis. There is not a history of construction in the watershed so cumulative impacts of this action are nonexistent.

Alternative 2 - Rehabilitation with Labyrinth Weir ASW (106-ft-wide with 4 cycles) with Dam Raise (NEE Alternative): Impacts to water resources from Alternative 2 are expected to be similar to those of Alternative 1 because both involve the same LOD and similar construction activities. However, Alternative 2 will entail only 0.11 acre of permanent wetlands impacts because the ASW stilling basin associated with Alternative 2 occupies a smaller surface area within the freshwater wetlands downstream of the dam. A total of 0.13 acre of freshwater emergent wetlands will be planted on the apron and, as such, a net increase of 0.29 acre of freshwater emergent wetlands (including the new wetlands in the location of the impoundment) is expected from Alternative 2.

Alternative 3 - Rehabilitation with RCC Concrete ASW (265-ft-wide) with Dam Raise: Impacts to water resources from Alternative 3 are expected to be similar to those of Alternative 1 because both involve the same LOD and similar construction activities. However, Alternative 3 will impact 0.28 acre of permanent freshwater wetlands and 0.02 acre of permanent freshwater forested wetlands because the ASW stilling basin associated with Alternative 3 occupies a larger surface area within the wetlands downstream of the dam. A total of 0.28 acre of freshwater emergent wetlands will be planted on the apron and, as such, a net increase of 0.27 acre of freshwater emergent wetlands (including the new wetlands in the location of the impoundment) is expected from this Alternative 3.

Air

Air Quality

Existing Conditions: Powdermill Dam is not located in any areas that violate EPA's standards for the six criteria pollutants, called nonattainment areas. As all concentrations in the area are below the standards, Powdermill Dam is located in an attainment area.

Greenhouse gases (GHGs) include carbon dioxide, methane, nitrous oxide, and fluorinated gases such as hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride. Except for routine

maintenance at the dam site, including grass mowing, there are no emissions sources of GHGs at the dam site.

Noise around the LOD is primarily from heavy equipment at the adjacent landfill and from the adjacent highway. Both of these sources can be heard on a regular basis from the site.

Future Without Federal Investment (Sponsors' Rehabilitation): Air quality impacts from the No Action Alternative are expected to be similar to those of Alternative 1 because both involve the same LOD and approximately the same amount of construction. However, the No Action Alternative will not require an onsite concrete batch plant.

Alternative 1 - Rehabilitation with Labyrinth Weir ASW (158-ft-wide with 6 cycles) at Existing ASW Crest Elevation: Short-term, direct, negligible, adverse impacts to air quality are anticipated. Alternative 1 will involve the use of heavy diesel and gasoline machinery, as well as trucking of project equipment and materials. This will result in a temporary increase in GHG emissions which have the potential to adversely impact air quality. As no permanent sources of emissions will be created, Alternative 1 is not anticipated to have long-term adverse effects on ambient air quality or local GHG emissions. No indirect effects were identified during analysis. Because of the absence of construction in the watershed, no significant cumulative effects exist. Some noise disturbances will occur to the residents surrounding the project site. However, it is anticipated that construction noise from the site will occur in accordance with all municipal regulations and not occur outside of normal business hours.

Construction of the RCC chute associated with Alternative 1 involves a large concrete footprint; therefore, a batch plant will be erected in the staging area in order to produce large quantities of concrete needed for the RCC construction. Other project materials, in addition to those needed to batch the concrete, will be trucked to the site daily. During construction work involving concrete placement (duration approximately 1 month), it is anticipated that an average of 4-5 concrete trucks will access the site each day. During the placement of the RCC spillway, the number of trucks is expected to increase to about 7-18 trucks per stockpile day (around 40 days total). Construction work involving drainfill is anticipated to last approximately 20 workdays during which 9-18 haul trucks will access the site each day. This work will result in emissions of pollutants associated with the batch plant and burning of fossil fuels from the trucks, as well as generation of particulate matter associated with driving equipment on dirt roads. Particulate matter will be dealt with via the use of BMPs which will be implemented to minimize dust, and which may include surface watering.

Alternative 2 - Rehabilitation with Labyrinth Weir ASW (106-ft-wide with 4 cycles) with Dam Raise (NEE Alternative): Same as Alternative 1.

Alternative 3 - Rehabilitation with RCC Concrete ASW (265-ft-wide) with Dam Raise: Same as Alternative 1.

Plants

Terrestrial Vegetation

Existing Conditions: Vegetation communities within the LOD have been classified by land cover

types using GIS data from MassDEP and were mapped by MassGIS. These land cover types within the LOD have been identified as: deciduous forest, developed open space, evergreen forest, grassland, palustrine emergent wetland, palustrine shrub/scrub wetland, pasture/hay, and scrub/shrub. Trees and plants observed in the upland areas of the LOD and the immediate surrounding vicinity during the site visit include white birch (*Betula papyrifera*), white pine (*Quercus alba*), red oak (*Quercus rubra*), black spruce (*Picea mariana*), and willow (*Salix*). Cattails (*Typha*) and common reed (*Phragmites australis*) were observed in the wetland areas and standing water.

Future Without Federal Investment (Sponsors' Rehabilitation): Terrestrial vegetation impacts from the No Action Alternative are expected to be similar to those of Alternative 1 because both involve the same LOD. However, approximately 1.15 acres of vegetated land will be permanently impacted by the ACB exit channel. The exit channel covers a total of 2.3 acres, but it is assumed that vegetation will be able to grow through the gaps in the stone, therefore only permanently impacting around 50% of the total area, 1.15 acres.

Alternative 1 - Rehabilitation with Labyrinth Weir ASW (158-ft-wide with 6 cycles) at Existing ASW Crest Elevation: The majority of the land cover within the LOD, outside of the staging area, is maintained grass and classified as pasture/hay by MassGIS. Approximately 1 acre of forested land exists in the LOD outside of the staging area. Vegetation in this area will experience short-term impacts due to construction work. Trees will only be cleared as necessary to facilitate construction. Once construction is complete, the site will be reseeded, and the natural succession of the forest will be allowed to re-establish on the site where allowable and acceptable with the Operation and Maintenance Agreement and mowing activities.

The ASW, which is currently grassed, will be permanently disturbed by the construction of the RCC chute and labyrinth weir, resulting in 1.5 acres of permanent vegetation impacts.

The movement of construction vehicles throughout the LOD, which will mostly take place across the top of dam, will disturb pasture/hay (grass) vegetation types. Any areas disturbed for vehicle and equipment staging or compacted by heavy equipment will be regraded and revegetated with an appropriate native seed mix or native plantings to the maximum extent practicable.

The staging area comprises a total of 10.5 acres, with approximately 6.45 acres of trees/forest. Of this 6.45 acres of forested area, it is anticipated that a maximum of only 4 acres will be cleared for staging and stockpiling, only as necessary. Historical aerial photographs indicate that portions of this staging area were previously cleared in the early 2000s, and potentially wholly or partially used during the original dam construction. During construction, emphasis will be placed on prioritizing previously cleared locations to minimize impacts and number of trees cleared. This area will also be replanted after construction

Alternative 2 - Rehabilitation with Labyrinth Weir ASW (106-ft-wide with 4 cycles) with Dam Raise (NEE Alternative): Same as Alternative 1.

Alternative 3 - Rehabilitation with RCC Concrete ASW (265-ft-wide) with Dam Raise: Same as Alternative 1.

Endangered and Threatened Species

Existing Conditions: The U.S. Fish and Wildlife Service (USFWS) Information for Planning and Consultation (IPAC) database did not identify any threatened or endangered plant species in the LOD.

Massachusetts Wildlife's NHESP lists threatened, endangered, and special concern plant species for the Commonwealth, protected under the Massachusetts Endangered Species Act. Fourteen of these species have been observed, either historically or recently, within the City of Westfield. Six are considered species of special concern, 2 have a status of threatened, and 6 have a status of endangered (NHESP 2019b). No surveys have been conducted to determine whether these species are present within the LOD. Formal consultation with Massachusetts Wildlife's NHESP and USFWS was initiated in November 2020 and again in October 2022. The USFWS provided a response to the letter on 30 November 2022 and did not have any comments on threatened and endangered plant species. No response was received from MassWildlife NHESP from the consultation letter.

Future Without Federal Investment (Sponsors' Rehabilitation): Same as Alternative 1.

Alternative 1 - Rehabilitation with Labyrinth Weir ASW (158-ft-wide with 6 cycles) at Existing ASW Crest Elevation: No impacts to special status plant species are anticipated as there are no confirmed occurrences in the LOD.

Alternative 2 - Rehabilitation with Labyrinth Weir ASW (106-ft-wide with 4 cycles) with Dam Raise (NEE Alternative): Same as Alternative 1.

Alternative 3 - Rehabilitation with RCC Concrete ASW (265-ft-wide) with Dam Raise: Same as Alternative 1.

Noxious Weed and Invasive Plant Species

Existing Conditions: Common reed, which is included on the list and is also a federally listed invasive species, was observed in abundance in the freshwater emergent wetlands both upstream and downstream of the dam within the LOD. The freshwater emergent wetlands upstream of the dam, which occupies 0.61 acre in the LOD, was comprised almost entirely of common reed. The freshwater emergent wetlands downstream of the dam, which occupies 1.36 acres in the LOD, was comprised of approximately 50% common reed.

Future Without Federal Investment (Sponsors' Rehabilitation): Same as Alternative 1.

Alternative 1 - Rehabilitation with Labyrinth Weir ASW (158-ft-wide with 6 cycles) at Existing ASW Crest Elevation: Common reed is an extremely aggressive plant species and appropriate treatment disposal steps will be taken to eliminate its potential spread as a result of project work. BMPs identified through consultation with the City, MA DEP, and USACE during permitting will be implemented to prevent the spread of invasive species and treat or remove invasive species within the LOD in accordance with Local, State, and Federal recommendations and requirements.

Alternative 2 - Rehabilitation with Labyrinth Weir ASW (106-ft-wide with 4 cycles) with Dam Raise (NEE Alternative): Same as Alternative 1.

Alternative 3 - Rehabilitation with RCC Concrete ASW (265-ft-wide) with Dam Raise: Same as Alternative 1.

Riparian Areas

Existing Conditions: Riparian habitat exists in transitional areas between uplands and watercourses adjacent to Powdermill Brook. Within the LOD, there are currently approximately 185 feet of stream (Powdermill Brook) with riparian zones buffering each side. Based on EA's wetland delineation, vegetation cover in the riparian corridor of the LOD is categorized as freshwater emergent wetlands.

Future Without Federal Investment (Sponsors' Rehabilitation): Same as Alternative 1.

Alternative 1 - Rehabilitation with Labyrinth Weir ASW (158-ft-wide with 6 cycles) at Existing ASW Crest Elevation: Riparian areas, which buffer Powdermill Brook exist in the dam embankment area and northwest of the dam. Short-term impacts to riparian zones may occur as a result of construction work near the dam embankment, such as the installation of new toe drains. Once the original gate valve on the dam is removed, an additional 45 feet of stream channel will be created (after the impoundment is eliminated), increasing the area of riparian zone in the LOD.

Alternative 2 - Rehabilitation with Labyrinth Weir ASW (106-ft-wide with 4 cycles) with Dam Raise (NEE Alternative): Same as Alternative 1.

Alternative 3 - Rehabilitation with RCC Concrete ASW (265-ft-wide) with Dam Raise: Same as Alternative 1.

Animals

Fish and Wildlife

Existing Conditions: The area around Powdermill Dam is located just off a major Massachusetts transportation corridor (Massachusetts Turnpike also known as Interstate 90), though the area is comprised of a rural setting with residential homes. Wildlife species that typically inhabit these areas include a variety of birds, migratory birds (seasonal), mammals, amphibians, and reptiles. Potential habitat for these species is provided by the many diverse habitats within the LOD, which includes water, grassland, palustrine emergent, and scrub/shrub wetlands, deciduous and evergreen forests, and pasture/hay.

The Massachusetts Division of Fisheries and Wildlife provided fish data from stream surveys which identified several common freshwater fish species in Powdermill Brook, both upstream and downstream of the Dam.

There are no known occurrences of invasive fish or wildlife in the LOD.

There are no known occurrences of bald or golden eagle nesting areas in or near the LOD.

Future Without Federal Investment (Sponsors' Rehabilitation): Impacts to fish and wildlife as a result of the No Action Alternative are expected to be similar to those Alternative 1 because both involve the same LOD and similar construction activities.

Alternative 1 - Rehabilitation with Labyrinth Weir ASW (158-ft-wide with 6 cycles) at Existing ASW Crest Elevation: Short-term, direct, minor, adverse impacts to fish and wildlife and long-term, direct, negligible, adverse impacts to wildlife are expected from Alternative 1. No indirect effects were identified during analysis. Because of the absence of construction in the watershed, no significant cumulative effects exist.

Alternative 1 will result in short- and long-term, adverse, minor, and negligible impacts to fish species. Construction work associated with Alternative 1 will allow Powdermill Brook to naturally reestablish through the floodpool, resulting in the conversion of the impoundment to a wetland. This will result in the permanent elimination of this 0.27 acre of fish habitat; however, impacts are anticipated to be negligible because the fish can relocate to upstream or downstream habitats. In addition, the elimination of the permanent pool will help decrease water temperatures downstream of the dam. Short-term impacts to fish will be considered minor as the fish seek alternate habitats from the disturbances caused during construction.

Alternative 1 will result in short-term, minor, adverse impacts and long-term, negligible, adverse impacts to wildlife associated with disruption and removal of habitat during construction, which is anticipated to last up to 2 years (with a construction shutdown during winter months). Potential tree cutting in the LOD and staging, as well as the permanent removal of some freshwater wetlands, will result in temporary displacement of birds and other wildlife who use the trees and plants as their habitats. In addition, the noises associated with construction are likely to displace wildlife temporarily. There are similar forested riparian corridors upstream and downstream of the site for birds and wildlife to relocate to during construction. It is anticipated that wildlife will return to the construction area soon after construction is complete and after new vegetation and wetlands are established.

Impacts to bald and golden eagles is considered short-term, adverse, and negligible because of the potential to impact a small area potentially used for foraging. Long-term impacts to bald or golden eagles have been determined as "no effect."

There are no anticipated effects to invasive fish or wildlife species since none have been documented in the LOD or surrounding areas.

Overall, the population and diversity of wildlife species within the LOD is not anticipated to change.

Alternative 2 - Rehabilitation with Labyrinth Weir ASW (106-ft-wide with 4 cycles) with Dam Raise (NEE Alternative): Impacts to fish and wildlife as a result of Alternative 2 are expected to be similar to those in Alternative 1 because both involve the same LOD and similar construction activities.

Alternative 3 - Rehabilitation with RCC Concrete ASW (265-ft-wide) with Dam Raise: Impacts to fish and wildlife as a result of Alternative 3 are expected to be similar to those Alternative 1 because both involve the same LOD and similar construction activities.

Endangered and Threatened Species

Existing Conditions: One federally-threatened species was found to be potentially present in the project area: the northern long-eared bat (NLEB). A Massachusetts State Listed Animals Species list was accessed through Massachusetts Wildlife's NHESP. The list includes three endangered species, four threatened species, and ten species of special concern present within the City of Westfield. The full list of Massachusetts special status animal species in Westfield is included in the Administrative Record for the project. Consultation with the USFWS and MassWildlife NHESP was initiated in November 2020 and completed in January 2021. Both agencies were contacted again in October 2022. The response from USFWS was summarized in the Affected Environment section above. No response was received from MassWildlife NHESP.

Future Without Federal Investment (Sponsors' Rehabilitation): Same as Alternative 1.

Alternative 1 - Rehabilitation with Labyrinth Weir ASW (158-ft-wide with 6 cycles) at Existing ASW Crest Elevation: Tree cutting may result in the negligible loss of nesting and foraging habitat for the NLEB. To minimize potential impacts on NLEB, tree cutting (greater than 3 inches diameter in breast height) will occur outside of the NLEB pup season (April 1 to October 31), as was requested by the USFWS in their response to the consultation letter. Potential impacts to NLEB are considered negligible as there are no known or documented NLEB summer or winter hibernacula within close proximity of the project site. The predominant threat to NLEB is the spread of a white-nose syndrome; project work is not expected to cause the spread of this disease.

There are no MassDEP priority habitats or documented occurrences of state listed animal species in the LOD. Therefore, no direct impacts to special status animal species are anticipated to occur as a result of project work.

Alternative 2 - Rehabilitation with Labyrinth Weir ASW (106-ft-wide with 4 cycles) with Dam Raise (NEE Alternative): Same as Alternative 1.

Alternative 3 - Rehabilitation with RCC Concrete ASW (265-ft-wide) with Dam Raise: Same as Alternative 1.

Social

Public Health and Safety

Existing Conditions: The dam currently fails to meet dam safety and performance criteria for a high hazard dam. One thousand three hundred fifty-two (1,352) people downstream would be at risk of loss of life should the dam fail.

Future Without Federal Investment (Sponsors' Rehabilitation): Under this alternative, the dam would be structurally rehabilitated to DCR standards (½ PMF). Continued flood protection for 75

years would be provided after the rehabilitation project is complete. The downstream flooding level would be the same for the 100-year and 500-year flood events. The threat to loss of life from failure of the dam would be greatly reduced, but potential for dam failure for floods greater than ½ PMF would still exist. Protection of people and infrastructure would be similar to Alternative 2. Access to the site will be restricted during construction.

Alternative 1 - Rehabilitation with Labyrinth Weir ASW (158-ft-wide with 6 cycles) at Existing ASW Crest Elevation and Dam at EL 203: Same as Alternative 2.

Alternative 2 - Rehabilitation with Labyrinth Weir ASW (106-ft-wide with 4 cycles) with Dam Raise (NEE Alternative): Under this alternative, the dam would be structurally rehabilitated to NRCS standards (full PMF). Continued flood protection for 75 years would be provided after the rehabilitation project is complete. The downstream flooding level would be the same for the 100-year and 500-year flood events. The threat to loss of life from failure of the dam would be greatly reduced. Conservative estimates indicate that at least 1,352 people living/working/driving downstream of the dam would be protected. Catastrophic damages to buildings, roadways, bridges, and utilities would also be avoided. Access to the site will be restricted during construction.

Alternative 3 - Rehabilitation with RCC Concrete ASW (265-ft-wide) and Dam at EL 205: Same as Alternative 2.

Scenic Beauty

Existing Conditions: Powdermill Dam is located in a primarily residential area of Westfield. The definition of scenic beauty from USDA takes into consideration landforms, water, vegetation, and structures, which all exist around Powdermill Dam. It was assumed that the scenic beauty and the rural nature at the dam site (and in the LOD) are valued by local residents.

Future Without Federal Investment (Sponsors' Rehabilitation): Same as Alternative 1.

Alternative 1 - Rehabilitation with Labyrinth Weir ASW (158-ft-wide with 6 cycles) at Existing ASW Crest Elevation: Alternative 1 is anticipated to have both short- and long-term negligible adverse effects on scenic beauty. Short-term effects will result from the appearance of an active construction site during the approximately 2 years of project work. Long-term impacts will result from the altering of the appearance of the ASW to RCC.

Alternative 2 - Rehabilitation with Labyrinth Weir ASW (106-ft-wide with 4 cycles) with Dam Raise (NEE Alternative): Same as Alternative 1.

Alternative 3 - Rehabilitation with RCC Concrete ASW (265-ft-wide) with Dam Raise: Same as Alternative 1.

Outdoor Recreation

Existing Conditions: Powdermill Brook, both upstream and downstream of the Dam and pool, is used by residents for recreational fishing and hunting. There are several other designated

recreational areas in the upstream and downstream areas surrounding Powdermill Dam. No designated recreational land is present in the LOD but there is a 605-ft-long pedestrian path that runs along the grassed top of the dam. The impoundment is also occasionally used for recreational fishing and the grassed areas are occasionally used for walking by local residents.

Future Without Federal Investment (Sponsors' Rehabilitation): Same as Alternative 1.

Alternative 1 - Rehabilitation with Labyrinth Weir ASW (158-ft-wide with 6 cycles) at Existing ASW Crest Elevation: Alternative 1 will result in long-term, minor, beneficial impacts to recreation and park lands. The project is proposing to insert a 960-ft-long pedestrian walking trail running east-west on the northern side of the top of dam. Short-term adverse impacts to recreation will occur while the site is under construction and inaccessible to residents. The elimination of the impoundment which was occasionally used for recreational fishing is considered a long-term adverse but negligible impact, because residents will still be able to fish in the brook.

Alternative 2 - Rehabilitation with Labyrinth Weir ASW (106-ft-wide with 4 cycles) with Dam Raise (NEE Alternative): Same as Alternative 1.

Alternative 3 - Rehabilitation with RCC Concrete ASW (265-ft-wide) with Dam Raise: Same as Alternative 1.

Historic Properties

Existing Conditions: The nearest recorded precontact site is 19-HD-286 which is located approximately 2,500 feet east of the project area and is described as a lithic workshop site. There are seven additional recorded precontact Native American archaeological sites located within a mile of the project area and an additional twenty-four sites located within 2 miles of the project area. These include nineteen camp sites, one isolated find, one fort, one flake scatter, one village site, one burial site, one petroglyph, and one lithic workshop /habitation site. There are also seven historic properties located within 2.5 miles of the project area. All of these properties are located within the Westfield Center Historic District located approximately 2 miles south of the project location.

NRCS has been in ongoing consultation with six federally recognized Indian Tribes who have expressed an interest in Hampden County Massachusetts. These consultation efforts are detailed in Appendix A. Most recently, on July 21, 2023, a copy of the Phase 1A Report and Architectural Historian's Report prepared by SEARCH were submitted to the Delaware Tribe of Indians, the Mashpee Wampanoag Tribe, the Mohegan tribe of Indians of Connecticut, the Narragansett Indian Tribe, the Stockbridge-Munsee Community Band of Mohican Indians, and the Wampanoag Tribe of Gay Head (Aquinnah) Tribal Historic Preservation Officers on with a determination of No Historic Properties Affected. NRCS received concurrence from the Stockbridge-Munsee Community THPO on August 9, 2023. No comments were received from the Delaware Tribe of Indians, the Mashpee Wampanoag Tribe, the Mohegan tribe of Indians of Connecticut, the Narragansett Indian Tribe, and the Wampanoag Tribe of Gay Head (Aquinnah) Tribal Historic Preservation Officers during this most recent consultation effort. Nor were any comments received following our February 9, 2023, consultation efforts. Hard copies of the Phase 1A and Architectural Historians report were submitted to the Massachusetts SHPO on July 31, 2023, via

certified mail and were received by SHPO staff on August 4, 2023. SHPO staff responded and reiterated that they have no concerns with the project and that the area of potential effect is not sensitive for containing historic or archaeological resources.

NRCS received no information regarding Traditional Cultural Properties within or near the APE that would be impacted by this project.

Future Without Federal Investment (Sponsors' Rehabilitation): Same as Alternative 1.

Alternative 1 - Rehabilitation with Labyrinth Weir ASW (158-ft-wide with 6 cycles) at Existing ASW Crest Elevation: Architectural Historian's found the dam not eligible for the National Register of Historic Places under all conditions. Reports prepared by SEARCH were submitted to the Delaware Tribe of Indians, the Mashpee Wampanoag Tribe, the Mohegan tribe of Indians of Connecticut, the Narragansett Indian Tribe, the Stockbridge-Munsee Community Band of Mohican Indians, and the Wampanoag Tribe of Gay Head (Aquinnah) Tribal Historic Preservation Officers on with a determination of No Historic Properties Affected. NRCS received concurrence from the Stockbridge-Munsee Community THPO on August 9, 2023. No comments were received from the Delaware Tribe of Indians, the Mashpee Wampanoag Tribe, the Mohegan tribe of Indians of Connecticut, the Narragansett Indian Tribe, and the Wampanoag Tribe of Gay Head (Aquinnah) Tribal Historic Preservation Officers during this most recent consultation effort. Nor were any comments received following our February 9, 2023, consultation efforts. Hard copies of the Phase 1A and Architectural Historians report were submitted to the Massachusetts SHPO on July 31, 2023, via certified mail and were received by SHPO staff on August 4, 2023. SHPO staff responded and reiterated that they have no concerns with the project and that the area of potential effect is not sensitive for containing historic or archaeological resources.

Alternative 2 - Rehabilitation with Labyrinth Weir ASW (106-ft-wide with 4 cycles) with Dam Raise (NEE Alternative): Same as Alternative 1.

Alternative 3 - Rehabilitation with RCC Concrete ASW (265-ft-wide) with Dam Raise: Same as Alternative 1.

Environmental Justice and Civil Rights

Existing Conditions: There is an estimated population of 2,290 people and about 900 households in the breach zone below the dam. The presence or absence of environmental justice groups within the watershed was assessed using EPA's EJSCREEN tool. There are no Tribal Communities or other Environmental Justice groups in the area of potential effect of the dam rehabilitation project.

Future Without Federal Investment (Sponsors' Rehabilitation): There are no known disparate impacts from the rehabilitation project. Avoiding a dam breach will directly benefit all local residents and taxpayers in general within the City of Westfield, Hampden County and the State of Massachusetts.

Alternative 1 - Rehabilitation with Labyrinth Weir ASW (158-ft-wide with 6 cycles) at Existing ASW Crest Elevation: Same as FWOFI (Sponsor's Rehabilitation).

Alternative 2 - Rehabilitation with Labyrinth Weir ASW (106-ft-wide with 4 cycles) with Dam Raise: Same as the FWOFI (Sponsors' Rehabilitation).

Alternative 3 - Rehabilitation with RCC Concrete ASW (265-ft-wide) with Dam Raise: Same as the FWOFI (Sponsors' Rehabilitation).

Economic

Local and Regional Economy

Existing Conditions: The roads used for commuting to work sites contribute to the local economy.

Future Without Federal Investment (Sponsors' Rehabilitation): There would be a temporary positive effect on the local economy during construction.

Alternative 1 - Rehabilitation with Labyrinth Weir ASW (158-ft-wide with 6 cycles) at Existing ASW Crest Elevation with Dam Leveling at EL 203: Same as FWOFI (Sponsor's Rehabilitation).

Alternative 2 - Rehabilitation with Labyrinth Weir ASW (106-ft-wide with 4 cycles) with Dam Raise to EL 205: Same as the FWOFI (Sponsors' Rehabilitation).

Alternative 3 - Rehabilitation with RCC Concrete ASW (265-ft-wide) with Dam Raise to EL 205: Same as the FWOFI (Sponsors' Rehabilitation).

ECOSYSTEM SERVICES

Regulating

Regulating ecosystem services are services which help maintain a world in which it is possible for people to live, providing critical benefits that buffer against environmental catastrophe. These benefits are obtained through moderation or control of ecosystem processes, including regulation of local climate, air, or soil quality; the carbon cycle; flood, erosion, or disease control; water filtration, and pollination. There is inherent uncertainty when trying to predict impacts on regulating ecosystem services, given that our ideas of climate change and potential environmental catastrophes are based on models and simulations. No indirect effects to this service were identified during analysis. Because of the absence of construction in the watershed, no significant cumulative effects exist to this ecosystem service.

Flood and Disease Control (DM 9500-013 P.31)

Powdermill Dam was constructed for the purpose of flood control to protect the City of Westfield and its residents from flooding events. The creation of the dam has limited the frequency and extent of flooding events, and as a result, the risk of pathogens, harmful bacteria, i.e., fecal coliform etc., and vector borne disease spreading through contaminated flood waters, is believed to be decreased. Disease control is not used as a metric for this service, it is only noted as a likely

associated benefit. The continuing functionality of the dam enhances public safety of downstream residents.

Surrogate Metric for Flood and Disease Control

The key metrics which were used as the surrogate measures of the flood control process (and by default disease control) are: the number of structures located within the FEMA 100-yr flood zone downstream of the dam and the acres of undeveloped land in the 100-year flood zone (Table P). The residents and businesses within the flood zone will be directly impacted by changes in flood control because the inundation and destruction of structures are more likely to impact human lives than the inundation of floodplain acres. The impact to critical structures like bridges and homes is likely to result in increasing the risk of loss of life. Reducing flood damages and the potential loss of life is a critical ecosystem service for this project.

Future Without Federal Investment (FWOFI) Alternative

Impacts to flood and disease control from the No Action Alternative are expected to be similar to those of Alternative 1 because both involve the same LOD and will rehabilitate the dam to the same level of protection and brings the dam up to State and NRCS standards.

Alternative 1

Long-term, direct, beneficial impacts to flood and disease control are anticipated from Alternative 1 and therefore to the Regulating Ecosystem Service within the LOD.

Alternative 1 will benefit flood and disease control in the City of Westfield because the actions will rehabilitate the dam so that it maintains its current level of flood protection and brings the dam up to State and NRCS standards. This is expected to reduce the risk of flooding and, in turn, the risk of disease spreading through flood waters in the City of Westfield.

Table P - Flood and Disease Control Metrics

	Existing Conditions	Post Construction
Alternative 1	126 Structures and 32 Acres of Land in 100-year flood zone	No anticipated change
Alternative 2	126 Structures and 32 Acres of Land in 100-year flood zone	No anticipated change
Alternative 3	126 Structures and 32 Acres of Land in 100-year flood zone	No anticipated change
No Action Alternative	126 Structures and 32 Acres of Land in 100-year flood zone	No anticipated change

Climate change is a key source of uncertainty associated with flood control because it has the potential to increase the frequency and intensity of storm events in the near future and, in turn, increase the risk of a dam breach. Thus, the uncertainty of the future effects from climate changes may result in a greater risk of flood damages because the dam may not have the capability to mitigate for the intensity of future weather patterns.

Alternative 2
Impacts to flood and disease control from Alternative 2 are anticipated to be similar to those of Alternative 1 because it will rehabilitate the dam to the same level of protection and brings the dam up to State and NRCS standards.

Alternative 3
Impacts to flood and disease control from Alternative 3 are anticipated to be similar to those of Alternative 1 because both involve the same LOD and will rehabilitate the dam to the same level of protection and brings the dam up to State and NRCS standards.

As shown in the above table, the trend of the Regulating Service as a result of project action is flat or no change.

Supporting
Supporting services refer to the underlying processes maintaining conditions for life on Earth, including nutrient cycling, soil formation, and primary production (i.e., the carbon cycle). There is inherent uncertainty when trying to determine impacts of the project on supporting ecosystem services since there are many other factors unrelated to the project that can affect processes such as nutrient cycling and soil formation. No indirect effects to this service were identified during analysis. Because of the absence of construction in the watershed, no significant cumulative effects exist to this ecosystem service.

Nutrient Cycling

Nutrient cycling in ecosystems is the exchange of organic and inorganic material back into the production of energy and matter. The nutrient cycle involves animals, plants, bacteria, fungi, as well as mineral components of the soil.

Surrogate Metric for Nutrient Cycling

The key surrogate metric which was used to represent nutrient cycling is vegetation because the addition, disturbance, or removal of vegetation can impact the nutrient cycling process. The change in the extent of established vegetation in the LOD for each alternative was analyzed with the results shown in Table Q below.

Table Q - Nutrient Cycling Metrics

	Established Vegetation (acres) Existing Condition	Established Vegetation (acres) Post Construction
Alternative 1	22.34	20.84
Alternative 2	22.34	21.29
Alternative 3	22.34	19.94
No Action Alternative	22.34	21.19

As shown in the above table, the trend of the Supporting Service metric as a result of project action is slightly downward, indicating there will be fewer acres of nutrient cycling biomass. One should note that the NEE alternative has the least change in vegetated acres.

Soil Formation

Factors that affect soil formation include parent material, climate, topography, biological factors, and time.

Surrogate Metric for Soil Formation

The key surrogate metric which was used to represent impacts to soil formation was the change in acreage of impervious surfaces in the LOD, based on the factors affecting soil formation mentioned above.

Table R - Soil Formation Metrics

	Impervious Surface (acres) Existing Condition	Impervious Surface (acres) Post Construction
Alternative 1	0	1.50
Alternative 2	0	1.05
Alternative 3	0	2.40
No Action Alternative	0	1.15

As shown in the above table, the trend of the Supporting Service metric as a result of project action is slightly upward, meaning there will be fewer acres where soil formation will occur. It should be noted that the NEE alternative has the smallest increase in imperious acres.

Future Without Federal Investment (FWOFI) Alternative

Impacts to nutrient cycling and soil formation from the No Action Alternative are expected to be similar to those of Alternative 1 because both involve the same LOD and similar construction activities. However, slightly fewer impacts to nutrient cycling and soil formation may occur as a result of the No Action Alternative because the ACBs are about 50% pervious. Although, the footprint of the ACB exit channel (2.3 acres) is larger than that of Alternative 1's RCC chute, it is estimated that only 1.15 acres of vegetation would be permanently impacted and converted to an impervious surface.

Alternative 1

Short-term and long-term negligible, direct, adverse impacts to nutrient cycling and soil formation are expected from Alternative 1 and therefore to the Supporting Ecosystem Service within the LOD.

The nutrient cycle of plants within the LOD may be affected by the construction work associated with Alternative 1. Some vegetation, including the grassed areas of the top of dam and ASW, will be disturbed and compacted, which will impact the nutrient cycle of the vegetation and soils. About 1.5 acres of vegetation will be permanently disturbed from the installation of the labyrinth

weird and RCC chute, resulting in 20.84 acres of vegetated areas post construction, compared to 22.34 acres pre-construction. Trees will be removed for project work as necessary to help facilitate construction, primarily in the staging area (maximum 4 acres). The construction team will try to use land which had been previously cleared to minimize the number of trees removed. Long-term impacts to the nutrient cycle may result from the removal of some trees to help facilitate construction. However, because very few trees will be removed and new trees will be planted, impacts to the nutrient cycle are anticipated to be negligible.

Soil formation in the LOD may also be temporarily impacted by the movement of construction vehicles and the staging of materials/equipment on the soils. Access roads will run east-west through the center of the LOD and materials and equipment will be stored in the designated staging area. Long-term effects to soil formation are expected to be negligible because only 1.5 acres of land will be converted to an impervious surface. Parent material, topography, and existing biological factors, which all affect soil formation, at the site are not expected to change as a result of Alternative 1.

Future climate change and variability have the potential to impact both soil formation and nutrient cycling. Project action is not anticipated to intensify any impacts imposed by climate change.

Alternative 2
Impacts to nutrient cycling and soil formation from Alternative 2 are anticipated to be similar to those of Alternative 1 because both involve the same LOD and similar construction activities. However, slightly fewer impacts to nutrient cycling and soil formation may occur as a result of Alternative 2 because the footprint of the RCC chute is smaller than that of Alternative 1, and therefore only 1.05 acres of vegetation would be permanently impacted and converted to an impervious surface.

Alternative 3
Impacts to nutrient cycling and soil formation from Alternative 3 are anticipated to be similar to those of Alternative 1 because both involve the same LOD and similar construction activities. However, slightly more impacts to nutrient cycling and soil formation may occur as a result of Alternative 3 because the footprint of the RCC ASW is larger than that of Alternative 1, and therefore, 2.4 acres of vegetation would be permanently impacted and converted to an impervious surface.

Cultural
Cultural services make the world a place in which people want to live. These services are the non-material benefits that ecosystems provide to human societies and culture, including opportunities for recreation, aesthetic or artistic appreciation, and spirituality. Uncertainty within cultural ecosystem services lies within society's restructuring of what is deemed culturally important as well as future management actions outside the realm of this project. No indirect effects to this Service were identified during analysis. Because of the absence of construction in the watershed, no significant cumulative effects exist to this ecosystem service.

Recreational Use

The LOD is predominantly grassed and wooded land with suburban areas surrounding the dam site. There are several designated recreational spaces in the upstream and downstream areas within the Powdermill Watershed, but no officially designated recreational land exists in the LOD. However, it is known that local residents utilize the land and impoundment for various recreational activities, including walking, fishing, and hunting. The surrogate metrics chosen to represent impacts to this service are:

- The length of trails in the LOD (ft)
- The impoundment size (acre)

Table S - Recreational Use Metric - Trails

	Length of trail in LOD (ft) Existing Condition	Length of trail in LOD (ft) Post construction
Alternative 1	605	960
Alternative 2	605	960
Alternative 3	605	960
No Action Alternative	605	960

As shown in the above table, the trend of the Cultural Service metric as a result of project action is significantly upward, meaning there will be a greater opportunity for recreational trail use.

Table T - Recreational Use Metric – Impoundment Acres

Alternatives	Impoundment Acres Existing Condition	Impoundment Acres Post construction
Alternative 1	0.27 acre	0 acres
Alternative 2	0.27 acre	0 acres
Alternative 3	0.27 acre	0 acres
No Action Alternative	0.27 acre	0 acres

A secondary metric used was impoundment size. Because the result of all project action alternatives is a dry dam, there will be a downward trend in impoundment size as displayed in the table above.

Aesthetic Viewsheds

Scenic beauty, as defined by the USDA takes into consideration landforms, water, vegetation, and structures, some of which are present within the LOD. Of these, the LOD contains landforms, such as small hills, a freshwater pond, brook, and vegetation. No structures, besides the dam, are located in the LOD.

Surrogate Metrics for Viewsheds

The key surrogate metric which was used to represent viewshed was the number of residences which have a direct line of sight or view of the downstream portion of the LOD. Only two residences have a view of this area. Although the residences do not have full views of the LOD. The view from these two residences will not change in terms of their ability to see the downstream portion of the LOD. Therefore, the trend of this metric is flat. A secondary metric that was used for aesthetics is the acres of green landscape in the LOD.

Table U - Aesthetic Viewsheds Metrics

	Green landscape in LOD (acres) Existing Condition	Green landscape in LOD (acres) Post construction
Alternative 1	22.34	20.84
Alternative 2	22.34	21.29
Alternative 3	22.34	19.94
No Action	22.34	21.19

As shown in the above table, the trend of this Cultural Service metric as a result of project action is slightly downward, meaning there will be fewer acres of green landscape to enjoy. It should be noted that the NEE alternative has the smallest decrease in green landscape.

Future Without Federal Investment (FWOFI) Alternative

Impacts to recreational use and aesthetic viewsheds from the No Action Alternative are expected to be similar to those of Alternative 1 because both involve the same LOD and similar construction activities. However, there will be slightly more impacts to aesthetic viewsheds because the ACB exit channel will cover 2.3 acres of land; however, it is expected that vegetation will be able to grow through the ACBs which will lessen the impacts on aesthetics.

Alternative 1

Short-term, adverse, moderate impacts and long-term, adverse, negligible impacts to recreational use and aesthetic viewsheds are expected from Alternative 1 and therefore to the Cultural Ecosystem Services in the LOD.

There are no designated recreational lands or trails within the LOD. However, it is believed that some land in the LOD is occasionally used by residents for walking and the impoundment is occasionally used for recreational fishing. Impacts to recreational use are anticipated to be short-term adverse, and moderate, and long-term both beneficial and adverse and negligible. Short-term impacts will occur during construction work (approximately 24 months) when residents will temporarily be restricted from the LOD, including access to the impoundment. Long-term adverse impacts to recreational use will result from the loss of the impoundment once the dam reverts to a dry dam. However, the impoundment only accounted for a very small area used for fishing (0.27 acre); upstream and downstream areas can still be utilized for recreational fishing post construction. Long-term beneficial impacts to recreational use include the installation of a 960-ft-long pedestrian walking trail running east-west along the northern side of the dam.

Two residences have a view of the LOD. During project construction work, which is expected to last approximately 24 months total, the aesthetic viewsheds within the LOD will be temporarily impacted. The green landscape in the LOD is only anticipated to change by 1.5 acres from the addition of the labyrinth weir and RCC chute. The addition of the RCC spillway and labyrinth weir will also alter the overall appearance of the dam site. Both long-term and short-term adverse impacts to aesthetic viewsheds are anticipated to be negligible.

Alternative 2
Impacts to recreational use and aesthetic viewsheds from Alternative 2 are anticipated to be similar to those of Alternative 1 because both involve the same LOD and similar construction activities. However, there will be slightly fewer impacts to aesthetics because the acres of green landscape will only change by 1.05 acres.

Alternative 3
Impacts to recreational use and aesthetic viewsheds from Alternative 3 are anticipated to be similar to those of Alternative 1 because both involve the same LOD and similar construction activities. However, there will be slightly more impacts to aesthetics because the acres of green landscape will change by 2.4 acres.

RISK AND UNCERTAINTY

ASSUMPTIONS

Assessments, considerations, and calculations in this plan are based on a 79-year period of analysis.

Projected sediment deposition is based on historical rates. Future built-out land use is based on City of Westfield zoning restrictions. PMP values are assumed to be conservative since they were obtained from studies developed in 1978. However, these studies have not been updated using the latest state-of-the-science tools and methods to incorporate data from storms that occurred since the studies were published.

The limiting factor for the expected useful life of the Future With Federal Assistance Alternative (The Preferred Alternative) is based on the service life of the labyrinth weir with roller compacted concrete (RCC) and reinforced concrete sidewalls, the RCC stilling basin, and the remaining expected life of the principal spillway pipe and associated components. Thus a 79-year period of analysis was used for this structure.

There is a need to provide flood protection downstream and to address dam safety and performance deficiencies of the existing high-hazard dam that are not in compliance with NRCS and DCR standards. From a financing and administrative standpoint, the Sponsors have committed to NRCS that they are able to fund the required 35% of the total project costs to complete installation of the preferred alternative and can perform the required maintenance on the upgraded structure for 75 years after construction.

The principal spillway and the labyrinth weir auxiliary spillway are planned to withstand the PMF without damage, but routine operation and maintenance costs could be incurred. This project plan assumes that an auxiliary spillway flow event has less than 1% chance of occurring in a given year. The operation and maintenance cost estimates do not include any costs for off-site damage that may occur during an auxiliary spillway flow event.

RISKS

National averages were used to identify the value of potential damages. However, the dam rehabilitation program requires the use of the PMP for dam overtopping prediction.

The Sponsors will restrict future construction of habitable dwellings upstream of the dam and below the elevation of their flowage easement. The Sponsors recognize that the dam is designed to detain floodwaters. The Sponsors accept the risk of flood damages that would occur in events between their flowage easement elevation and the elevation of the top of dam.

Construction activities should be sequenced and protected to reduce risks associated with potential flood events during construction.

UNCERTAINTY

Actual damages occurring from each storm event could realistically be higher or lower, depending on soil moisture conditions at the time of a given event, associated debris flows, future development, and other factors such as changes in precipitation from various storm events.

Although potential climatic changes are not expected to alter calculation of the PMP events, they could increase the occurrence of low frequency, high intensity storm events and associated flood damages. Furthermore, the PMP values have not been updated using the latest state-of-the-science tools and methods to incorporate data from storms that occurred since the studies were published. The uncertainty associated with rainfall data could be reduced if site-specific or state-wide PMP data were available. Additional uncertainty associated with hydrologic analyses is due to the use of input parameters that are the best approximation of hydrologic conditions in the watershed. The uncertainty and risk could be limited by calibration of the watershed response to rainfall events of the same magnitude; however, the lack of stream gage data limits the potential for calibration.

Very large storm events or deforestation by fire could cause an increased rate of erosion, sedimentation, and deposition.

Risk and uncertainty during construction can be reduced by conducting design-phase geotechnical explorations to provide additional characterization of subsurface conditions at locations based on the specific layout and features of the preferred alternative. Subsurface conditions between boring and test pit locations may vary, and the adequacy of the design should be confirmed if unanticipated conditions are encountered during construction.

Professional opinions of future performance of concrete structures at the dam are based on visual observations and engineering analyses. While these structures, including the principal spillway riser and conduit, are expected to perform as intended during design-level hydraulic and seismic loadings within the design life of the structures, risk and uncertainty can be reduced by regular inspection and maintenance, as well as monitoring during and after major flood and seismic events, in accordance with NRCS and DCR Dam Safety requirements.

The condition and performance of the existing BCCMP foundation trench drain pipes is unknown, as the outlets were not observed during the visual inspections. However, since each alternative, including the preferred alternative, includes grouting the existing foundation trench drain pipes and installing a new toe drain filter and pipe at the downstream toe, risk and uncertainty associated with that the condition and performance of the existing drain system will be mitigated.

CONSULTATION, COORDINATION, AND PUBLIC PARTICIPATION

The sponsoring organizations are the City of Westfield and the Hampden Hampshire Conservation District. The City of Westfield is considered the owner and operator of Powdermill Dam.

Local and federal support for the rehabilitation of the dam has been strong. Input and involvement of the public have been solicited throughout the planning of the project. At the initiation of the planning process, some meetings were held with representatives of the Sponsors to ascertain their interest and concerns regarding the dam. A Public Participation Plan was developed and approved for the project and has been followed during the planning process.

The City of Westfield and NRCS have worked closely with the local landowners and residents to provide information on the planning activities and to solicit their input on the pertinent issues to be considered during planning.

A scoping meeting was held on November 13, 2019, in the Westfield City Hall in Westfield, Massachusetts, to identify issues of economic, environmental, cultural, and social concerns in the watershed. Input was provided by local, regional, state and federal agencies at the meeting or through letters and emails to NRCS. There were 17 people in attendance. Agencies and organizations attending or providing input include Senator Elizabeth Warren's office, Westfield Flood Control Commission, City of Westfield, Schnabel Engineering, EA Engineering, Science and Technology, Inc., and the NRCS.

The first public meeting for Powdermill Dam was held in the Westfield City Hall in Westfield, Massachusetts on November 13, 2019. There were 19 people in attendance. Local, state, and federal perspectives on the rehabilitation needs of the dam were provided. Attendees were informed of the dam rehabilitation program and potential alternative solutions to bring the dam into compliance with current dam safety and design criteria. Meeting participants provided input on their issues and concerns to be considered during the planning process. Agencies and organizations attending or providing input include the City of Westfield, the Westfield News, the Westfield Flood Control Commission, Aterra Solutions, Schnabel Engineering, EA Engineering, Science and Technology, Inc., and NRCS.

Due to COVID-19 risks and restrictions for public gatherings, a virtual Public Meeting was held using ZOOM software on October 21, 2020, with 20 total participants. The meeting was also shown on local TV and recorded using YouTube. A summary of the findings, alternatives considered, and the preferred alternative were presented. Agencies and organizations participating and/or providing input include the City of Westfield, the Westfield Flood Control Commission, Aterra Solutions, Schnabel Engineering, EA Engineering, Science and Technology, Inc., and NRCS. The PowerPoint for the meeting and the YouTube meeting recording was saved to the City's website for reference and viewing by the general public at large.

NRCS has been in ongoing consultation with six federally recognized Indian Tribes who have expressed an interest in Hampden County Massachusetts. These consultation efforts are detailed in Appendix A. Most recently, on July 21, 2023, a copy of the Phase 1A Report and Architectural Historian's Report prepared by SEARCH were submitted to the Delaware Tribe of Indians, the

Mashpee Wampanoag Tribe, the Mohegan tribe of Indians of Connecticut, the Narragansett Indian Tribe, the Stockbridge-Munsee Community Band of Mohican Indians, and the Wampanoag Tribe of Gay Head (Aquinnah) Tribal Historic Preservation Officers on with a determination of No Historic Properties Affected. NRCS received concurrence from the Stockbridge-Munsee Community THPO on August 9, 2023. No comments were received from the Delaware Tribe of Indians, the Mashpee Wampanoag Tribe, the Mohegan tribe of Indians of Connecticut, the Narragansett Indian Tribe, and the Wampanoag Tribe of Gay Head (Aquinnah) Tribal Historic Preservation Officers during this most recent consultation effort. Nor were any comments received following our February 9, 2023, consultation efforts. Hard copies of the Phase 1A and Architectural Historians report were submitted to the Massachusetts SHPO on July 31, 2023, via certified mail and were received by SHPO staff on August 4, 2023. SHPO staff responded and reiterated that they have no concerns with the project and that the area of potential effect is not sensitive for containing historic or archaeological resources.

NRCS received no information regarding Traditional Cultural Properties within or near the APE that would be impacted by this project.

A Draft Plan was distributed for interagency and public review on ____. The distribution list A Draft Plan was distributed for interagency and public review on ____. The distribution list of agencies and organizations is included on pages 106 and 107 of this Plan-EA. Copies of the document were placed in local libraries and news articles were placed in local newspapers to solicit comments from the public during the comment period. After the interagency and public review period, comments received on the draft were incorporated into the Final Plan. Letters of comments received on the draft plan and NRCS responses to the comments are included in Appendix A.

THE PREFERRED ALTERNATIVE

Rationale for Plan Selection

The selected plan is to rehabilitate the dam to meet current Massachusetts DCR and NRCS safety and performance standards for high hazard potential dams. The selected plan meets the identified purposes and needs for the project, and significantly reduces the potential risk to human life. The project Sponsors, residents, and state and local government agencies all prefer the selected plan because it:

- Reduces the threat to loss of life to approximately 1,352 people who live and/or work in the breach zone.
- Protects 363 residences, 82 apartments, 45 commercial structures, 2 public properties, numerous outbuildings (sheds, barns, etc.), 1 stream crossing (bridge), and 19 roadways downstream within the breach inundation zone.
- Provides protection for over 14,600 vehicles and their occupants who utilize the roads downstream of Powdermill Dam daily (using an average of 2 people per vehicle results in about 29,200 motorists).
- Reduces the threat of loss of access and loss of emergency services for downstream properties and property owners.

- Provides downstream flood protection for the residents in the area, as well as those working, recreating, or traversing within the downstream floodplains, for an additional 75 years.
- Eliminates the liability associated with continuing to operate a dam that does not meet current Massachusetts and NRCS safety and performance standards.
- Retains the existing aquatic and terrestrial habitat in and around the dam.
- Leverages federal resources to install the planned works of improvement.
- Will meet current DCR and NRCS safety and performance standards for a high hazard potential dam.

The preferred alternative meets the Sponsors' objectives of bringing this dam into compliance with current dam design and safety criteria, providing the needed level of flood protection for downstream properties, and addressing resource concerns identified by the public. The selected plan is the NEE Alternative. The plan reasonably meets the following four criteria: completeness, effectiveness, efficiency, and acceptability. NRCS and the Sponsors agree on the selected plan.

Measures to be Installed

The selected plan of action for the dam is to:

- Raise the top of dam elevation to EL 205
- Armor the auxiliary spillway (ASW) with a 4-cycle, 106-ft-wide labyrinth weir at the existing ASW crest elevation;
- Construct the chute of the labyrinth weir with roller compacted concrete (RCC) and reinforced concrete sidewalls;
- Construct an RCC stilling basin with riprap outlet protection at the toe of the chute;
- Regrout the principal spillway conduit joints and apply a concrete sealant;
- Install a filter diaphragm near the downstream end of the existing principal spillway conduit;
- Install new plastic pipe toe drains and filter trench and fill the existing trench drain pipes with grout; and
- Remove the existing pond drain gate to allow Powdermill Brook to naturally re-establish through the floodpool.

After the implementation of these planned works of improvement, the Powdermill Dam will meet all current DCR and NRCS safety performance standards.

Detailed structural data for the proposed rehabilitated dam can be found in Table 3.

The preferred alternative will maintain the current level of flood protection. However, Table V reflects the type and number of properties that would still be at risk of flood damages.

Table V - Remaining Flood Hazard of the Preferred Alternative

Type of Property	Number	Depth of Floodwaters Above First Floor Elevation (FFE) [1/]		Velocity of Floodwaters	
		500-year	100-year	500-year	100-year
Residential	91	0.0 – 1.3	0.0		
Apartment Bldgs	18	0.0 – 0.5	0.0 – 0.1		
Commercial	16	0.0 – 9.5	0.0 – 7.3		
Public	1	0.1 – 0.4	-		-
Total	126	-	-	-	-

[1/] Depths of 0.0 feet indicate the presence of basements, which would flood at depths below first floor elevation.

As reflected in Table V, most of the flooding is confined to basements of houses, apartment buildings, and commercial properties (the lone public building does not have a basement). There are three commercial buildings associated with a miniature golf business that have major flooding above the first-floor elevation. One of the buildings, a gift shop/office for the business, would have flood depths of 5.6 and 3.9 feet from the 500-year and 100-year flood events, respectively. Two other buildings on the property appear to be storage related. One would flood 9.5 and 7.3 feet from the 500-year and 100-year flood events, respectively; and the other would flood 4.6 and 2.4 feet from the 500-year and 100-year flood events, respectively. These commercial buildings are the only ones that flood at such depths. All other commercial buildings have first floor elevation flooding less than 1.1 feet and 0.5 feet from the 500-year and 100-year flood events, respectively

Costs

As indicated in Table 1, the total installation cost of the selected plan is $7,734,800. Of this amount, PL-83-566 funds will bear $5,599,800 and nonfederal funds will bear $2,135,000. Table 2 shows details of the costs and cost-share amounts by category. Total annualized costs are shown in Table 4 along with the estimated costs for operation and maintenance. Table 5 displays the average annual flood damage reduction benefits by flood damage categories, and Table 6 displays a comparison of annual costs and benefits. A 2020 price base was used and amortized at 2.50 percent interest for the 79-year period of analysis (including a design and installation period of four years and an expected useful life of 75 years).

The cost projections for the proposed rehabilitation measures are estimated costs only for planning. The fact that these costs are included in this plan does not infer that they are final costs. Detailed structural designs and construction cost estimates will be prepared prior to contracting for the work

to be performed. Final construction costs will be those costs incurred by the contractor performing the work, including the cost of any necessary contract modifications.

Responsibilities

Operation, Maintenance, and Replacement

Measures installed as part of this plan, and previously installed measures, will be operated and maintained by the City of Westfield with technical assistance from federal, state, and local agencies in accordance with their delegated authority. A new operation and maintenance (O&M) agreement will be developed for Powdermill Dam and will be executed between the City of Westfield and the NRCS prior to construction of the project. The term of the new O&M agreement will be for 75 years following the completion of rehabilitation. The agreement will specify responsibilities of the Sponsors and include detailed provisions for retention, use, and disposal of property acquired or improved with PL 83-566 cost sharing. Provisions will be made for free access of state and federal representatives to inspect all structural measures and their appurtenances at any time.

Easements and Landrights

The City of Westfield flowage easement is currently below the auxiliary spillway (ASW) crest elevation of 196.3 (NAVD 88). The top of dam would be raised about 2 feet to elevation 205.0. At the ASW crest elevation, there is 0.415 acre outside of the currently secured easement elevation. At the proposed elevation (205.0) there would be 10.1 acres outside of the current secured easement elevation. There are no buildings currently below the top of dam elevation. However, to meet the minimum NRCS easement elevation, additional landrights will need to be procured. An economic analysis was conducted regarding costs and benefits of various easement elevation levels. The analysis is found in the Investigations and Analyses Report, Appendix D. There are no buildings downstream of the dam that would receive induced flooding from the auxiliary spillway during the passage of the design storm event.

For Powdermill Dam, the minimum NRCS easement elevation is the ASW crest, which equates to an elevation of 196.3. Therefore, to meet minimum NRCS policy, the City of Westfield must procure a minimum of an additional 0.415 acre of flood storage easements upstream of the dam.

The City of Westfield decided to procure the additional flood storage easements of 0.415 acre according to minimum NRCS land rights policy. They have chosen to accept this level of easement and its associated risk for potential damage upstream of the dam.

Mitigation

The northern long-eared bat (NLEB) is federally listed as a threatened species under the Endangered Species Act. The NLEB spend winters hibernating in small crevices and cracks within caves or mines called hibernacula. There are no known or documented NLEB hibernacula within close proximity to the project site. Consultation letters indicating the potential presence of the NLEB were submitted to USFWS and MassWildlife NHESP. The USFWS provided a response

to the letter on 30 November 2022. No response was received from MassWildlife NHESP. The USFWS indicated that the NLEB will be reclassified from threatened to endangered effective 30 January 2023. USFWS also provided clarification on the seasonal cutting restriction for NLEB. To minimize potential impacts on NLEB, tree cutting (greater than 3 inches diameter in breast height) will occur outside of the NLEB pup season (April 1 to October 30), as was requested by the USFWS in their consultation response letter.

Any work in the stream channel or waters of the U.S. and any impacts to jurisdictional wetlands, may require mitigation and will be addressed with USACE as well as state and local regulatory authorities during the design and permitting process. During construction, site mitigation measures will include erosion and sediment control, seeding of denuded areas, dust control, and other practices identified during the design process. The specific requirements for the use of BMPs during the construction phase will be identified during the design of this project and consultation with regulators during the permitting process.

Permits and Compliance

Prior to construction, the Sponsors will be responsible for obtaining all required permits. During construction, the successful contractor is required to develop a Stormwater Pollution Prevention Plan and acquire any applicable air quality and erosion and sediment control permits.

The construction general permit would require the operator to implement a site-specific SWPP. The SWPP would outline the steps that an operator must take to comply with the permit, including water quality and quantity requirements to reduce pollutants in the stormwater runoff from the construction site. The SWPP also specifies all potential pollutant sources that could enter stormwater leaving the construction site and covers methods used to reduce pollutants in stormwater runoff during and after construction.

The National Flood Insurance Program regulations state: "*A community's base flood elevations may increase or decrease resulting from physical changes affecting flooding conditions. As soon as practicable, but not later than six months after the date such information becomes available, a community shall notify the Administrator of the changes by submitting technical or scientific data in accordance with this part. Such a submission is necessary so that upon confirmation of those physical changes affecting flooding conditions, risk premium rates and floodplain management requirements will be based upon current data."* Implementation of the preferred alternative will have no impact on the 500-year and smaller floods; therefore, there will be no impact on the flooding conditions shown in the flood insurance studies or on the FIRMs; however, the local communities may choose to provide to FEMA the results of the hydraulic analyses developed for this project for consideration in revising the FIRMs.

In addition to the permits listed above, it is anticipated that the following natural resource related permit applications may also be necessary depending on disturbance areas outlined during the design process:

- Order of Conditions – City of Westfield Conservation Commission
- Chapter 91 Waterways License – MA DEP
- Section 401 Water Quality Certification – MA DEP
- Massachusetts General Permit for Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act of 1899 – U.S. Army Corps of Engineers
- Wetlands Permit – MA DEP (via submission to Conservation Commission)
- Beneficial Use Determination – MA DEP (may or may not be required but pre-permitting conversation with MA DEP suggested)
- Chapter 253 Dam Safety Permit – MA DEP Office of Dam Safety
- Certificate – MEPA

Other state or local permits may be necessary, and this determination will be made during pre-permit application meetings with local, state and federal regulatory agencies once designs have been sufficiently developed to facilitate conversations.

Installation Sequence

The installation of the project will be completed within four years following appropriation of construction funds. The City of Westfield has taxing authority to raise project funding and the power of eminent domain to acquire any necessary land rights. Actual construction will occur over about 24 months. However, with time allowed for set-up and winter shutdown, the actual construction activities will occur over about 15 months. All required easements and permits will be secured before the solicitation of construction bids for the project.

The contractor will determine the installation sequence after a construction contract has been awarded. The actual sequence of construction may vary somewhat from the bulleted items below, but these are the basic steps expected for this rehabilitation project.

- The contractor's schedule, Safety Plan, Quality Control Plan, Erosion and Sediment Control Plan, Water Control Plan and other necessary contract plans will be approved.
- A detailed survey and layout of the limits of disturbance, access routes, and major works of improvement will occur.
- The erosion and sediment control measures will be installed.
- The staging area will be cleared and grubbed. Gravel will be placed over geotextile fabric to limit ground disturbances within the staging area. Access routes will be established from the staging area to the work areas.
- Construction trailers will be set up and materials will begin to arrive onsite.
- The water control system and cofferdam will be installed. The sediment immediately adjacent to the riser will be removed. The riser and conduit will be dewatered to allow grouting of the 48-inch diameter reinforced concrete principal spillway conduit. The

concrete sealant will be applied to the worn concrete surfaces of the conduit and riser. After the sealant has cured, the existing pond drain gate will be removed along with the cofferdam.

- The existing bituminous coated corrugated metal pipe toe drains will be filled with grout. The new filter diaphragm will be constructed near the downstream slope around the existing principal spillway conduit and the plastic pipe toe drains and a filter trench will be installed closer to the toe of the dam slope.
- Simultaneously with the riser and conduit work, excavation of the auxiliary spillway will begin followed by construction of the reinforced concrete sidewalls.
- The concrete batch plant will be set up. The construction of the roller compacted concrete (RCC) stilling basin with riprap outlet protection will occur followed by the RCC chute.
- The auxiliary spillway will be completed with the construction of the 106-ft-wide, 4-cycle reinforced concrete labyrinth weir and earthen berm.
- Earth fill will be placed to raise the top of dam by 2-feet to elevation 205.0.
- The concrete batch plant will be removed.
- All disturbed areas, including the staging area, will be seeded and mulched.

Installation and Financing

The project is planned for installation in about 2 years. During construction, equipment will not be allowed to operate when conditions are such that soil erosion and water, air, and noise pollution cannot be satisfactorily controlled.

NRCS will assist the Sponsors with the Powdermill Dam rehabilitation project. NRCS will be responsible for the following:

- Execute a project agreement with the City of Westfield before either party initiates work involving funds of the other party. Such agreements set forth in detail the financial and working arrangements and other conditions that are applicable to the specific works of improvement.
- Execute a Memorandum of Understanding with the Sponsors to provide a framework within which cost-share funds are accredited.
- Execute an updated Operation and Maintenance Agreement with the City of Westfield that extends the O&M responsibilities for another 75 years following construction. This agreement will be based on the NRCS National Operation and Maintenance Manual.
- Provide financial assistance equal to 65% of total eligible project costs, not to exceed 100% of actual construction costs.
- Verify that a current Emergency Action Plan is developed before construction is initiated.
- Provide consultative engineering support, technical assistance, and approval during the design and construction of the project.
- Provide contract administration technical assistance during construction of the project.
- Provide construction management technical assistance.
- Certify completion of all installed measures.

The City of Westfield will be responsible for the following:

- Secure all needed environmental permits, easements, and rights for the installation, operation, and maintenance of the rehabilitated structure.
- Prepare an updated Emergency Action Plan for the dam prior to the initiation of construction.
- Execute a Memorandum of Understanding with the NRCS to provide a framework for crediting in-kind services.
- Execute an updated Operation and Maintenance Agreement with NRCS for the dam. This agreement will be based on the NRCS National Operation and Maintenance Manual.
- Provide engineering services for the design, construction, and certification of the project.
- Provide local administrative and contract services necessary for the installation of the project.
- Provide nonfederal funds for cost-sharing of the project at a rate equal to, or greater than, 35% of the total eligible project costs.
- Participate in and comply with applicable Federal floodplain management and flood insurance programs.
- Restrict future construction of habitable dwellings upstream of the dam and below the flowage easement (elevation 196.3 NAVD 88).
- Enforce all associated easements and rights-of-way for the safe operation of the dam.

Table 1 – Estimated Installation Cost

Powdermill Dam, Massachusetts

(Dollars) Installation Cost Items	Estimated Costs		
	PL-83-566 Funds[1/]	Other Funds	Total
Structural measures to rehabilitate Powdermill Dam	$5,599,800	$2,135,000	$7,734,800
Total Project:	**$5,599,800**	**$2,135,000**	**$7,734,800**

Price base: 2020 Prepared: November 2020

1/ Paid by the USDA/NRCS – the Federal agency responsible for assisting in installation of improvements.

Table 2 – Estimated Cost Distribution – Structural Measures

Powdermill Dam, Massachusetts

(Dollars)

	Installation Cost: PL-83-566 Funds[1/]					Installation Cost: Other Funds[2/]						
Installation Cost Items	Construction Costs	Engineering Technical Assistance Costs	Geo-Technical Costs	Project Admin. Costs	Total PL-83-566 Costs	Construction Costs	Engineering Costs	Real Property Landrights	Permits	Project Admin. Costs	Total Other Funds	Total Project Cost[3/]
Rehab. Powdermill Dam:	$3,954,800	$1,500,000	$85,000	$60,000	$5,599,800	$2,068,200	$30,000	$19,300	$5,500	$12,000	$2,135,000	$7,734,800
Totals:	**$3,954,800**	**$1,500,000**	**$85,000**	**$60,000**	**$5,599,800**	**$2,068,200**	**$30,000**	**$19,300**	**$5,500**	**$12,000**	**$2,135,000**	**$7,734,800**

Price base: 2020 Prepared: November 2020

1/Federal Engineering, Geo-Technical, and Project Administration costs ($1,645,000) are not included when calculating federal cost share for the rehabilitation project. Sponsors' permitting costs ($5,500) are not eligible for cost share either. Therefore, federal cost share (65%) is based on total eligible project cost of $6,084,300. The actual federal cost/share cannot exceed 100% of the construction cost.

2/35% of total eligible project cost, excluding permits cost.

3/As per the NRCS National Watershed Manual, Part 508.44, the actual federal cost/share amount will be calculated based on a total eligible project cost that excludes federal technical assistance costs, water, mineral and other resource rights, and all federal, state, and local permits. However, for the purpose of planning, all of these costs are included in the benefit/cost analysis and are displayed as part of the public record of this analysis.

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Table 3 – Structural Data for Rehabilitated Dam

Powdermill Dam

Hampden County, Massachusetts

Item	Unit	Structure Data
Class of structure		High Hazard
Uncontrolled drainage area	mi^2	0.97
Controlled drainage area	mi^2	3.49
Total drainage area	mi^2	4.46
Runoff curve number (AMC II)		70
Time of concentration (T_c); uncontrolled drainage area only	hours	1.7
Top of dam elevation	feet	205
Elevation crest auxiliary spillway	feet	196.3
Elevation crest high stage inlet	feet	162.3
Elevation crest low stage inlet	feet	156.8
Auxiliary spillway type		Structural/Labyrinth Weir
Auxiliary spillway crest width	feet	106
Auxiliary spillway exit slope	percent	3% and 19%
Maximum height of dam	feet	57
Volume of fill	yd^3	170,000
Total capacity		
Sediment submerged	acre-feet	N/A
Sediment aerated [1/]	acre-feet	17.2
Beneficial use (M&I water)	acre-feet	N/A
Floodwater retarding	acre-feet	892.6
Between high and low stage	acre-feet	0.8
Surface area		
Sediment pool	acres	N/A
Beneficial use pool (M&I water)	acres	N/A
Floodwater retarding pool	acres	53.3
Principal spillway design		
Rainfall volume (1-day)	inches	8.74
Rainfall volume (10-day)	inches	15.10
Runoff volume (10-day)	inches	8.0
Capacity	ft^3/s	339
Dimensions of conduit	inches	48

Item	Unit	Structure Data
Type of conduit		RCP
Frequency of operation-auxiliary spillway	percent chance	<1
Auxiliary spillway hydrograph		
Rainfall volume	inches	10.46
Runoff volume	inches	6.64
Storm duration	hours	6
Velocity of flow (V_e)	feet/sec.	N/A
Max. reservoir water surface elev.	feet	197.85
Freeboard hydrograph		
Rainfall volume	inches	25.34
Runoff volume	inches	20.84
Storm duration	hours	6
Max. reservoir water surface elev.	feet	204.73
Capacity equivalents		
Sediment volume	inches	0.07
Floodwater retarding volume	inches	3.75
Beneficial volume (M&I water)	inches	N/A

1/ Total sediment load was assumed to have aerated sediment characteristics and was converted to volume and added to the initially estimated aerated sediment volume.

Table 4 – Average Annual National Economic Development (NED) Costs

Powdermill Dam, Massachusetts

(Dollars[1/])

	Average Annual Equivalent Cost	**Average Annual Equivalent O&M Costs**	**Total Average Annual Equivalent Cost**
Rehabilitation of Powdermill Dam	$225,400	$13,500	$238,900
Totals:	**$225,400**	**$13,500**	**$238,900**

Price base: 2020 Prepared: November 2020

1/ The average annual equivalents are based on a 2.50% discount rate and a 79-year period of analysis (2 years for project design and 2 years for installation and 75 years of expected useful life).

Table 5 – Estimated Average Annual Flood Damage Reduction Benefits

Powdermill Dam, Massachusetts

(Dollars)

Flood Damage Category	Estimated Average Annual Equivalent Damages		Damage Reduction Benefits
	Without Federal Project	With Federal Project	Average Annual Equivalents
Urban Area	$150,500	$16,700	$133,800
Roads and Bridges	$85,600	$25,300	$60,300
Railroad	$1,300	$0	$1,300
Subtotal	**$237,400**	**$42,000**	**$195,400**
Totals:	**$237,400**	**$42,000**	**$195,400**

Price base: 2020 Prepared: November 2020

Table 6 – Comparison of National Economic Development (NED) Benefits and Costs

Powdermill Dam, Massachusetts

(Dollars)

Evaluation Unit	Average Annual Equivalents[1/]					Benefit/ Cost Ratios
	Damage Reduction Benefits	FWOFI Cost Avoidance	Total Average Annual Benefits	Average Annual Costs	Net Average Annual Benefits	
Powdermill Dam	$195,400	$195,300	$390,700	$238,900	$151,800	1.6 to 1.0
Totals:	**$195,400**	**$195,300**	**$390,700**	**$238,900**	**$151,800**	**1.6 to 1.0**

Price base: 2020 Prepared: November 2020

1/ The average annual equivalents are based on a 2.50% discount rate and a 79-year period of analysis (2 years for project design and 2 years for installation and 75 years of expected useful life).

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REPORT PREPARERS

The Powdermill Brook Watershed Supplemental Plan and Environmental Assessment was prepared by Aterra - Schnabel Joint Venture with support from EA Engineering, Science, and Technology (EA), and other consultants. The Draft Plan was reviewed by NRCS Massachusetts State Office Staff. The staff specialists concurring with the plan included those having responsibility for engineering, resource conservation, soils, biology, economics, geology, and contract administration. The in-house review was followed by a review by the NRCS National Water Management Center, an interagency and public review, and an NRCS National Office programmatic review.

Table W provides a list of preparers directly responsible for providing significant input to the preparation of the Supplemental Plan-EA.

Appreciation is extended to many other individuals, agencies and organizations for their input, assistance, and consultation, without which this document would not have been possible. Several agencies such as the U.S. Army Corps of Engineers, U.S. Fish and Wildlife Service and NOAA were considered as potential cooperating agencies in the development of the plan. However, none were invited to be a cooperating agency because the Planning Team had the needed expertise to complete the plan without their direct assistance. The agencies can still be involved during the design phase of the project. There is nothing in this plan that is controversial or requires other agencies to participate as a cooperating agency.

Table W – List of Preparers

Name	Present Title	Education	Experience (years)	Other
NRCS Staff				
Jim Lyons	Civil Engineer	M.S Civil Engineering BS Geology	NRCS Civil Engineer - 18	PE in PA
Deron Davis	State Conservation Engineer	B.S. Agricultural Engineering	NRCS State Cons. Engineer -7.5 NRCS Area Engineer – 16	PE in MA
Consultants				
Wade Biddix, Aterra Solutions	Planning Coordinator	M.S. Public Administration B.S. Agriculture	NRCS Assistant State Conservationist for Water Resources – 13 NRCS Supervisory District Cons. – 1.5 NRCS Planning Coordinator – 10.5 NRCS Area Resource Conservationist – 2 NRCS District Conservationist – 4 NRCS Soil Conservationist – 4	
Sal DeCarli, EA	Scientist	M.S. Environmental Science and Policy B.A. Geography and Environmental	Planner with North Central and Eastern Connecticut Resource Conservation District	
James Featherston, Consultant	Economist	M.S. Agricultural Economics B.S. Agricultural Economics	NRCS Agricultural Economist – 36	
Carl Gustafson, Aterra Solutions	Senior Civil Engineer	B.S. Civil Engineering	NRCS State Conservation Engineer - 24 NRCS Civil Engineer - 16	P.E. in MA, ID

Dennis Johnson, Aterra Solutions	Senior Hydrologist	PhD Civil Engineering M.S. Civil Engineering B.S. Civil Engineering	Full, Associate, and Assistant Professor (Juniata College) – 20 Assistant Professor (Michigan Technological University) – 2 Research Hydrologist (NWS) – 1 Post Doc Assistant Professor (Penn State) - 1	
Petr Masopust, Aterra Solutions	Principal Water Resources Engineer	M.S. Civil & Environmental Engineering M.S. Water Technology & Environmental Engineering	Senior Water Resources Engineer/Project Manager – 5 Water Resources Engineer/Project Manager - 2 Water Resources Engineer – 3 Environmental Engineer – 2 Graduate Research Assistant – 2	P.E. in NH, MA, CT, and PA
Tim Sweeney, Aterra Solutions	Planning Specialist	B.S. Natural Resources	NRCS Water Resources Planning Specialist – 37	
Brian Toombs, Schnabel Engineering	Associate Engineer	M.S. Geotechnical Engineering B.S. Civil & Environmental Engineering B.A. English Language & Literature	Geotechnical / Dams Engineer – 7.5 Geotechnical Engineer – 1.5	P.E. in MA and NY
Paul Welle, Schnabel Engineering	Hydraulic Engineer	B.S. Agricultural Engineering	NRCS Civil Engineer – 4 NRCS Hydraulic Engineer – 26	P.E. in CT, VA, WV, NJ, PA, and KS

Jeremy Young, Schnabel Engineering	Principal/Branch Leader	M.S. and B.S. Civil Engineering	Senior Associate/Department Leader – 4 Associate/Assistant Department Leader – 4 Project/Senior Engineer – 6 Staff/Sr. Staff Engineer – 5 Engineering Technician - 1	P.E. in MA and 7 other states

DISTRIBUTION LIST

Comments were requested on the Draft Supplemental Plan – EA from the following agencies and organizations.

	Response Received on Draft Plan/EA
Federal Agencies	
Environmental Protection Agency Region 1, Boston, MA	
U.S. Army Corps of Engineers North Atlantic District, Brooklyn, NY	
U.S. Department of the Interior Fish and Wildlife Service Northeast Region 5, Hadley, MA	
Federal Emergency Management Agency Region 1, Boston, MA	
U.S. Department of Agriculture U.S. Forest Service Farm Service Agency Rural Development	
National Marine Fisheries Service Northeast Regional Office	
Massachusetts State Agencies	
State Commission for the Conservation of Soil, Water and Related Resources	
Massachusetts Department of Agricultural Resources	
Massachusetts Department of Conservation and Recreation Bureau of Forest Fire Control and Forestry	
Massachusetts Department of Conservation and Recreation Division of Water Supply Protection	
Massachusetts Department of Conservation and Recreation Division of Dam Safety	

	Response Received on Draft Plan/EA
Massachusetts Department of Fish and Game MassWildlife Connecticut Valley District Office	
Massachusetts Department of Fish and Game	
Massachusetts Water Resources Commission	
Massachusetts Department of Environmental Protection Western Regional Office – Springfield	
Massachusetts Department of Environmental Protection Headquarters Office	
MassWildlife Field Headquarters	
Massachusetts Historical Commission	
Tribal Organizations	
Mashpee Wampanoag Tribe	
Wampanoag Tribe of Gay Head (Aquinnah)	
Delaware Tribe of Indians	
Mohegan Tribe of Indians of Connecticut	
Narragansett Indian Tribe	
Stockbridge Munsee Community of Wisconsin	
Other	
City of Westfield	
Hampden Hampshire Conservation District	
Pinsly Railroad Company – Pioneer Valley Railroad	
Westfield Flood Control Commission	

	Response Received on Draft Plan/EA
Westfield Health Department Twiss Street Transfer and Recycling Station	

INDEX

(Page numbers to be filled in for Final Plan-EA)

Threatened and Endangered Species
U.S. Army Corps of Engineers
U.S. Fish and Wildlife Service
U.S. Geological Survey (USGS)
USDA
Water Quality
Watershed Protection
Wetlands
Wildlife
Works of Improvement

APPENDIX A

LETTERS OF COMMENT AND NRCS RESPONSES TO COMMENTS RECEIVED ON DRAFT SUPPLEMENTAL PLAN – EA

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(Next pages reserved for review comments and responses)

(Next pages reserved for review comments and responses)

APPENDIX B

PROJECT MAP

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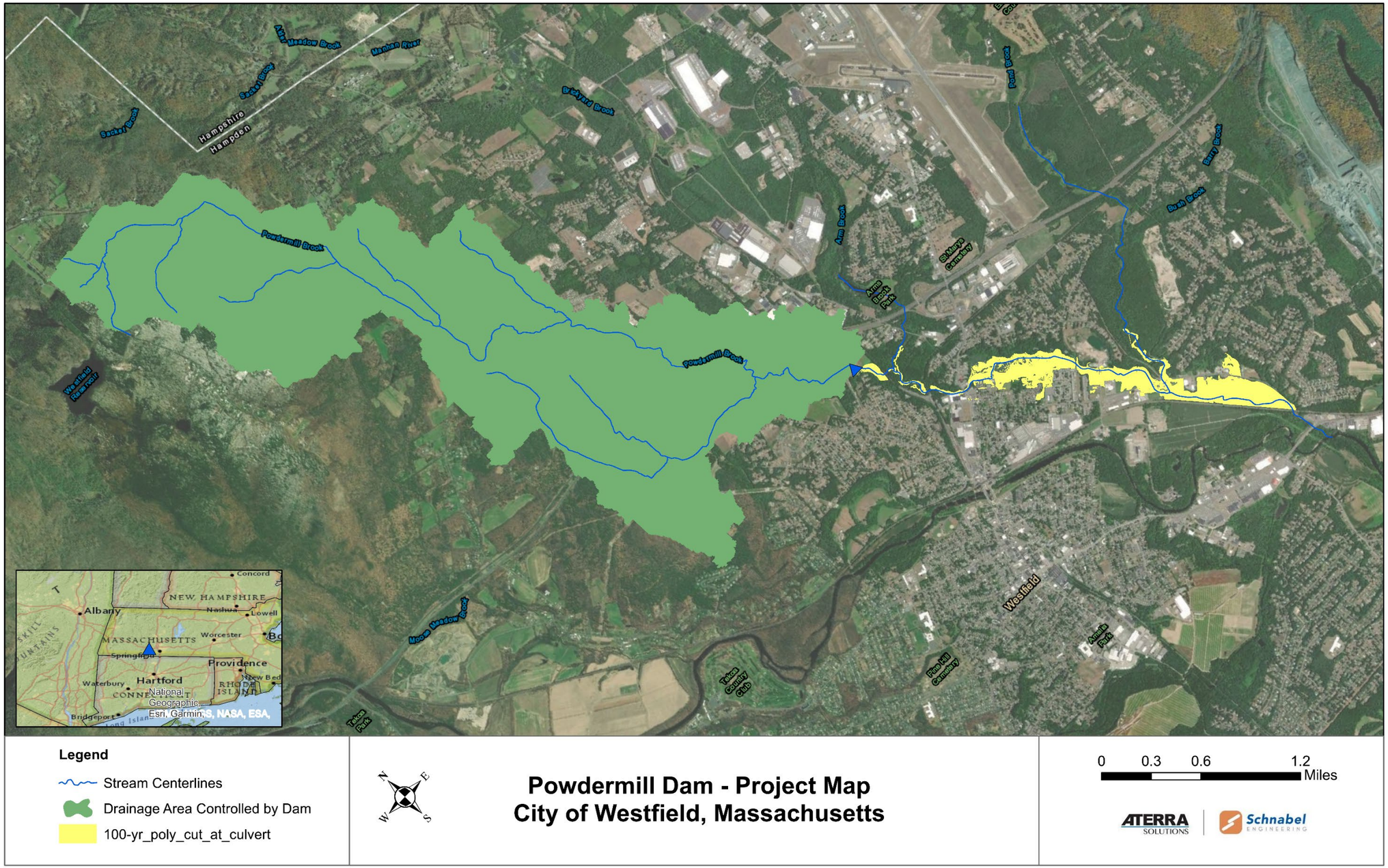

Figure B-1 - Project Map

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APPENDIX C

SUPPORT MAPS

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Figure C-1 - Limits of Disturbance Map

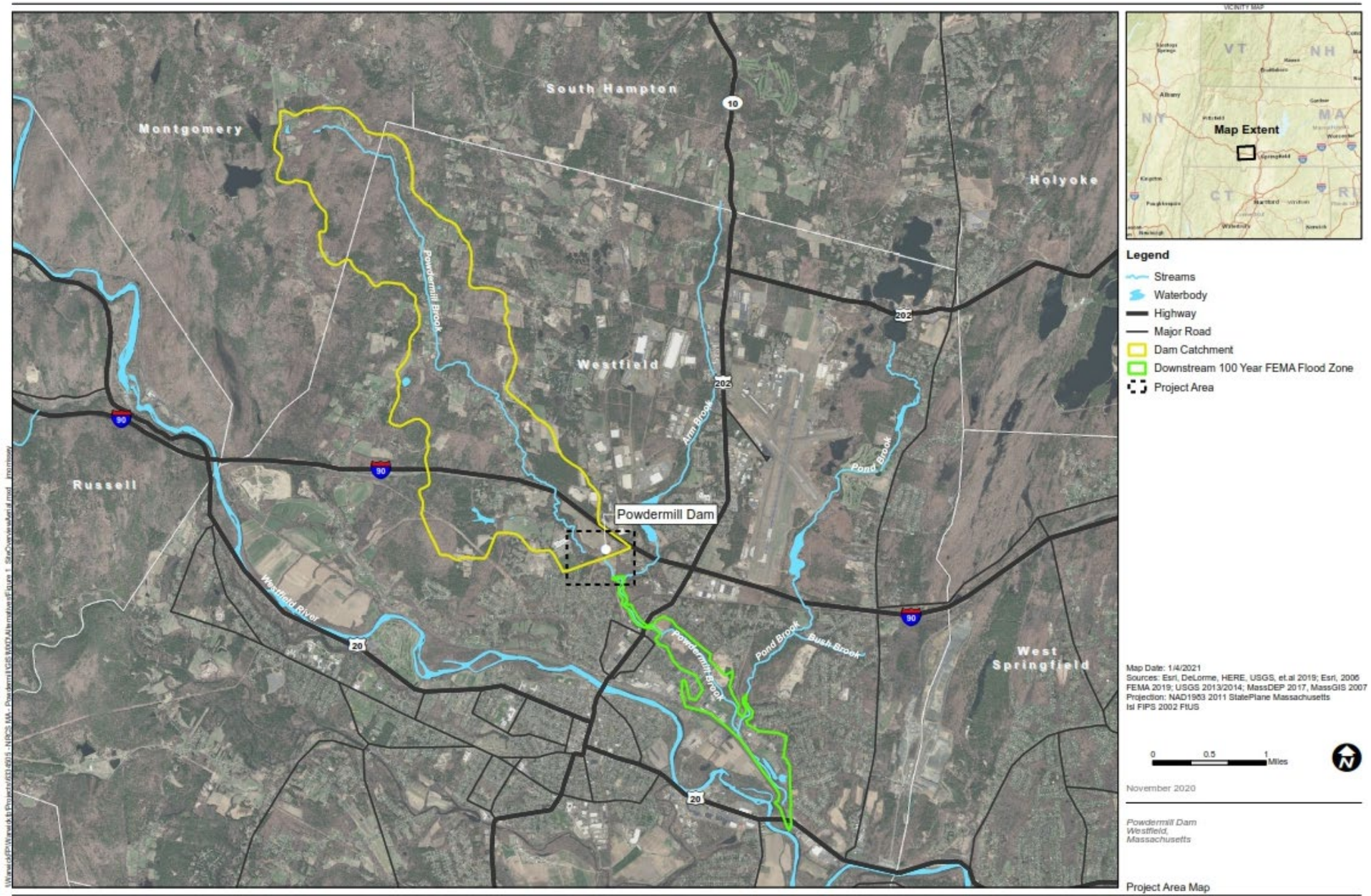


Figure C-2 - Project Area Map

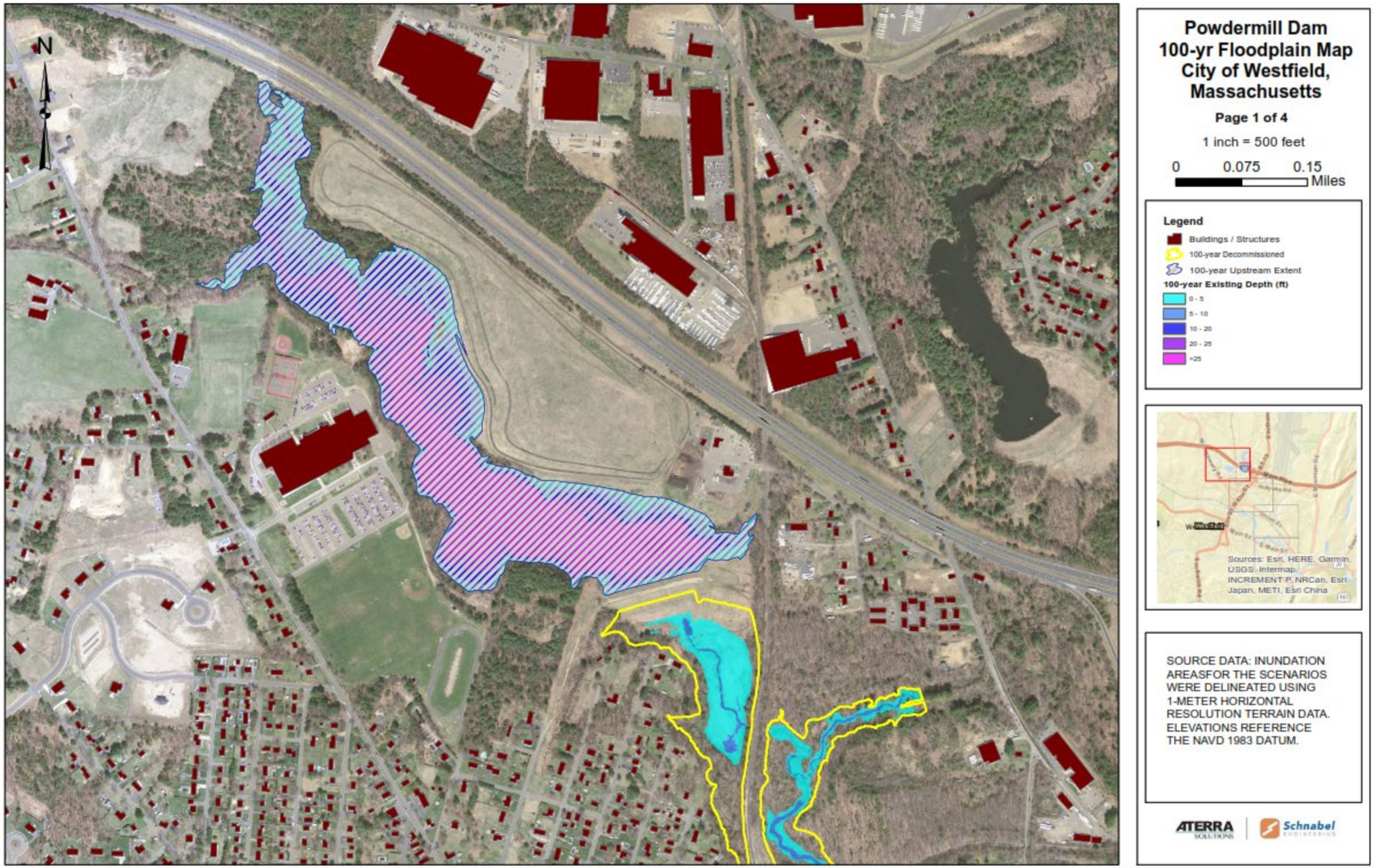


Figure C-3 - 100-Year Floodplain Map (Page 1 of 4)

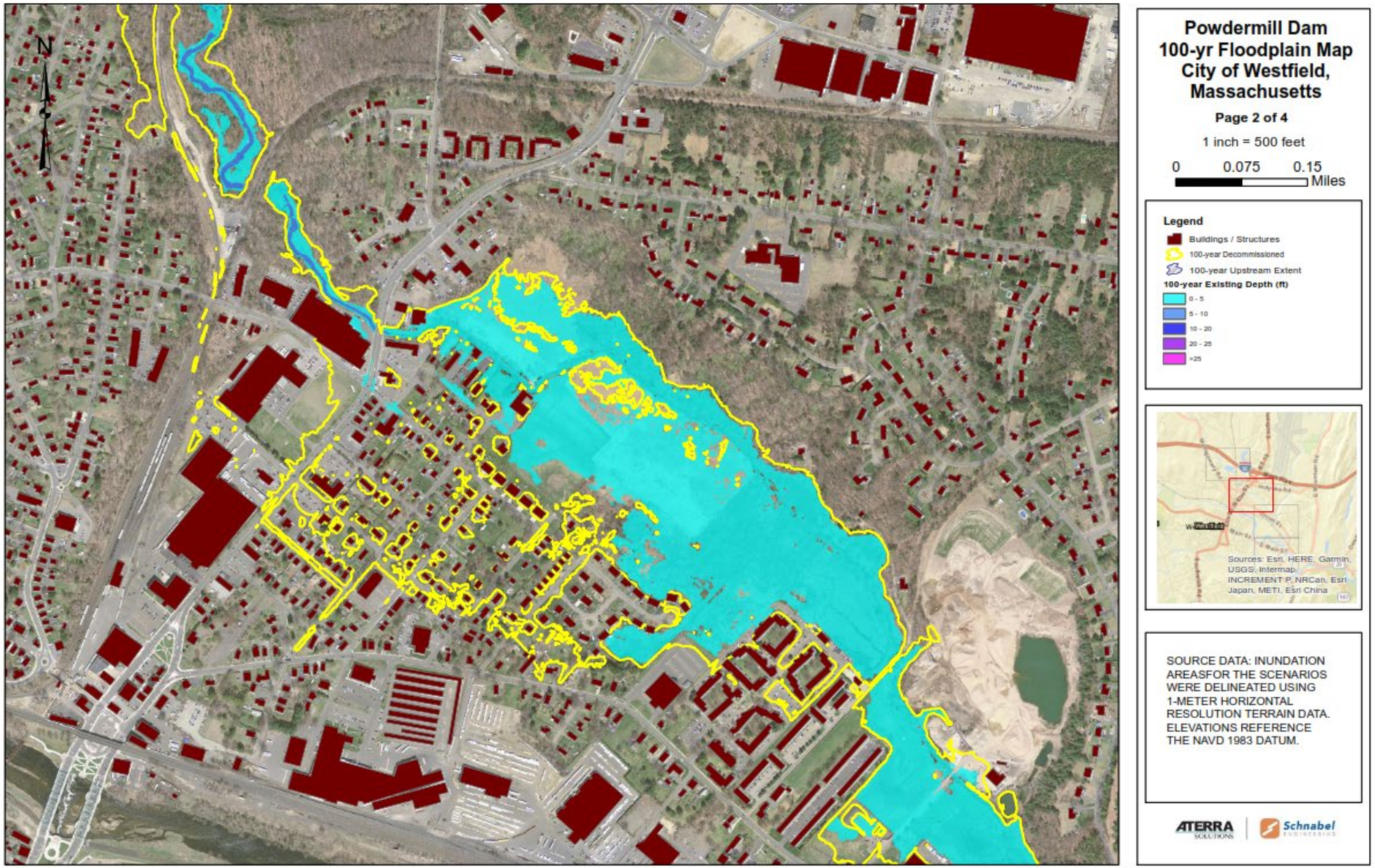


Figure C-4 - 100-Year Floodplain Map (Page 2 of 4)

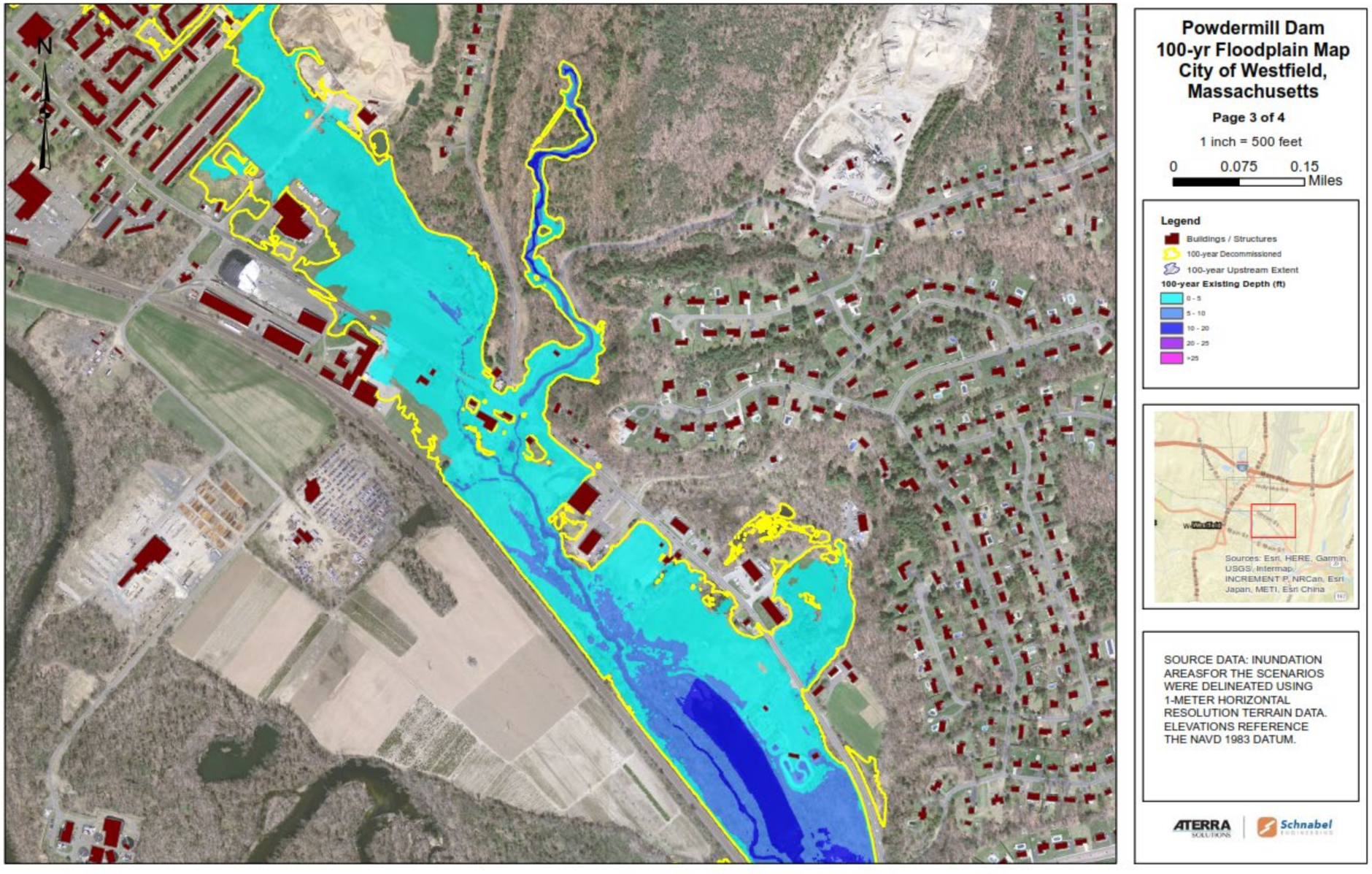


Figure C-5 - 100-Year Floodplain Map (Page 3 of 4)

Figure C-6 - 100-Year Floodplain Map (Page 4 of 4)

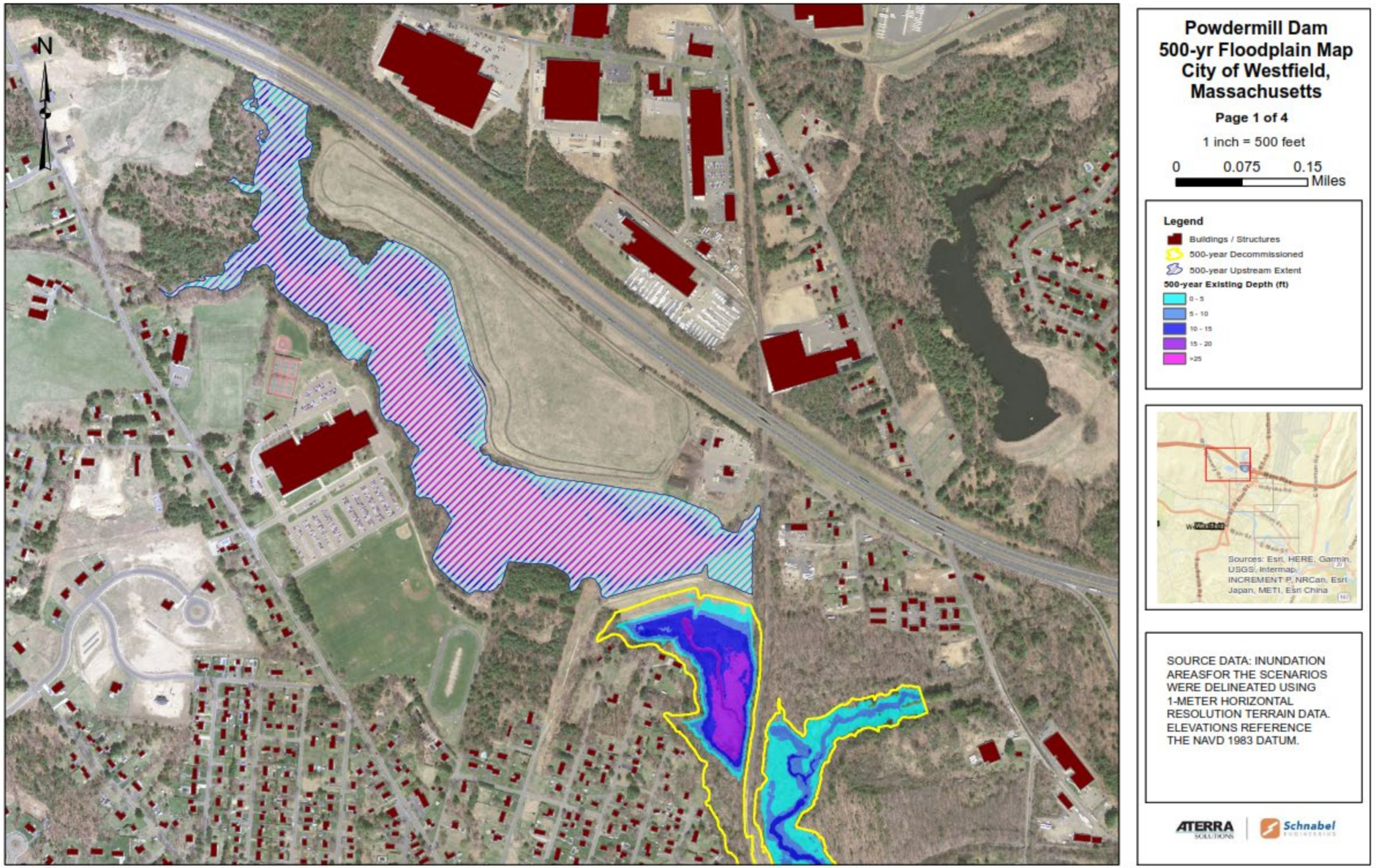


Figure C-7 - 500-Year Floodplain Map (Page 1 of 4)

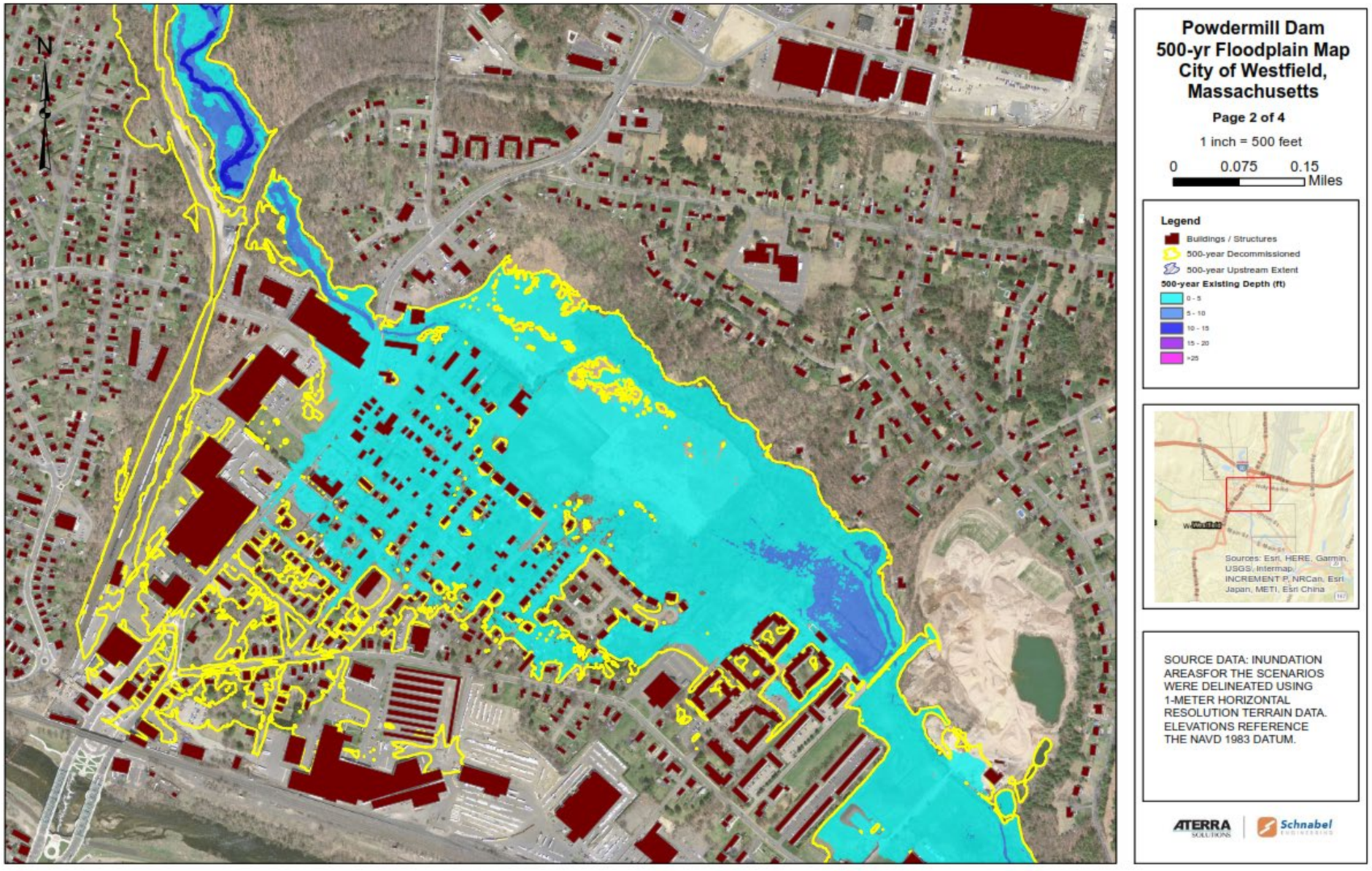


Figure C-8 - 500-Year Floodplain Map (Page 2 of 4)

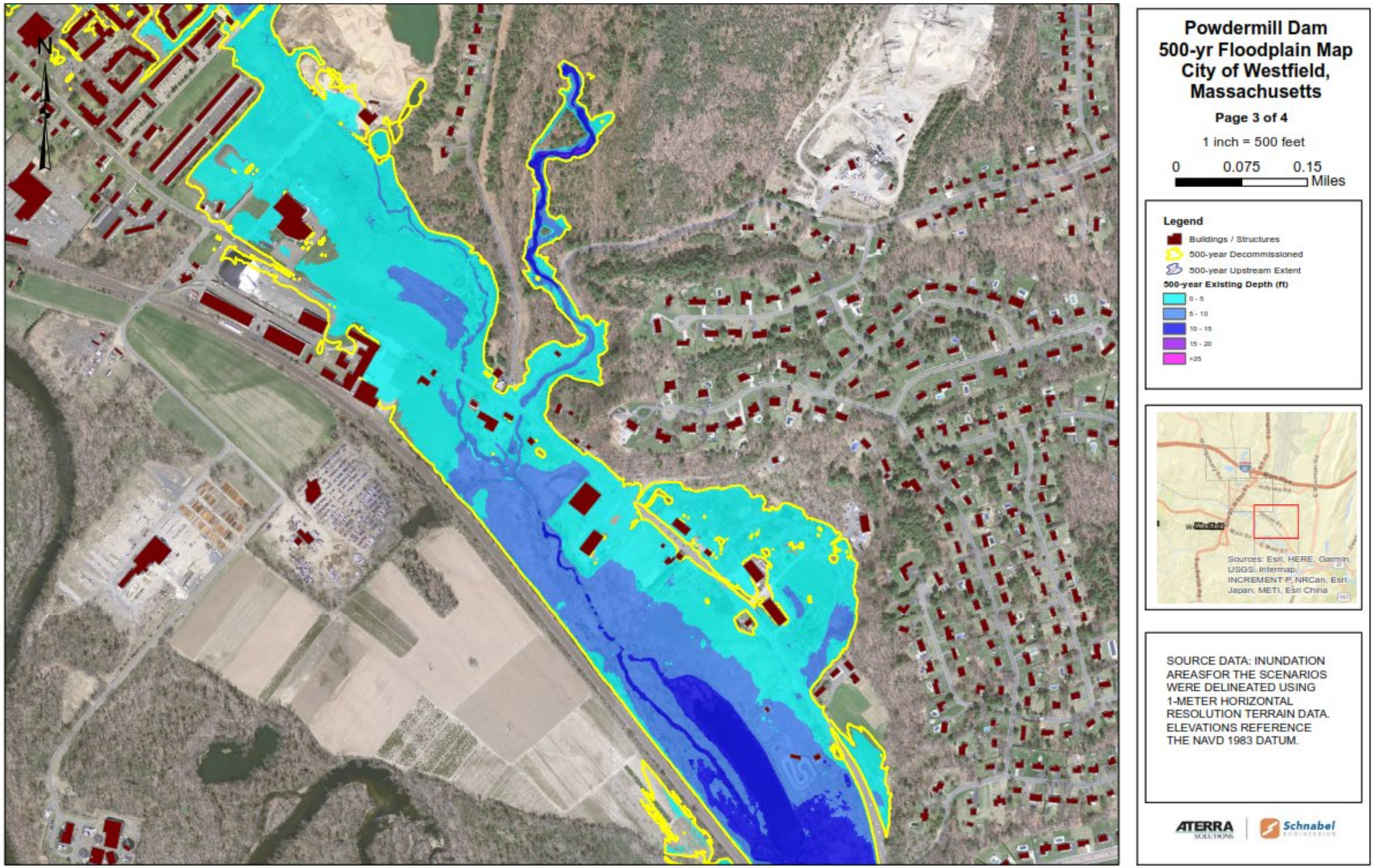


Figure C-9 - 500-Year Floodplain Map (Page 3 of 4)

Figure C-10 - 500-Year Floodplain Map (Page 4 of 4)

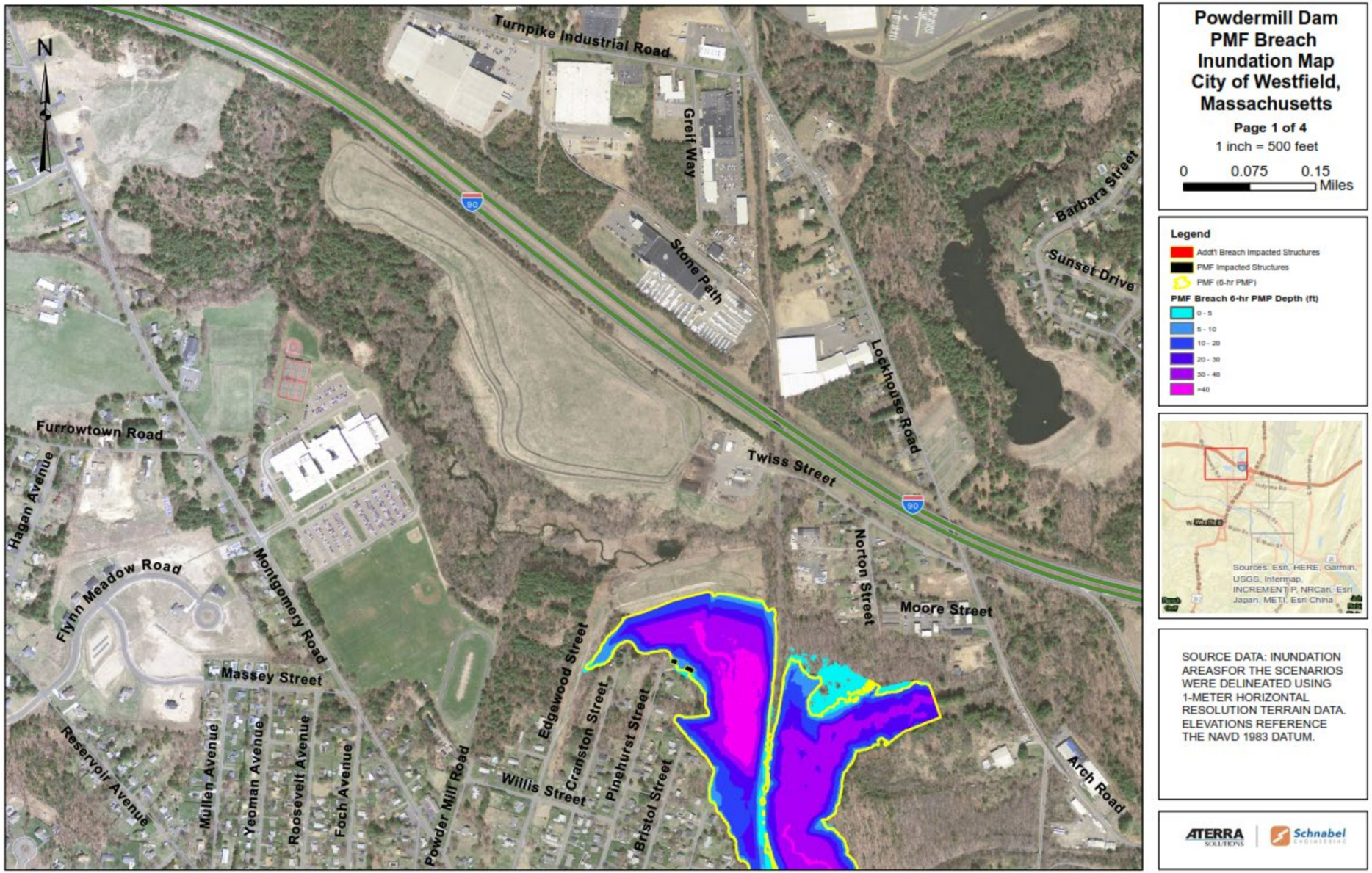
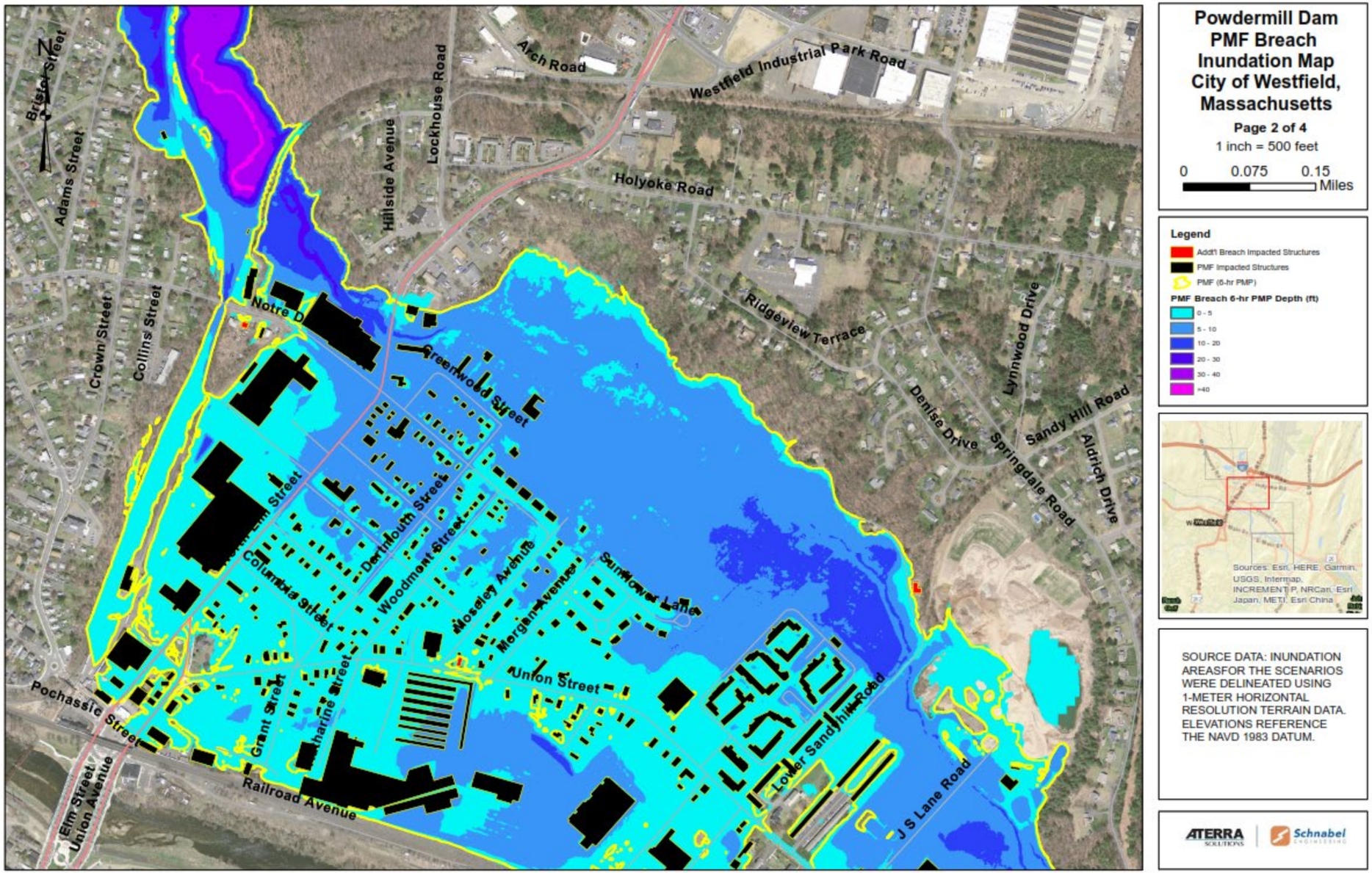


Figure C-11 - PMF Breach Inundation Map (Page 1 of 4)



Powdermill Dam
PMF Breach
Inundation Map
City of Westfield, Massachusetts

Page 2 of 4

1 inch = 500 feet

0 0.075 0.15 Miles

Legend

- Addt'l Breach Impacted Structures
- PMF Impacted Structures
- PMF (6-hr PMP)

PMF Breach 6-hr PMP Depth (ft)

- 0 - 5
- 5 - 10
- 10 - 20
- 20 - 30
- 30 - 40
- >40

SOURCE DATA: INUNDATION AREASFOR THE SCENARIOS WERE DELINEATED USING 1-METER HORIZONTAL RESOLUTION TERRAIN DATA. ELEVATIONS REFERENCE THE NAVD 1983 DATUM.

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Figure C-12 - PMF Breach Inundation Map (Page 2 of 4)

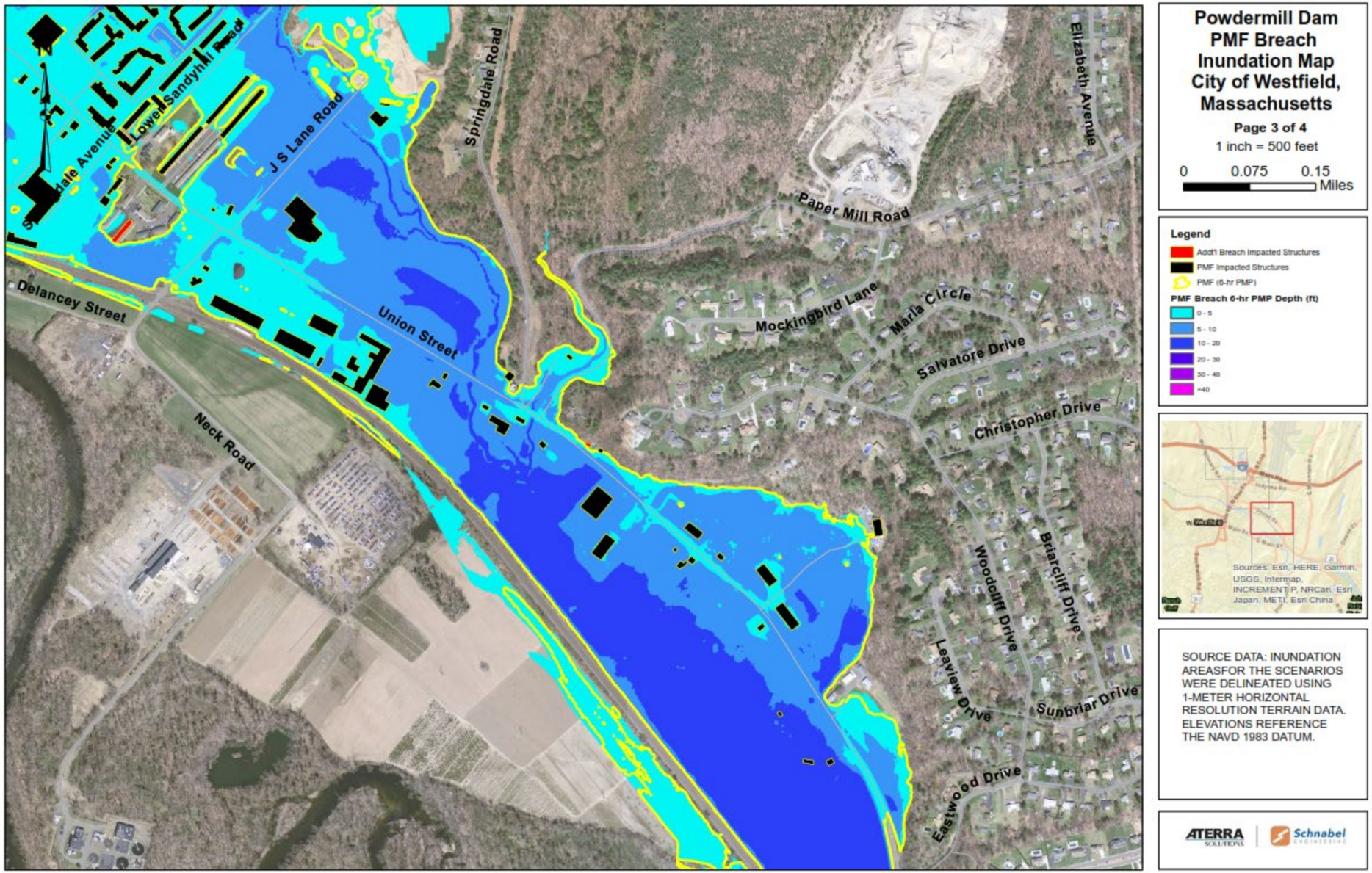


Figure C-13 - PMF Breach Inundation Map (Page 3 of 4)

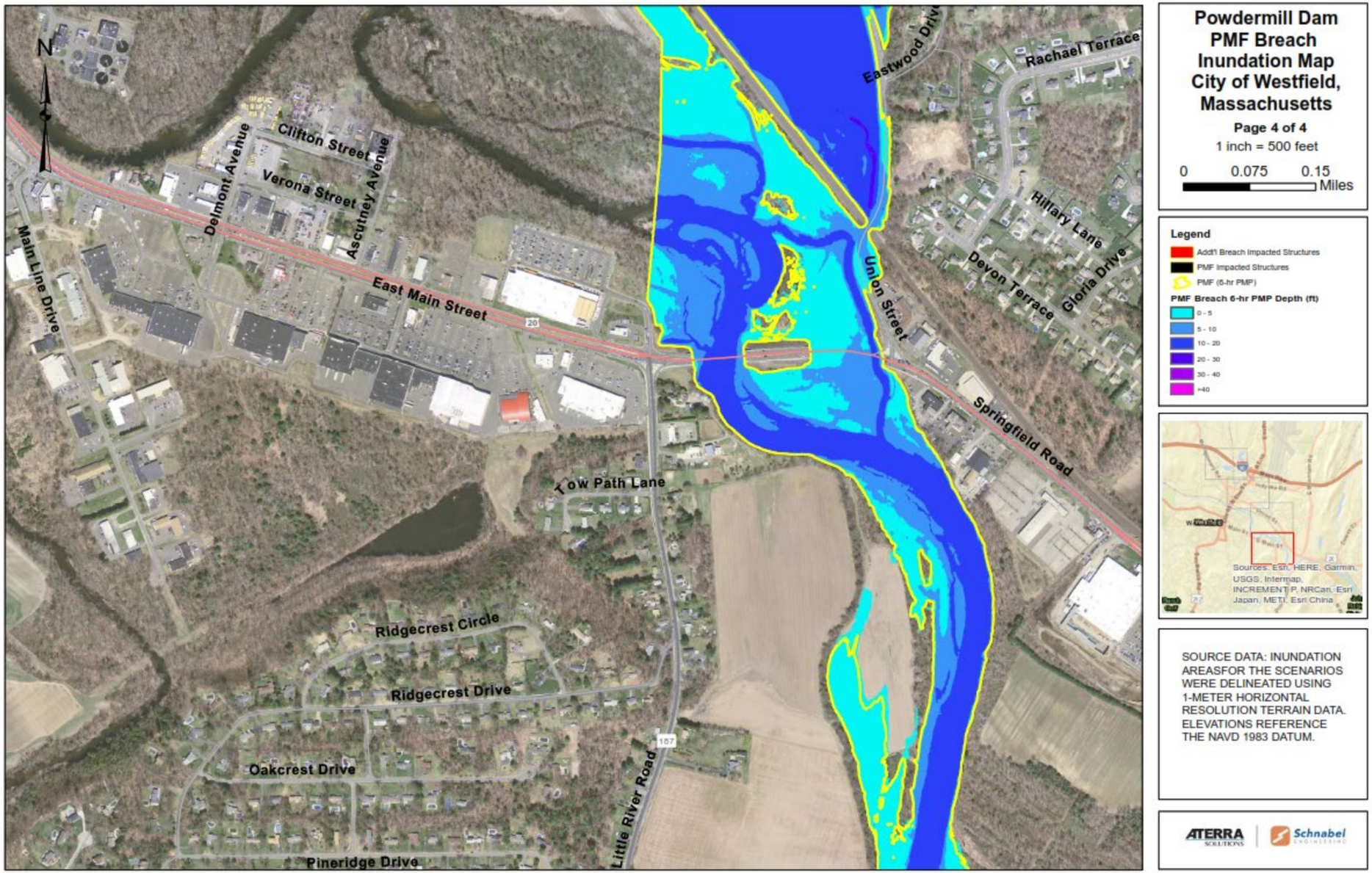


Figure C-14 - PMF Breach Inundation Map (Page 4 of 4)

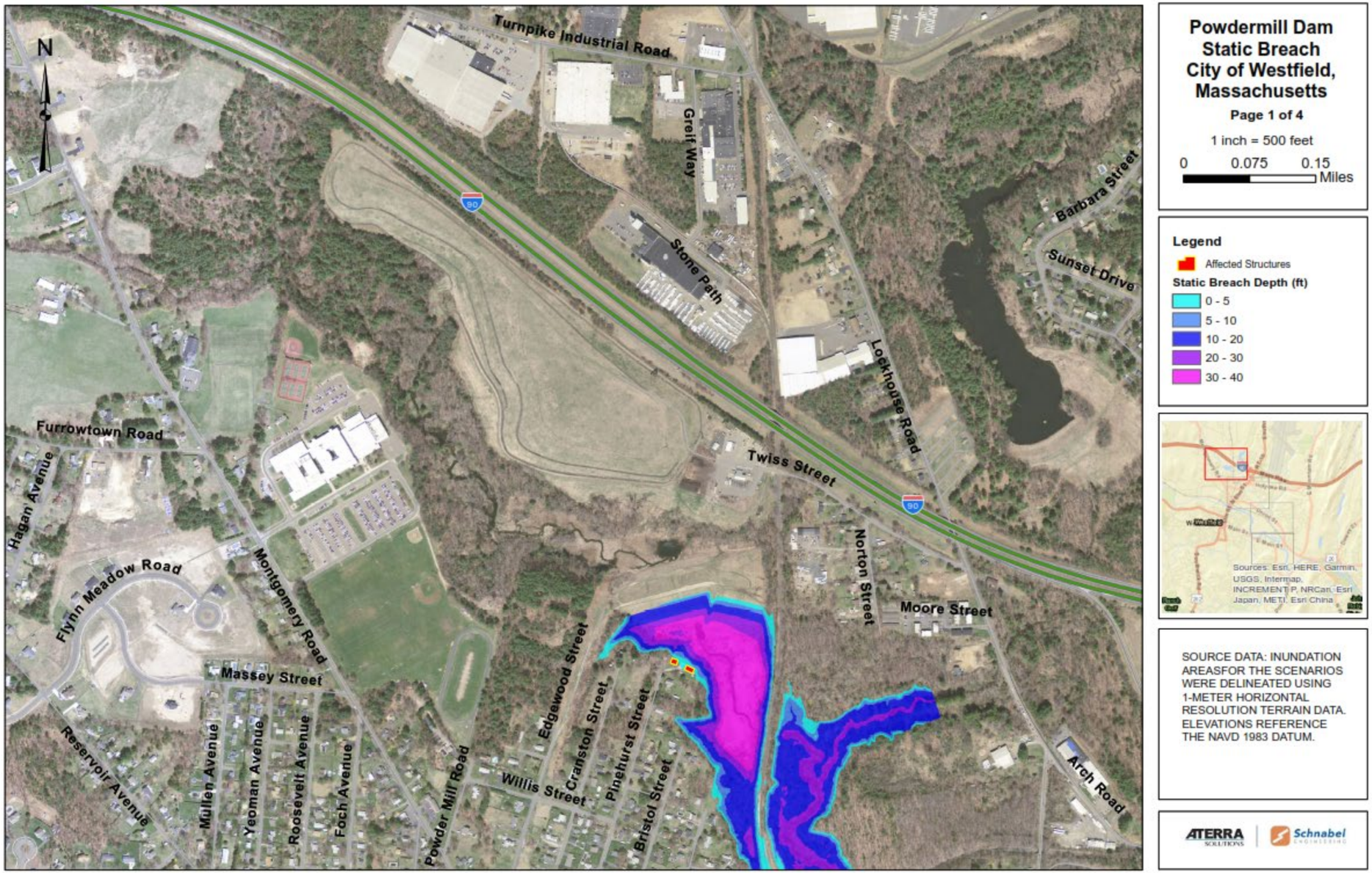


Figure C-15 - Static Breach Inundation Map (Page 1 of 4)

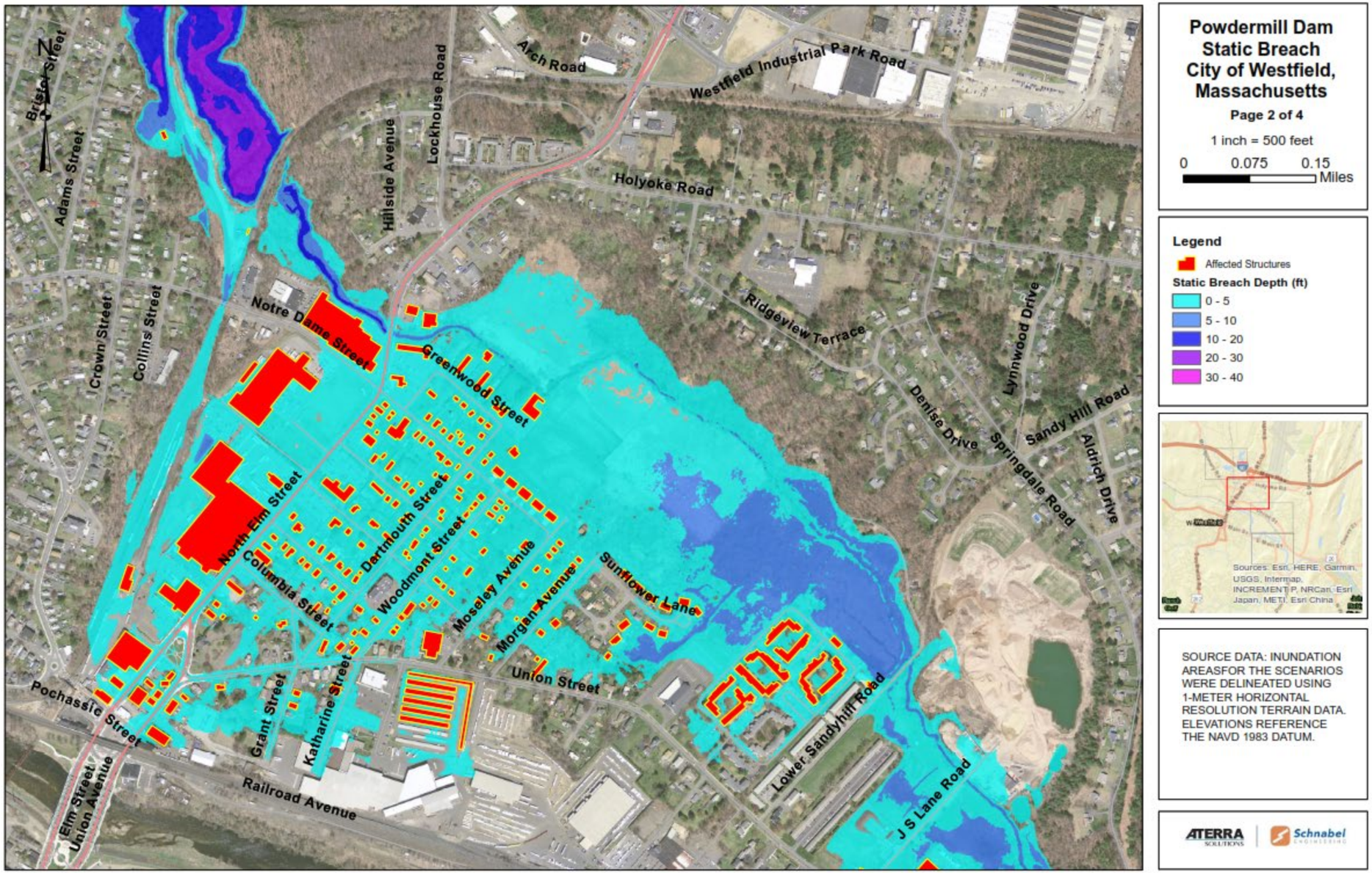


Figure C-16 - Static Breach Inundation Map (Page 2 of 4)

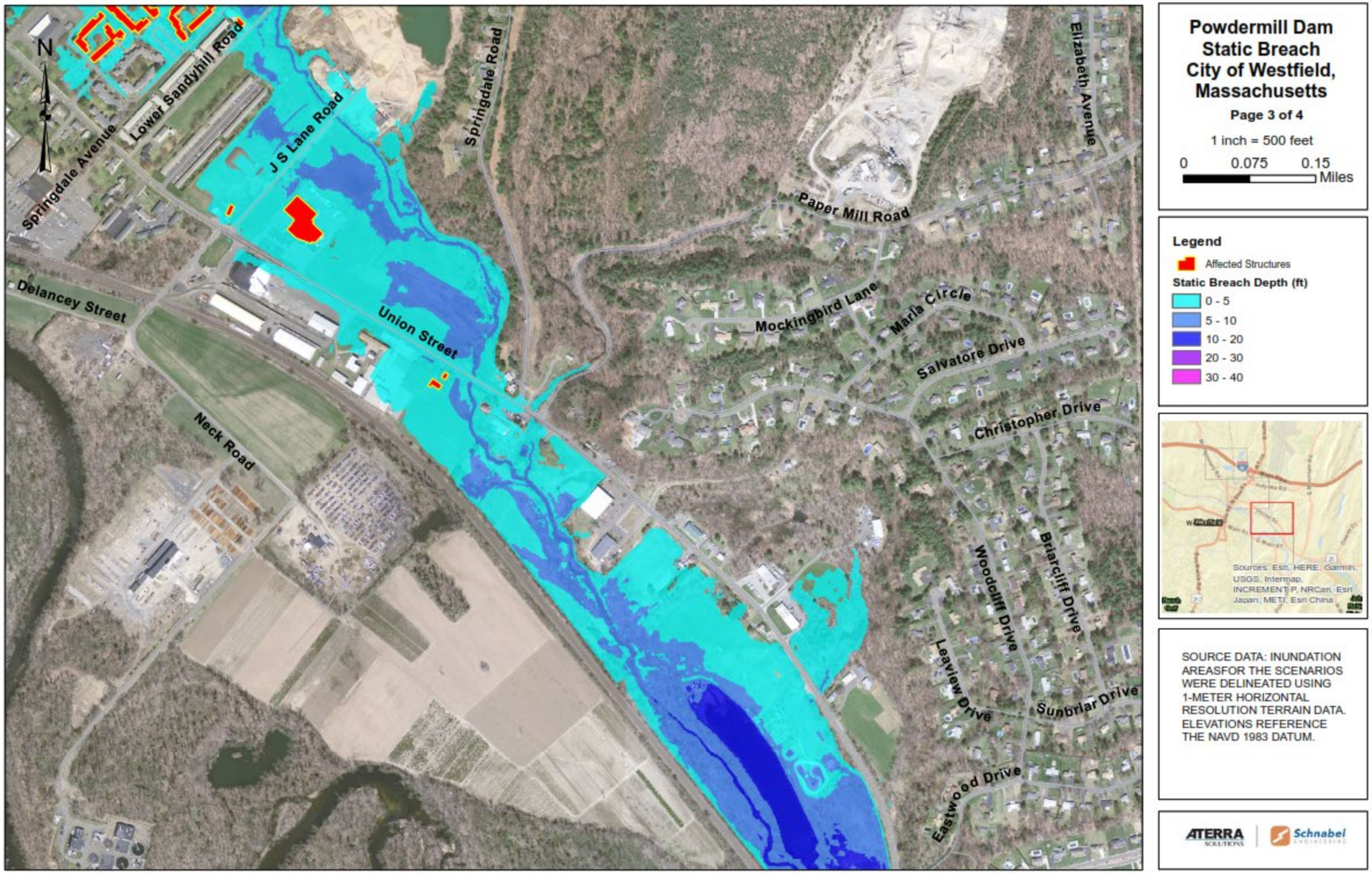


Figure C-17 - Static Breach Inundation Map (Page 3 of 4)

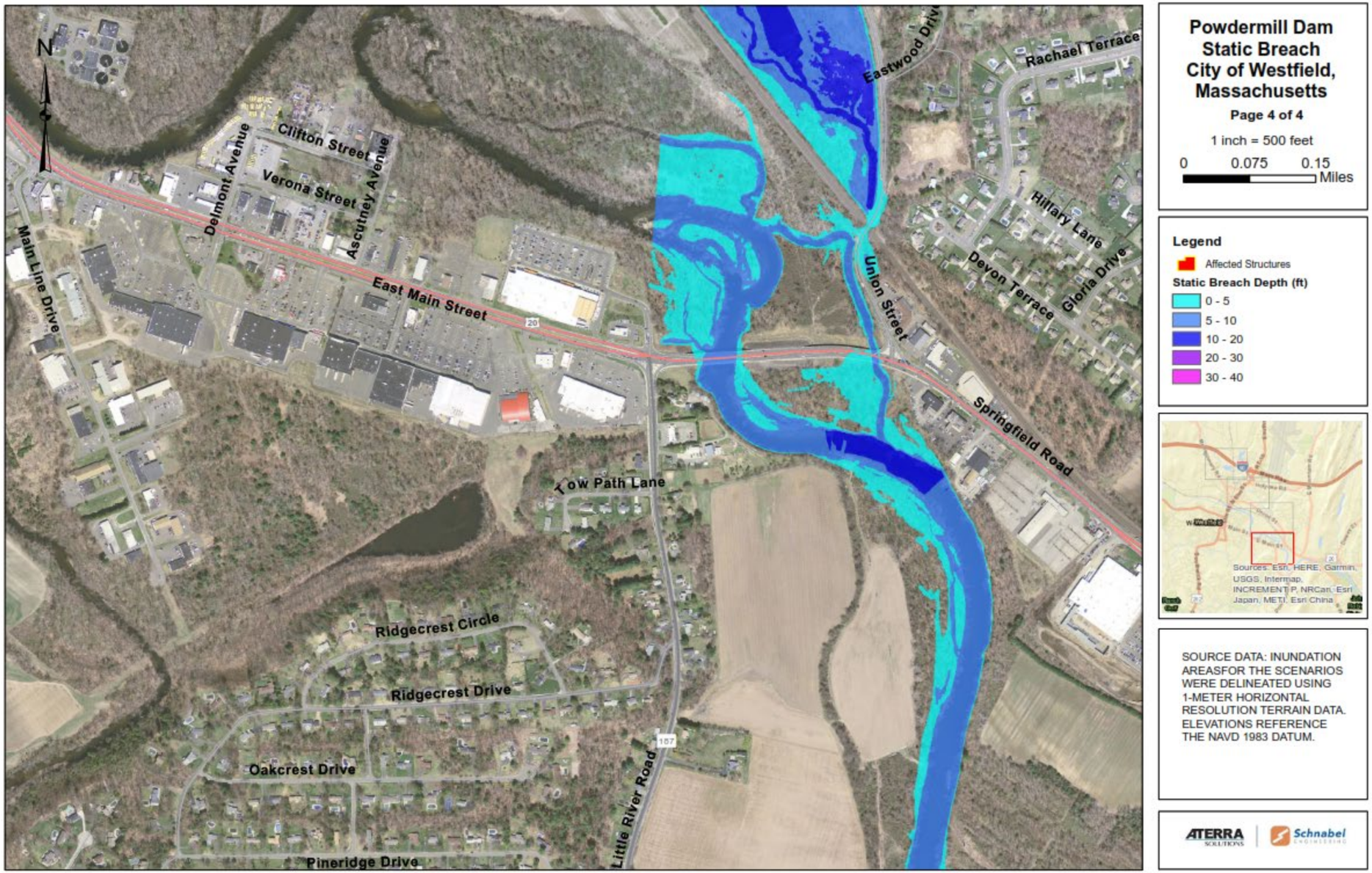


Figure C-18 - Static Breach Inundation Map (Page 4 of 4)

Figure C-19 – Aerial View of Alternative 1

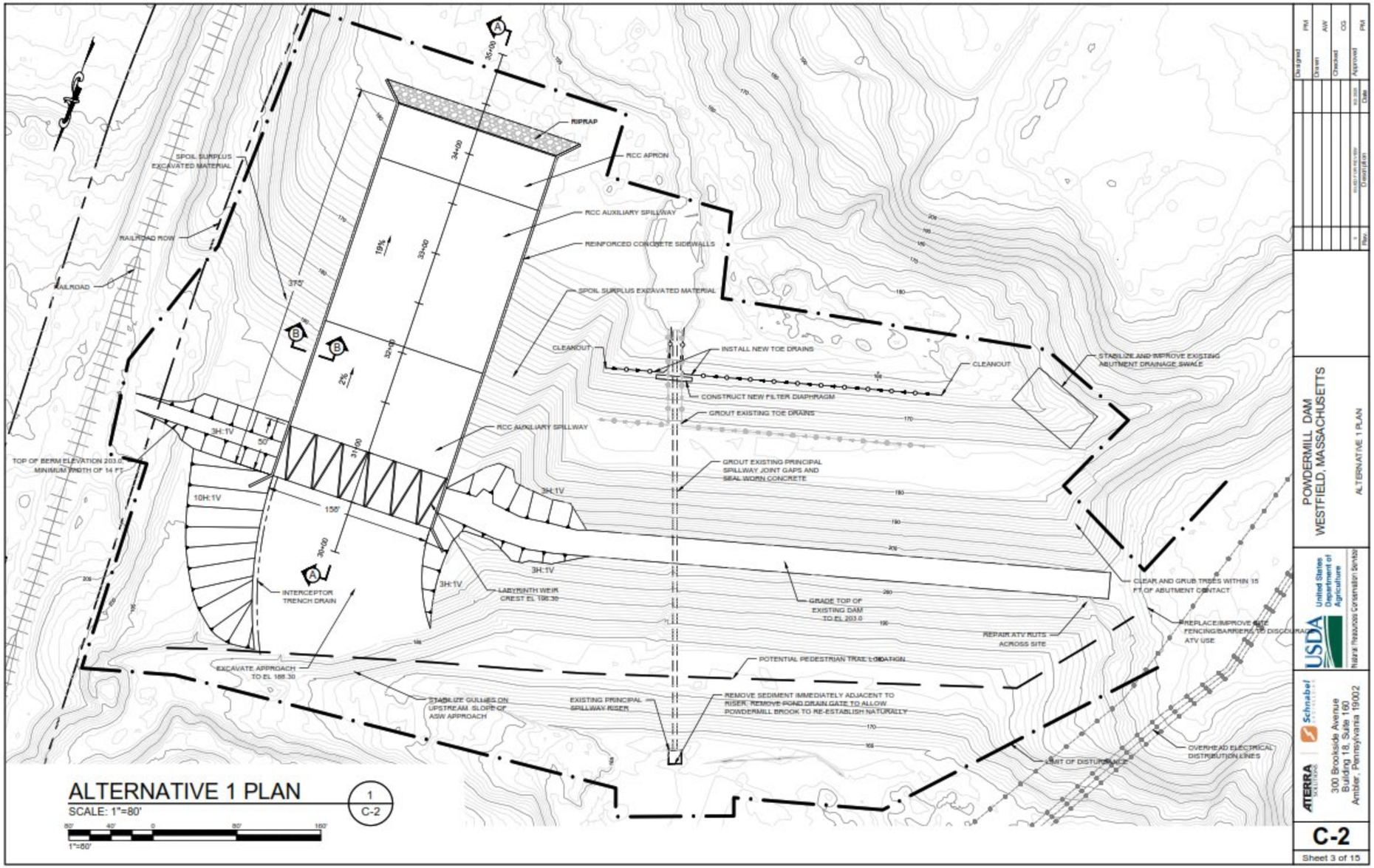
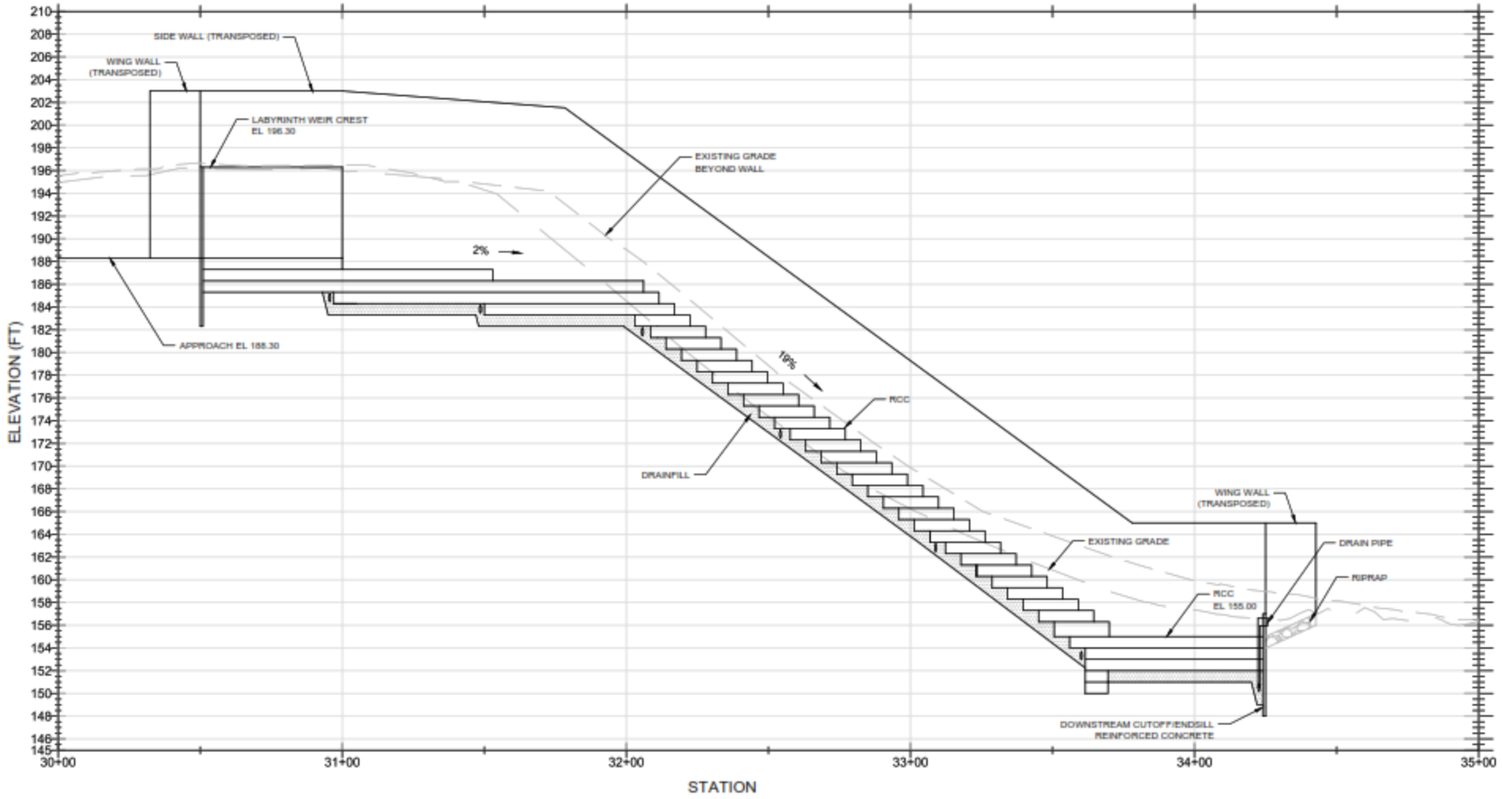


Figure C-20 - Plan View of Alternative 1



ALTERNATIVE 1 PROFILE A-A (1 / C-3)
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VERTICAL SCALE: 1"=10'

1"=40'

1"=10'

Designed PM
Drawn AW
Checked CG
Approved PM
Rev. | Description | Date

POWDERMILL DAM
WESTFIELD, MASSACHUSETTS
ALTERNATIVE 1 PROFILE

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Natural Resources Conservation Service

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Building 18, Suite 160
Ambler, Pennsylvania 19002

C-3
Sheet 4 of 15

Figure C-21 - Profile View of Alternative 1

Figure C-22 - Aerial View of Alternative 2

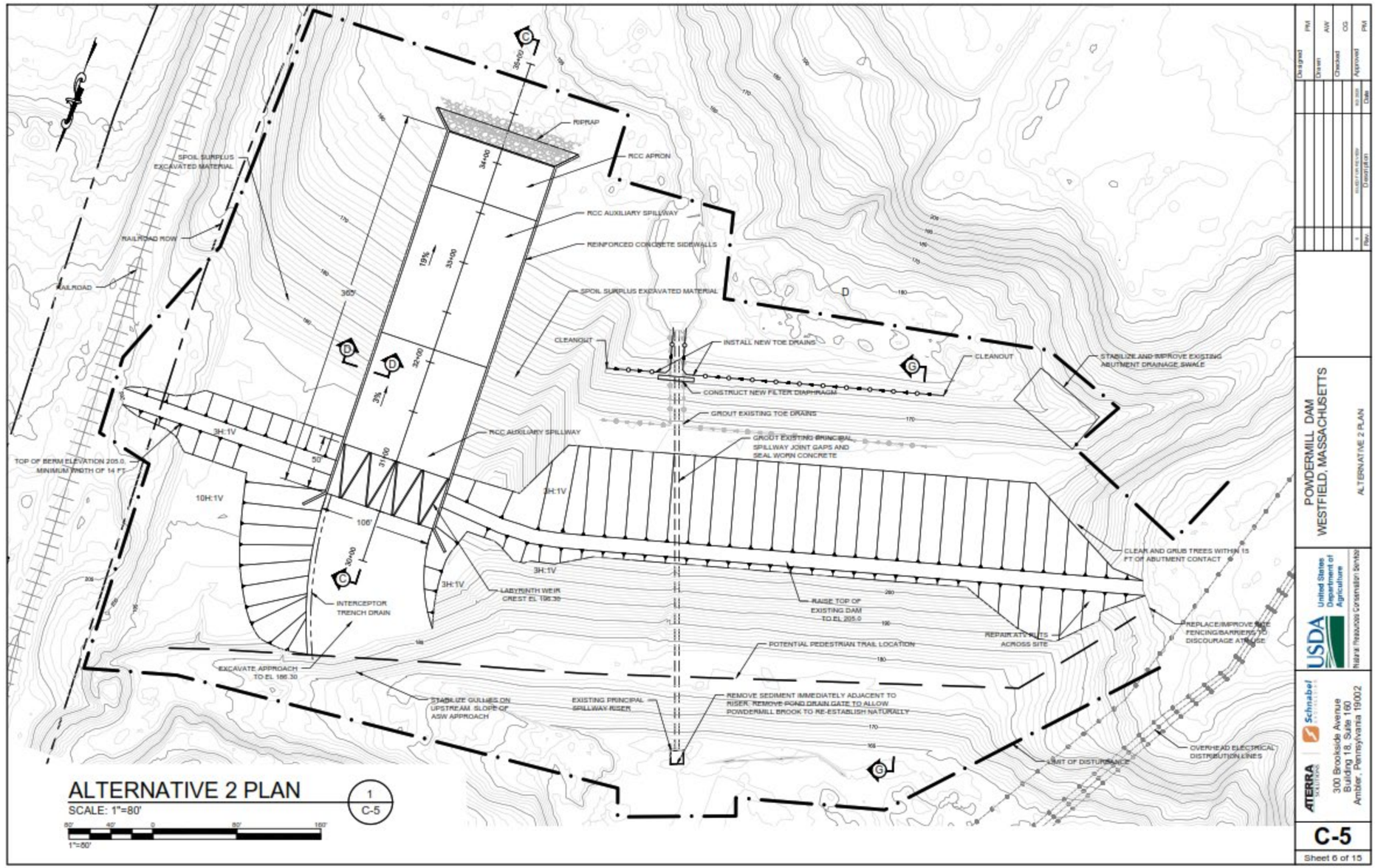


Figure C-23 - Plan View of Alternative 2

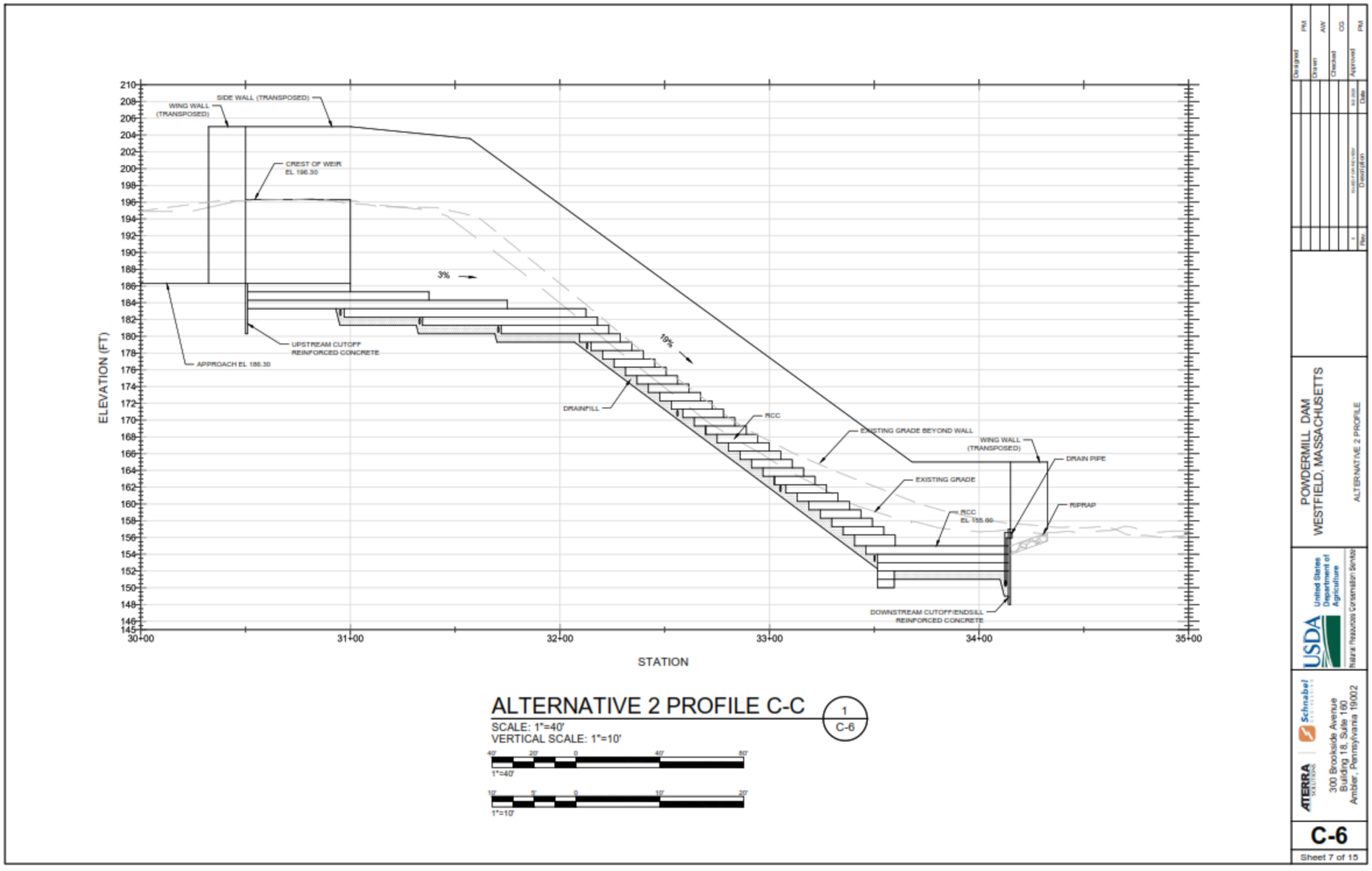


Figure C-24 - Profile View of Alternative 2

Figure C-25 - Aerial View of Alternative 3

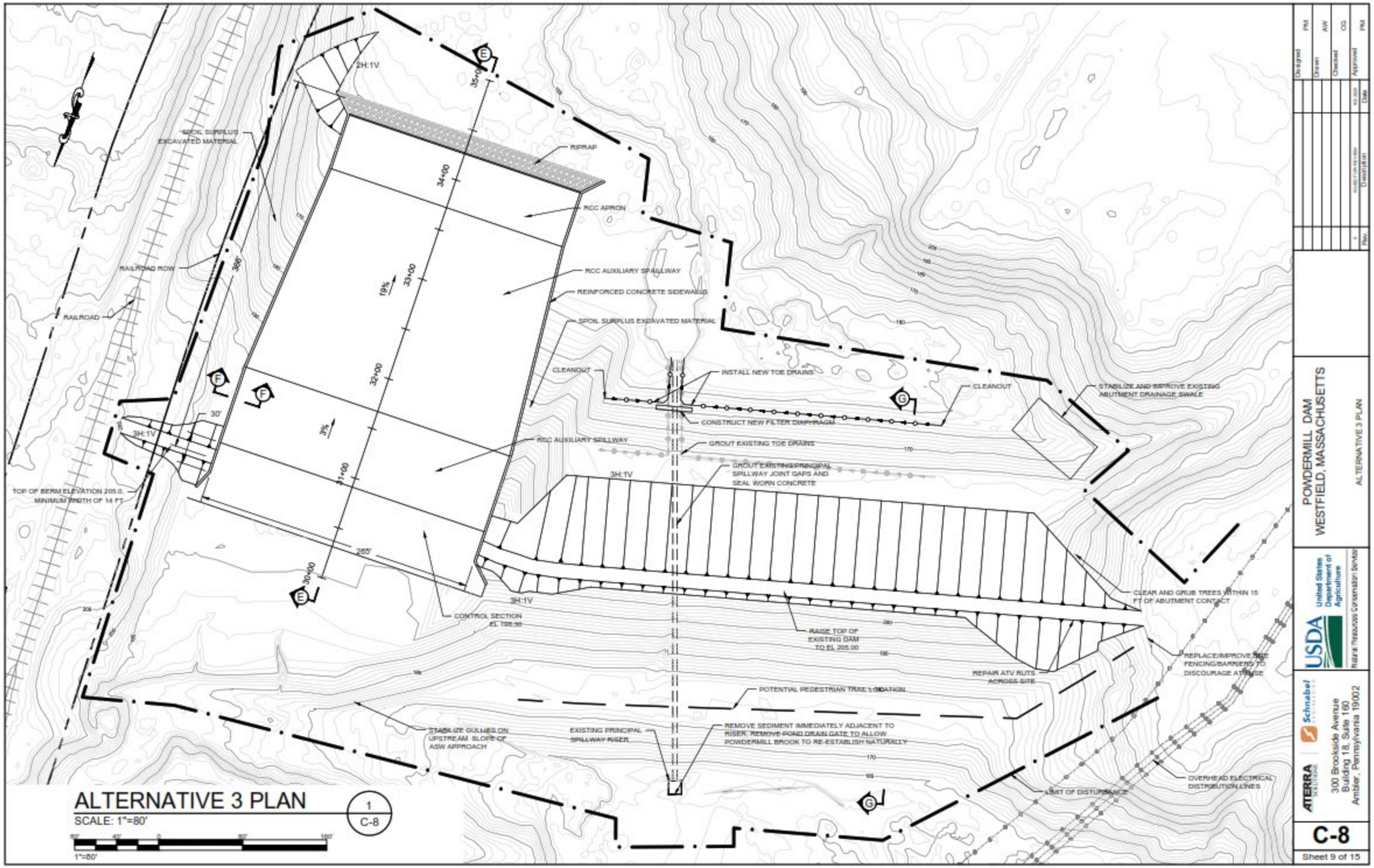
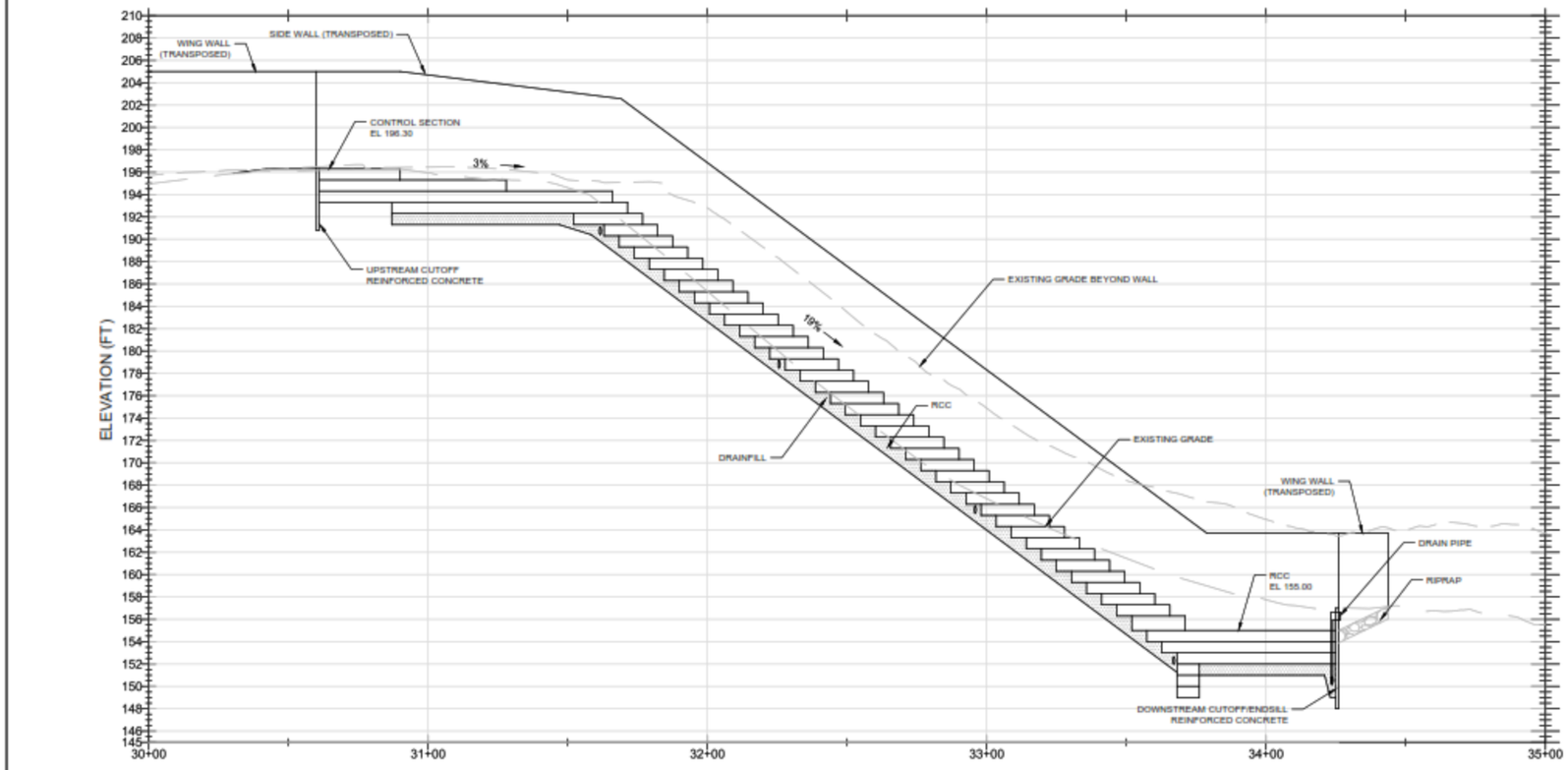


Figure C-26 - Plan View of Alternative 3



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1"=40'

1"=10'

Designed PM
Drawn AW
Checked CG
Approved PM
Rev. Description Date

POWDERMILL DAM
WESTFIELD, MASSACHUSETTS

ALTERNATIVE 3 PROFILE

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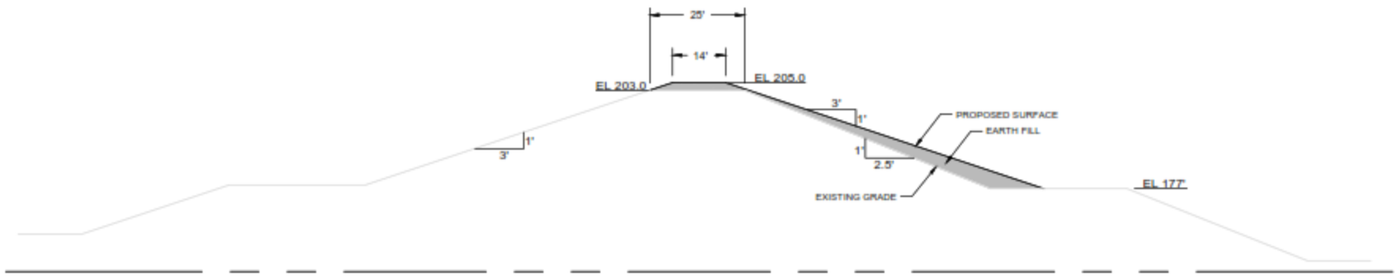
C-9

Sheet 10 of 15

Figure C-27 - Profile View of Alternative 3



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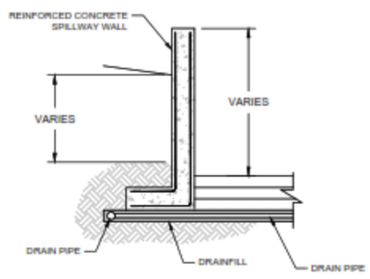

SECTION B-B
SECTION D-D
SECTION F-F (2 / C-10)
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Designed PM
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Checked CG
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Rev. | Description | Date

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WESTFIELD, MASSACHUSETTS
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C-10
Sheet 11 of 15

Figure C-28 – Details for Dam Raise and Training Wall

Figure C-29 - Aerial View of FWOFI Alternative

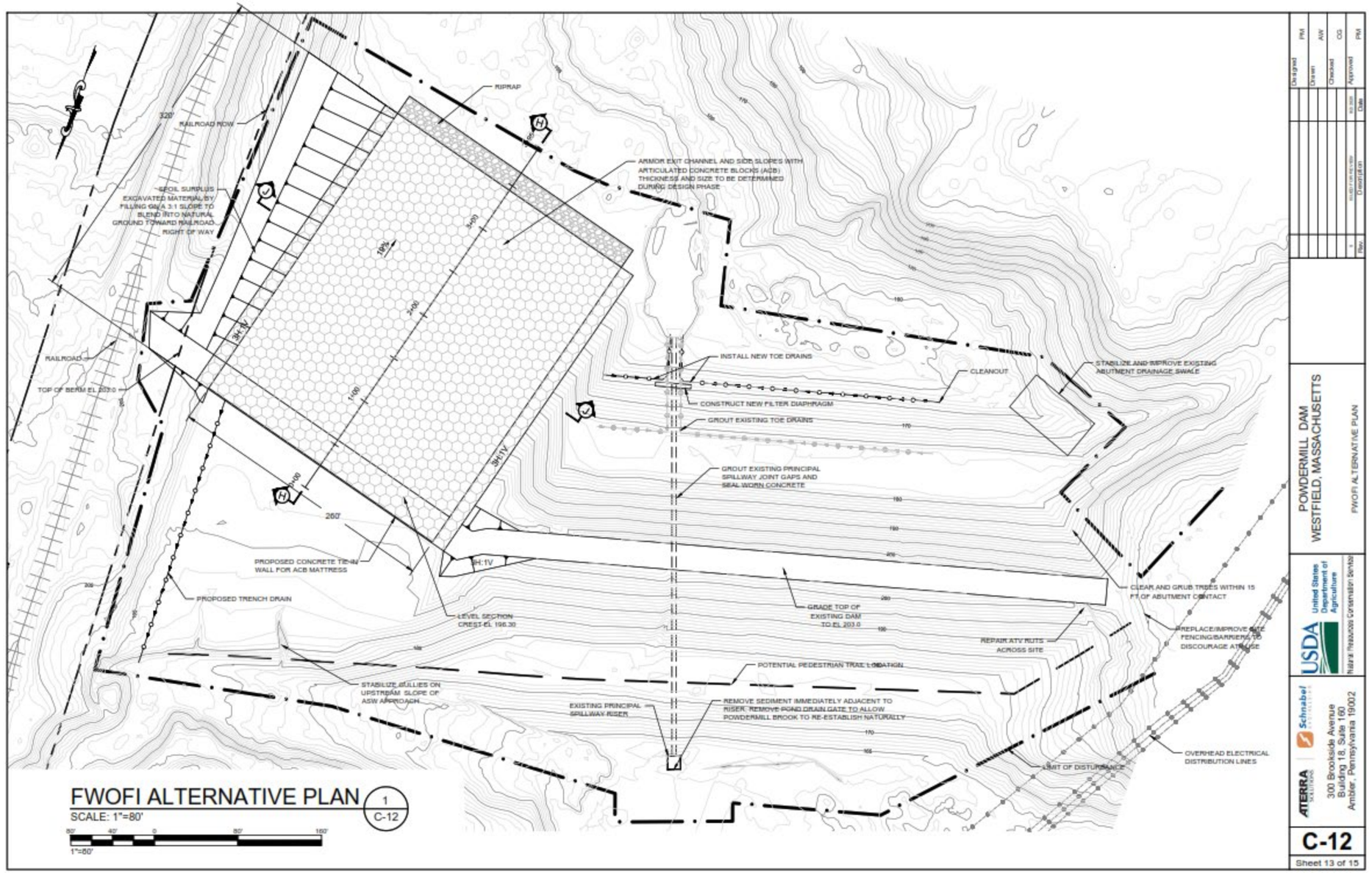
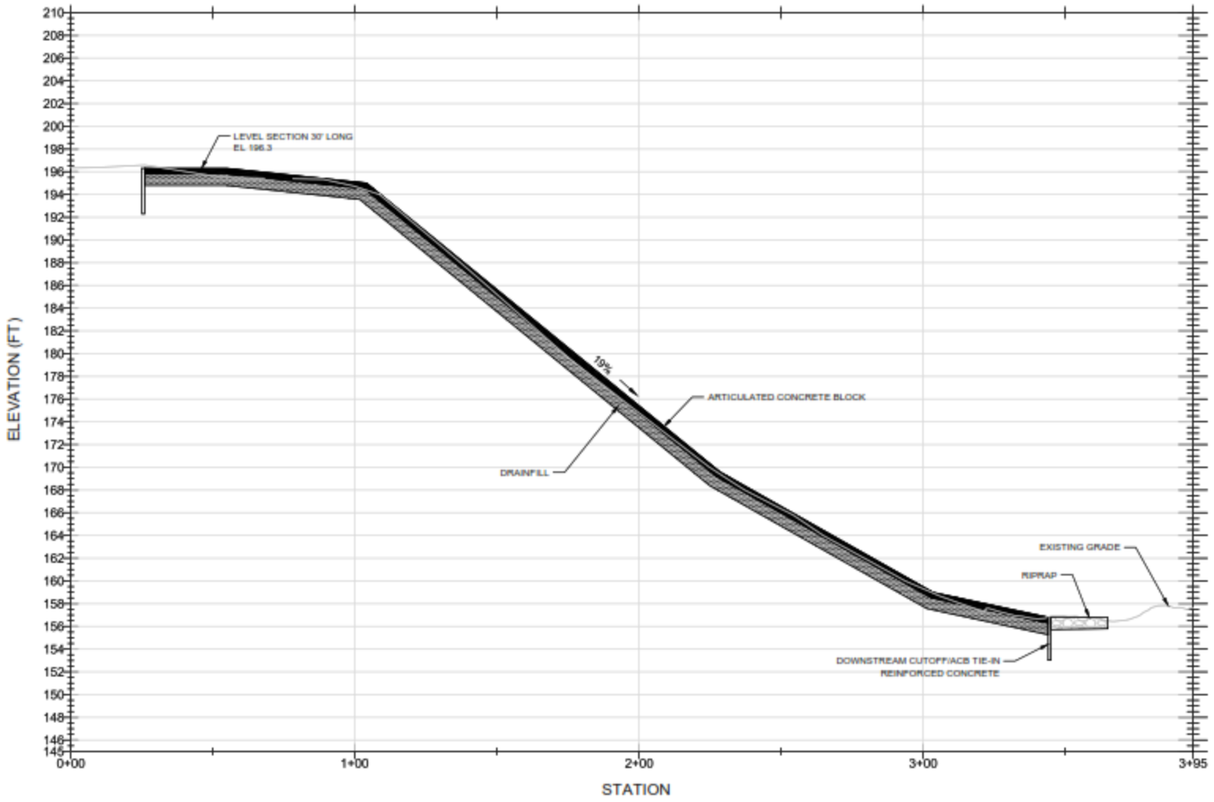


Figure C-30 – Plan View of FWOFI Alternative



FWOFI ALTERNATIVE PROFILE H-H (1 / C-13)
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1"=10'

Designed PM
Drawn AW
Checked CG
Approved PM
No. Revision/Description Date

POWDERMILL DAM
WESTFIELD, MASSACHUSETTS
FWOFI ALTERNATIVE PROFILE

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Natural Resources Conservation Service

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Ambler, Pennsylvania 19002

C-13
Sheet 14 of 15

Figure C-31 - Profile View of FWOFI Alternative

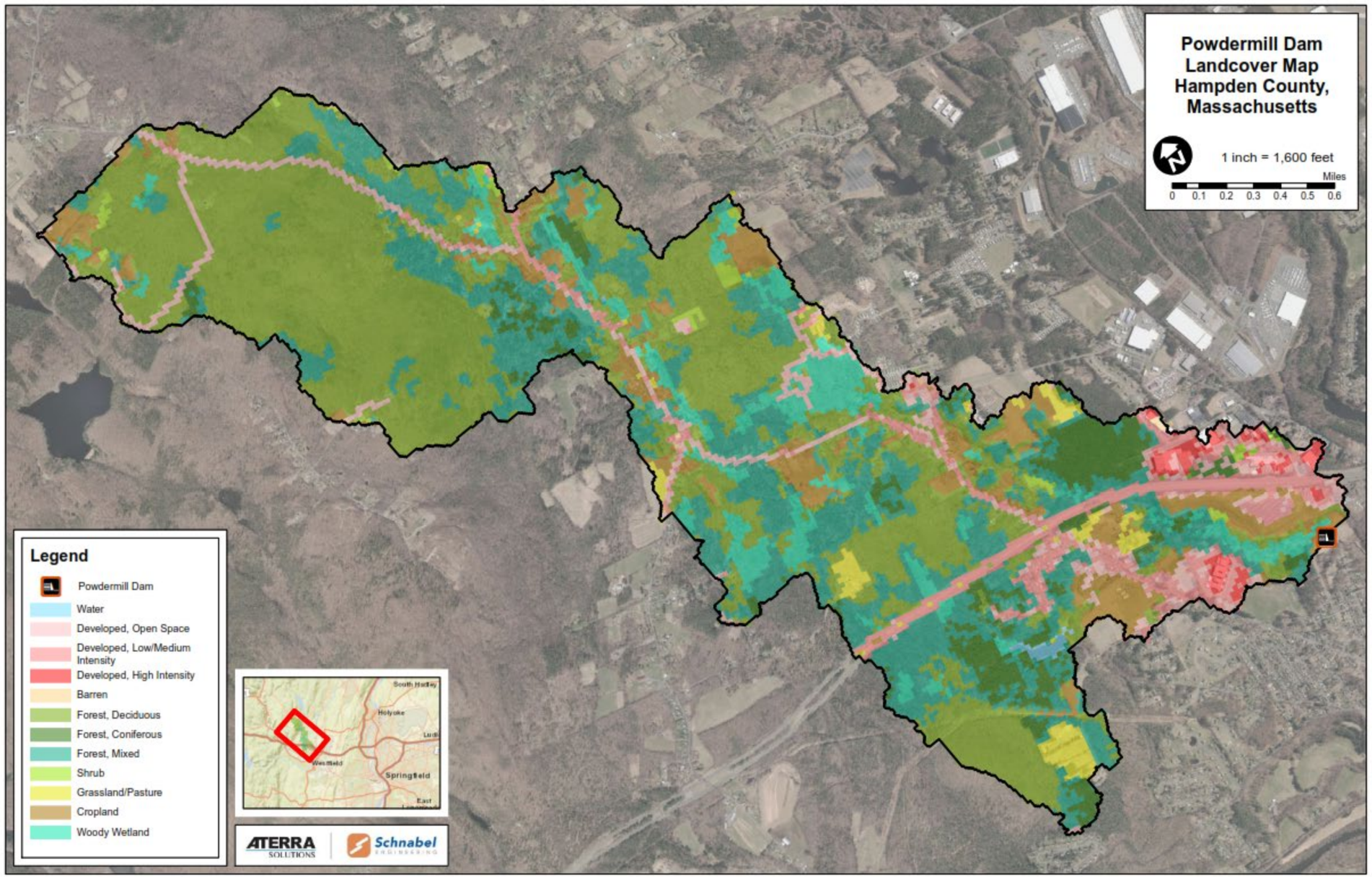

Figure C-32 – Land Cover in Powdermill Reservoir Contributing Area

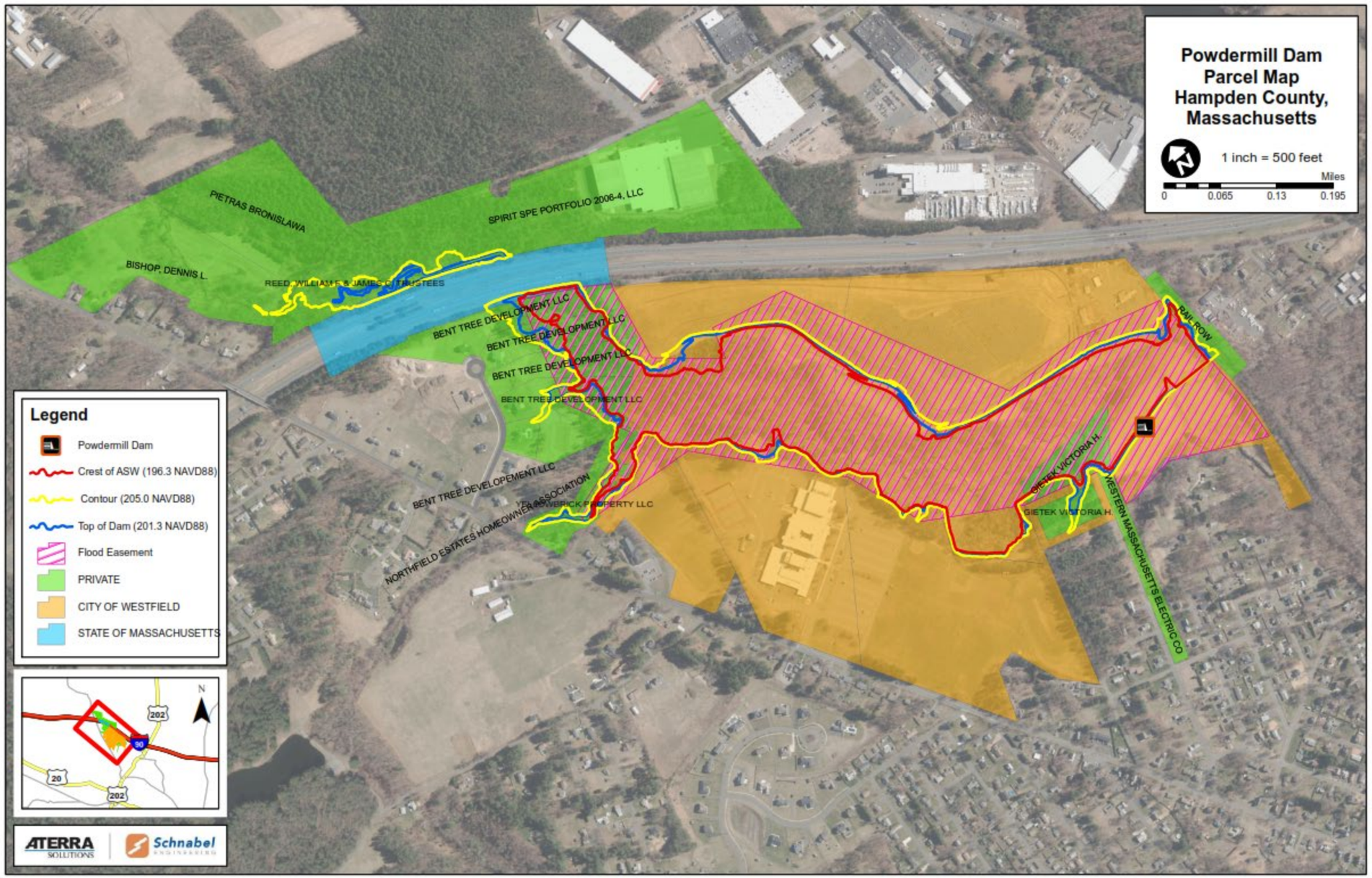

Figure C-33 – Parcels and Landrights Map

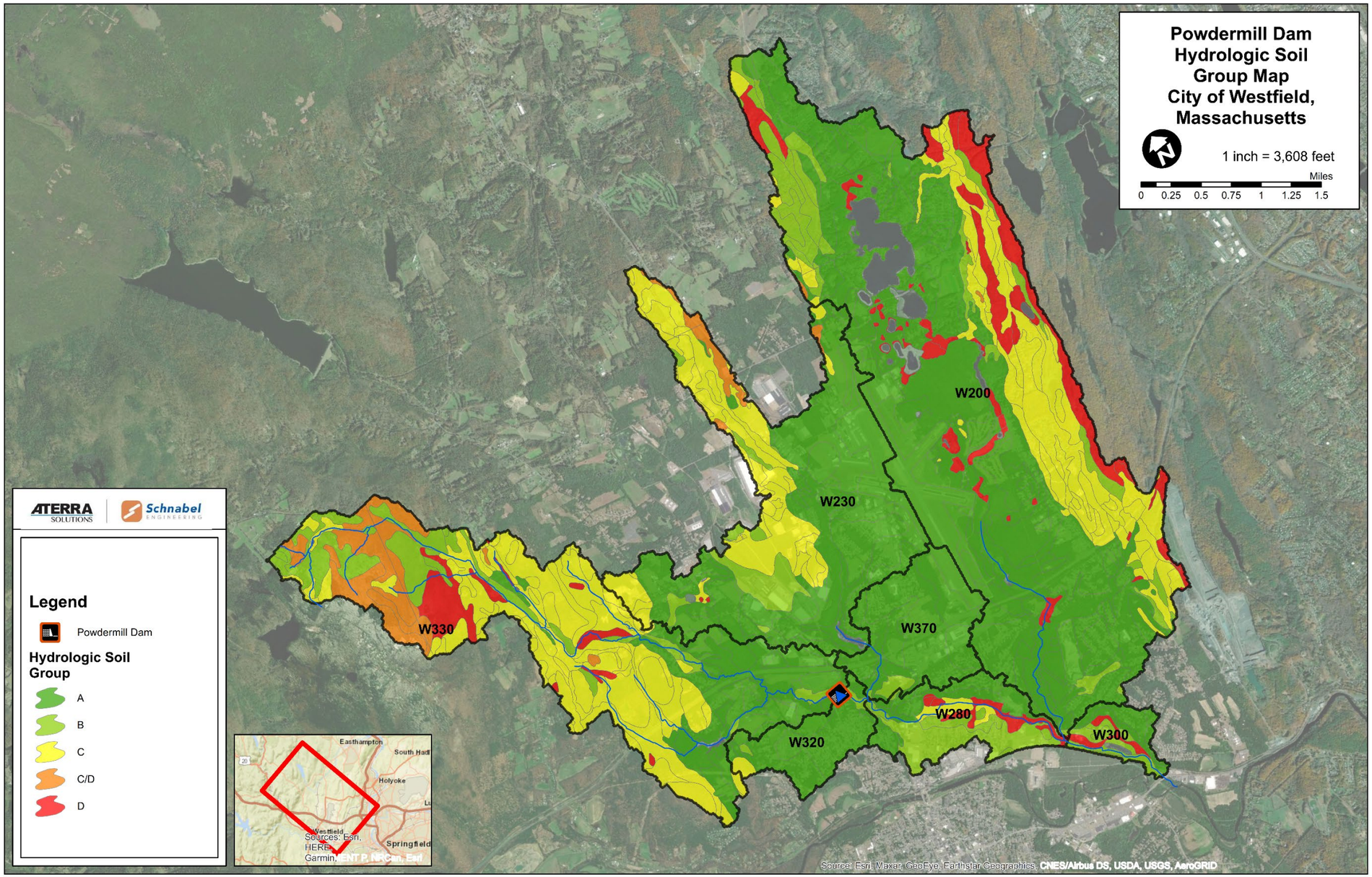

Figure C-34 – Hydrologic Soil Groups Map

APPENDIX D

INVESTIGATIONS AND ANALYSES REPORT

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Investigations and Analyses Used in the Planning for Rehabilitation of Powdermill Dam

PLANNING ENGINEERING

Purpose

This document summarizes the investigations and analysis completed for the dam rehabilitation planning engineering of the Powdermill Dam. This includes a summary and reference for the existing conditions, breach, deficiencies, alternatives studied, and the selected rehabilitation alternative for this dam.

The basis for the planning engineering investigations and analysis is current NRCS criteria and standards, including the following:

- National Engineering Handbook, Part 630, Hydrology
- National Engineering Handbook, Part 628, Dams
- Technical Release 60, Earth Dams and Reservoirs, March 2019
- NRCS Conservation Practice Standard Dam (Practice Code 402)

Baseline Survey: A topographic survey performed by North by Northeast in December 2019 was the basis for critical elevations and the design of rehabilitative measures. The differences between the NGVD 29 elevations contained in the as-built drawings and NAVD 88 elevations is -0.70 (e.g., EL 202 NGVD 29 - 0.70 = EL 201.3 NAVD 88). The topographic survey was supplemented with a bathymetric survey that was performed in November 2019 using a probing tool and a tape measure.

Geotechnical Review

Regional and Site Geology: Powdermill Dam is located in the western portion of the Connecticut Valley Lowland physiographic region, which extends from northern Massachusetts to southern Connecticut and contains the southern section of the Connecticut River. The U.S. Geological Survey (USGS) Surficial Materials Quadrangle Maps of Massachusetts (Stone, 2018) show the surficial material at the site to consist of lake-bottom fine deposits including very fine sand, silt, and clay occurring as well-sorted, thin layers of alternating silt and clay varves typically underlying fine sand deposits. Additional surficial materials include flood-plain alluvium (sand, gravel, and silt deposits in stream flood plains) and stream-terrace deposits (sand, gravel, and silt deposits from glacial meltwater sediments along rivers and streams) particularly denoted where overlying glaciolacustrine deposits (lake-bottom fine deposits). The site lies near the approximate western edge of historical glacial Lake Hitchcock. USGS surficial soils data obtained from the MassGIS OLIVER platform show the site to consist of thin till overlain by glaciolacustrine fine deposits underneath stream terrace deposits and alluvium.

According to the USGS Bedrock Geologic Map of Massachusetts (USGS, 1983), the site is underlain by Mesozoic Basin Sedimentary Rock, specifically comprising New Haven Arkose, a coarse-grained conglomeritic arkose (feldspar-rich sandstone) of Upper Triassic geologic age interbedded with shaley siltstone and fine grained arkosic sandstone.

Regional and Site Seismicity: The seismicity at the dam site is typical of the Central and Eastern United States (CEUS). The CEUS is a stable, intraplate region that is not nearly as active as the Western United States (WUS), which borders a plate boundary. However, CEUS earthquakes experience much less attenuation than the WUS given the thick, dense crust. Thus, earthquakes of similar magnitudes will impact a much larger region in the CEUS (USGS, 2018).

Two magnitude 4 (M4.0) or greater earthquakes are known to have occurred within a 100-km radius of the dam site based on data from the CEUS Seismic Source Characterization Model earthquake catalog (CEUS-SSCn, 2012) and New England Seismic Network (NESN, accessed March 2020). These events include an M4.4 in Moodus, Connecticut in 1791 and an M4.9 in Haddam, Connecticut in 1568. These listed earthquakes occurred before the creation of the modern-day seismic network; therefore, there is a great degree of uncertainty associated with their location and magnitude. Additionally, the reported body wave magnitudes for the events were estimated from the intensity of shaking that was reported in the area.

According to USGS maps (USGS, accessed March 2020), no surficial faults have been identified as active or capable during the Quaternary Period within the 100-km radius around the site.

Previous Explorations

Original Design Phase Exploration
A subsurface investigation program was performed during the design of the dam in 1962. Borings and test pits were performed along the proposed centerline of the dam crest (3 borings, 1 test pit), the proposed alignment of the principal spillway conduit (4 borings), the proposed auxiliary spillway (4 test pits), the proposed embankment upstream and downstream benches and toes (1 boring, 3 test pits), and in potential borrow areas generally located upstream of the dam and on the left abutment (6 borings, 5 test pits). Two additional borings and 6 test pits where also conducted but the locations are not clear in the historical documents. Stick logs with N-values and soil classification data for some of the test borings and test pits were included on the as-built drawings. A Geology Report dated February 7, 1962, provides additional soil and rock descriptions as well as other site conditions encountered during the program not presented on the stick logs in the as-built drawings.

Original Design and Construction Phase Laboratory Testing
The laboratory testing performed during the original design phase of the dam, with available documentation, included:

- 1 Consolidated Drained Triaxial Shear
- 5 1-D Consolidation
- 3 Atterberg Limits
- Specific Gravity, Dry and Natural density, and Moisture Content as part of the other tests

Details of the testing can be found in the 1962 Geology Report included in the documents provided to the Aterra - Schnabel Joint Venture by the NRCS.

2019 Geologic and Geotechnical Investigation

Borings and Test Pits

The 2020 geologic and geotechnical investigation was performed to explore and characterize the subsurface materials comprising the dam embankment, foundation, and auxiliary spillway. The investigation included five borings from the dam crest, upstream bench, downstream bench, and downstream toe, and four borings in the auxiliary spillway. The investigation also included four test pits in the auxiliary spillway. Open standpipe piezometers were installed in two borings located at the dam crest, one boring at the downstream bench, and one boring at the downstream toe; slug testing was performed in each of the piezometers.

Drilling, Sampling, and In Situ Testing Methods

The boreholes were advanced using 4¼-inch inside diameter (I.D.) hollow stem augers (HSA) with the exception of Boring B20-21 which was advanced using 4¼-inch I.D. HSA through the embankment before switching to 4-inch I.D. flush joint casing (FJC) and 3-inch I.D. FJC with fluid rotary (water) tricone "drive and wash" methods in the foundation soils. The 3-inch I.D. FJC was telescoped through the 4-inch I.D. FJC and was seated into bedrock prior to beginning the rock core. Bedrock was cored using NQ double barrel wireline coring methods. Bedrock was only encountered in Boring B20-21, drilled from the embankment crest.

The Standard Penetration Test (SPT) was performed continuously in the test borings until alternate sampling methods were used, the selected termination depth in soil was reached, and/or refusal occurred. SPTs were performed using a 24-inch long, split-spoon sampler lowered through the HSA or FJC to collect soil samples and measure the relative penetration resistance of the soils. The number of blows (blow count) of a 140-lb hammer falling 30-inches required to drive the split-spoon sampler four consecutive 6-inch increments was recorded. The SPT N-value, recorded as blows-per-foot (bpf), is defined as the sum of the second and third 6-inch blow count intervals. The SPT samples were obtained using a 140-lb automatic trip hammer (ATH) in general accordance with ASTM D1586.

Undisturbed thin-wall Shelby tube (SH) samples were collected at select depths in the foundation material underlying the embankment. Each SH sample was collected using a Gregory Undisturbed Sampler (GUS), a piston sampler that utilizes air or hydraulic pressure to push the thin-walled tube into the target soil. The GUS used for this project used hydraulic pressure to collect the SH sample. SH samples were not attempted within the embankment due to the higher relative density and grain size distribution, including gravel, being unsuitable for thin-walled sampling.

Schnabel Engineering personnel described the collected soils in the field using visual-manual procedures as described in ASTM D2488. Final soil descriptions provided on the logs are based on the visual-manual procedures (ASTM D2488) and confirmed by laboratory testing of select samples in accordance with the Unified Soil Classification System (USCS) per ASTM D2487.

Pocket penetrometer and Torvane field tests were performed on select portions of SPT and SH sampled materials. The vane shear test (VST) was performed at select depths in Boring B20-621 in an attempt obtain field estimates of the in situ undrained shear strength of the fine-grained foundation materials underlying the embankment. VSTs were performed in general accordance

with ASTM D2573. Split-spoon samples were collected through the tested zone after the completion of each VST.

Water level measurements were taken in the borings for the presence and depth of groundwater prior to backfill or the installation of piezometers. Water levels were typically measured in each boring, both during drilling and after completion of drilling activities.

Four borings were completed with the installation of an open standpipe piezometer, with the slotted screen set at selected depths to target strata of interest based on the conditions encountered. The remaining borings were grouted from the bottom of the boring to the ground surface with cement-bentonite grout using a tremie pipe.

Four test pits were excavated within the auxiliary spillway channel. Soil samples were collected from the side walls of the excavation at approximately 2 ft depth increments or in each distinct material encountered. Schnabel Engineering personnel described the collected soils in the field using the visual-manual procedure method described in ASTM D2488 and confirmed by laboratory testing of select samples in accordance with the Unified Soil Classification System per ASTM D2487. Test pits were typically terminated at the extent of the excavator's reach, or until the excavation sidewalls became unstable, which varied from about 6 ft to 10 ft below ground surface (bgs). Test pits were backfilled and compacted in 6-inch lifts of excavated materials with the excavator bucket until restored to approximate original grade.

Laboratory Testing for 2020 Investigations

The laboratory testing performed for the 2020 geologic and geotechnical investigation included:

- 43 Moisture Content (ASTM D2216)
- 46 Particle-Size Distribution (ASTM D422)
- 5 Particle-Size Distribution with Hydrometer (ASTM D422)
- 5 Specific Gravity (ASTM D854)
- 18 Atterberg Limits (ASTM D4318)
- 2 Constant Rate of Strain (CRS) Consolidation (ASTM D4186)
- 2 Consolidated Undrained Direct Simple Shear (CUDSS) (ASTM D6528)

The testing results aided in the classification of materials encountered during investigation and provided data for use with empirical correlations to support selection of material properties and engineering parameters.

Subsurface Conditions

Original Design Phase Investigation

Several geologic materials were identified at the site during the 1962 field investigations. The test borings and test pits in the area of the embankment and auxiliary spillway typically encountered a surficial stratum consisting of micaceous, poorly-graded sands to silty sands and gravels overlying a thick stratum of varved silts with periodic sand and clay varves. Underneath the varved silt stratum, a poorly graded to silty sand stratum overlying a thin layer of glacial till was encountered. Bedrock was encountered below the glacial materials and was reported in the 1962 Geology Report as conglomeritic arkosic sandstone at approximately 50 to 60 ft below the bottom of the proposed

embankment. During the pre-construction investigation, artesian pressures, relative to original ground surface, were encountered in Boring DH-3 penetrating the bedrock and overlying sand material. The as-built drawings indicate some of the surficial silty sand stream channel materials overlying the varved silt stratum were removed prior to the placement of the embankment fill.

The 1962 Geology Report discusses a historical glacial lake in the Connecticut Valley as the depositional source of the varved materials. The report also identifies the sandy material overlying the varved stratum as a more recent fluvial terrace deposit, varying across the site with frequent changes in the stream flow channels through the region. The sandy material overlying bedrock was described as glacial till which had varying thickness among the borings that were advanced through the till to bedrock.

The as-built drawings and Geology Report discuss multiple borrow pit locations containing sand and silt materials suitable for the Section I (embankment core) and Section II (embankment shell) fill soils, primarily located upstream of the dam along the flood plain of the stream in addition to materials sourced from the auxiliary spillway excavation.

2020 Geologic and Geotechnical Investigation
Several different natural geologic and embankment construction material strata were encountered during the 2020 investigation. The following informal, project-specific strata names have distinct characteristics that are identified based on visual descriptions, field testing, drilling observations, laboratory test results, and engineering properties. The soil classifications are visual-manual classifications, except at specific intervals where laboratory testing has been performed, using USCS classifications.

- Topsoil/Surficial Soils
- Fill Materials
    - Stratum ES: Embankment Shell Fill (SM, ML)
    - Stratum EC: Embankment Core Fill (ML, SM)
    - Stratum F: Fill – Auxiliary Spillway (ML, SM)
- Natural Materials
    - Stratum A1: Alluvial Deposits – Stream Channel Material / Terrace Deposits (SM, ML, SP, SP-SM)
    - Stratum A2: Alluvial Deposits – Varved Lacustrine Deposits (ML with CL and CH varves)
    - Stratum G: Glacial Deposits (SM)
    - Stratum B: Bedrock (Sandstone)

Water Level Observations
Water levels were measured in the borings and piezometers during and after the subsurface investigation program to obtain information about groundwater and piezometric conditions within the dam embankment, foundation, and auxiliary spillway. When possible, initial water level readings in boreholes were generally obtained during or after drilling and prior to the installation of a piezometer or grouting. Piezometers were installed in two borings along the dam crest, one boring at the downstream bench, and one boring at the downstream toe. The water levels recorded on the boring logs were measured before and after development of the piezometers. The four piezometers indicate that phreatic levels within the embankment and foundation, as represented

by the screened interval for each piezometer, generally range from approximately EL 160 to EL 161 below the embankment crest centerline to EL 156 at the downstream toe. The upstream pool level at the time of these readings was approximately EL 162.3.

Geotechnical Evaluations

Dispersive Soils

There is no significant evidence of materials that are potentially susceptible to dispersion being present within the embankment, the embankment foundation, or the auxiliary spillway in amounts that could compromise the integrity of either structure. The majority of soils encountered during the investigation, and in particular in the Strata ES, EC, and A1 soils, were observed to be non-plastic and low clay content (fraction finer than 0.005mm < 12%), which are indicative of non-dispersive soils. Atterberg limit and hydrometer testing was performed on the varved silt material in Stratum A2 which determined the material to generally be non-plastic or low plasticity (plasticity index of 7 or less) and a clay fraction finer than 0.005 mm less than 12%. While the thin clay layers observed in Stratum A2 were determined to be low to high plasticity and a clay fraction greater than 12%, they represent a minor portion of the foundation material. In general, no significant zone or quantity of fine grained, plastic soils was encountered that could be considered potentially problematic due to dispersive behavior. Therefore, based on the review of available data and geotechnical investigation results, dispersive soil is not anticipated to be a concern to the structures and further testing has not been performed.

Filter Compatibility

Schnabel performed an evaluation of NRCS filter and drain compatibility on the trench drain materials using the fine and coarse filter drain limits recorded in the as-built drawings. The evaluation was performed using procedures outlined in the NEH, Part 633, Chapter 26 Gradation Design of Sand and Gravel Filters (August 2017). Sheet 6 of the as-built drawings provides details for the constructed geometry of the two-stage filter drain and trench, where the drain is anticipated to contact Strata ES and A1 materials. Depending upon the depth and location of the installed trench drain, it is possible that the drain materials also contact Stratum A2 material. The fine filter is also shown to be in contact with the compacted base fill placed underneath the principal spillway (PSW) pipe. The filter compatibility calculations analyze the compatibility of each strata that potentially contacts the fine filter drain material, as well as analyzing the compatibility of the fine and coarse filter stages comprising the two-stage drain.

The as-built drawings show the two-stage filter drain to be located below the embankment downstream bench at a depth of approximately 20 feet and attempting to intercept the drain with a borehole could create a potential risk for damaging the trench drain and collector pipe, fouling the drain, or not encountering the drain materials due to the limited width of the drain. Therefore, the gradations for the fine and coarse drain materials as shown on Sheet 6 of the as-built drawings were used for the analysis. The results of the analyses are summarized in Table D-1 below.

Table D-1 – Summary of Filter Compatibility Evaluations

Base Soil Material	Filter Material (Candidate)	NRCS Filter and Drain Material Compatibility
Fine Drain Material	Coarse Drain Material	✓
Embankment Shell, ES	Fine Drain Material	✓
Alluvial Foundation, A1	Fine Drain Material	✓
Alluvial Foundation, A2	Fine Drain Material	X
PSW Compacted Base Fill	Fine Drain Material	✓
Embankment Core, EC	Embankment Shell, ES	See Note 1
Embankment Core, EC	Alluvial Foundation, A1	See Note 1
PSW Compacted Base Fill	Alluvial Foundation, A1	✓ (Coarse Boundary)

The results indicate that the coarse drain material is a generally compatible filter and drain for the fine drain material, and the fine drain material is a generally compatible filter and drain for Strata ES and A1 soils as well as the compacted base fill for the PSW. The results suggest the fine drain material is too coarse grained to be a compatible filter for the Stratum A2 soils; however, it is not clear, based on the as-built drawings and our investigation, to what extent these materials are in contact. If they are in contact, it appears to be likely limited to the lower portions of the trench drain near the middle of the valley and then with potentially increasing contact where the trench drain is constructed against the right and left abutments.

The results show that Strata ES and A1 are too fine grained to meet NRCS filter and drain compatibility with Stratum EC, but these materials likely provide adequate filtering of the Stratum EC material to prevent internal erosion, especially considering the relatively low gradients at normal pool and limited wetting front penetration during flood conditions based on transient seepage modeling.

The coarse boundary of the sampled Stratum A1 foundation soils is shown to be a compatible filter for the PSW compacted base fill materials, but the fine boundary is too fine grained. The natural materials sampled as Stratum A1 include a relatively wide range of particle size distributions; however, because the coarser materials are a candidate filter, internal erosion of the compacted back fill materials into the Stratum A1 foundation is considered unlikely.

Foundation Toe Drain System

The as-built drawings show the collector and outlet drain pipes consist of perforated bituminous coated corrugated metal pipe (BCCMP), which is no longer considered acceptable pipe material for use in dams due to known performance issues including corrosion, cracking, and joint separation (USBR, 2009). The as-built drawings show the outlets to have the same invert as the spillway conduit, and based on observed normal tailwater levels, the drain outlets are typically submerged by the tailwater and based on visual observations of the stilling basin, it is likely that the outlets are covered by vegetation and/or sediment since there is no headwall structure.

During the visual inspection of the dam in November 2019, the outlet pipes for the foundation trench drain could not be located, and it was assumed they were submerged by the tailwater. In April 2020, Aterra-Schnabel conducted a video inspection of the principal spillway conduit

including plugging the upstream end of the conduit to prevent flow, and which resulted in lowering of tailwater in the stilling basin. Flow, presumably from the right drain outlet pipe, was observed emerging at a steady rate from the muddy slope slightly above the lowered tailwater level, although the physical pipe outlet was not observed, and flow was visible coming through the buried riprap lining the stilling basin. The flow was mostly a muddy orangish-brown color although it briefly changed to clear before returning to orangish-brown. It was not apparent whether the coloring was due to fine soil particles or the result of iron-oxidizing bacteria deposits. The left drain outlet pipe was not located, and no visible flow was observed from the left side of the spillway conduit.

Multiple readings of the piezometers installed during the 2020 investigation at locations upstream and downstream of the existing trench drain indicated water levels to be approximately 2 to 3 feet above the trench drain collector pipe invert such that seepage flows through the pipe are likely during normal pool conditions. The readings in the piezometers collected during January 2020 were measured at times when the upstream pool was at or slightly above the normal pool level of EL 162.3. Tailwater was estimated to be about EL 154.5 to EL 155.0 for this period. No flooding events or elevated pool levels occurred in January 2020, and therefore the response in foundation seepage and water levels at the piezometer locations due to significant precipitation and/or elevated upstream pool conditions was not observed during the 2020 investigation.

The foundation drain pipes are BCCMP and more than 50 years old, and the steady flows observed from the right drain were mostly cloudy. Therefore, replacement of the existing collector and outlet pipes, or abandonment of the existing pipes combined with installation of a new foundation toe drain filter and drain system is recommended. TR 210-60 states that seepage collection and discharge systems must include access points. Cleanout and inspection ports should be installed at the opposite ends of the new collector pipes toward the right and left abutments respectively.

Filter Diaphragm for Principal Spillway Conduit

TR 210-60 states "for embankments of all hazard potential classifications with penetrations not protected by comprehensive filter and drainage features, include a filter drainage diaphragm around any structure that extends through the embankment to the downstream slope." At Powdermill Dam, this applies to the principal spillway conduit. The as-built drawings show that structural anti-seep collars were installed around the upstream and middle portions of the principal spillway conduit, but do not show that a dedicated filter diaphragm was installed around the conduit. The as-built drawings do provide detailed depictions of the two-stage filter for the trench drain outlet pipes which are located along both sides of the downstream 84 ft of the conduit. The drawings show that the filter materials are not constructed above or below the spillway conduit, although compacted bedding fill (called out as ML soils) is present below full length of the conduit. The filter compatibility calculations indicate the bedding fill is filtered by the fine drain materials and is also filtered by the coarser portion of the A1 foundations, based on the samples collected during the current investigation. Although potential seepage along the sides and bottom of the spillway conduit may be adequately filtered, the as-built drawings show there is no filter material constructed over the top of the conduit. It is recommended that a new filter diaphragm be installed around the downstream portion of the conduit as required by TR 210-60 and conforming to dimensions as required by 210-NEH-628, Chapter 45, "Filter Diaphragms."

Historical Concerns Regarding Seepage, Settlement, and Stability

The 1962 Geology Report discusses an artesian condition that was encountered in the poorly graded sand stratum overlying bedrock in Boring DH-3 during the 1962 investigation. While this condition is no longer considered to be artesian to the current ground surface due to the embankment built in this area, the uplift pressures may still be present, although they are likely confined below the thick layer of varved silts and clays. The 2020 investigation did not encounter a poorly graded sand stratum overlying bedrock; instead, boring B20-21 encountered approximately 10 ft of dense silty sands overlying rock.

The past inspection reports discuss significant erosion of the embankment and auxiliary spillway due to unauthorized motorized vehicle activity at the site. The evidence of motorized vehicle activity was still apparent on the embankment and auxiliary spillway during the 2019 inspection and 2020 investigation; new motorized vehicle tracks were observed during the 2020 investigation following a weekend break.

No numerical stability analyses were performed during the original design. More recently, there are no seepage, settlement, or stability concerns identified in the previous dam inspection and assessment reports provided by NRCS to Aterra-Schnabel for review.

Seepage Analysis

The finite-element analysis program SEEP/W, a module within the GeoStudio 2018 R2 suite of software, was used to develop a steady-state seepage model for the selected cross-section located at the approximate maximum section of the dam embankment using the data from the 2019 topographic survey of the dam. The model was developed to evaluate piezometric and seepage conditions through the embankment and foundation and estimate pore water pressures for use in the slope stability analysis.

Preliminary seepage input parameters for each stratum were selected based on the results of slug testing performed in the piezometers in addition to applicable published soil-type correlations using the soil classifications from our investigation and laboratory testing program. The model was calibrated to obtain general agreement with the recent piezometer water level readings, boring moisture content profiles, and sample moisture descriptions based on conditions at normal pool. For the steady state seepage analysis, the trench drain was included in the model, but because the pipe is submerged during normal tailwater conditions and was not clearly observed during the visual inspection, we conservatively did not assign functionality to the drain pipe.

To evaluate potential changes in seepage and piezometric conditions during flood events, a transient seepage analysis was performed based on the 6-hour freeboard hydrograph (FBH) event developed in HEC-RAS as part of the SITES model for this project and as stated as the preferred procedure for Flood surcharge conditions per Figure 5-3 in TR 210-60. The transient headwater (pool) condition increases from normal pool at EL 162.3 up to a maximum level at EL 203.3 above the crest of the dam before receding back to normal levels over a period of approximately 4 days. The analysis also considers a transient tailwater that was modeled as initiating at the approximate outlet elevation of EL 155 and increasing to EL 193.8 before receding. The HEC-RAS model shows the maximum headwater and tailwater to occur at approximately the same time. In the

transient model, the trench drain was conservatively modeled to match hydrostatic tailwater head to account for the potential for tailwater backflow into the outlet pipes.

Normal pool is low relative to the total height of the embankment and the reservoir is only expected to rise during flood events. The results of the steady-state seepage analysis at normal pool show that phreatic levels are generally linear from headwater through the embankment shell and core to the tailwater in the downstream principal spillway stilling basin. The transient FBH model indicates that during the 6-hour FBH storm, the migration of the saturated wetting front into the embankment materials is limited, and the majority of the embankment fill remains unsaturated. Given the relatively short duration of elevated pool conditions per the hydrologic and hydraulic model and the observed condition of the zoned, compacted embankment, it is Schnabel's opinion that internal erosion from seepage through the dam embankment is not likely to be a dam safety issue.

Static Slope Stability

We performed a two-dimensional, limit-equilibrium static slope stability analyses in accordance with Section 5 of TR 210-60, using SLOPE/W, a module within the GeoStudio 2018 R2 suite of software. The analysis considered the following load cases:

- Steady Seepage: Normal pool EL 162.3, steady-state seepage conditions
    - Upstream and downstream slopes
- Rapid Drawdown: Drawdown from normal pool level to the low-level outlet elevation
    - Upstream slope only
- Flood Surcharge: Freeboard hydrograph (FBH) pool with transient headwater from EL 162.3 to EL 203.3 and transient tailwater levels from EL 155 to EL 193.8
    - Upstream and downstream slopes

The model utilizes the same approximate maximum section of the dam used for the seepage analysis because it is considered to be a critical section for slope stability relative to other shorter embankment sections. Embankment and foundation stratigraphy are modeled based on the data collected during the 2020 field investigation and laboratory testing program, as well as our review of historical records. Soil strength parameters are selected based on current and historical laboratory testing in addition to a variety of applicable published empirical correlations for SPT N-values, material type, and anticipated shear behavior. Given the cohesionless nature of the embankment shell materials, the slope stability models and analyses assessed both near surface failures and deeper global failures per requirements provided in TR 210-60, Figure 5-3.

For the rapid drawdown load case, Schnabel performed a staged rapid drawdown analysis, with a pre-drawdown normal pool set to EL 162.3 ft and a post-drawdown pool level at the invert elevation of the low-level outlet (EL 156.8). The drawdown analysis is based on the Duncan, Wright, and Wong (1990) method as presented in USACE EM 1110-2-1902. Undrained strengths for applicable soil materials were assigned based on anticipated permeability and shear behavior under drawdown conditions. The seepage analysis indicates migrating of the saturated wetting front into the embankment during flood conditions will be limited, and therefore stability during drawdown from floodpool conditions was not modeled.

The static stability analysis results, including minimum required factors of safety (FS) per TR 210-60 Figure 5-3, are presented in Table D-2 below.

Table D-2– Slope Stability Analysis Results

Load Condition	Calculated Factor of Safety - Upstream Slope	Calculated Factor of Safety - Downstream Slope	NRCS TR 210-60 Minimum Required Factor of Safety
Normal Pool Steady Seepage	2.0 1.3 (Near Surface)	1.8 1.5 (Near Surface)	*1.5* *1.3 (Near Surface)*
Normal Pool Rapid Drawdown	1.9 1.9 (Near Surface)	n/a	*1.2* *1.1 (Near Surface)*
Flood Surcharge, FBH Event[1]	1.6 1.2 (Near Surface)	1.8 1.6 (Near Surface)	*1.4* *1.2 (Near Surface)*

1. Represents the critical (low) factor of safety slope stability calculated for transient FBH pool conditions based on the 6-hr FBH hydrograph for varying pool levels. Factors of safety and location of the critical slope surface vary throughout the transient analysis as the floodpool increases and recedes.

The slope stability results demonstrate that the dam satisfies minimum criteria for static slope stability for each load case considered.

Embankment Seismic Performance

Peak Ground Acceleration and Earthquake Magnitude

The seismic hazard analysis for this project consists of estimating the annual rate of exceedance of ground motion parameters of interest for design (e.g., peak ground acceleration, spectral ground accelerations, etc.) that may originate from the various earthquake sources existing around a site. Peak ground accelerations (PGA) were obtained using the Dynamic Conterminous US 2014 (v4.2.0) data from the online Unified Hazard Tool provided by the USGS as part of their Earthquake Hazards Program. The data indicate the horizontal PGA for boundary B/C "firm rock" (defined as having a shear wave velocity of 760 meters [2,500 ft] per second) for the dam site ranges from 0.020g to 0.179g for the 200 to 10,000-year recurrence interval earthquake events, respectively.

NRCS requires selection of a maximum design earthquake (MDE) and its corresponding PGA based on the anticipated consequence of seismic failure under normal pool conditions. Aterra-Schnabel modeled a dam breach at normal pool conditions which indicates that breach flows are very small and downstream impacts are negligible such that the consequence of a seismically-induced breach failure at normal pool is considered low. Per TR 210-60 Figure 4-1, the seismic analysis considers a Site Class Boundary B/C baseline PGA of 0.05g corresponding to a design seismic event with a 1,000-yr return period.

The USGS Uniform Hazard Tool provides deaggregation of the data that was the basis of the 2014 seismic mapping. The deaggregation plot is a graphical representation of the relative contribution

of various seismic sources based on magnitude and distance. The deaggregation data for the dam site indicates the mean value for the magnitude of the MDE is Mw 5.81.

Site Class and Factored Peak Ground Acceleration
The dam was constructed over a thick foundation stratum of varved lacustrine deposits which could result in amplification of seismic waves. PGA amplification factors were selected based on the site classification for the dam using the procedure outlined in Chapters 11 and 20 of American Society of Civil Engineers Standard 7-16, Minimum Design Loads for Buildings and Other Structures (ASCE 7-16). Although ASCE 7-16 is not typically applied to earthen embankments, the application of the site coefficients presented in this standard to account for soil amplification is appropriate since a site-specific seismic hazard analysis or site response analysis has not been performed. Site classification is based on the relative stiffness of the upper 100 ft of the site soil profile, the presence of soils vulnerable to potential failure or collapse under seismic loading, and the presence of thick layers of soft clays or organic soils. Table 20.3-1 of ASCE 7-16 provides guidance on selecting an appropriate Site Class based on *in situ* testing of the subsurface materials. A Site Class E was selected for this site based on the SPT N-values collected in the lacustrine foundation A2 stratum during the 2020 investigation. Average N-values in Stratum A2 encountered below the embankment were N_{60} = 14 bpf and $N_{1,60}$ = 11 bpf.

A Site Amplification Factor was applied as defined in Table 11.8-1 of ASCE 7-16. This coefficient represents the estimated site amplification within the foundation soils based on the specific Site Class E for the dam. The coefficient is multiplied by the Site Class Boundary B/C PGA to get the factored Class E Soil PGA. An amplification factor of 2.4 was applied resulting in a factored PGA of 0.12g.

Liquefaction Potential
As required by TR 210-60 based on the factored PGA of 0.12g, the potential for the dam and foundation was evaluated to experience cyclic liquefaction using the methodology presented by Idriss and Boulanger in *Soil Liquefaction during Earthquakes* (2008). This methodology estimates a factor of safety against liquefaction for a given soil interval. A factor of safety of 1.0 or greater indicates the soil is not anticipated to experience liquefaction during the analyzed earthquake ground motions.

The borings performed during the 2020 investigation were used for the evaluation. SPT N-values recorded during the field investigation were corrected to $N_{1,60}$ for the liquefaction analysis to account for hammer energy, overburden, borehole diameter, rod length, and sampler type. Where laboratory data was not available, fines contents (defined as materials passing the #200 sieve) were assumed based on soil descriptions from the boring logs. Soil unit weights were assigned, and groundwater depth was based on materials and conditions observed during the field investigation and piezometer readings.

The liquefaction potential was evaluated for the saturated embankment and foundation soils for ground motions corresponding to the factored PGA of 0.12g for a Mw 5.81 earthquake event. The results indicate that no soil zones within the embankment or foundation are susceptible to liquefaction under the design ground motions. The liquefaction susceptibility was also evaluated

for the 2,475-year return period PGA; the results indicate no liquefiable foundation layers underlying the embankment.

Seismic Yield Acceleration and Performance
A pseudo-static slope stability analysis was performed to estimate the seismic yield acceleration for the embankment upstream and downstream slopes. The yield acceleration is defined as the site ground accelerations at which the FS for slope stability is equal to 1.0, and above which deformation of the dam may begin to occur. Saturated soils in the bottom of the embankment fill and underlying foundation that are anticipated to experience undrained loading during seismic ground motions were modeled using estimated total stress shear strengths conservatively selected to reduce strength from drained strengths. Soils anticipated to be free-draining were modeled with effective strength strengths.

These results indicate that the yield acceleration of the upstream slope (0.15g) and downstream slope (0.14g) are greater than the Class E PGA for the site (PGA=0.12g), suggesting that the slopes are unlikely to deform during a seismic event. Therefore, seismic performance of the embankment is expected to be adequate.

Seismic Stability and Structural Condition of the Principal Spillway Riser

The principal spillway riser was evaluated for seismic stability in accordance with the NRCS Engineering Technical Release, TR 210-68 Seismic Analysis of Risers. This methodology uses the equivalent lateral force procedure and incorporates a spectral acceleration defined in a manner consistent with ASCE/SEI 7-16. The seismic parameters were obtained from the USGS/OSHPD seismic design maps.

The results indicate that the riser satisfies stability criteria for overturning and sliding for both riser in air and riser in water loading scenarios. The factor of safety against sliding for the riser in air and the riser in water loading conditions were calculated to be 3.2 and 1.6, respectively, which both exceed 1.125 as required by TR 210-68. Factors of safety against overturning for the riser in air and riser in water loading conditions were 4.4 and 2.4, respectively, which exceed 2.0 as required by TR-68.

Structural analysis of the reinforced concrete indicates that the existing riser meets ACI 350 criteria for seismic loading, except with respect to the spacing of the shrinkage and temperature steel. The primary function of temperature and shrinkage reinforcing steel is to limit cracking during the early life of a structure. For the existing riser, concrete shrinkage has already occurred, and the structure has likely experienced numerous thermal cycles during its lifespan with no reported performance issues.

Calculated bearing pressure of the existing riser is expected to be approximately 1.4 ksf, which is within the allowable limit of 3.9 ksf based on NAVFAC DM 7.02, Chapter 4, Table 1, *Presumptive Values of Allowable Bearing Pressures for Spread Foundations* for "medium to compact coarse to medium sand with little gravel." The foundation soil materials were estimated based on the results of the 2020 investigation and the boring data provided on the original as-built drawings.

Existing Conditions and Deficiencies

The dam was inspected on November 12, 2019, by Jeremy Young, PE, and Brian Toombs, PE, of Schnabel Engineering. At the time of the inspection, the weather was cloudy with temperatures in the 30s F. It rained approximately 0.2 inches earlier in the day. The pond was at about the normal pool level (EL 162.3 NAVD88). The dam was observed to be in fair condition. Notable observations and recommendations include:

- Erosion and rutting along the crest and upstream contacts with the right abutment and auxiliary spillway training dike were observed due to ATV traffic. These areas have poor to no grass cover and should be repaired. The extent of erosion and rutting caused by ATV traffic appears to be less than what was previously documented in the 2010 Dam Assessment Report, but efforts to prevent unauthorized access should continue.
- An animal burrow was observed on the upstream slope just below the bench in the area to the right of the principal spillway riser.
- The sediment pool appears to be filled to about the level of the principal spillway crest. Some logs and debris were partially obstructing the principal spillway weir openings. The debris should be removed.
- Much of the principal spillway riser was submerged, so the condition of the concrete structure, gate, and trashrack could not be observed during the inspection. The 2010 Dam Assessment Report noted that flow appeared to be entering the riser through a hole or crack on the downstream side of the structure, although the specific location of the crack was not identified. The downstream side of the riser was largely obscured during the 2019 inspection, and evidence of the previously identified leak was not observed. The riser was equipped with a manhole lid, which was reported as missing in the 2010 Dam Assessment Report.
- The lake drain gate appears to be buried in sediment, and it is unknown when it was last operated. The sediment should be removed, and gate operability should be investigated and improved as needed. The visible portion of the gate operator exhibited minor rusting. The gate hand wheel/crank was not present.
- Erosion gullies were observed on the upstream edge of the auxiliary spillway approach channel. It is likely that these gullies were originally also caused by ATV traffic, but they have since incised and revegetated in these areas. The upstream approach channel should be regraded.
- The dam was constructed with embankment foundation drains that, according to the 1962 As-Built Drawings, outlet on either side of the principal spillway conduit outlet. The drain outlets could not be located during the inspection and are likely submerged by tailwater.
- Minor erosion was observed on the left side of the principal spillway plunge pool. The plunge pool was filled at the time of the inspection, and the riprap could not be observed.
- Standing water and wetlands exist beyond the downstream toe of the dam.
- Flow through a drainage swale was observed on the downstream abutment contact (right side). The swale conveys seepage collected by a drain installed on the right abutment according to the 1962 As-Builts.

Aterra-Schnabel Joint Venture subcontracted to Integrity Aquatic (IA) to inspect the principal spillway riser and 48-inch diameter RCP conduit at the Powdermill Dam in the City of Westfield, Massachusetts. The inspection was performed on April 18, 2020. IA's Certified Confined Space

Team used ropes and flowing water to guide a large diameter pillow plug through the 24-inch manhole at the top of the riser and then into the 48-inch RCP entrance at the base of the riser. It was held in place with ropes and then inflated to about 15-20 psi air pressure. After about 15 minutes it completely blocked the flow of water into the conduit. The diver entered the pipe at the outlet and traveled upstream measuring the gaps at each pipe joint at the 12, 3, 6, and 9 o'clock positions (looking upstream). The pipes and joints were also checked for obvious damage. The diver inspected the surfaces of the pipe and provided the locations, descriptions, limits, and pertinent measurements of any deficiencies. Video and still photos were taken. The diver returned to the downstream end of the pipe to exit.

The diver was supported with a two-person surface-supplied air dive team as specified in the Association of Diving Contractors International Consensus Standards and the Occupational Safety & Health Administration Code of Federal Regulations Section 1910, Subpart T. The diver was tethered 100% of the time with an umbilical supplying air and hard wire communications. The diver is a Certified Commercial Diver experienced with construction of dams, sluice gates and pipelines. He is also a registered P.E.

High flows prevented an inspection of the interior of the riser, and debris and sediment limited the inspection of the outside of the riser and pond drain gate. The gate was not operated. The diver inspected the outside of the riser while standing on top of the riser using a video camera attached to a pole.

Results - The 48-inch RCP is in relatively good condition. The concrete is showing some minor surface wear within the normal flow depths. If any grout was used to fill the joints, none is now visible. Joints gaps average 9/16-inch with a median of ½-inch. The maximum gap of 1.25-inches occurs at joints 11 and 12. See attachment A – Joint Log located in the Administrative Record. One large shallow spall chip (3-inch wide and 20-inches long) is located at joint 12 at the 3 o'clock position. Although sediment and debris surround the outside sides of the riser, the limited inspection showed the concrete to be in good condition. The gate stem was straight and most of the gate is visible.

Conclusions - The principal spillway riser and conduit are in good condition. The joints on the principal spillway conduit should be cleaned and grouted. The debris and sediment at the riser should be removed and the gate exercised with any maintenance performed. The gate will be removed during the construction period and the structure returned to a dry dam.

The findings of the 2020 geotechnical investigation and analyses indicate that dispersive soils are not considered a potential threat to the integrity of the dam or auxiliary spillway, and that the embankment satisfies minimum NRCS criteria for seepage, static slope stability, and seismic performance, including liquefaction and deformation.

The condition and functionality of the trench drain is, at least in part, unknown with only limited flow presumably from the right drain observed during the visual inspections. Neither the right nor left drain pipe was actually seen, nor was flow observed from the drain outlet on the left side of the spillway conduit. The foundation drain pipes are BCCMP and more than 50 years old, and the steady flows observed from the right drain outlet were mostly cloudy with an orangish-brown

coloring. Based on the pipe material type, age, and field observations of the flow, replacement of the existing collector and outlet pipes, or abandonment of the existing pipes combined with installation of a new foundation toe drain filter and drain system is recommended. The new filter drain system should utilize solid wall or double-wall HDPE perforated and non-perforated pipes and should incorporate sweeping bends instead of sharp 90-degree bends to facilitate future camera inspections and flushing of the system. Clean-out ports should be installed at the ends of the perforated sections to facilitate future inspection and maintenance of the drain pipes. A concrete headwall for the outlet pipes should be installed to reduce the potential for clogging of the pipes.

The as-built drawings do not provide evidence that a filter diaphragm was constructed fully around the principal spillway conduit. The foundation drain filter materials are located along the either side of the downstream portion of the spillway conduit, and the conduit concrete cradle is constructed on a bedding of compacted fill. Although potential seepage along the sides and bottom of the spillway conduit may be adequately filtered, the as-built drawings show there is no filter material constructed over the top of the conduit. It is recommended that a new filter diaphragm be installed around the downstream portion of the conduit as required by TR 210-60 and conforming to dimensions as required by 210-NEH-628, Chapter 45, "Filter Diaphragms."

The erosion and damage from unauthorized all-terrain vehicle activity to the embankment crest, abutments, and portions of the upstream and downstream slopes, as well as the control section and downstream toe of the auxiliary spillway, should be repaired with compacted earthfill and grassy vegetation to prevent erosion of the embankment. More robust security features, including perimeter fencing and barriers, should be installed to prevent further unauthorized vehicle access to the dam.

Life Span

As of 2020, Powdermill Dam is 55 years old. The total annual sediment accumulation rate based on the November 2019 sediment survey was estimated to be 0.29 ac-ft per year. The remaining submerged sediment storage of 0.8 acre-feet does not satisfy the minimum requirement of 50 years of sediment storage. However, Powdermill Dam was originally planned and designed as a dry dam and the rehabilitation plan is to re-establish the "dry condition." Therefore, sediment deposit behind the dam was assumed to have aerated sediment characteristics and the total aerated sediment volume was accounted for in the stage-storage curve. Based on the annual sedimentation rate, it is estimated that 33,800 tons of sediment (approximately 17.2 ac-ft of aerated sediment) would be deposited behind the dam during the 79-year period of analysis (a design and installation period of four years and an expected useful life of 75 years).

The primary material components are the principal spillway riser, pipe, and toe drains. The BCCMP toe drains are beyond their service life and should be grouted and replaced as part of the rehabilitation. The riser and pipe are currently in good condition and are expected to last for another 75 years. The logic for determining the period of analysis is included in the Economics Section in Appendix D.

Reservoir Storage

Powdermill Dam was originally designed as a dry dam with 15-acre-feet sediment storage and 955-acre-feet floodwater detention storage. It is unknown when the pond drain was closed but significant accumulation of sediment was observed. To estimate historical sediment accumulation and the remaining submerged sediment storage, a sediment survey was completed in November 2019 by the planning team. ArcGIS was used to evaluate the data collected in the field and to estimate the volume of submerged and aerated sediment accumulated behind the dam. The data were used to estimate future sediment accumulation. However, since the intent is to restore the dam as "dry", the volume of submerged sediment was converted to aerated sediment based on the volume weight ratio of submerged to aerated sediment.

SUMMARY OF DATA SOURCES FOR PLANNING ENGINEERING

Land Cover – National Land Cover Database (NLCD) 2016 Land Cover (CONUS)

The National Land Cover Database (NLCD) provides nationwide data on land cover and land cover change at a 30-m resolution with a 16-class legend based on a modified Anderson Level II classification system. The database is designed to provide cyclical updates of United States land cover and associated changes. Systematically aligned over time, the database provides the ability to understand both current and historical land cover and land cover change and enables monitoring and trend assessments. The latest evolution of NLCD products were designed for widespread application in biology, climate, education, land management, hydrology, environmental planning, risk and disease analysis, telecommunications and visualization.

Land Cover - Future Buildout Conditions

The majority of the Powdermill Brook Watershed above the dam (outlined in black) is zoned as "Rural Residential" (white areas in Figure D-1). The northwestern section of the watershed is located in the Town of Montgomery, for which zoning information was not readily available. Therefore, zoning information from the City of Westfield was assumed to be applicable for the Town of Montgomery.

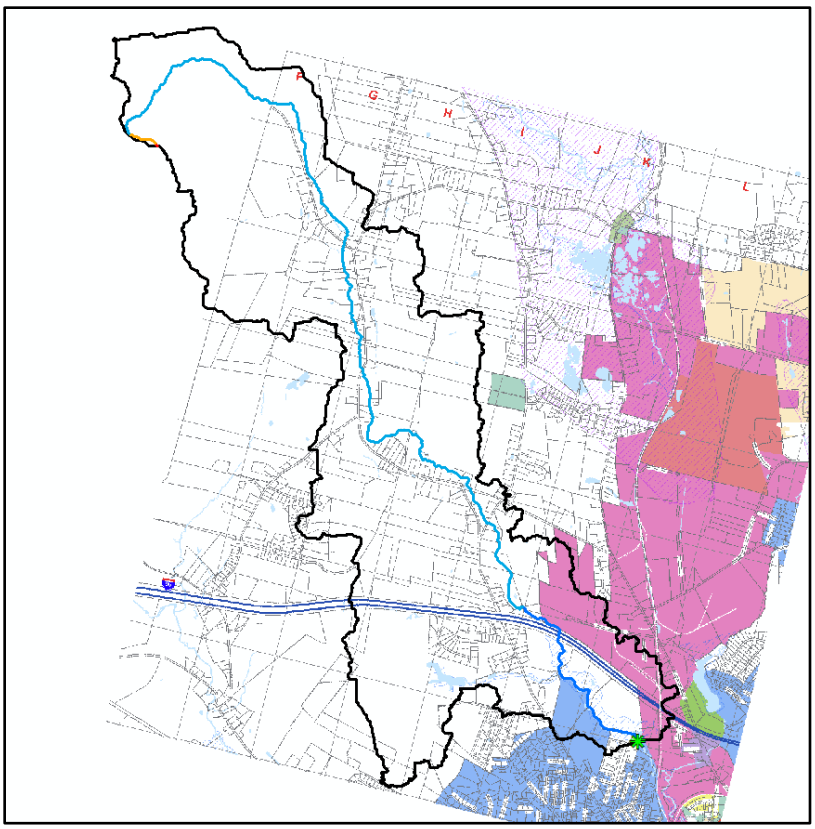

Figure D-1 - Powdermill Watershed Above the Dam and Zoning

The "Rural Residential District" description is provided in Figure D-2. Based on the zoning category description, these areas are not likely to be heavily urbanized in the future. Figure D-3 shows an area of the watershed that is developed to likely full extent under the zoning description.

ARTICLE III
Section 3-40

RURAL RESIDENTIAL DISTRICT

Section 3-40.1 – Intent. Rural Residentials are intended to accommodate agriculture, horticulture or floriculture as well as single family detached dwellings at low densities plus other land uses which minimally impact the aquifer and preserve or respect the City's open space.

Figure D-2 - Westfield Zoning Regulation

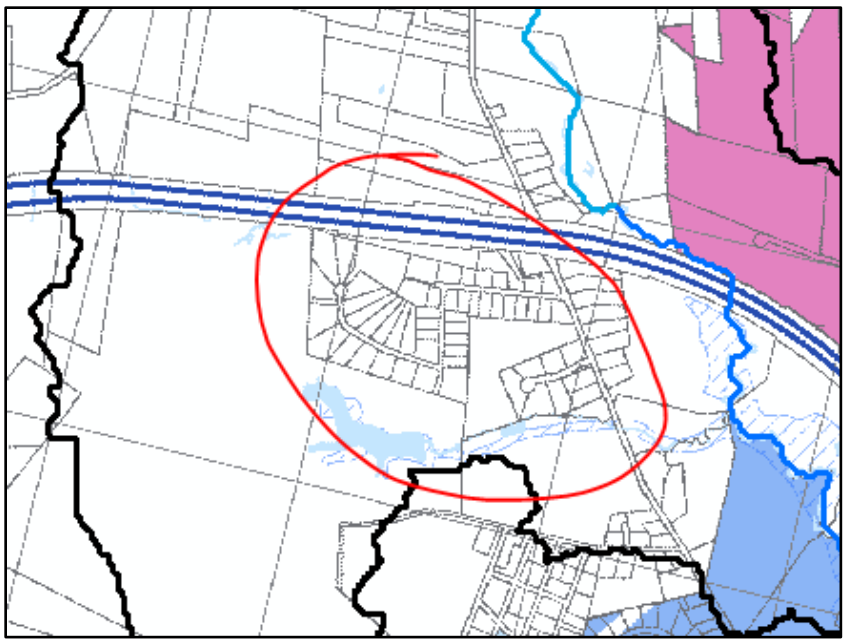

Figure D-3 - Developed Area within Rural Residential Zoning

The approach in developing the future buildout curve number for the entire watershed was based on identifying a sample area of the watershed that appears to be developed to the full extent under the zoning description and perform spatial analysis of this area. The National Land Cover Dataset (NLCD) was used to characterize the land cover in the sample area (see Figure D-4 and Figure D-5).

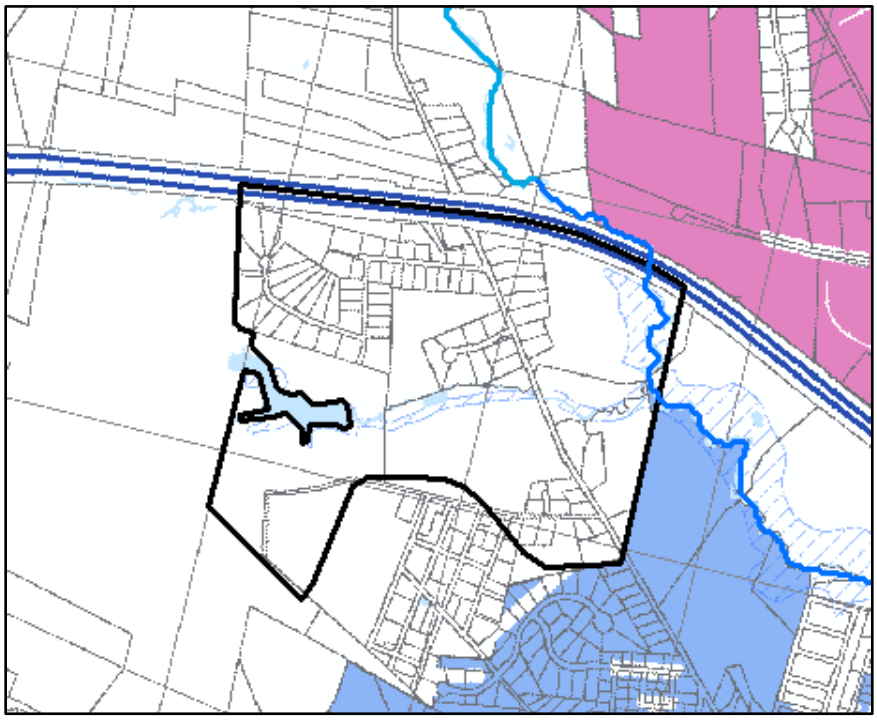

Figure D-4 - Sample Area and Zoning

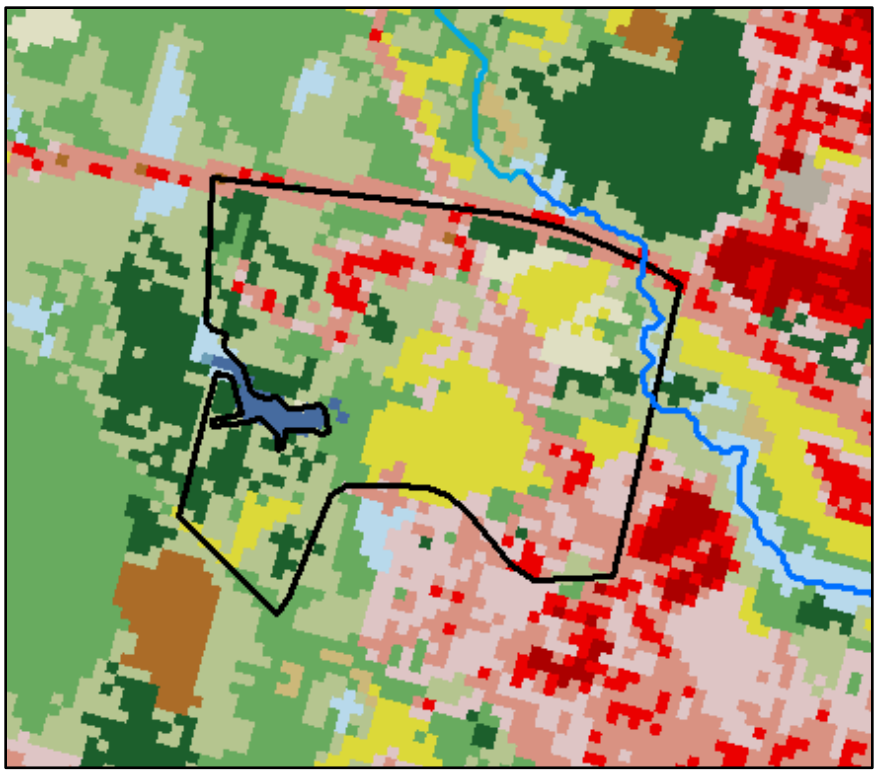

Figure D-5 - Sample Area and Existing Landcover

In the next step, percentages of various land cover types from the NLCD were determined and this percentage breakdown was applied to the remainder of the watershed. The various land cover values were randomly assigned to areas based on a weighted probability function with a distribution based on the sample area. An ArcPython script for ArcGIS was developed to perform this analysis. The resulting NLCD landcover distribution for the watershed under future buildout conditions is shown in Figure D-6. This approach essentially developed a future land cover data set that is statistically similar to the current land cover in the sample area.

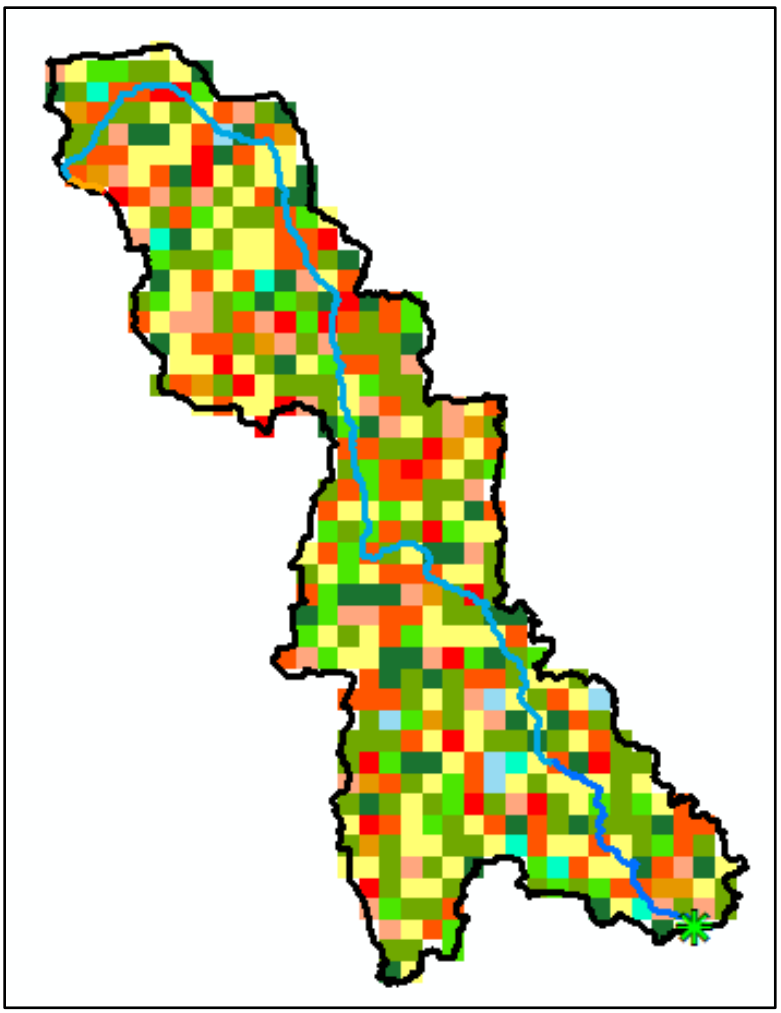

Figure D-6 - Random Landcover Raster Covering Watershed

Two versions of the future buildout NLCD landcover were developed. The first version (version 1) was based on the distribution in the sample area. The second version (version 2) was modified by forcing the percentage of open space (19%) to be equal to open space in current conditions (9%). The excess open space (10%) is considered developed. A summary of landcover types for current conditions and proposed future buildout conditions is provided below (Figure D-7).

Landcover	Value	11	21	22	23	41	42	43	71	81	90	
	Type	Open Water	Developed Open Space	Developed Low Intensity	Developed Medium Intensity	Deciduous Forest	Evergreen Forest	Mixed Forest	Grassland	Pasture/ Hay	Woody Wetlands	SUM OF WEIGHTS
Weights	Current	0.01	0.05	0.05	0.02	0.42	0.06	0.23	0.01	0.09	0.06	1
	Version 1	0.01	0.09	0.17	0.04	0.1	0.12	0.23	0.04	0.19	0.01	1
	Version 2	0.01	0.12	0.2	0.08	0.1	0.12	0.23	0.04	0.09	0.01	1

Figure D-7 - Landcover Types and Weighting Used in ArcPy Script

Version 2 (more conservative) of the future buildout NLCD landcover was combined with a wetlands layer and used to calculate a weighted Curve Number (CN) based on the underlying soils and the HSG type. The CN for existing conditions was estimated to be 68.1 and for buildout conditions 69.6.

SSURGO Soils

This product was used to derive the Prime Farmland and Hydrologic Groups in the Powdermill Brook Watershed. SSURGO datasets consist of map data, tabular data, and information about how the maps and tables were created. The extent of a SSURGO dataset is a soil survey area, which may consist of a single county, multiple counties, or parts of multiple counties. SSURGO map data can be viewed in the Web Soil Survey or downloaded in ESRI® Shapefile format. The coordinate systems are geographic. Attribute data can be downloaded in text format that can be imported into a Microsoft® Access® database.

Agricultural Land

The agricultural land within the breach inundation zone was estimated using the 2016 NLCD data. The land cover types associated with agricultural land were assumed to be cultivated crops and hay/pasture.

Hydrologic Soil Groups

This layer was derived from the USDA NRCS – SSURGO data for Massachusetts. The NRCS Soil Data Viewer version 6.2 was used, with ArcGIS 10.5. The attributes selected for this layer are under "Soil Qualities and Features" – Hydrologic Soil Groups. Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration, when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

Maine and Massachusetts 2015 QL1 and QL2 Lidar – Digital Elevation Model

The Maine and Massachusetts 2015 QL1 and QL2 LiDAR project called for the Planning, Acquisition, processing and derivative products of LIDAR data to be collected at an aggregate nominal pulse spacing (NPS) of 0.7 meters for the 5652 square miles of the QL2 Maine and Massachusetts AOIs, and an NPS of 0.35 meters for the 815 square miles of the QL1 Massachusetts AOI. Project specifications are based on the U.S. Geological Survey National Geospatial Program Base LIDAR Specification, Version 1.2. The data was developed based on a horizontal projection/datum of NAD83 (2011) UTM Zones 18 and 19, meters and vertical datum of NAVD88 (GEOID12A), meters. The application of GEOID12A was subsequently reversed for storage in the Digital Coast Data Access Viewer resulting in ellipsoid heights instead of NAVD88. Lidar data was delivered in RAW flight line swath format, processed to create Classified LAS 1.4 Files formatted to individual 1,500 meter X 1,500 meter tiles for the QL2 data and 750 meter X 750 meter tiles for the QL1 data. Corresponding 1-meter Intensity Image and 1-meter Bare Earth DEM tiles were created with the same tile schema. Breaklines were produced in Esri shapefile format. Lidar was partially collected in spring of 2015 and completed in winter 2015, while no snow was on the ground and rivers were at or below normal levels. In order to post-process the LiDAR data to meet task order specifications, Quantum Spatial established a total of 286 Land Cover control points in Maine, 255 Land Cover control points in Massachusetts UTM zone 18 and 29 Land Cover control points in Massachusetts zone 19.

The purpose of these lidar data was to produce high accuracy 3D hydro-flattened Digital Elevation Model (DEM) with a 1-meter cell size.

Data may be downloaded through The National Map Viewer (http://nationalmap.gov/viewer.html) or through NOAA Data Access Viewer (https://coast.noaa.gov/dataviewer) or through OLIVER: MassGIS's online Mapping Tool (http://maps.massgis.state.ma.us/map_ol/oliver.php).

Sub-Watershed Boundaries

Sub-watershed boundaries for evaluation of downstream hydrology were delineated using ArcGIS 10.5 Spatial Analyst tool and using USGS 1/3 arc-second Digital Elevation Model (DEM) terrain data.

HYDROLOGY AND HYDRAULIC ANALYSES

The hydrologic and hydraulic analyses were performed in support of meeting the requirements of TR 210-60 and 302 CMR 10.00: Dam Safety (Commonwealth of Massachusetts). The analyses completed as part of the project included a hydrologic and hydrologic analysis of the watershed upstream of Powdermill Dam using a SITES model, hydrologic analysis of the Powdermill Brook watershed using a HEC-HMS model, and hydraulic analysis for "with" and "without" dam scenarios for several recurrence intervals using a two-dimensional HEC-RAS model of Powdermill Brook. The "with" and "without" dam scenarios were modeled to evaluate the potential impacts on downstream properties. The results of the analysis were used as input for an economic analysis. In addition, WinDAM C model was used to develop dam breach hydrographs for seismic, static, and hydrologic dam breach conditions to evaluate consequences of dam breach, to confirm the hazard classification of the dam, and to develop breach inundation maps.

Hydrologic Analysis

HEC-HMS software package was used to develop a rainfall-runoff model for Powdermill Brook Watershed and to estimate inflow hydrographs for a two-dimensional HEC-RAS model. The Powdermill Brook watershed was divided into 7 sub-watersheds, represented by the schematic shown in Figure D-8.

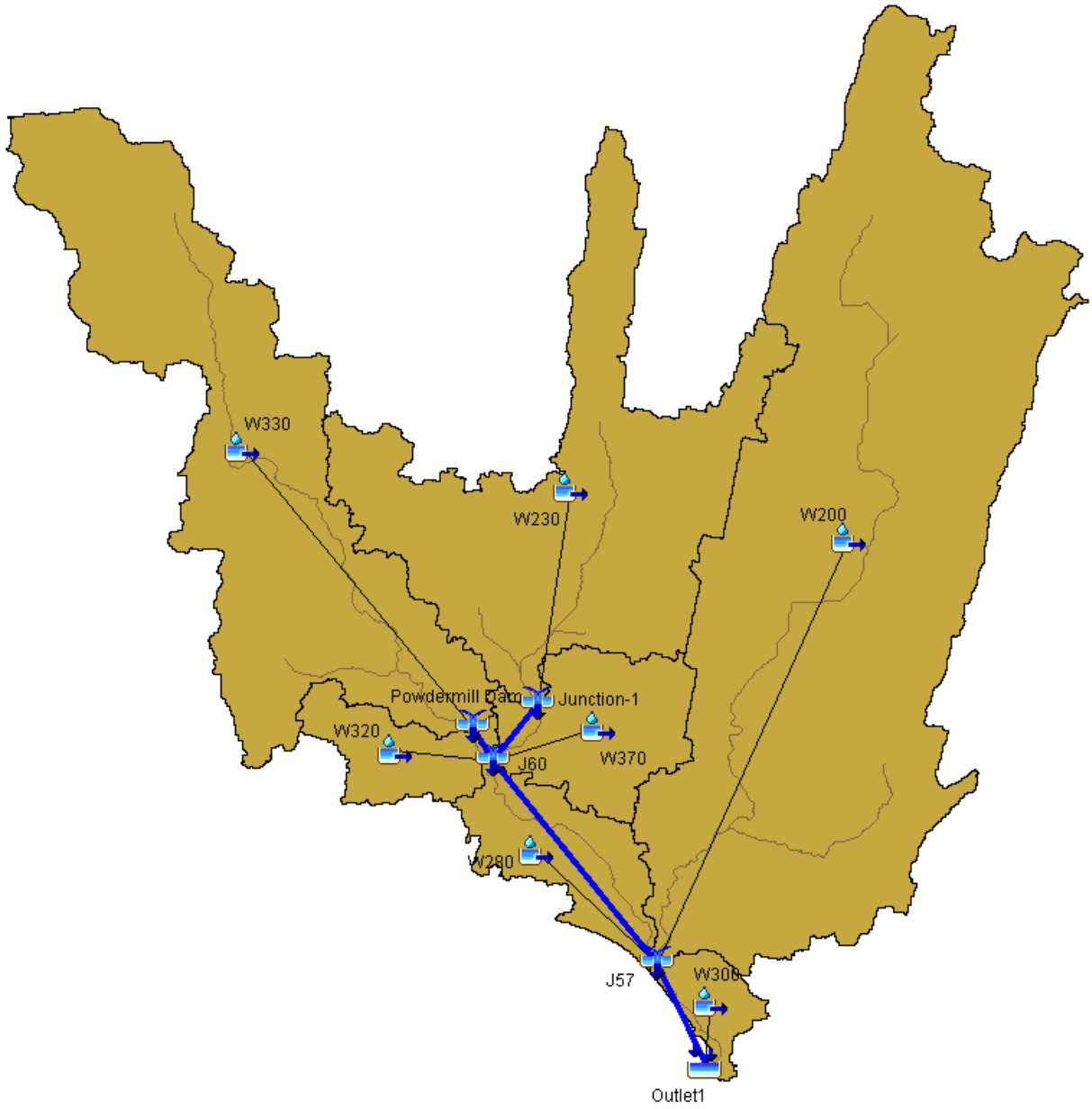

Figure D-8 – HEC-HMS Model Schematic

The components of the HEC-HMS model are described in the following sections. A summary of the resulting hydrologic parameters and hydrologic soil groups is provided in the tables below.

Table D-3 – Summary of Hydrologic Parameters

Sub-Watershed	Area (sq mi)	CN	Ia coeff	Lag (min)	Lag (hrs)
W200	8.95	59.22	0.20	454.52	7.58
W230	3.78	63.71	0.20	348.24	5.80

Sub-Watershed	Area (sq mi)	CN	Ia coeff	Lag (min)	Lag (hrs)
W280	0.81	72.46	0.20	122.56	2.04
W300	0.30	63.23	0.20	77.69	1.29
W320	0.56	51.72	0.20	217.01	3.62
W330	4.45	68.10	0.20	58.06	0.97
W370	1.00	53.42	0.20	219.20	3.65

Table D-4 – Hydrologic Soil Groups per Sub-Basin

Sub-Basin/HSG	Acres	Percent Sub-Basin
W200	**5727.37**	**45.05%**
A	3520.91	61.48%
B	416.71	7.28%
C	979.21	17.10%
C/D	5.46	0.10%
D	805.07	14.06%
W230	**2416.18**	**19.01%**
A	1495.31	61.89%
B	162.21	6.71%
C	671.30	27.78%
C/D	71.52	2.96%
D	15.84	0.66%
W280	**520.47**	**4.09%**
A	186.62	35.86%
B	235.26	45.20%
C	38.10	7.32%
D	60.49	11.62%
W300	**194.29**	**1.53%**
A	89.62	46.13%
B	71.41	36.75%
D	33.27	17.12%
W320	**360.05**	**2.83%**
A	328.21	91.16%
B	16.31	4.53%
C	15.53	4.31%
W330	**2851.06**	**22.43%**
A	705.98	24.76%
B	398.31	13.97%
C	1230.16	43.15%
C/D	339.19	11.90%
D	177.43	6.22%
W370	**642.91**	**5.06%**

Sub-Basin/HSG	Acres	Percent Sub-Basin
A	619.13	96.30%
B	23.78	3.70%
Grand Total	**12712.33**	**100.00%**

Rainfall

Point precipitation data for the 10-year, 25-year, 50-year, 100-year, 200-year, and 500-year and 24-hour durations were obtained from NOAA Atlas 14 (Table D-5). These rainfall volumes for each storm modeled were used to develop a site-specific frequency storm temporal distribution within HEC-HMS.

Table D-5 – NOAA Atlas 14 Rainfall Volume

Duration	Average Recurrence Interval (Years					
	10	25	50	100	200	500
	Precipitation (inches)					
5 minutes	0.41	0.518	0.609	0.733	0.828	0.925
15 minutes	0.683	0.864	1.02	1.22	1.38	1.54
1 hour	1.18	1.5	1.76	2.12	2.39	2.68
2 hours	1.51	1.91	2.24	2.69	3.03	3.4
3 hours	1.74	2.2	2.59	3.12	3.52	3.95
6 hours	2.2	2.84	3.37	4.1	4.63	5.22
12 hours	2.75	3.64	4.37	5.38	6.11	6.93
24 hours	3.31	4.46	5.41	6.72	7.67	8.74

Runoff Losses

The SCS curve number (CN) method was used to estimate runoff losses. CNs were developed using the National Engineering Handbook, Part 630, Chapter 9 based on cover type, hydrologic conditions, and hydrologic soil groups (HSGs) obtained from the following sources:

- NLCD land cover - https://www.mrlc.gov/data/nlcd-2016-land-cover-conus
- Soil Survey Geographic (SSURGO) database

For the watershed upstream of Powdermill Dam, future buildout conditions were also estimated using zoning information from the City of Westfield and used for determination of future buildout CN.

Runoff Transformation

The SCS Dimensionless Unit Hydrograph method was used to transform runoff volumes to flow hydrographs. This method consists of parameters such as rainfall duration (D), time-to-peak (T_p), time-of-recede (T_r), and peak flow (q_p). The dimensionless hydrograph is scaled by Lag Time (L)

and the Peak Flow (q_p) to produce the basic shape of unit hydrograph. Lag time can be calculated using various approaches, including the SCS lag equation and the segmental approach. The SCS lag equation is an empirical-based approach that estimates lag time directly. This approach is recommended for homogeneous basins less than 2,000 acres in size.

The SCS lag time equation is given as:

$$L = \frac{l^{0.8}(S+1)^{0.7}}{1900Y^{0.5}}$$

where:

L = lag time [hrs]
l = length of the longest path [ft]
Y = average watershed land slope [%]
S = maximum potential retention [inch]
= (1,000/CN) – 10
where:
CN = curve number

In the segmental approach, the parameter being estimated is essentially the time of concentration or longest travel time within the basin. The time of concentration is calculated individually for sheet flow, shallow concentrated flow, and channel flow. The sum of the individual travel times represents the time of concentration. USDA-NRCS relates lag time, L, and time of concentration, T_c, as:

$$L = 0.6T_c$$

For this analysis, the more detailed segmental approach was utilized to develop time of concentration (and lag time) for the watershed upstream of Powdermill Dam since time of concentration is one of the critical parameters for development of the design hydrograph. The individual segments were analyzed using the best available topography (LiDAR), aerial photography, and data obtained in the field. For the SITES analysis, the watershed upstream of Powdermill Dam was further divided to two sub-watersheds to account for a small dam upstream (Sportsmens' Club Dam) that needed to be modeled as breached for evaluation of Powdermill Dam due its non-compliance with NRCS TR 210-60 dam safety standards. The Sportsmens' Club Dam is a low-head dam with minimal storage capacity (estimated to be 26 ac-ft). Given the limited data available for the dam and its minimal storage capacity, dam breach hydrograph was developed using an Excel spreadsheet that incorporates TR-60 and TR-66 guidance. The spreadsheet was developed by the NRCS Water Quality and Quantity Technology Development Team and is available on NRCS website. The resulting dam breach hydrograph was added to the inflow hydrograph from the uncontrolled drainage area. Time of concentration was developed individually for both sub-watersheds.

For all other watersheds downstream of Powdermill Dam, the SCS lag equation was used to estimate lag time. The NRCS lag time equation's input parameters (flow length and average watershed land slope) were calculated for each sub watershed using HEC-GeoHMS. This approach was determined to be satisfactory for developing downstream hydrology and lateral

inflow hydrographs for hydraulic modeling and for evaluating flood damages for "with" and "without" dam scenarios.

Routing

The HEC-HMS model was not set up to perform the stream/river (reach element) since routing was performed directly in the HEC-RAS model.

Stage-Storage Relationship

The stage-storage relationship for the reservoir was updated using the latest LiDAR data and bathymetric survey performed in December 2019. The updated stage-storage relationship is presented in D-4.

Table D-6 – Stage-Storage Relationship

Stage Elevation [ft NAVD88]	Storage Volume Current [ac-ft]	
156.8	0.0	
157.0	0.0	
158.0	0.0	
159.0	0.1	
160.0	0.3	
161.0	0.5	
162.0	0.7	
162.3	**0.8**	◄ Normal Pool
163.0	1.1	
165.0	4.2	
167.0	12.9	
169.0	27.9	
173.0	78.6	
177.0	154.1	
181.0	258.3	
185.0	393.1	
189.0	553.4	
193.0	736.9	
196.0	888.9	
196.3	**906.1**	◄ Auxiliary Spillway Crest
202.0	1,233.7	◄ Existing Top of Dam
205.0	1,406.4	◄ Proposed Top of Dam

Hydraulic Analysis

A two-dimensional HEC-RAS hydraulic model was developed for hydraulic analysis of Powdermill Brook. The model domain extended from the dam site to the confluence with Westfield River. Unsteady flow modeling for several recurrence intervals was performed to simulate downstream flow conditions and estimate flood depth at impacted structures, roads, bridges, and culverts. For each model scenario, inflow hydrographs developed in the HEC-HMS model were dynamically linked with the HEC-RAS model. For the "without" dam scenarios, the storage area and the inline structure representing the reservoir and the dam were removed and a new geometry file was created.

LiDAR-based topographic data was used to develop model geometry. Manual adjustments were made to the terrain model in several areas, in particular around bridges, based on field measurements. Bridge and culvert dimensions were based on measurements obtained in the field durign the initial site reconnaissance. The model domain with boundary conditions and locations of stream crossings is shown in the figure below.

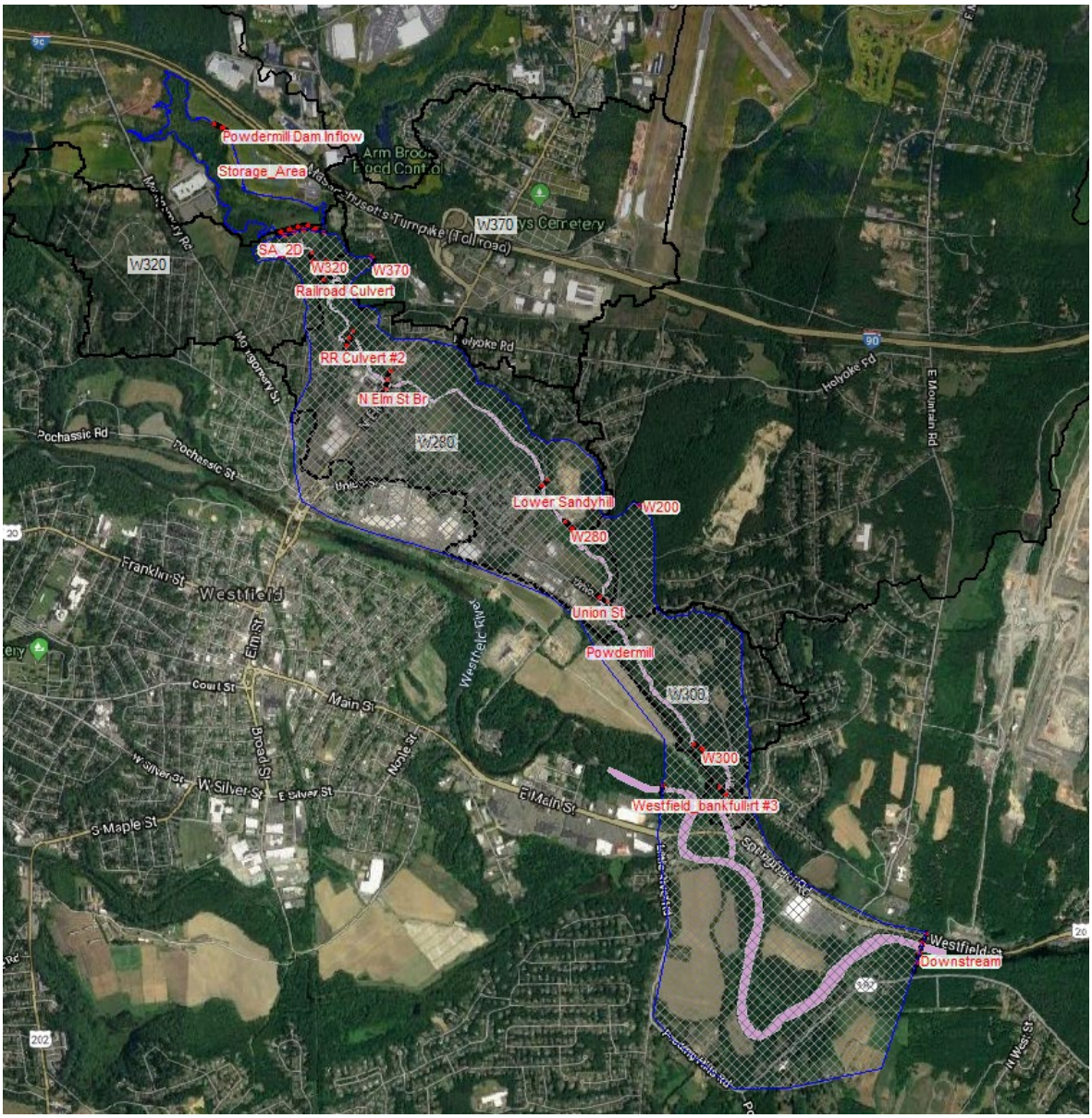

Figure D-9 – HEC-RAS Model Domain

Manning's n-values were assigned to each land cover type based on available guidance documents, including the HEC-RAS User's Manual and a publication by NRCS Kansas (Manning's n Values for Various Land Covers To Use for Dam Breach Analyses by NRCS in Kansas). The final Manning's n-values are provided in the table below.

Table D-7 - Manning's n-values

Land Cover	Manning's n-value
Open water	0.04
Developed, open space	0.04
Developed, low intensity	0.1
Developed, medium intensity	0.08

Land Cover	Manning's n-value
Developed, high intensity	0.15
Barren land rock/sand/clay	0.025
Deciduous forest	0.16
Evergreen forest	0.16
Mixed forest	0.16
Shrub/scrub	0.1
Grassland/herbaceous	0.035
Pasture/hay	0.03
Cultivated crops	0.035
Woody wetlands	0.12
Emergent herbaceous wetlands	0.07
Stream channel	0.03 – 0.04

Hydraulic Analysis Results

The hydraulic analysis was performed to estimate inundation depths at downstream structures for a range of flood recurrence intervals, from the 10-year to the 500-year floods, in support of the economic analysis. Flood inundation rasters for each recurrence interval were developed in HEC-RAS. Spatial location of structures downstream of the dam was obtained from a Microsoft Building Footprints layer available for ArcGIS. Flood depths at each affected structure (with at least 10% of the building footprint inundated) were extracted from the respective inundation rasters using GIS tools. The proposed rehabilitation alternatives do not negatively impact any downstream properties.

A comparison of peak discharges from the HEC-RAS model with a regression-based estimated peak flows from StreamStats is presented in the table below. Note that the model was not calibrated due to the absence of any stream flow or stage data on Powdermill Brook. Regression-based equations and methods are used to estimated peak flows in StreamStats and carry certain level of inaccuracy.

Table D-8 - Comparison of Flows at Key Locations

Location	HEC-RAS [cfs]			StreamStats [cfs]			StreamStats PIu [cfs]		
	10-yr	100-yr	500-yr	10-yr	100-yr	500-yr	10-yr	100-yr	500-yr
Powdermill Dam	265	325	1814	314	616	879	638	1380	2120
Powdermill Brook at Arm Brook confluence	374	659	2085	554	1060	1500	1120	2360	3610
Powdermill Brook at Pond Brook	1029	2295	4737	879	1660	2330	1780	3690	5580

Review of Hazard Classification

Breach inundation maps were developed to evaluate the current hazard classification and to estimate dam breach consequences for the Plan-EA. National Engineering Manual, Part 520, Subpart C - Dams (520.21), defines High Hazard Potential dams as structures where failure may cause loss of life or serious damage to homes, industrial or commercial buildings, important public utilities, main highways, or railroads. Furthermore, inundation maps showing discharge due to a sudden breach of the dam must be prepared. Unless otherwise determined by the NRCS State Conservation Engineer, the conditions at the time of breach may be water level in the reservoir at or above the crest elevation of the lowest open channel auxiliary spillway and "non-storm" conditions downstream of the dam.

Based on the Federal guidelines, the sunny-day failure at full-pool (auxiliary spillway crest) with non-storm conditions downstream can be considered the limiting case for determination of hazard classification. Therefore, the full-pool dam breach scenario was evaluated to confirm the dam hazard classification. The USDA-NRCS's WinDAM C computer program was used to generate the breach hydrographs, which were manually entered into the HEC-RAS hydraulic model. Table D-9 describes the key inputs for WinDAM C, including soil parameters, which were based on the geotechnical exploration performed as part of this project.

Table D-9 – WinDAM C Parameters

Parameter	Unit	Value	Basis for Value Assigned/Reference
Erosion Model	N/A	N/A	Hanson/Robinson Stress Erosion Model
Total Unit Weight	lb/ft^3	125	Based on geotechnical investigation
Erodibility Index (K_d)	$(ft/hr)/(lb/ft^2)$	50	Based on geotechnical investigation and *User Guide to WinDam Earthen Embankment Soil Inputs*
Undrained Shear Strength	lb/ft^2	300	Based on geotechnical investigation
Critical Shear Stress	lb/ft^2	0	Based on geotechnical investigation and *Development and Characterization of Soil Material Parameters for Embankment Breach*
<u>Upstream Embankment</u>			
Slope (H/V)	N/A	3.5	As-built drawings
Retardance Curve Index (or Manning n-value)	N/A	5.6	Used a Retardance Curve Index from Table 7-4, Part 650 Engineering Field Handbook, Chapter 7, Grassed Waterways, Retardance Class C; based on site visits (grass-legume mixture).
<u>Dam Crest</u>			
Width	feet	18	As-built drawings

Parameter	Unit	Value	Basis for Value Assigned/Reference
Retardance Curve Index (or Manning n-value)	N/A	0.020	Used Manning's n-value corresponding to sandy/gravel surface.
Downstream Embankment			
Slope (H/V)	N/A	3	As-built drawings
Retardance Curve Index (or Manning n-value)	N/A	5.6	Used Retardance Curve Index from Table 7-4, Part 650 Engineering Field Handbook, Chapter 7, Grassed Waterways, Retardance Class C; based on site visits (grass-legume mixture).
Plasticity Index	N/A	0	Based on geotechnical investigation
Particle Diameter	in	0.07	Based on geotechnical investigation
Vegetal Cover Factor (C_f)	N/A	0.75	Based on Table 7-3, Part 650 Engineering Field Handbook, Chapter 7, Grassed Waterways – grass mixture based on site visits.
Maintenance Code	N/A	2	Minor discontinuities in the cover (based on SITES reference manual)
Internal Erosion Conduit (width/height)	ft	0.25	Assumed
Invert elevation of Conduit	ft NAVD88	153.3	Assumed
Station of Conduit	ft	200	Assumed
Elevation to Start Routing	ft NAVD88	196.3	Based on full-pool elevation
Dam Base Elevation	ft NAVD88	156.8	Based on as-builts (converted from NGVD29)

Table D-10 - Peak Dam Breach Discharges

Breach Scenario	Peak Discharge [cfs]	Maximum Pool Elevation [ft]
Seismic Dam Breach	80	162.3
Static (Sunny-Day) Dam Breach	16593	196.3
Hydrologic Dam Breach	43260	203.75

Based on the limiting sunny-day dam breach scenario, there are 261 structures, 25 roadways, and 2 bridges that would be impacted by the static (sunny-day) breach and would experience flood depths greater than one foot resulting in likely loss of life. Therefore, based on the Federal guidelines, there is no justification for lowering the high hazard classification.

Evaluation of Dam Performance

A SITES model was developed to evaluate the performance of the dam in accordance with TR 210-60 design criteria. The Principal Spillway Hydrograph (PSH), the Stability Design Hydrograph (SDH), and the Freeboard Hydrograph (FBH) provide basis for evaluating dam capacity and stability and integrity of the auxiliary spillway in accordance with TR 210-60 design criteria (see additional information below). The Probable Maximum Precipitation (PMP) data was obtained from the Hydrometeorological Report (HMR) 51 – Probable Maximum Precipitation Estimates, United States East of the 105th Meridian. A summary of TR 210-60 design hydrographs and the corresponding rainfall values are provided in Table D-11.

The precipitation values for the Principal Spillway Hydrograph and the Stability Design Hydrograph include a 100-year precipitation component obtained from the NOAA Atlas 14 data (Table D-5).

The remaining hydrologic parameters that were used for the SITES analysis are described in the Hydrologic Analysis section above. As discussed previously, the watershed upstream of the Powdermill Dam was divided into two sub-watersheds to account for the breach wave from a private dam that does not meet TR 210-60 criteria. The breach hydrograph was developed using TR-66 guidance document.

Table D-11 – TR 210-60 Design Hydrographs and Rainfall/Runoff Volumes

Principal Spillway Hydrograph	**100-year Return Period**	**Source**
Distribution	*NRCS, 1-day/10-day*	
1-day Rainfall , inches	*8.74*	*NOAA Atlas 14*
10-day Rainfall, inches	*15.10*	*NOAA Atlas 14*
1-day Runoff, inches	*3.2*	*Figure 21-2 & 21-3, Part 630, Ch 21*
10-day Runoff; inches	*8.0*	*Figure 21-2, Part 630, Ch 21*
Stability Design Hydrograph	P_{100} + 0.26 (PMP - P_{100})	
Distribution	*NRCS, 6-hour*	
Rainfall, inches	*10.46*	*NOAA Atlas 14 & HMR51*
Freeboard Hydrograph	PMP	
Distribution	*NRCS, 6-hour; and NRCS, 24-hour 5-point PMP Distribution*	
6-hour Rainfall inches	*25.34*	*HMR51*
24-hour Rainfall, inches	*31.49*	*HMR51*

Soil parameters and material properties for stability and integrity analysis were developed based on data obtained as part of the geotechnical investigation. The auxiliary spillway was modelled with three soil layers:

- F – Fill material (ML, SM)
- A1 – Alluvial 1 deposits – stream channel / terrace (SP-SM, SP)
- A2 – Alluvial 2 deposits – varved material (thin veneer of SP-SM overlying varved ML with thin clay varves at variable spacing)

No rock was encountered in the borings completed in the auxiliary spillway. A summary of the soil parameters is provided in Table D-12. Figure D-10 shows the auxiliary spillway profile with the corresponding material stratification.

Table D-12 – SITES Material Properties

Material	Topsoil	Fill	Alluvial 1	Alluvial 2
USCS Classification	Same as FILL	ML, SM	SP-SM, SP	ML with CH
Plasticity Index	0	0	0	0
Dry Density (pcf)	90	90	95	85
Percent Clay (%)	2	2	0	6
Rep. Dia, D_{75} (mm)	0.07	0.07	0.40	0.05

Head Cut (Erodibility) Index, K_h	0.02	0.02	0.03	0.02

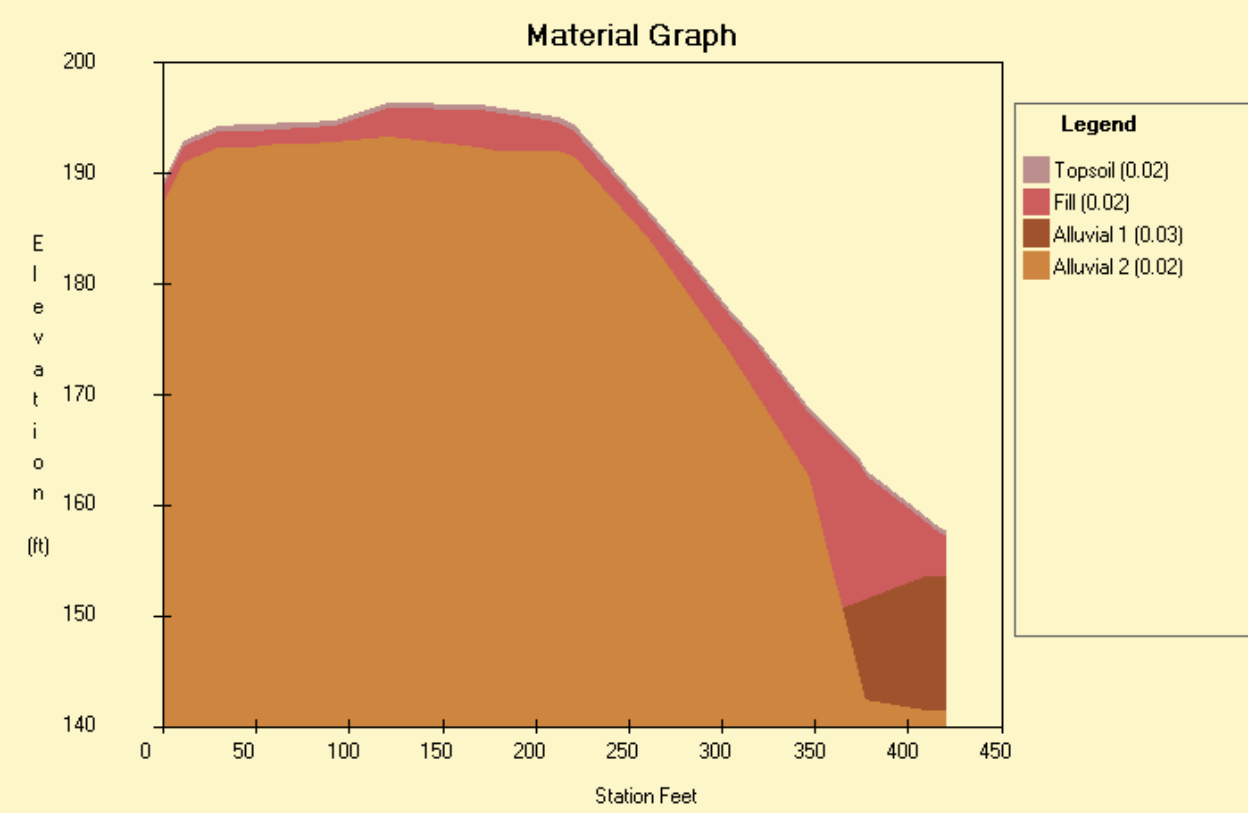

Figure D-10 – SITES Material Stratification of Auxiliary Spillway

Principal Spillway Design Criteria

For the PSH, a combined 1-day/10-day 100-year rainfall is used to analyze the capacity of the principal spillway. Typically, the objective is to pass the PSH without overtopping the auxiliary spillway; however, the NRCS allows for some overtopping if the spillway is considered "structural" (not applicable to the existing spillway). The pool elevation should be drawn down in 10 days passage of the PSH. If more than 15% of the storage at the maximum stage attained when routing the PSH remains after 10 days, the minimum elevation of the vegetated auxiliary spillway is typically raised to accommodate the remaining storm volume. If more than 15% of the PSH volume remains, the minimum elevation of the auxiliary spillway is typically raised to accommodate the remaining storm volume. Further routing of the FBH or SDH is performed with the starting reservoir elevation set to the 10-day drawdown water surface elevation.

Auxiliary Spillway Stability Design Criteria

The 6-hour SDH is used to evaluate the stability of the auxiliary spillway. During the design storm event, the auxiliary spillway should not experience excessive stripping of vegetation. The stress limitations may be increased 20 percent when the anticipated average use is once in 50 years or 50 percent when the anticipated average use is once in 100 years.

Auxiliary Spillway Integrity Design Criteria

The auxiliary spillway is evaluated for headcut development and advancement during the FBH event. The auxiliary spillway should pass the worst case of the 6-hour or the 24-hour FBH event without breaching.

Freeboard Design Criteria

The FBH is used to evaluate the total spillway flow and establish the minimum settled elevation of the top of the dam. In addition, the minimum elevation difference between the crest of the auxiliary spillway and the top of the dam must be 3 feet or higher. The auxiliary spillway should pass the worst case of the 6-hour or the 24-hour FBH event with the associated maximum water surface elevation at or below the crest of the top of the settled dam.

Commonwealth of Massachusetts, Department of Conservation and Recreation, Dam Safety Standards

According to 302 CMR 10.00: Dam Safety, for existing dams in the High Hazard category and intermediate and large size, the minimum design storm used to calculate required spillway capacity should be ½ PMF.

Existing Conditions

Based on the SITES analysis results, under existing watershed conditions the dam is overtopped both during the 6-hr and the 24-hr FBH storms. The required new top of dam for the controlling 6-hr FBH storm is 204.75 feet. For the future buildout watershed conditions, the new top of dam is 204.87 feet. In addition, the vegetated auxiliary spillway does not meet the stability (erosion resistance) design criteria and the integrity design criteria. To meet the stability and integrity design criteria, rehabilitation options would require armoring of the auxiliary spillway. The dam meets the spillway capacity and the floodwater retarding capacity criteria and, therefore, raising the crest of the auxiliary spillway is not required.

A summary of results for existing and future build-out conditions land use is presented in

Table D-13 and Table D-14, respectively.

Table D-13 – Existing Conditions SITES Analysis Results (Existing Land Use)

Storm	6-hour Duration		24-hour Duration		10-day Duration*	
	Outflow (cfs)	Peak Stage (ft.)	Outflow (cfs)	Peak Stage (ft.)	Outflow (cfs)	Peak Stage (ft.)
PSH (Runoff)	N/A	N/A	N/A	N/A	283.6	184.65
PSH (Rainfall)	N/A	N/A	N/A	N/A	329.2	194.63
SDH	2675	198.58	N/A	N/A	N/A	N/A
FBH	19688	204.75	11649	202.3	N/A	N/A
½ PMF	7464	200.79	N/A	N/A	N/A	N/A
*Note that the 10-day results (PSH) reflect the ASW being raised to meet the PSH criteria.						

Table D-14 - Existing Conditions SITES Analysis Results (Future Build-out Land Use)

Storm	6-hour Duration		24-hour Duration		10-day Duration*	
	Outflow (cfs)	Peak Stage (ft.)	Outflow (cfs)	Peak Stage (ft.)	Outflow (cfs)	Peak Stage (ft.)
PSH (Rainfall)	N/A	N/A	N/A	N/A	332.1	195.38
SDH	2896	198.71	N/A	N/A	N/A	N/A
FBH	20079	204.87	11711	202.32	N/A	N/A
*Note that the 10-day results (PSH) reflect the ASW being raised to meet the PSH criteria.						

Rehabilitation Alternatives

Rehabilitating Powdermill Dam to meet current Massachusetts and NRCS dam safety standards requires substantial modifications to the structure. Several alternatives were evaluated to rehabilitate the dam.

1. Dam Decommissioning - This action requires a controlled breach of the structure to reduce dam breaching hazard potential downstream. Since the regulatory floodplain (100-year) was established assuming the dam is in place, structures in the downstream flood zone would need to be relocated or floodproofed. This alternative removes the storage function of the dam and reconnects, restores, and stabilizes the stream and floodplain functions. Downstream flooding conditions would be similar to those that existed prior to construction of the dam. Therefore, all properties within the 100-year floodplain would need to be protected. A cost of $95 - $100 million was estimated that would include the relocation of the affected properties (118 residences, 29 apartment buildings, 30 businesses, and 3 public properties). Since relocating so many buildings was not only very expensive but also impractical, another effort was made to estimate the cost of floodproofing the affected buildings. This, too, proved very expensive - estimated at $15 - $20 million. Along with addressing the flooding of the buildings, this alternative would

also require modifying 26 roadways and 3 stream crossings so that flooding from a 100-year event would not impact vehicles as they traveled along these roads. And, at a minimum, partial removal of the dam's embankment would need to be completed so as to safely pass the 100-year, 24-hour frequency flood event, thus eliminating the structure's ability to store water. NOTE: Estimated cost only reflects cost to floodproof and/or relocate affected properties. Estimate does not include costs to decommission the dam, and upgrade stream crossings/roadways. Due to the exorbitant cost of relocating or floodproofing structures, this alternative was not studied in detail and eliminated from further study.

2. Alternative No. 1 involves constructing a 158-ft-wide, 6-cycle reinforced concrete labyrinth weir along with an earthen berm at the level control section of the existing auxiliary spillway. The chute of the labyrinth weir will be constructed of roller compacted concrete (RCC) with reinforced concrete sidewalls. An RCC stilling basin with riprap outlet protection will also be constructed at the toe of the chute. The dam crest will be leveled at existing EL 203 and existing depressions filled in. The pipe joints in the existing 48-inch diameter reinforced concrete principal spillway conduit will be re-grouted and a concrete sealant will be applied to the worn surfaces. In addition, a filter diaphragm will be constructed near the downstream slope around the existing principal spillway conduit. The existing bituminous coated corrugated metal pipe toe drains will be left in-place and filled with grout. New plastic pipe toe drains and a filter trench will be installed closer to the toe of the dam slope. Some sediment will be removed immediately adjacent to the existing principal spillway riser along with removing the existing pond drain gate to allow Powdermill Brook to naturally re-establish through the floodpool. There will be no change in the current levels of flood protection downstream as a result of project activity.

3. Alternative No. 2 involves raising the top of dam elevation to EL 205 and constructing a 106-ft-wide, 4-cycle reinforced concrete labyrinth weir along with an earthen berm at the level control section of the existing auxiliary spillway. The chute of the labyrinth weir will be constructed of roller compacted concrete (RCC) with reinforced concrete sidewalls. An RCC stilling basin with riprap outlet protection will also be constructed at the toe of the chute. The pipe joints in the existing 48-inch diameter reinforced concrete principal spillway conduit will be re-grouted and a concrete sealant will be applied to the worn surfaces. In addition, a filter diaphragm will be constructed near the downstream slope around the existing principal spillway conduit. The existing bituminous coated corrugated metal pipe toe drains will be left in-place and filled with grout. New plastic pipe toe drains and a filter trench will be installed closer to the toe of the dam slope. Some sediment will be removed immediately adjacent to the existing principal spillway riser along with removing the existing pond drain gate to allow Powdermill Brook to naturally re-establish through the floodpool. There will be no change in the current levels of flood protection downstream as a result of project activity.

4. Alternative No. 3 involves raising the top of dam elevation to EL 205 and constructing a 265-ft-wide level control section (reinforced concrete broad crested weir) along with an earthen berm at the level control section of the existing auxiliary spillway. An exit chute will be constructed of roller compacted concrete (RCC) with reinforced concrete sidewalls.

An RCC stilling basin with riprap outlet protection will also be constructed at the toe of the RCC chute. The pipe joints in the existing 48-inch diameter reinforced concrete principal spillway conduit will be re-grouted and a concrete sealant will be applied to the worn surfaces. In addition, a filter diaphragm will be constructed near the downstream slope around the existing principal spillway conduit. The existing bituminous coated corrugated metal pipe toe drains will be left in-place and filled with grout. New plastic pipe toe drains and a filter trench will be installed closer to the toe of the dam slope. Some sediment will be removed immediately adjacent to the existing principal spillway riser along with removing the existing pond drain gate to allow Powdermill Brook to naturally re-establish through the floodpool. There will be no change in the current levels of flood protection downstream as a result of project activity.

5. Nonstructural Alternatives - There are 492 buildings to elevate, floodproof and/or relocate downstream of the dam and elevate/modify 20 roadways/stream crossings. The estimated cost of this alternative was estimated at $210 - $220 million dollars. NOTE: Estimated cost only reflects cost to floodproof and/or relocate affected properties. Estimate does not include costs to purchase deed restrictions and modify stream crossings/roadways. Because of exorbitant costs of relocating or floodproofing structures, this alternative was not studied in detail and eliminated from further study.

6. Future Without Federal Investment Alternative (FWOFI) – The FWOFI alternative, also known as the No Action or Future Without Project alternative, would rehabilitate the dam to DCR standards (½ PMF). The FWOFI alternative involves stabilizing the 260-ft-wide existing auxiliary spillway using articulated concrete blocks (ACBs) and constructing a concrete cutoff wall at the downstream toe of the spillway. An ACB stilling basin with riprap outlet protection will also be constructed at the end of the auxiliary spillway. The dam crest will be leveled at existing EL 203 and existing depressions filled in. The pipe joints in the existing 48-inch diameter reinforced concrete principal spillway conduit will be re-grouted and a concrete sealant will be applied to the worn surfaces. In addition, a filter diaphragm will be constructed near the downstream slope around the existing principal spillway conduit. The existing bituminous coated corrugated metal pipe toe drains will be left in-place and filled with grout. New plastic pipe toe drains and a filter trench will be installed closer to the toe of the dam slope. Some sediment will be removed immediately adjacent to the existing principal spillway riser along with removing the existing pond drain gate to allow Powdermill Brook to naturally re-establish through the floodpool. There will be no change in the current levels of flood protection downstream as a result of project activity.

The table shows a comparison of peak flows and stages between the existing conditions and the preferred alternative (Alternative 1). Only the controlling 6-hr FBH event is presented.

Table D-15 – Comparison of SITES Analysis Results

Alternative	FBH		200-yr		500-yr	
	Peak Outflow (cfs)	Peak Stage (feet)	Peak Outflow (cfs)	Peak Stage (feet)	Peak Outflow (cfs)	Peak Stage (feet)
Existing	20079	204.87	690	196.59	1814	197.49
Alternative 1	20151	202.91	728	196.56	1956	197.25

SOCIAL AND ECONOMIC CONDITIONS

Economic Analysis

The NRCS National Watershed Program Manual (NWPM) was used as a reference for the economic analysis along with three other documents: the *National Resource Economics Handbook, Part 611 Water Resources Handbook for Economics*, USDA/Natural Resources Conservation Service, July 1998; *Principles and Guidelines for Water and Land Related Resources Implementation Studies (P&G)*, December 1983; and *Guidance for Conducting Analyses Under the Principles, Requirements, and Guidelines for Water and Land Related Resources Implementation Studies and Federal Water Resource Investments (PR&G), DM 9500-013*. The latter includes requirements set forth in the Council on Environmental Quality (CEQ) *Principles and Requirements for Federal Investments in Water Resources (P&R)* and *Interagency Guidelines (IAG)*. DM 9500-013 provides guidance on completing a PR&G analysis, including steps in the planning and evaluation process, differences between project- and programmatic-level evaluations, direction on incorporating an ecosystem services framework, and techniques for economic analysis.

PR&G requires that public benefits (monetary and non-monetary) be maximized relative to cost. Furthermore, there is not a hierarchal relationship among the economic, social, or environmental goals. In general, the economic, social, and environmental impacts presented in this plan were developed based on PR&G utilizing methods of evaluating rural community flood reduction damages and related impacts. In order to estimate annual benefits of Powdermill Dam, average annual floodwater damages and impacts as the result of no dam in place were compared to average annual floodwater damages and impacts with the dam in place.

In cooperation with local interests that have oversight or implementation authorities and responsibilities, the preferred alternative was identified. This alternative was fully considered and carried forward into the final array of solutions and given full and equal consideration in the decision-making process.

PR&G allows a wide range of alternatives to illustrate the range of potential tradeoffs among environmental, economic, and social goals. Alternatives considered included the Future Without Federal Investment (FWOFI) Alternative, nonstructural alternatives, the preferred alternative, and

the National Efficiency Evaluation (NEE) Alternative. Alternatives were compared against the FWOFI Alternative which involved projecting existing resources and conditions into the future to establish a benchmark against which alternatives were evaluated. Tradeoffs between alternatives with respect to environmental, economic, and social goals were identified.

The Federal Objective, as set forth in the Water Resources Development Act of 2007, specifies that Federal water resources investments shall reflect national priorities, encourage economic development, and protect the environment by: (1) seeking to maximize sustainable economic development; (2) seeking to avoid the unwise use of floodplains and flood-prone areas and minimizing adverse impacts and vulnerabilities in any case in which a floodplain or flood-prone area must be used; and (3) protecting and restoring the functions of natural systems and mitigating any unavoidable damage to natural systems.

The Guiding Principles constitute the concepts that should consider when analyzing Federal investments in water resources and the General Requirements are topics that agencies must consider when analyzing Federal investments in water resources. The following Principles constitute the overarching concepts the Federal government seeks to promote through Federal investments in water resources now and into the foreseeable future.

A. Healthy and Resilient Ecosystems. Federal investments in water resources should protect and restore the functions of ecosystems and mitigate any unavoidable damage to these natural systems.

B. Sustainable Economic Development. Federal investments in water resources should encourage sustainable economic development.

C. Floodplains. Federal investments in water resources should avoid the unwise use of floodplains and flood-prone areas and minimize adverse impacts and vulnerabilities in any case in which a floodplain or flood-prone area must be used.

D. Public Safety. Threats to people, including both loss of life and injury, from natural events should be assessed in the determination of existing and future conditions, and ultimately, in the decision-making process.

E. Environmental Justice. Environmental justice is the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. Agencies should ensure that Federal actions identify any disproportionately high and adverse public safety, human health, or environmental burdens of projects on minority, Tribal, and low-income populations.

F. Watershed Approach. A watershed approach to analysis and decision-making facilitates evaluation of a more complete range of potential solutions and is more likely to identify the best means to achieve multiple goals over the entire watershed.

According to PR&G, after preliminary consideration, agencies may remove from detailed study those alternatives that do not achieve the Federal Objective and Guiding Principles. In addition, alternatives that may at first appear reasonable but clearly become unreasonable because of cost, logistics, existing technology, social, or environmental reasons may also be eliminated from further analysis. These alternatives should be briefly discussed to indicate that they were considered, and the analysis should document the reason(s) why they were eliminated (e.g., they do not achieve the Federal Objective and Guiding Principles).

For this plan, several alternatives were eliminated from detailed study due to exorbitant cost. Following is a summary of these alternatives.

- **Decommissioning the Dam** – This alternative removes the storage function of the dam and reconnects, restores, and stabilizes the stream and floodplain functions. Downstream flooding conditions would be similar to those that existed prior to construction of the dam. NRCS policy does not allow induced damages as the result of project activity. Therefore, all properties subject to induced damages would need to be protected. This includes addressing induced damages to downstream properties, roadways, and crossings. Estimated Cost: $15 – $20 Million. NOTE: Estimated cost only reflects cost to floodproof and/or relocate affected properties. Estimate does not include costs to decommission the dam and upgrade road crossings/roadways. Due to the exorbitant cost of relocating or floodproofing structures, this alternative was not studied in detail and eliminated from further study.

- **Nonstructural** – This alternative leaves the dam in its current condition while relocating and/or floodproofing properties downstream that would be at risk from a dam failure. It would involve elevating, floodproofing and/or relocating buildings downstream of the dam; elevating/modifying roadways and stream crossings; and purchasing deed restrictions to restrict future development on land located between the 100-year storm and breach elevations. Estimated cost: $30 – $40 million. NOTE: Estimated cost only reflects cost to floodproof and/or relocate affected properties. Estimate does not include costs to purchase deed restrictions and modify road crossings/roadways. Due to the exorbitant cost of relocating or floodproofing structures, this alternative was not studied in detail and eliminated from further study.

In general, the National Economic Efficiency (NEE) benefits presented in this supplemental plan were developed based on PR&G utilizing methods of updating economic benefits (flood reduction benefits associated with the urban area, roadways, bridges, and other infrastructure) as well as social and environmental benefits. In order to display annual benefits of Powdermill Dam, for the structural scenario (rehabilitation of the dam), depicting average annual floodwater damages as the result of no dam in place was compared to average annual floodwater damages with the dam in place.

The Sponsors have indicated that without federal assistance, they would rehabilitate the dam according to DCR standards. According to their standards for existing dams, Powdermill Dam is not overtopped during the ½ PMF event and, therefore, the top of dam would not have to be raised. The proposed FWOFI rehabilitation alternative involves stabilizing the 260-ft-wide existing

auxiliary spillway using ACBs and constructing a concrete cutoff wall at the downstream toe of the spillway. Selecting an alternative involving federal funds would result in a cost avoidance by the City of Westfield and would be reflected as a benefit to the project. The FWOFI alternative has $6,236,500 in construction costs associated with rehabilitation to DCR standards. Amortized at 2.50% discount rate over 79 years, this annual cost of $195,300 is tracked as a beneficial value for the rehabilitation alternatives.

Along with the FWOFI alternative, three rehabilitation alternatives were identified and evaluated in detail:

1. Alternative No. 1 involves leveling the existing crest to EL 203 and constructing a 158-ft-wide, 6-cycle reinforced concrete labyrinth weir along with an earthen berm at the level control section of the existing auxiliary spillway and an RCC chute.

2. Alternative No. 2 involves raising the top of dam elevation to EL 205 and constructing a 106-ft-wide, 4-cycle reinforced concrete labyrinth weir along with an earthen berm at the level control section of the existing auxiliary spillway and an RCC chute.

3. Alternative No. 3 involves raising the top of dam elevation to EL 205 and constructing a 265-ft-wide level control section (reinforced concrete broad crested weir) along with an earthen berm at the level control section of the existing auxiliary spillway and a RCC chute.

The evaluation results indicated that the three alternatives have identical scope and equal effects. Benefits for each rehabilitation option are identical. However, Alternative No. 2, being the least cost, was the preferred alternative of the Sponsors and NRCS.

The preferred alternative will allow the Sponsors to comply with applicable dam safety and performance standards, to reduce the potential for loss of life, and continue protection of existing property and infrastructure downstream of the dam. The preferred alternative maximizes public benefits. For economics, average annual monetary benefits are estimated to be $390,700, which includes $195,400 flood damage reduction benefits and $195,300 cost avoidance benefits. Average annual cost is estimated at $238,900 resulting in net benefits of $151,800. Socially, the PMP storm event will be retained, thus minimizing the threat of a catastrophic dam failure (breach), and incidental recreation after construction will continue. And environmentally, adverse impacts will be minimized during construction. Long-term there would be adverse, although negligible, impacts.

In addition, one other overarching concern associated with dam rehabilitation analyses is the intent of the program to minimize threat to human life. Threat to human life is central to the dam rehabilitation program. Agency policy allows for use of the other social effects goal (account in P&G terms) to make the case for rehabilitating any given floodwater detention structure, even if the associated B/C ratio were less than 1:1. This is due to a priority placed on protecting lives. Also, trying to monetize the value of life, or in the case of dams, avoidance of loss of life, is fraught with subjective value judgments. Threat to human life can therefore be used to supersede purely economic considerations when deemed appropriate.

Environmental and Social Benefits

Environmental and social benefits were not monetized but are explained in detail for each alternative studied in detail in the Environmental Consequences Section of the Plan/EA and summarized in Table L –Summary and Comparison of Alternative Plans.

Stream Crossing Damages

For the breach analysis, NRCS policy, "Guidance for Completion of Evaluation of Potential Rehabilitation Projects" dated December 10, 2001, updated July 5, 2013, was utilized to estimate population at risk (PAR) for persons at risk in buildings and motorists downstream of the dam. The worksheet used to calculate PAR is separated into three sections: Structures (Elevated) Impacted by Potential Breach (i.e., mobile homes, etc.); Structures (with Foundations) Impacted by Potential Breach (homes, condos, commercial buildings, schools, etc.); and Highways and Railroads.

For the Highways and Railroads section, PAR is limited to road overflow depth (100-year storm) of 1.0 foot and greater. PAR where road overflow of less than 1.0 foot is not considered. There are a total of 43 roadways and three crossings that would be affected by a breach. However, twenty-four roadways and two crossings had overflow of depths less than 1.0 foot. Only one of the three crossings and nineteen roadways had floodwater depths greater than 1.0 foot.

For the economic analysis, there are three stream crossings and 26 associated roadways (areas located prior and after crossing) below Powdermill Dam within the project area affected by storms up to and including the 500-year event. A customized Excel worksheet (which has been utilized in multiple water resource projects in the past) was used. Past project's results formulated by the worksheet have been reviewed and concurred in by NRCS agency personnel at the State and national (NWMC) levels. Floods from the 2-year through the 500-year storms were included in the worksheet to estimate average annual damages to road crossings and roadways.

Urban Damages

Current, local tax appraisal district records were utilized in order to obtain the structural values of about 118 residences, 29 apartment buildings, 30 commercial and 3 public properties, and numerous outbuildings (sheds, workshops, etc.) that would be affected by project activities. Total value of properties: residential about $6 million; apartments $8 million, commercial $31 million; and public $700,000. Content values were estimated as a percentage (75%) of assessed property values. Estimated floodwater depths for various storms (including the 500-year storm) for each structure were extracted from the HEC-RAS inundation rasters for the with and without dam scenarios using ArcGIS tools. A Microsoft Building Footprints layer available in ArcGIS was the basis for flood depth extraction at each structure. The building footprints were spatially joined with publicly available tax assessor's data. Flood depths were calculated as the mean depth for the footprint of the building using ArcGIS tools. Structures that had a mean depth of flood depth of less than 0.1 ft, were excluded from the analysis. The elevation of the ground was based on LiDAR data obtained from MassGIS. Using photos taken during a field review in November 2019, elevation where damage starts for each property was estimated (e.g., basement window elevation

or first floor elevation). Floodwater data was then used with water depth to damage functions (*Floodwater Damage Estimated – Residential and Commercial Property*, USDA-NRCS) to estimate structural and content damages based on the point of entry where damages would begin, which in the case of the residences would be basement elevation. These depth-to-damage functions were specific for 1) different types of residences (i.e. one or two story homes with or without basements; split-level homes; mobile homes; apartments; etc.); and 2) over 30 different type of commercial and public properties. A similar analysis was conducted for vehicles located at residences, public properties, and businesses within the floodplain area. Using the same source as mentioned above, floodwater damages to vehicles located at affected properties were estimated, a conservative value of $7,500 per vehicle was used. Damages to other vehicles not located at each building but possibly in harm's way during a flood event were not included. Damage start for vehicle was 0.5 feet above ground surface elevation. It was estimated that each affected residence would have a minimum of two vehicles, public properties 1-3, and commercial properties 1-10.

It was determined that the cargo railroad than runs along the eastern boundary of the dam (Holyoke Branch) and continues to the south (New Haven and Hampton Railroad) would be affected by both the 200-year and 500-year storm events without the dam. Using information from *Compass International 2020 Construction Cost Estimating Data Publications, 2017 Railroad Engineering & Construction cost Benchmarks,* average annual damages to tracks (including repairs) without and with the dam were estimated.

All estimated values and damages were assessed within a customized Excel template prepared for this purpose.

Table D-16 - Floodwater Reduction Damages/Benefits Summary

Item	Average Annual Values		
	Damages Without the Dam	Damages With the Dam	Benefits
Floodwater Reduction			
Urban Structures	$148,200	$16,200	$132,000
Vehicles	$2,300	$500	$1,800
Road and Bridges	$85,600	$25,300	$60,300
Railroad	$1,300	$0	$1,300
Subtotal	$237,400	$42,000	$195,400
Total Floodwater Reduction	$237,400	$42,000	$195,400

As reflected in Table D-16, current average annual floodwater damages with the dam are $42,000. Floodwater damages without the dam were estimated to be $237,400. The difference of $195,400 reflects the average annual benefits that dam currently provides to downstream properties.

There are two critical facilities located within the 500-year floodplain without the dam scenario. One is a natural gas pressure control station and the other is a water well pump station. The gas pressure control station floods about 0.4 feet from the 500-year flood without the dam but does not flood with the dam. The water well pump station does not flood without the dam.

Incidental Recreation Benefits

Based on evidence found at the site and information from local people, the dam and reservoir, as well as Powdermill Brook, both upstream and downstream of the dam and reservoir, are used by some residents for recreational purposes. Incidental recreational activities such as fishing, hunting, and hiking/walking occur. However, since there is no official or unofficial count of usage, estimated number of annual visitor-days is not available. Therefore, incidental recreation impacts were not evaluated.

The City of Westfield is in process of completing a project known as the Columbia Greenway Rail Trail which will form a significant link in the New England Trail Network. Massachusetts Department of Transportation (MassDOT) is working on an extension from Southampton into Westfield. Linking the Greenway's northern terminus on the north bank of the Westfield River to that MassDOT effort, creating a continuous trail from New Haven and points south to Northampton and east to Boston, will involve establishing a multi-use trail across Powdermill Dam. However, no effort was made to estimate the impacts of this multi-use trail on recreational use of Powdermill Dam due to the small area that the proposed trail across the dam would entail.

Population at Risk (PAR)

The effect of a dam failure was measured as the net impact between a PMP storm event with no breach compared to a PMP storm event with a breach. Under the PMP without a breach scenario, many properties would be impacted by flooding. Thus, these properties were not accounted for under the PMP with a breach scenario. The properties and infrastructure potentially affected by the incremental effect of overtopping breach of the Powdermill Dam include: 363 residences, 82 apartments, 45 commercial structures, 2 public properties, numerous outbuildings (sheds, barns, etc.), 1 stream crossing (bridge), 19 roadways, and a cargo railroad.

Due to the potential catastrophic nature of a breach of Powdermill Dam, population at risk (PAR) was estimated. It should be noted that estimating a number for population at risk is based on professional judgment coupled with empirical data. However, conservative means were utilized in order to hopefully avoid misconceptions of the PAR leading to unwarranted fear. PAR estimates were provided for motorists, residents, and other people located downstream affected by the breach. These include people in cars (motorists) traveling on roads downstream of the dam and those living in homes and working in businesses.

Guidance for Completion of "Evaluation of Potential Rehabilitation Projects," December 10, 2001, updated July 5, 2013, was utilized to estimate PAR for residences and motorists downstream of the dam. According to the guidance, 3 people per residence are estimated to be at risk where floodwaters are greater or equal to 1.0-foot inundation depth above natural ground elevation. However, for buildings with furnished basements, people in those buildings would be considered at risk from floodwaters where water enters the basement (usually a small window). For public

and commercial properties, a reasonable number of people at risk should be used at the facility under normal conditions (not peak capacity). For paved roads with predominantly local traffic, two PAR are estimated to be at risk where floodwaters are road overflow depth of greater or equal to 1.0 foot. For state and federal highways with predominant traffic including non-local vehicles, four PAR are estimated to be at risk.

There are 363 residences located within the breach area. Using 3 people per residence provides an estimated PAR of 1,089. There are 82 apartments also within the breach area. Using 1.5 persons per building provides estimated PAR of 123. Forty-five businesses are also located in the breach area. Using 2 workers for each building results in an estimated PAR of 90. There are also 2 public buildings within the breach area, resulting in six PAR (3 per building). Total PAR for the urban buildings is 1,308. NOTE: In order to estimate population at risk (PAR) from a catastrophic dam failure for residents of apartment complexes, PAR within each affected apartment was estimated. For floodwater damage reduction effects, impacts to apartment buildings were estimated. Thus, in the narrative of the Plan/EA, "apartments" is associated only with PAR and "apartment buildings" is associated only with monetary value.

Eighteen roads in the breach area meet the definition of paved roads with predominantly local traffic, and one meets the definition for state and federal highways with predominant traffic including non-local vehicles. Two people per vehicle were used. Therefore, for the 18 local roads, using 1 vehicle per road results in 36 motorists at risk. For the other road, using 2 vehicles per road results in 4 motorists at risk. There is 1 crossing on the major road within the breach area. Using 2 vehicles and 2 motorists per vehicle results in 4 PAR. Total PAR for roadways and the crossing would be 44. Based on the above-mentioned scenarios, total PAR was estimated to be 1,352.

Period of Analysis Determination

The following was taken from *Sediment Survey Report for Powdermill Dam*, prepared by Aterra-Schnabel Joint Venture for this project.

"The total annual sediment accumulation rate based on the sediment survey was estimated to be 0.29 ac-ft per year. Using the typical distribution of submerged vs. aerated sediment ratio of 85%/15%, the required sediment storage for the next 55 years is 13.56 ac-ft of submerged sediment and 2.39 ac-ft of aerated sediment. The remaining submerged sediment storage is 0.8 ac-ft and, therefore, an additional 12.76 ac-ft of submerged sediment storage and 2.39 ac-ft of aerated sediment will need to be provided as part of the rehabilitation design. Powdermill Dam was originally planned and designed as a dry dam and, therefore, consideration should be given to reinstating the dry reservoir, in which case all sediment would be considered aerated sediment and the storage volume would have to be recalculated using a corresponding unit weight."

Since the dam was originally planned and designed as a dry dam, the new design will be for a dry reservoir. Thus, no dredging or other means is needed to meet the minimum 50-year sediment storage capacity and aerated sediment will be accounted for in the stage-storage curve.

Fifty-, 75-, and 100-year expected useful lives were evaluated (54, 79, and 104-year periods of analysis including 2 years for design and 2 years for construction). A net present value analysis was conducted comparing the three alternative periods of analysis. Average annual values were also estimated. All costs of installation, operation and maintenance were based on 2020 prices. The costs associated with designing and implementing all structural measures were assumed to be implemented over the four-year period. The federal action with a 79-year period of analysis yielded the highest net benefits using the mandated 2.50% discount rate for all federal water resource projects for FY21 to discount and amortize the anticipated streams of costs and benefits. NOTE: the FY23 discount rate is the same as the FY21 rate (2.50%). Therefore, there would be no change in the annualized value of benefits and costs.

Floodpool Risk Analysis

Planning principles were used to conduct an analysis of the risk associated with induced flooding due to floodpool water levels above the elevation of the flowage easement and the potential cost of meeting top of dam (TOD) easement policy. There are no buildings currently below the TOD elevation. However, for the analysis, a build-out of homes (where practical, meaning available and suitable land outside of the bounds of the upstream tributary) between the flowage easement and TOD was assumed. This would result in a total of 3 homes below TOD.

The City of Westfield flowage easement is currently below the auxiliary spillway (ASW) crest elevation of 196.3. At the ASW crest elevation, there is 0.41 acre outside of the current easement elevation. At the proposed TOD elevation (EL 205.0) there would be 10.1 acres outside of the current easement elevation.

For the analysis, the following assumptions were made: (1) the cost of easements for the additional acres of land (easement encumbrance costs and legal fees for each parcel owner); (2) the value of structures and parcels projected to be built based on average tax assessor values; and (3) estimated damages to projected structures from all storm events, as represented by the following specific modeled storms: 100-year), 200-year, 500-year, 1,000-year, and PMP event for the with rehabilitation conditions.

In order to determine the optimal easement elevation, an economic analysis of the various flood events upstream of the dam was completed. Average annual costs for each storm event induced from floodpool damages (average annual value of floodpool damages avoided) was compared to average annual cost of each procured easement (cost to avoid possible damages). The results are presented in the table below. Based on the analysis, the easement elevation of 199.1 NAVD 88 was the optimal easement.

NRCS policy states “As a minimum, landrights must be acquired to an elevation no lower than the maximum water surface elevation during passage of the 100-year, 24-hour storm through the dam or the minimum elevation determined to be appropriate and approved in the watershed plan, whichever is higher.

The landrights must include a prohibition on future construction of inhabitable dwellings below the elevation of the acquired landrights. The potential risks and liability the SLO and landowners

may be assuming for selecting landrights elevations lower than elevation of the PMF must be discussed with the SLO, disclosed to the public, and documented for future reference." (NRCS Circular 390-21-1, Attachment B, August 15, 2021.)

For Powdermill Dam, the minimum NRCS easement elevation is the ASW crest, which equates to an elevation of 196.3. Therefore, to meet minimum NRCS policy, the City of Westfield must procure a minimum of 0.415 acre of flood storage easements upstream of the dam.

This analysis, along with alternatives for managing floodpool risk, was presented to the City of Westfield. The alternatives presented were: (1) procure the minimum landrights and accept the potential risk and possible associated implications (whatever they might be) of not procuring landrights to top of dam; (2) acquire easements to the top of the dam; (3) procure an insurance policy explicitly for the floodpool risk; (4) acquire a waiver of the risk from all property owners of affected parcels below the top of dam; and/or 5) pass a setback ordinance preventing future development below the top of dam.

The City of Westfield decided to procure additional flood storage easements of 0.415 acre according to minimum NRCS land rights' policy. They prefer to accept this level of easement and its associated risk for potential damage. They accepted and have lived for over 50 years with the existing easement and its associated potential for risk of flood damage. They also recognize that the land rights must include a prohibition on future construction of inhabitable dwellings upstream from the dam below the elevation of the top of the dam.

Table D-17 - Economic Analysis of Various Floodpool Easement Elevations

Elevation Level	Elevation	Elevation Difference from TOD	Additional Acres Needed per Elevation	Cost of Procuring Additional Acres [1/]	Average Annual Cost of Additional Acres	Average Annual Benefits [2/]	Net Benefits
Proposed TOD	205.0	0.0	6.158	$286,700	$7,200	$3,100	-$4,100
1,000-year Event	199.1	5.9	0.969	$45,100	$1,100	$1,300	$200
500-year Event	198.2	6.8	0.734	$34,200	$900	$200	-$700
200-year Event	197.3	7.7	0.556	$25,900	$600	-$1,800	-$2,400
ASW (100-year event)	196.3	8.8	0.415	$19,300	$500	-$3,000	-$3,500

[1/] Costs include acquisition of land, legal fees, deed search, title fees, and closing costs.

[2/] Floodpool damages avoided due to easement acquisition.

ENVIRONMENTAL CONDITIONS

The onsite existing environmental conditions presented in this report were obtained from various resources, including the Aterra-Schnabel team, historical work plans and reports on Powdermill Dam, various online resources (both state and federal databases), and field observations. Evaluation and analyses of the anticipated environmental impacts from project work, as well as determination of mitigation measures, were performed by EA. Specific sources used for each environmental resource, along with their inherent uncertainties, are discussed below.

Soils

Soil information presented in this report was summarized from USDA NRCS WSS data (USDA NRCS 2019a). Online soil data from WSS was assumed to be accurate and utilized in the analysis of project impacts; no field surveys were conducted as a part of this project.

Geology

Geologic units in the LOD were identified using the 1:24,000 USGS bedrock lithology map of Westfield on Massachusetts Geographic Information System (MassGIS) online mapping tool, Oliver (USGS 2004). Descriptions of the formations were obtained from USGS (2014). Surficial geology information was obtained from the original Powdermill Brook Watershed Workplan (Hampden Soil Conservation District and City of Westfield 1961). Information on the sedimentation and sediment capacity of the dam was reported based on the results of the sediment survey conducted by Schnabel Engineering in November 2019 (Schnabel Engineering 2020). No additional geologic field mapping was performed as a part of this project.

Water Resources

Powdermill Dam is a flood control structure located on Powdermill Brook, a tributary of Westfield River and is located approximately 3 miles upstream of the confluence of Powdermill Brook with Westfield River. The Powdermill Dam watershed is an area of approximately 4.5 square miles (Westfield River Watershed Association 2019). Based on the U.S. Environmental Protection Agency (EPA) definition, Powdermill Brook impoundment and Powdermill Brook are considered Waters of the United States (EPA 2019a; U.S. Army Corps of Engineers 2012). Powdermill Brook impoundment and Powdermill Brook are considered impaired waters by EPA and MassDEP. EPA and MassDEP document that the 303(d) listed impairment for Powdermill Brook and the impoundment is for algae, E. coli, sedimentation/siltation, and turbidity. The National Wild and Scenic Rivers System website indicated that Powdermill Brook is not a wild, scenic, or recreational river. The dam is not located within a Massachusetts coastal zone.

Wetlands

Wetlands data from two sources was mapped and reported. The primary wetlands data used to evaluate wetlands impacts was delineated by EA in August 2020 using USACE wetland delineation guidelines and classified using the Cowardin system (EA 2020). Additionally, wetlands data obtained from the USFWS NWI was obtained and depicted on Figure 9. The NWI

is a publicly available resource that provides detailed information on the abundance, characteristics, and distribution of U.S. wetlands (USFW 2007).

Floodplains

Flood zone data was obtained from the Federal Emergency Management Agency (FEMA) flood insurance rate map for the study area (Panel 25013C0190F) effective September 17, 2014. According to the FEMA map, the dam and portions of the LOD upstream of the dam are located in a special flood hazard area subject to inundation by a 1%-annual-chance flood event; no base flood elevations have been determined in the area.

Air Quality

According to the EPA Green Book for 8-Hour Ozone (2020), which provides information about designations, classifications, and nonattainment area status for the 8-Hour Ozone National Ambient Air Quality Standards (NAAQS), Powdermill Dam is not located in a nonattainment area. All concentrations are below EPA standards (MassDEP 2019b).

Plants

Vegetation communities and land cover types present in the project area were mapped using online MassDEP GIS data (2016). Ten discrete communities or land cover types occur in the LOD, including deciduous forest, developed open land, evergreen forest, grassland, impervious surfaces, palustrine emergent wetlands, palustrine scrub/shrub wetlands, pasture/hay, scrub/shrub, and water (MassGIS 2016). Additionally, information from MassDEP Division of Wetlands and Waterways, MassWildlife's NHESP, and Massachusetts's Department of Agricultural Resources was used to obtain a general sense of common trees, bushes, and plant species in the area, since official field surveys to identify vegetation types were not conducted for this project.

Special Status Plant Species
A USFWS IPaC report was generated for the project. The report did not list any threatened or endangered plant species in the project area. Massachusetts's Wildlife's NHESP lists threatened, endangered, and special concern plant species for each city in the Commonwealth (NHESP 2019b). No endangered plant species have been identified near the dam using the data publicly available by Massachusetts's Wildlife's NHESP; however, no official surveys have been conducted to determine the presence or absence of State Listed Plant Species. Formal consultation with NHESP was initiated in November 2020 and completed in January 2021.

Noxious Weeds and Invasive Plants
There are approximately 150 plant species classified by the Massachusetts Department of Agricultural Resources as prohibited (Massachusetts Department of Agricultural Resources 2020). During the onsite wetland delineation on 28 August 2020, common reed (*Phragmites australis*), which is a state and federally listed invasive plant species, was observed in abundance in the freshwater emergent wetlands and the freshwater forested/shrub wetlands upstream of the dam (EA 2020).

Animals

The Massachusetts Division of Fisheries and Wildlife provided fish data from stream surveys collected in 2001, 2006, and 2011 using the backpack electroshock method, which identified several common freshwater fish species in Powdermill Brook, both upstream and downstream of the Dam. The iNaturalist website was used to identify common wildlife species observed in the LOD. It was also assumed that common wildlife species who inhabit similar natural environments would likely also utilize the LOD.

Threatened and Endangered Species
A USFWS IPaC report has been completed for the project site, and one federally threatened species has the potential to be present in the project area: the northern long-eared bat (NLEB) (*Myotis septentrionalis*). There have been no documented observations of the NLEB in the LOD. The IPaC also listed several migratory birds, including bald eagles, which have the potential to be present in the project area during portions of the year.

A Massachusetts State Listed Animals Species list was accessed through Massachusetts Wildlife's NHESP (NHESP 2019b). The list includes three endangered species, four threatened species, and ten species of special concern present within the City of Westfield. However, Massachusetts NHESP has not conducted any official surveys within the LOD to determine the presence of state listed species.

There are no "estimated habitats of rare wildlife," which are lands that have had occurrences of rare wetland wildlife observed in the last 25 years, located in the LOD (NHESP 2017).

The USFWS and MassWildlife NHESP were consulted on the project in October 2022. A response from USFWS was received on 30 November 2022, in which USFWS provided clarification on the season cutting restrictions from NLEB and the future reclassification of the species. MassWildlife NHESP did not provide a response. Copies of the consultation letters and USFWS response are included in Appendix A.

Cultural Resources

A review of the Massachusetts Cultural Resources Inventory System (MACRIS) indicated the nearest recorded precontact Native American site is 19-HD-286 which is located approximately 2,500 feet east of the project area and is described as a lithic workshop site. There are seven additional recorded precontact Native American archaeological sites located within a mile of the project area and an additional twenty-four recorded precontact sites and one historic site located within 2 miles of the project area. These include nineteen camp sites, one isolated find, one fort, one flake scatter, one village site, one burial site, one petroglyph, and one lithic workshop /habitation site. There are also seven historic properties located within 2.5 miles of the project area. All of these properties are located within the Westfield Center Historic District located approximately 2 miles south of the area of APE.

NRCS has been in ongoing consultation with six federally recognized Indian Tribes who have expressed an interest in Hampden County Massachusetts. These consultation efforts are detailed

in Appendix A. Most recently, on July 21, 2023, a copy of the Phase 1A Report and Architectural Historian's Report prepared by SEARCH were submitted to the Delaware Tribe of Indians, the Mashpee Wampanoag Tribe, the Mohegan tribe of Indians of Connecticut, the Narragansett Indian Tribe, the Stockbridge-Munsee Community Band of Mohican Indians, and the Wampanoag Tribe of Gay Head (Aquinnah) Tribal Historic Preservation Officers on with a determination of No Historic Properties Affected. NRCS received concurrence from the Stockbridge-Munsee Community THPO on August 9, 2023. No comments were received from the Delaware Tribe of Indians, the Mashpee Wampanoag Tribe, the Mohegan tribe of Indians of Connecticut, the Narragansett Indian Tribe, and the Wampanoag Tribe of Gay Head (Aquinnah) Tribal Historic Preservation Officers during this most recent consultation effort. Nor where any comments received following our February 9, 2023, consultation efforts. Hard copies of the Phase 1A and Architectural Historians report were submitted to the Massachusetts SHPO on July 31, 2023, via certified mail and were received by SHPO staff on August 4, 2023. SHPO staff responded and reiterated that they have no concerns with the project and that the area of potential effect is not sensitive for containing historic or archaeological resources.

NRCS received no information regarding Traditional Cultural Properties within or near the APE that would be impacted by this project.

Natural Areas, Parklands, Recreation, and Scenic Beauty

Powdermill Dam is not located in an officially designated state natural area, as defined by USDA National Environmental Compliance Handbook Part 610.32 (USDA 2016).

Information regarding recreational land in the LOD was obtained from MassDEP (2019). There is no officially designated recreational land in the LOD.

The definition of scenic beauty from USDA National Environmental Compliance Handbook Part 610.35 takes into consideration landforms, water, vegetation, and structures, which all exist around Powdermill Dam. It was assumed that the scenic beauty and the rural nature at the dam site (and in the LOD) are valued by local residents.