DRAFT SUPPLEMENTAL WATERSHED PLAN and ENVIRONMENTAL ASSESSMENT
JEWELL BROOK WATERSHED DAM SITES #1, #2, #3 AND #5
(NID: VT00014, VT00015, VT00016, VT00017)
Town of Ludlow, Windsor County, Vermont

Dam Site #2

USDA – Natural Resources Conservation Service

Prepared by:
Natural Resources Conservation Service - Vermont

In Cooperation with
Town of Ludlow, Vermont

January 10, 2023

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DRAFT Supplemental Watershed Plan No. 02 & Environmental Assessment
Rehabilitation of Jewell Brook Watershed Dam Sites #1, #2, #3 and #5

Windsor County, Vermont

Prepared by:
U.S. Department of Agriculture, Natural Resources Conservation Service
In Cooperation with:
Town of Ludlow, Vermont

AUTHORITY:

The original watershed work plan was prepared, and works of improvement have been installed, under the authority of the Watershed Protection and Flood Prevention Act of 1954 (Public Law 83-566) as amended. The rehabilitation of the Jewell Brook Dam Sites is authorized under Public Law 83-566 (as amended), and as further amended by the Small Watershed Rehabilitation Amendments of 2000 (Section 313 of Public Law 106-472).

ABSTRACT:

This Supplemental Watershed Plan No. 01 provides a plan to address regulatory deficiencies identified at each of the four (4) Jewell Brook Watershed Dam Sites to bring the dams into compliance with applicable United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) and Vermont Department of Environmental Conservation (DEC) – Dam Safety Division criteria and performance standards. The dams were designed by NRCS and completed from 1969 – 1972 as High hazard potential dams. A 2015 assessment of all four (4) dams found that each dam site has various deficiencies as described herein and that Jewell Brook Dams #2, #3, and #5 had severe erosion as a result of auxiliary spillway flow during Tropical Storm Irene in 2011, which were repaired in 2012.

As a part of the planning process, reasonable alternatives studied in detail included No Federal Action, Future Without Federal Investment (FWOFI) and Structural Rehabilitation. Additional alternatives considered but not advanced to detailed study due to exorbitant cost, environmental impacts, social impacts, or other considerations included decommissioning, non-structural measures and several rehabilitation measures.

The preferred alternative includes structural rehabilitation of each dam to meet applicable NRCS and State of Vermont dam safety performance criteria and standards and maintain the originally designed level of flood control and reduced damages. Each alternative provides the least impacts to environmental and natural resources, least impacts to social and cultural resources and represents the least cost alternative. Under the recommended plan, economic benefits will exceed project costs; total installation costs are estimated to be approximately $39,843,500, of which $11,035,200 will be incurred by the local Sponsor with $28,808,300 funded by NRCS.

COMMENTS AND INQUIRIES:

Comments and inquiries must be received by February 16, 2023. Submit comments and inquiries to Robert Thompson, P.E., State Engineer, USDA/NRCS – VT, 356 Mountain View Drive, Suite 105, Colchester, Vermont 05446, 802-951-6796, bob.thompson@usda.gov.

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Jewell Brook Watershed Dam Sites #1, #2, #3 and #5

Supplemental Watershed Agreement No. 02

between the
Town of Ludlow, Vermont
(Referred to herein as Sponsor)
and the
United States Department of Agriculture
Natural Resources Conservation Service
(Referred to herein as NRCS)

Whereas, the original Watershed Plan Agreement for the Jewell Brook Watershed, State of Vermont, executed by the Sponsors named therein and NRCS, became effective on the 3rd day of April 1964; and

Whereas, a Supplemental Watershed Plan Agreement No.1, for the Jewell Brook Watershed, State of Vermont, executed by the Sponsors named therein and NRCS, became effective on the 22nd, day of June 1966; 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 the Jewell Brook Watershed, State of Vermont, 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 supplemental watershed project plan no. 01 and environmental assessment for works of improvement for the rehabilitation for the Jewel Brook Watershed (Jewell Brook Dams VT00014, VT00015, VT00016, VT00017), State of Vermont, hereinafter referred to as the watershed project plan 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 (10-years) and evaluated (project) life (100-years) of the project (110-year total) 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 sponsors will acquire such real property as will be needed in connection with the works of improvement. 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 that 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 sponsor is legally unable to comply with the real property acquisition requirements, it agrees that, before any Federal financial assistance is furnished, it 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 estimated total rehabilitation costs to be paid by the sponsors and by NRCS are as follows:

Table S-1: Cost Share Table for Rehabilitation of Jewell Brook Sites 1, 2, 3 and 5					
Works of Improvement	NRCS		Sponsor		Total
Cost-Sharable Items	Percent	Cost	Percent	Cost	Cost
Rehabilitation of Sites 1, 2, 3 and 5	n/a	$20,308,300	n/a	$10,185,200	$30,493,500
Real Property Rights	0%	$0	100%	$250,000	$250,000
Sponsor Project Administration	n/a	n/a	100%	$500,000	$500,000
Subtotal Cost-Sharable Costs	65%	$20,308,300	35%	$10,935,200	$31,243,500
Non-Cost Sharable Items					
NRCS Technical Assistance/Engineering	100%	$7,500,000	0%	$0	$7,500,000
NRCS Project administration	n/a	$1,000,000	n/a	$500,000	$1,500,000
Permits	0%	$0	100%	$100,000	$100,000
Subtotal: Non-Cost-Share Costs	n/a	$8,500,000	n/a	$600,000	$9,100,000
Total Costs	n/a	$28,808,300	n/a	$11,035,200	$39,843,500
Annual O&M Costs	$0	0%	$22,100	100%	n/a

1. Price base 2021.
2. Maximum Public Law 83-566 cost-share is 65% of eligible cost-sharable items, not to exceed 100% of total construction costs.

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 retarding pool 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. For plans approved as of the date of this revised manual 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 evaluated (project) life (100-years). 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 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. The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, SW., Washington, DC 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

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 sub-recipients 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.

(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 5 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)

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 31 U.S.C. 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. (Applicable if this agreement exceeds $100,000, or a facility to be used has been subject of a conviction under the Clean Air Act (42 U.S.C. Section 7413(c)) or the Federal Water Pollution Control Act (33 U.S.C. Section 1319(c)) and is listed by EPA, or is not otherwise exempt.)

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 agree 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, plan, 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, plan, 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 sponsor 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 signing of this Public Law 83-566 Watershed Agreement by an authorized representative of the Sponsor indicates that the Sponsor has reviewed this agreement and the Jewell Brook Dams Supplemental Watershed Plan No. 01-Environmental Assessment and concur with the intent of contents of such. The Sponsors and NRCS further agree to all other terms, conditions, and stipulations of said watershed agreement not modified herein."

The signing of this plan was authorized by a resolution of the Town of Ludlow adopted at a meeting held on _____.

Town of Ludlow, Vermont
P.O. Box 359
37 Depot Street
Ludlow, Vermont 05149

By: _____

Title: _____

Date: _____

U.S. Department of Agriculture
Natural Resources Conservation Service

Approved by:

_____
Travis Thomason, State Conservationist
USDA Natural Resources Conservation Service
356 Mountain View Drive, Suite 105
Colchester, VT 05446

Summary

Summary Watershed Plan – Environmental Assessment Document
For
Jewell Brook Watershed Dam Sites #1, #2, #3 and #5
Ludlow, Windsor County, Vermont
Congressional District: At-Large

Authorization for Original Work Plan: The original watershed work plan was prepared, and works of improvement have been installed, under the authority of the Watershed Protection and Flood Prevention Act of 1954 (Public Law 83-566) as amended.

Authorization for Rehabilitation / Supplemental Work Plan: The rehabilitation of the Jewell Brook Watershed Dam Sites is authorized under Public Law 83-566 (as amended), and as further amended by the Small Watershed Rehabilitation Amendments of 2000 (Section 313 of Public Law 106-472).

Sponsor: Town of Ludlow, Vermont.

Proposed Action: Rehabilitation of the Jewell Brook Watershed Dam Sites #1, #2, #3 and #5.

Federal Objective: 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.

Purpose and Need for Action: The purpose of the Jewell Brook Dams project is to bring each dam site structure into compliance with NRCS and VT Dam safety and engineering criteria and performance standards and to provide flood protection to the watershed for the next 100 years while minimizing environmental, economic, and social impacts.

There is a need to bring the existing dam site structures up to current safety and performance standards to reduce the risk of loss of life due to a breach of the existing dams and to reduce risk of flood damage within the downstream flood zone to homes, commercial facilities, existing infrastructure, agriculture, and future development.

Preferred Alternative: Based on the supporting analysis performed and consultations with NRCS, the Agency Preferred, the National Economic Efficiency (NEE), and the Locally Preferred (PR&G) alternatives are identical. The Preferred Alternative involves Structural Rehabilitation to each of the four (4) dam sites. Observed deficiencies at each dam include (not limited to): insufficient hydraulic capacity of the spillways to achieve required freeboard, stability and integrity of each auxiliary spillway to safely pass the design storms without damage, less than required slope stability factors of safety and incompatibility of seepage filter material gradation and non-compliance with current NRCS filter criteria.

Project Measures: Rehabilitation measures to be implemented consist of soil borings, installation of new toe drain system on the downstream embankment; installation of an armoring system within the auxiliary spillway to address stability integrity concerns; and leveling the dam crest to provide required freeboard during design storm events.

Resource Information:

- Latitude and Longitude:

Jewell Brook Watershed Dam Site #1	43.362604N, -72.722844W
Jewell Brook Watershed Dam Site #2	43.367524N, -72.726936W
Jewell Brook Dam Watershed Site #3	43.391640N, -72.712228W
Jewell Brook Dam Watershed Site #5	43.380532N, -72.722589W

- Eight-Digit Hydrologic Unit Number:

Jewell Brook Watershed Dam #1, #2, #3, #5	01080106(0502)

- Watershed Size:

Jewell Brook Watershed Dam Site #1	1293.0 acres
Jewell Brook Watershed Dam Site #2	1209.5 acres
Jewell Brook Watershed Dam Site #3	913.0 acres
Jewell Brook Watershed Dam Site #5	1158.2 acres

- Land Uses in Drainage Area:

Land Use	**Dam Site #1**		**Dam Site #2**		**Dam Site #3**		**Dam Site #5**	
	Acres	%	Acres	%	Acres	%	Acres	%
Tree Canopy	1158.7	89.6%	1162.3	96.1%	710.6	77.8%	1103.2	95.3%
Grass/Shrubs	100.2	7.8%	38.6	3.2%	141.1	15.5%	53.6	4.6%
Bare Soil	0.79	0.06%	0.27	0.02%	12.6	1.4%	0.28	0.02%
Water	7.25	0.56%	2.5	0.2%	10.4	1.1%	0.83	0.07%
Buildings	1.98	0.15%	0.89	0.07%	5.5	0.6%	0.06	0.01%

Roads	15.5	1.2%	2.6	0.2%	14.5	1.6%	0.18	0.02%
Other Paved	8.6	0.67%	2.4	0.2%	18.2	2.0%	0.11	0.01%
Total	1293.0	100.0%	1209.5	100.0%	913.0	100.0%	1158.2	100.0%

Source: Vermont High Resolution Land Cover, 2016, University of Vermont Spatial Analysis Laboratory.

- Land Ownership in Drainage Area:

Land Ownership	**Dam Site #1**		**Dam Site #2**		**Dam Site #3**		**Dam Site #5**	
	Acres	%	Acres	%	Acres	%	Acres	%
Town of Ludlow (Dam Sites & Adjacent)	21.1	1.6%	128.2	10.6%	60.5	6.6%	61.0	5.3%
Town of Ludlow (Road Right-of-Way)	34.4	2.7%	13.1	1.1%	30.9	3.4%	0.0	0.0%
State of Vermont	178.0	13.8%	534.0	44.1%	99.4	10.9%	790.1	68.2%
Private	1,059.5	81.9%	534.2	44.2%	722.2	79.1%	307.1	26.5%
Total	1,293.0	100.0%	1,209.5	100.0%	913.0	100.0%	1,158.2	100.0%

Source: Statewide Standardized Parcel Data, 2020, The Vermont Center for Geographic Information.

- Climate: The average annual precipitation for Windsor County is 41.9-inchs and the average seasonal snowfall for Ludlow, Vermont is 90.7-inches (NOAA, 2019). In winter, the average mean temperature is 18.6 degrees Fahrenheit (^{o}F), and the average daily minimum is 8.6 ^{o}F. In summer, the average temperature is 63.5 ^{o}F, and the average daily maximum temperature is 76.5 ^{o}F (NOAA, 2019). The typical frost dates Windsor County, Vermont is September 19 – May 26, but may vary based on microclimate (NRCS AgACIS, 2000).

- Topography: The Jewell Brook Dams watershed and downstream affected area are within the Black River watershed at the eastern edge of the Green Mountains. The topography slopes from west to east, with the highest points on Ludlow Mountain, elevation 3,343', and South Mountain, approximate elevation 3,170', both of which are within the Okemo State Forest and straddle the Windsor/Rutland County line, and lowest points at the Black River, near elevation 1,000'.

- Population and Demographics:

Population & Demographics				
Beneficiary	**Ludlow**	**Windsor County**	**Vermont**	**U.S.**
Population (July 1, 2019)	1,955	55,062	623,989	328,239,523
Under 18 Years of Age	332	9,856	114,189	73,197,413
Over 65 Years of Age	482	13,325	124,797	55,159,521
Per Capita Income[1,3]	-	$35,152	$33,238	$32,621
Median Household Income[2]	$55,305	$58,303	$60,076	$60,293
Households, 2014-2018[3]	-	24,310	259,589	119,730,128
Median Value of Owner-Occupied Housing Units, 2014-2018[3]	-	$216,800	$223,700	$204,900
Percent of Persons Living in Poverty	15.9%	9.6%	11%	11.8%
1 – Per capita income in past 12 months (in 2018 dollars), 2014-2018 2 – Median household income (in 2018 dollars), 2014-2018 3 – No data available for towns under 5,000 people Source: U.S. Census Bureau 2019				

Table S-3: Summary of Resource Concerns:

Resource Concern	**Relevant to Proposed Action**	**Rationale**
Topography, Soils & Geology		
Soils	Yes	The proposed actions include leveling the top of embankment, widening the auxiliary spillways, and related work within the existing footprint to increase capacity, integrity, and stability.
Erosion & Sedimentation	Yes	Sites 2 & 5 have significant sediment accumulation within the pool area that requires dredging.

Prime & Unique Farmland	No	There are no anticipated changes in the current agricultural land use to non-agricultural land use within the affected area.
Water Resources		
Surface Water & Surface Water Quality	Yes	No waterbodies within the affected area of the sites are listed as impaired. Portions of Trailside Brook north and south of Site 3 are listed as stressed; Grant Brook north and south of Site 2 is used as a public water source.
Groundwater & Groundwater Quality	Yes	Sites 1 & 2 are within the Ludlow Groundwater Source Protection Area (SPA). There are no known contaminants to groundwater quality.
Floodplain Management	Yes	Review of the Federal Emergency Management Agency's Flood Insurance Rate Maps available for the Affected Area indicated no areas directly surrounding the dams as Zones A or AE. There are areas designated Zone X along Jewell Brook and surrounding the dams. The proposed action is to provide for the original design flood protection. This will not affect the currently mapped Flood Zones.
Regional Water Resource Plans	Yes	The Jewell Brook Dams were formulated under the "Jewell Brook Watershed Work Plan" completed in 1964. The Jewell Brook Watershed is part of the larger Black and Ottauquechee River watershed and is included in the 2018 Tactical Basin Plan.
Wild & Scenic Rivers	No	Jewell Brook and its tributaries are not listed as part of any wild or scenic rivers. It is noted that a segment of the Black River is on the NRI, however it is not relevant to the proposed action because no change to river hydrology or ecosystem conditions will occur.
Sole Source Aquifer	No	There are no designated sole source aquifers in Vermont.
Coral Reefs	No	There are no oceans or living coral reefs in the Jewell Brook watershed.

Wetlands & Waters of the U.S.		
Riparian Areas	Yes	Riparian areas are present in the vicinity of the Jewell Brook Dams. These are located along the edge of the retarding pools of all 4 dams as well as along the streams entering and exiting the pools.
Wetlands	Yes	Wetlands are extensively present surrounding the dam and retarding pools for each dam site. Each evaluated alternative, including the proposed action will have temporary and permanent impacts to wetlands within the affected areas.
Clean Water Act / Waters of the U.S.	Yes	The retarding pools, surrounding wetlands, and associated streams at all 4 dams are considered Waters of the U.S.
Biological Resources		
Endangered & Threatened Species	Yes	Consultation with the USFWS, including review an official list of species from the USFWS, indicates there is only one federal listed species in the entire project area, including all downstream affected areas, that being the Northern Long-Eared Bat. ~~. The USFWS IPaC~~ . A 4(d) Rule Verification Letter has confirmed the proposed work is currently allowed and does not require additional consultation, and any tree removal will occur outside of the NLEB active period of 4/1 through 10/31. Request for Concurrence of no adverse effects to NLEB submitted to USFWS, to apply to NLEB post-uplisting.
Plant Condition & Forest Resources	Yes	Plant condition within the Project Area is healthy; no degraded plant conditions were observed. Herbaceous and woody plants within the Affected Area, including staging areas and excess material disposal sites, will be disturbed.
Fish, Wildlife & Aquatic Resources	Yes	The Jewell Brook Watershed waters are notable for Brook Trout and other mixed species of Trout, including the Affected Environments at each dam site. Construction activities may cause temporary minor effects

		upon aquatic resources in the immediate area of the dams and downstream areas. Stream flows will be protected during construction with bypass piping.
Essential Fish Habitat	No	Consultation with NOAA/National Marine Fisheries Service states due to the lack of Atlantic Salmon presence, consultation is not required for this action.
Invasive Species	Yes	The reconnaissance survey for each dam site identified the presence of invasive species at dam sites #1, #3 and #5. Species included reed canary grass *(Phalaris arundinacea),* purple loosestrife *(Lythrum salicaria),* giant reed *(Phragmites australis),* and poison parsnip *(Pastinaca sativa).* Construction activities have the potential to introduce or spread invasive species.
Natural Areas	No	There are no natural areas within the Affected Environments at any of the four (4) dam sites.
Ecological Critical Areas	No	The USFWS IPaC review indicates no critical habitats at any of the four (4) dam sites. However, there is a potential presence of the federally threatened northern long-eared bat, and potential summer habitat must be considered when forest cutting is required.
Migratory Bird Treaty Act	Yes	The Jewell Brook Watershed and dam sites attract a variety of migratory bird species. Six migratory bird species, including bald eagle, have been identified by USFWS. However, consultation with USFWS concludes there are no nesting areas in the vicinity of the projects, no impacts resulting from the project are expected. The dams are not located in any Audubon Important Bird Areas. Temporary impacts may be caused to migratory birds from construction activities, and permanent impacts to birds would result from forest cutting for staging areas and/or excess material disposal areas.
Human, Economic & Social Conditions		

Land Use & Land Cover	No	The proposed action is not changing the land use in the immediate vicinity of the dams.
Public Health & Safety	Yes	The Jewell Brook Dams provide 100-year flood protection for residents, motorists, and other persons using downstream facilities. A breach of the dam would cause catastrophic property damage and loss of life in the downstream area. The proposed action is expected to prevent a breach of the dam from occurring.
Transportation	Yes	Site 1 Municipal-owned Road crosses the embankment of dam site #1; temporary impacts may occur during construction.
Floodwater Damage	Yes	The Jewell Brook Watershed dam sites provide flood protection and flood damage reduction for residents, motorists, and other persons using downstream facilities.
Environmental Justice & Civil Rights	Yes	Ludlow Village is on the list of designated places with LMISD (low/moderate income) of 55.4%.
Local and Regional Economy	Yes	Alternatives must be within the economic capacity of the Sponsor and address the needs of the community.
Economic Efficiency	Yes	Economic efficiency must consider the full range of costs and benefits of project alternatives.
Other Concerns		
Energy	No	The Jewell Brook Dams are not used as a source of energy.
Cultural Resources/Historic Properties/Scientific Resources	Yes	Consultation with SHPO and Tribes has been completed and documentation is attached in Appendix D.5. The Phase IA investigation identified several archaeologically sensitive areas, however a subsequent Phase IB investigation indicated no resources exist in these areas. Access to ASA's will be restricted to prevent any construction activities and avoid disturbance to the ASA's identified on the Plan-EA.

Air Quality / Clean Air Act	No	No long-term impacts are anticipated. Temporary construction activities may result in short term, direct, negligible adverse impacts to air quality but will be mitigated where possible, such as dust control.
Visual Impacts / Scenic Beauty	Yes	Minor impacts to scenic beauty will occur at each dam site through minor structural modifications, temporary land disturbance and select tree/vegetation removal, and disposal of excess dredging material.
Recreation & Parklands	Yes	Dam sites #3 and #5 have recreation adjacent to the Dams. Recreation would be temporarily impacted during construction activities.

Alternative Plans Considered:

No Action [NEPA]: The No Action alternative represents future conditions if no action is taken to address or correct any deficiencies over time at any of the four (4) dams, up to and including the point of theoretical dam breach failure. The No Action alternative leaves the public, environmental resources, cultural resources and infrastructure vulnerable from an increasing risk of breach failure over time. The No-action alternative constitutes the baseline from which effects of other alternatives are evaluated.

Future Without Federal Investment (FWOFI)[PR&G]: The FWOFI represents the Sponsor's projected actions if federal funds are not available to implement required rehabilitation to the dams. The Sponsor has stated their intention is to retain the dams in service for the indefinite future in order to continue to provide flood control benefits to the downstream areas. Under a FWOFI plan, the Sponsor would rely primarily on recommendations from the State of Vermont Dam Safety Program for future rehabilitation improvements. Because the State of Vermont does not currently have legislative-approved dam safety standards, state dam safety officials are not able to require rehabilitation upgrades to dams without a judicial order (normally once a dam has reached a state of deterioration where failure is a high probability). Therefore, each of the four (4) dams would be left as is for an undefined period of time, leaving them in a vulnerable risk the same as the No-Action alternative.

Decommissioning: Decommissioning would involve removal of the flood detention capacity of one or more of the four (4) dam sites by removing a portion or all of the embankments and restoring the function of the stream channel and 100-year floodplain. Costs for the decommissioning alternative would include construction ($38,600,000 for all four dams), elevating or relocating downstream properties ($14,000,000 for all four dams), and additional unquantified costs to elevate or resize approximately four (4) Route 100 road bridges and culverts (elevate or resize) provide flood protection to the Ludlow Fire Department, and elevate access routes for other emergency services such as the Ludlow Town-Ambulance services. Additionally, the decommissioning alternative would involve greater waterway and wetland impacts in comparison to other alternatives. It was determined that this alternative was not cost effective in comparison with other available alternatives. The total construction cost of decommissioning all four (4) dams is approximately sixty million dollars ($60,000,000.00) in

comparison to a construction cost of $30,493,500 for the rehabilitation alternative (includes all four dams).

Rehabilitation with Federal Assistance (Preferred Alternative): Federal and non-federal funds would be expended to rehabilitate Dam Sites #1, #2, #3 and #5 and meet the purpose and need for the project. Rehabilitation measures at each site generally include: modifying the principal spillway risers, sediment removal from the retarding pools, installing a new structural liner in each auxiliary spillway to address integrity concerns, installing a new stability toe berm combined with a new internal filter and drain system to address capacity and gradation compatibility concerns, regrade and/or slightly raise the top of the embankments to provide freeboard during the FBH.

Project Costs: The total project costs (Preferred Alternative) for all four dam sites combined are shown in Table S-5 below:

Table S-5: Estimated Project Costs: Preferred Alternative

Preferred Alternative	Source				Total Eligible Installation Costs
	PL 83-566 Funds		Other Funds		
	Cost	Percent	Cost	Percent	
Construction	$20,308,300	65%	$10,185,200	35%	$30,493,500
Engineering	$7,500,000	100%	$0	0%	$7,500,000
Project Administration	$1,000,000	67%	$500,000	33%	$1,500,000
Real Property Rights	$0	0%	$250,000	100%	$250,000
Permits	$0	0%	$100,000	100%	$100,000
Total Costs	$28,808,300	n/a	$11,035,200	n/a	$39,843,500
Annual O&M Costs	$0	0%	$22,100	100%	n/a

1. Price base 2021.
2. Maximum Public Law 83-566 cost-share is 65% of eligible cost-sharable items, not to exceed 100% of total construction costs

Project Benefits: Following the Principles, Requirements, and Guidelines (PR&G) planning policy, the Federal investments in water resources should strive to maximize public benefits, with appropriate consideration of costs. Public benefits measured as positive ecosystem services encompass environmental, economic, and social goals; include monetary and non-monetary effects; and may include both quantified and unquantified measures. The preferred alternative maximizes these public benefits.

Benefits of the Preferred Alternative at each dam site include:

1. Reduction in the potential for loss of life by reducing the possibility of dam failure.
2. Preservation of the current design's level of flood protection and flood damage reduction for residents, businesses, community and civic facilities, and infrastructure within the downstream floodplain.
3. Reduction in the sponsor's liability associated with the operation of a flood retarding structure which does not meet current dam safety engineering and performance criteria.
4. Protection of real estate values downstream within the downstream floodplain.
5. Provides an extended service life of 100 years.

Benefit Cost Ratio: 2.5 to 1.0

Net Beneficial Effects: $1,368,500 (Net average annual equivalent benefits of $2,284,800 - $916,300 in average annual equivalent costs)

Period of Analysis: 110-years (100-yr evaluated (project) life plus 10-year implementation period)

Evaluated (Project) Life: 100-years

Environmental Effects: Minor permanent and temporary impacts are expected at each dam site to implement the preferred alternative. These impacts are quantities below but generally include: Stream impacts at the immediate downstream toe of slope associated with the embankment and outlet works improvements. Tree cutting to install erosion protection measures at the downstream end of each auxiliary spillway and to create on-site disposal sites for dredged material from the retarding pools. Temporary displacement of wildlife during construction due to activity and noise; species anticipated to return following construction. Best Management Practices will be implemented to reduce transport and introduction of invasive plant species and reduce erosion and sedimentation into the outlet channels of each dam site and into Jewell Brook.

Controversial Issues: There have been no controversy or controversial issues identified to date.

Issues to be Resolved: None identified to date.

Evidence of Unusual Congressional or Local Interest: None

Compliance Certification: Is this report in compliance with executive orders, public laws, and other statues governing the formulation of water resource projects? Yes X No__

Changes Requiring Preparation of a Supplement

The Jewell Brook Watershed Dam Sites were designed and constructed as High Hazard potential dams to meet the dam safety engineering standards in place at the time of their construction. In response to a request from the primary local sponsor, the Town of Ludlow, Vermont, the Natural Resources Conservation Service (NRCS) completed a 2015 Dam Assessment to determine if the Jewell Brook dam sites meet current dam safety and performance standards.

The assessment work was scoped to include sediment survey, hydrologic analysis, hazard classification analysis, site inspection, Priority Risk Ranking and Population at Risk spreadsheets, and recommendations for the dams. The assessment determined that each dam site is not in compliance with key NRCS dam safety standards and performance criteria such as hydraulic capacity, spillway integrity, stability and internal drain compatibility. As such, structural rehabilitation of each dam site was determined necessary to comply with applicable design criteria.

This Supplemental Watershed Work Plan No. 1 and Environmental Assessment (herein referred to as the Plan-EA) formulates and evaluates alternatives for the rehabilitation of the Jewell Brook Watershed Dam Sites.

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TABLES

APPENDICES

1. Introduction

1.1 Background

The Jewell Brook Dams are located in the Town of Ludlow, Vermont. The project was originally planned and designed in 1966 by the Soil Conservation Service (now Natural Resources Conservation Service – NRCS) in conjunction with the Ottauquechee Soil Conservation District, the Town and Village of Ludlow, and the Vermont Water Resources Board. The original design life of each dam was 50-years.

The four (4) dam sites comprise the project and are known as Jewell Brook Watershed Dam Sites #1, #2, #3 and #5, (there is no Dam Site #4). The dams were constructed under the U.S. Department of Agriculture's (USDA's) PL-566 Small Watershed Program between 1969 and 1972.

1.2 Changes Requiring the Preparation of a Supplemental Watershed Plan

Each of the four dam sites was originally classified and designed to High Hazard (Class C) criteria applicable in the late 1960's when the dams were being designed. The USDA NRCS performed an assessment of each site in 2015 which concluded that the dams do not meet current NRCS and Vermont State Department of Environmental Conservation (VTDEC) dam safety and engineering criteria and performance standards (NRCS, 2015). Results of additional detailed planning level investigations that are documented in this Watershed Plan- Environmental Assessment (Plan-EA) have confirmed the presence of these deficiencies which include the lack of sound defensive measures to reduce, filter and discharge seepage; inadequate slope stability factors of safety, and concerns regarding the integrity of the auxiliary spillways. To bring the dam up to current regulations and engineering performance standards, structural rehabilitation measures and cost-sharing are required.

An amendment to PL 83 566, the Watershed Rehabilitation Amendments of 2000 (PL 106-472), Section 313, authorizes financial and technical assistance to rehabilitate dams under the USDA Watershed Rehabilitation Program. The rehabilitation of each of these four dam sites are authorized under this amendment.

Because the source of funding is under the Federal water resource investments, in addition to the NRCS Plan-EA guidance, this analysis was completed under USDA Policy DR 9500-013, "Conducting Analyses Under the Principles, Requirements, and Guidelines (PR&G) for Water and Land Related Resources Implementation Studies and Federal Water Resource Investments" and the affiliated Department Manual (DM) 95–0013 (2017). Because the NEPA evaluation criteria vary from the PR&G framework, the table below identifies the two processes in comparison. Wherever they do not align in the textual narrative, a parenthetical notation is inserted to identify which of the two is being addressed. Otherwise, the ensuing section applies under both frameworks.

Table 1 NEPA and PR&G Comparison and Completion Checklist

✓	Steps in NRCS/NEPA Planning Process	✓	Steps in the PR&G Project Level Procedures
✓	1. Identify Problems and Opportunities	✓	1. Identify Problems and Opportunities
✓	2. Determine Objectives (NEPA Purpose & Need)		No equivalent step; objectives specified in the Federal Objective and Guiding Principles
✓	3. Inventory Resources	✓	2. Inventory Existing Resources & Conditions
✓	4. Analyze Resource Data	✓	3. Forecast Future Conditions
✓	5. Formulate Alternative	✓	4. Develop Array of Alternatives
✓	6. Evaluate Alternatives	✓	5. Evaluate Effects of Individual Alternatives
✓	7. Make Decisions	✓	6. Compare Alternatives and 7. Identify Recommended Alternative
	8. Implement the Plan		8. Implement and Evaluate
	9. Evaluate the Plan		See Step Above

(Source: PR&G DM9500-013 2017, Table 6)

1.3 Federal Objective (PR&G)

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.

1.4 Purpose and Need Statement (NEPA)

The purpose of the Jewell Brook Watershed Dam Site project is to provide flood damage reduction to the watershed, for the next 100 years while minimizing environmental, economic social and cultural impacts.

Safety: The existing dam structures do not fully meet current safety and performance standards and action is needed to reduce the risk of loss of life due to a breach of the existing dams and to reduce risk of flood damage within the downstream flood zone to homes, commercial facilities, existing infrastructure, agriculture, and future development.

Flood Prevention (Flood Damage Reduction): Reduction in downstream flood damages to private and public facilities and infrastructure for the current level of protection (100-year flood event) and more frequent events continues to be a need for the community.

Under the Without- Dam condition (each of the 4 dam sites decommissioned for flood control

purposes), there are 309 properties with structures located within the inundation limits of the 100-year without-dam flood event (refer to Appendix D for detailed description of structures and vehicles subject to flooding). Under current conditions, approximately 188 properties with structures are subject to flooding and damages within the 100-year with-dam inundation limits of Jewell Brook and the Black River affected area. Therefore, approximately 121 properties with structures are provided with flood damage reduction, which includes an additional 83 residential structures.

Further, impacts to critical facility per 7 CFR 650.25emergency response facilities, such as the local fire departments, the post office and other public institutions are subject to either new or additional flooding under the Without Dam condition (refer to Appendix D Economics. Also VT RT 100 is also considered to be a critical facility because it is the only highway along Jewell Brook for emergency responders to use.

1.5 Project Opportunities

Opportunities that would be realized through the implementation of this watershed rehabilitation plan include:

- Compliance with current dam safety design and performance standards established by NRCS and Vermont Dam Safety.
- Reduction in the potential for loss of life by reducing the possibility of dam failure.
- Preservation of the original design's level of flood protection and flood damage reduction for residents, businesses, community and civic facilities, and infrastructure within the downstream floodplain.
- Reduction in the sponsor's liability associated with the operation of a flood retarding structure which does not meet current dam safety engineering and performance criteria.
- Enhance Public Health and Safety by continuing to provide flood protection for downstream properties, houses, businesses, and infrastructure for at least the 100-year flood event.
- Incidental preservation of environmental and recreational values.
- Protect real estate values by maintaining flood protection and flood damage reduction for the originally designed flood event.

1.6 Project Development

The Plan-EA documents the planning process by which the NRCS, in cooperation with the Sponsor, provided technical assistance to the local Sponsors, technical advisors, and the public in addressing resource issues and concerns within the Jewell Brook watershed. DDK Engineering-JV was retained by NRCS-VT to provide engineering and environmental services in support of the development of the Plan-EA. The purpose of the Plan-EA is to present information regarding alternatives that have been evaluated to address the identified deficiencies of these four (4) dam sites. As described above, the analysis included consideration of the Principles, Requirements, and Guidelines (PR&G) for Water and Land Related Resources Implementation Studies and Federal Water Resource Investments (DM 9500-013 (2017).

2. Scope of the Environmental Assessment

2.1 Scoping Process

A scoping process was used to solicit information and input from the project owner, sponsors, local citizens, and other groups with vested interest in the watershed and project regarding the most relevant resource that requires consideration. The intent of the scoping process is to identify issues of economic, environmental, cultural and social concern in the watershed. The scoping process for the four (4) dam sites involved site investigations, a public meeting, and consultations with resource and jurisdictional agencies.

2.2 Scoping Activities

Scoping letters were sent to public officials, resource agencies and local stakeholders informing them of the proposed project, requesting their input on relevant concerns and inviting them to a project scoping meeting. In addition, a notice was distributed to the public to attend an informational session. The public notice was published/announced in accordance with the Town of Ludlow's public notice procedures as well as a direct mailing to abutters and local newspapers.

The scoping meeting and public informational session were held on Monday, August 3, 2020 (see Section 6). The full distribution list to agencies and groups is included in Appendix E.

2.3 Summary of Resource Concerns and Ecosystem Services

A summary of the concerns highlighted during the scoping meeting for the Jewell Watershed Dam Site project is presented below in Table 1. A summary of ecosystem services provided by each dam site identified during the scoping process is included in Table 2.

Table 2 Summary of Resource Concerns

Resource Concern	Relevant to Proposed Action	Rationale
Topography, Soils & Geology		
Soils	Yes	The proposed action includes raising each dam's embankment, armoring auxiliary, and related areas within the constructed footprint and reconstructing the soils within the dam to increase capacity, integrity, and stability.
Erosion & Sedimentation	Yes	Sites 2 & 5 have significant sediment accumulation within the pool area that requires dredging.
Prime & Unique Farmland	No	There is no anticipated conversion of current agricultural use to non-agricultural within the affected area.
Water Resources		

Surface Water & Surface Water Quality	Yes	No waterbodies within the affected area of the sites are listed as impaired. Portions of Trailside Brook north and south of Site 3 are listed as stressed; Grant Brook north and south of Site 2 is used as a public water source.
Groundwater & Groundwater Quality	Yes	Sites 1 & 2 are within the Ludlow Groundwater Source Protection Area (SPA). There are no known contaminants to groundwater quality.
Floodplain Management	Yes	Review of the Federal Emergency Management Agency's Flood Insurance Rate Maps available for the Affected Area indicated no areas directly surrounding the dams as Zones A or AE. There are areas designated Zone X along Jewell Brook and surrounding the dams. The proposed action is to provide for the original design flood protection. This will not affect the currently mapped Flood Zones.
Regional Water Resource Plans	Yes	The Jewell Brook Dams were formulated under the "Jewell Brook Watershed Work Plan" completed in 1964. The Jewell Brook Watershed is part of the larger Black and Ottauquechee River watershed and is included in the 2018 Tactical Basin Plan.
Wild & Scenic Rivers	No	Jewell Brook and its tributaries are not listed as part of any wild or scenic rivers. It is noted that a segment of the Black River is on the NRI, however it is not relevant to the proposed action because no change to the river hydrology or ecosystem will occur.
Sole Source Aquifer	No	There are no designated sole source aquifers in Vermont.
Coral Reefs	No	There are no oceans or living coral reefs in the Jewell Brook watershed.
Wetlands & Waters of the U.S.		
Riparian Areas	Yes	Riparian areas are present in the vicinity of the Jewell Brook Dams. These are located along the edge of the retarding pools of all 4 dams as well as along the streams entering and exiting the pools.
Wetlands	Yes	Wetlands are extensively present surrounding the dam and retarding pools for each dam site. Each evaluated alternative, including the proposed action will have temporary and permanent impacts to wetlands within the affected areas.

Clean Water Act / Waters of the U.S.	Yes	The retarding pools, surrounding wetlands, and associated streams at all 4 dams are considered Waters of the U.S.
Biological Resources		
Endangered & Threatened Species	Yes	Consultation with the USFWS, including review an official list of species from the USFWS, indicates there is only one federal listed species in the entire project area, including all downstream affected areas, that being the Northern Long-Eared Bat. A 4(d) Rule Verification Letter has confirmed the proposed work is currently allowed and does not require additional consultation, and any tree removal will occur outside of the NLEB active period of 4/1 through 10/31. Request for Concurrence of no adverse effects to NLEB submitted to USFWS, to apply to NLEB post-uplisting.
Plant Condition & Forest Resources	Yes	Plant condition within the Project Area is healthy; no degraded plant conditions were observed. Herbaceous and woody plants within the Affected Area, including staging areas and excess material disposal sites, will be disturbed.
Fish, Wildlife & Aquatic Resources	Yes	The Jewell Brook Watershed waters are notable for Brook Trout and other mixed species of Trout, including the Affected Environments at each dam site. Construction activities may cause temporary minor effects upon aquatic resources in the immediate area of the dams and downstream areas. Stream flows will be protected during construction with bypass piping.
Essential Fish Habitat	No	Atlantic Salmon may have reached the tributaries of the Connecticut River at one point in history, but Vermont is not currently considered to have EFH.
Invasive Species	Yes	The reconnaissance survey for each dam site identified the presence of invasive species at dam sites #1, #3 and #5. Species included reed canary grass *(Phalaris arundinacea),* purple loosestrife *(Lythrum salicaria),* giant reed *(Phragmites australis),* and poison parsnip *(Pastinaca sativa).* Construction activities have the potential to introduce or spread invasive species.
Natural Areas	No	There are no natural areas within the Affected Environments at any of the four (4) dam sites.
Ecological Critical Areas	No	The USFWS IPaC review indicates no critical habitats at any of the four (4) dam sites. However, there is a potential presence of the federally threatened northern long-eared

		bat, and potential summer habitat must be considered when forest cutting is required.
Migratory Bird Treaty Act	Yes	The Jewell Brook Watershed and dam sites attract a variety of migratory bird species. Six migratory bird species, including bald eagle, have been identified by USFWS as having potential to occur in the project area, and others are likely to be present as well. The dams are not located in any Audubon Important Bird Areas. Temporary impacts may be caused to migratory birds from construction activities, and permanent impacts to birds would result from tree cutting for staging areas and/or excess material disposal areas.
Human, Economic & Social Conditions		
Land Use & Land Cover	No	The proposed action is not changing the land use in the immediate vicinity of the dams.
Public Health & Safety	Yes	The Jewell Brook Dams provide 100-year flood protection for residents, motorists, and other persons using downstream facilities. A breach of the dam would cause catastrophic property damage and loss of life in the downstream area. The proposed action is expected to prevent a breach of the dam from occurring.
Transportation	Yes	Site 1 a Municipally-owned Road crosses the embankment of dam site #1; temporary impacts may occur during construction.
Floodwater Damage	Yes	The Jewell Brook Watershed dam sites provide flood protection and flood damage reduction for residents, motorists, and other persons using downstream facilities.
Environmental Justice & Civil Rights	Yes	Ludlow Village is on the list of designated places with LMISD (low/moderate income) of 55.4%.
Local and Regional Economy	Yes	All reasonable alternatives that address the purpose and need are presented in the Plan-EA.
Economic Efficiency	Yes	Economic efficiency must consider the full range of costs and benefits of project alternatives.
Other Concerns		
Energy	No	The Jewell Brook Dams are not used as a source of energy.
Cultural Resources/Historic	Yes	Each of the four (4) dams are considered eligible for NRHP, per NRCS with SHPO and Tribal consultation and

Properties/ Scientific Resources		concurrence. In addition, archaeologically sensitive areas were found in the vicinity of the dams, but are believed to be avoidable from potential actions.
Air Quality / Clean Air Act	No	No long-term impacts are anticipated. Temporary construction activities may result in short term, direct, negligible adverse impacts to air quality but will be mitigated where possible, such as dust control.
Visual Impacts / Scenic Beauty	Yes	Minor impacts to scenic beauty will occur at all 4 Dams through minor structural modifications, temporary land disturbance, select tree/vegetation removal and disposal of excess dredging material.
Recreation & Parklands	Yes	Dam sites #3 and #5 have recreation adjacent to the Dams. Recreation would be temporarily impacted during construction activities.

Table 3 Scoping Results for Ecosystem Services

Ecosystem Services	**Services Identified as Relevant to Decision Making**				**Rationale**
	Site #1	**Site #2**	**Site #3**	**Site #5**	
Provisioning (tangible good provided for direct human use and consumption)					
Food (e.g., Private/ Commercial Fishing)					Non-applicable
Fiber					Non-applicable
Water (e.g., Municipal & Industrial Water; Irrigation Water; Hydropower)		**X [aquifer and piping]**			
Timber					Non-applicable
Biomass					Non-applicable
Regulating (maintain world in which it is possible for people to live, providing critical benefits that buffer against environmental catastrophe)					
Flood Control (e.g., Urban Flood Damage Reduction;	**X**	**X**	**X**	**X**	Purpose of dams is flood control

Ecosystem Services	Services Identified as Relevant to Decision Making				Rationale
	Site #1	Site #2	Site #3	Site #5	
Agricultural Flood Damage Reduction)					
Disease Control					Non-applicable
Water Filtration					Non-applicable
Climate Stabilization					Non-applicable
Crop Pollination					Non-applicable
Supporting (underlying processes maintaining conditions for life on Earth)					
Nutrient Cycling	**X**	**X**	**X**	**X**	Nutrient composition may be impacted
Soil Formation	**X**	**X**	**X**	**X**	Soils may be impacted
Primary Production					Non-applicable
Cultural (make the world a place in which people want to live)					
Recreational Use	**X [tourism in fall]**		**X [rec area]**		Site #2 has fall tour buses and #3 provides recreational services
Spiritual Values					Non-applicable
Aesthetic Viewsheds		**X [significant vistas]**			Project provides this service, especially at Site #2
Tribal Values					Non-applicable
Ecosystem Restoration	*	*	*	*	The ecosystem will retain its current wildlife and habitat values

3. Affected Environment

This section describes the existing conditions and the limits of the "affected environment" (per NEPA) and "inventory of existing resources" (per PR&G), which encompass the areas directly around the footprints of the dams, including the retarding pool, embankment, auxiliary spillway and access points. These limits also include the extents of the 100-year flood without the dams, beginning at Dam Site #1, the tributaries downstream of Dam Sites #2, #3 and #5, and extending upstream along the Black River to Fox Lane and downstream along the Black River for approximately 16 miles, to the North Springfield Lake Flood Risk Management Project (ACOE flood control reservoir), approximately 16 miles from the confluence of Jewell Brook and the Black River. Refer to the project maps located in Appendix B for limits.

3.1 Original Project Background

3.1.1 Background of Dam Sites

The Jewell Brook Watershed dam sites #1, #2, #3 and #5 are located on separate tributaries of the Jewell Brook in the Town of Ludlow, Windsor County, Vermont. Jewell Brook confluences with the Black River in Ludlow Village. The four dam sites are multipurpose earthen embankment dams that serve as flood protection for the town as well as recreational and environmental resources. They are along the VT Route 100 corridor, a major north-south scenic roadway through Central Vermont. The following excerpt from page 6 the 1978 FEMA FIS Report for the Village of Ludlow highlights the original purpose and need for the dams.

"The Town and Village of Ludlow has a long history of damaging floods, with historic accounts dating back to 1828. Major floods have occurred in 1828, 1850, 1869, 1892, 1927, 1936, 1938, 1952, 1960, 1973, and 1976 (References 7, 8 and 9). Much of the damage from the earlier flood was caused by raging waters overflowing the banks of the Jewell Brook. However, with the construction of flood control reservoirs combined with land use treatment measures in the Jewell Brook Watershed, damage is generally confined to the flood plains of the Black River and Branch Brook."

A major flooding event occurred in 2011 due to tropical storm Irene. NOAA's Tropical Cyclone Report Hurricane Irene (AL092011), last updated April 2013, reported the following:

"...widespread rainfall amounts of 4-7 inches occurred across much of southern and central Vermont. These rains caused devastating flash flooding across many mountain valleys with some record-breaking flood stages on larger rivers. This flood event will likely rank second to the November 1927 flood, with nearly 2400 roads, 800 homes and businesses, 300 bridges, and a half dozen railroad tracks destroyed or damaged from the flooding in southern Vermont."

During this storm event, water was observed to be flowing through the auxiliary spillways of dam sites #2, #3 and #5, however dam site #1 was not activated. The Town of Ludlow reported that the dams appeared to function as designed. The discharge end of the three auxiliary spillways did receive a modest amount of erosion damage and required repairs consisting of stone fill placement, regrading and revegetation.

The Town of Ludlow & Village of Ludlow, Vermont: Local Hazard Mitigation Plan (draft, 2018) indicates that since 1990, 30 federal disaster declarations have been made in Windsor County, all which were tied to severe storms and flooding.

3.1.2 Resources Not Affected

The following resources will not be affected by the proposed actions.

- Air Quality
- Coral Reefs
- Sole Source Aquifers
- Wild and Scenic Rivers

3.2 Topography, Soils & Geology

3.2.1 Topography

The Jewell Brook Watershed Dams and downstream affected areas are within the greater Black River watershed at the eastern edge of the Green Mountains. Based on U.S. Geological Survey (USGS) digital modeling, the topography of the affected environment ranges from a maximum elevation of approximately 3,343 feet (NAVD88) at the summit of Ludlow Mountain, the dominant topographic feature, to approximately 1,000 feet (NAVD88) at the confluence of the Jewell Brook and the Black River. The terrain slopes from west to east and contains rolling hills of the Vermont Piedmont from the base of the mountain to the Black River floodplain.

3.2.2 Soils

Based on a soil resource report custom-generated by NRCS Web Soil Survey on December 21, 2020, two to four primary soil types were found to be present for each dam and are outlined in Tables 2-6 below. According to the 1964 Watershed Work plan "the soils of Jewell Brook Watershed are developed on glaciofluvial deposits derived from igneous and metamorphic rock. The soils are relatively young in age, having been formed since the last Wisconsin glaciation."

Table 4 Soils - Dam Site #1

All Soils in Dam Site #1 Affected Area			
MUSYM	Map Unit Name	Acres	%
68D	Monadnock and Berkshire soils, 15 to 25 percent slopes	9.24	25.5%
28	Udorthents and Udipsamments	8.36	23.0%
W	Water	4.62	12.7%
70C	Adams loamy sand, 8 to 15 percent slopes	3.13	8.6%
33	Rumney fine sandy loam, 0 to 3 percent slopes, frequently	2.90	8.0%
70C	Adams loamy sand, 8 to 15 percent slopes	1.67	4.6%

24	Podunk fine sandy loam, 0 to 3 percent slopes, occasionally	1.44	4.0%
33	Rumney fine sandy loam, 0 to 3 percent slopes, frequently	1.44	4.0%
70D	Adams loamy sand, 15 to 25 percent slopes	1.12	3.1%
68C	Monadnock and Berkshire soils, 8 to 15 percent slopes	1.09	3.0%
70D	Adams loamy sand, 15 to 25 percent slopes	0.95	2.6%
71B	Croghan and Sheepscot soils, 0 to 8 percent slopes	0.17	0.5%
17C	Peru, Skerry, and Colonel soils, 8 to 15 percent slopes	0.12	0.3%
71B	Croghan and Sheepscot soils, 0 to 8 percent slopes	0.02	0.1%
71B	Croghan and Sheepscot soils, 0 to 8 percent slopes	0.00	0.0%
Site 1 total		36.26	100.0%

Source: Web Soil Survey, 2020, United States Department of Agriculture Natural Resource Conservation Service

Table 5 Soils - Dam Site #2

All Soils in Dam Site #2 Affected Area			
MUSYM	Map Unit Name	Acres	%
28	Udorthents and Udipsamments	18.67	39.2%
70D	Adams loamy sand, 15 to 25 percent slopes	13.33	28.0%
63E	Monadnock and Berkshire soils, 35 to 60 percent slopes, very stony	9.60	20.2%
68D	Monadnock and Berkshire soils, 15 to 25 percent slopes	4.80	10.1%
70C	Adams loamy sand, 8 to 15 percent slopes	0.79	1.7%
71B	Croghan and Sheepscot soils, 0 to 8 percent slopes	0.23	0.5%
18C	Peru, Skerry, and Colonel soils, 8 to 15 percent slopes, very stony	0.12	0.3%
18C	Peru, Skerry, and Colonel soils, 8 to 15 percent slopes, very stony	0.05	0.1%
Site 2 total		47.59	100.0%

Source: Web Soil Survey, 2020, United States Department of Agriculture Natural Resource Conservation Service

Table 6 Soils - Dam Site #3

All Soils in Dam Site #3 Affected Area			
MUSYM	Map Unit Name	Acres	%
28	Udorthents and Udipsamments	13.62	28.9%
W	Water	10.74	22.8%
70C	Adams loamy sand, 8 to 15 percent slopes	5.23	11.1%
11E	Marlow fine sandy loam, 35 to 60 percent slopes, very stony	4.56	9.7%
68C	Monadnock and Berkshire soils, 8 to 15 percent slopes	3.52	7.5%
17C	Peru, Skerry, and Colonel soils, 8 to 15 percent slopes	2.96	6.3%
54D	Tunbridge-Lyman complex, 15 to 25 percent slopes, rocky	2.94	6.2%
68D	Monadnock and Berkshire soils, 15 to 25 percent slopes	1.78	3.8%
68C	Monadnock and Berkshire soils, 8 to 15 percent slopes	1.17	2.5%
31B	Cabot silt loam, 0 to 8 percent slopes, very stony	0.51	1.1%
70E	Adams loamy sand, 25 to 60 percent slopes	0.12	0.3%
18C	Peru, Skerry, and Colonel soils, 8 to 15 percent slopes, very stony	0.01	0.0%
Site 3 total		47.16	100.0%

Source: Web Soil Survey, 2020, United States Department of Agriculture Natural Resource Conservation Service

Table 7 Soils - Dam Site #5

Primary Soils in Dam Site #5 Affected Area			
MUSYM	Map Unit Name	Acres	%
28	Udorthents and Udipsamments	23.59	48.2%
18C	Peru, Skerry, and Colonel soils, 8 to 15 percent slopes, very stony	14.41	29.5%
11E	Marlow fine sandy loam, 35 to 60 percent slopes, very stony	2.89	5.9%
68C	Monadnock and Berkshire soils, 8 to 15 percent slopes	2.23	4.6%
63E	Monadnock and Berkshire soils, 35 to 60 percent slopes, very stony	1.85	3.8%
18B	Peru, Skerry, and Colonel soils, 0 to 8 percent slopes, very stony	1.63	3.3%

68C	Monadnock and Berkshire soils, 8 to 15 percent slopes	1.38	2.8%
11C	Marlow fine sandy loam, 8 to 15 percent slopes, very stony	0.89	1.8%
63E	Monadnock and Berkshire soils, 35 to 60 percent slopes, very stony	0.07	0.1%
Site 5 total		48.94	100.0%

Source: Web Soil Survey, 2020, United States Department of Agriculture Natural Resource Conservation Service

Table 8 Soils - 100-year Floodplain

Primary Soils in 100 Year Floodplain			
MUSYM	Map Unit Name	Acres	%
11E	Marlow fine sandy loam, 35 to 60 percent slopes, very stony	53.8	5.7%
23	Ondawa fine sandy loam, 0 to 3 percent slopes, occasionally flooded	50.9	5.4%
24	Podunk fine sandy loam, 0 to 3 percent slopes, occasionally flooded	256.1	26.9%
33	Rumney fine sandy loam, 0 to 3 percent slopes, frequently flooded	83.0	8.7%
64B	Colton gravelly sandy loam, 3 to 8 percent slopes	49.0	5.2%
71B	Croghan and Sheepscot soils, 0 to 8 percent slopes	53.3	5.6%
75B	Urban land-Colton-Croghan complex, 0 to 8 percent slopes	225.0	23.5%
W	Water	180.8	19.0%
100 Year Floodplain Total		951.9	100.0%

Source: Web Soil Survey, 2020, United States Department of Agriculture Natural Resource Conservation Service

3.2.3 Geology

The Jewell Brook dams are located along the edge of the Green Mountain and Vermont Piedmont physiographic regions. The Green Mountains are part of the Appalachian Mountains, spanning the east coast from Georgia to Maine. The Vermont Piedmont includes hills and valleys, rolling from the Massachusetts to the Canadian border, and encompasses several major river valleys, including the Connecticut River and the Black River, which runs through Ludlow (SMCVT 2020).

Metamorphic rock dominates the bedrock of the greater Jewell Brook environment. The bedrock is Cambrian and Neoproterozoic in the Plymouth and Tyson formations. The surficial geology of the areas directly surrounding the dams are made up of till and glaciofluvial deposits of kame moraine and kame terrace. Till mantles the bedrock and reflects the underlying bedrock topography and is thicker in the valleys and thinner in the uplands. It may exist as rubble and scattered boulders. Kame moraine and kame terrace are

glaciofluvial deposits both in the vicinity of the dams and along the stream and river beds, containing stratified deposits of gravel, sand, silt and clay (VT ANR 2020).

The Vermont ANR Atlas shows a rockline on the downstream side of the embankment of Site 1, running parallel to Jewell Brook. There are bedrock outcrops throughout Ludlow, but only within the affected area of Site 3 and along the Black River (VT ANR 2020).

3.2.4 Erosion & Sedimentation

NRCS requires that dams be designed to account for aerated and submerged sediment over the dam's implementation period and design life. Aerated sediment is sediment that is accumulated within the reservoirs flood storage pool (above the normal pool elevation), and submerged sediment is sediment that is accumulated within the pond of the reservoir (below normal pool elevation).

Accumulated sediment deposition since original construction was estimated at each dam site by comparing computed design storage values and data from the original design documents to the existing storage that was determined using 2019/2020 survey & and 2016 LIDAR surface information. Results indicate that Dam Sites #2 & #5 had significant sediment accumulation. The existing drains at each dam site were affected by sediment accumulation resulting from the 2011 Tropical Storm Irene. To minimize the potential for reoccurrence of drain obstruction under any plan that maintains the drain would include: 1) reestablish the original grade of the reservoir geometry, 2) operate the drains on a regular basis per an updated Operations and Maintenance manual to flush accumulated sediment in the vicinity of the drains and 3) manually remove accumulated sediment following extreme storm events and associated deposition of sediment at the drains.

The following table below summarizes the findings of the sedimentation analysis. The reader is referred to Appendix D, H&H for additional information.

Table 9 Sedimentation Analysis

Sedimentation Analysis					
	Submerged Sedimentation Rate (ac-ft/yr)	Aerated Sedimentation Rate (ac-ft/yr)	Projected Remaining Service Life (years)	Design Life + Implementation Time (years)	Retarding Pool Dredging Required (Yes/No)
Dam Site #1	0.09	0.12	136	100 + 10 = 110	No
Dam Site #2	0.05	0.32	46	100 + 10 = 110	Yes
Dam Site #3	0.14	0.17	565	100 + 10 = 110	No
Dam Site #5	0.17	0.07	5	100 + 10 = 110	Yes

The Jewell Brook Watershed Work Plan (April 1964) provides qualitative and generalized information regarding erosion and sediment damage caused by flooding prior to construction of the dams. The Work Plan states "There is a very high rate of channel erosion within the Jewell Brook Watershed. The headwaters carry down their run's large

quantities of sediment and debris." "Flood flows on Jewell Brook also cause flood plain scour throughout the narrow valley". The Work Plan further describes sediment damage both along the Jewell Brook and its effects along the Black River channel and floodplain.

3.2.5 Prime and Unique Farmland

Prime Farmland and Farmland of Statewide Importance that are present at dam sites #1, #2, #3, and #5 are summarized in the table below. Dam Site #1 contains 7.1 acres of statewide and prime farmland, which is primarily located immediately south of the Jewell Brook Site 1 Reservoir. There are 7.7 acres of statewide and prime farmland in Site 3, located south of the Jewell Brook Site 3 Reservoir, including the land encompassing the access road. Site 5 has 3.6 acres located on the perimeter of the site area, and Site 2 has 0.2 acres.

There are approximately 568 acres of Prime Farmland and Farmland of Statewide Importance in the 100-year floodplain. Large areas of statewide and prime farmland soils are primarily located immediately adjacent to the Black River, downstream from the Village of Ludlow. A summary of all Prime Farmland and Farmland of Statewide Importance in the 100-year floodplain is summarized in the table below.

Table 10 Soils Classification

Soils Classification of Prime Farmland or Farmland of Statewide Importance in Sites #1, #2, #3, and #5			
MUSY	Map Unit Name	Farmland	Acres
Site 1			
17C	Peru, Skerry, and Colonel soils, 8 to 15 percent slopes	Statewide	0.1
24	Podunk fine sandy loam, 0 to 3 percent slopes, occasionally flooded	Prime	1.4
33	Rumney fine sandy loam, 0 to 3 percent slopes, frequently flooded	Statewide (b)	4.3
68C	Monadnock and Berkshire soils, 8 to 15 percent slopes	Statewide	1.1
71B	Croghan and Sheepscot soils, 0 to 8 percent slopes	Statewide	0.2
		Site 1 Total	7.1
Site 2			
71B	Croghan and Sheepscot soils, 0 to 8 percent slopes	Statewide	0.2
Site 3			
17C	Peru, Skerry, and Colonel soils, 8 to 15 percent slopes	Statewide	3.0

68C	Monadnock and Berkshire soils, 8 to 15 percent slopes	Statewide	4.7
		Site 3 Total	7.7
Site 5			
68C	Monadnock and Berkshire soils, 8 to 15 percent slopes	Statewide	3.6

Source: Web Soil Survey, 2020, United States Department of Agriculture Natural Resource Conservation Service

Table 11 Soils Classification in Floodplain

Soils Classification of Prime Farmland or Farmland of Statewide Importance in the 100 Year Floodplain			
MUSYM	Map Unit Name	Farmland Rating	Acres
23	Ondawa fine sandy loam, 0 to 3 percent slopes, occasionally flooded	Prime	50.9
24	Podunk fine sandy loam, 0 to 3 percent slopes, occasionally flooded	Prime	256.1
29A	Grange very fine sandy loam, 0 to 3 percent slopes	Prime(b)	10.5
33	Rumney fine sandy loam, 0 to 3 percent slopes, frequently flooded	Statewide (b)	83.0
40	Limerick silt loam, 0 to 2 percent slopes, frequently flooded	Statewide (b)	2.2
5B	Windsor loamy sand, 0 to 8 percent slopes	Statewide	1.3
64B	Colton gravelly sandy loam, 3 to 8 percent slopes	Statewide	49.0
68C	Monadnock and Berkshire soils, 8 to 15 percent slopes	Statewide	0.5
70B	Adams loamy sand, 3 to 8 percent slopes	Statewide	17.7
71B	Croghan and Sheepscot soils, 0 to 8 percent slopes	Statewide	53.3
71C	Croghan and Sheepscot soils, 8 to 15 percent slopes	Statewide	4.6
8B	Agawam fine sandy loam, 3 to 8 percent slopes	Prime	15.6
9B	Ninigret fine sandy loam, 0 to 8 percent slopes	Prime	23.4
		Total	568.1

Source: Web Soil Survey, 2020, United States Department of Agriculture Natural Resource Conservation Service

3.3 Water Resources

3.3.1 Surface Water & Surface Water Quality

Dam Site #1 is located on Jewell Brook, approximately 2,400 feet upstream from the confluence with Grant Brook. The normal pool covers an area of approximately 3.2 acres and an average water depth of 8.7 feet with a drainage area of 1.92 sq. mi.

Dam Site #2 is located along Grant Brook, approximately 2,300 feet upstream from the confluence with Jewell Brook. The normal pool covers an area of approximately 1 acre and an average water depth of 6.4 feet with a drainage area of 1.94 sq. mi.

Dam Site #3 is located along Trailside Brook, approximately 1,600 feet upstream from the confluence with Jewell Brook. The retarding pool covers an area of approximately 15.1 acres at a normal pool level and a depth of 21.5 feet with a drainage area of 1.40 sq. mi.

Dam Site #5 is located along Sanders Brook, approximately 2,200 feet upstream from the confluence with Jewell Brook. The normal pool covers an area of approximately 0.6 acres and an average water depth of 4.9 feet with a drainage area of 1.84 sq. mi.

There are no waterbodies within the immediate Jewell Brook watershed listed as impaired by the Vermont Department of Environmental Conservation (VTDEC, 2018). Three sections of Trailside Brook upstream and downstream of Dam #3 are listed as stressed by undefined pollutants (VTDEC, 2016). The headwaters of all the brooks within the Affected Area are within Class A(1) Ecological Waters (areas above 2,500' altitude) for all uses. Additionally, Grant Brook has Mixed Classifications for Uses; it is Class B(2) for Public Water Source and Irrigation and Class A(1) for all others (VT ANR, 2020).

Based on the 2018 Vermont Statutes Title 10 - Conservation and Development the definition of Classification of high-quality waters; mixing zones are provided below:

- Class A(1): Waters in a natural condition that have significant ecological value;
- Class A(2): Waters that are suitable for a public water source with filtration and disinfection or other required treatment; character uniformly excellent.
- Class B(1): Waters in which one or more uses are of demonstrably and consistently higher quality than Class B(2) waters; or
- Class B(2): Waters that are suitable for swimming and other primary contact recreation; irrigation and agricultural uses; aquatic biota and aquatic habitat; good aesthetic value; boating, fishing, and other recreational uses and suitable for public water source with filtration and disinfection or other required treatment.

3.3.2 Groundwater & Groundwater Quality

Dam Sites #1 and Site #2 are located within the Town of Ludlow Ground Water Source Protection Area (SPA), as defined by the Vermont DEC's Drinking Water and Ground Water protection Division. The zones associated with SPA's refers to the land area within the zone, with Zone 1 being area within the immediate vicinity of the water source, Zone 2 being the area where groundwater flows to the source from outside of Zone 1 and Zone 3 being the remaining area that recharges the rest of Zone 2.

The area upstream of both dams and encompassing Dam Site #2 is designated Zone 3,

where land uses have potential to impact drinking water quality and quantity. The area immediately upstream of and including Dam Site #1 is designated Zone 2, which includes areas within 200-ft of perennial surface water. There is a Zone 1 water withdrawal site beginning approximately 700-ft to the northwest of the Site 1 dam embankment crest. This site contains a 136-foot deep, 12-inch diameter gravel well, constructed in 2002. There is a 385-foot deep, 6-inch diameter well, constructed in 1997 at the eastern edge of the West Hill Recreation Area, directly to the east of Dam Site #3 (VT ANR, 2020). Construction activities around Dam Sites #1 and #2 have the potential to negatively impact water quality and preventive measures must be incorporated into future design construction management plans.

Based on the Vermont Department of Environmental Conservation, Drinking Water and Ground Water Protection Division, the SPA's are defined as follows: Zone 1 is an area immediately around the drinking water withdrawal site. This is the area where impacts from contamination are likely to be immediate and certain. For public community water systems, this area is generally 200 feet around the intake. Zone 2 consists of areas within the watershed located within 200 feet of perennial surface water. Zone 2 is limited to a maximum extent of 17,000 acres. Land uses occurring within this zone are considered to have a greater potential to impact the source than the majority of the watershed. Zone 3 consists of the remaining watershed area outside Zones 1 and 2 where land uses have potential to impact drinking water quantity and quality.

The Ludlow Village Water Department completed the most recent Annual Water Quality Report in 2019. This report outlined 4 groundwater sources and the contaminant monitoring results as compared to EPA and State of Vermont standards. There were no violations for water contaminants. The only two violations were for a late reporting period and an inadequate storage facility, both of which had been resolved or were underway in 2019 (Ludlow Village Water Department, 2019).

3.3.3 Floodplain Management

According to the Federal Emergency Management Agency (FEMA) Flood Insurance Rate Maps (FIRM) Panels 50027C0589E (Site 3), 50027C0680E (Sites 1 and 2), and 50027C0590E (Site 5), all effective date September 28, 2007 (Appendix C), Sites 1 and 2 are located upstream beyond the limits of FEMA mapping. Sites 3 and 5 are in unmapped areas. All are in Zone X, areas determined to be outside the 0.2% annual chance floodplain.

The tributaries of each dam site that discharge into Jewell Brook do not have a mapped or other designated FEMA flood area. However, the flood profiles contained in the FEMA Flood Insurance Study dated September 28, 2007 does include limited flood information along a portion of the tributaries.

3.3.4 Regional Water Resource Plans

The construction of the Jewell Brook Dam Sites is recommended in the "Jewell Brook Watershed Work Plan" from 1964 that summarized the past flooding and cost-benefits of various solutions in the watershed. Jewell Brook is also included in the "Black and Ottauquechee Rivers and adjacent Connecticut River & Tributaries 2018 Tactical Basin Plan" by the Vermont Agency of Natural Resources (VTANR) which indicates measures taken in the Basin to address water quality. There are several factors within the report that include

pertinent information regarding Jewell Brook. Jewell Brook was rated as Excellent to Very Good for macroinvertebrates during its last monitoring in 2007 and is among six waters proposed for reclassification to B(1) Fisheries due to important fish spawning and nursery habitat. The Basin, in particular the Black River and its tributaries, are highly impounded, impacting habitat passage and increasing sediment and nutrients. Several dams in the Basin were identified for removal, however the Jewell Brook dams, as High Hazard Dams, are not among them.

3.3.5 Wild and Scenic Rivers

The National Wild and Scenic Rivers Act of 1968 preserves certain rivers with outstanding natural, cultural and recreational values in a free-flowing condition for the enjoyment of present and future generations (National Wild and Scenic Rivers System, 2021). There are no designated Wild and Scenic Rivers in the Jewell Brook Watershed.

3.3.6 Sole Source Aquifers

The US EPA map of sole source aquifers indicates there are no sole source aquifers in Vermont (EPA, 2021).

3.3.7 Coral Reefs

There are no oceans or live coral reefs located in Vermont.

3.4 Wetlands & Waters of the U.S.

3.4.1 Clean Water Act/ Waters of the U.S.

Waters of the United States include the waters of intermittent and permanent streams, ponds and lakes, below their ordinary high-water elevations, as well as most wetlands. At Sites 1 through 5, the retarding pools, all intermittent and permanent streams, and all wetlands, as shown on the Wetland and Waterbody Focus Area Maps (Appendix D-3), are considered Waters of the United States. These waters are subject to Section 10 and Section 404 of the Clean Water Act.

The following is based on field investigations led by the project certified wetlands scientist in 2020 and review of available mapping at each dam site.

3.4.2 Riparian Areas

According to NRCS guidance, (NRCS, 2020, 1), “Riparian areas are lands that occur along watercourses and water bodies. Typical examples include flood plains and streambanks. They are distinctly different from surrounding lands because of unique soil and vegetation characteristics that are strongly influenced by the presence of water.”

At Dam Site #1, riparian areas exist along the edge of the retarding pool and along the edges of the streams, both entering and exiting the pool. Around the retarding pool, the riparian area is characterized by wetland. Along the streams, the riparian areas are primarily associated with the stream banks, where periodic flooding occurs.

At Dam Site #2, riparian areas exist along the edge of the retarding pool and along the edges of the streams, of which two enter the pool and one exits the pool. The riparian areas around the retarding pool and the northern entering stream are characterized primarily by wetland. The riparian areas of the southern entering stream and the exiting stream are primarily associated with the stream banks, where periodic flooding occurs.

At Dam Site #3, the riparian area around the retarding pool is characterized by wetland. A small wetland area occurs at the culvert outlet to the exiting stream, but the riparian area of that stream is primarily associated with the stream banks, where periodic flooding occurs.

At Dam Site #5, the riparian area around the retarding pool is characterized by wetland. At the principal spillway outlet, a minor amount of wetland is present, but the majority of the riparian area is currently riprapped.

3.4.3 Wetlands

Coordination with the U.S Army Corps of Engineers, New England District (USACE) has occurred for this project, as all wetlands in Vermont are subject to the jurisdiction of the USACE.

Vermont regulates "Class I" and "Class II" wetlands through the Vermont Wetland Rules. Class I wetlands are rare (nine in the State), of the highest value of all wetlands, and receive the highest level of protection, including a 100' protected upland buffer. Class II wetlands are valuable enough to receive State protection, including their 50' upland buffers, though less valuable than Class I wetlands, and more valuable than Class III wetlands which are not protected by the State. Impacts to Class II wetlands may be allowed if they are "not unduly adverse." Acreage of proposed impact and the number and quality of the functions and values provided by the wetland are evaluated to determine whether impacts may be permitted. Impacts to wetlands must be avoided if possible, and if not, they must be minimized to the maximum extent practicable by project re-design or relocation. Unavoidable impacts of approximately one-quarter acre or more may be permittable with the payment of a compensatory wetland mitigation fee of approximately $4.50 per square foot of impact.

Class II wetlands are characterized by their dominant vegetative cover type(s). A Class II emergent wetland is dominated by herbaceous or low-growing woody vegetation, and may or may not be inundated by standing water.

Existing wetlands at each dam site, which are described below, were delineated by a senior Certified Wetlands Scientist, and conducted in accordance with the USACE Wetland Delineation Manual and the Northcentral /Northeast Regional Supplement (https://www.nae.usace.army.mil/Missions/Regulatory/Jurisdiction-and-Wetlands/Wetland-Delineation-Manual/) as recommended in the above referenced consultation. A description of each wetland, Cowardin classification, and primary functions and values for each wetland type is provided.

At Dam Site #1, a narrow fringe of Class II emergent wetland occurs along the edges of the retarding pool. The fringe widens just south of the northeast corner of the pool into a broader band of scrub-shrub wetland. These fringe wetlands extend further south beyond the limits of the wetland mapping. Near the toe of the auxiliary spillway is a Class III emergent wetland which is kept mowed. Class II emergent and scrub-shrub wetland occurs adjacent to the stream at the principal spillway outlet, extending upslope along a drainage swale and into adjacent shrubland. The principal valuable functions of these wetlands include groundwater discharge, floodflow alteration and sediment /shoreline stabilization. The wildlife function is minimal.

At Dam Site #2, Class II scrub-shrub wetland occurs along the periphery of the retarding pool on the south, east and north of the dam, and along a stream entering the pool from the north. The wetland around the periphery of the dam continues along the west side of the dam beyond the limits of the wetlands study area. Emergent Class III wetland which is kept mowed occurs at the western extreme of the auxiliary spillway. Class II emergent wetland occurs at the head of a small stream just south of the principal spillway outlet. The western portion of that wetland is maintained in a mowed condition, while the eastern portion is in a natural condition. The principal valuable functions of the Class II wetland include groundwater discharge, floodflow alteration, sediment /shoreline stabilization, and to a lesser extent, wildlife habitat for fish and amphibians and their predators. The principal valuable function of the Class III wetland is sediment retention. The wildlife function is minimal.

At Dam Site #3, Class II emergent wetland and a minor component of scrub-shrub wetland occurs along the periphery of the retarding pool along its southern, eastern and northern edges. The emergent wetland widens out into a broad wet meadow at the northern end. The wetland continues along the western boundary of the retarding pool beyond the limits of the wetland study. The principal valuable functions of this wetland include groundwater discharge, floodflow alteration and sediment /shoreline stabilization. The wildlife function is minimal. Class II emergent wetland, with a minor component of scrub-shrub wetland, occurs on the uphill side of the principal spillway outlet. The principal valuable functions of this wetland include groundwater discharge and sediment /shoreline stabilization. The wildlife function is minimal. Class 3 emergent wetland occurs at an outlet of a drainage pipe along the southeastern boundary of the site. The principal valuable functions of this wetland include groundwater discharge, floodflow alteration, sediment /shoreline stabilization and minor wildlife habitat associated with a persistent emergent community mainly beyond the limits of the project.

At Dam Site #5, Class II emergent wetland occurs along the northeastern, eastern and southwestern periphery of the retarding pool, and continues southerly for several hundred feet within the auxiliary spillway. The wetland continues to the west of the retarding pool, including both emergent and scrub-shrub vegetation types. The principal valuable functions of this wetland include groundwater discharge, flood flow alteration, sediment /shoreline stabilization and wildlife habitat, primarily for fish and amphibians and their predators. Class II scrub-shrub wetland occurs around the periphery of the principal spillway outlet, and continues easterly beyond the limits of the wetland study. The principal valuable functions of this wetland include groundwater discharge, flood flow alteration and sediment /shoreline stabilization. The wildlife function is minimal. Class III emergent wetland occurs at the northeastern and southeastern boundaries of the site. All lands within the auxiliary spillway, including wetlands, are brush-hogged on an annual basis in order to maintain the spillways in operating condition. The principal valuable functions of these wetlands include groundwater discharge, flood flow alteration and sediment /shoreline stabilization. The wildlife function is minimal.

3.5 Biological Resources

3.5.1 Endangered & Threatened Species and State Species of Special Concern

A preliminary review of the United States Fish and Wildlife Service (USFWS) Information for Planning and Consultation (IPaC) database identified one federally threatened mammal, the northern long-eared bat, and six migratory bird species, including the bald eagle, protected by the Migratory Bird Treaty Act that could potentially occur in the Project Area (USFWS 2020). According to the Vermont Agency of Natural Resources, Natural Resource Atlas (VT ANR), there are no Rare, Threatened or Endangered Species within the immediate vicinity of Jewell Brook Dams and reservoirs; however, there is potential for 17 protected plant and animal species within the downstream inundation area.

Subsequent direct consultation with USFWS occurred, including the receipt of an Official Species List for the project area and a 4(d) Rule assessment. The USFWS indicates there is only one federal listed species in the entire project area, including all downstream affected areas, that being the Northern Long-Eared Bat. A 4(d) Rule Verification Letter of 10.24.22 confirmed that the proposed work is currently allowed and does not require additional consultation with the USFWS.

The USFWS consultation further indicated the NLEB species is expected to be elevated to Endangered Status in the near future, at which point the 4(d) Rule Determination will likely become invalid. Therefore, USFWS recommended the submittal of a Request for Concurrence with a "Not Likely to Adversely Affect" (NLAA) determination, which has been submitted. USFWS has indicated an expectation of concurrence, given the commitment to remove trees outside of the NLEB active period of April 1 through October 31, and has stated this concurrence will remain valid for the duration of the project even if the NLEB is elevated to endangered status. A decision on the NLAA is expected in December, 2022.

Consultation also occurred with wildlife specialists at the Vermont Agency of Natural Resources (VANR). State wildlife specialists (i.e., fisheries, herpetologist and furbearer programs), reviewed the project and provided input regarding E&TS. Written input from VT Fish and the Wildlife Department (VFWD) concluded that project activity is not expected to adversely impact the NLEB and occupied habitat. The coordination recommends limiting any potential tree clearing to the non-active bat season, April 15-Sept 30. Also, VFWD requests reporting of any observed wood turtles to VANR for further coordination.

State Agency consultation indicated the potential for presence of RTE plant species within the project area. A field review by the project's senior field naturalist and certified wetlands scientist did not identify any RTE plant species on the dam sites.

A separate letter report (attached, 5/24/2022) resulting from consultation was provided by VANR Fish and Wildlife Department, Fisheries Biologist (attached). The report did not identify any E&TS, but did state that Jewell Brook and the upper watershed reaches above the dam sites are considered highly productive, cold-water trout streams that will require adequate protections from impacts during construction.

The project area was reviewed by the VFWD for the potential presence of bald eagle nesting sites. The sites are far enough from the project that no impacts are expected, per VFWD and USFWS.

Table 12 State and Federally-Listed and State Species of Special Concern with Potential to occur in the Project Area

Mammals		
Northern Long-eared Bat	*Myotis septentrionalis*	FT, SGCN, RSGCN, S1
Hoary Bat	*Lasiurus cinereus*	SGCN, RSGCN
Birds		
Bald Eagle	*Haliaeetus leucocephalus*	BCC, BGEPA, MBTA
Bicknell's Thrush	*Catharus bicknelli*	BCC, MBTA
Canada Warbler	*Cardellina canadensis*	BCC, MBTA
Evening Grosbeak	*Coccothraustes vespertinus*	BCC, MBTA
Prairie Warbler	*Dendroica discolor*	BCC, MBTA
Wood Thrush	*Hylocichla mustelina*	BCC, MBTA
Fish		
Cutlip Minnow	*Exoglossum maxillingua*	S3
Reptiles		
Wood Turtle	*Glyptemys insculpta*	S3, SGCN, RSGCN
Insects		
Clamp-tipped Emerald	*Somatochlora tenebrosa*	S3S4
Slender Bluet	*Enallagma traviatum*	S1S2, SGCN
Harpoon Clubtail	*Phanogomphus descriptus*	S3, RSGCN
Plants		
Grass Rush	*Juncus marginatus*	S3
Drooping Bluegrass	*Poa saltuensis ssp. saltuensis*	S3
Wiegand's Sedge	*Carex wiegandii*	S1, SGCN
A Moss	*Anomobryum filiforme*	S1, SGCN
A Liverwort	*Scapania umbrosa*	S1, SGCN
A Moss	*Pseudotaxiphyllum distichaceum*	S2S3
Massachusetts Fern	*Parathelyperis simulata*	S2, SGCN
Loesel's Twayblade	*Liparis loeselii*	S3
Large-leaved Sandwort	*Moehringia macrophylla*	S2, SGCN

Rough Avens	*Geum laciniatum*	S3S4

Key:
BCC = USFWS Bird of Conservation Concern for region;
BGEPA = Bald and Golden Protection Act;
FT = Federally Threatened under Endangered Species Act (ESA);
MBTA = Migratory Bird Treaty Act;
The State of Vermont list of Rare and Uncommon Animals of Vermont indicates the following protection status for three categories of species listing, as follows:
SC = State Species of Special Concern (as determined by the Vermont Endangered Species Committee); should be watched, but does not denote legal protection;
SGCN = Species of Greatest Conservation Need (as determined by Vermont Fish & Wildlife Species Teams; not a statutory designation but prioritizes State conservation funds and measures conservation success within the state); does not denote legal protection;
The State of Vermont Explanation of Legal Status and Information Ranks indicates the following protection status:

RSGCN = Regional Species of Greatest Conservation Need (as designated by the Northeast Wildlife Diversity Technical Committee), (no legal protection indicated);
Note: Species in Vermont are ranked from S1 - S5 as follows:
S1 = Very rare; S2 = Rare; S3 = Uncommon; S4 = Common to Uncommon; S5 = Common
Sources: USFWS 2020; VT ANR 2020; Vermont Fish and Wildlife

3.5.2 Plant Condition & Forest Resources

A site visit performed on October 30, 2019 informed the observations described below.

At Dam Site #1, the condition of the plants is good, with no areas of stressed or diseased vegetation observed. Mixed deciduous/coniferous forest occurs along the eastern edge of the retarding pool, between the wetland and Route 100. An area of primarily coniferous forest occurs at the southwestern extreme of the pool. Hardwood forest and shrubland occurs along the outlet stream.

At Dam Site #2, the condition of the plants is good, with no areas of stressed or diseased vegetation observed. Mixed deciduous/coniferous forest occurs along the western and southern periphery of the retarding pool, the area south of the dam, and east of the dam around the outlet stream.

At Dam Site #3, the condition of the plants is good, with no areas of stressed or diseased vegetation observed. Mixed deciduous/coniferous forest occurs along and west of the southwestern periphery of the retarding pool.

At Dam Site #5, the condition of the plants is good, with no areas of stressed or diseased vegetation observed. Deciduous forest occurs to the northwest and southwest of the retarding pool outside a band of wetland along the incoming streams. Mixed deciduous/coniferous forest occurs in the southeastern portion of the project area, between the mowed auxiliary spillway and the primary spillway. Deciduous forest occurs along the northern limit of the dam.

3.5.3 Fish, Wildlife & Aquatic Resources

Wildlife habitat at the Sites generally includes open grassland associated with the dams and auxiliary spillways and varying amounts of shrub and forestland on the remainders of the sites. Aquatic habitat includes the open water of the retarding pools as well as streams

entering and exiting the pools. Common species likely to occur in these habitats include beaver, black bear, eastern cottontail, coyote, fox, squirrel, raccoon, porcupine, weasel, skunk, opossum, white-tailed deer, mice, voles, and a variety of songbirds, raptors, fish, turtles and snakes. Brook, brown and rainbow trout are common up and downstream of the four sites, on small portions of the affected areas of Sites #1 and #2, and the entirety of the affected areas of dam sites #3 and #5 (VT ANR).

Many of the waters within the Jewell Brook Watershed are notable for Brook Trout and other mixed species of Trout, such as Brown and Rainbow Trout, including the upstream watershed and portions of the downstream watershed of all four dam sites, small portions of the affected areas of Sites #1 and #2, and the entirety of the affected areas of dam sites #3 and #5 (VT ANR).

During the Jewell Brook Scoping Meeting on August 3, 2020, Vermont Fish and Wildlife representatives noted that there are multiple trout monitoring sites along Jewell Brook and that it is considered one of the highest quality trout streams in Southern Vermont. Common mammal species in Southern Vermont include beaver, black bear, eastern cottontail, coyote, fox, squirrel, racoon, porcupine, weasel, skunk, opossum, and white-tailed deer. No fish or wildlife were directly observed during the course of field work in 2019 and 2020.

3.5.4 Invasive Species

Consultation with the USACE was conducted relative to invasive species for this project. USACE representatives stated that while there is no listing of specific BMP's for invasive species control, all General Permits for the State of Vermont administered by the US Army Corps of Engineers are subject to General Conditions # 16 (Restoration of Wetland Areas), 26 (Environmental Functions and Values), and 27 (Invasive Species) which treat this topic. General Condition #16 prohibits the use of invasive species in seed mixes. General Condition #26 requires the permittee to discourage the establishment or spread of plant species identified as non-native invasive species. General Condition #27, Invasive Species, states, "The introduction, spread, or the increased risk of invasion of invasive plant or animal species on the project site, into new or disturbed areas, or areas adjacent to the project site caused by the site work shall be avoided. Hence, swamp and timber mats shall be thoroughly cleaned before reuse." A reference to these General Conditions will be included in the project plans.

The Vermont Agency of Natural Resources maintains partial lists of invasive species common to Vermont. Common wetland invasive species include reed canary grass (*Phalaris arundinacea*), giant reed (*Phragmites australis*) and purple loosestrife (*Lythrum salicaria*). Common upland invasive species include poison parsnip (*Pastinaca sativa*), alder-leaf buckthorn (*Rhamnus alnifolia*), European buckthorn (Rhamnus *cathartica*), Japanese barberry (*Berberis thunbergii*), and burning bush (*Euonymus alatus*).

The invasive species observed at the sites during field investigations on October 30, 2019 include the following.

Dam Site #1- Reed canary grass *(Phalaris arundinacea)* occurs in Wetland A.

Dam Site #2- No invasive species were noted.

Dam Site #3- Reed canary grass *(Phalaris arundinacea)* occurs in Wetlands A and C. Purple loosestrife *(Lythrum salicaria)* and giant reed *(Phragmites australis)* occur in Wetland B.

Dam Site #5- Reed canary grass *(Phalaris arundinacea)* occurs in Wetlands A and C. Purple loosestrife *(Lythrum salicaria)* occurs in Wetland A. Poison parsnip *(Pastinaca sativa)* occurs in the upland adjacent to Wetlands A and B.

Best management practices referenced by the USACE are incorporated into this Plan-EA and the final design and subsequent permitting to control the spread of invasive species. These BMP's include: 1) use of equipment and construction / timber mats that is thoroughly cleaned prior to mobilization to the site and prior to demobilization, 2) cleaning construction equipment before moving to a new site to minimize the risk of transporting seeds or propagules, 3) proper disposal of excavated or dredged material, 3) dispose of excavated and dredged material in pre-approved, non-wetland areas, 4) provide training or personnel with knowledge of identification of invasive species; 5) applying control treatments prior to construction and monitoring during and after construction;.

3.5.5 Natural Areas

There are no natural areas within the immediate affected area of each dam, however there are several within the downstream affected area and the upstream drainage area. Along the Black River, the affected area intersects a Vermont Land Trust easement, the Cavendish Wood Lot, and the Hawks Mountain Wildlife Management Area in the Town of Cavendish, and the North Springfield Reservoir in the Town of Weathersfield. The upstream drainage area of each of the 4 dams includes portions of the Okemo State Forest. Grant Brook bisects a VHCB easement in the drainage area of Site 2 (VT ANR).

3.5.6 Ecological Critical Areas

For all four Dam Sites, consultation with the USFWS, including the development and review of a species list specific for the project area indicates that there are no known Critical Habitat areas within the project location. However, the project locations, as for the entire State of Vermont, has the potential to support summer range habitat for the federally-threatened Northern Long-Eared Bat (NLEB). Such potential habitat consists of trees greater than 3" diameter at breast height (DBH). USFWS consultation concluded that the cutting and removal of trees is to occur outside of the NLEB active period of April 1 through October 31, which is reflective in the Plan-EA.

3.5.7 Migratory Bird Treaty Act

All native wild birds found in the U.S., with the exception of the house sparrow (*Passer domesticus*), European starling (*Sturnus vulgaris*), feral pigeons (*Columba livia domestic*a) and resident game birds (e.g. pheasant and grouse [Order *Galliformes*], and wild turkey [*Meleagris gallopavo*]), are protected under the Migratory Bird Treaty Act (MBTA). The bald eagle (*Haliaeetus leucocephalus*) and golden eagle (*Aquila chrysaetos*) are also protected by the Bald and Golden Eagle Protection Act (BGEPA). Habitat for native birds, including nesting sites, exists in and around the Jewell Brook Watershed Dam sites; however, foraging and nesting habitat to support eagles is not known to occur in the Project Area around the

dams. There have been sightings around the North Springfield Reservoir at the end of the downstream inundation area (Vermont eBird 2020). No Audubon Important Bird Areas are located within the vicinity of the project (Audubon 2007).

3.6 Human, Economic & Social Conditions

3.6.1 Social Conditions / Demographics

The Town of Ludlow, Vermont, founded in 1761, had an estimated population of 1,955 as of July 2019 and a land area of approximately 23,000 acres (Municipal Plan, 2019). It is located within the Southern Windsor County Regional Planning Commission jurisdiction in south-central Vermont (SWCRPC, 2020) and includes Ludlow Village, a state-designated Village Center, Historic District, and Preservation District (Municipal Plan, 2019). The Town of Ludlow is bordered by the Town of Plymouth to the north, the Town of Cavendish to the east, the Towns of Chester and Andover to the south, and the Town of Mount Holly to the west (VTrans, 2020). While historically an agricultural and manufacturing community, today it has become a destination for outdoor recreation, including the Okemo Mountain ski resort and related tourist industries, and has a high percentage of second homes (Municipal Plan, 2019).

Table 13 Social and Economic Profile

Social and Economic Profile				
Beneficiary	**Ludlow**	**Windsor County**	**Vermont**	**U.S.**
Population (July 1, 2019)	1,955	55,062	623,989	328,239,523
Under 18 Years of Age	332	9,856	114,189	73,197,413
Over 65 Years of Age	482	13,325	124,797	55,159,521
Per Capita Income[1,3]	-	$35,152	$33,238	$32,621
Median Household Income[2]	$55,305	$58,303	$60,076	$60,293
Households, 2014-2018[3]	-	24,310	259,589	119,730,128
Median Value of Owner-Occupied Housing Units, 2014-	-	$216,800	$223,700	$204,900
Percent of Persons Living in Poverty	15.9%	9.6%	11%	11.8%
Race and Hispanic Origin				
White alone	97.1%	95.9%	94.2%	76.3%
Black or African American	0.6%	1.0%	1.4%	13.4%
American Indian and Alaska Native	0.2%	0.3%	0.4%	1.3%
Native Hawaiian and Other Pacific Islander	0.2%	n/a	n/a	0.2%
Two or More Races	5.1%	1.8%	2.0%	2.8%

Hispanic or Latino	2.0%	1.8%	2.0%	18.5%
White alone, not Hispanic or Latino	92.0%	94.3%	92.6%	60.1%
Asian	0.9%	1.0%	1.9%	5.9%
1 – Per capita income in past 12 months (in 2018 dollars), 2014-2018 2 – Median household income (in 2018 dollars), 2014-2018 3 – No data available for towns under 5,000 people Source: U.S. Census Bureau 2019				

3.6.2 Land Use & Land Cover

The land use and land cover of the Site 1, 2, 3, and 5 drainage areas is summarized in the table below. All four drainage areas are predominantly forested.

Table 14 Land Cover

Land Cover in the Jewell Brook Dams Drainage Areas								
Land Cover	Site 1		Site 2		Site 3		Site 5	
	Acres	%	Acres	%	Acres	%	Acres	%
Tree Canopy	1,158.7	89.6%	1,162.3	96.1%	710.1	77.8%	1,103.2	95.3%
Grass/Shrub	100.2	7.8%	38.6	3.2%	141.1	15.5%	53.6	4.6%
Bare Soil	0.8	0.06%	0.3	0.02%	12.6	1.4%	0.3	0.02%
Water	7.3	0.6%	2.5	0.2%	10.4	1.1%	0.8	0.07%
Buildings	2.0	0.2%	0.9	0.07%	5.5	0.6%	0.06	0.01%
Roads	15.5	1.1%	2.6	0.2%	14.5	1.6%	0.2	0.02%
Other Paved	8.6	0.7%	2.4	0.2%	18.2	2.0%	0.1	0.01%
Total	1,293.0	100.0%	1,209.6	100.0%	912.4	100.0%	1,158.3	100.0%

Source: Vermont High Resolution Land Cover, 2016, University of Vermont Spatial Analysis Laboratory

Land cover in the affected environment is dominated by tree canopy and grass/shrubs, and approximately 90% or more of the dam sites #1, #2, and #5 drainage areas are covered with tree canopy. Two percent (2%) of the land cover in the Site 1 drainage area is impervious (which includes the buildings, roads, and other paved land cover types). Approximately one-half of one percent (0.5%) of the dam site #2 drainage area is impervious, with limited residential development and mostly forested land and grassed areas. Only 0.04% of dam site #5's drainage area is impervious. The remaining portion of the Site 1, 2, and 5 drainage areas are rural/residential, where some development may occur but land uses would be limited to low density residential, small-scale commercial, and outdoor recreation (SWCRPC, 2018).

The drainage area of dam site #3 has more development than dam sites #1, # 2, and #5, with approx. 78% tree canopy cover and 4.2% impervious. This drainage area includes ski slopes, several buildings, parking lots, and roads that are part of the Okemo ski resort. Some changes to the future lane use and land cover is expected in this drainage area. A small section of land in the lower portion of the watershed is part of the regional plan's medium density residential area where future development may occur (SWCRPC, 2018). Most of the drainage area is rural/residential, with some protected lands above 2,500 feet as well.

Land development patterns in Ludlow are consistent with rural Vermont, diffuse residential development with higher density development clustered in villages. Within the combined drainage area for the Jewell Brook Dams, there are five zoning districts (Ludlow Zoning and Flood Hazard Regulations, Adopted January 7, 2019) that define the type and allowed density of development.

- The **Aquifer Protection District**, which covers a majority of the drainage areas for sites 1 & 2 has a minimum allowable lot size of 5 acres, and uses are limited to largely residential or natural resource-based activities (wildlife refuge, government recreation area).
- The **State Forest or WMA (Wildlife Management Area) district** includes lands that are part of Okemo State Forest, which is maintained by the Vermont Department of Forests, Parks and Recreation. Upland portions of drainage areas for sites 2, 5 and 3 are included in this district. This land is permanently conserved and new development is generally not permitted unless part of a Ski Lease arrangement, such as is present for Okemo Mountain Resort.
- The **Town Residential district** guides development on portions of sites 5 & 2. This district allows single and multi-family residential, offices and recreational uses. Minimum lot sizes are roughly 2.7 acres in size.
- The **Mountain Recreation district** provides a regulatory structure for all development within the existing ski resort of Okemo Mountain. These regulations allow uses common to ski areas and encourage the clustering of buildings in order to maintain open space and protect fragile areas. Okemo Mountain Resort also has an associated Act 250 permit under which any new development will be reviewed in addition to Ludlow's own permitting process.
- The **Proprietary Municipal District** areas include upstream lands immediately adjacent to and including portions of the Jewell Brook Dams. These lands are maintained by the Town and provide space for public recreation and flood control. New development is prohibited within these areas.

A majority of the lands within the combined Jewell Brook Dam drainage area are either conserved or are limited in allowed density. Further, new commercial development over 10 acres or commercial, industrial and residential development above 2500ft is subject to Vermont's Act 250 (Act 250) regulation, which has significant requirements with regard to the protection of natural resources as well as storm water management. By right, the Municipality and any relevant State agencies are parties under the Act 250 permitting

process and can provide input into any potential conditions that might be necessary to allow a proposed project to be permitted.

Development within the 100-year floodplain is regulated by Ludlow's Zoning and Flood Hazard Regulations. New development is allowed within the FEMA mapped floodplain provided that it is elevated to at least one foot above base flood elevation if elevations are available, or that such development will not increase base flood elevation by more than one-foot at any point in the community. New construction is prohibited in the Floodway.

The table below shows land cover in the affected area for each site as well as the 100-year floodplain.

Table 15 Land Cover within Floodplain

	Site #1		Site #2		Site #3		Site #5		100-year Floodplain	
	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%
Tree canopy	12.3	34.3%	24.9	49.7%	11.7	24.9%	27.8	56.7%	502.0	40.4%
Grass/Shrubs	17.8	49.0%	20.15	40.2%	23.3	49.4%	19.7	40.3%	451.9	36.3%
Bare soil	0.0	0.0%	0.01	0.0%	0.2	0.3%	0.02	0.0%	9.7	0.8%
Water	4.1	11.4%	2.51	5.0%	10.1	21.3%	1.0	2.0%	150.3	12.1%
Buildings	0.0	0.0%	0	0.0%	0.3	0.6%	0.04	0.1%	26.5	2.1%
Roads	1.3	3.7%	2.51	5.0%	0.6	1.3%	0.4	0.9%	39.5	3.2%
Other Paved	0.6	1.6%	0.02	0.0%	1.1	2.2%	0.03	0.1%	61.3	4.9%
Railroads	0.0	0.0%	0	0.0%	0	0.0%	0	0.0%	2.3	0.2%
Total	36.3	100.0%	50.1	100.0%	47.17	100.0%	48.9	100.0%	1243.4	100.0%

Source: Vermont High Resolution Land Cover, 2016, University of Vermont Spatial Analysis Laboratory
Approximately 9.41% is covered by impervious surfaces (including railroad).

3.6.3 Public Health & Safety

Construction of the Jewell Brook Dams was completed between 1969-1972 with federal assistance provided by the SCS. The dams were constructed for the purposes of flood control; however, the reservoirs and surrounding areas provide recreational opportunities to local residents. All four dams are classified as High Hazard dams under USDA NRCS standards. Dam breach hydraulic analyses were performed for the dams using the USACE's HEC-RAS computer model to determine the downstream inundation limits of the flood wave created by a dam breach.

Human health and safety concerns associated with the dams include items of risk such as flooding or other disasters affecting the security of life or health; potential loss of human

life, property, and essential public services due to structural failure; and other environmental effects such as changes in air or water quality. Since none of the dams meet all of the current federal and state dam safety design and performance standards, there is an increased risk of dam failure that would result in downstream flooding, which could greatly impact the lives, health, and essential public services such as infrastructure and emergency assistance.

3.6.4 Breach Analysis & Hazard Classification

Each of the four (4) dam sites were originally designed as High Hazard dams. This classification has been reaffirmed over the years by the Vermont Dam Safety Program, Army Corps of Engineers and NRCS (2015 Assessment Report) subsequent breach analysis and engineering investigations. The NRCS-High Hazard classification is consistent with the Vermont Dam Safety Section's High Hazard classification. Details of the 2022 breach analyses are discussed further in Appendix D.2.

As part of this 2022 Plan-EA, an updated dam breach analysis was performed for each of the four dam sites. The breach analyses were developed in accordance with TR-210-60, Part 1, Breach Discharge Criteria, and associated downstream flood routing conducted using the USACOE's HEC-RAS computer model. The HECRAS-computed inundation limits for each of the four dam sites were imported into GIS and digital inundation maps were prepared for each dam breach.

A static breach failure was conducted for each dam and routed downstream with a 100-yr flood base flow. The potential mode of failure for each dam included an internal erosion (piping) for the static breach. HEC-RAS model breach parameters were initially calculated using the Froehlich dam breach equations (1995) and then were iteratively adjusted within the model to generate an outflow hydrograph meeting TR-210-60 criteria. All breach hydrographs had a peak discharge equal to or greater than the minimum computed value by the HEC-RAS equations and less than the maximum value computed by the TR- 210-60 equations.

As indicated in Appendix D.2, Section 5.0, Breach Analysis, the computed peak breach outflow varies from 22,372 to 53,235 cfs for Dam sites 1-5, respectively. The estimated maximum breach failure wave height varies from 34.5-ft to 48.8-ft (Sites 1-5).

Breach inundation mapping, which has been prepared in accordance with TR-210-60, extends from the base of each dam, down each tributary, along the Jewell Brook valley to the Black River confluence, where the breach wave propagates for an additional 15 miles downstream the Black River to the USACE North Springfield Flood Control Dam. The 34.5-ft to 48.8-ft breach wave from the dam sites is expected to impact up to approximately 490 buildings and structures.

3.6.5 Consequences of Dam Failure

As described above, a No Action alternative assumes the dams are left as is, no rehabilitation or repairs to the dam are conducted, other than the annual maintenance conducted by the owner. In theory, the dams are left to deteriorate to the point where one or more results in an ultimate failure or breach.

To determine the consequence of dam failure, the number of properties with structures / buildings impacted was estimated (conservatively) for individual dam failure, and the results are shown in Appendix D.2, Table 41. The four dams are located in parallel with each other, not in series. This means no dam flows into another and the failure of any given dam does not impact or influence the remaining three dams. For example, a breach of dam site #5 does not impact dam sites 1, 2 or 3. A breach of dam site #5 would produce a failure wave approximately 48.8-ft in height and is estimated to impact 445 properties with structures, as outlined below.

Multiple, simultaneous dam failures would result in a greater inundation limit and number of affected properties with structures than those shown in Appendix D.2, Table 41.

Based on HECRAS and GIS modeling, during the 100-year base flow, approximately 188 properties with structures are located within the non-breach inundation limit. The breach inundation limit resulting from a Dam Site #5 failure is modeled to impact an additional 257 properties with structures, as well as increasing the flooding depth of the 188 properties. The additional 257 properties with structures subject to flooding from a dam site #5 breach is:

- Residential dwellings 134
- Commercial properties 47
- Public safety 4
- Other (utility, recreation, etc.) 72
- Mapped bridges (over 20' span) 24 (VTrans 2020)
- Mapped bridges (less 20' span) 4 (VTrans 2020)
- Mapped culverts 4 (VTrans 2020)

As indicated in Appendix D.2, the number of impacted properties with structures has been estimated as described above. The number of impacted properties with structures ranges from 421 to 490.

3.6.6 Transportation

Transportation in the study area includes VT-100, which runs north-south, and is classified as a Minor Arterial Highway, running adjacent to Jewell Brook. It connects many tourist destinations along the Green Mountains. VT-103 is classified as a Principal Arterial Highway and runs along the Black River, downstream of the dams. Both roads are Class I, (locally controlled roadways connecting state highways as they pass through downtowns and villages) town-maintained, within Ludlow Village for a total of 2.295 miles, and state-maintained outside of the Village.

Site 1 Road crosses the embankment of Site 1, wrapping around to the southwest side of Site 2 and services multiple homes. Site 2 is upstream of Snell Spring Road and Brooks Road. West Hill Road bounds Site 3 to the north and turns into a Class 4 road before it terminates at the northern side of Site 5 (VTRANS, 2017). Automobile travel is the primary mode of transportation, and traffic volumes have been increasing since 1999, particularly in peak tourist seasons. Both VT-100 and VT-103 experience high truck traffic - 6.1% and 14% respectively (Municipal Plan, 2019). Cycling is common along existing roadways, however

there are no dedicated bike lanes.

The Green Mountain Railroad roughly parallels VT-103 through the town, providing freight service, and is state-owned and privately operated (VTRANS, 2015). The Green Mountain Flyer operates during foliage season (Municipal Plan, 2019).

3.6.7 Floodwater Damage

There have been 27 FEMA disaster declarations related to flooding for Windsor County from 1990-2018 (SWCRPC, 2018). Much of the town's residences and services are located within or surrounded by floodplains. There are estimated to be 137 residential structures and 39 commercial structures within the FEMA floodplain with 541 bridges and culverts as of a 2010 inventory. Flash flooding is also a concern among higher elevation infrastructure and properties. Tropical Storm Irene in 2011 damaged nearly every road in the Town of Ludlow as well as the water/wastewater treatment facility and Little League fields, with total damages estimated to be $2.5 - 3 million (SWCRPC, 2013).

Tropical Storm Irene also caused the first recorded activation of the auxiliary spillways at dam sites #2, #3 and #5. The spillway discharge resulted in significant erosion at the discharge end of each spillway, resulting in the NRCS-VT and the Town of Ludlow partnering together to make repairs including the placement of stonefill and regrading/ revegetating the eroded areas. The auxiliary spillway at dam site #1 was not activated and no significant damages were reported.

3.6.8 Environmental Justice & Civil Rights

Environmental Justice is defined as the fair treatment and meaningful involvement of all people regardless of race, color, national origin or income regarding the development, implementation and enforcement of environmental laws, regulations and policies. In order to identify potential EJ populations and their susceptibility to risk within the APE under the proposed action, the Environmental Protection Agency's EJScreen tool was used (Version 2.0, 2022). EJScreen is an environmental justice mapping and screening tool that provides a nationally consistent dataset and approach for combining environmental and demographic indicators.

Environmental indicators

Of the environmental indicators used to identify potential risks to EJ populations, EJScreen indicates several are present in Ludlow, including higher than 50th percentiles for Lead Paint, Underground Storage Tanks and Wastewater Discharge pollutants. While there are no known pollution concerns related to underground storage tanks, surface and groundwater quality are identified as a resource concern for this project.

Based on the lead paint indicator, it is reasonable to assume that much of the housing stock within the area of potential effect is pre-1960, which can make non-structural solutions such as floodproofing challenging due to structural weaknesses in older buildings.

Socioeconomic indicators

The results of the EJScreen socioeconomic analysis indicates that minority populations are limited (7% of the total population within the project area), and there are no known Native American tribes are in the area. EJ Screen's Demographic Index, which is a combination of percent low-income and percent minority is below the 50th percentile in the Affected Area.

However, several socioeconomic indicators do exceed the 50th percentile. Nineteen percent (19%) of the population in the Affected Area is over the age of 64, which is slightly above the US average (but consistent with Vermont's demographic profile). Thirty-nine percent (39%) of the population in this are considered low income, which is higher than the national average.

The results of this analysis indicate that there are several EJ populations that will need to be considered as part of the alternatives analysis process as a percentage of the homes within the Affected Area are likely to house residents over the age of 64 and/or low-income populations.

Table 16 Environmental Justice EJScreen Tool

Selected Variables	Value	USA	
		Avg.	% tile
Pollution and Sources			
Particulate Matter 2.5 (µg/m3)	6.06	8.74	4
Ozone (ppb)	36.1	42.6	15
2017 Diesel Particulate Matter* (µg/m3)	0.0489	0.295	<50th
2017 Air Toxics Cancer Risk* (lifetime risk per million)	20	29	<50th
2017 Air Toxics Respiratory HI*	0.2	0.36	<50th
Traffic Proximity (daily traffic count/distance to road)	170	710	43
Lead Paint (% Pre-1960 Housing)	0.45	0.28	74
Superfund Proximity (site count/km distance)	0.055	0.13	46
RMP Facility Proximity (facility count/km distance)	0.14	0.75	23
Hazardous Waste Proximity (facility count/km distance)	0.068	2.2	10
Underground Storage Tanks (count/km2)	2.1	3.9	59
Wastewater Discharge (toxicity-weighted concentration/m distance)	2.6	12	95
Socioeconomic Indicators			
Demographic Index	22%	36%	34
People of Color	5%	40%	11
Low Income	39%	31%	67
Unemployment Rate	5%	5%	54
Linguistically Isolated	0%	5%	45
Less Than High School Education	5%	12%	31
Under Age 5	4%	6%	28
Over Age 64	19%	16%	70

Source: EPA EJ Screen Report (Version 2.0), 2022

Further, the number of EJ population estimated to be affected by actions within the APE is assumed to 24-percent of the residential properties within the flood plain times of the average 2.28 people per household.

3.7 Cultural Resources

3.7.1 Cultural Resources / Historic Properties

Consultation with the federally recognized Stockbridge-Munsee Tribal Community's Historic Preservation Officer, who serves as a representative for these cultural-related issues and also the VT State Historical Preservation Officer (VT SHPO) has been conducted regarding the work outlined below. Pertinent correspondence is attached in Appendix D.5.

An initial Phase IA Archeological Resource Assessment was conducted for each of the 4 dams, investigating archaeological sites within the Area of Potential Effects (APE) and within 2 miles. A senior consulting archaeologist conducted the site visit to each dam site and the surrounding areas. Site files from the Vermont Archaeological Inventory indicate 13 sites within 2 miles of the APEs. There are 5 precontact sites north of the dam area along the Black River corridor. None of the sites have scores indicating precontact sensitivity. General precontact sensitivity is considered moderate and historic sensitivity is considered low.

Dam Site #1 has 2 historic properties adjacent to the APE and 1 area of precontact archeological potential. Dam Site #2 has 2 areas of precontact archeological potential. Dam Site #3 has 3 historic properties adjacent to the APE and 2 areas of precontact archeological potential. Dam Site #5 has two (2) areas that may have been sites of precontact occupation. None of the four (4) dam sites have scores indicating precontact sensitivity. General precontact sensitivity is considered moderate and historic sensitivity is considered low.

A follow up Phase IB investigation was conducted in July, 2022. The report concluded that no precontact Native American or historic period artifacts were identified within the two (2) ASA's that could not be avoided.

The NRCS Archeologist has consulted with the VT Stockbridge-Munsee Community Historic Preservation Officer. The Phase IB report was provided to this representative, who concluded that due to lack of any Native American archaeological resources recovered during the Phase IB investigation, the Stockbridge-Munsee Community has no concerns with this project moving forward, with several stipulations (reference documentation attached in Appendix D.5).

Consultation with the VT SHPO has occurred regarding Historic Properties resources. A NRHP analysis by a qualified consulting Senior Architectural Historian was conducted between July and September 2022 (reference documentation in Appendix D). This analysis included a site review of each dam, data research and preparation of the Vermont Architectural Resource Inventory Individual Property Forms for each dam.

The results indicate the four (4) Jewell dam sites meet the eligibility criteria for inclusion into the State and National Registers of Historic Places under Criterion A and C. Potential impacts to these resources will be considered as part of the alternative analysis scoping process. NRCS has provided the Phase IA, Phase IB and the NRHP eligibility reports to the VT State Historical Preservation Officer, who has concurred with the findings.

3.8 Climate and Noise

3.8.1 Climate

Vermont has a temperate, continental climate, generally with hot summers and cold and snowy winters. The average annual precipitation for Windsor County is 41.92" and the average seasonal snowfall for Ludlow, Vermont is 90.7" (NOAA, 2019). In winter, the average mean temperature is 18.6 degrees Fahrenheit (°F), and the average daily minimum is 8.6 °F. In summer, the average temperature is 63.5 °F, and the average daily maximum temperature is 76.5 °F (NOAA, 2019). The typical frost dates Windsor County, Vermont is September 19 – May 26, but may vary based on microclimate (NRCS AgACIS, 2000).

3.8.2 Noise

Ambient noise in the project area has not been measured, however, each of the four dam sites are located in a rural part of Vermont. Residential development is a very low density and ambient noise includes rural-level roadway activity on adjacent roadways.

3.9 Air Quality & Visual Resources

3.9.1 Air Quality / Clean Air Act

The Clean Air Act and the US EPA sets National Ambient Air Quality Standards (NAAQS) for six principal pollutants. There are 3 permanent monitoring sites in Vermont, 2 urban and 1 rural, with the closest to Ludlow being the urban Rutland site. For the data available since 2001, all pollutants have been under the NAAQS (Vermont Department of Environmental Conservation [VTDEC], 2020). Based on the EPA August 2020 update for Counties Designated as "Nonattainment", Ludlow (as well as Windsor County as a whole) is not within a "nonattainment" or "maintenance" county (USEPA, 2020).

There are no specific emission sources associated with the Dam Sites and the dams themselves are currently in full compliance with the Clean Air Act.

3.9.2 Visual Resources

The Town of Ludlow includes the Ludlow Village Historic District, set in a rural countryside, which is surrounded by open fields, hardwood forests and lakes and rivers. Several ridgelines, water features, the Okemo State Forest, forests within the public water source protection area, and the dark night sky are identified by residents as important scenic resources (Municipal Plan, 2019). It is located along Scenic Route 100 in south-central Vermont, a byway known as one of the most scenic drives in Vermont, running along the eastern foothills of the Green Mountains (Okemo Valley Chamber of Commerce, 2020).

Each of the four dam sites are easily accessible from this corridor and include large expanses of mowed embankment and auxiliary spillway, open retarding pools, and adjacent hardwood forests and wetlands. A local road passes over the embankment of dam site #1, the West Hill Recreation Area is adjacent to dam site #3 and forested parkland and trails are adjacent to dam site #5. The dams are visual icons in the Town and any changes to the configuration or components will be visible. The Ludlow Village Historic District does not fall within the cultural resources viewshed (see Appendix C).

To quantify the value of the aesthetic viewsheds of the four dam sites, a viewshed map to

indicate what portion of the reservoir surface area and natural green landscape is visible from surrounding homes was determined for each dam within the identified limit of disturbance. None of the dams or immediate adjacent areas are visible from the historic village district. Viewshed maps for each dam site are included in Appendix C. The aesthetic viewsheds for each dam include:

- Dam Site #1: 3.0 acres of natural green landscape. (None of the reservoir surface area is visible from nearby homes.)
- Dam Site #2: None of the reservoir surface area or natural green landscape are visible from nearby homes.
- Dam Site #3: None of the reservoir surface area or natural green landscape are visible from nearby homes.
- Dam Site #5: 8.6 acres of reservoir surface area and 24.9 acres of natural green landscape.

3.9.3 Water-based Recreation & Parklands

Dam sites #3 and #5 have recreational use incidental to flood control. The West Hill Recreation Area is adjacent to dam site #3 and includes shelters, restrooms, hiking trails, horseshoe pits, playing fields, and basketball courts. There is a desire from the Town Recreation Department for expanded future use at the Recreation Area, possibly including a dog park and swimming. The 20-acre Olaf Naess Wilderness Area is adjacent to dam site #5 and includes trails for hiking and mountain biking. Dam sites #1 and #2 are within the Town of Ludlow source protection areas and recreation is discouraged at these sites.

3.10 Dam Site Descriptions

3.10.1 Dam Site Descriptions

Dam Site #1:

- Designed in 1966, constructed in 1969
- Located on Jewell Brook, 2,400-feet upstream of the confluence with Grant Brook
- Intermediate sized, High (Class I) hazard potential dam by NRCS and the State of Vermont Dam Safety.
- A 450-foot long and 58-foot high zoned, compacted earth embankment with toe/trench drain system.
- A 320-foot long saddle dike along the western edge of the auxiliary spillway.
- A principal spillway system comprised of the following
  - 254-foot long, 30-inch diameter reinforced concrete outlet pipe with (12) reinforced concrete anti-seepage collars and impact basin
  - Two stage cast in place concrete intake riser
  - 18” diameter CMP pond drain with (2) C.M. anti-seepage collars
- 4-inch cast iron water supply pipe (generally follows alignment of PS outlet pipe)
- A 250-foot wide broad crested trapezoidal earthen auxiliary spillway

Dam Site #2:

- Designed in 1967, constructed in 1970
- Intermediate sized, High (Class I) hazard potential dam by NRCS and the State of Vermont
- A 1,110-foot long and 70-foot high zoned, compacted earth embankment with

toe/trench/spring drain system.
- A principal spillway system comprised of the following
  - 303-foot long, 30-inch diameter reinforced concrete outlet pipe with (14) reinforced concrete anti-seepage collars and impact basin.
  - Two stage cast in place concrete intake riser
  - 18" diameter reinforced concrete pond drain
- 4" cast iron water supply pipe (generally follows alignment of PS outlet pipe)
- A 300-foot wide broad crested trapezoidal earthen auxiliary spillway.

Dam Site #3:
- Intermediate sized, High (Class I) hazard potential dam by NRCS and the State of Vermont
- A 670-foot long and 64-foot high zoned, compacted earth embankment with toe/trench drain system.
- A 300-foot long saddle dike along the south eastern edge of the reservoir.
- A principal spillway system comprised of the following
  - 273-foot long, 30-inch diameter reinforced concrete outlet pipe with (12) reinforced concrete seepage collars
  - Two stage cast in place concrete intake riser
  - 18" diameter CMP pond drain with (4) reinforced concrete seepage collars.
- A 200-foot wide broad crested trapezoidal earthen auxiliary spillway.

Dam Site #5:
- Large sized, High (Class I) hazard potential dam by NRCS and the State of Vermont
- A 660-foot long and 112-foot high zoned earthen embankment with toe/trench drain system.
- A principal spillway system comprised of the following
  - 480-foot long, 30-inch diameter reinforced concrete outlet pipe with (23) reinforced concrete seepage collars and riprap plunge pool.
  - Single stage cast in place concrete intake riser
  - 18" diameter RCP pond drain.
- Two 150-foot wide broad crested trapezoidal earthen auxiliary spillways.

3.10.2 Current Conditions

A visual review of each of the four dam sites was conducted in 2020 and 2021, in general accordance with NRCS and the Vermont Dam Safety Office dam inspection protocols. Areas reviewed included the embankment and non-earthen components, such as the principal spillway riser, gates, trash rack, conduit, and outlet structure were completed. A summary of the visual inspections is provided below for each dam. The visual inspection of the riser structures and their auxiliary components were completed with a mobile camera unit.

Dam Site #1:

The overall condition of the dam is considered FAIR.

Reservoir:
- Sediment deposition observed at the upper end of the reservoir.

Upstream Slope of Embankment:
- The upstream slope of the embankment appeared to be in good condition (no rutting or erosion observed).

Dam Crest:

- Some erosion from vehicular traffic along the edge of the road which passes over the dam crest. People appear to park along the edge of the dam crest. The dam crest should be closely monitored and repaired as necessary.
- Nothing prevents a vehicle from driving off of the dam crest and into the reservoir.

Downstream Slope of Embankment:

- The downstream slope appeared to be in good condition (no rutting or erosion observed).

Saddle Dike:

- Saddle dike surfaces appeared to be in good condition with no rutting or erosion. People appear to walk across the crest of the saddle dike towards a trail (slight difference in vegetation quality).

Principal Spillway Riser Structure:

- Concrete appeared to be in good condition for the age of the structure. Some water marks near concrete joints but not necessarily from joint leakage. The joints appeared to be in good condition.
- The pond drain slide gate was observed to function. Very minor leak through the gate when closed.

Principal Spillway Outlet Pipe:

- Concrete appeared to be in good condition for the age of the structure. The joints appeared to be in good condition (no observed unsealed gaps).

Principal Spillway Stilling Basin:

- Concrete is in fair condition. It is expected the concrete needed surface repair within the next 50 years.

Trench/Toe Drains:

- Bends in the toe/trench drain pipes prevent the mobile camera unit from inspecting the full length of pipe. The corrugated metal was intact but showed some signs of rust.

Auxiliary Spillway:

- A trail which starts at the northwestern end of the spillway is being accessed by vehicular traffic through the auxiliary spillway. The condition of the grass along the path that they are driving is not uniform with the rest of the spillway.
- No major rutting or erosion observed.

Dam Site #2:

The overall condition of the dam is considered FAIR.

Reservoir:

- Fair amount of sediment deposition at upstream end of reservoir.

Upstream Slope of Embankment:

- The upstream slope of the embankment appeared to be in good condition (no major rutting or erosion observed).

Dam Crest:

- Dam crest appeared to be in good condition, no wet spots, or rutting/erosion observed. People appear to walk across the dam crest (slight difference in vegetation condition from upstream and downstream slopes).

Downstream Slope of Embankment:

- The downstream slope appeared to be in good condition (no rutting or erosion

observed).

Principal Spillway Riser Structure:

- Concrete appeared to be in good condition for the age of the structure. Some water marks near concrete joints but not necessarily from joint leakage. The joints appeared to be in good condition.
- The pond drain slide gate was observed to function. Noticeable leak through the pond drain gate when closed.

Principal Spillway Outlet Pipe:

- Concrete appeared to be in good condition for the age of the structure. The joints appeared to be in good condition (no observed unsealed gaps).

Principal Spillway Stilling Basin:

- Concrete is in fair condition. It is expected that left as is, concrete surface repairs will be required within the next 50-years.

Trench/Toe Drains:

- Trench/Toe Drains discharge directly into the collection system used to collect and covey ground water to the Town water treatment plant used for this water source.

Auxiliary Spillway:

- At the downstream end of the auxiliary spillway where the grass transitions to woods, there is a noticeable channel that has eroded (believed to have occurred when the spillway was activated in 2011).
- Some wet spots were observed.

<u>Dam Site #3:</u>

The overall condition of the dam is considered FAIR.

Reservoir:

- Fair amount of sediment deposition at upstream end of reservoir.

Upstream Slope of Embankment:

- The upstream slope of the embankment appeared to be in good condition (no major rutting or erosion observed).

Dam Crest:

- Dam crest appeared to be in good condition, no wet spots, or rutting/erosion observed. People appear to walk across the dam crest (slight difference in vegetation condition from upstream and downstream slopes).

Downstream Slope of Embankment:

- The downstream slope appeared to be in good condition (no rutting or erosion observed).

Saddle Dike:

- Saddle dike surfaces appeared to be in good condition with no rutting or erosion. People appear to walk across the crest of the saddle dike (slight difference in vegetation quality).

Principal Spillway Riser Structure:

- Concrete appeared to be in good condition for the age of the structure. Some water marks near concrete joints but not necessarily from joint leakage. The joints appeared to be in good condition.
- The pond drain slide gate was observed to function.
- The structure is modified in the winter to raise the pond level to store additional water to be used for snow making.

Principal Spillway Outlet Pipe:

- Concrete pipe appeared to be in good condition. The joints appeared to be in good condition (no observed unsealed gaps).

Principal Spillway Plunge Pool:

- Outlet pipe discharges onto a bedrock outcrop plunge pool area. No signs of erosion were noted at the discharge location.

Trench/Toe Drains:

- Toe drain pipes at the downstream toe were observed to be deteriorated. The CMP pipe drains are rusted on the bottom of the pipes and one pipe appears to be partial crushed.

Auxiliary Spillway:

- At the downstream end of the auxiliary spillway where the grass transitions to woods, there is noticeable erosion (assumed to have occurred when the spillway was activated during Tropical Storm Irene).

<u>Dam Site #5:</u>

The overall condition of the dam is considered FAIR.

Reservoir:

- Significant amount of sediment deposition within the reservoir.

Upstream Slope of Embankment:

- The upstream slope of the embankment appeared to be in good condition (no major rutting or erosion observed).

Dam Crest:

- Dam crest appeared to be in fair condition, no wet spots, or rutting/erosion observed. There appears to be a fair bit of vehicular traffic across the dam crest (more noticeable vegetation differences than at the other three dams).

Downstream Slope of Embankment:

- The downstream slope appeared to be in fair condition. Some erosion has occurred near the top center of the embankment. The crest drain discharge pipe is no longer visible (appears to have been buried). Topsoil covering crest drain rip-rap is sloughing down. Rip-rap is now visible in places.

Principal Spillway Riser Structure:

- Trash rack filled with leaves and debris.
- Pond drain does not function (appears to be buried by sediment).

Principal Spillway Outlet Pipe:

- An inspection of the outlet pipe could not be completed due to site constraints. The exposed end of the outlet pipe appears to be in good condition.

Principal Spillway Plunge Pool:

- The outlet pipe discharges directly into a rip-rap lined plunge pool. The pool seemed to be appropriately dissipating energy. No issues were observed.

Trench/Toe Drains/Relief Wells:

- Drains along the right auxiliary spillway were observed to be flowing into the concrete structure.
- The dam embankment crest drain could not be located.

Left Auxiliary Spillway:

- Wet spots observed in the spillway (various locations).
- Erosion at the transition of grass to woods (assumed from activation during Tropical Storm Irene).

Right Auxiliary Spillway:

- Significant wet spots observed in the spillway (various locations).
- Erosion at the transition of grass to woods (assumed from activation during Tropical Storm Irene).

3.10.3 Labor

The dams are currently mowed once a year and are maintained on an as-needed basis. Labor activities are estimated at an average of 2 hours per month.

3.10.4 Management Level

The dams are managed by the Town of Ludlow Water Department. Biannual inspections are conducted by the Vermont Dam Safety Program. Management is conducted on an as-needed basis.

3.10.5 Status of Operation & Maintenance

The Jewell Brook Dams are owned and maintained by the Town of Ludlow.
The original Operation & Maintenance Agreements for the dams were authorized in 1966 and included annual monitoring and an estimated annual cost of $500. The most recent inspection reports are from 2018 and inspections occur biannually. Some of the operation and maintenance recommendations noted within the reports include the following:

- Establish and maintain clearing limits for brush and trees a minimum of 15 feet from all portions of the dam. Annually cut and remove woody vegetation and debris from the upstream and downstream slope to ground surface.
- Once to twice annually, mow the grass surfaces of the embankment and auxiliary spillway. Following mowing, reinspect for any deficiencies that were not observed during this inspection.
- Maintain trash racks and the spillways free of debris to ensure free flow conditions.

4. Alternatives

4.1 Formulation Process

The Plan-EA is formulated in accordance with NEPA and NRCS guidance to address the identified watershed problems and opportunities with consideration of the effects of various alternative solutions on resource concerns. The purpose and need (NEPA) for federal action is to bring each of the four (4) dam sites into compliance with current NRCS and VT dam design safety and engineering criteria and performance standards while continuing to provide the planned level of flood protection for the next 100-year evaluation period. The Federal Objective (PR&G) includes maximizing sustainable economic development, avoiding the unwise use and minimizing adverse impacts and vulnerabilities relevant to floodplains and flood-prone areas, protecting and restoring the functions of natural systems, and mitigating any unavoidable damage to natural systems.

Formulation of alternative rehabilitation concepts followed procedures outlined in the NRCS National Watershed Program Manual (NWPM), Part 505.35B. Other guidance incorporated into the alternative's formulation process included the NRCS National Planning Procedures Handbook and other applicable NRCS watershed planning guidance.

Alternative plans were also developed in consideration of completeness, effectiveness, efficiency and acceptability criteria, in accordance with the Economic and Environmental Principles, Requirements, and Guidelines for Water and Land Related Resource Implementation Studies (PR&G) and the Principles and Requirements for Federal Investments in Water Resources (2013) and Interagency Guidelines (IAG).

The formulation process began with discussions between the Sponsor and NRCS. NRCS explained agency policy associated with the Small Watershed Dam Rehabilitation Program and related alternative plans of action. As a result, alternative plans of action were developed based on NRCS planning requirements and the ability of the alternatives to address the objective of bringing the four dam sites into compliance with current design criteria and performance standards.

Alternative plans were formulated with consideration given to the ecosystem services presented during the scoping process (Section 2, Table 2). Furthermore, the alternatives considered completeness, effectiveness, efficiency, and acceptability and Guiding Principles as required by the PR&G (May 10, 2018). These criteria are described below:

- **Completeness**. Completeness is the extent to which a given alternative plan provides and accounts for all necessary investments or other actions to ensure the realization of the planned effects. This may require relating the plan to other types of public or private plans if the other plans are crucial to the realization of the contributions to the objective.

- **Effectiveness**. Effectiveness is the extent to which an alternative plan alleviates the specified problems and achieves the specified opportunities.

- **Efficiency**. Efficiency is the extent to which an alternative plan is the most cost-effective means of alleviating the specified problems and realizing the specified opportunities, consistent with protecting the Nation's environment.

- **Acceptability**. Acceptability is the workability and viability of the alternative plan with respect to acceptance by State and local entities and the public and compatibility with existing laws, regulations, and public policies.

All of the alternatives that were considered are summarized in the table below. Those alternatives that were retained and carried forward were also evaluated according to the PR&G Guiding Principles for as presented below.

Table 17 Summary of All Alternatives Considered

ALTERNATIVE	RATIONALE OVERVIEW
Alternatives Considered but Eliminated	
Decommissioning of Dam with Non-Structural Measures - Remove dam and acquire/ floodproof downstream properties and infrastructure	● Removal of dam, and acquisition, demolition, relocation, and flood protection of existing structures ● Modifications to prevent overtopping at bridge crossings ● Acquisition or easements to prevent or regulate future development within the 100-year floodplain ● Hundreds of downstream buildings and structures would need to be raised, flood proofed, or protected by other method to meet project purpose and need ● Cost estimate at >$60 million, nearly double the cost of rehabilitation ● Significant impacts to environmental, social, and cultural resources
Non-Structural Measures - No Dam Removal; Acquire or Relocate At-Risk Buildings and Flood-proofing	● Consist of relocating or flood proofing structures in the 100-year floodplain ● Relocation of roads, bridges, and utilities protected by the 4 dam sites would not be practicable or reasonable ● Substantial adverse economic and environmental impacts ● Not cost effective
Structural Rehabilitation to Current High Hazard Potential Dam Standards	• Evaluated for each of the four dam sites • Achieved similar dam safety rehabilitation objectives to the Preferred Alternative but a higher cost.
Alternatives Retained for Detailed Study	
1) No Action/FWOFI	• Required under NEPA and PR&G • Meets ecosystem services (Table 3) • Highest probability of dam failure and major impacts to

ALTERNATIVE	RATIONALE OVERVIEW
	ecosystem services and potential socioeconomic impacts and protects downstream communities and properties
2) Structural Rehabilitation - Combined Alternatives 1.2, 2.6, 3.2, 5.4	• Achieves dam safety standards and criteria for rehabilitation • More cost effective than other considered rehabilitation alternatives • Avoids potential socioeconomic impacts and protects downstream communities and properties
3) Structural Rehabilitation - Combined Alternative - Alt 2 plus RCC to auxiliary spillway, exit slope, and Labyrinth spillway at Dam Site #5	• Achieves dam safety standards and criteria for rehabilitation • More cost effective than other considered rehabilitation alternatives that were eliminated • Reduces likelihood for potential socioeconomic impacts and protects downstream communities and properties

4.2 Climate Change Resilience Factors

Uncertainty due to climate change variables is difficult to predict and attribute to the proposed actions. However, given the concern and importance of taking this factor into account, cursory treatment of the resilience to climate change was considered within the alternative's evaluation. Each construction alternative receives equivalent treatment, such as the proposing the use of grass species and plantings during revegetation that are drought and flood tolerant. Additional considerations are described under risk and uncertainty in Section 5.9.

4.3 Alternatives Considered but Eliminated from Detailed Study

Some of the alternatives considered in the planning process were eliminated from detailed consideration because they did not meet the purpose and needs of the project (NEPA), or they did not meet the Federal Objectives (PR&G) when taking into consideration impacts to environmental and social resources, as well as higher construction costs and lower economic benefits.

4.3.1 Incremental Analysis.

Per NRCS NWPM 501.38.B, an incremental analysis to determine the optimal level of flood protection was conducted. Exhibit tables D4.4-D4.14 in Appendix D4, Economics presents the expected damages, both in singular event total and expressed as Expected Annual Damages for recurrence events ranging from the 10-year storm (Q10) to the 500-year storm (Q500), under a With-Out Dam (decommissioned) and With-Dam (Preferred Alternative) conditions. The monetized damages were estimated for 1) Structures and Vehicles (buildings, residences, commercial, institutions, etc.), 2) Roadways and Bridges and 3) Railroad infrastructure.

The results of the analysis demonstrate the incremental benefits for flood damage reduction exceed the annualized installation cost of rehabilitation through the 100-year flood event, resulting in a benefit to cost ratio of approximately 2.1. Providing additional flood protection beyond the 100-year level was considered, but the cost to raise the dam to

provide 200+ year protection was estimated to be $47,812,200.00, or $1,094,500.00 in annualized cost. This annualized cost would exceed the estimated additional annual benefits provided of $1,183,590. As such, the optimal level of flood damage protection at the Jewell Brook dam sites remains the 100-year storm event.

In addition, the incremental analysis also considered a combination of dam decommissioning and dams rehabilitated scenarios/configurations ("With-Dam and "With-out Dams" in place). The objective of this analysis is to determine whether the rehabilitation of each individual dam, or various combinations of dams, provides beneficial effects that outweigh adverse effects. The analysis characterizes the impacts to environmental and social/cultural/historic resources as part of optimizing the level of flood protection.

Approximately thirty-two (32) different scenarios of With Project and Decommissioned were evaluated. These scenarios ranged from all four (4) dams rehabilitated and operational, to all four (4) dams decommissioned.

The analysis included 16 scenarios with the 100-year recurrence discharge (Q100) occurring in the Jewell watershed and the 25-year recurrence discharge (Q25) in the Black River (tailwater). The Q25 tailwater in the Black River is considered a reasonable condition that represents less than the fully conservative coincident peaks occurring in the Black River and Jewell Brook. In order to characterize the influence of the Black River during a coincident peak with the Jewell Watershed discharge, an additional 16 scenarios were conducted with the same Q100 discharge in the Jewell Brook and the Black River floodplain at a 100-year recurrence discharge (Q100).

Hydraulic modeling was conducted to estimate the number of properties with structures within the floodplain for each dam site scenario listed in Table 18 below. The number was estimated using the USACE's HEC-RAS and ARCGIS models and current LiDar and GIS data layers. Impacts to social and cultural impacts and environmental resources, as well as impacts to Environmental Justice populations were also estimated with the scenarios and are discussed in each section below.

For the modelled With Dam floodplain, (100-year recurrence discharge in the Jewell Brook watershed and a 25-year recurrence discharge in the Black River), the number of properties with structures located with the floodplain is estimated at 158.

For the modeled With-Out Dam (decommissioned) floodplain (100-year recurrence level in the Jewell Brook watershed and a 25-year recurrence level in the Black River), the number of properties with structures located with the floodplain is estimated at 324.

Table 18 below presents the number of properties with structures for the array of dam site rehabilitated/decommissioned scenarios. An additional 166 properties with structures are impacted when all four dam sites are decommissioned compared to all four dam sites being rehabilitated and retained for service. Furthermore, virtually all of the 158 properties with structures located within the floodplain under a Fully (1, 2, 3,5) dam sites rehabilitated experienced increased depth of flooding when the dam sites are decommissioned.

Table 18 Incremental Analysis: Impacted Properties with Structures

Incremental Analysis: Impacted Properties with Structures			
Dam Site Scenario		Total Number of Properties with Structures Impacted within the APE	
Rehabilitated	Decommissioned	Jewell Brook Q100 Black River Q25	Jewell Brook Q100 Black River Q100
Fully (1, 2, 3, 5)	none	158	243
1, 2, 5	3	290	339
1, 2, 3	5	235	288
2, 3, 5	1	269	324
1, 3, 5	2	243	295
2, 5	1, 3	211	266
1, 2	3, 5	189	245
1, 5	2, 3	215	269
2, 3	1, 5	281	328
3, 5	1, 2	255	306
1, 3	2, 5	231	287
2	1, 3, 5	212	267
5	1, 2, 3	306	368
1	2, 3, 5	264	318
3	1, 2 & 5	286	335
none	Fully (1, 2, 3 & 5)	324	379

Notes:

1. Rehabilitated Dam Sites are Preferred Alternative
2. The Fully decommissioned scenario results in approx. 166 additional properties with structures located within the floodplains compared to the Rehabilitated scenario.
3. Note there are minor differences of the total count of number of properties with structures between Table 18 and the Economic tables shown in Appendix D4. Differences are attributed to different model software for different purposes, associated parameters and assumptions.

4.3.2 Decommissioning of Dam with Nonstructural Measures.

The Decommissioning Alternative is a mandatory rehabilitation alternative that must be considered under NRCS policy (NWPM Part 505.35). Decommissioning is defined as the removal of the storage function of the structure and also the reconnection, restoration and stabilization of the stream and floodplain functions.

This alternative includes federal -funding assistance for removal of the dam and stabilizing the site. This alternative also includes acquisition and demolition, relocation, and flood protection of existing structures; modifications to prevent overtopping at bridge crossings; and acquisition or easements to prevent or regulate future development within the 100-year floodplain. In addition to the removal of the dams, downstream properties would need

to be raised, flood proofed, or protected by some other method to meet the purpose and need for the project. These costs are added to the cost of removing the dams themselves.

As indicated in Appendix D, Economics, the building and structure types include residential and commercial buildings and associated outbuildings and supporting infrastructure. Other property subject to flooding includes roads, bridges, fences, landscaping, and miscellaneous improvements.

Public property, such as municipal buildings, public safety facilities, schools, state and municipal-owned roads and bridges, water lines, electric utilities would also be subject to increased damages during floods if the dam sites were decommissioned. A number of these public properties are not easily subject to flood proofing, due to historical age and construction, so additional flood damages would occur.

Further, it was determined that these properties within the floodplain are receiving existing incremental flood control benefits from the presence of the dams. If the dams were decommissioned, flood depths at various points within the With Project floodplain increases in excess of 5-feet, with an increase at the RT 103 crossing of 2.9-feet during the 100-year event. The incremental damages from a significant depth of flooding increase represent an additional cost of the decommissioning alternative, which would either be borne by the property owners, or need to be mitigated through flood proofing or relocation.

The overall economic cost of decommissioning is estimated to be approximately 60 million dollars, nearly double the cost of rehabilitating all of the four (4) dams. The total construction cost of the decommissioning alternative was estimated at $38,500,000, based on a total (all 4 dams) removal cost. This assumes (in part) that fifty-percent of the originally placed embankment volume is excavated and disposed of on-site.

The floodproofing and/or removal of buildings and structures that are subject to new and/or increased flood depths as a result of decommissioning is estimated at $15.5 million dollars. This estimate is based on approx. 188 properties with structures that are subjected to the above-described incremental damage resulting from the increased flooding and flood depths and the additional 121 properties with structures which would be subjected to new flooding. An average cost of $50,000 per property with structure to remove, raise and/or floodproof was assumed.

Costs to floodproof U.S. Route 100 and local roads and streets subject to flood damages were not quantified, but would increase the total cost of decommissioning between 5 and 10 million dollars.

The decommissioning alternative has significant impacts to environmental, social and cultural resources. For example, the disruption to the social setting by the removal of (at least) a modest number of the residential properties, public and institutional areas, multi-year construction impacts associated with flood proofing the transportation system (raising roads and bridges) would be significant to the population as a whole compared to the isolated construction improvements at each dam site. Further, approximately 20 acres of wetland impacts by dewatering the existing four dam site reservoirs as indicated in Table 19 below.

Based on the consultation results between NRCS, VT SHPO and the Stockbridge-Munsee Tribal Community's Historic Preservation Office, the dams and the built environment are considered eligible for listing in the National Register of Historic Places. Decommissioning or removing part or all of this NR Eligible property would be an Adverse Effect as it would be a significant change to some of the aspects listed above and would require mitigation. The mitigation measures would need to be agreed to by NRCS and the SHPO and a MOU outlining the mitigation measures should decommissioning occur.

At each dam site, decommissioning would involve the draining of the retarding pool and restoration of a free-flowing stream, with associated aquatic organism passage, though the project area. Some portions of the existing retarding pool waterbodies would likely revert to wetland; however, the extent and quality are not qualified or quantified. Some portions of wetlands surrounding the retarding pools may become drier in association with a lowering of the local water table, or could revert to upland if the change in the local water table is pronounced.

Impacts to wildlife associated with tree cutting for structural rehabilitation measures and disposal of excess material associated with dredging would be avoided. Impacts to wetlands, wetland buffers and waterbodies associated with structural rehabilitation alternatives would be avoided. Construction activity associated with dam embankment and control structure removal, as well as the exposure of mud flats following the draining of the retarding pools, would pose a threat of introducing or spreading invasive species, and would require implementation of an invasive species management plan. Areas of estimated impacts for each dam site are provided in Table 19 below.

Table 19 Area (acre) of estimated impact due to decommissioning and draining the reservoirs

	Dam Site #1	Dam Site #2	Dam Site #3	Dam Site #5
Potential Impacts (Loss) to Wetland and Waterbody	3.5	5.0	10.1	1.2
Tree Clearing Impacts Avoided	0.5	2.4	1.0	1.1

The incremental analysis also considers potential impacts to the key PR&G Guiding Principles, as outlined in Table 20 below:

Table 20 Ecosystem Guideing Principles

Healthy and Resilient Ecosystems	Consultation with the Vermont Fish and Wildlife Department indicates under existing conditions, the Jewell and Grant brooks are specifically identified as "…cold-water, highly productive trout streams…" The number of properties with structures within the APE floodplain is lowest with all 4 dam sites in operation and increases as dam sites are decommissioned. Based on the 1964 Work Plan erosion and sedimentation information, incremental removal of the dam sites could reestablish hydrologic conditions that created the chronic flood damages.
Sustainable Economic Development	The depth and extent of flooding to properties with structures is minimized with all 4 dams in operation and incrementally increases as dam sites are decommissioned. Flood protection of the additional 166 properties with structures is impractical given the significat number of structures and the age and construction type of many.
Floodplains	Floodplains will experience increased frequency of flooding and disruption, depth and extent of flooding as dam sites are incrementally decommissioned.
Public Safety	An additional 166 properties with structures become subject to flooding, and the existing 158 properties with structures subjected to greater flooding depths as the dam sites are incrementally decommissioned.
Environmental Justice	The impact to EJ properties is minimized with all 4 dam sites in operation and will increase as dam sites are incrementally decommissioned.
Watershed Approach	The dam sites have largely resolved the chronic watershed-wide problems identified in the 1964 Work Plan, and have established quality environmental conditions and historic resources. Incremental decommissioning of the dam sites is expected to reverse this.

Table 21 below presents the number of residential properties for the array of rehabilitated/decommissioned scenarios as discussed above. Residential properties within the following count, which are a subset of the total properties with structures identified in Table 18 above, were identified in the ARCGIS data layer as 1) Single Family Dwellings, 2) Multi-family Dwellings, 3) Mobile Homes and 4) Other Residential.

As discussed in Section 3.6 above, the EJScreen tool estimates that 39-percent of the population is included in the EJ community, and the number of people per household averages 2.28 people. Therefore, the number of EJ Community population effected by each scenario presented in Table 21 below is estimated by multiplying the number of residential properties impacted by 39-percent to estimate the number of EJ properties and multiplying that value by 2.28 to estimate the number of affected EJ population.

Table 21 Estimated Number of Affected Residential Properties within the APE

Incremental Analysis: Number of Affected Community Residential Properties			
Dam Site Scenario		Estimated Number of Residential Properties Impacted within the APE	
Rehabilitated	Decommissioned	Jewell Brook Q100 Black River Q25	Jewell Brook Q100 Black River Q100
1, 2, 3, 5	none	98	150
1, 2, 5	3	139	148
1, 2, 3	5	163	164
2, 3, 5	1	144	165
1, 3, 5	2	126	166
2, 5	1, 3	111	173
1, 2	3, 5	129	172
1, 5	2, 3	168	174
2, 3	1, 5	152	183
3, 5	1, 2	138	194
1, 3	2, 5	127	173
2	1, 3, 5	193	198
5	1, 2, 3	160	203
1	2, 3, 5	176	206
3	1, 2 & 5	174	232
none	1, 2, 3 & 5	203	238

Notes:

1.Rehabilitated Dam Sites are Preferred Alternative

2. Note there are minor differences of the total count of number of properties with structures between Table 21 and the Economic tables shown in Appendix D4. Differences are attributed to modeling software parameters, assumptions and data bases.

Based on the above, it was concluded the decommissioning alternative is not only cost prohibitive compared to other more reasonable alternatives, but the significant impact to historic, social and environmental resources are significantly greater in comparison with those other reasonable and available alternatives.

4.3.3 Non-structural Measures (Acquisition or Relocation of At-Risk Buildings and Flood-proofing

This alternative includes acquisition and demolition, relocation, or flood protection of existing structures; modifications to prevent overtopping at downstream road crossings; and acquisition or easements to prevent or regulate future development within the flood inundation area. Per DM9500-013, additional nonstructural measures include, but are not limited to, modifications to public policy, regulatory policy, and pricing policy, as well as

management practices, including the use of green infrastructure. Non-Structural measures could also include the relocation or flood proofing of structures in the 100-year floodplain (see Decommissioning Alternative).

The Jewell Brook flood retarding structures provide significant downstream flood damage reduction to homes, buildings, transportation corridors, and other infrastructure and improvements. Each of the four (4) dam sites were classified as High Hazard structures when constructed between 1969 and 1972. Urban or developed land in the Jewell Brook Watershed and in the Village of Ludlow has increased since the original 1965 watershed plan and this Plan has affirmed that each of the dams remains classified as High Hazard.

As a result, there are no apparent Non-structural measures that would be deemed cost or functionally effective and were eliminated from further consideration.

4.3.4 Rehabilitation Alternatives

Structural Rehabilitation to Current High Hazard Potential Dam Standards. The rehabilitation Alternative includes federally-assisted modification of the existing dam to meet current applicable NRCS and VT Dam Safety criteria and standards. Multiple structural rehabilitation alternatives which addressed the identified deficiencies were identified and evaluated as part of this study and are identified below.

In addition to the two (2) structural rehabilitation alternatives listed in Section 4.3 below, several additional structural rehabilitation alternatives for each dam site were considered but eliminated from detailed study. These alternatives achieve the same performance as the two (2) listed in Section 4.4, but were eliminated because the impacts to environmental resources and the construction costs were greater than the two that are retained for detailed study.

In addition to the narrative descriptions provided above, the alternatives were compared in a side-by-side, visual format in Table 20 below. The objective of Table 20 is to provide a visual overview of each alternative as it compares to each other. As described at the bottom of the table, a singular check mark illustrates the alternative maintains the existing condition for the item or concern identified. A horizontal line indicates a decrease or adverse impact tot the item and multiple check marks indicate a modest to significant improvement compared to baseline / existing conditions.

4.4 Alternatives Retained for Detailed Study

4.4.1 Alternative #1: No Action

No Action [NEPA]: As stated in Section 4.1, the No Action alternative represents future conditions if no action is taken to address or correct any deficiencies over time at any of the four (4) dams, up to and including the point of theoretical dam breach failure. As evidenced in 2011 during Tropical Storm Irene, when three of the four dam site auxiliary spillways were activated and significant erosion occurred at the downstream end of each of the three spillways, the dams are clearly vulnerable to failure under a No Action alternative. As documented herein, a breach of only one of the dam sites results is a failure wave of at least 34.5-ft and impacts an estimated 490 properties with structures, including hundreds of residential structures, for approximately 15 miles to the USACE North Springfield Flood

Control Dam. The potential for significant loss of life under a singular dam breach is HIGH. Similarly, the damages from a breach flood wave to the built and natural environments from erosion, debris deposition and destruction of infrastructure is also HIGH.

4.4.2 Future Without Federal Investment (FWOFI).

Future Without Federal Investment (FWOFI)[PR&G]: The Future Without Federal Investment (No Federal Action Alternative) is a mandatory rehabilitation alternative that must be considered under NRCS policy (NWPM Part 505.35). The FWOFI represents the Sponsors' most likely course of action in the absence of federal funding. This alternative provides a basis for comparison among alternatives to determine the magnitude of benefits and adverse effects. The Sponsor has stated their intention is to retain the dams in service for the indefinite future in order to continue to provide flood control benefits to the downstream areas.

Under a FWOFI plan, the Sponsor would rely primarily on recommendations from the State of Vermont Dam Safety Program for future rehabilitation improvements. Because the State of Vermont does not currently have legislative-approved dam safety standards, state dam safety officials are not able to require rehabilitation upgrades to dams without a judicial order (normally once a dam has reached a state of deterioration where failure is a high probability). Therefore, it is reasonably concluded that each of the four (4) dams would be left and maintained as is for an undefined period of time, leaving them in a vulnerable risk, similar as the No-Action alternative.

For this study, the FWOFI Alternative is defined as follows:

The Sponsors would not seek the 65 percent federal cost-share available through the Watershed Rehabilitation Program, and no federal funds would be expended. To meet the purpose and needs of the project, the Sponsors would use state and/or local funding to update the four dam sites in order to meet State of Vermont dam safety standards in effect at that time, and applicable federal standards and performance criteria.

The FWOFI alternative would include the same primary rehabilitation elements as the Preferred Alternative. This includes (not limited to): 1) armoring of the auxiliary spillways to reduce the potential for erosion, headcutting and failure, 2) flattening of the downstream embankments to address stability and to accommodate a modern internal drain and filter system, dredging of the retarding pools to reestablish the pond drains and the storage capacity and related project items. The total installation cost of this alternative is $30,493,500, equivalent to the Preferred Alternative.

The primary difference between the FWOFI and Alternative #2, Preferred Alternative is the period of implementation. Based on consultation with the Vermont Dam Safety Program Engineer, these dam sites have not been programed for any level of rehabilitation beyond on-going O&M and repairs as needed (ie: following 2011 Tropical Storm Irene). The VT Dam Safety Program is supportive and concurs with the key elements of Preferred Alternative identified in this Plan-EA.

4.4.3 Alternative #2: Structural Rehabilitation to meet NRCS & VT Dam Safety Standards and Criteria. (Preferred Alternatives, #1.2, #2.6, #3.2, #5.4)

The primary concerns which need to be addressed by the rehabilitation alternative, at each

dam site include:

- Overall drainage and seepage concerns,
- Downstream embankment stability,
- Freeboard of the embankment during major storm events,
- Integrity of the auxiliary spillways during the freeboard hydrograph storm event.

1. **Drainage, Seepage and Downstream Embankment Stability.** Rehabilitation of the four (4) dam sites would include the following components to address the overall drainage and seepage concerns associated with the downstream embankment and principal spillway conduits.

   - Construct a stability berm and mineral filter diaphragm system, including a new toe drain pipe along the downstream toe of the dam. The gradation of the new drainage filter material would be designed in accordance with applicable NRCS criteria and would address all non-compatibility issues and provide a positive filter for seepage along the low-level conduits.

   - Existing embankment slopes will not be steepened, and some flattening of the slopes is acceptable.

   - Permanently-installed piezometers would be installed in each embankment, downstream slope to facilitate on-going measurements for phreatic water level monitoring.

   - Existing (old and/or deteriorated) internal drain pipe would be removed and/or abandoned in place (ie: grout filled). The stability berm will also increase factor of safety for embankment stability. The berm would extend up the existing embankment slope an adequate length (approx. 1/3 of height).

2. **Top of Embankment:** The top of embankment for each dam site is presented in Table 23 below. The primary criteria used in establishing the top of the embankment is TR 210-60, which requires the maximum water level resulting from the freeboard hydrograph (FBH) be contained within the reservoir and not allowed to overtop the earth embankment. For the Jewell dam sites, the FBH 6-hour duration (as compared to the 24-hr duration) resulted in the highest water levels. The development of the SITES model and computation of the water surface levels is discussed in Appendix D.2.

   An additional consideration for establishing the top of the dam is the Vermont Dam Safety Program freeboard requirement. VT Dam Safety requires 1.0-ft of freeboard for earth embankments during an IDF, which is normally a PMF, 24-hour duration event. The PMP-24-hour duration produces results similar to the SITES FHB 24-hr duration.

   For dam sites #1 and #2, the existing top of the embankment is 6 to 12 inches higher than the FHB 6-hr and exceeds the VT Dam Safety requirements. The top of embankment for dam site #3 will be raised 0.33-feet, and dam site #5 raised 1.08-ft to meet the primary criteria, which will also satisfy the secondary criteria.

   Each embankment has areas of settled and/or low points along the top of the dam

crests, which will be filled and graded with suitable embankment material to provide a uniform top of crest elevation. The placement of embankment material required to achieve the above will vary from approximately several inches up to approx. 1-foot (Site 1 along roadway).

3. **Auxiliary Spillway Integrity:** To address the auxiliary spillway (AUX) integrity concerns, several options were explored which provide alternative approaches (ie: AUX structural liner, AUX relocation, embankment overtopping protection, etc.) to meet NRCS and VT Dam Safety design, safety and performance criteria. The alternative which minimized impacts and had the lower cost was to armor the existing auxiliary spillway with articulated concrete blocks (ACB's). A concrete cutoff wall will be located at the downstream end of each AUX.

4. **Decommission Dam Site #5 Second Auxiliary Spillway (right).** The existing auxiliary spillway on the right (looking downstream) at dam site #5 can be used as a disposal site for dredged accumulated sediment. Detailed SITES modeling for future conditions indicates the dam is not overtopped during the Future FBH and as such, the spillway can be decommissioned and used as a disposal site.

5. **Protect Exit (downstream) Slope.** The discharge end of the auxiliary spillway varies between 60 and over 100-ft in elevation above the dam foundation and discharge from this spillway flows down natural, vegetated hillsides. The SITES hydraulic model predicts under existing conditions, portions of the hillsides at each dam site is subject to erosion and potential headcutting into the auxiliary spillway. This condition occurred during the August 2011 Tropical Storm Irene event at three of the dam sites. In order to provide a stable condition during the FBH, armoring the slopes with riprap is included in each alternative.

4.4.4 Alternative #3: Structural Rehabilitation to meet NRCS & VT Dam Safety Standards and Criteria.

The structural rehabilitation measures for each dam under Alternative #3 are largely the same as Alternative #2, except the method to provide auxiliary spillway integrity during the ASH and the downstream exit slope is different. Key differences of Alt #3 compared to Alt #2 include:

- Roller Compacted Concrete (RCC) was evaluated to provide auxiliary spillway integrity.
- RCC was evaluated as protection of the exit slope from the auxiliary spillways.
- A concrete Labyrinth spillway was considered for Dam Site #5.

4.4.5 PR&G Comparison

The following tables below provide a narrative-based comparison of the PR&G Guiding Principles of the alternatives carried forward into the detailed study. Sections 4.3 and 4.4 below provide greater detail of these alternatives.

Table 22 Summary PR&G Comparison of Retained Alternative Plans
(see bottom of table for description of symbols)

Item or Concern		**Alternative #1 No Action / FWOFI**	**Alternative #2 Rehabilitation Alt.'s # 1.2, #2.6, #3.2, #5.4 LOCALLY PREFERRED**	**Alternative #3 Rehabilitation Alt's #1.3, #2.4, #3.3, #5.5**
Installation Cost	NRCS Contribution Sponsor Contrib. Totals	$0 $30,493,500 $30,493,500	$20,308,300 $10,185,200 $30,493,500	$29,419,000 $15,841,000 $45,260,000
PR&G Guiding Principles	Healthy and Resilient Ecosystems	✓	✓✓	✓✓
	Sustainable Economic Development	✓	✓✓✓	✓
	Floodplains	✓	✓✓	✓✓
	Public Safety	✓	✓✓	✓✓
	Environmental Justice	✓	✓✓	✓✓
	Watershed Approach	✓	✓✓✓	✓✓✓
Provisioning Services	Erosion and Sedimentation	✓	✓✓	✓✓
	Prime and Unique Farmland	✓	✓✓	✓✓
	Migratory Birds/Bald and Golden Eagles	✓	✓	✓
	Water Source		[Site #2 has an aquifer and piping infrastructure]	
Regulating Services	Water Quality	✓	✓	✓

	Regional Water Management plan	✓	✓✓	✓✓
	Floodplain Management	✓	✓✓	✓✓
	Streams and Riparian Habitat	✓	✓	✓
	Flood Damages	✓	✓✓	✓✓
	Wetlands	✓	✓✓	✓✓
	Public Health and Safety	✓_	✓✓✓	✓✓✓
	Climate Change	✓	✓	✓
	Land Use	✓	✓✓	✓✓
	Fish and Wildlife Habitat	✓_	✓	✓
Supporting Services	Nutrient Cycling			
	Soil Formation			
Cultural Services	Historic and Cultural properties	✓	✓	✓
	Environmental Justice	✓	✓✓	✓✓
	Recreational			
	Aesthetic		[Site #1 has a Vista Value]	

Symbol legend:

- - decrease over existing condition primarily due to Increased Risk of Dam Safety

✓ maintains existing condition

✓✓modest improvement over existing condition

✓✓✓ significant improvement over existing condition

Table 23 Combined Four (4) Dam Sites

PR&G Guiding Principles	No Action / FWOFI Alternatives (Combined dam sites)	Combined Rehabilitation Alt.'s # 1.2, #2.6, #3.2, #5.4	Combined Rehabilitation Alt's #1.3, #2.4, #3.3, #5.5
Healthy and Resilient Ecosystems	Similar to No 2., except the extended implementation period elevates the risk of auxiliary spillway erosion and instability compared to Alt. No 2.	Improves public health and resiliency by implementing dam deficiencies in an efficient manner including the use of federal financial and technical resources.	Same as Alt #1.2 but has higher construction cost.
Sustainable Economic Development	Similar to No 2.,	Rehabilitation improves the ability to maintain the existing established floodplain and for the dam sites to safety pass severe storm events, thus increasing economic development opportunities compared to Alt #1.	Same as Alt #1.2 but has higher construction cost.
Floodplains	Similar to No 2.,	Improves resiliency of floodplains because dam sites are designed to accommodate Future Watershed Conditions.	Same as Alt #1.2 but has higher construction cost.
Public Safety	Similar to No 2., however elevates safety risks due to extended implementation period.	Improves by accelerating timeline of bringing dams into compliance with dam safety criteria.	Same as Alt #1.2 but has higher construction cost.
Environmental Justice	Similar to No 2., however elevates existing residential dwellings in floodplain at higher risk over time.	Maintains and lowers risks compared to Alt #1 because dam safety and resiliency is increased.	Same as Alt #1.2 but has higher construction cost.
Watershed Approach	Similar to No 2., however places the watershed and cumulative impacts at elevated risk compared to rehabilitation alternatives.	Improves over Alt #1 by increasing dam safety, resiliency, sediment storage and avoidance of adverse impacts resulting from decommissioning.	Same as Alt #1.2 but has higher construction cost.

4.5 Comparison of Alternatives Retained for Detailed Study

As stated above, the Sponsor has made clear that in the absence of federal funds (No Action), the Town would rehabilitate the dams to meet Vermont Dam Safety Standards required by the Vermont Dam Safety Section. Consultation with the Vermont Dam Safety Engineer during the preparation of this Plan-EA indicates the expected required rehabilitation measures at each dam site under a No Action scenario would largely parallel and be consistent with those required to meet NRCS dam safety performance criteria that Alternative No. 2 is based upon.

The PR&G comparison between Alternatives #2 and #3 are essentially the same. This is expected because the key difference is the construction material and associated details required to provide auxiliary spillway integrity. Because the Alternative #3 costs are significantly higher and because Alternative #3 does not provide any greater PR&G benefits compared to Alternative #2, Alternative #3 is not considered further.

As stated above, the No Action and the FWOFI are considered equivalent because of the expected time to address and implement all dam deficiencies. FWOFI could take multiple decades to implement the deficiencies and as observed during the 2011 Tropical Storm Irene, the dams are vulnerable to erosion and potential failure as well as other deterioration-related issues.

The FWOFI implementation measures are considered equivalent to Alternative #2, Structural Rehabilitation, with the FWOFI being staged over this several decades of time. The availability of federal funds and technical resources associated with Alternative #2 allows the Sponsor (Town of Ludlow) to advance the implementation of the rehabilitation measures in a systematic and timely process. Upon the availability of federal funds, the intent is to implement each dam rehabilitation measures singularly in order to maintain the maximum level of flood protection and also to recognize the limitations of specialized and experienced construction resources within the Vermont community for this project. A two (2) year construction period per dam has been assumed and an additional two years has been added, resulting in an overall ten (10) year implementation period. A No Federal Action construction period is not known at this time, but could exceed several decades due to the anticipation of on-going limited funding resources.

Because the FWOFI and Alternative No. 2 considered to be equivalent for the reasons described above, the estimated impacts to various resource concerns presented below in the following table are also the same.

Table 24 Summary and Comparison of Alternative Plans

Resource Concern	Alternative No. 1 No Action/FWOFI (Sponsor's Rehabilitation)	Alternative No. 2 Structural Rehabilitation to Current High Hazard Potential Dam Criteria (Preferred Alternatives #1.2, #2.6, #3.2, #5.4)
Installation Costs		
Total Project Investment	$39,843,500	$39,843,500
Total Construction	$30,493,500	$30,493,500

Resource Concern	Alternative No. 1 No Action/FWOFI (Sponsor's Rehabilitation)	Alternative No. 2 Structural Rehabilitation to Current High Hazard Potential Dam Criteria (Preferred Alternatives #1.2, #2.6, #3.2, #5.4)
Total Beneficial Annualized (AAE's)	$2,284,800	$2,284,800
Total Adverse Annualized (AAE's)	$916,300	$916,300
Economic Efficiency		
Net Beneficial	$1,368,500	$1,368,500
Benefit / Cost Ratio	2.5 to 1.0	2.5 to 1.0
O, M & R Total	$22,700	$22,700
Topography, Soils and Geology		
Soils	Same as Alt No. 2	The alternative includes raising each dam's embankment, auxiliary spillway modifications and related work within the constructed footprint and reconstructing the soils within the dam to increase capacity, integrity, and stability.
Erosion & Sedimentation	Same as Alt No. 2	All four (4) sites will be dredged to varying degrees to provide sediment storage for a project life of 100-years. Temporary sediment and erosion control measures will be implemented to reduce and control sediment and erosion during construction.
Prime and Unique farmland	Same as Alt No. 2	No impacts to prime or unique farmland as the construction footprint is within the existing footprint of the dam or immediately along the downstream tope of slope where there are no such soils or active farming.
Water Resources		
Surface Water & Surface Water Quality	Same as Alt No. 2	Proposed improvements will have no permeant impact on water quality, normal operations will not change. Erosion and sediment controls will be implemented before and during construction to reduce the potential for impacts to the dam site's receiving waters and to Jewell Brook.
Groundwater & Groundwater Quality	Same as Alt No. 2	Rehabilitation measures are not expected to impact ground water resources. Design measures and restrictions on construction practices (equipment, material stockpiles, etc), will be implemented to reduce any potential impact to ground water

Resource Concern	Alternative No. 1 No Action/FWOFI (Sponsor's Rehabilitation)	Alternative No. 2 Structural Rehabilitation to Current High Hazard Potential Dam Criteria (Preferred Alternatives #1.2, #2.6, #3.2, #5.4)
		resources during construction.
Floodplain Management	Same as Alt No. 2	Present level of flood protection is designed to be maintained or improved. The project will not increase floodplain occupancy or change floodplain boundaries.
Regional Water Resource Plan	Same as Alt No. 2	Each dam site is identified in the 2018 regional water resource plan as flood control and is not identified for removal. The alternative will not adversely impact the 2018 plan or change its status.
Wild & Scenic Rivers	Same as Alt No. 2	No impact, there are no designated Wild or Scenic Rivers in the watershed.
Sole Source Aquifer	Same as Alt No. 2	No impact, there are no designated sole source aquifers in VT.
Coral Reefs	Same as Alt No. 2	No impacts, there are no oceans or living coral reefs in the Jewell Brook watershed.
Wetlands and Waters of the US (WOTUS)		
Riparian Areas	Same as Alt No. 2	No impacts to streams feeding into or discharging from the dam sites. Minor permanent and temporary impacts will occur at the toe of embankment within or immediately adjacent to the constructed footprint.
Wetlands	Same as Alt No. 2	The proposed action will have temporary and permanent impacts to wetlands within the affected areas resulting from dredging and construction activities within and immediately adjacent to the constructed footprint at each dam site.
Clean Water Act/ Waters of the U.S.	Same as Alt No. 2	Temporary impacts during construction will include drawdown of the reservoirs and bypass pumping to isolate flowing water from construction activities. Minor permanent impacts are expected at the toe of each dam's embankment.
Biological Resources		
Threatened and Endangered	Same as Alt No. 2	No effect. Consultation with federal resource agencies (USFWS, NOAA, USACOE) and state agencies and on field observations, no resources are identified at any of the dam sites so temporary or permanent impacts are not expected. Exception is the potential presence of long-eared bats and six protected

Resource Concern	Alternative No. 1 No Action/FWOFI (Sponsor's Rehabilitation)	Alternative No. 2 Structural Rehabilitation to Current High Hazard Potential Dam Criteria (Preferred Alternatives #1.2, #2.6, #3.2, #5.4)
		migratory bird species. Consultation with USFWS indicates limiting the period of tree cutting and removal to outside the NLEB active period of April 1 – October 31 is acceptable mitigation, and these tree clearing time restrictions will be required in the Construction Documents.
Plant Condition & Forest Resources	Same as Alt No. 2	Temporary impacts are expected during construction from staging of equipment and materials and select removal of a small number of trees immediately adjacent to the constructed footprint at each dam site. Impacts will be mitigated through the avoidance of construction impacts to sensitive areas and through the restoration of disturbed surfaces with native vegetation following construction.
Fish, Wildlife & Aquatic Resources	Same as Alt No. 2	Construction activities may cause temporary minor affects upon aquatic resources in the immediate area of the dams and downstream areas. Stream flows will be protected during construction with bypass piping. Construction fill, dredging and excess material disposal will permanently impact grasslands and some forestland. Tree cutting will impact forestland.
Essential Fish Habitat	Same as Alt No. 2	No impact as no essential fish habitat is identified within the project area.
Invasive Species	Same as Alt No. 2	Best management practices referenced by the USACE are incorporated into this Plan-EA and will be incorporated into the final design and subsequent permitting to control the spread of invasive species.
Natural Areas	Same as Alt No. 2	No impacts as there are no defined Natural Areas at any of the dam sites.
Ecological Critical Areas	Same as Alt No. 2	No impacts as no critical areas identified by USFWS. Northern Long-eared Bat (NLEB) habitat will be mitigated through restrictions of tree removal periods.
Migratory Bird Treaty Act	Same as Alt No. 2	Temporary impacts may be caused to migratory birds from construction activities, and permanent impacts to birds would result from tree cutting for staging areas and/or excess material disposal areas.
Human, Economic & Social Concerns		

Resource Concern	Alternative No. 1 No Action/FWOFI (Sponsor's Rehabilitation)	Alternative No. 2 Structural Rehabilitation to Current High Hazard Potential Dam Criteria (Preferred Alternatives #1.2, #2.6, #3.2, #5.4)
Land Use & Land Cover	Same as Alt No. 2	No impact on existing conditions or influence on future land use.
Public Health & Safety	Same as Alt No. 2	The project will improve dam safety and reduce the risk of a dam failure and will improve public health and safety.
Transportation	Same as Alt No. 2	A municipally-owned local road crosses over the top of the site #1 dam embankment. The road will be closed and traffic detoured during construction. No other impacts are anticipated.
Floodwater Damage	Same as Alt No. 2	No adverse impact as this alternative will allow the dam sites to continue to provide the originally planned level of flood protection and flood damage reduction.
Environmental Justice & Civil Rights	Same as Alt No. 2	This alternative will maintain the floodplain and will have no impacts to environmental justice and civil rights issues.
Local and Regional Economy	Same as Alt No. 2	The proposed action maintains the originally planned level of flood protection and flood damage reductions and will not result in any adverse impact to the economy. The Sponsor has publicly selected the proposed plan for implementation.
Economic Efficiency	Same as Alt No. 2	This alternative provides for the least impact to environmental and cultural resources by avoidance of significant impacts in the built floodplain as well as provides the lowest cost and most economically efficient alternative.
Other Concerns		
Energy	Same as Alt No. 2	The dam sites do not currently consume or generate energy and no impacts will occur from this alternative. Temporary use of energy associated with construction activities will occur.
Cultural Resources/ Historic Properties	Same as Alt No. 2	Section 106 consultation has been completed and concluded Alternative 2 results in a No-Adverse effect. The Phase IB archaeological analysis concludes no precontact Native American artifacts were identified. The VT SHPO and Tribal representatives concur with the findings.

Resource Concern	Alternative No. 1 No Action/FWOFI (Sponsor's Rehabilitation)	Alternative No. 2 Structural Rehabilitation to Current High Hazard Potential Dam Criteria (Preferred Alternatives #1.2, #2.6, #3.2, #5.4)
Air Quality/ Clean Air Act	Same as Alt No. 2	Temporary effects will occur during construction (dust and equipment/vehicle exhaust). There are no permanent impacts associated with this alternative.
Visual Impacts / Scenic Beauty	Same as Alt No. 2	Minor impacts to scenic beauty will occur at all 4 dam sites through minor structural modifications, temporary land disturbance, select tree/vegetation removal and disposal of excess dredging material.
Recreation & Parklands	Same as Alt No. 2	Recreation activities within the construction zone will be temporary disrupted during construction and restored when the project is completed. Temporary trail bypass may be implemented to mitigate impacts.

4.6 Rationale for Plan Selection:

Alternatives for Federal water and related land resources implementation studies must be formulated in accordance with the Principles and Requirements for Federal Investments in Water Resources and Interagency Guidelines (PR&G), where applicable.

5. Environmental Consequences

This section addresses the environmental impacts or effects that would result from implementation of the alternatives. The alternatives include the No Action/FWOFI alternative and the Preferred Alternative. See Section 4.0 for additional alternatives that were eliminated from further consideration.

5.1 Comparative Environmental Consequences and Effects of Alternative Plans

The Environmental Assessment is a planning process that identifies and analyzes the effects on the human and natural environment that may occur as a result of the alternative plans. These alternatives include the No Action/FWOFI and the Preferred Alternatives including direct effects, indirect effects and cumulative effects.

The primary resource concerns identified within the scoping effort (Table 2-1) as relevant to the proposed action were carried forward for analysis in Section 5. Those that were identified as not relevant are not discussed in this section.

5.2 Topography, Soils and Geology

5.2.1 Soils

No Action and Preferred Alternative: There would be no substantive permanent impact to soils within the study area under the No Action/FWOFI Alternative or the Preferred Alternative.

Soil would be excavated during the installation of the auxiliary spillway structural lining work activities and also with installing the downstream toe drain diaphragm and stability berms. Excavation depths within the auxiliary spillway may extend upwards of 15 feet below grade. The first foot of topsoil would be stockpiled and reserved for backfill after installation and would be reseeded with herbaceous vegetation.

There are no areas of agricultural production in the immediate areas of the projected area of construction, and as such, no impacts associated with Local Importance for either the No Action/FWOFI Alternative or the Preferred Alternative are expected. Also, the areas where rehabilitation construction would occur are not areas that could be converted to future agricultural production due to elevated risk of impacts to the dam structure integrity.

5.2.2 Erosion & Sedimentation

Existing Conditions: Sites #2 and #5 have significant accumulated sediments that require removal through dredging to achieve an evaluated (project) life of 100 years.

No Action and Preferred Alternative: Both plans are intended to reduce the potential for erosion during storm events. Temporary erosion protection and sediment control measures will be implemented and maintained during construction and will be removed upon the satisfactory placement of permanent erosion control measures at each dam site.

Comparison of previous storage values and data from the original design documents to the existing storage from a 2019/2020 survey & and 2016 LIDAR surface information found that

Sites #2 and #5 had significant sediment accumulation such that the cost for dredging in subsequent years for these two sites has been added to the cost analysis.

5.2.3 Prime & Unique Farmland

Existing Conditions: Prime Farmland and Farmland of Statewide Importance are present in Dam Sites #1, #2, #3, and #5. Site #1 contains 7.2 acres of statewide and prime farmland, which is primarily located immediately south of the Dam Site 1 Reservoir. There are 7.6 acres of statewide and prime farmland in Dam Site #3, located south of Dam Site #3, including the land encompassing the access road. Dam Site #5 has 3.2 acres located on the perimeter of the site area, and Dam Site #2 has 0.2 acres.

No Action and Preferred Alternative:
Dam Site #1: The proposed action will not affect the statewide and prime soils identified south of the reservoir. The proposed action is estimated to impact up to 0.4 acres of Statewide (b) soils at the dam, which are classified as Farmland of Statewide Importance, if drained. The Statewide (b) designation indicates that "the soils in this soil map unit have a wetness limitation that may be difficult to overcome. Areas of this soil map unit don't qualify as Prime, Statewide, or Local, if artificial drainage is not feasible" (USDA NRCS). The Statewide (b) soils are within 100 feet of the dam auxiliary spillway and are not currently used for agricultural purposes.

Dam Site #2: The area of impact for both alternatives 1 and 2 will not have an impact on soils designated as prime farmland or farmland of statewide importance.

Dam Site #3: The area of impact for both alternatives would impact 0.5 acres of Farmland of Statewide Importance. These soils are along the top of the dike on the southeastern side of the dam, underneath and surrounding the dam access road, and are not currently used for agricultural purposes.

Dam Site #5: The area of impact for both alternatives would impact 0.25 acres of Farmland of Statewide Importance. These soils are in the northeast corner of the impacted area under the existing tree canopy, and are not currently used for agricultural purposes.

5.3 Water Resources

5.3.1 Surface Water & Surface Water Quality

Existing Conditions: The dams and Jewell Brook are located within the greater Black - Ottauqueechee Watershed. No waterbodies within the immediate Jewell Brook watershed are listed as impaired by the Vermont Department of Environmental Conservation (VTDEC, 2018). Grant Brook, north and south of Site #2 is used as a public water source. Three sections of Trailside Brook upstream and downstream of Dam #3 are listed as stressed by undefined pollutants (VTDEC, 2016). The headwaters of all the brooks within the Affected Area are within Class A(1) Ecological Waters (areas above 2,500' altitude) for all uses. Additionally, Grant Brook has Mixed Classifications for Uses; it is Class B(2) for Public Water Source and Irrigation and Class A(1) for all others (VT ANR, 2020).

No Action/FWOFI and Preferred Alternative: All Dam Sites: There are no expected long-term adverse impacts to surface water or water quality as a result of either alternative.

Short-term potential impacts to water quality such as sedimentation will be controlled by erosion and sediment control measures during dredging and construction activities. Potential water quality impacts due to dredging activities to remove accumulated sediment in the permanent pools and reconstruction of the outlets channel will be minimized by the use of appropriate erosion control measures such as filter curtains or cofferdams. Low flows of the streams would be maintained by bypass piping.

5.3.2Groundwater & Groundwater Quality

Existing Conditions:
Dams #1 and #2 are within the Town of Ludlow GroundWater Source Protection Area (SPA). The area upstream of both dams and encompassing Dam #2 is designated Zone 3, where land uses have potential to impact drinking water quality and quantity. The area immediately upstream of and including Dam #1 is designated Zone 2, which includes areas within 200' of perennial surface water. There is a Zone 1 water withdrawal site beginning approximately 700' to the northwest of the Dam #1 embankment crest. This site contains a 136' deep, 12" diameter gravel well, constructed in 2002. There is a 385' deep, 6" diameter well, constructed in 1997 at the eastern edge of the West Hill Recreation Area, directly to the east of Dam #3 (VT ANR, 2020).

No Action and Preferred Alternative:
Dam Site #1: There is potential for temporary impacts to groundwater within the Source Protection Area due to construction activities. Depth of groundwater should be established prior to construction. Best Management Practices should be employed. Mitigation measures may include (but not be limited to) isolation of groundwater collection/extraction locations, exclusion of construction equipment and the associated potential for release of contaminants and ground disturbance in these areas, and avoidance of deep excavation and drain systems that may lower the ground water table.

Dam Site #2: There is potential for temporary impacts to groundwater within the Source Protection Area due to construction activities. Depth of groundwater should be established prior to construction. Best management practices should be employed. Mitigation measures may include (not limited to) isolation of groundwater collection/extraction locations and prevention of construction equipment and the associated potential for release of contaminates and ground disturbance in these areas, avoidance of deep excavation and drain systems that may lower the ground water table.

Dam Site #3: The dam is not within a Source Protection Area. Nevertheless, best management practices during construction should be employed.

Dam Site #5: The dam is not within a Source Protection Area. Seepage has been noted at the dam. Nevertheless, best management practices during construction should be employed.

5.3.3Floodplain Management

Existing Conditions: FEMA identifies 3 floodplain types in the Jewell Brook Watershed. Only Zone X is within the affected area of the dams, with 180 acres total. The four (4) dam sites are shown on the FEMA FIS maps located in Appendix C, Support Maps.

No Action and Preferred Alternative:

- Dam Site #1: Construction is likely to temporarily impact 8.3 acres in Zone X, immediately surrounding the dam.

- Dam Site #2: Construction is likely to temporarily impact 12.7 acres in Zone X, immediately surrounding the dam.

- Dam Site #3: Construction is likely to temporarily impact 6.8 acres in Zone X, immediately surrounding the dam.

- Dam Site #5: Construction is likely to temporarily impact 8.6 acres in Zone X, immediately surrounding the dam.

5.3.4 Regional Water Resource Plan

Existing Conditions: The construction of the Jewell Brook Dam Sites was recommended in the "Jewell Brook Watershed Work Plan" from 1964 that summarized the past flooding and cost-benefits of various solutions in the watershed. These dams are recognized for their flood control function in the "Black and Ottauquechee Rivers and adjacent Connecticut River & Tributaries 2018 Tactical Bain Plan" by the Vermont Agency of Natural Resources (VTANR, 2018.).

No Action and Preferred Alternative: All four dam sites will retain their flood control function.

5.3.5 Wild & Scenic Rivers

Existing Condition: There are no designated National Wild and Scenic Rivers in the Jewell Brook watershed.

No Action and Preferred Alternative: There will be no impacts to any designated Wild and Scenic Rivers in the Jewell Brook Watershed.

5.3.6 Sole Source Aquifer

Existing Conditions: There are no designated sole source aquifers in the Jewell Brook Watershed.

No Action and Preferred Alternative: There will be no impacts to any sole source aquifers in the Jewell Brook Watershed.

5.4 Wetlands and Waters of the U.S.

5.4.1 Riparian Areas

Existing Conditions: Riparian areas are present at all four dam sites.

At Dam Site #1, riparian areas exist along the edge of the retarding pool and along the edges of the streams, both entering and exiting the pool. Around the retarding pool, the riparian area is characterized by wetland. Along the streams, the riparian areas are primarily associated with the stream banks, where periodic flooding occurs.

At Dam Site #2, riparian areas exist along the edge of the retarding pool and along the edges of the streams, of which two enter the pool and one exits the pool. The riparian

areas around the retarding pool and the northern entering stream are characterized primarily by wetland. The riparian areas of the southern entering stream and the exiting stream are primarily associated with the stream banks, where periodic flooding occurs.

At Dam Site #3, the riparian area around the retarding pool is characterized by wetland. A small wetland area occurs at the culvert outlet to the exiting stream, but the riparian area of that stream is primarily associated with the stream banks, where periodic flooding occurs.

At Dam Site #5, the riparian area around the retarding pool is characterized by wetland. At the principal spillway outlet, a minor amount of wetland is present, but the majority of the riparian area is currently riprapped.

No Action and Preferred Alternative:
At Dam Site #1. (Alternative 1.2), approximately 33 linear feet of riparian area on each side of the stream exiting the dam will be impacted by grading to construct a new filter diaphragm system and by the construction of a new impact basin. Approximately 60 LF of riparian area adjacent to the wetland at the retarding pool will be temporarily impacted by construction of two temporary construction access roads. The roads will be removed, seeded and mulched upon completion of construction, and the areas will be returned to vegetated condition. The total riparian length impact is 126 LF.

At Dam Site #2**,** approximately 20 linear feet of riparian area on each side of the stream exiting the dam will be impacted by grading to construct a new filter diaphragm system and by the construction of a new impact basin. The riparian area currently consists of stone fill, and will remain as stone fill following the proposed construction. Approximately 30 LF of riparian area adjacent to the wetland at the retarding pool will be temporarily impacted by construction of an access road. The area is stone riprap and grassed dam embankment. The road will be removed, seeded and mulched within the grassed area where soil is present upon completion of construction. The total riparian length impact is 70 LF.

At Dam Site #3, approximately 48 LF of riparian area on each side of the stream exiting the dam will be impacted by grading to construct a new filter diaphragm system and by the construction of a new plunge pool. The area to be disturbed is currently rocky ledge, and the riparian area will be of the same character following construction. Approximately 30 LF of riparian area adjacent to the retarding pool will be temporarily impacted by construction of an access road. The road will be removed, seeded and mulched upon completion of construction, and the area will be returned to vegetated condition. The total riparian length impact is 126 LF.

At Dam Site #5, approximately 30 LF of riparian area on each side of the stream exiting the dam will be impacted by grading to construct a new filter diaphragm system and by the construction of a new plunge pool. The riparian area currently consists of stone fill, and will remain as stone fill following the proposed construction. Approximately 212 LF of riparian area adjacent to the wetland at the retarding pool will be temporarily impacted by construction of an access road. The road will be removed, seeded and mulched upon completion of construction, and the area will be returned to vegetated condition. The total riparian length impact is 272 LF.

Removal and disposal of accumulated silts and sediments, through dredging from within the retarding pools is required at each of the four dam sites, but to varying extents. Removal of accumulated sediments will not exceed the limits of original construction, and is required to access and reestablish operational control of the low-level outlets for dam safety purposes and to reestablish the service life of the pools. Dredging may impact either wetland, waterbody or both. Dredged material is to be stockpiled immediately adjacent to point of excavation to allow excess water to drain and solidify the dredged silts and sediment prior to loading and hauling. BMPs for erosion protection and sediment control will be specified in the contract documents.

- At Site 1, excavation will facilitate low level outlet rehabilitation and will also involve removal of accumulated sediments from the waterbody. The dredging will not directly impact wetlands.

- At Site 2, excavation will facilitate low level outlet rehabilitation and will also involve removal of accumulated sediments from the waterbody. The dredging will directly impact the wetlands which have developed within sediments in the retarding pool. These sediments are believed to have accumulated since the building of the dam, with a significant influx occurring during the 2011 Tropical Storm Irene.

- At Site 3, dredging will be minimal to access the low-level outlet, and will impact a minimal amount of wetland and waterbody, as described in Section 5.4.2.

- At Site 5, excavation will involve removal of accumulated sediments from the waterbody. The dredging will directly impact wetlands which have developed within sediments in the retarding pool, as described in Section 5.4.2. These sediments are believed to have accumulated since the building of the dam, with a significant influx occurring during the 2011 Tropical Storm Irene.

5.4.2 Wetlands

Existing Conditions:

At Dam Site #1, a narrow fringe of Class II emergent wetland occurs along the edges of the retarding pool. The fringe widens just south of the northeast corner of the pool into a broader band of scrub-shrub wetland. These fringe wetlands extend further south beyond the limits of the wetland mapping. Near the toe of the auxiliary spillway is a Class III emergent wetland which is kept mowed. Class II emergent and scrub-shrub wetland occurs adjacent to the stream at the principal spillway outlet, extending upslope along a drainage swale and into adjacent shrubland.

At Dam Site #2, Class II scrub-shrub wetland occurs along the periphery of the retarding pool on the south, east and north of the dam, and along a stream entering the pool from the north. The wetland around the periphery of the dam continues along the west side of the dam beyond the limits of the wetlands study area. Emergent Class III wetland which is kept mowed occurs at the western extreme of the auxiliary spillway. Class II emergent wetland occurs at the head of a small stream just south of the principal spillway outlet. The western portion of that wetland is maintained in a mowed condition, while the eastern portion is in a natural condition.

At Dam Site #3, Class II emergent wetland and a minor component of scrub-shrub wetland occurs along the periphery of the retarding pool along its southern, eastern and northern edges. The emergent wetland widens out into a broad wet meadow at the northern end. The wetland continues along the western boundary of the retarding pool beyond the limits of the wetland study. Class II emergent wetland, with a minor component of scrub-shrub wetland, occurs on the uphill side of the principal spillway outlet. Class 3 emergent wetland occurs at an outlet of a drainage pipe along the southeastern boundary of the site.

At Dam Site #5, Class II emergent wetland, maintained in mowed condition, occurs along the northeastern, eastern and southwestern periphery of the retarding pool, and continues southerly for several hundred feet within the auxiliary spillway. The wetland continues to the west of the retarding pool, including both emergent and scrub-shrub vegetation types. Class II scrub-shrub wetland occurs around the periphery of the principal spillway outlet, and continues easterly beyond the limits of the wetland study. Class III emergent wetland occurs at the northeastern and southeastern boundaries of the site.

No Action and Preferred Alternative:
Dam Site #1 (Alternative 1.2)
Wetland impacts associated with this alternative include 11,294 SF of impact to wetland, 51,440 SF of impact to wetland buffer, and 44,704 SF of impact to waterbody. The total of all these impacts is 107,438 SF/2.47 acres. These impacts are broken down and characterized as follows:

- 2,400 SF permanent impact to Class III wetland
- 1,822 SF permanent impact to Class II wetland
- 7,202 SF temporary impact to Class II wetland
- 26,549 SF permanent impact to Class II wetland buffer
- 24,891 SF temporary impact to Class II wetland buffer
- 26,226 SF permanent impacts to waterbody
- 18,478 SF temporary impacts to waterbody

The impacts are a result of temporary fill for access roads and construction access, temporary fill for coffer-damming, temporary dewatering of the retarding pool, permanent fill to extend the downstream slope of the dam for a new filter diaphragm system, permanent fill to reconstruct the impact basin, concrete grout stone fill on the auxiliary spillway, and permanent excavation for dredging of the retarding pool.

Dam Site #2 (Alternative 2.6)
Wetland impacts associated with this alternative include 60,989 SF of impact to wetland, 45,938 SF of impact to wetland buffer, and 42,778 SF of impact to waterbody. These impacts total 149,705 SF/3.44 AC. The impacts are further broken down and characterized as follows:

- 43,467 SF permanent impact to Class II wetland.
- 17,522 SF temporary impact to Class II wetland.
- 43,423 SF permanent impact to Class II wetland buffer.
- 2,515 SF temporary impact to Class II wetland buffer.

- 42,778 SF permanent impacts to waterbody.

The impacts are a result of temporary fill for access roads and construction access, temporary fill for coffer-damming, permanent fill to extend the downstream slope of the dam for a new filter diaphragm system, permanent fill to reconstruct the impact basin, and permanent excavation for dredging of the retarding pool.

Dam Site #3 (Alternative 3.2)
Wetland impacts associated with this alternative include 3,904 SF of impact to wetland, 29,961 SF of impact to wetland buffer, and 8,057 SF of impact to waterbody. The total of all these impacts is 41,922 SF/0.96 acres. These impacts are broken down and characterized as follows:

- 2,025 SF permanent impact to Class II wetland.
- 1,879 SF temporary impact to Class II wetland.
- 19,402 SF permanent impact to Class II wetland buffer.
- 10,559 SF temporary impact to Class II wetland buffer.
- 8,057 SF permanent impacts to waterbody.

The impacts are a result of temporary fill for access roads and construction access, permanent fill to raise the dam crest, permanent fill to extend the downstream slope of the dam for a new filter diaphragm system, permanent fill to reconstruct the approach to the auxiliary spillway, and permanent excavation for dredging of the retarding pool.

Dam Site #5 (Alternative 5.4)
Wetland impacts associated with this alternative include 35,230 SF of impact to wetland, 51,812 SF of impact to wetland buffer, and 31,405 SF of impact to waterbody. The total of all these impacts is 118,447 SF/2.72 acres. These impacts are broken down and characterized as follows:

- 440 SF permanent impact to Class III wetland.
- 28,345 SF permanent impact to Class II wetland.
- 6,445 SF temporary impact to Class II wetland.
- 43,131 SF permanent impact to Class II wetland buffer.
- 8,681 SF temporary impact to Class II wetland buffer.
- 31,405 SF permanent impacts to waterbody.

The impacts are a result of temporary fill for access roads and construction access, temporary fill for coffer-damming, permanent fill to extend the downstream slope of the dam for a new filter diaphragm system, permanent grading at the northern auxiliary spillway, and permanent excavation for dredging of the retarding pool.

5.4.3 Clean Water Act / Waters of the U.S.

Existing Conditions: At Sites #1 - #5, the retarding pools, all intermittent and permanent streams, and all wetlands, as shown on the Wetland and Waterbody Focus Area Maps, Appendix D-3, are considered Waters of the United States.

No Action and Preferred Alternative:

Dam Site #1 (Alternative 1.2)

Impacts to waterbody and wetland will include:

- 33 Linear Feet (LF) of impact to the outlet channel due to the reconstruction of the impact basin downstream of the existing impact basin.
- 26,226 SF of permanent impact to waterbody for reconstruction of the impact basin and dredging within the retarding pool.
- 18,478 SF of temporary impact to waterbody due to dewatering of the retarding pool.
- 4,222 SF of permanent wetland fill for construction of the filter diaphragm system, construction of the concrete grout stone fill, and for dredging of the retarding pool.
- 7,072 SF of temporary impact to wetland due to dewatering of the retarding pool during construction.

Dam Site 2 (Alternative 2.6)

Impacts to waterbody and wetland will include:

- 24 Linear Feet (LF) of impact to the outlet channel due to the reconstruction of the impact basin downstream of the existing impact basin.
- 42,778 SF of permanent impact to waterbody due to reconstruction of the impact basin and dredging within the retarding pool.
- 43,487 SF of permanent wetland impact for dredging of the retarding pool.
- 17,502 SF of temporary impact to wetland due to vehicle access at the retarding pool during construction.

Dam Site #3 (Alternative 3.2)

Impacts to waterbody and wetland will include:

- 50 Linear Feet (LF) of impact to the outlet channel due to the reconstruction of the impact basin downstream of the existing impact basin.
- 8,057 SF of permanent impact to waterbody due to reconstruction of the impact basin and dredging within the retarding pool.
- 2,025 SF of permanent wetland impact for construction of the filter diaphragm system, grading of the auxiliary spillway entrance, and for dredging of the retarding pool.
- 1,879 SF of temporary impact to wetland due to equipment access during construction.

Dam Site #5 (Alternative 5.4)

Impacts to waterbody and wetland will include:

- 33 Linear Feet (LF) of impact to the outlet channel due to the reconstruction of the impact basin downstream of the existing impact basin.
- 31,405 SF of permanent impact to waterbody due to reconstruction of the impact basin and dredging within the retarding pool.
- 28,785 SF of permanent wetland impact for construction of the filter diaphragm system, excess material disposal at the southern auxiliary spillway and dredging of the retarding pool.
- 6,445 SF of temporary impact to wetland due to equipment access and dewatering of the retarding pool during construction.

5.5 Biological Resources

5.5.1 Threatened and Endangered Species

Existing Conditions: Consultation with the USFWS and a species list of the project area identified one federally threatened mammal, the northern long-eared bat. In addition,

according to the Vermont Agency of Natural Resources Natural Resource Atlas (VT ANR), there are no Rare, Threatened or Endangered Species within the immediate vicinity of Jewell Brook Dams and reservoirs; however, there is potential for 17 plant and animal species within the downstream inundation area.

As described in Section 3.5 above, consultation outreach has been conducted with the Vermont Department of Environmental Services (DES) Natural Heritage and site reviews by qualified field naturalists indicate there are no RTE's on the dams themselves and none were observed during the course of the field work.

No Action and Preferred Alternative: Per consultation with the USFWS, proposed tree cutting will be restricted to the period outside of the NLEB active period (4/1 – 10/31) to avoid impacts to tree-roosting habitat of the federal and state listed northern long-eared bat. The proposed work is not expected to affect any other federal or state listed species.

5.5.2 Plant Condition & Forest Resources

Existing Conditions:

At Dam Site #1, the condition of the plants is good, with no areas of stressed or diseased vegetation observed. Mixed deciduous/coniferous forest occurs along the eastern edge of the retarding pool, between the wetland and Route 100. An area of primarily coniferous forest occurs at the southwestern extreme of the pool. Hardwood forest and shrubland occurs along the outlet stream.

At Dam Site #2, the condition of the plants is good, with no areas of stressed or diseased vegetation observed. Mixed deciduous/coniferous forest occurs along the western and southern periphery of the retarding pool, the area south of the dam, and east of the dam around the outlet stream.

At Dam Site #3, the condition of the plants is good, with no areas of stressed or diseased vegetation observed. Mixed deciduous/coniferous forest occurs along and west of the southwestern periphery of the retarding pool.

At Dam Site #5, the condition of the plants is good, with no areas of stressed or diseased vegetation observed. Deciduous forest occurs to the northwest and southwest of the retarding pool outside a band of wetland along the incoming streams. Mixed deciduous/coniferous forest occurs in the southeastern portion of the project area, between the mowed auxiliary spillway and the primary spillway. Deciduous forest occurs along the northern limit of the dam.

No Action and Preferred Alternative:

<u>Dam Site #1 (Alternative 1.2)</u>

At Alternative 1.2, temporary impact areas will be seeded and mulched, returning vegetation to good condition. Wetland vegetation to be temporarily impacted due to dewatering of the retarding pool is expected to re-establish itself upon return to normal pool levels. There will be 22,168 SF/0.51 AC of tree cutting at the filter diaphragm system and concrete grout stone fill. Tree cutting will occur in the winter months to avoid potential impacts to summer habitat (roosting trees) for the State- and Federal-listed Northern Long-Eared Bat.

Dam Site #2 (Alternative 2.6)
Temporary impact areas will be seeded and mulched, returning vegetation to good condition. Wetland vegetation to be temporarily impacted due to dewatering of the retarding pool is expected to re-establish itself upon return to normal pool levels. There will be 102,047 SF/2.34 AC of tree cutting at the disposal areas, the lower end of the ACB system in the auxiliary spillway, the filter diaphragm system, the area of dredging at the retarding pool, and potentially at the southern end of the road on the dam crest. Tree cutting will occur in the winter months to avoid potential impacts to summer habitat (roosting trees) for the State- and Federal-listed Northern Long-Eared Bat**.**

Dam Site# 3 (Alternative 3.2)
Temporary impact areas will be seeded and mulched, returning vegetation to good condition. Wetland vegetation to be temporarily impacted due to dewatering of the retarding pool is expected to re-establish itself upon return to normal pool levels. There will be 42,728 SF/0.98 AC of tree cutting.at the eastern end of the auxiliary spillway, the impact basin, and the dike. Tree cutting will occur in the winter months to avoid potential impacts to summer habitat (roosting trees) for the State- and Federal-listed Northern Long-Eared Bat.

Dam Site #5 (Alternative 5.4)
Temporary impact areas will be seeded and mulched, returning vegetation to good condition. Wetland vegetation to be temporarily impacted due to dewatering of the retarding pool is expected to re-establish itself upon return to normal pool levels. There will be 47,612 SF/1.09 AC of tree cutting at the disposal area, the northern auxiliary spillway, the filter diaphragm system, the dredging area at the retarding pool, and the southwestern end of the access road on the dam crest. Tree cutting will occur in the winter months to avoid potential impacts to summer habitat (roosting trees) for the State- and Federal-listed Northern Long-Eared Bat.

5.5.3 Fish, Wildlife & Aquatic Resources

Existing Conditions: Based on consultation with the Fisheries Biologist responsible for this region of the state, the Vermont Fish and Wildlife Department, many of the waters within the Jewell Brook Watershed are notable for Brook Trout and other mixed species of Trout, including the upstream watershed and portions of the downstream watershed of all 4 dams, small portions of the affected areas of dam sites #1 and #2, and the entirety of the affected areas of dam sites #3 and #5 (VT ANR). During the Jewell Brook Scoping Meeting, Vermont Fish and Wildlife noted that there are multiple trout monitoring sites along Jewell Brook and that it is considered one of the highest quality trout streams in Southern Vermont.

No Action and Preferred Alternative:
The implementation of the Preferred Alternative is expected to be sequenced, with only one (1) dam under construction at any time. The primary reason is to limit the exposure of flood damages if a significant storm were to occur while the dams were under reconstruction. An important benefit to this sequencing is limited temporary impacts to fish and wildlife and other environmental resources resulting from reduced construction activities. Each dam reconstruction is estimated to be up to 2 years in duration.

Habitat at each of the four dam sites are generally similar and includes open grassland associated with the grass-lined dam embankments and the auxiliary spillways. Also, there are varying amounts of shrub and forestland that have grown into minor areas of the built footprint of the dams. The rehabilitation of each dam's earth embankment will result in a similar grass-lined cover, so no permeant impacts of open grasslands on these areas are expected. A portion of each auxiliary spillway (refer to project plans) is to be lined with new articulated concrete blocks (ACB's) to prevent severe erosion and potential failure of the dams during storm events. The footprint of the ACB's will be within the existing auxiliary spillway constructed footprint and will be recessed below ground, and a grass-lined cover with 9-inches of topsoil will cover the ACB's. Thus, the open grassland areas of the auxiliary spillways will be similar to existing conditions. Site 5 will require some excavation of the left auxiliary spillway cut slope and existing shrub/tree habitat will be replaced with a open grassland land cover following construction.

Stonefill will be placed for a section downstream of each auxiliary spillway ACB for the intent of providing headcutting and undermining erosion of the ACB's during severe storm events. The existing land cover in these footprints is shrubs and trees, which will be permanently impacted. Based on consultation with SHPO-VT, the stonefill areas will be covered with located excavated topsoil and grubbed material and then re-seeded to mitigate impacts to these areas.

Aquatic habitat includes the open water of the retarding pools as well as streams entering and exiting the pools. Common species likely to occur in these habitats include beaver, black bear, eastern cottontail, coyote, fox, squirrel, raccoon, porcupine, weasel, skunk, opossum, white-tailed deer, mice, voles, and a variety of songbirds, raptors, fish, turtles and snakes. Brook, brown and rainbow trout are common up and downstream of the four dam sites, on small portions of the affected areas of Sites #1 and #2, and the entirety of the affected areas of dam sites #3 and #5 (VT ANR). Excavation of accumulated silts and sediments from the existing retarding pool open water areas may benefit cold water fish species by a lowering of water temperatures associated with increased depths.

Dredge and existing material disposal and grading in grassland areas will replace existing grassland habitat with new grassland habitat. Dredge and excess material disposal in the existing rights auxiliary spillway at Site 5, will replace existing grassland habitat and a minor area of woodland with new grassland habitat.

Tree cutting and grading in woodlands for staging areas, excess material disposal, or structural rehabilitation will reduce forest habitat for several decades, replacing it in the short term with grassland habitat. Excavation of wetland within retarding pools will reduce habitat for wetland-dependent species.

At Dam Site #1, minor impacts to wildlife habitat will be caused by the construction activities at the dam. Effects of potential sedimentation will be mitigated by implementing erosion and sediment control measures. Impacts to riparian areas (126 LF), wetlands, wetland buffers and waterbodies (2.47 ac.), and forest cutting (0.51 ac) will affect fish, wildlife and aquatic resources.

At Dam Site #2, minor impacts to wildlife habitat will be caused by the construction activities

at the dam. Effects of potential sedimentation will be mitigated by implementing erosion and sediment control measures. Impacts to riparian areas (78 LF), wetlands, wetland buffers and waterbodies (3.44 ac.), and forest cutting (2.41 ac) will affect fish, wildlife and aquatic resources.

At Dam Site #3, minor impacts to wildlife habitat will be caused by the construction activities at the dam. Effects of potential sedimentation will be mitigated by implementing erosion and sediment control measures. Impacts to riparian areas (126 LF), wetlands, wetland buffers and waterbodies (0.96 ac.), and forest cutting (0.98 ac) will affect fish, wildlife and aquatic resources.

At Dam Site #5, minor impacts to wildlife habitat will be caused by the construction activities at the dam. Effects of potential sedimentation will be mitigated by implementing erosion and sediment control measures. Impacts to riparian areas (212 LF), wetlands, wetland buffers and waterbodies (2.72 ac.), and forest cutting (1.09 ac) will affect fish, wildlife and aquatic resources.

5.5.4 Essential Fish Habitat

Existing Conditions: Atlantic Salmon may have reached the tributaries of the Connecticut River at one point in history, but Vermont is not currently considered to have EFH.

No Action and Preferred Alternative: For all dam sites and both alternatives, there will be no impact to Essential Fish Habitat.

5.5.5Invasive Species

Existing Conditions: The invasive species observed at each of the dam sites include the following:

Dam Site #1- Reed canary grass *(Phalaris arundinacea)* occurs in Wetland A.
Dam Site# 2- No invasive species were noted.
Dam Site #3- Reed canary grass *(Phalaris arundinacea)* occurs in Wetlands A and C. Purple loosestrife *(Lythrum salicaria)* and giant reed *(Phragmites australis)* occur in Wetland B.
Dam Site #5- Reed canary grass *(Phalaris arundinacea)* occurs in Wetlands A and C. Purple loosestrife *(Lythrum salicaria)* occurs in Wetland A. Poison parsnip *(Pastinaca sativa)* occurs in the upland adjacent to Wetlands A and B.

As stated in Section 3.5.4, best management practices to control the spread of invasive species referenced by the USACE are incorporated into this Plan-EA and will be detailed specific for each dam site in the final design and subsequent permitting to control the spread of invasive species. These BMP's include: 1) use of equipment and construction / timber mats that is thoroughly cleaned prior to mobilization to the site and prior to demobilization, 2) cleaning construction equipment before moving to a new site to minimize the risk of transporting seeds or propagules, 3) proper disposal of excavated or dredged material, 3) dispose of excavated and dredged material in pre-approved, non-wetland areas, 4) provide training or personnel with knowledge of identification of invasive species; 5) applying control treatments prior to construction and monitoring during and after construction;.

No Action: The No Action alternative, in theory results in a breach of one of more of the dams, which will not incorporate a BMP to control the potential spread of invasive species.

Preferred Alternative: For all Dam Sites, the incorporation of the BMP's identified above into the construction documents for compliance by the contractor will provide for the control of spread of invasive species.

5.5.6 Natural Areas

Existing Conditions: There are no natural areas within the immediate affected area of each dam site, however there are several natural areas within the downstream affected area and the upstream drainage area. Along the Black River, the affected area intersects a Vermont Land Trust easement, the Cavendish Wood Lot, and the Hawks Mountain Wildlife Management Area in the Town of Cavendish, and the North Springfield Reservoir in the Town of Weathersfield.

No Action and Preferred Alternative: Neither alternative at any of the four dam sites are expected to have any adverse (or other) impact on any Natural Areas.

5.5.7Ecological Critical Areas

Existing Conditions: Consultation with the USFWS indicates no critical habitats at any of the 4 dams. However, there is a potential presence of the federally threatened northern long-eared bat, and potential summer habitat must be reviewed by USFWS when forest cutting will be required. Habitat impact will be mitigated by limiting the tree cutting to the winter months, and thus avoiding activities during the NLEB active period of 4/1-10/31.

No Action and Preferred Alternative:
At Dam Site #1, there will be 0.5 acres of tree cutting.
At Dam Site #2, there will be 2.4 acres of tree cutting.
At Dam Site #3, there will be 1.0 acre of tree cutting.
At Dam Site #5, there will be 1.1 acres of tree cutting.

5.5.8Migratory Bird Treaty Act

Existing Conditions: Habitat for native birds, including nesting sites, exists in and around the dam sites, however, foraging and nesting habitat to support eagles is not known to occur in the Project Area around the dams. There have been sightings around the North Springfield Reservoir at the end of the downstream inundation area (Vermont eBird 2020). No Audubon Important Bird Areas are located within the vicinity of the project (Audubon 2007).

No Action and Preferred Alternative: Temporary impacts to migratory birds may occur during construction at all dams. Tree clearing will impact nesting and feeding sites. Winter tree clearing will minimize impacts. The scheduling of construction activities will be coordinated with appropriate wildlife agencies (USFWS and VT ANR) to avoid or minimize adverse impacts.

5.6 Human, Economic & Social Concerns

5.6.1 Land Use & Land Cover

Existing Conditions: Land use and cover are summarized in Table 12 and Table 13 for

existing conditions. The land use/cover within the watershed and affected area is primarily forested or grass lands with minor residential development.

No Action and Preferred Alternative: The proposed project would not generate any permanent changes in existing land use or land cover. Areas where excess dredged sediment is disposed would be revegetated with the same cover type (grass / shrub / tree) as existing conditions. The dam rehabilitation would not induce or increase the potential for future development within the watershed. The proposed project would have no permanent direct, indirect or cumulative impact on recreational activities. Therefore, there would not be direct, indirect or cumulative effects to land use as a result of the No Federal Action or Preferred Alternative.

5.6.2 Public Health & Safety

Existing Conditions: Human health and safety concerns associated with each dam site includes items of risk such as flooding or other disasters affecting the security of life or health; potential loss of human life, property, and essential public services due to structural failure; and other environmental effects such as changes in air or water quality. Since the dams do not meet current federal and state dam safety design and performance standards, there is an increased risk of dam failure that would result in downstream flooding, which could greatly impact the lives, health, and essential public services such as infrastructure and emergency assistance.

No Action and Preferred Alternative: The proposed project would directly reduce the hazard potential for the loss of life and property to the breach inundation zone by reducing the potential for a dam breach of each dam. Rehabilitation of the dam sites to become compliant with NRCS and state dam safety standards and performance criteria will increase public health and safety.

5.6.3 Transportation

Existing Conditions: The major transportation resources in the study area include, VT RT 100 and VT RT 103. VT-100 runs north-south, is classified as a Minor Arterial Highway, and runs adjacent to Jewell Brook. It connects many tourist destinations along the Green Mountains. VT-103 is classified as a Principal Arterial Highway and runs along the Black River, downstream of the dams. Both roads are Class I, town-maintained, within Ludlow Village for a total of 2.295 miles, and state-maintained outside of the Village. In addition, Site 1 Road crosses the embankment of Dam Site #1, wraps around to the southwest side of Dam #2 and services multiple homes. Dam Site #2 is upstream of Snell Spring Road and Brooks Road. West Hill Road abuts Dam Site #3 to the north and turns into a Class 4 road before it terminates at the northern side of Dam Site #5 (VTRANS, 2017). Automobile travel is the primary mode of transportation, and traffic volumes have been increasing since 1999, particularly in peak tourist seasons. Both VT-100 and VT-103 experience high truck traffic, with 6.1% and 14% respectively (Municipal Plan, 2019). Cycling is common along existing roadways, however there are no dedicated bike lanes.

The Green Mountain Railroad roughly parallels VT-103 through the town, providing freight service, and is state-owned and privately operated (VTRANS, 2015). The Green Mountain Flyer train operates during foliage season (Municipal Plan, 2019).

No Action and Preferred Alternative: For all Dam Sites, temporary impacts to transportation will occur during construction, with additional truck access to the sites. Additionally, Site 1 Road will be temporarily closed to raise the top of the dam by 2.5' or reduced to one lane during the duration of Dam Site #1 construction, resulting in potential detours and rerouting of local traffic to Old Weston Mountain Road.

5.6.4 Floodwater Damage

Existing Conditions: Based on existing documentation such as the Regional Water Resource Plan (SWCRPC 2018), Ludlow is susceptible to floodwater damages due to the presence of the Black River, Jewell Brook and development within the floodplain. Tropical Storm Irene in 2011 damaged nearly every road in the Town of Ludlow as well as the water/wastewater treatment facility and Little League fields, with total damages estimated to be $2.5 - 3 million (SWCRPC, 2013). Hydraulic (HECRAS) modeling has demonstrated that without the dams in place, flood water depths and area expands along with associated flood damages increases under a With No Dam condition.

No Action and Preferred Alternative: The proposed project will continue to provide flood protection and flood damage reductions by the dam sites and will not increase flooding in the affected area.

5.6.5Environmental Justice & Civil Rights

Existing Conditions: Ludlow Village is on the list of Designated Places LMISD ACS (Low/Moderate Income) with the number of low-income persons at 225, the number of low-moderate income persons at 440, and the percentage of low/moderate income persons at 55.4% (Vermont ACCD, 2020).

No Action and Preferred Alternative: For all Dam Sites, the proposed work will increase the service life and safety of the dams and decrease risk for damage to property and loss of life downstream, including in the LMISD ACS areas.

5.6.6 Local and Regional Economy

Existing Conditions: The local and regional economies have been established in part due to the flood protection provided by the dam sites over the past 50-years. The dam sites further contribute to the local economy through their recreation and scenic beauty resources.

No Action and Preferred Alternative: The proposed action maintains the originally planned level of flood protection and flood damage reductions and will not result in any adverse impact to the economy. The Sponsor has publicly selected the proposed plan for implementation. The proposed project will not permanent adverse impacts to their scenic beauty resource and the associated contribution to the economy.

5.6.7 Economic Efficiency

The proposed action results in the least impact to environmental and cultural resources by avoidance of significant impacts in the built floodplain and does not increase flood discharge from the sites. The proposed action also provides the lowest cost and is the most economically efficient alternative.

5.7 Other Concerns

5.7.1 Energy

Energy generation does not occur at any of the dam sites and the dams themselves do not require energy consumption for operations or maintenance. The proposed project will not impact energy resources and will not affect the opportunity to develop energy generation at the sites. The proposed project will not increase the need for energy consumption at the dam sites.

5.7.2Cultural Resources / Historic Properties

Existing Conditions: An Archeological Resource Assessment, Phase 1A Site Assessment, was conducted for each of the 4 dams, investigating archaeological sites within the Area of Potential Effects (APE) and within 2 miles of each APE. Site files from the Vermont Archaeological Inventory indicate 13 sites within 2 miles of the APEs. There are five (5) precontact sites north of the dam sites, along the Black River corridor, and each of the four dam sites has archeological sensitivity areas within the defined Areas of Potential Effects.

NRCS Consultation with the federally recognized Stockbridge-Munsee Tribal Community Historic Preservation Officer, and the VT State Historical Preservation Officer (VT SHPO) has been conducted, as described in Section 3.7 above. Both entities have concurred with the NRCS determination of No Adverse Effect associated with the preferred alternative. Concurrence has also been achieved that the ASA's at dam sites 1 and 3 are able to be avoided from any impacts. A follow up IB site evaluation in July 022 at sites 2 and 5 ASA's concluded no precontact Native American artifacts were found.

Dam Site #1 had two historic properties adjacent to the APE, but these were destroyed by construction of the dam site. There is one area of precontact archeological potential at the southwest corner of the APE.

Dam Site #2 has one area of precontact and historic archeological potential on the west side of the APE, as well as the concrete water supply channel, an archeological feature, on the east side of the APE. Two historic sites were once present, but are believed to have been destroyed during the original dam construction.

Dam Site #3 has two areas of precontact archeological potential along the southwest side of the APE, and two historic structures along the north side of the APE.

Dam Site #5 has two areas of precontact archeological sensitivity on the northern and western edges of the APE and no historic sites.

No Action and Preferred Alternative:
Dam Site #1: The Archaeologically Sensitive Area (ASA) at Site 1 is to the southwest of the area impacted by rehabilitation and will not be affected. A historic site north of the APE will not be impacted.

Dam Site #2: One of the Archaeologically Sensitive Areas, ASA 3, (the concrete water supply channel) is immediately adjacent to Shell Spring Road, which acts as the access road into the site. This site will be protected from impact by temporary construction fencing. ASA 2 is

immediately adjacent to the access road to the west of the permanent pool. No work will occur in this area, so there will be no impacts to this site.

Dam Site #3: The two ASAs (#5 and #7) at Site 3 immediately to the west of the reservoir are outside of the area of impacts for rehabilitation. There is one historic building adjacent to the auxiliary spillway, an 1880 farmhouse identified on Map 2c of the archaeological report as SR #1410-69 (See Appendix X). This area should be avoided during construction activities by utilizing temporary construction fencing.

Dam Site #5: One of the Archaeologically Sensitive Areas, ASA 6, crosses West Hill Road, which acts as the access road into the site. Impacts from access activities should be minimized by utilizing temporary construction fencing on either side of the access road. ASA 6 also overlaps with an area of grading associated with northern auxiliary spillway. Disturbance in this area would require a Phase 1B archeological reconnaissance survey. ASA 7 is not located in or adjacent to areas to be disturbed for the project; therefore, no impacts are anticipated.

5.7.3 Air Quality / Clean Air Act

Existing Conditions: The Clean Air Act and the US EPA set National Ambient Air Quality Standards (NAAQS) for six principal pollutants. There are 3 permanent monitoring sites in Vermont, 2 urban and 1 rural, with the closest to Ludlow being the urban Rutland site. For the data available since 2001, all pollutants have been below the NAAQS Standards (Vermont Department of Environmental Conservation [VTDEC], 2020). Based on the EPA August 2020 update for Counties Designated as “Nonattainment” (meaning that they do not attain the required air quality standards), Ludlow is not within a “nonattainment” county (USEPA, 2020).

There are no specific emission sources associated with the Jewell Brook Watershed Dam Sites and the dams themselves are currently in full compliance with the Clean Air Act.

No Action and Preferred Alternative:
For all dam sites, temporary effects are expected to occur during construction including dust and exhaust. Control measures, including best management practices (BMPs) for dust control and vehicle idling would be implemented during construction to minimize impacts.

5.7.4 Visual Impacts/Scenic Beauty

Existing Conditions: The Town of Ludlow includes the Ludlow Village Historic District, set in a rural countryside, which is surrounded by open fields, forests and lakes and rivers. Several ridgelines, water features, the Okemo State Forest, forests within the public water source protection area, and the dark night sky are identified by residents as important scenic resources (Municipal Plan, 2019). It is located along Scenic Route 100 in south-central Vermont, a byway known as one of the most scenic drives in Vermont, running along the eastern foothills of the Green Mountains (Okemo Valley Chamber of Commerce, 2020).

Each of the four dam sites are easily accessible from this corridor and include large expanses of mowed embankment and auxiliary spillway, open retarding pools, and adjacent forests and wetlands. A local road passes over the embankment of Dam #1, the West Hill

Recreation Area is adjacent to Dam #3, and forested parkland and trails are adjacent to Dam #5. The dams are visual icons in the Town and any changes to the configuration or components will be visible.

No Action: The No Action results in a breach of one or more of the dams, which will cause destruction of the dam(s), ensuing significant erosion, deposition of silts and sediments, creation of mudflats in the former reservoir(s) and downstream channel and floodplains as well as loss of vegetation. In addition, a breach will cause destruction of the road over dam site 1, which is very popular with the population, as well as recreational trails and associated resources at the other 3 dam sites. As a result, the No Action alternative will have an adverse effect to the visual resource the dams and associated reservoirs currently provide.

Preferred Alternative: Temporary impacts to visual resources and scenic beauty are expected at each dam site during construction. Permanent changes to the viewshed from the dams or adjacent transportation routes will be visually minimal to non-existent as the rehabilitation to the dams themselves will retain the existing dam geometry and cover. From even a short distance, the flattening of the downstream slope from a 1V:2H to a 1V:3H and grass-covered will look the same as existing conditions. Rehabilitation measures in the auxiliary spillways will result in a permanent grass cover, very similar to existing conditions. Tree cutting to facilitate the rehabilitation at the dam sites will be limited to the original construction footprint. In areas where excess dredged material disposal is required, trees will be cut, the dredged material graded and grass seeded. Overtime, tree growth is expected to reestablish as the areas are surrounded by existing forest.

Dam Site #1: Minor impacts to scenic beauty will occur. Low points in the top of the dam will be filled and leveled and the existing gravel road will retain its alignment. The auxiliary spillway will be armored with articulated concrete block and stone fill, covered with topsoil and seeded. The 0.51 acre of tree clearing will be divided into several small areas adjacent to existing clearings.

Dam Site #2: Minor impacts to scenic beauty will occur. Low points in the top of the dam will be filled and leveled, covered with topsoil and seeded with grass. The auxiliary spillway will be armored with articulated concrete block and covered with topsoil and seed. There will be 2.41 acres of tree clearing for project construction and disposal of excess material. In the disposal area, a treed area will be cleared to receive the excess dredged nmaterial, the area will be regraded, and seeded. Native trees will be planted in the area to facilitate revegetation of the area with native trees.

Dam Site #3: Minor impacts to scenic beauty will occur. Low points in the top of the dam will be filled and leveled, covered with topsoil and seeded with grass. The dike embankment will be raised by 3.1-ft, seeded and mulched to match existing grass cover. The auxiliary spillway will be armored with articulated concrete block and covered with topsoil and seed, both of which will alter the current appearance of the dam. There will be approximately 1.0 acre of tree clearing for project construction.

Dam Site #5: Minor impacts to the scenic beauty resource will occur due to the 1.09 acres of cutting of trees for project construction and placement of dredging material to meet the

project life. Low points in the top of the dam will be filled and leveled, covered with topsoil and seeded with grass. The tree cutting will be restricted to the original build footprint of the dam and the immediate area next to the embankments. Dredged material will be placed in right auxiliary spillway, graded and seeded to match abutting areas. These will be primarily visible from the residence located to the north of the dam.

5.7.5 Recreation & Parklands

Existing Conditions: Dam Sites #3 and #5 have recreational use incidental to flood control. The West Hill Recreation Area is adjacent to Dam #3 and includes shelters, restrooms, hiking trails, horseshoe pits, playing fields, and basketball courts. There is a desire from the Town Recreation Department for expanded future use at the Recreation Area, possibly including a dog park and swimming. The 20-acre Olaf Naess Wilderness Area is adjacent to Dam #5 and includes trails for hiking and mountain biking. Dam Sites #1 and #2 are within the Town of Ludlow source protection areas and recreation is discouraged at these sites.

No Action and Preferred Alternative: Dam Sites #1 and #2 are not encouraged for recreation and will have no impacts from the preferred alternative.

Dam Site #3: Rehabilitation work at Site #3 will occur mainly in the areas immediately surrounding the dam and will not impact the existing recreation features. A temporary staging area will be located adjacent to the recreation entrance.

Dam Site #5: Temporary impacts to passive recreation such as walking and wildlife viewing will occur during construction.

5.8 Cumulative Effects & Ecosystem Services

The four (4) Jewell Brook Watershed dam sites designed and constructed by NRCS between 1968 and 1972, provided an integrated network of flood protection and flood damage reduction for the downstream floodplain, including Ludlow Village. By design, the dam sites have altered the hydrology of Jewell Brook by provisioning flood retarding and storage, resulting in the reduction of downstream flows during storm events, and consequently protecting property and people in otherwise flood-prone areas. Over the past 50-plus years since these dams became operational, the downstream community has relied on the FEMA floodplain mapping affected by the altered hydrology and has developed appropriately within the floodplain. Information included in the FEMA FIS dated September 28, 2007 indicates the discharge rates in the Black River within the Town of Ludlow, downstream of the confluence with Jewell brook were developed by HUD (1978) in part using peak discharge-frequency hydrologic methods specific for Jewell Brook and Grant Brook.

Since construction, the dam sites have indirectly affected the natural environment by temporary inundation of the floodplain upstream of the dams during storm events and by trapping sediment that would otherwise move downstream during these events. As an example, in 2011, significant sediment was deposited into each reservoir as a result of erosion from Tropical Storm Irene rainfall.

In addition to providing flood protection, the dam sites provide additional benefits to the community, which has developed over time. Several examples include: Dam site #1 serves as a significant passive / visual resource, having scenic vistas into the surrounding mountains

to the public. For example, during the seasonal Fall Foliage season, busloads of people regularly visit the site, which is directly accessible off VT Rt. 100.

The aquifer located under and adjacent to dam site #2 serves as a potable water supply source for the Town of Ludlow and the collection and piping infrastructure for this water is integrated into the dam embankment. The protection of this water supply resource from both construction activities and permeant design changes and the infrastructure that collects and conveys water from the dam is required. Rehabilitation measures associated with the Preferred Alternative is limited to internal drains associated with each embankment, and will not have any impact to the underlying aquifer. The details of the protection will be incorporated into the final design.

Hiking through the area has become popular as the Town has developed hiking trails adjacent to the dam site.

Subsequent to the original Dam Site #3 construction, a water supply intake to the permanent pool was added to serve as a seasonal (winter) water source for snow making to the adjacent Okemo Mountain Resort, a key economic resource in the Town of Ludlow. This water supply has no operational or functional impact to the dam site. Dam site #3 also serves as a recreational resource to the public, which has been developed since the dams were constructed and the Town plans to continue to develop this resource as well as continue to develop recreational opportunities, such as hiking trails to dam sites #2 and #5.

To summarize the environmental consequences to ecosystem services, the following categories were identified within the project area:

- Provisioning - Municipal water supply at Site #1 with no impact resulting from the project.
- Regulating - Flood control at all four dam sites will remain in place resulting in no impacts to this ecosystem service
- Supporting - Nutrient cycling and soil formation may be temporarily impacted, but conditions will stabilize post-construction; future climate change and variability have the potential to impact both soil formation and nutrient cycling, but project action is not anticipated to intensify any impacts imposed by climate change
- Cultural - Recreational use at Site #2 and Site #3 will be temporarily impacted but will return to pre-construction condition following rehabilitation
- Cultural - Aesthetic viewsheds will continue, and conditions at Site #2 will return to pre-construction condition following rehabilitation.

5.9 Risk & Uncertainty

Estimating project costs and benefits involves a certain degree of risk and uncertainty. Assumptions made during the planning process are based on the best available technology and information at the time of this planning study. Primary examples include:

5.9.1 Geologic

Areas of uncertainty regarding the proposed rehabilitation elements include the location of competent subsurface soils at the downstream end of each auxiliary spillway, which is required to properly anchor the rehabilitation measures. The Preferred Alternative includes

the use of stonefill in areas downstream of the rehabilitated auxiliary spillways, and the location of competent subsurface soils may impact the volume of excavation and stonefill and other construction materials needed to construct the rehabilitation measures. This uncertainly is minimized due to the successful repairs to eroded areas resulting from the 2011 Tropical Storm Irene, but the extent of excavation and stone volume may vary depending on site specific conditions.

5.9.2 Future Land Use

Limitations of future land use and environmental conditions introduce a degree of uncertainty, especially related to future hydrology and dam hydraulic performance. Future land use conditions have been estimated based on current zoning regulations and incorporated into the hydrologic and hydraulic models. Much of the land within each dam site's watershed is privately held and therefore not in the control of the Town. However, while not anticipated due to terrain and other natural constraints, additional urbanization in the next 100 years could cause increased runoff, associated sedimentation and runoff pollution concerns within the Jewell Brook watershed. Additionally, changes in land use and impervious coverage in the watershed and downstream areas may affect the extent of local floodplain areas and the severity of flood events.

5.9.3 Economic

The areas of risk and uncertainty associated with the economic analysis consist of uncertainty associated with abbreviated procedures, such as indexing, simplifying assumptions used to estimate benefits, and uncertainty related to future changes in cost estimates as engineering design progresses. While the assumptions made represent the best methodology available within the scope of the analysis, there is some increased risk that economic conditions will not be as accurately captured as by raw data collection. To minimize this risk, aerial photography review and field verification of economic conditions were conducted for each dam site.

This Plan-EA is based on a 110-year period of analysis, including a 100-year evaluated life, and ten (10) year implementation period of all four dams. The life expectancy of the concrete structures, such as the principal spillways and associated components is expected to meet the minimum requirements of the rehabilitation period, but it has not been confirmed that these components would last for a longer period and periodic maintained and repairs are expected. As the service life is extended, there is an increased risk that assumptions and conditions will be different than predicted.

Finally, there is inherent uncertainty in estimating the social and environmental costs associated with each alternative because values and judgments vary among interested parties.

Extended delays between planning and implementation increase the degree of risk and uncertainty. Estimated project costs are based on computed work quantities multiplied by the appropriate unit cost for that type of work. Unit costs are based on historical data from similar projects, indexed to current price levels. Costs can be influenced by several economic factors that cannot be predicted with certainty during the planning process. Future natural disasters, vegetation changes driven by climate change, fuel shortages, unforeseen labor

and materials shortages, and political-driven incidents can adversely affect costs and construction schedules.

5.10 Controversy

There is no known controversy at any of the four (4) Jewell Brook Watershed dam sites project. The Sponsor and NRCS have conducted three (3) public meetings and as well as scoping meetings with resource agencies. Comments received have been in support of maintaining the Dam Sites with the Preferred Alternatives, which contains repairs of minimal resource impacts.

6. Consultation, Coordination & Public Participation

6.1 Public Participation

The scoping process included a series of meetings with the public and with local, state and federal government officials. The public participation plan for the project includes two public meetings to present the project to the public and interested parties and potentially affected communities.

Project Scoping Meeting: The first (initial) scoping session was held on August 3, 2020 at 2:00pm at the Ludlow Town Offices and via the virtual platform Zoom. Representatives of federal and state resource and regulatory agencies, local sponsoring organizations, local stakeholders, and the general public were invited to attend invited in accordance with the approved Public Participation Plan (PPP). Included in the scoping session was a review of the key items to consider as part of the scoping process, as defined in Part 501 - Development of Watershed Project plans, Subsection 501.24 - Public Participation was reviewed with the attendees.

Participants were presented with an overview of the project including a review of the National Dam Rehabilitation Program, review of the Jewell Brook Dam Sites, discussion of potential concerns relevant to the project and solicitation from the public and all meeting attendees for questions and input of the process of evaluation conducted as part of the planning process. The meeting sign in sheet and meeting minutes are included in Appendix E1.

Project Scoping Letters and Agency Coordination: Project information and requests for comments were sent to regulatory and resource agencies, Sponsors, local stakeholders, and public officials to help identify relevant environmental concerns and to provide information that would be helpful in evaluating potential environmental impacts. Results of the scoping process identified the concerns to be considered in the development of project alternatives and evaluation through the Plan-EA process.

Suggestions received from agency consultations, and during the scoping meeting, were evaluated and, where appropriate, incorporated into the rehabilitation plan. Additional consultations with resource agencies will be conducted as alternatives are evaluated and during the agency and public review process. These consultations are to ensure that the project effects upon resources of concern are adequately avoided, minimized, or mitigated.

Second Pubic Informational Meeting: Presentation of Alternatives. A second public informational meeting was conducted on April 13, 2021, at 5:00pm via a Zoom platform and consistent with the Town of Ludlow Covid-19 protocols. This meeting was an Alternatives Presentation and the public and elected officials were presented with the alternatives developed for the project and provided with an opportunity to provide input. Elected public officials, government agencies, organizations and watershed association representatives, including local, state and federal entities were invited in accordance with the approved Public Participation Plan (PPP).

In addition, a third public meeting was conducted on June 7, 2021 at 5:30pm. This meeting was intended for elected officials representing the Sponsor (Town of Ludlow Selectboard) to select a

preferred alternative at each dam site. This was a warned public meeting, in accordance with the Town's established public notice policy and the public was invited to attend. During this meeting, the Town of Ludlow Selectboard, acting as the formal decision-making entity of the Sponsor, selected the Preferred Alternative for each dam site, as presented in Section 7 below.

6.2 Agency Consultation

As part of the approved Public Participation Plan, the following municipal, state and federal agencies were contacted and invited to provide input and/or were consulted for the Draft Supplemental Watershed Plan No. 02 and Environmental Assessment for the Jewell Brook Watershed Dams:

- Town of Ludlow Water Department
- Town of Ludlow Town Administrator
- Town of Ludlow Recreation Department
- Southern Windsor County Regional Planning Commission
- Vermont Agency of Natural Resources, Department of Environmental Conservation (DEC)
  - DEC Facilities Engineering, Dam Safety Program
  - DEC Watershed Management Division, Wetlands Program
  - DEC Watershed Management Division, Rivers Program
  - DEC Geology Survey
  - DEC Air Quality and Climate Division
- Vermont Agency of Natural Resources, Department of Fish and Wildlife
  - Wildlife Division, Furbearer Program
  - Fisheries Division
- Vermont Department of Transportation
- Vermont Agency of Agriculture, Foods and Markets
- Vermont Agency of Commence and Community Development
  - VT State Historic Preservation Office (SHPO)
- Vermont Agency of Natural Resources, Department of Forests, Parks and Recreation
- Vermont Emergency Management
-
- U.S Army Corps of Engineers, Burlington VT Regional Office
- U.S Fish and Wildlife Service, Concord, NH Regional Office
- Stockbridge-Munsee Community

6.3 Public Review

The draft Supplemental Watershed Plan and Environmental Assessment is scheduled to be issued on or about January 10, 2023for public review and comment in accordance with the NRCS NECH Part 610B.31 Public Participation requirements.

The public review of this draft Plan-EA will be conducted as outlined below:

1. Provide public notice regarding the distribute of the draft Plan-EA following Sponsor public notice procedures,
2. Distribute paper and digital copies of the draft Plan-EA to the Sponsor (Town of Ludlow) for public notice on their current public notice outlets, such as (not limited to), 1) Municipal Hall bulletin boards, 2) Digital media, such as Town of Ludlow Municipal website, 3) direct

notification to abutters, Tribal representatives, federal resource agencies, local agencies, other interested parties, 4) other official Town public review process,

3. Public review and comment period shall be for 45-days following the distribution date,
4. Schedule and conduct a Public Information meeting to solicit public review comments at the conclusion of the 45-day review period,

Because the impacts associated with the project are considered local not national, distribution of the draft Plan-EA will be through local publishing outlets, such as the Sponsor's public website, not the federal register. Copies of the draft Plan-EA will also be on file at the Town's municipal office for public viewing. Also, individual letters of notification will be distributed to applicable regulatory and resource agencies and stakeholders. Review comments offered by the public and regulatory agencies will be summarized in the final Plan-EA.

7. Preferred Alternative

7.1 Rationale for the Preferred Alternative

Alternative plans for each dam site were formulated in consideration of the purposes of the project and concerns expressed during the public scoping process. Formulation of the alternative plans considered four criteria: completeness, effectiveness, efficiency, and acceptability. The following alternatives were presented to the public, regulatory and resource state and federal agencies and to the Sponsor (Town of Ludlow), for review and comment.

- No Action / Future Without Federal Investment (FWOFI)
- Dam Decommissioning
- Nonstructural Measures
- Structural Rehabilitation
- Local Sponsor Alternative

The Preferred Alternative for each dam site listed below was identified by the Sponsor as the recommended plan because each represent the federally assisted alternative that best fulfills the purpose and need for the project.

Dam Site #1: Alternative #1.2, Structural Rehabilitation
Dam Site #2: Alternative #2.6, Structural Rehabilitation
Dam Site #3: Alternative #3.2, Structural Rehabilitation
Dam Site #5: Alternative #5.4, Structural Rehabilitation

7.2 Measures to be Installed

Based on review of the project purpose and need and the overall impacts on human and natural environmental resources, the Preferred Alternatives will sustain the present level of flood protection and reduce the threat to public health and safety. The following measures are to be installed at each dam site, and specific technical data is presented in Table 3, Structural Data, below.

All Dam Sites: Structural Rehabilitation Measures

- Fill in low points and level the top of dam crests to the Freeboard Hydrograph level and reduce the potential for a dam overtopping event. Land rights and flowage easements to these elevations are to be confirmed by the Town prior to finalization of this Plan-EA.

- Regrade the auxiliary spillway (AUX) control section and armor the floor of the AUX with Articulated Concrete Blocks (ACB's) to address spillway integrity concerns and reduce the potential for erosion and dam failure during storm events.

- Key elevations, such as top of dam, principal and auxiliary spillway crests were established based on the hydraulic requirements in TR-210-60, including the FBH, ASH and PSH. Hydraulic modeling using SITES and HECRAS was conducted to serve as the basis for the elevations.

- To contain the FBH based on SITES and HECRAS modeling, the top of the dam

embankments Sites 1 and 2 will not change, Site 3 top of dam will be raised by 0.33-ft and the Site 5 top of dam will be raised 1.08-ft.

- Install structural modifications to the principal spillway riser low level orifice.

- Install a slope bench on the lone-third (1/3) of the downstream embankment slope to install a new internal filter and drainage system, increase stability to meet current slope stability factors of safety and facilitate future maintenance. Additional soil investigations using sonic drilling methods is required to access and sample the existing internal drain filter material and confirm the gradation compatibility.

- Extend existing principal spillway outlet pipe to a new plunge pool or impact basins.

- Dredge and remove a portion of accumulated sediment within the reservoir to expose the low-level drain and restore its operational capacity.

- Site 5 requires a raise of the top of embankment crest by 0.3-ft, from El. 1496.8 to El. 1497.1 to contain the FBH.

7.3 Mitigation

Consultation with the USACE indicates that mitigation requirements will depend upon the permanent impacts associated with each site. The extent of potential impacts associated with the preferred alternative have been considered and incorporated into the Plan-EA. An example is the disposal locations of dredged material, the fencing off of ASA's, wetlands and other site resources, to prevent the disturbance. Also, the current intention is to construct the four dams in sequence, that is, one at a time. This will significantly avoid impacts to resources and reduce unavoidable impacts to level that can be effectively managed and mitigated.

The USACE has indicated the excavation of waterbodies to remove accumulated sediments will not likely require mitigation.

The Northern Long-eared Bat (NLEB) is currently proposed to be reclassified as an endangered species (https://www.fws.gov/species/northern-long-eared-bat-myotis-septentrionalis). This may change the consultation process in the near future. According to the USACE, currently, if a project involves cutting trees that are >3" DBH, then we are required to consult with USFWS via the Northern Long-eared Bat (NLEB) 4(d) Rule. This process involves reporting the amount of tree clearing (sq. ft. / acreage) to USFWS by submitting a 4(d) determination via their IPaC website https://ipac.ecosphere.fws.gov/user/login). If USFWS does not respond within 30 days with recommendations for time of year restrictions or other conservation measures, then USACE may not require restrictions on the project. Additional information on the consultation process is available here: https://www.fws.gov/office/new-england-ecological-services/endangered-species-project-review.

Prior to commencement of any federally-funded rehabilitation activity, the Sponsor will be responsible for obtaining and complying with permits required by Federal, State and/or local regulatory agencies. Due to the relatively minor impacts associated with the Preferred Alternative, the conceptual approach for wetland mitigation could include on-site wetland creation and/or enhancement and/or a financial contribution to an applicable VTDEC In Lieu Fee

Stream and Wetland Mitigation Program, for permittees to pay a mitigation fee based on the proposed impacts.

7.4 Permits & Compliance

Prior to construction, the Sponsors would be responsible for obtaining and complying with permits required by Federal, State, and/or local regulatory agencies. Permit approvals expected to be necessary to construct the proposed project would include a VT Dam Safety Authorization for Construction, USACE Section 404 Permit/VTDEC 401 Permit and VTDEC Wetlands permit for the physical alteration of waters and wetlands. The cost of the permit was estimated to be $100,000, which includes application fees and labor fee to generate the applications and an allowance of $50,000 to purchase mitigation credits for wetland impacts.

Prior to construction, the contractor would be required to obtain a VT Department of Environmental Conservation Construction Stormwater General Permit (GP) and develop and implement a Stormwater Pollution Prevention Plan (SWPPP), which includes applicable erosion and sediment control measures.

7.5 Costs

Costs are shown in Economics Table 1; Economics Table 2 shows the costs by category. Total annual costs are shown in Economics Table 4 along with the estimated costs for operation and maintenance. Economics Table 5 displays the average annual flood damage reduction benefits by flood damage categories, and Economics Table 6 displays a comparison of annual costs and benefits. A 2021 price base was used and amortized at 2.5 percent for the 110-year period of analysis. The planning costs for the proposed rehabilitation measures are estimated costs only. Detailed structural designs and construction cost estimates would be prepared prior to contracting for the work to be performed. The final cost would be the low price received by competitive bidding plus or minus the amounts of contract modifications.

Table 25(Economics Table 1) – Estimated Installation Cost
Jewell Brook Watershed Dam Sites #1, #2, #3 and #5
Town of Ludlow, Windsor County, VT
(Dollars)[1]

Works of Improvement	Unit	Number (Non-Federal Land)	Estimated Cost[1]		
			Public Law 83-566 Funds	Other Funds	Total
Rehabilitation of Jewell Dam Site #1	No.	1	$7,006,800	$2,653,700	$9,960,500
Rehabilitation of Jewell Dam Site #2	No.	2	$8,295,900	$3,347,800	$11,643,700
Rehabilitation of Jewell Dam Site #3	No.	3	$6,467,300	$2,363,100	$8,830,400
Rehabilitation of Jewell Dam Site #5	No.	5	$7,038,300	$2,670,600	$9,708,900
Total Project			*$28,808,300*	*$11,305,200*	*$39,843,500*

1 Price base 2021 (Prepared August 2021)

2 Federal Funds include NRCS Engineering Services and Project Administration ($8,500,000 of $28,808,300 Public Law Funds),

which are not included when calculating eligible federal cost-share. Permit costs ($100,000 of the $11,035,200 Other Funds) are also not included. Therefore, federal cost-share is based on Total Eligible Project Cost of $31,243,500.

Table 26 (Economics Table 2) – Estimated Cost Distribution – Water Resource Project Measures
Jewell Brook Watershed Dam Sites #1, #2, #3 and #5
Town of Ludlow, Windsor County, VT
(Dollars)[1]

Works of Improvement	Installation Costs (Federal Funds)[2]			
	Const.	Eng. Services	Project Admin.	Total Public Law 566
Rehabilitation of Jewell Dam Site #1	$4,881,800	$1,875,000	$250,000	$7,006,800
Rehabilitation of Jewell Dam Site #2	$6,170,900	$1,875,000	$250,000	$8,295,900
Rehabilitation of Jewell Dam Site #3	$4,342,300	$1,875,000	$250,000	$6,467,300
Rehabilitation of Jewell Dam Site #5	$4,913,300	$1,875,000	$250,000	$7,038,300
Total	*$20,308,300*	*$7,500,000*	*$1,000,000*	*$28,808,300*

Works of Improvement	Installation Costs (Other Funds)						
	Const.	Eng. Services	Real Property Rights	Req'ed Permits	Project Admin.	Total Other Funds	Total Install. Cost
Rehabilitation of Jewell Dam Site #1	$2,503,700	$0	$0	$25,000	$125,000	$2,653,700	$9,660,500
Rehabilitation of Jewell Dam Site #2	$3,197,800	$0	$0	$25,000	$125,000	$3,347,800	$11,643,700
Rehabilitation of Jewell Dam Site #3	$1,963,100	$0	$250,000	$25,000	$125,000	$2,363,100	$8,830,400
Rehabilitation of Jewell Dam Site 5	$2,520,600	$0	$0	$25,000	$125,000	$2,670,600	$9,708,900
Total	*$10,185,200*	*$0*	*$250,000*	*$100,000*	*$500,000*	*$11,035,200*	*$39,843,500*

1 Price base 2021 (Prepared August 2021)

2 Federal cost share for total eligible dam rehabilitation costs is 65%. Federal engineering services and project administration costs, as well as permit costs, are not included when calculating eligible federal cost share. Therefore, federal cost share for construction is based on total eligible project cost of $31,243,500.00.

Table 27(Economics Table 3) Structural Data
Dams with Planned Storage Capacity
Jewell Brook Watershed Dam Sites #1, #2, #3 and #5
Town of Ludlow, Windsor County, VT

Item	Unit	Jewell Dam Site No. (Preferred Alternative Future Conditions			
		Dam Site #1	Dam Site #2	Dam Site #3	Dam Site #5
Hazard Class of Structure	-	High	High	High	High
Total Drainage Area	Sq. Mi.	1.92	1.94	1.40	1.83
Existing Runoff Curve Number	-	69.2	67.9	68.5	68.3
Future Runoff Curve Number	-	71.7	70.2	71.9	69.5
Time of Concentration (T_c)	Hours	0.90	0.60	0.49	0.80
Top of Dam Elevation	Feet	1620.00	1573.50	1252.33	1497.88
Auxiliary Spillway Crest Elevation	Feet	1613.00	1566.81	1245.51	1490.86
Principal Spillway Riser Crest Elevation	Feet	1605.50	1558.71	1239.16	1449.90
Principal Spillway Low-level Intake Crest Elevation (Permanent Pool)	Feet	1583.67	1531.51	1229.47	N/A
Auxiliary Spillway Type	-	Vegetated Earth (ACB armored)	Vegetated Earth (ACB armored)	Vegetated Earth (ACB armored)	Vegetated Earth (ACB armored)
Auxiliary Spillway Bottom Width	Feet	250	300	200	235
Auxiliary Spillway Exit Slope	%	3.33	3.33	3.33	2.85
Maximum Height of Dam	Feet	60	73.5	75	121
Total Capacity (Below top of dam)	Acre-Feet	647.2	392.65	352.4	276.4
Submerged Sediment (future conditions)	Acre-Feet	14.8	8.3	22.7	27.5
Aerated Sediment (future conditions)	Acre-Feet	18.4	48.8	27.4	11.9
Flood Retarding Capacity (Auxiliary Spillway Crest to Permanent Pool)	Acre-Feet	391.2	226.2	171.5	197.2
Permanent Pool Capacity (below low-level intake structure crest)	Acre-Feet	12.3	2.3	79.0	0.9
Principal Spillway Design					
Principal Spillway Design Rainfall (1-day)	Inches	6.58	6.63	6.66	6.69
Principal Spillway Design Rainfall (10-day)	Inches	11.1	11.1	11.0	11.1
Principal Spillway Design Runoff (1-day)	Inches	2.61	2.61	2.61	2.61

Principal Spillway Design Runoff (10-day)	Inches	8.70	8.70	8.70	8.70
Capacity of low stage (max.)	CFS	36.8	38.6	34.9	N/A
Capacity of high stage (max.)	CFS	106	109.9	113.4	163.0
Principal Spillway Outlet Conduit Type	-	RCP	RCP	RCP	RCP
Principal Spillway Outlet Conduit Diameter	Inches	30	30	30	30
Principal Spillway Conduit Capacity (max)	CFS	142.8	148.5	148.3	163.0
7Frequency of operation- auxiliary spillway	% Chance	1%	1%	1%	1%
Auxiliary Spillway Hydrograph					
Auxiliary spillway hydrograph (ASH) 24-hr event Rainfall	Inches	12.44	12.47	12.49	12.52
Velocity of Flow (Vc) (max.) (24-hr)	Ft/s	7.35	6.82	9.19	6.53
Max. reservoir water surface elevation (24-hr)	Ft	1614.8	1567.38	1246.60	1492.54
Freeboard Hydrograph					
Freeboard Hydrograph 6-hr event Rainfall	Inches	23.7	23.7	23.7	23.7
Freeboard Hydrograph 24-hr event Rainfall	Inches	29.1	29.1	29.1	29.1
Max. reservoir water surface elevation (6-hr)	Ft	1619.00	1573.31	1252.33	1496.63*

1 Top of Dam based on maximum water surface elevation for FBH.
2 All elevations based on NAVD88.
3 Estimated fill needed for Rehabilitation.
4 Capacity at crest of auxiliary spillway.
5 Based on 100-years of sediment loading
6 Not applicable to a structural spillway
7 * Assumes hydraulic performance waiver for Site 5

Table 28 (Economics Table 4) – Estimated Average Annual Costs
Jewell Brook Watershed Dam Sites #1, #2, #3 and #5
Town of Ludlow, Windsor County, VT
(Dollars) [1]

Works of Improvement	Project Outlays		Total
	Amortization of Installation Cost[2]	Operation, Maintenance and Replacement Cost	
Rehabilitation of Jewell Dam Site #1	$217,000	$5,200	$222,200
Rehabilitation of Jewell Dam Sites #2	$261,000	$5,200	$266,200
Rehabilitation of Jewell Dam Sites #3	$198,000	$5,200	$203,200
Rehabilitation of Jewell Dam Sites #5	$217,600	$7,100	$224,700
Total	*$893,600*	*$22,700*	*$916,300*

1 Price Base 2021 Prepared August 2021
2 Amortized for 100 years at 2.5%. Installation cost expected to be incurred in evaluation year 8, construction completed in evaluation year 10. Therefore, structure life begins at study year 11, assumed to last 100-years.

Table 29(Economics Table 5) – Estimated Average Annual Flood Damage Reduction Benefits
Jewell Brook Watershed Dam Sites #1, #2, #3 and #5
Town of Ludlow, Windsor County, VT
(Dollars) [1]

Item	Estimated average annual damage		Damage Reduction Benefit[2]
	Without Project (Non-Agriculture Related)	With Project (Non-Agriculture Related)	
Floodwater			
Residential	$1,027,700	$643,600	$384,100
Commercial	$1,190,300	$355,100	$835,200
Institutional	$91,500	$34,600	$56,900
Infrastructure	$882,800	$30,500	$852,300
Insurance Administration Costs	$45,600	$0	$45,600
Total	***$3,237,900***	***$1,063,800***	***$2,174,100***

1 Price base 2021. Prepared: August 2021
2 Because the Future Without Federal Investment (FWOFI) is a Sponsors' Rehabilitation that would maintain flood damage reduction benefits throughout the life of the project, the flood reduction benefits shown here are the same for both alternatives. No net change in benefits occurs when comparing the two candidate plans to each other.
3 With Project benefits also include $7,000 in recreation benefits.

Table 30(Economics Table 6) – Comparison of Preferred Alternative Benefits and Costs
Jewell Brook Watershed Dam Sites #1, #2, #3 and #5
Town of Ludlow, Windsor County, VT
(Dollars) [1]

Works of Improvement	Total Average Annual Equivalent Non-Agricultural Related Benefits 2/3	Average Annual Equivalent Costs 4/	Benefit-Cost Ratio
Rehabilitation of Jewell Dam Site #1	$2,284,800	$222,200	2.5 to 1.0
Rehabilitation of Jewell Dam Site #2		$266,200	
Rehabilitation of Jewell Dam Site #3		$203,200	
Rehabilitation of Jewell Dam Site #5		$224,700	
Total	*$2,284,800*	*$916,300*	*2.5 to 1.0*

1 Price base 2021. Prepared: August 2021
2 Damage reduction benefits are the same for both the FWOFI and Preferred Alternative. No net change in benefits occurs when comparing the two candidate plans to each other.
3 Annual benefits ($2,239,500) are presented here as average annual equivalents, amortized for 110 years at 2.5%. Because the dams would remain in place until rehabilitation, the benefits are present throughout the analysis period.
4 From Table 4.

7.6 Installation & Financing

Each dam site is planned for installation in two (2) construction seasons and assumes an overall 10-year implementation period. The order and sequencing of each dam will be determined during the Final Design phase of the project. The project costs are expected to be expended in year 8 of 110, with construction of the last dam site to be completed in year 10.

During construction, equipment would not be allowed to operate when conditions are such that soil erosion and water, air, and noise pollution cannot be satisfactorily controlled. If additional cultural resources, (beyond those identified as part of this study) are discovered during installation, work would cease and procedures discussed in General Manual 190-601.29, National Cultural Resources Procedures Handbook, would be implemented.

The NRCS would provide technical and financial assistance to the Sponsors with the design and implementation of each dam site rehabilitation project. NRCS would be responsible for the following:

1. Execute a project agreement with the Sponsors before either party initiates work involving funds of the other party. Such agreements would set forth, in detail, the financial and working arrangements and other conditions that are applicable to the specific works of improvement.

2. Execute a Memorandum of Understanding with the Sponsors to provide a framework for which cost-share funds are accredited.

3. Execute an updated Operation and Maintenance (O&M) Agreement with the Sponsors for the dam.

4. Provide financial assistance equal to 65% of total eligible project costs, not to exceed 100% of actual construction costs.

5. Provide engineering support and technical assistance during design and following construction of the project.

6. Certify completion of all installed measures.

The Sponsors would be responsible for the following:

1. Secure all needed environmental permits and land rights for installation of the rehabilitation measures.

2. Prepare an updated Emergency Action Plan (EAP) for each dam prior to the initiation of construction.

3. Execute an updated Operation and Maintenance Agreement with NRCS for each dam.

4. Execute a Memorandum of Understanding with NRCS to provide a framework within which cost-share funds are accredited.

5. Execute a project agreement with NRCS before either party initiates work involving funds of the other party. Such agreements would set forth in detail the financial and working arrangements and other conditions that are applicable to the specific works of improvement.

6. Provide nonfederal funds for cost-sharing of the project at a rate equal to, or greater than, 35% of the total eligible project costs.

7. Participate in and comply with applicable Federal floodplain management and flood insurance programs.

8. Enforce all associated project easements and right-of-ways.

9. The Sponsor maintains ownership and/or maintenance easements for lands at the originally-designed top of dam for operation and maintenance of each dam site. The Sponsor is prepared to obtain any additional ownership/easements at the dam sites that require the top of embankment to be raised higher than the original design elevation.

7.7 Operation, Maintenance & Replacement

Measures installed as part of this plan, and previously installed measures, would be operated and maintained by the Sponsor with technical assistance from federal, state, and local agencies in accordance with their delegated authority.

A new Operation and Maintenance (O&M) agreement would be developed for each dam site utilizing the NRCS National Operation and Maintenance Manual. The O&M agreement would be executed prior to signing the project agreement for the construction of the project. The term of the new O&M agreement would be for the stated design life of the project (100 years), after which the agreement would be renewed, or a new agreement would be developed for the remaining service life of the project.

The agreement would specify responsibilities of the Sponsor and include detailed provisions for retention, use, and disposal of property acquired or improved with PL-106-472 cost sharing. Provisions would be made for free access of district, State, and Federal representatives to inspect all structural measures and their appurtenances at any time.

The annual costs of operations and maintenance of the dam sites is estimated to be $22,700. The majority of this cost includes the amortized cost of dredging dam site #5 at year 57. Based on the sedimentation analysis, this Plan estimates an additional 14,500 cubic yards of sediment will be required to be dredged from dam site #5 in year 57 in order to provide the 100-year project life for an estimated cost of $363,000.00. This dredging cost has been amortized into the total, for an annual O&M cost of $22,100.

8. References

8.1 Previous Reports and References

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

1. Dam Assessment Report, Jewell Brook Dam #1 – Revision 1.0, October 2015, McMillen Jacobs Associates.

2. Dam Assessment Report, Jewell Brook Dam #2 – Revision 1.0, October 2015, McMillen Jacobs Associates.

3. Dam Assessment Report, Jewell Brook Dam #3 – Revision 1.0, October 2015, McMillen Jacobs Associates.

4. Dam Assessment Report, Jewell Brook Dam #5 – Revision 1.0, October 2015, McMillen Jacobs Associates.

5. Jewell Brook Dam Site No. 1 VT 00014: Phase I Inspection Report, National Dam Inspection Program, New England Division, Corps of Engineers, April 1980.

6. Jewell Brook Dam Site No. 2 VT 00015: Phase I Inspection Report, National Dam Inspection Program, New England Division, Corps of Engineers, April 1980.

7. Jewell Brook Dam Site No. 3 VT 00016, VT 00262: Phase I Inspection Report, National Dam Inspection Program, New England Division, Corps of Engineers, April 1980.

8. Jewell Brook Dam Site No. 5 VT 00017: Phase I Inspection Report, National Dam Inspection Program, New England Division, Corps of Engineers, April 1980.

9. FEMA Flood Insurance Study, Volume 1 of 4, Windsor Co., September 28, 2007

8.2 Literature Cited

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NOAA, 2020. https://www.fisheries.noaa.gov/resource/map/essential-fish-habitat-mapper

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U.S. Census Bureau. 2018. Quick Facts: Town of Ludlow, VT; Windsor County, VT; United States. Available online at: https://www.census.gov/quickfacts/fact/table/VT,windsorcountyvermont,ludlowtownwindsorcountyvermont,US/PST045219. Accessed March, 2021.

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USFWS. 2020. https://ecos.fws.gov/ipac/

U.S. Climate Data. 2020. Ludlow. Available online at: https://www.usclimatedata.com/climate/ludlow/vermont/united-states/usvt0437 Accessed March, 2021.

VANR, 2018. Black and Ottauquechee Rivers and adjacent Connecticut River & tributaries Spencer, Blood, Mill, Mill and Lulls Brooks 2018 TACTICAL BASIN PLAN https://dec.vermont.gov/sites/dec/files/documents/mp_TacticalBasinPlan_Basin10_BlackAndOttauquecheeRivers.pdf

VANR,2020. Natural Resource Atlas mapping, https://anrmaps.vermont.gov/websites/anra5/

Vermont Fish and Wildlife Department. Mammals. https://vtfishandwildlife.com/learn-more/vermont-critters/mammals. Accessed March 1, 2021.

9. List of Preparers

Table 31 List of Preparers

List of Preparers			
Name / Title	**Role**	**Education**	**Years Experience**
NRCS-VT			
Travis Thomason, State Conservationist	Technical Reviewer		
Robert Thompson, P.E., State Conservation Engineer	Technical Reviewer		
DDK Engineering-JV (DuBois & King)			
Jeffrey Tucker, PE, Project Principal	Project Manager	B.S. Civil Engineering, University of Vermont	34
Charles Johnston, PE	Project Engineer	B.S. Civil Engineering, Rensselaer Polytechnic Institute	8
Charlotte Brodie, CWS	Senior Field Naturalist	M.S., University of Vermont, Field Ecology	32
Aimee Rutledge, PWS, CPESC, CPSWO	Senior Environmental Specialist	B.S., Environmental Management University of Rhode Island	23
Brenda Bhatti	Senior Environmental Planner	MS Environmental Studies, Antioch New England, BS Zoology/Wildlife Biology, Ohio University	22
Chris Sargent, AICP, CFM	Senior Planner	M.S., Antioch University of New England, Resource Management and Administration	18
Emily Lewis, PLA, LEED AP	**Sr.** Environmental Planner / Landscape Architect	B.LA., Landscape Architecture Pennsylvania State University M.S., Environmental Sciences and Policy, Johns Hopkins University,	13
Andrew Sampsell, E.I.	Hydraulics Engineer	B.S. Civil Engineering, University of Vermont	4
DDK Engineering-JV (D'Appolonia)			
Robert Shusko, PE	Senior Geotechnical Engineer	B.S. Civil Engineering, University of Pittsburgh B.S. Environmental Science, Allegheny College M.B.A., Temple University	25
Andrew A. Antell, PE	Project Engineer	B.S., University of Maine, Civil Engineering M.S., Missouri University of Science and Engineering, Civil Engineering	9

Melissa J Daugherty, PE	Assistant Project Engineer	B.S., Pennsylvania State University, Civil Engineering	5
Gannett Fleming			
Amanda Hess, PE, CFM, Vice President	Hydrology & Hydraulics Task Leader, QA/QC	M.S., Pennsylvania State University	21
Katherine Sharpe, AICP, ENV-SP	Task Leader for Economics, QA/QC	B.A., Pennsylvania State University, English M.P.S., Cornell University, Environmental Management	20
Kayla Briggs	GIS Analyst	B.S., Geoenvironmental Studies/GIS Certificate, Shippensburg University	11
Claire Woleslage	Environmental Scientist	B.S., Geography, Mansfield University	3
Hartgen Archeological Associates Inc.			
Tom Jamison, PhD RPA	Senior Archaeologist	B.A., Hamilton College, Anthropology, PhD, The University of Albany, SUNY, Anthropology	26
Walter Wheeler	Senior Architectural Historian	B.A., (B. Arch) Architecture Rensselaer Polytechnic Institute	23

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11. 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	
U.S. Army Corps of Engineers	
U.S. Department of the Interior Fish and Wildlife Service	
Federal Emergency Management Agency	
U.S. Department of Agriculture U.S. Forest Service	
Vermont State Agencies Department of Environmental Conservation Department of Fish and Wildlife	

(This Table will be revised prior to finalizing the Plan-EA).