June 2026

DRAFT SUPPLEMENTAL WATERSHED PLAN NO. 1

FOR THE REHABILITATION OF UPPER TURTLE RIVER WATERSHED DAM NO. 9 (LARIMORE DAM)

Grand Forks County Water Resource District

Grand Forks County, North Dakota

USDA United States Department of Agriculture

Draft Supplemental Watershed Plan No. 1
For the Rehabilitation of Upper Turtle River Watershed Dam No. 9 (Larimore Dam)
Grand Forks County, North Dakota (North Dakota At-Large Congressional District)

Lead Agency: U.S. Dept. of Agriculture, Natural Resources Conservation Service
Sponsoring Organization: Grand Forks County Water Resource District
Cooperating Agencies: U.S. Army Corps of Engineers, U.S. Fish and Wildlife Service

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 flood water retarding structure Upper Turtle River Watershed Dam No. 9 is authorized under Public Law 83-566 (as amended) and as further amended by Section 313 of Public Law 106-472.

ABSTRACT (Fly Sheet)

Construction for the Upper Turtle River Watershed Dam No. 9 (Larimore Dam) was completed in 1979 and is part of a series of works of improvement to provide flood control and reduce erosion within the Upper Turtle River Watershed. Larimore Dam is a high-hazard dam located on the South Branch of the Turtle River that was built for watershed protection, conservation of wildlife resources, flood prevention, agricultural water management, and public recreation development. The design life of Larimore Dam was 50 years from when it was constructed. The design life has not been exceeded, however there are deficiencies at the dam site have been noted. Deficiencies include inadequate auxiliary spillway integrity, and incompatibility of the foundation drain with embankment and foundation soil properties. The preferred alternative for Larimore Dam is to harden the auxiliary spillway using articulated concrete block within the spillway chute, replace the existing principal spillway conduit and riser tower, and reduce the downstream embankment slope at the dam to improve slope stability. Total project installation cost is estimated at $14,099,890, of which $9,660,395 would be paid from the NRCS Small Watershed Rehabilitation Program and $4,439,495 would be paid from Sponsor funds.

COMMENTS AND INQUIRIES

Comments and inquires must be received by Month ??, 202X. Submit comments and inquiries to: TBD, State Conservation Engineer/Watershed Program Manager, USDA-NRCS (TBD@usda.gov 701-530-????).

Upper Turtle River Watershed

Watershed Plan Agreement

between the

Grand Forks County Water Resource District
(Referred to herein as Sponsor)

State of North Dakota

and the

UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
(Referred to herein as NRCS)

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 Upper Turtle River Watershed, State of North Dakota, under the authority of the Watershed Protection and Flood Prevention Act, as amended (16 U.S.C. Sections 1001 to 1008, 1010, and 1012); and

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

Whereas, there has been developed through the cooperative efforts of the Sponsors and NRCS a watershed project plan for works of improvement for the Upper Turtle River Watershed, State of North Dakota, 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 and evaluated life of the project (102 years) and does not commit NRCS to assistance of any kind beyond the end of the evaluated life.

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

3. **Real property.** The 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 item 5 hereof.

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

4. **Uniform Relocation Assistance and Real Property Acquisition Policies Act.** The sponsor hereby agrees to comply with all of the policies and procedures of the Uniform Relocation Assistance and Real Property Acquisition Policies Act (42 U.S.C. Section 4601 et seq. as further implemented through regulations in 49 CFR Part 24 and 7 CFR Part 21) when acquiring real property interests for this federally assisted project. If the sponsors are legally unable to comply with the real property acquisition requirements, 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 Work Plan.** The following table shows cost-share percentages and amounts for Watershed Work Plan implementation.

Rehabilitation of Upper Turtle River Watershed Dam No. 9 (Larimore Dam) (Upper Turtle River Watershed) (North Dakota).					
Works of Improvement	**NRCS**		**Sponsor**		**Total**
Cost-Shareable Items	Percent	Cost	Percent	Cost	Cost
Construction Costs for Works of Improvement[4/]	65%	$8,077,895	35%	$4,349,636	$12,427,531
Acquisition of Wetland Mitigation Credits	50	$28,500	50	$28,500	$57,000
Subtotal: Cost-Sharable Costs		**$8,106,395**		**$4,378,136**	**$12,484,531**
Non-Cost-Sharable Items [1/]					
Engineering Costs	100	$1,554,000	0	-	$1,554,000
Project Administration Costs [2/]	0	-	100	$50,000	$50,000
Real Property Rights [3/]	0	-	100	$5,031	$5,031
Required Permits	0	-	100	$6,328	$6,328
Subtotal: Non-Cost-Share Costs		**$1,554,000**		**$60,000**	**$1,615,359**
Total:					**$14,099,890**

Prepared in 2025

1/ If actual non-cost-sharable item expenditures vary from these figures, the responsible party would bear the change.

2/ The sponsor and NRCS would each bear the costs of project administration that each incurs. Sponsor costs for project administration include relocation assistance advisory service.

3/ The sponsor would acquire with other than Watershed Protection and Flood Prevention Act funds, such real property as would be needed in connection with the works of improvement. The value of real property is eligible as in-kind contributions toward the sponsor' share of the works of improvement costs. In no case would the amount of an in-kind contribution exceed the sponsor' share of the cost for the works of improvement. The maximum cost eligible for in-kind credit is the same as that for cost sharing.

4/ Percentages in the construction costs for works of improvement reflect sponsor contributions to planning costs as eligible, non-federal match toward the rehabilitation program requirements.

6. **Land treatment agreements.** The sponsors will obtain agreements from owners of not less than 50 percent of the land above each multiple-purpose and floodwater-retarding structure. These agreements must provide that the owners will carry out farm or ranch conservation plans on their land. The sponsors will ensure that 50 percent of the land upstream of any retention reservoir site is adequately protected before construction of the dam. The sponsors will provide assistance to landowners and operators to ensure the installation of the land treatment measures shown in the watershed project plan. The sponsors will encourage landowners and operators to continue to

operate and maintain the land treatment measures after the long-term contracts expire, for the protection and improvement of the watershed.

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

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

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

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

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

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

13. **Prohibitions.** No member of or delegate to Congress, or resident commissioner, may be admitted to any share or part of this plan, or to any benefit that may arise therefrom; but this provision may not be construed to extend to this agreement if made with a corporation for its general benefit.

14. **Operation and Maintenance (O&M).** The sponsors will be responsible for the operation, maintenance, and any needed replacement of the works of improvement by actually performing the work or arranging for such work, in accordance with an O&M Agreement. An O&M agreement will be entered into before Federal funds are obligated and will continue for the project life (102 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 the NRCS Title 180, National Operation and Maintenance Manual (NOMM), Part 500, Subpart F, Section 500.52, and meet applicable State agency dam safety requirements. The NRCS will determine that an EAP is prepared prior to the execution of fund obligating documents for construction of the structure. EAPs must be reviewed and updated by the sponsors annually.

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

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

To file a program discrimination complaint, complete the USDA Program Discrimination Complaint Form, AD-3027, found online at How to File a Program Discrimination Complaint and at any USDA office or write a letter addressed to USDA and provide in the letter all of the information requested in the form. To request a copy of the complaint form, call (866) 632-9992. Submit your completed form or letter to USDA by: (1) mail: U.S. Department of Agriculture, Office of the Assistant Secretary for Civil Rights, 1400 Independence Avenue, SW, Washington, D.C. 20250-9410; (2) fax: (202) 690-7442; or (3) email: program.intake@usda.gov.

USDA is an equal opportunity provider, employer, and lender.

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

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

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

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

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

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

Certification:

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

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

(2) Establishing an ongoing drug-free awareness program to inform employees about—

(a) The danger of drug abuse in the workplace;

(b) The grantee's policy of maintaining a drug-free workplace;

(c) Any available drug counseling, rehabilitation, and employee assistance programs; and

(d) The penalties that may be imposed upon employees for drug abuse violations occurring in the workplace

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

(4) Notifying the employee in the statement required by paragraph (1) that, as a condition of employment under the grant, the employee must—

(a) Abide by the terms of the statement; and

(b) Notify the employer in writing of his or her conviction for a violation of a criminal drug statute occurring in the workplace no later than five calendar days after such conviction.

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

(6) Taking one of the following actions, within 30 calendar days of receiving notice under paragraph (4) (b), with respect to any employee who is so convicted—

(a) Taking appropriate personnel action against such an employee, up to and including termination, consistent with the requirements of the Rehabilitation Act of 1973, as amended; or

(b) Requiring such employee to participate satisfactorily in a drug abuse assistance or rehabilitation program approved for such purposes by a Federal, State, or local health, law enforcement, or other appropriate agency.

(7) Making a good faith effort to continue to maintain a drug-free workplace through implementation of paragraphs (1), (2), (3), (4), (5), and (6).

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

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

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

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

(1) 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.

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

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

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

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

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

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

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

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

(4) (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 is unable to certify to any of the statements in this certification, such prospective participant must attach an explanation to this agreement.

20. Clean Air and Water Certification.

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

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

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

(3) To include substantially this certification, including this subparagraph, in every nonexempt sub-agreement.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

23. Signatures.

Grand Forks County Water Resource District

The signing of this plan was authorized by a resolution by the Grand Forks County Water Resource District governing body and adopted at an official meeting held on

_____, 2026 in Grand Forks, North Dakota

By:

_____ Date: _____

Bob Drees
Chairman, Grand Forks County Water Resource District
151 South Fourth Street, Suite 348
Grand Forks, ND 58201

USDA-NATURAL RESOURCES CONSERVATION SERVICE

Approved by:

_____ Date: _____

Dan Hovland, State Conservationist
Natural Resources Conservation Service
220 East Rosser Avenue
PO Box 1458
Bismarck, ND 58502-1458

Draft Supplemental Watershed Plan No. 1

For the Rehabilitation of Upper Turtle River Watershed Dam No. 9 (Larimore Dam)

June 2026

Prepared By: U.S. Dept. of Agriculture, Natural Resources Conservation Service

In Cooperation With: Grand Forks County Water Resource District &

Cooperating Agencies: U.S. Army Corps of Engineers, U.S. Fish and Wildlife Service

USDA United States Department of Agriculture

Natural Resources Conservation Service

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Summary (OMB Fact Sheet)

Supplemental Watershed Plan No. 1- Environmental Assessment
For
The Rehabilitation of Upper Turtle River Watershed Dam No. 9
(Larimore Dam)
Grand Forks County, North Dakota
North Dakota At-Large Congressional District

Authorization:	Public Law 83-566 Stat. 666 as amended (16 USC Section 1001 et. Seq.) by Section 313 of Public Law 106-472.
Sponsor:	Grand Forks County Water Resource District
Proposed Action:	The proposed action (Project) consists of the rehabilitation of the Upper Turtle River Watershed Dam No. 9, located in Grand Forks County, North Dakota.
Purpose and Need for Action:	The purpose of this project is to rehabilitate Upper Turtle River Dam No. 9 (Larimore Dam) to eliminate the threat the dam, in its current condition, poses to human lives, infrastructure, cropland, and natural resources downstream. Larimore Dam delivers important flood prevention and recreation benefits to the watershed, which were the originally authorized purposes of the watershed dam. The need for the project is that Larimore Dam does not meet current NRCS and State of North Dakota dam safety standards in regard to embankment design and earthen spillway integrity requirements. The proposed action would meet the originally authorized purposes, which include Flood Prevention (Flood Damage Reduction) and Public Recreation. Opportunities to be realized result from addressing design standards and earthen spillway inadequacies leading to uncontrolled breach of the dam. The breach puts at risk 82 human lives, 31 residential structures, 62 agricultural structures, 27 grain storage bins, 17 bridges, 9.7 miles of roadway, 20 historical sites, and 7,714 acres of cropland. The normal pool and downstream river channel also provides recreation opportunities, consisting primarily of camping, recreating, boating, fishing, hiking, and leisure sport activities which are at risk.
Preferred Alternative:	The preferred alternative is structural rehabilitation of the dam to a high-hazard designation. Features include: modification of auxiliary spillway by lining with articulated concrete blocks (ACB); new principal spillway riser tower, conduit, and stilling basin; and new chimney filter and foundation drain.

Resource Information:	**Latitude and Longitude:** 47.93733693 N, -97.59242142 W
	Eight-Digit Hydrologic Unit No.: 09020307
	Climatology and Topography: The climate within the project area is continental and characterized by large variances in temperature, low to moderate precipitation rates, and windy conditions. The average annual rainfall is ~22 inches per year (1991-2020). Topography is generally steeper in the western and central portions of the study area, with moderating slopes grading to a plain in the east. The steepest slopes have several rivers rapidly directing runoff from the upper portions of the watershed (west) to lower portions of the watershed (east).
	Watershed Size: The total South Branch Turtle River Watershed area is 65.7 square miles and the contributing area to Larimore Dam 65.5 square miles. The watershed downstream of the dam is 298.9 square miles.
	Land Uses: According to the USDA National Agricultural Statistics Service CroplandCROS data base 2023 U-AA: cropland (68.0%), perennial grass cover/pasture/grazing (18.4%), natural land (8.5%), developed (5.2%) D-AA: cropland (58.5%), grassland/pasture/grazing (29.6%), natural land (6.3%), developed 5.6%
	Land Ownership: Approximate values based on tax parcel information. U-AA: Private: 98%, State-Local: 1%, Federal: 1% D-AA: Private: 86%, State-Local: 2%, Federal: 12%
	Population and demographics: The population (2024 Census estimate) within the project area is approximately 8,000 individuals. The demographics include the communities of Larimore, Gilby, Inkster, Arvilla, Emerado, Niagara, Manvel and the Grand Forks Air Force Base. These communities are within the Census Block Groups within the Drainage Area and D-AA of which 86% of the population is white (alone), with the predominant minority being classified as Hispanic (6%). In the project area 12% of the

	population is classified as persons in poverty (11% for the state and 11% for the nation).
	Scoping Concerns: Relevant ecosystem services and resource concerns identified in scoping include: Provisioning Services (food and fresh water), Regulating Services (flood control, erosion regulation, climate and pest control), Cultural Services (cultural diversity & heritage, recreation and tourism, & aesthetic value), Supporting Services (soil formation and retention, nutrient cycling & provisioning of habitat), Land Use, Geology/Soils (surface geology, soil erosion/deposition, prime farmland), Water Resources (ground & surface water, US jurisdictional waters (CWA), water quality, water management, floodplain management, regional/international water resource plans), Air Quality (dust/emissions), Biotic Communities (plants, communities & habitat quality, ecologically critical areas, parklands, mammals/amphibians/ reptiles/invertebrates, Federal T&E species, undesirable species), Human Environment (cultural resources/historic properties, public health & safety, recreation resources, visual resources, local/regional economy, civil rights and noise). Maintaining flood control benefits, life safety risks due to dam breach and recreational values were the primary concerns identified through the public scoping effort.

Alternative plans considered:	**Alternatives considered:**
	
	Alternatives are broken down into three broad categories, including subcategories listed below.
	
	• No Action (NAA)
	• Non-Structural Rehabilitation
	  o Decommissioning with downstream flood protection and environmental impact minimization
	  o Decommissioning with environmental impact minimization
	  o Future without Federal Investment (FWOFI), Minimal Decommissioning
	• Structural Rehabilitation
	  o High-Hazard Designation
	  o Significant-Hazard Designation
	
	Evaluation of alternatives resulted in carrying forward three alternatives to detailed study. Those eliminated from detailed study are because they because unreasonable due to cost to meet the purpose and need, or due to the low benefit-cost ratio, as well as the negative environmental and public safety consequences. The alternatives studied in detail include

	No Action, Non-Structural FWOFI (Minimal Decommissioning), and Structural Rehabilitation to High-Hazard Designation.
	No-Action: represents a scenario where the existing dam remains in place with no measures taken to address the dam safety inadequacies. The dam would remain in place and function as it currently does until failure. The dam would breach during a 1,844-year rainfall event, due to failure of the existing earthen auxiliary spillway. The breach would result in a rapid release of stored flood water and a portion of the accumulated reservoir sediments. The resulting flood wave would impact 31 residential structures, 62 agricultural properties, and 27 grain storage bins. An estimated 82 lives would be at risk during the breach at 14 homes, 1 federal highway,16 local road crossings, and 20 cultural resource sites. Upstream, 28.17 acres of lacustrine fringe wetlands around the reservoir would be lost. Recreation benefits from the reservoir would no longer be provided. A portion of the combined 1.07 million cubic yards of erosion occurring from the initial breach and downstream erosion would be deposited within the downstream breach zone, requiring a significant clean-up effort to remove the deposited sediments. Sediment deposition would occur over 3,284 acres of cropland and 1,480 acres of natural areas. Crop impacts caused by erosion, flooding, and the resultant cleanup costs are estimated at approximately $12.6 million in the year of the initial breach. Surface water quality aquatic life standards would be exceeded due to heavy metals and nutrients, with risks to human health and aquatic species. Deposition of sediment bound contaminants on cropland could impact production and/or food safety. Risk of contamination of a drinking water aquifer would exist. The total economic losses initially caused by the breach are modeled to exceed more than $74 million, including damages to structures, contents, vehicles, agricultural land, infrastructure, and recreation losses. Due to the potential for devastating economic losses and the significant public safety risk, the no-action alternative was not considered viable by the planning team.
	Future Without Federal Investment (Minimal Decommissioning): The sponsor would conduct a controlled breach of the dam by constructing a grade control structure without stabilizing sediments behind the dam. The principal spillway riser tower and conduit would be removed. Downstream flooding conditions would be like those that existed prior to the construction of the dam. Upstream, 28.17 acres of lacustrine fringe wetlands around the reservoir would be lost. Recreation benefits from the reservoir would no longer be provided.
	Structural Rehabilitation to a High-Hazard Designation: Multiple structural rehabilitation alternatives to bring Larimore Dam into

<table>
<tr><td></td><td colspan="4">compliance with high-hazard dam safety criteria were considered. Various auxiliary spillway hardening options, auxiliary spillway dimensions, principal spillway modifications, and embankment changes were considered. All structural rehabilitation alternatives had similar impacts to identified resource concerns. Costs were used as a preliminary comparison tool to eliminate various structural rehabilitation options. Ultimately, the structural rehabilitation alternative chosen to be carried forward for detailed analysis was the least cost structural alternative and involves hardening the auxiliary spillway by using articulated concrete block within the spillway chute, replacing the existing principal spillway conduit, riser tower, stilling basin, and new chimney filter and foundation drain. A structural rehabilitation of the dam to a high-hazard designation was determined to be the preferred alternative.</td></tr>
<tr><td rowspan="11">Project costs (Structural Rehabilitation High-Hazard Designation)</td><td>Item</td><td>Federal Assistance</td><td>Other Funds</td><td>Total</td></tr>
<tr><td>Construction</td><td>$8,077,895 (65%)</td><td>$4,349,636 (35%)</td><td>$12,427,531</td></tr>
<tr><td>Engineering</td><td>$1,554,000 (100%)</td><td>$0 (0%)</td><td>$1,554,000</td></tr>
<tr><td>Real Property Rights</td><td>$0</td><td>$5,031 (100%)</td><td>$5,031</td></tr>
<tr><td>Project Administration</td><td>$0 (0%)</td><td>$50,000 (100%)</td><td>$50,000</td></tr>
<tr><td>Permits</td><td>$0 (0%)</td><td>$6,328 (100%)</td><td>$6,328</td></tr>
<tr><td>Mitigation</td><td>$28,500 (50%)</td><td>$28,500 (50%)</td><td>$57,000</td></tr>
<tr><td>Total</td><td>$9,660,395</td><td>$4,438,136</td><td>$14,099,890</td></tr>
<tr><td colspan="4">Average Annual Installation Cost: $517,523</td></tr>
<tr><td colspan="4">Annual O&M Cost: $5,000</td></tr>
<tr><td colspan="4">Total Average Annual Cost: $522,523</td></tr>
<tr><td rowspan="2">Project benefits:</td><td colspan="4">Monetary benefits: $29,100 (Average Annual Equivalent)</td></tr>
<tr><td colspan="4">The Preferred Alternative maintains the current flood damage reduction benefits of the dam, including reduced flooding on cropland, reduced flood impacts to agricultural and residential buildings, reduced overland</td></tr>
</table>

	flood flows, and reduced roadway overtopping occurrences downstream of the dam site. Flood damage reduction on cropland results in $5,539 of average annual benefit. Reduced damages to structures downstream of the dam results in an annual monetary benefit of $20,955 for both residential and agricultural buildings. Reduced repair costs for roadways and infrastructure downstream of the dam site result in an annual monetary benefit of $822. The Preferred Alternative also maintains recreational benefits of the dam, including boating, fishing (open water and ice), and camping. Recreational benefits at the site are estimated to be $620 annually. The Preferred Alternative reduces administrative costs to the NFIP by $1,164.
	Number of direct beneficiaries (Onsite-Offsite): Risks associated with a breach of Larimore Dam would be lessened for 82 human lives, 31 residential structures, 62 agricultural properties, 17 bridges, 20 historic sites potentially eligible for the NRHP, 9.7 miles of roadway, and 7,714 acres of cropland. Two habitable structures would continue to be protected from inundation during a 100-year flood event with the project in place. The project would assure flood damage reduction benefits for more than 100 landowners in the Turtle River Watershed for a 500-year flood event based on Grand Forks County Parcel Data from the year 2025.
	Benefit to Cost Ratio*: 0.1 *The benefit-cost ratio uses the No Action Alternative as the basis against which to compare the Preferred Alternative. This was determined on the basis of 390-303-NI (NRCS, 2022).* *The No-Action alternative was deemed unreasonable for use as the economic basis due to the significant social and environmental impacts, notably the predicted loss of 82 human lives and $74.1 million of economic losses during the No-Action breach event. The Sponsor and ND Department of Water Resources (state dam safety authority) would not allow Larimore Dam to knowingly operate under its current condition to the point of failure, given the risk to human life downstream.*
	Funding schedule (budget year + 5): Federal funds: $9,660,395 Non-federal funds: $4,438,136
	Period of analysis: 102-years
Project life:	100 years

Environmental effects, impacts:	Beneficial environmental effects: • Existing flood prevention benefits of the dam are maintained, which reduce the frequency, extent, and duration of inundation on cropland thereby reducing long term transport of dissolved phosphorus to the Turtle River, downstream Red River, and ultimately Lake Winnipeg. Sediment and nitrogen are also reduced, to a lesser degree. • Avoidance of water quality impacts that would occur if 300,080 cubic yards of contaminant laden sediment behind the dam were to mobilize downstream. Surface water quality aquatic life standards would be exceeded for cadmium and zinc; regional standards are exceeded for nitrogen and phosphorus. Water, flowing downstream for years after the breach will pose risks to human health and aquatic species. • Preservation of 45.99 acres of deep-water habitat and 28.17 acres of wetlands upstream of the dam that would be lost due to a catastrophic dam breach. Preservation of 999.2 acres of wetlands downstream of the dam that would be lost to the estimated 1.3 million cubic yards of deposition within the river channel and floodplain during the dam break. • Preservation of 434 acres of riparian habitat, including 325 acres of mature trees in the riparian forest between Larimore Dam and Manvel which is estimated to be completely lost with a catastrophic dam breach. Detrimental environmental effects: • Continued barrier to natural sediment transport along the South Branch Turtle River. • Permanent wetland loss is estimated at 0.95 acres (fill and excavation) as outline in Section 6.2.4.2 and Appendix D-9. The wetlands lost would be mitigated through purchase of credits from an approved USACE mitigation bank. • Temporary disruptions during construction related to human presence, noise, air quality, and temporary pool drawdown.
Areas of controversy:	No areas of controversy were identified
Issues to be resolved:	None
Evidence of Unusual Congressional	No evidence of unusual congressional or local interest was identified.

or Local Interest	
Compliance:	**Is this report in compliance with executive orders, public laws, and other statutes governing the formulation of water resource projects?** Yes

1 Introduction

1.1 Summary of Watershed Work Plan

The initial watershed work plan for the Upper Turtle River (US Department of Agriculture Soil Conservation Service, 1959) was sponsored by the Grand Forks and Nelson County Soil Conservation Districts and the Grand Forks and Nelson County Water Management Districts. The principal problem identified was “flooding of agricultural land by overtopping existing channel banks and flowing across the extensive flat land areas, and lack of adequate water-based recreation in the area”. Spring snowmelt leads to delayed planting, and heavy summer rainfall events can damage seeded and/or growing crops. Upper Turtle River Watershed Dam No. 9 (Larimore Dam) was originally sized to prevent activation of the auxiliary spillway during a 50-year storm event. Structural measures were expected to reduce crop damages in the watershed by 80%. Larimore Dam was sized for a watershed area of 64.6 square miles with a total storage capacity of 10,410 acre-feet. The dam was designed with a maximum height of 66 feet with a flood pool covering 410 acres. Aside from Larimore Dam, other structural improvements included in the watershed work plan included seven other floodwater retarding structures and 26.5 miles of channel improvements. All structural improvements associated with the watershed work plan are shown in Figure B-1: Project Location Map.

1.2 Changes Requiring the Preparation of a Supplemental Watershed Plan

Larimore Dam was originally designed and constructed with a significant-hazard classification. Larimore Dam is now classified as a high-hazard dam due to changes related to dam safety policy and improved hydraulic routing capabilities during breach scenarios. Inundation resulting from a breach analysis indicates that 15 habitable structures, one federal highway, and 17 local road crossings that have a high danger potential (i.e., where loss of life is likely to occur during a breach of the magnitude simulated) downstream of Larimore Dam. Dams with potential for loss of life during a breach have more stringent design criteria than sites without downstream hazards. Additional deficiencies related to geotechnical integrity and structural components are summarized in detail in this Watershed Plan-EA.

A supplement to the Upper Turtle River Watershed Work Plan is needed to address dam performance, design, and public safety issues associated with Larimore Dam. Modification measures and financial assistance from NRCS is required to bring the dam into compliance for performance, design, and public safety requirements of high-hazard classification dams. An amendment to Public Law 83-566, the Watershed Rehabilitation Amendments of 2000 (Public Law 106-472), Section 313 authorizes financial and technical assistance to upgrade dams under the USDA Watershed Rehabilitation Program. The rehabilitation of Larimore Dam is authorized under this amendment.

1.3 Project Setting

1.3.1 Location and Context

Larimore Dam is located in Section 32 of Hegton Township (T152N, R54W), Grand Forks County, ND. The dam is on the South Branch Turtle River within the Turtle River

Watershed (see Appendix B, Figure B-1: Project Location Map). The area benefited by Larimore Dam is shown as the 500-year inundation extents if the dam were not in place. The inundation extents for other recurrence intervals are available in Appendix C. Based on current topographic data and drainage area delineation tools, the contributing drainage area to Larimore Dam is approximately 65.5 square miles, which is more than the 64.6 square mile area in the original design. The area of scoping evaluation downstream of the dam extends from the dam to the Burlington Railroad and Interstate 29, just downstream of City of Manvel; also included is overland flow area where Turtle River drainage breaks to the north and enters County Ditch 12 of the Forest River watershed. This area is approximately 300 square miles and is almost entirely within Grand Forks County (see Appendix C, Figure C-1: Area of Interest / Benefit Area), a small portion extends into Walsh county to include Lake Ardoch.

The Turtle River Watershed begins in the Northern Glaciated Plains Major Land Resources Area (MLRA 55A) and continues moving east and south into the Red River Valley of the North MLRA (MLRA 56). The upper portion of the South Branch of the Turtle River begins in the Drift Plains Ecosystem. Just upstream of Larimore Dam the South Branch Turtle River cross through Beach Ridges and Sand Deltas ecoregion. Larimore Dam is located in the Glacial Lake Agassiz Basin, which includes Turtle River running east until the Grand Forks Air Force Base. The Turtle River east of Air Force Base is considered Saline Area ecoregion. Ultimately, the Turtle River confluences with the Red River of the North in Glacial Lake Agassiz Basin east of Manvel. These ecoregions are composed of transitional grasslands within a continental climate zone formed on recent glaciation.

Geologic formations transition through the watershed and include Coleharbor, Oahe and Pierre formations with varying glacial sedimentary deposits including glacial till, glacial outwash, clay and shale sediments. This ecoregion is extremely productive for agriculture, thus most of the wetlands and natural areas have been drained and cultivated. Refer to Appendix D-6: Environmental Resources Memorandum for additional information on the ecoregion associated with Larimore Dam and the Turtle River Watershed.

The climate of North Dakota is a humid continental climate characteristic of fluctuating temperatures of hot summers and cold winters. Climate data recorded at the nearest National Weather Service weather station (Grand Forks University) summarizes the average temperature, rainfall, and snowfall (US Climate Data, 2020). Average temperatures near Larimore Dam range from -14 °C (7 °F) in January to 21 °C (70 °F) in July. An average 21 inches of annual rainfall and 49 inches of annual snowfall occur near Larimore Dam. The highest rainfall amounts occur during the month of June. More information on climate is provided in Appendix D-10: Biological Inventory Report.

Topography of the watershed is characterized by moderate slopes in the west (Nelson and western Grand Forks counties), which flatten in eastern Grand Forks county (see Figure C-11: LiDAR Map). In the upper portion of the South Branch Turtle River Watershed, tributary streams that carry flood flows have moderately steep gradients and the valley of the South Branch Turtle River is easily identified using topographic maps such as that shown in Appendix C (Figure C-11). In the eastern portion of the watershed, approximately where the Turtle River is adjacent to Grand Forks Air Force Base, slopes flatten and the clearly defined valley for the Turtle River becomes a widespread floodplain.

Flood flows spread extensively; the general direction of flow though is northeast, so flows that spread on south side re-enter channel through drainageways. However, some flows that breakout north eventually make it to Drainage Ditch #12 and eventually Forest River.

Land use is predominantly agricultural over the Turtle River Watershed, but natural land, including open water, is also abundant in the area. Land use data for the area upstream of Larimore Dam and the area downstream of the dam within the Turtle River Watershed are presented in Appendix C (Figure C-12: Land Use Map), and in Figure 1-1 (USDA NASS, 2023). The developed area makes up approximately 13,250 acres (5.7%). Agricultural lands make up approximately 87.6% of the area analyzed, which includes cultivated crop land that covers 60.5% of the planning area (approximately 141,819 acres) and pastureland/CRP/grassland that covers 27.18% of the planning area (approximately 63,728 acres). Natural land (largely the riparian area - wetlands, open water, shrubland and forestland) makes up a small portion covering only 6.7% (15,709 acres) in the planning area. The predominant crops in the watershed are corn, spring wheat and soybeans. There are a few irrigated fields in the sandy soils near the dam; corn is the primary irrigated crop.

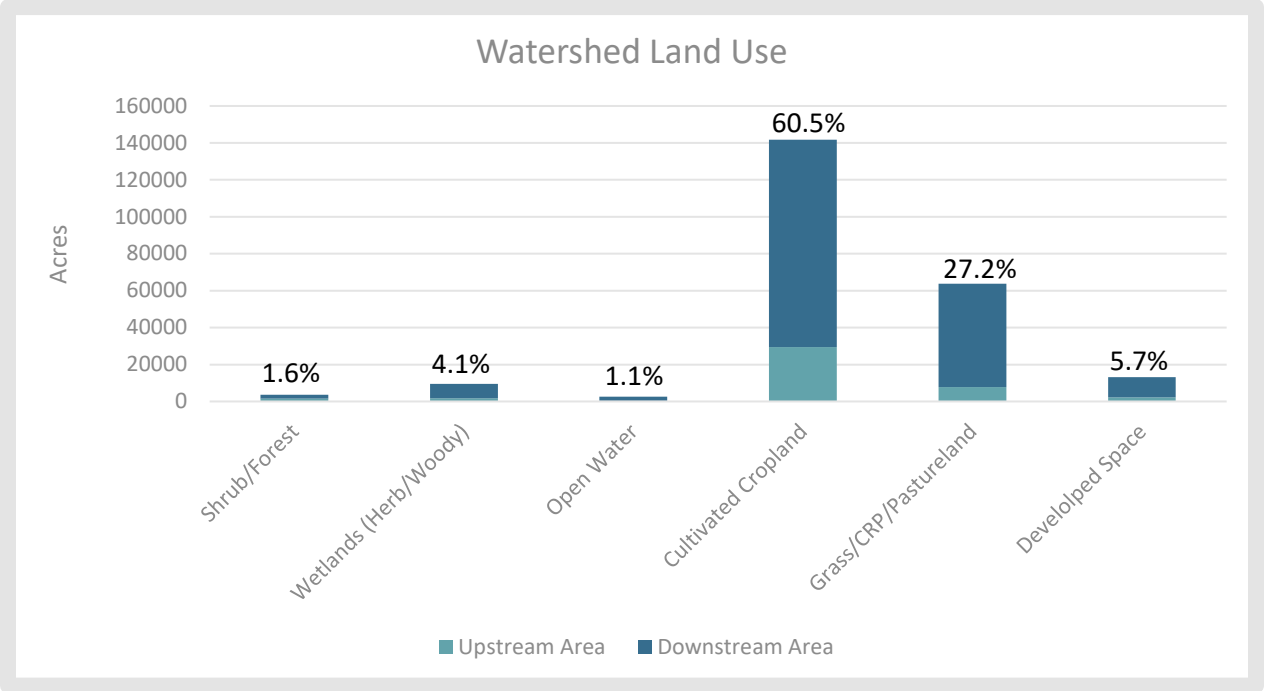

***Figure 1-1**: Land Use in the Area of Interest (values above bars indicate combined percentage). (USDA NASS, 2023)*

1.3.2 Planning Area

This environmental assessment refers to three specific zones within the Area of Interest (AOI) (see Appendix C, Figure C-1: Area of Interest / Benefit Area).

- Upstream Assessment Area (U-AA), the zone near the reservoir where there are direct impacts of plan alternatives. The U-AA includes the dam site, the normal and flood pools upstream from the dam, and a short stretch of river immediately downstream from the dam, for a total of 748 acres (1.2 sq mi) (see Appendix C, Figure C-2 Upstream Assessment Area Map).

- Downstream Assessment Area (D-AA), the downstream zone where the environment may be indirectly affected by plan alternatives. The D-AA includes 0.5 miles of the South Branch of the Turtle River (historically called Upper Turtle River in SCS watershed planning documents), 15 miles of North Branch Turtle River, and 77 miles of Turtle River (below confluence between South and North Branch Turtle River). Adjacent floodplains to the 82.5 miles of Turtle River channels are also included, which spread significantly downstream of the beach ridge. The D-AA is 192,000 acres (300 sq.mi.) (see Appendix C, Figure C-1 Area of Interest / Benefit Area Map).
- Area Upstream, the total drainage area to dam which is not expected to be affected by the project, is 43,206 acres (65.5 square miles) (including the U-AA) as shown in Appendix C, Figure C-1 Area of Interest / Benefit Area Map. This was not utilized for resource assessment descriptions but is noted to describe the context of the environmental conditions where appropriate (e.g., soils and erodibility potential).

1.4 Background and Current Status of the Dam As-Built / Existing Features

As-built plans for Larimore Dam, which was constructed between 1977 and 1979 are available in Appendix D-1: Existing Conditions Assessment Report. The dam embankment consists of impervious glacial fill material. The auxiliary spillway is a 300-foot-wide earthen spillway with a 15% average slope cut into the existing hill slope north of the embankment; the auxiliary spillway outlets in the North Branch Turtle River floodplain. The principal spillway consists of an open top riser tower with an anti-vortex baffle. The riser tower is connected to a 6' x 6' box conduit that carries flow through the embankment. Additional as-built information for Larimore Dam is provided in Table 1-1 and in Appendix D-1: Existing Conditions Assessment Report. The existing dam data presented in Table 1-1 was determined from updated topographic data, site survey, and sediment survey as outlined in Appendix D-1. See Appendix C for maps of the topography near Larimore Dam (Figure C-3), an existing conditions site plan (Figure C-2), and a cross-section of the dam (Figure C-5). Elevations provided in Table D-1-1 are converted to the 1988 North American Vertical Datum (NAVD88) from the as-built drawings which were completed in the 1929 National Geodetic Vertical Datum (NGVD29).

Table 1-1: As-Built and Existing Condition Information for Larimore Dam

Description	As-Built Drawings	Existing Condition
GENERAL DATA		
Year Construction Completed	1979	no change
Design Drainage Area	64.6 Square Miles (42.7 Uncontrolled, 21.9 Controlled)	65.5 Square Miles
Dam Height	66 Feet	no change
Embankment Length	1,040 Feet	no change
Embankment Top Width	20 Feet	no change
Embankment Upstream Slope	3.5H:1V	no change
Embankment Downstream Slope	2.5H:1V	no change
CRITICAL ELEVATIONS (NAVD88)		

Description	As-Built Drawings	Existing Condition
Top of Dam	1100.8 Feet	no change
Auxiliary Spillway Crest	1090.5 Feet	no change
Principal Spillway Riser Tower Crest	1083.2 Feet	no change
Principal Spillway Orifice Invert	1068.4 Feet	no change
Maximum Recreation Pool Elevation	1068.4 Feet	no change
Low Flow Drawdown Elevation	1045.7 Feet	no change
Principal Spillway Conduit outfall invert	1034.2 Feet	no change
STORAGE CAPACITIES		
Sediment Capacity Available	292 Acre-Feet	106 Acre-Feet
Principal Spillway Orifice Invert (1st Stage)	823 Acre-Feet	637 Acre-Feet
Principal Spillway Riser Tower Invert (2nd Stage)	2,850 Acre-Feet	2,414 Acre-Feet
Auxiliary Spillway Crest	5,003 Acre-Feet	4,434 Acre-Feet
Top of Dam	10,410 Acre-Feet	9,643 Acre-Feet
POOL SURFACE AREAS		
Maximum Recreation Pool	72 Acres	65.9 Acres
Principal Spillway Orifice Invert (1st Stage)	72 Acres	65.9 Acres
Principal Spillway Riser Tower Invert (2nd Stage)	Not Documented	198.0 Acres
Auxiliary Spillway Crest	375 Acres	362.8 acres
OTHER FEATURES		
Principal Spillway Orifice Size	1.5 Feet by 2.5 Feet	no change
Principal Spillway Conduit Diameter	30 Inches	no change
Principal Spillway Conduit Material	Reinforced Concrete	no change
Principal Spillway Conduit Length	304 Feet	no change
Principal Spillway Weir Crest Length	19.5 Feet	no change
Auxiliary Spillway Width at Crest	300 Feet	no change
Prepared March 2024		

1.4.1 Dam Inspection

Site inspections for Larimore Dam were conducted by HDR Engineering, Inc. in November of 2022. The objective of the inspections was to assess the condition of all elements of the dam including the embankment, slope protection, concrete inlet structure, principal spillway conduit, auxiliary spillway, and all related miscellaneous elements. Previous inspection reports were reviewed to verify existing conditions and to evaluate deteriorating conditions. Additional information regarding inspections is available in Appendix D-1: Existing Conditions Assessment Report. Relevant inspection observations are summarized below:

- Dam condition overall considered “Fair”
- Minor vegetation growth in numerous locations
- Severe rutting from wheel tracks on downstream slope and auxiliary spillway
- Collapsed and eroded areas within auxiliary spillway
- Principal spillway inlet in good overall condition, but steel plates corroding, separated, or missing

- Limited corrosion testing resulted in moderate corrosion rate, with estimated service life of 6-20 years

1.4.2 Status of Operation and Maintenance

The Sponsor has completed operation and maintenance of Larimore Dam, as outlined in the Operation and Maintenance Agreement with NRCS, since construction completion. Annual inspections of the dam were completed by NRCS staff, with the last inspection completed in September 2025. Engineers from the Dam Safety Section of the North Dakota Department of Water Resources have conducted regular formal inspections of the dam as well.

1.4.3 Breach Analysis and Hazard Classification

A breach analysis was completed for both the existing dam and the no action alternative. The breach analysis for the existing condition of Larimore Dam is described in Appendix D-1: Existing Conditions Assessment Report and for the no action alternative in Appendix D-3: Alternatives Evaluation Report. The breach scenario for the existing condition and no action results in similar inundation, flood depth, and flood velocity. The reason for multiple breach analyses is that existing conditions assessment is for hazard classification, which follows guidance from *Technical Release 210-60 Earth Dams and Reservoirs* (NRCS, 2019), hereafter TR 210-60. TR 210-60 allows water surface elevation of the reservoir to be at dam crest or peak stage resulting from PMF; the assumption made in Appendix D-1 is at dam crest (1100.8), which caused peak breach flow of 110,000 cfs. The no action breach is described in D-3, which is associated with rainfall depth of 14.5 inches (1,844-year frequency), peak reservoir water surface elevation of 1095.7 and peak breach flow of 96,100 cfs.

The hazard classification downstream water surface profiles for the breach were developed using the hydraulic model described in Appendix D-1: Existing Conditions Assessment Report. The inundation produced from the simulated breach based on TR 210-60 criteria is shown through the breach zone in Appendix C, Figure C-6: Breach Larimore Dam Breach Inundation - Overall. Figure C-7 through Figure C-10 show more detailed views of the inundation mapping along with structures affected and roads overtopped throughout the breach zone. All residential structures impacted by the dam breach are summarized and labeled in the breach inundation figures in Appendix C. The maximum inundation depth of the structure, maximum velocity of flow at the structure location, and the amount of time it would take for the breach discharge to reach the structure are also listed in the maps within Appendix C (Figure C-6 through Figure C-10).

Title 210, National Engineering Manual, Part 520 Subpart C “Dams” (NRCS, 2017) describes the hazard potential resulting from failure of dams. According to this guidance, a high-hazard potential is “Dams where failure may cause loss of life or serious damage to homes, industrial or commercial buildings, important public utilities, main highways, or railroads.” The potential for loss of life was determined using guidance in *Downstream Hazard Classification Guidelines* (U.S. Bureau of Reclamation, 1988). Depth and flood velocity flood danger level relationships were used to which structures have a high danger potential during a breach at Larimore Dam. The analysis showed that fifteen structures and eighteen roads would fall under the high danger potential category during a breach of Larimore Dam. Therefore, Larimore Dam is classified as a high-hazard dam. Additional

information on the breach analysis and hazard classification at Larimore Dam is available in Appendix D-1: Existing Conditions Assessment Report.

1.4.4 Sediment Accumulation

Cumulative sediment volume in the reservoir upstream of Larimore Dam was estimated based on multibeam echosounder and Real-time Kinematic GPS rover data that were collected in the summer of 2020. The estimated volume of sediment that accumulated in the reservoir since the construction of the dam is 186 acre-feet. The resultant sediment deposition can be seen in Appendix D-7: Accumulated Sediment Report and, more specifically, on Figure 5. The sedimentation upstream of Larimore Dam shows a relatively uniform distribution of sediment across the reservoir, with higher thickness in delta where river meets reservoir. This is likely due to the predominance of fine-grained sediments that are transported through the South Branch Turtle River. The calculated sedimentation rate for the combined reservoir upstream of Larimore Dams is 4.5 acre feet per year, or 0.07 acre-feet per year per square mile of total drainage area. The sedimentation rate that was predicted in the original watershed work plan for the Upper Turtle River Watershed was 0.08 acre-feet per year per square mile of total drainage area. Additional information on methods used to obtain sediment accumulation volume and how sediment accumulation has impacted water storage is available in Appendix D-7: Accumulated Sediment Report.

Design considerations to account for future sediment accumulation in the rehabilitation plan are discussed in Appendix D-4, Section 2.2.3. Current sedimentation trends near the low-level outlet induced only ~1 foot of deposition, leaving the low-level outlet ~14 feet above current sediment level. Therefore, a decision was made to set the elevation of the low-level drawdown near the elevation of the existing drawdown conduit at the dam, which is at 1045.7 feet (NAVD88). This elevation would accommodate similar sedimentation trends and the predicted sediment accumulation over the planned 102-year lifespan.

1.4.5 Embankment and Geotechnical Evaluation

Criteria within *Technical Release 210-60 Earth Dams and Reservoirs* (NRCS, 2019) were used to evaluate the slope stability and seepage at Larimore Dam. The results for the existing condition of Larimore Dam (Appendix D-2: Geotechnical Engineering Report) show the embankment is adequate in all of the required slope stability analyses conditions; rapid drawdown (upstream,), steady state seepage (downstream), and surcharge conditions (downstream). The geotechnical evaluation also reviewed the as-built drawings for the drain fill gradation used for the foundation drain constructed with the dam does not meet state of practice standards. The existing foundation drain fill was found to be too coarse for the existing foundation soils. Additionally, the correspondence concerning the original dam construction indicate the lean clay soils encountered during the original geotechnical exploration were assumed not to pipe. Initial soils tests indicate that the embankment and foundation soils are potentially dispersive and therefore have the potential to pipe and internally erode.

1.4.6 Consequences of Dam Failure

The hazard classification of Larimore Dam was confirmed based on results of the breach routing described in Section 1.4.3. Due to the high flood depth and flow velocity at fifteen structures and eighteen roads, the dam is classified as a high-hazard dam; see documentation in Appendix D-1. Assuming 3 lives people per structure, 2 lives per local road and 8 people per Federal Highway based on NRCS Population at Risk computation procedures, the resulting is 87 lives at risk. In addition to the potential for loss of 87 lives due to hazardous flood conditions at 15 homes, 17 local roads, and 1 federal highway, damage to an additional 18 homes, 61 agricultural properties, 27 grain storage bins, 9.7 miles of roadway, 27 bridges, and 55,580 acres of cropland would occur. Many of the structures that would be affected by dam failure contain equipment used for agricultural purposes. Many of the structures affected by inundation, and the contents within them would need to be replaced or repaired in a dam failure scenario. Twenty Cultural resource sites, 8 of which are eligible for the NRHP downstream. Sites include the Turtle River State Park CCC stone and wood structures would be damaged in the breach event.

The volume of material eroded from the assumed initial breach of the auxiliary is approximately 560,000 cubic yards and would be transported downstream during the breach event. The flood wave would stay within the Turtle River valley through the Air Force Base. At 21st Ave NE, the flood wave would break out of the Turtle River and travel overland through agricultural fields beyond 1-mile buffer from the main channel. This overland flooding of cropland would result in additional floodplain erosion, totaling approximately 423,200 cubic yards of erosion, reducing or eliminating crop yields depending on the depth of topsoil loss. A portion of the combined 1.1 million cubic yards of erosion occurring from the initial breach and downstream would be deposited within the downstream breach zone, requiring a significant clean-up effort to remove the deposited sediments from roadway crossings, conveyance channels, and cropland. The flood wave from the breach would cause loss of mature trees on 325 acres of riparian forest downstream of the dam. An estimated 1,004 acres of wetlands would be lost to scour and sediment deposition downstream of the dam and 32 acres would be lost to altered hydrology upstream of the dam. Sediment deposition would occur over 3,284 acres of cropland and 1,480 acres of natural areas. Crop impacts caused by erosion, flooding, and the resultant cleanup costs are estimated at approximately $12.6 million just in the year of the initial breach.

In future years following the breach event, multiple channels would headcut west through accumulated reservoir sediments, transporting an additional 198,600 cubic yards of sediment downstream. The 1.3 million cubic yards of newly mobilized sediment would result in a highly unstable river channel and negatively impact agricultural drainage systems downstream. EPA surface water quality aquatic life standards would be exceeded for cadmium and zinc; regional standards are exceeded for nitrogen and phosphorus. Water flowing downstream for years after the breach will pose risks to human health and aquatic species. Deposition of sediment bound contaminants on cropland could impact production and/or food safety. Risk of contamination of a drinking water aquifer would exist.

2 Purpose and Need for Action

2.1 Purpose and Need

The purpose of this project is to rehabilitate Upper Turtle River Dam No. 9 (Larimore Dam) to eliminate the threat the dam, in its current condition, poses to human lives, infrastructure, cropland, and natural resources downstream. Larimore Dam delivers important flood prevention and recreation benefits to the watershed, which were the originally authorized purposes of the watershed dam.

The need for the project is that Larimore Dam does not meet current State of North Dakota dam safety standards regarding embankment design and earthen spillway stability requirements. As a result, 82 human lives, 32 residential structures, 62 agricultural properties, 27 grain storage bins, 17 bridges, 9.7 miles of roadway, 20 historic structures, and 7,714 acres of cropland are currently at risk due to a breach of the dam. The normal pool also provides recreation opportunities, consisting primarily of camping, recreating, boating, fishing, hiking, and sport activities.

2.2 Watershed and Resource Opportunities

The following opportunities could be recognized by implementing one or more of the alternatives outlined in this watershed plan.

- Comply with dam performance, design, and public safety criteria established by NRCS and the North Dakota Department of Water Resources (ND DWR).
- Minimize the potential for loss of life and property associated with the failure of Larimore Dam.
- Continue providing flood damage reduction benefits for downstream cropland, infrastructure, homesteads, and other buildings.
- Maintain existing recreation amenities.
- Maintain existing fish and migratory bird habitat.
- Maintain existing water quality benefits.
- Maintain existing wetlands.
- Maintain existing cultural resources downstream of the dam.
- Restore a free-flowing river through the current dam.
- Restore natural riparian floodplain through the existing permanent pool of the dam.
- Restore natural sediment transport.

3 Scope of the Environmental Assessment

3.1 Scoping Process

Systematic scoping was used to identify problems, issues, concerns, and opportunities within the watershed and to rate their significance. Stakeholders were invited to participate (see Section 7 and Appendix A) in the process and the project was described during public meetings. The public, watershed stakeholders, and interagency team were engaged to initially determine resources of concern within the study area. Outreach

continued throughout the planning effort to ensure that reasonable alternatives were developed.

3.2 Identified Ecosystem Services and Resource Concerns

Methods and geographic limits for these evaluations are described in Sections 4 and 1.3**.** There are two types of resource concerns included in this assessment: a) ecosystem services and b) National Environmental Policy Act (NEPA) resource concerns identified through scoping. **Error! Reference source not found.** Tables 3-1 and 3-2 show an inventory of ecosystem services and NEPA resource concerns identified through scoping to be relevant to the alternatives evaluated under this plan.

Table 3-1 Scoping Table Ecosystem Services

Ecosystem Service	Relevant?	Rationale
PROVISIONING SERVICES - tangible goods provided for direct human use and consumption		
Food	yes	Reservoir provides consumptive use opportunities for fish and waterfowl, a water source for livestock, and reduced flood damages for downstream crops.
Fresh Water	yes	Dam provides deepwater habitat and associated lacustrine fringe wetlands. Reservoir provides local recreation opportunities.
Fuel	no	Not applicable to this project.
Fiber	no	Not applicable to this project.
Aggregates	no	A few gravel pits are present in U-AA and D-AA, however the dam is not providing protection to their operation.
REGULATING SERVICES - maintain a world in which human life is possible		
Climate Stabilization	no	Not applicable to this project.
Flood and Disease Control	yes	Dam provides flood prevention for downstream human lives, occupied and unoccupied structures, infrastructure, and cropland. Reservoir has experienced harmful algal blooms.
Erosion Regulation	yes	Flood attenuation reduces downstream floodplain erosion and deposition on cropland, wetlands, and riparian habitat.
Water Supply	no	Not applicable to this project.
Crop Pollination	no	Not applicable to this project.
Salinity Regulation	no	Not applicable to this project.
Emissions and Pest Control	yes	The reservoir emits methane, and both captures carbon and releases carbon dioxide. Impacts of the dam on downstream riparian forests has an influence on pest control.
CULTURAL SERVICES - making the world a place in which people want to live		
Cultural Diversity and Heritage	yes	Dam protects 20 downstream cultural sites from flood damage. The dam itself has historic architectural value.
Recreation and Ecotourism	yes	The reservoir provides opportunities for camping, recreating, boating, fishing, and athletic facilities.
Spiritual and Religious Value	no	Not applicable to this project.
Aesthetic Value (Visual Resources)	yes	The reservoir provides scenic beauty and visual diversity in the landscape.
Inspiration Value	no	Not applicable to this project.

Ecosystem Service	Relevant?	Rationale
Social Relations / Sense of Place	no	Not applicable to this project.
Knowledge Systems	no	Not applicable to this project.
Species Existence Value	no	Not applicable to this project.
Tribal value	no	Not applicable to this project.
SUPPORTING SERVICES – underlying processes maintaining conditions for life on Earth		
Soil Formation and Retention	yes	Dam interrupts sediment transport to the river downstream and also results in reduced erosion on cropland within the downstream floodplain.
Primary Production / Photosynthesis	No	While present, does not occur at a scale that would be significant as an ecosystem service.
Nutrient Cycling	yes	Nutrient cycling occurs within the reservoir and the dam impacts downstream nutrient cycling.
Water Recycling	no	Not applicable to this project.
Production of Atmospheric Oxygen	no	Not applicable to this project.
Provisioning of Habitat	yes	Reservoir supports lake fish, waterfowl, and migration corridors. Dam regulates water supply to downstream habitats.

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Table 3-2 Scoping Table - NEPA Resource Concerns

Resource	Relevant?	Rationale
LAND COVER AND LAND USE		
Land Use	yes	Presence of the dam influences land use.
SURFACE GEOLOGY AND SOIL RESOURCES		
Surface Geology	yes	Late Wisconsin glacial till mantled by glacial lake sediments.
Soil Resources, Erosion, and Deposition	yes	Erosion occurs. Reservoir sediments contain nutrients and metals.
Prime Farmland	yes	Prime farmland is present.
WATER RESOURCES		
Groundwater Resources	yes	The wellhead protection area for the city of Larimore is within the AOI. The Emerado Aquifer underlies a small area including the GFAFB and the city of Emerado. The majority of the U-AA is underlain by Elk Valley aquifer.
Surface Water Resources	yes	River, tributary, lake, and wetland resources are present
Jurisdictional Waters of the US (Clean Water Act)	yes	River, tributary, lake, and wetland resources that fall under CWA jurisdiction are present
Water Quality	yes	Turtle River downstream of Larimore on the ND DEQ 303d list of impaired water; Nutrient TMDL for Larimore Dam completed September 2009. Reservoir is eutrophic with impairment due to nutrient/eutrophication/biological indicators
Water Management	yes	The dam currently regulates peak flows downstream. Legal drains and private drainage infrastructure downstream were designed with consideration of the existing flood retention.

Resource	Relevant?	Rationale
Floodplain Management (FEMA)	yes	No FEMA detailed studies present within any AOI
Regional and International Water Resource Plans	yes	Dam has an influence on the Boundary Waters Treaty, International Joint Council adopted resolution of phosphorus and nitrogen concentration objectives at the international border crossing of the Red River and Red River Basin Commission goal of 20% peak flow reduction.
Sole Source Aquifers	no	None present
Wild and Scenic Rivers	no	No Wild and Scenic Rivers, no Nationwide Rivers Inventory segments
AIR QUALITY		
Air Quality – Dust and Emissions	yes	No permanent air polluting infrastructure but potential for temporary effects during construction.
BIOTIC COMMUNITIES		
Plants, Communities, and Habitat Quality	yes	River, tributary, lake, wetland, forest, grassland resources present, several species of state conservation concern could exist and be impacted by some alternatives. Significant Ecological Communities have been identified as present.
Riparian Woodlands	yes	Riparian woodlands are present.
Coral Reefs	no	None present
Designated Natural Areas	no	No specifically designated areas present
Ecologically Critical Areas	yes	NDGF Habitat Focus Areas are present. ND Park and Recreation significant ecological communities are present.
Essential Fish Habitat	no	None present
Parklands	yes	Larimore Recreational Area and Turtle River State Park are present.
Scientific Resources	no	No specifically designated areas present
Mammals, Amphibians, Reptiles, Invertebrates	yes	Species present, several species of state conservation concern possible.
Fish	yes	Fish present, several species of state conservation concern possible in the South Branch Turtle River and Turtle River
Birds, Migratory Birds, Eagles	yes	Eagles and migratory birds of conservation concern possible. Potential impacts from all alternatives
Federal Threatened and Endangered Species	yes	No designated critical habitat, two federally listed species possible. Potential impact from all alternatives
Undesirable Species (including Invasive Species)	yes	State and county listed noxious/invasive species are present, prevalence of introduced species
HUMAN ENVIRONMENT		
Cultural Resources, Historic Properties	yes	Historic properties present.
Public Health and Safety	yes	Public health and safety are currently jeopardized by the dam
Transportation and Infrastructure	yes	Downstream roads, bridges, and drainage infrastructure are currently protected from damage by the dam but also at risk from a dam breach
Recreation Resources	yes	The dam reservoir currently provides limited and highly desired opportunities for camping and open water recreational activities
Visual Resources (Scenic Beauty)	yes	No designated scenic sites, but scenic beauty relevant. Potential impacts from some alternatives

Resource	Relevant?	Rationale
Local and Regional Economy	yes	Dam provides benefits to the economy through reduced flood damages downstream
Environmental Justice, Civil Rights	yes	Potential presence of minority populations, low-income populations, or Tribes in the planning area
Noise	yes	No permanent effects anticipated. Temporary noise during construction project

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4 Affected Environment

Evaluation of the plan alternatives was done using methods described in Department Manual (DM) 9500-013, Guidance for Conducting Analyses Under the Principles, Requirements, and Guidelines for Water and Land Related Resources Implementation Studies and Federal Water Resource Investments (PR&G) completed in 2017 (U.S. Department of Agriculture). The requirements of the PR&G include evaluation of the ecosystem services and environmental resources as appropriate. The following sections describe the existing environment of the project area, including ecological, physical, biological, economic, and social services found to be relevant in Table 4-1. These form the baseline from which plan alternatives are compared to in Section 6 of this planning document.

4.1 Ecosystem Services

Ecosystem services are defined as simply the benefits (goods and services) people obtain from ecosystems. As a framework to understand and identify ecosystem services, they are categorized into four groups, each with subcategories of services (Millenium Ecosystem Assessment, 2005):

- Provisioning services are tangible goods provided for direct human use and consumption, such as food, fiber, water, timber, or biomass.
- Regulating services maintain a world in which it is possible for people to live, providing critical benefits that buffer against environmental catastrophe—examples include flood and disease control, water filtration, climate stabilization, and crop pollination.
- Cultural services make the world a place in which people want to live—examples include recreational uses, spiritual uses, aesthetic viewsheds, and a role in tribal values.
- Supporting services refer to the underlying processes maintaining conditions for life on Earth, including nutrient cycling, soil formation, and primary production.

PR&G evaluations must evaluate alternatives by the merits of their ecosystem service tradeoffs; ecosystem services related to impacted resource areas must be identified and quantified using appropriate metrics relevant to the benefits which they provide to society (DM 9500-013-8.b.2). A few of these services are quantifiable and can be assessed at a dollar amount, but most are not possible to monetize at this time.

4.1.1 Provisioning Services

4.1.1.1 Food

The reservoir supports populations of fish and waterfowl that are direct provisions (food sources) for humans. As summarized in Appendix D-10 Biological Inventory, consumable fish include yellow perch, walleye, northern pike, and black crappie. Consumable waterfowl consist of Canada geese, wood duck, green-winged teal, mallard, blue-winged teal, gadwall, and American wigeon. Flood attenuation protects cropland by preventing losses from delayed plant or extended inundation. Crops grown in the watershed are predominately corn, soybeans, and spring wheat. Other crops grown in lesser amounts are dry beans, sugar beets, barley, and sunflowers.

4.1.1.2 Fresh Water

The dam provides reduced flooding in the downstream watershed, which directly protects several wellheads in the D-AA. Wellheads are common in the Elk Valley Aquifer which extends into both the Upstream area and D-AA, as well as almost fully underlying the U-AA. The Elk Valley Aquifer is an important source of drinking water for the city of Larimore and for the Grand Forks-Trail and Tri-County Rural Water Districts. The municipal wells in the city of Larimore are included in a Wellhead Protection Area Plan. Two wells are within the U-AA – both are irrigation wells. Irrigation wells are by far the most common type of well and make up the largest percent of permitted water use, however other well types are present in the larger watershed of the D-AA, including an industrial well, several stock wells, a production well, another municipal well and 2 domestic wells. The location of the wellheads within flood and dam breach inundations can be seen on Figure C-29 in Appendix C.

4.1.2 Regulating Services

4.1.2.1 Flood and Disease Control

The dam provides flood damage reduction benefits, for events up to the 1,844-yr flood. The largest modeled flood without breach is 500-year event, which inundates 40,330 acres of cropland, 61 residences, 118 agricultural properties, 38 grain storage bins, 67 commercial, three industrial, and one government building. Approximately 3,011 acres of riparian forest in the D-AA currently provide flow regulation due to the capacity of the vegetation to retain water and release it slowly (Riis, 2020).

4.1.2.2 Erosion Regulation

The dam attenuates flood flows and reduces downstream flood extents, frequencies, depths, and duration. As a result, 758 acres of crop land is protected from inundation and not susceptible to sheet and rill, as well as gully erosion as the flood waters recede during the 25-year event. As determined from a bathymetric survey documented in Appendix D-7: Accumulated Sediment, the dam has served to capture 4.5 ac-ft per year of sediment (submerged, consolidated volume) over its lifespan. Clear water conditions below dams often generate channel incision and/or riverbank erosion, which has occurred to a minor extent downstream of Larimore Dam. Geomorphic assessment of the downstream channel, documented in Appendix D-8: Stream Classification and Riparian Area Assessment, indicates incision and bank erosion, although to a limited degree due to the

relatively intact riparian zone forest along the majority of adjacent stream banks. The existing riparian forest stabilizes the streambank and provides erosion control.

4.1.2.3 Emissions and Pest Control

The role of reservoirs in emissions regulation is mixed and difficult to quantify. The pool is storing carbon in the sediments but also releasing carbon dioxide in the summer months from algae. Reservoirs are a significant source of methane, particularly during their initial years of establishment as labile organic matter is rapidly degraded by microbial breakdown. Over time reservoir methane emissions decline to a steady rate. The EPA (2022) rate for reservoirs over 20 years old in cool temperate (0.05 MMT/ha/yr) indicates that the Larimore reservoir generates approximately 1.34 metric tons per year of methane currently.

The role of the reservoir for pest control is not likely to provide value as native control agents are equally likely to find water sources in the stream. The existing ~5215 acres of riparian forest in the D-AA provide multiple ecosystem regulation benefits including sequestering carbon which helps regulate emissions. Riparian forests also provide a high degree of pest control regulation as forests are suitable for native pest control agents (Riis, 2020).

4.1.3 Cultural Services

4.1.3.1 Cultural Diversity and Heritage

See section 4.2.6.1 for a complete discussion of cultural resources. In the U-AA, Larimore Dam was determined to not be eligible for the NRHP but was listed as an architectural site with the ND State Historic Preservation Office. A Class III survey was completed by NRCS on 7/30/2025. A culturally significant site was found within the U-AA and indicates the area may have been an encampment – artifacts may lie below the plow zone. Other sites within a 1-mile radius of the U-AA include culturally significant burial mound sites. No sites in the D-AA have been listed in the NRHP, however there are 20 culturally significant sites including 15 wood and stone structures constructed by the Civilian Conservation Corp in the Turtle River State Park.

4.1.3.2 Recreation and Ecotourism

The population (2024 Census estimate) within the project area is approximately 8,000 individuals. The demographics within the U-AA and D-AA include the communities of Larimore, Mekinock, Arvilla, Manvel, Ardoch and the Grand Forks Air Force Base. The project area is adjacent to the large community of Grand Forks, ND (population 59,845) and is nearby or adjacent to other small cities including Petersburg, Gilby, Johnstown, Emerado, and Niagara. The reservoir provides recreation opportunities generally not common in the area, consisting of camping, swimming, water recreating, fishing, and boating. The dam and reservoir are part of the Larimore Dam Recreation Area. Amenities include a campground, boat ramp, fishing pier, picnic areas, swimming beach, and arboretum (Appendix D-5: Economics Evaluation Report). The campground has 144 camp sites, including water and electrical hookups, plus comfort stations with showers and flush toilets. Other facilities include softball diamond, horseshoe pits, volleyball nets, frisbee golf, playgrounds, and hiking trails, both paved and rustic. The Myra Arboretum has 500 varieties of trees and shrubs. Fishing is a popular activity here, and the lake is

stocked annually by the NDGFD. Ice fishing occurs during the winter that creates a village of ice houses. Alternate fishing opportunities exist at four other locations in the area (within 16 miles). However, other fishing waters have limited sport fish species, stocking frequency, and deep-water habitat, compared to Larimore Dam. The Larimore Dam flood pool is closed to hunting. Larimore Dam has an annual recreation value of $487,849 (2024 dollars). Adjacent to the recreation area is the Larimore Golf Course.

Recreation in the U-AA includes a public swimming pool and public parks in the city of Larimore and a motorcross track ½ mile north of Larimore. The D-AA includes large blocks of land open to public hunting, fishing and birdwatching within the USFWS Kellys Slough Wildlife Refuge and several USFWS Waterfowl Production Areas (WPAs). The city of Manvel has a golf course and the other smaller communities typically offer playgrounds and picnicking at city parks. The Turtle River State Park provides many recreational services including fishing, camping and picnicking.

4.1.3.3 Aesthetic Value (Visual Resources)

The scenic beauty or aesthetic nature of a viewshed includes the existing natural and built features visible to a viewer. Some features that elicit viewers' positive perceived value can include historic properties; cultural resources, traditional cultural places, and cultural landscapes; areas of scenic beauty, scenic overlooks, and highways; wilderness areas, parks, and national forests; wild and scenic rivers, recreational, or nationwide inventory rivers; and pastoral landscapes. Changes to these viewsheds can be perceived as a negative impact on the landscape. The U-AA is located within a rural, agricultural setting, but the view of the lake and the gentle valley below the dam provide some relief to the flat landscape and a surprise as the viewer descends into the valley. There are no designated scenic byways or scenic waterways within the study area. In the D-AA, the Kelly's Slough USFWS refuge and WPA's provide large viewsheds of undisturbed wetlands and prairie landscapes.

4.1.4 Supporting Services

4.1.4.1 Soil Formation and Retention

The dam provides flood attenuation that protects against downstream cropland soil loss due to sheet and rill as well as gully erosion but also is a barrier to soil deposition downstream during flood events within historically inundated wetlands and riparian woodlands. The large expanses of grass habitat in the D-AA provide significant soil retention.

4.1.4.2 Nutrient Cycling

The reservoir has disrupted the sediment flux to the river system. As documented in Appendix D-7, 186 acre-ft of sediment accumulation. Assuming grain size is clay-silt mixture with equal parts submerged and aerated sediment, the volume weight is estimated to be 65 lb/ft^3.(NRCS, 2024). Therefore, the weight of sediment accumulation is 263,320 tons. Assuming the average of pool and inlet analyte concentration from Appendix D-7 Table 6, 2.7 tons of phosphorus, 261 tons of nitrogen, and 4,358 tons of organic carbon are stored in the accumulated reservoir sediments. Internal nutrient cycling in reservoirs occurs within the water column, sediment, suspended particles, and

water-air and sediment-air interfaces. Nutrient cycling closely relates to biological (i.e. bacterial and algal communities within the reservoir) and/or physiochemical processes. The existing 5215 acres of riparian forest in the D-AA removes some of the nitrogen and phosphorus attached to sediments from the agricultural runoff (Binder, et al., 2017).

4.1.4.3 Provisioning of Habitat

The reservoir provides habitat for animals that are vulnerable to environmental impairments, including habitat fragmentation, global change (significant and cumulative alteration of land use by humans), and emission induced changes. The reservoir habitat supports lake fish species, waterfowl, and migration corridors. Flood attenuation impairs the downstream floodplain by limiting inundation and sediment transport to riparian areas closer to the river. The existing 5,215 acres of riparian forest in the D-AA supports by maintaining nursery populations and habitats for species of mammals, birds and insects. This habitat may include or be suitable for NDGF Species of Concern or Federally Endangered Species such the Northern Long Eared Bat (NLEB). In the D-AA, the Kelly's Slough USFWS refuge and WPA's serves as important migration stopovers and staging areas for snowbirds and waterfowl in an area where there are few options for waterbirds (USFWS, 2025). There are also large tracts of lands in the CRP program which provides habitat for a wide variety of birds and mammals. The ND Game and Fish Department considers these areas as key habitat for Greater Prairie Chickens (Tympanuchus cupido), a Level II species of concern. Detailed information on biotic communities is provided in Section 4.2.5.

4.2 NEPA Resource Concerns

Evaluation of the plan alternatives was done under the National Environmental Policy Act as required by the NRCS National Watershed Planning Manual (NRCS, 2014) and the NRCS National Environmental Compliance Handbook. The following sections describe the existing environment of the project area, including ecological, physical, biological, economic, and social aspects in regard to the NEPA Resource Concerns found to be relevant in Table 3-2. These form the baseline from which plan alternatives are compared to in Section 6 of this planning document.

4.2.1 Land Use

Land use in the drainage area upstream of the dam (43,206 acres including the U-AA) consists of 68% cropland, 18.5% grass/hayland, 8.5% Natural areas and 5% developed areas. Land use in the U-AA (745 acres) consists of 25% cropland, 27% grass/hayland, 46% Natural areas (including 71.8 acres of open water largely from the reservoir), and 2% developed areas. The Grand Forks Water Resource District stated there are no cattle grazing in or directly adjacent to the reservoir. In the D-AA (191,300 acres) land use consists of 58.5% cropland, 29.5% grass/hayland, 6.3% Natural areas and 5.7% developed areas. Cropping is limited in the D-AA due to the high-water table and high saline content of the groundwater. A significant portion of the D-AA grassland area is enrolled in the Conservation Reserve Program. This area also includes Kelly's Slough National Wildlife Refuge (1,207 acres).

4.2.2 Surface Geology and Soil Resources

4.2.2.1 Surface Geology

The surface geology at the dam site is made up of 30 feet of glacial till underlain by harder pre-consolidated glacial till. Bedrock was not encountered at the site during the investigation, but previous nearby investigations suggest that bedrock underlies the site at an approximate depth between 250 and 300 below ground surface (Appendix D-2 Geotechnical Engineering Report). Within the U-AA, the surface material is alluvial between floodplain valley terraces. The Upstream watershed drainage area begins in the west with surface geology formed by the ground moraine consisting of chiefly glacial till. The geology abruptly changes at the western edge of the former glacial Lake Agassiz. Here, the shallow proglacial lake that existed in front of the glacial ice deposited lake sediments. In the D-AA, the geologic deposits are alluvial within Turtle River belt width. The river cuts through Lake Agassiz beach lines with sand and gravel outwash geology. Finally, the river enters the Lake Plain geology consisting of interlaminated clays and silts.

4.2.2.2 Soil Resources, Erosion, and Deposition

The soils in the watershed upstream of Larimore Dam are generally characterized as having moderate to severe limitations for cropping suitability (USDA NRCS, 2025) (Web Soil Survey (WSS) Land Capability Class). Erosion is the greatest cropping limitation (WSS Land Capability Subclass). With the exception of some areas of steeper slopes, these soils have very low potential for water erosion. (Appendix D-6 Environmental Evaluation). The dominant soils in the upper portion of upstream watershed are dominated by fine-loamy till formed by ground moraines on glacial till plains. Moving east, the Upper Turtle River crosses into the interbeach area where parent material changes to loamy glaciolacustrine deposits. Both the river channel sections upstream and downstream of the dam are stable with a slight tendency toward being vertically incised and channel enlargement (Appendix D-8 Stream Classification and Riparian Area Assessment). Wave action and recreation activities directly and indirectly increase the incidence of erosion in the U-AA. Soils in the U-AA are dominated by sandy loams with severe cropping limitations due to the high erodibility of the sandy loam soils. The parent material consists of course-loamy alluvium. Also significant in the U-AA, are frequently flooded silty clay loams formed in fine-silty alluvium.

Sediment accumulation in the reservoir is discussed in Section 1.4.4 and Appendix D-7 Accumulated Sediment. Sediments contain carbon, nutrients (nitrogen and phosphorus), and metals. Generally, concentrations are higher in the pool sediment, compared to inlet sediment. None of the analyte concentrations exceeded the USEPA thresholds (Ingersoll, MacDonald et al., 2000).

Soils in the D-AA vary as the Turtle River descends through the interbeach soils into the lacustrine soils of the bottom of glacial Lake Agassiz. The river crosses through soils formed on beaches of the lake plain which have loamy alluvium over sandy and gravelly glaciofluvial parent materials. The D-AA is dominated by saline affected soils formed on the lake plains. Further east, the saline lense subsides, greatly improving the cropability of the soil. Cropping potential is greatly limited by the salinity in the D-AA (Web Soil Survey (WSS) Land Capability Class).

4.2.2.3 Prime Farmland

Protection for important farmland is established in the Farmland Protection Policy Act (FPPA), US Department of Agriculture regulations implementing the FPPA (7 CFR Part 658), and USDA DR No. 9500-3, Land Use Policy. Federal agencies are to consider actions impacting farmland and assure that federal programs, to the extent practicable, are compatible with state, local government, and private programs.

The U-AA has a large proportion of land area rated as “not prime farmland” (79%) with the rest being rated as “all areas prime farmland” (12.1%) and “prime farmland if drained” (9%) (USDA NRCS, 2025). The Upstream watershed drainage area has mixed designations of soils designated as prime farmland, soils of statewide importance and not prime in MLRA 55A where the glacial till soils vary greatly. The lower portion of the upstream watershed in MLRA 56, soils are primarily designated as prime farmland. Just below the dam, areas of prime farmland are common throughout the interbeach area and in the far eastern area closest to the Red River. The largest portion of the D-AA (over 60%) is designated as Not Prime Farmland due to the high salinity of the soil.

4.2.3 Water Resources

4.2.3.1 Groundwater Resources

There are no Wellhead Protection areas within the U-AA or D-AA. The U-AA and D-AA are within the Elk Valley Aquifer extents. The Elk Valley Aquifer is unconfined surficial with area of 178.9 mi^2. Depth to water ranges from 0.5 to 50 feet. Maximum thickness is 61 feet and average is 34 feet. The city of Larimore, Grand Forks-Traill Water District, Tri-County Water District rural water systems, irrigation wells, and a few domestic wells draw water from the aquifer. In 2019, 2.9 billion gallons of permitted water was drawn from the aquifer. There are no wellheads within the U-AA or D-AA located within the aquifer extents. There are three wellheads within the no action breach extents and one wellhead within the current 500-year floodplain, excluding plugged or test wells, downstream of the Elk Valley Aquifer within the D-AA, see Figure C-29. The three wellheads within no action breach extents are production, irrigation, and stock wells. The one wellhead within 500-year floodplain is stock well.

4.2.3.2 Surface Water Resources

Aquatic resources in the area consist of wetlands, open water (lakes), and a network of rivers. There are no Wild and Scenic Rivers and there are no Nationwide Rivers Inventory segments within the AOI watershed (US Department of Interior, 2022).

The aquatic resources within the U-AA were surveyed in 2021 and documented in Appendix D-9 (Aquatic Resource Delineation and Fen Search Report, 2021), and NRCS Addendum to Aquatic Resource Delineation and Fen Report, 2024). These are categorized as wetland and potential Other Waters (OW). The four wetland classes identified include mineral soil flat, riverine, lacustrine fringe, and depressional. There are 76 wetland areas, totaling 161.66 acres, of which 129.08 acres are considered naturally present on the landscape and of which 32.58 acres are identified as artificial wetlands formed from construction of the dam and reservoir. There are 32 acres of artificial wetlands in the U-AA which could be affected by plan alternatives, including 3.83 acres depressional and 28.17 acres of lacustrine fringe class wetlands. Therefore, these were

the focus of existing condition functional assessments. Natural wetlands would not be affected by plan alternatives due to their independent hydrology from the reservoir and topography.

Executive Order 11990 requires all federal agencies to avoid, to the extent possible, short- or long-term adverse impacts to wetlands through avoidance, minimizing impacts, or mitigation. EO 11990 applies to both natural and artificially formed wetlands. An evaluation of existing wetland functions was completed via the NRCS Hydrogeomorphic Functional Assessment Prairie Pothole (depressional) Model to score and summarize existing wetland functions for depressional. There are no expected losses to mineral soil flat, riverine, and lacustrine fringe wetlands, therefore functions for these wetland classes were not completed. Measurements are completed for multiple variables and result in Functional Capacity Indices (FCI). The FCI is a measure of functional capacity of a wetland compared to reference standard; score of 1.0 is the reference standard and represents pristine condition function, where lower values indicate the wetland is functioning below reference standard. Functional Capacity Units (FCU) are computed from product of each wetland area and FCI and are summarized in Table 4-1 for wetlands within the U-AA, which could be affected by some plan alternatives.

Table 4-1: Wetlands within U-AA Planning Area Lost due to Alternatives

Wetland Classes	Depressional	Lacustrine Fringe	Riverine	Mineral Soil Flat
Area in U-AA (acres)	105.94	28.17	27.54	0.01
Potentially Affected Area in U-AA by Alternatives (acres)	3.83	28.17	0	0
Function	**FCU**	**FCU**	**FCU**	**FCU**
Static	0.85	17.25	-	-
Dynamic	0.00	0.00	-	-
Cycling	2.44	21.91	-	-
Removal	0.35	20.23	-	-
Retention	2.25	20.83	-	-
Plants	1.64	21.13	-	-
Structure	1.75	17.77	-	-
Habitat	0.68	6.80	-	-
Shoreline Integrity	-	9.10	-	-

There is no HGM calculator available for the Potential Other Waters that could be impacted by plan alternatives. Potential Other Waters include deepwater (50.31 acres), and reaches of the South Branch Turtle River (28.51). The riverine areas OW-4, OW-5, and OW-6 have very little influence from the dam and reservoir; while OW-2, OW-7, and OW-9 are still riverine but heavily influenced by dam and reservoir. Potential Other Waters functions align similarly to wetland functions, notably river alignments to riverine HGM functions, and lacustrine areas to depressional HGM functions. However, Other Waters provide variations and additional social and ecological values. Similarities include water storage, nutrient retention and removal, vegetation, soils, and habitat. Additional

functions for deepwater habitats include unique habitats for larger fish, migrating birds, microscopic plants and animals, and recreation benefits for humans. Additional functions for riverine areas include moving water which connect varying ecologic settings, including wetland and deepwater habitats.

The D-AA has 15,486 acres of wetlands, as determined from NWI data. The South Branch Turtle River extending from Larimore Dam to the confluence with North Branch Turtle River, the start of main stem Turtle River, is 0.6 miles. The main stem Turtle River to outlet at Red River of the North is 77.4 miles. Individual wetlands were not delineated in the D-AA, however it can be assumed that wetlands have similar characteristics to those described in the U-AA and nearby streams. NWI wetland areas include riverine, lacustrine, and palustrine systems; classes include semi-permanent, emergent, temporary, forested, shrub, excavated, and streambed. Therefore, wetlands fit riverine, depressional, and lacustrine fringe wetland classes. Riverine wetlands could be categorized as Potential Other Waters if delineation was completed, but since NWI included only polygons these are listed by area. Wetland functions were estimated using riverine, pothole, and lacustrine fringe HGM models under existing conditions, given that some plan alternatives would result in impacts to downstream wetlands. Since the NWI wetland areas are vast in area, an average condition was assumed to score variables for all classes. For depressional and lacustrine Fringe, the FCI score from U-AA is assumed. For riverine, an FCI score is adopted from a nearby stream with similar conditions. Average conditions for wetlands include significant drainage features within channel, wetlands, and floodplains, upland uses mostly cultivated agricultural areas, sporadic cropping and perennial vegetation within wetlands, and sparse vegetation buffering polygons. Table 4-2 is the summary of approximate area and functions for existing conditions D-AA wetlands based on NWI polygons and types.

Table 4-2 Wetlands in D-AA Planning Area

Affected Area in D-AA by Alternatives		Wetland Classes		
		Riverine	Depressional	Lacustrine Fringe
	Area (acres)	13,015	871	1,600
Wetland Functions (FCU)	Static	-	193	980
	Dynamic	-	0	0
	Cycling	-	554	1,244
	Removal	-	80	1,149
	Retention	-	512	1,183
	Plants	-	373	1,200
	Structure	-	398	1,010
	Habitat	-	155	386
	Shoreline Integrity	-	-	517
	Velocity Reduction Surface Water	7,679	-	-
	Storage & Release Subsurface Water	4,946	-	-
	Removal Imported Elements & Compounds	7,028	-	-
	Retention of Particulates & Organic Materials	7,809	-	-
	Organic Carbon Export	7,158	-	-
	Maintains Plant Community	8,460	-	-
	Maintains Habitat Structure	9,111	-	-
	Habitat Structure & Connectivity Among Wetlands	8,460	-	-

4.2.3.3 Jurisdictional Waters of the US (Clean Water Act)

Water resources are protected to varying degrees under the Clean Water Act and other legislation. When federal funding is used for construction and improvement projects, Executive Order 11990 requires federal agencies to preserve, enhance, or minimize degradation and losses to wetlands regardless of Clean Water Act status. NRCS policy for implementing the executive order can be found at 190-GM, Part 410, Subpart B, Section 410.26. The Clean Water Act Section 404 requires permitting from the US Army Corps of Engineers (USACE) for activities that impact Waters of the US. The NRCS floodplain management policy reviews activities in wetlands that occur within the 50-year floodplain (190-GM Section 510.25). The Red River of the North is a navigable river therefore by definition, the Turtle River and tributaries would be considered Waters of the US and under the jurisdiction of USACE.

Aquatic resources within the U-AA may be jurisdictional, but this determination has not been completed by the USACE. USACE is a cooperating agency on this EA, however,

has limited resources and prefers to make final jurisdictional determinations after final design is complete and a 404-permit submitted, immediately prior to construction. Jurisdictional determinations would only be completed on identified wetlands that would be impacted by proposed alternative. Given Executive Order 11990, NRCS would address any wetland impacts through mitigation regardless of jurisdictional status. Potential Waters of the US include the Turtle River, its tributaries, and the reservoir at Larimore Dam (normal pool 66 acres). Wetlands regulated by the Food Security Act of 1985 (as amended) are not relevant to this project for reasons outlined in 5.1.3. Field aquatic resources delineation was completed within the U-AA and is documented in Appendix D-9 (Aquatic Resource Delineation and Fen Search Report, 2021), and NRCS Addendum to Aquatic Resource Delineation and Fen Report, 2024).

The D-AA has many wetlands and watercourses, as summarized in Section 4.2.3.2 and Appendix D-6: Environmental Resources Memorandum. Given that potential impacts to these wetlands would be indirect, no field delineation was completed; National Wetlands Inventory data was utilized. As with the U-AA, USACE did not choose to complete a jurisdictional determination as a part of this planning process.

4.2.3.4 Water Quality

The Clean Water Act (Section 303(d)) requires states to monitor and evaluate their waters to determine if they meet water quality standards. Waters that do not meet their designated uses due to poor water quality are listed as impaired. The regional aquatic resources are documented in the Integrated Section 305(b) Water Quality Assessment Report and Section 303(d) List of Waters Needing Total Maximum Daily Loads (Larsen et al, 2003), which include the Turtle River, South Branch Turtle River, and Larimore reservoir Several sections of the Turtle River are considered impaired due to designed uses including fish and other aquatic biota, municipal and domestic, and recreation. The South Branch Turtle River is considered impaired due to designated use fish and other aquatic biota. The Larimore reservoir had a nutrient Total Maximum Daily Load (TMDL) study completed in 2009 due to nutrient/eutrophication/biological indicator impairments based on Trophic State Index (TSI) and recreation uses (Hargiss, 2009). Trophic State Index (TSI) values for phosphorus and Secchi disk suggest Larimore Dam is a hypereutrophic, while TSI values for chlorophyll-a indicate the reservoir is eutrophic. A 75 percent nutrient load reduction was established for the entire Larimore Dam watershed in order to lower the phosphorus TSI from 63 to 50. AnnAGNPS modeling show sensitive subwatersheds to target for planning and implementing Best Management Practices (BMP) through a volunteer, incentive-based approach.

The South Branch Turtle River ending at Larimore Dam, including 18.2 miles upstream are listed as impaired and requires further evaluation (Larsen et al, 2003). The river designated uses of fish and other aquatic biota is impaired due to combined biota/habitat bioassessments and Selenium. The Turtle River impairments include combined biota/habitat bioassessments, sedimentation/siltation, Selenium, Arsenic, Chloride, Sulfate, dissolved oxygen, nutrients, and Cadmium. All these reaches are considered low TMDL priority.

One aquifer is located within the U-AA and D-AA and is known as the Elk Valley Aquifer, an unconfined surficial aquifer (Appendix C, Figure C-?). The aquifer has been sampled for water quality six times from 1993 to 2018, which is on a 5-year rotation (North Dakota

Department of Environmental Quality, 2021). Other important findings from North Dakota Department of Environmental Quality Groundwater Monitoring Program Elk Valley Aquifer Fact Sheet relate to water chemistry and pesticides. Water chemistry analytes considered high include Arsenic, Iron, and Manganese. Water hardness is considered "Very Hard". Percentage of wells exceeding Nitrate Maximum Contamination Level (MCL) range, in test years, from about 2-5%. Percentage of wells with detections of each pesticide detected in the aquifer range in test years from 0 to 18%. The total unique wells with pesticide detections since 1993 include 35 of 105. Pesticides listed include Picloram (13 wells), Bentazon (4 wells), Dicamba (3 wells), 2,4-D (1 well), and Metribuzine (1 well). Statewide aquifer monitoring and scoring ranked the Elk Valley Aquifer as "High" in all categories evaluated, including Vulnerability (Pesticide DRASTIC Model), Sensitivity (Agricultural Sales per Farmed Acre), Risk (Aquifer Appropriations per Square Mile), and Total Monitoring Score (Kannenberg et al, 2018).

4.2.3.5 Water Management

Historically, this watershed had extensive natural flood retention capacity with wide distribution of Prairie Pothole wetlands and a large population of beavers that facilitate dynamic water retention. Since the 1800s, humans have drastically altered the landscape and a significant amount of natural flood retention has been lost via beaver trapping, extensive conversion of tall grass prairie to cropland, and widespread wetland drainage. Natural flood retention is still being lost through stream channelization and tile drainage development. After the highly damaging floods that occurred during the 1940s and 1950s, many dams, including Larimore Dam, were constructed in the region during the 1960s and 1970s. These dams replaced much of the natural flood retention, although not the ecological value of interconnected wetlands, prairie, meandering streams, and beaver dam complexes. It is important to note the flood attenuation provided by Larimore Dam is more concentrated than the historically distributed water retention on the landscape, however the dams do serve to restore more natural (lower) peak flows to the downstream river reaches.

Flows within the Upper Turtle River Watershed (at confluence of North Branch and South Branch Turtle Rive) are regulated by eight flood control dams. These dams are located primarily in the upper portions of the Turtle River Watershed, and none are located downstream of Larimore Dam on the South Branch Turtle River or Turtle River. The seven other dams are within a 20-mile radius of Larimore Dam. Dams UTR # 1, 2, 4, and 5 are along tributaries of the North Branch Turtle River. Dams UTR # 6, 7, and 8 are upstream of UTR #9 (Larimore Dam) along tributaries of the South Branch Turtle River. There are two other significant dams in the Turtle River watershed, which are along Freshwater Coulee. Those dams are downstream of Larimore Dam, ~16 miles east; Freshwater Coulee joins the Turtle River near Manvel, ND.

4.2.3.6 Floodplain Management (FEMA)

Floodplain maps and designations are developed by the Federal Emergency Management Agency (FEMA) for the National Flood Insurance Program (NFIP). The current Flood Insurance Rate Map (FIRM,) for Grand Forks County was adopted in 2010 and identifies Special Flood Hazard Areas. Panels which cover Larimore Dam and the downstream watershed include 38035C 0325E, 0350E, 0355E, 0360E, 0365E, 0370E, 0500E, 0525E, 0540E, and 0560E. The mapped extents for Zone A (high risk areas

subject to inundation by the 1% annual-chance flood event) extend throughout the U-AA and D-AA. No detailed modeling and mapping are completed for any of the U-AA or D-AA extents, therefore no Zone AE are designated.

Detailed, calibrated hydrologic and hydraulic modeling was completed for this watershed rehabilitation planning effort as summarized in Appendix D-1, Section 5. The resulting 100-year and 500-year floodplain extents were developed to analyze the economic and environmental impacts of alternatives downstream of Larimore Dam. In addition, detailed mapping was used to provide recommendations on alternatives and was provided to the project Sponsor and cooperating local/state agencies for their use in consideration of future downstream floodplain development. Those maps are available in Appendix C.

4.2.3.7 Regional and International Water Resource Plans

Flooding along the Red River and its tributaries is a prolonged issue for the region and since 1997 severe flooding has occurred more frequently. The Red River Basin Commission recommends acceptable levels of flood risk within the Red River Basin, which would include protection of rural residences for a 100-year flood event and protection of cities for a 200-year flood event (Red River Basin Commission, 2011). The Red River Basin Commission has adopted a strategy to achieve the acceptable levels of flood risk with a goal of a 20% reduction of peak flow in the Red River through construction new flood water retention projects in the US portion of the Basin. The Red River Basin Commission and Red River Retention Authority are strongly in support of dam rehabilitation efforts to ensure that existing flood water retention is preserved into the future.

Water quality is also an important consideration because the Turtle River discharges to the Red River, where nutrient loading is an international concern due to the eutrophication of Lake Winnipeg in Manitoba, the world's tenth largest freshwater lake. While the Red River contributes only 10-15% of runoff water by volume to Lake Winnipeg, it is estimated to contribute 60% of the total phosphorus load. Continual expansion of cyanobacteria populations is linked to increased phosphorus loadings from fertilization and more frequent and intense spring floods in the Red River Basin. The Boundary Waters Treaty of 1909 was signed to prevent and resolve disputes over the use of the waters shared by Canada and the United States and to settle other transboundary issues. The treaty specifies "waters flowing across the boundary shall not be polluted on either side to the injury of health or property on the other." Through the International Joint Commission, in 2020 the government of the United States committed to water quality objectives which include a reduction in annual phosphorus loading at the international border by more than 50% (Water Quality Committee, 2020). Flood control dams in this region provide a critical water quality function in reducing the frequency and duration of cropland inundation, thereby limiting the transport of dissolved phosphorus (which is the dominant form in this watershed) to the Red River.

4.2.4 Air Quality

The National Ambient Air Quality Standards (NAAQS) (40 CFR 50), set by the Environmental Protection Agency (EPA 2023), as directed under the Clean Air Act, define standards for six criteria air pollutants. The North Dakota Department of Environmental Quality (NDDEQ), Division of Air Quality has the responsibility to ensure the ambient air

quality in North Dakota is maintained in accordance with the levels established by the state and federal NAAQS and the Prevention of Significant Deterioration of Air Quality Rules. The EPA developed National Ambient Air Quality Standards (NAAQS) for the criteria pollutants to protect public health and welfare. The EPA recommends establishing the existing environment for air quality and Air Quality Related Values (AQRV's) to obtain a baseline from which alternatives can be judged. An AQRV is a resource identified by the Federal Land Manager (FLM) for one or more federal areas that may be adversely affected by a change in air quality. The resource may include specific scenic, physical, biological, ecological or recreational resources identified by the FLM.

The existing environment includes not only the values for the 6 criteria pollutants (Ozone, Particulate Matter (both 2.5mm and 10 mm), Sulfur Dioxide, Lead, Nitrogen Dioxide and Carbon Monoxide), but also visibility and resources sensitive to deposition (wet deposition for Nitrogen and Sulfur). Several federal agencies conduct air quality monitoring as well as the ND Department of Environmental Equality (NDDEQ).

4.2.4.1 Related Values for Criteria Pollutants

NDDEQ operates and maintains a network of ambient air quality monitoring sites throughout the state; the nearest air quality monitoring station to Larimore Dam is in Fargo North Dakota; however, this station does not record all parameters. Data from other state and federal monitoring sites was utilized to obtain a complete baseline for existing air quality. These other sites included Bismarck, ND; Theodore Roosevelt National Park (north unit) in western ND; Lostwood National Wildlife Refuge in Burke County ND; Hiddenwood National Wildlife Refuge near Ryder ND; Voyagers National Park, MN; Red Lake Nation, MN; and Icelandic State Park, Pembina County ND. Design Values for the six criteria pollutants are summarized in Table 4-3. A design value is a mathematically determined pollutant concentration at a particular site that must be reduced or maintained at or below the National Standard (NAAQS) to assume attainment. There were no monitoring sites where the Design Value exceeded the NAAQS standard. No non-attainment areas were documented (EPA 2022 Design Value Interactive Map epa.gov).

Table 4-3: EPA Design Values for Air Quality Pollutants

Criteria Pollutants	NAAQS Threshold	Fargo, ND	Lostwood NWR, ND	Hiddenwood NWR, ND	Teddy Roosevelt National Park, ND (North Unit)	Bismarck, ND	Voyagers National Park, MN	Red Lake Nation, MN
Ozone (8-hr) ppm	70	58	55	53	56	no data	55	24
Particulate Matter 2.5 mm (Annual) µg/m²	12	8.3	6.4	6.3	5.4	7.7	4.7	6.2
Particulate Matter 2.5 mm (24-hr) µg/m²	35	32	23	24	22	28	16	24
Particulate Matter 10 mm (24-hr) µg/m²	150	no data	0	no data	no data	0	no data	no data

Criteria Pollutants	NAAQS Threshold	Fargo, ND	Lostwood NWR, ND	Hiddenwood NWR, ND	Teddy Roosevelt National Park, ND (North Unit)	Bismarck, ND	Voyagers National Park, MN	Red Lake Nation, MN
Sulfur Dioxide (1-hour) ppb	75	4	17.5	6.7	3.7	7.3	15.8	no data
Lead NAAQS (3 months) µg/m²	0.15	no data	no data	no data	no data	no data	no data	no data
Nitrogen Dioxide (1-hr) ppb	100	32.2	11	9.5	10.5	9.7	35.9	no data
Nitrogen Dioxide (Annual) ppb	53	3.72	1.65	1.63	1.49	4.39	4.5	no data
Carbon Monoxide (8-hr) ppm	9	no data	no data	no data	no data	0.8	no data	no data

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4.2.4.2 Trends and Visibility

Interagency monitoring programs evaluate air quality conditions and trends for Particulate Matter (2.5mm), Ozone, Visibility, Nitrogen deposition and Sulfur deposition in Class 1 areas which include national parks. The closest national parks are Theodore Roosevelt National Park in ND and Voyagers NP in Minnesota. In both parks, for 10-year average data from 2012 – 2021, the condition for all the parameters was “fair”, except for Sulfur deposition which was rated “good”. Trends for all the parameters in both parks was considered Relatively Unchanged for all parameters (USDI NPS 2023).

4.2.4.3 Deposition

Existing deposition was characterized by utilizing the National Atmospheric Deposition Program’s National Trends Network (NTN)(2023). Deposition data is available from precipitation data collected from 1988- 2023 at Icelandic State Park in central Pembina County. The NTN Wet Deposition Summary for the park indicates a downward trend in Nitrate and Sulfate deposition. The Ammonium Ion trend has been increasing in this time period. Potential sources of ammonium include livestock manure, synthetic fertilizer, and automobile exhaust.

4.2.5 Biotic Communities

4.2.5.1 Plants - Communities, and Habitat Quality

The U-AA is within two EPA Level IV sub-ecoregions - Beach Ridges and Sand Deltas to the west and Glacial Lake Agassiz Basin to the east. The U-AA has a variety of habitats and plant communities with a quality range of fair to good. The U-AA is partially within an NDGF habitat focus area: *Sand Deltas and Beach Ridges*. Plant communities include

tame grassland (i.e., tilled, or other disturbed land returned to grassland), wetland, upland deciduous forest, river and stream, lake, and prairie. PL-566 Section 12 consultation with the USFWS and ND Parks and Recreation Department resulted in identification of two vegetative communities they deem “Significant Ecological Communities” present in the U-AA: Dogwood-willow Thicket (Cornus sericea-salix (bebbiana, discolor, petiolaris) thicket) and Bur Oak Upland Woodland (Quercus macrocarpa/prunis virginiana northern ravine woodland). They also had identified a rare plant - Small Yellow Lady’s Slipper Orchid (Cyprpedium parviflorum) within the U-AA.

Refer to Section 4.2.3.2, Appendix D-9 (Aquatic Resource Delineation and Fen Search Report, 2021 with addendum (2024)) for more information on wetland classification and location. Refer to Appendix D-10: Biological Inventory Report for additional information on the habitats and plant communities identified at the project site.

Three NDGF habitat focus areas are within the D-AA: *Sand Deltas and Beach Ridges*, *Saline Area and the Turtle River*. Immediately downstream of the dam, some areas of the native riparian woodlands have been cleared for cropland and negatively impacted by grazing. However, a more robust corridor of riparian vegetation picks up about 4 miles downstream and continues to just north of the Grand Forks Air Force Base (GFAFB). This area includes native riparian mature woodlands in the Turtle River State Park. Riparian woodlands in the Red River valley are typically dominated by green ash (Fraxinus pennsylvanica), boxelder (Acer negundo), bur oak (Quercus macrocarpa) basswood (Tilia americana). Downstream of the GFAFB, in the Saline Area Sub-ecoregion, the riparian woodland is more sporadic and the cover is more commonly in grass or cropland all the way to the confluence with the Red River of the North. The D-AA contains vast expanses of tall grass prairie, including a NDGF designated *saline focus area* (NDGF, 2015). The salty groundwater flowing to the surface is most suitable for salt tolerant species such as Salicornia rubra (red saltwort), Pascopyrum smithii (Western wheatgrass) and Spartina pectinata (prairie cordgrass). Other introduced species such as Kentucky Bluegrass, Smooth Brome, and Reed Canarygrass are also common in the D-AA. The saline area is also where wetlands are most concentrated; the D-AA has 15,486 acres of wetlands, as determined from NWI data. The USFWS Kellys Slough National Wildlife Refuge is largely within the D-AA. The refuge was established to develop and manage a system of wetlands and grasslands unique to the Red River Valley of North Dakota. It contains an intermittent stream and pools of water that flow into the Turtle River. The refuge serves as an important migration stopover and staging area for shorebirds and waterfowl in an area where there are few options for waterbirds (USFWS, 2025). Several USFWS Waterfowl Production Areas (WPAs) are contiguous with Kellys Slough. The WPAs are open to public hunting, fishing and bird watching recreation.

4.2.5.2 Riparian Areas

The NRCS integrates management of riparian areas into all plans and alternatives (190-GM, Part 411). The riparian zone is defined as land that occurs along waterbodies and watercourses. Vegetation here receives more water than adjacent upland areas, and the soils are subject to intermittent flooding or fluctuating water tables.

The riparian zone in the Upstream Drainage Area is approximately 4,744 acres. The area is primarily acres adjacent to the South Branch of the Turtle River and its smaller intermittent tributaries. Most of this area lacks sufficient hydrology for woody vegetation.

Lower elevation areas support herbaceous wetland vegetation such as reed canary grass; the upper slopes are most commonly vegetated with cool season invasives such as brome grass and Kentucky bluegrass. These areas are commonly grazed. The Upstream area also includes 3 smaller SCS Flood Retention Dams – Upper Turtle Dam #s 6,7 & 8.

The riparian zone in the U-AA is 553 acres (this does not include the area of the reservoir at normal pool elevation) and includes riparian woodlands, wetlands, and riverine communities, in addition to some grasslands located within the floodplain (Appendix D-10 Biological Inventory Report). This zone has experienced minor changes in community structure and the community type is largely intact. When the dam was built and the reservoir pool filled, a large area of riparian woodland was lost.

The riparian area in the D-AA is approximately 17,818 acres and consists mainly of the corridor of riparian woodland and herbaceous vegetation along the Turtle River, including the confluence of the North Branch with the South Branch, portions of the North Branch, and several unnamed tributaries. The area continues to the confluence with the Red River of the North just southwest of the city of Oslo, MN. Approximately 29% of the vegetation is woodland; forest vegetation is largely confined to the upper reaches of the D-AA. A large block of native forestland is maintained in the Turtle River State Park. The upper-story native riparian trees are dominated by Burr Oak, Green Ash and Basswood, while understory species typically include chokecherry, hazel and snowberry. Significant areas of riparian herbaceous wetland are present in the middle region of the D-AA due to the high-water tables and salinity. Forest vegetation was largely removed in the reaches closest to the Red River, These areas are cropped when possible. The flatter slopes were tilled land and/or drained via channelization to facilitate cropping.

4.2.5.3 Ecologically Critical Areas (See section 4.2.5.1)

4.2.5.4 Mammals, Amphibians, Reptiles, Invertebrates

The NDGFD has listed species of concern for the state's wildlife conservation strategy, which are considered "species of conservation priority" and are included in the 2015 State Wildlife Action Plan (NDGF, 2015). These species are ranked in priority from level I to level III, with I being the highest priority. In the U-AA and D-AA there are 2 reptiles, 9 mammals, 5 freshwater mussels, and 4 insects species of conservation priority that may be present in this ecoregion. One Level I species potentially present include: Plains Hog-nosed Snake (Heterodon naicus), Big Brown Bat (Eptesicus fuscus), Little Brown Bat (Myotis lucifugus), Northern Long-eared Bat (Myotis spetrentrionalis), Creek Heelsplitter (Lasmingona compressa) and Monarch Butterfly (Danaus Plexippus). This butterfly species requires milkweeds. Preferred habitat may be present in the project area. Refer to Appendix D-10: Biological Inventory Report for additional information.

4.2.5.5 Fish

Larimore Dam has been classified as a Class 2 cool-water fishery, which is considered capable of supporting natural reproduction and growth of cool-water fishes (i.e. walleye and northern pike). A Class 2 fishery is also considered to be capable of supporting associated aquatic biota for marginal growth of fish. The reservoir is stocked by North

Dakota Game and Fish Department (NDGFD) since 2014. Stocking included Pure Muskellunge, Walleye, and Northern Pike. The 2023 NDGFD Survey Report indicates sport fish include Common Carp (44.9%), Black Crappie (14.3%), Black Bullhead (12.2%), White Sucker (10.2%), Northern Pike (8.2%), Yellow Perch (8.2%), and Largemouth Bass (2.0%). The fishery status also indicates Walleyes are present, but low in number, and a few Bluegills with some up to 8-inches. The reservoir relies primarily on stocking efforts made by NDGFD; natural reproduction is limited.

The Turtle River in Grand Forks County is also listed as a fishery by NDGFD. The Turtle River is one of only 15 rivers in the state the department manages and stocks. The next closest rivers are Sheyenne and Red River, which have only been stocked two years in the last 10 and only for one species (Walleye). The Turtle River within the Turtle River State Park has been stocked annually since 2014 with catchable Rainbow Trout. The Turtle River is a very rare trout stream in the region; the only other river in North Dakota stocked with Trout is Missouri River.

The NDGFD has listed eleven fish species of conservation priority potentially present in the U-AA and D-AA, including the level I species: Northern Pearl Dace (Margariscus nachtriebi). The ND Parks and Recreation Department identified a rare fish species – Northern Redbelly Dace (Chrosomus eos) as present within the U-AA.

Twenty-three native fish species were present in the Turtle River during a USGS survey in 1995. Of these, two are listed as Level II Species of Conservation Priority in the 2015 SWAP: Silver chub and Trout-perch. More recent native species found in the reservoir have include: Black Bullhead, Northern Pike, Walleye, White Sucker and Yellow Perch

4.2.5.6 Birds, Migratory Birds, Eagles

The Bald and Golden Eagle Protection Act and Migratory Bird Treaty Act (MBTA) makes it unlawful to “take, possess, import, export, transport, sell, purchase, barter, or offer for sale, purchase, or barter, any migratory birds (including eagles), or the parts, nests, or eggs of such a bird except under the terms of a valid federal permit.” Provisions are in place for the protection of migratory birds, part, nest, egg, or product. Under the MBTA, “migratory birds” essentially include all birds native to the U.S.; and the law pertains to any time of the year, not just during migration. According to NDGFD, the bald eagle population and the number of eagle nests are increasing in North Dakota; however, there are no documented bald eagle nests or large stick nests in the area near the dam.

North Dakota is located within the Central Flyway, one of the major migration paths in North America. Migratory birds can occur within the U-AA or in the vicinity during spring and fall migration or even use the area for breeding or nesting during summer months.

The USFWS IPaC Migratory Bird list for the U-AA was generated in June 2025 and included 13 bird species. All the birds listed are considered Birds of Conservation Concern (BCC), except for the Bald Eagle, which is not considered a BCC, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from development activities. The list provides a bird’s relative probability of presence during a year in the U-AA. The list included 6 land birds, 3 shorebirds, 2 waterbirds and 2 raptors (See Table 5 Appendix D-10 Biological Survey).

In the D-AA there are many migratory bird species of concern as North Dakota is located within the Central Flyway. Migratory birds occur in the D-AA during spring and fall migration as well as use the area as breeding and nesting grounds through the summer.

4.2.5.7 Federal Threatened and Endangered Species

The Endangered Species Act (ESA) directs federal agencies to conserve endangered and threatened species. Because North Dakota does not have a state threatened or endangered (T&E) species list, those species listed by the ESA of 1973, as amended, are considered listed, and the USFWS has primary oversight of these species. The USFWS IpaC (Information for Planning and Consultation) review process was utilized in 2020 and updated in 2025 for compliance with the ESA. Four species were included in the Official Species list for the U-AA on 6/13/2025. Myotis septentrionalis (Norther Long-eared Bat) status is *Endangered*, while the Danaus plexippus (monarch butterfly), Bobus suckleyi (Suckley's cuckoo bumble bee), and Argynnis idalia occidentalis (western regal fritillary) statuses are *Proposed* (See Appendix E Environmental Evaluation). No critical habitats were identified as present in the project area. However, suitable habitat is noted within the study area.

In the U-AA, Danaus plexippus (monarch butterfly) was observed. There are no known hibernacula or maternity roost trees in North Dakota for NLEB, however there is the presence of preferred habitat (Appendix D-10: Biological Inventory Report). Common milkweed (Asclepias syriaca), a critical species for Monarch Butterfly, was identified in the U-AA. United States Fish and Wildlife Service (USFWS) indicates no designated critical habitat in the D-AA, but the bat may be present based on habitat preferences.

4.2.5.8 Undesirable Species (including Invasive Species)

Nine invasive and troublesome weeds listed in the state identification document (NDSU Extension, 2023) were observed during the wetland delineation. One county-listed noxious weed species - kochia (Bassia scoparia) and three state-listed (NDDA, 2025) noxious weeds - absinth wormwood (Artemisia absinthium), leafy spurge (Euphorbia esula) and Canada thistle (Cirsium arvense) are present in the U-AA. Other invasive plants found in the U-AA include Kentucky bluegrass (Poa pratensis), smooth bromegrass (Bromus inermis), reed canary grass (Phalaris arundinacea), Russian olive (Elaeagnus angustifolia) and common buckthorn (Rhamnus cathartica).

There were no invasive animal species observed during the biological inventory survey. Zebra mussels have not been identified in Larimore Reservoir, but they are present in North Dakota and as close as Red River in Grand Forks. There is the possibility this species could be introduced to the reservoir by users of the recreational boating opportunities.

There is high potential for undesirable species in the D-AA (not surveyed) due to intensive agriculture and other natural community disturbance.

4.2.6 Human Environment

4.2.6.1 Cultural Resources, Historic Properties

The National Historic Preservation Act (NHPA) of 1966 directed federal agencies to develop a program of cultural preservation and consider effects of projects on historic

properties. NRCS has established a policy and guidance for compliance with NHPA and other authorities, including the American Indian Religious Freedom Act (42 U.S.C. Section 1996); Native American Graves Protection and Repatriation Act (25 U.S.C. Sections 3001-3013); Executive Order (EO) 13175, Consultation and Coordination with Indian Tribal Governments (2000); EO 13007, Indian Sacred Sites (1996); and a range of additional executive orders.

Thirty-one tribes were formally consulted and invited to participate in the planning process in March 2020. One tribe (Northern Cheyenne Tribe), requested to be included in all planning communications (see appendix A). No tribes commented specifically on resource concerns that may be present in the planning area at that time. In the U-AA, a literature review and archive review were conducted by NRCS Cultural Resource Specialists prior to conducting a Class III field surveys in October of 2021 and April 2025. The surveys were performed by NRCS Staff (Appendix D11 – Class III Cultural Resources Inventory Report). The literature search found there were historic properties and properties eligible for the NRHP located within the U-AA.

The downstream area (D-AA), which is not within the cultural resources area of potential direct effect from the preferred alternative, was not surveyed, however a Class I search was completed. There are no properties downstream listed on the National Register of Historic Places. However, there are a significant number of sites deemed *eligible* for the NRHP. These include 15 Civilian Conservation Corps (CCC) stone and wood structures constructed within the Turtle River State Park between 1935 and 1941. Of the 15, 12 are recognized as buildings and three as structures. Eight structures were inventoried and analyzed in Appendix D-1 and D-3; structure ID's include S37, S38, S39, S70, S71, S72, S73, and S74. There are also several historic bridges eligible for the NRHP downstream of the dam.

4.2.6.2 Public Health and Safety

In the dam's current condition, a breach during a major flooding event would pose a significant risk to public safety. The breach analysis described in Section 1.4.3 and in Appendix D-1: Existing Conditions Assessment Report indicates that loss of life is likely given a dam failure under the evaluated conditions. 15 homes, 17 local roads, and 1 federal highway would have flow depths and velocities place them in the high danger potential category where loss of life would likely occur. An estimated 87 lives would be at risk at the residences, roads, and highway. The dam currently provides water quality protection to 8 downstream wellheads.

4.2.6.3 Transportation and Infrastructure

There are multiple public and private roads within the watershed. State Highway 18, Federal Highway 2, Federal Highway 81, and Federal Interstate 29 are the only roads within the D-AA or U-AA with an average daily traffic load of over 400 vehicles. State Highway 18 is within the U-AA as it crosses the South Branch Turtle River within the flood storage pool; the lowest spot of road crest is elevation 1091.6, which is 1.1 feet higher than auxiliary spillway crest invert. Larimore Dam reservoir levels overtop State Highway 18 at approximately the 300-year flood event. Federal Highway 2 is within D-AA and crosses the Turtle River ~9 river miles downstream of Larimore dam. This highway has four lanes, with two eastbound lanes separate from two westbound lanes, and separate

bridges are used for each set of directional lanes. Federal Highway 81 and Federal Interstate 29 are within D-AA and ~60 river miles downstream of Larimore Dam. These highways are not affected by breach event as river flows return within banks by this point.

4.2.6.4 Recreation Resources

See Section 4.1.3.2.

4.2.6.5 Visual Resources (Scenic Beauty)

See Section 4.1.3.3.

4.2.6.6 Local and Regional Economy

Roughly 83% of the land in Grand Forks County is farmland; the 2022 Census of Agriculture county factsheet that the county is home to 956 farms (National Agricultural Statistics Service, 2022). The county ranked 1st in ND for production of dry edible beans, 9th for corn and 10th in the state for soybeans for 2023 crop production (National Agricultural Statistics Service, 2024). Walsh county was a top-10 producer in the state for dry edible beans (2) and for production of spring wheat (7). Together, Grand Forks and Walsh Counties harvested just over one-quarter of the total dry bean acreage in North Dakota during the 2023 crop season and accounted for 26.93% of our state's dry bean production. The pair accounted for 4.9% of soybean acres and 6.37% of spring wheat production in the state. The unemployment rate in Grand Forks County has remained notably below the U.S. average for the last ten years. The 2024 county unemployment rate was 2.1%, compared to a national rate of approximately 4% (Bureau of Labor Statistics, 2026a, b).

4.2.6.7 Population Demographics

The population within the project area is approximately 8,000 individuals, of which 86% of the population is white (alone), with the predominant minority being classified as Hispanic or Latino (6%) (Table 4-4). Persons with disabilities averages 7% within the planning area, which is consistent but slightly less than US average (9%).

Table 4-4 Demographic Statistics within the Turtle River Planning Area

Location	Population (2024)	Median Household Income (2020-2024; in 2024 dollars)	Persons in Poverty (%)	Predominant Race	Predominant Minority (2023 est.)
Turtle River Planning Area*	8,000	$68,000	12%	White, 86%	Hispanic or Latino, 6%
Grand Forks County	73,771	$68,075	12%	White, 86%	Hispanic or Latino, 6%

Location	Population (2024)	Median Household Income (2020-2024; in 2024 dollars)	Persons in Poverty (%)	Predominant Race	Predominant Minority (2023 est.)
North Dakota	796,568	$76,657	11%	White, 86%	American Indian and Alaska Native, 5%

*Turtle River Planning Area follows County trends Prepared Feb 2026
Source: US Census Bureau, 2026

4.2.6.8 Noise

Noise is not specifically addressed in any planning or zoning documents in Grand Forks county. Noise ordinances are present in some cities such as Larimore and Emerado.

5 Alternatives

5.1 Formulation Process

Alternatives were formulated and evaluated based on the NRCS National Watershed Program Manual, National Environmental Policy Act, and the Principles, Requirements, and Guidelines for Federal Water Resource Projects. Also, as required by PR&G, alternatives were formulated and evaluated based on their *Completeness, Effectiveness, Efficiency,* and *Acceptability* as further defined below.

1. *Completeness* is the extent to which an alternative provides and accounts for all features, investments, and/or other actions necessary to realize the planned effects, including any necessary actions by others. It does not necessarily mean that alternative actions need to be large in scope or scale.

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

3. *Efficiency* is the extent to which an alternative alleviates the specified problems and realizes the specified opportunities at the least cost.

4. *Acceptability* is the viability and appropriateness of an alternative from the perspective of the nation's general public and consistency with existing federal laws, authorities, and public policies. It does not include local or regional preferences for particular solutions or political expediency.

A comprehensive array of alternatives was first identified and preliminarily analyzed to determine their ability to meet the purpose and need, and address other issues identified through Scoping *(Completeness and Effectiveness)*. After an initial array of alternatives that successfully met the purpose and need was developed, a comparative cost analysis was completed to narrow the array of alternatives *(Efficiency)*. Interagency and public input was used to further refine the alternatives as necessary *(Acceptability).*

5.1.1 Structural Rehabilitation to High-Hazard Designation

Multiple variations of the structural rehabilitation to a high-hazard designation were considered. The least cost variation of the structural rehabilitation alternatives was selected to be carried forward for detailed analysis (see Section 5.2.2); all other eliminated alternatives are discussed in this section.

NRCS and State of North Dakota requirements for a high-hazard designation structure were used to size the dam spillways. Consideration was given to widening the auxiliary spillway, making structural auxiliary spillway, and armoring the auxiliary spillway to prevent a dam breach. The dam spillway sizing criteria deficiencies are principal spillway criteria and auxiliary spillway integrity, see details in Appendix D-1 Existing Conditions Assessment Report. However, with rehabilitation of the dam auxiliary spillway the principal spillway would be reconstructed with same overall dimensions with increased size of upstream first stage orifice. This will accommodate the 100-year extension of design life and embankment drain filter addresses compatibility with dispersive embankment fill. The principal spillway and drain filter are features applied to all auxiliary spillway alternatives.

Alternatives were compared initially on a comparative cost basis to determine which structural rehabilitation alternative to a high-hazard designation would provide the most efficient rehabilitation option for Larimore Dam. Consideration was given to the effects of the alternatives on PR&G and NEPA concerns, however no differing impacts between structural alternatives were identified (other than the grass lined earthen spillway alternative, which was clearly impractical). Consideration was also given to the constructability and/or practicality of the alternatives evaluated. After the review of the various structural rehabilitation alternatives to high-hazard designation, several of the alternatives were eliminated based on comparative costs. A review was also completed to ensure that alternatives to be carried forward would not have significant negative environmental impacts or have significant differences in impacts between alternatives. The following list of structural rehabilitation alternatives to high-hazard designation were eliminated from detailed study because of higher construction costs than the alternative selected to move forward. Detailed descriptions and preliminary costs of each of the alternatives and reasons for their elimination from further consideration are provided in Appendix D-3: Alternatives Evaluation Report.

- Widen auxiliary spillway to 1,250 feet.
- Use articulated concrete block to armor the auxiliary spillway, maintain 300 feet width with 15% slope in current auxiliary spillway, and realign to remove 15-degree curve.
- Structural auxiliary spillway with RCC, 200 feet width in current auxiliary spillway.
- Structural auxiliary spillway with RCC, 200 feet width over top of dam.
- Structural auxiliary spillway chute, 200 feet width in current auxiliary spillway.
- Structural auxiliary spillway chute with baffle blocks, 200 feet width in current auxiliary spillway.
- Structural auxiliary spillway chute, 200 feet width over top of dam.

- Structural auxiliary spillway chute with baffle blocks, 200 feet width over top of dam.

5.1.2 Structural Rehabilitation to Significant-Hazard Designation

After consideration of structural rehabilitation to a high-hazard designation, potential alternatives that would reduce the hazard classification associated with Larimore Dam to a significant-hazard classification were evaluated.

Larimore Dam is currently a high-hazard dam based on the criteria described in Section 1.4.3. Rehabilitation of the dam to a significant-hazard designation would involve either flood proofing or removing the habitable structures and overtopped roads downstream of the dam that cause it to have the high-hazard designation. Several of the habitable structures would have flood depths in excess of 8 feet during the significant hazard breach scenario. Therefore, floodproofing these structures by means of ring levees or raising the structures is considered undesirable and buyouts are assumed. The total cost to buy out 15 habitable structures is $7.5 million. Addressing overtopping potential at 18 roadways include constructing larger culverts or bridges and raised roadways; the estimated cost for this is $72 million. Due to the extremely high cost for buyouts and roadway reconstruction ($79.5 million), any other work at the dam, i.e. armor or structural auxiliary spillway was not researched further. Given the high cost of this alternative and the difficulties associated with social acceptance, it was eliminated from detailed analysis.

5.1.3 Nonstructural Alternative – Decommissioning with Downstream Flood Protection & Environmental Impact Minimization

The decommissioning with downstream flood protection alternative for Larimore Dam would involve the removal of the embankment at Larimore Dam to provide minimal flow attenuation through the former embankment location. It would also involve excavation of a new channel and floodplain through the existing sediment pool upstream of Larimore Dam to stabilize sediments. Historic imagery was reviewed and the alignment for the proposed channel between the existing embankments at Larimore would approximately follow the historic channel alignment before the construction of Larimore Dam. Appendix D-3, Figures 23 and 24 provide site plans for this alternative at the dam site.

The grade of the proposed channel would be approximately 0.004 feet per foot, which is similar to the existing channel grade of the South Branch Turtle River Channel downstream of the dam. A rock arch rapid design would be implemented near the existing Larimore Dam embankment location to stabilize sediments upstream of the existing embankment and provide aquatic species passage. Additionally, a sheet pile at the upstream end of the rock arch rapid would be installed for added protection against excessive sediment migration downstream of the former dam. Three cross vanes are located at the upstream portion of the reservoir, due to lower slope within delta formation (0.00045 ft/ft), and design slope through reservoir that matches downstream slope (0.004 ft/ft).

Nine farmstead levees are used to protect 18 structures for the 100-year flood event with Larimore Dam removed. The total length of levees is approximately 4,800 feet. Setback levees were also considered for the protection of downstream agricultural land, however

were determined to be impractical. The additional inundation is typically 50 feet or less, and a levee would take a high portion of this additional width out of production.

The cost of constructing the proposed channel through the decommissioned dam and accumulated reservoir sediments, constructing farmstead levees, and bridge updates would be required to decommission the dam, would be exorbitantly high (~ $21.2 million) to achieve the flood prevention goals that are commensurate with the current flood prevention provided by the dam. Recreational opportunities provided by the dam would be lost. A total of 32.0 acres wetlands would be lost; 28.17 acres of lacustrine fringe wetlands adjacent to the existing reservoir and 3.83 acres of depressional would be eliminated because of the decommissioning activities. The lacustrine fringe, along with deepwater habitat, would be lost due to removing the principal spillway and normal operating pool. The 3.83 acres of depressional wetlands within the auxiliary spillway would be lost due to dam material volume placed in auxiliary spillway. Under E.O. 11990 and potentially the Clean Water Act, mitigation would be required for those lost acres. Estimated costs for mitigating the 32 acres of wetlands is $1.92 million (e.g., Ducks Unlimited charges $60,000 per acre in the appropriate Bank Service Area as of 2022). Restoration of the natural river channel and associated riparian wetland would provide fish and wildlife habitat benefits. In addition, if downstream flowage easements were to require conversion of cropland to grassland within the setback levees, there could be wildlife habitat benefits.

While the decommissioning alternative is effective in the sense that it would address the flood prevention goals associated with this Watershed Work Plan, it does not completely address the need of the project because of how it would limit potential recreational opportunities. The decommissioning alternative is also less efficient than other alternatives described in Section 5.2 because of the high costs that primarily would come updated bridge construction, farmstead levees, and grade stabilization. The benefits of the decommissioning alternative with all elements in place would be protection of agricultural infrastructure, residential structures, and public infrastructure.

The 2045 Grand Forks Land Use Plan (Grand Forks Metropolitan Planning Organization, 2016) a public document with the purpose of being used as a policy guide to inform decisions within the metropolitan planning area. The Land Use Plan was created to guide future development and investment. The plan contains the specific goal to preserve valuable farmland and maintain Grand Forks' rural setting. The decommissioning alternative described would reduce agricultural activity and farm services, which is in direct contrast with the goals detailed in the comprehensive plan. In addition, neither the public, landowners, nor the local Sponsor are supportive of this alternative. The decommissioning with maintained flood control alternative was eliminated from detailed review because it offered the same benefit of reducing the risk of loss of life as the FWOFI, but at a notably higher *cost.*

Following decommissioning the Larimore Dam Recreation area would remain, allowing upland activities. However, recreation users would likely reduce significantly post decommissioning due to lack of reservoir and water recreation activities. The owner (Grand Forks Water Resource District) expects to maintain ownership of the grassland, wetland, and forest complex; with contract grazing where feasible.

5.1.4 Nonstructural Alternative – Decommissioning with Environmental Impact Minimization

The decommissioning alternative for Larimore Dam involves the removal of the embankment at Larimore Dam to provide minimal flow attenuation through the former embankment location. This alternative is identical to the FWOFI with the exception that excavation of a new stable channel through the existing sediment pool upstream of Larimore Dam would be completed to minimize environmental impacts of the project. Historic imagery was reviewed and the alignment for the proposed channel under the decommissioning alternative under Larimore Dam and reservoir would approximately follow the historic channel alignment before the construction of Larimore Dam. Appendix D-3, Figures 23 and 24 provide site plans for this alternative.

The grade of the proposed channel would be approximately 0.004 feet per foot, which is similar to the existing channel grade of the South Branch Turtle River Channel downstream of the dam. A rock arch rapid design would be implemented near the existing Larimore Dam embankment location to stabilize sediments upstream of the existing embankment

The grade of the proposed channel would be approximately 0.004 feet per foot, which is similar to the existing channel grade of South Branch Turtle River Channel upstream and downstream of the existing pool locations. A rock arch rapid design would be implemented near the existing Larimore Dam embankment location to stabilize sediments upstream of the existing embankment. Additionally, a sheet pile at the upstream end of the rock arch rapid would be installed for added protection against excessive sediment migration downstream of the former dam.

The construction cost of this alternative was estimated at $8.1 million. Removal of the dam without additional downstream flood protection generates extensive economic damages due to future flood events. This alternative was eliminated because it offered the same benefit of reducing the risk of loss of life as the FWOFI, but at a notably higher cost.

5.2 Alternatives Carried Forward

The National Watershed Program Manual (NWPM) (NRCS, 2014), notably section 505.35, is guidance for choosing alternatives carried forward due to this project initially funded and work initiated in 2019. National Instruction (NI) Title 390, Part 303 is considered in regard to No Action being the condition of existing dam, without improvements. Furthermore, National Bulletin (NB) 190-26-1 states that No Action is optional for Environmental Assessments. No Action is chosen to be analyzed due to significant affects that result. Structural rehabilitation is included to remediate dam deficiencies, and maintain the projects original benefits, which are considerably different than benefits documented in this Plan. The Future without Federal Investment (FWOFI) meets NWPM (NRCS, 2014) guidance and highlights flood control benefits without the dam in place.

5.2.1 Alternative No. 1 – Future without Federal Investment (FWOFI), Minimal Decommissioning

Due to significant economic losses and the potential loss of 82 human lives, neither the state dam safety authority (ND Department of Water Resources) nor the Sponsor sees the No Action alternative as a reasonable assumed FWOFI. The Sponsor indicated that what they would do, if a structural rehabilitation were not undertaken on the dam with federal assistance, would be to remove their liability for public safety and property damages by taking a “least cost” approach to decommissioning the dam embankment to the point it no longer posed downstream risk.

The minimally decommissioned dam would consist of a sheet pile weir and riprap installed near the upstream toe of the existing dam location to minimize sediment migration through the breach section. The structure would not be fish passable. The weir length for the opening at the breach section would be large enough to pass a 100-year flood event at the bank full channel elevation (the weir length required would be approximately 120 feet). Riprap would also be placed up the side slopes of the former dam embankment up to the 100-year water surface profile elevation. The side slopes of the breach section would be flat enough as to not create slope stability issues through the breach section (a minimum of two to one horizontal to vertical side slope would be necessary). The removed material from the dam would be placed in the current auxiliary spillway. Additionally, the principal spillway riser tower and conduit would be excavated and removed. The upstream sediment pool would not be addressed in any manner.

Areas impacted by the constructed breach would be seeded after construction activities have been completed. Downstream flooding conditions would be similar to those that existed prior to the construction of the dam. The 100-year floodplain would be expanded from 45,963 acres to 47,138 acres.

Following decommissioning the Larimore Dam Recreation area would remain, allowing upland activities. However, recreation users would likely reduce significantly post decommissioning due to lack of reservoir and water recreation activities. The owner (Grand Forks Water Resource District) expects to maintain ownership of the grassland, wetland, and forest complex; with contract grazing where feasible.

5.2.2 Alternative No. 2 – Structural Rehabilitation to High-Hazard Designation (Structural Rehabilitation)

The auxiliary spillway profile would be armored with articulated concrete block (ACB). The auxiliary spillway alignment would match the existing alignment, but the profile would be modified to a uniform 0.11 feet/feet throughout the spillway channel to accommodate the appropriate ACB design guidance. The auxiliary spillway width would remain the same as the existing width, which is approximately 300 feet. The existing principal spillway riser tower would be removed, and the existing principal spillway conduit would be grouted. The proposed 78” principal spillway conduit would be installed via NRCS approved boring and jacking methods through the existing embankment. Open cut placement methods are not feasible based on stable slopes and existing embankment extents. A new USACE stilling basin would be constructed at the outlet of the principal spillway conduit. Downstream of the stilling basin, a constructed channel would be implemented to carry flows from the plunge pool back to the South Branch Turtle River channel (less than 100

feet of new channel construction). A new principal spillway riser tower would be installed that would pass the principal spillway design hydrograph without activation of the auxiliary spillway. The proposed riser tower would be a NRCS standard two-way covered riser tower with a low stage orifice opening and second stage overflow weir.

A chimney drain would be installed on the downstream side of the existing embankment to intercept any seepage concerns through the embankment during flood events. Seepage flows captured would be routed to a foundation drain near the existing embankment toe and would then be discharged into the constructed principal spillway outlet works. The top width of the embankment crest will be widened to 24.0 feet. Other measures to ensure slope stability is adequate at the dam are described in Appendix D-2: Geotechnical Engineering Report.

For more detailed information on the concept and a preliminary plan set of Alternative No. 2, refer to Appendix D-4: Concept Design Report. A proposed site plan for Alternative No. 2 is available in Appendix C, Figure C-22: Preferred Alternative Overall Site Plan.

Alternative No. 2 would correct all deficiencies associated with the existing structure in a manner that is as cost-efficient as possible. This alternative also effectively addresses the need for flood prevention and would provide recreational opportunities that are commensurate with the existing structure. Furthermore, the land use downstream would be similar to the present condition, which is aligned with the goals of the sponsor. Alternative 2 is also aligned with International Treaty obligations of the United States government through the IJC for nutrient reduction and long-term flood reduction objectives adopted through the Red River Basin Commission. The Larimore Dam Recreation area would remain intact and continue to function similarly as it has recently.

5.2.3 Alternative No. 3 – No Action

The no action alternative represents a scenario where the existing dam remains in place with no measures taken to address the dam safety inadequacies associated with the dam. The dam would remain in place and would function as it currently does for the 2- through 500-year flood events. Flood reduction benefits would remain the same, until such time as the dam fails, as no changes would be made to the outlet works of the structure. Recreation activities would continue while the dam is intact and all wetlands on the perimeter of the reservoir and surrounding the dam would be unaffected by this alternative until dam failure.

The no action alternative for Larimore Dam would result in a breach of Larimore Dam during a 1,844-year event. The breach would occur in the existing auxiliary spillway and would begin headcutting near the toe of the spillway. The headcut would progress rapidly upstream until it reached the reservoir of the dam. The volume of material eroded from auxiliary spillway would be approximately 552,500 cubic yards. The material eroded from the breach would be transported downstream where it would settle out in the floodplain or continue down through the North Branch Turtle River and main stem Turtle. The reservoir upstream of the dam would be drained completely during the breach and the dam would not be reconstructed for this scenario. Appendix D-3, Figure 30 illustrates the modeled breach extents. The resulting flood wave would impact 31 residential structures, 62 agricultural properties, and 27 grain storage bins. An estimated 82 lives would be at risk during the breach at 14 homes, 1 federal highway, and 16 local road crossings. The

breach would cause overtopping of 9.8 miles of paved roadway and 45.7 miles of gravel roadway. The breach would also cause overtopping and potential damage to 17 road bridges downstream of the dam. During the breach, hydraulic modeling indicates that approximately 20 cultural resource sites would be inundated and potentially damaged or destroyed. Eight of these sites have been deemed eligible for the NRHP, including CCC stone and wood structures at Turtle River State Park, the other seven sites maybe deemed eligible with further analysis.

The flood wave would stay within the Turtle River valley through the river crossing at 29th Street NE, 3 miles west of the Grand Forks Air Force Base. Just upstream of the 29th Avenue bridge, the flood wave would initially break out of the Turtle River and travel overland through agricultural fields. Downstream of 21st Avenue NE breakouts would increase causing expanded inundations several miles away from the main channel. A small amount of flow would breakout into County Ditch 12, which flows to Lake Ardoch and Forest River. This overland flooding of cropland would result in additional floodplain erosion, totaling approximately 523,200 cubic yards of erosion, reducing or eliminating crop yields depending on the depth of topsoil loss. A portion of the combined 1.07 million cubic yards of erosion occurring from the initial breach and downstream would be deposited within the downstream breach zone, requiring a significant clean-up effort to remove the deposited sediments from roadway crossings, conveyance channels, and cropland. The flood wave from the breach would cause loss of mature trees on 325 acres of riparian forest downstream of the dam. An estimated 5.1 acres of wetlands would be affected by scour, and 999.2 acres of wetlands with sediment deposition downstream of the dam. Sediments deposited would not be removed in non-cropland areas, such as riparian floodplain and upland grasslands, resulting in reduced wildlife habitat quality, runoff nutrient filtration, and natural flood storage in an area where these functions are already limited. Crop impacts caused by erosion, flooding, and the resultant cleanup costs are estimated at approximately $12.6 million just in the year of the initial breach.

In future years following the breach event, a significant headcut would migrate west through accumulated reservoir sediments, transporting an additional ~198,000 cubic yards of sediment downstream. The 1.3 million cubic yards of newly mobilized sediment would result in a highly unstable river channel and negatively impact agricultural drainage systems downstream. Surface water quality standards would be exceeded for cadmium, chromium, copper, lead, nickel, zine, nitrogen, and phosphorus downstream for years after the breach with risks to human health and aquatic species. Deposition of sediment bound contaminants on cropland could impact production and/or food safety.

Following breach the Larimore Dam Recreation area would remain, allowing upland activities. However, recreation users would likely reduce significantly post decommissioning due to lack of reservoir and water recreation activities. The owner (Grand Forks Water Resource District) expects to maintain ownership of the grassland, wetland, and forest complex; with contract grazing where feasible.

5.3 Summary and Comparison of Alternatives

The following tables show the three alternatives that were carried forward and how they compare in the context of trade-offs related economic, environmental, and social goals. Table 5-1 shows the various alternative plan categories where Alternative No. 1, Alternative No. 2, and Alternative No. 3 are placed, as well as the total project investment

and benefits for all the alternatives. Table 5-2 shows the impacts from each of the alternatives related to ecosystem services and Table 5-3 shows comparative considerations for each alternative relative to NEPA resource concerns. Detailed descriptions for each are provided in the *Environmental Consequences* section of this Assessment (Section 6).

Table 5-1: Summary and Comparison of Alternatives

Resource	Alternative No. 1 – FWOFI	Alternative No. 2 - Structural Rehabilitation	Alternative No. 3 - No Action
		Alternative Plans	
Locally Preferred		✓	
Non-Structural	✓		✓
National Economic Efficiency (NEE)		✓	
Environmentally Preferred		✓	
Brief Description of Major Features	• Controlled dam breach of the earthen embankment. • Placement of embankment material in the current auxiliary spillway. • Installation of riprap grade control structure through the breached embankment. • No remediation accumulated sediments in the upstream flood pool.	• Bring the dam into compliance with current dam safety requirements for a high hazard dam. • Articulated Block Concrete armoring of earthen auxiliary spillway to prevent dam failure caused by erosion. • Installation of new principal spillway riser structure and 6'x6' conduit through the embankment via jack-and-bore construction methods.	• No action taken on the dam until an uncontrolled breach occurs (1,844-year rainfall event). • After the breach, no remediation would occur at the dam site.
Rehabilitation Project Investment	$4,876,800 (Appendix D-3)	$14,099,890 (Appendix D-4)	-
Annualized Project Investment[1]	$178,998	$517,523	-
Annual O&M Costs	1,000	$5,000	$5,000
Total Annual Costs	$179,998	$522,523	$5,000
Annual Benefits[2]	-$310,379	$40,570	-

Resource	Alternative No. 1 – FWOFI	Alternative No. 2 - Structural Rehabilitation	Alternative No. 3 - No Action
Annual Net Benefits	-$490,377	-$481,953	$0[3]
Benefit to Cost Ratio	Negative	0.1	*Not a legitimate alternative given risk for loss of life and significant economic and environmental losses. The dam owner would decommission the dam (and State Dam Safety would require that action,) as described in the rationale for conditions of the FWOFI alternative, to remove their liability.*

Prepared May 2026

Notes:
1. Installation cost is amortized for 100 years at 3.25% (price base is 2024).
2. Benefits are based on the average annual equivalent and are amortized for 100 years at 3.25% (price base is 2024) with a 2-year implementation period.
3. This is the baseline condition for which the comparison is based against which the other benefits are determined.

Table 5-2: Summary and Comparison of Ecosystem Services by Alternative

Resource	Alternative No. 1 – FWOFI	Alternative No. 2 - Structural Rehabilitation	Alternative No. 3 - No Action
Provisioning Services	***Provisioning services are tangible goods provided for direct human use and consumption, such as food, fiber, water, timber, or biomass.***		
Food	Fish and waterfowl food sources would be removed with loss of the reservoir. Crop production within the downstream floodplain would be reduced due to more frequent, longer duration, and more intense impacts from floodwaters.	Fish and waterfowl food sources would continue to be present. Cropland in the downstream floodplain would continue to be provided flood protection, and there would be reduced risk of cropland damages due to an uncontrolled breach.	Fish and waterfowl food sources would be present and use the normal pool as a water source until an uncontrolled failure of the auxiliary spillway. After failure, fish would be removed and waterfowl diminished. Cropland in the downstream floodplain would be provided flood protection until an uncontrolled failure of the auxiliary spillway. The flood wave would result in 523,200 cubic yards of erosion on cropland and 747,400 cubic yards of deposition on cropland resulting in reduced food production on a temporary or permanent basis. After failure, crop production would be reduced because of increased extents, frequency, depth, and duration of flooding.
Fresh Water	The 500-year flood event would temporarily pond water over three private wellheads (one production, one stock and one irrigation well). No known drinking water wells would be inundated by the event. Leaching of nitrates and pesticides into portions of the Elk River Aquifer is a potential concern.	Flood protection would continue to be provided to the three wellheads downstream of the existing dam.	Prior to the uncontrolled breach, this alternative maintains the current level of flood attenuation and downstream flood protection which includes three wells (1 production, 1 irrigation, and 1 stock well). During a breach, the flood wave moving downstream would inundate these wells. The inundation water is also adjacent to a rural water well used for consumption where leaching may reach the wellhead drawdown area. Leaching of nitrogen, cadmium, chromium, copper, lead, nickel, and zinc to the Elk River Aquifer is a concern.
Regulating Services	***Regulating services help maintain a world in which it is possible for people to live, providing critical benefits that buffer against environmental catastrophe.***		
Flood and Disease Control	Public safety risk of an uncontrolled breach is removed. Increased frequency, extents, depth, and duration of downstream flooding because of lost retention at the dam. The 100-year flood would inundate 47,138 acres that includes 10 residential structures, 104	Public safety risk of an uncontrolled breach is significantly reduced by meeting current dam safety requirements. Flood protection would remain unchanged from existing conditions for the 2 to 500-year floods.	The dam would function for flood protection as it does under the current condition until the uncontrolled breach occurs. The breach would release a sudden flood wave downstream, putting 82 human lives at risk. Contaminants

Resource	Alternative No. 1 – FWOFI	Alternative No. 2 - Structural Rehabilitation	Alternative No. 3 - No Action
	unoccupied structures, and 22.3 miles of roads	The 100-year floodplain would inundate 45,962 acres that includes 7 residential structures, 83 unoccupied structures, and 22.0 miles of roads. Flood risk is reduced for an uncontrolled breach by meeting dam safety and current design requirements for a high hazard dam.	would be deposited on 3,132 acres of cropland. After the failure, flood protection provided by the dam would be removed, and the downstream floodplain would function as described for the FWOFI alternative.
Erosion Regulation	Accumulated sediments in the normal pool of the dam would be mobilized and transported downstream over time. A braided river channel would likely form and migrate across the 66 acres of accumulated sediments. Beaver dams and vegetation would help to stabilize the area over decades. Restored natural sediment transport may improve streambank stability downstream of the dam as far as Hwy 2, where a riparian corridor exists. Downstream of Hwy 2 bank erosion would likely increase due to increased peak flows and limited perennial vegetation. Loss of flood storage would increase the incidence of erosion on cropland in the downstream floodplain.	Accumulated sediments would remain within the normal pool. Risk for erosion of the embankment, accumulated sediments, and downstream cropland due to an uncontrolled dam breach would be reduced by meeting dam safety and design requirements for a high hazard dam. Erosion rates within the downstream channel and floodplain would be consistent with the current condition.	No impact would occur prior to the uncontrolled breach. During the breach, approximately 552,500 cubic yards of earthen material would be eroded from the auxiliary spillway and accumulated sediments during the dam failure event. An additional 523,200 cubic yards of earthen material would be eroded from cropland in the downstream floodplain. In the 1-3 years subsequent approximately 198,600 cubic yards of additional sediment deposits behind the dam would erode. Sediment deposition would occur on 3,284 acres of cropland and the remainder would deposit over 6,787 acres of riparian areas and pasture downstream of the dam. Over decades, erosion rates would begin to stabilize through the failed embankment and accumulated sediments, with erosion consistent with the FWOFI alternative.
Emissions and Pest Control Regulation	Temporary increase in carbon dioxide emissions during construction. Removal of the dam would decrease methane emissions by an estimated 1.34 metric tons a year. During initial years after the drawdown, organic carbon in exposed reservoir sediments would decompose, emitting large volumes of carbon dioxide. Loss of 32 ac of wetland would also reduce carbon sequestration. As sediments were colonized by trees, weeds and herbaceous vegetation, carbon sequestration would increase over time. Both carbon capture and carbon emissions from the current	Temporary increase in carbon dioxide emissions during construction. Post construction emissions unchanged: an estimated 1.34 metric tons per year of methane emissions and both carbon capture and carbon emissions would occur from the reservoir. No changes to pest control regulation anticipated from existing condition.	No change from existing condition until dam breach occurs. After breach event, organic carbon in the 66 acres of exposed reservoir sediments would decompose, emitting large volumes of carbon dioxide. Methane emissions would decrease by an estimated 1.34 metric tons a year. As sediments were colonized by trees, weeds and herbaceous vegetation, carbon sequestration would increase over time from the pool area, however loss of mature trees over 325 acres of riparian forest and an estimated 999.2 acres of wetlands downstream of the dam would

Resource	Alternative No. 1 – FWOFI	Alternative No. 2 - Structural Rehabilitation	Alternative No. 3 - No Action
	reservoir would decrease. Increased incidences of flooding in the forested riparian zone between the dam and Hwy 2 could increase carbon storage. As trees, weeds and herbaceous vegetation colonize the reservoir sediments, native pest control agent habitat would increase.		significantly decrease carbon sequestration. No change to pest control regulation anticipated from existing condition. As trees, weeds and herbaceous vegetation colonize the reservoir sediments, native pest control agent habitat would increase.
Cultural Services	***Cultural services make the world a place in which people want to live - recreational use, spiritual, aesthetic viewsheds, or tribal values.***		
Cultural Diversity and Heritage	See Cultural Resources, Historic Properties	See Cultural Resources, Historic Properties	See Cultural Resources, Historic Properties
Recreation and Ecotourism	Camping, boating, fishing, and most leisure sports provided by the current reservoir would be eliminated. Some upland recreation opportunities may still exist, however without the lake the amount of users would dramatically decrease. The sponsor would likely close the campground to reduce operation expenses. The golf course would lose potential clientele and the irrigation water from the reservoir. During the 500 year event, the Turtle River State Park would experience significant losses in their recreational facilities (lodge, fishery, camping and picnicking). Limited new upland hunting opportunities would be created by conversion of open water habitat	Recreation would temporarily be negatively impacted through the removal of the normal pool. After completion, the normal pool would refill to levels consistent with the current condition. Recreation opportunities would be consistent with the current condition; this includes a NDGF sponsored accessible fishing pier. Recreation opportunities downstream of the dam would remain unchanged from the current condition.	Recreation opportunities would remain unchanged from the current condition until the uncontrolled breach occurs. The breach would result in a sudden loss of the normal pool and elimination of boating, fishing, and water recreation opportunities currently provided. Some upland recreation opportunities may still exist, however without the lake the amount of users would dramatically decrease likely cause loss of recreation area and upkeep. The breach would cause significant damage to the golf course and the loss of irrigation water from the reservoir. The breach would cause substantial erosion and deposition of sediments in natural

Resource	Alternative No. 1 – FWOFI	Alternative No. 2 - Structural Rehabilitation	Alternative No. 3 - No Action
	to grassland habitat. The downstream floodplain would have restored natural function, resulting in increased habitat for hunting and birding opportunities.		areas within the downstream floodplain, degrading habitat conditions that provide hunting opportunities. Decades after the breach, the normal pool would be reclaimed to forest and grassland and would provide limited new hunting opportunities if no longer a campground and recreation area.
Aesthetic Value (Visual Resources)	See Visual Resources	See Visual Resources	See Visual Resources
Supporting Services	***Supporting services refer to the underlying processes maintaining conditions for life on Earth, including nutrient cycling, soil formation, and primary production.***		
Soil Formation and Retention	Temporary erosion impacts at the dam during construction would be mitigated through implementation of a stormwater pollution prevention plan and use of best management practices. Exposed accumulated sediments over 66 acres would be initially exposed during drawdown of the normal pool, leaving them susceptible to wind and water erosion. Over time, sediments would be stabilized as trees, weeds and herbaceous vegetation colonize the sediment. Soils in the downstream floodplain would experience more frequent erosion because of the increased incidence, extents, and intensity of flood flows. Downstream floodplains would have increased deposition due to restoration of sediment transport past the dam, which would increase soil formation.	Temporary erosion impacts during construction would be mitigated through implementation of a stormwater pollution prevention plan and use of best management practices. Long term, no change would occur from the current condition.	No change would occur from the current condition prior to the uncontrolled breach. The breach would erode 552,500 CY within the auxiliary spillway, 198,600 CY of reservoir sediments both initially and in the several years following. An additional 523,200 CY of earthen material would be eroded in the downstream floodplain. The 66 acres of exposed remaining sediment in the old reservoir pool would be susceptible to continued wind and water erosion until vegetation began to establish. Deposition of the eroded sediments would occur over 3,284 acres of cropland and 1,480 acres of natural lands and pastures. Long term, the downstream floodplain would experience both soil loss and soil formation through restored natural erosion/deposition processes typical of unregulated rivers.
Nutrient Cycling	The minimal decommissioning would result in a more controlled release of nutrients than the No Action alternative but would still result in large loss of nutrients downstream. Some cycling would take place as trees, weeds and herbaceous vegetation naturally colonizes the exposed sediments. Nutrients would be	During drawdown for construction nutrients in both dissolved and sediment bound forms would be released downstream. After construction nutrient cycling is expected to return to existing	Prior to the uncontrolled breach, nutrient cycling would remain at existing levels. The breach would release 2 tons of phosphorus, 173 tons of nitrogen, and 2,884 tons of carbon into the downstream river and floodplain from 198,600 cubic yards of reservoir sediment. Erosion of an

Resource	Alternative No. 1 – FWOFI	Alternative No. 2 - Structural Rehabilitation	Alternative No. 3 - No Action
	transported downstream to the river channel, cropland, and natural areas; each of which would increase various biogeochemical cycling processes.	conditions both in the reservoir and downstream.	additional 523,200 cubic yards of sediment from the downstream floodplain and channel will also release high quantities of nitrogen and phosphorus. Some of those nutrients would convert to dissolved fraction and be washed downstream and the remainder would settle out on 3,284 acres of cropland and 1,480 acres of natural lands and pasture. Loss of mature trees in 325 acres of riparian forest would affect nutrient cycling rates. Nutrient cycling in the 4,764 -acre depositional zone would be affected by the nutrient rich sediment. Leaching and removal of nitrogen is expected in the outwash plain soils.
Provisioning of Habitat	The existing 45.99 acres of existing open water habitat that currently supports game fish and waterfowl species would be lost as would 28.17 acres of lacustrine fringe wetlands, and 3.83 acres of depressional wetlands. For several years the exposed sediments would provide shorebird habitat after the constructed breach. The system of braided, shallow channels, beaver dams, and vegetation successional processes that follows would provide habitat for grassland nesting birds, amphibians, deer, beaver, and other small mammals. Fish passage into the reach would be blocked by the grade control structure constructed at the former dam site. Both riparian and depressional wetlands could form over the very long term, benefiting fish and wildlife. Downstream fish habitat would be expected to slightly improve between the former dam and Hwy 2, due to restored sediment transport and reduced incision rates. Downstream of Hwy 2 fish habitat would not expect to see a substantial difference.	Temporary effects will be loss of game fish within the 66-acre reservoir. ND Game and Fish would restock the reservoir when it re-filled, which would be an opportunity to improve species composition. Trends of eutrophication in the normal pool due to nutrient loading and sediment accumulation would continue to degrade game fish habitat over time. Function of existing lacustrine wetland habitat would not be impacted this alternative. Downstream fish and wildlife habitat conditions would not be expected to change.	Prior to the breach, no impacts from the current condition would occur. The breach would result in loss of 45.99 acres of open water habitat, 28.17 acres of lacustrine fringe wetlands, and 3.83 acres of depressional wetlands. As channels eroded across reservoir sediments, exposes sediments would initially provide shorebird habitat after the breach. The system of braided, shallow channels, beaver dams, and vegetation successional processes that follows would provide habitat for grassland nesting birds, amphibians, deer, beaver, and other small mammals. Both riparian and depressional wetlands could form over the very long term, benefitting fish and wildlife. The breach would cause total activation of 1.3 million cubic yards of sediment and contaminants causing EPA surface water quality aquatic life standards to be exceeded for cadmium and zinc; regional standards would be exceeded for nitrogen and phosphorus. Water flowing downstream for years after the breach will pose risks to human health and aquatic

Resource	Alternative No. 1 – FWOFI	Alternative No. 2 - Structural Rehabilitation	Alternative No. 3 - No Action
			species. Scouring from the breach wave on over 15.9 miles of the Turtle River and adjacent floodplains would also degrade habitat quality. These would cause habitat risks to fish, amphibians, birds, and mammals for years after the breach. Loss of 325 acres of mature trees in riparian forest downstream of the dam would impact mammal and bird species. Impacts to 5 acres (scour) and 999.2 acres (sediment deposition) of wetlands would also cause negative impact on habitat for dependent species.

Prepared May 2024

Table 5-3: Summary and Comparison of Alternative Plans for NEPA Resource Concerns

Resource	Alternative No. 1 – FWOFI	Alternative No. 2 - Structural Rehabilitation	Alternative No. 3 - No Action
		Land Cover and Land Use	
Land Use	Conversion of the 66 ac normal pool from open water and fringe wetland to a riparian grassland and wetland complex used primarily for grazing. Loss of flood storage would reduce ability to grow crops on the downstream floodplain, which could result in conversion from cropland to pasture or natural lands.	No change from existing condition.	Preserve current use in the 66-acre normal pool and downstream floodplain until the uncontrolled breach occurs. Over time, the former pool area would convert to channels, beaver dams, wetlands, and grazed pasture. Scour and deposition from the breach wave could take some cropland permanently out of production downstream. Loss of mature trees on 325 acres could encourage conversion to pasture or cropland. Loss of dam would increase flood damages on downstream cropland, which could result in conversion to pasture or natural lands.
		Surface Geology and Soil Resources	
Surface Geology	There would be no effect. All excavations occur in previously affected areas.	Excavation on the auxiliary spillway is only expected to surface material, which is glacial till. Therefore, no effect expected. NDGS would be consulted if fossils were encountered during construction.	Breach would form into the glacial till deposits. Potential for uncontrolled fossil exposure is unlikely.
Soil Resources, Erosion, and Deposition	A full channel restoration would not be completed. The floodplain and exposed slopes would be left to revegetate naturally. This would leave the unconsolidated floodplain sediments and exposed slopes vulnerable to significant wind and water erosion for several years until vegetation establishes. Over time, sediments would be stabilized as trees, weeds and herbaceous vegetation colonize the sediment. Soils in the downstream floodplain would experience more frequent erosion because of the increased incidence, extents, and intensity of flood flows. Downstream floodplains would have increased deposition due to restoration of sediment transport past the dam, which would increase soil formation.	After construction is complete, soils on the dam embankment and the auxiliary spillway would be stabilized by ACB and grass seeding. Once the water level returns to the normal pool elevation, stabilization of the accumulated sediments and exposed slopes would return to pre-project conditions. Sediment will continue to deposit in the reservoir (design assumes historic rates would continue. Therefore, the low level drawdown is to remain at 1040.2, to accommodate anticipated future sedimentation and drawdown potential. No change expected to downstream conditions.	No change to existing conditions prior to dam failure. The breach will erode 751,100 cubic yards of dam and reservoir sediments both initially and in the several years following. An additional 523,200 cubic yards of earthen material would be eroded in the downstream floodplain. The 76 acres of exposed remaining sediment in the old reservoir pool would be susceptible to continued wind and water erosion until vegetation began to establish. Deposition of eroded sediments would occur over 3,284 acres of cropland and 1,480 acres of natural lands and pastures, which will be subject to wind and water erosion until stabilized by vegetation. Long term, the downstream floodplain would experience both soil loss and soil formation through restored natural erosion/deposition processes typical of unregulated rivers.

Resource	Alternative No. 1 – FWOFI	Alternative No. 2 - Structural Rehabilitation	Alternative No. 3 - No Action
Prime Farmland	Increase in flooding, for example 11,530 acres inundated during the 100-year rainfall event. Flooding could result in some cropland erosion, crop damage, then wind-driven erosion.	No change to existing flood impacts, for example 11,285 acres inundated during the 100-year rainfall event. No prime farmland converted to non-farmland.	Prior to the uncontrolled breach, no change to existing flood impacts. The breach alone would inundate 4,050 acres of prime farmland causing significant damage from erosion and deposition. If the breach occurred during a larger scale flooding event acres of prime farmland affected would be even larger. After the breach increased flooding, for example 11,530 acres of prime farmland would be inundated during the 100-year rainfall event.
		Water Resources	
Groundwater Resources	The 500-year flood event would temporarily pond water over 1 stockwater wellhead, potentially contaminating the source directly. Leaching of nitrates and pesticides into the Elk River Aquifer and local groundwater area is a concern.	Wellheads are protected from inundation to the 500-year event, with the exception of one stock well.	Prior to the breach, one stockwater wellhead is impacted from inundation up to the 500-year event. The dam breach would inundate 2 additional wellheads (one production, one irrigation) with risk of leaching nitrogen, cadmium, chromium, copper, lead, nickel, and zinc to the Elk River Aquifer.
Surface Water Resources	Loss of 28.17 acres of lacustrine wetlands (FCU 0 to 21.91) and 45.99 acres of lacustrine other waters. Whether the Sponsor would be required to mitigate would be dependent on USACE jurisdiction determination, which would be completed when they submitted a 404 permit for the project. A braided channel system would form upstream of Larimore Dam, with small, shallow channels migrating back and forth across sediments for several decades. Over many decades, it is possible a single thread channel could form and upland vegetation establish to either side which would likely be natural areas. A more natural downstream riparian floodplain between Larimore and Hwy 2 would be restored by allowing sediment transport, which could reduce the minor channel incision in this area. Peak flows would be higher than natural, however, with removal of the dam given all of the upstream drainage that has taken place. This could generate bank erosion in the	Loss of 0.95 acres of depressional wetlands (FCU 0 to 2.44). Given this would be a federal action, purchase of mitigation credits would be required by NRCS under EO 11990 regardless of USACE jurisdictional determination. Credits would be purchased from an approved CWA mitigation bank. Temporary impacts to 45.99 acres of lacustrine other waters and 28.17 acres of lacustrine fringe wetland due to reservoir drawdown during construction. Downstream sediment transport would continue to be regulated by the dam, creating minor channel incision in the natural meandering portion of the river between Larimore and Hwy 2.	Prior to the breach, no change from the current condition would occur. The breach would result in loss of 28.17 acres of lacustrine fringe wetlands (FCU 0 to 21.91), 3.83 acres of depressional wetlands (FCU 0-2.44), and 45.99 acres of lacustrine other waters upstream and within auxiliary spillway of the dam. Downstream of the dam the flood wave would scour at least 15.9 miles of Turtle River, and approximately 5 acres of wetlands; sediment deposition would impact 999.2 acres of wetlands. Over many decades the river channel and tributaries would stabilize, wetlands could form within scoured areas, and water quality would improve.

Resource	Alternative No. 1 – FWOFI	Alternative No. 2 - Structural Rehabilitation	Alternative No. 3 - No Action
	South Branch Turtle River, until the confluence with North Branch Turtle.		
Jurisdictional Waters of the US (Clean Water Act)	Under this alternative, the Sponsor would submit a Section 404 Permit to USACE immediately prior to construction, who would determine CWA jurisdiction. The maximum CWA wetland acreage would be 32 acres.	Under this alternative, the Sponsor would submit a Section 404 Permit to USACE immediately prior to construction, who would determine CWA jurisdiction. The maximum wetland acreage would be 3.83 acres. The CWA determination would be irrelevant for a NRCS funded project; mitigation credits would be purchased to meet EO 11990 requirements.	The dam breach would be an act of nature; therefore, no jurisdictional determination would be made. The maximum CWA wetland acreage impacted would 32 acres in the U-AA. Downstream, approximately 5.1 acres of wetlands impacted by scour and sediment deposition would impact 999.2 acres of wetlands.
Water Quality	Drawdown and later erosion of accumulated sediments upstream of the dam would transport nutrients and contaminants downstream. Increased levels of nitrogen, phosphorus, carbon, arsenic, cadmium, chromium, copper, lead, nickel, and zinc would be expected downstream as a result. Over the long term, increased frequency, extents, and duration of flooding on cropland would transport higher levels of dissolved phosphorus to the Turtle River, as well as nitrogen and sediment to a lesser degree.	Drawdown may temporarily increase nutrient loading to the downstream river. Accumulated sediments would remain in the normal pool. Erosion and nutrient loading consistent with the current condition would continue in the long term.	No impact to water quality would occur prior to the breach. With the breach, water quality would be impacted by mobilization of 751,100 cubic yards of contaminant laden sediment within and behind the dam. EPA surface water quality aquatic life standards would be exceeded for cadmium and zinc; regional standards are exceeded for nitrogen and phosphorus. Water flowing downstream for years after the breach will pose risks to human health and aquatic species. Water quality would also be impacted from the expected 523,200 cubic yards of scour in the downstream channel and floodplains that would also release high nutrient loads. Over the long term, increased frequency, extents, and duration of flooding on cropland would transport higher levels of dissolved phosphorus to the Turtle River, as well as nitrogen and sediment to a lesser degree,
Water Management	See Regulating Service: Flood and Disease Control	See Regulating Service: Flood and Disease Control	See Regulating Service: Flood and Disease Control
Floodplain Management (FEMA)	After construction, there would be 47,166 acres and 114 structures (including 10 residential) located within the 100-year floodplain. 24 structures (three are residences) have increased flood damages from the 100-year flood after the constructed breach.	After construction, there would be 45,986 acres and 90 structures (including 7 residential) would be located within the 100-year floodplain.	No change to existing conditions would occur prior to the dam breach. A sunny day breach would impact 3,132 acres and 104 structures (including 17 residential).

Resource	Alternative No. 1 – FWOFI	Alternative No. 2 - Structural Rehabilitation	Alternative No. 3 - No Action
Regional and International Water Resource Plans	Increased phosphorus and nitrogen transport out of the Turtle River watershed, from both sediment mobilization from upstream of the dam and increased extents, duration, and frequency of cropland flooding, conflicts with U.S. government commitment to reducing phosphorus and nitrogen concentrations at the international border crossing of the Red River through the International Joint Commission's implementation of the Boundary Waters Treaty. Loss of flood retention is in direct conflict with the strategies laid out in the Red River Basin Commissions Long Term Flood Solutions Report.	Bringing the dam into compliance for state and federal dam safety requirements would ensure downstream nutrient reduction benefits provided by the dam would continue into the future, thus meeting the U.S. government commitment to reducing phosphorus and nitrogen concentrations at the international border crossing of the Red River through the International Joint Commission's implementation of the Boundary Waters Treaty. Implementation of this alternative is in keeping with the strategies laid out in the Red River Basin Commissions Long Term Flood Solutions Report.	With the breach, over 2 tons of phosphorus and 173 tons of nitrogen would be transported downstream in the Turtle River. This, combined with long term impacts of increased cropland flooding, would conflict with the U.S. government commitment to reducing phosphorus and nitrogen concentrations at the international border crossing of the Red River through the International Joint Commission's implementation of the Boundary Waters Treaty. Loss of flood retention is in direct conflict with the strategies laid out in the Red River Basin Commissions Long Term Flood Solutions Report.
		Air	
Air Quality – Dust and Emissions	Short term emissions during construction would occur, including an estimated 1,257 tons of PM10 fugitive dust emissions. Exposed accumulated sediments over 66 acres would be mobilized into the air through wind erosion for several years prior to weeds and herbaceous vegetation naturally colonizing the sediments. Effects would not be expected to exceed air quality monitoring thresholds or ambient air quality standards.	Short term emissions during construction would occur, including an estimated 1,488 tons of PM10 fugitive dust. Effects would not be expected to exceed air quality monitoring thresholds or ambient air quality standards.	Exposed accumulated sediments over 66 acres would be mobilized into the air through wind erosion for several years prior to weeds and herbaceous vegetation naturally colonizing the sediments upstream of the dam. Downstream deposition areas of approximately 4,764 acres would also have potential for wind erosion prior to sediment removal, grading, and crop seeding or weeds and herbaceous vegetation establishment. Clean up efforts would have short term emissions from both construction and dust. Effects would not be expected to exceed air quality monitoring thresholds or ambient air quality standards.
		Biotic Communities	
Plants, Communities, and Habitat Quality	Removal of the reservoir would eliminate a large area of artificial deep-water habitat (45.99 acres).Most of the newly exposed soils on the valley slopes and floodplain would not be deliberately seeded. Therefore, natural plant succession typically associated with shallow braided stream and flood plains that are interspersed with small beaver dams would occur. The ND Park and Recreation deemed ecologically significant	Rehabilitation of the dam would mean retaining the open water habitat, enlarging the herbaceous cover of construction sites, wetland loss in the long-term (absence of floodplain wetlands) versus poor-quality lacustrine fringe wetlands), and absence of riparian woodlands. The ND Park and Recreation deemed ecologically significant communities of Dogwood-willow thicket, and Bur Oak Upland Woodland would remain in-	No change from the current condition until the breach occurs. Changes to plant communities at and upstream of the dam would be similar to FWOFI. During the breach, the flood wave would scour 15.9 miles of the Turtle River and cause damage to mature trees on 325 acres of riparian woodlands and scour or fill 999.2 acres of wetlands. Some of these communities would redevelop, depending on landowner decisions depressional wetlands where hydric soils were

Resource	Alternative No. 1 – FWOFI	Alternative No. 2 - Structural Rehabilitation	Alternative No. 3 - No Action
	community of Dogwood-willow thicket, may be reduced by the removal of the fringe hydrology of the reservoir. The Bur Oak Upland Woodland significant community existed prior to the dam construction and could potentially increase with the reduced hydrology around the perimeter of the reservoir. For a short period, annual grasses and broadleaf plants) would likely temporarily establish along with other early succession perennial plants. Perennial grasses, composed of both native and non-native wet meadow species, wetland plants, and sedge and rush species would make up the majority of the plant community. Woody plant species would primarily be composed of early successional species, willows, and dogwoods. Increased flooding downstream would continue to encourage land use conversion from agriculture to rehabilitated natural plant communities. However, sediment and contaminants transported downstream from the dam will degrade habitat and impair ecological functions for some time.	tact. Habitat favorable to the rare species: Small Yellow Lady's Slipper, would not be impacted by temporary construction impacts. Approximately 13.7 acres of tame grass in the auxiliary spillway and embankment will be disturbed for construction and would be reseeded to a native grass/forb suitable for critical use areas. Any other tame grass areas disturbed for roads or staging would be seeded to a superior mix of native grasses and forbs suitable for pollinators. The seed mix on the dam itself needs to result in a grass stand that can be mowed and monitored to ensure that tree growth does not occur. No change would be expected from current condition downstream of the dam.	entirely scoured would be unlikely to re-form over the time period of this watershed plan, however wetlands lost to sediment deposition with intact hydric soils below could re-establish over time. The increased flooding incidence downstream would improve remaining riparian woodlands and floodplain wetlands in a manner similar to the FWOFI. Increased flooding downstream would continue to encourage land use conversion from agriculture to rehabilitated natural plant communities. However, sediment and contaminants transported downstream from the dam would degrade habitat and impair ecological functions for some time.
Riparian Woodlands	Over time, increased incidence downstream flooding and restoration of sediment transport could improve existing riparian forest conditions.	During construction, up to 2.7 acres of woodland may need to be removed. Most of this would regenerate over time. 0.1 acres of permanent woodland loss is expected.	No change from the current condition until the breach occurs. The breach flood wave would damage mature trees on 325 acres of existing riparian forest. The extent to which that would be converted to pastureland or cropland during flood reclamation work in the watershed is unknown, but the area of riparian woodlands could be reduced.

Resource	Alternative No. 1 – FWOFI	Alternative No. 2 - Structural Rehabilitation	Alternative No. 3 - No Action
Mammals, Amphibians, Reptiles, and Invertebrates	Temporary disruptions during construction include the presence of humans and noise. The movements and foraging patterns of larger mammals would be temporarily disrupted. There would be no suitable bat roosting trees removed. For animals dependent on the permanent loss of 32 acres of wetland habitat and 45.99 acres of deep water habitat from the reservoir, the drawdown and auxiliary spillway fill would cause displacement or death. Species make-up and distribution would shift to those more suitable for riparian and grassland habitats instead of open water and lacustrine wetlands. Downstream conditions could improve for species reliant on a riparian forest but could be reduced for aquatic species not suited to high turbidity.	Temporary disruptions during construction due to the presence of humans, noise, and drawdown of the deep-water habitat. The reseeding of staging and incidental areas to native pollinator mixes would increase the quality of the grass habitat potentially benefiting bumblebees and Danaus plexippus (monarch butterfly). Mature tree losses are expected to be minimal, but some trees suitable for for NFGFD Level I species including the Big Brown Bat (Eptesicus fuscus), Little Brown Bat (Myotis lucifugus), and federally endangered Northern Long-Eared Bat (Myotis spetrentrionalis) could be potentially destroyed. Long term, species makeup and distribution would be equivalent to the current condition.	Prior to the uncontrolled breach, no effect from the current condition is expected. During a breach, the reservoir would suddenly drain, removing the 66 acres of open water habitat and also damaging some riparian woodlands nearby downstream. For species dependent on the 28.17 acres of lacustrine fringe wetlands and 3.83 acres of depressional wetlands, the dam failure would cause displacement or death. For several years the exposed sediments over 66 acres would provide shorebird habitat in the former reservoir area. The system of braided, shallow channels, beaver dams, and vegetation successional processes that follow the dam failure would provide habitat for amphibians, reptiles, deer, beaver, and other small mammals, particularly mussels (Level I Lasmigona compressa, creek heelsplitter) and amphibians. The floodwave would cause the loss of mature trees on 325 acres of riparian forest. Scour would occur on over 15.9 miles of the Turtle River. Impacts from the contaminants in the sediment such as heavy metals would be a concern for safe mammal, amphibian, reptile and invertebrate habitat. .Loss of mature woodland may impact NFGFD Level I or federally listed T&E species including the Big Brown Bat (Eptesicus fuscus) and Little Brown Bat (Myotis lucifugus), Northern Long-Eared Bat (Myotis spetrentrionalis) and monarch butterfly. Deposition would occur over 3,284 acres of cropland and 1,480 acres of natural lands and pasture. Reduced water quality due to contaminants would likely impact some species as well. Over the course of many decades, downstream conditions would improve from the degraded condition created by the breach for species reliant on a functional riparian floodplain and wetlands.

Resource	Alternative No. 1 – FWOFI	Alternative No. 2 - Structural Rehabilitation	Alternative No. 3 - No Action
Fish	Species reliant on the deep-water habitat would no longer be present above the location of Larimore Dam. The grade control structure would not be fish passable, therefore the downstream and upstream channel would function independently. Lessening downstream channel incision processes could benefit several species, including the Level I Margariscus nachterbi (northern pearl dace). Restored floodplain connectivity, additional channel length, and a more functional downstream floodplain would benefit several other native (non-gamefish) species in the long term. In the short term, species sensitive to turbidity could be negatively impacted. Fish species that prefer cooler water conditions would benefit in the long term.	Temporary impacts during construction; NDGF has indicated potential opportunities to improve species composition in the fishery. NDGF would restock fish populations with locally desirable game fish such as perch, walleye and northern pike enjoyed for sport and human consumption. Other native species found in the reservoir would also benefit including black bullhead, and white sucker. Trends of eutrophication in the of the normal pool due to nutrient loading and sediment accumulation would continue to degrade game fish habitat over time. Downstream impacts during construction would be mitigated through implementation of the required stormwater pollution prevention plan. In the long-term, fish species that require clear water (e.g., Margariscus nachterbi, northern pearl dace) would benefit from the presence of the dam and continued retention of the large volume of accumulated sediments.	No change from the current condition until the breach occurs. The rapid release of the reservoir during the breach would result in fish death. Extensive scour, sedimentation, contaminants, and loss of riparian forests would compromise fish habitat. This would be detrimental to cold water fishery in and around the Turtle River State Park where trout are stocked, which is a popular fishery. Long term, conditions would slowly improve to function consistently with the FWOFI alternative.

Resource	Alternative No. 1 – FWOFI	Alternative No. 2 - Structural Rehabilitation	Alternative No. 3 - No Action
Birds, Migratory Birds, Eagles	During construction, noise and reservoir drawdown would displace some bird species but be an attractant for fish-eating birds. Once the project is complete, fish-eating birds and those that depend on open water habitat and lacustrine fringe wetlands would be permanently displaced. These include four NDGFD Level I species of conservation concern. Shorebirds could benefit from 66 acres of exposed sediment flats in the short term. Restored sediment transport could improve riparian woodlands, which could benefit woodland nesting species such as Level I/USFWS listed Coccyzus erythropthalmus(Black-billed Cuckoo) and Melanerpes erythrocephalus (Red-headed Woodpecker). Long term improved riparian grassland habitat could provide opportunities for other bird species. No significant changes from the current condition for eagles.	Temporary impacts during construction to habitat for species dependent on open water and fringing wetland habitats. Long term, species would remain unchanged from the current condition.	No change from the current condition until the breach occurs. During the breach, the open water habitat would be eliminated suddenly, resulting in a change in the type of migratory birds that would use the habitat. Downstream of the dam, the flood wave would scour at least 15.9 miles of Turtle River, and destroy 325 acres of mature trees in riparian woodland. Approximately 5.1 acres of wetlands would be lost to scour and sediment deposition would impact 999.2 acres of wetlands Depending on the time of year, this would result in bird mortality and long term losses of eagle and migratory nesting areas. These losses would negatively impact several USFWS listed migratory birds and NDGF Level I-III species of concern. Contaminants from the sediments would be a concern for health of the migratory birds in the downstream USFWS waterfowl production areas. Shorebirds could benefit from 4,831 acres of exposed sediment flats in the short term. Migratory bird and eagle habitat loss would be greater than the FWOFI alternative.
Federal Threatened and Endangered Animal Species	During construction there would be no adverse direct or indirect effects on species – no trees would be removed and herbaceous habitat would not change in type or scope. It is unlikely the number of trees suitable as roosting sites for M. septentrionalis (northern long-eared bat) would increase in the short or long term. Herbaceous vegetation suitable for Monarch Butterflies, Suckley's cuckoo bumble bees and western regal fritillaries would be expected to increase in the long term with the gradual replacement of open water with herbaceous vegetation. Long term effects of improved downstream riparian woodlands may benefit the northern long eared bat and monarch butterfly.	During construction, a few trees of suitable size for the nationally Endangered NLEB could be removed. This alternative was submitted for consultation through the USFWS IPaC site and received a determination of "May Affect - Not Likely to Adversely Affect" the NLEB on 2/26/2026. Long term, no change from existing conditions expected. Construction would cause a temporary loss of herbaceous vegetation suitable for Suckley's Cuckoo bumble bee, western regal fritillary, Monarch Butterflies and milkweed, necessary for their production. Long term, no change from existing conditions expected.	No impact until the breach occurs. The breach flood wave would destroy mature trees on 325 acres of riparian woodlands suitable for NLEB habitat. The development of a braided stream and beaver dam system would create floodplain wetlands which may benefit herbaceous vegetation suitable for Suckleys cuckoo bumble bee, western regal fritillary, Monarch Butterflies and milkweed species. Long term, the re-establishment of herbaceous habitat in the pool sediments and downstream deposition areas could increase monarch butterfly, Suckley's Cuckoo bumble bee, and western regal fritillary habitat.

Resource	Alternative No. 1 – FWOFI	Alternative No. 2 - Structural Rehabilitation	Alternative No. 3 - No Action
Undesirable Species (including invasive species)	Seeding and weed control would be required only in the constructed breach of the embankment. Natural regeneration in the sediment pool would for a short period, result in infestations of noxious weeds such as Canadian thistle along with other annual grasses and broadleaf plants. Presence of non-native undesirable species and noxious weeds is likely over the 66 acres of exposed accumulated sediment behind the dam.	Seeding of desirable native species and weed control would be required for all areas disturbed during construction. Long term, no change from existing conditions expected.	No impact until the breach occurs. During the breach, the flood wave would carry any invasive species of fish, mussels, invertebrates and propagules of undesirable plant species to a wide area downstream. Currently, there are no known invasive fish species or zebra mussels in the reservoir, however this increasingly possible over time. Long-term, these species would colonize additional areas and be a problem for agricultural production or waterbodies. The breach would cause 1.3 million cubic yards of downstream sediment erosion, the deposition from which is expected to cover 4,764 acres that would provide opportunity for undesirable species and noxious weeds to take hold. After the breach, 66 acres of exposed sediments above the dam and the breached embankment would also provide opportunity for undesirable species and noxious weeds.
Human Environment			
Cultural Resources, Historic Properties	Massive disturbance to Larimore Dam – an ND SHPO designated architectural site. The FWOFI would be the most destructive to the dam compared with other alternatives. CCC stone and brick structures have been deemed eligible for the NRHP within the Turtle River State Park, would be impacted by a 500-year event. There are several historic bridges eligible for the NRHP downstream of the dam that may be affected during a 500-year event.	ND SHPO was consulted on the Class III Cultural Resource Survey (Appendix D-11), completed on 7/30/2025. The ND SHPO concurred with the NRCS recommendation of “No Historic Properties Affected” for Alternative 2. An adjacent area will require “avoidance area” signage to prevent incidental impacts during construction. The Larimore Dam itself was documented as a cultural site, however it will remain in the existing footprint, it was deemed Not Eligible for any NRHP criteria. Alternative 2 will not significantly alter the position or function of the dam or its impoundment zone and, thus, does not pose an adverse effect to the integrity or eligibility status of surrounding cultural resource sites. NRHP eligible sites downstream, including 8 CCC structures within the Turtle River State Park and other potentially eligible bridges, would be inundated only during the 500-year event (as it is currently unless the dam were to fail).	No effect would occur to existing Larimore Dam (considered by ND SHPO to be an architecturally significant site) prior to the uncontrolled breach. During the breach, disturbance to existing Larimore Dam would be severe. Massive erosion of the auxiliary spillway would occur which would negatively affect the architectural value of Larimore Dam. Failure of the embankment itself is also possible with this alternative. This massive erosion would also likely erode the archeological site within the U-AA, potentially destroying culturally significant material. During the breach, approximately 20 cultural resource sites would be inundated and potentially damaged or destroyed. 8 of these sites have been deemed eligible for the NRHP including the CCC structures at Turtle River State Park. been deemed eligible for the NRHP

Resource	Alternative No. 1 – FWOFI	Alternative No. 2 - Structural Rehabilitation	Alternative No. 3 - No Action
Public Health and Safety	See Flood and Disease Control	See Flood and Disease Control	See Flood and Disease Control
Transportation infrastructure	More frequent flooding downstream would cause more frequent damages. Increased costs for larger structure sizes would be realized as stream crossings are replaced. There would be three bridge crossings (28th St., 21st Ave., and 23rd Ave) that would no longer meet North Dakota Century Code Stream Crossing Standards.	Long term, no change from the current condition.	No change prior to the breach. The breach would result overtopping of 18 roads, and overwhelm bridge opening causing potential damage and road washouts. There would be 55.4 miles of overtopped roads. Road damages would require alternative routes to cross the river which would increase haul distance for agricultural products, reduce emergency services access for local residents, and increase commute times.
Recreational Resources	See Cultural Services: Recreation and Ecotourism	See Cultural Services: Recreation and Ecotourism	See Cultural Services: Recreation and Ecotourism
Visual Resources	See Aesthetic Value (Visual Resources)	See Aesthetic Value (Visual Resources)	See Aesthetic Value (Visual Resources)
Local and Regional Economy	Total expected annual damages of $1.8 million (1,823,252), including damages to structures, crop production, and roadways. Expected annual damages to structures, crop production, and roadways is $141,444 higher than it would be under the No Action Alternative. The project results in negative net annual benefits, (-$491,541).	Total expected annual damages of $1.6 million (1,643,022), including damages to structures, crop production, and roadways. The structural rehabilitation would reduce expected annual damages to structures, crop production, and roadways by $38,786, compared to the No Action Alternative. The project results in negative net annual benefits (-$483,117) and a benefit to cost ratio of 0.1.	No effect until the dam breach occurs. Total expected annual damages of $1.7 million (1,681,808), including damages to structures, crop production, and roadways. The breach during the 1844-year event would result in $39.4 million in damages to structures and vehicles, $31 million in damages to agricultural land, and $3.6 million in damages to roadways. Additional long-term impacts to crop production would result from erosion and deposition of sediments within the floodplain.
Noise	During construction, noise from heavy equipment would be expected to be a maximum of 95 decibels at a distance of 50 feet. No permanent effects.	During construction, noise from heavy equipment would be expected to be a maximum of 95 decibels at a distance of 50 feet. No permanent effects.	No effect.

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6 Environmental Consequences

Environmental consequences of each alternative, with respect to relevant ecosystem services and NEPA resource concerns, are summarized in detail for each of the alternatives in this section. The descriptions of environmental consequences address the potential environmental, social, and economic effects of each alternative. Descriptions of cumulative impacts, consisting of historical, current, and future effects of the alternatives, are located in Section 6.3.

6.1 Ecosystem Services

For ecosystem services, evaluation of the environmental consequences focuses direct and indirect effects in the zone near the reservoir (Upstream Assessment Area, U-AA) or effects downstream (D-AA) as appropriate.

6.1.1 Provisioning Services

6.1.1.1 Food

Alternative No. 1 - FWOFI

- U-AA: Fish and waterfowl living in or visiting the reservoir provide a direct food source to humans. During the construction project, as the lake was being drawn down, there would be good fishing for a very brief period in the remaining pool as fish became concentrated. With the dam removed, the current game fish species in the lake which rely on deep water habitat (walleye, northern pike, perch) would no longer be able to survive in the river system perennially. Over the next several decades a multi-thread channel would likely form across the sediments behind the dam, with dense thickets of reed canary grass and occasional beaver dams. Fish species that could survive shallow channels less than a foot deep with warm water, such as minnows, suckers, and dace would populate this reach. These species are very small and not a food source for humans. There is no waterfowl hunting at Larimore, so no major change from current hunting opportunities. Many decades post project, the existing 66 acre normal pool would convert to a riparian grassland and wetland complex which would provide suitable habitat for game animals such as whitetail deer and pheasant that would be available for consumptive use through recreational hunting.
- D-AA: After project completion, the eliminated flood attenuation would result in long-term increased flooding on farmland downstream, thus decreasing crop yields and impacting food production. Impacts to crop production are detailed in Appendix D-5 Economics Evaluation.

Alternative No. 2 - Structural Rehabilitation

- U-AA: During construction, as the lake was being drawn down, there would be good fishing for a very brief period in the remaining pool as fish became concentrated. Access to fish food sources would be interrupted as the reservoir refills. After the reservoir refills, likely 1-2 years, NDGF would restock the reservoir with game fish. Waterfowl could use the site for nesting and migratory stopover sites, which could improve the regional waterfowl numbers.

- D-AA: Maintaining flood attenuation at the dam would protect farmland downstream from flooding except for the 100-year event. The structural modifications proposed for the 100-year do increase flooding by 600 acres of cropland. However, the 50-year and 500-year inundation are reduced by 927- and 1189- acres respectively. Impacts to crop production and acreage for all recurrence intervals are detailed in Appendix D-5 Economics Evaluation.

Alternative No. 3 – No Action

- U-AA: The normal pool would continue to provide fish and waterfowl for consumptive uses until an uncontrolled breach of the dam occurred. Game fish would be lost in the dam failure and afterwards the current game fish species in the lake would be which rely on deep water habitat (walleye, northern pike, perch) would no longer be present. The banks of an initial deep headcut channel would collapse in and over the next several decades a multi-thread channel would likely form across the sediments behind the dam, with dense thickets of reed canary grass and occasional beaver dams. Impacts on consumptive uses would be identical to the FWOFI, long term.
- D-AA: Cropland downstream would be protected until an uncontrolled breach of the dam. The flood wave would result in 523,200 cubic yards of erosion on cropland, and 747,400 cubic yards of deposition on cropland, resulting in reduced food production from the impacted acres either on a temporary or permanent basis. The uncontrolled breach would impact 9,840 acres of cropland. After failure, the eliminated flood attenuation would result in long-term increased flooding on farmland downstream, thus decreasing crop yields and impacting food production. Impacts to crop production are detailed in Appendix D-5 Economics Evaluation.

6.1.1.2 Fresh Water

Alternative No. 1 – FWOFI

U-AA: No sources of fresh water for human use (drinking water) are located within this area.

D-AA: The 500-year flood event would temporarily pond water over three private wellheads (one production, one stock and one irrigation well). No known drinking water wells would be inundated by the event. Leaching of nitrates and pesticides into portions of the Elk River Aquifer is a potential concern.

Alternative No. 2 - Structural Rehabilitation

U-AA: No sources of fresh water for human use (drinking water) are located within this area.

D-AA: The 500-year flood event would temporarily pond water over one private wellhead, potentially contaminating the source water directly. The well is a stock well. Leaching of nitrates and pesticides into the local groundwater area is a concern.

Alternative No. 3 – No Action

U-AA: No sources of fresh water for human use (drinking water) are located within this area.

D-AA: Within the downstream area, there are three private wellheads that provide water supply to landowners. The breach event would mobilize multiple contaminants with potential to leach to the local groundwater of these wells, including 751,100 cubic yards of dam reservoir sediments projected to erode. Levels of heavy metals (cadmium and zinc) in the pool sediments exceed EPA drinking water standards. Additional nutrients would be released from the projected 523,200 cubic yards of scour on the downstream floodplain.

6.1.2 Regulating Services

6.1.2.1 Flood and Disease Control

Alternative No. 1 - FWOFI

- U-AA: No impact.
- D-AA: The public safety risk due to a dam breach would be eliminated. During construction, the reservoir drawdown may cause slight increases to discharge downstream. No flooding would result, however, because allowable discharges to drawdown the reservoir would be regulated based on downstream flow conditions. Thus, all drawdown discharge would be contained within the stream channel. After the project is completed, flood attenuation would be eliminated, increasing the incidence of flooding downstream. During a 100-year flood event, approximately 47,138 acres would be inundated (25,450 acres of cropland), including 10 residential structures, 71 agricultural structures, 32 commercial structures, and one industrial structure. Flooding impacts at other recurrence intervals are provided in Appendix D-5 Economics Evaluation.

Alternative No. 2 – Structural Rehabilitation

- U-AA: No impact.
- D-AA: Flood risk associated with an uncontrolled breach would be reduced by meeting dam safety and design requirements for a high hazard dam. During construction, the reservoir drawdown may cause slight increases to discharge downstream. No flooding would result, however, because allowable discharges to drawdown the reservoir would be regulated based on downstream flow conditions. Thus, all drawdown discharge would be contained within the stream channel. During construction of the principal spillway riser tower there would be a temporary interruption in flood attenuation. Once the construction is complete, the alternative would result in compliance with dam safety design requirements for a high hazard designation dam. Flood protection would be provided to cropland, residential structures, non-residential structures, and roads. Flood protection for the 2-year through 500-year events would remain unchanged from the current condition. During a 100-year flood event, approximately 45, 963 acres would be inundated (26,050 acres of cropland), including seven residential structures, 55 agricultural structures, 27 commercial structures, and one industrial structure. Flooding impacts at other recurrence intervals are provided in Appendix D-5 Economics Evaluation.

Alternative No. 3 – No Action

- U-AA: No impact.
- D-AA: Flood prevention would be provided up to the uncontrolled breach of Larimore Dam. The flood wave resulting from the breach would place 82 human lives and 14 residential structures at risk. Contaminants would deposit on 3,284 acres of cropland, which could put food supply at risk. After the breach, the downstream floodplain would function as described in the FWOFI alternative.

6.1.2.2 Erosion Regulation

Alternative No. 1 - FWOFI

U-AA: During construction the reservoir would be drawn down and the dam removed. This would eliminate the erosion regulation the dam and the reservoir waters provide. The Sponsor would not have the financial resources for a full channel restoration or floodplain revegetation. The reservoir area would form multiple shallow channels (braided stream) and migrate across the 66 acres of unconsolidated sediments with each flood event. Beaver dams and vegetation would establish over time, although larger floods would cause new erosion and channels to form. Over the course of decades, the valley would stabilize, and trees, weeds, and grasses would start to grow on higher elevation sediments. Both riparian and depressional wetlands could form over the very long term and it is possible a single thread channel could eventually form. Tributary stream channels down the valley side slopes would lengthen and resume pre-reservoir conditions.

- D-AA: Lack of flood attenuation would result in increased flooding incidence downstream. Increased flood extents and velocities would result in additional cropland erosion. Inundation caused crop damage would leave soils bare and prone to wind-driven erosion. Resumed sediment supply to the downstream river channel between the dam and Hwy 2 would alleviate some channel incision activity but increased peak flows in the channelized portions of the river downstream of Hwy 2 would cause increased bank erosion.

Alternative No. 2 – Structural Rehabilitation

- U-AA: During construction, the reservoir would be temporarily drawn down, however mobilization of accumulated sediments would be mitigated through the temporary cofferdam that would be installed, as well as implementation of the 404 Permit and Stormwater Pollution Prevention Plan required for the project. After the construction is completed, the soils on the dam embankment and the auxiliary spillway would be stabilized by ACB and vegetation. Once the water level returns to the normal pool elevation, stabilization of the accumulated sediments and exposed slopes would return to pre-project conditions. The alternative would result in compliance with dam design requirements for a high hazard dam, significantly lowering the risk of failure due to erosion of the auxiliary spillway.
- D-AA: The dam would continue to attenuate downstream peak flows for the next 100-years, resulting in reduced erosion on cropland by floodwater. The dam would cause a barrier to natural sediment migration within the river causing minor channel incision and instability to continue at current rates.

Alternative No. 3 – No Action

- U-AA: Accumulated sediments would remain within the reservoir until the uncontrolled breach of the auxiliary spillway occurs. The failure of the auxiliary spillway would rapidly erode 552,200 cubic yards of material from the auxiliary spillway. In addition, 198,600 cubic yards of accumulated sediments in the reservoir would be mobilized through multiple channels headcutting upstream over the course of 1-3 years after the breach.
- D-AA: Erosion to cropland in the downstream floodplain would be consistent with the current condition until the uncontrolled breach of the dam occurs. The eroded material from the auxiliary spillway and accumulated sediments would be transported into the downstream floodplain. Erosion of an additional 523,200 cubic yards of sediment would occur from the channel and floodplain downstream of the dam. An estimated 325 acres of mature riparian trees would be lost from the breach with a corresponding loss of erosion regulation. Sediment deposition would occur on approximately 3,284 acres of cropland and 6,787 acres of riparian lands. After the breach, erosion would occur more frequently on downstream cropland due to increased flood flows (Appendix D-3) but in the long term be consistent with Alternative 1.

6.1.2.3 Emissions and Pest Control

Alternative No. 1 – FWOFI

- U-AA: Implementation would contribute to atmospheric carbon dioxide through fossil fuel use in the construction equipment, and oxidation of soil organic matter during the period of topsoil removal and temporary grass cover losses. Decommissioning of the dam would reduce the ability of the pool to store carbon within the contained sediments. In the long term, the reservoir pool would no longer emit the 1.34 metric tons of methane annually, or carbon dioxide during times of high algal content. During initial years following drawdown of the pool area, organic carbon in exposed reservoir sediments would decompose, emitting large volumes of carbon dioxide (Amani et al, 2022). In the mid-term, grasses, weeds, and invasive species would populate the sediments. Herbaceous vegetation is considered to provide a “medium” level of carbon dioxide reduction. In the long term, more native species of shrubs and trees may repopulate the pool and increase carbon storage to a higher level. It is also possible the existing pool area would be converted to pastureland and grazed which would provide less emission induced regulation benefits compared with the return of tree/shrub vegetation. The return of either herbaceous or forest vegetation would provide a similarly “high” level of native pest control agent habitat benefit (Riis, 2020).
- D-AA: Lack of flood attenuation would result in increased flooding incidence downstream. These events could result in some cropland scouring and a loss of the ability of the soil to store carbon. The resumed sediment supply to the downstream channel may improve the conditions for riparian forest vegetation which could increase carbon storage and also increase native pest control agent habitat.

Alternative No. 2 – Structural Rehabilitation

- U-AA: During construction, the temporary removal of vegetation and exposed sediments may result in a temporary increase in carbon dioxide emissions and loss of native pest control agents. Post construction carbon sequestration levels and native pest control agent habitat would be unchanged compared with the FWOFI alternative. Methane emissions would continue to average 1.34 metric tons per year as is the case currently. Regular mowing of the dam and the toe slopes for maintenance would require fossil fuels.
- D-AA: Once the project is completed, compliance with dam design standards for a high hazard dam would protect cropland from erosion and deposition caused by an uncontrolled breach. The dam would continue to cause a barrier to natural sediment migration within the river causing channel incision and instability. Changes to the regulating ability of the downstream vegetation would not be significantly changed compared with the FWOFI.

Alternative No. 3 – No Action

- U-AA: The regulatory effects of the reservoir would remain unchanged until the uncontrolled breach of the auxiliary spillway occurs. pest control agent habitat benefit (Riis, 2020). In the current condition, continuing maintenance contributes to atmospheric carbon dioxide with use of fossil fuels. Regular mowing of the dam and the toe slopes for maintenance requires fossil fuels. Construction would contribute to atmospheric carbon dioxide through production of concrete, fossil fuel use in the construction equipment, and oxidation of soil organic matter during the period of topsoil removal and temporary grass cover losses. The ability of the pool to store carbon within the contained sediments would be lost. Methane emissions would be reduced by 1.34 metric tons per year and the pool would no longer emit carbon dioxide during times of high algal bloom. In the mid-term, weeds and invasive species would colonize sediments left within the former pool. Herbaceous vegetation is considered to provide a “medium” level of carbon dioxide reduction. In the long term, more native species of shrubs and trees may repopulate the pool and increase carbon storage to a higher level. It is also possible the existing pool area would be converted to pastureland and grazed which would provide less emission induced regulation benefits compared with the return of tree/shrub vegetation. The return of either herbaceous or forest vegetation would provide a similarly “high” level of native pest control agent habitat benefit (Riis, 2020).
- D-AA: The uncontrolled breach would result in an estimated loss of 325 acres of riparian forest vegetation immediately downstream of the dam. The loss of the carbon sequestration and pest control benefits provided by the riparian forest would be large compared with Alternative No. 2 or FWOFI.

6.1.3 Cultural Services

6.1.3.1 Cultural Diversity and Heritage

See Section 6.2.6.1.

6.1.3.2 Recreation and Ecotourism

Alternative No. 1 - FWOFI

- U-AA: Decommissioning of the dam would eliminate boating, fishing, and water based recreational opportunities currently provided by the reservoir. The recreation area would remain open as some recreational opportunities will be present in upland areas. However, lack of a reservoir would severely limit recreation use volume. Additional opportunities for new users are limited, rather would provide additional huntable acres for those holding one of the limited whitetail deer hunting permits. Increased opportunities for upland game birds would be present, however Larimore Dam is not located in primary range for North Dakota's popular upland gamebirds (pheasant, sharptailed grouse, and Hungarian partridge), therefore additional users of those resources are limited.
- D-AA: A more naturally functioning floodplain and sediment transport would increase quality of riparian habitat that may enhance hunting and fishing opportunities for floodplain areas downstream. During the 500 year event, the Turtle River State Park would experience significant losses in their recreational facilities (lodge, fishery, camping and picnicking). Some of these would be rebuilt over time. Most land downstream of the dam is in private ownership with access regulated by landowners. While this would enhance recreational opportunities for those with access, it would not increase the number of recreation users to the area.

Alternative No. 2 – Structural Rehabilitation

- U-AA: During construction, all water-based recreation activities would be restricted. However, upland based activities would remain. After completion, the project would provide all recreation activities including fishing, boating, and camping through the remainder of the dam's extended design life (at least 100 years from construction). Fishing and boating activities are expected to diminish over the design life due to increased sediment accumulation and eutrophication in the reservoir, however, the maximum normal pool depth after the project life is expected to be at least 25 feet. Though fishing opportunities may diminish over time, a fish population in the reservoir would be maintained through the design life of the dam.
- D-AA: Recreational opportunities downstream of the dam would remain unchanged.

Alternative No. 3 – No Action

- U-AA: The current recreation activities, including fishing, boating, and camping, would be provided until the dam has an uncontrolled breach through the failure of the auxiliary spillway (1,844-year rainfall event). After the uncontrolled breach of the dam, the upland recreational opportunities will still be present; however, with loss of the reservoir visitors will reduce significantly. Additional opportunities for new users are limited, rather would provide additional huntable acres for those holding one of the limited whitetail deer hunting permits. Increased opportunities for upland game birds would be present, however Larimore Dam is not located in primary range for North Dakota's popular upland gamebirds (pheasant, sharptailed grouse, and Hungarian partridge), therefore additional users of those resources are limited

- D-AA: Recreational opportunities downstream of the dam would remain unchanged until the uncontrolled breach occurred. The breach would result in sediment erosion and deposition within channel and natural riparian areas downstream. The Turtle River State Park would experience drastic losses in their recreational facilities (lodge, fishery, camping and picnicking). Some of these would be rebuilt over time. The stream and riparian area would see degrading available habitat for game species that are recreationally hunted. Over time as the breach begins to stabilize, a more naturally functioning floodplain and sediment transport would increase quality of riparian habitat that may enhance hunting and fishing opportunities for floodplain areas downstream. Most land downstream of the dam is in private ownership with access regulated by landowners. While this would enhance recreational opportunities for those with access, it would not increase the number of recreation users to the area.

6.1.3.3 Aesthetic Value

See 6.2.6.5

6.1.4 Supporting Services

6.1.4.1 Soil Formation and Retention

Alternative No. 1 - FWOFI

- U-AA: Drawdown of the reservoir would expose unvegetated valley slopes and 66 acres of highly erodible sediments that have accumulated behind the dam. The sediments in these locations would initially not have a cover of healthy topsoil and it would take some time for this to develop. In the interim, they would be vulnerable to wind and water erosion, thus slowing the rate of topsoil development. Over time, sediments would be stabilized as trees, weeds, and herbaceous vegetation colonize the bare soils.
- D-AA: Soils downstream consist primarily of those associated with riparian systems (i.e., stream depositional areas, oxbows), wetlands, grasslands used as pasture, and croplands. During construction there would be no impacts. Once the project is completed and the dam removed, the accumulated sediments would be transported and deposited downstream. In locations with perennial vegetation and potential for stabilization, soil formation would increase downstream. Increased flooding incidence would damage sites where excess erosion would occur. Cropland is vulnerable to topsoil loss after flood erosion due to scour, crop damages due to inundation (and decreased phytostabilization), and subsequent wind erosion. In low-lying areas, conversion from agricultural land use to grasslands or to rehabilitated wetlands may occur and this would increase the potential for soil formation.

Alternative No. 2 – Structural Rehabilitation

- U-AA: During construction, the exposed slopes and accumulated sediments would not contain or form soils that would be affected. Once the reservoir is refilled, these sediments would again be covered by water. Impacts through construction would

be required to be mitigated through implementation of a Stormwater Pollution Prevention Plan.

- D-AA: The project would maintain downstream flood reductions. During construction there would be no sediment transport and the waters released during drawdown would not exceed the channel limitation. Once the project is completed, the outcome would maintain decreased sediment deposition and new soil development, decreased potential of expanded grasslands/wetlands, but also increased soil retention on croplands compared to natural hydrology without the dam.

Alternative No. 3 – No Action

- U-AA: Sediments from the upstream watershed would be deposited in the reservoir upstream of the dam embankment like the current condition. After the dam experiences an uncontrolled breach, accumulated sediments and auxiliary spillway material would be transported downstream, and deposited in the breach floodplain. The accumulated sediments would continue to be released and transported downstream until the breach began to stabilize. In total, 751,100 cubic yards of earthen material would be transported downstream over time. Exposed sediments would be further erodible by wind, until vegetation establishment.
- D-AA: Larimore Dam would continue to be a barrier to sediment transport downstream, resulting in decreased sediment deposition and new soil development, decreased potential of expanded grasslands/wetlands, but also increased soil retention on croplands, until the dam failure occurred.

  During the breach, the flood wave would cause scour of 523,200 cubic yards on the downstream floodplain, within both cropland, natural areas, and pasture. Deposition of the eroded sediment would occur over 3,284 acres of cropland and 1,480 acres of natural lands and pastures. Long-term, the incidence of flooding would increase. The downstream channel would resume a dynamic erosion/deposition condition resulting in both soil loss and soil formation. If land use would be converted from crop farming to grassland or wetlands, then soil formation would increase.

6.1.4.2 Nutrient Cycling

Alternative No. 1 FWOFI

- U-AA: The minimal decommissioning option would result in a more controlled release of nutrients stored in the lake sediments compared with the No Action Alternative. The pool sediments would be rich in nitrogen and phosphorus. Some of these would stay in place and would be cycled with the gradual increase of herbaceous vegetation.
- D-AA: Nutrient rich water is expected to occur during draw down and during spring freeze thaw cycles. Nutrients are expected to be transported in both dissolved and sediment bound forms to them downstream river channel, cropland, pastureland, and natural areas; each of which would generate an increase in various biogeochemical cycling processes.

Alternative No. 2 Structural Rehabilitation

- U-AA: During drawdown for construction, nutrients in both dissolved and sediment bound forms would be released downstream. Upon refilling, the nutrient content of the water would be reduced, however is expected to rebound as the natural lake turnover processes reintroduce nutrients from the sediment.
- D-AA: During construction, nutrient rich waters would alter nutrient cycling in the river. Nutrient cycling is expected to return to existing conditions quickly following construction.

Alternative No. 3 No Action

- U-AA: Prior to the uncontrolled breach, nutrient cycling would remain at existing levels with the reservoir acting as a nutrient sink with seasonal turning over of nutrients. The breach would release approximately 2 tons of phosphorus, 173 tons of nitrogen, and 2,884 tons of carbon into the downstream river and floodplain that is currently stored in accumulated reservoir sediments.
- D-AA: Scour of 523,200 cubic yards of river channel and floodplain sediments would release large quantities of carbon, nitrogen, and phosphorus as well. Nutrient cycling in the estimated 3,284 acres of cropland and 1,480 acres of natural lands and pasture impacted by sediment deposition would be affected by the nutrient rich sediment. Leaching and removal of nitrogen from the cycle is expected in the outwash plain soils with loss to the underlying aquifer. Loss of mature trees on 325 acres of riparian forest downstream would also affect nutrient cycling.

6.1.4.3 Provisioning of Habitat

Alternative No. 1 - FWOFI

- U-AA: Removal of the reservoir and fill in auxiliary spillway would eliminate 45.99 acres of lacustrine, 28.17 acres of lacustrine fringe wetlands, and 3.83 acres of depressional wetlands. For several years the exposed sediments would provide shorebird habitat after the constructed breach. The system of braided, shallow, channels, beaver dams, and vegetation successional processes that follows would provide habitat for grassland nesting birds, amphibians, deer, beaver, and other small mammals. Fish passage into the reach would be blocked by the grade control structure at the former dam site and game fish remaining would likely not survive in the shallow, warm channels. Both riparian and depressional wetlands could form over the very long term, benefitting fish and wildlife. The newly exposed soils on the valley slopes and floodplain would not be deliberately seeded nor rehabilitated to a natural plant community and no maintenance for non-native species control would be conducted. The non-native plant community would result in low quality environment for birds, mammals and other species.
- D-AA: Downstream fish habitat would be expected to slightly improve between the former dam and confluence with North Branch Turtle River, due to restored sediment transport and reduced incision rates. Altered hydrology due to removal of the dam combined with all of upstream drainage in the watershed would create the highest peak flows and lowest low flows the river has ever experienced. The

unnatural hydrologic regime, increase in suspended sediment and contaminants from reservoir sediments, and increased erosion rates downstream of Hwy 2 would degrade habitat. If downstream agricultural landowners chose to enroll frequently flooded cropland into conservation programs. This would provide habitat benefits to a wide variety of fish, bird, amphibian, and mammal species. Improved sediment transport and hydrologic variability could indirectly benefit other organisms and contribute to ecosystem resiliency and biodiversity. However, sediments and associated contaminants (nutrients) transported downstream from the dam accumulated sediments would degrade habitat and impair ecological functions for some time.

Alternative No. 2 – Structural Rehabilitation

- U-AA: Temporary effects will be loss of game fish within the 66-acre reservoir. ND Game and Fish would restock the reservoir when it re-filled, which would be an opportunity to improve species composition. Trends of eutrophication in the normal pool due to nutrient loading and sediment accumulation would continue to degrade game fish habitat over time. Functions of existing lacustrine, lacustrine fringe wetland, and auxiliary spillway depressional wetland habitat would not be impacted this alternative.
- D-AA: Limited impact would be experienced downstream during construction. The drawdown would be in a controlled manner that would limit impacts to downstream habitats. Once construction is completed, the flood attenuation provided by the dam would restore the historical hydrology and sediment transport, thus maintaining current habitat conditions.

Alternative No. 3 – No Action

- U-AA: Prior to the dam failure, no changes from current habitat condition other than trends of eutrophication in the normal pool due to nutrient loading and sediment accumulation, which would continue to degrade game fish habitat over time. After dam failure, multiple channels would headcut up through the reservoir sediments, migrating and refilling with each flood event. The 45.99 acres of open water habitat, 28.17 acres of lacustrine fringe wetlands, and 3.83 -acre depressional wetland would be lost. Exposed sediments in the reservoir pool would initially provide shorebird habitat after the breach. The eventual system of braided, shallow channels, beaver dams, and vegetation successional processes that follows would provide habitat for grassland nesting birds, amphibians, deer, beaver, and other small mammals. Both riparian and depressional wetlands could form over the very long term, benefiting fish and wildlife. The newly exposed soils on the valley slopes and floodplain would not be deliberately seeded nor rehabilitated to a natural plant community and no maintenance for non-native species control would be conducted. The non-native plant community would result in low quality environment for birds, mammals and other species. At the dam itself, the exposed side slopes from the breach would eventually become revegetated, but likely by non-native opportunistic dry grassland species.

  D-AA: Prior to the uncontrolled breach, no changes from current habitat condition would be expected. The breach would cause total activation of 1.3 million cubic yards of sediment and contaminants causing. EPA surface water quality aquatic

life standards would be exceeded for cadmium and zinc; regional standards would be exceeded for nitrogen and phosphorus. Water flowing downstream for years after the breach will pose risks to human health and aquatic species. Scouring from the breach wave on over 15.9 miles of the Turtle River would also degrade habitat quality. These would cause habitat risks to fish, amphibians, birds, and mammals for years after the breach. Loss of 325 acres of mature trees in riparian forest downstream of the dam would impact mammal and bird species. Impacts to 5.1 acres (scour) and 999.2 acres (sediment deposition) of wetlands would also cause negative impact on habitat for dependent species. Riparian forests with downed trees could be reforested or could be converted to pasture. Cropland severely damaged in the breach wave could be converted to natural areas or pasture over time, providing habitat for some species. Increased flood incidence and the result of erosion could expand the extent of natural areas and floodplain wetlands, if agricultural landowners chose to enroll frequently flooded cropland into conservation programs. Increased flooding on downstream cropland would continue to encourage land use conversion from agriculture to rehabilitated natural plant communities. However, sediments and associated contaminants (nutrients) transported downstream from the dam accumulated sediments would degrade habitat and impair ecological functions for some time.

6.2 NEPA Resource Concerns

For NEPA resource concerns, evaluation of the environmental consequences includes the geographic areas of the zone near the reservoir (Upstream Assessment Area, U-AA) and estimates of effects downstream (Downstream Assessment Area D-AA).

6.2.1 Land Use

Alternative No. 1 – FWOFI

- U-AA: Conversion of the 66-ac normal pool from open water and lacustrine fringe wetland to a riparian grassland and wetland complex used primarily for long-term grazing would occur. Loss of flood storage would reduce ability to grow crops on the immediate downstream floodplain, which could result in conversion from cropland to pasture or natural lands.
- D-AA: Removal of the dam and increased flooding downstream may prompt land use changes. There may also be land use changes where agricultural land reverts to “natural” land use if flooding makes farming difficult and former cropland is enrolled in conservation programs.

Alternative No. 2 – Structural Rehabilitation

- U-AA: During reservoir drawdown for the 1-year construction period, the outcomes would be similar to the FWOFI. Once completed, the natural land use of the reservoir would resume (open water), along with lacustrine fringe wetlands.

  D-AA: There would be no effects during construction. Once completed, the current level of flood attenuation and flood protection would be maintained for an additional 100-yr lifespan, likely retaining the crop production land use. Rural residential land use would also be protected from flooding.

Alternative No. 3 - No Action

- U-AA: This alternative includes no reservoir drawdown; thus, the land uses for natural land and built land would not be affected until the uncontrolled breach occurs. During a breach, the reservoir would be eliminated, but the sum of natural land use would not change. The basin which currently services as public recreational land use would likely change to contracted grazing land use. Long-term, eventual rehabilitation of vegetation in the valley floodplain may enable grazing land expansion if livestock can use the new stream channel as a water supply.
- D-AA: The flood attenuation capacity upstream is not changed until the uncontrolled breach occurs. During the breach, the flood wave moving downstream would permanently damage some agricultural land via major scouring and sediment deposition. Long-term, there would be increased flooding over some agricultural land and many areas suitable for building. The loss of 325 acres of mature riparian trees with the flood wave may lead to the conversion of forest to grazing land. Some portion of the scoured cropland may not be possible to farm in the future, so would be converted to grazing lands.

6.2.2 Surface Geology and Soil Resources

6.2.2.1 Surface Geology

Alternative No. 1 – FWOFI

- U-AA and D-AA: There would be no effect. All excavations occur in previously affected areas.

Alternative No. 2 – Structural Rehabilitation

- U-AA: Excavation for the auxiliary spillway is planned in glacial till soils, not a potentially fossiliferous geologic unit. Depth of excavation would be approximately 2 feet, 1 foot for block thickness and 1 foot for subbase.
- D-AA: No effect.

Alternative No. 3 – No Action

- U-AA: Prior to the uncontrolled breach, there would be no effect. During the breach, erosion of any subsurface strata may result in uncontrolled exposure of glacial till soils. There is very low likelihood of fossils being exposed. This may continue as more strata are exposed during channel incision over time.
- D-AA: No effect prior to, during, or after the uncontrolled breach.

6.2.2.2 Soil Resources, Erosion, and Deposition

Alternative No. 1 – FWOFI

- U-AA: During construction there would be temporary erosion from earthwork (dam excavation, possible bypass channel). Drawdown of the surface water would expose unvegetated valley slopes (referred to as exposed slopes) and highly

erodible sediments that have accumulated behind the dam (referred to as accumulated sediments) to wind erosion.

A full channel restoration would not be completed. Meaning no soils would be reseeded to standard NRCS grass seed mixes. The floodplain and exposed slopes would be left to revegetate naturally. This would leave the unconsolidated floodplain sediments and exposed slopes vulnerable to significant wind and water erosion for several years until vegetation establishes.

A braided stream would form in the accumulated sediments, inhibiting vegetation establishment and sediment stabilization for some time.

- D-AA: Lack of flood attenuation would result in increased flooding incidence downstream. These events could result in some cropland scouring. Inundation would lead to crop damage, then wind-driven erosion, and then further soil loss, thus reducing the productivity of the land. Uncontrolled sediment transport would increase sediment loading downstream. Sediments deposited in the downstream floodplain could be deposited on farmland and riparian communities. A supply of sediment flowing downstream may alleviate channel incision issues. Also, this sediment supply could benefit soil health in perennial plant communities including riparian woodlands.

Alternative No. 2 – Structural Rehabilitation

- U-AA: Construction activities and impacts would be similar to those of the FWOFI at the dam site. After the construction is complete, the soils on the dam embankment and the auxiliary spillway would be stabilized by ACB and grass seeding. Once the water level returns to the normal pool elevation, stabilization of the accumulated sediments and exposed slopes would return to pre-project conditions. The low-level drawdown elevation should be set no lower than 1050.0 based on current sedimentation rate and dredging operations may be possible in the future. Regular maintenance and operation of the low-level drawdown conduit may help to flush some sediment through the principal spillway structure throughout the life of the dam. However, all analysis and calculations for sediment deposition in the reservoir were completed assuming that historical sediment deposition rates continue.
- D-AA: During construction, temporary increases in sediment transport would be possible, but best management practices (BMPs) would be implemented to minimize erosion. Once the project is complete, the reservoir would once again protect downstream lands from scouring and erosion and would prevent the accumulated sediments from eroding and moving downstream, thus preventing sediment loading downstream. This would protect agricultural land, but riparian communities would not receive a natural replenishing sediment supply and thus could continue to be of poor quality. By limiting the sediment supply moving downstream, channel incision and bank erosion would continue at current rates.

Alternative No. 3 – No Action

- U-AA: Prior to the uncontrolled breach, this alternative would provide flood attenuation and would maintain the water cover above the accumulated sediments and on the slopes. Also, because there would be no drawdown nor construction

activity, this alternative precludes associated erosion. During a breach, the dam auxiliary spillway would drastically erode, and the subsequent sudden drawdown of the reservoir would expose the accumulated sediments and the sideslopes and cause uncontrolled release of sediments to flow downstream. In the short-term, a new braided stream channel or channels would develop in the accumulated sediments. In the long term, a headcut would likely develop as a result of multiple flood events and would continue to erode an incised channel moving upstream, and all flood attenuation would have been lost.

- D-AA: This alternative would continue to reduce flood erosion and prevent uncontrolled sediment transport downstream prior to the uncontrolled breach. During the breach, the flood wave would travel downstream causing scouring and depositing massive amounts of sediments in areas downstream. 523,200 cubic yards of earthen material would be eroded from the downstream floodplain, and deposition of 682,000 cubic yards would occur, resulting in nearly $12.6 million in clean-up costs on cropland. Long-term, erosion from the reservoir site would continue to deposit sediments downstream. Increased flooding incidence would cause cropland erosion and soil loss. This would lead to wind-driven erosion and further soil loss, thus greatly reducing the productivity of the land. Downstream riparian communities may expand with a more dynamic erosion/deposition system.

6.2.2.3 Prime Farmland

Alternative No. 1 – FWOFI

U-AA: Through review of pre-construction aerial imagery, the area of impact for this alternative has no history of agricultural commodity production. According to form NECH 610.33, because no farmland is being converted to non-farmland, it is not necessary to complete forms AD-1006 or CPA-106. After the controlled breech, residual sediment flats on either side of the channel may provide a very small amount of land suitable for farming. However, it would be unlikely until a major flood event converts the braided wetlands and flood plain into a single incised channel.

- D-AA: During construction there would be no impacts. After the controlled dam breach, downstream flooding would inundate approximately 11,530 acres of prime farmland during 100-year flood events. These events could result in some cropland scouring. This would lead to crop damage, then wind-driven erosion, and then further soil loss, thus greatly reducing the productivity of the land. If the flood events occur during the summer months, the crop damages would be greater than during spring flooding events.

Alternative No. 2 – Structural Rehabilitation

- U-AA: Through review of pre-construction aerial imagery, the area of impact for this alternative has no history of agricultural commodity production. The project features impact soils largely designated as Not Prime. A small area of prime farmland in the existing auxiliary spillway will be shaped and filled, however, this area will still remain viable for haying, therefore because no prime farmland is being converted to non-farmland, it is not necessary to complete forms AD-1006 or CPA-106.

- D-AA: During construction there would be no impacts. Once the project is complete, downstream flooding would inundate 11,285 acres of prime farmland at the 100-year flood event. In total, 245 acres of prime farmland would be protected when compared to the FWOFI 100-year flood event.

Alternative No. 3 – No Action

- U-AA: Through review of pre-construction aerial imagery, the area of impact for this alternative has no history of agricultural commodity production. According to form NECH 610.33, because no farmland is being converted to non-farmland, it is not necessary to complete forms AD-1006 or CPA-106. After the uncontrolled breech, residual sediment flats on either side of the incised channel could provide a very small amount of land suitable for farming.
- D-AA: The 500-yr return interval inundates approximately 16,096 acres of prime farmland. The breach alone, without a coincidental flooding event on the Turtle River main stem, would inundate 4,050 acres of prime farmland, causing significant damage via scouring and/ deposition. Should the breach occur while the Turtle River is also experiencing flooding, the prime farmland impacted would be significantly greater. In the long-term, 100-year flood events would inundate approximately 11,285 acres of prime farmland. This would lead to wind-driven erosion and further soil loss, thus reducing the productivity of the land.

6.2.3 Water Resources

6.2.3.1 Groundwater Resources

Alternative No. 1 – FWOFI

- U-AA: No public wellheads or other groundwater resources are located within this area.
- D-AA: There would be no effects during construction. Once completed, current flood protection would be removed. Three wells (one production, one stock and one irrigation well) downstream of the existing dam would be inundated and potentially contaminated during a 500-year event. One rural water well adjacent to the inundated area would be susceptible potential contamination during a 500 year event.

Alternative No. 2 – Structural Rehabilitation

- U-AA: No public wellheads or other groundwater resources are located in this area.
- D-AA: There would be no effects during construction. Once the project is complete, only the one stock well would remain unprotected during a 500-year rainfall event.

Alternative No. 3 – No Action

- U-AA: No public wellheads or other groundwater resources are located within this area.

  D-AA: Prior to the uncontrolled breach, this alternative maintains the current level of flood attenuation and downstream flood protection which includes three wells (1

production, 1 irrigation, and 1 stock well). During a breach, the flood wave moving downstream would inundate these wells. The inundation water is also adjacent to a rural water well used for consumption where leaching may reach the wellhead drawdown area. A portion of the Elk River Aquifer lies within the breach area, just downstream and to the north of the dam along the North Branch of the Turtle River. The 751,100 cubic yards of contaminant laden sediment behind the dam and auxiliary spillway sediment would be transported downstream; some of these analytes would deposit over the wellheads, which have a direct connection to the local groundwater. EPA surface water quality aquatic life standards would be exceeded for cadmium and zinc; regional standards would be exceeded for nitrogen and phosphorus. Water flowing downstream for years after the breach will pose risks to human health and aquatic species. A dam breach would not likely change the presence or lack thereof, of pesticides in the local groundwater.

6.2.3.2 Surface Water Resources

Alternative No. 1 – FWOFI

- U-AA: Expected permanent impacts include elimination of 32 acres of wetlands, 45.99 acres of Other Waters (OW). This drawdown alternative includes removal of artificial deepwater system which is numbered OW-8 (45.99 acres). Consequently, the artificial lacustrine fringe wetlands adjacent to deepwater (W-75 & W-76) totaling 28.17 acres would also be lost. The depressional wetlands (W4 – W12) within auxiliary spillway and at toe of embankment would be lost due to auxiliary spillway fill, dam excavation, and altered hydrology; the sum of these wetland areas is 3.83 acres. Alternative grading extents results in ~0.4 acres of fill in OW-2, which is artificial section of South Branch Turtle River including dam principal spillway plunge pool and short stretch of downstream channel. For more details regarding functional losses see Table 6-1, and map of impacted areas see Appendix C-23.

Table 6-1: Alternative 1 Wetland Functional Losses in the U-AA.

Wetland Classes	Depressional	Lacustrine Fringe
Affected Area in U-AA by Alternatives	3.83 acres	28.17 acres
Function	**FCU**	**FCU**
Static	0.85	17.25
Dynamic	0.00	0.00
Cycling	2.44	21.91
Removal	0.35	20.23
Retention	2.25	20.83
Plants	1.64	21.13
Structure	1.75	17.77
Habitat	0.68	6.80
Shoreline Integrity	-	9.10

If USACE determined that these were jurisdictional wetlands, the WRD would be required to purchase credits for up to 32 acres. If a 1:1 replacement ratio is required, mitigation credit purchases could be approximately $1,920,200 (e.g., Ducks Unlimited charges $60,000 per acre in the appropriate Bank Service Area as of 2022). Given this would not be a federal project, if wetlands were determined to be non-jurisdictional then no mitigation would occur.

Within the reservoir area multiple shallow channels (braided stream) would form and migrate across the unconsolidated sediments with each flood event. Beaver dams and vegetation would establish over time, although larger floods would cause new erosion and channels to form. Over the course of decades, the valley would stabilize, and grasses may start to grow on higher elevation sediments along the margins. It is possible a single thread channel could form over the long term, or the area could remain in a multiple-thread channel condition. Both riparian and depressional wetlands could form over the very long term. Tributary stream channels down the valley side slopes would lengthen and resume pre-reservoir conditions.

D-AA: During the construction period, reservoir drawdown would result in greater volumes of water (less or more depending upon construction techniques) flowing downstream. This could temporarily cause minor flooding conditions. Removal of Larimore Dam would result in an increase in flooding downstream, but the stream would remain a perennial stream. Appendix D-4 (Concept Design Report) and D-5 (Economics Report) summarize synthetic event site performance, and downstream flood affects without dam. Increased flooding could support more wetlands, develop new meanders in the river channel, and form new oxbow wetlands. It is possible that some agricultural land use could revert to natural wetland areas. Downstream riparian wetlands would benefit over time from this alternative by restoring riparian floodplain function.

Alternative No. 2 – Structural Rehabilitation

- U-AA: Expected temporary impacts include loss of hydrology to 28.17 acres of lacustrine fringe wetlands, and 45.99 acres of Other Waters (OW). Temporary impacts would consist of reservoir drawdown to the point that deepwater is no longer present (Figure C-24 Alternative 2 – Structural Alternative - Aquatic Resources Impacts Map, Appendix D-9 Aquatic Resources). There would also be inundation of wetlands (~0.5 acres) around the reservoir when the 2-year, 24-hour storm events temporarily increased the pool elevation.

  Expected permanent impacts include loss of 0.95 acres of wetlands. Permanent impacts would consist of filling W-8 through W-11 with ACB spanning the auxiliary spillway. W-12 would also be lost due to two-stage filter system properly conveying any potential seepage away from dam toe. No losses are expected to lacustrine fringe wetlands and other waters as dam embankment and principal spillway we be replaced with the same dimensions and locations as existing features. For more details regarding functional losses see Table 6-2, and map of impacted areas see Appendix C-24.

Mitigation would be required under EO 11990 for permanent wetland impacts, regardless of whether USACE determined they were jurisdictional or not. Mitigation credit purchases could be approximately $60,000 (e.g., Ducks Unlimited charges $60,000 per acre in the appropriate Bank Service Area as of 2022).

Table 6-2 Alternative 2 Wetland Functional Losses in U-AA

Wetland Classes	Depressional
Affected Area in U-AA by Alternatives	0.95 acres
Function	**FCU**
Static	0.85
Dynamic	0.00
Cycling	2.44
Removal	0.35
Retention	2.25
Plants	1.64
Structure	1.75
Habitat	0.68

Temporary construction impacts would occur to a ~0.1 acres of OW-2 due to principal spillway outlet construction. Temporary reservoir drawdown for construction would remove 45.99 acres of deep water habitat and 28.17 acres lacustrine fringe wetlands, and would occur from early-summer to the time the reservoir refills (1-3 years dependent on precipitation). Alternative No. 2 retains the pool behind Larimore Dam as well as the fringing wetlands for 100 years from when construction is complete and reservoir re-fills.

D-AA: During construction the reservoir would be drawn down at a rate that would minimize potential for increased downstream flooding. No wetland impacts are anticipated in the D-AA from Alternative 2. Appendix D-4 (Concept Design Report) and D-5 (Economics Report) summarize synthetic event site performance, and downstream flood effects with maintained dam conditions.

Alternative No. 3 – No Action

- U-AA: Prior to the uncontrolled breach, no effects compared to the current condition are expected. During and after the breach the expected permanent impacts include elimination of 32 acres of wetlands and 45.99 acres of Other Waters (OW). The loss of reservoir would result in loss of deepwater (45.99 acres) and adjacent lacustrine fringe wetlands 75 & 76 (28.17 acres), plus dam toe seepage wetland (W-12, 0.03 acres). Since the breach is through the auxiliary spillway, Wetlands 4 - 11 (3.8 acres) would also be lost. For more details regarding functional losses see Table 6-3, and map of impacted areas see Appendix C-25.

Table 6-3 Alternative 3 Wetland Functional Losses in U-AA

Wetland Classes	Depressional	Lacustrine Fringe
Affected Area in U-AA by Alternatives	3.83 acres	28.17 acres
Function	**FCU**	**FCU**
Static	0.85	17.25
Dynamic	0.00	0.00
Cycling	2.44	21.91
Removal	0.35	20.23
Retention	2.25	20.83
Plants	1.64	21.13
Structure	1.75	17.77
Habitat	0.68	6.80
Shoreline Integrity	-	9.10

As the headcut progressed through the sediment deposits behind the dam in years following the breach, it would likely form multiple branches and side channels. Beaver dams and vegetation would establish over time, although larger floods would cause new erosion and channels to form. Over the course of decades, the valley would stabilize, and perennial vegetation may start to grow on higher elevation sediments along the margins. It is possible a single thread channel could form over the long term, or the area could remain in a multiple-thread channel condition. Both riparian and depressional wetlands could form over the very long term. The new floodplain would be more limited that in the FWOFI alternative. Tributary stream channels down the valley sideslopes would lengthen and resume pre-reservoir conditions.

D-AA: Prior to the uncontrolled breach, no effects compared to the current condition are expected. During the breach, the flood wave has potential affect over 50 miles of Turtle River, and approximately 7,129 wetlands, accounting for 15,486 acres, to varying degrees ranging from minimal disturbance to complete removal of the channel or basin. Some wetlands would experience erosion from the high erosive currents during peak, others by deposition during receding limb of breach hydrograph, and some both erosion and subsequent deposition. Where the breach wave breaks out of the flood plain and moves overland, a large zone of low-lying areas would be inundated, leaving sediment deposits throughout the zone.

Maximum velocities from hydraulic model breach event are compared to allowable velocity to estimate potential erosion of stream channels and wetlands. Allowable velocities are exceeded, resulting in erosion potential, of 15.9 miles of streams and 5.1 acres of wetlands. Sediment deposition is determined spatially based on typical sediment particles (silt), hydraulic model shear stresses, and Stokes's Law

for settling velocity. Approximately 1,323 wetlands, accounting for 999.2 acres, would fill with sediment ranging in depths from 0 to 2 feet of fill. Additionally, rivers and creeks categorized as "other waters" would fill with varying degrees of sediment ranging in depth from 0 to 4 feet of deposition. Table 6-4 shows the estimated significant area (1,004.3 acres) and wetland functional losses from both scour and sediment deposition in the downstream analysis area. The remaining 14,482 acres of wetland may have affects from breach, but are expected to be much less severe than 1,004 acres that are predicted to erode or deposit significant amounts of sediment based on breach hydraulic modeling.

Table 6-4 Alternative 3 Wetland Functional Losses in D-AA

Area (acres)	1,004.3
Static	664
Dynamic	586
Cycling	642
Removal	537
Retention	565
Plants	697
Structure	610
Habitat	259

Long-term, increased flooding would supply more water to remaining wetlands which would increase wetland function. In low-lying areas, conversion from agricultural land use to restored wetlands could occur as a result of recurring flooding impacts. Appendix D-4 (Concept Design Report) and D-5 (Economics Report) summarize synthetic event site performance, and downstream flood effects without dam.

6.2.3.3 Jurisdictional Waters of the US (Clean Water Act)

Alternative No. 1 – FWOFI

U-AA: As noted in Section 6.2.3.2 the USACE could determine there are anywhere from 0 to 32 acres of jurisdictional wetlands impacted by this alternative. That determination would determine whether the Sponsor would purchase mitigation credits for the project or not.

D-AA: Downstream riparian wetlands would benefit over time from the alternative by restoring riparian floodplain function.

Alternative No. 2 – Structural Rehabilitation

- U-AA: As noted in Section 6.2.3.2 the USACE could determine there are anywhere from 0 to 3.83 acres of jurisdictional wetlands impacted by this alternative. Regardless of that determination, NRCS would require purchase of 0.95 acres of wetland mitigation bank credits to mitigate permanent impacts. The remaining

wetland impacts would be temporary, during construction, and therefore no mitigation costs would be incurred.

- D-AA: Downstream riparian wetlands would remain unchanged from the current condition.

Alternative No. 3 – No Action

- U-AA: The dam breach would be an act of nature and therefore no jurisdictional determinations would be made, however the breach would impact the same (0 to 32 acres) of potential jurisdictional wetlands in the U-AA as the FWOFI.
- D-AA: The dam breach would be an act of nature and therefore no jurisdictional determinations would be made, however the scouring from the breach would have the potential to impact approximately 15,486 acres of wetlands. Significant effects are predicted for ~1,004 acres of wetlands due to erosion (5.1 acres) and sediment deposition (999.2 acres) as described in 6.2.3.2.

6.2.3.4 Water Quality

Alternative No. 1 – FWOFI

- U-AA: After the drawdown, the eutrophic reservoir water associated with Larimore Dam would be absent. Water temperatures downstream of the dam would be reduced. The accumulated sediments, previously held under anoxic conditions and now exposed to air, would become oxidized and begin to release mobile metals and bioavailable phosphorus into the porewater. Contaminated porewater has potential to migrate to the underlying groundwater aquifer over time. Of the contaminants documented in reservoir sediments (see Appendix D-7), the ones with the potential to migrate into underlying groundwater include arsenic, chromium, copper, nickel, and zinc. Risks of exceeding water quality thresholds are less than Alternative 3 and more than Alternative 2.

  D-AA: As the multi-thread channel system forms and migrates migrate back and forth across the reservoir sediments upstream of the grade control structure constructed at the former dam site, the eroded sediments would be transported downstream. Increased levels of nitrogen, phosphorus, carbon, arsenic, cadmium, chromium, copper, lead, nickel, and zinc would be expected as a result. Erosion quantity would be substantially less than outlined for Alternative 3. The process would take place over several decades but occur at higher rates during major flood events. Risks of exceeding water quality thresholds are less than Alternative 3 and more than Alternative 2 in the short team. After decades, water quality could improve as wetlands and vegetation provide chemical sequestration, sediment stabilization, filtration, and phytoremediation benefits. Due to increased frequency, extents, and duration of cropland flooding dissolved phosphorus transport to the Turtle River downstream of the dam would increase significantly over the long term.

Alternative No. 2 – Structural Rehabilitation

- U-AA: During construction, the reservoir drawdown would result in temporary water quality degradation, similar to the FWOFI. The sediment would become oxidized and mobile metals and bioavailable phosphorus would be released into the porewater. Once the project is complete, the sediments transported from the contributing watershed would be again contained by the dam. Potentially mobile metals and bioavailable phosphorus would be sequestered in the anoxic sediments at the reservoir bottom (Larimore Dam is stratified with an approximately four-meter anoxic zone). The low-level drawdown elevation should be set no lower than 1050.0 based on current sedimentation rate, which would provide 100+ years of sediment storage. The reservoir would refill and would again become eutrophic. Increasing rainfall intensity trends would exacerbate sediment transport from the contributing watershed and predicted warmer temperatures would increase growth of algae in the reservoir, both factors likely causing harmful algal blooms to increase in frequency.
- D-AA: As the reservoir waters are drawn down, there would be potential for temporary increased sediment and nutrient loading downstream, the intensity of this depending on the construction techniques used. Temporary BMPs would be implemented to minimize adverse impacts (from e.g., total suspended solids) to water quality. Once the construction is complete, the reservoir would again reduce nutrient, metals, and sediment transport downstream, thus improving the quality of the water flowing downstream.

Alternative No. 3 – No Action

- U-AA: No effects on water quality would occur prior to the uncontrolled breach. During the breach, the reservoir water would be eliminated and exposed sediments would begin leaching metals and phosphorus. The suddenly exposed sideslopes would erode, contributing additional unconsolidated sediments to the valley floor. In the long-term, this leaching would continue indefinitely. The presence of pesticide compounds has been detected in nearly all streams throughout much of the year across the country (Gilliom, 2007, and Medalie et.al. 2019). The fact that the south branch of the Turtle River is located within an agricultural setting makes the likelihood that pesticide compounds are present, and would continue to be present, quite high.

  D-AA: No effects on water quality would occur prior to the uncontrolled breach. During the breach, massive amounts of sediment would be transported downstream in addition to the drained reservoir water. Water quality downstream would be immediately impacted by excess nutrients, metals, and suspended sediments over a large area.

  Analyte constituents accumulated mass in reservoir sediments were determined by lab testing sediment samples (Table 6, Appendix D-7 Accumulated Sediment). These results were applied to flood volumes to gauge effects of their release during a dam breach. During a breach flood wave, constituents would travel variable distances; dissolved constituents would likely travel farther than those bound to sediment. The breach event is based on Probably Maximum Flood (PMF) for hazard classification. Because the PMF is an extremely rare event with extreme flood volume; it was considered inappropriate for calculating the potential

concentration of analytes. Therefore, the constituent masses were applied to the existing conditions 100-year flood volume from hydrologic modeling. The 100-year event analysis was assumed to be appropriate because during the PMF event there is a high likelihood large amounts of all constituents would remain in the Turtle River watershed, either attached to deposited sediment, stored in depressional areas, i.e. lakes and wetlands, or infiltrated into groundwater paths. As a result, however, concentrations could be substantially higher at lower peak flows in the downstream river in years following the breach.

The average analyte concentration within 100-year flood hydrograph is at, near, or above all Environmental Protection Agency (EPA) criteria, as shown in table below. Pollutant criteria are based on National Recommended Aquatic Life acute values for freshwater (National Recommended Water Quality Criteria - Aquatic Life Criteria Table | US EPA). Nutrient reference standards are adopted from Ambient Water Quality Criteria Recommendations for rivers and streams in Great Plains Region (Ecoregion IV: Great Plains Grass and Shrublands (epa.gov)). Pollutants above EPA aquatic life criteria include cadmium and zinc. The nutrient flood concentrations (Nitrogen and Phosphorus) are greater than two orders of magnitude above regional reference standard. Therefore, flood concentration is compared to, and greater than one order of magnitude above 90 percentile concentration for agricultural watersheds (Nitrogen and Phosphorus in Streams in Agricultural Watersheds (epa.gov)). The 90 percentile represents the value, Nitrogen = 10 mg/L that 90% of streams in agricultural watersheds are below. In summary, release of the pollutants and nutrients due to dam breach would have significant effects on downstream watershed, notably to streams and rivers but also could affect wetlands, lakes, and groundwater.

Table 6-5: Estimated Breach Floodwater Contaminant Analysis

EPA Nutrient & Metal Conditions					
Analyte	Concentration (100-yr flood)	EPA Water Quality Criteria	Reference Regionally	Ag Watersheds 90 Percentile	100-year> EPA limit?
	mg/l	mg/l	mg/l	mg/l	
Arsenic	0.04	0.34			No
Cadmium	0.004	0.002			Yes
Chromium	0.09	0.57			No
Lead	0.03	0.07			No
Nickel	0.10	0.47			No
Zinc	0.33	0.12			Yes
N(Total)	14.03		0.56	10	Yes
Phosphorus	0.14		0.02	0.5	Yes

Nitrogen and Phosphorus in Streams in Agricultural Watersheds (epa.gov)

Long-term, there would likely be ongoing erosion upstream and sediment loading downstream. The contaminants would continue to cause water quality problems indefinitely, particularly with increased turbidity disrupting river and lake ecosystems and with increased incidence of HABs in waterbodies. After decades, water quality could improve as wetlands and vegetation provide chemical

sequestration, sediment stabilization, filtration, and phytoremediation benefits. Due to increased frequency, extents, and duration of cropland flooding dissolved phosphorus transport to the Turtle River downstream of the dam would increase significantly over the long term.

6.2.3.5 Water Management

See Section 6.1.2 Regulating Service: Flood and Disease Control.

6.2.3.6 Floodplain Management (FEMA)

Alternative No. 1 – FWOFI

- U-AA: FEMA flood maps do not show any areas within the U-AA in the 100-year regulatory floodplain.
- D-AA: Short-term effects during the construction period are not relevant to this analysis. During a 100-year flood event, approximately 47,138 acres (25,450 acres cropland) would be inundated and would affect 114 structures, of which 10 would be residential dwellings. For the completed project, the 100-year regulatory floodplain may need to be revised to accommodate increased inundation.

Alternative No. 2 – Structural Rehabilitation

- U-AA: FEMA flood maps do not show any areas within the U-AA in the 100-year regulatory floodplain.
- D-AA: Effects caused during construction would be mitigated through water control measures. After construction, flooding in the 100-year flood zone would be 45,963 acres (26,050 acres cropland) and would affect 90 structures, of which seven would be residential dwellings. The 100-year regulatory floodplain may need to be revised to accommodate the change to the principal spillway structure.

Alternative No. 3 – No Action

- U-AA: FEMA flood maps do not show any areas within the U-AA in the 100-year regulatory floodplain.
- D-AA: Prior to the uncontrolled breach, there would be no changes to the regulatory 100-year floodplain. Flooding in the 100-year flood zone is considered like Alternative No. 2. During the breach alone, a flood wave would rapidly travel downstream, flooding 3,132 acres and 104 total structures. Residential structures would account for 17 of the 104 structures. A total of 9.7 miles of roadway would also be inundated (6.4 miles gravel and 3.3 miles pavement). If the breach coincided with a significant flooding event on the Turtle River mainstem, the impacts would be even larger. After the breach, the 100-year flood event would flood 47,138 acres (25,450 acres cropland), affecting 114 structures, of which 10 would be residential dwellings.

6.2.3.7 Regional and International Water Resource Plans

Alternative No. 1 – FWOFI

- U-AA and D-AA: Increased phosphorus and nitrogen transport out of the Turtle River watershed, from both sediment mobilization from upstream of the dam and increased extents, duration, and frequency of cropland flooding, conflicts with U.S. government commitment to reducing phosphorus and nitrogen concentrations at the international border crossing of the Red River through the International Joint Commission's implementation of the Boundary Waters Treaty.

  Removal of flood storage through the decommissioning of Larimore Dam would work against flood damage reduction objectives defined in the Red River Basin Commission's Long Term Flood Solutions report. Additional storage elsewhere in the Red River Basin would be required to offset flood storage lost through this alternative to meet the 20% flow reduction goal on the Red River mainstem.

Alternative No. 2 – Structural Rehabilitation

- U-AA and D-AA: Bringing the dam into compliance for state and federal dam safety requirements would ensure downstream nutrient reduction benefits provided by the dam would continue into the future, thus meeting the U.S. government commitment to reducing phosphorus and nitrogen concentrations at the international border crossing of the Red River through the International Joint Commission's implementation of the Boundary Waters Treaty.
- Rehabilitation to current state and federal dam safety requirements would also ensure flood storage currently provided by the current condition would remain into the future. This aligns with the Red River Basin Commission's Long Term Flood Solutions objective to reduce peak flows on the Red River Mainstem by 20% by not requiring resources to be invested into identifying and implementing flood storage projects to offset storage lost under the FWOFI.

Alternative No. 3 – No Action

- U-AA and D-AA: Prior to the uncontrolled breach, no effects are anticipated. During the breach, the sudden release of over 2 tons of phosphorus and 173 tons of nitrogen will impact water quality in the Red River in the short term. Long term impacts of increased frequency, extent, and duration of cropland flooding will be increased nutrient phosphorus transport to the Red River, conflicting with the U.S. government's commitment the International Joint Commission's phosphorus reduction goal.

  Flood storage provided by the current condition would continue until the uncontrolled breach. During the breach, significant flooding would occur downstream. Long term, flood storage would be lost, and increased flooding would be expected downstream. Both the devastated consequences to public safety during the breach, and increased flood levels after the breach make this alternative counterproductive to the goals outlined in the Red River Basin Commission's Long Term Flood Solutions objective to reduce peak flows on the Red River Mainstem by 20%.

6.2.4 Air Quality

Effects on Air Quality of dust and emissions are evaluated in the context as described in the Affected Environment section for each alternative.

Alternative No. 1 – FWOFI

U-AA: The most significant air effects under Alternative 2 would occur during construction where temporary increases in tailpipe emissions and fugitive dust are possible. An equipment roster is shown in Table 6-6. Construction specifications would likely require equipment meet EPA Tier Exhaust Emission Standards. Equipment must be manufactured no earlier than 2014 and within the equipment's Useful Life hours/year, NTE 8,000hrs/10 years. The criteria pollutants for tailpipe emissions include carbon monoxide, nitrogen oxides and particulate matter. EPA standards are provided for expected construction engine types in Table 6-7.

Table 6-6: Equipment Roster and EPA Tier Rating

Heavy Equipment	Model	Power	EPA Tier Rating
Tracked Hydraulic Excavators	Cat 320	109 kW/146 hp	Tier 4
Tracked Bulldozer	CatD6	97 kW/130 hp	Tier 4
Self-propelled Scrapers	Cat 623L	304 kW/407 hp	Tier 4

Table 6-7: Equipment Emission Standards

Heavy Equipment	Model	Power	EPA Tier Rating
Tracked Hydraulic Excavators	5.0	0.40	0.02
Tracked Bulldozer	5.0	0.40	0.02
Self-propelled Scrapers	3.5	0.40	0.02

The criteria pollutant of interest associated with fugitive dust is PM10 (EPA AP-42 2023). Dust is generated by the pulverization and abrasion of surface materials by application of mechanical force through implements. Emission factors for fugitive dust emissions were derived from table values in EPA AP-42 Compilation of Air Pollutant and Emission Factors, Vol 1, 5th Edition: Section 11.9, Section 13.2.2, and Section 13.3.3 as shown in Table 6-8: Estimated Construction PM10 Emissions, Alternative 2. Note that these assume a 50% effective control rate via dust abatement activities such as watering roads and the construction site.

Table 6-8: Alternative 1 Estimated Construction Emissions

Activity	Emission Factor	Amount Traveled or Moved	Estimate Construction PM10 Emissions
Excavator (excavation, finish grading, riprap placement)	2.66 lb/VMT	644 VMT	856 tons
Scrapers Excavating	0.06 lb/ton	107 tons	3 tons
Scrapers Traveling	0.69 lb/VMT	1,120 VMT	336 tons
Scrapers Dumping	0.04 lb/ton	119 tons	2 tons
Dozer Spreading	0.75 lb/ton	119 tons	45 tons
Vehicle Travel, Unpaved Roads	0.86 lb/VMT	30 VMT	13 tons

Activity	Emission Factor	Amount Traveled or Moved	Estimate Construction PM10 Emissions
Wind Erosion, Exposed Surfaces	0.38 ton/ac	10 ac	2 ton
Total Construction Project Estimate			**1,257 tons**

To minimize localized effects, best practices during construction activities including, but not limited to, the use of water sprays for fugitive dust suppression and the use of construction equipment with appropriate emission controls would likely be incorporated as requirements in the construction contract.

Once the minimal decommissioning is complete, the 66 acres once inundated under the normal pool within the former reservoir would be exposed for 1-3 years as weeds and grass naturally colonize the exposed sediments. Annual PM10 could be as high as 25 tons from the exposed sediment during that time, based on 66-acre pool area and 0.38 T/acre/year of wind erosion of exposed areas (EPA, 2023). Alternative 1 would not be expected to exceed air quality monitoring thresholds or ambient air quality standards in the region.

D-AA: There would be no effect of this alternative.

Alternative No. 2 – Structural Rehabilitation

U-AA: The most significant air effects under Alternative 2 would occur during construction where temporary increases in tailpipe emissions and fugitive dust are possible. An equipment roster is shown in Table 6-9. Construction specifications would require equipment meet EPA Tier Exhaust Emission Standards. Equipment must be manufactured no earlier than 2014 and within the equipment's Useful Life hours/year, NTE 8,000hrs/10 years. The criteria pollutants for tailpipe emissions include carbon monoxide nitrogen oxides and particulate matter. EPA standards are compared with expected construction engine types in Table 6-10.

Table 6-9: Equipment Roster and EPA Tier Rating

Heavy Equipment	Model	Power	EPA Tier Rating
Tracked Hydraulic Excavators	Cat 320	109 kW/146 hp	Tier 4
Tracked Bulldozer	CatD6	97 kW/130 hp	Tier 4
Self-propelled Scrapers	Cat 623L	304 kW/407 hp	Tier 4
Self-propelled Vibratory Compactor	Cat 815K	185 kW/248 hp	Tier 4

Table 6-10: Equipment Emission Standards

Heavy Equipment	CO (g/kW-hr)	NO(x) (g/kW-hr)	PM (g/kW-hr)
Tracked Hydraulic Excavators	5.0	0.40	0.02
Tracked Bulldozer	5.0	0.40	0.02
Self-propelled Scrapers	3.5	0.40	0.02
Self-propelled Vibratory Compactor	3.5	0.40	0.02

The criteria pollutant of interest associated with fugitive dust is PM10 (EPA AP-42 2023). Dust is generated by the pulverization and abrasion of surface materials by application of mechanical force through implements. Emission factors for fugitive dust emissions were derived from table values in EPA AP-42 Compilation of Air Pollutant and Emission Factors, Vol 1, 5th Edition: Section 11.9, Section 13.2.2, and Section 13.3.3 as shown in Table 6-11: Estimated Construction PM10 Emissions, Alternative 2. Note that these assume a 50% effective control rate via dust abatement activities such as watering roads and the construction site.

Table 6-11: Alternative 2 Estimated Construction Emissions

Activity	Emission Factor	Amount Traveled or Moved	Estimate Construction PM10 Emissions
Excavator (earthfill movement down slope, finish grading, drainfill/riprap placement)	2.66 lb/VMT	441 VMT	586 ton
Scrapers Excavating	0.06 lb/ton	121 ton	4 ton
Scrapers Traveling	0.69 lb/VMT	1751 VMT	525 ton
Scrapers Dumping	0.04 lb/ton	121 ton	2 ton
Dozer Spreading, Finish Grading	0.75 lb/ton	121 ton	45 ton
Compactor	2.99 lb/VMT	147 VMT	220 ton
Vehicle Travel, Unpaved Roads	0.86 lb/VMT	60 VMT	26 ton
Wind Erosion, Exposed Surfaces	0.38 ton/ac	420 ac	80 ton
Total Construction Project Estimate			**1,488 tons**

Alternative 2 construction and operation activities would not be expected to exceed air quality monitoring thresholds or ambient air quality standards. To minimize localized effects, however, best practices during construction activities including, but not limited to, the use of water sprays for fugitive dust suppression and the use of construction equipment with appropriate emission controls would be incorporated as requirements in the construction contract.

- D-AA: There would be no effect of this alternative.

Alternative No. 3 – No Action

U-AA: Prior to the uncontrolled breach, no effect is expected as compared to the current condition. The breach would cause exposure of the accumulated sediments and the side slopes would produce wind-eroded dust. Also, because there would be no managed seeding and revegetation of the newly eroded dam and spillway areas, erosion would occur on these areas for some time until natural vegetation cover becomes established. Annual PM10 could be as high as 25 tons from the exposed sediment during that time, based on 66-acre pool area and 0.38 T/acre/year of wind erosion of exposed areas (EPA, 2023). Alternative 3 impacts would not be expected to exceed air quality monitoring thresholds or ambient air quality standards.

- D-AA: There would be no effect prior to the uncontrolled breach. The breach would cause erosion from flood wave scour and deposition of that sediment downstream leaving 1,480 acres of natural lands and 3,284 acres of cropland exposed in the first year. Field leveling operations on cropland would further generate emissions over the following year, where it was possible to re-establish cropland by grading off deposition or filling in scoured areas. On non-cropland areas, weeds and grass would establish naturally over the course of 1-3 years. Alternative 3 would not be expected to exceed air quality monitoring thresholds or ambient air quality standards.

6.2.5 Biotic Communities

6.2.5.1 Plants, Communities, and Habitat Quality

Alternative No. 1 – FWOFI

U-AA: Removal of the reservoir would eliminate a large area of artificial deep-water habitat (45.99 acres). Subsurface aquatic plant species found in the reservoir would be recolonized by the remaining stream channel. The reservoir would be replaced by an exposed floodplain where eventually rehabilitated grasslands and floodplain wetlands would develop. Existing upland woody habitat would not be affected by the construction. The NDPRD identified ecologically significant community of Dogwood-willow thicket may be negatively impacted by the removal of the fringe hydrology of the reservoir. The Bur Oak Upland Woodland community existed prior to the dam construction and could potentially increase with the reduced hydrology around the perimeter of the reservoir.

Most of the newly exposed soils on the valley slopes and floodplain would not be deliberately seeded nor rehabilitated to a natural plant community and no maintenance for non-native species control would be conducted. Therefore, natural plant succession typically associated with shallow braided stream and flood plains that are interspersed with small beaver dams would occur. For a short period, annual grasses and broadleaf plants such Echinochloa crus-galli (Barnyardgrass), and Polygonum pensylvanicum (Pennsylvania smartweed), will likely temporarily establish along with other early succession perennial plants like Hordeum jubatum (Foxtail barley), some of which would also be noxious weeds like Cirsium arvense (Canada thistle) and Sonchus arvensis (Field sowthistle). Perennial grasses, composed of both native and non-native wet meadow (FAC wet) species such as Phalaris arundinacea (Reed canarygrass),and Spartina pectinata (Prairie cordgrass); and wetland (obligate) plants such as Typha xglauca (hybrid cattail) and Polygonum amphibium (water smartweed) would make up the majority of the plant community. Woody plant species would primarily be composed of early successional species such as Salix petiolaris (meadow willow) and Cornus sericea (Redosier dogwood). Establishment of willows and dogwoods would provide necessary woody material to support a beaver population and would help create the floodplain wetlands mentioned above. Other upland non-native invasive grasses like Bromus inerimis (Smooth brome), and Poa pratensis (Kentucky bluegrass) would also establish on the upper floodplain. After herbaceous vegetation has established, and the reservoir sediments are

stabilized, it is likely livestock would graze the flatter and higher floodplain areas. Woody vegetation is expected in steeper and wetter floodplain areas. The natural development of the riparian area primarily provides habitat for grassland nesting birds, amphibians, deer, and other small mammals.

These conditions would likely remain in place for several decades, or until a major flood event occurs. After what would likely be several decades, the braided stream/beaver pond complex may become more channelized. The once shallow braided system could become a single channel, effectively eliminating the floodplain. Due to the drier condition brought on by the elimination of the flood plain, a shift in plant community would occur. Plant species would transition from predominantly wet meadow and hydrophytic species to a scenario dominated by upland plant species on the former floodplain with hydrophytes remaining only in the channel.

- D-AA: Generation of a "flashier" hydrologic regime compared to both current and historic conditions in the watershed, with unnaturally high peak flows, suspended sediment, and erosion downstream would increase habitat complexity but would also adversely affect some species and provide ample areas for invasive species establishment. Predictions of long-term increased precipitation in this area has the potential to further increase peak flows. Increased frequency and extents of downstream flooding on cropland could encourage land use conversion from agriculture to either pasture or rehabilitated natural plant communities associated with the Glacial Lake Agassiz Basin sub-ecoregions, through which the D-AA runs. This would improve habitat connectivity and would indirectly benefit other organisms and contribute to ecosystem resiliency and biodiversity. On the other hand, increased flooding could encourage construction of additional cropland drainage systems in the downstream floodplain, which would result in loss of depressional and riverine wetlands and contribute to wildlife habitat loss and decreased ecosystem resiliency and biodiversity. Increased peak flows would damage some of the riparian areas and sediments and associated contaminants transported downstream from the dam accumulated sediments would degrade habitat and impair ecological functions for some time.

Alternative No. 2 – Structural Rehabilitation

U-AA: Rehabilitation of the dam would mean retaining the open water habitat, enlarging the herbaceous cover of construction sites, wetland loss in the long-term (absence of floodplain wetlands) versus poor-quality lacustrine fringe wetlands), and absence of riparian woodlands. The ND Park and Recreation deemed ecologically significant communities of Dogwood-willow thicket, and Bur Oak Upland Woodland would remain in-tact. Habitat favorable to the rare species: Small Yellow Lady's Slipper, would not be impacted by temporary construction impacts.

Temporary impacts during construction to wetlands, grasslands, and forested areas would be mitigated to the extent possible with the use of BMPs. Grassland beyond the footprint of the embankment and auxiliary spillway footprint would likely be affected by the operation of construction equipment. Any areas outside of the

construction footprint that are damaged in a way that does not allow existing grasses to grow back would be reseeded.

Approximately 2.6 acres of trees are present in the estimated work area of Alternative 2. Approximately 0.1 acres of woodland near the existing embankment toe would be removed entirely to ensure flow paths through the embankment are not created via tree roots. The remaining 2.5 acres would only be removed if necessary for construction access or safety. This woodland habitat is peripheral and not significant compared with the adjacent undisturbed woodland habitat. Over a very long time, sediments would continue to accumulate behind the dam, causing the reservoir to become shallower and eventually become deep-water wetland habitat.

Approximately 13.7 acres of tame grass in the auxiliary spillway and embankment will be disturbed for construction and would be reseeded to a native grass/forb suitable for critical use areas. Any other tame grass areas disturbed for roads or staging would be seeded to a superior mix of native grasses and forbs suitable for pollinators. Existing tame grass in the ACB area (5.66 ac.) would be permanently lost as grassland habitat, however the quality of the reseeded grasslands will improve in vigor and diversity. The seed mix on the dam itself needs to exclude legume species that attract rodents. The stand will be mowed and monitored to ensure that tree growth does not occur. Root depths should be shallow enough so that flow paths are not created through the embankment, but deep enough to ensure stability of the embankment. Control over the types of grasses growing on the embankment are crucial for monitoring and inspection purposes. The seed mixes selected for this purpose would likely be an NRCS approved critical area grass mixes or something similar.

- D-AA: Once construction is complete, downstream biotic communities would function similar to their present condition.

Alternative No. 3 – No Action

U-AA: Prior to the uncontrolled breach, the current open water habitat, lacustrine fringe wetlands, and poor quality of the various plant communities would prevail. Maintenance of the dam embankment would result in some tree removal. During a breach, the open water habitat would suddenly be eliminated, the unvegetated valley slopes would be exposed. The flood wave would erode ~6 acres of tame upland grasses and ~4 wetland acres of the auxiliary spillway. It would also damage a riparian woodland area immediately downstream of the dam. In the long-term, the exposed sideslopes would eventually become revegetated, likely by non-native upland grasses like Poa pratensis (Kentucky bluegrass) and Bromus inerimis (Smooth brome), broadleaves like Thlaspi arvense (Field pennycress), and noxious weed species such as Cirsium arvense (Canada thistle) and Euphorbia esula (Leafy spurge).

In the exposed unconsolidated sediments at the valley floor, the drainage would form a braided stream and vegetative succession would be similar to what is described in the FWOFI alternative.

These conditions would likely remain in place for several decades, or until a major flood event occurs. At that time, the braided stream/beaver pond complex may become more channelized. The once shallow braided system could become a single channel, effectively eliminating the floodplain. Due to the drier condition brought on by the elimination of the flood plain, a shift in plant community would occur. Plant species would transition from predominantly wet meadow and hydrophytic species to a scenario dominated by upland plant species on the former floodplain with hydrophytes remaining only in the channel.

Existing upland woody habitat would not be affected by the breach event in the U-AA.

- D-AA: Prior to the uncontrolled breach, downstream biotic communities would continue to function consistent with present conditions. During the breach, the flood wave would cause damage to mature trees on 325 acres of riparian woodlands and deposition on 999.2 acres of riverine and depressional wetlands. Scour would occur on over 15.9 miles of the Turtle River during the breach. Riparian woodlands could be replanted to trees or allowed to naturally re-establish, or in flatter topography may be converted to grazed pasture. Depressional wetlands where hydric soils were entirely scoured would be unlikely to re-form over the time period of this watershed plan, however wetlands lost to sediment deposition with intact hydric soils below could re-establish over time. Riverine wetlands could form in newly scoured areas in the floodplain over many decades, unless they are filled and leveled for cropland. Increased sediment transport downstream would improve remaining riparian woodlands and floodplain wetlands in a manner similar to the FWOFI. Inundation, scouring and sediment deposition would not impact Kelly's Slough National Wildlife Refuge, however ten USFWS Waterfowl Production Area leases would experience varying degrees of disturbance. The USFWS service would be responsible for decisions regarding reseeding or allowing natural regeneration of these areas. Impacts from the contaminants in the sediment such as heavy metals would be a concern for safe waterfowl habitat.

  Generation of a "flashier" hydrologic regime compared to both current and historic conditions in the watershed, with unnaturally high peak flows, suspended sediment, and erosion downstream would increase habitat complexity but would also adversely affect some species and provide ample areas for invasive species establishment. Predictions of increased precipitation in this area have the potential to further increase peak flows. Increased frequency and extents of downstream flooding on cropland could encourage land use conversion from agriculture to either pasture or rehabilitated natural plant communities associated with the Glacial Lake Agassiz Basin sub-ecoregion, through which the D-AA runs. This would improve habitat connectivity and would indirectly benefit other organisms and contribute to ecosystem resiliency and biodiversity. On the other hand, increased flooding could encourage construction of additional cropland drainage systems in the downstream floodplain, which would result in loss of depressional and riverine wetlands and contribute to wildlife habitat loss and decreased ecosystem resiliency and biodiversity. Increased peak flows would damage some of the riparian areas and sediments and associated contaminants transported

downstream from the dam accumulated sediments would degrade habitat and impair ecological functions for some time.

6.2.5.2 Riparian Areas

Alternative No. 1 – FWOFI

- U-AA: The removal of the dam would eliminate the reservoir which would be replaced by a new braided stream channel and floodplain area on the accumulated sediments. Initially the reclaimed floodplain would be vulnerable to significant erosion, but over time (decades) riparian habitat would develop, however, riparian woodlands would likely be limited to shrub species such as Salix petiolaris (meadow willow) and Cornus sericea (Redosier dogwood) that would be found along the stream channel(s) and in or around newly formed floodplain wetlands. The riparian area would be mixed woodlands and herbaceous plants based on competition; nearby river corridors are an example of a likely ratio. Existing woodland habitat in the river valley would remain unchanged.
- D-AA: Restored sediment transport downstream would increase the quality of riparian woodlands. In addition, increased peak flows could increase natural propagation of historically native tree species such as Bur Oak, Green Ash and Basswood. Increased erosion from unnaturally high peak flows would cause loss of mature trees, as well, however.

Alternative No. 2 – Structural Rehabilitation

- U-AA: Temporary impacts during construction to riparian areas would be mitigated to the extent possible with the use of BMPs. A temporary loss of up to 2.6 acres is expected for construction access. 0.1 acres of permanent riparian woodland loss is expected.
- D-AA: Rehabilitation of the dam would maintain riparian woodland conditions downstream, including incision effects from interrupted sediment transport.

- *Alternative No. 3 – No Action*

  U-AA: Prior to the uncontrolled breach, no effect from the current condition would occur. During the breach, scour from flood wave would damage a riparian woodland area just below the dam. The reservoir would be replaced by a new braided stream channel and floodplain area on the accumulated sediments. Initially the reclaimed floodplain would be vulnerable to significant erosion, but over time (decades) riparian habitat would develop, however, riparian woodlands would likely be limited to shrub species such as Salix petiolaris (meadow willow) and Cornus sericea (Redosier dogwood) that would be found along the stream channel(s) and in or around newly formed floodplain wetlands. The riparian area would be mixed woodlands and herbaceous plants based on competition; nearby river corridors are an example of a likely ratio. Rainfall trend changes may reduce the hydrologic regime, also retarding the natural regeneration of riparian woody species. The geographic position of the floodplain is not conducive to developing a riparian woodland corridor that is the same as what is present downstream of the current dam site. Existing woodland habitat in the river valley would remain unchanged.

- D-AA: No effects would occur prior to the uncontrolled breach. The flood wave from the breach would cause deep inundation to 6787 acres of riparian area downstream of the dam and cause the loss of 325 acres of mature trees. Over decades, this community may redevelop into a natural riparian corridor that would likely contain many of the same species of trees found today, or those lands may be converted to pasture. Increased sediment transport and flooding could improve the quality of remaining riparian woodlands in a manner much like the FWOFI.

6.2.5.3 Ecologically Critical Areas (See section 6.2.5.1)

6.2.5.4 Mammals, Amphibians, Reptiles, Invertebrates

Alternative No. 1 – FWOFI

- U-AA: During construction, movements and foraging patterns of mammals would be temporarily disrupted due to human presence and noise. The plan to complete construction and vegetation reestablishment in construction zone within a year minimizes direct disturbance impacts to local animals. There would be no significant effect on terrestrial animals because they would avoid human activity and there would be no suitable bat roosting trees removed. For animals dependent on the 32 acres of wetland habitat and 45.99 acres of open water, the reservoir drawdown and auxiliary spillway fill would cause displacement or death. An expanded stream corridor would benefit many riverine and riparian species, particularly mussels (Level I *Lasmigona compressa*, creek heelsplitter) and amphibians. The system of braided, shallow channels, beaver dams, and vegetation successional processes that follow the controlled breach would provide habitat for amphibians, reptiles, deer, beaver, and other small mammals.
- D-AA: Generation of a “flashier” hydrologic regime compared to both current and historic conditions in the watershed, with unnaturally high peak flows, suspended sediment, and erosion downstream would increase habitat complexity but would also adversely affect some species and provide ample areas for invasive species establishment. Predictions of increased precipitation in this area have the potential to further increase peak flows. Increased frequency and extents of downstream flooding on cropland could encourage land use conversion from agriculture to either pasture or rehabilitated natural plant communities associated with the Glacial Lake Agassiz Basin sub-ecoregion, through which the D-AA runs. These habitats support a wide range of animals and invertebrates. They also provide increased habitat connectivity. These corridors are particularly important to many species in this region where trees are relatively uncommon on the landscape. On the other hand, increased flooding could encourage construction of additional cropland drainage systems in the downstream floodplain, which would result in loss of depressional and riverine wetlands and contribute to wildlife habitat loss and decreased ecosystem resiliency and biodiversity. Increased peak flows would damage some of the riparian areas and sediments and associated contaminants transported downstream from the dam accumulated sediments would degrade habitat and impair ecological functions for some time.

Alternative No. 2 – Structural Rehabilitation

- U-AA: During construction, temporary effects would be similar to the FWOFI. Rehabilitating the dam and refilling the reservoir would retain the artificial lake, precluding historical, suitable habitat for many riparian and riverine species. The ACB used for part of the auxiliary spillway would reduce grass cover and prevent some animal species from browsing or burrowing in this area. The reseeding of staging and incidental areas to native pollinator mixes would increase the quality of the grass habitat potentially benefitting bumblebees and *Danaus plexippus* (monarch butterfly). Mature tree losses are minimal but some trees may be suited for NFGFD Level I species including the Big Brown Bat (Eptesicus fuscus), Little Brown Bat (Myotis lucifugus), and Northern Long-Eared Bat (Myotis spetrentrionalis).
- D-AA: Current habitat conditions would persist into the future.

Alternative No. 3 – No Action

- U-AA: Prior to the uncontrolled breach, no effect from the current condition is expected. During a breach, the reservoir would suddenly drain, removing the 66 acres of open water habitat and also damaging some riparian woodlands nearby downstream. For species dependent on the 28.17 acres of lacustrine fringe wetlands and 3.83 acres of depressional wetlands, the dam failure would cause displacement or death. For several years the exposed sediments over 66 acres would provide shorebird habitat in the former reservoir area. The system of braided, shallow channels, beaver dams, and vegetation successional processes that follow the dam failure would provide habitat for amphibians, reptiles, deer, beaver, and other small mammals, particularly mussels (Level I *Lasmigona compressa*, creek heelsplitter) and amphibians.
- D-AA: Prior to the uncontrolled breach, no change from the current condition is expected. During the breach, the flood wave would cause damage to mature trees on 325 acres of riparian woodlands and deposition on 999.2 acres of riverine and depressional wetlands. Scour would occur on over 15.9 miles of the Turtle River. Impacts from the contaminants in the sediment such as heavy metals would be a concern for safe mammal, amphibian, reptile and invertebrate habitat. Loss of mature woodland may impact NFGFD Level I species including the Big Brown Bat (Eptesicus fuscus), Little Brown Bat (Myotis lucifugus), Northern Long-Eared Bat (Myotis spetrentrionalis) and monarch butterfly. Deposition would occur over 3,284 acres of cropland and 1,480 acres of natural lands and pasture. Riparian woodlands could be replanted to trees or allowed to naturally re-establish, or in flatter topography may be converted to grazed pasture. Depressional wetlands where hydric soils were entirely scoured would be unlikely to re-form over the time period of this watershed plan, however wetlands lost to sediment deposition with intact hydric soils below could re-establish over time. Riverine wetlands could form in newly scoured areas in the floodplain over many decades, unless they are filled and leveled for cropland. Increased sediment transport downstream would improve remaining riparian woodlands and floodplain wetlands in a manner similar to the FWOFI.

  Generation of a “flashier” hydrologic regime compared to both current and historic conditions in the watershed, with unnaturally high peak flows, suspended

sediment, and erosion downstream would increase habitat complexity but would also adversely affect some species and provide ample areas for invasive species establishment. Predictions of increased precipitation in this area have the potential to further increase peak flows. Increased frequency and extents of downstream flooding on cropland could encourage land use conversion from agriculture to either pasture or rehabilitated natural plant communities associated with the Glacial Lake Agassiz Basin sub-ecoregions, through which the D-AA runs. This would improve habitat connectivity and would indirectly benefit other organisms and contribute to ecosystem resiliency and biodiversity. On the other hand, increased flooding could encourage construction of additional cropland drainage systems in the downstream floodplain, which would result in loss of depressional and riverine wetlands and contribute to wildlife habitat loss and decreased ecosystem resiliency and biodiversity. Increased peak flows would damage some of the riparian areas and sediments and associated contaminants transported downstream from the dam accumulated sediments would degrade habitat and impair ecological functions for some time.

6.2.5.5 Fish

Alternative No. 1 – FWOFI

- U-AA: During construction, drawdown of the reservoir would leave a small area of shallow water over the winter but not enough to support the fish species currently in the dam. North Dakota Game and Fish Department (NDGFD) has no plans to capture and move fish in Larimore reservoir during lake drawdown. There is a greater chance of oxygen depletion in the winter or freezing to the reservoir bottom, both potentially resulting in winter fish kill. After construction, absence of the lake habitat would eliminate lake species at this location. A new stream channel would develop in the accumulated sediments, and this could become suitable habitat for riverine fish in the long-term if water quality improves. However, there would be no fish passage from the downstream channel over the weir. Lessening downstream channel incision processes could benefit several species, including the Level I *Margariscus nachterbi* (northern pearl dace).
- D-AA: Impacts during construction would be mitigated through implementation of the required stormwater pollution prevention plan and 404 permit. In the long-term, high sediment loading would continue until the stream channel stabilizes and vegetation becomes established in the rehabilitated floodplain. Increased sediment loading could continue depending on agricultural practices in the contributing watershed. Generation of a “flashier” hydrologic regime compared to both current and historic conditions in the watershed, with unnaturally high peak flows, suspended sediment, and erosion downstream would increase habitat complexity but cause degradation of habitat for fish species such as *Margariscus nachterbi* (northern pearl dace) which require clear water. Water temperatures downstream of the dam will be lower, which could improve conditions for stocked trout in Turtle River State Park section.

Alternative No. 2 – Structural Rehabilitation

- U-AA: Temporary reservoir drawdown during construction will result loss of fish species in the lake, which NDGF indicated would provide opportunities to improve species composition for the fishery. Once the construction is complete and the lake water levels return, NDGF would restock fish populations with locally desirable game fish such as perch, walleye and northern pike enjoyed for sport and human consumption. Other native species found in the reservoir would also benefit including black bullhead, and white sucker. An operational drawdown gate would enable the NDGFD to collect more reliable inventories of fish populations in the lake and would improve the efficiency of large catches used to transport them to other locations if necessary (i.e., prior to sediment dredging or for controlling invasive species). As in the recent past, fish could experience winter kills and algal bloom impacts. Sediment will continue to accumulate in the reservoir. Since majority of the reservoir sediment thickness is <1 foot over the past 41 years; this rate will continue over the next 100 years. Therefore, the average depth (11 feet) will still be above 9 feet, and max depth (28 feet) will still be at least 26 feet. The reservoir will remain habitable by fish species within the 100-year planning timeframe, however composition of sport fish will be dependent on management and use.
- D-AA: Impacts during construction would be mitigated through implementation of the required stormwater pollution prevention plan and 404 permit. In the long-term, fish species that require clear water (e.g., *Margariscus nachterbi,* northern pearl dace) would benefit from the presence of the dam and continued retention of the large volume of accumulated sediments. Species that require cold water (stocked trout in Turtle River State Park reach) will retain current stream temperatures, which are raised from natural conditions due to dam impoundment and warmer surface water flowing over principal spillway weir.

Alternative No. 3 – No Action

- U-AA: Until the uncontrolled breach occurs, conditions would be as described for Alternative 2. During an uncontrolled breach, erosion of the dam structures and drainage of the reservoir would result in fish death. In the long-term, conditions in the channel and floodplain ecosystem would improve, potential benefitting fish species currently present in the Turtle River that are adaptable to small, shallow, warm channels. Suitable conditions for fish species dependent on deep water habitat would be absent.
- D-AA: No effects would occur prior to the uncontrolled breach. During the breach, scour from the flood wave and sediment loading would harm downstream fish populations. Long-term, water quality would be poor for many years, but would eventually improve once the erosion/deposition regime equilibrates and riparian woodlands and floodplain wetlands redevelop to some level. However, the habitat quality would still be impaired by continued erosion in the upstream accumulated sediments and contaminants moving downstream. Water temperatures downstream of the dam will be lower, which could improve conditions for stocked trout in Turtle River State Park section.

6.2.5.6 Birds, Migratory Birds, Eagles

Alternative No. 1 – FWOFI

- U-AA: During construction, noise and reservoir drawdown would displace some bird species but be an attractant for fish-eating birds such as *Haliaeetus leucocephalus* (bald eagle), *Lophodytes cucullatus* (hooded merganser), *Phalacrocorax auratus* (double-crested cormorant), *Podiceps nigricollis* (eared grebe), and *Pelecanus erythrorhynchos* (American white pelican) who would feast on fish within the shrinking pool area. Once the project is complete, fish-eating birds and those that depend on open water habitat and lacustrine fringe wetlands would be permanently displaced. These include four NDGFD Level I species of conservation concern: *Leucophaeus pipixcan* (Franklin's gull), Botaurus lentiginosus (American Bittern), Coturnicops noveboracensis (Yellow Rail), Limosa fedoa (Marbled Godwit) and USFWS listed migratory birds including the aforementioned Franklin's Gull and Marbled Godwit as well as Tringa flavipes (Lesser Yellowlegs), Aechmophorus occidentalis (Western Grebe) and Tringa semiplmata (Willet). For several years following the controlled dam breach, the exposed sediments would continue to provide habitat for most of the aforementioned birds with reduced habitat for those requiring open water such as the western grebe and marbled godwit. After several decades, a system of braided, shallow channels, beaver dams would develop. The vegetation successional processes that follow would provide habitat for grassland nesting birds like *Agelaius phoeniceas* (Red winged blackbird), *Xanthocephalus xanthocephalus* (Yellow headed blackbird), and many species of duck. The development of riparian woodlands would be mixed due to landscape position and competition from herbaceous plants. Therefore, benefits to woodland nesting birds would be minimal.

  D-AA: There would be no effect during the construction period. Long term, generation of a "flashier" hydrologic regime compared to both current and historic conditions in the watershed, with unnaturally high peak flows, suspended sediment, and erosion downstream would increase habitat complexity, which could benefit some bird species. Restored sediment transport could improve riparian woodlands, which could benefit woodland nesting species such as Level I/USFWS listed Coccyzus erythropthalmus(Black-billed Cuckoo) and Melanerpes erythrocephalus (Red-headed Woodpecker). These riparian corridors are particularly important to many species in highly agricultural areas where trees are relatively uncommon on the landscape.

Alternative No. 2 – Structural Rehabilitation

- U-AA: Construction and reservoir drawdown activities would be similar to the FWOFI in terms of temporary benefits to fish-eating birds but negative impacts others due to disturbance and drawdown. Once the project is complete, no effect is expected compared to the current condition.
- D-AA: Once the project is complete, no effect is expected compared to the current condition.

Alternative No. 3 – No Action

- U-AA: No effect would occur prior to the uncontrolled breach. During the breach, the open water habitat would be eliminated suddenly, resulting in a change in the type of migratory birds that would use the habitat. Effects to birds would be similar to those mentioned in the FWOFI alternative.
- D-AA: No effect would occur prior to the uncontrolled breach. During the breach, the flood wave would cause damage to mature trees on 325 acres of riparian woodlands, which would negatively impact woodland nesting species such as Coccyzus erythropthalmus (Black-billed Cuckoo) and Melanerpes erythrocephalus (Red-headed Woodpecker). These riparian corridors are particularly important to many species in highly agricultural areas where trees are relatively uncommon on the landscape. Contaminants from the sediments would be a concern for health of the migratory birds in the downstream USFWS waterfowl production areas. The potential for raptor habitat/nesting would also be greatly reduced potentially affecting the USFWS listed Circus hudsonius (Northern Harrier) and Bald Eagles. Migratory bird and eagle habitat loss would be greater than the FWOFI. Deposition would occur over 3,284 acres of cropland and 1,480 acres of natural lands and pasture. In the years immediately following the dam breach, shorebirds would benefit from the exposed sediment flats left behind by the flood event. The damage caused by the dam breach and restored natural flooding regime downstream may result in conversion of land use from agriculture to reestablishment of naturalized habitats supporting both grassland and woodland nesting bird populations. Grassland nesting bird species would be similar to that listed under the FWOFI.

6.2.5.7 Federal Threatened and Endangered Animal Species

Alternative No. 1 – FWOFI

- U-AA: During construction there would be no adverse direct or indirect effects on species – no trees would be removed and herbaceous habitat would not change in type or scope. The development of riparian woodlands would be mixed due to landscape position and competition from herbaceous plants. It is unlikely the number of trees suitable as roosting sites for *M. septentrionalis* (northern long-eared bat) would increase in the short or long term. Herbaceous vegetation suitable for Monarch Butterflies, Suckley's cuckoo bumble bees and western regal fritillaries would be expected to increase in the long term with the gradual replacement of open water with herbaceous vegetation.
- D-AA: Generation of a "flashier" hydrologic regime compared to both current and historic conditions in the watershed, with unnaturally high peak flows, suspended sediment, and erosion downstream would increase habitat complexity. Restoration of natural sediment transport could benefit riparian woodlands, which would benefit *M. septentrionalis* (northern long-eared bat).

Alternative No. 2 – Structural Rehabilitation

- U-AA: During construction, trees of suitable size (> 3" diameter) for the nationally Endangered NLEB would be removed primarily for heavy equipment access to the stilling basin and ACB installation. A field inventory found 196 trees > 3-inch diameter (bur oak, basswood and green ash) in the potential removal zone (2.7 acres). This alternative was submitted for consultation through the USFWS IPaC

site on February 26, 2026, and received a determination of "May Affect - Not Likely to Adversely Affect" the Northern Long-eared Bat (see Appendix E). USFWS recommends completing the IPaC at frequent intervals to stay current with the required protocols. If bats are observed near the construction site, construction would cease and USFWS would be consulted. Construction specifications will include language to minimize the loss of trees to the largest extent possible. Construction would cause a temporary loss of herbaceous vegetation suitable for Suckley's Cuckoo bumble bee, western regal fritillary, Monarch Butterflies and milkweed, necessary for their production. Loss of herbaceous habitat is minimal in the long term and limited to the conversion of the grassed auxiliary spillway to ACB's.

- D-AA: Once the project is complete, no effect is expected compared to the current condition.

Alternative No. 3 – No Action

- U-AA: No effect would occur prior to the uncontrolled breach. During a breach, the reservoir would be eliminated. In the long-term, a level of natural floodplain condition would develop. The development of riparian woodlands would be mixed due to landscape position and competition from herbaceous plants. The loss of trees suitable as roosting sites for *M. septentrionalis* (northern long-eared bat) would be substantial in the U-AA area immediately downstream of the dam. The development of a braided stream and beaver dam system would create floodplain wetlands which may benefit herbaceous vegetation suitable for Suckleys cuckoo bumble bee, western regal fritillary, Monarch Butterflies and milkweed species.
- D-AA: No effect would occur prior to the uncontrolled breach. During the breach, the flood wave and sediment loading would damage mature trees on 325 acres of riparian woodlands, potentially harming NLEB habitat. Long-term, the riparian habitats would redevelop. Restored flooding downstream would encourage land use conversion from agriculture to historical riparian and wetland habitats. This would expand riparian habitat and enhance the important tree habitat corridors used by bats. Herbaceous vegetation suitable for Suckleys cuckoo bumble bee, western regal fritillary, Monarch Butterflies and milkweed species is expected to increase.

6.2.5.8 Undesirable Species (including Invasive Species)

Alternative No. 1 – FWOFI

U-AA: During construction, reservoir drawdown would expose the slopes and the accumulated sediments, and earthwork would create areas of bare ground. This disturbed ground provides sites for opportunistic, rapidly colonizing species including a wide variety of non-native species and noxious weeds. The wetland inventory found eight species of ND Dept of Ag invasive and troublesome plants and one county listed species in the UAA. Populations of undesirable species can be mitigated if the disturbed areas would be reseeded with native species mixes and managed correctly. For this project, disturbed soils on the dam embankment would be seeded with native seed mixes, but the accumulated sediments and the sideslopes would not be seeded.

In accordance with North Dakota Century Code 4.1-47-030, it is illegal to willfully transport any material, or equipment in a manner that allows for the dissemination of noxious weeds. Furthermore, materials containing noxious weed seeds or propagating parts may not be disposed of. Neither the North Dakota Department of Agriculture, nor the Grand Forks County noxious weed board have equipment inspection protocols. To reduce the spread of aquatic nuisance species, North Dakota Administrative Code 30-03-06-01 states that upon entering or leaving any water body, construction equipment must be free of prohibited or regulated aquatic nuisance species, as defined in the state's aquatic nuisance species list. All construction related equipment traveling into the state or for which the vessel's last exit was from a class 1 infested water body must be certified free of aquatic nuisance species by the North Dakota Game & Fish Department before entering into any water of the state. Inspection criteria include but are not limited to: Last known location, and water body equipment was at, the last known time the equipment was in the water, date of last cleaning, cleaning procedures.

The 66 acres of exposed reservoir sediments would not be deliberately seeded nor rehabilitated to a natural plant community and no maintenance for non-native species control would be conducted. Therefore, there would be extensive colonization of undesirable and native species such as Hordeum jubatum (Foxtail barley), Cirsium arvense (Canada thistle), Sonchus arvensis (Field sowthistle), and Typha xglauca (hybrid cattail). Long-term, these undesirable species could be a serious problem until eventually the riparian grass and shrub communities become reestablished and outcompete the non-native species (or this may never occur).

- D-AA: The river can transport vegetative propagules of non-native/noxious species, and this can exacerbate the spread of these populations of undesirable and invasive species downstream. Unnaturally high peak flows, post breach, could increase the extent of non-native/noxious species spread. Currently, there are no known invasive fish species or zebra mussels in the reservoir, so downstream spread during drawdown is not an issue.

Alternative No. 2 – Structural Rehabilitation

- U-AA: During construction the incidence of undesirable species is similar to the FWOFI.

  In accordance with North Dakota Century Code 4.1-47-030, it is illegal to willfully transport any material, or equipment in a manner that allows for the dissemination of noxious weeds. Furthermore, materials containing noxious weed seeds or propagating parts may not be disposed of. Neither the North Dakota Department of Agriculture nor the Grand Forks County noxious weed board have noxious weed inspection protocols. To reduce the spread of aquatic nuisance species, North Dakota Administrative Code 30-03-06-01 states that upon entering or leaving any water body, construction equipment must be free of prohibited or regulated aquatic nuisance species, as defined in the state's aquatic nuisance species list. All construction related equipment traveling into the state or for which the vessel's last exit was from a class 1 infested water body must be certified free of aquatic nuisance species by the North Dakota Game & Fish Department before entering

into any water of the state. Inspection criteria include but are not limited to: Last known location, and water body equipment was at, the last known time the equipment was in the water, date of last cleaning, cleaning procedures

Once the project is complete, presence of the reservoir precludes opportunistic plant species from colonizing exposed sediments in that area. The tame grassland area affected by the footprint of the construction currently contains a high proportion of non-native species. This area would be reseeded with a typical construction seed mix (with native grasses), and not a native prairie mix. Currently, there are no known invasive fish species or zebra mussels in the reservoir, but with continued recreation on the lake, spread of these organisms is a continuing threat.

- D-AA: Concerns about construction equipment transporting invasive species to the site are the same as the U-AA. During construction, the effects would be similar to the FWOFI. After the project is complete, no effect is expected compared to the current condition.

Alternative No. 3 – No Action

U-AA: No effect from the current condition would occur prior to an uncontrolled breach. Following the breach, the 66 acres of exposed reservoir sediments would not be deliberately seeded nor rehabilitated to a natural plant community and no maintenance for non-native species control would be conducted. Therefore, there would be extensive colonization of undesirable and native species such as Hordeum jubatum (Foxtail barley), Cirsium arvense (Canada thistle), Sonchus arvensis (Field sowthistle), and Typha xglauca (hybrid cattail). Long-term, these undesirable species could be a serious problem until eventually the riparian grass and shrub communities become reestablished and outcompete the non-native species (or this may never occur).

- D-AA: No effect from the current condition would occur prior to an uncontrolled breach. During the breach, the flood wave would carry any invasive species of fish, mussels, invertebrates and propagules of undesirable plant species to a wide area downstream. Currently, there are no known invasive fish species or zebra mussels in the reservoir, however this is likely to change over time. The breach would cause 1.3 million cubic yards of downstream sediment erosion, the deposition from which is expected to cover 4,764 acres that would provide opportunity for undesirable species and noxious weeds to take hold. The unnaturally high peak flows in the watershed would continue to transport plant propagules as they are continually produced upstream.

6.2.6 Human Environment

6.2.6.1 Cultural Resources, Historic Properties

Class I Cultural Resource searches were completed for the U-AA in 2021 and again in 2025 for information on the presence of eligible or potentially eligible NRHP properties. A Class III Cultural Resource Survey was completed in July 2025 for the area within the U-AA which would experience direct impacts from Alternative 2. A Class I search was completed for the area within the D-AA

which would experience impacts from Alternatives 1 (FWOFI) and 3 (No Action). More detailed consultation information is found in section 7.3.

Alternative No. 1 – FWOFI

- U-AA: As a result of the Class III Cultural Resource Survey consultation (Appendix D-11), ND SHPO recommended NRCS record Larimore Dam itself, as an architectural site. The FWOFI alternative would be the most destructive to the existing dam as the structure would be significantly altered by the planned breach compared with Alternatives 2 and 3. Ground-disturbing activities associated with the proposed project include excavation, grading, or other disturbance that could damage or destroy undiscovered subsurface features comprising archaeological resources. This alternative would also disturb the greatest amount of land not previously disturbed by the initial dam construction, because the new road alignment requires work outside of the original footprint of the dam.

- D-AA: There are no properties downstream listed on the National Register of Historic Places, however, there are a significant number of sites deemed *eligible* for the NRHP that may be impacted by planned breach. This includes all 15 originally constructed Civilian Conservation Corps (CCC) stone and wood structures within the Turtle River State Park. There are also several historic bridges eligible for the NRHP downstream of the dam.

- *Alternative No. 2 – Structural Rehabilitation*

  U-AA: ND SHPO was consulted on the Class III Cultural Resource Survey (Appendix D-11), completed on 7/30/2025. The ND SHPO concurred with the NRCS recommendation of “No Historic Properties Affected” for Alternative 2. An adjacent area will require “avoidance area” signage to prevent incidental impacts during construction. The Larimore Dam itself was documented as a cultural site, however, it was deemed Not Eligible for any NRHP criterion. Alternative 2 will not significantly alter the position or function of the dam or its impoundment zone and, thus, does not pose an adverse effect to the integrity or eligibility status of surrounding cultural resource sites. Alternative 2 will change the appearance of the dam slightly as the existing riser tower will be removed and replaced in a different location. The appearance of the auxiliary spillway will also change due to the addition of articulated concrete blocks. The aesthetics of this alternative, once complete and vegetated, would be the most similar to the current condition, compared with FWOFI and Alternative 3 (no action). The construction footprint for this alternative is almost entirely within the original construction footprint of Larimore Dam. However, ground-disturbing activities associated with the proposed project include excavation, grading, or other disturbance that could damage or destroy undiscovered subsurface features comprising archaeological resources. The project agreement and the construction contract would specify that if there are any inadvertent or unanticipated discoveries of cultural resources during construction or operation, work shall immediately be stopped, the affected site secured, and the state archaeologist notified. The contract would also specifically address the procedure required upon the discovery of human remains. In addition, the construction contract would prohibit project workers from collecting artifacts or intentionally disturbing cultural resources in any area under any circumstances. All

borrow material is expected to come from onsite, however should the project require additional borrow material from an offsite or unevaluated location, the location would be evaluated by the NRCS Archeologist and Tribes, and the State Historic Preservation Office consulted to its utilization outlined in 36 CFR800.13B.

- D-AA: This area was not surveyed; however, NRHP eligible sites downstream, including 15 CCC structures within the Turtle River State Park and other potentially eligible bridges.

Alternative No. 3 - No Action

- U-AA: No effect would occur to existing Larimore Dam (considered by ND SHPO to be an architecturally significant site) prior to the uncontrolled breach. During the breach, disturbance to existing Larimore Dam would be severe. Massive erosion of the auxiliary spillway would occur which would negatively affect the architectural value of Larimore Dam. Failure of the embankment itself is also possible with this alternative. This massive erosion would also likely erode the archeological site within the U-AA, potentially destroying culturally significant material.
- D-AA: No effect would occur prior to the uncontrolled breach. During the breach, hydraulic modeling indicates that approximately 20 cultural resource sites would be inundated and potentially damaged or destroyed. All 15 originally constructed CCC structures at Turtle River State Park could be deemed eligible for the NRHP. A CCC constructed lodge in the park was severely damaged during the 2020 flood which eroded the Larimore dam auxiliary spillway. The integrity of the lodge was compromised, however many of the lodge features were salvageable and it remains eligible for NRHP listing. The remaining inundated sites are historic bridges which would be vulnerable to an uncontrolled event. There are no properties downstream listed on the National Register of Historic Places that would be impacted by this alternative.

6.2.6.2 Public Health and Safety

Alternative No. 1 – FWOFI

- U-AA: Once the project is complete, absence of the dam would eliminate risk of a breach.
- D-AA: After construction, the 100-year flood event would affect 114 structures, ten of these being residential (See Figures C-15 through C-21 for more information). No lives would be at risk (based on depth-velocity requirements used for the breach hazard classification). The 500-year flood event would also impact two wellheads within the downstream inundation zone.

Alternative No. 2 – Structural Rehabilitation

- U-AA: The project would bring the dam up to current performance, design, and safety standards to protect public safety. Incidence of HABs would continue and become exacerbated by rainfall intensity trend changes and intensified agriculture in the contributing watershed.
- D-AA: The 100-year flood event would affect 90 structures, 7 of these being residential (See Figures C-15 through C-21 for more information). No lives would

be at risk (based on depth-velocity requirements used for the breach hazard classification). One wellhead is located within the D-AA 500-year flood inundation.

Alternative No. 3 – No Action

- U-AA: Prior to the uncontrolled breach, there would be continued risk of dam failure. During the breach, there would be erosion of the dam and the road, and rapid drawdown of the reservoir. Safety would be a concern if the breach occurred when people were present. Long-term, the risk of dam failure would no longer be of concern.
- D-AA: Prior to the uncontrolled breach, there would be continued risk of dam failure. During the breach, 82 human lives would be at risk due to hazardous conditions at 14 residential structures and overtopping of Federal Highway 2. There are 31 residential structures potentially impacted by the dam breach, which 14 are high hazard classification. There are 27 roads potentially impacted by the dam breach, which 17 are high hazard classification. No Action Dam Breach Zone Depth-Velocity-Danger Level Relationships for Houses and Passenger Vehicles is summarized in Appendix D-3, Figure D-3-29. The flood wave moving downstream would inundate three wells. The inundation water is also adjacent to a rural water well used for consumption where leaching may reach the wellhead drawdown area and risk contaminating drinking water resources.

  Long term, after the dam breached, the 100-year flood event would affect 90 structures, seven of these being residential (See Figure C-20 for more information). 82 lives would be at risk (based on depth-velocity requirements used for the breach hazard classification). The 500-year flood event would also impact two wellheads, neither are located within a wellhead protection area downstream of the dam.

6.2.6.3 Transportation and Infrastructure

Alternative No. 1 – FWOFI

- U-AA: State Highway 18 would no longer be affected by Larimore Dam reservoir impoundment, which currently would overtop the road at ~300-year flood recurrence.
- D-AA: Lack of flood attenuation upstream would result in downstream road overtopping, road damages, and decreased residential and community access. Adverse impacts would likely need to be addressed and costs of adapting to flood protection assessed. Without flood attenuation and downstream flood reductions, three bridges would no longer meet North Dakota Century Code Chapter 24-3 stream crossing standards. The standards require sufficient capacity for variable frequency flows to permit the water flow freely and unimpeded under the bridge based on use volume. The three bridges are crossing at 28th St. NE, 21st Ave. NE, and 23rd Ave. NE (CR11), see Table D-3-5 for more details.

Alternative No. 2 – Structural Rehabilitation

- U-AA: State Highway 18 would continue to be affected by Larimore Dam reservoir impoundment, which currently would overtop the road at ~300-year flood recurrence.
- D-AA: The project would result in decreased risk of failure of the dam would reduce the potential for downstream road overtopping, road damages, and residential and community access problems. Existing conditions bridge hydraulic design standards would remain, as documented in Table D-3-5.

Alternative No. 3 – No Action

- U-AA: No effect would occur prior to the uncontrolled breach. After the breach, State Highway 18 would no longer be affected by Larimore Dam reservoir impoundment, which currently would overtop the road at ~300-year flood recurrence.
- D-AA: No effect would occur prior to the uncontrolled breach. During a breach alone, the flood wave traveling downstream would result in 26 downstream roads overtopped and bridge being potentially permanently impacted. There would also be more than 6.5 miles of gravel roads that would be overtopped, plus approximately 3.3 miles of paved road impacts. See Appendix D-5 Economic Evaluation Report for more information. If flooding on the mainstem of the Turtle River occurred at the same time as a breach, the impacts would be greater. In the long-term, lack of flood attenuation would result in continued downstream road overtopping, road damages, and decreased residential and community access. Adverse impacts would likely need to be addressed and costs of adapting to flood protection assessed.

6.2.6.4 Recreation Resources

See Section 6.1.3 Cultural Service: Recreation and Ecotourism

6.2.6.5 Visual Resources (Scenic Beauty)

See Section 6.1.3 Aesthetic Value (Visual Resources)

6.2.6.6 Local and Regional Economy

Alternative No. 1 – FWOFI

- U-AA: Recreation is the main economic aspect in the U-AA. The owner would likely install a stockwater pipeline and water tanks off the rural water system to replace the reservoir as a livestock water source under this alternative. Under this alternative, approximately $74,000 in expected annual recreation value would be absorbed by other recreational facilities within the region; this is a decrease in value of $168,935 compared to the No Action baseline.
- D-AA: Dam removal and subsequent lack of flood attenuation downstream would result in property damage to structures, contents, and vehicles ranging from $157,793 for the 5-year flood event to over $24 million for the 500-year flood event. The expected annual damages to structures and vehicles are $419,940, and to roadways: $200,601. The expected annual crop damage is $1,202,711. The total expected annual flood damage to all three categories is $1,823,252; this is

$141,444 higher than under the No Action baseline. Under this outcome, three additional properties would be required to participate in the National Flood Insurance Program; increasing administrative costs by an estimated $1,164 per year.

Alternative No. 2 – Structural Rehabilitation

- U-AA: Once the construction is complete, recreation activities would resume, protecting an annual expected value of $243,924, an increase of $620 compared to the No Action baseline.
- D-AA: Once the project is complete, there would be numerous benefits to the local and regional economy. The total expected annual damages to structures (including contents) and vehicles is $336,227, which is a $20,955 reduction compared to the total expected annual damages under the No Action baseline. Property damage due to flooding, including structures, contents, and vehicles, would range from $86,456 for the 5-year flood event to over $20 million for the 500-year flood event. Expected annual damages to crops are estimated at $1,135,306, and expected annual damages to roadways are $171,489. The total expected annual damage to all three categories is $1,643,022, which is a decrease of $38,786 compared to the No Action baseline.

Alternative No. 3 – No Action

- U-AA: No effect would occur prior to the uncontrolled breach. The breach would eliminate the current recreation value provided by the normal pool. The owner (Grand Forks Water Resource District) expects to maintain ownership of the grassland, wetland, and forest complex; with contract grazing where feasible. The expected annual value of recreation under this scenario follows the return under Alternative 2 until the breach; the expected annual value of recreation under this alternative is $620 less than it is under Alternative 2.

  D-AA: Prior to the breach event, damages follow those described under Alternative 2. The breach is modeled to cause more than $39 million in damages to structures, contents, and vehicles, $31 million in damages to crops, and $3.6 million in damages to roadways. The total expected annual damages under this alternative are $1,681,808.

6.2.6.7 Noise

Alternative No. 1 – FWOFI

- U-AA: During construction, noise from heavy equipment would be expected to be a maximum of 95 decibels at a distance of 50 feet (USDOT, 2006).
- D-AA: No effects.

Alternative No. 2 – Structural Rehabilitation

- U-AA: During construction, noise from heavy equipment would be expected to be a maximum of 95 decibels at a distance of 50 feet (USDOT, 2006).
- D-AA: No effects.

Alternative No. 3 – No Action

- U-AA: No effects.
- D-AA: No effects.

6.3 Cumulative Effects

This section includes a description of past, current, reasonably foreseeable future actions, and cumulative effects. Cumulative effects are defined as the effect on the environment which results from the incremental effect of an action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions (40 CFR 1508.7).

Historically, the South Branch Turtle River Watershed provided natural flood retention capacity with distribution of Prairie Pothole wetlands and healthy riparian corridors providing natural floodplain storage. Since the 1800s, humans have altered the landscape, and a significant portion of natural flood retention has been lost via conversion of tall grass prairie to cropland and wetland drainage. After the severe flooding that occurred in 1938, 1943, 1948, 1950, 1962, 1964, and 1965, planning in several watersheds was initiated by the Soil Conservation Service. This included North Branch and South Branch of Turtle River Watershed, called Upper Turtle River Watershed. The resulting Upper Turtle River Watershed Work Plan resulted in the construction of 11.9 miles of channels and eight flood retarding structures (including Larimore Dam). Construction and maintenance of these features have resulted in protection of downstream cropland, roads, and structures from flood damages.

Prior to construction of the dam, the floodplain consisted of mixed forested and grassland riparian habitat that provided floodplain storage and fish passage. After Larimore Dam was constructed, the upland ecological value was marginalized by converting the riparian floodplain habitat into deep water habitat. Larimore Dam also created a barrier to fish passage and natural sediment transport within the channel.

The current state of the watershed is a large, artificially drained landscape that has increased peak flow rates within the watershed. The flood attenuation provided by Larimore Dam dampens these increased flow rates to a more historical hydrologic condition. This results in reduced flood damages and reduced soil, nutrient, and pesticide loss off cropland due to anthropogenic changes. Larimore Dam consolidates the flood retention into one location, rather than the historically available wetlands and riparian floodplain storage that has since been altered due to human activity. There is currently a low supply and high demand for open water public recreation in the region, such that Larimore Recreation Area provides.

Despite the retention provided by Larimore Dam, loss of natural floodplain storage is continuing via stream channelization and tile drainage. Land use changes and drainage intensification to support crop production have also occurred in the watershed above Larimore Dam, resulting in increased flood flows, sediment loads, and nutrient loads. Larimore Dam attenuates peak flood flows and provides for deposition of sediments (and sediment bound nutrients) from the upper watershed before continuing downstream. The demand for open water public recreation is trending upward in the region; campgrounds operated by GFWRD have seen increased use in the past 10 years.

Past, ongoing, and reasonably foreseeable actions in the Turtle River basin all impact ecosystem services in the watershed. When combined with other future actions, the proposed action is anticipated to have a beneficial cumulative effect on many ecosystem services, notably water resources, biotic communities, and human environment.

6.4 Risk and Uncertainty

Making predictions naturally comes with some degree of uncertainty. Engineering analyses were based upon an additional 100 years of dam functional life. A vast amount of survey data was collected for this project to minimize risk and uncertainty for the engineering analysis conducted. The survey data were added to a detailed hydraulic model that was used for flood routing of synthetic rainfall events and the breach scenario downstream of Larimore Dam. The hydrologic model utilized NOAA Atlas 14 (NOAA, 2017) rainfall depths for rainfall events and was calibrated using a historic rainfall event (refer to Appendix D-1: Existing Conditions Assessment Report for additional information on model calibration). In addition to synthetic rainfall events, the probable maximum precipitation (PMP) was simulated. Depths for the PMP event were based on state-of-the-art meteorological tools and data specifically designed for the State of North Dakota. While the input data associated with the hydrologic and hydraulic analysis was recently collected or verified, and methods used are widely accepted in the engineering community, there is still some level of uncertainty and error associated with the models and data inputs.

Soil borings were collected, and geotechnical analyses were completed for the 30% design completed with the watershed plan, however additional borings would be conducted with the final design. Appropriate factors of safety were applied to the slope stability calculations associated with the structural rehabilitation alternative, however if additional borings yielded substantially different information the final design may be modified. More information on the geotechnical analyses completed for the project are available in Appendix D-2: Geotechnical Engineering Report. While all of the input data associated with the geotechnical analysis was recently collected or verified, and methods used are widely accepted in the engineering community, there is still some level of uncertainty and error associated with the models and data inputs.

Economic predictions entail estimations of prices for agricultural inputs and outputs and yield. Potential sources of uncertainty include changes in land values, populations, the built environment, and future development. Uncertainty in estimation of environmental effects includes community mapping estimates, probabilities of species presence, and predictions associated with ecosystem threats, including rainfall intensity trend changes.

Based on guidance in the PR&G, specific consideration for risk and uncertainty should be given to rainfall intensity trend changes, future land use, and adaptive management. Those subjects are covered in more detail in the following sections.

6.4.1 Future Land Use

Future land use may have an impact on project performance. If the downstream properties that cause the dam to have the high-hazard designation are removed in the future, the dam may be overdesigned. Additionally, if land use upstream of the dam changes significantly over time, the runoff potential of the landscape would change and

may have an impact on the hydrology and design adequacy of Alternative No. 2. Additionally, changes in future land use may also affect the sedimentation rate upstream of the dam. Further increases to tillable acres and erosion from intensive precipitation events may lead to an increased sedimentation rate at the dam site.

6.4.2 Adaptive Management

Adaptive management practices should be used to mitigate uncertainty as the life of the dam progresses. An adaptive management practice for Alternative No. 2 would include modifying the principal spillway riser tower to accommodate an increased sediment loading if the reservoir were in jeopardy of being eliminated. While this is not likely given the current sedimentation rate, increases to the sedimentation rate through more high-intensity rainfall events and changes to land use may dictate a change to the normal pool elevation.

6.5 Controversy

There are no known areas of controversy associated with this rehabilitation project.

7 Consultation, Coordination, and Public Participation

Consultation, coordination, and public participation was conducted throughout the course of the project Planning (See Appendix A).

7.1 Stakeholder Participation During the Scoping Process

Federal, State and local government as well as tribal governments were invited to participate in the planning process on March 20, 2020. This included three potential federal cooperating agencies (USFWS, USACE and FEMA). The USFWS participated as official federal cooperating agencies throughout the NEPA planning process. The USFWS Information for Planning and Consultation (IPaC) online planning tool was accessed in 2025, and the generated species list was used to inform the Biological Inventory (Appendix D-10); results are discussed in sections 4.2.5 and 6.2.5.. The USFWS recommends utilizing IPaC at regular intervals to stay current with Threatened and Endangered Species protocols.

Systematic scoping was used to identify problems within the watershed and to rate their significance. Stakeholders, including the general public, were invited to participate in the process and the project was described during public meetings. The means of notification were notice of public meetings submitted to local newspaper (Larimore Leader-Tribune). Scoping documentation is provided in Appendix A.

The first public meeting was held at the American Legion Club/Willy's on July 20, 2021, meeting invitations were sent to 16 federal, state, and local agencies. Dennis Reep (HDR Engineering) along with Christi Fisher, State Conservation Engineer for the NRCS, presented an introduction to the project. The public notice, invitation letters, responses and topics are included in Appendix A.

The comments received from stakeholders were as follows:

- Need for maintained flood protection.

- Desire for maintained recreation opportunity

In addition to the comments provided during the public meeting held on July 19, 2021, comments were received via email and mail in the days that followed the meeting.

7.2 Stakeholder Participation – Evaluating Alternatives

In addition to the public meeting being held, a sponsor meeting was held February 5, 2025 to review the existing conditions analysis, alternative development process, and to discuss the preferred alternative. Structural alternative #2 (ACB at 11% grade with new principal spillway) was chosen to move forward as the structural rehabilitation preferred alternative. See Appendix A for agenda and attendee list which included some state and local officials in addition to the sponsor (GFWRD).

7.3 Stakeholder Participation – Tribal/SHPO Consultation

Consultation with ND SHPO and Tribal Historic Preservation Officers (THPO's) and federally recognized tribes is required by the NHPA and the Advisory Council on Historic Preservation's regulations. Consultation is the process of seeking, discussing, and considering the views of other participants. The tribal consultation process was initiated on March 19, 2020. Thirty-one tribes and ND SHPO were sent invitations to participate in the planning process for Larimore Dam Rehabilitation (see example letter in Appendix A). One response was received from the Northern Cheyenne Tribe requesting to be included on all correspondence.

The ND State Historic Preservation Office (SHPO) was provided with the Class III Survey in May 2025, they requested some edits to the document. On July 30, 2025, ND SHPO concurred with the NRCS recommendation of "No Historic Properties Affected", provided an historic site be fenced and avoided during construction. Language for the signage will be limited to "avoidance area". Any modifications or additional borrow areas would need to come from an approved source. On September 4th, 2025 31 tribes and ND SHPO were sent the Class III Cultural Resources Survey (Appendix D-11). Section 106 consultation on the Class III survey was completed on December 19th, 2025. The following list is inclusive of all 31 tribes consulted on the project:

- Apache Tribe of Oklahoma
- The Blackfeet Nation
- Chippewa Cree Tribe of the Rocky Boy's Reservation
- Confederated Salish and Kootenai Tribes
- The Crow Tribe of Montana
- Fort Belknap Indian Community
- Fort Peck Assiniboine and Sioux Tribes
- Northern Cheyenne Tribe
- Shoshone Tribe of the Wind River Reservation
- Northern Arapaho Tribe
- Mandan, Hidatsa & Arikara Nation
- Spirit Lake Tribe of Fort Totten
- Standing Rock Sioux Tribe
- Turtle Mountain Band of Chippewa
- Bois Forte Band of Chippewa Indians
- Fond du Lac Band of Lake Superior Chippewa
- Santee Sioux Nation
- Grand Portage Band of Lake Superior Chippewa
- Leech Lake Band of Ojibwe
- Prairie Island Indian Community of Minnesota
- Lower Sioux Indian Community
- Mille Lacs Band of Ojibwe
- Upper Sioux Community
- Red Lake Band of Chippewa Indians
- Cheyenne River Sioux Tribe
- Crow Creek Sioux Tribe
- Flandreau Santee Sioux Tribe
- Oglala Sioux Tribe
- Rosebud Sioux Tribe of Indians
- Sisseton-Wahpeton Oyate
- White Earth Nation of Minnesota Chippewa
- Yankton Sioux Tribe

7.4 Stakeholder Participation – Draft Watershed Plan – Environmental Assessment

Stakeholders (see Section 11 Distribution List) were informed and encouraged to attend a public meeting held on XX, 2026 to provide comments on the Draft Larimore Dam Rehabilitation Watershed Plan and Environmental Assessment by the following methods:

General Public: The general public was informed by the placement of an advertisement in the Larimore leader-Tribune. The ad ran in 3 editions Month X, XX, and XX, 2026. The advertisement included a link to a virtual meeting, plus links and contact information for online access or the availability of hard copies of the Draft Plan/EA (See Appendix A)

Landowners within, adjacent and downstream of the project: Invitations with the invitation/link to the public meeting were mailed to adjacent landowners and landowners downstream that may be affected by a breach. Information on where to access the Plan/EA, and how to provide comments were sent to all landowners within and adjacent to the project (See Appendix A).

Technical Team/Interagency Team: Team members were mailed/emailed the invitation with links to the meeting, the online Plan/EA and online comment forms.

Cooperating Agencies: NRCS mailed the two federal cooperating agencies (USACE and USFWS) the invitation and links to the virtual meeting, online Plan/EA, and online comment forms.

Tribes/THPO's/SHPO: NRCS mailed the invitation/link to the public meeting, as well as links to the Draft Plan EA to 32 tribal leaders and their THPO's and encouraged to provide comments (See Appendix A).

Comments and Responses on the Draft Plan/EA: The public comment period on the Draft Plan EA was from Month X, 2026 to Month X, 2026. A total of X comments were received at the public meeting on Month X, 2026. An additional X comments were provided by the XXX and XXX. Comments and responses are included in Appendix A.

8 The Preferred Alternative

8.1 Rationale for Selection of the Preferred Alternative

Under the Principles, Requirements, and Guidelines for Water Resource Projects federal agencies are directed to consider tradeoffs between the economic, social, and environmental consequences of plan alternatives. Agencies are directed to select the federally preferred alternative based on no single one of these three objectives being higher priority than another.

As summarized in Table 5-1 and Appendix D-5, Alternative 3 (No Action) is the National Economic Efficiency Alternative because there are no construction costs involved and the probabilistic analysis summarized in Appendix D-3 indicates that the 14.25-inch runoff event that would cause dam failure has a statistically derived return interval of 1,844 years. Therefore, economic analysis credits the No Action Alternative as having the flood protection and recreation benefits as the dam being present for flood events smaller than the breach event. The damages that result from the flood contribute only a relatively small value to the expected annual damages, as the exceedance probability of the breach event is 0.00054. Note that this is simply a probabilistic assessment; in reality it is possible runoff event(s) could trigger a dam failure at any point in time given its current condition. Of the remaining alternatives, only Alternative 2 (Structural Rehabilitation) provides positive annual benefits; it has a benefit-cost ratio of 0.1:1.

As summarized in Tables 5-2 and 5-3 and Section 6, Alternative 2 (Structural Rehabilitation Alternative) is the preferred alternative from the standpoint of social impacts. The alternative would ensure flood protection benefits to homes, public roads, agricultural structures, cropland, and the local economy remain in place for the next 100 years. Alternative 2 also continues to provide public recreation benefits and maintains protection for 15 originally constructed CCC stone and wood structures at Turtle River State Park deemed eligible for the NRHP. Of the remaining alternatives, Alternative 1 (FWOFI) would provide the next highest social benefits as it also would prevent loss of life. Removal of flood retention, however, would negatively impact individuals and communities due to regular flood damages to homes, public roads, agricultural structures, cropland, and risk to historic structures. In addition to losses to the local economy, Alternative 1 would remove the public recreation opportunity. From a social standpoint, Alternative 3 (No Action) has significant negative social impacts including the projected loss of 82 lives and damages to 31 homes, 17 bridges, and 9.7 miles of overtopped roads, and destructive impacts to the 20 historic sites during a failure. The public recreation opportunity would be lost and societal results of reduced public land access with unique recreation features. From the standpoint of the U.S. government's commitment to implementation of the Boundary Waters Treaty, through recent commitment to International Joint Commission objectives for nutrient reductions in the U.S. portion of the Red River, Alternative 2 is also strongly preferred.

As summarized in Tables 5-2 and 5-3 and Section 6, from an environmental standpoint, Alternative 1 (FWOFI) and Alternative 2 (Structural Rehabilitation) both have merit from the standpoint of certain ecosystem services and resources. Alternative 2 (Structural Rehabilitation) was determined to be the environmentally preferred alternative due to the important benefits it provides for water quality and the closer to natural hydrologic regime the dam provides for the downstream river channel and floodplain, due to its function of replacing natural retention in the highly drained watershed. Alternative 2 is also preferred to Alternative 1 on the basis of undesirable (invasive) species, erosion, and prime farmland. The selection of Alternative 2 was done with recognition of the fact that Alternative 1 would provide a higher level of benefits in terms of natural sediment transport, rainfall intensity trends, and habitat for grassland species. Alternative 3 (No Action) would have severe environmental consequences in terms of degraded surface and groundwater quality, loss of wetlands, degradation of the river channel, and loss of mature trees within riparian woodland habitat.

The federally preferred alternative is Alternative No. 2 (Structural Rehabilitation), based on social and environmental benefits. As the owner of the dam, the final decision on action to be taken was made by the Sponsor, the Grand Forks County WRD who selected Alternative No. 2 (Structural Rehabilitation) as the locally preferred alternative because of its ability to maintain current flood protection and recreation benefits of the dam. Because crop production is such an important aspect of the local economy in this part of North Dakota, locals looked favorably upon alternatives that provide this protection. Camping and fishing at the dam was also emphasized, along with the desire to keep the recreational opportunity in place. Because the federal and locally preferred alternatives are the same, USDA-NRCS and the Grand Forks County WRD intend to move forward with implementation of Alternative No. 2 (Structural Rehabilitation) through the NRCS Watershed Rehabilitation Program, subject to availability of federal funding.

8.2 Measures to be Installed

A site plan for the preferred alternative is provided in Appendix C, Figure C-22.

The auxiliary spillway profile would be armored with articulated concrete block (ACB). The auxiliary spillway alignment would match the existing alignment, but the profile would be modified to a uniform 0.11 feet/foot throughout the spillway channel to accommodate the appropriate ACB design guidance. The auxiliary spillway width would remain the same as the existing width, which is approximately 300 feet.

A chimney drain would be installed on the downstream side of the existing embankment to intercept any seepage concerns through the embankment during flood events. Seepage flows captured would be routed to a foundation drain near the existing embankment toe and would then be discharged into the principal spillway outlet works. The top width of the embankment crest will be widened to 24.0 feet. Other measures to ensure slope stability is adequate at the dam are described in Appendix D-2: Geotechnical Engineering Report.

The existing principal spillway riser tower would be removed and existing conduit filled. A new riser tower would be constructed and new conduit placed using bore and jack methods. The proposed 78” principal spillway conduit is approximately the same size as existing conduit, as it would need to be replaced due to limited estimated design life

remaining (6 to 20 years). A NRCS standard 2-way covered principal spillway riser tower would be installed that would pass the principal spillway design hydrograph without activation of the auxiliary spillway. The proposed riser tower would be a two-way covered riser tower with two low stage orifice openings and second stage overflow weir.

8.3 Avoidance, Minimization, and Mitigation Features

Compensatory mitigation is anticipated for the loss of 0.95 acres of depressional wetlands through purchase of credits at a USACE approved mitigation bank. Wetland impacts would be kept to a minimum by using the smallest construction footprints possible and repairing any damage equipment may have caused in areas of temporary impact. The remaining 2.88-acre depressional wetlands within the auxiliary spillway would be protected from compaction through placement of temporary bridge decking during the project and reseeded to existing species post construction. Construction would utilize best management practices (BMP) to mitigate erosion at the construction site. A storm water pollution prevention plan would be completed prior to construction. Silt fence and/or staked straw bales would be used in the channel downstream of the construction area to capture any potential sediment loading resulting from construction. Erosion control bio rolls would be used after construction of the embankment is completed to prevent erosion on the embankment face. The embankment and all other disturbed areas would be seeded and mulched immediately after construction. Silt fence would also be used adjacent to the construction site to mitigate sediment movement and erosion. Any other potential mitigation measures identified during the permitting process would be incorporated into the rehabilitation construction.

8.4 Permits and Compliance Requirements

8.4.1 State Permits

The North Dakota Department of Water Resources (DWR) regulates the construction of dams, dikes, and other devices. The preferred alternative would require a Construction/Modification permit (SFN 51695) from the State Engineer. The permit review would ensure compliance with state dam safety design standards.

A permit for construction in a floodplain will be submitted to the Grand Forks County National Flood Insurance Program Coordinator (County Emergency Manager).

A construction site discharge permit (NPDES) is required by the North Dakota Department of Environmental Quality on behalf of the EPA if the construction site footprint is greater than one acre. Construction of the preferred alternative would involve more than one acre of disturbance; therefore, the construction contract will require that the Contractor will be required to develop and submit a Stormwater Pollution Prevention Plan (SWPPP) to minimize pollution from soil erosion and other sources during construction.

The final construction contract will require the Grand Forks WRD’s Contractor, and any subcontractors, to adhere to the ND Game and Fish Department Aquatic Nuisance Species rules for inspection of all vehicles, vessels, pumps, and equipment to be launched or placed in waters of the state. Notification to NDGF at least 72 hours prior to proposed work will be required.

A North Dakota Sovereign Lands permit is not applicable because the Turtle River in this reach is not classified in North Dakota as a Navigable Water.

No local land disturbance permits exist or are required.

8.4.2 Federal Permits

The USACE regulates the deposition of fill into Waters of the US under Section 404 of the Clean Water Act. While a jurisdictional determination can be requested to provide a greater level of certainty regarding the need for an authorization under this authority, it is likely that the proposed project would require a permit under Section 404.

8.5 Costs and Cost Sharing

Costs for the construction of the rehabilitation of Larimore Dam to a high-hazard classification would be shared amongst the NRCS and the project Sponsor. According to the Title 390 – National Watershed Program Manual, Part 500, Subpart E, 500.42, construction costs for watershed structure rehabilitation would be equal to 65% of the total construction cost. The Sponsor would be credited with local contributions to the watershed rehabilitation planning effort, as outlined in the MOU (see Appendix A), which increases federal share to 68% of the anticipated construction costs. NRCS would assume 100% of engineering and technical assistance costs, as well. For this rehabilitation effort, no cost is anticipated for real property rights, as the current land rights in existence for the dam extend beyond the proposed construction footprint. Permitting required to be completed for the project would be the responsibility of the Sponsor.

The preliminary cost estimate completed for the construction of the preferred alternative is presented in Appendix D-4: Concept Design Report. The planning costs for the proposed rehabilitation effort are estimated costs only. Unit costs of construction materials presented in the preliminary cost estimate are subject to change and are based on prices estimated in the year 2024. Detailed structural design, some additional geotechnical investigation, and a detailed construction cost estimate would be completed before the implementation of the proposed rehabilitation plan. The final cost would be dependent on bids received for the project and any change orders completed throughout construction.

8.6 Sequence of Installation

One construction season is planned to install the proposed works of improvement associated with the preferred alternative at Larimore Dam. Construction of the proposed principal spillway riser tower and conduit would likely take place in the late summer and early fall once the reservoir has been drawn down significantly. Installation would take place after funding has been secured and when installation conditions are favorable.

The reservoir upstream of the dam would need to be drawn down a substantial amount and a cofferdam would need to be implemented to construct the new principal spillway riser tower. The existing principal spillway conduit would be used to draw the reservoir down and portions of the riser tower may be removed to lower the outflow elevation associated with the existing principal spillway. Pumps at the site would help to decrease the drawdown time to get the reservoir to a workable level by late summer. A cofferdam would be implemented to ensure adequate working conditions at the proposed conduit

and riser tower location. The conduit would be installed through the embankment cut and cover methodology after the reservoir has been drawn down and the cofferdam constructed.

After the conduit has been installed through the existing embankment, the proposed riser tower would be constructed. After construction of the proposed riser tower and low-level drawdown is completed, any portions of the existing riser tower that remain would be removed, and the existing principal spillway conduit would be grouted. The coffer dam would then be removed, and the reservoir would be allowed to rise to the normal pool elevation.

Construction of the proposed auxiliary spillway would take place as early in the year as possible considering foundation drain work. The proposed conduit for the principal spillway that is being placed via open cut methods, and the foundation drains near the dam toe would be installed prior to excavation of the auxiliary spillway. Material used from the excavation of the auxiliary spillway would be placed in fill areas of auxiliary spillway in an effort to equalize these amounts and remove smaller first drop in existing spillway. The embankment material and proposed chimney drain would be constructed simultaneously with compaction and material testing taking place during construction. Upon completion of the downstream embankment and placement of ACBs, any disturbed areas would be seeded to prevent any future erosion issues.

8.7 Emergency Action Plan

An Emergency Action Plan (EAP) for Larimore Dam was completed in 2009, however hydraulic modeling completed through the course of the rehabilitation effort is of much higher quality and based on LiDAR topographic data rather than USGS quad data. Therefore, the EAP would be updated with the updated modeling and shall be made available and reviewed prior to any construction activities at the site. The Sponsor shall update the plan with any required changes after review by NRCS and the DWR.

8.8 Contracts and Financing

The project would be installed by means of a Sponsor led construction contract, with reimbursements through a cooperative agreement with NRCS. Contracting arrangements would be agreed to between NRCS and the Sponsor before either party commences work activities. A project or other implementation agreement between NRCS and the Sponsor would detail the work activities and financial responsibilities for both parties. A local assessment district, if required, would require a formal process defined in the North Dakota Century Code in order to establish taxing authority by the Sponsor specific to the preferred alternative. The taxing authority would allow for continued generation of funds for operation and maintenance responsibilities after installation is completed.

8.9 Real Property

The Sponsor would be responsible for all necessary land rights to implement the project. The current flowage easements upstream of the reservoir cover the area inundated up to an elevation of approximately 1100, which is near the top of dam and above the existing auxiliary spillway. The 100-year event rises to a level that does not overtop the auxiliary spillway, which is at an elevation of 1090.5. Therefore, current flowage easements are

provided above the 100-year event elevation, which is in compliance with the NRCS Real Property Rights Updated Policy from August of 2021. The flowage easements for the preferred alternative would not need to be modified because the existing auxiliary spillway elevation would remain the same under the preferred alternative scenario. Therefore, requirements in the National Watershed Program Manual, Part 504 – Project Installation, Section 3(C.3) are met, and no additional flowage easements are required as part of the plan. The inundation related to the proposed and existing top of dam elevations is provided in Appendix C, Figure C-26: Land Rights Map.

No additional land acquisition would be required for the proposed changes to the dam. All of the land where the proposed changes for the preferred alternative would take place is currently owned by the Sponsor. This includes the proposed embankment footprint, which extends beyond the existing embankment footprint, and the proposed auxiliary spillway footprint. Any construction easements required for stockpiling material or storing equipment would be the responsibility of the Sponsor. A temporary easement east of the auxiliary spillway location may be required during construction. The identified location to temporary stockpile any spoil material necessary for the construction effort is shown in Appendix C, Figure C-26: Land Rights Map, however the contractor would be instructed to spoil material within the land that is currently owned by the Sponsor if possible, during construction.

8.10 Operation, Maintenance, and Replacement Responsibilities

Measures installed as part of this plan 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 Agreement would be executed prior to signing the project agreement for the construction of the project. The agreement would specify the responsibilities of the Sponsor and include detailed provisions for retention, use, and disposal of property acquired or improved with Public Law 83-566 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.

8.11 Economic and Structural Tables

The tables provided this sub-section are described in the National Watershed Program Manual (Part 506, Subpart B – Exhibits). Overall costs of the preferred alternative are provided in Table 8-1. Federal funds include NRCS engineering services, which are not included when calculating eligible cost-share. Permitting costs are also not included in federal cost share dollars.

The cost distribution for the rehabilitation of Upper Turtle River Dam # 9 (Larimore Dam) is provided in Table 8-2. Federal cost share for total eligible dam rehabilitation construction costs is 65%. Federal cost share for the acquisition of wetland mitigation credits is 50%. Federal engineering services costs, as well as permit costs, are not included when calculating eligible federal cost share.

Table 8-3 shows pertinent information related to the dam after the preferred alternative is in place.

Table 8-1: Economics Table 1 - Estimated Installation Cost for South Branch Turtle River Dam #9 (Larimore Dam) Rehabilitation (Dollars)[1/]

Works of Improvement	Unit	Number (Non-Federal Land)	Estimated Cost[1/]		
			Public Law 83-566 Funds[2/]	Other Funds	**Total**
Multiple Purpose Structure – Rehabilitation of Upper Turtle River Dam #9 (Larimore Dam)	No.	1	$9,660,395	$4,439,495	$14,099,890
Total			$9,660,395	$4,439,495	**$14,099,890**

1/ Price Base 2024 Prepared: March 2025
2/ PL 83-566 funds reflect sponsor contributions to planning costs as eligible, non-federal match toward the rehabilitation program requirements.

Table 8-2: Economics Table 2 – Estimated Cost Distribution – Water Resource Project Measures for Upper River Dam #9 (Larimore Dam) Rehabilitation (Dollars)[1/]

Works of Improvement	Installation Costs ---------Federal Funds---------			Installation Costs ---------Other Funds---------				Total Installation Costs
	Construction[2/]	Engineering	Total Public Law 566	Construction[2/]	Permits & Easements	Project Admin.	Mitigation (50%)	
Multiple Purpose Structure – Rehabilitation of Upper Turtle River Dam #9 (Larimore Dam)	$8,106,400	$1,554,000	$9,660,400	$4,349,636	$11,359	$50,000	$28,500	$14,099,895
Total	$8,106,400	$1,554,000	$9,660,400	$4,349,636	$11,359	$50,000	$28,500	**$14,099,895**

1/ Price Base 2024 Prepared: May 2025
2/ Construction costs include wetland mitigation costs and reflect sponsor contributions to planning costs as outlined in the MOU.

Table 8-3: Table 3 - Structural Data for Upper Turtle River Dam #9 (Larimore Dam) Rehabilitation

Item	Unit	Upper Turtle River Dam #9 (Larimore Dam) Rehabilitation
General Data		
Class of Structure		High Hazard
Seismic Zone		1
Uncontrolled Drainage Area	sq. mi.	44.2
Controlled Drainage Area	sq. mi.	21.3
Total Drainage Area	sq. mi.	65.5
Runoff Curve No. (1-day, AMC II)		Variable (55 – 70)
Time of Concentration (Tc)	hrs.	18.5
Elevation Top Dam	ft, NAVD88	1100.8
Elevation Crest Auxiliary Spillway	ft, NAVD88	1090.5
Elevation Crest High Stage Inlet	ft, NAVD88	1083.2
Elevation Crest Low Stage Inlet	ft, NAVD88	1068.4
Auxiliary Spillway Type		Articulated Concrete Block
Auxiliary Spillway Bottom Width	ft	300
Auxiliary Spillway Exit Slope	percent	11
Maximum Height of Dam	ft	66
Volume of Fill[2]	cubic yards	0
Storage Capacities		
Total Capacity[3]	acre-feet	4,327
Sediment Submerged[4]	acre-feet	167
Sediment Aerated	acre-feet	19
Beneficial Use (Recreation)	acre-feet	637
Floodwater Retarding	acre-feet	4,434
Between High and Low Stage	acre-feet	1,777
Surface Area		
Sediment Pool	acres	71.3
Beneficial Use (Recreation)	acres	66
Floodwater Retarding[3]	acres	370
Principal Spillway Design		

Item	Unit	Upper Turtle River Dam #9 (Larimore Dam) Rehabilitation
Rainfall Volume (1-day)	inches	5.82
Rainfall Volume (10-day)	inches	8.31
Runoff Volume (10-day)	inches	4.69
Capacity of Low Stage (max.)	cfs	110
Capacity of High Stage (max.)	cfs	1,319
Dimensions of Conduit	inches	78” Diameter
Type of Conduit		Reinforced Concrete Circular Conduit
Frequency Operation-Auxiliary Spillway	percent chance	<1
	Auxiliary Spillway Hydrograph	
Rainfall Volume	inches	7.48
Runoff Volume	inches	3.38
Storm Duration	hrs.	12
Max. Reservoir Water Surface Elev.	ft, NAVD88	1089.3
	Freeboard Hydrograph	
Rainfall Volume	inches	21.23
Runoff Volume	inches	15.67
Storm Duration	hrs.	48
Max. Reservoir Water Surface Elev. [5]	ft, NAVD88	1098.7
	Capacity Equivalents	
Sediment Volume	Inches	0.1
Floodwater Retarding Volume	Inches	1.3
Beneficial Volume (Recreation)	inches	0.2

1 – The area upstream of Dougherty Dam is considered uncontrolled because Dougherty Dam is a low-head structure that has a negligible impact on flood attenuation and sediment deposition

2 – No fill material needed as part of the preferred alternative

3 – Crest of auxiliary spillway, area excludes islands above 1090.5

4 – Existing conditions sediment deposition based on Appendix D-7

5 – Assume no flow through principal spillway (ND DWR Dam Safety Standards procedures)

Prepared May 2026

Table 8-4 provides information on annual costs for the Upper Turtle River Dam # 9 (Larimore Dam). Annual costs were amortized for 100 years at an interest rate of 3.25 percent.

Table 8-4: Economics Table 4 - Estimated Average Annual Costs for Upper River Dam #9 (Larimore Dam) Rehabilitation (Dollars)[1/]

Works of Improvement	---------Project Outlays---------		Total
	Amortization of Installation Cost[2/]	Operation, Maintenance and Replacement Cost	
Multiple Purpose Structure – Rehabilitation of Upper Turtle River Dam #9 (Larimore Dam)	$517,523	$5,000	$522,523
Total	$517,523	$5,000	**$522,523**
1/Price Base 2024			
2/Amortized for 100 years at 3.25 percent			Prepared: May 2026

Table 8-5 provides summary information on average annual flood damage reduction benefits for Larimore Dam after rehabilitation. Because all floodwater damages occur within rural communities, all floodwater damages are considered agriculture related. Details of the analysis are provided in Appendix D-5 Economics.

Table 8-5: Economics Table 5 - Estimated Average Annual Flood Damage Reduction Benefits for Upper Turtle River Dam #9 (Larimore Dam) Rehabilitation (Dollars)[1/]

Item	Estimated Average Annual Damage		Damage Reduction Benefit
	Without Project (Agriculture Related)[2/]	With Project (Agriculture Related)	
Floodwater			
Cropland	$1,152,315	$1,135,306	$17,009
Structures and Vehicles	$357,182	$336,227	$20,955
Roads	$172,311	$171,489	$822
Reduction in Expected Annual Recreation Value	$620	$0	$620
Total	**$1,682,428**	**$1,643,022**	**$39,406**
1/ Price Base 2024			Prepared: May 2026
2/ Because all floodwater damages occur within rural communities, all floodwater damages are considered agriculture-related			

Table 8-6 provides information on the benefits and costs associated with the preferred alternative.

Table 8-6: Economics Table 6 – Comparison of Preferred Alternative Benefits and Costs for Upper River Dam #9 (Larimore Dam) Rehabilitation (Dollars)[1/]

Works of Improvement	Total Average Annual Equivalent Related Benefits[2/]	Average Annual Equivalent Cost[3/]	Benefit-Cost Ratio
Multiple Purpose Structure – Rehabilitation of Upper Turtle River Dam #9 (Larimore Dam)	$39,406	$522,523	0.1 to 1.0
Total	$39,406	$522,523	**0.1 to 1.0**
1/ Price Base 2024			Prepared: May 2026
2/ Annual benefits ($39,406) are presented here as average annual equivalents, amortized for 100 years at 3.25 percent with a 2 year implementation time period.			
3/ From Table 4			

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10 List of Preparers

Table 10-1: List of Preparers

Name	Current Position	Education	Years of Experience
NRCS Staff			
Christi Fisher, P.E.	State Conservation Engineer	B.S. Forest Engineering M.S. Environmental Science	30
Jonathan Petersen, P.E.	Hydrologist	B.S., M.S. Civil Engineering	23
Rita Sveen	Watershed Planner	B.S. Natural Resources, Environmental Studies	30
Ana Vargo, P.G.	Geologist	B.A., M.S. Geology	34
Thomas Schanandore, P.E.	Design Engineer	B.S., M.S. Civil Engineering	12
John Bauer	Watershed Planner	B.S. Zoology	21
Richard Webb	State Resource Conservationist	BS Agricultural Systems Management	20
Curt Bradbury	State Biologist	BS Fisheries, Wildlife Management	26
Janelle Harrison	Cultural Resources Specialist	M.S. Maritime Archaeology & History	22
Dana Whippo	Economist	MS Economics BA University Scholars Program	14
Brian Mager	Civil Engineer	B.S., M.E. Civil Engineering	13
HDR Engineering, Inc. Staff			
Dennis Reep	Managing Principal	BS Civil Engineering	40
Chris Korkowski	Water Resource Engineer	BS Civil Engineering	12
Greta Backman, HDR Eng Inc	Geological Engineer	BS Geological Engineering MS Civil Engineering	15
Dustin Kulseth, HDR Eng Inc	BIM Manager	AAS Mechanical Engineering Technology	20

Name	Current Position	Education	Years of Experience
Kendall Vande Kamp, HDR Eng Inc	Sr. Environmental Scientist	BS Environmental Management, MS Biological Sciences	15
Tina Fricke Robinson, HDR Eng Inc.	Sr. Environmental Project Manager	BS Natural Resources	20

Prepared June 2026

11 Distribution List

The Draft Watershed Plan/Environmental Assessment was directly mailed to the local, state, federal agencies, and tribes as listed below requesting comments. It was also directly mailed to directly impacted property owners as well as individuals who signed up to be on the mailing list for the project. In addition, it was advertised XXX in the Grand Forks County Record and placed on the ND NRCS public website.

Affected Landowners	NRCS – East Zone
Apache Tribe of Oklahoma	NRCS – State Office
Bois Forte Band of the MN Chippewa Tribe	NRCS – Grand Forks County Field Office
Cheyenne River Sioux Tribe	Oglala Sioux Tribe
Chippewa Cree Tribe of the Rocky Boy's Reservation	Prairie Island Indian Community in MN
Confederated Salish and Kootenai Tribes	Red Lake Band of Chippewa Indians
Crow Creek Sioux Tribe	Red River Retention Authority
Federal Emergency Management Agency - Region 8	Rosebud Sioux Tribe of Indians
Flandreau Santee Sioux Tribe	Shepherd, Ruth
Fond du Lac Band of MN Chippewa Tribe	Shoshone Tribe of the Wind River Reservation
Fort Belknap Indian Community	Sisseton-Wahpeton Oyate
Fort Peck Assiniboine and Sioux Tribes	Spirit Lake Tribe of Fort Totten
Grand Portage Band of MN Chippewa Tribe	Standing Rock Sioux Tribe
Leech Lake Band of Ojibwe	Upper Sioux Community

Lower Sioux Indian Community	US Army Corp of Engineers
Mille Lacs Band of Ojibwe	US Environmental Protection Agency
ND Department of Emergency Services	US Fish and Wildlife Service
ND Department of Environmental Quality	Grand Forks County Water Resource District
ND Department of Water Resources	Grand Forks County Commission
ND Game and Fish Department	Grand Forks County Emergency Services
Governor of North Dakota	Grand Forks County Hwy Dept
ND Parks and Recreation	Grand Forks County SCD
North Dakota Department of Transportation	Grand Forks County SCD Watershed Coordinator
Northern Arapaho Tribe	White Earth Nation of MN Chippewa
Northern Cheyenne Tribe	Yankton Sioux Tribe

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