October 2024

SUPPLEMENTAL WATERSHED PLAN NO. 3 - ENVIRONMENTAL ASSESSMENT

FOR THE REHABILITATION OF NORTH BRANCH FOREST RIVER WATERSHED DAM NO. 1 (BYLIN DAM)

Walsh County Water Resource District

Walsh County, North Dakota

USDA United States Department of Agriculture

Natural Resources Conservation Service

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FOR THE REHABILITATION OF NORTH BRANCH FOREST RIVER WATERSHED DAM NO. 1 (BYLIN DAM)

October 2024

Prepared By:

U.S. Department of Agriculture

Natural Resources Conservation Service

In Cooperation With:

Walsh County Water Resource District

U.S. Army Corps of Engineers

U.S. Fish and Wildlife Service

USDA United States Department of Agriculture

Natural Resources Conservation Service

Supplemental Watershed Plan No. 3 - Environmental Assessment

For the Rehabilitation of North Branch Forest River Watershed Dam No. 1 (Bylin Dam)

Walsh County, North Dakota

Prepared By:

Federal Lead Agency: U.S. Department of Agriculture, Natural Resources Conservation Service

In Cooperation With:

Sponsoring Local Organization: Walsh County Water Resource District

Cooperating Federal 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 North Branch Forest River Watershed Dam No. 1 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 North Branch Forest River Watershed Dam No. 1 (Bylin Dam) was completed in 1964 and is part of a series of works of improvement to provide flood control and reduce erosion within the North Branch Forest River Watershed. Bylin Dam is a high-hazard dam located on the North Branch of the Forest River that was built for flood protection. In addition to flood protection provided by the dam, recreational opportunities at the dam site were added through supplements to the original Watershed Work Plan. The design life of Bylin Dam was 50 years from when it was constructed. The design life has been exceeded and several deficiencies at the dam site have been noted. Deficiencies include inadequate spillway hydraulic capacity, erodibility potential of the auxiliary spillway, inadequate embankment slope stability, and incompatibility of the embankment drainage system.

The preferred alternative for Bylin Dam is to raise the top of dam elevation to accommodate the appropriate design event for a high-hazard dam, harden the auxiliary spillway by 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 $10,860,000, of which $6,183,281 would be paid from the NRCS Small Watershed Rehabilitation Program and $3,016,719 would be paid from Sponsor funds.

COMMENTS AND INQUIRIES

Comments and inquires must be received by September 24, 2024. Submit comments and inquiries to: Christi Fisher, State Conservation Engineer/Watershed Program Manager, USDA-NRCS (christi.fisher@usda.gov, 701-530-2091).

status, family/parental status, income derived from a public assistance program, political beliefs, or reprisal or retaliation for prior civil rights activity, in any program or activity conducted or funded by USDA (not all bases apply to all programs). Remedies and complaint filing deadlines vary by program or incident.

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Supplemental Watershed Agreement No. 3

North Branch Forest River Watershed

between the

WALSH COUNTY WATER RESOURCE DISTRICT
(Referred to herein as Sponsor)

and the

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

Whereas, the watershed plan for the North Branch Forest River Watershed, executed by the sponsor named therin and the Soil Conservation Service (SCS), now the Natural Resource Conservation Service (NRCS), became effective on the 8th day of April, 1960; and

Whereas, supplemental agreements for said watershed, executed by the sponsor named therin and the Soil Conservation Service (SCS), now the Natural Resource Conservation Service (NRCS), became effective on the 24th day of July, 1962 and the 7th day of January, 1964; and

Whereas, in order to carry out the watershed plan for said watershed, it has become necessary to modify said watershed agreement; 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, a Supplemental Watershed Plan which modifies the watershed plan dated the 7th day of January, 1963 for said watershed has been developed through cooperative efforts of the Sponsors and NRCS;

Now, therefore, the Secretary of Agriculture through NRCS and the Sponsors hereby agree upon the following modification of the terms, conditions, and stipulations of said watershed agreement;

1. **Term.** The term of this agreement is for the installation period and evaluated life of the project (100 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 sponsors 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 sponsors 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 North Branch Forest River Watershed Dam No. 1 (Bylin Dam) (North Branch Forest 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	$6,183,300	35	$3,016,700	$9,200,000
Acquisition of Wetland Mitigation Credits	50	$3,250	50	$1,750	$5,000
Subtotal: Cost-Sharable Costs		**$6,186550**		**$3,018,450**	**$9,205,000**
Non-Cost-Sharable Items [1/]					
Engineering Costs	100	$1,600,000	0	-	$1,600,000
Project Administration Costs [2/]	0	-	100	$50,000	$50,000
Real Property Rights [3/]	0	-	100	-	-
Required Permits	0	-	100	$10,000	$10,000
Subtotal: Non-Cost-Share Costs		**$1,600,000**		**$60,000**	**$1,660,000**
		$ 7,841,990		**$ 3,018,010**	
Total:					**$10,860,000**

Prepared November 2023

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 reprisas 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.ePersons 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 eelay Service at (800) 877-8339. Additionally, program information may be made available in languages other than English.

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

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

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

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

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

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

Certification:

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Walsh County Water Resource District

The signing of this plan was authorized by a resolution by the Walsh County Water Resource District governing body and adopted at an official meeting held on Oct 15/2024, 2024 in Grafton, North Dakota

By: _____ Date: Oct 15/2024

Daryl Campbell
Chairman, Walsh County Water Resource District
600 Cooper Avenue
Grafton, ND 58237

USDA-NATURAL RESOURCES CONSERVATION SERVICE

Approved by:

DANIEL HOVLAND Digitally signed by DANIEL HOVLAND Date: 2024.10.21 10:39:05 -05'00' Date: _____

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

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Appendices

Summary (OMB Fact Sheet)

Supplemental Watershed Plan No. 3- Environmental Assessment
For
The Rehabilitation of North Branch Forest River Watershed Dam No. 1
(Bylin Dam)
Walsh 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:	Walsh County Water Resource District
Proposed Action:	The proposed action (Project) consists of the rehabilitation of North Branch Forest River Watershed Dam No. 1, located in Walsh County, North Dakota.
Purpose and Need for Action:	The purpose of this project is to rehabilitate North Branch Forest River Dam No. 1 (Bylin Dam) to eliminate the threat the dam, in its current condition, poses to human lives, infrastructure, cropland, and natural resources downstream. Bylin 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 Bylin Dam does not meet current NRCS and State of North Dakota dam safety standards in regard to embankment design, hydraulic spillway capacity, and earthen spillway stability requirements. As a result, 25 human lives, 19 residential structures, 39 agricultural properties, 37 grain storage bins, 3 bridges, 5.1 miles of roadway, 2 historical sites, and 3,168 acres of cropland are currently at risk. The normal pool also provides recreation opportunities, consisting primarily of boating, fishing, hiking, and waterfowl hunting which are at risk.
Preferred Alternative:	The preferred alternative is the structural rehabilitation of the dam to a high-hazard designation. The top of dam (and associated road) would be raised 3.9 feet to accommodate the probable maximum flood. The alternative consists of construction of an auxiliary spillway channel that is lined with articulated concrete blocks (ACB) to prevent erosion and failure of the spillway. A newly constructed principal spillway riser tower and a principal spillway conduit would be installed by boring and jacking through the existing dam. A rock lined plunge pool would be constructed for energy dissipation at the new conduit outlet. The existing principal spillway riser tower would be removed, and the existing principal spillway conduit would be abandoned by grouting it closed. The downstream embankment slope would be flattened, and the addition of a new chimney filter and foundation drain would be implemented to address seepage concerns.
Resource Information:	**Latitude and Longitude:** 48.368163 N, -98.011315 W
	Eight-Digit Hydrologic Unit No.: 09020308
	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 project is located in the eastern portion of the state where rainfall is typically greater than in the western portion. 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 (acres): The total North Branch Forest River Watershed area is 63.5 square miles and the contributing area to Bylin Dam 20.5 square miles. The areas used for this environmental assessment are upstream of the dam (U-AA, 953 acres) and downstream of the dam (D-AA, approximately 27,283 acres).
	Land Uses (acres): According to the National Land Cover Data Base from 2019 U-AA: grassland/pasture/grazing (71%), natural land (16%), cropland (10%), developed (3%) D-AA: cropland (64%), grassland/pasture/grazing (19%), natural land (12%), developed 5%
	Population and demographics: The population within the project area is approximately 3,527 individuals, of which 94% of the population is white (includes those who identify as more than one race), with the predominant minority being classified as Native American (2.0%). In the project area 24.4% of the population is classified as having low income (26% for the state and 31% for the nation) and there was one census block group with a population of People of Color which was meaningfully greater than the reference community.
	Scoping Concerns: The need for continued flood control in the watershed was the primary concern identified through the public scoping effort. The area downstream of Bylin Dam experiences frequent flood damages due to inundation of crop land and infrastructure, even with the dam in place. Concern regarding the extent to which sediment deposition has impact the lifespan of the dam was expressed. Need for maintenance of the recreation value provided by the dam was noted by several members of the public. Fishing, boating, swimming, and waterfowl hunting were described as important amenities to the public. Concerns about adequate water quality for the fishery and impact of algal blooms on summer recreation were noted. River channel and riparian conditions downstream of the dam, as well as nutrient loads in the watershed, were also noted as concerns. Maintaining flood protection for the historic Hoff School, a one room schoolhouse a mile downstream of the dam, was noted by several individuals as important. Also brought up was the importance of maintaining the farm-to-market township road, which crosses the dam, for farm equipment, emergency services access, and local resident access to State Highway 17. Concern for cattle access to the reservoir during construction, or with some alternatives, was noted. Likewise, there was a comment that burying existing above ground power lines should be considered in conjunction with the rehabilitation project.

Alternative plans considered:	**Future Without Federal Investment (Minimal Decommissioning):** Continued deterioration of the dam would require the Sponsor implement a solution to address safety concerns. The Sponsor would not have financial means to complete a structural rehabilitation of the dam, therefore they would conduct a controlled breach of the dam. It is anticipated that the Sponsor would be granted permits to breach the dam and construct a grade control structure, but not be required to stabilize sediment deposits in the reservoir or provide fish passage. Therefore, this alternative is very similar to the Decommissioning without Non-Structural Measures, with the only difference being a lower construction cost and higher negative environmental impacts; fish passage would not be provided at the former dam site and the river channel upstream through the reservoir sediments would not be stabilized. A sheet pile weir and riprap would be installed near the upstream toe of the existing dam location to minimize sediment migration through the breach section. 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 48 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). Additionally, the principal spillway riser tower and conduit would need to be excavated and removed. The road that currently exists atop Bylin Dam would be realigned to its original location west of the dam embankment, and a 90-inch diameter culvert would be installed to pass flows through the road crossing with the North Branch Forest River. Excavation of sediment deposits captured upstream of the former embankment within the road footprint would be necessary prior to construction of the road. Areas impacted by the constructed breach and construction of the new road 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 3,029 acres to 3,810 acres downstream of the dam. Upstream, 7.4 acres of lacustrine fringe wetlands around the reservoir would be lost. Upstream, a braided channel condition through the sediment deposits would develop and be likely to form with a plant community consisting of mixed upland grasses, shrubs, and riparian wetland species. Bare sediments would have the potential to increase noxious weed populations especially Canadian and musk thistle species. Other non-native invasive species such as brome grass and non-native cattails are also likely. Specific plant types and recruitment would not be managed by the Sponsor, rather would be dependent on the presence of other species adjacent to the site. Free and affordable water recreation benefits from the reservoir would no longer be provided to the low income and minority populations under this alternative, given that land would no longer be inundated for the public to access via water; the private land now under the permanent pool would likely be converted to grazing land over the long term. The benefit-cost ratio of this alternative is 0.2:1.
	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 function as it currently does for the 2- through 500-year flood events. The dam would breach during a 625-year rainfall event, due to failure of the existing earthen auxiliary spillway. Erosion would begin at the toe of the spillway and progress rapidly upstream until it reached the reservoir of the dam. The breach would result in a rapid release of stored flood water and a portion of the accumulated sediments in the normal pool, initially. The resulting flood wave would impact 19 residential structures, 39 agricultural properties, and 37 grain storage bins. An estimated 25 lives would be at risk during the breach at 7 homes and 1 highway crossing. The breach would cause overtopping damage on 0.35 miles of paved roadway, 3.76 miles of maintained gravel roadway, and 0.98 miles of minimally

	maintained roadway. The breach would also cause damage to three bridges, one of which is historic, and a historic one room schoolhouse that has been turned into museum downstream of the dam. Economic losses to roadways, structures, and contents caused by the breach are approximately $24.5 million. Free and affordable water recreation benefits from the reservoir would no longer be provided to the low income and minority populations under this alternative, given that land would no longer be inundated for the public to access via water; the private land now under the permanent pool would likely be converted to grazing land over the long term. The volume of material eroded from the assumed initial breach of the auxiliary is approximately 323,400 cubic yards and would be transported downstream during the breach event. The flood wave would stay within the North Branch Forest River valley through the river crossing at Walsh County Road 14. Approximately one mile east of Walsh County Road 14, the flood wave would break out of the North Branch Forest River and travel overland through agricultural fields. This overland flooding of cropland would result in additional floodplain erosion, totaling approximately 915,000 cubic yards of erosion, reducing or eliminating crop yields depending on the depth of topsoil loss. A portion of the combined 1.24 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 338 acres of riparian forest downstream of the dam. An estimated 81.9 acres of wetlands would be lost to scour and sediment deposition downstream of the dam and 7.97 would be lost to altered hydrology upstream of the dam. Sediment deposition would occur over 372 acres of cropland and 304 acres of natural areas. Crop impacts caused by erosion, flooding, and the resultant cleanup costs are estimated at approximately $15.9 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 340,200 cubic yards of sediment downstream. The 1.6 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, zinc, 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. Risk of contamination of a drinking water aquifer would exist. The total economic losses initially caused by the breach would be $40.4 million. Due to the potential for devastating economic losses and the significant public safety risk from an uncontrolled breach of Bylin Dam, the no-action alternative was not considered viable by the planning team. The ND Department of Water Resources (state dam safety regulator) and the local sponsor would not allow the dam to remain in place at its current state because of the risk to human life and catastrophic economic consequences of a failure. Absent federal funding, the ND Department of Water Resources and/or the local sponsor would decommission the dam as defined in the FWOFI alternative.
	Decommissioning (with or without Non-Structural Measures): Multiple levels of decommissioning were evaluated, both with and without non-structural measures to provide flood protection at various levels in place of the dam. • *Decommissioning (Without Non-Structural Measures):* A federal decommissioning project through the rehabilitation program, without non-structural measures, would be similar to the FWOFI (Minimal Decommissioning) alternative. The primary changes from the FWOFI alternative are a modified grade control structure to accommodate fish passage through the construction of a rock arch rapid structure and incorporated sheet

	pile for grade stabilization through the dam embankment. A stable, single thread, meandering river channel would also be constructed through the upstream reservoir sediment deposits with vegetation established on the floodplain. In comparison to the FWOFI, this alternative would have fewer negative environmental consequences, identical long term economic consequences, and a higher construction cost of $7,081,600 along with the average annual damages of $465,400 documented for the FWOFI. The benefit-cost ratio of this alternative is 0.11. This alternative was eliminated from detailed study based on economic analysis indicating that the preferred alternative (structural rehabilitation) provides a higher level of benefit. • *Decommissioning (With Non-Structural Measures):* Decommissioning as described above with a combination of non-structural measures to replace portions of the flood damage reduction benefits of the current dam were also explored. This suite of alternatives would involve 100-year flood protection of properties with habitable structures and construction of setback levees for flood protection to agricultural lands. Alternatives were evaluated for agricultural setback levees focused on at the 5-, 10-, 25-, 50- and 100-year recurrence interval floods to determine which level of protection provided the highest net benefits. Floodplain easements would be required within the levee setback zone and modifications to roads would be required. Construction costs ranged from $36,896,850 to $38,704,650 for these alternatives, with average annual benefits ranging from $423,365 to $440,885. The incremental benefits analysis indicated that 10-year flood protection for agricultural lands provided the highest benefit, as documented in Appendix D-3. The benefit cost ratio of this alternative was 0.48. This alternative was eliminated from detailed study based on economic analysis indicating that the preferred alternative (structural rehabilitation) provides a higher level of benefit. In addition to decommissioning alternatives being eliminated from detailed study based on exorbitant costs as compared to the benefits achieved, decommissioning is also counter to other international priorities within the Red River Basin. Dam decommissioning would increase the extents, frequency, and duration of cropland flooding in the watershed, which would increase dissolved phosphorus delivery to the Red River of the North at the U.S./Canada international border, counter to international treaty obligations of the U.S. government. Dam decommissioning would also increase peak streamflow in the Red River of the North, and reduce peak streamflow along the Red River of the North by 20% which is counter to the Red River Basin Commission Long Term Flood Solutions Agreement priorities of increasing flood retention.
	Structural Rehabilitation to a Lower Hazard Classification: Alternatives that involve lowering the hazard classification of Bylin Dam would still require some form of structural change to the dam. Costs of the structural rehabilitation required for a lower hazard classification were considered in combination with property buy-outs downstream of the dam site. Several of the habitable structures would have flood depths in excess of 15 feet during a dam breach scenario. Therefore, floodproofing these structures by means of ring levees or raising the structures was considered impractical and was eliminated from detailed analysis. The cost to rehabilitate the dam to a lower hazard classification (along with property buy-outs) was more than the cost to rehabilitate the dam to a high-hazard classification and would provide similar benefits as a rehabilitation to a high hazard designation. Because the benefits remain the same, and the cost to rehabilitate the structure to a lower hazard classification is higher than structural rehabilitation because of the property buy-outs required, the benefit cost ratio of this alternative would be less than 0.11. This alternative was eliminated from detailed review. More detailed information is available in Appendix D-3.

<table>
<tr><td></td><td colspan="4">Structural Rehabilitation to a High-Hazard Designation: Multiple structural rehabilitation alternatives to bring Bylin Dam into 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 raising the top of dam elevation to accommodate the appropriate design event for a high-hazard dam, hardening the auxiliary spillway by using articulated concrete block within the spillway chute, replacing the existing principal spillway conduit and riser tower, and reducing the downstream embankment slope at the dam to improve slope stability. A structural rehabilitation of the dam to a high-hazard designation was determined to be the preferred alternative. Refer to Section 5.1.1 and Appendix D-3 for more detail on preliminary structural rehabilitation alternatives that were considered and eliminated.</td></tr>
<tr><td rowspan="9">Project costs (Structural Rehabilitation to High-Hazard Designation)</td><td>Item</td><td>Federal Assistance</td><td>Other Funds</td><td>Total</td></tr>
<tr><td>Construction</td><td>$6,183,300 (65%)</td><td>$3,016,700 (35%)</td><td>$9,200,000</td></tr>
<tr><td>Engineering</td><td>$1,600,000 (100%)</td><td>$0 (0%)</td><td>$1,600,000</td></tr>
<tr><td>Real Property Rights</td><td>$0</td><td>$0</td><td>$0</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>$10,000 (100%)</td><td>$10,000</td></tr>
<tr><td>Total</td><td>$7,783,300</td><td>$3,076,700</td><td>$10,860,000</td></tr>
<tr><td colspan="4">Average Annual Installation Cost: $260,700</td></tr>
<tr><td colspan="4">Annual O&M Cost: $5,000</td></tr>
<tr><td colspan="4">Total Average Annual Cost: $265,700</td></tr>
<tr><td rowspan="2">Project benefits:</td><td colspan="4">Monetary benefits: $346,700 (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 flood flows, and reduced roadway overtopping occurrences downstream of the dam site. Flood damage reduction on cropland results in $13,500 of average annual benefit. Reduced damages to structures downstream of the dam results in an annual monetary benefit of $321,400 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 $7,700. The Preferred Alternative also maintains recreational benefits of the dam, including boating,</td></tr>
</table>

	fishing (open water and ice), and duck hunting. Recreational benefits at the site are estimated to be $12,100 annually.
	Number of direct beneficiaries (Onsite-Offsite): Risks associated with a breach of Bylin Dam would be lessened for 25 human lives, 19 residential structures, 39 agricultural properties, 3 bridges, 2 historic sites, 5.1 miles of roadway, and 3,168 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 90 landowners in the North Branch Forest River Watershed for a 500-year flood event based on Walsh County Parcel Data from the year 2022.
	Benefit to Cost Ratio*: 1.3 to 1.0 **The benefit to cost ratio uses the FWOFI (Minimal Decommissioning) as the basis to compare the Preferred Alternative. 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 25 human lives and $41.9 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 Bylin 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: $7,783,300 Non-federal funds: $3,076,700
	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 Forest 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 663,600 cubic yards of contaminant laden sediment behind the dam were to mobilize downstream. 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. • Preservation of 59.6 acres of deep-water habitat and 7.4 acres of wetlands upstream of the dam that would be lost due to a catastrophic dam breach. Preservation of 68.9 acres of wetlands downstream of the dam that would be lost to the estimated 915,000 cubic yards of scour and deposition within the river channel and floodplain during the dam break. • Preservation of 338 acres of mature trees in the riparian forest between Bylin Dam and Highway 32 that would be lost in the flood wave from a breach event. Detrimental environmental effects:

	• Continued barrier to natural sediment transport along the North Branch Forest River. • Permanent wetland loss is estimated at 0.065 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 or Local Interest	No evidence of unusual congressional or local interest was identified.
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 North Branch of the Forest River (US Department of Agriculture Soil Conservation Service, 1959) was sponsored by the Walsh County Soil Conservation District and the Walsh County Water Conservation and Flood Control District. The principal problem identified was floodwater damage to roads, bridges, crops, and agricultural properties. Spring snowmelt leads to delayed planting, and heavy summer rainfall events can damage seeded and/or growing crops. North Branch Forest River Watershed Dam No. 1 (Bylin 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 60%. Bylin Dam was sized for a watershed area of 22 square miles with a total storage capacity of 3,970 acre-feet. The dam was designed with a maximum height of 62 feet with a flood pool covering 220 acres. Aside from Bylin Dam, other structural improvements included in the watershed work plan included two other floodwater retarding structures and 25.4 miles of channel improvements. All structural improvements associated with the watershed work plan are shown in Figure B-1: Project Location Map.

In addition to the initial watershed work plan for the North Branch Forest River Watershed, there were supplements to the plan in subsequent years. The initial watershed work plan completed in 1959 has North Branch Forest River Watershed Dam No. 1 (Bylin Dam) as one of three floodwater retarding structures. Bylin Dam was then listed as a multi-purpose structure in a supplemental watershed work plan for the North Branch Forest River Watershed (US Department of Agriculture Soil Conservation Service) completed in 1964. The supplemental watershed plan from 1964 also indicates that there was a previous supplement completed in 1962. While access to the supplemental watershed plan from 1962 cannot be located, it is reasonable to assume that that supplemental watershed plan included adding recreation as a purpose for Bylin Dam. The purpose of the Supplemental Watershed Work Plan completed in 1964 was to remove one of the channel improvements (Channel Improvement No. 3) that was part of the original Watershed Work Plan and to add an additional floodwater retarding structure. Costs for the improvements and structures associated with the plan were also updated as part of the Supplemental Watershed Work Plan completed in 1964. The storage capacity for Bylin Dam was updated to include the normal pool volume in the Supplemental Watershed Work Plan as well. The floodwater detention storage for Bylin Dam listed in the Supplemental Watershed Work Plan remain unchanged from the original Watershed Work Plan completed in 1959 (3,828 acre-feet).

1.2 Changes Requiring the Preparation of a Supplemental Watershed Plan

Bylin Dam was originally designed and constructed with a significant-hazard classification. Bylin 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 seven habitable structures and one highway have a high danger potential (i.e., where loss of life is likely to occur during a breach of the magnitude simulated) downstream of Bylin 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 stability, hydraulic capacity, and structural components are summarized in detail in this Watershed Plan-EA.

A supplement to the North Branch Forest River Watershed Work Plan is needed to address dam performance, design, and public safety issues associated with Bylin 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 Bylin Dam is authorized under this amendment.

1.3 Project Setting

1.3.1 Location and Context

Bylin Dam is located in Sections 5 and 6 of Norton Township (T156N, R57W), Walsh County, ND. The dam is on the North Branch Forest River within the Forest River Watershed (see Appendix B, Figure B-1: Project Location Map). The area benefited by Bylin 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 D-5. Based on current topographic data and drainage area delineation tools, the contributing drainage area to Bylin Dam is approximately 20.5 square miles, which is less than the 22 square mile area in the original design. The area of scoping evaluation downstream of the dam extends from the dam to the confluence of the North Branch Forest River and the Middle Branch Forest River near Fordville. This area is approximately 41.1 square miles and is entirely within Walsh County (see Appendix C, Figure C-1: Area of Interest / Benefit Area).

The Forest River Watershed begins in the Northern Black 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 North Branch of the Forest River begins in the Drift Plains Ecosystem and continues crossing through a remnant of the Glacial Lake Agassiz Basin running south and joining with the Middle Brance of the Forest River just west of the City of Fordville ND. Beyond the scoping area, the Forest River turns to the SE cutting through the Beach Ridges and Sand Deltas Ecosystem. In Grand Forks County it heads NE passing once again though the Glacial Lake Agassiz Basin and ultimately confluencing with the Red River of the North. These ecoregions are composed of transitional grasslands within a continental climate zone formed on recent glaciation. The reservoir is located within the Drift Plains ecoregion.

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 cultivated. Refer to Appendix D-6: Environmental Resources Memorandum for additional information on the ecoregion associated with Bylin Dam and the Forest 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 weather station (Edmore, ND) summarizes the average temperature, rainfall, and snowfall (US Climate Data, 2020). Average temperatures near Bylin Dam range from -14 °C (7 °F) in January to 27 °C (80 °F) in July. An average 20 inches of annual rainfall and 35 inches of annual snowfall occur near Bylin 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 Walsh counties), which flatten in the east (Grand Forks and eastern Walsh counties) (see Figure C-11: LiDAR Map). In the upper portion of the North Branch Forest River Watershed, tributary streams that carry flood flows have moderately steep gradients and the valley of the North Branch Forest 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 North Branch Forest River crosses Walsh County Road 14, slopes flatten and the clearly defined valley for the North Branch Forest River becomes a widespread floodplain. The flatter slopes in the eastern portion of the North Branch Forest River Watershed are within what is locally referred to as the Golden Valley. A drainage project that was part of the initial Watershed Work Plan completed in 1959 through the Golden Valley was designed to reduce widespread flooding in that area.

Land use is predominantly agricultural over the Forest River Watershed, but natural land, including open water, is also abundant in the area. Land use data for the area upstream of Bylin Dam and the area downstream of the dam within the North Branch Forest River Watershed are presented in Appendix C (Figure C-12: Land Use Map), and in Figure 1-1 (Multi-Resolution Land Characteristics Consortium, 2019). The built environment area is low within the planning area (see Section 1.3.2) and makes up approximately 1,600 acres (3.9%). Agricultural lands make up approximately 85.4% of the area analyzed, which includes cultivated crop land that covers 71.8% of the planning area (approximately 29,100 acres) and pastureland that covers 13.6% of the planning area (approximately 5,500 acres). Natural land (wetlands, grasslands open water, and deciduous forests) makes up a small portion covering only 9.9% (4,000 acres) in the

planning area. The predominant crops in the watershed are spring wheat and soybeans. The planning area downstream of the dam has a higher percentage of cultivated crop production (75.6%, 20,500 acres) when compared to the contributing area upstream of Bylin Dam.

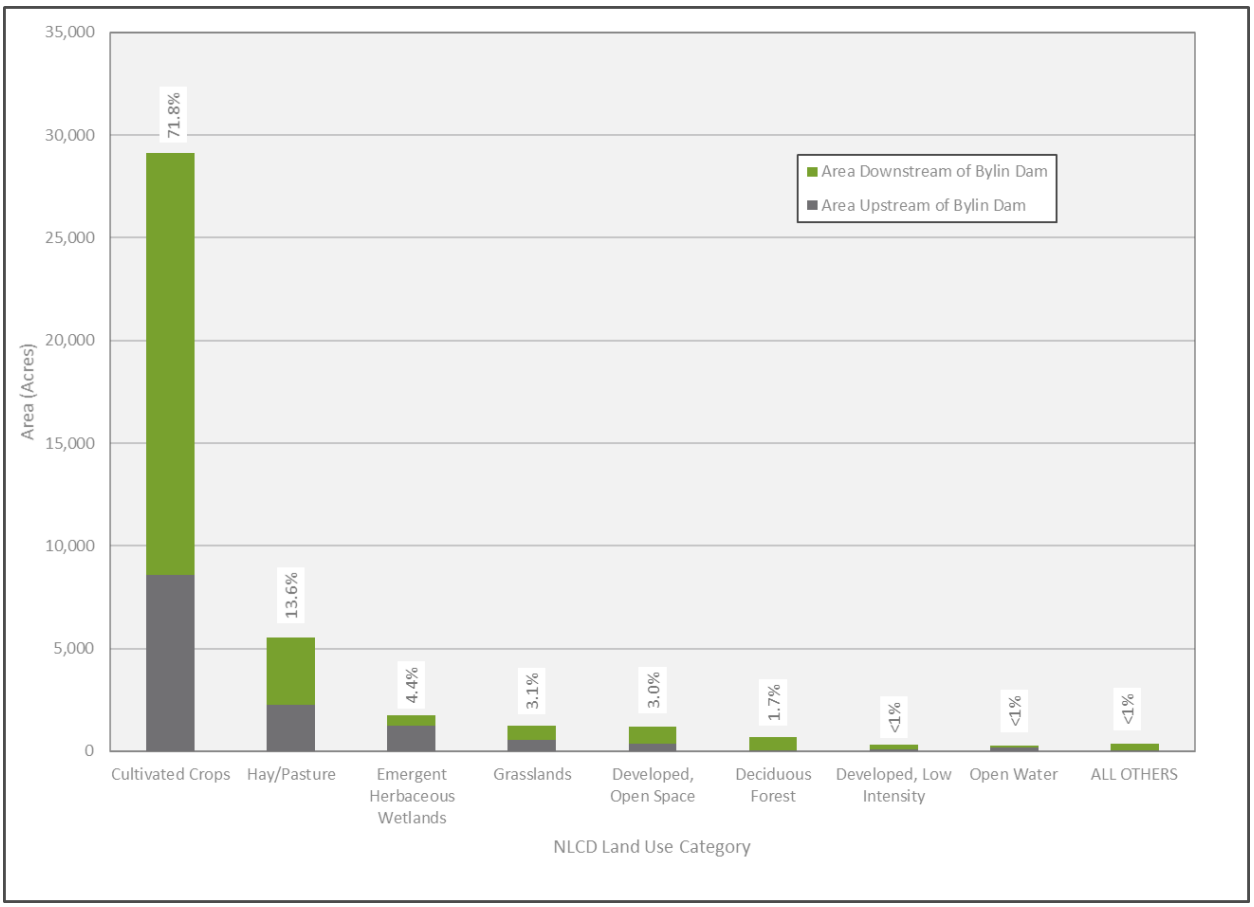

***Figure 1-1**: Land Use in the Area of Interest (values above bars indicate combined percentage)*

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 953 acres (see Appendix C, Figure C-2 Upstream Assessment Area Map).
- Downstream Assessment Area (D-AA), the zone downstream where the environment may be indirectly affected by plan alternatives. The D-AA includes 23 miles of the North Branch Forest River and the adjacent floodplain to the confluence of the North Branch Forest River with the Middle Branch Forest River, just west of Fordville, North Dakota. The D-AA is 27,283 acres (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 20.5 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 describes the context of the environmental conditions where appropriate (e.g., soils and erodibility potential).

1.4 Background and Current Status of the Dam

1.4.1 As-Built / Existing Features

As-built plans for Bylin Dam, which was constructed in 1964 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 south of the embankment. The principal spillway consists of an open top riser tower with an anti-vortex baffle. The riser tower is connected to a 30-inch conduit that carries flow through the embankment. Additional as-built information for Bylin Dam is provided in Table 1-1 and in Appendix D-1: Existing Conditions Assessment Report. The as-built data presented in Table 1-1 was obtained from either the as-built plan set for the dam, or from the final Supplemental Watershed Work plan for the North Branch Forest River Watershed (US Department of Agriculture Soil Conservation Service, 1964). 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 Bylin 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 Bylin Dam

Description	As-Built Drawings	Existing Condition
GENERAL DATA		
Year Constructed	1964	no change
Design Drainage Area	22.1 Square Miles	20.5 Square Miles
Dam Height	58 Feet	57.2 Feet
Embankment Length	760 Feet	no change
Embankment Top Width	26 Feet	23 Feet
Embankment Upstream Slope	3H:1V	3.5H:1V
Embankment Downstream Slope	2.5H:1V	no change
CRITICAL ELEVATIONS (NAVD88)		
Top of Dam	1523.6 Feet	1523.8 Feet
Auxiliary Spillway Crest	1518.4 Feet	1518.6 Feet
Principal Spillway Riser Tower Crest	1511.4 Feet	1511.3 Feet
Principal Spillway Orifice Invert	1490.4 Feet	1490.2 Feet
Maximum Recreation Pool Elevation	1490.4 Feet	1490.2 Feet
Low Flow Drawdown Elevation	1479.3 Feet	1477.2 Feet
Principal Spillway Conduit outfall invert	1463.9 Feet	1463.8 Feet
STORAGE CAPACITIES		
Sediment Storage (Low Flow Draw Down)	179.0 Acre-Feet	59 Acre-Feet
Principal Spillway Orifice Invert (1st Stage)	708.1 Acre-Feet	524 Acre-Feet
Principal Spillway Riser Tower Invert (2nd Stage)	3,073.3 Acre-Feet	2,790 Acre-Feet
Auxiliary Spillway Crest	4,518.8 Acre-Feet	4,223 Acre-Feet
Top of Dam	5,819.7 Acre-Feet	5,554 Acre-Feet
POOL SURFACE AREAS		
Maximum Recreation Pool	59.9 Acres	57 Acres
Principal Spillway Orifice Invert (1st Stage)	59.9 Acres	57 Acres

Description	As-Built Drawings	Existing Condition
Principal Spillway Riser Tower Invert (2nd Stage)	179.5 Acres	167 Acres
Auxiliary Spillway Crest	235.9 Acres	230 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		

1.4.2 Dam Inspection

Site inspections for Bylin Dam were conducted by Houston Engineering, Inc. in September of 2020. 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:

- Inoperable low-level drawdown riser tower pipe
- Minor spalling at the exterior walls of the riser tower
- Minor cracking in the principal spillway conduit
- Concrete loss at the conduit outlet
- Missing north toe drain animal guard
- Trees growing directly adjacent to the auxiliary spillway
- Scarring and erosion on the access road and beach upstream of the auxiliary spillway

1.4.3 Status of Operation and Maintenance

The Sponsor has completed operation and maintenance of Bylin Dam, as outlined in the Operation and Maintenance Agreement with NRCS, since construction completion. Annual inspections of the dam occurred with the Sponsor and NRCS staff until completion of the Federal Operation and Maintenance period in 2014. Engineers from the Dam Safety Section of the North Dakota Department of Water Resources have conducted regular formal inspections of the dam as well.

1.4.4 Dougherty Dam

Dougherty Dam was built in 1935 and is located approximately 6,800 feet upstream (west) of the Bylin Dam embankment. The design, materials, and workmanship of the structure bear resemblance to other Federal relief era conservation structures and the structure has been determined eligible for inclusion in the National Register of Historic Places (NRHP) as it meets several of the qualifying criteria for Depression era conservation structures in North Dakota (32WA837). The spillway for Dougherty Dam is a 50-foot-wide concrete weir section. Based on hydraulic modeling results, the weir at Dougherty Dam would be affected by backwater from retention at Bylin Dam during a 5-year rainfall event. The reservoir at Bylin Dam raises to approximately 1,501.0 feet during the 5-year event, and the approximate weir elevation for the 50-foot concrete section at Dougherty Dam is 1500.3 feet (based on survey data). During a 10-year rainfall event, the reservoir at Bylin Dam raises to 1504.1 feet, which is just below the minimum embankment elevation for Dougherty Dam of 1504.6 feet. During rainfall or runoff events that exceed the 10-year event, the reservoir for Bylin Dam would rise to a level that would cause the embankment of Dougherty Dam to be

fully immersed under water and the pools for both Bylin and Dougherty Dam would combine as one. Due to the limited floodwater attenuation that results from the weir flow at Dougherty Dam, the flood storage available upstream of Dougherty Dam was combined with the flood storage upstream of Bylin Dam to form one elevation-storage relationship for both structures.

More sediment deposition would be expected upstream of Dougherty Dam compared to upstream of Bylin Dam (and downstream of Dougherty Dam). However, a sedimentation survey showed that the sediment deposited in the two reservoirs was relatively uniform, which is an indication that Dougherty Dam does not have a substantial impact on sediment deposition. This is likely due to the amount of fine-grained suspended sediment particles in the overall sediment load and due to the weir flow over Dougherty Dam causing minimal floodwater attenuation upstream of Dougherty Dam. The continued maintenance of Dougherty Dam is not critical for the function of Bylin Dam but does help to maintain a normal depth upstream of the dam, which would help with providing recreational benefits that are commensurate with the current recreation benefits associated with the structure. A failure of Dougherty Dam would not result in a cascading failure of Bylin Dam because there is storage available upstream of Bylin that far exceeds the floodwater storage capacity of Dougherty Dam.

1.4.5 Breach Analysis and Hazard Classification

A breach analysis was completed for both the existing dam and the structural rehabilitation alternative. The breach analysis for the existing condition of Bylin Dam is described in Appendix D-1: Existing Conditions Assessment Report and for the structural alternative in Appendix D-4: Concept Design Report. The breach scenario for the existing condition results in similar inundation, flood depth, and flood velocity when compared to the scenario with the proposed changes in place.

The peak discharge criteria for the dam breach were developed using equations found in Chapter 1 of *Technical Release 210-60 Earth Dams and Reservoirs* (NRCS, 2019). The peak breach discharge calculated for the proposed conditions at Bylin Dam was approximately 116,000 cubic feet per second. The elevation of the reservoir during a breach simulation was assumed to be at the dam crest.

The 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 Bylin 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 Bylin Dam. The analysis showed that seven structures and Highway 32 would fall under the high danger potential category during a breach of Bylin Dam. Therefore, Bylin Dam is classified as a high-hazard dam. Additional information on the breach analysis and hazard classification at Bylin Dam is available in Appendix D-1: Existing Conditions Assessment Report.

1.4.6 Sediment Accumulation

Cumulative sediment volume in the reservoir upstream of Bylin Dam (including the reservoir of Dougherty Dam) was estimated based on multi-frequency sonar 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 179 acre-feet. The resultant sediment deposition can be seen in Appendix D-1: Existing Conditions Assessment Report and, more specifically, on Figure D-1-5. The sedimentation in the combined reservoir upstream of both Bylin and Dougherty Dam shows a relatively uniform distribution of sediment across the reservoir. This is likely due to the predominance of fine-grained sediments that are transported through the North Branch Forest River and the fact that Dougherty Dam is a low head structure that has minimal floodwater attenuation. The calculated sedimentation rate for the combined reservoir upstream of Dougherty and Bylin Dams is 0.16 acre-feet per year per square mile of uncontrolled drainage area. The sedimentation rate that was predicted in the original watershed work plan for the North Branch Forest River Watershed was 0.15 acre-feet per year per square mile of uncontrolled 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-1: Existing Conditions Assessment Report.

Design considerations to account for future sediment accumulation in the rehabilitation plan are discussed in Appendix D-4, Section 2.2.3. Based on input from the Sponsor and planning team, 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 1,477.6 feet (NAVD88). This elevation would accommodate the predicted sediment accumulation over the planned 102-year lifespan. At the existing permanent pool elevation, sediment would fill in approximately 43% of the existing sediment capacity available over the 102-year lifespan. The mean depth in the pool upstream of Bylin Dam is expected to reduce from 8.6 feet to 4.9 feet over the 102-year lifespan.

1.4.7 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 Bylin Dam. The results for the existing condition of Bylin Dam (Appendix D-2: Geotechnical Engineering Report) show the embankment is adequate in the rapid drawdown condition (upstream slope failure) and for normal pool seepage conditions (downstream slope failure). However, the embankment does not pass the minimum factor of safety requirement for the downstream slope under the flood surcharge pool condition. The results also indicate the existing foundation drain for Bylin Dam does not meet state of the practice standards.

1.4.8 Consequences of Dam Failure

The hazard classification of Bylin Dam was confirmed based on results of the breach routing described in Section 1.4.5. Due to the high flood depth and flow velocity at seven habitable structures downstream and State Highway 32, the dam is classified as a high-hazard dam; see maps in attachment D-5-2. In addition to the potential for loss of 25 lives due to hazardous flood conditions at 7 homes and State Highway 32, damage to an additional 12 homes, 39 agricultural properties, 37 grain storage bins, 5.1 miles of roadway, 3 bridges, and 3,168 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. Cultural resource sites downstream, including one bridge and one school (Hoff School, now a museum) listed on the NRHP, would be damaged in the breach event.

The volume of material eroded from the assumed initial breach of the auxiliary is approximately 323,400 cubic yards and would be transported downstream during the breach event. The flood wave would stay within the North Branch Forest River valley through the river crossing at Walsh County Road 14.

Approximately one mile east of Walsh County Road 14, the flood wave would break out of the North Branch Forest River and travel overland through agricultural fields. This overland flooding of cropland would result in additional floodplain erosion, totaling approximately 915,000 cubic yards of erosion, reducing or eliminating crop yields depending on the depth of topsoil loss. A portion of the combined 1.24 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 338 acres of riparian forest downstream of the dam. An estimated 81.9 acres of wetlands would be lost to scour and sediment deposition downstream of the dam and 7.97 would be lost to altered hydrology upstream of the dam. Sediment deposition would occur over 372 acres of cropland and 304 acres of natural areas. Crop impacts caused by erosion, flooding, and the resultant cleanup costs are estimated at approximately $15.9 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 340,200 cubic yards of sediment downstream. The 1.6 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, zinc, 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. 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 North Branch Forest River Dam No. 1 (Bylin Dam) to eliminate the threat the dam, in its current condition, poses to human lives, infrastructure, cropland, and natural resources downstream. Bylin 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 Bylin Dam does not meet current NRCS and State of North Dakota dam safety standards regarding embankment design, hydraulic spillway capacity, and earthen spillway stability requirements. As a result, 25 human lives, 19 residential structures, 39 agricultural properties, 37 grain storage bins, 3 bridges, 5.1 miles of roadway, 2 historic structures, and 3,168 acres of cropland are currently at risk due to a breach of the dam. The normal pool also provides recreation opportunities, consisting primarily of boating, fishing, hiking, and waterfowl hunting.

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 Bylin 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. 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 protects two wellheads used for water supply in the surrounding communities, as well as limited risk of leaching to the Fordville Aquifer.
Fuel	no	Not applicable to this project.
Fiber	no	Not applicable to this project.
Aggregates	yes	Dam provides flood protection for 3 gravel mines located 9 miles downstream.
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.
Climate 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		

Ecosystem Service	Relevant?	Rationale
Cultural Diversity and Heritage	yes	Dam protects two downstream historic sites from flood damage. The dam itself has historic architectural value.
Recreation and Ecotourism	yes	The reservoir provides opportunity for boating, fishing, and waterfowl hunting.
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.
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	Pierre shale contains fossils. Aggregate mines downstream of dam.
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	No Sole Source Aquifers. Public wellheads within the wellhead protection area.
Surface Water Resources	yes	River, tributary, lake, and wetland resources are present.

Resource	Relevant?	Rationale
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	North Branch Forest River downstream of Bylin on the ND DEQ 303d list of impaired water. Reservoir is eutrophic with regular algal blooms; harmful algal blooms have been recorded. Wellhead Protection Area downstream.
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.
Floodplain Management (FEMA)	yes	Zone A FEMA designated land is present downstream of the dam.
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.
Riparian Woodlands	yes	Riparian woodlands are present.
Coral Reefs	no	None present
Designated Natural Areas	no	No specifically designated areas present
Ecologically Critical Areas	no	No specifically designated areas present
Essential Fish Habitat	no	None present
Parklands	no	No specifically designated areas present
Scientific Resources	no	No specifically designated areas present
Mammals, Amphibians, Reptiles, Invertebrates	yes	Species present, several species of state conservation concern possible. Cattle presently graze grassland around reservoir.
Fish	yes	Fish present, several species of state conservation concern possible in the North Branch Forest 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.

Resource	Relevant?	Rationale
Public Health and Safety	yes	Public health and safety are currently jeopardized by the dam.
Transportation and Infrastructure	yes	Walsh Co Road 3 (122nd Ave NE), crosses the dam and provides important farm to market and emergency services access. 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 significant and uncommon opportunities for open water recreational activities.
Visual Resources (Scenic Beauty)	yes	No designated scenic sites, but scenic beauty relevant. Potential impacts from some alternatives.
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. Thes 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, waterfowl, and livestock that are direct provisions (food sources) for humans. As summarized in Appendix D-10 Biological Inventory, consumable fish include yellow perch, walleye, northern pike, bluegill, black crappie, and smallmouth bass. Consumable waterfowl consist of Canada geese, wood duck, green-winged teal, mallard, blue-winged teal, gadwall, and American wigeon. Flood attenuation protects cropland, thereby increasing yields downstream. Crops grown in the watershed are predominately spring wheat, soybeans, dry beans, and corn. Other crops grown in lesser amounts are potatoes, canola, and sunflowers. The reservoir provides livestock drinking water to 25 cow/calf pairs that are grazed on adjacent pastures.

4.1.1.2 Fresh Water

A wellhead protection area in the North Branch Forest River watershed downstream of Bylin Dam contains nine wellheads that provide drinking water supply to surrounding communities. The dam provides reduced flooding in the downstream watershed, which protects 2 wellheads from surface water contamination and reduces the risk of contaminant leaching to the Fordville Aquifer in the Wellhead Protection Area in areas of the floodplain where water may pond (including 3 gravel mines). The location of the wellheads can be seen on Figure C-10 in Appendix C.

4.1.1.3 Aggregates

Flood attenuation provided by the dam reduces flood impacts that would otherwise cause increased damages to three gravel mining operations approximately nine miles downstream; even with the dam in place one operation has experienced damages in the past.

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 500-yr flood, to 3,016 acres of cropland, 4 residences, 23 agricultural properties, 16 grain storage bins. Approximately 2,160 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). The reservoir experiences algal blooms in the summer and there is one recorded incidence of a Harmful Algal Bloom (HAB).

4.1.2.2 Erosion Regulation

The dam attenuates flood flows and reduces downstream flood extents, frequencies, depths, and duration. As a result, the total volume of sheet and rill, as well as gully, erosion on over 3,169 acres of cropland is reduced. As determined from a bathymetric survey documented in Appendix D-1: Existing Conditions Assessment, the dam has served to capture 3.2 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 Bylin Dam. Geomorphic assessment of the downstream channel, documented in Appendix D-8: Stream Classification and Riparian Assessment, indicates incision and bank erosion, although to a limited degree due to the relatively intact riparian zone forest for the first ~9 miles downstream (to Hwy 32). The existing riparian forest stabilizes the streambank and provides erosion control.

4.1.2.3 Climate and Pest Control

The role of reservoirs in climate 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 climates indicates that the Bylin reservoir generates approximately 1.24 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 2,160 acres of riparian forest in the D-AA provide multiple ecosystem regulation benefits including sequestering carbon which helps regulate the climate. 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

The Hoff School, listed with the National Register of Historic Places (NRHP) (NR08000233) and currently used as a museum, is located one mile downstream from the dam and is currently protected from inundation for floods up to the 500-year event. In addition, the dam provides protection to a bridge ½ mile downstream that is on the NRHP (32WA207). Bylin Dam was determined to not be eligible for the NRHP but was listed as an architectural site with the ND State Historic Preservation Office. Dougherty Dam was built in 1935 and is located approximately 6,800 feet upstream (west) of the Bylin Dam embankment. The design, materials, and workmanship of the structure bear resemblance to other Federal relief era conservation structures and the structure was determined eligible for inclusion in the National Register of Historic Places (NRHP) as it meets several of the qualifying criteria for Depression era conservation structures in North Dakota (32WA837).

4.1.3.2 Recreation and Ecotourism

The reservoir provides recreation opportunities generally not common in the area, consisting of fishing, waterfowl hunting, and boating. Alternate fishing opportunities exist at four other locations in the area, at a distance of 15 to 41 miles. The Walsh County Water Resource District owns some of the land around the reservoir (there are also two private landowners), although Bylin reservoir is not officially designated as a park. Amenities include a boat ramp, fishing pier, and public restrooms (Appendix D-5: Economics Evaluation Report). Fishing, recreational boating, and hunting are the predominant activities at the lake. Fishing is a popular activity here, and the lake is stocked annually by the NDGFD. Ice fishing occurs during the winter. Alternate fishing opportunities exist at four other locations in the area within 15-41 miles. Bylin Dam has an annual recreation value of $12,100 (2023 dollars).

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.

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.

4.1.4.2 Nutrient Cycling

The reservoir has disrupted the sediment flux to the river system. As documented in Appendix D-7, 41 tons of phosphorus, 612 tons of nitrogen, and 7,570 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 2,160 acres of riparian forest in the D-AA remove 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 climate change. The reservoir habitat supports lake fish species, waterfowl, and migration corridors. Flood attenuation impairs the downstream floodplain by restricting inundation and sediment transport to riparian woodland, wetland, and grassland habitats. The existing 2,160 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).

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 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 U-AA consists of 71% grass and pasture (679 acres), followed by 16% natural land, 10% crop land, and only 3% developed land (artificial structures). One landowner uses approximately 90 acres on the north side of the reservoir and 90 acres on the south side for grazing 25 cow/calf pairs. There are similar numbers of cattle grazing around the Dougherty reservoir. In the D-AA, land use is divided between tilled land (64%, 8,544 acres), grazing land (19%), land not used for economic purposes (12%), and developed with structures (5%). There are also 3 gravel mining operations downstream of the dam.

The latest zoning manual available for Walsh County was completed in 1994 (Red River Regional Council, 1994). Goals outlined in that plan include promoting and enhancing the agricultural industry by preserving farmland and farm businesses and services and recognizing the importance of agriculture. Therefore, based on the best information available, there is no indication that land use in the D-AA would be altered from the current use, which is predominantly agriculture. However, individual landowners may make land conversion decisions themselves depending on their own cost-benefit analyses and conservation preferences.

4.2.2 Surface Geology and Soil Resources

4.2.2.1 Surface Geology

The surface geology in the AOI is made up of Pierre shale, Coleharbor glacial till, and Oahe clays. Within the U-AA, the predominant surface material is Pierre shale, which has shown to contain fossils in nearby areas. In the D-AA, the geologic deposits in the Wellhead Protection Area (WHPA) the surficial glacial deposits consist of deltaic outwash plains deposits and beach deposits composed chiefly of permeable sand and gravel. These surficial deposits comprise the Fordville aquifer (NRCS 2020). . There are several sites of aggregate mining also in this region. For additional information on the surface geology within the AOI, refer to Appendix D-6 Environmental Resources Memorandum.

4.2.2.2 Soil Resources, Erosion, and Deposition

The soils in the watershed upstream and downstream of Bylin Dam are generally characterized as having only moderate limitations for cropping suitability (Web Soil Survey (WSS) Land Capability Class) and are considered low-to-moderately erodible for water erosion. (Appendix D-6 Environmental Resources Memorandum). The most predominant limitations for cropping include susceptibility to wind erosion,

wetness and cold climate (WSS Land Capability Subclass). The river channel upstream is moderately stable while the downstream channel is stable laterally but shows a higher degree, and future probability of, vertical incision relative to the upstream channel (Appendix D-8 Stream Classification and Riparian Assessment Memorandum). Wave action and livestock grazing directly and indirectly increase the incidence of erosion in the U-AA.

Sediment accumulation in the reservoir is discussed in Section 1.4.6 and Appendix D-7 Reservoir Sediments Characterization Memorandum. Sediments contain carbon, nutrients (nitrogen and phosphorus), and metals, some of which have been increasing in concentration over time. None of the analyte concentrations exceeded the USEPA thresholds.

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” (78%) with the rest being rated as “all areas prime farmland” (20%) and “farmland of statewide importance” (2%) (US Department of Agriculture Natrual Resources Conservation Sercvice Soil Survey Staff, 2020). The portion of the D-AA from the dam to North Dakota Highway 32 contains a few areas along the river that are designated as “farmland of statewide importance”. The watershed east of North Dakota State Highway 32 to the North Branch Forest River outlet into the Middle Branch Forest River near Fordville, ND shows most of the land adjacent to the river is classified as “prime” farmland. Figure C-13: Farmland Classification Map shows the different categories of prime and unique farmland within the AOI.

4.2.3 Water Resources

4.2.3.1 Groundwater Resources

The Wellhead Protection (WHP) Program was established by the state of North Dakota and was approved by the Environmental Protection Agency (EPA) in 1992. The WHP Program is a primary water protection activity for public water systems throughout the state of North Dakota (Burgum & Glatt, 2018). There is a WHP area downstream of Bylin Dam within the D-AA. The WHP area can be seen in Figure C-6 through Figure C-10. Downstream from the dam there are nine wellheads located north and east of the North Branch Forest River in Vernon (T156N, R56W) and Medford (T155N, 56W) Townships. The location of the wellheads can be seen in Figures C-6 through C-10. The wellheads provide drinking water for the city of Park River and water used to irrigate crops. One of the nine wellheads is affected by flooding with the dam in place (see Figure C-10). There are no other WHP areas within the U-AA or D-AA. The gravel mining operations downstream from the dam may be hydrologically connected to the drinking water supplied by this aquifer (NWQI Source Water Assessment, Walsh County, ND, June 22, 2020).

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 2020 and documented in Appendix D-9 (Aquatic Resources Report). These are categorized as wetland and potential Other Waters (OW). The three wetland classes identified include RIVERINE, LACUSTRINE FRINGE, and DEPRESSIONAL, the summarized areas for which Table 4-1 for the U-AA. There are 37 wetland areas, totaling 34.87 acres, of which 20.36 acres are considered naturally present on the landscape and of which 14.51 acres are identified as artificial wetlands formed from construction of the road, the dam, and the reservoir. There are 7.99 acres of artificial wetlands in the U-AA below Dougherty Dam which could be affected by plan alternatives, 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. Wetlands upstream and wetland upstream of Dougherty Dam would remain as there are no proposed changes to that dam.

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 as well as Lacustrine Fringe wetland class areas. There is not an approved Lacustrine Fringe model for North Dakota or Great Plains region, however a Lacustrine Fringe model from Texas (USACE, 2024) was reviewed and many functions are similar to the Pothole Model, with the addition of Shoreline Integrity. Since there are no existing Lacustrine Fringe mitigation banks in North Dakota, historically projects have used pothole credits for Lacustrine Fringe losses. Therefore, the Lacustrine Frige wetland functions are documented with Pothole functional categories, with the addition of Shoreline Integrity. 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 below Dougherty Dam, which could be affected by some plan alternatives.

Table 4-1: Wetlands within U-AA Planning Area

		Wetland Classes		
		RIVERINE	LACUSTRINE FRINGE	DEPRESSIONAL
Area in U-AA (acres)		19.83	13.28	1.76
Potentially Affected Area in U-AA by Alternatives (acres)		-	7.12[1]	0.87[2]
Wetland Functions (FCU)	Static	-	4.36	0.56
	Dynamic	-	0.00	0.00
	Cycling	-	5.54	0.71
	Removal	-	5.11	0.65
	Retention	-	5.27	0.67
	Plants	-	5.34	0.68
	Structure	-	4.49	0.57
	Habitat	-	1.72	0.22
	Shoreline Integrity	-	2.30	-

[1]Artificial Wetlands 23,25-28,30-33 Prepared May 2024

[2]Artificial Wetlands 34,36

There is no HGM calculator available for the Potential Other Waters that could be impacted by plan alternatives. Potential Other Waters include deepwater (80.19 acres), and tributaries and drainage features (45,730.82 linear feet). Potential Other Waters functions align similarly to wetland functions, however 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 tributaries and drainage features include linear swaths that include moving water which connect varying ecologic settings, including wetland and deepwater habitats.

The D-AA has 1,305.3 acres of wetlands, as determined from NWI data. The river extending to the confluence of the mainstem Forest River near Fordville consists of 23 miles with 69 miles of unnamed tributaries (see Appendix D-6: Environmental Resources Memorandum). 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. NWI wetland areas include riverine, lacustrine, and palustrine systems; classes

include semi-permanent, emergent, temporary, forested, shrub, excavated, and streambed. Therefore, wetlands fit Riverine and Depressional wetland classes; the NWI lacustrine areas were evaluated with off-site analysis, which include gravel pits that do not appear to have deepwater present. 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 and Pothole 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 both Riverine and Depressional class wetlands. 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
	Area (acres)	69.6	143.4
Wetland Functions (FCU)	Static	-	84.1
	Velocity Reduction	15.1	-
	Dynamic/ Storage	17.1	77.7
	Cycling	-	67.7
	Removal	17.2	61.4
	Retention	15.4	62.8
	Plants	17.2	79.7
	Structure/ Organic Carbon Export	16.1	71.7
	Habitat	15.3	32.1
	Linear Habitat	17.0	-

Prepared May 2024

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 Forest 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 North Branch Forest River, its tributaries, and the reservoirs at Bylin Dam (normal pool 60

acres) and Dougherty Dam (normal pool 21 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 Resources Report.

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 aquatic resources monitored by NDDEQ include the Forest River, North Branch Forest River, and Bylin reservoir (Appendix D-6 Environmental Resources Memorandum). The Bylin reservoir is not listed as an impaired water. Historically, water quality was characteristic of a hypereutrophic reservoir but has improved to be classified as eutrophic. Based on comments provided during public scoping, algal blooms have been observed in the reservoir in the past and the NDDEQ issued a harmful algal bloom (HAB) advisory in August 2021. Uncertainty is high for water quality constituents and related algal blooms to the dam as there is no gauging in the watershed and no internal loading analysis or model for the lake.

The North Branch Forest River between Highway 32 and Fordville is listed as impaired and requires further evaluation (TMDL study). The river is fully supporting the designated uses of “Fish” and “Other Aquatic Biota,” but these uses are threatened, and the impairments were identified via combined biota/habitat bioassessments (Appendix D-6 Environmental Resources Memorandum).

One aquifer is located within the D-AA and is known as the Fordville Aquifer, an unconfined surficial aquifer (Appendix C, Figure C-6 Bylin Dam Breach Inundation – Overall). The aquifer has been sampled for water quality six times from 1993 to 2018. In 2018, the median concentration of arsenic that was sampled in the aquifer was 8 µg L^{-1} (exceeding the safe drinking standard of 0.01 µg L^{-1}). None of the wells that were sampled in 2018 or 2013 had nitrate concentrations that exceeded the maximum contaminant level. Four of the wells sampled in the aquifer have detectable pesticide since 1993, however, no pesticides were detected during the latest sampling completed in 2018 (North Dakota Department of Environmental Quality, 2021).

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 the1940s and 1950s, many dams, including Bylin Dam, were constructed in the region during the 1960s. These dams replaced much of the natural flood retention, although not the ecological value of mosaic of wetlands, prairie, meandering streams, and beaver dam complexes. It is important to note the flood attenuation provided by Bylin Dam is more concentrated than the historically distributed water retention on the landscape, however the dams did serve to restore more natural (lower) peak flows to the downstream river reaches.

Flows within the North Branch Forest River Watershed are regulated by several small flood control dams. These dams are located primarily in the upper portions of the North Branch Forest River Watershed, and none are located downstream of Bylin Dam on the North Branch Forest River. Several dams are within a 35-mile radius of Bylin Dam (Appendix D-6 Environmental Resources Memorandum). Several miles downstream of Bylin Dam, near the North Branch Forest River crossing with North Dakota State Highway 32, the river flows within a constructed drainage improvement ditch known as Walsh County Drain 97. Both Bylin Dam and Dougherty Dam are included within the U-AA. Dougherty Dam was designed to provide recreational opportunities and not to provide any flood reduction benefit. Dougherty Dam was constructed in 1935 and continues to be maintained by the Walsh County Water Resource District. The structure is

currently in good condition. A potential failure of Dougherty Dam does not pose a risk to the downstream floodplain because of its lack of storage and height (less than 15 feet) associated with the structure. The top of embankment elevation for Dougherty Dam is at an elevation of 1504.6 feet (NAVD88) and the elevation of the second stage of the principal spillway at Bylin Dam is at an elevation of 1511.3. Therefore, by the time the second stage of the principal spillway is activated for Bylin Dam, Dougherty Dam is under approximately 6.7 feet of water.

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 Walsh County was adopted in 2012 and identifies Special Flood Hazard Areas. Panels which cover Bylin Dam and the downstream watershed include 38099C06 10D, 20D, 25D, 50D and 38099C09 06D, 08D, 25D. The mapped extents for Zone A (high risk areas subject to inundation by the 1% annual-chance flood event) extend up the North Branch Forest River to the crossing with 66th Street NE, which is located approximately 5,000 feet downstream of the Bylin Dam outlet. Therefore, the U-AA (which only extends approximately 2,000 feet downstream of the dam) is entirely within Zone X (low risk areas outside the 100-year flood zone or protected by a levee for a 100-year flood. While the area upstream of the dam is not mapped within Zone A, it is recognized that this area would likely experience flooding due to retention at Bylin Dam. The D-AA has 85% of land in Zone X and 15% in Zone A.

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 Bylin 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 D-5: Economics Evaluation Technical Memorandum.

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 achieving 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 Forest 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 Bylin 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
Sulfur Dioxide (1-hour) ppb	75	4	17.5	6.7	3.7	7.3	15.8	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
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 has a variety of habitats and plant communities with a quality range of fair to good. These communities include tame grassland (i.e., tilled, or other disturbed land returned to grassland), wetland, upland deciduous forest, river and stream, lake, and prairie. Refer to Appendix D-9 Aquatic Resources Report 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.

An inventory of the U-AA showed 143 species. Preferred habitat is possible for one state Level I species of concern: (*Asclepias lanuginosa*, wooly milkweed). Common milkweed (Asclepias syriaca), a critical species for Monarch Butterfly (candidate for federal T&E listing), was identified in the U-AA. Refer to Appendix D-10: Biological Inventory Report for additional information on the inventory of plants collected within the U-AA.

The D-AA has 710.33 acres of wetlands (based on the National Wetland Inventory) and has no sites of open water. The North Branch Forest River from the dam to the confluence of the mainstem Forest River

consists of 23 miles of river and 69 miles of unnamed tributaries. A corridor of riparian woodland extends from Bylin Dam downstream to North Dakota State Highway 32 near Lankin, ND. A plant inventory was not taken in the D-AA but riparian woodlands in Northeastern North Dakota are typically dominated by Green Ash and Elm trees (NDGF State Wildlife Action Plan, 2015). Between North Dakota State Highway 32 and Fordville, the river is channelized and supports sparse stands of riparian woodland. Grassland and pastureland cover are the predominant naturalized habitats in the area. Upland deciduous forest covers some areas. An ecoregion transition occurs within the D-AA from the Drift Plains sub-ecoregion which extends from Bylin Dam to approximately Lankin. The Lake Agassiz Glacial Plain extends from approximately Lankin, downstream to the confluence of the mainstem of the Forest River. This also marks a transition point in plant community from mixed grass prairie to tall grass prairie. Each is unique in its plant species components. The Mixed Grass Prairie is comprised of species from the Tall Grass Prairie to the east, and Short Grass Prairie to the west. Tall Grass Prairie can include more than 200 plant species (NDGF State Wildlife Action Plan, 2015) including several native species from each of these ecoregions such as Big Bluestem, Little Bluestem, and numerous sedge species. Other introduced species such as Kentucky Bluegrass, Smooth Brome, and Reed Canarygrass most likely make up the majority of plants in the D-AA

For additional information on wetlands, streams, forests, grasslands, and prairies within the D-AA, refer to Appendix D-6: Environmental Resources Memorandum.

4.2.5.2 Riparian Woodlands

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 U-AA is 138 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.

In the D-AA a corridor of riparian woodland extends from Bylin Dam downstream to ND Highway 32 and is estimated from aerial photography to be approximately 2,160 acres. This unusually large block of native riparian forest community, for this watershed, typically exists where slopes were too steep for conversion to cropland. The upper-story native riparian trees are dominated by Burr Oak, Green Ash and Basswood, while understory species typically include chokecherry, hazel and snowberry. East of ND Hwy 32, very little riparian woodland remains as the flatter slopes were tilled land and/or drained via channelization to facilitate cropping.

4.2.5.3 Mammals, Amphibians, Reptiles, Invertebrates

An inventory of the U-AA (D-10 Biological Inventory Report) showed 36 species (including birds and fish). Preferred habitat is likely for *Myotis septentrionalis* (northern long-eared bat) (forests, roosts in trees with loose bark or holes). One Level I state-listed insect species of conservation concern (*Danaus plexippus*, monarch butterfly) was observed. This butterfly species requires milkweeds. Preferred habitat may be present in the project area is also possible for 20 other ND species of conservation concern, including birds, bats, mussels, amphibians, fish, invertebrates, and reptiles (Appendix D-10: Biological Inventory Report). Refer to Appendix D-10: Biological Inventory Report for additional information on the inventory of animals collected within the U-AA.

The D-AA likely supports a large variety of species characteristic to the habitats present (not surveyed).

4.2.5.4 Fish

There are no critical fisheries in the vicinity of the dam, and there are no formal management plans for the dam or for the North Branch Forest River. Bylin reservoir is stocked by the North Dakota Game and Fish Department (NDGFD) and is classified as a Class III warm water fishery. Only walleye have been stocked in the reservoir over the last ten years. Yellow perch, northern pike, fathead minnows, and crayfish have

been collected in samples by the North Dakota Game & Fish Department (NDGF). The reservoir relies primarily on stocking efforts made by NDGF. Natural reproduction is minimal at best. The reservoir is used for fishing mostly by residents of the area. NDGF maintains an accessible fishing dock free of cost to the public. It is not a primary fishing destination for individuals residing outside the local region.

Twenty-seven native fish species have been listed as characteristic to the Forest River and 16 species (all native species) have been identified in the river at sampling sites near Fordville (Appendix D-10 Biological Inventory Report). *Nocomis biguttatus* (hornyhead chub, a Level III species) has been observed in the Forest River and there is potential for *Margariscus nachtriebi* (northern pearl dace, a Level I species of state conservation concern) to occur within the North Branch Forest River.

4.2.5.5 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.

During the biological survey, 17 species of birds were identified. One migratory bird species, a USFWS bird of conservation concern and state-listed Level I species, was observed *Leucophaeus pipixcan* (Franklin's gull). This species is protected under the MBTA. Its habitat requirements include large wetlands with semi-open emergent plant cover, and it often feeds in cultivated agricultural fields. No eagles or large stick nests were observed during the inventory. Refer to Appendix D-10: Biological Inventory Report for additional information on the inventory of birds, and their protection status, observed within the U-AA.

In the D-AA there may be many migratory bird species of concern as North Dakota is located within the Central Flyway. Migratory birds may occur in the AOI during spring and fall migration as well as use the area as breeding and nesting grounds through the summer. Because the AOI is located within the Prairie Pothole Region, the area has additional importance to waterfowl species**.** 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.

4.2.5.6 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 on 5/16/2024 for compliance with the ESA. Two species include Danaus plexippus (monarch butterfly) and Myotis septentrionalis (Norther Long-eared Bat – NLEB) were included in the Official Species list on 5/16/2024 (See Appendix E Environmental Evaluation). The monarch butterfly is an official Candidate for listing and the NLEB is listed as Endangered. No critical habitats were identified as present in the project area.

In the U-AA there were no T&E species observed. Danaus plexippus (monarch butterfly) – a federal T&E candidate species was observed. The whooping crane is classified as an Endangered Species that may occasionally visit Walsh County, ND. Their preferred habitat is shallow wetlands with cattails, bulrushes, and sedges, but they may rest in upland areas during migrations. 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 (candidate for federal T&E listing), 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.

4.2.5.7 Undesirable Species (including Invasive Species)

The biological inventory showed 12 species of introduced/problematic plants including the state noxious weeds *Carduus nutans* (musk thistle), *Cirsium arvense* (Canada thistle), and *Euphorbia esula* (leafy spurge)

(Appendix D-10: Biological Inventory Report). There is high potential for undesirable species in the D-AA (not surveyed) due to intensive agriculture and other natural community disturbance. Zebra mussels have not been identified in Bylin Reservoir, but they are present in North Dakota. There is the possibility this species could be introduced to the reservoir by users of the recreational boating opportunities.

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 tribes were formally consulted and invited to participate in the planning process in January 2020. One tribe (Northern Arapaho), 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. A literature review and archive review were conducted by NRCS Cultural Resource Specialists prior to conducting a Class III field survey in October of 2021. The survey was performed by NRCS Staff (Appendix D11 – Class III Cultural Resources Inventory Report). The NRCS State Cultural Resource Specialist examined Dougherty Dam – thought to be built in 1935. Its construction is similar to dams built by the Works Progress Administration (WPA). NRCS determined that Dougherty Dam is a National Register of Historic Places eligible historic property and that the proposed undertaking would have no adverse effect. The presence of accumulated sediments makes observations of additional historic items unlikely.

The ND State Historic Preservation Office (SHPO) concurred with both eligibility and the no adverse effect determination on March 21, 2022 (see Appendix A). NRCS completed additional survey work that included minor additional areas on August 15, 2022. The Class III survey was sent to the 31 Tribal Governments and ND SHPO on 8/3/2023. Two tribal governments responded. The Crow Creek tribe deferred to local tribes. The Spirit Lake Nation concurred with the finding of No Effect to Historic Properties, however they cautioned that the area was significant to their tribe and stressed the necessity of the project staying within the footprint of the conceptual design (see communications in Appendix A). ND SHPO concurred with the finding of No Adverse Effect and requested that Bylin dam be recorded as an architectural site. The ND NRCS Cultural Resource Specialist complied with this request. The Apache Tribe of Oklahoma was later identified as having potential interest in the planning area. The Class III Survey was sent to them for consultation on May 20, 2024.

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. Historical properties are located within the area of indirect effect. The Hoff School, listed with the national register (NR08000233), is located one mile from the dam and is currently at risk of inundation if the dam were to breach. In addition, the dam provides protection to 1 downstream bridge that is on the NHRP (32WA207). Two other bridges in the area are also on the NHRP but are unaffected by the dam or any alternatives (32WA205, 32WA276).

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 1.4.5 and in Appendix D-1: Existing Conditions Assessment Report indicates that loss of life is likely given a dam failure under the evaluated conditions. Seven habitable structures and one highway would have flow depths and velocities place them in the high danger potential category where loss of life would likely occur. An estimated 25 lives would be at risk at the residences and highway. The reservoir has experienced harmful algal blooms which are a public health risk. The dam currently provides water quality protection to a downstream wellhead protection area.

4.2.6.3 Transportation and Infrastructure

The gravel township road across the dam, (122nd Ave NE) is essential for public and commercial transportation. There are multiple public and private roads within the watershed. North Dakota State Highway 32 is the only road within the D-AA or U-AA with an average daily traffic load of over 400 vehicles.

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

Agriculture is the largest category of land use in Walsh County, comprising approximately 98% of the land area, contributing to 31% of the total annual income for residents (Headwaters Economics, 2021). In the AOI, agricultural land in the study area consists of nine major crops comprising more than 99% of active agricultural land (3,529 acres). Refer to Appendix D-5: Economics Evaluation Report for additional information on the local and regional economy. While the majority of the land in the AOI is crop land, there are also various farm sites throughout the AOI where farming operations are conducted including storage buildings and farming equipment.

4.2.6.7 Environmental Justice, Civil Rights

U.S. Census Bureau and U.S. Environmental Protection Agency Environmental Justice data was obtained to develop an understanding of the demography of the project area. Demographic statistics for the project area were generated by using Census block group data from the Census Bureau's ACS (American Community Survey) 2017-2021 5-year Summary. Any census block group that is incorporated into the project area was included in its entirety, therefore demographic data for the project area is only an estimate. The affected environment includes the five block groups encompassing the rural areas within the project area and also includes the cities of Lankin, Fordville, Pisek, Adams, Edinburg and Park River, as each of the cities is either directly, or indirectly affected by the proposed project. The planning area is comprised of the following five census block groups: 380999583002 (includes rural areas west of the U-AA and the city of Lankin), 380999581002 (rural areas east of the U-AA - includes cities of Pisek and Fordville), 380999583001 (includes contributing watershed and cities of Adams and Edinburg), 38099582001 (western portion of the city of Park River, ND), and 380999582002 (eastern portion of the city of Park River, ND) .

The population within the project area is approximately 3,527 individuals, of which 94% of the population is white (includes those who identify as more than one race), with the predominant minority being classified as Native American (2.0%) (Table 4-4). Persons with Disabilities averages 15% within the Planning Area which is consistent with other populations.

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

Location	Population (2023)	Per-Capita Income (2017-2021; in 2021 dollars)	Persons in low-income households (%)	Predominant Race (2023 est.)(white includes those who indicated more than one race)	Predominant Minority (2023 est.)
North Branch Forest River Planning area	3,527	$33,110	24.4%	White, 94%	Native American, 2.0%
Walsh County	10,631	$35,032	30%	White, 83%	Hispanic or Latino, 12%

Location	Population (2023)	Per-Capita Income (2017-2021; in 2021 dollars)	Persons in low-income households (%)	Predominant Race (2023 est.)(white includes those who indicated more than one race)	Predominant Minority (2023 est.)
Nelson County	3,035	$33,392	28%	White, 92%	Hispanic or Latino, 4%
North Dakota*	783,926	$37,343	24%	White, 86.6%	American Indian and Alaska Native, 5.3%

Source: https://www.census.gov/quickfacts/ and https://www.epa.gov/ejscreen Prepared May 2024

As recommended by the US EPA, the presence of minority populations was determined by conducting both the Fifty Percent analysis and the Meaningfully Greater analysis in concert (Table 4-5). The reference community chosen for the analysis was Nelson County. Other reference communities were considered, such as the State of North Dakota, Walsh and Grand Forks Counties. The rationale for choosing Nelson County was that the scale, influence and location were most appropriate for analysis. The population demographics for the State, Walsh and Grand Forks County would have masked the demographics in the planning area, while the location in Grand Forks County was too dissimilar because of the large differences in soils, geology and flood prone landscape position.

50 % Analysis: The percent of People of Color within the individual census block groups did not exceed 50% of the population in those groups. Likewise, the percent of People of Color within the Affected Environment did not exceed 50%. Therefore, no minority populations were detected using the 50% analysis method. A threshold of 10% exceedance was determined to be reasonable and subjective when comparing the reference community with the block group geographic units.

Meaningfully Greater Analysis: The purpose of this analysis was to determine whether the percent of People of Color in individual block groups was Meaningfully Greater than the percent of People of Color in the reference community (Nelson County). One block group exceeded the 10% threshold for People of Color. Block 380999582002 (eastern portion of the City of Park River) had a People of Color population that was 12% greater than the reference community. When looking more closely at demographic data, this difference can be attributed to the Native American population within this group.

Table 4-5 50% and Meaningfully Greater Population Analysis

Geographic Unit	Total Population	Population of People of Color	% People of Color	Does the % People of Color Exceed 50%? Y/N	% Difference of People of Color compared with Reference Community	Is the % People of Color Meaningfully Greater (by 10% or more) than the Reference Community (Y/N)
Affected Environment (portions of Walsh County)	3527	196	6%	No	NA	NA
Reference Community Nelson County	3035	243	8%	No	equal	No
380999583002 (SW includes Lankin, ND	510	5	1%	No	-155%	No

Geographic Unit	Total Population	Population of People of Color	% People of Color	Does the % People of Color Exceed 50%? Y/N	% Difference of People of Color compared with Reference Community	Is the % People of Color Meaningfully Greater (by 10% or more) than the Reference Community (Y/N)
380999583001 (NW includes Adams * Edinburg, ND) includes Hensel, ND)	595	18	3%	No	-90%	No
380999581002 (East includes Fordville & Pisek, ND)	642	45	7%	No	-13%	No
380999582002 (Western Park River City, ND)	633	24	4%	No	-100%	No
380999582002 (Includes Eastern Park River City, ND)	1147	103	9%	No	12%	Yes

Prepared April 2024

Potential environmental justice concerns which may affect some populations disproportionately were assessed by running the EPA's EJ Screen Community Reports for each of the 5 block groups. The EPA has identified 13 environmental indicators which are analyzed with data combined from low income and people of color statistics. The EJ Screen also calculates a Supplemental Index that combines demographic statistics of low income, linguistically isolated, less than high school education, percent unemployed and low life expectancy. The 13 environmental indicators include: Particulate Matter, Ozone, Diesel Particulate Matter, Air Toxics Cancer Risk, Air Toxics Respiratory Hazard Index, Toxic Releases to Air, Traffic Proximity, Lead Paint (pre-1960's housing), Superfund Proximity, RMP (Risk Management Plan) Proximity, Hazardous Waste Proximity, Underground Storage Tanks and Wastewater Discharge. The US EPA suggests agencies use an 80th percentile as a starting point when identifying geographic areas that may warrant further consideration, analysis, or outreach. No index values exceeded the 80th percentile except for lead paint in the eastern block group which includes the cities of Fordville and Pisek.

4.2.6.8 Noise

The Walsh County Comprehensive Plan adopts a policy of minimizing noise disturbances so as to preserve property values. No known sources of noise that exceeds 100 dB (gravel mining, farm equipment, road/drain maintenance, traffic) exist in the AOI.

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 raising the dam embankment, widening the auxiliary spillway, modifying the principal spillway, and armoring the auxiliary spillway to prevent a dam breach. 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 Bylin 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 is provided in Appendix D-3: Alternatives Evaluation Report.

- Widen auxiliary spillway to 720 feet, use articulated concrete block to armor the auxiliary spillway, and modify principal spillway.
- Raise embankment by approximately 3.5 feet and use roller compacted concrete to armor auxiliary spillway.
- Widen auxiliary spillway to 720 feet and use roller compacted concrete to armor auxiliary spillway.
- Raise embankment by approximately 3.5 feet and use reinforced concrete to armor auxiliary spillway.
- Widen auxiliary spillway to 720 feet and use reinforced concrete to armor auxiliary spillway.
- Widen auxiliary spillway to more than 3,200 feet (distance required to eliminate breach potential during freeboard hydrograph design event) and keep as earthen auxiliary spillway.
- Raise embankment by approximately 1.5 feet, construct ogee weir structure at current auxiliary spillway elevation, use articulated concrete block to armor the auxiliary spillway, and modify principal spillway.

- Widen auxiliary spillway to approximately 440 feet, construct ogee weir structure at current auxiliary spillway elevation, use articulated concrete block to armor the auxiliary spillway, and modify principal spillway.
- Raise embankment by approximately 1.5 feet, construct ogee weir structure at current auxiliary spillway elevation, use roller compacted concrete to armor the auxiliary spillway.
- Widen auxiliary spillway to approximately 440 feet, construct ogee weir structure at current auxiliary spillway elevation, use roller compacted concrete to armor the auxiliary spillway.
- Raise embankment by approximately 1.5 feet, construct ogee weir structure at current auxiliary spillway elevation, use reinforced concrete to armor the auxiliary spillway.
- Widen auxiliary spillway to approximately 440 feet, construct ogee weir structure at current auxiliary spillway elevation, use reinforced concrete to armor the auxiliary spillway.
- Construct labyrinth weir within the existing spillway footprint (300-foot base width with 722 feet of effective weir length), use articulated concrete block to armor the auxiliary spillway, and modify principal spillway.
- Construct labyrinth weir to minimize base width (216-foot base width with 1,577 feet of effective weir length), use articulated concrete block to armor the auxiliary spillway, and modify principal spillway.
- Construct labyrinth weir to minimize base width (216-foot base width with 1,577 feet of effective weir length), use roller compacted concrete to armor the auxiliary spillway.

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 Bylin Dam to a significant-hazard classification were evaluated.

Bylin Dam is currently a high-hazard dam based on the criteria described in Section 1.4.5. Rehabilitation of the dam to a significant-hazard designation would involve either flood proofing or removing the habitable structures downstream of the dam that cause it to have the high-hazard designation. Several of the habitable structures would have flood depths that exceed of 15 feet during the breach scenario described in Section 1.4.5. Therefore, floodproofing these structures by means of ring levees or raising the structures was considered impractical and was eliminated from detailed analysis. Addressing overtopping potential of Hwy 32 during a breach was also determined impractical. Property buy-outs were considered in combination with a structural rehabilitation alternative to significant-hazard designation. The breach analysis with the lower hazard classification still showed that the auxiliary spillway would breach during passage of the freeboard hydrograph. Therefore, armoring of the spillway would still need to be implemented as part of the alternative.

The alternative evaluation process for a high-hazard designation was used to narrow the scope of alternatives evaluated for significant-hazard designation. The structural rehabilitation to significant-hazard designation used to compare to the structural rehabilitation to a high-hazard designation involved lining the auxiliary spillway with articulated concrete block (ACB). No embankment raise was necessary under the significant-hazard designation. The principal spillway riser tower would need to be modified to accommodate the appropriate design event. The cost to buy out properties with habitable structures would offset the cost savings from no longer having to raise the embankment. Additionally, placement of fill material excavated for the auxiliary spillway was not considered in the cost estimate for the structural rehabilitation to significant-hazard designation but, after consideration of slope stability concerns discussed in Appendix D-2: Geotechnical Engineering Report, the excavated material would likely be needed for fill material on the downstream slope of the dam. Given the high cost of this alternative and the difficulties associated with limited fill material for the downstream embankment of the dam, it was eliminated from detailed analysis.

5.1.3 Non-Structural Alternative – Decommissioning with Setback Levees

The decommissioning with setback levee alternative for Bylin Dam would involve the removal of the embankment at Bylin 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 Bylin Dam to stabilize sediments. Historic imagery was reviewed and the alignment for the proposed channel between the existing embankments at Bylin and Dougherty Dams would approximately follow the historic channel alignment before the construction of Bylin Dam. Dougherty Dam would be left in place to ensure stabilization of the sediments upstream of that structure. Appendix D-3, Figures 14 through 17 provide site plans for this alternative at the dam site.

The grade of the proposed channel would be approximately 0.0027 feet per foot, which is similar to the existing channel grade of the North Branch Forest River Channel upstream and downstream of the existing pool locations. A rock arch rapid design would be implemented near the existing Bylin 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.

The farm-to-market gravel township road (122nd Ave NE), which is currently located on top of the dam embankment, would be moved west to its former location before construction of Bylin Dam in 1964. A 90-inch diameter culvert would be installed through the road crossing and was sized based on Stream Crossing Standards outlined in the North Dakota Century Code

Setback levees downstream of the existing dam location would be constructed to protect the agricultural land that currently benefits from the flood reduction provided by the dam. The levees would be set back from the channel to ensure that floodplain storage is utilized, and peak flows are not substantially increased downstream. Flowage easements within the setback levees would be required to achieve the flood prevention purpose of the project. Ring levees would be included around structures downstream of the dam location to continue providing flood prevention for critical infrastructure as well. Levee protection alternatives to the 5, 10, 25, 50 and 100-year flood recurrence intervals were analyzed for the locations shown in Appendix D-3, Figure 19. Additional information, including incremental costs associated the range of setback levee alternatives are outlined Appendix D-3: Alternatives Evaluation Report.

The cost of constructing the proposed channel through the decommissioned dam and accumulated reservoir sediments, constructing the setback levees, constructing the ring levees, and the cost of acquiring land rights that would be required to decommission the dam, would be exorbitantly high (more than $37,000,000) 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. Approximately 7.44 acres of lacustrine fringe wetlands adjacent to the existing reservoir would be eliminated because of the decommissioning activities. Under E.O. 11990 and potentially the Clean Water Act, mitigation would be required for those lost acres. Estimated costs for mitigating the 7.44 acres of lacustrine wetlands is $446,400 (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 exorbitant costs that primarily would come with the setback levee construction and land acquisition. The benefits of the decommissioning alternative with all elements in place would be protection of agricultural land, protection of agricultural infrastructure, and protection of residential structures. When these benefits are monetized and compared to the overall cost of the decommissioning alternative, the benefit to cost ratio is below 0.5 to 1 for all levee protection levels analyzed.

The Walsh County Comprehensive Plan (Red River Regional Council, 1994) is a public document with the purpose of being used as a policy guide to inform decisions by the county. The Walsh County Comprehensive Plan was created to promote health, safety, morals, public convenience, general prosperity, and public welfare for the county. The plan contains specific goals that promote the

enhancement of agricultural activity by preserving farmland and other farm services. 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 setback levees alternative was eliminated from detailed review due the low benefit cost ratio.

5.1.4 Nonstructural Alternative – Decommissioning

The decommissioning alternative for Bylin Dam involves the removal of the embankment at Bylin 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 Bylin 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 between the existing embankments at Bylin and Dougherty Dams would approximately follow the historic channel alignment before the construction of Bylin Dam. Dougherty Dam would be left in place to ensure stabilization of the sediments upstream of that structure. Appendix D-3, Figures 14 through 17 provide site plans for this alternative.

The grade of the proposed channel would be approximately 0.0027 feet per foot, which is similar to the existing channel grade of the North Branch Forest River Channel upstream and downstream of the existing pool locations. A rock arch rapid design would be implemented near the existing Bylin 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 farm-to-market gravel township road (122nd Ave NE), which is currently located on top of the dam embankment, would be moved west to its former location before construction of Bylin Dam in 1964. A 90-inch diameter culvert would be installed through the road crossing and was sized based per the Stream Crossing Standards outlined in the North Dakota Century Code.

The construction cost of this alternative was estimated at $7.1 million. Removal of the dam without additional downstream flood protection generates extensive economic damages due to future flood events, resulting in a benefit cost ratio of 0.1. The alternative was eliminated due to the low benefit-cost ratio, as well as the negative environmental and public safety consequences of it.

5.2 Alternatives Carried Forward

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

Due to significant economic losses and the potential loss of 25 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 48 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). Additionally, the principal spillway riser tower and conduit would be excavated and removed. The upstream sediment pool would not be addressed in any manner.

The township gravel road (122nd Ave NE), which currently exists atop Bylin Dam, would be realigned to its original location (prior to the construction of Bylin Dam) west of the dam embankment, and a 90-inch diameter culvert would be installed to pass flows through the road crossing with the North Branch Forest

River. This road has been identified as an important route to transport goods from agricultural production over the North Branch Forest River. If it were to be removed, local agricultural producers would be forced to take a longer route to transport goods north of the river and emergency services access would be reduced. Excavation of sediment deposition material captured upstream of the former embankment within the road footprint would be necessary prior to construction of the road. Areas impacted by the constructed breach and construction of the new road 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 3,029 acres to 3,810 acres.

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

The embankment would be raised a total of 3.9 feet to pass the freeboard hydrograph. The proposed embankment top would also serve (as it does currently) as a township road and would have a top width of 26 feet. A three-cable guard rail is proposed on both sides of the road. The downstream embankment of the dam would be modified to address slope stability concerns described in Appendix D-2: Geotechnical Engineering Report. The downstream slope adjacent to the embankment top would be 3:1 (horizontal: vertical) down to 1498.2 feet elevation where a 20-foot bench would be implemented. Downstream of the bench a 4:1 (horizontal: vertical) slope on the embankment would be implemented. 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 a plunge pool constructed at the principal spillway outlet. Other measures to ensure slope stability is adequate at the dam are described in Appendix D-2: Geotechnical Engineering Report.

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 0.13 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 36” principal spillway conduit would be installed via NRCS approved boring and jacking methods through the existing embankment. Open cut placement methods would be used outside of the existing embankment extents. A new plunge pool would be constructed at the outlet of the principal spillway conduit. Downstream of the plunge pool, a constructed channel would be implemented to carry flows from the plunge pool back to the North Branch Forest River channel (less than 150 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.

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-20: 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 and policies described in the Walsh County Comprehensive Plan. 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.

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 Bylin Dam would result in a breach of Bylin Dam during a 625-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 323,400 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 Forest River until the confluence with the Middle Branch Forest River. 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 21 illustrates the modeled breach extents. The resulting flood wave would impact 19 residential structures, 39 agricultural properties, and 37 grain storage bins. An estimated 25 lives would be at risk during the breach at 7 homes and 1 highway crossing. The breach would cause overtopping damage on 0.35 miles of paved roadway, 3.76 miles of maintained gravel roadway, and 0.98 miles of minimally maintained roadway. The breach would also cause damage to three bridges downstream of the dam, one of which is on the National Register of Historic Places (NRHP), and an 1883 schoolhouse which has been converted to a museum (also on the NRHP).

The flood wave would stay within the North Branch Forest River valley through the river crossing at Walsh County Road 14. Approximately one mile east of Walsh County Road 14, the flood wave would break out of the North Branch Forest River and travel overland through agricultural fields. This overland flooding of cropland would result in additional floodplain erosion, totaling approximately 915,000 cubic yards of erosion, reducing or eliminating crop yields depending on the depth of topsoil loss. A portion of the combined 1.24 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 338 acres of riparian forest downstream of the dam. An estimated 31.8 acres of wetlands would be lost to scour, and 61.9 acres of wetlands lost to 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 $15.9 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 340,200 cubic yards of sediment downstream. The 1.6 million cubic yards of newly mobilized sediment would result in a highly unstable river channel and negatively impact agricultural drainage systems downstream. 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.

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. • Re-route of the current road over the embankment to travel into the river valley, cross the North Branch Forest River via a new river crossing, and travel out of the river valley. • No remediation accumulated sediments in the upstream flood pool.	• Bring the dam into compliance with current dam safety requirements for a high hazard dam. • Increased embankment height by 3.9 feet. • Articulated Block Concrete armoring of earthen auxiliary spillway to prevent dam failure caused by erosion. • Installation of new principal spillway riser structure and 36” diameter conduit through the embankment via jack-and-bore construction methods.	• No action taken on the dam until an uncontrolled breach occurs (625-year rainfall event). • After the breach, no remediation would occur at the dam site.
Total Project Investment	$3,207,000	$10,860,000	-
Annualized Project Investment[1]	$77,000	$260,700	-
Annual O&M Costs	-	$5,000	$5,000
Total Annual Costs	$77,000	$265,700	$5,000

Resource	Alternative No. 1 – FWOFI	Alternative No. 2 - Structural Rehabilitation	Alternative No. 3 - No Action
Annual Benefits[3]	$19,200[2]	$346,700[3]	$292,300
Annual Net Benefits	- $57,800	$81,000	$287,300[4]
Benefit to Cost Ratio	0.2 to 1.0	1.3 to 1.0	*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.*

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Notes:

1. Installation cost is amortized for 102 years at 2.25% (price base is 2023).
2. Benefits are only present for the first two years prior to construction of the controlled breach.
3. Benefits are based on an average annual benefit of $357,000 and are amortized for 102 years at 2.25% (price base is 2023) with a 2-year implementation period.
4. Benefits of the No Action Alternative are equivalent to the benefits of rehabilitation (Alternative No. 2), minus the expected annual damage from an uncontrolled breach during the 625-year flood event ($64,700). Because the only cost of the No Action Alternative is continued operation and maintenance, the benefits are positive. The dam owner (Sponsor) has indicated that they would not implement the No Action alternative under any circumstance, given the liability they hold for 25 lives,19 residential structures, 39 agricultural properties, 37 grain storage bins, 5.1 miles of roadway, and 3,168 acres of cropland in the event of a breach. Immediate economic losses due to the dam breach are estimated at $40.4 million (price base 2023), unadjusted for probability of failure. If NRCS assistance through the Watershed Rehabilitation Program is not provided for the Structural Rehabilitation Alternative, the dam owner (Sponsor) would implement the FWOFI. The No Action Alternative is presented in this Plan-EA to meet NRCS agency policy but is for informational purposes only; it is not a legitimate alternative.

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. Beef cattle water supply would be replaced with a well, pipelines, and stock tanks. 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. Beef cattle would continue to use the normal pool as a water source. 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 beef cattle food sources would use the normal pool as a water source until an uncontrolled failure of the auxiliary spillway. After failure, fish and waterfowl food sources would be removed and beef cattle water supply would likely be replaced with a well, pipelines and stock tanks. Cropland in the downstream floodplain would be provided flood protection until an uncontrolled failure of the auxiliary spillway. The flood wave would result in 915,000 cubic yards of erosion on cropland and 670,000 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	One of the nine wellheads within the wellhead protection area downstream of the existing dam would be impacted during a 500-year flood event, as would downstream gravel mines, posing a risk of groundwater contamination.	Flood protection would continue to be provided to all 9 wellheads within the wellhead protection area downstream of the existing dam. Neither the wellheads nor the gravel mines would be inundated during the 500-year flood.	The breach would inundate 2 wellheads within the wellhead protection area as well as downstream gravel mines, posing a risk of groundwater contamination from the diesel range organics, arsenic, chromium, copper, lead, nickel, zinc, and nitrogen. Long term, one wellhead would be inundated during a 500-year flood. Leaching would be expected to increase nitrogen and pesticide concentrations in the Fordville Aquifer.
Aggregates	Gravel mines approximately 9-miles downstream would have more frequent operational impacts and increased costs due to more frequent flooding.	Gravel mines approximately 9-miles downstream would continue operating as they have been.	Gravel mines approximately 9-miles downstream would continue operating as they have been until dam failure. The failure would result in clean-up costs for de-watering and sediment removal. After failure, increased operational costs would be a result of more frequent flooding.

Resource	Alternative No. 1 – FWOFI	Alternative No. 2 - Structural Rehabilitation	Alternative No. 3 - No Action
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. The public health risk from HABs in the reservoir would be removed. Increased frequency, extents, depth, and duration of downstream flooding because of lost retention at the dam. The 100-year flood would inundate 3,810 acres that includes 4 residential structures, 17 unoccupied structures, and 2.1 miles of roads	Public safety risk of an uncontrolled breach is significantly reduced by meeting current dam safety requirements. The public health risk from HABs in the reservoir would persist. Flood protection would remain unchanged from existing conditions for the 2 to 500-year floods. The 100-year floodplain would inundate 3,039 acres that includes 2 residential structures and 4 unoccupied structures. Flood risk is reduced for an uncontrolled breach by meeting dam safety and current design requirements for a high hazard dam.	The dam would function for flood protection and be a source of HAB risk as it does under the current condition until the uncontrolled breach occurs. The breach would release a sudden flood wave downstream, putting 25 human lives at risk. Contaminants would be deposited on 372 acres of cropland, which could put food supply at risk. 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 59.6 acres of accumulated sediments, continuing migrate across them. Beaver dams and vegetation would help to stabilize the area over decades. Grazing would likely preclude woody vegetation establishment except in very wet areas. Restored natural sediment transport may improve streambank stability downstream of the dam as far as Hwy 32, where a riparian corridor exists. Downstream of Hwy 32 bank erosion would likely increase due to increased peak flows in the channelized river. 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 323,400 cubic yards of earthen material would be eroded from the auxiliary spillway and accumulated sediments during the dam failure event. An additional 915,000 cubic yards of earthen material would be eroded from cropland in the downstream floodplain. In the 1-3 years subsequent approximately 340,200 cubic yards of additional sediment deposits behind the dam would erode. Approximately 55% of the total 1.6 million cubic yards of sediment would deposit on 372 acres of cropland and the remainder would deposit over 304 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.

Resource	Alternative No. 1 – FWOFI	Alternative No. 2 - Structural Rehabilitation	Alternative No. 3 - No Action
Climate and Pest Control Regulation	Temporary increase in carbon dioxide emissions during construction. Removal of the dam would decrease methane emissions by an estimated 1.24 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 7.12 ac of wetland would also reduce carbon sequestration. As sediments were colonized by weeds and herbaceous vegetation, carbon sequestration would increase over time. Both carbon capture and carbon emissions from the current reservoir would decrease. Increased incidences of flooding in the forested riparian zone between the dam and Hwy 32 could increase carbon storage. As weeds and herbaceous vegetation colonize the reservoir sediments, native pest control agent habitat would increase.	Temporary increase in carbon dioxide emissions during construction. Post construction climate regulation unchanged: an estimated 1.24 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 59.6 acres of exposed reservoir sediments would decompose, emitting large volumes of carbon dioxide. Methane emissions would decrease by an estimated 1.24 metric tons a year. As sediments were colonized by weeds and herbaceous vegetation, carbon sequestration would increase over time from the pool area, however loss of mature trees over 328 acres of riparian forest and an estimated 69.87 acres of wetlands downstream of the dam would significantly decrease carbon sequestration. No change to pest control regulation anticipated from existing condition. As 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

Resource	Alternative No. 1 – FWOFI	Alternative No. 2 - Structural Rehabilitation	Alternative No. 3 - No Action
Recreation and Ecotourism	Boating, fishing, and waterfowl hunting provided by the current reservoir would be eliminated. Some limited recreation opportunities may still exist at Dougherty Dam however access would limit use. Limited new upland hunting opportunities would be created by conversion of open water habitat to grassland habitat over the course of decades. The downstream floodplain would have restored natural function, resulting in increased habitat for hunting opportunities. These recreation opportunities would be limited due to a lack of public access.	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. Fishing and boating activities are expected to diminish over time due to eutrophication and shallower pool depths. 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 waterfowl hunting opportunities currently provided. The breach would also cause substantial erosion and deposition of sediments in natural areas within the downstream floodplain, degrading habitat conditions that provide hunting opportunities. Decades after the breach, the normal pool would be reclaimed to grassland and would provide limited new hunting opportunities.
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 59.6 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 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 663,600 cubic yards of reservoir sediments both initially and in the several years following. An additional 915,000 cubic yards of earthen material would be eroded in the downstream floodplain. The 59.6 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 372 acres of cropland and 304 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	During drawdown for construction nutrients in both dissolved and sediment bound forms would be	Prior to the uncontrolled breach, nutrient cycling would remain at existing levels. The breach would release 612 tons of

Resource	Alternative No. 1 – FWOFI	Alternative No. 2 - Structural Rehabilitation	Alternative No. 3 - No Action
	in large loss of nutrients downstream. Some cycling would take place as weeds and herbaceous vegetation naturally colonizes the exposed sediments. Nutrients would be transported downstream to the river channel, cropland, and natural areas; each of which would increase various biogeochemical cycling processes.	released downstream. After construction nutrient cycling is expected to return to existing conditions both in the reservoir and downstream.	phosphorus, 41 tons of nitrogen, and 7,570 tons of carbon into the downstream river and floodplain from 663,600 cubic yards of reservoir sediment. Erosion of an additional 915,000 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 372 acres of cropland and 304 acres of natural lands and pasture. Loss of mature trees in 338 acres of riparian forest would affect nutrient cycling rates. Nutrient cycling in the 676-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 59.6 acres of existing open water habitat that currently supports game fish and waterfowl species would be lost as would 7.1 acres of lacustrine fringe wetlands on the margin of the reservoir. 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 and game fish washed over Dougherty Dam upstream 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. Grazing would likely preclude establishment of woody vegetation on upland sites, although shrub species in wetter areas could establish.	Temporary effects will be loss of game fish within the 59.6-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 59.6 acres of open water habitat, 7.1 acres of lacustrine fringe wetlands, and a 0.85-acre depressional wetland. 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 1.6 million cubic yards of sediment and contaminants causing EPA water quality standards to be exceeded for years after the breach for cadmium, chromium, lead, nickel, zinc, nitrogen, and phosphorus in

Resource	Alternative No. 1 – FWOFI	Alternative No. 2 - Structural Rehabilitation	Alternative No. 3 - No Action
	Downstream fish habitat would be expected to slightly improve between the former dam and Hwy 32, due to restored sediment transport and reduced incision rates. Downstream of Hwy 32 fish habitat would decrease in quality due to increased bank erosion within the channelized river corridor.		the river. Scouring from the breach wave on 23 miles of the Forest River and 21 miles of unnamed tributaries would also degrade habitat quality. These would cause habitat risks to fish, amphibians, birds, and mammals for years after the breach. Loss of 338 acres of mature trees in riparian forest downstream of the dam would impact mammal and bird species. Loss of 81.9 acres of wetlands would also cause negative impact on habitat for dependent species.

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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 59.6 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 59.6-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 338 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 12.8 ft into the Pierre formation, which is a potentially fossiliferous geologic unit. NDGS would be consulted if fossils were encountered during construction.	Breach would form into the Pierre formation, a potentially fossiliferous geologic unit. Potential for uncontrolled fossil exposure and damage would be present.

Resource	Alternative No. 1 – FWOFI	Alternative No. 2 - Structural Rehabilitation	Alternative No. 3 - No Action
Soil Resources, Erosion, and Deposition	A full channel restoration would not be completed; only soils disturbed by the road construction and in the road right-of-way 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. Over time, sediments would be stabilized as 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, with 164 years of sediment storage available in the reservoir). No change expected to downstream conditions.	No change to existing conditions prior to dam failure. The breach will erode 663,600 cubic yards of reservoir sediments both initially and in the several years following. An additional 915,000 cubic yards of earthen material would be eroded in the downstream floodplain. The 59.6 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 372 acres of cropland and 304 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.
Prime Farmland	Increase in flooding, for example 2,740 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 2,130 acres inundated during the 100-year rainfall event.	Prior to the uncontrolled breach, no change to existing flood impacts. The breach would inundate 4,159 acres of prime farmland causing significant damage from erosion and deposition. After the breach increased flooding, for example 2,740 acres of prime farmland would be inundated during the 100-year rainfall event.
		Water Resources	
Groundwater Resources	Increased risk of groundwater contamination in wellhead protection area of the Fordville Aquifer due to the fact that 1 wellhead would be inundated during a 500-year rainfall event, as would gravel mines.	Wellheads and gravel mines are protected from inundation to the 500-year event.	Prior to the breach, no wellheads or gravel mines are impacted from inundation to the 500-year event. The dam breach would inundate 2 wellheads and 3 gravel mines, with risk of leaching nitrogen, cadmium, chromium, copper, lead, nickel, and zinc to the Fordville Aquifer. Long term, one wellhead and gravel mines would be inundated during a 500-year flood.
Surface Water Resources	Loss of 7.12 acres of lacustrine wetlands (FCU 0 to 5.54), 59.6 acres of open water habitat, and 251.5 linear feet of river. Whether the Sponsor would be required to mitigate would be dependent on USACE jurisdiction determination, which would be	Loss of 0.008 acres of lacustrine fringe (FCU 0 to 0.006) and 0.057 acres of depressional wetlands (FCU 0 to 0.04). Given this would be a federal action, purchase of mitigation credits would be required by NRCS under EO 11990	Prior to the breach, no change from the current condition would occur. The breach would result in loss of 7.12 acres of lacustrine wetlands (FCU 1.72 to 5.54), 0.85 acres of depressional wetlands (FCU 0-0.66), and 59.6 acres of open water habitat upstream of the dam. Downstream

Resource	Alternative No. 1 – FWOFI	Alternative No. 2 - Structural Rehabilitation	Alternative No. 3 - No Action
	completed when they submitted a 404 permit for the project. A braided channel system would form between Bylin and Dougherty 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 grazed. A more natural downstream riparian floodplain between Bylin and Hwy 32 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 would generate a high level of erosion in the ditched/channelized portions of the river downstream of Hwy 32.	regardless of USACE jurisdictional determination. Credits would be purchased from an approved CWA mitigation bank. Temporary impacts to 43 acres of open water habitat and 7.12 acres of lacustrine fringe wetland due to reservoir drawdown during construction. Temporary construction impacts to 0.85 ac of depressional wetlands. Downstream sediment transport would continue to be regulated by the dam, creating minor channel incision in the natural meandering portion of the river between Bylin and Hwy 32. The channelized portion of the river downstream of Hwy 32 would continue to perform as engineered, given it was designed with the assumption of Bylin Dam in place.	of the dam scour or deposition from the breach would result in an estimated loss of 61.9 acres of depressional wetlands and 20.0 acres of riverine wetlands. Total FCU losses, which include partial impacts plus the full losses described, range from 9.4 to 55.5 for riverine wetlands and 27.1 to 63.3 for depressional wetlands. EPA water quality standards would be exceeded for cadmium, chromium, lead, nickel, zinc, nitrogen, and phosphorus for several years after the breach even. Over many decades the river channel and tributaries would stabilize, wetlands could form within scoured areas, and water quality would improve.
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 7.12 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 0.065 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 be 81.9 acres downstream, 7.12 acres upstream, and 0.85 acres on the auxiliary spillway crest.
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 Forest 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 663,600 cubic yards of contaminant laden sediment behind the dam. Water quality standards would be exceeded for cadmium, chromium, copper, lead, nickel, zine, nitrogen, and phosphorus downstream in the Forest River for years after the breach with risks to human health and aquatic species. Water quality would also be impacted from the expected 915,000 cubic yards of scour in the downstream channel and floodplains that would occur, which would also release high nutrient

Resource	Alternative No. 1 – FWOFI	Alternative No. 2 - Structural Rehabilitation	Alternative No. 3 - No Action
			loads. Over the long term, increased frequency, extents, and duration of flooding on cropland would transport higher levels of dissolved phosphorus to the Forest 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 3,810 acres and 21 structures (including 4 residential) would be located within the 100-year floodplain after the constructed breach.	After construction, there would be 3,039 acres and 6 structures (including 2 residential) would be located within the 100-year floodplain, which is unchanged from the existing condition.	No change to existing condition would occur prior to the dam breach. The breach would impact 5,755 acres and 54 structures (including 12 residential). Post breach there would be 3,810 acres and 21 structures (including 4 residential) within the 100-year floodplain after the breach.
Regional and International Water Resource Plans	Increased phosphorus and nitrogen transport out of the Forest 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 41 tons of phosphorus and 612 tons of nitrogen would be transported downstream in the Forest 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 958 tons of PM10 fugitive dust emissions. Exposed accumulated sediments over 59.6 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 1,836 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 59.6 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 676 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

Resource	Alternative No. 1 – FWOFI	Alternative No. 2 - Structural Rehabilitation	Alternative No. 3 - No Action
			quality monitoring thresholds or ambient air quality standards.
		Biotic Communities	
Plants, Communities, and Habitat Quality	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) 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. Due to grazing, woody vegetation establishment would be limited. Increased flooding downstream would continue the encourage land use conversion from agriculture to rehabilitated natural plant communities. However, sediment and contaminants transported downstream from the dam degrade habitat and impair ecological functions for some time.	The tame grassland area affected by the footprint of the enlarged embankment (3.42 acres), auxiliary spillway (1.83 acres, excluding ACB) and the ACB (3.49 acres), for a total of 8.74 acres, would be reseeded again into native/introduced grasses and forbs including pollinator species suitable for critical area plantings. 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. 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 seeding herbaceous mix or something similar. No change would be expected from current condition downstream of the dam.	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 cause damage to mature trees on 338 acres of riparian woodlands and scour or fill 89.9 acres of wetlands. Some of these communities would redevelop, dependent on landowner decisions. 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 the encourage land use conversion from agriculture to rehabilitated natural plant communities. However, sediment and contaminants transported downstream from the dam 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.	No effect from the current condition.	No change from the current condition until the breach occurs. The breach flood wave would damage mature trees on 338 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 due to the presence of humans and noise. Permanent loss of 7.12 acres of lacustrine wetlands and 59.6 acres of open water. 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. Long term, species makeup and distribution would be equivalent to the current condition.	No change from the current condition until the breach occurs. The breach would remove 7.12 acres of lacustrine wetlands, 59.6 acres of open water, 62.75 acres of depressional wetlands, 20 acres of riverine wetlands, and cause the loss of mature trees on 338 acres of riparian forest all of which would impact these species. 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.
Fish	Species reliant on the deep-water habitat would no longer be present above the location of Bylin Dam. The grade control structure would not be fish passable, therefore fish would not be present between the current location of Bylin and Dougherty Dam. Game fish would likely continue to be stocked at Dougherty Dam. Restored 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.	No change from current condition. 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.	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. Long term, conditions would slowly improve to function consistent with the FWOFI alternative.
Birds, Migratory Birds, Eagles	Loss of 59.6 acres of open water and 7.12 acres of lacustrine wetlands would displace species dependent on that habitat type. Shorebirds could benefit from 59.6 acres of exposed sediment flats in the short term. 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. The breach would cause a rapid loss of 7.12 acres of lacustrine wetlands, 59.6 acres of open water, 62.75 acres of depressional wetlands, 20 acres of riverine wetlands, and mature trees on 338 acres of riparian woodland. Shorebirds could benefit from 736 acres of exposed sediment flats in the short term. Depending on the time of year, this would result in bird mortality and long term losses of eagle and migratory nesting areas.

Resource	Alternative No. 1 – FWOFI	Alternative No. 2 - Structural Rehabilitation	Alternative No. 3 - No Action
Federal Threatened and Endangered Animal Species	Long term effects of improved downstream riparian woodlands may benefit the northern long eared bat and monarch butterfly. Improved floodplain wetlands downstream of the dam would benefit the whooping crane.	No trees suitable for NLEB brooding would be destroyed with this alternative. No net loss of herbaceous vegetation suitable for milkweed and monarch butterflies. Long term, no change from existing conditions expected.	No impact until the breach occurs. The breach flood wave would destroy mature trees on 338 acres of riparian woodlands suitable for NLEB habitat. Long term the re-establishment of herbaceous habitat in the pool sediments and downstream deposition areas could increase monarch butterfly habitat.
Undesirable Species (including invasive species)	Seeding and weed control would be required in the breach of the embankment and new road construction right-of-way. Presence of undesirable species and noxious weeds is likely over the 59.6 acres of exposed accumulated sediment behind the dam.	Seeding 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. The breach would cause 1.6 million cubic yards of downstream sediment erosion, the deposition from which is expected to cover 676 acres that would provide opportunity for undesirable species and noxious weeds to take hold. After the breach, 59.6 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	No disturbance to Dougherty Dam. Massive disturbance to Bylin Dam. Historic Hoff School would be inundated with 4 ft of water at a 5-year flood, 5.4 ft of water during a 10-year flood, 6.3 ft of water during a 25-yr flood, 7 ft of water during a 50-yr flood, 7.6 ft of water during a 100-yr flood, and 7.8 ft of water during a 500-yr flood. The historic bridge ½ mile downstream is projected to fail sometime between the 50-yr and 100-yr flood events.	No disturbance to Dougherty Dam. Some alternations to Bylin Dam, however it largely remains in the existing footprint. Hoff School property would not be inundated at flood events less than or equal to the 100-yr flood. At the 500-yr flood the school would be inundated with 5.2 ft of water. Historic bridge ½ mile downstream would be protected up to probable maximum flood event.	No disturbance to Dougherty Dam. Massive disturbance to Bylin Dam. Hoff School property would be heavily damaged during the breach, which would have an inundation depth of 21.4 feet at the school. After the breach event, the property would remain in the floodplain for the 5-year flood and greater. Historic bridge ½ mile downstream of Bylin would fail during the breach event.
Public Health and Safety	See Flood and Disease Control	See Flood and Disease Control	See Flood and Disease Control
Transportation infrastructure	The township gravel road (122nd Ave NE) over the dam embankment would be rerouted into the river valley, across the North Branch Forest River via a new crossing, and out of the river valley. More frequent flooding downstream would cause more frequent damages. Increased costs for larger structure sizes would be realized as stream crossings are replaced.	Temporary road closures of the gravel road (122nd Ave NE) over the dam embankment during construction. Long term, no change from the current condition.	No change prior to the breach. The breach would result in loss of 3 bridges and damages to 5.1 miles of roads. The farm-to-market gravel road (122nd Ave NE) over dam embankment would be lost, requiring 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)

Resource	Alternative No. 1 – FWOFI	Alternative No. 2 - Structural Rehabilitation	Alternative No. 3 - No Action
Local and Regional Economy	Average annual damages of $465,400, and includes damages to structures, crop production, and roadways. The project results in negative net benefits ($-57,800) and a benefit to cost ratio less than one (0.2 to 1.0).	Average annual damages of $120,500, and includes damages to structures, crop production, and roadways. The project results in positive net benefits ($81,600) and a benefit to cost ratio greater than one (1.3 to 1.0).	No effect until the dam breach occurs. The breach during the 625-year event would result in $24.4 million in damages to structures and roadways. Additional long-term impacts to crop production would result from erosion and deposition of sediments within the floodplain.
Environmental Justice, Civil Rights	Bylin dam provides free access to fishing, boating and swimming. The loss of this recreational resource would remove affordable water recreation opportunities for the significant population (24%) of low income and minority populations in the region.	Accessing the free water recreation opportunities at Bylin dam would continue to benefit the low income population (24%) and possibly minority populations.	No effect until the dam breach. Bylin dam provides free access to fishing, boating and swimming. The loss of this recreational resource would remove affordable water recreation opportunities for the significant population (24%) of low income and minority populations in the region.
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 would be which rely on deep water habitat (walleye, northern pike, perch, bass) would no longer inhabit the river downstream of Dougherty Dam. Over the next several decades a multi-thread channel would likely form across the sediments behind the dam for the ~7,000 ft upstream to Dougherty 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. Game fish populations would likely remain upstream of Dougherty Dam. Open water for waterfowl hunting would be limited to that formed by small beaver dams, so would be much reduced from current hunting opportunities. A livestock water system would be developed from rural water to replace the current reservoir source for cattle below Dougherty Dam. Many decades post project, the existing 59.6 acre normal pool would convert to a grazed 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 and waterfowl 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 and waterfowl would resume using the lake for breeding, nesting, and migratory stopover sites. Doughtery Dam may provide an adequate permanent pool for livestock watering during construction and subsequent years of the reservoir refilling, or it may not have the ability to hold water. To prevent cattle from accessing the soft sediments in the pool area, temporary electric fence would be run on the reservoir edge during construction and stockwater pipelines/tanks installed off the rural water system. The reservoir would return as a water source for cattle after construction is completed and the reservoir is refilled.
- D-AA: Maintaining flood attenuation at the dam would protect farmland downstream from flooding. For example, 2,413 acres of cropland is protected from flooding during a 100-year flood event. 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, and a water source for cattle 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, bass) would no longer inhabit the river downstream of Dougherty Dam. 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 for the ~7,000 ft upstream to Dougherty Dam, with dense thickets of reed canary grass and occasional beaver dams. A stockwater pipeline and tanks would from the rural water system would be installed for livestock water to replace the current reservoir source for cattle below Dougherty Dam. 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 915,000 cubic yards of erosion on cropland, and 670,000 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 3,168 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: Within the Fordville Aquifer wellhead protection area (WHPA) downstream there are nine public wellheads that provide drinking water supply to surrounding communities. The 500-year flood event would temporarily pond water within the WHPA and within excavated gravel mines increasing the risk of contaminants leaching into the aquifer. This event would also impact one public wellhead, potentially contaminating the source water directly. Leaching of nitrates and pesticides into the Fordville Aquifer would be the highest 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: All wellheads within the wellhead protection area would continue to be protected through a 500-year flood event. The WHPA and gravel mines with a direct connection to the aquifer would also be protected from contamination during a 500-year event.

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 wellhead protection area (WHPA) downstream, there are nine public wellheads that provide drinking water supply to surrounding communities. This event would also impact two public wellheads, potentially contaminating the source water directly. The uncontrolled breach would temporarily pond runoff within 3 excavated gravel mines in the Fordville Aquifer, increasing the risk of groundwater contamination. The breach event would mobilize multiple contaminants with potential to leach to the Fordville Aquifer including 4 tons of chromium, 3 tons of lead, 6 tons of nickel, 14 tons of zinc, and 612 tons of nitrogen just from the 663,600 cubic yards of reservoir sediments projected to erode. Additional nitrogen would be released from the projected 915,009 cubic yards of scour on the downstream floodplain.

6.1.1.3 Aggregates

Alternative No. 1 - FWOFI

- U-AA: No impact.

- D-AA: With consideration of the gravel mining operations located nine miles downstream; decommissioning of the dam would increase flood incidence, and additional sediments would be transported and deposited in the open pit mines during flood events. Floodwaters would inundate the sites and temporarily pause operations until the water levels are reduced. Materials contaminated by the deposited sediments would need to be either cleaned or removed.

Alternative No. 2 - Structural Rehabilitation

- U-AA: No impact.
- D-AA: No impact.

Alternative No. 3 – No Action

- U-AA: No impact.
- D-AA: The mines located nine miles downstream would continue to receive flood protection from the dam until the uncontrolled breach occurred. During the breach, the flood wave would inundate the gravel mine sites, likely causing damage due to significant scouring erosion. After the breach flood wave travels through the mine locations, any sediment still in suspension could deposit within the mines, which would result in contaminated material that would either need to be cleaned or removed. Long-term, decreased flood attenuation would result in increased flood incidence. This would cause damages and interruptions in gravel provisioning.

6.1.2 Regulating Services

6.1.2.1 Flood and Disease Control

Alternative No. 1 - FWOFI

- U-AA: Public health risk due to HABs is removed with loss of the reservoir.
- 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 3,810 acres would be inundated, including 4 residential structures and 17 agricultural structures. Flooding impacts at other recurrence intervals are provided in Appendix D-5 Economics Evaluation.

Alternative No. 2 – Structural Rehabilitation

- U-AA: Public health risks from HABs would remain present.
- 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 3,039 acres would be inundated, including two residential structures and four agricultural structures. Flooding impacts at other recurrence intervals are provided in Appendix D-5 Economics Evaluation.

Alternative No. 3 – No Action

- U-AA: Public health risks from HABs would remain present until the uncontrolled breach of Bylin Dam occurs.
- D-AA: Flood prevention would be provided up the uncontrolled breach of Bylin Dam. The flood wave resulting from the breach would place 25 human lives and 19 residential structures at risk. Contaminants would deposit on 372 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. Below Dougherty Dam multiple shallow channels (braided stream) would form and migrate across the 59.6 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 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. Grazing would likely preclude establishment of woody vegetation throughout most of the area. 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 32 would alleviate some channel incision activity but increased peak flows in the channelized portions of the river downstream of Hwy 32 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. Erosion attributed to livestock may resume. 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 embankment and/or auxiliary spillway.
- D-AA: The dam would continue to attenuate downstream peak flows for the next 100-yearrs, 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 323,400 cubic yards of material from the auxiliary spillway and reservoir sediments. In addition, 340,200 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. Dougherty Dam would remain in place and continue to be a minor barrier to sediment migration from the upstream watershed.
- 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 915,000 cubic yards of sediment would occur from the channel and floodplain

downstream of the dam. Sediment deposition would occur on approximately 372 acres of cropland and 304 acres of natural 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 Climate 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 1.24 metric tons of methane annually, or carbon dioxide during times of high algal bloom. During initial years following drawdown of the pool area, however, organic carbon in exposed reservoir sediments would decompose, emitting large volumes of carbon dioxide (Amani et al, 2022). In the mid-term, 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 climate 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 1.24 metric tons per year as is the case currently. Regular mowing of the dam and the toe slopes for maintenance would requires 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 1.24 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 climate 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 339 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 waterfowl hunting opportunities currently provided by the reservoir. Some limited recreational opportunities may be present in the reservoir upstream of Dougherty Dam; however, vehicle and boat access would severely limit opportunities. As the riparian area upstream of Bylin Dam began to re-vegetate, hunting opportunities would be present for whitetail deer. While this would provide more opportunities, North Dakota's deer season is regulated by the number of tags available. Therefore, 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 Bylin 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. 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 recreation activities would be restricted. After completion, the project would provide recreation activities including fishing, boating, and hunting 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 algal blooms in the reservoir, however, the maximum normal pool depth after the project life is expected to be approximately 16 feet. Though fishing opportunities may diminish over time, a fish population in the reservoir would be maintained through the design life of the dam. Waterfowl hunting opportunities within the reservoir would continue to be provided, providing access to a recreational opportunity currently experiencing national demand.
- 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 hunting, would be provided until the dam has an uncontrolled breach through the failure of the auxiliary spillway (625-year rainfall event). After the uncontrolled breach of the dam, some limited recreational opportunities may be present in the reservoir upstream of Dougherty Dam; however, vehicle and boat access would severely limit opportunities. As the riparian area upstream of Bylin Dam began to re-vegetate, hunting opportunities would be present for whitetail deer. While this would provide more opportunities for land access, North Dakota's deer season is regulated by the number of tags

available. Therefore, 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 Bylin 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 deposition within natural riparian areas downstream, 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 59.6 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 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. In areas where the stream is currently channelized, increased flooding incidence would cause meanders to redevelop, expanding the areas of erosion/deposition and soil development. 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 reduce the incidence of flooding downstream. 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 be decreased sediment deposition and new soil development, decreased potential of expanded grasslands/wetlands, but also increased soil retention on croplands.

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 embankment 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, 663,600 cubic yards of earthen material would be transported downstream over time. Exposed sediments would be further erodible by wind, until vegetation establishment. As the breach began to stabilize, sediment transport would still be limited due to Dougherty Dam.
- D-AA: Bylin 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 915,000 cubic yards on the downstream floodplain, within both cropland, natural areas, and pasture. Deposition of the eroded sediment would occur over 372 acres of cropland and 304 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. Large losses of 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 612 tons of phosphorus, 41 tons of nitrogen, and 7,570 tons of carbon into the downstream river and floodplain that is currently stored in accumulated reservoir sediments.
- D-AA: Scour of 915,000 cubic yards of river channel and floodplain sediments would release large quantities of carbon, nitrogen, and phosphorus as well. Nutrient cycling in the estimated 372 acres of cropland and 304 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 338 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 would eliminate 59.6 acres of open water habitat and 7.1 acres of lacustrine fringe 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 washed over Dougherty Dam upstream 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. Grazing would likely preclude establishment of woody vegetation on upland sites, although shrub species in wetter areas could establish. 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 Hwy 32, due to restored sediment transport and reduced incision rates. Downstream of Hwy 32 habitat would decrease in quality due to increased bank erosion within the channelized river corridor. 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 Hwy32 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 59.6-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 7.1-acre lacustrine fringe 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 59.6 acres of open water habitat, 7.1 acres of lacustrine fringe wetlands, and 0.85-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, benefitting fish and wildlife. Grazing would likely preclude establishment of woody vegetation on upland sites, although shrub species in wetter areas could establish. 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 1.6 million cubic yards of sediment and contaminants causing EPA water quality standards to be exceeded for years after the breach for cadmium, chromium, lead, nickel, zinc, nitrogen, and phosphorus in the river. Scouring from the breach wave on 23 miles of the Forest River and 21 miles of unnamed tributaries would also degrade habitat quality. These would cause habitat risks to fish, amphibians, birds, and mammals for years after the breach. Loss of 338 acres of mature trees in riparian forest downstream of the dam would impact mammal and bird species. Loss of 81.9 acres of wetlands would also cause negative impact on habitat for dependent species. Downstream of the dam, 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 to estimates of effects downstream (Downstream Assessment Area D-AA).

6.2.1 Land Use

Alternative No. 1 – FWOFI

- U-AA: Conversion of the 59.6 ac normal pool from open water and lacustrine fringe wetland to a riparian grassland and wetland complex used primarily for grazing would occur. 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. The road at the top of the dam would be rerouted and the gravel parking area would be removed.
- D-AA: Removal of the dam and increased flooding downstream may prompt land use changes. There would be increased flooding incidence to a downstream gravel mine that may be hydrologically connected to the drinking water supply in the aquifer. Mitigation of this potential for contamination may stimulate rehabilitation of disused mining areas. 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), grazing land use would resume, and the built land use would be of similar acreage for the road and a reconstructed parking area for boat launch.

  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. The commercial land use of the gravel mines would be protected as well as the public infrastructure land use in the wellhead protection areas.

Alternative No. 3 - No Action

- U-AA: This alternative includes no reservoir drawdown; thus, the land uses for natural land, grazing 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 provide return to more private

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 a large extent of agricultural land and many areas suitable for building. The loss of 338 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 soils above the Pierre Formation, a potentially fossiliferous geologic unit. This excavation, to 12.8 feet deep, may expose fossils. If fossils are identified, the North Dakota Geologic Survey would be consulted for guidance.
- 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 fossils. 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 (road realignment, 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. Best management practices (BMPs) would be implemented to minimize erosion at the road site during construction. Erosion on the hillside caused by livestock overgrazing, would be temporarily or potentially, permanently removed.

  A full channel restoration would not be completed. Meaning only soils disturbed by the road construction and in the road right-of-way 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 greatly 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. Erosion attributed to livestock may resume. At the normal pool elevation, the dam can accommodate approximately 164 more years of accumulated sediments at the 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. Additionally, increasing the principal spillway conduit from a 30” diameter pipe to a 36” diameter pipe would cause an increase to in-stream shear stress and erosion near the dam. The hydraulic model results show that shear stresses in the channel within 4,000 feet of the dam increase by as much as 50% for the 2-, 5-, and 10-year events. The 50% increase is only an additional 0.1 pounds per square foot of pressure on the bank but may still lead to increased streambank erosion along this stretch of channel. Further downstream (more than 4,000 feet), the increase in shear stress is minimal and there would be minimal impact from the increased principal spillway conduit.

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. Livestock would continue to contribute to hillside erosion. During a breach, the dam structures (embankment and 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. 915,000 cubic yards of earthen material would be eroded from the downstream floodplain, and deposition of 682,000 cubic yards would occur, resulting in nearly $15.5 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 2,740 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. 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.
- D-AA: During construction there would be no impacts. Once the project is complete, downstream flooding would inundate the same 2,130 acres of prime farmland at the 100-year flood event. In total, 610 acres of prime farmland would continue to be protected by this alternative during 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: Prior to the uncontrolled breach, downstream flooding would inundate approximately 2,130 acres of prime farmland. During the breach, the initial flood wave moving downstream would inundate 4,159 acres of prime farmland, causing significant damage via scouring and/ deposition. In the long-term, 100-year flood events would inundate approximately 2,740 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 and one wellhead within the Fordville Aquifer wellhead protection area downstream of the existing dam would be flooded and potentially contaminated by a 500-year event (see Figure C-19 in Appendix C). Risk of aquifer contamination due to gravel mine inundation at the 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, all nine public wellheads within the wellhead protection area would be protected during a 500-year rainfall event. No gravel mines are inundated during the 500-year 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. During a breach, the flood wave moving downstream would inundate two wells and may contaminate drinking water resources. Long-term, lack of flood attenuation upstream would result in flooding of one wellhead within the wellhead protection area during 500-year flood events. With 663,600 cubic yards of contaminant laden sediment behind the dam transported downstream, some of these analytes would deposit over the aquifer, public wellhead protection area and within gravel mines which have a direct connection to the aquifer. Contaminants pose risks to human health and include: cadmium, chromium, copper, lead, nickel, zinc, and nitrogen. A 1992-2001 study of pesticides in US streams and groundwater across the country showed pesticides to have been detected in 33% of aquifers used for drinking water, located beneath agricultural land (Gilliom, 2007). A dam breach would not likely change the presence or lack thereof, of pesticides in the Fordville aquafer.

6.2.3.2 Surface Water Resources

Alternative No. 1 – FWOFI

- U-AA: Expected permanent impacts include elimination of 7.12 acres of wetlands, 59.62 acres of Other Waters (OW), and 104.9 feet of Other Waters. This drawdown alternative includes removal of artificial deepwater system which is numbered OW 1 (59.62 acres). Consequently, the artificial lacustrine fringe wetlands adjacent to deepwater (Wetlands 23,25-28,30-33) totaling 7.12 acres would also be lost. Alternative grading extents results in 104.9 feet of fill in OW-2, which is artificial section of North Branch Forest 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 Losses due to Alt. 1	LACUSTRINE FRINGE
	Affected Area in U-AA by Alternatives (acres)	7.12
Wetland Functions	Static	4.36
	Dynamic	0.00
	Cycling	5.54
	Removal	5.11
	Retention	5.27
	Plants	5.34
	Structure	4.49
	Habitat	1.72
	Shoreline Integrity	2.30

If USACE determined that these were jurisdictional wetlands, the WRD would be required to purchase credits for up to 7.12 acres. If a 1:1 replacement ratio is required, mitigation credit purchases could be approximately $427,200 (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.

Below Dougherty Dam 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. Grazing would likely preclude establishment of woody vegetation in most of the area. Tributary stream channels down the valley sideslopes 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 Bylin Dam would result in an increase in flooding downstream, but the stream would remain a perennial stream. 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 disturbance of 0.85 acres of Depressional wetlands and loss of hydrology to 7.12 acres of lacustrine fringe wetlands, and 43 acres of Other Waters (OW). Temporary impacts would consist of reservoir drawdown to the point that deepwater is reduced to 16.62 acres (Figure C-24 Alternative 2 – Structural Alternative - Aquatic Resources Impacts Map, Appendix D-9 Aquatic Resources). There would also be inundation of wetlands (0.44 acres) around the reservoir when the 2-year, 24-hour storm events temporarily increased the pool elevation.

  Expected permanent impacts include loss of 0.065 acres of wetlands and loss of 251.53 feet of Other Waters (OW). Permanent impacts would consist of excavation of lacustrine fringe wetland26 for the new riser tower (0.057 acres) and permanent fill within wetland 34 for the downstream embankment of the dam (0.008 acres wetland). The downstream channel (OW-2) would also be rerouted consisting of a stretch receiving permanent fill (251.53 river feet). 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 $5,000 (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 Losses due to Alt. 2		LACUSTRINE FRINGE	DEPRESSIONAL
Affected Area in U-AA		0.057	0.008
Wetland Functions	Static	0.03	0.005
	Dynamic	0.00	0.000
	Cycling	0.04	0.006

Wetland Losses due to Alt. 2		LACUSTRINE FRINGE	DEPRESSIONAL
	Removal	0.04	0.006
	Retention	0.04	0.006
	Plants	0.04	0.006
	Structure	0.04	0.005
	Habitat	0.01	0.002
	Shoreline Integrity	0.02	-

The 3.9 f foot top of dam raise would generate a higher flood water surface elevation "bounce" due to increased hydrologic capacity of the principal spillway before activation of the auxiliary spillway and inundate additional wetland acres in extreme flood events. Additional frequency and depth of flooding would occur on 0.44 acres of wetlands during a 2-year 24-hour rainfall event. Due to the raised elevation of the top of the dam under Alternative No. 2, approximately 50.1 additional acres may be temporarily inundated during periods of flooding (Fig. C-26). No detrimental impacts to wetland function were identified based on increased inundation.

Temporary construction impacts would occur to a 0.85 ac wetland (#36) for equipment access and materials staging on the auxiliary spillway. Soils on the wetland would be protected through placement of temporary bridge planking to distribute loads, so as to not cause compaction on the wetland. The wetland would be reseeded to existing grass species after construction. Temporary reservoir drawdown for construction would remove approximately 43 acres of deep water habitat and lacustrine fringe wetlands, and would occur from early-summer to the time the reservoir refills (1-3 years dependent on precipitation). The normal pool elevation behind Dougherty Dam would be the same elevation as currently exists and in the FWOFI. Alternative No. 2 retains the pool behind Bylin Dam as well as the fringing wetlands.

D-AA: During construction the reservoir would be drawn down at a rate that would minimize potential for increased downstream flooding. Given that the low level drawdown gate is not functional, this would likely be accomplished with a constructed siphon. No wetland impacts are anticipated in the D-AA from Alternative 2.

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 7.97 acres of wetlands and 59.62 acres of Other Waters (OW). The loss of reservoir would result in loss of deepwater (59.62 acres) and adjacent lacustrine fringe wetlands 23,25-28,30-33 (7.12 acres). Since the breach is through the auxiliary spillway, Wetland 36 (0.85 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 Losses due to Alt. 3		LACUSTRINE FRINGE	DEPRESSIONAL
Affected Area in U-AA (acres)		7.12	0.85
Wetland Functions	Static	4.36	0.52
	Dynamic	0.00	0.00
	Cycling	5.54	0.66
	Removal	5.11	0.61
	Retention	5.27	0.63
	Plants	5.34	0.64

Wetland Losses due to Alt. 3	LACUSTRINE FRINGE	DEPRESSIONAL
Structure	4.49	0.54
Habitat	1.72	0.21
Shoreline Integrity	2.30	-

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 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. Grazing would likely preclude establishment of woody vegetation in upland areas. 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 would scour 23 miles of Forest River, 21 miles of unnamed tributaries, and approximately 63 depressional wetlands to varying degrees ranging from minimal disturbance to complete removal of the channel or basin. 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. Approximately 39 depressional wetlands would fill with sediment ranging in depths from 0 to 1.3 feet of fill. Additionally, riverine wetlands adjacent to 7.6 miles of river would fill with varying degrees of sediment ranging in depth from 0 to 3.9 feet of deposition. An estimated 20.5 acres of those riverine wetlands would be expected to be fully filled with sediment. Table 6-4 shows the estimated wetland functional losses from both scour and sediment deposition in the downstream analysis area.

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

Wetland Losses due to Alt. 3		Wetland Classes	
		RIVERINE	DEPRESSIONAL
	Area in D-AA (acres)	20.5	46.6
Wetland Functions	Static	-	30.0
	Velocity Reduction	6.7	-
	Dynamic/ Storage	6.0	29.3
	Cycling	-	24.7
	Removal	7.1	20.9
	Retention	8.4	20.4
	Plants	9.9	28.6
	Structure/ Organic Carbon Export	5.2	26.8
	Habitat	6.0	12.3
	Linear Habitat	7.2	-

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.

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 7.44 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 0.07 acres of jurisdictional wetlands impacted by this alternative. Regardless of that determination, NRCS would require purchase of 0.07 acres of wetland mitigation bank credits.
- 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 7.44 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 breach would have the potential to impact the 78.3 acres of wetlands 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 Bylin Dam would be absent and the presence of algal blooms eliminated. 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 2 and more than Alternative 1.

  D-AA: As the multi-thread channel system forms and migrates migrate back and forth across the reservoir sediments between Dougherty Dam and 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 2 and more than Alternative 1 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 Forest 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. The intensity with which the water quality would be impacted is dependent on the construction techniques used. 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 (Bylin Dam is stratified with an approximately four-meter anoxic zone). At the normal pool elevation, the dam can accommodate approximately 164 more years of accumulated sediments at the current sedimentation rate and dredging operations may be possible in the future. The reservoir would refill and would again become eutrophic with periodic Harmful Algal Blooms (HABs). Climate change and increased rainfall intensity would exacerbate sediment transport from the contributing watershed and warmer temperatures would increase growth of algae in the reservoir, both factors likely causing HABs to increase more 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 north branch of the Forest 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 3, Appendix 1 Sediment Analysis Memorandum). 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 Forest 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)). The pollutants are all above EPA criteria, except Arsenic which is 18% below criteria. 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 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	0.28	0.34			No
Cadmium	0.01	0.002			Yes
Chromium	0.90	0.57			Yes
Lead	0.63	0.07			Yes
Nickel	1.26	0.47			Yes
Zinc	3.09	0.12			Yes
N (Total)	139.37		0.56	10	Yes
Phosphorus	9.31		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 Forest 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 3,810 acres would be inundated and would affect 21 structures and four residential. 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 3,029 acres and would affect 15 structures and one residential structure. There would be no changes to the regulatory 100-year floodplain from the current condition.

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 would be 3,029 acres and would affect 15 structures and one residential structure. During the breach, the flood wave would rapidly travel downstream, flooding 5,755 acres and 146 structures, 12 of these being residential. Three bridges would also be damaged. After the breach, the 100-year flood event would flood 3,810 acres, affecting 21 structures, four of these residential structures.

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 Forest 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 Bylin 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 41 tons of phosphorus and 612 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	489 VMT	650 tons
Scrapers Excavating	0.06 lb/ton	81 tons	2 tons
Scrapers Traveling	0.69 lb/VMT	850 VMT	255 tons
Scrapers Dumping	0.04 lb/ton	90 tons	2 tons
Dozer Spreading	0.75 lb/ton	90 tons	34 tons
Vehicle Travel, Unpaved Roads	0.86 lb/VMT	30 VMT	13 tons
Wind Erosion, Exposed Surfaces	0.38 ton/ac	10 ac	2 ton
Total Construction Project Estimate			**958 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 59.6 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 23 tons from the exposed sediment during that time period. 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	641 VMT	852 ton
Scrapers Excavating	0.06 lb/ton	47 ton	1 ton
Scrapers Traveling	0.69 lb/VMT	887 VMT	266 ton
Scrapers Dumping	0.04 lb/ton	47 ton	1 ton
Dozer Spreading, Finish Grading	0.75 lb/ton	47 ton	18 ton
Compactor	2.99 lb/VMT	97 VMT	145 ton
Vehicle Travel, Unpaved Roads	0.86 lb/VMT	60 VMT	26 ton
Wind Erosion, Exposed Surfaces	0.38 ton/ac	10 ac	2 ton
Total Construction Project Estimate			**1,836 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. The approximately 70 acres would be exposed for 1-3 years as weeds and grass naturally colonized the exposed sediments. PM10 emissions in the first year could be as high as 27 tons. 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 304 acres of natural lands and 372 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 (59.6 acres). Subsurface aquatic plant species found in the reservoir would be recolonized in the remaining stream channel. The reservoir would be replaced by an exposed floodplain where

eventually rehabilitated grasslands and floodplain wetlands would develop. Soils disturbed by the road construction and in the road right-of-way would be reseeded to standard ND Department of Transportation seed mixes – commonly a mixture of introduced and native grasses and forbs. Existing upland woody habitat would not be affected by the construction.

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 as Beckmannia syzigachne (American sloughgrass), Eleocharis parvula (Dwarf spikerush), 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), Spartina pectinata (Prairie cordgrass), and Alopecurus arundinaceus (Creeping meadow foxtail); and wetland (obligate) plants such as Typha xglauca (hybrid cattail), Polygonum amphibium (water smartweed), and a variety of sedge and rush species 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 grasses like Bromus inerimis (Smooth brome), and Poa pratensis (Kentucky bluegrass) would also establish on the floodplain. After herbaceous vegetation has established, and the reservoir sediments are stabilized, it is likely livestock would graze the floodplain, severely limiting the degree to which woody habitat establishes. The natural development of the riparian area would primarily provide 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. Climate change predictions of 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 Drift Plain and 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. 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.

The trees present near the existing embankment toe would be removed entirely to ensure flow paths through the embankment are not created via tree roots. 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.

The tame grassland area affected by the footprint of the enlarged embankment (3.42 acres), auxiliary spillway (1.83 acres, excluding ACB) and the ACB (3.49 acres), for a total of 8.74 acres, would be reseeded into native/introduced grass and forb species suitable for critical area plantings. The mix will include appropriate pollinator species. 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 a large area of tame grassland and some wetland acres. 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. For a short period, annual grasses and broadleaf plants such as Beckmannia syzigachne (American sloughgrass), Eleocharis parvula (Dwarf spikerush), Echinochloa crus-galli (Barnyardgrass), and Polygonum pensylvanicum (Pennsylvania smartweed), would likely temporarily establish along with other early succession perennial plants like Hordeum jubatum (Foxtail barley), some of which would also be noxious weeds like Canada thistle and Sonchus arvensis (Field sow-thistle. Perennial grasses, composed of both native and non-native wet meadow (FAC wet) species such as Phalaris arundinacea (Reed canarygrass), Spartina pectinata (Prairie cordgrass), and Alopecurus arundinaceus (Creeping meadow foxtail); and wetland (obligate) plants such as Typha xglauca (hybrid cattail), Polygonum amphibium (water smartweed), and a variety of sedge and rush species 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). Establishment of willows would provide necessary woody material to support a beaver population and would help create the floodplain wetlands mentioned above. Other upland grasses like Smooth brome, and Kentucky bluegrass would also establish on the floodplain. Once the herbaceous vegetation has established, and the reservoir sediments are stabilized, it is likely livestock would graze the floodplain, severely limiting the degree to which woody habitat establishes. The natural development of the riparian area would primarily provide 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. 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.

- 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 338 acres of riparian woodlands and scour or significant deposition on 89.9 acres of riverine and depressional wetlands. Scour would occur on 23 miles of the mainstem Forest River and 21 miles of unnamed tributaries 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.

  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. Climate change predictions of 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 Drift Plain and 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.

6.2.5.2 Riparian Woodlands

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. A full riparian woodland would not likely develop due to several factors. Once the unconsolidated sediments are stabilized and the herbaceous plant community develops, grazing by livestock would keep woodland habitat development to a minimum. 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: 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: Rehabilitation of the dam would involve a dam raise, generating increased inundation of upstream riparian woodland areas at events larger than the 100-year flood, however the frequency of the expanded inundation is low resulting in no effect on the small stands of riparian woodlands upstream
- 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. A full riparian woodland would not likely develop due to several factors. Once the unconsolidated sediments are stabilized and the herbaceous plant community develops, grazing by livestock would keep woodland habitat development to a minimum. Climate change 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. During the breach, the flood wave would cause loss of mature trees in over 338 acres of riparian woodlands downstream. 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 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 activities 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 7.12 acres of lacustrine wetland habitat, the reservoir drawdown 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. However, the presence of the weir and Dougherty Dam would limit the scope of this benefit. 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. Various pollinator species, including bumblebees and *Danaus plexippus* (monarch butterfly), would benefit from the embankment slopes being seeded with native prairie species mixes.
- 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. Climate change predictions of 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 Drift Plain and Glacial Lake Agassiz Basin sub-ecoregions, 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. Because the embankment would be seeded with construction seed mixes, consisting of a limited range of species and no forbs, various prairie and pollinator species, including bumblebees and *Danaus plexippus* (monarch butterfly), would lose potential habitat.
- 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 59.6 acres of open water habitat and also damaging some riparian woodlands nearby downstream. For species dependent on the 7.12 acres of lacustrine wetlands and 0.85 acres of depressional wetlands, the dam failure would cause displacement or death. For several years the exposed sediments over 59.6 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. However, the presence of Dougherty Dam would limit the scope of this benefit.
- 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 338 acres of riparian woodlands and scour or significant deposition on 89.9 acres of riverine and depressional wetlands. Scour would occur on 23 miles of the mainstem Forest River and 21 miles of unnamed tributaries during the breach. Deposition would occur over 372 acres of cropland and 304 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. Climate change predictions of 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 Drift Plain and 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.

6.2.5.4 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 Bylin reservoir during lake drawdown. The reservoir behind Dougherty Dam may not be an adequate replacement for lake fish habitat because it is much shallower (13.4 feet deep maximum). 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) and the Level III *Nocomis biguttatus* (hornyhead chub), but these species require clear water. Stocked game fish washed downstream over Dougherty Dam would likely not survive in the shallow, warm channels that develop over the former reservoir sediments.

  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.

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. 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 (including HABs). Sediment will continue to accumulate in the reservoir, causing an expected reduction in average pool depth to 4.9 ft in 100 years. When this happens, deep water habitat (pool depth of at least 6.6 ft.) would be eliminated from the reservoir, making winter kill of fish via lack of dissolved oxygen or freezing of the entire water column inevitable. The reservoir would be rendered uninhabitable by fish species dependent on deep water habitat towards the end of the 100-year planning timeframe.
- 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. However, stream channelization would be maintained.

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 Forest 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.

6.2.5.5 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 two Level I species of conservation concern: *Leucophaeus pipixcan* (Franklin's gull) and *Podiceps auritus* (Horned grebe) and the Level II *Pelecanus erythrorhynchos*, (American white pelican). For several years following the controlled dam breach, the exposed sediments would provide habitat for shorebirds such as *Charadrius vociferus* (Killdeer), *Gallinago gallinago* (Wilson's snipe), and *Actitius macularia* (Spotted sandpiper). 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), *Limosa fedoa* (Marbled godwit), and many species of duck. The development of riparian woodlands would be minimal due to landscape position and grazing pressure from livestock. 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 *Poecile atricapilla* (Black capped chickadee), *Picoides pubescens* (Downy Woodpecker), and *Bubo virginianus* (Great horned owl). 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. For several years following the uncontrolled dam breach, the exposed sediments would provide habitat for shorebirds such as *Charadrius vociferus* (Killdeer), *Gallinago gallinago* (Wilson's snipe), and *Actitius macularia* (Spotted sandpiper). 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 wing blackbird), *Xanthocephalus xanthocephalus* (Yellow headed blackbird), *Limosa fedoa* (Marbled godwit), and many species of duck. The development of riparian woodlands would be minimal due to landscape position and grazing pressure from livestock. Therefore, benefits to woodland nesting birds would be minimal.

D-AA: No effect would occur prior to the uncontrolled breach. During the breach, the flood wave would cause damage to mature trees on 338 acres of riparian woodlands, which would negatively impact woodland nesting species such as *Poecile atricapilla* (Black capped chickadee), *Picoides pubescens* (Downy Woodpecker), and *Bubo virginianus* (Great horned owl). These riparian corridors are particularly important to many species in highly agricultural areas where trees are relatively uncommon on the landscape. Loss, due to scour or significant deposition, would occur on 89.9 acres of riverine and depressional wetlands which would negatively impact migratory species such as *Recurvirostra americana* (Avocet), *Oxyura jamaicensis* (Ruddy Duck), *Anser caerulescens* (Snow Geese), and Aechmophorus occidentalis (Western Grebe). The potential for eagle habitat/nesting would also be greatly reduced. Migratory bird and eagle habitat loss would be greater than the FWOFI. Deposition would occur over 372 acres of cropland and 304 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. High levels of contaminants released within the watershed could impact some species, particularly ones who consume fish, amphibians, or invertebrates from riparian areas and could impact nesting success. 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.

6.2.5.6 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 whooping cranes would avoid areas with human activity. The current grazing land use in the U-AA would limit the natural regeneration of trees and favor non-native herbaceous vegetation to dominate. It is unlikely the U-AA would increase the number of trees suitable as roosting sites for *M. septentrionalis* (northern long-eared bat). The development of a braided stream and beaver dam system would create floodplain wetlands which may add preferred habitat for Grus americana (whooping cranes). Herbaceous vegetation suitable for Monarch Butterflies would be expected to increase in the long term.
- 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 could benefit Grus americana (whooping cranes). 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, no trees of suitable size for the nationally Endangered NLEB would 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 May 20, 2024 (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. Whooping cranes typically avoid areas with human activity, but if observed on site, construction would temporarily cease until they move to another habitat. Construction would cause a temporary loss of herbaceous vegetation suitable for 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 current grazing land use in the U-AA would limit the natural regeneration of trees and favor non-native herbaceous vegetation to dominate. It is unlikely the U-AA would increase the number of trees

suitable as roosting sites for *M. septentrionalis* (northern long-eared bat). The development of a braided stream and beaver dam system would create floodplain wetlands which may add preferred habitat for Grus americana (whooping cranes). Herbaceous vegetation suitable for Monarch Butterflies would be expected to increase in the long term.

- 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 338 acres of riparian woodlands, potentially harming bats if the breach occurs during mating or pup-rearing season. 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 Monarch Butterflies would be expected to increase as well.

6.2.5.7 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 biological inventory showed 12 species of introduced/problematic plants (e.g., *Phalaris arundinacea*, reed canary grass) and state noxious weeds *Carduus nutans* (musk thistle), *Cirsium arvense* (Canada thistle), and *Euphorbia esula* (leafy spurge). 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 Walsh 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 59.6 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 Walsh 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. 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. Long-term, these species would colonize additional areas and be a problem for agricultural production or waterbodies.
- 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 1.6 million cubic yards of downstream sediment erosion, the deposition from which is expected to cover 676 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

Alternative No. 1 – FWOFI

- U-AA: Dougherty Dam is thought to be a potential WPA project and ND SHPO has determined it is eligible for listing on the National Register of Historic Places. The FWOFI is not expected to impact Dougherty Dam as the sheet pile weir would prevent a headcut from migrating upstream. As a result of the Class III Cultural Resource Survey consultation (Appendix D-11), ND SHPO recommended NRCS record Bylin 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: The downstream Hoff School property is listed on the National Register. Under the FWOFI alternative, hydraulic modeling indicates that the school would be inundated by 4.0 ft at a 5-yr flood, 5.4 ft at a 10-yr flood, 6.3 ft at a 25-yr flood, 7.0 ft at a 50-yr flood, 7.6 ft at a 100-yr flood, and 7.8 ft at a 500-yr flood. Approximately ½ mile downstream a historic bridge is projected to fail sometime between the 50-yr and 100-yr flood event.

Alternative No. 2 – Structural Rehabilitation

U-AA: No disturbance to Dougherty Dam would occur. Disturbance to the embankment and auxiliary spillway of the existing Bylin Dam (considered by ND SHPO to be an architecturally significant site) would be moderate. 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 Bylin 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. The Spirit Lake Tribe would also be consulted, as they had requested continued consultation in the event of inadvertent or unanticipated discoveries. 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 anticipated 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 the downstream Hoff school property would be inundated only during the 500-year event (as it is currently unless the dam were to fail). At the 100-yr flood the water surface elevation is 2.7 feet lower than the building elevation. At the 500-yr flood, the school would be inundated 5.2 feet. Approximately ½ mile downstream a historic bridge would be protected up to the probable maximum flood event.

Alternative No. 3 - No Action

- U-AA: No disturbance to Dougherty Dam is anticipated prior to the breach. After the breach there is a small possibility a developing headcut could eventually move upstream and impact Dougherty Dam, however it is expected that the Walsh County WRD would stabilize erosion threatening Dougherty Dam. No effect would occur to existing Bylin Dam (considered by ND SHPO to be an architecturally significant site) prior to the uncontrolled breach. During the breach, disturbance to existing Bylin Dam would be severe. Massive erosion of the auxiliary spillway would occur which would negatively affect the architectural value of Bylin Dam. Failure of the embankment itself is also possible with this alternative.

- D-AA: No effect would occur prior to the uncontrolled breach. During the breach (625-year flood), hydraulic modeling indicates that the Hoff school property would be inundated by 21.4 feet of water. That would likely cause significant damage to the building. In the years prior to dam breach, flood impacts to the school would be similar to those described for Alternative 2 and after the breach flood impacts to the site would be similar to those described for Alternative 1. Approximately ½ mile downstream from the dam a historic bridge would fail during the breach wave.

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. Absence of a reservoir would eliminate risk from HABs. The road crossing the dam would be removed and replaced by another road with a culvert to safely accommodate river flows to the 10-year flood. Beyond the 25-year flood, water over the roadway would pose a public safety hazard.

- D-AA: After construction, the 100-year flood event would affect 21 structures, four of these being residential (See Figures C-13 through C-19 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 one public wellhead within a wellhead protection area downstream of the dam.

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 climate change and intensified agriculture in the contributing watershed.
- D-AA: The 100-year flood event would affect 15 structures, one 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). All wellheads within the wellhead protection area in the D-AA would be protected through a 500-year flood event.

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, 25 human lives would be at risk due to hazardous conditions at 7 residential structures and overtopping of State Highway 32. The flood wave moving downstream would inundate two wells within a wellhead protection area and may contaminate drinking water resources.

  Long term, after the dam breached, the 100-year flood event would affect 21 structures, four of these being residential (See Figures C-13 through C-19 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 one public wellhead within a wellhead protection area downstream of the dam.

6.2.6.3 Transportation and Infrastructure

Alternative No. 1 – FWOFI

- U-AA: Construction would include temporary road closure. The road that currently exists atop Bylin Dam would be realigned to its original, pre-dam location west of the embankment, and a 90-inch diameter culvert would be installed to pass flows through the road crossing with the North Branch Forest River. The road would slope down as far as possible while still following roadway design guidance. This road would ensure the local community has adequate transportation access in the region, up to the 25-year flood.
- 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.

Alternative No. 2 – Structural Rehabilitation

- U-AA: Construction required during dam rehabilitation would involve temporary road closure. Road realignment and modification to the vertical curves along 121st Avenue NE (which also serves as the top of embankment) would improve safety along the road. A new three-cable guard rail would also be installed to help improve traffic safety and the road would be widened slightly from approximately 22 feet to 26 feet where improvements are planned along 121st Avenue NE. Any impacts to the road during construction would be addressed. The road would be restored to the pre-construction condition.
- 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.

Alternative No. 3 – No Action

- U-AA: No effect would occur prior to the uncontrolled breach. During the breach, the road along the top of the dam would suddenly be eliminated. Long-term it is unknown if a replacement road would be constructed.
- D-AA: No effect would occur prior to the uncontrolled breach. During a breach, the flood wave traveling downstream would result in three bridges downstream of the dam being potentially impacted. There would also be more than 3.5 miles of gravel roads that would be washed out, plus approximately 0.35 miles of paved road impacts. See Appendix D-5 Economic Evaluation Report for more information. 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: Livestock and recreation are the main economic aspects 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. Recreation revenue would be eliminated until good hunting opportunities return.
- D-AA: Dam removal and subsequent lack of flood attenuation downstream would result in property damage to structures, contents, and vehicles ranging from $286,000 for the 5-year flood event to over $11 million for the 500-year flood event. The overall expected annual flood damages would be $465,400. The expected annual total crop flood damage would be $44,700. Expected damages to roadways would be estimated at $274,700 during the 500-year flood event (annual damages $15,700). It was determined that without the dam, six additional properties would need to participate in the National Flood Insurance Program, resulting in an estimated $2,300 more per year for administrative costs.

Alternative No. 2 – Structural Rehabilitation

- U-AA: Once the construction is complete, recreation activities would resume, resulting in a total annual benefit of $12,100.
- D-AA: Once the project is complete, there would be numerous benefits to the local and regional economy. Property damage due to flooding, including structures, contents, and vehicles, would range from $0 for the 5-year flood event to over $2.8 million for the 500-year flood event. The expected annual flood damages estimate is $81,300. Overall, this reflects an annual benefit of $321,400 for property assets. After the project is complete, flooding would impact fewer acres of cropland. The expected annual total flood damage value would be $31,200. Overall, this reflects an annual benefit of $13,500 for crop assets. Expected annual damages to roadways are estimated at $8,000. This reflects an overall annual benefit of $7,700 for roads. It was determined that the dam reduces the number of properties required to participate in the National Flood Insurance Program by six properties. This reduction represents a savings in administrative costs of $2,300 per year.

  Bylin Dam provides a total of $44,900 in annual flood damage reduction and recreation benefits to the local and regional community.

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.

  D-AA: No effect would occur prior to the uncontrolled breach. During the breach event, damages to structures, vehicles, and infrastructure would occur. Damages to structures and vehicles would be estimated at $24 million, an additional $13 million in damages compared with the FWOFI 500-year flood event. Damages to infrastructure (roadways) would be estimated at $360,000, an additional $85,300 in damages compared with the FWOFI 500-year flood event. Estimated crop damages during a breach are unknown, but they would be greater than the FWOFI at the 500-year flood event. Participation in the National Flood Insurance Program is not applicable to this scenario.

6.2.6.7 Environmental Justice, Civil Rights

Potential effects on environmental justice and civil rights were reviewed in the context as discussed in Section 4.2.6.7. Population demographics were compared across five census block groups with the reference community. There is one block group (eastern City of Park River) with a meaningfully greater minority population (12% greater than reference). While the percentage of low-income population is fairly consistent compared with the state, Walsh County and the reference community (Nelson County), it is still a significant portion of the population (24%). Persons with Disabilities averages 15% across the block groups and is not significantly greater among any groups.

Alternative No. 1 – FWOFI

- U-AA and D-AA:

  This alternative may have a slight disproportionate effect on minorities, persons with disabilities or low-income demographic groups because the loss of the free/low-cost water recreational opportunities associated with the reservoir, including the NDGF sponsored accessible fishing pier. The alternative involves elimination of the reservoir and associated recreation, construction activities, minor airborne dust, changes in plant communities, and changes in aesthetic views.

Alternative No. 2 – Structural Rehabilitation

- U-AA: Construction activities consist of minor airborne dust and temporary road closures. The outcome of the project includes retaining the reservoir, associated recreation, and associated eutrophic waters and HAB incidence, plant communities, animal populations, and aesthetic views.

  The reservoir would continue to provide free/low-cost water recreational opportunities, such as the usage of the NDGF sponsored accessible fishing pier and boat access for small crafts such as kayaks and canoes. There are no known adverse human health or environmental effects that would affect minority populations and low-income populations.

  D-AA: The outcome of the project includes maintaining the current reduction of flooding incidence on structures and farmland; downstream water quality aquifer/public wellhead protection, and cropland land use. This protects income opportunities for persons of low income in the greater community. The reduction in dynamic hydrologic conditions is not expected to result in any disproportionate effects to any populations.

Alternative No. 3 – No Action

U-AA: Absence of construction activities would preclude minor airborne dust and temporary road closures. The outcome of this alternative includes retaining the reservoir, associated recreation, and associated eutrophic waters and HAB incidence, plant communities, and aesthetic views until a breach event occurs. At that point the loss of the reservoir would reduce free/low-cost water recreational opportunities, such as the usage of the NDGF sponsored accessible fishing pier and boat access for small crafts such as kayaks and canoes.

- D-AA: The outcome of this alternative includes retaining upstream flood attenuation and decreased flood incidence downstream; protection of structures, farmland, and wellheads; decreased quality and quantity of habitat corridors and biodiversity; and downstream water quality improvements. The potential for aquifer contamination and the loss of a public wellhead may have a

disproportionate effect on minority populations. The reduction in dynamic hydrologic conditions is not expected to result in any disproportionate effects to any populations.

6.2.6.8 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

Historically, the North Branch Forest 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 (42% reduction). After the highly damaging floods that occurred during the spring of 1948 and the spring of 1950, planning in several watersheds was initiated by the Soil Conservation Service. This included North Branch and Middle-South Branch of Forest River Watershed. The resulting North Branch Forest River Watershed Work Plan, and subsequent Amendments, resulted in the construction of two channelization projects and four flood retarding structures (including Bylin 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 riparian corridor provided limited ecological function due to the presence of Dougherty Dam, directly upstream of Bylin Dam. The floodplain consisted of mixed forested and grassland riparian habitat that provided floodplain storage and fish passage, although Dougherty Dam is a barrier to fish passage immediately upstream. Prior to construction of Bylin Dam, flow rates and sediment transport were already regulated from Dougherty Dam, inhibiting natural riparian processes at the current dam site and downstream. After Bylin Dam was constructed, the ecological value was further marginalized by converting the riparian floodplain habitat into deep water habitat. Fringe wetlands developed along the shore of the reservoir pool; however, they do not fully support the loss of the riparian floodplain. Bylin Dam also created another barrier to fish passage and natural sediment transport within the channel, in addition to Dougherty Dam.

Although Bylin Dam does not restore the ecological value of mosaic of wetlands, prairie, forest, and riparian floodplain, it does perform an important function. 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 Bylin 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. Bylin 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.

Despite the retention provided by Bylin Dam, loss of natural floodplain storage is continuing via stream channelization and tile drainage. While drainage intensification persists, flood attenuation provided by Bylin Dam has curbed the rate of intensification. As an example, a recent planning effort on the Lower Forest River downstream of Bylin Dam contemplated a floodwater diversion to reduce flood damages to cropland. Ultimately, the sponsor ceased planning due to an apparent lack of local need for the project. Upstream

watershed dams constructed as part of the North Branch and Middle-South Branch Forest River Watershed Work Plans has already addressed a portion of the need, ultimately limiting further drainage intensification. Land use changes and drainage intensification to support crop production have also occurred in the watershed above Bylin Dam, resulting in increased flood flows, sediment loads, and nutrient loads. Bylin Dam attenuates peak flood flows and provides for deposition of sediments (and sediment bound nutrients) from the upper watershed before continuing downstream.

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 Bylin 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 and demand. Analyses also include estimates of changes in land values, populations, the built environment, and flood damages. Uncertainty in estimation of environmental effects includes community mapping estimates, probabilities of species presence, and predictions associated with ecosystem threats, including climate change.

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

6.4.1 Climate Change

Climate change is an overriding threat to ecosystems globally. A warming climate can alter the current equilibrium of abiotic and biotic environments. Consequences of climate change include altered species distribution, population, and survival. Northeastern North Dakota, already seeing some effects, is anticipated to become warmer, wetter in winter and spring, with a predicted 10-20% increase in average precipitation by the end of the 21st century (Appendix D-6 Environmental Resources Memorandum). Precipitation events are expected to be more intense. These changes may result in thinner ice or alter the typical amount of snow cover, thus affecting the timing or thickness of sunlight-restricting snow. This could have direct implications on how the eutrophic waters mediate bacteria growth and oxygen depletion during the winter season. Warming waters can increase the frequency and severity of algal blooms, and lakes are known to release higher quantities of carbon dioxide and methane as they become warmer. If lakes lose their water cover, the stored organic matter in the sediments can become oxidized, degrade more quickly, and release carbon dioxide.

As it relates to Bylin Dam, climate change may have an impact on future considerations for hydrologic design. Future analyses may find, with new data regarding intensification of precipitation events, the principal and/or auxiliary spillway structures designed for Alternative No. 2 to be undersized. The

importance of maintaining downstream flood reduction benefits of dams such as Bylin, to maintain agricultural production as southern areas of the Midwest are subjected to increased frequencies of drought, would continue to increase, thereby making economic benefits of this dam higher than estimated. In addition, reduction of nutrient runoff from cropland would be an even more critical need in the future.

6.4.2 Future Land Use

Future land use may have an impact on the 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.

6.4.3 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

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 newspapers (the Walsh County Record and the Grand Forks Herald). Scoping details including invitation letters, meeting materials, and comments received through the public participation process are provided in Appendix A.

Three potential federal cooperating agencies were sent letters of invitation to participate in the planning process (USFWS, USACE and FEMA) on March 6, 2020. The USFWS and USACE participated as official federal cooperating agencies throughout the NEPA planning process. The USACE responded formally with a letter agreeing to participate in the process. The USFWS Information for Planning and Consultation (IPaC) online planning tool was accessed in 2020, and the generated species list was used to inform the Biological Inventory (Appendix D-10). The USFWS recommends utilizing IPaC at regular intervals to stay current with Threatened and Endangered Species protocols. IPac was accessed on 5/16/2024 – results are discussed in sections 4.2.5 and 6.2.5.

Consultation with 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 January 24, 2020. Thirty tribes and ND SHPO were sent invitations to participate in the planning process for Bylin Dam Rehabilitation (see example letter in Appendix A). One response was received from the Northern Arapaho tribe requesting to be included on all correspondence.

The first public meeting was held at the Minto Community Center on March 6, 2020. The meeting was advertised in the Walsh County Record Newspaper and meeting invitations were sent to 20 federal, state, and local agencies. Zach Herrmann and Mike Opat of Houston Engineering Inc. (HEI) along with Christi Fisher, State Conservation Engineer for the NRCS, presented an introduction to the project for an audience of 16 stakeholders. The public notice, invitation letters, responses and presentation materials are included in Appendix A.

The comments received from stakeholders were as follows:

- Need for maintained flood protection.
- Desire for maintained recreation opportunity
- Need for maintained dam crossing road for farm equipment and passenger travel.
- Stakeholder highlighted historic Hoff School (one-room schoolhouse still in original site)
- Concern for functionality of Dougherty Dam as an access route during low water conditions
- Concern about sediment accumulation and dam lifespan, concern about sediment accumulation if Dougherty Dam is removed.
- Request for considerations of downstream erosion impacts and upstream BMPs to reduce sediment and nutrient loading (cropland buffers, sediment loading impacts, study of nitrate and phosphorus impacts)
- Access road across the dam needed as a farm to market route.

In addition to the comments provided during the public meeting held on March 6, 2020, 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 meetings held during project planning, interagency meetings were held to review the existing conditions analysis conducted for Bylin Dam, to review the alternative development process, and to discuss the preferred alternative.

The first interagency meeting was held on January 26, 2021, with the purpose of discussing the data collected for the existing conditions assessment and identifying deficiencies associated with Bylin Dam that would need to be addressed throughout the project. In attendance were members from HEI, the North Dakota Department of Water Resources (DWR), NRCS, Red River Retention Authority, USFWS, and the Walsh County Water Resource District.

A technical team was formed to assist with alternative development for the project. The technical team consisted of engineers and geologists from HEI, Gannet Fleming Inc., DWR, and the NRCS. This team met during a virtual meeting held on July 20, 2021. The meeting involved discussion on various potential alternatives for the rehabilitation of Bylin Dam. The material discussed during the meeting is available in Appendix D-3: Alternatives Evaluation Report.

A second interagency meeting was held virtually on September 9, 2021, to discuss alternative evaluation and the elimination of various alternatives. A locally preferred alternative was identified during the meeting by the Walsh County Water Resource District (Sponsor). Project stakeholders who had expressed further interest were also invited to the meeting. Meeting material for both interagency meetings is available upon request from the North Dakota NRCS.

A second public meeting was held as a virtual meeting through Microsoft Teams and with some of the public in attendance at the Walsh County Courthouse in Grafton, ND, on February 8, 2022. The meeting was advertised in the Walsh County Record and letter/email invitations were sent to the cooperating agencies, SHPO, Tribes and 20 Federal, State and Local agencies. The public notice, invitation letters, responses and presentation materials are included in Appendix A. Paul LeClaire of HEI presented the alternative development process and consequences of the alternatives identified for the audience.

Only a few comments and questions were provided from one local stakeholder following the second public meeting. See Appendix A-4 for comments and responses.

7.3 Stakeholder Participation – Tribal/SHPO Consultation on Class III Survey

On August 3, 2023, 31 tribes and ND SHPO were sent the Class III Cultural Resources Survey (Appendix D-11). The Apache Tribe of Oklahoma was also sent the survey for consultation on May 20, 2024. Two tribal responses were received. The Crow Creek tribe indicated they would defer to local tribes. The Spirit Lake Nation Tribe (SLN) responded that they concurred with the determination of No Effect to Historic Properties, however they stressed that the area was heavily utilized in prehistoric times. SLN stressed the necessity to keep the project within the conceptual design boundary and to notify them of any discoveries during construction. The following list is inclusive of all 32 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 August 27, 2024 to provide comments on the Draft Bylin 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 local Walsh County Record and the Walsh County Press. The ad ran in 3 editions August 7, 14, and 21, 2024. 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 August 1, 2023 to September 24, 2024. A total of 8 comments were received at the public meeting on August 27, 2024. An additional 8 comments were provided by the ND Department of Water Resources and ND Game and Fish. 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 8.53-inch runoff event (snowmelt and/or precipitation) that would cause dam failure has a statistically derived return interval of 625 years. Therefore, economic analysis credits flood protection and recreation benefits of the dam being present for 624 years prior to applying the $ 24.5 million in economic losses due to the dam breach and discounting those back to present value. 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, Alternative 2 (Structural Rehabilitation) provides a significantly higher benefit cost ratio than Alternative 1 (FWOFI), at a comparative benefit-cost of 1.3:1.

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 two downstream historic structures. 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 homes, public roads, agricultural structures, cropland, and put historic structures at risk. 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 25 lives and damages to 19 homes, 3 bridges, and 5.1 miles of roads, and destruction of 2 historic structures. The public recreation opportunity would be lost and societal results of reduced road access for emergency services, local residents, and agricultural producers hauling harvested crops would persist into the future. 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, climate, 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 Walsh 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. 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 Walsh 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 embankment for Bylin Dam would need to be raised to accommodate the freeboard design hydrograph discussed in Appendix D-1. A detailed hydraulic model was developed to determine the required height of the embankment during passage of the freeboard hydrograph. The embankment would need to be raised a total of 3.9 feet to pass the freeboard hydrograph. The proposed embankment top would also serve (as it does currently) as a township road and would have a top width of 26 feet. A three-cable guard rail is proposed on both sides of the road. The downstream embankment of the dam would be modified to address slope stability concerns described in Appendix D-2: Geotechnical Engineering Report. The downstream slope adjacent to the embankment top would be 3:1 (horizontal: vertical) down to a specified elevation where a 20-foot bench would be implemented. Downstream of the bench a 4:1 (horizontal: vertical) slope on the embankment would be implemented. 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 a plunge pool constructed at the principal spillway outlet. Other measures to ensure slope stability is adequate at the dam are described in Appendix D-2: Geotechnical Engineering Report.

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 0.13 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 36” principal spillway conduit would be installed via NRCS approved boring and jacking methods through the existing embankment. Open cut placement methods would be used outside of the existing embankment extents. A new plunge pool would be constructed at the outlet of the principal spillway conduit. Downstream of the plunge pool, a constructed channel would be implemented to carry flows from the plunge pool back to the North Branch Forest River channel (less than 150 feet of new channel construction). 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 a low stage orifice opening and second stage overflow weir.

8.3 Avoidance, Minimization, and Mitigation Features

Compensatory mitigation is anticipated for the loss of 0.008 acres of depressional wetlands and 0.057 acres of lacustrine fringe 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 0.85-acre depressional wetland on 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 Walsh 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 Walsh 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 Forest 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 Bylin 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 credit 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 2021. 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 Bylin 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 via jack and bore methodology after the reservoir has been drawn down and the cofferdam constructed. The jack and bore methods would only be used for the conduit through the existing embankment. Open cut methods would be used for placement of the conduit under the proposed embankment extents. Therefore, the proposed conduit through the existing embankment would need to be installed before placement of embankment on the downstream slope of the dam begins.

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 and the embankment raise would take place as early as possible without affecting local agricultural transport. 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 on the downstream embankment of the dam and would be laid over the foundation drain and proposed principal spillway conduit. The embankment material and proposed chimney drain would be constructed simultaneously with compaction and material testing taking place during construction. Embankment material would be placed starting at the toe of the dam until modifications to the top of dam elevation are required, at which point 121st Avenue NE would be closed, fill would be placed, and the road atop Bylin Dam would be reconstructed. 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 Bylin 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 1521.2, which is 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 1518.6. 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. Additionally, the increase in top of dam elevation does not have any impacts to flooding of roads and railroads, buildings, water sources, utilities, and burial and/or historical sites upstream of the dam. 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 North Branch Forest River Dam # 1 (Bylin 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 North Branch Forest River Dam #1 (Bylin 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 North Branch Forest River Dam #1 (Bylin Dam)	No.	1	$7,783,300	$3,076,700	$10,860,000
Total			$7,783,300	$3,076,700	**$10,860,000**

1/ Price Base 2023 Prepared: July 2024
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 North Branch Forest River Dam #1 (Bylin 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/]	Required Permits	Project Admin.	Total Other Funds	
Multiple Purpose Structure – Rehabilitation of North Branch Forest River Dam #1 (Bylin Dam)	$6,183,300	$1,600,000	$7,783,300	$3,016,700	$10,000	$50,000	$3,076,700	$10,860,000
Total	$6,183,300	$1,600,000	$7,783,300	$3,016,700	$10,000	$50,000	$3,076,700	**$10,860,000**

1/ Price Base 2023 Prepared: July 2024
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 North Branch Forest River Dam #1 (Bylin Dam) Rehabilitation

Item	Unit	North Branch Forest River Dam #1 (Bylin Dam) Rehabilitation
General Data		
Class of Structure		High Hazard
Seismic Zone		1
Uncontrolled Drainage Area	sq. mi.	20.5
Controlled Drainage Area	sq. mi.	0
Total Drainage Area	sq. mi.	20.5
Runoff Curve No. (1-day, AMC II)		75
Time of Concentration (Tc)	hrs.	7.4
Elevation Top Dam	ft, NAVD88	1527.7
Elevation Crest Auxiliary Spillway	ft, NAVD88	1518.6
Elevation Crest High Stage Inlet	ft, NAVD88	1511.3
Elevation Crest Low Stage Inlet	ft, NAVD88	1490.2
Auxiliary Spillway Type		Articulated Concrete Block
Auxiliary Spillway Bottom Width	ft	300
Auxiliary Spillway Exit Slope	percent	13
Maximum Height of Dam	ft	64.3
Volume of Fill[2]	cubic yards	52,658
Storage Capacities		
Total Capacity[3]	acre-feet	4223
Sediment Submerged[4]	acre-feet	251
Sediment Aerated	acre-feet	29
Beneficial Use (Recreation)	acre-feet	244
Floodwater Retarding	acre-feet	3699
Between High and Low Stage	acre-feet	2266
Surface Area		
Sediment Pool[3]	acres	18
Beneficial Use (Recreation)	acres	57
Floodwater Retarding[3]	acres	229
Principal Spillway Design		

Item	Unit	North Branch Forest River Dam #1 (Bylin Dam) Rehabilitation
Rainfall Volume (1-day)	inches	5.1
Rainfall Volume (10-day)	inches	7.4
Runoff Volume (10-day)	inches	4.7
Capacity of Low Stage (max.)	cfs	172
Capacity of High Stage (max.)	cfs	228
Dimensions of Conduit	ft - inches	3'-0" diameter
Type of Conduit		Reinforced Concrete Circular Conduit
Frequency Operation-Auxiliary Spillway	percent chance	1
Auxiliary Spillway Hydrograph		
Rainfall Volume	inches	9.5
Runoff Volume	inches	6.4
Storm Duration	hrs.	12
Max. Reservoir Water Surface Elev.	ft, NAVD88	1521.7
Freeboard Hydrograph		
Rainfall Volume	inches	21.6
Runoff Volume	inches	18.0
Storm Duration	hrs.	12
Max. Reservoir Water Surface Elev.	ft, NAVD88	1527.7
Capacity Equivalents		
Sediment Volume	Inches	0.1
Floodwater Retarding Volume	Inches	3.4
Beneficial Volume (Recreation)	inches	0.5

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 – Includes fill material added to the embankment after installation of the preferred alternative

3 – Crest of auxiliary spillway

4 – Sediment deposition is expected to occur throughout the reservoir similar to how it has deposited historically

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Table 8-4 provides information on annual costs for the North Branch Forest River Dam # 1 (Bylin Dam). Annual costs were amortized for 102 years at an interest rate of 2.25 percent.

Table 8-4: Economics Table 4 - Estimated Average Annual Costs for North Branch Forest River Dam #1 (Bylin Dam) Rehabilitation (Dollars)[1/]

Works of Improvement	---------Project Outlays--------- Amortization of Installation Cost[2/]	Operation, Maintenance and Replacement Cost	Total
Multiple Purpose Structure – Rehabilitation of North Branch Forest River Dam #1 (Bylin Dam)	$260,700	$5,000	$265,700
Total	$260,700	$5,000	**$265,700**
1/Price Base 2021			
2/Amortized for 102 years at 2.25 percent			Prepared: March 2024

Table 8-5 provides summary information on average annual flood damage reduction benefits for Bylin 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 North Branch Forest River Dam #1 (Bylin Dam) Rehabilitation (Dollars)[1/]

Item	Estimated Average Annual Damage		Damage Reduction Benefit
	Without Project (Agriculture Related)[2/]	With Project (Agriculture Related)	
Floodwater			
Cropland	$44,700	$31,200	$13,500
Structures and Vehicles	$402,700	$81,300	$321,400
Roads	$15,700	$8,000	$7,700
Insurance Administration Costs	$2,300	$0	$2,300
Total[3/]	**$465,400**	**$120,500**	**$344,900**
1/ Price Base 2023			Prepared: July 2024
2/ Because all floodwater damages occur within rural communities, all floodwater damages are considered agriculture-related			
3/ Note this is a total of flood damage reduction benefits only, excluding recreation.			

There is also a $12,100 annual benefit from recreation provided by Bylin Dam, as outlined in Appendix D-5 Economics. Therefore, the total annual benefits provided by Bylin Dam are **$ 357,000**.

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 North Branch Forest River Dam #1 (Bylin 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 North Branch Forest River Dam #1 (Bylin Dam)	$346,700	$265,700	1.3 to 1.0
Total	$346,700	$265,700	**1.3 to 1.0**
1/ Price Base 2023			Prepared: July 2024
2/ Annual benefits ($357,000) are presented here as average annual equivalents, amortized for 100 years at 2.25 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	21
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	11
John Bauer	Watershed Planner	B.S. Zoology	21
Richard Webb	State Resource Conservationist	BS Agricultural Systems Management	20

Name	Current Position	Education	Years of Experience
Curt Bradbury	State Biologist	BS Fisheries, Wildlife Management	26
Christopher Plount	Cultural Resources Specialist	BA Anthropology, MS Cultural Resource Management	6
Sarah Laundry	Cultural Resources Specialist	BS Anthropology, MA Anthropology/Archeology	21
Houston Engineering, Inc. Staff			
Donna Jacob, PhD, PWS, CMWP	Senior Scientist	BS Environmental Biology MSc Botany, Wetland Science PhD Botany, Wetland Science	28
Tanner Wilson	GIS Analyst	BS Natural Resources Management	2
Paul LeClaire, PE, MS	Engineer III	BS Civil Engineering MS Civil Engineering	8
Zachary Herrmann, PE	Sr Project Manager	BS Civil Engineering	17
Mike Opat, PE, MBA	Sr Project Manager	BS Civil Engineering	19
Rachel Glatt	Engineer II	BS Civil Engineering	4
Gannett Fleming, Inc. Staff			
Katherine Sharpe, AICP, ENV SP	Principal Environmental Economist	MPS Environmental Management	22
Edward J. Barben, PE	Senior Geotechnical Engineer	BS Civil Engineering MS Civil Engineering	14

Prepared March 2024

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 August 1, 2024 in the Walsh 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 - Walsh 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	Walsh Co Water Resource District
ND Department of Water Resources	Walsh County Commission
ND Game and Fish Department	Walsh County Emergency Services
Governor of North Dakota	Walsh County Hwy Dept
ND Parks and Recreation	Walsh County SCD
North Dakota Department of Transportation	Walsh County SCD Watershed Coordinator
Northern Arapaho Tribe	White Earth Nation of MN Chippewa
Northern Cheyenne Tribe	Yankton Sioux Tribe

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