SUPPLEMENTAL WATERSHED PLAN NO. IX & ENVIRONMENTAL ASSESSMENT

FOR THE REHABILITATION OF FLOODWATER RETARDING STRUCTURES NO. 4 & 6 OF THE CHAMBERS CREEK WATERSHED

Prepared by:

U.S. Department of Agriculture
Natural Resources Conservation Service

In Cooperation With:

City of Alvarado
City of Ennis
Ellis-Prairie Soil and Water Conservation District #504
Dalworth Soil and Water Conservation District #519
Hill County-Blackland Soil and Water Conservation District #541
Navarro Soil and Water Conservation District #514
Ellis County Commissioners Court
Hill County Commissioners Court
Johnson County Commissioners Court
Navarro Commissioners Court
Ellis County

October 2022

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SUPPLEMENTAL WATERSHED PLAN NO. IX and Environmental Assessment for the Rehabilitation of Floodwater retarding Structures No. 4 and No. 6 of the Chambers Creek Watershed Ellis County, Texas

Prepared by:
U.S. Department of Agriculture
Natural Resources Conservation Service

In Cooperation With:
Texas State Soil and Water Conservation Board
City of Alvarado, City of Ennis, Ellis-Prairie Soil and Water Conservation District #504, Dalworth Soil and Water Conservation District #519, Hill County-Blackland Soil and Water Conservation District #541, Navarro Soil and Water Conservation District #514, Ellis County Commissioners Court, Hill County Commissioners Court, Johnson County Commissioners Court, Navarro Commissioners Court

Authority

The original watershed work plan was prepared, and works of improvement have been installed, under the authority of the Flood Control Act of 1944 (Public Law 78-534) as amended. The rehabilitation of floodwater retarding structures No. 4 & 6 is authorized under Public Law 83-566 (as amended), and as further amended by Section 313 of Public Law 106-472.

Abstract

The presence of residential and commercial structures, several residential streets, county roads, and FM 1387 downstream of Chambers Creek Floodwater Retarding Structure (FRS) No. 4 cause the dam to be classified as a high-hazard structure. In its current state, Chambers Creek FRS No. 4 does not comply with current dam safety and performance criteria, regarding the ability of the dam to safely pass a design flood commensurate with the potential downstream hazards. The purposes of the proposed rehabilitation of Chambers Creek FRS No. 4 are to maintain a level of flood control benefits that minimizes changes to present conditions and to comply with current performance and safety standards. Rehabilitation of the dam will require installing a 30-inch-diameter principal spillway pipe with an intake riser and an impact basin at the outlet. The auxiliary spillway crest elevation will be raised 0.4 feet. In addition, the top of the dam will be raised an average of 2.4 feet, the downstream slope will be flattened from 2.0:1 to 3:1, and the dam will be lengthened by 160 feet. Project installation cost is estimated to be $2,630,200 of which $1,709,600 will be paid from the Small Watershed Rehabilitation funds and $920,600 from local funds.

The presence of residential and commercial structures, several county roads and private roads downstream of Chambers Creek FRS No. 6 cause the dam to be classified as a high-hazard structure. In its current state, Chambers Creek FRS No. 6 does not comply with current dam safety and performance criteria, regarding the ability of the dam to safely pass a design flood commensurate with the potential downstream hazards. The purposes of the proposed rehabilitation of Chambers Creek FRS No. 6 are to maintain a level of flood control benefits that minimizes changes to present conditions and to comply with current performance and safety standards. Rehabilitation of the dam will require installing a 30-inch-diameter principal spillway pipe with an intake riser and an impact basin at the outlet. The auxiliary spillway crest elevation will be raised 0.25 feet. In addition, the top of the dam will be raised an average of 2.1 feet, the downstream slope will be flattened from 2:1 to 3:1, and the dam will be lengthened by 55 feet. Project installation cost is estimated to be $2,940,000 of which $1,911,000 will be paid from the Small Watershed Rehabilitation funds and $1,029,000 from local funds.

Comments and Inquiries

The U.S. Department of Agriculture (USDA) and the Natural Resources Conservation Service (NRCS) has completed this Final Plan-Environmental Assessment (EA) in accordance with the National Environmental Policy Act (NEPA) and USDA-NRCS guidelines and standards. Reviewers should provide comments to NRCS during the allotted Final Plan-EA review period. To submit comments, send via U.S. Mail to:

Mark Northcut
NRCS Texas State Office
101 South Main Street
Temple, Texas 76501

Or email to mark.northcut@usda.gov

Non-Discrimination Statement

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

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

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

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Chambers Creek
Supplemental Watershed Plan Agreement No. IX

between the
Texas State Soil and Water Conservation Board
City of Alvarado
City of Ennis
Ellis-Prairie Soil and Water Conservation District #504
Dalworth Soil and Water Conservation District #519
Hill County-Blackland Soil and Water Conservation District #541
Navarro Soil and Water Conservation District #514
Ellis County Commissioners Court
Hill County Commissioners Court
Johnson County Commissioners Court
Navarro Commissioners Court
(Referred to herein as Sponsors)

and the

UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE
Formerly the Soil Conservation Service (SCS)

(Referred to herein as NRCS)

Whereas, the original Watershed Plan Agreement for the Chambers Creek Watershed, State of Texas, executed by the Sponsors named therein and NRCS, became effective on the 9th day of December 1955; and

Whereas, a Supplemental Watershed Plan Agreement No. I for the Chambers Creek Watershed, State of Texas, executed by the Sponsors named therein and NRCS, became effective on the 14th day of April 1959; and

Whereas, a Supplemental Watershed Plan Agreement No. II for the Chambers Creek Watershed, State of Texas, executed by the Sponsors named therein and NRCS, became effective on the 25th day of October 1962; and

Whereas, a Supplemental Watershed Plan Agreement No. III for the Chambers Creek Watershed, State of Texas, executed by the Sponsors named therein and NRCS, became effective on the 4th day of February 1972; and

Whereas, a Supplemental Watershed Plan Agreement No. IV for the Chambers Creek Watershed, State of Texas, executed by the Sponsors named therein and NRCS, became effective on the 8th day of March 1976; and

Whereas, a Supplemental Watershed Plan Agreement No. V for the Chambers Creek Watershed, State of Texas, executed by the Sponsors named therein and NRCS, became effective on the 24th day of March 1988; and

Whereas, a Supplemental Watershed Plan Agreement No. VI for the Chambers Creek Watershed, State of Texas, executed by the Sponsors named therein and NRCS, became effective on the 31st day of May 1991; and

Whereas, a Supplemental Watershed Plan Agreement No. VII for the Chambers Creek Watershed, State of Texas, executed by the Sponsors named therein and NRCS, became effective on the 11th day of October 1995; and

Whereas, a Supplemental Watershed Plan Agreement No. VIII for the Chambers Creek Watershed, State of Texas, executed by the Sponsors named therein and NRCS, became effective on the 8th day of May 2018; and

Whereas, in order to carry out the watershed plan for the Chambers Creek Watershed, it has become necessary to modify the Watershed Plan Agreement,

Whereas, application has heretofore been made to the Secretary of Agriculture by the Sponsors for assistance in preparing a plan for works of improvement for the Flood Retarding Structures No. 4 and No. 6 in the Chambers Creek Watershed, State of Texas, under the authority of the Watershed Protection and Flood Prevention Act, as amended (16 U.S.C. Sections 1001 to 1008, 1010, and 1012); and

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

Whereas, there has been developed through the cooperative efforts of the Sponsors and NRCS a Watershed Work Plan No. IX and Environmental Assessment for works of improvement for the rehabilitation of Flood Retarding Structures No. 4 and No. 6 in the Chambers Creek Watershed, State of Texas, hereinafter referred to as the watershed project plan or plan, which plan is annexed to and made a part of this agreement;

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

1. **Term.** The term of this agreement is for the installation period and evaluated life of the project (101 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 will only obtain land rights up to the 100-year elevation, and acknowledge the risk associated with not acquiring land rights up to the proposed top of dam elevation for the preferred alternative.

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

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

Works of Improvement	Chambers Creek 4					Chambers Creek 6				
	NRCS		Sponsors		Total	NRCS		Sponsors		Total
	Percent	Cost	Percent	Cost	Cost	Percent	Cost	Percent	Cost	Cost
Cost Shareable-Items										
Rehabilitation of Dam (Construction Costs)	65%	$1,709,600	35%	$920,600	$2,630,200	65%	$1,911,000	35%	$1,029,000	$2,940,000
Sponsors' Engineering Costs	65%	$0	35%	$0	$0	65%	$0	35%	$0	$0
Subtotal: Cost-Shareable Costs	**65%**	**$1,709,600**	**35%**	**$920,600**	**$2,630,200**	**65%**	**$1,911,000**	**35%**	**$1,029,000**	**$2,940,000**
Non-Cost-Shareable Items [1/]										
NRCS Technical Assistance/Engineering		$263,100		-	$263,100		$294,000		-	$294,000
Project Administration [2/]		$315,700		$0	$315,700		$352,800		$0	$352,800
Water, Mineral and Other Resource Rights		-		$0	$0		-		$0	$0
Real Property Rights [3/]		-		$12,900	$12,900		-		$22,000	$22,000
Subtotal: Non-Cost-Share Costs		**$578,800**		**$12,900**	**$591,700**		**$646,800**		**$22,000**	**$668,800**
Total:		**$2,288,400**		**$933,500**	**$3,221,900**		**$2,557,800**		**$1,051,000**	**$3,608,800**

1/ If actual non-cost-sharable item expenditures vary from these figures, the responsible party will bear the change.
2/ The sponsors and NRCS will each bear the costs of project administration that each incurs. Sponsor costs for project administration include relocation assistance advisory service.
3/ The sponsors will acquire with other than Watershed Protection and Flood Prevention Act funds, such real property as will be needed in connection with the works of improvement. The value of real property is eligible as in-kind contributions toward the sponsors' share of the works of improvement costs. In no case will the amount of an in-kind contribution exceed the sponsors' 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.

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 (100 years).

Although the sponsors' responsibility to the Federal Government for O&M ends when the O&M agreement expires upon completion of the evaluated life of measures covered by the agreement, the sponsors acknowledge that continued liabilities and responsibilities associated with works of improvement may exist beyond the evaluated life.

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

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

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

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

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

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

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

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

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

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

Certification:

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

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

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

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

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

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

(6) Taking one of the following actions, within 30 calendar days of receiving notice under paragraph (4) (b), with respect to any employee who is so convicted—
(a) Taking appropriate personnel action against such an employee, up to and including termination, consistent with the requirements of the Rehabilitation Act of 1973, as amended; or

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

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

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

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

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

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

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

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

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

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

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

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

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

(2) Have not within a 3-year period preceding this proposal been convicted of or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection

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

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

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

B. Where the primary sponsors 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 assure 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.

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

23. Signatures.

City of Alvarado

The signing of this plan was authorized by a resolution by the City of Alvarado governing body and adopted at an official meeting held on

_____, 2022 at Alvarado, Texas.

By:
_____ Date: _____

Jacob Wheat
Mayor

City of Ennis

The signing of this plan was authorized by a resolution by the City of Ennis governing body and adopted at an official meeting held on

_____, 2022 at Ennis, Texas.

By: Angeline Juenemann Date: _____

Angeline Juenemann
Mayor

Ellis-Prairie Soil and Water Conservation District

The signing of this plan was authorized by a resolution by the Ellis-Prairie Soil and Water Conservation District governing body and adopted at an official meeting held on

November 14th, 2022 at Waxahachie, Texas.

By: Scott J. Born Date: 11-14-22

Scott Born
Chairman

Dalworth Soil and Water Conservation District

The signing of this plan was authorized by a resolution by the Dalworth Soil and Water Conservation District governing body and adopted at an official meeting held on

_____, 2022 at Arlington, Texas.

By: _____ Date: _____

Tracey Lee Landess
Chairman

Hill County-Blackland Soil and Water Conservation District

The signing of this plan was authorized by a resolution by the Hill County-Blackland Soil and Water Conservation District governing body and adopted at an official meeting held on

_____, 2022 at Hillsboro, Texas.

By: _____ Date: 11-9-22

Todd Kimbrell, Jr.
Chairman

Navarro Soil and Water Conservation District

The signing of this plan was authorized by a resolution by the Navarro Soil and Water Conservation District governing body and adopted at an official meeting held on

_____, 2022 at Corsicana, Texas.

By: _____ Date: 11-23-22

Conrad M. Newton III
Chairman

Ellis County Commissioners Court

The signing of this plan was authorized by a resolution by the Ellis County Commissioners Court governing body and adopted at an official meeting held on

_____, 2022 at Waxahachie, Texas.

By: _____ Date: Nov. 29, 2022

Todd Little
County Judge

Hill County Commissioners Court

The signing of this plan was authorized by a resolution by the Hill County Commissioners Court governing body and adopted at an official meeting held on

_____, 2022 at Hillsboro, Texas.

By: _____ Date: _____

Justin Lewis
County Judge

Johnson County Commissioners Court

The signing of this plan was authorized by a resolution by the Johnson County Commissioners Court governing body and adopted at an official meeting held on

December 12, 2022 at Cleburne, Texas.

By: _____ Date: 12-12-22

Roger Harmon
County Judge

Navarro County Commissioners Court

The signing of this plan was authorized by a resolution by the Navarro Commissioners Court governing body and adopted at an official meeting held on

_____, 2022 at Corsicana, Texas.

By: _____ Date: 11-14-22

H. M. Davenport
County Judge

USDA-NATURAL RESOURCES CONSERVATION SERVICE

Approved by: Date: _____

_____
Kristy Oates, State Conservationist

Natural Resources Conservation Service
NRCS Texas State Office
101 South Main Street
Temple, TX 76501

23. Signatures.

City of Alvarado

The signing of this plan was authorized by a resolution by the City of Alvarado governing body and adopted at an official meeting held on

_____, 2022 at Alvarado, Texas.

By:
_____ Date: _____

Jacob Wheat
Mayor

City of Ennis

The signing of this plan was authorized by a resolution by the City of Ennis governing body and adopted at an official meeting held on

_____, 2022 at Ennis, Texas.

By:
_____ Date: _____

Angeline Juenemann
Mayor

Ellis-Prairie Soil and Water Conservation District

The signing of this plan was authorized by a resolution by the Ellis-Prairie Soil and Water Conservation District governing body and adopted at an official meeting held on

_____, 2022 at Waxahachie, Texas.

By:
_____ Date: _____

Scott Born
Chairman

Dalworth Soil and Water Conservation District

The signing of this plan was authorized by a resolution by the Dalworth Soil and Water Conservation District governing body and adopted at an official meeting held on

_____, 2022 at Arlington, Texas.

By:
_____ Date: _____

Tracey Lee Landess
Chairman

Hill County-Blackland Soil and Water Conservation District

The signing of this plan was authorized by a resolution by the Hill County-Blackland Soil and Water Conservation District governing body and adopted at an official meeting held on

_____, 2022 at Hillsboro, Texas.

By:
_____ Date: _____

Todd Kimbrell, Jr.
Chairman

Navarro Soil and Water Conservation District

The signing of this plan was authorized by a resolution by the Navarro Soil and Water Conservation District governing body and adopted at an official meeting held on

_____, 2022 at Corsicana, Texas.

By:
_____ Date: _____

Conrad M. Newton III
Chairman

Ellis County Commissioners Court

The signing of this plan was authorized by a resolution by the Ellis County Commissioners Court governing body and adopted at an official meeting held on

_____, 2022 at Waxahachie, Texas.

By:
_____ Date: _____

Todd Little
County Judge

Hill County Commissioners Court

The signing of this plan was authorized by a resolution by the Hill County Commissioners Court governing body and adopted at an official meeting held on

_____, 2022 at Hillsboro, Texas.

By:
_____ Date: _____

Justin Lewis
County Judge

Johnson County Commissioners Court

The signing of this plan was authorized by a resolution by the Johnson County Commissioners Court governing body and adopted at an official meeting held on

_____, 2022 at Cleburne, Texas.

By:
_____ Date: _____

Roger Harmon
County Judge

Navarro County Commissioners Court

The signing of this plan was authorized by a resolution by the Navarro Commissioners Court governing body and adopted at an official meeting held on

_____, 2022 at Corsicana, Texas.

By:
_____ Date: _____

H. M. Davenport
County Judge

USDA-NATURAL RESOURCES CONSERVATION SERVICE

Approved by: Date: _____

_____
Kristy Oates, State Conservationist

Natural Resources Conservation Service
NRCS Texas State Office
101 South Main Street
Temple, TX 76501

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Acronyms, Abbreviations, And Short-Forms

ACS	American Community Survey
APE	Area of Potential Affect
BMP	Best Management Practice
CAA	Clean Air Act
CWA	Clean Water Act
CZMA	Coastal Zone Management Act
EA	Environmental Assessment
EAP	Emergency Action Plan
EFH	Essential Fish Habitat
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
FEMA	Flood Emergency Management Act
FIRMS	Flood Insurance Rate Maps
FNI	Freese and Nichols, Inc.
FPPA	Farmland Protection Policy Act
FRS	Flood Retarding Structure
IPaC	Information for Planning and Consultation
MBTA	Migratory Bird Treaty Act
NAAQS	National Ambient Air Quality Standards
NED	National Economic Development
NEE	National Economic Efficiency
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NLCD	National Land Cover Database
NNSR	Nonattainment New Source Review
NOAA	National Atmospheric and Oceanographic Administration

NOMM	National Operation and Maintenance Manual
NPDES	National Pollutants Discharge Elimination System
NPS	National Park Service
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NWI	National Wildlife Inventory
O&M	Operations and Maintenance Cost
Plan-EA	Plan Environmental Assessment
PMP	Probable Maximum Precipitation
PSD	Prevention of Significant Deterioration
SHPO	State Historic Preservation Office
SLO	Sponsoring Local Organization
SWP3	Storm Water Pollution Prevention Plan
SWP	Supplemental Watershed Plan
TCEQ	Texas Commission on Environmental Quality
THPO	Texas Historic Preservation Office
TMDLs	Total Maximum Daily Loads
TPWD	Texas Parks and Wildlife Department
TSSWCB	Texas State Soil and Water Conservation Board
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USFWS	U.S. Fish and Wildlife Service
WOTUS	Waters of the United States

1.0 SUMMARY-OFFICE OF MANAGEMENT AND BUDGET (OMB) FACT SHEET

Supplemental Watershed Plan No. IX - Environmental Assessment
for
Chambers Creek Watershed
Ellis County, Texas
Texas 6th Congressional District

Authorization: The original watershed work plan was prepared, and works of improvement have been installed, under the authority of the Flood Control Act of 1944 (Public Law 78-534) as amended. The rehabilitation of floodwater retarding structures No. 4 & 6 is authorized under Public Law 83-566 (as amended), and as further amended by Section 313 of Public Law 106-472.

Sponsors:

- City of Alvarado
- City of Ennis
- Ellis-Prairie Soil and Water Conservation District #504
- Dalworth Soil and Water Conservation District #519
- Hill County-Blackland Soil and Water Conservation District #541
- Navarro Soil and Water Conservation District #514
- Ellis County Commissioners Court
- Hill County Commissioners Court
- Johnson County Commissioners Court
- Navarro Commissioners Court

Proposed Action

- Upgrade Chambers Creek FRS No. 4 & 6 to meet current safety and performance standards for a high-hazard dam.

Purpose and Need for Action

- There is need for continued flood protection in the Chambers Creek Watershed and to meet current safety standards. The original purpose of the Watershed Plan was watershed protection and flood prevention. The purpose for federal action is to meet current safety and performance standards and to maintain a level of flood prevention that minimizes change to conditions for downstream properties.

- Chambers Creek FRS No. 4 & 6 were designed as low-hazard dams and have since been reclassified as high-hazard dams. Therefore, the dams do not meet NRCS or Texas Commission on Environmental Quality (TCEQ) dam safety standards. The dams need to be rehabilitated and upgraded to meet current criteria for a high-hazard dam. Based on HEC-RAS breach models, there are 61 structures (40 residential and 21 barns/outbuildings) identified within the breach extents of FRS No. 4, and 19 structures (5 residential, 2 commercial, and 12 barns/outbuildings) identified within the breach extents of FRS No. 6. The Population at Risk (PAR) for FRS No. 4 is estimated to be 189 based on the number of impacted residential and commercial structures and the overtopping of FM 1387. The PAR for FRS No. 6 is estimated to be 93 based on the number of impacted residential and commercial structures and the overtopping of Mt Zion Rd, Shady Grove Rd, and Plainview Rd.

Description of the Preferred Alternative

Chambers Creek FRS No. 4: The preferred alternative is to rehabilitate the dam, providing sediment storage for 100 years after construction and maintaining the level of flood protection that minimizes changes to present conditions downstream. This includes raising the top of dam an average 2.4 feet and lengthening the dam by 160 feet in the right end abutment area, installing a 30-inch principal spillway pipe with an intake riser and impact basin, raising the crest of the auxiliary spillway 0.4 feet, and maintaining the auxiliary spillway width at 50 feet.

Chambers Creek FRS No. 6: The preferred alternative is to rehabilitate the dam, providing sediment storage for 100 years after construction and maintaining the level of flood protection that minimizes changes to present conditions downstream. This includes raising the top of dam an average 2.1 feet and lengthening the dam by 55 feet in the right end abutment area, installing a 30-inch principal spillway pipe with an intake riser and impact basin, raising the crest of the auxiliary spillway 0.24 feet, and widening the auxiliary spillway from 75 feet to 200 feet.

Site Coordination Needs

There is an ongoing Texas Department of Transportation (TxDOT) road widening project on FM 1387, immediately downstream of FRS No. 4. As part of any proposed rehabilitation to FRS No. 4, collaboration with TxDOT will be required. The following dates describe the schedule of the project as of January 2021:

- Mar 2022 – Schematic Approval
- Nov 2022 – Environmental Clearance
- May 2024 – ROW Acquired by
- Nov 2025 – Utilities Relocated
- Nov 2025 – Ready to Let Date
- Mar 2026 – Tentative Letting Date

Resource Information

- Ellis County has a humid subtropical climate, predominately cold and windy in winter and warm and muggy in summer. Average annual rainfall is approximately 36 inches. Normal temperatures range from an average daily high of 96 degrees Fahrenheit in July to an average daily low of 35 degrees in January. The normal freeze-free period of 324 days (Climate-Data, 2021).
- The Eight Digit Hydrologic Unit Number for Chambers Creek Watershed is 12030109.
- Chambers Creek FRS No. 4 is located at Latitude 32.4895° and Longitude -96.9682° (decimal degree)
- Chambers Creek FRS No. 6 is located at Latitude 32.4550° and Longitude -96.9562° (decimal degree)
- The project area for Chambers Creek FRS No. 4, comprised of the watershed and inundation extents from a breach, totals 732 acres.
- The project area for Chambers Creek FRS No. 6, comprised of the watershed and inundation extents from a breach, totals 1,239 acres.
- Land uses within the project area for Chambers Creek 4 are: 399 acres grassland, 147 acres forest, 54 acres pasture, 85 acres developed, 22 acres cropland, 16 acres shrubland, 9 acres other.
- Land uses within the project area for Chambers Creek 6 are: 674 acres grassland, 226 acres forest, 320 acres developed, 9 acres other.
- Land ownership within the project area for Chambers Creek 4 is: Private 62.8%, State-Local 37.2%.
- Land ownership within the project area for Chambers Creek 6 is: Private 80.1%, State-Local 19.9%.

- The population of the project area for Chambers Creek 4 and 6 is approximately 833 and 1,512, respectively. Demographic population estimates of the area reflect a minority (all races except non-Hispanic white) population of approximately 13%. The per capita income for the area is approximately $35,084.
- Relevant Resource Concerns identified during the scoping process.

    - Aesthetics
    - Air Quality
    - Environmental Justice
    - Fish & Wildlife Resources
    - Floodplain Management
    - Flood Damages
    - Land Values
    - National Economic Efficiency (NEE)
    - Public Health and Safety
    - Riparian Area
    - Sedimentation and Erosion
    - Water Bodies (Including Waters of the U.S.)
    - Water Quality
    - Wetlands
    - Wildlife Community (Including Migratory Birds)

Alternative Plans Considered for Chambers Creek 4: the following five alternatives were considered and evaluated in detail.

- **Alternative #1 – No Federal Action/Future Without Federal Investment:** The local sponsor, public, and project stakeholders opposed to a dam decommissioning and do not have funds to rehabilitate the dam without federal investment. Hence, alternative #1 is a true no-action alternative in which no rehabilitation measures take place. The dam would remain in its current configuration with regular maintenance continuing. The current level of flood protection would remain, though the overtopping risk associated with the dam not passing the state and federal requirements would also remain. Repairs would need to be made to maintain the existing spillways and upstream and downstream slopes on an as-needed basis, such as if significant erosion occurred. The dam would not be in compliance with the NRCS or TCEQ criteria for a high hazard dam, and the embankment would remain in place with elevated risk.

- **Alternative #2 – Decommission FRS No. 4:** Alternative #2 utilizes federal to funds to remove the ability of the dam to impound water and reconnects, restores, and stabilizes the stream and floodplain functions. Channel work would be performed to reconnect the stream channel through the sediment pool and vegetation would be established along the stream channel. A grade stabilization structure would be installed to prevent head cutting and sediment movement to the downstream areas. Exposed areas within the sediment pool would be vegetated for erosion and sediment control. Partial removal of the embankment would consist of excavating a breach in the dam of sufficient size to safely pass the 100-year, 24-hour frequency flood event, thus eliminating the structure's ability to store water. In order not to impede flows through the breached embankment and to remove potential safety hazards, the principal spillway components would also be removed. The 100-year inundation area downstream would increase from 114 acres to 139 acres. Regulatory base flood elevations (BFEs) exit for the downstream area. Impacted residences in the 100-year floodplain would increase from 23 to 36, with the total number of impacted structures increased from 55 to 80. The number of impacted roads would increase from 14 to 15.

- **Alternative #3 – Rehabilitate FRS No. 4:** Alternative #3 consists of raising the top of the dam by 2.4 feet. Raise auxiliary spillway crest by 0.4 feet and maintain 50-foot width. Replace the existing principal spillway with a new 30-inch diameter pipe with intake riser and impact basin. Flatten downstream embankment to 3:1. Install 2,500 square yards of articulated concrete blocks (ACB) erosion protection along toe and interior training dike of auxiliary spillway. The 100-year inundation area downstream would be reduced, but only by an insubstantial amount. Regulatory BFEs exist for the downstream area. All disturbed areas will be re-vegetated using adapted and/or native species.

- **Alternative #4 – Rehabilitate FRS No. 4:** Alternative #4 consists of replacing the existing principal spillway with a standard intake riser with a 30-inch diameter pipe and an impact basin at the outlet end. The embankment will extend through the existing earthen auxiliary spillway preventing any discharge through the earthen spillway; thus, a structural spillway will be constructed. The structural spillway will be constructed with roller compacted concrete (RCC) over the embankment along the existing principal spillway alignment with a stilling basin on the downstream end. The RCC spillway will be 170 feet-wide with the crest 0.4 ft above the existing earthen spillway to allow for full passage of the design storm. The top of dam will be kept at the existing elevation while the downstream slope will be flattened from 2:1 to 3:1 using fill material from the surrounding area. The 100-year inundation area downstream would be reduced, but only by an insubstantial amount. Regulatory BFEs exist for the downstream area. All disturbed areas will be re-vegetated using adapted and/or native species.

- **Alternative #5 – Rehabilitate FRS No. 4:** Alternative #5 consists of raising the top of the dam by 2.1 feet. Maintain current auxiliary spillway crest and width. Replace existing principal spillway with a new 36-inch diameter pipe with intake riser and stilling basin. Flatten downstream embankment slope from 2:1to 3:1. Install 2,500 square yards of articulated concrete blocks (ACB) erosion protection along toe and interior training dike of auxiliary spillway. The 100-year inundation area downstream would be increased from 113.8 acres to 114.0 acres (an increase of 0.2%) without increasing the number of structures impacted. Regulatory BFEs exist for the downstream area. All disturbed areas will be re-vegetated using adapted and/or native species.

Alternative Plans Considered for Chambers Creek 6: the following five alternatives were considered and evaluated in detail.

- **Alternative #1 – No Federal Action/Future Without Federal Investment:** The local sponsor, public, and project stakeholders opposed to a dam decommissioning and do not have funds to rehabilitate the dam without federal investment. Hence, alternative #1 is a true no-action alternative in which no rehabilitation measures take place. The dam would remain in its current configuration with regular maintenance continuing. The current level of flood protection would remain, though the overtopping risk associated with the dam not passing the state and federal requirements would also remain. Repairs would need to be made to maintain the existing spillways and upstream and downstream slopes on an as-needed basis, such as if significant erosion occurred. The dam would not be in compliance with the NRCS or TCEQ criteria for a high hazard dam, and the embankment would remain in place with elevated risk

- **Alternative #2 – Decommission FRS No. 6**: Alternative #2 utilizes federal to funds to remove the ability of the dam to impound water and reconnects, restores, and stabilizes the stream and floodplain functions. Channel work would be performed to reconnect the stream channel through the sediment pool and vegetation would be established along the stream channel. A grade stabilization structure would be installed to prevent head cutting and sediment movement to the downstream areas. Exposed areas within the sediment pool would be vegetated for erosion and sediment control. Partial removal of the embankment would consist of excavating a breach in the dam of sufficient size to safely pass the 100-year, 24-hour frequency flood event, thus eliminating the structure's ability to store water. In order

not to impede flows through the breached embankment and to remove potential safety hazards, the principal spillway components would also be removed. Exposed areas within the sediment pool would be vegetated for erosion and sediment control. The 100-year inundation area downstream would increase from 105.5 acres to 128.2 acres. Regulatory base flood elevations (BFEs) exist for the downstream area located after the confluence with Waxahachie Creek. Impacted residences in the 100-year floodplain would increase from 105.5 to 128.8 (an increase of 1.3%), with the total number of impacted structures increased from 3 to 4. The number of impacted roads would increase from 4 to 5.

- **Alternative #3 – Rehabilitate FRS No. 6**: Alternative #3 consists of raising the top of the dam by 2.1 feet. The auxiliary spillway crest will be raised by 0.25 feet while the control section will be widened 125 feet from 75 feet to 200 feet. Replace the existing principal spillway with a new 30-inch diameter pipe with intake riser and impact basin. Flatten downstream embankment to 3:1. The dam will be lengthened by approximately 55 feet. The 100-year inundation area downstream would be increased from 105.5 acres to 106.0 acres (an increase of 0.5%), without increasing the amount of road or structures impacted compared to existing conditions. Regulatory BFEs exist only for the downstream area after the confluence with Waxahachie Creek. All disturbed areas will be re-vegetated using adapted and/or native species.

- **Alternative #4 – Rehabilitate FRS No. 6:** Alternative #4 consists of replacing the existing principal spillway with a standard intake riser with a 36-inch diameter pipe and an impact basin at the outlet end. The auxiliary spillway crest will be lowered 0.45 feet maintaining the existing width of 75 ft and the earthen channel will be armored with Articulated Concrete Blocks (ACB) to prevent erosion and head cutting that is produced due to the hydraulic head on the spillway. The top of the dam will be raised an average of 4.4 feet and the downstream slope flattened from 2:1 to 3:1. The dam will be lengthened by approximately 60 feet. The 100-year inundation area downstream would be increased from 105.5 acres to 106.9 acres (an increase of 1.3%), without increasing the amount of road or structures impacted compared to existing conditions. All disturbed areas will be re-vegetated using adapted and/or native species.

- **Alternative #5 – Rehabilitate FRS No. 6**: Alternative #5 consists of raising the top of the dam by 1.5 feet. Lower the current auxiliary spillway crest 0.45 feet and widen it 125 feet from 75 feet to 200 feet. Replace existing principal spillway with a new 36-inch diameter pipe with intake riser and stilling basin. Flatten downstream embankment slope from 2:1to 3:1. The 100-year inundation area downstream would be increased from 105.5 acres to 106.9 acres (an increase of 1.3%) without increasing the amount of road or structures impacted compared to existing conditions. Regulatory BFEs exist only for the downstream area after the confluence with Waxahachie Creek. All disturbed areas will be re-vegetated using adapted and/or native species.

Mitigation Measures: Appropriate measures will be implemented to avoid and minimize any potential adverse impacts associated with construction. No compensatory mitigation will be required as a result of implementing any of the alternatives for Chambers Creek 4&6.

Preferred Alternative

Chambers Creek 4: Alternative #3 was selected as the preferred alternative to maximize net benefits with a benefit/cost ratio of 1.31. This alternative was selected based on discussions with stakeholders and in consideration with public input.

Table S-1: Project Costs Chambers Creek FRS No. 4

Installation Cost	Estimated Costs		
	PL 83-566	Sponsors	Total
Construction	$1,709,600	$920,600	$2,630,200
Engineering	$263,100	$0	$263,100
Land Acquisition / Easements	$0	$12,900	$12,900
Project Administration	$315,700	$0	$315,700
Total Costs	**$2,288,400**	**$933,500**	**$3,221,900**
Annual O&M (non-Fed)	$0	$8,900	$8,900

Chambers Creek 6: Alternative #3 was selected as the preferred alternative to maximize net benefits with a benefit/cost ratio of 0.62. This alternative was selected based on discussions with stakeholders and in consideration with public input.

Table S-2: Project Costs Chambers Creek FRS No. 6

Installation Cost	Estimated Costs		
	PL 83-566	Sponsors	Total
Construction	$1,911,000	$1,029,000	$2,940,000
Engineering	$294,000	$0	$294,000
Land Acquisition / Easements	$0	$22,000	$22,000
Project Administration	$352,800	$0	$352,800
Total Costs	**$2,557,800**	**$1,051,000**	**$3,608,800**
Annual O&M (non-Fed)	$0	$8,900	$8,900

Project Benefits

Chambers Creek 4

Project benefits are derived from assuring the continued performance of FRS No. 4 by meeting current safety and performance standards. Benefits are based on continued flood damage reductions to the downstream area. The total average annual benefits for the proposed action is $126,600 including:

- Flood Damage Reduction
  - Structures $100,700
  - Cropland and Pastureland $32
  - Erosion and Sedimentation $610
  - Roads and Bridges $25,300
- Number of Direct beneficiaries: Onsite – 189 (Population at Risk), Offsite – N/A
- Description of Other beneficial Physical Effects:
  - Reduces the threat to loss of life to approximately 189 people.
  - Protects 63 structures within the project area.
  - Reduces the threat of loss of access to residents, employees, and emergency services to 40 residences and 23 outbuilding structures.
  - If the dam is removed at least 1 residence would be included in the enlarged floodplain.
  - Maintains and ensures the downstream flood protection of crop and pastureland.
  - Eliminates the liability of operating a dam which does not meet state and federal requirements.
  - Maintains existing stream habitat downstream of the dam.
  - Retains existing aquatic and terrestrial habitat in and around the reservoir.
  - Brings the dam into compliance with NRCS dam safety and performance standards.
- Benefit to Cost Ratio: 1.31

- Net Beneficial Effects: $126,600

Chambers Creek 6

Project benefits are derived from assuring the continued performance of FRS No. 6 by meeting current safety and performance standards. Benefits are based on continued flood damage reductions to the downstream area. The total average annual benefits for the proposed action is $66,500 including:

- Flood Damage Reduction
    - Structures $27,300
    - Cropland and Pastureland $75
    - Erosion and Sedimentation $1,000
    - Roads and Bridges $38,100
- Number of Direct beneficiaries: Onsite – 93 (Population at Risk), Offsite – N/A
- Description of Other beneficial Physical Effects:
    - Reduces the threat to loss of life to approximately 93 people.
    - Protects 23 structures within the project area.
    - Reduces the threat of loss of access to residents, employees, and emergency services to 7 residences, 2 commercial structures, and 14 outbuilding structures.
    - Maintains and ensures the downstream flood protection of crop and pastureland.
    - Eliminates the liability of operating a dam which does not meet state and federal requirements.
    - Maintains existing stream habitat downstream of the dam.
    - Retains existing aquatic and terrestrial habitat in and around the reservoir.
    - Leverages federal resources to complete the planned works of improvement.
    - Brings the dam into compliance with NRCS dam safety and performance standards.
- Benefit to Cost Ratio: 0.62
- Net Beneficial Effects: $66,500

Funding Schedule

Chambers Creek FRS No. 4:

- Funding Schedule (budget year + 1):
    - Federal Funds (budget year): $263,100
    - Federal Funds (year after budget year): $2,025,300
    - Non-Federal Funds (budget year): $933,500
    - Non-Federal Funds (year after budget year): $8,900 annually
- Period of Analysis – 100 years
- Project Life – 100 years

Chambers Creek FRS No. 6:

- Funding Schedule (budget year + 1):
    - Federal Funds (budget year): $294,000
    - Federal Funds (year after budget year): $2,263,800
    - Non-Federal Funds (budget year): $1,051,000
    - Non-Federal Funds (year after budget year): $8,900 annually
- Period of Analysis – 100 years
- Project Life – 100 years

Table S-3: Environmental Effects/Impacts

Resource	Impact
Air Quality	Temporary increase in particulate matter on site during construction.
Land Use Changes	Land use will not change, however local sponsors will prevent future development below the new crest of the earthen spillway.
Floodplains	Current regulatory floodplain will be maintained.
Forest Resources	None.
Wetlands	There were no wetlands observed upstream or downstream of the project area, and no impacts to wetlands will occur.
Water Quality	Turbidity in the reservoir and sediment loading downstream will increase temporarily during construction. Construction of the dam spillway will require a cofferdam which will decrease streamflow downstream. During low flow periods, sedimentation and erosion downstream are expected to decrease. After construction is complete, stream flow will be restored to preconstruction conditions, and sedimentation and erosion of the streambed downstream will co
Wildlife Habitat	Wildlife habitat would be temporarily impacted during construction. The amount of vegetation clearing will be minimized to the greatest extent possible. Disturbed areas will be revegetated with native species after construction is completed. Revegetation and invasive species management will be consistent with TPWD guidance (Appendix D).
Prime Farmland	Approximately 0.5 acres of Farmland of Statewide Importance are located within the maximum extent of potential disturbance that could potentially be impacted by construction activities.
Cultural Resources	No historic properties present or affected by the project per SHPO concurrence. Tribal consultation is ongoing through NRCS.
Threatened and Endangered Species	Consultation with USFWS and TPWD was performed to identify all federal- and state-listed species with the potential to occur within the project area. BMPs will be incorporated to reduce or eliminate negative impacts or comply with applicable laws (See Table H in Section 7.2). The Project has a “No Effect” determination for relevant federally listed species within Ellis County. Coordination documents from USFWS and TPWD are included in Appendix D.
Mitigation	None.

Major Conclusions

Chambers Creek FRS No. 4:

The most cost-effective and efficient alternative to bring this dam into compliance with NRCS safety and performance standards and State safety criteria is to rehabilitate the dam by replacing the existing principal spillway with a standard intake riser and a 30-inch diameter pipe; raising the existing vegetated earth auxiliary spillway by 0.4 feet and maintaining its current width; raising the top of the dam by 2.4 feet; flattening the downstream slope from 2:1 to 3:1; and extending the dam at the right abutment by 160 ft.

The current degree of downstream flood protection will not change for events equal to or greater than the 100-year storm event. No permanent change in the lake will occur after rehabilitation is complete. There may be environmental impacts limited to the duration of construction.

Chambers Creek FRS No. 6:

The most cost-effective and efficient alternative to bring this dam into compliance with NRCS safety and performance standards and State safety criteria is to rehabilitate the dam by replacing the existing principal spillway with a standard intake riser and a 30-inch diameter pipe; raising the existing vegetated earth auxiliary spillway by 0.25 feet and widening its current width from 75 feet to 200 feet; raising the top of the dam by 2.1 feet; flattening the downstream slope from 2:1 to 3:1; and extending the dam by approximately 55 feet.

The current degree of downstream flood protection will not change for events equal to or greater than the 100-year storm event. No permanent change in the lake will occur after rehabilitation is complete. There may be environmental impacts limited to the duration of construction.

Areas of Controversy: There are no known areas of controversy for Chambers Creek FRS No. 4&6.

Issues to be Resolved

- A new Operation and Maintenance (O&M) Agreement will be developed with Ellis County and Ellis-Prairie Soil and Water Conservation District (SWCD) for the 100-year program life of the structures. The new O&M Agreement must be signed before the Project Agreement is signed.
- For projects with disturbances equal to or greater than five acres it is necessary to have a Storm Water Pollution Prevention Plan (SWP3) in place at least 48 hours prior to and during construction of the proposed project and filing Notice of Intent with the Texas Commission on Environmental Quality is required. A Notice of Termination (NOT) must be filed once the site has reached final stabilization.
- The Sponsor will be responsible for developing an Emergency Action Plan (EAP) prior to construction and will review and update the EAP annually with local emergency response officials.

Evidence of Unusual Congressional or Local Interest: No

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

2.0 CHANGES REQUIRING PREPARATION OF A SUPPLEMENT

This supplement addresses the rehabilitation of both Chambers Creek Watershed FRS No. 4 and No. 6. The dams were originally designed as a Class A, or low hazard, structures to provide flood control and are currently classified as high hazard dams due to the potential loss of life downstream in the event of a dam failure. The potential risk of loss of life due to a dam breach supports action to rehabilitate the dam to meet current NRCS and TCEQ performance and safety standards.

When the Chambers Creek Watershed was planned more than 60 years ago, the original intent of the flood retarding structures was to protect downstream agricultural areas of the watershed and prevent the adverse economic and physical effect of flooding throughout the entire watershed. The economy in the Chambers Creek Watershed was primarily agricultural when the original planning was completed. In the last 20 years, the population growth of Ellis County, which contains Chambers Creek FRS No. 4, has grown from 21,426 in 2000 to an estimated 184,826 in 2019 (Bureau of Census), an increase of 763 percent. Section 5.7 contains additional demographic information of the project area.

This Supplemental Plan-EA documents the planning process by which NRCS provided technical assistance to the Sponsors and the public in addressing resource issues and concerns within the Chambers Creek Watershed and complied with the requirements of the NEPA.

In accordance with NRCS NEPA policy, an Environmental Evaluation Worksheet (NRCS-CPA-52) was completed for the Chambers Creek Watershed FRS No. 4 and the Chambers Creek Watershed FRS No. 6 rehabilitation projects to determine the requisite level of NEPA documentation to support the proposed action. Based upon the results of this analysis, an EA was required.

CHAMBERS CREEK FRS NO. 4 SUPPLEMENTAL WATERSHED PLAN AND ENVIRONMENTAL ASSESSMENT

3.0 PURPOSE AND NEED FOR ACTION

This supplemental Watershed Plan was prepared, and an Environmental Assessment was performed, to evaluate alternatives to bring Chambers Creek FRS No. 4 into compliance with current performance and safety standards. Chambers Creek FRS No. 4 was originally installed under the authority of the Flood Control Act of 1944 (Public Law 78-534) as amended. The rehabilitation of floodwater retarding structures No. 4 is authorized under Public Law 83-566 (as amended), and as further amended by Section 313 of Public Law 106-472. The authorized purposes of the rehabilitation of Chambers Creek FRS No. 4 per the 390-NWPM, part 500, Subpart A, Section 500.4B are: 1) Flood Prevention (Flood Damage Reduction), and 2) Watershed Protection (sediment capture).

Chambers Creek Watershed FRS No. 4 was originally designed as a Class A, or low hazard structure, to provide flood control. However, the structure has been reclassified as a high hazard dam. The dam does not meet the TCEQ criteria for a high hazard dam, specifically, the dam embankment is overtopped during the minimum required design flood. In addition, the dam does not pass the NRCS criteria for the 6-hour FBH. The purposes of this supplement are to comply with current NRCS and TCEQ dam design and safety standards and reduce risk to life and property that could result from a potential dam failure. Maintaining flood protection from the dam is a primary objective. The dam is located immediately upstream from a residential subdivision, to which it provides flood protection by restricting the discharge during storm events. Criteria for the TCEQ are established by the Guidelines for Operations and Maintenance of Dams in Texas and the dam safety rules in Chapter 299 of the Texas Administrative Code.

There is a need to comply with current state and federal safety and performance standards, to provide the required level of flood protection for a high hazard dam and reduce the potential of a catastrophic failure of the dam and subsequent loss of life. The FRS captures the runoff from 560 acres, or 1.5% of the total watershed (32,504 acres). The 2010 Dam Assessment Report performed by URS Corporation indicates that 52 residences, in addition to portions of FM 1387, are at risk from a catastrophic breach. A new breach model was developed by FNI using HEC-RAS 2D as part of the development of this supplemental watershed plan. According to the results of the dam breach modeling and inundation mapping, dam failure could result in impact to 40 residential structures, segments of FM 1387, Lon Hayes Road, Lynnie Pennie Street, Clinton Lane, and multiple rural roads.

Currently, Chambers Creek FRS No. 4 is functioning as originally planned and providing downstream flood damage prevention. However, there is a possibility of the dam failing from overtopping if a storm produces runoff that is greater than the structure's current capacity. The following is a list of opportunities that will be realized through the implementation of this watershed rehabilitation plan:

- Comply with current dam safety criteria.
- Protect human health and safety.
- Protect infrastructure and transportation systems.
- Maintain flood control benefits with minimal change to present conditions and prevent increased flood damages in the floodplain.
- Maintain or improve water quality.
- Protect fish and wildlife habitats.

3.1 Watershed Problems

The Sponsors were aware of the problems with Chambers Creek FRS No. 4 no later than 2010 when URS Corporation produced their Dam Assessment Report, confirming the inadequacies of the dam. NRCS criteria states that the dam, in its current conditions, must be capable of passing the 100-year storm without

engaging the auxiliary spillway. The 2010 assessment report evaluated that the principal spillway of the dam does not have sufficient capacity to convey the 100-year flood without engaging the auxiliary spillway. In addition, the report indicated that the auxiliary spillway capacity would be exceeded in the Probable Maximum Precipitation (PMP) event. This would result in overtopping of the dam embankment, which could cause an uncontrolled breach of the embankment or of the auxiliary spillway. Due to the release of NOAA Atlas 14 for Texas, the results of the assessments report were revised in this Plan since the precipitation depths that are used to compute the design hydrograph decreased.

Sponsor Concerns: The 2010 dam assessment report served to notify the Sponsors that the dam no longer meets State requirements and must be modified to meet State law. NRCS deemed it was necessary to prepare a watershed plan (current study) that would identify the improvements necessary to comply with State and federal regulations. The study is funded with federal funds under agreement between TSSWCB and NRCS. Per TCEQ, the dam is required to safely route 75% of the Probable Maximum Flood (PMF). At existing conditions, the dam is overtopped and therefore, does not meet the requirement to safely route 75% of the PMF. Per NRCS, the dam is required to safely route 100% of the Free Board Hydrograph (FBH).

Auxiliary Spillway Issues: The vegetated earth auxiliary spillway does not meet NRCS criteria for hydraulic capacity. In its present configuration, the auxiliary spillway engages during the principal spillway hydrograph (PSH) event with a depth of 1 foot above the crest. Therefore, the auxiliary spillway does not meet current NRCS criteria and engages more frequently than requirements dictate.

Floodplain Management: The Sponsors have identified the neighborhood immediately downstream, Country East Estates, as the primary concern regarding flood risk. The Sponsors understand that the dam in its current configuration provides flood protection benefits to the neighborhood for frequent storm events, and that it also poses a hazard in failing to meet current dam safety criteria.

Erosion and Sedimentation: Upon the completion of the most recent bathymetric surveys in 2020, Chambers Creek FRS No. 4 has reached 62 years of its planned 50-year design life. According to the as-built plans, the dam was originally constructed with 62 acre-feet of sediment storage. The latest bathymetric surveys performed in 2020 indicate that the reservoir has 40 acre-feet of remaining sediment storage, with an estimated 22 acre-feet of submerged sediment present within the reservoir pool. The sedimentation rate appears to be much lower than originally anticipated. Based on the estimated sedimentation rate from observed data of 0.35 acre-feet per year, there is over a100 years of remaining life before the submerged sediment storage is filled. **Local Concerns:** The Chambers Creek Watershed dams were planned and constructed in the 1950s and 1960s to enhance agricultural land use by mitigating flood damages as well as reducing sediment damages. The possibility of decommissioning Chambers Creek FRS No. 4 was mentioned at the first public meeting in June 2020 since decommissioning must be considered under NRCS rehabilitation policy. However, during multiple meetings with the stakeholders, the sponsors indicated that they were opposed to decommissioning because of their concern that flooding would increase in the absence of the dam. The ability of the dam to attenuate floods is uniquely important as many residential structures are present immediately downstream. The 100-year inundation area, shown as Zone AE on Federal Emergency Management Agency (FEMA) flood maps, would be increased from 114 to 139 acres. Furthermore, the Soil and Water Conservation District mentioned that it would be preferred to maintain the existing dam aesthetics while considering the selected alternative. For the past 62 years, the dam has performed as designed and constructed.

3.2 Watershed Opportunities

The following is a general list of opportunities that will be realized through the implementation of this watershed rehabilitation plan that are developed in accordance with Step 2 of the 9-step planning process

per NPPH. Some quantification of these opportunities will be provided in other sections of the report, as appropriate.

- Bring the dam into compliance with NRCS and TCEQ dam safety and performance standards.
- Mitigate the potential for loss of life and damage to property associated with a dam failure.
- Reduce the Sponsor liability associated with continuing to operate a dam that does not meet State and Federal requirements.
- Sustain the existing flood protection for the 100-year storm event for the downstream residences, structures, and roadways.
- Prohibit future construction of inhabitable dwelling upstream of the dam below the top of dam.

4.0 SCOPE OF THE ENVIRONMENTAL ASSESSMENT

A scoping process was used to identify the issues significant to the process of defining the problems and formulating and evaluating the alternatives. Scoping included public meetings, a request for input from NRCS and State and local agencies. Watershed concerns of the involved parties were expressed during these meetings. Factors which could affect soil, water, air, plant, animals, and human resources were identified during this process.

Several meetings were held with the stakeholders of the project. The first stakeholders meeting was held on May 20, 2020. This meeting served as a project kickoff meeting in which the project scope, personnel, and schedule were reviewed and discussed.

On June 23, 2020, the first public meeting was held at the Midlothian Conference Center in Midlothian, Ellis County. The public was informed about the development of a Supplemental Watershed Plan (SWP) for Chambers Creek FRS No. 4. The methodology and scope of the SWP and EA was explained along with the timeline.

On August 18, 2020, December 15, 2020, and January 21, 2021, additional meetings were held with the stakeholders to discuss possible alternatives for the project to bring the dam in compliance with NRCS and TCEQ standards and requirements. Several comments were solicited and received for consideration in the planning procedure. The meetings helped to narrow the list of potential rehabilitation alternatives based on public input, particularly affected landowners. Table A provides a summary of the items addressed for rehabilitation.

Table A: Summary of Resource Concerns for Rehabilitation of Chambers Creek Watershed FRS No. 4

Item/Concern	Relevant to the Proposed Action		Rationale
	Yes	**No**	
SOILS			
Upland Erosion	X		Temporary impacts for upland erosion possible with dam breach or during construction activities with clearing and vegetation removal.
Stream Bank Erosion	X		Temporary impacts from erosion of the stream bed is possible with a dam breach or during construction activities.
Sedimentation	X		Sedimentation of the impoundment and creek downstream will be reduced through appropriate BMPs and approved SWPPP.
Prime and Unique Farmland	X		There are 0.5 acres of farmland of statewide importance/Prime Farmlands within the maximum extent of possible ground

			disturbance of Chambers Creek FRS No. 4.
WATER			
Surface Water Quality		X	Waxahachie Creek and it's unnamed tributaries are not listed as impaired streams.
Groundwater Quality		X	Project would not affect the Trinity or Edwards-Trinity aquifers.
Floodplain Management	X		The proposed action could potentially affect floodplain management within the subwatershed. Ellis County participates in the National Flood Insurance Program. The project area is located within Zone A. The goal of the project is to maintain current flood protections and prevent impacts to downstream roads and crossings. The 100-year inundation area downstream would be reduced by an insubstantial amount. The 500-year inundation area downstream would be reduced from 134 acres to 132.3 acres (a decrease of approximately 0.2 percent). A CLOMR or LOMR may potentially be required. Coordination with the floodplain administrator (Ellis County) would be required prior to construction to acquire floodplain-related authorizations and determine if the applicability of a CLOMR or LOMR.
Waters of the U.S./Wetlands (Clean Water Act- 401 and 404)	X		There are no wetlands upstream or downstream of the dam that would be impacted by construction activities. Minimize impacts to water quality within the stream during construction with BMPs.
Water Quality (Clean Water Act – 303(d)/305(b))	X		Minimize sediment transport. Maintain oxygen levels. Prevent downstream impediments to water quality.
Coastal Zone Management Act		X	The project is not located within a coastal zone management area (CZMA).

National Wild and Scenic Rivers Act		X	None present in the project area.
AIR			
Air Quality	X		Potential temporary increase in particulate matter and other emissions with alternatives
Clean Air Act (Criteria Pollutants)	X		Although there would be increased air emissions during construction, Ellis County is in attainment for all Criteria Pollutants except Ozone.
Clean Air Act (Regional Visibility Degradation)		X	The project site is not within a Class I Area.
ANIMALS			
Coral Reefs		X	None present in project area
Threatened and Endangered Species		X	Consultation with USFWS indicated potential occurrences of 5 threatened and endangered species within Ellis County (Section 5.6, Table C). However, upon further coordination, the Project has a "No Effect" determination for federally listed species. The Consistency Letter from USFWS is included in Appendix D. Guidance to avoid impacts to state and tribe- listed species can be found in the Concurrence Letter from TPWD (Appendix D).
Fish and Wildlife Resources	X		Potential for fish and wildlife habitat improvement with alternatives.
Essential Fish Habitat		X	There are no designated EFH areas within the project area.
Ecologically Critical Areas		X	There are no ecologically critical areas within the vicinity of the project area.
Invasive Wildlife Species		X	There were no invasive wildlife species identified in the project area. Invasive species management would be consistent with TPWD recommendations (Appendix D).
Migratory Birds/Bald Eagles/Golden Eagles		X	While habitat is present, no Bald or Golden Eagle nests were found during the project site visit. Additionally, no recorded nests

			are documented within the project area.
PLANTS			
Threatened and Endangered Species		X	There are no federally listed plant species with the potential to occur within Ellis County. The Consistency Letters from USFWS and TPWD are included in Appendix D.
Invasive Plant Species	X		There are invasive species with the potential to occur within the project area or may be transported into the project area by construction activities. See Section 5.6 for summary of invasive species transportation prevention plan.
Ecologically Critical Areas		X	There are no ecologically critical areas in the vicinity of the project area.
Forest Resources	X		Impacts to forest resources will be minimized. Some clearing of trees may occur as a result of construction activities.
Riparian Areas	X		There are riparian areas that may be impacted by construction within the project area.
HUMANS			
Environmental Justice and Civil Rights		X	No disparate treatment is anticipated, however alternatives to be assessed for effects.
Historic Properties		X	No known historic resources in the vicinity and no effect to historic properties expected. Coordination with the THC was completed on 9/20/2021. THC Concurrence letter is included in Appendix D.
Land Use		X	Land use will not change; however local sponsors will prevent future development below the new crest of the earthen spillway.
Local and Regional Economy	X		Temporary benefit during construction.
Natural Areas		X	No impact to natural areas.
National Parks, Monuments, and Historical Sites		X	No impact to national parks, monuments, or historical sites.
Portable Water Supply/Regional Water Management Plans		X	The site is not used for water supply.

Public Health and Safety	X		Rehabilitation is needed because the dam does not meet current safety standards.
Recreation		X	No public recreation.
Scenic Beauty and Parklands		X	No impact to scenic beauty or parklands.
Scientific Resources		X	No research sites identified.
Social/Cultural Issues	X		Concerns about flooding if the dam were decommissioned.

5.0 AFFECTED ENVIRONMENT

5.1 PLANNING ACTIVITIES

Geologic and engineering investigation and analyses were conducted by Freese and Nichols, Inc. (FNI) with oversight from NRCS-Texas staff. This work included evaluating the condition of the existing dam and performing hydrologic and hydraulic analyses. Both the existing conditions and proposed rehabilitation alternatives were evaluated with these tools.

Other planning activities included performing topographic surveys, reviewing reservoir sediment surveys, and inventorying watershed resources (environmental, economic, and cultural resources). Potential alternatives were evaluated for cost-effectiveness and for local responsibility. Both the benefits and the costs of the alternatives were calculated and analyzed.

The purpose of the Affected Environment section is to provide a description of existing physical, biological, economic, and cultural resources likely to be affected by Alternatives #1 through #5 in a manner that allows the alternatives' effects to be better understood. The following summarizes the existing environmental conditions.

5.2 EXISTING CONDITIONS

Original Project

The original watershed work plan was prepared, and works of improvement have been installed, under the authority of the Flood Control Act of 1944 (Public Law 78-534) as amended. The rehabilitation of floodwater retarding structure No. 4 is authorized under Public Law 83-566 (as amended), and as further amended by Section 313 of Public Law 106-472.

The sponsors of the project are the City of Alvarado,22s22 the City of Ennis, Ellis-Prairie Soil and Water Conservation District #504, Dalworth Soil and Water Conservation District #519, Hill County-Blackland Soil and Water Conservation District #541, Navarro Soil and Water Conservation District #514, Ellis County Commissioners Court, Hill County Commissioners Court, Johnson County Commissioners Court, and the Navarro Commissioners Court.

Description of Existing Dam

Chambers Creek FRS No. 4 was originally designed and constructed in 1958 as a low-hazard (class A) dam. A low-hazard classification is given to dams which do not pose a threat to loss of life. Chambers Creek FRS No. 4 was constructed as a zoned earth fill embankment with one vegetated auxiliary spillway located at the left abutment and a principal spillway consisting of an inlet tower with a 17-inch concrete outlet pipe that discharges into an unlined plunge basin. A site visit was performed in June 2020. The embankment was found to be in good condition with good vegetative cover.

The effective top of dam elevation is 734.6 feet per the as-built plans. The upstream slope of the embankment was constructed to a 3 horizontal:1 vertical slope (3H:1V), and the downstream slope was constructed to a 2H:1V slope. There is a 10-foot-wide wave berm on the upstream slope located at elevation 718.2 feet. The auxiliary spillway has a 50-foot-wide bottom width, and the crest elevation is 729.6 feet. The principal spillway inlet structure is a 2.5-foot by 2.5-foot (interior dimensions) by 12.1-foot-tall tower with a crest elevation of 719.2 feet. Metal grating covers the top of the inlet tower. There is an 8-inch sluice

gate located at the bottom of the tower with an invert elevation of 709.7 feet to facilitate lowering the permanent water level for repairs and maintenance. The principal spillway outlet pipe consists of 192 feet of 17-inch diameter reinforced concrete pipe connected to the downstream side of the inlet tower. The original design included a steel baffle plate inside the inlet tower at the entrance of the pipe.

Several bathymetric surveys were performed from June to August 2020. The Chambers Creek FRS No. 4 reservoir was filled with thick aquatic vegetation which caused significant uncertainty in the initial acoustic survey. A ground truth survey was performed in order to measure the lake bottom elevation more accurately. The final results of the survey indicate a volume at normal pool (719.2 feet) of 40.4 acre-feet, approximately a 35% decrease compared to the as-built plans which indicate a normal pool volume of 62 acre-feet.

Table B: Chambers Creek 4 Existing Structural Data

Item	Unit	FRS No. 4
Surface Area (Principal Spillway Crest)	Acres	14.0
Elevation, Top of Dam (effective)	Feet	734.6
Length of Dam	Feet	1,200
Principal Spillway	Type	Drop Inlet
Elevation, Principal Spillway Crest	Feet	719.2
Pipe Diameter, Principal Spillway	inches	17
Principal Spillway Discharge at AS Crest	cfs	26
Auxiliary Spillway	Type	Earth Channel
Elevation, Auxiliary Spillway	Feet	729.6
Bottom Width, Auxiliary Spillway	Feet	50
Surface Area (Auxiliary Spillway Crest)	Acres	39.0
Sediment Reserve Below Riser	Acre-feet	40.4
Flood Storage	Acre-feet	233.6
Total Storage at Auxiliary Spillway Crest	Acre-feet	273.9

5.3 PHYSICAL FEATURES AND LOCATION

Project Location

The Chambers Creek FRS No 4 watershed includes 560 acres (0.875 square miles) in Ellis County, Texas. The site is located approximately one mile east of Midlothian, Texas and is situated about 1.2 miles north of U.S. Highway 287 on an unnamed tributary of Waxahachie Creek, which flows southeast into Chambers Creek. The approximate latitude and longitude coordinates of Chambers Creek FRS No. 4 are 32.4895°N and 96.9682°W. Appendix B shows the project maps for the watershed. The watershed is located within the Trinity River Basin as delineated by the United States Geological Survey, hydrologic unit number 12030109.

Topography

The project area lies on the western edge of the West Gulf Coastal Plain physiographic area. The topography of the watershed ranges from gentle slopes near the watershed divide to moderate slopes in the valleys. The watershed for Chambers Creek FRS No. 4 has an average gradient of 64 feet per mile.

Soils

The primary soil units underlying the Chambers Creek FRS No. 4 watershed were identified using the NRCS web soil survey (NRCS, 2021). Dominant soils consist of silty clays over bedrock and terraced alluvial deposits (Peabody, 1961). The major soil groups in the watershed include Eddy soils, 235 acres (42%) and Austin silty clay, 153 acres (27%). Eddy soils can be described as shallow, well drained soils on gently sloping to moderately steep uplands (slopes ranging from 1 to 20 percent) and are known to be located along the western edge of the Blackland Prairie of Texas (NRCS, 2021). Austin soils consist of moderately deep, well drained, permeable soils that are nearly level to sloping uplands. Other smaller soil map units make up the remainder of the acreage in the watershed. Additionally, there are 124 acres of designated Farmland of Statewide Importance located within the watershed (NRCS, 2021). Prime farmland soils are discussed further in the Environmental Consequences section.

Geology

The geologic development of Texas consists of a long and dynamic history of igneous activity, structural deformation, and sedimentary processes. The Upper Cretaceous Austin Chalk and the Ozan Formation (Taylor Marl) form the bedrock that is overlain by silty clay soils in Ellis County, Texas. The topography of the area includes low, wide hills that are drained by southeast-flowing streams and tributaries (Peabody, 1961). The project area is located within the Texas Blackland Prairie Ecoregion, which spans from the Red River along the northern border of the state to San Antonio in Central Texas. This ecoregion is known for its rich, dark soil ideally suited for agricultural production. Dominate tree species include pecan, cedar elm, various oaks, hackberry, and some mesquite. Big bluestem, Indiangrass, eastern gammagrass, switchgrass, and side oats grama are among the grasses found throughout this region. Annual rainfalls of 30 to 40 inches and temperatures of 66 to 70 degrees are average for this region (TPWD, 2020a).

Climate

The Chambers Creek FRS No. 4 watershed lies within the Blackland Prairie Ecoregion. The climate of the Blackland Prairie ecoregion can be described as subtropical, experiencing mild winters and hot summers. In the winter, the average temperatures range between 40 and 60°F. In the summer, the average temperatures are in the 90s. The average annual rainfall ranges from 28 to 40 inches. (Climate-Data, 2021).

5.4 WATER

Water from the Chambers Creek FRS No. 4 reservoir flows downstream where it converges with Waxahachie Creek. Waxahachie Creek flows into Lake Bardwell and confluences with Chambers Creek, north of Emhouse, Texas. Chambers Creek is a major tributary to the Trinity River. Chambers Creek confluences with another major tributary, Richland Creek, near Streetman, Texas in Richland-Chambers Reservoir. Richland Creek flows downstream from the Richland-Chambers Dam less than two miles to its confluence with the Trinity River, which eventually reaches the Gulf Coast with a delta in the Upper Galveston Bay system.

Clean Water Act

Sections 303(d) and 305(b)

Section 303(d) of the Clean Water Act (CWA) requires states, territories, and tribes to identify "impaired waters" and to establish total maximum daily loads (TMDLs). By definition, an impaired water does not meet the standards associated with its assigned use classification. The State of Texas assesses its waters every two years to meet the requirements of Sections 303(d) and 305(b) of the Clean Water Act. These assessments are published in an integrated report which is titled the "2020 Texas Integrated Report of Surface Water Quality for the Clean Water Act Sections 305(b) and 303(d)" and describes the quality of all waters in the State and contains a list of waters in good condition and those that are impaired/polluted (TCEQ, 2020).

The 2020 Texas Integrated Report of Surface Water Quality for the Clean Water Act Sections 305(b) and 303(d) was released in May 2020 and summarizes the water quality conditions in Texas over a two-year period, January 1, 2018, through December 31, 2019. The Bardwell Reservoir segment which impounds Waxahachie Creek is listed as impaired for sulfates in the water. The segment is categorized as 5c which means additional data or information will be collected or evaluated by the State before a management strategy is selected (TCEQ, 2020).

Sections 401 and 404

Waterbodies and wetlands that are considered Waters of the U.S. (WOTUS) are subject to the regulatory authority of the U.S. Army Corps of Engineers (USACE). Section 404 of the CWA prohibits the discharge of dredged or fill material into WOTUS, including streams and wetlands, unless the action is exempted or authorized by a permit issued by the USACE. If a CWA Section 404 permit is required, the State must issue a Section 401 State Water Quality Certification to certify that the activity will not violate State water quality standards. Potential impacts to WOTUS, including wetlands and streams, are further discussed in the Environmental Consequences section.

Section 402

Section 402 of the CWA establishes the National Pollutants Discharge Elimination System (NPDES) Program, also administered by the State. Section 402 requires any point source, including developments, construction sites, or other areas of soil disturbance, that discharges or intends to discharge to waters of the State must obtain a NPDES permit. In Texas, wastewater and stormwater state-issued permits are administered by the TCEQ through the Texas Pollutant Discharge Elimination System (TPDES) Program.

Waters of the U.S. (Including Wetlands)

The Chambers Creek FRS No. 4 watershed contains numerous aquatic resources, including wetlands, lakes, ponds, and ephemeral, intermittent, and perennial streams, as well as riparian areas. It is NRCS policy to protect and promote wetland functions and values. Wetlands and riparian areas play a principal role in the ecology of a watershed, such as water storage, water filtration, and biological productivity. Wetlands are defined by NRCS (190-GM, Part 410, Subpart B, Section 410.26) as areas, natural or artificial, that have hydric soil, hydrophytic vegetation, and indicators of wetland hydrology. Generally, wetlands include swamps, marshes, bogs, bottomland hardwood areas, and similar areas.

NRCS conducts wetland determinations and/or delineations in compliance with the Food Security Act Wetland Identification Procedures (2010) for the purpose of assisting the US Department of Agriculture (USDA) program participants in complying with the wetland conservation provisions of the Food Security

Act (FSA) of 1985. For FSA purposes, the term "wetland" is defined as land that has a predominance of hydric soils; is inundated or saturated by surface or groundwater at a frequency and duration sufficient to support a prevalence of hydrophytic vegetation typically adapted for life in saturated soil conditions; and, under normal circumstances supports a prevalence of such vegetation. In addition to NRCS requirements, the USACE regulates the discharge of dredged and fill material into wetlands and other WOTUS under Section 404 of the CWA. Activities that impact wetlands and other WOTUS may be subject to the requirements of Section 404 of the CWA. The 1987 USACE Wetlands Delineation Manual and the approved USACE regional supplements to the manual are the foundations to the FSA wetland identification procedures. Under NRCS policy and Executive Order 11990, the presence/absence of both jurisdictional and non-jurisdictional WOTUS, including wetlands, must be evaluated in all NRCS planning projects.

Wetland locations and boundaries were preliminarily identified by reviewing the U.S. Fish and Wildlife Service (USFWS) National Wetland Inventory (NWI) mapper, and then confirmed during a field survey performed on July 15, 2020. There are a total of 11 acres of WOTUS within the watershed that include 2 acres of freshwater ponds and 9 acres of lake (Appendix C-21). Besides the open water of the reservoir, no wetlands were observed in the project area. Additionally, the watershed includes approximately 1.17 miles (6,118 linear feet) of streams and tributaries. Appendix D contains additional documentation regarding the field investigation methodology. State and local permitting requirements that may be required based upon the alternative carried forward for impacts analysis are outlined in the Environmental Consequences section.

Coastal Zone Management Areas

Coastal Zone Management Areas (CZMAs) are areas located within or near the officially designated "coastal zone" of a state. Ellis County is not located in or near a designated Coastal Zone Management Area (CZMA). Accordingly, the CZMA is not applicable to the project's affected environment and will not be carried forward for impacts analysis in the Environmental Consequences section.

Floodplain Management

The NRCS policy on floodplain management reflects the requirements of Executive Order 11988 that decisions by federal agencies must recognize that floodplains have unique and significant public values (190-GM, Part 410, Subpart B, Section 410.25). The objectives of Executive Order 11988 are to avoid, to the extent possible, the long- and short- term adverse impacts associated with occupancy and modification of floodplains and to avoid direct and indirect support of floodplain development where there is a practical alternative.

The floodplain of Waxahachie Creek and portions of its unnamed tributaries are managed by Ellis County, and Ellis County participates in the National Flood Insurance Program administered by the Federal Emergency Management Agency (FEMA). Flood hazard areas are categorized by FEMA and identified on Flood Insurance Rate Maps (FIRMS). Special flood hazard areas are defined as areas that have a one percent or greater chance of being inundated by a flood event in any given year. The one-percent annual chance of flood is also referred to as the base flood or 100-year flood (FEMA, 2022). FEMA FIRM Panel 48139C0155F (effective on 6/3/2013) indicates the project is located within Zone A, which include areas subject to inundation by the 1-percent-annual-chance flood event. Additionally, Zone A indicates that no BFEs or flood depths are available for the area because hydraulic analyses have not been performed (FEMA, 2013; FEMA, 2022).

Wild and Scenic Rivers

The National Wild and Scenic Rivers Act of 1968 was created by Congress to preserve certain rivers with outstanding natural, cultural, and recreational values in a free-flowing condition for the enjoyment of present and future generations. Texas has approximately 184,797 miles of river of which only the Rio Grande River is designated as Wild and Scenic (National Wild and Scenic River System, 2022). Therefore, the National Wild and Scenic Rivers Act (Public Law 90-542) is not applicable to the project's affected environment and will not be carried forward for impacts analysis in the Environmental Consequences section.

5.5 AIR

Clean Air Act

The Clean Air Act (CAA) of 1970 requires the U.S. Environmental Protection Agency (EPA) to set National Ambient Air Quality Standards (NAAQS) for pollutants considered harmful to public health and the environment. The EPA established NAAQS for six criteria pollutants including carbon monoxide, nitrogen dioxide, lead, sulfur dioxide, fine particulate matter (PM_{10} and $PM_{2.5}$), and ozone (O_3). The EPA categorizes individual regions or counties into two levels of compliance with the NAAQS for criteria pollutants: attainment and nonattainment. Attainment areas are that meet the NAAQS; nonattainment areas exceed the NAAQS and must have and implement a plan to meet the NAAQS. Ellis County in Texas is categorized as non-attainment for O_3. Ellis County is subject to the requirements of the 'Dallas-Fort Worth Serious Classification Attainment Demonstration State Implementation Plan (SIP) Revision' due to reclassification of the DFW nonattainment area from moderate to serious for the 2008 eight-hour ozone NAAQS. Ellis County is also listed a marginal nonattainment category for the 2015 eight-hour ozone NAAQS. Construction activities related to the dam improvement project are expected to be de minimis (below 10 tons per year [tpy] PM2.5 and below 15 tpy PM10) and would not require Construction permits for Nonattainment New Source Review (NNSR) and Prevention of Significant Deterioration (PSD) (TCEQ, 2021).

General Conformity Rule (Criteria Pollutants)

Established under the CAA, the General Conformity Rule (40 CFR Part 51, subpart 54) ensure that Federal actions conform to the Texas State Implementation Plan (SIP). To proceed with a Federally funded project, a General Conformity program requires an emissions inventory to ensure that increased air pollution from the project does not negatively affect the state's emissions budget and SIP. The General Conformity Rule are applicable to project located in nonattainment areas. Since Ellis County is categorized as non-attainment, a General Conformity Determination is required.

Regional Haze Regulations

Haze occurs when small particulates in air pollution scatter and absorb sunlight. The hazy effect blurs and decreases visibility. Congress enacted Section 169A of the CAA to protect visibility in National Parks and Wilderness Areas (Class 1 areas). The Regional Haze Regulation calls for states to enact rules to reduce emissions of fine particle pollution and improve visibility in these areas. The Project Area is not within a designated Class 1 area and would not be bound to the Regional Haze rule.

5.6 VEGETATION AND WILDLIFE

Vegetation Communities and Habitat

The Chambers Creek FRS No. 4 watershed lies within the Blackland Prairie Ecoregion (TPWD, 2020a). This ecoregion historically supported tallgrass prairies of big bluestem, little bluestem, Indiangrass, and switchgrass. Much of the original prairie has been converted to agricultural crops such as corn, milo, and cotton, or cattle ranching. Soils derived from the Ozan formation support irrigated croplands, unimproved pasturelands, and riparian areas characterized by deciduous forests and juniper woodlands. Elevation ranges from 300 to 800 feet above sea level (TPWD, 2020a).

The National Land Cover Dataset (NLCD), a 30-meter resolution, landscape scale, raster coverage created by satellite imagery interpretation, was used to characterize the spatial distribution of vegetation communities across the project area (USGS, 2016). The NLCD identified a total of eight landcover classes across the watershed of the project area. Table E lists the vegetation cover types in order of prevalence in the project area. Appendix C-7 depicts the spatial distribution of vegetation communities throughout the watershed.

Riparian Areas

Riparian areas are present within the project area. NRCS policy requires integration of riparian area management into all plans and alternatives (GM 190, Park 411). Although Federal Law does not specifically regulate riparian areas, portions of riparian areas, such as wetlands and other waters of the U.S., may be subject to Federal regulation. These riparian areas are located along the perimeter of the reservoir created by Chambers Creek FRS No. 4. Additional riparian areas are located downstream of the dam along the unnamed tributary that flows into Waxahachie Creek. Most of the riparian areas downstream of the dam are forested.

Invasive Species

Invasive species include species of plants and animals that have been introduced, either intentionally or accidentally, into areas outside of their natural environments. An invasive species can grow and spread rapidly and establish themselves over a large area. As a result, invasive species can cause economic and environmental damage, or harm to human health (Texas Invasives, 2022).

Typical invasive plant species within the Blackland Prairie ecoregion include Johnson grass (*Sorghum halepense*), King Ranch bluestem (*Bothriochloa ischaemum var. songarica*), chinaberry (*Melia azedarach*), heavenly bamboo (*Nandina domestica*), and wax-leaf privet (*Ligustrum japonicum*). Common invasive wildlife species include Asian clam (C*orbicula fluminea),* European Starling (*Sturnus vulgaris*), red imported fire ants (*Solenopsis invicta*), Mediterranean house gecko (*Hemidactylus turcicus*), feral pig (*Sus scrofa*), and nutria (*Myocastor coypus*) (Texas Invasives, 2022).

Additionally, TPWD recommends the following vegetation removal, revegetation, and landscaping recommendations regarding invasive species: reduce the amount of vegetation proposed for clearing if possible and minimize clearing of native vegetation, particularly mature native trees, riparian vegetation, and shrubs to the greatest extent practicable; replacement/restoration of the native vegetation wherever practicable; remove invasive species early on while allowing the existing native plants to revegetate the disturbed areas. Invasive species management will be consistent with TPWD guidance (Appendix D).

Federally Protected Threatened and Endangered Species and Natural Areas

Section 7(a) of the Endangered Species Act (ESA) requires the NRCS, in consultation with and with the assistance of the Secretary of the Interior (USFWS) and/or National Oceanographic and Atmospheric Administration (NOAA), National Marine Fisheries Service, to advance the purposes of the ESA by implemented programs for the conservation of endangered and threatened species, and to ensure that NRCS actions and activities do not jeopardize the continued existence of threatened and endangered species or result in the destruction or adverse modification of the species' critical habitat. There were no known tribal species of concern listed within the project area.

Table C, which was generated from the USFWS Information for Planning and Consultation (IPaC) website (USFWS, 2022b), provides a list of federally listed fish species which have been identified as potentially occurring in Ellis County. Only species that are listed as threatened or endangered by the USFWS have complete federal protection under the ESA. These include three species of birds, one species of freshwater mussel, and one species of insect. Information such as life history, habitat requirements, and potential project effects are provided below.

Table C: Federally Protected Species Potentially Occurring in Ellis County, Texas

Common Name	Scientific Name	Federal Status[1]	Federally Designated Critical Habitat within the Project Area
Birds			
Piping Plover	*Charadrius melodus*	T	No
Red Knot	*Calidrus canutus rufa*	T	No
Whooping Crane	*Grus americana*	E	No
Mollusks			
Texas Fawnsfoot	*Truncilla macrodon*	PT	No
Insects			
Monarch Butterfly	*Danaus plexippus*	C	No

T = threatened; E = endangered; PT = proposed threatened; C = candidate
[1]according to USFWS, 2022

Piping Plover

The threatened piping plover (*Charadrius melodus*) is a small shorebird that inhabits coastal beaches and tidal flats (Haig and Elliott-Smith, 2004). Approximately 35 percent of the known global population of piping plover winters along the Texas Gulf coast, where they spend 60 to 70 percent of the year (Campbell, 2003). From September to March, piping plovers are typically found along the Gulf coast shoreline using beaches, sandflats, tidal mudflats, dunes, and dredge islands as loafing and foraging areas (Haig and Elliott-Smith, 2004). eBird (2022) and TPWD (2022a) data show no observations of piping plover near the project area. Habitat suitable for piping plover was not observed within the project area.

Red Knot

The threatened red knot (*Calidris canutus rufa*) is a medium-sized, stocky, short-necked sandpiper with a short, straight bill. The rufa subspecies, one of three subspecies occurring in North America, has one of the longest distance migrations known, travelling between its breeding grounds in the central Canadian Arctic

to wintering areas in South America (USFWS, 2011). It is an uncommon to common migrant along the coast, and a rare to casual inland, primarily in the eastern half of the state (USFWS, 2013). There have been no recorded observations of red knots in Ellis County (TPWD, 2022a). eBird (2022) data shows no observation near the project area. No suitable habitat for the red knot was observed within the project area.

Whooping Cranes

Endangered whooping cranes (*Grus americana*) are the tallest birds in North America and are known for their call, size, and white plumage. The migratory Texas population breeds and nests in Wood Buffalo National Park in northern Alberta, Canada during the summer and flies south to Aransas National Wildlife Refuge near Rockport, Texas where they spend the winter (USFWS, 2007). During migration, whooping cranes stop over at wetlands, fallow cropland, and pastures to roost and feed. Based on migration data compiled from a variety of information gathered from 1975 through 1999 (Austin and Richert, 2001), the project area is not located within the designated migration corridor for the whooping crane. Their preferred habitat includes coastal marshes, estuaries, inland marshes, lakes, and ponds. For feeding, they forage in brackish bays, marshes, and salt flats. eBird (2022) and TPWD (2022a) data show no official observations reported within 5-miles of the Chambers Creek dams. Habitat suitable for whooping cranes was not identified near the project areas.

Texas Fawnsfoot

The Texas fawnsfoot is a species of freshwater mussel that can be found within the Trinity River basin. Chambers Creek FRS No. 4 is situated along the tributary of Waxahachie Creek which is a tributary to the Trinity River. Although the dam is within the Trinity River Basin, the open water habitat of the dam reservoir has slack water and silt substrate that do not meet the habitat requirements for the mussel. The dam is located high in the watershed and the creek is considered an ephemeral drainage, therefore lacking persistent aquatic habitat to support mussels. TPWD (2022a) data show no official observations reported near the Chambers Creek dams.

Monarch Butterfly

Adult Monarch Butterflies are large with bright orange wings with black borders and white spots. During the breeding season, Monarch Butterflies lay their eggs on milkweed (*Asclepias sp*.) plants. Due to their short lifespan, there are multiple generations of Monarch Butterflies within a breeding season and along their 3,000-mile migratory route. Monarch migration begins in early spring from February to March. Due to their long migratory routes, Monarch Butterflies can be found in a variety of habitats. The eastern population of Monarch Butterflies can be found throughout Texas during its migratory season. Individuals have been observed within the project area. Construction for the project is not expected to impact Monarch Butterfly migratory route and the monarch butterfly host plant, milkweed is not found within the project area.

State Protected Endangered and Threatened Species

Texas Parks and Wildlife Department provides an online resource for state listed species information through the TPWD Rare, Threatened, and Endangered Species of Texas by County (RTEST) website. The RTEST list for Ellis County identifies the following flora and fauna with the potential to occur within the county.

Table D: State Listed Species Potentially Occurring in Ellis County, Texas

Common Name	Scientific Name	State Protection Status[1]	Habitat within the Project Area
Birds			
Piping Plover	*Charadrius melodus*	T	No
Red Knot	*Calidrus canutus rufa*	T	No
Whooping Crane	*Grus americana*	E	No
Black Rail	*Laterallus jamaicensis*	T	No
White-faced Ibis	*Plegadis chihi*	T	No
Wood Stork	*Mycteria americana*	T	No
Mollusk			
Trinity Pigtoe	*Fusconaia chunii*	T	No
Texas Heelsplitter	*Potamilus amphichaenus*	T	No
Louisiana Pigtoe	*Pleurobema riddellii*	T	No
Sandbank Pocketbook	*Lampsilis satura*	T	No
Reptile			
Texas Horned Lizard	*Phrynosoma cornutum*	T	Yes
Alligator Snapping Turtle	*Macrochelys temminckii*	T	Yes

T = threatened; E = endangered

[1]According to TPWD, 2022a

Of the twelve state listed species with the potential to be found in Ellis County, Texas Horned Lizard and Alligator Snapping Turtle have the highest chance of occurring within the project area. Texas Horned Lizards are found in open grassy, prairie habitats with scattered brush and trees. Alligator Snapping Turtles are found near perennial waterbodies, swamps, bayous, and ponds. Contractors will follow TPWD recommendations to avoid impacts to state listed and SGCN species during construction, maintenance, and operation activities. Additional information can be found in the TPWD coordination letter found in Appendix D.

Migratory Birds

The Migratory Bird Treaty Act (MBTA) of 1918 makes it illegal to kill, possess, transport, buy, sell, or trade any migratory bird parts, nest, or eggs unless a valid Federal permit is issued. To prevent impacts to migratory birds, construction activities such as clearing, and grubbing should be performed outside of the migratory bird breeding season (March 15 through September 15). USFWS IPaC resources has listed Bald

Eagle (*Haliaeetus leucocephalus*), Lesser Yellowlegs (*Tringa flavipes*), and Red-headed Woodpecker (*Melanerpes erythrocephalus*) as migratory birds with the potential to occur within the project area. Lesser Yellowlegs and Red-headed Woodpeckers are considered Birds of Conservation Concern (BCCs). Birds of Conservation Concern are designated by the USFWS as species which are likely to become candidates for listing under the ESA without additional conservation action. Lesser Yellowlegs and Bald Eagles are commonly found in lacustrine environments where they forage and roost near the shoreline. Red-headed Woodpeckers live in open forests with clear understory near wetlands. Additional information about Bald and Golden Eagles can be found in the section below as well as Table L in Section 7.2.

Bald and Golden Eagle Protection Act

In addition to the MBTA, all Bald and Golden Eagles are protected under the Bald and Golden Eagle Protection Act and Executive Order 13186. The Act prohibits individuals without a special permit from taking eagle parts, nests, or eggs. The Act defines "take" as "pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest, or disturb." In addition to those immediate impacts, the Act also covers impacts that may result from human-induced alterations around nest sites in a manner that may interfere with or interrupts normal breeding, feeding, sheltering habits, and causes injury, death, or nest abandonment. No Bald or Golden Eagles were observed within the project area during the site visit in June 2020. The Texas Parks and Wildlife Department (TPWD) Natural Diversity Database (TPWD, 2022b) does not list any Bald or Golden Eagle nests within 2 miles of Chambers Creek FRS No. 4. Therefore, the Bald and Golden Eagle Protection Act is not applicable to the project's affected environment and will not be carried forward for impact analysis in the Environmental Consequences section.

Essential Fish Habitat

EFH are areas identified as being vital for sustaining marine or anadromous fish populations. They include the waters and substrate necessary for spawning, breeding, feeding, or growth to maturity (NRCS, 2014). The affected environment of the Chambers Creek FRS No. 4 watershed is located inland and does not include saltwater tributaries or marine fisheries. Therefore, there is no potential essential fish habitat protected under the Magnusson-Stevens Fishery Conservation and Management Act. EFH is not applicable to the project's affected environment and will not be carried forward for impacts analysis in the Environmental Consequences section.

Coral Reefs

The recognition of the importance of conserving coral reef ecosystems was issued in Executive Order 13089 in 1998. The Executive Order created a Coral Reef Task Force of 11 federal agencies, including the U.S. Department of Agriculture (NRCS, 2014). Ellis County is located inland. Therefore, the protection of coral reefs is not applicable to the project's affected environment and will not be carried forward for impact analysis in the Environmental Consequences section.

5.7 HUMAN ENVIRONMENT

Cultural and Historic Resources

NRCS is required to consider the effects of proposed actions and undertakings on National Register of Historic Places (NRHP) eligible cultural resources and historic properties in consultation with specific parties. Consultation with the State Historic Preservation Office (SHPO), Tribal Historic Preservation Office (THPO), and federally recognized Tribes, as appropriate, as well as other interested parties, is

required when an agency action may alter the characteristics that qualify a historic property for inclusion in the NRHP.

Section 106 of the National Historic Preservation Act

Section 106 of the National Historic Preservation Act (NHPA) of 1966 required Federal Agencies to consider the impacts of their actions on historic properties and establish a program for the preservation of historic properties and archeological sites. The NRCS identifies the Area of Potential Effect (APE) as the areas of potential ground disturbance (using the maximum possible extent of ground disturbance). The indirect APE is the viewshed from any identified historic resource to the proposed undertaking (using the maximum possible extent of ground disturbance). The APE considers areas that would be directly or indirectly affected by the proposed undertaking in addition to the viewshed of historic properties that would be affected by the project. The viewshed includes all of the visible area in the line of sight of the project and excludes areas obstructed by terrain or other features. The APE for Chambers Creek FRS No. 4 comprised an area of approximately 15.6 acres and included rehabilitation of the dam structure and the slight increase in flood pool as a result. Temporary staging areas were considered part of the APE since they may constitute significant ground disturbance. Some existing haul roads were within the viewshed APE, but do not constitute significant ground disturbance and are not included in the APE.

A cultural resources desktop review was performed by FNI archeologists in January 2021 and concurrence was received from SHPO in September 2021. The desktop review included a search of archeological records available on the THC Texas Archeological Site Atlas (TASA) to determine if any previously recorded archeological sites or historic properties listed in the National Register of Historic Places (NRHP), State Antiquities Landmarks (SAL), and Recorded Texas Historic Landmarks (RTHL) were located within one kilometer of the APE. Additionally, historic and aerial topographic maps were evaluated to determine changing land use over time. The records review revealed no historic properties or previously recorded archeological sites, however the records review revealed one historical marker for the Site of the Old Hawkins Springs (5139007114) within one kilometer of the project. FNI concluded that there are no known cultural resource sites within the APEs, although the area has potential to contain unrecorded archaeological resources. Coordination was completed with the Texas SHPO and concurrence was received for no effect and no additional survey required (Appendix D). Consultation with the THPO is to be completed by NRCS-TX.

Additionally, Chambers Creek FRS No. 4 was constructed in 1958, and therefore, is old enough for National Register consideration due to its age (50+ years old). A property must be at least 50 years of age and must have cultural significance to be considered a historic place and be eligible for listing in the National Register (National Park Service, 1997). The NRHP Registration Form (NPS 10-900) is used to document the eligibility determination of historic properties. The NPS 10-900 has not been completed for Chambers Creek FRS No. 4. SHPO concurrence confirmed that the Chambers Creek FRS No. 4 structure is not considered a historic resource for NRHP inclusion.

National Historic Landmarks Program

The National Parks Services (NPS) National Historic Landmarks Program identifies nationally significant historic places or properties designated by the Secretary of the Interior and listed in the National Register of Historic Places. These places or properties possess a high degree of historic integrity, which can be defined as the ability of a place or property to convey its historical associations or attributes (NPS, 2021).

Per the NPS's National Historic Landmarks Program website, there are no National Historic Landmarks listed in Ellis County, Texas. Therefore, the National Historic Landmarks Program is not applicable to the

project's affected environment and will not be carried forward for impact analysis in the Environmental Consequences section.

Land Use

The total drainage area of the Chambers Creek FRS No. 4 watershed includes 560 acres (0.86 square miles). The dominant land uses within the watershed are forests, pastures, and low to medium intensity developed area supporting residential and commercial uses. Table E shows the percentage of the dominant land use categories in the watershed. This table also lists the land use in the breach inundation zone below the dam. The land uses were derived from the NLCD 2016 landcover dataset. There are no anticipated land use changes. Table E was gathered to show land use in Chambers Creek FRS No. 4 in percentage over the watershed.

Table E: Land Use Chambers Creek FRS No. 4

Land Cover Type	Drainage Area of Chambers Creek FRS No. 4	Percentage of Total Watershed Area	Breach Inundation Zone (acres)	Percentage of Total
Range	16	3%	0.44	0%
Forest	46	8%	78	67%
Developed Land	61	11%	15	13%
Water	371	66%	23	20%
Pasture	66	12%	0	0%
Total	560	100%	117	100%

Scenic Beauty and Visual Resources

As described in the NRCS General Manual, Title 190, Part 410.24, contributions to scenic beauty are a normal product of NRCS work. Scenic beauty can be defined as the viewer's positive perceived value of special, unique, and memorable physical elements of a landscape. Although there would potentially be temporary visual impacts to the reservoir formed by the Chambers Creek FRS No. 4 during the construction period, there are no designated State or National Natural and Scenic Area Preserves or river segments located within the project areas. Therefore, Scenic Beauty is not applicable to the project's affected environment and will not be carried forward for impact analysis in the Environmental Consequences Section.

Socioeconomics

The watershed of Chambers Creek FRS No. 4 lies within Ellis County, Texas. According to the results of the dam breach modeling and inundation mapping performed in conjunction with the development of this plan, a dam failure could result in impact to 40 residential structures, segments of FM 1387, Lon Hayes Road, Lynnie Pennie Street, Clinton Lane, and multiple rural roads.

Population and Race

According to the 2019 5-Year Estimate from the American Community Survey (ACS) of the U.S. Census Bureau, the population of Ellis County was estimated at 173,772 persons. Of this population, 81.5% (141,636 persons) were White and 9.7% (17,580 persons) were Black or African American. All other racial

groups combined comprised 8.4% of the total population. According to the 2019 5-Year Estimate, the population within Census Tract 602.14 was 10,199 persons. Of this population, 91.2% (9,298 persons) were White and 3.7% (377 persons) were Black or African American. All other racial groups combined comprised 5.1% of the total population.

Age

The 2019 5-Year Estimate from the ACS indicates that the median age (middle point with ½ above and ½ below) of the population of Census Tract 602.14 and Ellis County was 35.0 years and 36.2 years, respectively. The median age for the State of Texas was lower at 34.6 years (and was 38.1 years for the United States). Residents in Census Tract 602.14 and Ellis County that were 65 years old or older totaled 9.3% and 12.6%, respectively. These statistics compare to 12.3% for the State and 15.6% nationally. Of the Census Tract and Ellis County populations, 71.8% and 73.2%, respectively, were over the age of 18 years. The same statistic for the State as a whole was 74.0% and the percentage nationally was 77.4%.

Education

The 2019 5-Year Estimate from the ACS indicates that of the residents in Ellis County that are 25 years of age or older, approximately 86.2% had a high school education or higher. Of the residents within Census Tract 602.14 that are 25 years of age or older, 94.0% have a high school education or higher compared to the state-wide and national percentages of 83.7% and 88.0%, respectively. About 39.0% percent of Census Tract 602.14 and 24.3% of Ellis County residents hold a bachelor's degree or higher, and 10.1% and 7.5%, respectively, hold graduate or professional degrees. In the State, 29.9% of the population hold a bachelor's degree or higher and 10.4% hold a graduate or professional degree. These same statistics for the nation total 32.1% and 12.4%, respectively. Additionally, 25.8% in Ellis County have completed at least some college level work with 8.4% having obtained an associate degree. The same statistics at the state and national level are 21.6% and 20.4% and 7.2% and 8.5%, respectively (Source: U.S. Census Bureau, 2019 ACS 5-Year Estimate).

Employment/Unemployment, Class of Worker and Commuter Status

There are 7,579 residents in Census Tract 602.14 who are 16 years of age or older according to the U.S. Census Bureau, 2019 ACS 5-Year Estimate. Of those, 5,404 persons (71.3%) are considered to be in the labor force pool, with 70.1% being employed and 1.2% being unemployed. There are 132,496 Ellis County residents who are 16 years of age or older. Of those, 88,445 persons (66.8%) are considered to be in the labor force pool, with 64.4% being employed and 2.3% being unemployed. The unemployment rate for Census Tract 602.14 and Ellis County is 1.6% and 3.4%, respectively, which is lower than the unemployment rate projected for the State of Texas at 5.1%, and lower than the same statistic for the nation at 5.3%.

Ellis County has a diverse economy. According to the 2019 ACS 5-Year Estimate, there are 13 sub-sectors of the local economy that employ the civilian workforce: agriculture, forestry, fishing and hunting, and mining (1.3%); construction (9.2%); manufacturing (13.1%); wholesale trade (3.0%); retail trade (11.9%); transportation and warehousing, and utilities (7.6%); information (1.8%); finance and insurance, and real estate and leasing (6.7%); professional, scientific, and management, and administrative and waste management services (9.6%); educational services, and health care and social assistance (20.2%); arts, entertainment, and recreation, and accommodation and food services (7.2%); other services, except public administration (4.6%); public administration (3.8%).

Income

Median household income (householder and all others, related or not) for Census Tract 602.14 was $106,820 and $76,871 for Ellis County as estimated in the 2019 ACS 5-Year Estimate. These numbers compare to $61,874 per year for the median household income calculated for the State of Texas with the national figure at $62,843.

Median family income was estimated to be $111,127 in Census Tract 602.14 and $86,150 in Ellis County, according to the 2019 ACS 5-Year Estimate. The median family income is higher in Census Tract 602.14 and Ellis County than the $73,349 median family income for the State of Texas as a whole. A similar situation exists for the median family income in Census Tract 602.14 and Ellis County compared to the national figure of $77,263 report for the entire United States. Median family income is consistently higher than median household income because the household universe includes people who live alone. Their income would typically be lower than family income because by definition, a family must have two or more people.

With respect to per capita income, Census Tract 602.14 residents were estimated to have per capita incomes of $53,062. Ellis County residents had estimated mean per capita incomes of $32,571. Texas residents were estimated to have mean per capita incomes of $31,277; while the entire United States had mean per capita incomes of $34,103. That makes the Census Tract per capita income figure 41.1% more than the state's level and 35.7% more than the national figure. The County per capita income figure is 4.0% higher than the state's level and 4.7% lower than the national figure.

Poverty

According to the 2019 5-Year Estimate from the ACS, Census Tract 602.14 had 1.4% of the population living below the poverty level. Ellis County had 8.8% of the population living below the poverty level. State-wide, 13.6% of Texas's citizens had incomes below the poverty level. At the national level, 12.3% of Americans were estimated to be living below the poverty level.

Housing

The 2019 5-Year Estimate from the ACS estimates indicate that 95.8% of housing units (10,199 units) in Census Tract 602.14 were occupied. Of the occupied housing units, 93.4% were owner-occupied and 6.5% were renter-occupied. In Ellis County, 92.8% of housing units (57,307 units) are occupied. Of these units, 74.4% were owner occupied and 25.6% were occupied by renters. The state-wide occupancy rate for Texas as a whole was reported as 88.6% and the national figure was 87.9%. The state-wide rates for owner- and renter-occupancy were 62.0% and 38.0%, respectively, and the national rates for owner- and renter-occupancy were 64.0% and 36.0%, respectively.

According to the results of the dam breach modeling and inundation mapping performed for the Breach studies indicate that approximately 40 residences and portions of FM 1387 would be at risk. The residential properties in the Block Group in which most of the inundation zone is located (Census Tract 602.14, Block Groups 1 and 3) ranges between $13,500 and $239,340 in total value with a median value of about $72,124. The total value of residential property (structures and contents only, excluding land values) at risk below the dam is an estimated $9,015,450.

Recreation

Chambers Creek FRS No. 4 provides incidental recreation to residents with homes around the lake and to their guests. Lake-based recreation and other activities associated with the site include fishing, boating, and hiking.

Environmental Justice

Executive Order 12898 mandates federal agencies to identify and address disproportionately high and adverse human health or environmental effects of their programs, policies, and activities on minority populations, low-income populations, and Indian Tribes. The term "environmental justice" means that, to the greatest extent practicable and permitted by law, all populations are provided the opportunity to comment before decisions are rendered on proposed federal actions (NRCS, 2014).

An environmental justice and civil rights analysis was conducted for the breach inundation zone and associated nearby areas downstream of Chambers Creek FRS No. 4 (Figure 1 and Table F). EPA's "EJSCREEN" tool and USDA's Departmental Regulation 5600-02, Environmental Justice, were used to identify environmental justice groups within the breach inundation zone of the dam. The estimated population of the delineated area is 204 persons according to the U.S. Bureau EJSCREEN ACS 2014-2018 Summary Report. The minority population totals 27%, or 55 persons, and 89% of the total population is white. A total of 3% of household incomes are at or below $25,000, which is below the $26,500 poverty level for households with four individuals for the 48 contiguous states (per the 2021 Poverty Guidelines from the US Department of Health and Human Services, effective as of January 13, 2021). 5% percent of the population have less than a high school education. 75% percent own their homes and 25% percent rent. Of the population age 16 and over, 63% are in the labor force while 37% are not in the labor force. With respect to the environmental indicators assessed using the EJSCREEN tool, the assessed areas have values below or slightly above statewide and national levels.

The statistics displayed in Table F indicate the likely presence of individuals with environmental justice concerns. However, rehabilitation of the dam will provide benefits to all socioeconomic groups upstream and downstream of the dam without disparate treatment to any individuals or social groups.

Table F: Indicators and Groups from EPA's Environmental Justice Tool

Selected Variables	Value	State		EPA Region		USA	
		Avg.	%tile	Avg.	%tile	Avg.	%tile
Environmental Indicators							
Particulate Matter (PM 2.5 in µg/m^3)	9.37	9.18	48	8.95	59	8.55	76
Ozone (ppb)	43.5	41.3	64	41.8	62	42.9	55
NATA* Diesel PM (µg/m^3)	0.325	0.428	34	0.401	<50th	0.478	<50th
NATA* Air Toxics Cancer Risk (risk per MM)	32	35	37	36	<50th	32	50-60th
NATA* Respiratory Hazard Index	0.42	0.43	41	0.45	<50th	0.44	<50th
Traffic Proximity and Volume (daily traffic count/distance to road)	120	470	41	400	46	750	39
Lead Paint Indicator (% pre-1960s housing)	0.058	0.15	64	0.17	59	0.28	39
Superfund Proximity (site count/km distance)	0.034	0.084	40	0.081	43	0.13	30

Selected Variables	Value	State		EPA Region		USA	
		Avg.	%tile	Avg.	%tile	Avg.	%tile
RMP Proximity (facility count/km distance)	0.96	0.91	63	0.82	67	0.74	70
Hazardous Waste Proximity (facility count/km distance)	1.4	0.88	75	0.99	71	5	53
Wastewater Discharge Indicator (toxicity-weighted concentration/m distance)	0.000425	0.41	51	9.5	54	9.4	62
Demographic Indicators							
Demographic Index	24%	47%	11	44%	12	36%	27
People of Color Population	27%	58%	11	52%	17	39%	36
Low Income Population	21%	35%	26	37%	22	33%	29
Linguistically Isolated Population	1%	8%	27	6%	37	4%	46
Population with Less Than High School Education	7%	17%	23	16%	21	13%	28
Population under Age 5	5%	7%	57	7%	59	6%	68
Population over Age 64	8%	12%	53	13%	46	15%	35

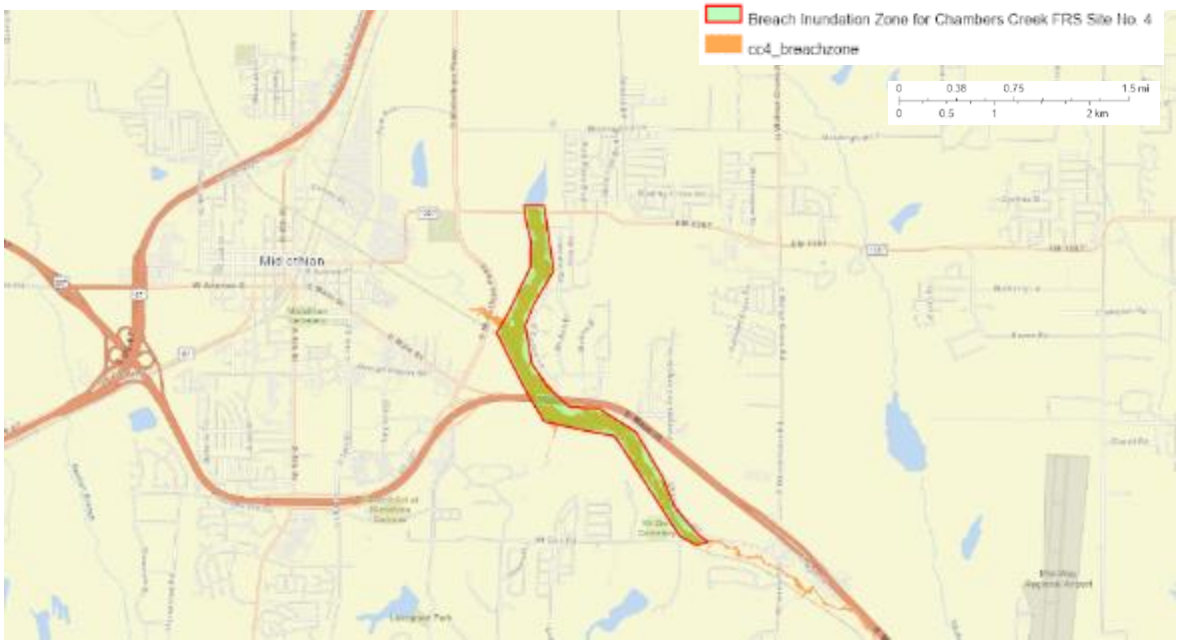

Figure 1. Area Evaluation (Breach Inundation Zone) for Environmental Justice Effects

5.8 STATUS OF OPERATION AND MAINTENANCE

The Ellis-Prairie Soil and Water Conservation District is currently responsible for the operation and maintenance of FRS No. 4. Inspections of the dam have indicated that the dam is being operated and maintained properly. The dam is in good condition and has good vegetative cover. The inlet structure and conduit of the principal spillway were visually inspected, and no deficiencies were observed. Investigations indicate that the dam, including the principal spillway, is structurally sound and is being properly

maintained. The 8-inch low flow sluice valve was not tested during these inspections and is assumed to be non-operational due to age and lack of use. Determination will be made during constriction whether low flow capacity is required, as this level of detail is not necessary during the planning phase.

5.9 RESERVOIR STORAGE

The original planned total sediment volume was 62 acre-feet (according to the 1958 as-built drawings). As stated in the original work plan, the estimated annual sediment load for the Chambers Creek watershed was 2.16 acre-feet per square mile. For the FRS No. 4 watershed, this equates to approximately 1.9 acre-feet per year. At this rate, the original 62 acre-feet of sediment storage would provide at least 32 years of service from the original construction date of 1958.

Specialty Devices, Inc. (SDI) performed a bathymetric survey of the reservoir with acoustic survey equipment and traditional ground survey equipment on June 2, 2020. Chambers Creek FRS No. 4 had a thick layer of aquatic vegetation which was determined to be a source of error in determining the true water bottom surface. An additional ground-truth survey was performed on August 11, 2020 to reduce the uncertainty. The results of this survey were combined with available LiDAR topography data to update the elevation-storage curve for FRS No. 4. This data indicates that the reservoir volume at normal pool is approximately 40.4 acre-feet.

Based on the results of the bathymetric survey, the reservoir has lost approximately 21.6 acre-feet of storage below normal pool. Assuming that this is driven solely by sedimentation, a revised annual sedimentation rate of 0.35 acre-feet can be estimated. This revised sedimentation rate predicts that the preferred alternative provides the required sediment storage capacity to extend the design life for 100 years. Hence, the new principal spillway elevation will remain the same as the existing, 719.2 feet, which allows for 40.4 acre-feet of sediment storage below the principal spillway crest. Maintaining the existing normal pool elevation eliminates the environmental impacts associated with modifications of the normal pool elevation. Since the existing configuration provides sufficient sediment storage for the design life, the accumulated sediment in the sediment and detention storage areas was not tested as it will not be disturbed during the rehabilitation of FRS No. 4.

5.10 BREACH ANALYSIS AND HAZARD CLASSIFICATION

Chambers Creek FRS No. 4 does not meet current dam design and safety requirements. The dam was originally constructed in 1958 as a low-hazard structure for the purposes of protecting downstream agricultural lands from flooding. The NRCS and the TCEQ Dam Safety Program both agreed on the classification of the structure as high-hazard. The high hazard classification is based on the risk of loss of life concerning at-risk properties located in the downstream dam breach inundation area.

As a result of population growth and rural development, 40 residential structures, FM 1387, multiple residential streets, county roads and rural roads are now at risk from a catastrophic breach of FRS No. 4. The residences would experience floodwater depths from first floor elevation to over 5 feet.

A breach analysis was performed as part of the preparation of this plan. The breach analysis results indicate that, if the dam were to fail, FM 1387 would be overtopped by approximately 6 feet of water; Lon Hayes Road would be overtopped by approximately 7 feet; Lynnie Pennie Street would be overtopped by 5 feet; Clinton Lane would be overtopped by 4.5 feet; and multiple rural roads would also be impacted. According to the Texas Department of Transportation (TxDOT) Traffic Count Database System (TCDS), about 11,606 vehicles utilize FM 1387 daily and about 1,089 vehicles utilize Clinton Lane daily. Traffic counts were not available for Lynnie Pennie Street or Lon Hayes Drive.

Although FRS No. 4 is presently sound, there is always a risk of failure. The most likely cause of FRS No. 4 is failing is by overtopping. In the event that the structure failed by overtopping, the most serious failure would be a breach in the tallest section of the embankment. This scenario would result in a breach hydrograph that has a peak discharge of 14,000 cubic feet per second, based on minimum peak discharge criteria contained in NRCS Technical Release Number 60. Fair weather conditions were assumed to develop the breach hydrograph. The reservoir pool elevation was static at top of dam with non-storm conditions downstream. See Appendix C-11, Breach Inundation Map and Appendix D, Investigation and Analysis – Hydrology.

5.11 EVALUATION OF POTENTIAL FAILURE MODES

Both NRCS and the TCEQ Dam Safety Program, recognize that Chambers Creek FRS No. 4 is a high-hazard dam. Several potential modes of failure were examined as follows:

Sedimentation: Sediment can be deposited in both the sediment pool (the area below the principal spillway crest) and flood detention pool (the area between the principal spillway crest and the auxiliary spillway crest). When the sediment pool has filled to the elevation of the principal spillway inlet, the pool no longer has water storage. As the detention pool loses storage due to sediment deposition, the auxiliary spillway operates, or has flowage, more often and is therefore subject to erosion. A potential mode of failure exists as the auxiliary spillway continues to degrade, and depth and frequency of flow increases. The dam will ultimately breach.

FRS No. 4 was designed with a 50-year sediment storage life. The bathymetric survey indicates that while some sediment has accumulated, FRS No. 4 has sufficient storage capacity remaining for more than 100 years. Given the minor changes to the undeveloped upstream land use since the original design and construction, future sediment rates are expected to be similar to past sediment rates. Therefore, in the near future, sedimentation presents a low potential mode of failure for FRS No. 4.

Hydrologic Capacity: Hydrologic failure of a dam can occur by breaching the auxiliary spillway or overtopping the dam during a storm event. The integrity and stability of the auxiliary spillway is dependent on the depth, velocity, and the duration of flow; the vegetative cover; and the spillway's resistance to erosion. The integrity and stability of the embankment during overtopping is dependent on the depth, velocity, and duration of flow; the vegetative cover; and the embankment's resistance to erosion.

FRS No. 4 currently has a capacity of 273.9 acre-feet of detention storage (at crest of auxiliary spillway) and 5.0 feet of freeboard (to top of dam elevation). Current NRCS criteria require FRS No. 4 to safely pass the 6- and 24-hours Freeboard Hydrograph (FBH) without overtopping the embankment. The capacity of the current auxiliary spillway is not sufficient to prevent the FBH from overtopping the dam embankment. Therefore, FRS No. 4 is categorized as having high potential to fail due to deficiency in required hydrologic capacity.

Seepage: Embankment and foundation seepage can contribute to failure of an embankment by removing (piping) soil material through the embankment or foundation. As the soil material is removed, voids can be created, allowing ever-increasing amounts of water to flow through the embankment or foundation until the dam collapses due to the internal erosion. Seepage that increases with an increase in pool elevation is an indication of a potential problem and if it is stained or muddy water. Foundation and embankment drainage systems can alleviate the seepage problem by removing the water without allowing soil particles to be transported out of the dam. FRS No. 4 shows no visible signs of seepage along the downstream toe of the dam. There is a tree with some debris below it located within the auxiliary spillway channel; however, it does not present a significant risk of seepage since it is not located on the downstream slope. The

embankment has generally been kept clear of trees and brushy vegetation. Therefore, in the near future, seepage presents a low potential mode of failure for FRS No. 4.

Seismic: The integrity and stability of an earthen embankment are dependent on the presence of a stable foundation. Foundation movement through consolidation, compression, or lateral movement can create weak zones or voids within an embankment, separation of the principal spillway conduit joints, or in extreme cases, complete collapse of the embankment.

According to United States Geological Survey national seismic hazard maps, FRS No. 4 is located in an area where the peak ground acceleration (PGA) is estimated as 0.05g for 2 percent probability of exceedance in 50 years. There are no indications that any foundation movement has occurred in the past that would weaken the integrity of the embankment or any of the components of the structure, and none is anticipated in the future. Seismic activity creates only a low potential for failure of FRS No. 4.

Embankment Slope Failure: An embankment slope failure allows increased saturation and weakens the integrity of the dam during the PMF and could result in a catastrophic failure. Slope failure can also create slides and sloughing that lower the top of dam elevation so that overtopping may occur during the PMF.

FRS No. 4 shows no visible signs of slope failure, sloughing, or any other noticeable indications of embankment instability. Embankment slope failure presents a low potential mode of failure for FRS No. 4, but it should continue to be monitored in the future.

Material Deterioration: Material used in the principal spillway system and fences are normal, common construction materials, but they are subject to weathering and chemical reaction due to natural elements within the soil, water, and atmosphere. Concrete components can deteriorate and crack, metal components can rust and corrode, and leaks can develop. Embankment failure can occur from internal erosion caused by these leaks.

Based on available information and field observations, the structure appears to be in good condition with no evidence of deterioration on any of the materials that would require structural repair at this time. As a result, the potential for failure of the existing dam due to deteriorating components is determined to be low. However, due to the age of existing structural components, FRS No. 4 should continue to be monitored annually and after significant storm events.

5.12 CONSEQUENCES OF DAM FAILURE

All of the structural components of the dam appear to be in good condition. However, the dam does not meet current performance and safety standards for a dam in this hazard classification, and there is a risk of the dam failing from overtopping. An analysis of the dam indicated that a storm of the magnitude of the 6- hour FBH event would overtop the dam. The risk of dam failure is low but the consequences of a failure, if it were to occur, would likely be catastrophic.

Forty residences as well as motorists on FM 1387, three residential streets and multiple rural roads would be at risk in the event of a breach. Vehicles on the roads would be washed downstream, and the road surfaces would be damaged and impassable. Traffic would be disrupted for an extended time while the roadways were being repaired. Given the number of properties and vehicles located within the breach zone, it is estimated that at a minimum the number of people at risk due to a breach of FRS No. 4 would be 189. Table G shows the effects of a breach of FRS No. 4 on downstream properties and crossings (figures 2 to 5).

Table G: Effects of Breach of FRS No. 4 to Downstream Properties and Crossings

Downstream Properties/Crossings	Depth Above First Floor Elevation (ft)	Depth Over Crossing (ft)	Daily Traffic Count	Maximum Velocity (ft/s)
40 residences	≤ 5	-	-	-
21 barns/outbuildings	≤ 6	-	-	-
FM 1387	-	6.0	11,606	14
Lon Hayes Road	-	7.0	Not Available	10
Lynnie Pennie Street	-	5.0	Not Available	5
Clinton Lane	-	4.5	1,089	5

Figure 2 FM 1387 would be inundated by about 6 feet of floodwaters during a breach of Chambers Creek FRS No. 4 (seen on the right

Figure 3 Lon Hayes Road would be inundated by about 7 feet of floodwaters during a breach of Chambers Creek FRS No. 4

Figure 4 Lynnie Pennie Street would be inundated by about 5 feet of floodwaters during a breach of Chambers Creek FRS No. 4.

Figure 5 Clinton Lane would be inundated by about 4.5 feet of floodwaters during a breach of Chambers Creek FRS No. 4

6.0 FORMULATION AND COMPARISON OF ALTERNATIVES

The alternatives were developed with the stated objectives in mind, primarily to 1) modify the dam to comply with NRCS dam safety criteria, and 2) maintain or increase the existing level of flood protection provided during the 100-year storm event. These objectives can be achieved by installing dam rehabilitation measures. In rehabilitating the dam, the risks to life and property from a potential catastrophic dam failure will be mitigated.

6.1 FORMULATION PROCESS

Formulation of the proposed alternatives for Chambers Creek 4 followed procedures detailed in the NRCS *National Watershed Program Manual*. Alternatives are eligible for financial assistance under the Watershed Protection and Flood Prevention Act (PL 83-566) as amended by the Watershed Rehabilitation Amendments of 2000 (Public Law 106-472). To be eligible for federal assistance, an alternative must meet the requirements as contained in the Watershed Rehabilitation Amendments of 2000.

A 100-year evaluated life and 101-year period of analysis were established. The high-hazard structure has the same design requirements and construction costs for all operation life increments between 50 and 100 years. Therefore, the greatest net benefit under this condition would be the 100-year operation life and no additional analysis was performed for other time increments. All alternatives were planned to function for a minimum of 100 years with proper maintenance.

Ellis-Prairie Soil and Water Conservation District is the entity that owns the easements for the dam and is responsible for determining what action to take if the dam is not brought up to current performance and safety standards. The Ellis-Prairie Soil and Water Conservation District currently owns easements up to two foot above the existing auxiliary spillway crest. Any additional land below the proposed top of dam will be located in the upstream headwaters of the reservoir, and development in those areas must be restricted by proper floodplain administration.

The “Future Without federal Investment” alternative serves as a baseline to evaluate the other alternatives. It represents the most probable future conditions in the absence of a federally assisted project. Based on conditions set forth by the Future Without Federal Investment baseline, present conditions were developed. The dam does not meet current safety standards for a dam in this location, and there is a risk of the dam failing from overtopping. An analysis of the dam indicated that the 6-hour Freeboard Hydrograph (FBH) event would overtop the dam. In addition, the dam is not capable of passing the required 75% TCEQ PMF without overtopping. Thus, in the absence of updated guidance, the baseline conditions assume the dam is not in place, since the dam would be expected to fail at some point in the future.

Appendix C-11 (Breach Inundation Map) depicts the area that could be flooded if the dam breached under fair weather conditions with the water surface in the reservoir static at the top of dam elevation, per Technical Report 210-60 guidelines.

Failure of the dam could result in significant damage and risk to loss of life. The Ellis-Prairie Soil and Water Conservation District considered the following options in deciding the most likely course of action:

- Take no action and accept the risk of potential dam failure.
- Decommission (breach) the dam to eliminate the risk of failure from an extreme storm event.
- Modify the dam to comply with current dam safety standards without Federal assistance.
- Modify the dam to comply with current dam safety standards with Federal assistance.

After considering the options, the District decided that their best option in the absence of Federal assistance is a true no-action alternative and accept the risk of damages from failure.

Alternatives eligible for financial assistance under the Watershed Protection and Flood Prevention Act (PL 83-566) as amended by the Watershed Rehabilitation Amendments of 2000 were developed. To be eligible for federal assistance, an alternative must meet the requirement as contained in 16 U.S.C. Section 1012 (Public Law 83-566, as amended).

Among three rehabilitation alternatives that were developed, Alternative No. 3 was selected. The alternative was chosen based on its benefit-cost ratio, which was the largest among the evaluated alternatives, as well as its relatively low capital costs.

6.2 ALTERNATIVES CONSIDERED BUT ELIMINATED FROM DETAILED STUDY

A wide range of non-structural and structural measures were considered singly and in combination during the planning process. Considered alternatives included floodplain management, and liability insurance. These alternatives were eliminated either due to exorbitant costs or because they did not meet the purpose and/or need of the project.

In addition, a range of rehabilitation alternatives were considered in order to develop the final list of alternatives. Many combinations of principal spillway, auxiliary spillway, and dam raise modifications were considered and are shown in Table H.

Table H: Alternatives Development Matrix for Chambers Creek FRS 4

Alternative ID	Principal Spillway	Auxiliary Spillway		Dam Raise (ft)
	Conduit Diam. (in.)	Total Width (ft)	Crest Elev. (ft)	
A1	30	50	730.0	2.4
A2		75		1.7
A3		100		1.2
A4		170 (structural)		0.0
B1	36	50	729.6	2.1
B2		75		1.4
B3		100		0.9
C1	42	50	729.2	1.8
C2		75		1.1
C3		100		0.5
D1	48	50	728.7	1.4
D2		75		0.7
D3		100		0.1
E1	54	50	728.3	1.1
E2		75		0.3

E3		100		0.0

One non-structural alternative considered was the purchase of deed restrictions of all land outside of the current 100-year floodplain and within the breach area and relocating residences within the breach area. Enacting this alternative would not necessarily result in the dam being reclassified as a low-hazard structure, since population as risk would still be associated with the downstream roadways. This alternative was rejected due to high cost of acquisition and loss of flood prevention benefits. The estimated cost of this alternative is at least $7.0 million, based solely on the estimated average value of single-family residences, mobile homes and commercial structures in the economic analysis and the number of structures within the breach area.

6.3 DESCRIPTION OF ALTERNATIVE PLANS CONSIDERED

Alternative No. 1 – No Federal Action/Future Without Federal Investment

Under this alternative, no additional federal funds would be expended on the project. Alternative #1 is a true no-action alternative in which no rehabilitation measures take place. The dam would remain in its current configuration with regular maintenance continuing. The current level of flood protection would remain, though the overtopping risk associated with the dam not passing the state and federal requirements would also remain. Repairs would need to be made to maintain the existing spillways and upstream and downstream slopes on an as-needed basis, such as if significant erosion occurred.

The estimated cost to implement this alternative is $0.

Alternative No. 2 – Dam Decommissioning

This alternative consists of removing the ability of the dam to impound water and reconnecting, restoring, and stabilizing the upstream reservoir area/sediment pool and downstream floodplain functions. Channel work would be performed to reconnect the stream channel through the sediment pool and vegetation would be established along the stream channel. A grade stabilization structure would be installed to prevent head cutting and sediment movement to the downstream areas. Exposed areas within the sediment pool would be vegetated for erosion and sediment control. Though the complete removal of the embankment is sometimes required for decommissioning, only partial removal of the embankment was assumed in this alternative. Partial removal of the embankment would consist of excavating a breach in the dam of sufficient size to safely pass the 100-year, 24-hour flood event with no influence on the water surface profile. This would eliminate the structure's ability to impound water.

The remaining portion of the embankment and the land currently covered by the sediment pool would be maintained as a greenbelt area. The excavated material (about 37,000 cubic yards) would be placed in the sediment and detention pool areas and all exposed areas would be vegetated as needed for erosion control (approximately 12 acres). Due to the lack of a defined bed and bank, channel work would be required to reconnect the stream channel through the sediment pool. Riparian vegetation would be established along the swale (approximately 1,920 feet of stream length). In order to not impede flows through the breached embankment, the principal spillway components would be removed. Construction activities will require that a SWP3 be in effect.

Since the 100-year inundation area (modeled for the purposes of this plan) would be enlarged from 114 acres to 139 acres due to the absence of flood attenuation, potential present and future downstream development would be affected by the increased flood profiles. Warning lights would need to be installed

at fifteen stream crossings of bridges and culverts. Floodwaters from a 100-year storm event without the dam would overtop FM 1387 by approximately 1.5 feet, Lon Hayes Drive by approximately 2.7 feet. In the 100-year storm event, a total of four bridges and eleven culverts are impacted by Alternative No. 2. Several of these bridges would not be overtopped above the deck but are predicted to experience damage according to the methodology used in the economic analysis. Thirty-three houses, three mobile homes, seven commercial structures and thirty-seven barns/outbuildings would be subjected to flooding from a 100-year event without the dam.

The estimated cost to implement this alternative is $2,105,200.

Alternative No. 3 – Dam Rehabilitation

This alternative consists of replacing the existing principal spillway with a standard intake riser with a 30-inch diameter pipe with an impact basin at the outlet end. The existing principal spillway needs to be replaced in order to meet requirements of the Principal Spillway Hydrograph (PSH) and facilitate the discharge of the design storm event. The auxiliary spillway crest will be raised by 0.4 feet while maintain the existing width of 50 feet. The existing auxiliary spillway configuration passes stability and integrity analysis. The top of the dam will be raised an average of 2.4 feet and the downstream slope flattened from 2:1 to 3:1 using fill material from the surrounding area. The dam will be lengthened by approximately 160 feet. All disturbed areas in or adjacent to the existing embankment, abutment areas, auxiliary spillway and sediment pool will be re-vegetated using adapted and/or native species, and construction activities will require that a SWP3 be in effect.

The estimated cost to implement this alternative is $3,221,900 and a conceptual figure representing this alternative is included in Appendix C-15.

Alternative No. 4 – Dam Rehabilitation

This alternative consists of replacing the existing principal spillway with a standard intake riser with a 30-inch diameter pipe. The existing principal spillway needs to be replaced in order to meet requirements of the Principal Spillway Hydrograph (PSH) and facilitate the discharge of the design storm event. The embankment will extend through the existing earthen auxiliary spillway preventing any discharge through this structure, thus, a structural spillway will be constructed. The structural spillway consists of roller compacted concrete (RCC) over the embankment along the existing principal spillway alignment with a stilling basin on the downstream end. The RCC spillway will be 170 feet-wide and has a crest elevation of 730.0 ft to allow for full passage of the design storm. Due to the discharge capacity of the structural spillway, the top of the dam will be kept at the existing elevation while the downstream slope is flattened from 2:1 to 3:1 using fill material from the surrounding area. All disturbed areas in or adjacent to the existing embankment, abutment areas, auxiliary spillway and sediment pool will be re-vegetated using adapted and/or native species, and construction activities will require that a SWP3 be in effect.

The estimated cost to implement this alternative is $6,802,200 and a conceptual figure representing this alternative is included in Appendix C-16.

Alternative No. 5 – Dam Rehabilitation

This alternative consists of replacing the existing principal spillway with a standard intake riser with a 36-inch diameter pipe with an impact basin at the outlet end. The existing principal spillway needs to be replaced in order to meet requirements of the Principal Spillway Hydrograph (PSH) and facilitate the discharge of the design storm event. The auxiliary spillway crest will maintain the existing width of 50 feet

and crest elevation of 736.7 ft. The top of the dam will be raised an average of 2.1 feet and the downstream slope flattened from 2:1 to 3:1 using fill material from the surrounding area. The dam will be lengthened by approximately 160 feet. All disturbed areas in or adjacent to the existing embankment, abutment areas, auxiliary spillway and sediment pool will be re-vegetated using adapted and/or native species, and construction activities will require that a SWP3 be in effect.

The estimated cost to implement this alternative is $3,234,700 and a conceptual figure representing this alternative is included in Appendix C-17.

6.4 NATIONAL ECONOMIC EFFICIENCY ALTERNATIVE

For water and related land resources implementation studies, standards and procedures have been established in formulating alternative plans. These standards and procedures are found in the *Principles, Requirements, and Guidelines for Water and Land Related Resources Implementation Studies and Federal Water Resource Investment, 2017 (PR&G)*. According to PR&G, Federal investment in water resources should strive to maximize public benefits, with appropriate consideration to cost and an alternative that reasonably maximizes net national economic efficiency is to be formulated. This alternative is to be identified as the national economic efficiency (NEE) , previously known as the national economic development (NED). During the process of formulating alternatives, the NEE alternative was determined to be Alternative No. 3. Further discussion is included in Section 9.1, and a summary of the alternative plans is included in Table I and Table J. Moreover, the Future without Federal Investment, Alternative #1, is a true no-action alternative in which no rehabilitation measures take place, hence, it does not meet state and federal dam safety regulation making this alternative no viable as the NEE alternative.

Table I: Summary and Comparison of Alternative Plans for Chambers Creek FRS No. 4

Resource Concerns	Alternative 1 (Future without Federal Investment)	Alternative 2 (Decommissioning)	Alternative 3 (Rehabilitation) (NEE) (Recommended)	Alternative 4 (Rehabilitation)	Alternative 5 (Rehabilitation)
NEE Account[1]					
Project Investment	$0	$2,105,200	$3,221,900	$6,802,200	$3,234,700
Annual Benefits	$0	$0	$126,600	$126,300	$124,500
Annual Costs	$0	$60,000	$96,800	$193,900	$96,400
Net Benefits	$0	-$60,000	$29,700	-$67,600	$28,000
EQ Account[2]					
Air Quality	No change to air quality.	Only temporary minor impacts due to construction activities, such as increased dust, exhaust, etc.; not anticipated to exceed air quality standards.			
Fish and Wildlife Resources	Fish & wildlife habitat maintained, sediment pool remains the same, will continue to capture sediment and attenuate floodwater.	Converts the 12 acres of sediment pool to unimproved riparian area. Riparian vegetation established.	Fish & wildlife habitat maintained, sediment pool remains the same, will continue to capture sediment and attenuate floodwater.		
Prime Farmland (FPPA)	No changes to prime farmland. In the event of a breach, prime farmlands downstream would be impacted.	Approximately 0.5 acres of Farmland of Statewide Importance are located within the maximum extent of potential disturbance that could potentially be impacted by construction activities.			
Riparian Area	No changes to riparian area. In the event of a breach, riparian area downstream will be impacted with sediments.	Same as Fish & Wildlife Resources above, increases riparian area.	Minor temporary impacts during construction (disturbance, dust, exhaust, etc.), riparian area returned to pre-construction condition.		
Water Bodies (Including Waters of the U.S.)	No changes to the sediment pool. In the event of a breach,	Converts 12 acres of sediment pool to approx. 1,500 feet of ephemeral	Sediment pool retained. Most likely authorized by NWP 3 without PCN.		

Resource Concerns	Alternative 1 (Future without Federal Investment)	Alternative 2 (Decommissioning)	Alternative 3 (Rehabilitation) (NEE) (Recommended)	Alternative 4 (Rehabilitation)	Alternative 5 (Rehabilitation)
	sediment pool will be lost.	stream, most likely authorized by NWP 27.			
Wetlands	No changes to wetlands downstream. In the event of a breach, downstream wetlands will be impacted.	Change in wetland types. Re-establish riparian areas along 1,500 feet of ephemeral stream with associated wetlands.	Minor temporary impacts during construction (disturbance, dust, exhaust, etc.); wetlands return to pre-existing conditions.		
Wildlife Community (Incl. Migratory Birds)	No changes to wildlife communities. In the event of a breach, downstream habitat for wildlife and birds may be impacted.	Decreases 12 acres of open water habitat during and after storm events and increases unimproved riparian area.	Temporary impacts, disturbance during construction; maintains sediment pool and attenuates flows in downstream ephemeral stream.		
Water Quality	No changes to water quality. In the event of a breach, water quality may be temporarily impacted by sediments.	Increased sediment loads could occur downstream. Efforts would be made to stabilize existing sediment and to prevent head cutting. SWP3 in effect during construction.	Minor temporary impacts during construction (turbidity, sediment, etc.), SWP3 in effect during construction.		
Sedimentation and Erosion	No changes to sediments or erosion patterns. In the event of a breach, sediment and erosion downstream would be expected.	Minor erosion during and after construction. Loss of sediment pool increases sedimentation downstream.	Minor erosion during construction. Sediment pool has sufficient storage for evaluated 100-year life.		
RED Account[3]					
Land Values	No changes to land values. In the event of a breach, land values downstream may decrease.	Negative impact to properties not currently in floodplain due to induced flood damages,	No changes to land values.		

Resource Concerns	Alternative 1 (Future without Federal Investment)	Alternative 2 (Decommissioning)	Alternative 3 (Rehabilitation) (NEE) (Recommended)	Alternative 4 (Rehabilitation)	Alternative 5 (Rehabilitation)
		approximately an additional 25 acres.			
OSE Account[4]					
Public Health & Safety	Public health and safety will continue to be at risk of a breach.	Reduced threat to loss of life from breach, but more frequent flooding.	Reduced threat to loss of life. Level of flood protection maintained with minimal change to existing conditions.		
Flood Damages	In the event of a breach, downstream homes and buildings would be damaged.	Downstream flood damages would increase.	Level of flood protection maintained with minimal change to existing conditions.		
Environmental Justice	Affected populations downstream of the dam would be at risk in the event of a breach.	Loss of flood protection for affected population below dam regardless of economic status.	Flood protection maintained with minimal change to existing conditions for affected population.		
Floodplain Management	No changes to floodplain. Level of flood protection would decrease.	Regulatory BFEs exist downstream. Letter of Map Revision (LOMR)	Level of flood protection maintained with minimal change to existing conditions.		

[1] NEE – National Economic Efficiency previously known as National Economic Development
[2] EQ – Environmental Quality
[3] RED – Regional Economic Development
[4] OSE – Other Social Effects

Table J: Project Alternatives and Associated Ecosystem Services for Chambers Creek FRS No.4

Resource Concerns	**Alternative 1 (Future without Federal Investment)**	**Alternative 2 (Decommissioning)**	**Alternative 3 (Rehabilitation) (NEE[1]) (Recommended)**	**Alternative 4 (Rehabilitation)**	**Alternative 5 (Rehabilitation)**
Alternatives					
Locally Preferred			X		
Non-Structural					
Environmentally Preferable		X			
Brief Description of Major Project Features	No change to project features.	Excavate breach in embankment and reconnect stream channel through sediment pool. Establish riparian vegetation along swale.	Replace principal spillway. Raise auxiliary spillway crest. Raise top of dam and flatten downstream slope.	Replace principal spillway. Replace existing auxiliary spillway with RCC structural spillway.	Replace principal spillway. Maintain existing auxiliary spillway. Raise top of dam and flatten downstream slope.
Total Project Investment					
Project Investment	$0	$2,105,200	$3,221,900	$6,802,200	$3,234,700
Annual Costs	$0	$60,000	$96,800	$193,900	$96,400
Monetized Net Benefits					
Annual Benefits	$0	$0	$126,600	$126,300	$124,500
Net Benefits	$0	-$60,000	$29,700	-$67,600	$28,000
Provisioning Services					
Endangered and threatened species	No Effect	No Effect	No Effect	No Effect	No Effect
Invasive species	No Effect	Invasive species management performed during construction	Invasive species management performed during construction	Invasive species management performed during construction	Invasive species management performed during construction
Riparian areas	No Change	Return to natural ephemeral stream condition; riverine	Maintain impounded waterbody; lacustrine	Maintain impounded waterbody; lacustrine	Maintain impounded waterbody; lacustrine

Resource Concerns	Alternative 1 (Future without Federal Investment)	Alternative 2 (Decommissioning)	Alternative 3 (Rehabilitation) (NEE[1]) (Recommended)	Alternative 4 (Rehabilitation)	Alternative 5 (Rehabilitation)
Regulating Services					
Floodplain management	No Change	Stabilizes and restores stream function; revise FEMA flood maps	Level of flood protection maintained with minimal change to existing conditions	Level of flood protection maintained with minimal change to existing conditions	Level of flood protection maintained with minimal change to existing conditions
Public health and safety	No Change	Minimum impact to downstream communities from loss of protection	Maintain flood protection	Maintain flood protection	Maintain flood protection
Waters of the United States	No Change	Conversion of 12 acres of sediment pool to unimproved stream; increased sediment loads could occur downstream	Minor temporary impacts during construction	Minor temporary impacts during construction	Minor temporary impacts during construction
Supporting Services					
Nutrient Cycling	Dam remains in place and reduces downstream nutrient transfer	Short term release of trapped nutrients downstream and long term trend to riverine system with downstream nutrient transfer	Dam remains in place and reduces downstream nutrient transfer	Dam remains in place and reduces downstream nutrient transfer	Dam remains in place and reduces downstream nutrient transfer
Soil Formation	Downstream migration of sediment is prevented by the dam structure	Dam removal would result in downstream migration of sediment	Downstream migration of sediment is prevented by the dam structure	Downstream migration of sediment is prevented by the dam structure	Downstream migration of sediment is prevented by the dam structure
Primary Production	Perennial hydrology supports primary production (algae, cyanobacteria, macrophytes)	Return to ephemeral stream – primary production is reduced with the loss of a perennial waterbody	Perennial hydrology supports primary production (algae, cyanobacteria, macrophytes)	Perennial hydrology supports primary production (algae, cyanobacteria, macrophytes)	Perennial hydrology supports primary production (algae, cyanobacteria, macrophytes)
Cultural Services					
Cultural resources	No Effect	No Effect	No Effect	No Effect	No Effect
Fish and wildlife	Recreational value (fishing, boating) maintained for private landowners. Wetlands upstream, open water, and	Recreational value (fishing, boating) removed with dam decommissioning. Loss of open water habitat for	Recreational value (fishing, boating) maintained for private landowners. Wetlands upstream, open water, and	Recreational value (fishing, boating) maintained for private landowners. Wetlands upstream, open water, and	Recreational value (fishing, boating) maintained for private landowners. Wetlands upstream, open water, and

Resource Concerns	**Alternative 1 (Future without Federal Investment)**	**Alternative 2 (Decommissioning)**	**Alternative 3 (Rehabilitation) (NEE[1]) (Recommended)**	**Alternative 4 (Rehabilitation)**	**Alternative 5 (Rehabilitation)**
	riparian habitat within the project area are maintained.	fish and wildlife species and wetlands upstream may cause fish and wildlife species to relocate to adjacent areas. Natural stream condition will be restored.	riparian habitat within the project area are maintained.	riparian habitat within the project area are maintained.	riparian habitat within the project area are maintained.
Water quality	No Change	Sediment releases downstream	Minimal temporary impacts during construction	Minimal temporary impacts during construction	Minimal temporary impacts during construction
Regional Economic Impacts	No Effect	Temporary benefits to local economy during construction	Temporary benefits to local economy during construction	Temporary benefits to local economy during construction	Temporary benefits to local economy during construction

[1] NEE – National Economic Efficiency previously known as National Economic Development

Table K. Consideration of PR&G Guiding Principles for Chambers Creek FRS No. 4

PR&G GUIDING PRINCIPLES	Alternative 1 (Future without Federal Investment)	Alternative 2 (Decommission-ing)	Alternative 3 (Rehabilitation) (NEE/NED) (Recommended)	Alternative 4 (Rehabilitation)	Alternative 5 (Rehabilitation)
Healthy and Resilient Ecosystems	Maintain current ecological function of reservoir for fish and wildlife habitat	Return stream's ecological function to pre-impoundment conditions following decommissioning of dam and partial embankment removal	Maintain current ecological function of reservoir for fish and wildlife habitat	Maintain current ecological function of reservoir for fish and wildlife habitat	Maintain current ecological function of reservoir for fish and wildlife habitat
Sustainable Economic Development	No Effect	Complies with sustainable use and management of water resources through return to natural conditions	Complies with sustainable use and management of water resources through maintaining flood protection and recreation	Complies with sustainable use and management of water resources through maintaining flood protection and recreation	Complies with sustainable use and management of water resources through maintaining flood protection and recreation
Floodplains	The dam would remain in its current configuration. The current level of flood protection would remain	The 100-year inundation area downstream would increase from 114 acres to 139 acres (an increase of 17.9%)	The 100-year inundation area downstream would be reduced, but only by an insubstantial amount	The 100-year inundation area downstream would be reduced, but only by an insubstantial amount	The 100-year inundation area downstream would be increased from 113.8 acres to 114.0 acres (an increase of 0.2%)
Public Safety	The current level of flood protection would remain, though the overtopping risk associated with the dam not passing the state and federal requirements would also remain	Impacted residences in the 100-year floodplain would increase from 23 to 36, with the total number of impacted structures increased from 55 to 80. The number of impacted roads would increase from 14 to 15.	Reduced threat to loss of life with flood protection maintained	Reduced threat to loss of life with flood protection maintained	Reduced threat to loss of life with flood protection maintained
Environmental Justice	Affected populations downstream will continue to be at risk of a dam breach	Loss of flood protection for affected population below dam regardless of economic status	Flood protection maintained with minimal change to existing conditions for affected population	Flood protection maintained with minimal change to existing conditions for affected population	Flood protection maintained with minimal change to existing conditions for affected population
Watershed Approach	Maintain ecological function of Waxahachie Creek and Brazos River system	Decommissioning of dam could improve ecological function of Waxahachie Creek and Brazos River system	Maintain ecological function of Waxahachie Creek and Brazos River system	Maintain ecological function of Waxahachie Creek and Brazos River system	Maintain ecological function of Waxahachie Creek and Brazos River system

7.0 ENVIRONMENTAL CONSEQUENCES

Five alternative plans were considered and evaluated in detail, including the No Federal Action/Future without Federal Investment Alternative. The Environmental Consequences section describes the environmental effects of the existing conditions of the project area and alternative plans considered.

Summary of Special Environmental Concerns Not Within the Affected Environment and Excluded from Consequences Analysis.

- Coastal Zone Management Areas
- Wild and Scenic Rivers
- Clean Air Act – Regional Haze Regulations
- Essential Fish Habitat
- Coral Reefs
- Bald and Golden Eagle Protection Act
- National Historic Landmarks Program
- Scenic Beauty and Visual Resources

7.1 SPECIAL ENVIRONMENTAL CONCERNS

Soils

Existing Conditions: There are approximately 0.5 acres of Farmland of Statewide Importance located within the maximum extent of potential disturbance of Chambers Creek FRS No. 4 that would potentially be impacted by construction activities.

Alternative No. 1 - No Federal Action/Future without Federal Investment: There would be no effect to soils. The dam would continue to exist in its current state. The risk of a dam breach would persist. In the event of a dam breach, sediment from the sediment pool would be released downstream.

Alternative No. 2 - Dam Decommissioning: Under the Dam Decommissioning Alternative, approximately 37,000 cubic yards of excavated materials will be placed in the present easement area of the dam. Portions of the embankment and the land covered by the sediment pool will be maintained as a greenbelt. Native vegetation will be established along the disturbed areas.

Alternatives No. 3, 4, 5, - Dam Rehabilitation Alternatives: The Dam Rehabilitation Alternatives would require borrow material to raise the top of dam and auxiliary spillway may be taken from nearby borrow source. The actual acres that will be disturbed will be determined by the design process but will not exceed the designated limits of Farmland of Statewide Importance. After construction is complete, disturbed areas will be revegetated with native or adapted plant species.

Cumulative Impacts: Ground disturbing activities and the movement of construction vehicles and equipment during the proposed actions would contribute to minor temporary impacts and loss of soils. The impacts would be incremental to other regional effects occurring as a result of increased residential and commercial developments, and ongoing agricultural land uses. Soil effects in the long term as a results of the project would be considered minor.

Water

Clean Water Act

Sections 303(d) and 305(b)

Existing Conditions: The 2020 Texas Integrated Report of Surface Water Quality for the Clean Water Act Sections 305(b) and 303(d) was released in May 2020, lists one impairment (Sulfate in the water) within the Bardwell Reservoir (Stream Segment 0815), which impounds Waxahachie Creek. The proposed project site was surveyed by FNI engineers on June 3, 2020. No wetlands were observed near the dam embankment, auxiliary spillway, downstream stilling basin, or around the project area.

Alternative No. 1 - No Federal Action/Future without Federal Investment: Under this alternative, no additional federal funds would be expended on the project and the dam would remain in its current configuration with regular maintenance continuing. There would be no effects to water quality from construction activities. The risks associated with a dam breach and the dam not passing the state and federal requirements would remain. In the event of a dam breach, there would be temporary impacts to water quality downstream due to sediment release from the sediment pool.

Alternative No. 2 - Dam Decommissioning: This alternative consists of removing the ability of the dam to impound water and reconnecting, restoring, and stabilizing the upstream reservoir area/sediment pool and downstream floodplain functions. Channel work would be performed to reconnect the stream channel through the sediment pool and vegetation would be established along the stream channel. There may be temporary impacts to water quality downstream due to the sediment release related to breaching of the dam. Erosion and sediment control measures would be implemented to minimize impacts to water quality during construction and meet the appropriate water quality standards.

Alternatives No, 3, 4, 5 - Dam Rehabilitation: There may be temporary impacts to water quality downstream due to the sediment disturbance from earth moving and construction-related activities. With the required erosion and sediment control measures in place during construction, downstream impacts to water quality should be minimal and temporary. Any water releases from the project area are expected to meet the appropriate water quality standards. Streamflow may be temporarily impacted by dewatering activities to rehabilitate the intake tower. Partial dewatering may be necessary to access the dam embankment.

Cumulative Impacts: Sediment release from construction activities related to the rehabilitation or decommissioning of the dam would be temporary and localized to the project area. Impacts to water quality to Chambers or Waxahachie Creek from the dam rehabilitation project are expected to be minor. No long-term impacts on water quality from rehabilitation activities are anticipated. The water quality impacts would be incremental to other regional effects occurring because of increased residential and commercial developments upstream, and ongoing agricultural land uses.

Sections 401 and 404

Existing Conditions: The shorelines of the Chambers Creek FRS No. 4 reservoir pool were visually surveyed by a biologist for wetlands on July 15, 2020. There are wetlands located upstream of the reservoir impoundment. There were no wetlands observed along the shorelines of the reservoir or below the dam at the outfall stilling basin.

Alternative No 1. - No Federal Action/ Future without Federal Investment: There would be no effects to wetlands. The risk of a dam breach would persist. In the event of a dam breach, downstream conditions and

natural resources would be impacted. The wetlands upstream of the impoundment may be impacted due to loss of the reservoir pool.

Alternative No. 2 - Dam Decommissioning: Breach of the dam would permanently lower the water levels of the reservoir. Channel work would be performed to reconnect the stream channel through the sediment pool and vegetation would be established along the stream channel. There may be temporary impacts to water quality downstream due to the sediment releases when the water is drawn down prior to construction related to the dam breach. Wetlands located upstream of the dam may be impacted as the natural conditions and flow of the stream are restored.

Alternatives No. 3, 4, 5 - Dam Rehabilitation: The water levels of the reservoir would be temporarily lowered to facilitate construction activities. Any water releases from the project area are expected to meet the appropriate water quality standards.

Cumulative Impacts: Water levels within the reservoir would be permanently lowered with the No Federal Action/ Future without Federal Investment and Dam Decommissioning Alternatives. No long-term impacts to WOTUS, including wetlands, from rehabilitation activities are anticipated. No long-term impacts on water quality from rehabilitation activities are anticipated. The water quality impacts would be incremental to other regional effects occurring because of increased residential and commercial developments upstream, and ongoing agricultural land uses.

Floodplain Management

Existing Conditions: The TCEQ administers the National Flood Insurance Program for the State of Texas and maintains a list of local floodplain administrators. The local administrators have the responsibility of reviewing potential floodplain modifications within their jurisdiction. The floodplain of Chambers Creek is managed by the floodplain administrator at the City of Midlothian.

Alternative No. 1 - No Federal Action/ Future without Federal Investment: There would be no changes to the floodplain. The dam would continue to exist in its current state. The risk of a dam breach would persist. In the event of a dam breach, there would be flooding downstream.

Alternative No. 2 - Dam Decommissioning: Alternative No. 2 utilizes federal to funds to remove the ability of the dam to impound water and reconnects, restores, and stabilizes the stream and floodplain functions. The 100-year inundation area downstream would increase from 114 acres to 139 acres. Regulatory BFEs exist for the downstream area along Waxahachie Creek. A CLOMR may be required from FEMA post-construction to revise effective FIRMs and show changes to the floodplains and/or flood elevations.

Alternatives No. 3, 4, 5 - Dam Rehabilitation: Rehabilitation activities will enlarge the 100-year floodplain downstream of the dam within the project area by approximately 161 acres, from 1,047 acres to 1,208 acres. These acreages were newly developed for the purposes of this Supplemental Watershed Plan to compare existing and proposed rehabilitation conditions. A CLOMR may be required from FEMA post-construction to revise effective FIRMs and show changes to the floodplains and/or flood elevations.

Cumulative Impacts: The Dam Decommissioning and Rehabilitation Alternatives would have long-term impacts on the floodplain and flooding severity and frequencies downstream of the reservoir.

Air

Existing Conditions: According to the TCEQ, Ellis County is categorized as attainment for all NAAQS except ozone. Air quality is satisfactory and below the National Ambient Air Quality Standards for particulate matter. Emissions from construction related activities are expected to result in de minimis and

would not require Nonattainment New Source Review (NNSR) and Prevention of Significant Deterioration (PSD) permits for air emissions.

Alternative No. 1 – No Federal Action/Future without Federal Investment: There would be no change to air quality. Ellis County would continue to be in attainment status for all NAAQS except for ozone.

Alternative No. 2 - Dam Decommissioning: During the decommissioning of the dam, particulate matter and air pollutant emissions from earth moving activities and operation of construction vehicles will increase. Although there would be a temporary increase in particulate matter, carbon monoxide, nitrogen oxide, and other pollutants from heavy equipment, the proposed work is not expected to violate any federal, state, or local air quality standards. During construction activities, BMPs would be implemented to reduce construction-related emissions. Impacts to air quality is anticipated to be temporary and localized.

Alternative No. 3, 4, 5 - Dam Rehabilitation: During the rehabilitation of the dam, particulate matter and air pollutant emissions from earth moving activities and operation of construction vehicles will increase. The use of a mobile concrete batch plant will generate dust. Although there would be a temporary increase in particulate matter, carbon monoxide, nitrogen oxide, and other pollutants during construction, the proposed work is not expected to violate any federal, state, or local air quality standards. During construction activities, BMPs would be implemented to reduce construction-related emissions. Impacts to air quality is anticipated to be temporary and localized.

Cumulative Impacts: The regional air quality is good and the project area is in attainment for all criteria pollutants except ozone. Cumulative effects to regional and local air quality may result from future construction associated with increased development within the watershed.

Vegetation

Wetlands and Riparian Areas

Existing Conditions: There are riparian areas around the reservoir and along Chambers Creek. No wetlands were identified upstream or downstream of the dam structure during the field survey on June 3, 2020.

Alternative No. 1 – No Federal Action/Future without Federal Investment: There would be no effects to wetlands and riparian areas. The dam would continue to exist in its current state. In the event of a dam breach, riparian and wetland areas downstream of the project area may be impacted by flooding.

Alternative No. 2 - Dam Decommissioning: During the decommissioning of the dam, construction activities would be limited to the dam embankment and around the stilling basin of the dam. Vegetation community and habitat along the reservoir and project area will be temporarily affected. After the completion of construction activities, disturbed areas will be revegetated with native or adapted species. Impacts to habitat and vegetation are expected to be temporary and minor. Wetlands upstream of the reservoir impoundment may decrease in size with the decommissioning alternative, and a return to the natural condition of the stream.

Alternative No. 3, 4, 5 - Dam Rehabilitation: During the rehabilitation of the dam, construction activities would be limited to the dam embankment, auxiliary spillway, and around the stilling basin of the dam. Construction will be limited to the smallest possible extent. Vegetation community and habitat along the reservoir and project area will be temporarily affected. After the completion of construction activities, disturbed areas will be revegetated with native or adapted species. Impacts to habitat and vegetation are expected to be temporary and minor.

Cumulative Impacts: The area around the dam would be regularly maintained by the responsible party. The dam embankment will be regularly mowed to prevent trees from growing along the dam slopes.

Special Status Plant Species

There are no known plant species protected by the ESA within Ellis County. No critical habitat has been designated near the Chambers Creek No. 4 Project Area. A copy of the TPWD and USFWS concurrence letters can be found in Appendix D.

Invasive Plant Species

During the field site visit on June 3, 2020, King Ranch bluestem, an invasive grass species was observed around the project area. Special care will be taken during construction to avoid the spread or introduction of invasive species. Executive Order 13112 established the National Invasive Species Council. The National Invasive Species Management Plan was developed to identify actions to prevent, eradicate, and control invasive species. Clipping and frequent mowing before seed production, prescribed burning during the summer (growing season), and herbicide application are all methods that can be used to suppress the species on a local level. Additionally, disturbed areas will be vegetated with non-invasive species.

7.2 WILDLIFE

Terrestrial Wildlife Communities

The reservoir and adjacent areas could potentially be utilized by several species of migratory birds for feeding, nesting, or roosting. No Bald Eagle nests are located within the project area. There are also several federally listed species that have the potential for occurrence within Ellis County (Table L).

Construction activities would be limited to the dam embankment, auxiliary spillway, and around the stilling basin of the dam. Wildlife community and habitat along the reservoir and project area will be temporarily affected and may locate to adjacent properties. After the completion of construction activities, disturbed areas will be revegetated with native species. Impacts to wildlife are expected to be temporary and minor. Table L summarizes impacts to wildlife communities that would result from the No Action, Dam Decommissioning, and Dam Rehabilitation Alternatives. BMPs or other measures are paired with each impact to reduce or eliminate negative impacts or comply with applicable laws.

Table L: Potential Impacts to Wildlife Communities from No Action, Dam Decommissioning, and Dam Rehabilitation Alternatives for Chambers Creek FRS No. 4

Wildlife Community	Timeframe	Impact Type	Impact Description	BMP or Measures to Comply with Applicable Laws
All	Short term	Direct	Stress, disturbance, and displacement due to construction activities and human presence.	Minimize direct disturbance impacts by completing construction of project components in the shortest practicable timeframe
All	Short term	Direct	Loss of water source	Since the pool level may be drained during construction it may be temporarily unavailable for use to migratory birds and other wildlife. However, there are similarly sized

				bodies of water throughout the region for wildlife usage.
Small mammals, reptiles, and amphibians	Short term	Direct	Direct mortality of small, ground dwelling mammals, reptiles, or amphibians in the construction area, disturbed habitat.	Limit the construction footprint to the smallest area practicable.
Nesting raptors (hawks, falcons, owls)	Short term	Direct	Potential for "take" under the MBTA (loss of eggs or young from nest abandonment) due to construction activities and human presence.	Complete construction outside of the nesting season (March 1 to September 30). If construction occurs within the nesting season, complete a nesting raptor survey and operate outside of the recommended USFWS-approved guidance on buffer distance. If nesting raptors are present within the recommended buffer zone, coordination should be initiated with the local USFWS biologist to adjust the buffer distance if warranted; otherwise work must not proceed until nesting is complete and young chicks have fledged. Cease work if a nesting raptor is discovered within the recommended buffer distance during construction and consult the local USFWS biologist for next steps.
Bald and Golden Eagles	Short term	Direct	Potential for "take" under the MBTA (loss of eggs or young from nest abandonment) due to construction activities and human presence. Potential to interfere with an eagle's "substantial lifestyle, including shelter, breeding, feeding" as defined by the Bald and Golden Eagle Protection Act of 1940.	Bald and Golden Eagles typically use the same nest sites year after year; consult with local USFWS biologists for the most recent understanding of the locations of active nests and operate outside of the recommended buffer distance. If operating heavy machinery inside the recommended buffer distance, operate outside of the nesting season; Bald Eagles may commence nesting as early as January.
Nesting migratory birds	Short term	Direct	Potential for "take" under the MBTA (loss of eggs or young from nest abandonment or direct destruction).	Operate outside of the primary nesting season for migratory birds (March 1 to September 30). Accomplish any vegetation clearing or grubbing prior to the nesting season.

				If planning on vegetation clearing or grubbing during the nesting season, the area must be surveyed by qualified biologists for active nests no more than 2 weeks prior to commencement of the work. If active nests are found during the nest surveys, establish a nest buffer in coordination with USFWS biologist. If an active nest is discovered during construction, stop work and consult the local USFWS biologist for next steps.
All	Long term	Indirect	Introduction of invasive plant species to the construction area causing habitat degradation.	Clean construction equipment and vehicles prior to bringing it onsite. Ensure that borrow material imported to the construction area is not infested with plant species. Ensure seed sources for revegetation are weed-free.

State Protected Threatened and Endangered Species

Suitable habitat for State protected Texas Horned Lizard and Alligator Snapping Turtle exists within the project area. Construction contractors will be trained on the life history, physical description, and habitat preference of the species and follow TPWD recommendations to avoid impacts to state listed and SGCN species during construction, maintenance, and operation activities. Additional information can be found in the TPWD coordination letter found in Appendix D.

7.3 HUMAN ENVIRONMENT

Local and Regional Economy

Existing Conditions: Developed residential areas surround the Chambers Creek FRS No. 4 project area, however the dam and reservoir are located on private property. The property owners utilize the lake for recreational purposes, and access is not provided to the general public.

Alternative No. 1 - No Federal Action/Future without Federal Investment: There would be no effect to the local or regional economy. The dam would continue to exist in its current state. The risk of a dam breach would persist. In the event of a dam breach, the local economy could be negatively affected by flood damage.

Alternative No 2. - Dam Decommissioning: Dam Decommissioning would result in a temporary positive effect on the local economy during construction efforts; however, there would be potentially long-term negative effects to the economy through the loss of flood protection to downstream communities.

Alternative No. 3, 4, 5 - Dam Rehabilitation: There would likely be a temporary positive effect on the local economy during construction and rehabilitation of the dam.

Cumulative Impacts: Same as Dam Rehabilitation.

Public Health and Safety

Existing Conditions: According to the results of the dam breach modeling and inundation mapping performed in conjunction with the development of this plan, a dam failure could result in impact to 40 residential structures, segments of FM 1387, Lon Hayes Road, Lynnie Pennie Street, Clinton Lane, and multiple rural roads.

Alternative No. 1 - No Federal Action/Future without Federal Investment: There would be no immediate effects to public health and safety. The dam would continue to exist in its current state. The risk of a dam breach and flooding downstream would remain for the public downstream of the dam.

Alternative No. 2 - Dam Decommissioning: Under the No Federal Action Alternative, dam decommissioning would result in an increased threat of loss of life and property from flood risk to the downstream community. Residential homes and property would no longer be able to rely on Chambers Creek FRS No. 4 to capture flood waters during extreme precipitation events.

Alternative No. 3, 4, 5, - Dam Rehabilitation: The actions proposed under the rehabilitation alternatives would structurally rehabilitate the dam using current design and safety standards to provide continued flood protection for 100 years following construction of the project. The level of flood protection provided by the dam would remain the same. The threat of loss of life and property from failure of the dam would be greatly reduced. Access to the site will be restricted during the construction period.

Cumulative Impacts: Same as Dam Rehabilitation.

Cultural and Historic Resources

Existing Conditions: Chambers Creek FRS No. 4 is located within the direct Impact Area of Potential Effect of the proposed actions. The dam was built in 1958, and therefore, meets the age requirement to be eligible for National Register consideration due to its age (50+ years old). The assessment of eligibility was performed through consultation with the Texas SHPO, and the dam was deemed ineligible for inclusion in the NRHP, with no effect to historic resources.

Alternative No. 1 - No Federal Action/Future without Federal Investment: There will be no impacts to cultural or historical resources.

Alternative No. 2 - Dam Decommissioning: Dam decommissioning would result in the loss of flood protection capabilities and impacts to the existing dam structure would be minimal.

Alternative No. 3, 4, 5 – Dam Rehabilitation: While no known historic resources have been recorded within the project area, a review of the project's rehabilitation impacts within the APE is ongoing. Through consultation with the Texas Historical Commission (THC), the project was deemed to have no effect on historic or cultural resources. within the APE, as defined in 36 CFR Part 800.5(d)(1).

Cumulative Impacts: Same as Dam Rehabilitation.

Land Use and Recreation

Existing Conditions: The existing land use around the reservoir consists of open rangeland with scattered trees and shrubs, adjacent to developing residential communities. The existing dam and auxiliary spillway are vegetated with grassland plant species. Private residents currently utilize the reservoir for boating and fishing.

Alternative No. 1 – No Federal Action/Future without Federal Investment: The land use is expected to remain the same. The dam would continue to exist in its current state. Recreational opportunities for the private landowners are not expected to change. However, in the event of a dam breach the recreational use of the reservoir will be diminished.

Alternative No. 2 - Dam Decommissioning: Under the No Federal Action and Dam Decommissioning Alternative, the dam will be breached, and the reservoir will no longer hold water. The land use is expected to change as water-based recreational activities such as boating or fishing will be diminished.

Alternative No. 3, 4, 5 - Dam Rehabilitation: Alternatives will consist of a new spillway configuration and stilling basin to be constructed on the embankment. Rehabilitation of the dam would involve clearing of vegetation on the dam and lowering of water levels in the reservoir to facilitate construction. Recreational opportunities, including fishing, may be hindered during the construction period. The lake will be filled following construction and no long-term impacts are anticipated to the fishery.

Cumulative Impacts: The land use is expected to remain the same. Recreational opportunities are not expected to change significantly. Surrounding changes to land use and recreation would remain the same due to private access to the reservoir. Increased residential and commercial development in the area should have no effect on the private use of the reservoir.

Environmental Justice

Existing Conditions: There is an estimated population of 189 people in the breach zone below the dam. The presence or absence of environmental justice groups within the breach inundation zone of the dam was assessed using EPA's EJSCREEN tool (EPA, 2021).

Alternative No. 1 - No Federal Action/Future without Federal Investment: Environmental justice populations will continue to be at risk in the event of a dam breach.

Alternative No. 2 - Dam Decommissioning: The dam decommissioning would result in an increased flood risk to downstream communities regardless of socioeconomic status and without disparate treatment to any individuals or social groups. Residential homes and property would no longer be able to rely on Chambers Creek FRS No. 4 to capture flood waters during extreme precipitation events.

Alternative No. 3, 4, 5 - Dam Rehabilitation: Rehabilitation of Chambers Creek No. 4 and avoidance of a dam breach will have positive economic and social effects across all residents within the upstream and downstream areas of the dam. Since vehicle operators are also significant beneficiaries of the proposed rehabilitation, it is reasonable to conclude that protection of the roads and bridges will benefit all racial, ethnic, and socioeconomic groups within the watershed and downstream of the dam.

There are no known disparate impacts from rehabilitation of a dam. It was explained to residents that rehabilitation of the dam would not enhance their downstream flood protection, but simply maintain the designed level of flood protection while reducing the risk of life and property that might occur from a dam breach.

Approximately 189 people are within the breach inundation zone and would benefit directly from rehabilitation of the dam. Additionally, there may be indirect benefits for the residential communities upstream of the dam who use the area around the reservoir for recreational purposes throughout the year.

7.4 CUMULATIVE EFFECTS

The No Federal Action/Future without Federal Investment Alternative would involve no additional federal funding and the dam would remain in its current configuration with regular maintenance continuing. There would be no change to soils, surface water or water quality, floodplains, air quality, vegetation or wildlife, public health, cultural resources, land use, recreation, or environmental justice populations. The dam decommissioning alternative would have impacts (both adverse and beneficial) on soils, surface water and water quality, floodplains, land use, and recreation. The alternative consists of removing the ability of the dam to impound water and reconnecting, restoring, and stabilizing the upstream reservoir area/sediment pool and downstream floodplain functions. Channel work would be performed to reconnect the stream channel through the sediment pool and vegetation would be established along the stream channel. The proposed rehabilitation alternatives would involve some impacts to the environment, including temporary impacts to soils and vegetation, and permanent impacts to WOTUS. The cumulative effects of this project on the principal resources of concern, along with the social and economic effects, is to maintain the existing social, economic, and environmental conditions of the community. In the selected alternative, the dam would stay in place and provide continued flood protection. The existing Emergency Action Plan will be revised to reflect the higher top of dam elevation. There is an overall positive effect on the downstream residents due to the reduced threat to loss of life and property for a catastrophic breach of the dam. The useful life of the project will be extended by an additional 100 years following construction.

There is only one known proposed project within the watershed which involves a roadway expansion of FM 1387 immediately downstream of the dam. The project has been designed considering that the dam will remain in place; however, if the dam is decommissioned, then the culverts at the roadway crossing will need to be modified.

8.0 CONSULTATION AND PUBLIC PARTICIPATION

The lead sponsoring organization is the Ellis-Prairie Soil and Water Conservation District. The local, state and federal support for the rehabilitation of the Chambers Creek FRS No. 4 has been strong. Thus, multiple meetings were held throughout the project with representatives of the Ellis-Prairie SWCD, NRCS, and TSSWCB to establish their interest and concerns regarding the dam. Moreover, a roadmap for the development of the Supplemental Watershed Plan and Environmental Assessment as well as the public participation was defined.

A key element of the planning process is the solicitation of public comments to identify, understand, and address the issues and concerns of the relevant agencies and the public. The Sponsors' intent during the scoping process was to inform local, state, and federal agencies and the public about the planning process and solicit their comments in order to identify issues and questions to consider when preparing the Supplemental Watershed Plan and Environmental Assessment. During the scoping period, the Sponsors announced the commencement of the planning process through various means, invited written comments, and held a public scoping meeting. Opportunities for the public to participate in the planning process occurred at key milestones throughout the process.

The first stakeholders meeting was held on May 12, 2020. This meeting served as a project kickoff meeting in which the project scope, personnel, schedule, public participation plan were reviewed and discussed. The meeting was attended by representatives of the Ellis County, City of Midlothian, Ellis-Prairie SWCD, NRCS, and TSSWCB.

On June 23, 2020, a public meeting was held in the Midlothian Convention Center to explain the Watershed Rehabilitation Program and to discuss resource problems, issues, and concerns of local residents associated with the FRS No. 4 project area. Invitations to participate in the public meeting were made to potentially affected landowners and interested parties around and below FRS No. 4 and reservoir area. A presentation and handout materials were utilized to provide information to the group. Potential alternative solutions to bring Chambers Creek FRS No. 4 into compliance with current dam safety criteria were presented at the initial meeting.

Additional meetings were held with sponsor, NRCS and TSSWCB on August 18, 2020, August 20, 2020, December 15, 2020, and January 21, 2021. Presentations and handout materials were also utilized to communicate information regarding the status of the study, and the meetings helped to narrow the list of potential rehabilitation alternatives based on input from the affected landowners.

A second public meeting was planned for January 25, 2021, presentations and handouts were prepared to communicate information regarding the status of the study and the proposed rehabilitation alternatives and economic analysis to the public. However, Ellis County officials expressed concerns regarding the critical COVID-19 status in the county, hence, the lead sponsoring organization in agreement with NRCS and TSSWCB officials decided that the public meeting should be replaced by an informational video that summarized all the findings of the study. The video was uploaded to the Ellis County website on February 25, 2021. Additionally, hard copies of the presentation were available until March 15, 2021 at the City of Midlothian's Engineering department, 100 W. Avenue F, Midlothian, Texas 76065. Instructions to download the video, obtain hard copies of the presentation, and provide comments were publicly announced in various newspapers for multiple days.

A final public meeting was held in the Midlothian Conference Center on August 22, 2022, presentations and handouts were utilized to communicate information regarding the status of the study and informed the changes that had been implemented in the Plan after addressing the comments received through the NWMC and National headquarters review process. Invitations to participate in the public meeting were made to potentially affected landowners and interested parties around and below FRS No. 4 and No.6.

While the Natural Resource Conservation Service (NRCS) Texas works to build a relationship with Federally Recognized Tribes (FRT) in this county through establishing Tribal consultation protocols, the NRCS State Conservationist is responsible for inviting Tribes to consult on proposed projects that may impact places of cultural or religious significance and NHPA historic properties. NRCS-Texas recognizes Tribal sovereignty and importance of Tribes' interest in places of cultural or religious significance on ancestral lands, including those on private lands. Tribal coordination was performed in accordance with the NHPA and other related authorities and will be completed by NRCS-TX.

9.0 PREFERRED ALTERNATIVE

Alternative No. 3 is the preferred alternative. The dam will be modified to meet current performance safety standards for a high-hazard dam and the service life of FRS No. 4 will be extended for 100 years. The modification will consist of installing a 30-inch diameter principal spillway pipe with an intake riser. The auxiliary spillway crest will be raised by 0.4 feet, and the width will be maintained at 50 feet. The top of the dam will be raised an average of 2.4 feet, and the downstream slope flattened from 2:1 to 3:1. The dam will be lengthened by approximately 160 feet. The estimated cost to implement this alternative is $3,221,900.

Construction activities will result in the disturbance in or adjacent to the existing embankment, abutment areas, auxiliary spillway, and sediment pool, and will require that a Storm Water Pollution Prevention Plan (SWP3) be in effect. The removal of vegetation will be that necessary to allow rehabilitation of the structure. Disturbed areas will be re-vegetated using adapted and/or native species to reduce erosion.

The Sponsors will develop an Emergency Action Plan (EAP) before any rehabilitation construction activities begin that establishes the responsibilities for the development, implementation, and review of actions necessary to provide safety to individuals downstream of structure should extreme flood occur.

9.1 RATIONALE FOR PLAN PREFERENCE

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

- Reduces the threat to loss of life to approximately 189 people.
- Protects 63 structures within the project area.
- Reduces the threat of loss of access and loss of emergency services for 41 residences and 20 outbuildings.
- Ensures downstream flood protection for residents, as well as others who may work, travel, or use the area for recreation.
- Eliminates the liability of operating a dam which does not meet state and federal requirements.
- Maintains existing stream habitat downstream of the dam.
- Retains the existing aquatic and terrestrial habitat in and around the reservoir.

The preferred alternative meets the Sponsors' objectives of bringing this dam into compliance with current dam design and safety criteria, maintaining the existing 100-yr level of flood protection for downstream properties. Formulation of the alternative plans gave consideration to four criteria: completeness, effectiveness, efficiency, and acceptability. All alternatives meet the criteria for completeness. Alternatives No. 1 and 2 remove the safety hazard of the dam from failing, but they do not address the primary problem of assuring downstream flood protection. Alternatives No. 3, 4, and 5 effectively reduces the risk of dam failure by overtopping and minimizes the change to the level of flood prevention downstream compared to existing conditions. Among the rehabilitation alternatives, the selected alternative – Alternative No. 3 has the highest NEE benefits, and hence, the highest benefit-cost ratio.

9.2 SUMMARY AND PURPOSE

The selected plan consists of structural modifications to FRS No. 4 as follows:

- Replace existing principal spillway pipe and install a 30-inch diameter principal spillway pipe with an intake riser and an impact basin
- Raise the auxiliary spillway by 0.4 feet and maintain width of 50 feet;
- Raise top of dam 2.4 feet and lengthen the dam 160 feet in the right abutment area;
- Flatten downstream embankment slope from 2.5:1 to 3:1;

After the implementation of these planned works of improvement, Chambers Creek FRS No. 4 will meet all current NRCS and TCEQ dam safety performance standards.

9.3 EASEMENTS AND LANDRIGHTS

Land rights for the structure currently exist for the construction, operation, and maintenance of the dam and the storage of water to the elevation two feet above the crest of the earthen spillway based on the original easements procured for the project. The elevation of the crest of the earthen spillway will change for implementation of the recommended alternative. The minimum land rights area was decided by the sponsors to be set to the 100-year elevation, which is the minimum requirement. The sponsors acknowledge the risk associated with this decision. The 100-year elevation is below the elevation of land rights already owned by the local sponsor; therefore, no new land rights need to be obtained in the upstream area. Some property acquisition is required to develop the preferred alternative where the footprint of the dam would be expanded.

The sponsors' rationale for using the minimum requirement for land rights around the reservoir is three-fold: One, NRCS does not require obtaining land rights up to the proposed top of dam elevation. Two, the purchase of these land rights increases sponsor expenses as the item is not cost shareable. Three, there are not currently any habitable structures below the top of dam elevation, so no significant risk is considered to be incurred in present conditions. Additionally, the local sponsors will enact a land use ordinance that prevents future development below the proposed top of dam elevation.

9.4 MITIGATION

An environmental evaluation was performed early in the planning process to determine the potential effects of alternative solutions for meeting the Sponsors objectives to comply with safety and performance standards concerning FRS No. 4. No extraordinary circumstances or significant impacts will result from actions of the preferred alternative. The project would avoid adverse impacts by working while the sediment pool is dry to complete the required rehabilitation measures. Adverse impacts would be minimized by using appropriate erosion control measures in accordance with the SWP3 as filed with TCEQ and posted on site. Rehabilitation activities under the preferred alternative are most likely authorized under Section 404 of the Clean Water Act by Nationwide Permit No. 3 for Maintenance without Pre-Construction Notification. Due to the minor, temporary nature of the impacts, no other appropriate mitigation measures were identified, and no compensatory mitigation would be required as part of the preferred alternative.

9.5 PERMITS AND COMPLIANCE

Potential Permits Needed

U.S. Army Corps of Engineers (USACE) guidelines indicate that any discharge of dredged or fill material into "Waters of the United States" require authorization under Section 404 of the Clean Water Act of 1972. Based on previous consultations with USACE, it appears that any discharges into Waters of the U.S. associated with the rehabilitation of FRS No. 4 may be authorized by a general permit such as Nationwide General Permit No. 3 for Maintenance without a Pre-Construction Notification. It will be the responsibility of the sponsors to comply with the conditions of the general permit during design and construction.

For projects with disturbances equal to or greater than five acres, it is necessary to have a Storm Water Pollution Prevention Plan (SWP3) in place prior to construction of the proposed project and filing a Notice of Intent with the TCEQ is required. A Notice of Termination (NOT) must be filed once the site has reached final stabilization. Construction activities associated with the rehabilitation of FRS No. 4 will require a SWP3.

Compliance with Local, State, and Federal Laws

All applicable local, state, and federal laws will be complied with in the installation of this project.

The preferred alternative involves increasing the principal spillway pipe diameter, and thus the peak discharge from the spillway during a flood event. However, because the existing auxiliary spillway engages in the 100-year event, Alternative No. 3 will reduce total peak 100-year discharge, since the auxiliary spillway will no longer be engaged below the 100-year event. A FEMA Letter of Map Revision (LOMR), effective as of September 2017, exists downstream of FRS No. 4. Zone AE and X are mapped downstream of the dam. An overlay of the mapped Zone AE area with the proposed conditions 100-year flood inundation area indicates that the area modeled for this plan falls outside of the mapped Zone AE area in several locations. However, the proposed peak discharge is reduced compared to the existing peak discharge. Likewise, the modeled inundation area for the 100-year event for the preferred alternative falls within the modeled existing conditions inundation area. Thus, a LOMR will not be required as a result of the rehabilitation.

The proposed project may involve de-watering of the sediment pool for construction activities. The location of the dam and impoundment on private property likely indicates that a survey for State listed threatened or endangered (T&E) mollusks is not required and the development of an Aquatic Resources Relocation Plan (ARRP) to avoid impacts to T&E and/or aquatic species is not required. If a T&E survey and/or an ARRP were required, the cost of these activities will be added to the overall cost of the project at that time and will most likely be cost shared at the appropriate rate.

Efforts to identify cultural resources have been conducted in compliance with Section 106 and Section 110 (f) and (k) of the National Historic Preservation Act. No historic properties were identified in the areas of Alternative No. 3 and no known sites are recorded in the vicinity. Ensuing disturbances associated with rehabilitation measures will be monitored for the presence of undiscovered sites. In the event of such discovery, appropriate actions will be taken in accordance with the State Level Prototype Programmatic Agreement (PPA) among NRCS and the Texas SHPO, the National Programmatic Agreement among NRCS, the National Conference of State Historic Preservation Officers, and the Advisory Council on Historic Preservation, and NRCS General Manual 420, Part 401 guidance.

9.6 COSTS

Public Law 83-566 Funds include NRCS Engineering and Project Administration ($578,800), which are not included when calculating eligible federal cost share. Therefore, federal cost share is based on Total Eligible Project Cost of $2,630,200. The percentages of the eligible project costs including construction, engineering, project administration, and land rights to be paid by the District and the NRCS are shown in Table M.

Table M: Eligible Project Cost FRS No. 4

	Sponsors	NRCS	Estimated Eligible Project cost
Rehabilitation of dam	35%	65%	$2,630,200

An amount up to the percentage rate specified may be satisfied by the District for cost of an element such as engineering, real property acquisition, or construction. The decision to, and arrangements for, such action will be negotiated between the District and NRCS and will be included in a project agreement executed immediately before implementation. NRCS costs will not exceed 100 percent of the construction cost.

NRCS is responsible for the engineering services and project administration costs it incurs. These costs are not used in the calculation of the federal cost share; however, the costs are included in Table 1 - Estimated Installation Cost. Also, costs of water, mineral, and other resource rights, as well as federal, state, and local permits, are the responsibility of the District and are not counted toward local cost share. See Table 2 for a complete distribution of total rehabilitation costs.

9.7 INSTALLATION AND FINANCING

The installation of the project will be financed jointly by the District and the NRCS. NRCS will use funds appropriated for this purpose. Additionally, the District has submitted a grant application to the Texas State Soil and Water Conservation Board (TSSWCB) to supplement the appropriated NRCS funds. The installation schedule indicates that real property rights will be secured during the 2022 fiscal year and construction funding will be requested for fiscal year 2023. The District has the power of eminent domain to secure the real property rights and will serve as the local contracting agent. The duration of construction is approximately 12 months, not including national holidays and weather days.

NRCS will aid the Sponsors with the Chambers Creek FRS No. 4 rehabilitation project. NRCS will be responsible for the following:

- Establish a project agreement with the Sponsors prior to either party's initiation of work utilizing funds of the other party. The agreement will establish in detail the financial and working arrangements as well as other conditions that are applicable to the works of improvement.
- Enact an updated Operation and Maintenance Agreement with the Sponsors that extends the O&M responsibilities for another 100 years after construction. The O&M Agreement will be completed based on the NRCS National Operation and Maintenance Manual.
- Provide financial assistance equivalent to to 65% of the total eligible project costs not exceeding the actual construction costs.
- Verify that a current Emergency Action Plan is completed before construction is initiated.
- Provide consultative engineering support, technical assistance and certification during the project's design and construction.
- Certify completion of all constructed rehabilitation measures.

The sponsors will be responsible for the following:

- Obtain all necessary environmental permits, easements, and rights for the construction, operation and maintenance of the rehabilitated structure.
- Enforce the County's floodplain management to restrict future development below the new top of dam elevation.
- Develop an updated Emergency Action Plan for the dam before construction is initiated.

- Complete a current Operation and Maintenance Agreement with NRCS for the dam. This agreement will be based on the NRCS National Operation and Maintenance Manual.
- Furnish local administrative and contract services necessary for project installation.
- Provide funds from sources other than Public Law 83-566 for cost sharing of the project equal to or greater than 35% of the total eligible project costs.
- Enforce all applicable easements and rights-of-way for the safe operation of the dam.

Memorandum of Understanding

The District and NRCS have entered into a Memorandum of Understanding (MOU) to establish a framework under which the District may proceed with work on specific aspects of the proposed rehabilitation project. Accordingly, that specified work might then contribute towards the Sponsor's 35 percent cost-share obligation.

Project Agreement

The Sponsoring Local Organization (District) responsible for the 35 percent non-federal cost share and the NRCS will enter into a Project Agreement in accordance with the National Contract Grants and Agreement Manual before any work is initiated by either the District or the NRCS.

9.8 OPERATION, MAINTENANCE, AND REPLACEMENT

Operation and Maintenance Agreement

The project will be operated and maintained by the Sponsors. Once FRS No. 4 is rehabilitated, the District will have the primary responsibilities for maintenance of FRS No. 4. A new Operation and Maintenance (O&M) Agreement will be developed with the Sponsors for FRS No. 4 for the 100-year program life of the structure. The new O&M Agreement will be based on the National Operation and Maintenance Manual (NOMM) and will be signed before the Project Agreement is signed. The agreement will specify responsibilities of the Sponsors and include detailed provisions for retention, use, and disposal of property acquired or improved with PL 83-566 cost sharing. O&M activities include but are not limited to inspections, maintenance, replacement of inoperable components, and repairs of the principal spillways, dam, vegetation, and the auxiliary spillways. It is estimated that O&M activities will cost about $8,900 per year.

Emergency Action Plan

The Sponsors will provide leadership in developing an Emergency Action Plan (EAP) prior to the commencement of construction and will review and update the EAP annually with local emergency response officials. As required by the National Engineering Manual, Part 520, Subpart C, Section 520.27 and the NOMM, Part 500, Subpart F, the NRCS State Conservationist is to determine that an EAP is prepared for FRS No. 4 prior to the execution of fund obligating documents for construction of the structure. NRCS will provide technical assistance in preparation and updating of the EAP. The breach inundation map of the final design and its data will be the basis for potential areas to be affected and citizens to be notified. The purpose of the EAP is to identify areas at risk, outline appropriate actions, and to designate parties responsible for those actions in the event of a potential failure of FRS No. 4.

9.9 ECONOMIC AND STRUCTURAL TABLES

Table 1: Estimated Installation Cost FRS No. 4

Table 2: Estimated Cost Distribution – Water Resource Project Measures FRS No. 4

Table 3: Structural Data – Dams with Planned Storage Capacity FRS No. 4

Table 4: Estimated Average Annual NEE Cost FRS No. 4

Table 5: Estimated Average Annual Flood Damage Reduction Benefits FRS No. 4

Table 6: Comparison of NEE Benefits and Costs FRS No. 4

Table 1: Estimated Installation Cost FRS No. 4

Chambers Creek Watershed, Texas

(Dollars) [1]

	Estimated Costs		
Works of Improvement	**Public Law 83-566 Funds**	**Other Funds**	**Total**
Rehabilitation of FRS No. 4	$2,288,400	$933,500	$3,221,900
Total Project	**$2,288,400**	**$933,500**	**$3,221,900**

[1] Price base: 2021

Table 2: Estimated Cost Distribution – Water Resource Project Measures FRS No. 4

Chambers Creek Watershed, Texas

(Dollars) [1]

Works of Improvement	Installation Cost – Public Law 83-566					Installation Cost – Other Funds					Total Installation Cost
	Construction	Engineering	Real Property Rights	Project Administr-ation	Total Public Law 566	Construction	Engineering	Real Property Rights	Project Administr-ation	Total Other	
Rehabilitation of FRS No. 4	$1,709,600	$263,100	$0	$315,700	$2,288,400	$920,600	$0	$12,900	$0	$933,500	$3,221,900
TOTAL	**$1,709,600**	**$263,100**	**$0**	**$315,700**	**$2,288,400**	**$920,600**	**$0**	**$12,900**	**$0**	**$933,500**	**$3,221,900**

[1] Price base: 2021

Table 3: Structural Data – Dams with Planned Storage Capacity FRS No. 4
Chambers Creek Watershed, Texas

Item	Unit	FRS No. 4
Hazard classification		High
Seismic zone		0
Location	decimal degrees	32.490 N, 96.968 W
Uncontrolled drainage area	sq. mi	0.88
Runoff curve number (1-day) (AMC avg.)		81
Time of Concentration (T_c)	hr	1.18
Elevation top of dam	feet NAVD88	737.1
Elevation crest of auxiliary spillway	feet NAVD88	730.0
Elevation crest principal spillway	feet NAVD88	719.2
Maximum height of dam	ft	27.4
Volume of fill	yd^3	52,420
Total Capacity (auxiliary spillway crest)	acre-ft	288.8
Sediment submerged	acre-ft	40.4
Floodwater retarding capacity	acre-ft	248.4
Surface Area		
Sediment pool	acres	11.9
Floodwater retarding pool	acres	40.1
Principal Spillway		
Rainfall volume (1-day)	in	9.64
Rainfall volume (10-day)	in	15.00
Runoff volume (10-day)	in	10.21
Type of conduit		RCP
Diameter	in	30
Capacity	ft^3/s	113
Auxiliary Spillway (earthen)		
Bottom width	ft	50
Exit slope	%	4.6
Frequency of operation	% chance	0.01%
Auxiliary Spillway Hydrograph		
Rainfall volume	in	13.02
Runoff volume	in	10.57
Storm duration	hr	6
Velocity of flow (V_c)	ft/s	8.6
Maximum reservoir water surface elevation	feet NAVD88	732.4
Freeboard Hydrograph		
Rainfall volume	in	30.25

Runoff volume	in	27.61
Storm duration	hr	6
Maximum reservoir water surface elevation	feet NAVD88	737.1
Storage Capacity Equivalents		
Sediment volume	in	0.86
Floodwater retarding volume	in	5.31

Table 4: Estimated Average Annual NEE Cost FRS No. 4

Chambers Creek Watershed, Texas

(Dollars) [1]

	Project Outlays		
Evaluation Unit	**Amortization of Installation Cost [2]**	**Operation, Maintenance and Replacement Cost**	**Total**
FRS No. 4	$88,000	$8,900	$96,800
Grand Total	$88,000	$8,900	$96,800

[1] Price base: 2021
[2] Amortized over 100 years at a discount rate of 2.5 percent

Table 5: Estimated Average Annual Flood Damage Reduction Benefits FRS No. 4

Chambers Creek Watershed, Texas

(Dollars) [1, 2, 3]

Damage Category	Estimated Average Annual Damages Without the Project[4]	Estimated Average Annual Damages With the Project	Estimated Average Annual Benefits
Structures	$321,100	$220,400	$100,650
Crops	$610	$590	$30
Pastureland	$90	$90	$10
Roads and Bridges	$127,130	$101,870	$25,270
Erosion and Sedimentation	$720	$110	$610
Total	**$449,620**	**$323,060**	**$126,560**

[1] Price base: 2021
[2] Damages and benefits will accrue from floods of greater magnitude than the 500-year frequency event, but these were not evaluated.
[3] Values have been rounded to the nearest ten.
[4] Based on average annual damages as if the dam was not in place (same as decommissioning alternative)

Table 6: Comparison of NEE Benefits and Costs FRS No. 4

Chambers Creek Watershed, Texas

(Dollars) [1]

Works of Improvement	Average Annual Benefits [2]			Average Annual Cost [3]	Benefit/ Cost Ratio	Net NEE Benefit
	Agriculture-Related	Nonagricultural	Total			
Rehabilitation of FRS No. 4	$650	$125,920	$126,560	$96,850	1.31	$29,710

[1] Price base: 2021
[2] From Table 5
[3] From Table 4
[4] Estimated Average Annual Benefits are based on the decrease in average annual damages if the site was not in place, as in the decommissioning alternative

CHAMBERS CREEK FRS NO. 6 SUPPLEMENTAL WATERSHED PLAN ENVIRONMENTAL ASSESSMENT

10.0 PURPOSE AND NEED FOR ACTION

This supplemental Watershed Plan was prepared, and an Environmental Assessment was performed, to evaluate alternatives to bring Chambers Creek FRS No. 6 into compliance with current performance and safety standards. Chambers Creek FRS No. 6 was originally installed under the authority of the Flood Control Act of 1944 (Public Law 78-534) as amended. The rehabilitation of floodwater retarding structures No. 4 is authorized under Public Law 83-566 (as amended), and as further amended by Section 313 of Public Law 106-472. The authorized purposes of the rehabilitation of Chambers Creek FRS No. 6 per the 390-NWPM, part 500, Subpart A, Section 500.4B are: 1) Flood Prevention (Flood Damage Reduction), and 2) Watershed Protection (sediment capture).

Chambers Creek Watershed FRS No. 6 was originally designed as a Class A, or low hazard structure, to provide flood control. However, the structure has been reclassified as a high hazard dam. The dam does not meet the NRCS or TCEQ criteria for a high hazard dam, specifically, the dam embankment is overtopped during the minimum required design flood and the auxiliary spillway stability requirement is not met due to potential soil erosion. The purposes of this supplement are to comply with current NRCS and TCEQ dam design and safety standards and reduce risk to life and property that could result from a potential dam failure. Maintaining flood protection from the dam is a primary objective. The dam is located upstream of multiple roads and residential structures, to which it provides flood protection by restricting the discharge during storm events. Criteria for NRCS are outlined in the NRCS publications Technical Release 60 and National Engineering Handbook Part 630. Criteria for the TCEQ are established by the Guidelines for Operations and Maintenance of Dams in Texas and the dam safety rules in Chapter 299 of the Texas Administrative Code.

The FRS captures the runoff from 1,048 acres, or 3.2% of the total watershed (32,504 acres). The 2010 Dam Assessment Report performed by URS Corporation indicates that 11 residences, 2 commercial properties, and 1 industrial facility are at risk from a catastrophic breach. A new breach model was developed by FNI using HEC-RAS 2D as part of the development of this supplemental watershed plan. According to the results of the 2D dam breach modeling and inundation mapping, dam failure could result in impact to 5 residential structures, 2 commercial structures, 12 barns/outbuildings, segments of Mt Zion Road, Shady Grove Road, Plainview Road, and 2 private roads.

Currently, Chambers Creek FRS No. 6 is functioning as originally planned and providing downstream flood damage prevention. However, there is a possibility of the dam failing from overtopping if a storm produces runoff that is greater than the structure's current capacity. The following is a list of opportunities that will be realized through the implementation of this watershed rehabilitation plan:

- Comply with current dam safety criteria.
- Protect human health and safety.
- Protect infrastructure and transportation systems.
- Maintain flood control benefits with minimal change to present conditions and prevent increased flood damages in the floodplain.
- Maintain or improve water quality.
- Protect fish and wildlife habitats.

10.1 WATERSHED PROBLEMS

The Sponsors were aware of the problems with Chambers Creek FRS No. 6 no later than 2010 when URS Corporation produced their Dam Assessment Report, confirming the inadequacies of the dam. NRCS

criteria states that the dam, in its current conditions, must be capable of passing the 100-year storm without engaging the auxiliary spillway. The 2010 assessment report evaluated that the principal spillway of the dam does not have sufficient capacity to convey the 100-year flood without engaging the auxiliary spillway. In addition, the report indicated that the auxiliary spillway capacity would be exceeded in the Probable Maximum Precipitation (PMP) event. This would result in overtopping of the dam embankment, which could cause an uncontrolled breach of the embankment or of the auxiliary spillway. Due to the release of NOAA atlas 14 for Texas, the results of the assessments report were revised in this Plan since the precipitation depths that are used to compute the design hydrograph decreased.

Sponsor Concerns: The 2010 dam assessment report served to notify the Sponsors that the dam no longer meets State requirements and must be modified to meet State law. NRCS deemed it was necessary to prepare a watershed plan (current study) that would identify the improvements necessary to comply with State and NRCS regulations. The study is funded with federal funds under agreement between TSSWCB and NRCS. Per TCEQ, the dam is required to safely route 75% of the Probable Maximum Flood (PMF). At existing conditions, the dam is overtopped and therefore, does not meet the requirement to safely route 75% of the PMF. Per NRCS, the dam is required to safely route 100% of the Free Board Hydrograph (FBH).

Auxiliary Spillway Issues: The vegetated earth auxiliary spillway does not meet NRCS criteria for hydraulic capacity. In its present configuration, the auxiliary spillway engages during the principal spillway hydrograph (PSH) event with a depth of 1.1 feet above the crest. Therefore, the auxiliary spillway does not meet current NRCS criteria and engages more frequently than requirements dictate.

Floodplain Management: The Sponsors have identified the residences immediately downstream as the primary concern regarding flood risk. The Sponsors understand that the dam in its current configuration provides flood protection benefits to the residents for frequent storm events, and that it also poses a hazard in failing to meet current dam safety criteria.

Erosion and Sedimentation: Upon the completion of the most recent bathymetric surveys in 2020, Chambers Creek FRS No. 6 has reached 62 years of its planned 50-year design life. The designed submerged sediment capacity was 127 acre-feet, however, after including the borrow area that was used to build the dam located in the pool area, the actual sediment capacity was 183 acre-feet. As per the 2020 bathymetric survey, it is estimated that the reservoir has 34.3 acre-feet of submerged sediment. Based on the estimated sedimentation rate from observed data of 0.55 acre-feet per year, FRS No. 6 has sufficient storage capacity remaining for at least another 100 years before the sediment storage is filled.

Local Concerns: The Chambers Creek Watershed dams were planned and constructed in the 1950s and 1960s to enhance agricultural land use by mitigating flood damages as well as reducing sediment damages. The possibility of decommissioning Chambers Creek FRS No. 6 was mentioned at the first public meeting in June 2020 since decommissioning must be considered under NRCS rehabilitation policy. However, during multiple meetings with the stakeholders, the sponsors indicated that they were opposed to decommissioning because of their concern that flooding would increase in the absence of the dam. The ability of the dam to attenuate floods is uniquely important as many residential structures are present immediately downstream. If the dam is decommissioned, then the 100-year inundation area, shown as Zone A and Zone AE on Federal Emergency Management Agency (FEMA) flood maps, would be increased from 105 to 128 acres. Furthermore, the Soil and Water Conservation District mentioned that it would be preferred to maintain the existing dam aesthetics while considering the selected alternative. For the past 62 years, the dam has performed as designed and constructed. Additionally, landowners on the reservoir area expressed that they would like to keep the dam unless it is completely necessary to remove it.

10.2 WATERSHED OPPORTUNITIES

The following is a general list of opportunities that will be realized through the implementation of this watershed rehabilitation plan that are developed in accordance with Step 2 of the 9-step planning process per NPPH. Some quantification of these opportunities will be provided in other sections of the report, as appropriate.

- Bring the dam into compliance with NRCS and TCEQ dam safety and performance standards.
- Mitigate the potential for loss of life and damage to property associated with a dam failure.
- Reduce the Sponsor liability associated with continuing to operate a dam that does not meet State and Federal requirements.
- Sustain the existing flood protection for the 100-year storm event for the downstream residences, structures, and roadways.
- Prohibit future construction of inhabitable dwelling upstream of the dam below the top.

11.0 SCOPE OF THE ENVIRONMENTAL ASSESSMENT

A scoping process was used to identify the issues significant to the process of defining the problems and formulating and evaluating the alternatives. Scoping included public meetings, a request for input from NRCS and State and local agencies. Watershed concerns of the involved parties were expressed during these meetings. Factors which could affect soil, water, air, plant, animals, and human resources were identified during this process.

Several meetings were held with the stakeholders of the project. The first stakeholders meeting was held on May 20, 2020. This meeting served as a project kickoff meeting in which the project scope, personnel, and schedule were reviewed and discussed.

On June 23, 2020, the first public meeting was held at the Midlothian Conference Center in Midlothian, Ellis County. The public was informed about the development of a Supplemental Watershed Plan (SWP) for Chambers Creek FRS No. 4. The methodology and scope of the SWP and EA was explained along with the timeline.

On August 18, 2020, December 15, 2020, and January 21, 2021, additional meetings were held with the stakeholders to discuss possible alternatives for the project to bring the dam in compliance with NRCS and TCEQ standards and requirements. Several comments were solicited and received for consideration in the planning procedure. The meetings helped to narrow the list of potential rehabilitation alternatives based on public input, particularly affected landowners. Table N provides a summary of the scope and the specific discussed items.

Table N: Summary of Resource Concerns for Chambers Creek Watershed FRS No. 6

Item/Concern	Relevant to the Proposed Action		Rationale
	Yes	**No**	
SOILS			
Upland Erosion	X		Temporary impacts for upland erosion possible with dam breach or during construction activities with clearing and vegetation removal.
Stream Bank Erosion	X		Temporary impacts from erosion of the stream bed possible with a dam breach or during construction activities.
Sedimentation	X		Sedimentation of the impoundment and creek downstream will be reduced through appropriate BMPs and approved SWPPP.
Prime and Unique Farmland		X	There are no Prime Farmlands within the maximum extent of possible ground disturbance.
WATER			
Surface Water Quality		X	Waxahachie Creek and its unnamed tributaries are not listed as impaired streams.
Groundwater Quality		X	Project would not affect the Trinity or Edwards-Trinity aquifers.

Floodplain Management	X		Ellis County participates in the National Flood Insurance Program. The project aera is located within Zone A. The goal of the project is to maintain current flood protections and prevent impacts to downstream roads and crossings. The 100-year inundation area downstream would be increased from 105.5 acres to 106 acres (an increase of approximately 0.5 percent). The 500-year inundation area downstream would be increased from 145.5 acres to 146.4 acres (an increase of approximately 0.6 percent). A CLOMR or LOMR may potentially be required. Coordination with the floodplain administrator (Ellis County) would be required prior to construction to acquire floodplain-related authorizations and determine if a CLOMR or LOMR would be required.
Waters of the U.S./Wetlands (Clean Water Act- 401 and 404)	X		There are no wetlands upstream or downstream of the dam that would be impacted by construction activities. Minimize impacts to water quality within the stream during construction with BMPs.
Water Quality (Clean Water Act – 303(d)/305(b))	X		Minimize sediment transport. Maintain oxygen levels. Prevent downstream impediments to water quality.
Coastal Zone Management Act		X	The project is not located within a coastal zone management area (CZMA).
National Wild and Scenic Rivers Act		X	None present in the project area.
AIR			
Air Quality	X		Potential temporary increase in particulate matter and other emissions with alternatives.
Clean Air Act (Criteria Pollutants)	X		Although there would be increased air emissions during construction, Ellis County is in attainment for all Criteria Pollutants except Ozone.
Clean Air Act (Regional Visibility Degradation)		X	The project site is not within a Class I Area.
ANIMALS			
Coral Reefs		X	None present in project area

Threatened and Endangered Species	X		Consultation with USFWS indicated potential occurrences of 5 threatened and endangered species within Ellis County (Section 12.6, Table P). However, upon further coordination, the Project has a "No Effect" determination for federally listed species. The Consistency Letter from USFWS is included in Appendix D. PWD lists 3 state listed species with the potential to occur within the project area. Guidance to avoid impacts to state and tribe-listed species can be found in the Concurrence Letter from TPWD (Appendix D) and in Section 14.2.
Fish and Wildlife Resources	X		Potential for fish and wildlife habitat improvement with alternatives.
Essential Fish Habitat		X	There are no designated EFH areas within the project area.
Ecologically Critical Areas		X	There are no ecologically critical areas within the vicinity of the project area.
Invasive Wildlife Species		X	There were no invasive wildlife species identified in the project area. Invasive species management would be consistent with TPWD recommendations (Appendix D).
Migratory Birds/Bald Eagles/Golden Eagles		X	While habitat is present, no Bald or Golden Eagle nests were found during the project site visit. Additionally, no recorded nests are documented within the project area.
PLANTS			
Threatened and Endangered Species		X	There are no federally or state listed plant species with the potential to occur within Ellis County. The Consistency Letters from USFWS and TPWD are included in Appendix D.
Invasive Plant Species	X		There are invasive species with the potential to occur within the project area or may be transported into the project area by construction activities. See Section 12.6 for summary of invasive species transportation prevention plan.
Ecologically Critical Areas		X	There are no ecologically critical areas listed within the vicinity of the project area.

Forest Resources	X		Impacts to forest resources will be minimized. Some clearing of trees may occur as a result of construction activities.
Riparian Areas	X		There are riparian areas that may be impacted by construction within the project area.
HUMANS			
Environmental Justice and Civil Rights		X	No disparate treatment is anticipated, however alternatives to be assessed for effects.
Historic Properties		X	No known historic resources in the vicinity and no effect to historic properties expected. Coordination with the THC was completed on 9/20/2021. THC Concurrence Letter is included in Appendix D. Tribal coordination with the Tribal Historic Preservation Office is to be completed by NRCS-TX.
Land Use		X	Land use will not change; however local sponsors will prevent future development below the new crest of the earthen spillway.
Local and Regional Economy	X		Temporary benefit during construction.
Natural Areas		X	No impact to natural areas.
National Parks, Monuments, and Historical Sites		X	No impact to national parks, monuments, or historical sites.
Portable Water Supply/Regional Water Management Plans		X	The site is not used for water supply.
Public Health and Safety	X		Rehabilitation is needed because the dam does not meet current safety standards.
Recreation		X	No public recreation.
Scenic Beauty and Parklands		X	No impact to scenic beauty or park lands.
Scientific Resources		X	No research sites identified.
Social/Cultural Issues	X		Concerns about flooding if the dam were decommissioned.

12.0 AFFECTED ENVIRONMENT

12.1 PLANNING ACTIVITIES

Geologic and engineering investigation and analyses were conducted by Freese and Nichols, Inc. (FNI) with oversight from NRCS-Texas staff. This work included evaluating the condition of the existing dam and performing hydrologic and hydraulic analyses. Both the existing conditions and proposed rehabilitation alternatives were evaluated with these tools.

Other planning activities included performing topographic surveys, reviewing reservoir sediment surveys, and inventorying watershed resources (environmental, economic, and cultural resources). Potential alternatives were evaluated for cost-effectiveness and for local responsibility. Both the benefits and the costs of the alternatives were calculated and analyzed.

The purpose of the Affected Environment section is to provide a description of existing physical, biological, economic, and cultural resources likely to be affected by Alternatives #1 through #5 in a manner that allows the alternatives' effects to be better understood. The following summarizes the existing environmental conditions.

12.2 EXISTING CONDITIONS

Original Project

The original watershed work plan was prepared, and works of improvement have been installed, under the authority of the Flood Control Act of 1944 (Public Law 78-534) as amended. The rehabilitation of floodwater retarding structure No. 4 is authorized under Public Law 83-566 (as amended), and as further amended by Section 313 of Public Law 106-472.

The sponsors of the project are the City of Alvarado, the City of Ennis, Ellis-Prairie Soil and Water Conservation District #504, Dalworth Soil and Water Conservation District #519, Hill County-Blackland Soil and Water Conservation District #541, Navarro Soil and Water Conservation District #514, Ellis County Commissioners Court, Hill County Commissioners Court, Johnson County Commissioners Court, and the Navarro Commissioners Court.

Description of Existing Dam

Chambers Creek FRS No. 6 was originally designed and constructed in 1959 as a low-hazard (class A) dam. A low-hazard classification is given to dams which do not pose a threat to loss of life. Chambers Creek FRS No. 6 was constructed as a zoned earth fill embankment with one vegetated auxiliary spillway located at the left abutment and a principal spillway consisting of an inlet tower with a 17-inch concrete outlet pipe that discharges into an unlined plunge basin. An environmental site visit was performed in June 2020. The embankment was found to be in good condition with good vegetative cover.

The effective top of dam elevation is 697.0 feet per the as-built plans. The upstream slope of the embankment was constructed to a 3 horizontal:1 vertical slope (3H:1V), and the downstream slope was constructed to a 2H:1V slope. There is a 12-foot-wide wave berm on the upstream slope located at elevation 680.0 feet. The auxiliary spillway has a 75-foot-wide bottom width, and the crest elevation is 693.5 feet. The principal spillway inlet structure is a 2.5-foot by 2.5-foot (interior dimensions) by 15.0-foot-tall tower with a crest elevation of 680.0 feet. Metal grating covers the top of the inlet tower. There is an 8-inch sluice gate located at the bottom of the tower with an invert elevation of 665.0 feet to facilitate lowering the permanent water level for repairs and maintenance. The principal spillway outlet pipe consists of 204 feet

of 17-inch diameter reinforced concrete pipe connected to the downstream side of the inlet tower. The original design included a steel baffle plate inside the inlet tower at the entrance of the pipe. A bathymetric survey was performed from July 7, 2020. The final results of the survey indicate a volume at normal pool (680 feet) of 149 acre-feet.

Table O: Chambers Creek 6 Existing Structural Data

Item	Unit	FRS No. 6
Surface Area (Principal Spillway Crest)	Acres	18.0
Elevation, Top of Dam (effective)	Feet	697.0
Length of Dam	Feet	1,300
Principal Spillway	Type	Drop Inlet
Elevation, Principal Spillway Crest	Feet	680.0
Pipe Diameter, Principal Spillway	inches	17
Principal Spillway Discharge at AS Crest	cfs	33
Auxiliary Spillway	Type	Earthen Channel
Elevation, Auxiliary Spillway	Feet	693.5
Bottom Width, Auxiliary Spillway	Feet	75
Surface Area (Auxiliary Spillway Crest)	Acres	54.0
Sediment Reserve Below Riser	Acre-feet	148.7
Flood Storage	Acre-feet	475.1
Total Storage at Auxiliary Spillway Crest	Acre-feet	623.8

12.3 PHYSICAL FEATURES AND LOCATION

Project Location

The Chambers Creek FRS No. 6 watershed includes 1,048 acres (1.638 square miles) in Ellis County, Texas. The site is located approximately one mile east of Midlothian, Texas and is situated about 0.8 miles southwest of U.S. Highway 287 on an unnamed tributary of Waxahachie Creek, which flows southeast into Chambers Creek. The approximate latitude and longitude coordinates of Chambers Creek FRS No. 6 are 32.4550°N and 96.9562°W. Appendix B shows the project maps for the watershed. The watershed is located within the Trinity River Basin as delineated by the United States Geological Survey, hydrologic unit number 12030109.

Topography

The project area lies on the western edge of the West Gulf Coastal Plain physiographic area. The topography of the watershed ranges from gentle slopes near the watershed divide to moderate slopes in the valleys. The watershed for Chambers Creek FRS No. 6 has an average gradient of 64 feet per mile.

Soils

The primary soil units underlying the Chambers Creek FRS No. 6 watershed were identified using the NRCS web soil survey (NRCS, 2021). Dominant soils consist of silty clays over bedrock and terraced

alluvial deposits (Peabody, 1961). The major soil groups in the watershed include Eddy soils, 587 acres (56%) and Austin silty clay, 260 acres (25%). Eddy soils can be described as shallow, well drained soils on gently sloping to moderately steep uplands (slopes ranging from 1 to 20 percent) and are known to be located along the western edge of the Blackland Prairie of Texas (NRCS, 2021). Austin soils consist of moderately deep, well drained, permeable soils that are nearly level to sloping uplands. Other smaller soil map units make up the remainder of the acreage in the watershed. Additionally, there are 217 acres of designated Farmland of Statewide Importance located within the watershed (NRCS, 2021). Prime farmland soils are discussed further in the Environmental Consequences section.

Geology

The geologic development of Texas consists of a long and dynamic history of igneous activity, structural deformation, and sedimentary processes. The Upper Cretaceous Austin Chalk and the Ozan Formation (Taylor Marl) form the bedrock that is overlain by silty clay soils in Ellis County, Texas. The topography of the area includes low, wide hills that are drained by southeast-flowing streams and tributaries (Peabody, 1961). The project area is located within the Texas Blackland Prairie Ecoregion, which spans from the Red River along the northern border of the state to San Antonio in Central Texas. This ecoregion is known for its rich, dark soil ideally suited for agricultural production. Dominate tree species include pecan, cedar elm, various oaks, hackberry, and some mesquite. Big bluestem, Indiangrass, eastern gammagrass, switchgrass, and side oats grama are among the grasses found throughout this region. Annual rainfalls of 30 to 40 inches and temperatures of 66 to 70 degrees are average for this region (TPWD, 2021).

Climate

The Chambers Creek FRS No. 6 watershed lies within the Blackland Prairie Ecoregion (TPWD, 2021). The climate of the Blackland Prairie ecoregion can be described as subtropical, experiencing mild winters and hot summers. In the winter, the average temperatures range between 40 and 60°F. In the summer, the average temperatures are in the 90s. The average annual rainfall ranges from 28 to 40 inches. (Climate-Data, 2021).

12.4 WATER

Water from the Chambers Creek FRS No. 6 reservoir flows downstream where it converges with Waxahachie Creek. Waxahachie Creek flows into Lake Bardwell and confluences with Chambers Creek, north of Emhouse, Texas. Chambers Creek is a major tributary to the Trinity River. Chambers Creek confluences with another major tributary, Richland Creek, near Streetman, Texas in Richland-Chambers Reservoir. Richland Creek flows downstream from the Richland-Chambers Dam less than two miles to its confluence with the Trinity River, which eventually reaches the Gulf Coast with a delta in the Upper Galveston Bay system.

Clean Water Act

Sections 303(d) and 305(b)

Section 303(d) of the Clean Water Act (CWA) requires states, territories, and tribes to identify “impaired waters” and to establish total maximum daily loads (TMDLs). By definition, an impaired water does not meet the standards associated with its assigned use classification. The State of Texas assesses its waters every two years to meet the requirements of Sections 305(b) and 303(d) of the Clean Water Act. These assessments are published in an integrated report which is titled the “2020 Texas Integrated Report of Surface Water Quality for the Clean Water Act Sections 305(b) and 303(d)” and describes the quality of all

waters in the State and contains a list of waters in good condition and those that are impaired/polluted (TCEQ, 2020).

The 2020 Texas Integrated Report of Surface Water Quality for the Clean Water Act Sections 305(b) and 303(d) was released in May 2020 and summarizes the water quality conditions in Texas over a two-year period, January 1, 2018, through December 31, 2019. The Bardwell Reservoir segment which impounds Waxahachie Creek is listed as impaired for sulfates in the water. The segment is categorized as 5c which means additional data or information will be collected or evaluated by the State before a management strategy is selected (TCEQ, 2020).

Sections 401 and 404

Waterbodies and wetlands that are considered Waters of the U.S. (WOTUS) are subject to the regulatory authority of the U.S. Army Corps of Engineers (USACE). Section 404 of the CWA prohibits the discharge of dredged or fill material into WOTUS, including streams and wetlands, unless the action is exempted or authorized by a permit issued by the USACE. If a CWA Section 404 permit is required, the State must issue a Section 401 State Water Quality Certification to certify that the activity will not violate State water quality standards. Potential impacts to WOTUS, including wetlands and streams, are further discussed in the Environmental Consequences section.

Section 402

Section 402 of the CWA establishes the National Pollutants Discharge Elimination System (NPDES) Program, also administered by the State. Section 402 requires any point source, including developments, construction sites, or other areas of soil disturbance, that discharges or intends to discharge to waters of the State must obtain a NPDES permit. In Texas, wastewater and stormwater state-issued permits are administered by the TCEQ through the Texas Pollutant Discharge Elimination System (TPDES) Program.

Waters of the U.S. (Including Wetlands)

The Chambers Creek FRS No. 6 watershed contains numerous aquatic resources, including wetlands, lakes, ponds, and ephemeral, intermittent, and perennial streams, as well as riparian areas. It is NRCS policy to protect and promote wetland functions and values. Wetlands and riparian areas play a principal role in the ecology of a watershed, such as water storage, water filtration, and biological productivity. Wetlands are defined by NRCS (190-GM, Part 410, Subpart B, Section 410.26) as areas, natural or artificial, that have hydric soil, hydrophytic vegetation, and indicators of wetland hydrology. Generally, wetlands include swamps, marshes, bogs, bottomland hardwood areas, and similar areas.

NRCS conducts wetland determinations and/or delineations in compliance with the Food Security Act Wetland Identification Procedures (2010) for the purpose of assisting the US Department of Agriculture (USDA) program participants in complying with the wetland conservation provisions of the Food Security Act (FSA) of 1985. For FSA purposes, the term “wetland” is defined as land that has a predominance of hydric soils; is inundated or saturated by surface or groundwater at a frequency and duration sufficient to support a prevalence of hydrophytic vegetation typically adapted for life in saturated soil conditions; and, under normal circumstances supports a prevalence of such vegetation. In addition to NRCS requirements, the USACE regulates the discharge of dredged and fill material into wetlands and other WOTUS under Section 404 of the CWA. Activities that impact wetlands and other WOTUS may be subject to the requirements of Section 404 of the CWA. The 1987 USACE Wetlands Delineation Manual and the approved USACE regional supplements to the manual are the foundations to the FSA wetland identification procedures. Under NRCS policy and Executive Order 11990, the presence/absence of both jurisdictional and non-jurisdictional WOTUS, including wetlands, must be evaluated in all NRCS planning projects.

Wetland locations and boundaries were preliminarily identified by reviewing the U.S. Fish and Wildlife Service (USFWS) National Wetland Inventory (NWI) mapper, and then confirmed during a field survey performed on July 15, 2020. There is a total of 20 acres of WOTUS within the watershed that includes 3 acres of freshwater ponds and 14 acres of lake (Appendix C-21). There are 3 acres of freshwater forested/shrub wetlands and 0.5 acres of freshwater emergent wetlands within the watershed Additionally, the watershed includes approximately 1.17 miles (6,118 linear feet) of streams and tributaries. Appendix D contains additional documentation regarding the field investigation methodology. State and local permitting requirements that may be required based upon the alternative carried forward for impacts analysis are outlined in the Environmental Consequences section.

Coastal Zone Management Areas

Coastal Zone Management Areas (CZMAs) are areas located within or near the officially designated "coastal zone" of a state. Ellis County is not located in or near a designated Coastal Zone Management Area (CZMA). Accordingly, the CZMA is not applicable to the project's affected environment and will not be carried forward for impacts analysis in the Environmental Consequences section.

Floodplain Management

The NRCS policy on floodplain management reflects the requirements of Executive Order 11988 that decisions by federal agencies must recognize that floodplains have unique and significant public values (190-GM, Part 410, Subpart B, Section 410.25). The objectives of Executive Order 11988 are to avoid, to the extent possible, the long- and short- term adverse impacts associated with occupancy and modification of floodplains and to avoid direct and indirect support of floodplain development where there is a practical alternative.

Flood hazard areas are categorized by the Federal Emergency Management Agency (FEMA) and identified on Flood Insurance Rate Maps (FIRMS). Special flood hazard areas are defined as areas that have a one percent or greater chance of being inundated by a flood event in any given year. The one-percent annual chance of flood is also referred to as the base flood or 100-year flood (FEMA, 2022). FEMA FIRM Panel 48139C0155F (effective on 6/3/2013) indicates the project area is partially comprised of Zone A, which indicates the reservoir, auxiliary spillway, and downstream riparian areas are subject to inundation by the 1-percent-annual-chance flood event (100-year flood).

Wild and Scenic Rivers

The National Wild and Scenic Rivers Act of 1968 was created by Congress to preserve certain rivers with outstanding natural, cultural, and recreational values in a free-flowing condition for the enjoyment of present and future generations. Texas has approximately 184,797 miles of river of which only the Rio Grande River is designated as Wild and Scenic (National Wild and Scenic River System, 2022). Therefore, the National Wild and Scenic Rivers Act (Public Law 90-542) is not applicable to the project's affected environment and will not be carried forward for impacts analysis in the Environmental Consequences section.

12.5 AIR

Clean Air Act

The Clean Air Act (CAA) of 1970 requires the U.S. Environmental Protection Agency (EPA) to set National Ambient Air Quality Standards (NAAQS) for pollutants considered harmful to public health and the

environment. The EPA established NAAQS for six criteria pollutants including carbon monoxide, nitrogen dioxide, lead, sulfur dioxide, fine particulate matter (PM_{10} and $PM_{2.5}$), and ozone (O_3). The EPA categorizes individual regions or counties into two levels of compliance with the NAAQS for criteria pollutants: attainment and nonattainment. Attainment areas are that meet the NAAQS; nonattainment areas exceed the NAAQS and must have and implement a plan to meet the NAAQS. Ellis County in Texas is categorized as non-attainment for O_3. Ellis County is subject to the requirements of the 'Dallas-Fort Worth Serious Classification Attainment Demonstration State Implementation Plan (SIP) Revision' due to reclassification of the DFW nonattainment area from moderate to serious for the 2008 eight-hour ozone NAAQS. Ellis County is also listed a marginal nonattainment category for the 2015 eight-hour ozone NAAQS. Construction activities related to the dam improvement project are expected to be de minimis (below 10 tons per year [tpy] PM2.5 and below 15 tpy PM10) and would not require Construction permits for Nonattainment New Source Review (NNSR) and Prevention of Significant Deterioration (PSD) (TCEQ, 2021).

General Conformity Rule (Criteria Pollutants)

Established under the CAA, the General Conformity Rule (40 CFR Part 51, subpart 54) ensure that Federal actions conform to the Texas State Implementation Plan (SIP). To proceed with a Federally funded project, a General Conformity program requires an emissions inventory to ensure that increased air pollution from the project does not negatively affect the state's emissions budget and SIP. The General Conformity Rule are applicable to project located in nonattainment areas. Since Ellis County is categorized as non-attainment, a General Conformity Determination is required.

Regional Haze Regulations

Haze occurs when small particulates in air pollution scatter and absorb sunlight. The hazy effect blurs and decreases visibility. Congress enacted Section 169A of the CAA to protect visibility in National Parks and Wilderness Areas (Class 1 areas). The Regional Haze Regulation calls for states to enact rules to reduce emissions of fine particle pollution and improve visibility in these areas. The Project Area is not within a designated Class 1 area and would not be bound to the Regional Haze rule. Since all project alternatives would have negligible air impacts that would be considered temporary and localized during construction, and since all project alternatives would have no effect on air quality once in operation, air quality will not be carried forward for impacts analysis in the Environmental Consequences section.

12.6 VEGETATION AND WILDLIFE

Vegetation Communities and Habitat

The Chambers Creek FRS No. 6 watershed lies within the Blackland Prairie Ecoregion (TPWD, 2021). This ecoregion historically supported tallgrass prairies of big bluestem, little bluestem, Indiangrass, and switchgrass. Much of the original prairie has been converted to agricultural crops such as corn, milo, and cotton, or cattle ranching. Soils derived from the Ozan formation support irrigated croplands, unimproved pasturelands, and riparian areas characterized by deciduous forests and juniper woodlands. Elevation ranges from 300 to 800 feet above sea level (TPWD, 2020a).

The National Land Cover Dataset (NLCD), a 30-meter resolution, landscape scale, raster coverage created by satellite imagery interpretation, was used to characterize the spatial distribution of vegetation communities across the project area (USGS, 2016). The NLCD identified a total of eight landcover classes across the watershed of the project area. Table R lists the vegetation cover types in order of prevalence in the project area. Appendix C-8 depicts the spatial distribution of vegetation communities throughout the watershed.

Riparian Areas

Riparian areas are present within the project area. NRCS policy requires integration of riparian area management into all plans and alternatives (GM 190, Park 411). Although Federal Law does not specifically regulate riparian areas, portions of riparian areas, such as wetlands and other waters of the U.S., may be subject to Federal regulation. These riparian areas are located along the perimeter of the reservoir created by Chambers Creek FRS No. 6. Additional riparian areas are located downstream of the dam along the unnamed tributary that flows into Waxahachie Creek. Most of the riparian areas downstream of the dam are forested.

Invasive Species

Invasive species include species of plants and animals that have been introduced, either intentionally or accidentally, into areas outside of their natural environments. An invasive species can grow and spread rapidly and establish themselves over a large area. As a result, invasive species can cause economic and environmental damage, or harm to human health (Texas Invasives, 2022).

Typical invasive species within the Blackland Prairie ecoregion include Johnson grass (*Sorghum halepense*), King Ranch bluestem (*Bothriochloa ischaemum var. songarica*), chinaberry (*Melia azedarach*), heavenly bamboo (*Nandina domestica*), and wax-leaf privet (*Ligustrum japonicum*). Common invasive wildlife species include Asian clam (C*orbicula fluminea),* European Starling (*Sturnus vulgaris*), red imported fire ants (*Solenopsis invicta*), Mediterranean house gecko (*Hemidactylus turcicus*), feral pig (*Sus scrofa*), and nutria (*Myocastor coypus*) (Texas Invasives, 2022).

Federally Protected Threatened and Endangered Species and Natural Areas

Section 7(a) of the Endangered Species Act (ESA) requires the NRCS, in consultation with and with the assistance of the Secretary of the Interior (USFWS) and/or National Oceanographic and Atmospheric Administration (NOAA), National Marine Fisheries Service, to advance the purposes of the ESA by implemented programs for the conservation of endangered and threatened species, and to ensure that NRCS actions and activities do not jeopardize the continued existence of threatened and endangered species or result in the destruction or adverse modification of the species' critical habitat.

Table P, which was generated from the USFWS Information for Planning and Consultation (IPaC) website (USFWS, 2022), provides a list of federally listed fish species which have been identified as potentially occurring in Ellis County. Only species that are listed as threatened or endangered by the USFWS have complete federal protection under the ESA. These include four species of birds and one species of freshwater mussel. Information such as life history, habitat requirements, and potential project effects are provided below.

Table P: Federally Protected Species Potentially Occurring in Ellis County, Texas

Common Name	Scientific Name	Federal Status[1]	Federally Designated Critical Habitat within the Project Area
Birds			
Piping Plover	*Charadrius melodus*	T	No
Red Knot	*Calidrus canutus rufa*	T	No
Whooping Crane	*Grus americana*	E	No

Common Name	Scientific Name	Federal Status[1]	Federally Designated Critical Habitat within the Project Area
Mollusks			
Texas Fawnsfoot	*Truncilla macrodon*	PT	No
Insects			
Monarch Butterfly	*Danaus plexippus*	C	No

T=threatened; E= endangered; PT= proposed threatened; C= candidate
[1]according to USFWS, 2022

Piping Plover

The threatened piping plover (*Charadrius melodus*) is a small shorebird that inhabits coastal beaches and tidal flats (Haig and Elliott-Smith, 2004). Approximately 35 percent of the known global population of piping plover winters along the Texas Gulf coast, where they spend 60 to 70 percent of the year (Campbell, 2003). From September to March, piping plovers are typically found along the Gulf coast shoreline using beaches, sandflats, tidal mudflats, dunes, and dredge islands as loafing and foraging areas (Haig and Elliott-Smith, 2004). eBird (2022) and TPWD (2022a) data show no observations of piping plover near the project area. Habitat suitable for piping plover was not observed within 5 miles of the project area.

Red Knot

The threatened red knot (*Calidris canutus rufa*) is a medium-sized, stocky, short-necked sandpiper with a short, straight bill. The *rufa* subspecies, one of three subspecies occurring in North America, has one of the longest distance migrations known, travelling between its breeding grounds in the central Canadian Arctic to wintering areas in South America (USFWS, 2011). It is an uncommon to common migrant along the coast, and a rare to casual inland, primarily in the eastern half of the state (USFWS, 2013). There have been no recorded observations of red knots in Ellis County (TPWD, 2022a). eBird (2022) data shows no observation near the project area. No suitable habitat for the red knot was observed within 5 miles of the project area.

Whooping Crane

Endangered whooping cranes (*Grus americana*) are the tallest birds in North America and are known for their call, size, and white plumage. The migratory Texas population breeds and nests in Wood Buffalo National Park in northern Alberta, Canada during the summer and flies south to Aransas National Wildlife Refuge near Rockport, Texas where they spend the winter (USFWS, 2007). During migration, whooping cranes stop over at wetlands, fallow cropland, and pastures to roost and feed. Based on migration data compiled from a variety of information gathered from 1975 through 1999 (Austin and Richert, 2001), the project area is not located within the designated migration corridor for the whooping crane. Their preferred habitat includes coastal marshes, estuaries, inland marshes, lakes, and ponds. For feeding, they forage in brackish bays, marshes, and salt flats. eBird (2022) and TPWD (2022a) data show no official observations reported near the Chambers Creek dams. Habitat suitable for whooping cranes was not identified within 5 miles of the project areas.

Texas Fawnsfoot

The Texas Fawnsfoot is a species of freshwater mussel that can be found within the Trinity River basin. Chambers Creek FRS No. 6 is situated along the tributary of Waxahachie Creek which is a tributary to the Trinity River. Although the dam is within the Trinity River Basin, the open water habitat of the dam reservoir has slack water and silt substrate that do not meet the habitat requirements for the mussel. The

dam is located high in the watershed and the creek is considered an ephemeral drainage, therefore lacking persistent aquatic habitat to support mussels. TPWD (2022a) data show no official observations reported within 5-miles of the Chambers Creek dams.

Monarch Butterfly

Adult Monarch Butterflies are large with bright orange wings with black borders and white spots. During the breeding season, Monarch Butterflies lay their eggs on milkweed (*Asclepias sp*.) plants. Due to their short lifespan, there are multiple generations of Monarch Butterflies within a breeding season and along their 3,000-mile migratory route. Monarch migration begins in early spring from February to March. Due to their long migratory routes, Monarch Butterflies can be found in a variety of habitats. The eastern population of Monarch Butterflies can be found throughout Texas during its migratory season. Individuals have been observed within the project area. Construction for the project is not expected to impact Monarch Butterfly migratory route and the monarch butterfly host plant, milkweed is not found within the project area.

State Protected Endangered and Threatened Species

Texas Parks and Wildlife Department provides an online resource for state listed species information through the TPWD Rare, Threatened, and Endangered Species of Texas by County (RTEST) website. The RTEST list for Ellis County identifies the following flora and fauna with the potential to occur within the county.

Table Q: State Listed Species Potentially Occurring in Ellis County, Texas

Common Name	Scientific Name	State Protection Status[1]	Habitat within the Project Area
Birds			
Piping Plover	*Charadrius melodus*	T	No
Red Knot	*Calidrus canutus rufa*	T	No
Whooping Crane	*Grus americana*	E	No
Black Rail	*Laterallus jamaicensis*	T	No
White-faced Ibis	*Plegadis chihi*	T	No
Wood Stork	*Mycteria americana*	T	No
Mollusk			
Trinity Pigtoe	*Fusconaia chunii*	T	No
Texas Heelsplitter	*Potamilus amphichaenus*	T	No
Louisiana Pigtoe	*Pleurobema riddellii*	T	No
Sandbank Pocketbook	*Lampsilis satura*	T	No
Reptile			

Texas Horned Lizard	*Phrynosoma cornutum*	T	Yes
Alligator Snapping Turtle	*Macrochelys temminckii*	T	Yes

T = threatened; E = endangered
[1]According to TPWD, 2022b

Of the twelve state listed species with the potential to be found in Ellis County, Texas Horned Lizard and Alligator Snapping Turtle have a realistic chance to being found within the project area. Texas Horned Lizards are found in open grassy, prairie habitats with scattered brush and trees. Alligator Snapping Turtles are found near perennial waterbodies, swamps, bayous, and ponds. Contractors will follow TPWD recommendations to avoid impacts to state listed and SGCN species during construction, maintenance, and operation activities. Additional information can be found in the TPWD coordination letter found in Appendix D.

Migratory Birds

The Migratory Bird Treaty Act (MBTA) of 1918 makes it illegal to kill, possess, transport, buy, sell, or trade any migratory bird parts, nest, or eggs unless a valid Federal permit is issued. To prevent impacts to migratory birds, construction activities such as clearing, and grubbing should be performed outside of the migratory bird breeding season. USFWS IPaC resources has listed Bald Eagle (*Haliaeetus leucocephalus*), Lesser Yellowlegs (*Tringa flavipes*), and Red-headed Woodpecker (*Melanerpes erythrocephalus*) as migratory birds with the potential to occur within the project area. Lesser Yellowlegs and Red-headed Woodpeckers are considered Birds of Conservation Concern (BCCs). Birds of Conservation Concern are designated by the USFWS as species which are likely to become candidates for listing under the ESA without additional conservation action. Lesser Yellowlegs and Bald Eagles are commonly found in lacustrine environments where they forage and roost near the shoreline. Red-headed Woodpeckers live in open forests with clear understory near wetlands.

Bald and Golden Eagle Protection Act

In addition to the MBTA, all bald and golden eagles are protected under the Bald and Golden Eagle Protection Act and Executive Order 13186. The Act prohibits individuals without a special permit from taking eagle parts, nests, or eggs. The Act defines “take” as “pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest, or disturb.” In addition to those immediate impacts, the Act also covers impacts that may result from human-induced alterations around nest sites in a manner that may interfere with or interrupts normal breeding, feeding, sheltering habits, and causes injury, death, or nest abandonment. No Bald or Golden Eagles were observed within the project area during the site visit in June 2020. The Texas Parks and Wildlife Department (TPWD) Natural Diversity Database (TPWD, 2022b) does not list any Bald or Golden Eagle nests within 2 miles of Chambers Creek FRS No. 6. Therefore, the Bald and Golden Eagle Protection Act is not applicable to the project’s affected environment and will not be carried forward for impact analysis in the Environmental Consequences section.

Essential Fish Habitat

The affected environment of the Chambers Creek FRS No. 6 watershed is located inland and does not include saltwater tributaries or marine fisheries. Therefore, there is no potential essential fish habitat protected under the Magnusson-Stevens Fishery Conservation and Management Act. Essential fish habitat

is not applicable to the project's affected environment and will not be carried forward for impacts analysis in the Environmental Consequences section.

Coral Reefs

The recognition of the importance of conserving coral reef ecosystems was issued in Executive Order 13089 in 1998. The Executive Order created a Coral Reef Task Force of 11 federal agencies, including the U.S. Department of Agriculture (NRCS, 2014). Ellis County is located inland. Therefore, the protection of coral reefs is not applicable to the project's affected environment and will not be carried forward for impact analysis in the Environmental Consequences section.

12.7 HUMAN ENVIRONMENT

Cultural and Historic Resources

NRCS is required to consider the effects of proposed actions and undertakings on National Register of Historic Places (NRHP) eligible cultural resources and historic properties in consultation with specific parties. Consultation with the State Historic Preservation Office (SHPO), Tribal Historic Preservation Office (THPO), and federally recognized Tribes, as appropriate, as well as other interested parties, is required when an agency action may alter the characteristics that qualify a historic property for inclusion in the NRHP.

Section 106 of the National Historic Preservation Act

Section 106 of the National Historic Preservation Act (NHPA) of 1966 required Federal Agencies to consider the impacts of their actions on historic properties and establish a program for the preservation of historic properties and archeological sites. The NRCS identified the Area of Potential Effect (APE) as the areas of potential ground disturbance (using the maximum possible extent of ground disturbance). The indirect APE is the viewshed from any identified historic resource to the proposed undertaking (using the maximum possible extent of ground disturbance). The APE considers areas that would be directly or indirectly affected by the proposed undertaking in addition to the viewshed of historic properties that would be affected by the project. The viewshed includes all of the visible area in the line of sight of the project and excludes areas obstructed by terrain or other features. The APE for Chambers Creek FRS No. 6 comprised an area of approximately 25.22 acres and included rehabilitation of the dam structure and the slight increase in flood pool as a result. Temporary staging areas were considered part of the APE since they may constitute significant ground disturbance. Some existing haul roads were within the viewshed APE, but do not constitute significant ground disturbance and are not included in the APE.

A cultural resources desktop review was performed by FNI archeologists in January 2021 and concurrence was received from SHPO in September 2021. The desktop review included a search of archeological records available on the THC Texas Archeological Site Atlas (TASA) to determine if any previously recorded sites or historic properties listed in the National Register of Historic Places (NRHP), State Antiquities Landmarks (SAL), and Recorded Texas Historic Landmarks (RTHL) were located within one kilometer of the APE. Additionally, historic and aerial topographic maps were evaluated to determine changing land use over time. The records review revealed no historic properties or previously recorded archeological sites within the APE, however a single previously documented historic cemetery and associated historic marker, Mount Zion Cemetery (5139007130) was located within one kilometer of the project. FNI concluded that there are no known cultural resource sites within the APEs, although the area has potential to contain unrecorded archeological resources. Coordination was completed with the Texas SHPO and concurrence was received for no effect and no additional survey required (Appendix D). Coordination with the THPO is still ongoing for the project.

Additionally, Chambers Creek FRS No. 6 was constructed in 1959, and therefore, is old enough for National Register consideration due to its age (50+ years old). A property must be at least 50 years of age and must have cultural significant to be considered a historic place and be eligible for listing in the National Register (National Park Service, 1997). The NRHP Registration Forms (NPS 10-900) is used to document the eligibility determination of historic properties. The NPS 10-900 has not been completed for Williams Creek FRS No. 6. SHPO concurrence confirmed that the Chambers Creek FRS No. 6 structure is not considered a historic resource for NRHP inclusion.

National Historic Landmarks Program

The National Parks Services (NPS) National Historic Landmarks Program identifies nationally significant historic places or properties designated by the Secretary of the Interior and listed in the National Register of Historic Places. These places or properties possess a high degree of historic integrity, which can be defined as the ability of a place or property to convey its historical associations or attributes (NPS, 2021).

Per the NPS's National Historic Landmarks Program website, there are no National Historic Landmarks listed in Ellis County, Texas. Therefore, the National Historic Landmarks Program is not applicable to the project's affected environment and will not be carried forward for impact analysis in the Environmental Consequences section.

Land Use and Recreation

The total drainage area of the Chambers Creek FRS No. 6 watershed includes 1,048 acres (0.86 square miles). The dominant land uses within the watershed are forests, pastures, and low to medium intensity developed area supporting residential and commercial uses. Table R, shows the percentage of the dominant land use categories in the watershed. This table also lists the land use in the breach inundation zone below the dam. The land uses were derived from the NLCD 2016 landcover dataset. There are no anticipated land use changes. Table R was gathered to show land use in Chambers Creek FRS No. 6 in percentage over watershed.

Table R: Land Use Chambers Creek FRS No. 6

Land Cover Type	Drainage Area of Chambers Creek FRS No. 4	Percentage of Total Watershed Area	Breach Inundation Zone (acres)	Percentage of Total
Range	0	0%	5	1%
Forest	125	12%	337	70%
Developed Land	304	29%	18	4%
Water	618	59%	111	23%
Pasture	0	0%	12	2%
Total	1,048	100%	483	100%

Scenic Beauty and Visual Resources

As described in the NRCS General Manual, Title 190, Part 410.24, contributions to scenic beauty are a normal product of NRCS work. Scenic beauty can be defined as the viewer's positive perceived value of special, unique, and memorable physical elements of a landscape. Although there would potentially be temporary visual impacts to the reservoir formed by the Chambers Creek FRS No. 6 during the construction period, there are no designated State or National Natural and Scenic Area Preserves or river segments

located within the project areas. Therefore, Scenic Beauty is not applicable to the project's affected environment and will not be carried forward for impact analysis in the Environmental Consequences Section.

Socioeconomics

The watershed of Chambers Creek FRS No. 6 lies within Ellis County, Texas. According to the results of the dam breach modeling and inundation mapping performed in conjunction with the development of this plan, a dam failure could result in impact to 5 residential structures, 2 commercial structures, segments of Mt Zion Road, Shady Grove Road, Plainview Road, and 2 private roads.

Population and Race

According to the 2019 5-Year Estimate from the American Community Survey (ACS) of the U.S. Census Bureau, the population of Ellis County was estimated at 173,772 persons. Of this population, 81.5% (141,636 persons) were White and 9.7% (17,580 persons) were Black or African American. All other racial groups combined comprised 8.4% of the total population. According to the 2019 5-Year Estimate, the population within Census Tract 608.01608.01 was 7,559 persons. Of this population, 95.4% (7,214 persons) were White and 1.8% (136 persons) were Black or African American. All other racial groups combined comprised 2.8% of the total population.

Age

The 2019 5-Year Estimate from the ACS indicates that the median age (middle point with ½ above and ½ below) of the population of Census Tract 608.01608.01 and Ellis County was 43.4 years and 36.2 years, respectively. The median age for the State of Texas was lower at 34.6 years (and was 38.1 years for the United States). Residents in Census Tract 608.01 and Ellis County that were 65 years old or older totaled 15.4% and 12.6%, respectively. These statistics compare to 12.3% for the State and 15.6% nationally. Of the Census Tract and Ellis County populations, 74.8% and 73.2%, respectively, were over the age of 18 years. The same statistic for the State as a whole was 74.0% and the percentage nationally was 77.4%.

Education

The 2019 5-Year Estimate from the ACS indicates that of the residents in Ellis County that are 25 years of age or older, approximately 86.2% had a high school education or higher. Of the residents within Census Tract 608.01 that are 25 years of age or older, 98.1% have a high school education or higher compared to the state-wide and national percentages of 83.7% and 88.0%, respectively. About 38.6% percent of Census Tract 608.01 and 24.3% of Ellis County residents hold a bachelor's degree or higher, and 13.6% and 7.5%, respectively, hold graduate or professional degrees. In the State, 29.9% of the population hold a bachelor's degree or higher and 10.4% hold a graduate or professional degree. These same statistics for the nation total 32.1% and 12.4%, respectively. Additionally, 25.8% in Ellis County have completed at least some college level work with 8.4% having obtained an associate degree. The same statistics at the state and national level are 21.6% and 20.4% and 7.2% and 8.5%, respectively (Source: U.S. Census Bureau, 2019 ACS 5-Year Estimate).

Employment/Unemployment, Class of Worker and Commuter Status

There are 5,895 residents in Census Tract 608.01 who are 16 years of age or older according to the U.S. Census Bureau, 2019 ACS 5-Year Estimate. Of those, 4,237 persons (71.9%) are considered to be in the labor force pool, with 68.3% being employed and 3.6% being unemployed. There are 132,496 Ellis County residents who are 16 years of age or older. Of those, 88,445 persons (66.8%) are considered to be in the labor force pool, with 64.4% being employed and 2.3% being unemployed. The unemployment rate for Census Tract 608.01 and Ellis County is 5.0% and 3.4%, respectively, which is lower than the

unemployment rate projected for the State of Texas at 5.1%, and lower than the same statistic for the nation at 5.3%.

Ellis County has a diverse economy. According to the 2019 ACS 5-Year Estimate, there are 13 sub-sectors of the local economy that employ the civilian workforce: agriculture, forestry, fishing and hunting, and mining (1.3%); construction (9.2%); manufacturing (13.1%); wholesale trade (3.0%); retail trade (11.9%); transportation and warehousing, and utilities (7.6%); information (1.8%); finance and insurance, and real estate and leasing (6.7%); professional, scientific, and management, and administrative and waste management services (9.6%); educational services, and health care and social assistance (20.2%); arts, entertainment, and recreation, and accommodation and food services (7.2%); other services, except public administration (4.6%); public administration (3.8%).

Income

Median household income (householder and all others, related or not) for Census Tract 608.01 was $106,820 and $76,871 for Ellis County as estimated in the 2019 ACS 5-Year Estimate. These numbers compare to $61,874 per year for the median household income calculated for the State of Texas with the national figure at $62,843.

Median family income was estimated to be $117,778 in Census Tract 608.01 and $86,150 in Ellis County, according to the 2019 ACS 5-Year Estimate. The median family income is higher in Census Tract 608.01 and Ellis County than the $73,349 median family income for the State of Texas as a whole. A similar situation exists for the median family income in Census Tract 608.01 and Ellis County compared to the national figure of $77,263 report for the entire United States. Median family income is consistently higher than median household income because the household universe includes people who live alone. Their income would typically be lower than family income because by definition, a family must have two or more people.

With respect to per capita income, Census Tract 608.01 residents were estimated to have per capita incomes of $52,984. Ellis County residents had estimated mean per capita incomes of $32,571. Texas residents were estimated to have mean per capita incomes of $31,277; while the entire United States had mean per capita incomes of $34,103.

Poverty

According to the 2019 5-Year Estimate from the ACS, Census Tract 608.01 had 1.4% of the population living below the poverty level. Ellis County had 8.8% of the population living below the poverty level. State-wide, 13.6% of Texas's citizens had incomes below the poverty level. At the national level, 12.3% of Americans were estimated to be living below the poverty level.

Housing

The 2019 5-Year Estimate from the ACS estimates indicate that 99.5% of housing units (2,630 units) in Census Tract 608.01 were occupied. Of the occupied housing units, 89.6% were owner-occupied and 10.4% were renter-occupied. In Ellis County, 92.8% of housing units (57,307 units) are occupied. Of these units, 74.4% were owner occupied and 25.6% were occupied by renters. The state-wide occupancy rate for Texas as a whole was reported as 88.6% and the national figure was 87.9%. The state-wide rates for owner- and renter-occupancy were 62.0% and 38.0%, respectively, and the national rates for owner- and renter-occupancy were 64.0% and 36.0%, respectively.

According to the results of the dam breach modeling and inundation mapping performed for the Breach studies indicate that approximately 5 residences would be at risk. The single-family residential properties in the Block Group in which most of the inundation zone is located (Census Tract 608.01, Block Groups 1

and 2) range between $64,550 and $192,050 in total value, including land value, with a median value of about $128,717. The total value of residential property (structures and contents only, excluding land values) at risk below the dam is an estimated $616,850.

Recreation

Chambers Creek FRS No. 6 provides incidental recreation to residents with homes around the lake and to their guests. Lake-based recreation and other activities associated with the site include fishing, boating, and hiking.

Environmental Justice

Executive Order 12898 mandates federal agencies to identify and address disproportionately high and adverse human health or environmental effects of their programs, policies, and activities on minority populations, low-income populations, and Indian Tribes. The term "environmental justice" means that, to the greatest extent practicable and permitted by law, all populations are provided the opportunity to comment before decisions are rendered on proposed federal actions (NRCS, 2014).

An environmental justice and civil rights analysis was conducted for the breach inundation zone and associated nearby areas downstream of Chambers Creek FRS No. 4 (Figure 6 and Table S). EPA's "EJSCREEN" tool and USDA's Departmental Regulation 5600-02, Environmental Justice, were used to identify environmental justice groups within the breach inundation zone of the dam. The estimated population of the delineated area is 79 persons according to the U.S. Bureau EJSCREEN ACS 2014-2018 Summary Report. The minority population totals 12%, or 10 persons, and 95% of the total population is white. A total of 4% of household incomes are at or below $25,000, which is below the $26,500 poverty level for households with four individuals for the 48 contiguous states (per the 2021 Poverty Guidelines from the US Department of Health and Human Services, effective as of January 13, 2021). 11% percent of the population have less than a high school education. 88% percent own their homes and 12% percent rent. Of the population age 16 and over, 64% are in the labor force while 36% are not in the labor force. With respect to the environmental indicators assessed using the EJSCREEN tool, the assessed areas have values below or slightly above statewide and national levels.

These statistics indicate the likely presence of individuals with environmental justice concerns. However, rehabilitation of the dam will provide benefits to all socioeconomic groups upstream and downstream of the dam without disparate treatment to any individuals or social groups.

Table S: Indicators and Groups from EPA's Environmental Justice Tool

Selected Variables	Value	State		EPA Region		USA	
		Avg.	%tile	Avg.	%tile	Avg.	%tile
Environmental Indicators							
Particulate Matter (PM 2.5 in µg/m^3)	9.32	9.18	48	8.95	59	8.55	76
Ozone (ppb)	43.2	41.3	64	41.8	62	42.9	55
NATA* Diesel PM (µg/m^3)	0.355	0.428	34	0.401	<50th	0.478	<50th
NATA* Air Toxics Cancer Risk (risk per MM)	32	35	37	36	<50th	32	50-60th
NATA* Respiratory Hazard Index	0.41	0.43	41	0.45	<50th	0.44	<50th
Traffic Proximity and Volume (daily traffic count/distance to road)	110	470	41	400	46	750	39

Selected Variables	Value	State		EPA Region		USA	
		Avg.	%tile	Avg.	%tile	Avg.	%tile
Lead Paint Indicator (% pre-1960s housing)	0.056	0.15	64	0.17	59	0.28	39
Superfund Proximity (site count/km distance)	0.03	0.084	40	0.081	43	0.13	30
RMP Proximity (facility count/km distance)	0.3	0.91	63	0.82	67	0.74	70
Hazardous Waste Proximity (facility count/km distance)	0.58	0.88	75	0.99	71	5	53
Wastewater Discharge Indicator (toxicity-weighted concentration/m distance)	0.00078	0.41	51	9.5	54	9.4	62
Demographic Indicators							
Demographic Index	19%	47%	11	44%	12	36%	27
People of Color Population	12%	58%	11	52%	17	39%	36
Low Income Population	26%	35%	26	37%	22	33%	29
Linguistically Isolated Population	0%	8%	27	6%	37	4%	46
Population with Less Than High School Education	14%	17%	23	16%	21	13%	28
Population under Age 5	4%	7%	57	7%	59	6%	68
Population over Age 64	17%	12%	53	13%	46	15%	35

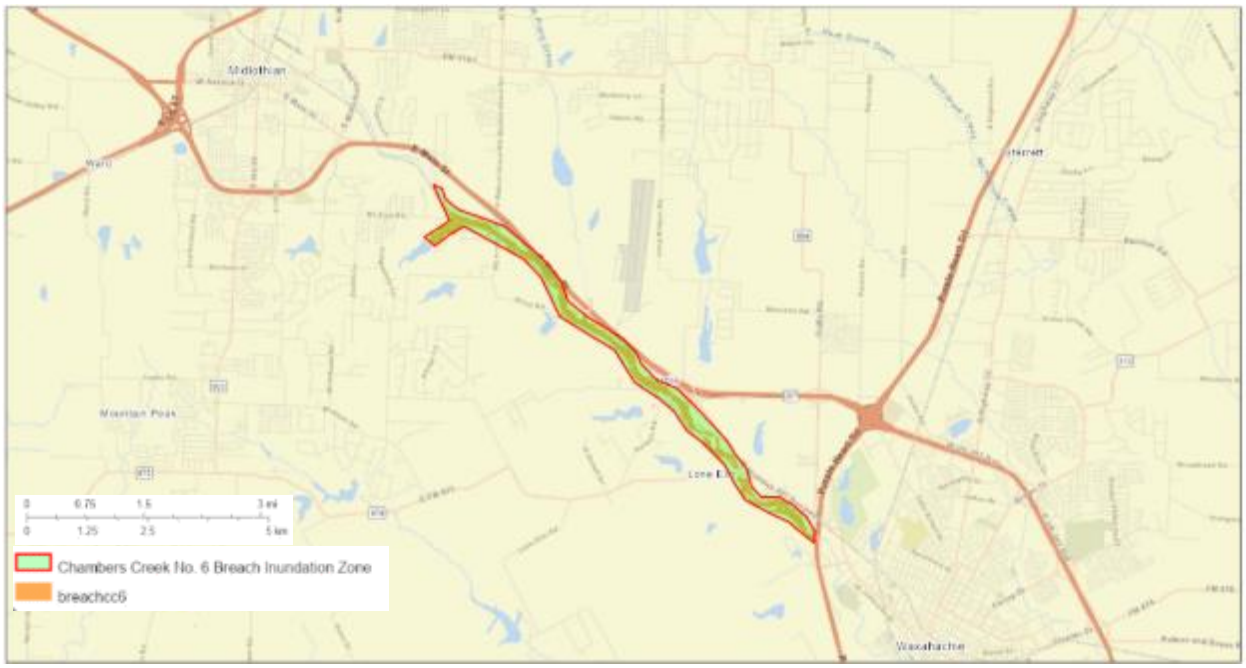

Figure 6. Area Evaluation (Breach Inundation Zone) for Environmental Justice Effects

12.8 STATUS OF OPERATION AND MAINTENANCE

The Ellis-Prairie Soil and Water Conservation District is currently responsible for the operation and maintenance of FRS No. 6. Inspections of the dam have indicated that the dam is being operated and maintained properly. The dam is in good condition and has good vegetative cover. The inlet structure and conduit of the principal spillway were visually inspected, and no deficiencies were observed. Investigations indicate that the dam, including the principal spillway, is structurally sound and is being properly maintained. The 8-inch low flow sluice valve was not tested during these inspections and is assumed to be non-operational due to age and lack of use. Determination will be made during constriction whether low flow capacity is required, as this level of detail is not necessary during the planning phase.

12.9 RESERVOIR STORAGE

The original planned total sediment volume was 127 acre-feet (according to the 19589 as-built drawings). As stated in the original work plan, the estimated annual sediment load for the Chambers Creek watershed was 2.16 acre-feet per square mile. For the FRS No. 6 watershed, this equates to approximately 3.537 acre-feet per year. At this rate, the original 127 acre-feet of sediment storage would provide at least 36 years of service from the original construction date of 1959.

Specialty Devices, Inc. (SDI) performed a bathymetric survey of the reservoir with acoustic survey equipment and traditional ground survey equipment on July 7, 2020. Due to the existing shallow water in the pond (less than 0.5 feet of water for some areas), the survey results were combined with available LiDAR topography data to update the elevation-storage curve for FRS No. 6. This data indicates that the reservoir volume at normal pool is 149 acre-feet.

Based on the results of the bathymetric survey, the reservoir has gained an approximate 22 acre-feet of storage below normal pool. It was assumed that the apparent increase in storage may be attributed to excavations from a borrow pit within the normal pool footprint that was used in the original construction of FRS No. 6. Without more detailed information of the post-construction submerged volume, it is difficult to assess an accurate sedimentation rate over the past 62 years since the reservoir was impounded. Further, the volume of borrow excavated from the lake was estimated to be approximately 56 acre-ft using available information in the as-built drawings and assessment report. The excavated volume was used in the sedimentation analysis to calculate a new sedimentation rate of 0.553 acre-ft per year. In that case, the current 149 acre-feet would provide the required sediment storage capacity for a design life of 100 years. Hence, the new principal spillway elevation will remain the same as the existing, 680.0 feet, which allows for 149 acre-feet of sediment storage below the principal spillway crest. Since the existing configuration provides sufficient sediment storage for the design life, the accumulated sediment in the sediment and detention storage areas was not tested as it will not be disturbed during the rehabilitation of FRS No. 6.

12.10 BREACH ANALYSIS AND HAZARD CLASSIFICATION

Chambers Creek FRS No. 6 does not meet current dam design and safety requirements. The dam was originally constructed in 1959 as a low-hazard structure for the purposes of protecting downstream agricultural lands from flooding. The NRCS and the TCEQ Dam Safety Program both agreed on the classification of the structure as high-hazard. The high hazard classification is based on the risk of loss of life concerning at-risk properties located in the downstream dam breach inundation area.

As a result of population growth and rural development, 5 residential structures, 2 commercial structures, segments of Mt Zion Road, shady Grove Road, Plainview Road, and 2 private roads are now at risk from a catastrophic breach of FRS No. 6. The residences would experience floodwater depths from first floor elevation to over 4 feet.

A breach analysis was performed as part of the preparation of this plan. The breach analysis results indicate that, if the dam were to fail, Mt Zion Road would be overtopped by approximately 5.0 feet of water; Shady Grove Road would be overtopped by approximately 0.7 feet; Plainview Road would be overtopped by 2.9 feet; and multiple private driveways would also be impacted. According to the Texas Department of Transportation (TxDOT) Traffic Count Database System (TCDS), about 1,066 vehicles utilize Mt Zion Road daily; 141 vehicles utilize Shady Grove Road; 1,662 vehicles utilize Plainview Road.

Although FRS No. 6 is presently sound, there is always a risk of failure. The most likely cause of FRS No. 6 is failing is by overtopping. In the event that the structure failed by overtopping, the most serious failure would be a breach in the tallest section of the embankment. This scenario would result in a breach hydrograph that has a peak discharge of 34,400 cubic feet per second, based on minimum peak discharge criteria contained in NRCS Technical Release Number 60. Fair weather conditions were assumed to develop the breach hydrograph. The reservoir pool elevation was static at top of dam with non-storm conditions downstream. See Appendix C-12, Breach Inundation Map and Appendix D, Investigation and Analysis – Hydrology.

12.11 EVALUATION OF POTENTIAL FAILURE MODES

Both NRCS and the TCEQ Dam Safety Program, recognize that Chambers Creek FRS No. 6 is a high-hazard dam. Several potential modes of failure were examined as follows:

Sedimentation: Sediment can be deposited in both the sediment pool (the area below the principal spillway crest) and flood detention pool (the area between the principal spillway crest and the auxiliary spillway crest). When the sediment pool has filled to the elevation of the principal spillway inlet, the pool no longer has water storage. As the detention pool loses storage due to sediment deposition, the auxiliary spillway operates, or has flowage, more often and is therefore subject to erosion. A potential mode of failure exists as the auxiliary spillway continues to degrade, and depth and frequency of flow increases. The dam will ultimately breach.

FRS No. 6 was designed with a 50-year sediment storage life. The bathymetric survey indicates that while some sediment has accumulated, FRS No. 6 has sufficient storage capacity remaining for more than 100 years. Given the minor changes to the upstream land use since the original design and construction, future sediment rates are expected to be similar to past sediment rates. Therefore, in the near future, sedimentation presents a low potential mode of failure for FRS No. 6.

Hydrologic Capacity: Hydrologic failure of a dam can occur by breaching the auxiliary spillway or overtopping the dam during a storm event. The integrity and stability of the auxiliary spillway is dependent on the depth, velocity, and the duration of flow; the vegetative cover; and the spillway's resistance to erosion. The integrity and stability of the embankment during overtopping is dependent on the depth, velocity, and duration of flow; the vegetative cover; and the embankment's resistance to erosion.

FRS No. 4 was originally designed with a capacity of 601 acre-feet of detention storage (at crest of auxiliary spillway) and 3.5 feet of freeboard (to top of dam elevation). Current NRCS criteria require FRS No. 6 to safely pass the 6- and 24-hours Freeboard Hydrograph (FBH) without overtopping the embankment. The capacity of the current auxiliary spillway is not sufficient to prevent the FBH from overtopping the dam embankment. Therefore, FRS No. 6 is categorized as having high potential to fail due to deficiency in required hydrologic capacity.

Seepage: Embankment and foundation seepage can contribute to failure of an embankment by removing (piping) soil material through the embankment or foundation. As the soil material is removed, voids can be created, allowing ever-increasing amounts of water to flow through the embankment or foundation until the dam collapses due to the internal erosion. Seepage that increases with an increase in pool elevation is

an indication of a potential problem and if it is stained or muddy water. Foundation and embankment drainage systems can alleviate the seepage problem by removing the water without allowing soil particles to be transported out of the dam. FRS No. 6 shows no visible signs of seepage along the downstream toe of the dam. The embankment has generally been kept clear of trees and brushy vegetation. Therefore, in the near future, seepage presents a low potential mode of failure for FRS No. 6.

Seismic: The integrity and stability of an earthen embankment are dependent on the presence of a stable foundation. Foundation movement through consolidation, compression, or lateral movement can create weak zones or voids within an embankment, separation of the principal spillway conduit joints, or in extreme cases, complete collapse of the embankment.

According to United States Geological Survey national seismic hazard maps, FRS No. 6 is located in an area where the peak ground acceleration (PGA) is estimated as 0.05g for 2 percent probability of exceedance in 50 years. There are no indications that any foundation movement has occurred in the past that would weaken the integrity of the embankment or any of the components of the structure, and none is anticipated in the future. Seismic activity creates only a low potential for failure of FRS No. 6.

Embankment Slope Failure: An embankment slope failure allows increased saturation and weakens the integrity of the dam during the PMF and could result in a catastrophic failure. Slope failure can also create slides and sloughing that lower the top of dam elevation so that overtopping may occur during the PMF.

FRS No. 6 shows no visible signs of slope failure, sloughing, or any other noticeable indications of embankment instability. Embankment slope failure presents a low potential mode of failure for FRS No. 6, but it should continue to be monitored in the future.

Material Deterioration: Material used in the principal spillway system and fences are normal, common construction materials, but they are subject to weathering and chemical reaction due to natural elements within the soil, water, and atmosphere. Concrete components can deteriorate and crack, metal components can rust and corrode, and leaks can develop. Embankment failure can occur from internal erosion caused by these leaks.

Based on available information and field observations, the structure appears to be in good condition with no evidence of deterioration on any of the materials that would require structural repair at this time. As a result, the potential for failure of the existing dam due to deteriorating components is determined to be low. However, due to the age of existing structural components, FRS No. 6 should continue to be monitored annually and after significant storm events.

12.12 CONSEQUENCES OF DAM FAILURE

All of the structural components of the dam appear to be in good condition. However, the dam does not meet current performance and safety standards for a dam in this hazard classification, and there is a risk of the dam failing from overtopping. An analysis of the dam indicated that a storm of the 6-hour FBH event would overtop the dam. The risk of dam failure is low but the consequences of a failure, if it were to occur, would likely be catastrophic.

Five residences, two commercial structures as well as motorists on Mt Zion Road, Shady Grove Road, Plainview Road, and two private roads would be at risk in the event of a breach. Vehicles on the roads would be washed downstream, and the road surfaces would be damaged and impassable. Traffic would be disrupted for an extended time while the roadways were being repaired. Given the number of properties and vehicles located within the breach zone, it is estimated that at a minimum the number of people at risk due to a breach of FRS No. 6 would be 93. Table T shows the effects of a breach of FRS No. 6 on downstream properties and crossings (figures 7 to 9).

Table T: Effects of Breach of FRS No. 6 to Downstream Properties and Crossings

Downstream Properties/Crossings	Depth Above First Floor Elevation (ft)	Depth Over Crossing (ft)	Daily Traffic Count	Maximum Velocity (ft/s)
5 residences	≤ 4	-	-	-
2 commercial structures	≤ 4	-	-	-
12 barns/outbuildings	≤ 6	-	-	-
Mt Zion Rd	-	5.0	1,066	13
Shady Grove Rd	-	0.7	141	3
Plainview Rd	-	2.9	1,662	11

Figure 7 Mt Zion Rd would be inundated by about 5 feet of floodwaters during a breach of Chambers Creek FRS No. 6

Figure 8 Shady Grove Road would be inundated by about 0.7 feet of floodwaters during a breach of Chambers Creek FRS No. 6

Figure 9 Plainview Road would be inundated by about 2.9 feet of floodwaters during a breach of Chambers Creek FRS No. 6

13.0 FORMULATION AND COMPARISON OF ALTERNATIVES

The alternatives were developed with the stated objectives in mind, primarily to 1) modify the dam to comply with NRCS dam safety criteria, and 2) maintain or increase the existing level of flood protection provided during the 100-year storm event. These objectives can be achieved by installing dam rehabilitation measures. In rehabilitating the dam, the risks to life and property from a potential catastrophic dam failure will be mitigated.

13.1 FORMULATION PROCESS

Formulation of the proposed alternatives for Chambers Creek 6 followed procedures detailed in the NRCS *National Watershed Program Manual*. Alternatives are eligible for financial assistance under the Watershed Protection and Flood Prevention Act (PL 83-566) as amended by the Watershed Rehabilitation Amendments of 2000 (Public Law 106-472). To be eligible for federal assistance, an alternative must meet the requirements as contained in the Watershed Rehabilitation Amendments of 2000.

A 100-year evaluated life and 101-year period of analysis were established. The high-hazard structure has the same design requirements and construction costs for all operation life increments between 50 and 100 years. Therefore, the greatest net benefit under this condition would be the 100-year operation life and no additional analysis was performed for other time increments. All alternatives were planned to function for a minimum of 100 years with proper maintenance.

Ellis-Prairie Soil and Water Conservation District is the entity that owns the easements for the dam and is responsible for determining what action to take if the dam is not brought up to current performance and safety standards. The Ellis-Prairie Soil and Water Conservation District currently owns easements up to two foot above the existing auxiliary spillway crest. Any additional land below the proposed top of dam will be located in the upstream headwaters of the reservoir, and development in those areas must be restricted by proper floodplain administration.

The “Future without Federal Investment” alternative serves as a baseline to evaluate the other alternatives. It represents the most probable future conditions in the absence of a federally assisted project. Based on conditions set forth by the Future without Federal Investment baseline, present conditions were developed. The dam does not meet current safety standards for a dam in this location, and there is a risk of the dam failing from overtopping. An analysis of the dam indicated that the 6-hour Freeboard Hydrograph (FBH)

event would overtop the dam. In addition, the dam is not capable of passing the required 75% TCEQ PMF without overtopping. Thus, in the absence of updated guidance, the baseline conditions assume the dam is not in place, since the dam would be expected to fail at some point in the future.

Appendix C-12 (Breach Inundation Map) depicts the area that could be flooded if the dam breached under fair weather conditions with the water surface in the reservoir static at the top of dam elevation, per Technical Report 210-60 guidelines.

Failure of the dam could result in significant damage and risk to loss of life. The Ellis-Prairie Soil and Water Conservation District considered the following options in deciding the most likely course of action:

- Take no action and accept the risk of potential dam failure.
- Decommission (breach) the dam to eliminate the risk of failure from an extreme storm event.
- Modify the dam to comply with current dam safety standards without Federal assistance.
- Modify the dam to comply with current dam safety standards with Federal assistance.

After considering the options, the District decided that their best option in the absence of Federal assistance is a true no-action alternative and accept the risk of damages from failure.

Alternatives eligible for financial assistance under the Watershed Protection and Flood Prevention Act (PL 83-566) as amended by the Watershed Rehabilitation Amendments of 2000 were developed. To be eligible for federal assistance, an alternative must meet the requirement as contained in 16 U.S.C. Section 1012 (Public Law 83-566, as amended).

Among three rehabilitation alternatives that were developed, Alternative No. 3 was selected. The alternative was chosen based on its benefit-cost ratio, which was the largest among the evaluated alternatives, as well as its relatively low capital costs.

13.2 ALTERNATIVES CONSIDERED BUT ELIMINATED FROM DETAILED STUDY

A wide range of non-structural and structural measures were considered singly and in combination during the planning process. Considered alternatives included floodplain management, and liability insurance. These alternatives were eliminated either due to exorbitant costs or because they did not meet the purpose and/or need of the project.

In addition, a range of modifications were considered in order to develop the final list of alternatives. Many combinations of principal spillway, auxiliary spillway, and dam raise modifications were considered and are shown in Table U.

Table U: Alternatives Development Matrix Chambers Creek FRS No. 6

Alternative ID	Principal Spillway	Auxiliary Spillway		Dam Raise (ft)
	Conduit Diam. (in.)	Total Width (ft)	Crest Elev. (ft)	
A1	30	75	693.74	5.1
A2		100		4.2
A3		125		3.5
A4		150		2.9

A5		175		2.5
A6		200		2.1
B1	36	75	693.06	4.4
B2		100		3.5
B3		125		2.8
B4		150		2.3
B5		175		1.8
B6		200		1.5
C1	42	75	692.40	3.7
C2		100		2.8
C3		125		2.1
D1	48	75	691.72	3.0
D2		100		2.1
D3		125		1.5
E1	54	75	691.01	2.3
E2		100		1.5
E3		125		0.8

One non-structural alternative considered was the purchase of deed restrictions of all land outside of the current 100-year floodplain and within the breach area and relocating residences within the breach area. Enacting this alternative would not necessarily result in the dam being reclassified as a low-hazard structure, since population as risk would still be associated with the downstream roadways. This alternative was rejected due to high cost of acquisition, which would total more than $4.1 million, loss of flood prevention benefits, and difficult implementation.

13.3 DESCRIPTION OF ALTERNATIVE PLANS CONSIDERED

Alternative No. 1 – No Federal Action/Future without Federal Investment

Under this alternative, no additional federal funds would be expended on the project. Alternative #1 is a true no-action alternative in which no rehabilitation measures take place. The dam would remain in its current configuration with regular maintenance continuing. The current level of flood protection would remain, though the overtopping risk associated with the dam not passing the state and federal requirements would also remain. Repairs would need to be made to maintain the existing spillways and upstream and downstream slopes on an as-needed basis, such as if significant erosion occurred.

Alternative No. 2 – Dam Decommissioning

This alternative consists of removing the ability of the dam to impound water and reconnecting, restoring, and stabilizing the upstream reservoir area/sediment pool and downstream floodplain functions. Channel work would be performed to reconnect the stream channel through the sediment pool and vegetation would be established along the stream channel. A grade stabilization structure would be installed to prevent head

cutting and sediment movement to the downstream areas. Exposed areas within the sediment pool would be vegetated for erosion and sediment control. Though the complete removal of the embankment is sometimes required for decommissioning, only partial removal of the embankment was assumed in this alternative. Partial removal of the embankment would consist of excavating a breach in the dam of sufficient size to safely pass the 100-year, 24-hour flood event with no influence on the water surface profile. This would eliminate the structure's ability to impound water.

The remaining portion of the embankment and the land currently covered by the sediment pool would be maintained as a greenbelt area. The excavated material (about 57,000 cubic yards) would be placed in the sediment and detention pool areas and all exposed areas would be vegetated as needed for erosion control (approximately 18 acres). Due to the lack of a defined bed and bank, channel work would be required to reconnect the stream channel through the sediment pool. Riparian vegetation would be established along the swale (approximately 2,160 feet of stream length). In order to not impede flows through the breached embankment, the principal spillway components would be removed. Construction activities will require that a SWP3 be in effect.

Since the 100-year inundation area (modeled for the purposes of this plan) would be enlarged from 105 acres to 128 acres due to the absence of flood attenuation, potential present and future downstream development would be affected by the increased flood profiles. Warning lights would need to be installed at seventeen stream crossings of bridges and culverts. Twenty-two houses, three mobile homes, seven commercial structures and twenty-eight barns/outbuildings would be subjected to flooding from a 100-year event without the dam. In the 100-year storm event, a total of six bridges and eleven culverts are impacted by Alternative No. 2. Several of these bridges would not be overtopped above the deck but are predicted to experience damage according to the methodology used in the economic analysis. The estimated cost to implement this alternative is $2,939,800.

Alternative No. 3 – Dam Rehabilitation

This alternative consists of replacing the existing principal spillway with a standard intake riser with a 30-inch diameter pipe with an impact basin at the outlet end. The existing principal spillway needs to be replaced in order to meet requirements of the Principal Spillway Hydrograph (PSH) and facilitate the discharge of the design storm event. The auxiliary spillway crest will be raised by 0.25 feet while the control section will be widened 125 feet from 75 feet to 200 feet. The top of the dam will be raised an average of 2.1 feet and the downstream slope flattened from 2:1 to 3:1 using fill material from the surrounding area. The dam will be lengthened by approximately 55 feet. All disturbed areas in or adjacent to the existing embankment, abutment areas, auxiliary spillway and sediment pool will be re-vegetated using adapted and/or native species, and construction activities will require that a SWP3 be in effect.

The estimated cost to implement this alternative is $3,608,800 and a conceptual figure representing this alternative is included in Appendix C-18.

Alternative No. 4 – Dam Rehabilitation

This alternative consists of replacing the existing principal spillway with a standard intake riser with a 36-inch diameter pipe with an impact basin at the outlet end. The existing principal spillway needs to be replaced in order to meet requirements of the Principal Spillway Hydrograph (PSH) and facilitate the discharge of the design storm event. The auxiliary spillway crest will maintain the existing width of 75 feet and it will be armored with Articulated Concrete Blocks (ACB) in order to prevent erosion and head cutting that is produced due to the hydraulic head on the spillway. The crest of the auxiliary spillway will be lowered 0.45 ft to elevation 693.1 feet. The top of the dam will be raised an average of 4.4 feet and the downstream slope flattened from 2:1 to 3:1 using fill material from the surrounding area. The dam will be lengthened by approximately 60 feet. All disturbed areas in or adjacent to the existing embankment,

abutment areas, auxiliary spillway and sediment pool will be re-vegetated using adapted and/or native species, and construction activities will require that a SWP3 be in effect.

The estimated cost to implement this alternative is $6,958,900 and a conceptual figure representing this alternative is included in Appendix C-19.

Alternative No. 5 – Dam Rehabilitation

This alternative consists of replacing the existing principal spillway with a standard intake riser with a 36-inch diameter pipe with an impact basin at the outlet end. The existing principal spillway needs to be replaced in order to meet requirements of the Principal Spillway Hydrograph (PSH) and facilitate the discharge of the design storm event. The auxiliary spillway crest will be lowered by 0.45 feet while the control section will be widened 125 feet from 75 feet to 200 feet. The top of the dam will be raised an average of 1.5 feet and the downstream slope flattened from 2:1 to 3:1 using fill material from the surrounding area. The dam will be lengthened by approximately 30 feet. All disturbed areas in or adjacent to the existing embankment, abutment areas, auxiliary spillway and sediment pool will be re-vegetated using adapted and/or native species, and construction activities will require that a SWP3 be in effect.

The estimated cost to implement this alternative is $3,667,900 and a conceptual figure representing this alternative is included in Appendix C-19.

13.4 NATIONAL ECONOMIC EFFICIENCY ALTERNATIVE

For water and related land resources implementation studies, standards and procedures have been established in formulating alternative plans. These standards and procedures are found in the *Principles, Requirements, and Guidelines for Water and Land Related Resources Implementation Studies and Federal Water Resource Investment, 2017 (PR&G)*. According to PR&G, Federal investment in water resources should strive to maximize public benefits, with appropriate consideration to cost and an alternative that reasonably maximizes net national economic efficiency is to be formulated. This alternative is to be identified as the national economic efficiency (NEE), previously known as the national economic development (NED). During the process of formulating alternatives, the NEE alternative was determined to be Alternative No. 3. Further discussion is included in Section 16.0, and a summary of the alternative plans is included in Table V and Table W.

Table V: Summary and Comparison of Alternative Plans for Chambers Creek FRS No. 6

Resource Concerns	**Alternative 1 (Future without Federal Investment)**	**Alternative 2 (Decommissioning)**	**Alternative 3 (Rehabilitation) (NEE) (Recommended)**	**Alternative 4 (Rehabilitation)**	**Alternative 5 (Rehabilitation)**
NEE Account[1]					
Project Investment	$0	$2,939,800	$3,608,800	$6,958,900	$3,667,900
Annual Benefits	$0	$0	$66,500	$64,900	$64,800
Annual Costs	$0	$82,800	$107,400	$199,700	$109,000
Net Benefits	$0	-$82,800	-$40,900	-$134,800	-$44,200
EQ Account[2]					
Air Quality	No change to air quality.	Only temporary minor impacts due to construction activities, such as increased dust, exhaust, etc.; not anticipated to exceed air quality standards.			
Fish and Wildlife Resources	No changes to wildlife or fish resources. In the event of a breach, reservoir pool will be eliminated, and sediment pool will be converted to unimproved riparian area.	Converts the 18 acres of sediment pool to unimproved riparian area.	Fish & wildlife habitat maintained, sediment pool remains the same, will continue to capture sediment and attenuate floodwater.		
Prime Farmland (FPPA)	No prime farmland located in the project area.				
Riparian Area	No changes to riparian area. In the event of a breach, riparian area downstream will be impacted with sediments.	Same as Fish & Wildlife Resources above, increases riparian area.	Minor temporary impacts during construction (disturbance, dust, exhaust, etc.), riparian area returned to pre-construction condition.		

Resource Concerns	**Alternative 1 (Future without Federal Investment)**	**Alternative 2 (Decommissioning)**	**Alternative 3 (Rehabilitation) (NEE) (Recommended)**	**Alternative 4 (Rehabilitation)**	**Alternative 5 (Rehabilitation)**
Water Bodies (Including Waters of the U.S.)	No changes to the sediment pool. In the event of a breach, sediment pool will be lost.	Converts 18 acres of sediment pool to approx. 1,500 feet of ephemeral stream, most likely authorized by NWP 27.	Sediment pool retained. Most likely authorized by NWP 3 without PCN.		
Wetlands	No changes to wetlands downstream. In the event of a breach, downstream wetlands will be impacted.	Reduction in wetlands due to conversion of 18 acres of sediment pool to unimproved stream.	Minor temporary impacts during construction (disturbance, dust, exhaust, etc.); wetlands return to pre-existing conditions.		
Wildlife Community (Incl. Migratory Birds)	No changes to wildlife communities. In the event of a breach, downstream habitat for wildlife and birds may be impacted.	Decreases 18 acres of open water habitat during and after storm events and increases unimproved riparian area.	Temporary impacts, disturbance during construction; maintains sediment pool and attenuates flows in downstream ephemeral stream.		
Water Quality	No changes to water quality. In the event of a breach, water quality may be temporarily impacted by sediments.	Increased sediment loads could occur downstream. SWP3 in effect during construction.	Minor temporary impacts during construction (turbidity, sediment, etc.), SWP3 in effect during construction.		
Sedimentation and Erosion	No changes to sediments or erosion patterns. In the event of a breach, sediment and erosion downstream would be expected.	Minor erosion during and after construction. Loss of sediment pool increases sedimentation downstream.	Minor erosion during construction. Sediment pool has sufficient storage for evaluated 100-year life.		
RED Account[3]					
Land Values	No changes to land values. In the event of	Negative impact to properties not currently	No impact.		

Resource Concerns	**Alternative 1 (Future without Federal Investment)**	**Alternative 2 (Decommissioning)**	**Alternative 3 (Rehabilitation) (NEE) (Recommended)**	**Alternative 4 (Rehabilitation)**	**Alternative 5 (Rehabilitation)**
	a breach, land values downstream may decrease.	in floodplain due to induced flood damages, approximately an additional 25 acres.			
OSE Account[4]					
Public Health & Safety	Public health and safety will continue to be at risk of a breach.	Reduced threat to loss of life from breach, but more frequent flooding.	Reduced threat to loss of life. Level of flood protection maintained with minimal change to existing conditions.		
Flood Damages	In the event of a breach, downstream homes and buildings would be damaged.	Downstream flood damages would increase.	Level of flood protection maintained with minimal change to existing conditions.		
Environmental Justice	Affected populations downstream of the dam would be at risk in the event of a breach.	Loss of flood protection for affected population below dam regardless of economic status.	Flood protection maintained with minimal change to existing conditions for affected population.		
Floodplain Management	No changes to floodplain. Level of flood protection would decrease.	Regulatory BFEs exist downstream. Conditional Letter of Map Revision (CLOMR)	Level of flood protection maintained with minimal change to existing conditions.		

[1] NEE – National Economic Efficiency/National Economic Development
[2] EQ – Environmental Quality
[3] RED – Regional Economic Development
[4] OSE – Other Social Effects

Table W: Project Alternatives and Associated Ecosystem Services Chambers Creek FRS No. 6

Resource Concerns	**Alternative 1 (Future without Federal Investment)**	**Alternative 2 (Decommissioning)**	**Alternative 3 (Rehabilitation) (NEE[1]) (Recommended)**	**Alternative 4 (Rehabilitation)**	**Alternative 5 (Rehabilitation)**
Alternatives					
Locally Preferred			X		
Non-Structural					
Environmentally Preferable		X			
Brief Description of Major Project Features		Excavate breach in embankment and reconnect stream channel through sediment pool. Establish riparian vegetation along swale.	Replace principal spillway. Raise and widen auxiliary spillway crest. Raise top of dam and flatten downstream slope.	Replace principal spillway. Lower auxiliary spillway crest and armor with ACBs. Raise top of dam and flatten downstream slope.	Replace principal spillway. Lower and widen auxiliary spillway crest. Raise top of dam and flatten downstream slope.
Total Project Investment					
Project Investment	$0	$2,939,800	$3,608,800	$6,958,900	$3,667,900
Annual Costs	$0	$82,800	$107,400	$199,700	$109,000
Monetized Net Benefits					
Annual Benefits	$0	$0	$66,500	$64,900	$64,800
Net Benefits	$0	-$82,800	-$40,900	-$134,800	-$44,200
Provisioning Services					
Endangered and threatened species	No Effect	No Effect	No Effect	No Effect	No Effect
Invasive species	No Effect	Invasive species management performed during construction	Invasive species management performed during construction	Invasive species management performed during construction	Invasive species management performed during construction
Riparian areas	No Change	Return to natural ephemeral stream condition; riverine	Maintain impounded waterbody; lacustrine	Maintain impounded waterbody; lacustrine	Maintain impounded waterbody; lacustrine

Resource Concerns	**Alternative 1 (Future without Federal Investment)**	**Alternative 2 (Decommissioning)**	**Alternative 3 (Rehabilitation) (NEE[1]) (Recommended)**	**Alternative 4 (Rehabilitation)**	**Alternative 5 (Rehabilitation)**
Regulating Services					
Floodplain management	No Change	Stabilizes and restores stream function; revise FEMA flood maps	Level of flood protection maintained with minimal change to existing conditions	Level of flood protection maintained with minimal change to existing conditions	Level of flood protection maintained with minimal change to existing conditions
Public health and safety	No Change	Minimum impact to downstream communities from loss of protection	Maintain flood protection	Maintain flood protection	Maintain flood protection
Waters of the United States	No Change	Conversion of 18 acres of sediment pool to 1,500 feet of ephemeral stream; increased sediment loads could occur downstream	Minor temporary impacts during construction	Minor temporary impacts during construction	Minor temporary impacts during construction
Supporting Services					
Nutrient Cycling	Dam remains in place and reduces downstream nutrient transfer	Short term release of trapped nutrients downstream and long term trend to riverine system with downstream nutrient transfer	Dam remains in place and reduces downstream nutrient transfer	Dam remains in place and reduces downstream nutrient transfer	Dam remains in place and reduces downstream nutrient transfer
Soil Formation	Downstream migration of sediment is prevented by the dam structure	Dam removal would result in downstream migration of sediment	Downstream migration of sediment is prevented by the dam structure	Downstream migration of sediment is prevented by the dam structure	Downstream migration of sediment is prevented by the dam structure
Primary Production	Perennial hydrology supports primary production (algae, cyanobacteria, macrophytes)	Return to ephemeral stream – primary production is reduced with the loss of a perennial waterbody	Perennial hydrology supports primary production (algae, cyanobacteria, macrophytes)	Perennial hydrology supports primary production (algae, cyanobacteria, macrophytes)	Perennial hydrology supports primary production (algae, cyanobacteria, macrophytes)
Cultural Services					
Cultural resources	No Effect	No Effect	No Effect	No Effect	No Effect
Fish and wildlife	Recreational value (fishing, boating) maintained for private landowners	Recreational value (fishing, boating) removed with dam decommissioning	Recreational value (fishing, boating) maintained for private landowners	Recreational value (fishing, boating) maintained for private landowners	Recreational value (fishing, boating) maintained for private landowners

Resource Concerns	**Alternative 1 (Future without Federal Investment)**	**Alternative 2 (Decommissioning)**	**Alternative 3 (Rehabilitation) (NEE[1]) (Recommended)**	**Alternative 4 (Rehabilitation)**	**Alternative 5 (Rehabilitation)**
Water quality	No Change	Sediment releases downstream	Minimal temporary impacts during construction	Minimal temporary impacts during construction	Minimal temporary impacts during construction
Regional Economic Impacts	No Effect	Temporary benefits to local economy during construction	Temporary benefits to local economy during construction	Temporary benefits to local economy during construction	Temporary benefits to local economy during construction

[1] NEE – National Economic Efficiency previously known as National Economic Development

Table X. Consideration of PR&G Guiding Principles Chambers Creek FRS No. 6

PR&G GUIDING PRINCIPLES	Alternative 1 (Future without Federal investment)	Alternative 2 (Decommissioning)	Alternative 3 (Rehabilitation) (NEE/NED) (Recommended)	Alternative 4 (Rehabilitation)	Alternative 5 (Rehabilitation)
Healthy and Resilient Ecosystems	Maintain current ecological function of reservoir for fish and wildlife habitat	Return stream's ecological function to pre-impoundment conditions following decommissioning of dam and partial embankment removal	Maintain current ecological function of reservoir for fish and wildlife habitat	Maintain current ecological function of reservoir for fish and wildlife habitat	Maintain current ecological function of reservoir for fish and wildlife habitat
Sustainable Economic Development	No Effect	Complies with sustainable use and management of water resources through return to natural conditions	Complies with sustainable use and management of water resources through maintaining flood protection and recreation	Complies with sustainable use and management of water resources through maintaining flood protection and recreation	Complies with sustainable use and management of water resources through maintaining flood protection and recreation
Floodplains	The dam would remain in its current configuration. The current level of flood protection would remain	The 100-year inundation area downstream would increase from 105.5 acres to 128.2 acres (an increase of 17.7%)	The 100-year inundation area downstream would be increased from 105.5 acres to 106.0 acres (an increase of 0.5%)	The 100-year inundation area downstream would be increased from 105.5 acres to 106.9 acres (an increase of 1.3%)	The 100-year inundation area downstream would be increased from 105.5 acres to 106.9 acres (an increase of 1.3%)
Public Safety	Threat to loss of life from breach	Threat to loss of life from breach eliminated	Reduced threat to loss of life with flood protection maintained	Reduced threat to loss of life with flood protection maintained	Reduced threat to loss of life with flood protection maintained
Environmental Justice	Affected populations downstream will continue to be at risk of a dam breach	Loss of flood protection for affected population below dam regardless of economic status	Flood protection maintained with minimal change to existing conditions for affected population	Flood protection maintained with minimal change to existing conditions for affected population	Flood protection maintained with minimal change to existing conditions for affected population
Watershed Approach	Maintain ecological function of Williams Creek and Pedernales River system	Decommissioning of dam could improve ecological function of Williams Creek and Pedernales River system	Maintain ecological function of Williams Creek and Pedernales River system	Maintain ecological function of Williams Creek and Pedernales River system	Maintain ecological function of Williams Creek and Pedernales River system

14.0 ENVIRONMENTAL CONSEQUENCES

Five alternative plans were considered and evaluated in detail, including the No Federal Action/Future Without Federal Investment Alternative. The Environmental Consequences section describes the environmental effects of the existing conditions of the project area and alternative plans considered.

Summary of Special Environmental Concerns Not Within the Affected Environment and Excluded from Consequences Analysis.

- Coastal Zone Management Areas
- Wild and Scenic Rivers
- Clean Air Act – Regional Haze Regulations
- Essential Fish Habitat
- Coral Reefs
- Bald and Golden Eagle Protection Act
- National Historic Landmarks Program
- Scenic Beauty and Visual Resources

14.1 SPECIAL ENVIRONMENTAL CONCERNS

Soils

Existing Conditions: There is no Farmland of Statewide Importance located within the maximum extent of potential disturbance of Chambers Creek FRS No. 6 that would potentially be impacted by construction activities.

Alternative No. 1 - No Federal Action/Future Without Federal Investment: There would be no effect to soils. The dam would continue to exist in its current state. The risk of a dam breach would persist. In the event of a dam breach, sediment from the sediment pool would be released downstream.

Alternative No 2. - Dam Decommissioning: Under the Dam Decommissioning Alternative, approximately 57,000 cubic yards of excavated materials will be placed in the present easement area of the dam. Portions of the embankment and the land covered by the sediment pool will be maintained as a greenbelt. Native vegetation will be established along the disturbed areas.

Alternative No. 3, 4, 5 - Dam Rehabilitation Alternatives: The Dam Rehabilitation Alternatives would require borrow material to raise the top of dam and auxiliary spillway may be taken from nearby borrow source. The actual acres that will be disturbed will be determined by the design process but will not exceed the designated limits of Farmland of Statewide Importance. After construction is complete, disturbed areas will be revegetated with native or adapted plant species.

Cumulative Impacts: Ground disturbing activities and the movement of construction vehicles and equipment during the proposed actions would contribute to minor temporary impacts and loss of soils. The impacts would be incremental to other regional effects occurring as a result of increased residential and commercial developments, and ongoing agricultural land uses. Soil effects in the long term as a results of the project would be considered minor.

Water

Clean Water Act

Section 303(d) and 305(b)

Existing Conditions: The 2020 Texas Integrated Report of Surface Water Quality for the Clean Water Act Sections 305(b) and 303(d) was released in May 2020, lists one impairment (Sulfate in the water) within the Bardwell Reservoir (Stream Segment 0815), which impounds Waxahachie Creek.

Alternative No. 1 - No Federal Action/Future Without Federal Investment: There would be no effects to water quality. The dam would continue to exist in its current state. The risk of a dam breach would persist. In the event of a dam breach, there would be temporary impacts to water quality downstream due to sediment release from the sediment pool.

Alternative No. 2 - Dam Decommissioning: There may be temporary impacts to water quality downstream due to the sediment release related to the dam breach. Erosion and sediment control measures would minimize impacts to water quality during construction and meet the appropriate water quality standards.

Alternative No. 3, 4, 5 - Dam Rehabilitation: There may be temporary impacts to water quality downstream due to the sediment disturbance from earth moving and construction-related activities. With the required erosion and sediment control measures in place during construction, downstream impacts to water quality should be minimal and temporary. Any water releases from the project area are expected to meet the appropriate water quality standards.

Cumulative Impacts: Sediment release from construction activities related to the rehabilitation or decommissioning of the dam would be temporary and localized to the project area. Impacts to water quality to Chambers or Waxahachie Creek from the dam rehabilitation project are expected to be minor. No long-term impacts on water quality from rehabilitation activities are anticipated. The water quality impacts would be incremental to other regional effects occurring because of increased residential and commercial developments upstream, and ongoing agricultural land uses.

Sections 401 and 404

Existing Conditions: The shorelines of the Chambers Creek FRS No. 6 reservoir pool were visually surveyed by a biologist for wetlands on July 15, 2020. There were no wetlands observed along the shorelines or below the dam at the outfall stilling basin.

Alternative No 1. - No Federal Action/Future Without Federal Investment: There would be no effects to wetlands. The risk of a dam breach would persist. In the event of a dam breach, downstream conditions and natural resources would be impacted.

Alternative No. 2 - Dam Decommissioning: Breach of the dam would permanently lower the water levels of the reservoir. Channel work would be performed to reconnect the stream channel through the sediment pool and vegetation would be established along the stream channel. There may be temporary impacts to water quality downstream due to the sediment releases when the water is drawn down prior to construction related to the dam breach.

Alternatives No. 3, 4, 5 - Dam Rehabilitation: The water levels of the reservoir would be temporarily lowered to facilitate construction activities. Any water releases from the project area are expected to meet the appropriate water quality standards.

Cumulative Impacts: Water levels within the reservoir would be permanently lowered with the No Federal Action/Future Without Federal investment and Dam Decommissioning Alternatives. No long-term impacts to WOTUS, including wetlands, from rehabilitation activities are anticipated. No long-term impacts on water quality from rehabilitation activities are anticipated. The water quality impacts would be incremental to other regional effects occurring because of increased residential and commercial developments upstream, and ongoing agricultural land uses.

Floodplain Management

Existing Conditions: The TCEQ administers the National Flood Insurance Program for the State of Texas and maintains a list of local floodplain administrators. The local administrators have the responsibility of reviewing potential floodplain modifications within their jurisdiction. The floodplain of Chambers Creek is managed by the floodplain administrator at the City of Midlothian.

Alternative No. 1 - No Federal Action/Future Without Federal Investment: There would be no changes to the floodplain. The current level of flood protection would remain, though the overtopping risk associated with the dam not passing the state and federal requirements would also remain. Repairs would need to be made to maintain the existing spillways and upstream and downstream slopes on an as-needed basis, such as if significant erosion occurred. The risk of a dam breach would persist. In the event of a dam breach, there would be flooding downstream.

Alternative No. 2 - Dam Decommissioning: Alternative No. 2 involves only partial removal of the embankment. Partial removal of the embankment would consist of excavating a breach in the dam of sufficient size to safely pass the 100-year, 24-hour flood event with no influence on the water surface profile. This would eliminate the structure's ability to impound water. A CLOMR may be required from FEMA post-construction to revise effective FIRMs and show changes to the floodplains and/or flood elevations.

Alternatives No. 3, 4, 5 - Dam Rehabilitation: Rehabilitation activities will enlarge the 100-year floodplain downstream of the dam within the project area by approximately 161 acres, from 1,047 acres to 1,208 acres. These acreages were newly developed for the purposes of this Supplemental Watershed Plan to compare existing and proposed rehabilitation conditions.

Cumulative Impacts: The No Federal Action/Future Without Federal Investment and Dam Decommissioning Alternatives would have long-term impacts on the floodplain and flooding severity and frequencies downstream of the reservoir.

Air

Existing Conditions: According to the TCEQ, Ellis County is categorized as attainment for all NAAQS except ozone. Air quality is satisfactory and below the National Ambient Air Quality Standards for particulate matter. Emissions from construction related activities are expected to result in de minimis and would not require Nonattainment New Source Review (NNSR) and Prevention of Significant Deterioration (PSD) permits for air emissions.

Alternative No. 1 - No Federal Action/Future Without Federal Investment: There would be no change to air quality. Ellis County would continue to be in attainment status for all NAAQS except for ozone.

Alternative No. 2 - Dam Decommissioning: During the decommissioning of the dam, particulate matter and air pollutant emissions from earth moving activities and operation of construction vehicles will increase. Although there would be a temporary increase in particulate matter, carbon monoxide, nitrogen oxide, and other pollutants from heavy equipment, the proposed work is not expected to violate any federal, state, or

local air quality standards. During construction activities, BMPs would be implemented to reduce construction-related emissions. Impacts to air quality is anticipated to be temporary and localized.

Alternative No. 3, 4, 5 - Dam Rehabilitation: During the rehabilitation of the dam, particulate matter and air pollutant emissions from earth moving activities and operation of construction vehicles will increase. The use of a mobile concrete batch plant will generate dust. Although there would be a temporary increase in particulate matter, carbon monoxide, nitrogen oxide, and other pollutants during construction, the proposed work is not expected to violate any federal, state, or local air quality standards. During construction activities, BMPs would be implemented to reduce construction-related emissions. Impacts to air quality is anticipated to be temporary and localized.

Cumulative Impacts: The regional air quality is good and the project area is in attainment for all criteria pollutants except ozone. Cumulative effects to regional and local air quality may result from future construction associated with increased development within the watershed.

Vegetation

Wetlands and Riparian Areas

Existing Conditions: There are riparian areas around the reservoir and along Chambers Creek. No wetlands were identified upstream or downstream of the dam structure during the field survey on June 3, 2020.

Alternative No. 1 - No Federal Action/Future Without Federal Investment: There would be no effects to wetlands and riparian areas. The dam would continue to exist in its current state. In the event of a dam breach, riparian and wetland areas downstream of the project area may be impacted by flooding.

Alternative No. 2 - Dam Decommissioning: During the decommissioning of the dam, construction activities would be limited to the dam embankment and around the stilling basin of the dam. Vegetation community and habitat along the reservoir and project area will be temporarily affected. Following construction, the remaining portion of the embankment and the land currently covered by the sediment pool would be maintained as a greenbelt area. Disturbed areas would be revegetated with native or adapted species. Impacts to habitat and vegetation are expected to be temporary and minor.

Alternative No. 3, 4, 5 - Dam Rehabilitation: During the rehabilitation of the dam, construction activities would be limited to the dam embankment, auxiliary spillway, and around the stilling basin of the dam. Construction will be limited to the smallest possible extent. Vegetation community and habitat along the reservoir and project area will be temporarily affected. After the completion of construction activities, disturbed areas will be revegetated with native or adapted species. Impacts to habitat and vegetation are expected to be temporary and minor.

Cumulative Impacts: The area around the dam would be regularly maintained by the responsible party. The dam embankment will be regularly mowed to prevent trees from growing along the dam slopes.

Special Status Plant Species

There are no known plant species protected by the ESA within Ellis County. No critical habitat has been designated near the Chambers Creek No. 6 Project Area. A copy of the TPWD and USFWS concurrence letters can be found in Appendix D.

Invasive Plant Species

During the field site visit on June 3, 2020, King Ranch bluestem, an invasive grass species was observed around the project area. Special care will be taken during construction to avoid the spread or introduction

of invasive species. Construction vehicles and equipment will be cleaned of vegetative matter before entering the project area. Disturbed areas will be vegetated with non-invasive, native plant species after construction is completed.

14.2 WILDLIFE

Terrestrial Wildlife Communities

The reservoir and adjacent areas could potentially be utilized by several species of migratory birds for feeding, nesting, or roosting. No bald eagle nests are located within the project area. There are also several federally listed species that have the potential for occurrence within Ellis County (Table Y).

Construction activities would be limited to the dam embankment, auxiliary spillway, and around the stilling basin of the dam. Wildlife community and habitat along the reservoir and project area will be temporarily affected and may locate to adjacent properties. After the completion of construction activities, disturbed areas will be revegetated with native species. Impacts to wildlife are expected to be temporary and minor. Table Y summarizes impacts to wildlife communities that would result from the No Action, Dam Decommissioning, and Dam Rehabilitation Alternatives. BMPs or other measures are paired with each impact to reduce or eliminate negative impacts or comply with applicable laws.

Table Y: Potential Impacts to Wildlife Communities from No Action, Dam Decommissioning, and Dam Rehabilitation Alternatives Chambers Creek FRS No. 6

Wildlife Community	Timeframe	Impact Type	Impact Description	BMP or Measures to Comply with Applicable Laws
All	Short term	Direct	Stress, disturbance, and displacement due to construction activities and human presence.	Minimize direct disturbance impacts by completing construction of project components in the shortest practicable timeframe
All	Short term	Direct	Loss of water source	Since the pool level may be drained during construction it may be temporarily unavailable for use to migratory birds and other wildlife. However, there are similarly sized bodies of water throughout the region for wildlife usage.
Small mammals, reptiles, and amphibians	Short term	Direct	Direct mortality of small, ground dwelling mammals, reptiles, or amphibians in the construction area, disturbed habitat.	Limit the construction footprint to the smallest area practicable.
Nesting raptors (hawks, falcons, owls)	Short term	Direct	Potential for “take” under the MBTA (loss of eggs or young from nest abandonment) due to construction activities and human presence.	Complete construction outside of the nesting season (March 1 to September 30). If construction occurs within the nesting season, complete a nesting raptor survey and operate outside of the recommended USFWS-

				approved guidance on buffer distance. If nesting raptors are present within the recommended buffer zone, coordination should be initiated with the local USFWS biologist to adjust the buffer distance if warranted; otherwise work must not proceed until nesting is complete and young chicks have fledged. Cease work if a nesting raptor is discovered within the recommended buffer distance during construction and consult the local USFWS biologist for next steps.
Bald and golden eagles	Short term	Direct	Potential for "take" under the MBTA (loss of eggs or young from nest abandonment) due to construction activities and human presence. Potential to interfere with an eagle's "substantial lifestyle, including shelter, breeding, feeding" as defined by the Bald and Golden Eagle Protection Act of 1940.	Bald and Golden Eagles typically use the same nest sites year after year; consult with local USFWS biologists for the most recent understanding of the locations of active nests and operate outside of the recommended buffer distance. If operating heavy machinery inside the recommended buffer distance, operate outside of the nesting season; bald eagles may commence nesting as early as January.
Nesting migratory birds	Short term	Direct	Potential for "take" under the MBTA (loss of eggs or young from nest abandonment or direct destruction).	Operate outside of the primary nesting season for migratory birds (March 1 to September 30). Accomplish any vegetation clearing or grubbing prior to the nesting season. If planning on vegetation clearing or grubbing during the nesting season, the area must be surveyed by qualified biologists for active nests no more than 2 weeks prior to commencement of the work. If active nests are found during the nest surveys, establish a nest buffer in coordination with USFWS biologist. If an active nest is discovered during construction, stop work and consult the local USFWS biologist for next steps.

All	Long term	Indirect	Introduction of invasive plant species to the construction area causing habitat degradation.	Clean construction equipment and vehicles prior to bringing it onsite. Ensure that borrow material imported to the construction area is not infested with plant species. Ensure seed sources for revegetation are weed-free.

State Protected Threatened and Endangered Species

Suitable habitat for State protected Texas Horned Lizard and Alligator Snapping Turtle exists within the project area. Construction contractors will be trained on the life history, physical description, and habitat preference of the species and follow TPWD recommendations to avoid impacts to state listed and SGCN species during construction, maintenance, and operation activities. Additional information can be found in the TPWD coordination letter found in Appendix D.

14.3 HUMAN ENVIRONMENT

Local and Regional Economy

Existing Conditions: Developed residential areas surround the Chambers Creek FRS No. 6 project area, however the dam and reservoir are located on private property. The property owners utilize the lake for recreational purposes, and access is not provided to the general public.

Alternative No. 1 – No Federal Action/Future Without Federal Investment: There would be no effect to the local or regional economy. The dam would continue to exist in its current state. The risk of a dam breach would persist. In the event of a dam breach, the local economy could be negatively affected by flood damage.

Alternative No. 2 - Dam Decommissioning: Dam Decommissioning would result in a temporary positive effect on the local economy during construction efforts; however, there would be potentially long-term negative effects to the economy through the loss of flood protection to downstream communities.

Alternative No. 3, 4, 5 - Dam Rehabilitation: There would likely be a temporary positive effect on the local economy during construction and rehabilitation of the dam.

Cumulative Impacts: Same as Dam Rehabilitation.

Public Health and Safety

Existing Conditions: According to the results of the dam breach modeling and inundation mapping performed in conjunction with the development of this plan, a dam failure could result in impact to 5 residential structures, 2 commercial structures and segments of Mt Zion Road, Shady Grove Road, Plainview Road, and 2 private roads.

Alternative No. 1 - No Federal Action/Future Without Federal Investment: There would be no immediate effects to public health and safety. The dam would continue to exist in its current state. The risk of a dam breach and flooding downstream would remain for the public downstream of the dam.

Alternative No. 2 – Dam Decommissioning: Under the No Federal Action Alternative, dam decommissioning would result in an increased threat of loss of life and property from flood risk to the downstream community. Residential homes and property would no longer be able to rely on Chambers Creek FRS No. 6 to capture flood waters during extreme precipitation events.

Alternative No. 3, 4, 5 - Dam Rehabilitation: The actions proposed under the rehabilitation alternatives would structurally rehabilitate the dam using current design and safety standards to provide continued flood protection for 100 years following construction of the project. The level of flood protection provided by the dam would remain the same. The threat of loss of life and property from failure of the dam would be greatly reduced. Access to the site will be restricted during the construction period.

Cumulative Impacts: Same as Dam Rehabilitation.

Cultural and Historic Resources

Existing Conditions: Chambers Creek FRS No. 6 is located within the direct Impact Area of Potential Effect of the proposed actions. The dam was built in 1959, and therefore, meets the age requirement to be eligible for National Register consideration due to its age (50+ years old). The assessment of eligibility was performed through consultation with the Texas SHPO, and the dam was deemed ineligible for inclusion in the NRHP, with no effect to historic resources.

Alternative No. 1 - No Federal Action/Future Without Federal Investment: There will be no impacts to cultural or historical resources.

Alternative No. 2 - Dam Decommissioning: Dam decommissioning would result in the loss of flood protection capabilities and impacts to the existing dam structure would be minimal.

Alternative No. 3, 4, 5 - Dam Rehabilitation: While no known historic resources have been recorded within the project area, a review of the project's rehabilitation impacts within the APE is ongoing. Through consultation with the Texas Historical Commission (THC), the project was deemed to have no effect on historic or cultural resources within the APE, as defined in 36 CFR Part 800.5(d)(1).

Cumulative Impacts: Same as Dam Rehabilitation.

Land Use and Recreation

Existing Conditions: The existing land use around the reservoir consists of open rangeland with scattered trees and shrubs, with woodlands on the upstream end of the reservoir. Single family homes and residential communities line the shoreline around the reservoir. The existing dam and auxiliary spillway is vegetated with grassland plant species. Private residents currently utilize the reservoir for boating and fishing.

Alternative No. 1 - No Federal Action/Future Without Federal Investment: The land use is expected to remain the same. The dam would continue to exist in its current state. Recreational opportunities for the private landowners are not expected to change. However, in the event of a dam breach the recreational use of the reservoir will be diminished.

Alternative No. 2 – Dam Decommissioning: Under the No Federal Action and Dam Decommissioning Alternative, the dam will be breached, and the reservoir will no longer hold water. The land use is expected to change as water-based recreational activities such as boating or fishing will be diminished.

Alternative No. 3, 4, 5 - Dam Rehabilitation: Alternatives will consist of a new spillway configuration and stilling basin to be constructed on the embankment. Rehabilitation of the dam would involve clearing of vegetation on the dam and lowering of water levels in the reservoir to facilitate construction. Recreational

opportunities, including fishing, may be hindered during the construction period. The lake will be filled following construction and no long-term impacts are anticipated to the fishery.

Cumulative Impacts: The land use is expected to remain the same. Recreational opportunities are not expected to change significantly. Surrounding changes to land use and recreation would remain the same due to private access to the reservoir. Increased residential and commercial development in the area should have no effect on the private use of the reservoir.

Environmental Justice

Existing Conditions: There is an estimated population of 79 people in the breach zone below the dam. The presence or absence of environmental justice groups within the breach inundation zone of the dam was assessed using EPA's EJSCREEN tool (EPA, 2021).

Alternative No. 1 – No Federal Action/Future Without Federal Investment: Environmental justice populations will continue to be at risk in the event of a dam breach.

Alternative No. 2 - Dam Decommissioning: The dam decommissioning would result in an increased flood risk to downstream communities regardless of socioeconomic status and without disparate treatment to any individuals or social groups. Residential homes and property would no longer be able to rely on Chambers Creek FRS No. 6 to capture flood waters during extreme precipitation events.

Alternative No. 3, 4, 5 - Dam Rehabilitation: Rehabilitation of Chambers Creek No. 6 and avoidance of a dam breach will have positive economic and social effects across all residents within the upstream and downstream areas of the dam. Since vehicle operators are also significant beneficiaries of the proposed rehabilitation, it is reasonable to conclude that protection of the roads and bridges will benefit all racial, ethnic, and socioeconomic groups within the watershed and downstream of the dam.

There are no known disparate impacts from rehabilitation of a dam. It was explained to residents that rehabilitation of the dam would not enhance their downstream flood protection, but simply maintain the designed level of flood protection while reducing the risk of life and property that might occur from a dam breach.

Approximately 79 people are within the breach inundation zone and would benefit directly from rehabilitation of the dam. Additionally, there may be indirect benefits for the residential communities upstream of the dam who use the area around the reservoir for recreational purposes throughout the year.

14.4 CUMULATIVE EFFECTS

The No Federal Action alternative would result in decommissioning of the dam by removing the storage function of the reservoir, and therefore increase downstream flood risk. The proposed rehabilitation alternatives would involve some impacts to the environment, including temporary impacts to soils and vegetation, and permanent impacts to WOTUS. The cumulative effects of this project on the principal resources of concern, along with the social and economic effects, is to maintain the existing social, economic, and environmental conditions of the community. In the selected alternative, the dam would stay in place and provide continued flood protection. The existing Emergency Action Plan will be revised to reflect the higher top of dam elevation.

There is an overall positive effect on the downstream residents due to the reduced threat to loss of life and property for a catastrophic breach of the dam. The useful life of the project will be extended by an additional 100 years following construction.

15.0 CONSULTATION AND PUBLIC PARTICIPATION

The lead sponsoring organization is the Ellis-Prairie Soil and Water Conservation District. The local, state and federal support for the rehabilitation of the Chambers Creek FRS No. 6 has been strong. Thus, multiple meetings were held throughout the project with representatives of the Ellis-Prairie SWCD, NRCS, and TSSWCB to establish their interest and concerns regarding the dam. Moreover, a roadmap for the development of the Supplemental Watershed Plan and Environmental Assessment as well as the public participation was defined.

A key element of the planning process is the solicitation of public comments to identify, understand, and address the issues and concerns of the relevant agencies and the public. The Sponsors' intent during the scoping process was to inform local, state, and federal agencies and the public about the planning process and solicit their comments in order to identify issues and questions to consider when preparing the Supplemental Watershed Plan and Environmental Assessment. During the scoping period, the Sponsors announced the commencement of the planning process through various means, invited written comments, and held a public scoping meeting. Opportunities for the public to participate in the planning process occurred at key milestones throughout the process.

The first stakeholders meeting was held on May 12, 2020. This meeting served as a project kickoff meeting in which the project scope, personnel, schedule, public participation plan were reviewed and discussed. The meeting was attended by representatives of the Ellis County, City of Midlothian, Ellis-Prairie SWCD, NRCS, and TSSWCB.

On June 23, 2020, a public meeting was held in the Midlothian Convention Center to explain the Watershed Rehabilitation Program and to discuss resource problems, issues, and concerns of local residents associated with the FRS No. 6 project area. Invitations to participate in the public meeting were made to potentially affected landowners and interested parties around and below FRS No. 6 and reservoir area. A presentation and handout materials were utilized to provide information to the group. Potential alternative solutions to bring Chambers Creek FRS No. 6 into compliance with current dam safety criteria were presented at the initial meeting.

Additional meetings were held with sponsor, NRCS and TSSWCB on August 18, 2020, August 20, 2020, December 15, 2020, and January 21, 2021. Presentations and handout materials were also utilized to communicate information regarding the status of the study, and the meetings helped to narrow the list of potential rehabilitation alternatives based on input from the affected landowners.

A second public meeting was planned for January 25, 2021, presentations and handouts were prepared to communicate information regarding the status of the study and the proposed rehabilitation alternatives and economic analysis to the public. However, Ellis County officials expressed concerns regarding the critical COVID-19 status in the county, hence, the lead sponsoring organization in agreement with NRCS and TSSWCB officials decided that the public meeting should be replaced by an informational video that summarized all the findings of the study. The video was uploaded to the Ellis County website on February 25, 2021. Additionally, hard copies of the presentation were available until March 15, 2021 at the City of Midlothian's Engineering department, 100 W. Avenue F, Midlothian, Texas 76065. Instructions to download the video, obtain hard copies of the presentation, and provide comments were publicly announced in various newspapers for multiple days.

While the Natural Resource Conservation Service (NRCS) Texas works to build a relationship with Federally Recognized Tribes (FRT) in this county through establishing Tribal consultation protocols, the NRCS State Conservationist is responsible for inviting Tribes to consult on proposed projects that may impact places of cultural or religious significance and NHPA historic properties. NRCS-Texas recognizes Tribal sovereignty and importance of Tribes' interest in places of cultural or religious significance on

ancestral lands, including those on private lands. Tribal coordination was performed in accordance with the NHPA and other related authorities and will be completed by NRCS-TX

16.0 PREFERRED ALTERNATIVE

Alternative No. 3 is the preferred alternative. The dam will be modified to meet current performance safety standards for a high-hazard dam and the service life of FRS No. 6 will be extended for an additional 100 years. The modification will consist of installing a 30-inch diameter principal spillway pipe with an intake riser and an impact basin at the outlet pipe. The auxiliary spillway crest will be raised by 0.25 feet, and the width will be widened 125 feet from 75 feet to 200 feet. The top of the dam will be raised an average of 2.1 feet, and the downstream slope flattened from 2:1 to 3:1. The dam will be lengthened by approximately 55 feet. The estimated cost to implement this alternative is $3,608,800.

Construction activities will result in the disturbance in or adjacent to the existing embankment, abutment areas, auxiliary spillway, and sediment pool, and will require that a Storm Water Pollution Prevention Plan (SWP3) be in effect. The removal of vegetation will be that necessary to allow rehabilitation of the structure. Disturbed areas will be re-vegetated using adapted and/or native species to reduce erosion.

The Sponsors will develop an Emergency Action Plan (EAP) before any rehabilitation construction activities begin that establishes the responsibilities for the development, implementation, and review of actions necessary to provide safety to individuals downstream of structure should extreme flood occur.

16.1 RATIONALE FOR PLAN PREFERENCE

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

- Reduces the threat to loss of life to approximately 93 people.
- Protects 23 structures within the project area.
- Reduces the threat of loss of access and loss of emergency services for 8 residences, 2 mobile homes, 2 commercial structures and 12 outbuildings.
- Ensures downstream flood protection for residents, as well as others who may work, travel, or use the area for recreation.
- Eliminates the liability of operating a dam which does not meet state and federal requirements.
- Maintains existing stream habitat downstream of the dam.
- Retains the existing aquatic and terrestrial habitat in and around the reservoir.

The preferred alternative meets the Sponsors' objectives of bringing this dam into compliance with current dam design and safety criteria, maintaining the existing 100-yr level of flood protection for downstream properties. Formulation of the alternative plans gave consideration to four criteria: completeness, effectiveness, efficiency, and acceptability. All alternatives meet the criteria for completeness. Alternatives No. 1 and 2 remove the safety hazard of the dam from failing, but they do not address the primary problem of assuring downstream flood protection. Alternatives No. 3, 4, and 5 effectively reduces the risk of dam failure by overtopping and minimizes the change to the level of flood prevention downstream compared to existing conditions. Among the rehabilitation alternatives, the selected alternative – Alternative No. 3 has the highest NEE benefits, and hence, the highest benefit-cost ratio.

16.2 SUMMARY AND PURPOSE

The selected plan consists of structural modifications to FRS No. 6 as follows:

- Replace existing principal spillway pipe and install a 30-inch diameter principal spillway pipe with an intake riser and an impact basin.
- Raise the auxiliary spillway by 0.25 feet and widen it 125 feet from 75 feet to 200 feet.
- Raise top of dam 2.1 feet and lengthen the dam approximately 55 feet.
- Flatten downstream embankment slope from 2.5:1 to 3:1.

After the implementation of these planned works of improvement, Chambers Creek FRS No. 6 will meet all current NRCS and TCEQ dam safety performance standards.

16.3 EASEMENTS AND LANDRIGHTS

Land rights for the structure currently exist for the construction, operation, and maintenance of the dam and the storage of water to the elevation two feet above the crest of the earthen spillway based on the original easements procured for the project. The elevation of the crest of the earthen spillway will change for implementation of the recommended alternative. The minimum land rights area was decided by the sponsors to be set to the 100-year elevation, which is the minimum requirement. The sponsors acknowledge the risk associated with this decision. The 100-year elevation is below the elevation of land rights already owned by the local sponsor, therefore, no new land rights need to be obtained in the upstream area. Some property acquisition is required to develop the preferred alternative where the footprint of the dam would be expanded.

The sponsors' rationale for using the minimum requirement for land rights around the reservoir is three-fold: One, NRCS does not require obtaining land rights up to the proposed top of dam elevation. Two, the purchase of these land rights increases sponsor expenses as the item is not cost shareable. Three, there are not currently any habitable structures below the top of dam elevation, so no significant risk is considered to be incurred in present conditions.

16.4 MITIGATION

An environmental evaluation was performed early in the planning process to determine the potential effects of alternative solutions for meeting the Sponsors objectives to comply with safety and performance standards concerning FRS No. 6. No extraordinary circumstances or significant impacts will result from actions of the preferred alternative. The project would avoid adverse impacts by working while the sediment pool is dry to complete the required rehabilitation measures. Adverse impacts would be minimized by using appropriate erosion control measures in accordance with the SWP3 as filed with TCEQ and posted on site. Rehabilitation activities under the preferred alternative are most likely authorized under Section 404 of the Clean Water Act by Nationwide Permit No. 3 for Maintenance without Pre-Construction Notification. Due to the minor, temporary nature of the impacts, no other appropriate mitigation measures were identified, and no compensatory mitigation would be required as part of the preferred alternative.

16.5 PERMITS AND COMPLIANCE

Potential Permits Needed

U.S. Army Corps of Engineers (USACE) guidelines indicate that any discharge of dredged or fill material into "Waters of the United States" require authorization under Section 404 of the Clean Water Act of 1972. Based on previous consultations with USACE, it appears that any discharges into Waters of the U.S. associated with the rehabilitation of FRS No. 6 may be authorized by a general permit such as Nationwide General Permit No. 3 for Maintenance without a Pre-Construction Notification. It will be the responsibility of the sponsors to comply with the conditions of the general permit during design and construction.

For projects with disturbances equal to or greater than five acres, it is necessary to have a Storm Water Pollution Prevention Plan (SWP3) in place prior to construction of the proposed project and filing a Notice of Intent with the TCEQ is required. A Notice of Termination (NOT) must be filed once the site has reached final stabilization. Construction activities associated with the rehabilitation of FRS No. 6 will require a SWP3.

Compliance with Local, State, and Federal Laws

All applicable local, state, and federal laws will be complied with in the installation of this project.

The preferred alternative involves increasing the principal spillway pipe diameter, and thus the peak discharge from the spillway during a flood event. However, because the existing auxiliary spillway engages in the 100-year event, Alternative No. 3 will reduce total peak 100-year discharge, since the auxiliary spillway will no longer be engaged below the 100-year event. A FEMA Letter of Map Revision (LOMR), effective as of September 2017, exists downstream of FRS No. 6. Zone AE and X are mapped downstream of the dam. An overlay of the mapped Zone AE area with the proposed conditions 100-year flood inundation area indicates that the area modeled for this plan falls outside of the mapped Zone AE area in several locations. However, the proposed peak discharge is reduced compared to the existing peak discharge. Likewise, the modeled inundation area for the 100-year event for the preferred alternative falls within the modeled existing conditions inundation area. Thus, a LOMR will not be required as a result of the rehabilitation.

The proposed project may involve de-watering of the sediment pool for construction activities. The location of the dam and impoundment on private property likely indicates that a survey for State listed threatened or endangered (T&E) mollusks is not required and the development of an Aquatic Resources Relocation Plan (ARRP) to avoid impacts to T&E and/or aquatic species is not required. If a T&E survey and/or an ARRP were required, the cost of these activities will be added to the overall cost of the project at that time and will most likely be cost shared at the appropriate rate.

Efforts to identify cultural resources have been conducted in compliance with Section 106 and Section 110 (f) and (k) of the National Historic Preservation Act. No historic properties were identified in the areas of the alternatives and no known sites are recorded in the vicinity. Ensuing disturbances associated with rehabilitation measures will be monitored for the presence of undiscovered sites. In the event of such discovery, appropriate actions will be taken in accordance with the State Level PPA among NRCS and the Texas SHPO, the National Programmatic Agreement among NRCS, the National Conference of State Historic Preservation Officers, and the Advisory Council on Historic Preservation, and NRCS General Manual 420, Part 401 guidance.

16.6 COSTS

Public Law 83-566 Funds include NRCS Engineering and Project Administration ($646,800), which are not included when calculating eligible federal cost share. Therefore, federal cost share is based on Total Eligible Project Cost of $2,940,000. The percentages of the eligible project costs including construction, engineering, project administration, and land rights to be paid by the District and the NRCS are shown in Table Z.

Table Z: Eligible Project Cost FRS No. 6

	Sponsors	NRCS	Estimated Eligible Project cost
Rehabilitation of dam	35%	65%	$2,940,000

An amount up to the percentage rate specified may be satisfied by the District for cost of an element such as engineering, real property acquisition, or construction. The decision to, and arrangements for, such action will be negotiated between the District and NRCS and will be included in a project agreement executed immediately before implementation. NRCS costs will not exceed 100 percent of the construction cost.

NRCS is responsible for the engineering services and project administration costs it incurs. These costs are not used in the calculation of the federal cost share; however, the costs are included in Table 1 - Estimated Installation Cost. Also, costs of water, mineral, and other resource rights, as well as federal, state, and local permits, are the responsibility of the District and are not counted toward local cost share. See Table 2 for a complete distribution of total rehabilitation costs.

16.7 INSTALLATION AND FINANCING

The installation of the project will be financed jointly by the District and the NRCS. NRCS will use funds appropriated for this purpose. Additionally, the District has submitted a grant application to the Texas State Soil and Water Conservation Board (TSSWCB) to supplement the appropriated NRCS funds. The installation schedule indicates that real property rights will be secured during the 2022 fiscal year and construction funding will be requested for fiscal year 2023. The District has the power of eminent domain to secure the real property rights and will serve as the local contracting agent. The duration of construction is approximately 12 months, not including national holidays and weather days.

NRCS will aid the Sponsors with the Chambers Creek FRS No. 6 rehabilitation project. NRCS will be responsible for the following:

- Establish a project agreement with the Sponsors prior to either party's initiation of work utilizing funds of the other party. The agreement will establish in detail the financial and working arrangements as well as other conditions that are applicable to the works of improvement.
- Enact an updated Operation and Maintenance Agreement with the Sponsors that extends the O&M responsibilities for another 100 years after construction. The O&M Agreement will be completed based on the NRCS National Operation and Maintenance Manual.
- Provide financial assistance equivalent to to 65% of the total eligible project costs not exceeding the actual construction costs.
- Verify that a current Emergency Action Plan is completed before construction is initiated.
- Provide consultative engineering support, technical assistance and certification during the project's design and construction.
- Certify completion of all constructed rehabilitation measures.

The sponsors will be responsible for the following:

- Obtain all necessary environmental permits, easements, and rights for the construction, operation and maintenance of the rehabilitated structure.
- Enforce the County's floodplain management to restrict future development below the new top of dam elevation.
- Develop an updated Emergency Action Plan for the dam before construction is initiated.

- Complete a current Operation and Maintenance Agreement with NRCS for the dam. This agreement will be based on the NRCS National Operation and Maintenance Manual.
- Furnish local administrative and contract services necessary for project installation.
- Provide funds from sources other than Public Law 83-566 for cost sharing of the project equal to or greater than 35% of the total eligible project costs.
- Enforce all applicable easements and rights-of-way for the safe operation of the dam.

Memorandum of Understanding

The District and NRCS have entered into a Memorandum of Understanding (MOU) to establish a framework under which the District may proceed with work on specific aspects of the proposed rehabilitation project. Accordingly, that specified work might then contribute towards the Sponsor's 35 percent cost-share obligation.

Project Agreement

The Sponsoring Local Organization (District) responsible for the 35 percent non-federal cost share and the NRCS will enter into a Project Agreement in accordance with the National Contract Grants and Agreement Manual before any work is initiated by either the District or the NRCS.

16.8 OPERATION, MAINTENANCE, AND REPLACEMENT

Operation and Maintenance Agreement

The project will be operated and maintained by the Sponsors. Once FRS No. 6 is rehabilitated, the District will have the primary responsibilities for maintenance of FRS No. 6. A new Operation and Maintenance (O&M) Agreement will be developed with the Sponsors for FRS No. 6 for the 100-year program life of the structure. The new O&M Agreement will be based on the National Operation and Maintenance Manual (NOMM) and will be signed before the Project Agreement is signed. The agreement will specify responsibilities of the Sponsors and include detailed provisions for retention, use, and disposal of property acquired or improved with PL 83-566 cost sharing. O&M activities include but are not limited to inspections, maintenance, replacement of inoperable components, and repairs of the principal spillways, dam, vegetation, and the auxiliary spillways. It is estimated that O&M activities will cost about $8,900 per year.

Emergency Action Plan

The Sponsors will provide leadership in developing an Emergency Action Plan (EAP) prior to the commencement of construction and will review and update the EAP annually with local emergency response officials. As required by the National Engineering Manual, Part 520, Subpart C, Section 520.27 and the NOMM, Part 500, Subpart F, the NRCS State Conservationist is to determine that an EAP is prepared for FRS No. 6 prior to the execution of fund obligating documents for construction of the structure. NRCS will provide technical assistance in preparation and updating of the EAP. The breach inundation map of the final design and its data will be the basis for potential areas to be affected and citizens to be notified. The purpose of the EAP is to identify areas at risk, outline appropriate actions, and to designate parties responsible for those actions in the event of a potential failure of FRS No. 6.

16.9 ECONOMIC AND STRUCTURAL TABLES

Table 1: Estimated Installation Cost FRS No. 6

Table 2: Estimated Cost Distribution – Water Resource Project Measures FRS No. 6

Table 3: Structural Data – Dams with Planned Storage Capacity FRS No. 6

Table 4: Estimated Average Annual NEE Cost FRS No. 6

Table 5: Estimated Average Annual Flood Damage Reduction Benefits FRS No. 6

Table 6: Comparison of NEE Benefits and Costs FRS No. 6

Table 1: Estimated Installation Cost FRS No. 6

Chambers Creek Watershed, Texas

(Dollars) [1]

	Estimated Costs		
Works of Improvement	**Public Law 83-566 Funds**	**Other Funds**	**Total**
Rehabilitation of FRS No. 6	$2,557,800	$1,051,000	$3,608,800
Total Project	**$2,557,800**	**$1,051,000**	**$3,608,800**

[1] Price base: 2021

Table 2: Estimated Cost Distribution – Water Resource Project Measures FRS No. 6

Chambers Creek Watershed, Texas

(Dollars) [1]

Works of Improvement	Installation Cost – Public Law 83-566					Installation Cost – Other Funds					Total Installation Cost
	Construction	Engineering	Real Property Rights	Project Administration	Total Public Law 566	Construction	Engineering	Real Property Rights	Project Administration	Total Other	
Rehabilitation of FRS No. 6	$1,911,000	$294,000	$0	$352,800	$2,557,800	$1,029,000	$0	$22,000	$0	$1,051,000	$3,608,800
TOTAL	**$1,911,000**	**$294,000**	**$0**	**$352,800**	**$2,557,800**	**$1,029,000**	**$0**	**$22,000**	**$0**	**$1,051,000**	**$3,608,800**

[1] Price base: 2021

Table 3: Structural Data – Dams with Planned Storage Capacity FRS No. 6
Chambers Creek Watershed, Texas

Item	Unit	FRS No. 6
Hazard classification		High
Seismic zone		0
Location	decimal degrees	32.455 N, 96.956 W
Uncontrolled drainage area	sq. mi	1.64
Runoff curve number (1-day) (AMC avg.)		81
Time of Concentration (T_c)	hr	2.59
Elevation top of dam	feet NAVD88	699.2
Elevation crest of auxiliary spillway	feet NAVD88	693.75
Elevation crest principal spillway	feet NAVD88	680.0
Effective Dam Height	ft	36.5
Volume of fill	yd^3	34,300
Total Capacity (auxiliary spillway crest)	acre-ft	636.8
Sediment submerged	acre-ft	148.7
Floodwater retarding pool	acre-ft	488.1
Surface Area		
Sediment pool	acres	18.0
Floodwater retarding pool	acres	54.6
Principal Spillway		
Rainfall volume (1-day)	in	9.68
Rainfall volume (10-day)	in	15.0
Runoff volume (10-day)	in	10.02
Type of conduit		RCP
Diameter	in	30
Capacity	ft^3/s	135
Auxiliary Spillway (earthen)		
Bottom width	ft	200
Exit slope	%	3.65
Frequency of operation	% chance	0.01%
Auxiliary Spillway Hydrograph		
Rainfall volume	in	13.05
Runoff volume	in	10.60
Storm duration	hr	6
Velocity of flow (V_c)	ft/s	7.02
Maximum reservoir water surface elevation	feet NAVD88	695.83
Freeboard Hydrograph		
Rainfall volume	in	30.25

Runoff volume	in	27.61
Storm duration	hr	6
Maximum reservoir water surface elevation	feet NAVD88	699.15
Storage Capacity Equivalents		
Sediment volume	in	1.38
Floodwater retarding volume	in	5.65

Table 4: Estimated Average Annual NEE Cost FRS No. 6

Chambers Creek Watershed, Texas

(Dollars) [1]

	Project Outlays		
Evaluation Unit	**Amortization of Installation Cost [2]**	**Operation, Maintenance and Replacement Cost**	**Total**
FRS No. 6	$98,600	$8,900	$107,400
Grand Total	$98,600	$8,900	$107,400

[1] Price base: 2021
[2] Amortized over 100 years at a discount rate of 2.5 percent

Table 5: Estimated Average Annual Flood Damage Reduction Benefits FRS No. 6

Chambers Creek Watershed, Texas

(Dollars) [1, 2, 3]

Damage Category	Estimated Average Annual Damages Without the Project[4]	Estimated Average Annual Damages With the Project	Estimated Average Annual Benefits
Structures	$245,830	$218,530	$27,310
Crops	$660	$590	$70
Pastureland	$90	$80	$10
Roads and Bridges	$125,040	$86,950	$38,090
Erosion and Sedimentation	$1,190	$170	$1,020
Total	**$372,810**	**$306,320**	**$66,490**

[1] Price base: 2021
[2] Damages and benefits will accrue from floods of greater magnitude than the 500-year frequency event, but these were not evaluated.
[3] Values have been rounded to the nearest hundred.
[4] Based on average annual damages as if the dam was not in place (same as decommissioning alternative)

Table 6: Comparison of NEE Benefits and Costs FRS No. 6

Chambers Creek Watershed, Texas

(Dollars) [1]

Works of Improvement	Average Annual Benefits [2]			Average Annual Cost [3]	Benefit/ Cost Ratio [4]	Net NEE Benefit
	Agriculture-Related	Nonagricultural	Total			
Rehabilitation of FRS No. 6	$1,100	$65,470	$66,490	$107,410	0.62	-$40,930

[1] Price base: 2021
[2] From Table 5
[3] From Table 4
[4] Refer to Section 16.1, Rationale for Plan Preference
[5] Estimated Average Annual Benefits are based on the decrease in average annual damages if the site was not in place, as in the decommissioning alternative

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19.0 DISTRIBUTION LIST

Comments were requested on the Draft Supplemental Plan – EA from the following Agencies and organizations:

- Natural Resources Conservation Services (NRCS-TX)
- National Water Management Center (NWMC)
- Texas State Soil & Water Conservation Board (TSSWCB)
- Ellis-Prairie Soil and Water Conservation District.
- City of Alvarado
- City of Ennis
- Dalworth Soil and Water Conservation District #519
- Hill County-Blackland Soil and Water Conservation District #541
- Navarro Soil and Water Conservation District #514
- Ellis County Commissioners Court
- Hill County Commissioners Court
- Johnson County Commissioners Court
- Navarro Commissioners Court
- Texas Historical Commission
- State Historic Preservation Office
- Apache Tribe of Oklahoma
- Oklahoma Tribe of Indians of Oklahoma
- Comanche Nation, Oklahoma
- Cousatta Tribe of Louisiana
- Tonkawa Tribe of Indians of Oklahoma
- Oklahoma Wichita and Affiliated Tribes (Wichita, Keechi, Waco & Tawakonie)
- Kiowa Indian Tribe of Oklahoma

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21.0 APPENDICES

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Appendix A

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Appendix D – Investigation and Analysis Report

Appendix D

Investigations and Analyses Report Chambers Creek 4 & 6

Engineering

Engineering work items completed as part of this study include the following and additional information is provided on key items in subsequent paragraphs:

- Gathered and reviewed existing data on the dam design, construction, and project site.
- Identified problems, opportunities, and concerns.
- Performed site visits to evaluate the condition of existing structures.
- Conducted geotechnical field investigations to obtain additional data.
- Conducted bathymetric survey of the sediment pool area.
- Performed engineering analysis per NRCS requirements, including embankment stability analyses, analysis of reservoir sediment capacity and projected sedimentation rates, hydraulic analyses to determine impacts of a dam failure, hydraulic analyses to determine downstream impacts of alternatives including impacts to downstream bridges.
- Developed conceptual figures and cost estimates for plan alternatives.
- Provided public involvement support services, including coordinating with the Sponsor, local and state NRCS offices, and the public; preparing presentations to the public; preparing videos to the public; and attending public meetings.
- Preparing a Supplemental Watershed Plan and Environmental Evaluation for the project Sponsors.

Hydrology and Hydraulics

The following list presents the tasks that were performed as part of the hydrologic and hydraulic analysis, and *Table D-1*includes key parameters for the Chamber Creek No. 4 & 6 watersheds:

- Delineation of the watersheds (see Appendix B)
- Estimation of rainfall depths for event and design storms
- Estimation of watershed time of concentration, Tc, using the Kerby-Kirpich method
- Estimation of watershed curve numbers
- Estimation of flow rates for the watersheds in the study using the computer model HEC-HMS. The hydrograph for the watershed above the dam (contributing drainage area to the dam) and the hydrograph for the drainage basins that contribute downstream of the dam were determined using HEC-HMS. The hydrographs were developed using the SCS Curve number and SCS unit hydrograph methodologies. Flood events from 1-year to 500-year were analyzed in order to estimate the frequency of use of the auxiliary spillway.
- Evaluation of hydraulic adequacy of the existing dam
- Development of breach hydrograph and evaluation of downstream impacts of breach
- Development of rehabilitation alternatives to meet hydraulic requirements
- Use of the SITES program to evaluate rehabilitation alternatives, specifically to determine the top of dam, auxiliary and principal spillway crests, and principal spillway conduit dimensions
- Estimation of downstream water surface elevations using the computer model HEC-RAS for existing conditions and rehabilitation alternatives (models used HEC-RAS 2D capabilities).

Table D-1 Watershed Characteristic Parameters

Item	Unit	FRS No. 4	FRS No. 6

Hazard classification	n/a	High	High
Location	decimal degrees	32.490 N, 96.968 W	32.455 N, 96.956 W
Uncontrolled drainage area	sq. mi	0.88	1.64
Runoff curve number (1-day) (AMC avg.)	n/a	81	81
Time of Concentration (T_c)	hr	1.18	2.59
Principal Spillway Design			
Rainfall volume (1-day)	in	9.64	9.68
Rainfall volume (10-day)	in	15.00	15.00
Runoff volume (10-day)	in	10.21	10.02
Auxiliary Spillway and Freeboard Design			
6-hour Stability Rainfall	in	13.02	13.05
6-Runoff Volume Rainfall	in	10.57	10.60
24-hour Stability Rainfall	in	18.11	18.08
24-Runoff Volume Rainfall	in	15.57	15.54
Freeboard Rainfall Design			
6-hour Freeboard Rainfall	in	30.25	30.25
6-Runoff Volume Rainfall	in	27.61	27.61
24-hour Stability Rainfall	in	40.20	42.00
24-Runoff Volume Rainfall	in	39.51	39.31

Chambers Creek FRS No. 4

Hydraulic Adequacy

Chambers Creek Site 4 dam is classified by TCEQ as a small size dam based on a maximum storage at top of dam of 561 acre-feet and height of 25 feet. The structure was a low hazard structure when constructed but it has since been reclassified as a high hazard dam by TCEQ and NRCS.

A hydrologic model was developed in HEC-HMS to assess the dam's hydraulic capacity for computation of frequency storms and the Probable Maximum Flood (PMF). The model consists of the contributing area to FRS No. 4 and the reservoir. Runoff losses were calculated using the NRCS Curve Number Method. Curve numbers were calculated for each basin based on both the hydrologic soil classification and the land use classification. Soils information was obtained from the USGS SSURGO database, and land use information was taken from the National Land Cover Dataset.

Per TCEQ requirements, the dam is required to safely pass 75% of the PMF. Initial abstractions for runoff calculations were set to zero and the curve numbers were raised to Antecedent Moisture Condition (AMC) III, per TCEQ guidelines, to represent the worst-case scenario of soils fully saturated prior to the beginning of the storm. However, AMC II curve numbers were used to safely route 100% of the NRCS Freeboard Hydrograph (FBH) and the 1-day/10-day Principal Spillway Hydrograph (PSH) flood event per NRCS guidelines. The NRCS Unit Hydrograph Method was used to calculate the timing and shape of the runoff hydrograph by applying the lag time, as calculated according to the method described in the Technical Release 55 (TR-55).

Following TCEQ criteria, the Probable Maximum Precipitation (PMP) depths were computed for the study area using the prescribed TCEQ guidelines regarding temporal distributions and rainfall depths

methodology. HEC-HMS was used to perform the hydrologic routing of the Probable Maximum Flood (PMF) through the watershed and subsequently the existing reservoir. From this analysis it was determined that the required 75% TCEQ PMF overtops the dam by 0.4 feet. Therefore, the dam does not currently meet the state dam safety requirement to safely pass 75% of the PMF, as defined by TCEQ.

Frequency storm events were computed based on NRCS criteria for curve number. Specifically, AMC II was assumed, and initial abstraction was determined using an initial abstraction ratio $I_a/S = 0.2$. Refer to Table D-2 for a summary of frequency event results.

A SITES model was developed to evaluate the dam against NRCS criteria. Curve numbers assumed AMC II with an initial abstraction ratio $I_a/S = 0.2$. Per NRCS requirements, the 100-year, 1-day/10-day Principal Spillway Hydrograph (PSH) flood event is required to not overtop the auxiliary spillway crest. This was evaluated in SITES, and the dam does not currently meet this requirement as this flood event overtops the auxiliary spillway crest by 1.0 feet. The Freeboard Hydrograph (FBH) is required to not overtop the top of dam and was evaluated in SITES. The maximum water surface elevation was greater than the maximum produced by the PMF analysis (described above). The 6-hour FBH is the critical storm event and it overtops the existing top of dam by 2.3 ft; therefore, the NRCS requirements governed the required top of dam used in the plan.

Table D-2 Frequency Event Results for FRS No. 4, Existing Conditions

Frequency Storm	Peak WSE (ft)	Peak Inflow (cfs)	Peak Discharge (cfs)		
			Principal Spillway	Auxiliary Spillway	Total
2-year	724.26	532.2	22.4	0.0	22.4
5-year	726.03	754.9	23.5	0.0	23.5
10-year	727.33	948.0	24.4	0.0	24.4
25-year	729.01	1220.5	25.4	0.0	25.4
50-year	729.98	1429.2	26.0	19.4	45.4
100-year	730.48	1648.6	26.3	80.7	107.0
200-year	731.02	1889.1	26.6	198.9	225.5
500-year	731.74	2213.9	27.0	396.4	423.4

Residual Risk

While the recommended modifications reduce the downstream flood risk, there is a level of remaining flood hazard in the downstream area. Table D-3 describes the remaining flood hazard in the recommended plan in the 100-year and 500-year storm events.

Table D-3 Downstream Remaining Flood Hazard for FRS No. 4

Item	100-year Storm	500-year Storm
Distance of Flood Hazard	4,500 feet – beyond Waxahachie Creek confluence, dam does not contribute to flooding	
Number of Roads	Lon Hayes Drive	FM 1387, Lon Hayes Drive
Number of Structures	5 barns/outbuildings along Lynnie Pennie Street and Clinton Lane	3 residential structures and 9 barns/outbuildings along Lynnie Pennie Street and Clinton Lane
Flooding Depths	• 5 barns/outbuildings flooded by less than 1 foot • Lon Hayes Drive flooded by more than 1 foot	• 3 residential structures flooded by less than 1 foot • 4 barns/outbuildings flooded by more than 1 foot

		• 5 barns/outbuildings flooded by less than 1 foot • FM 1387 flooded by 1.5 feet • Lon Hayes Drive flooded by 1.5 feet
Flooding Velocities	1-5 ft/s in creek channel	1-6 ft/s in creek channel 2-4 ft/s overtopping roads
Population at Risk (PAR)	0	24

Breach Analysis

In the event the embankment was overtopped and failed, the most serious failure would be a breach in the tallest section of the embankment. The Simplified Dam Breach Routing Procedures (TR-66) were used to develop a breach hydrograph for FRS No. 4 with a maximum breach discharge given by the criteria stated in TR-60. Three breach scenarios were considered for this breach analysis: Hydrologic, Static, and Seismic. The Hydrologic Breach scenario was selected for use in the breach analysis due to its greater peak discharge rate and thus its greater potential flood impacts. The Hydrologic Breach hydrograph is shown in Figure D-1 below. The peak breach discharge was determined to be 14,000 cfs which was fit to a curvilinear breach hydrograph. The breach hydrograph was used as the upstream boundary condition of the HEC-RAS 2-D model that was developed to determine downstream flood elevations and characteristics. Additional details regarding the development of the breach hydrograph are included in Appendix E.

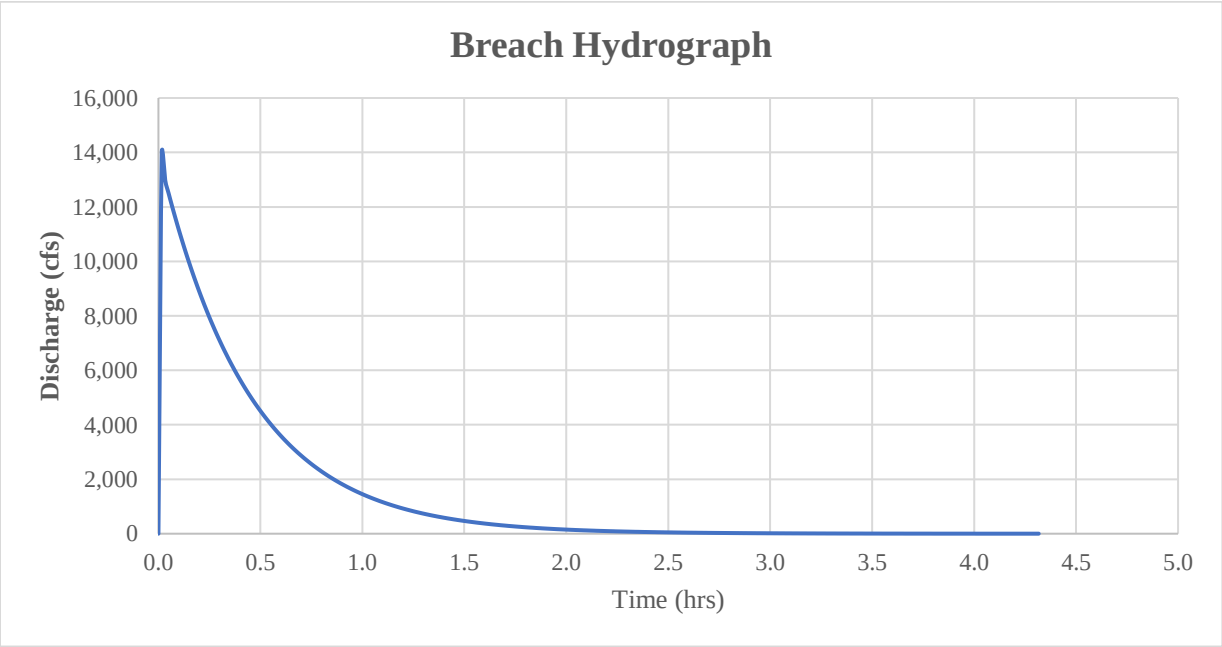

Figure D-1 TR-60 Breach Hydrograph for FRS No. 4

Based on the updated dam breach modeling, FM 1387, three residential streets, multiple rural roads, 40 residential structures, and 21 non-habitable structures could be impacted by breach inundation. The breach inundation map showing the location of the impacted structures is included in Appendix C, Attachment C-11.

Auxiliary Spillway Stability and Integrity

Soil material testing performed as part of the geotechnical field investigations provided erodibility input parameters based on the soil classifications as outlined in the Geotechnical Investigation Report (GIR). Three distinct materials were encountered in the auxiliary spillway area, Figure D-2, and pertinent parameters for each material are presented in Table D-9.

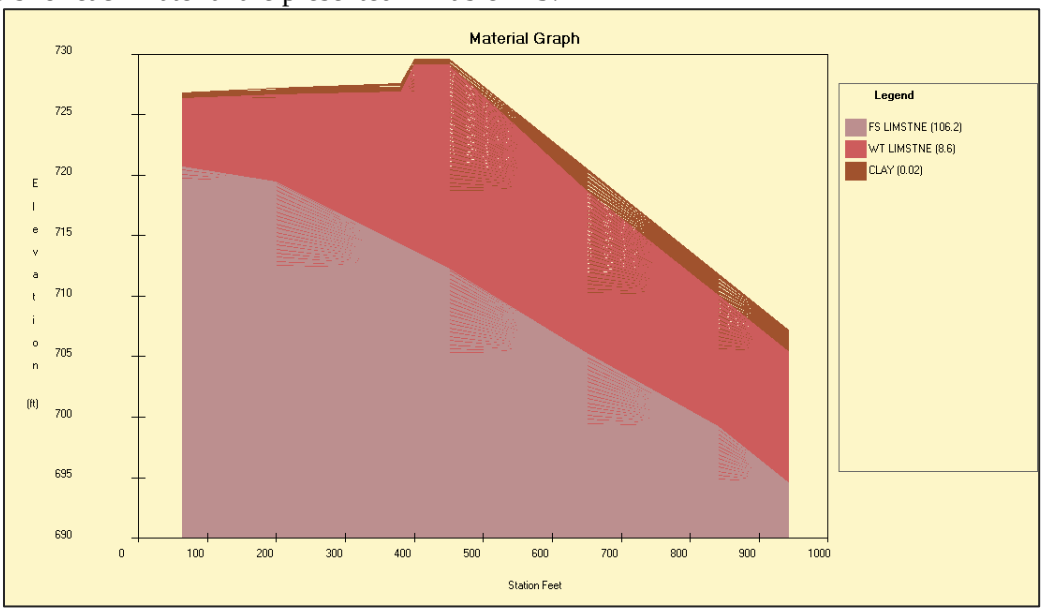

Figure D-2 Auxiliary Spillway Soil Profile FRS No. 4

In existing conditions, the auxiliary spillway has a 4.56% exit slope. The SDH runs result in an exit velocity of 9.5 ft/s. The overall stability of the auxiliary spillway design was found to be acceptable for both soil and vegetal stress factors. The allowable soil stress is 0.183 psf, while the effective soil stress from the SITES output is 0.162 psf. The allowable vegetal stress is 4.20 psf, and the effective vegetal stress is 3.19 psf (calculated as the total stress from the SITES output minus the soil effective stress). The integrity analysis also indicates an acceptable spillway design. The spillway integrity distance is 47 feet in the 24-hour FBH for the preferred alternative as presented in Table D-4**Error! Reference source not found.**.

For the preferred alternative, the auxiliary spillway has a 4.63% exit slope. The SDH runs result in an exit velocity of 8.6 ft/s. The overall stability of the auxiliary spillway design was found to be acceptable for both soil and vegetal stress factors. The allowable soil stress is 0.183 psf, while the effective soil stress from the SITES output is 0.135 psf. The allowable vegetal stress is 4.20 psf, and the effective vegetal stress is 2.90 psf (calculated as the total stress from the SITES output minus the soil effective stress). The integrity analysis also indicates an acceptable spillway design. The spillway integrity distance is 25 feet in the 24-hour FBH for the preferred alternative as presented in Table D-4**Error! Reference source not found.**.

Table D-4 Stability and Integrity Results for FRS No. 4

Stability/Integrity	Preferred Alternative	Existing Conditions
Stability (6hr SDH)	Pass	Pass
Integrity (6hr FBH)	Pass, 41 ft	Pass, 47 ft
Integrity (24hr FBH)	Pass, 25 ft	Pass, 47 ft

Chambers Creek FRS No. 6

Hydraulic Adequacy

Chambers Creek Site 6 dam is classified by TCEQ as a small size dam based on a maximum storage at top of dam of 812 acre-feet and height of 35 feet. The structure was a low hazard structure when constructed but it has since been reclassified as a high hazard dam by TCEQ and NRCS.

A hydrologic model was developed in HEC-HMS to assess the dam's hydraulic capacity for computation of frequency storms and the Probable Maximum Flood (PMF). The model consists of the contributing area to FRS No. 6 and the reservoir. Runoff losses were calculated using the NRCS Curve Number Method. Curve numbers were calculated for each basin based on both the hydrologic soil classification and the land use classification. Soils information was obtained from the USGS SSURGO database, and land use information was taken from the National Land Cover Dataset.

Per TCEQ requirements, the dam is required to safely pass 75% of the PMF. Initial abstractions for runoff calculations were set to zero and the curve numbers were raised to Antecedent Moisture Condition (AMC) III, per TCEQ guidelines, to represent the worst-case scenario of soils fully saturated prior to the beginning of the storm. The NRCS Unit Hydrograph Method was used to calculate the timing and shape of the runoff hydrograph by applying the lag time, as calculated according to the method described in the Technical Release 55 (TR-55).

Following TCEQ criteria, the Probable Maximum Precipitation (PMP) depths were computed for the study area using the prescribed TCEQ guidelines regarding temporal distributions and rainfall depths methodology. HEC-HMS was used to perform the hydrologic routing of the Probable Maximum Flood (PMF) through the watershed and subsequently the existing reservoir. From this analysis it was determined that the required 75 percent PMF overtops the dam by 2.4 feet. Therefore, the dam does not currently meet the state dam safety requirement to safely pass 75% of the PMF, as defined by TCEQ.

Frequency storm events were computed based on NRCS criteria for curve number. Specifically, AMC II was assumed, and initial abstraction was determined using an initial abstraction ratio $I_a/S = 0.2$. Refer to Table D-5 for a summary of frequency event results.

A SITES model was developed to evaluate the dam against NRCS criteria. Curve numbers assumed AMC II with an initial abstraction ratio $I_a/S = 0.2$. Per NRCS requirements, the 100-year, 1-day/10-day Principal Spillway Hydrograph (PSH) flood event is required to not overtop the auxiliary spillway crest. This was evaluated in SITES, and the dam does not currently meet this requirement as this flood event overtops the auxiliary spillway crest by 1.1 feet. The Freeboard Hydrograph (FBH) is required to not overtop the top of dam and was evaluated in SITES. The maximum water surface elevation was greater than the maximum produced by the PMF analysis (described above). The 6-hour FBH is the critical storm event and it overtops the existing top of dam by 5.0 ft; therefore, the NRCS requirements governed the required top of dam used in the plan.

Table D-5 Frequency Event Results for FRS No. 6

Frequency Storm	Peak WSE (ft)	Peak Inflow (cfs)	Peak Discharge (cfs)		
			Principal Spillway	Auxiliary Spillway	Total
2-year	685.90	566.3	29.3	0.0	29.3
5-year	688.11	812.2	30.4	0.0	30.4
10-year	689.88	1028.4	31.3	0.0	31.3
25-year	692.24	1341.9	32.4	0.0	32.4

50-year	693.86	1589.6	33.1	20.3	53.5
100-year	694.48	1853.0	33.4	149.9	183.3
200-year	695.11	2139.2	33.7	357.3	390.9
500-year	695.94	2548.0	34.0	751.6	785.7

Residual Risk

While the recommended modifications reduce the downstream flood risk, there is a level of remaining flood hazard in the downstream area. Table D-6 describes the remaining flood hazard in the recommended plan in the 100-year and 500-year storm events.

Table D-6 Downstream Remaining Flood Hazard for FRS No. 6

Item	100-year Storm	500-year Storm
Distance of Flood Hazard	2,500 feet – beyond Waxahachie Creek confluence, dam does not contribute to flooding	
Number of Roads	0	Private driveway located off Mt Zion Road
Number of Structures	0	0
Flooding Depths	N/A	Private driveway flooded by 1.4 feet
Flooding Velocities	1-6 ft/s in creek channel	1-8 ft/s in creek channel 6-8 ft/s overtopping private driveway
Population at Risk (PAR)	0	0

Breach Analysis

In the event the embankment was overtopped and failed, the most serious failure would be a breach in the tallest section of the embankment. The Simplified Dam Breach Routing Procedures (TR-66) were used to develop a breach hydrograph for FRS No. 6 with a maximum breach discharge given by the criteria stated in TR-60. Three breach scenarios were considered for this breach analysis: Hydrologic, Static, and Seismic. The Hydrologic Breach scenario was selected for use in the breach analysis due to its greater peak discharge rate and thus its greater potential flood impacts. The Hydrologic Breach hydrograph is shown in Figure D-3 below. The peak breach discharge was determined to be 34,400 cfs which was fit to a curvilinear breach hydrograph. The breach hydrograph was used as the upstream boundary condition of the HEC-RAS 2-D model that was developed to determine downstream flood elevations and characteristics. Additional details regarding the development of the breach hydrograph are included in Appendix E.

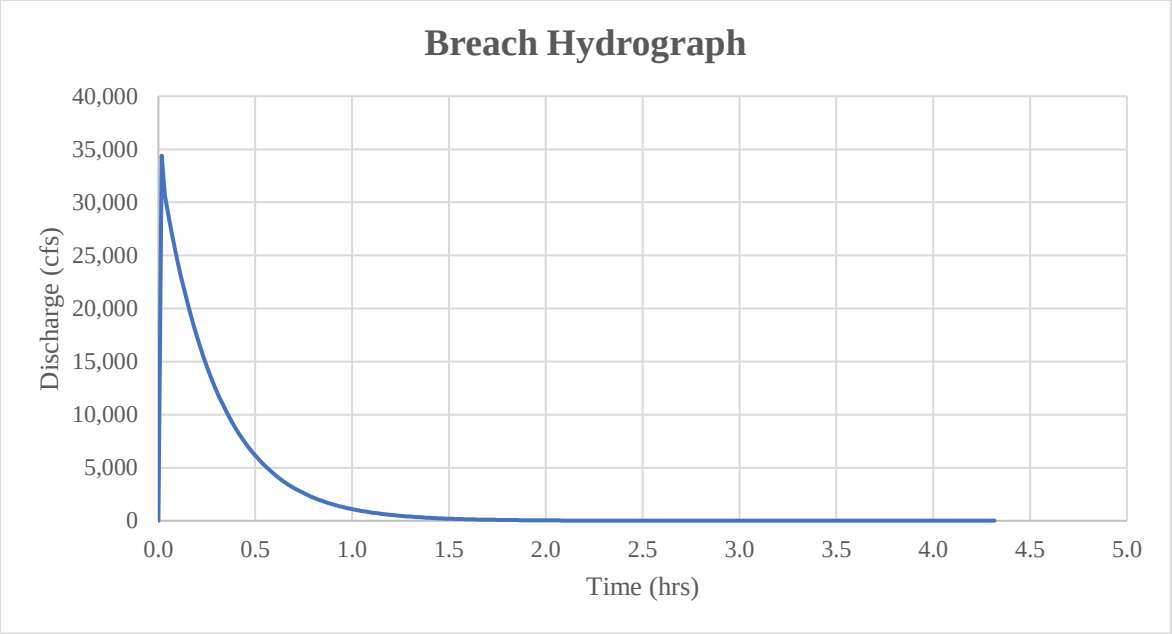

Figure D-3 TR-60 Breach Hydrograph for FRS No. 6

Based on the updated dam breach modeling, segments of Mt Zion Road, Shady Grove Road, Plainview Road, 2 private roads, 5 residential structures, 12 non-habitable structures, and 2 commercial buildings could be impacted by breach inundation. The breach inundation map showing the location of the impacted structures is included in Appendix C, Attachment C-12.

Auxiliary Spillway Stability and Integrity

Soil material testing performed as part of the geotechnical field investigations provided erodibility input parameters based on the soil classifications as outlined in the Soil Mechanics Report. Three distinct materials were encountered in the auxiliary spillway area, Figure D-4, and pertinent parameters for each material are presented in Table D-11.

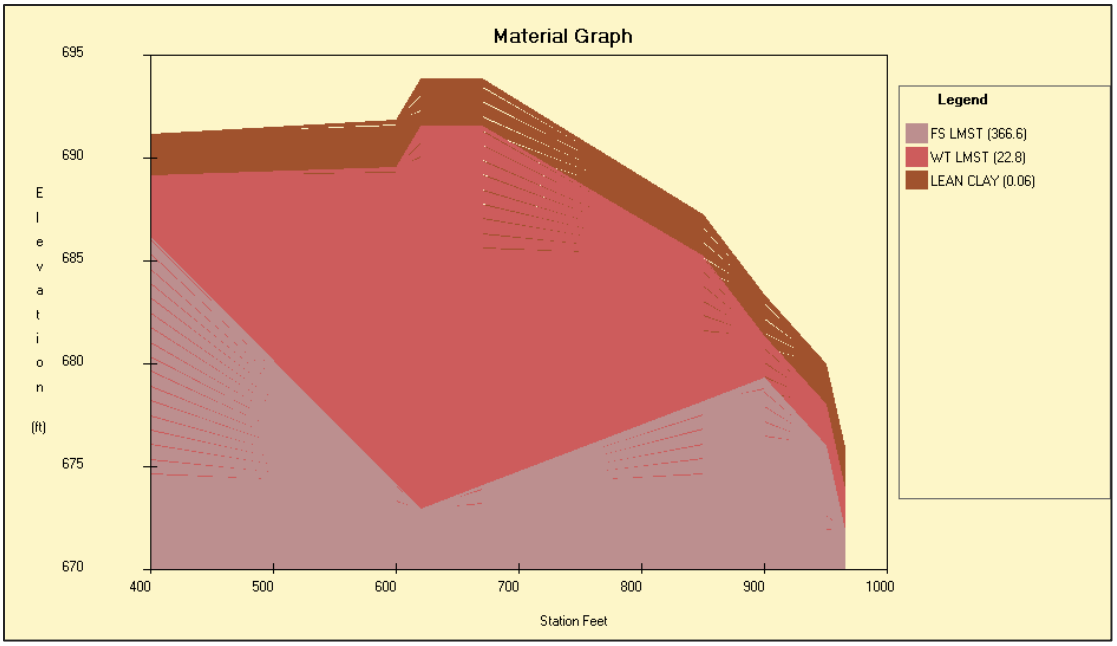

Figure D-4 Auxiliary Spillway Soil Profile FRS No. 6

In existing conditions, the auxiliary spillway has a 3.50% exit slope. The SDH runs result in an exit velocity of 10.2 ft/s. The overall stability of the auxiliary spillway design was found to be unacceptable for soil stress factors. The allowable soil stress is 0.119 psf, while the effective soil stress from the SITES output is 0.681 psf. The allowable vegetal stress is 4.20 psf, and the effective vegetal stress is 2.51 psf (calculated as the total stress from the SITES output minus the soil effective stress). The integrity analysis passes. The spillway integrity distance is 50 feet in the 24-hour FBH for the preferred alternative as presented in Table D-7**Error! Reference source not found.**.

For the preferred alternative, the auxiliary spillway has a 3.67% exit slope. The SDH runs result in an exit velocity of 8.6 ft/s. The overall stability of the auxiliary spillway design was found to be acceptable for both soil and vegetal stress factors. The allowable soil stress is 0.119 psf, while the effective soil stress from the SITES output is 0.088 psf. The allowable vegetal stress is 4.20 psf, and the effective vegetal stress is 2.11 psf (calculated as the total stress from the SITES output minus the soil effective stress). The integrity analysis also indicates an acceptable spillway design. The spillway integrity distance is 50 feet in the 24-hour FBH for the preferred alternative as presented in Table D-7**Error! Reference source not found.**.

Table D-7 Stability and Integrity Results for FRS No. 6

Stability/Integrity	Preferred Alternative	Existing Conditions
Stability (6hr SDH)	Pass	Fail
Integrity (6hr FBH)	Pass, 50 ft	Pass, 50 ft
Integrity (24hr FBH)	Pass, 50 ft	Pass, 50 ft

Geotechnical Investigation Report

Chambers Creek FRS No. 4

Subsurface Exploration and Laboratory Testing

Field exploration included five (5) geotechnical borings drilled in June 2020. Two borings (01 and 02) were drilled along the centerline of the dam for characterizing the existing embankment and foundation materials, and three borings (201 through 203) were drilled within the existing auxiliary spillway to evaluate the stability and integrity of the spillway with a focus on erodibility and headcut potential of the underlying strata. A schedule of borings is provided in Table D-8, and the boring locations are shown on the attached Boring Location Map (Attachment E-2 in Appendix E).

Table D-8 Chambers Creek Site 4 Boring Schedule

Boring	Location	Boring Depth (ft below ground surface)
01	Center line of Dam	60
02	Center line of Dam	50
201	Existing Eastern Spillway	25
202	Existing Eastern Spillway	25
203	Existing Eastern Spillway	25

The drilling was performed on June 1 and 2, 2020 using a CME-75 truck-mounted drilling rig provided and staffed by Texplor of Dallas, Inc. (TDI). Mr. Aaron Brewer, with Freese and Nichols, Inc. (FNI), supervised the drilling and logged the borings. The borings were observed for indications of subsurface water entry during drilling and were checked for accumulated water before being backfilled with cement-bentonite grout.

Hollow-stem augers and rotary wash drilling techniques were used to advance the borings. Push tube sampling techniques were used to obtain soil samples. Seepage and groundwater were not encountered within the borings during drilling and after completion of drilling. At the completion of drilling and sampling, each boring was pressure-tremie grouted using a cement-bentonite grout mixture.

Undisturbed samples of cohesive soils were collected using the drilling rig to push a seamless, steel tube sampler into the soil (based upon ASTM D1587). After a tube was recovered, the sample was extruded in the field, examined, and logged. During logging, an estimate of the sample consistency was obtained using a hand penetrometer. The result of the penetrometer reading is recorded for a particular sample at the corresponding depth on the boring logs. Note that a reported value of “4.5+” indicates the capacity of the penetrometer device was exceeded.

Samples of rock and rock-like materials were obtained using an NX-size, double tube core barrel with a carbide bit. The total length of the recovered sample (REC) was measured and reported as a percentage of the total run length. The total length of all the pieces greater than four inches was also measured in the field, recorded as a percentage of the total sample length and reported as the rock quality designation (RQD). Core breaks obviously caused by the drilling process were counted as a continuous piece. Breaks that were not easily distinguished as being a result of the drilling process were considered a natural break. Rock core samples were photographed during the logging process, and the photos are presented in Appendix E, Attachment E-4.

Testing was performed to allow for material classification according to the Unified Soil Classification System (USCS) and to evaluate pertinent engineering properties of the materials. These tests included moisture content, Atterberg limits, sieve gradation, hydrometer, crumb tests and unconfined compression tests. The results of these tests are presented on the boring logs in Appendix E, Attachment E-3 and individual test reports included in Appendix E, Attachment E-5.

The boring logs were prepared from the field logs and represent a generalized interpretation of the stratigraphy encountered within each boring based on field descriptions, in situ testing, and laboratory test results. Stratigraphy lines shown on the logs correspond to the approximate boundary between strata. In situ, this transition can be, and often is, gradual. Groundwater was not encountered during the drilling operations and after completion of drilling. However, the groundwater level at the subject site is anticipated to fluctuate seasonally depending on the amount of rainfall, prevailing weather conditions, and subsurface drainage characteristics. Therefore, several days of observation would be required to evaluate actual groundwater levels within the depths explored. The boring logs are included in Appendix E, Attachment E-3 with a key to the symbols and terms used on the logs.

Summary of Subsurface Stratigraphy

Embankment Centerline of Dam

The dam embankment core is interpreted as engineered fill overlying consolidated Austin Chalk formation (Kau) material weathered to varying degrees. The subsurface can be generally described as follows:

- Embankment Fill: The embankment core fill is interpreted as consisting of stiff to very stiff, moist to wet fat clay (CH) and lean clay (CL) with occasional gravel within the upper 5 ft in contact with the Kau formation in the bottom section. No groundwater was observed in any of the borings.
- Foundation/Bedrock Formation: The lower member of the Kau formation forms the primary foundation for the dam and was encountered in the dam centerline borings. The surface of the Kau beneath the embankment occurs from 27 to 28 feet below the dam crest in Boring 01 and Boring 02. The Kau is mostly an argillaceous (fine grained) weakly to moderately cemented competent limestone containing chalky seams. Bedding thickness was found to be moderately thick to massive. Thickness of the uppermost weathered section of Kau was found from 6 to 9 feet between Boring 01 and Boring 02. The weathered section is generally stained with limonite as a light-yellow brown and was moderately weathered. The less weathered or unweathered section of Kau is light gray and dark gray and is generally harder and moderately cemented. Dark gray fissile and argillaceous shaly layers were found to occur from 50-ft and 37-ft below the dam crest in Boring 01 and Boring 02, respectively within the limestone. Weathered layers, historically caused from groundwater leaching through discontinuities, were occasionally encountered within the less weathered or unweathered section. However, few natural discontinuities were observed from the rock core samples. This texture facilitated generally high rock quality designation (RQD) percentages for the less weathered or unweathered sections in the rock coring process.

Existing Auxiliary Spillway

The existing auxiliary spillway is interpreted as thin-graded sections of fat clay (CH) overlying mostly graded, weathered Kau to varying degrees. The subsurface can be generally described as follows:

- Soil: Borings 201 through 203 within the existing auxiliary spillway show that the surface soils consist of a thin mantle of fat clay (CH) ranging 0.5 ft to 1.75 ft in thickness.
- Foundation/Bedrock Formation: Weathered Kau was encountered below the clay mantle to 7.3 ft to 17.3 ft in Borings 201 through 203. Very soft, severely weathered Kau was found within the upper 2 ft to 3 ft in Boring B-210 and Boring B-203. Weathered Kau is generally light yellow-brown, soft to moderately soft, weakly to moderately cemented limestone with chalky layers. The

unweathered Kau was found mostly as an argillaceous (fine grained), weakly to moderately cemented competent limestone containing chalky seams and layers and contained frequent dark gray consolidated, argillaceous shale layers.

SITES Parameter Development

Based on the field investigation, the material overlying bedrock in the existing auxiliary spillway is largely lean clay (CL) and fat clay (CH). The overburden soils are estimated to meet common excavation criteria in NRCS Construction Specification 21, Excavation. Bedrock was encountered at shallow depths in the auxiliary spillway borings.

Headcut erodibility index (Kh) values were developed for the auxiliary spillway at Site 4 based on site-specific information from Borings 201 through 203. The Headcut Erodibility Index Calculation is included in Appendix E, attachment E-6. Headcut erodibility index values were developed for the overlying clays, the weathered limestone, and the unweathered limestone based on a range of RQD values. Table D-9 summarizes the headcut erodibility index values in the vicinity of the auxiliary spillway at Site 4. Associated calculations and assumptions made with the development of the headcut erodibility index values are included in Appendix E, attachment E-6.

Table D-9 Summary of Headcut Erodibility Index Determination (Kh) for FRS No. 4

Description of Soil	Material Strength Number (M_s)	Block/ Particle Size Number (K_b)	Discontinuity/ Interparticle Bond Shear Strength Number (K_d)	Relative Ground Structure Number (J_s)	Headcut Erodibility Index (K_h)
Overlying Clays	0.06	1	0.24	1	0.02
Weathered Limestone	4.8	17	0.08	1.3	8.6
Fresh Limestone	9	18.2	0.5	1.3	106.2

Chambers Creek FRS No. 6

Field exploration included eight (8) geotechnical borings drilled in May 2020. Two borings (01 and 02) were drilled along the centerline of the dam for characterizing the existing embankment and foundation materials, three borings (101, 102 and 103) were drilled within the proposed potential borrow area, generally located south of the right abutment (southeast of the existing dam) for strata identification, and three borings (201, 202 and 203) were drilled within the auxiliary spillway, one at the upstream end (Boring 201) near the shoreline of the lake, one at the crest (Boring 202) of the spillway and one at the downstream end of the spillway (Boring 203). The purpose of the auxiliary spillway borings was to evaluate the stability and integrity of the existing spillway with a focus on erodibility and headcut potential of the underlying strata. A schedule of borings is provided below in Table D-10, and the boring locations are shown on the attached Boring Location Map (Appendix E, Attachment E-7).

Table D-10 Chambers Creek Site 6 Boring Schedule

Boring	Location	Boring Depth (ft below ground surface)
01	Center line of Dam	70
02	Center line of Dam	60
101	Proposed Borrow Area	10
102	Proposed Borrow Area	10

103	Proposed Borrow Area	10
201	Existing Auxiliary Spillway (Upstream End)	25
202	Existing Auxiliary Spillway (Crest of Spillway)	25
203	Existing Auxiliary Spillway (Downstream End of Spillway)	25

The drilling was performed on May 28 and 29, 2020 using a CME-75 truck-mounted drilling rig provided and staffed by Texplor of Dallas, Inc. (TDI). Mr. Aaron Brewer, with Freese and Nichols, Inc. (FNI), supervised the drilling and logged the borings. The borings were observed for indications of subsurface water entry during drilling and were checked for accumulated water before being backfilled with cement-bentonite grout.

Hollow-stem augers and rotary wash drilling techniques were used to advance Borings 01, 02 and 201 through 203. Push tube sampling techniques were used to obtain soil samples. Borings 101 through 103 were drilled using continuous-flight augers. At the completion of drilling and sampling, each boring was pressure-tremie grouted using a cement-bentonite grout mixture.

Undisturbed samples of cohesive soils were collected using the drilling rig to push a seamless, steel tube sampler into the soil (based upon ASTM D1587). After a tube was recovered, the sample was extruded in the field, examined, and logged. During logging, an estimate of the sample consistency was obtained using a hand penetrometer. The result of the penetrometer reading is recorded for a particular sample at the corresponding depth on the boring logs. Note that a reported value of “4.5+” indicates the capacity of the penetrometer device was exceeded.

Samples of rock and rock-like materials were obtained using an NX-size, double tube core barrel with a carbide bit. The total length of the recovered sample (REC) was measured and reported as a percentage of the total run length. The total length of all the pieces greater than four inches was also measured in the field, recorded as a percentage of the total sample length, and reported as the rock quality designation (RQD). Core breaks obviously caused by the drilling process were counted as a continuous piece. Breaks that were not easily distinguished as being a result of the drilling process were considered a natural break. Rock core samples were photographed during the logging process, and the photos are presented in Appendix E, Attachment E-9.

Laboratory testing was performed on collected samples by Kleinfelder. Testing was performed to allow for material classification according to the Unified Soil Classification System (USCS) and to evaluate pertinent engineering properties of the materials. These tests included moisture content, Atterberg limits, double hydrometer tests, crumb tests and unconfined compression tests. The results of these tests are presented on the boring logs in Appendix E, Attachment E-8 and individual test reports included in Appendix E, Attachment E-10.

The boring logs were prepared from the field logs and represent a generalized interpretation of the stratigraphy encountered within each boring based on field descriptions, in situ testing, and laboratory test results. Stratigraphy lines shown on the logs correspond to the approximate boundary between strata. In situ, this transition can be, and often is, gradual. The boring logs are included in Appendix E along with a key to the symbols and terms used on the logs.

Summary of Subsurface Stratigraphy

Embankment Centerline of Dam

The dam embankment core is interpreted as engineered fill and natural soil overlying Austin Chalk formation (Kau) material weathered to varying degrees. The subsurface can be generally described as follows:

- Embankment Fill: The embankment core fill consists of stiff to very stiff, moist to wet fat clay (CH) and lean clay (CL) with occasional limestone gravel and fragments in the lower section.
- Foundation/Bedrock Formation: The lower member of the Kau formation forms the primary foundation for the dam and was encountered in Borings 01 and 02 at respective depths of approximately 33 and 48 ft below the dam crest. The Kau is mostly an argillaceous (fine grained) weakly to moderately cemented competent limestone containing chalky seams. Bedding thickness was found to be moderately thick to massive. The upper 2 ft and 6 ft of limestone encountered in Borings 01 and 02, respectively was considered weathered. The weathered section is generally stained with limonite as a yellow-brown and was slightly weathered. The less weathered or unweathered section of Kau is light gray and dark gray and is generally harder and moderately cemented. Some fissile and argillaceous shale layers were found to occur within the limestone. Weathered layers, historically caused from groundwater leaching through discontinuities, were occasionally encountered within the less weathered or unweathered section. However, few natural discontinuities were observed from the rock core samples. This texture facilitated generally high rock quality designation (RQD) percentages for the less weathered or unweathered sections in the rock coring process.

Proposed Borrow Area

The proposed borrow area consists of lean clay (CL) encountered in Borings 101 and 102 overlying weathered Kau to varying degrees. The subsurface can be generally described as follows:

- Soil: A mantle of soft to stiff, lean clay (CL) ranging from 1 ft to 9 ft in thickness was encountered in Borings 101 and 102, respectively, within the proposed borrow area. Lean clay (CL) soil was not encountered in Boring 103.
- Foundation/Bedrock Formation: Moderately to slightly weathered Kau was found below the clay mantle at 9 ft extending to the boring termination depth of 10 ft in Boring B-101and and between one to 2 ft in Boring 102. Moderately to slightly weathered Kau was encountered at the ground surface and extended to the termination depth of 10 ft in Boring 103. Weathered Kau is generally yellow-brown, soft to moderately soft, weakly to moderately cemented limestone with calcareous clay and chalky layers.
- The unweathered Kau was found as a moderately soft limestone containing chalky seams in Boring 102 only at a depth of 2 feet and extended to the boring termination depth of 10 feet.

Existing Auxiliary Spillway

The existing auxiliary spillway stratigraphy consists of thin graded sections of fat clay (CH) and lean clay (CL) overlying mostly graded, weathered Kau to varying degrees. The subsurface can be generally described as follows:

- Existing Fill: Very stiff, fat clay fill with fine limestone gravel was encountered within the upper 3 ft in Boring 201 drilled at the upstream end (near the lake shore) of the existing auxiliary spillway and within the upper 6 ft in Boring 202 drilled at the crest of the spillway. Fill was not encountered in Boring 203 drilled at the downstream end of the spillway.

- Soil: Borings 201 through 203 within the existing auxiliary spillway show that the surface soils consist of a mantle of stiff to very stiff, fat clay (CH) and lean clay (CL) natural soils with fine limestone gravel within the upper 1 ft to 7.5 ft.
- Foundation/Bedrock Formation: Slightly weathered Kau was encountered below the clay mantle between 4 ft and 7.5 ft in Boring 201 and between one and 3 ft in Boring 203. Highly weathered Kau was encountered in Boring 202 between 7.5 and 8.5 ft and moderately to slightly weathered Kau was present below 8.5 ft to the termination depth of the boring at 25 ft. Weathered Kau is generally yellow-brown, soft to moderately soft, weakly to moderately cemented limestone with chalky layers.

In Borings 201 and 203, the unweathered Kau was found mostly as an argillaceous (fine grained), weakly to moderately cemented competent limestone containing chalky seams and layers and contained frequent consolidated, argillaceous shale layers.

Groundwater Presence in the Borings

Groundwater was encountered at a depth of 6 ft below existing grade during drilling in Boring 101 and was measured at a depth of 3.5 ft below existing grade after completion of drilling. Seepage and groundwater were not encountered within the other borings during drilling and after completion of drilling.

SITES Parameter Development

Based on the field investigation, the material overlying bedrock in the existing auxiliary spillway is largely lean clay (CL) and fat clay (CH) fill and natural soils. The overburden soils are estimated to meet common excavation criteria in NRCS Construction Specification 21, Excavation. Bedrock was encountered at shallow depths in the auxiliary spillway borings.

Headcut erodibility index (Kh) values were developed for the auxiliary spillway at FRS No. 6 based on site-specific information from Borings 201, 202 and 203. The Headcut Erodibility Index Calculation is included in Appendix E, Attachment E-6. Headcut erodibility index values were developed for the overlying clays, the weathered limestone, and the unweathered limestone based on a range of RQD values. Table D-11 summarizes the headcut erodibility index values in the vicinity of the auxiliary spillway at FRS No. 6. Associated calculations and assumptions made with the development of the headcut erodibility index values are included in Appendix E, Attachment E-6.

Table D-11 Summary of Headcut Erodibility Index Determination (Kh) for FRS No. 6

Description of Soil	Material Strength Number (M_s)	Block/ Particle Size Number (K_b)	Discontinuity/ Interparticle Bond Shear Strength Number (K_d)	Relative Ground Structure Number (J_s)	Headcut Erodibility Index (K_h)
Overlying Clays	0.18	1	0.36	1	0.06
Weathered Limestone	8.23	10	0.38	0.74	22.8
Fresh Limestone	12.06	41	1	0.74	366.6

Environmental Conditions

Project maps have been developed for each dam to conduct a desktop assessment and identify potential environmental constraints within the watershed. Examples of literature and databases reviewed to conduct the desktop assessment included, but were not limited to, recent and historic aerial imagery, U.S. Fish and Wildlife Service's (USFWS) National Wetland Inventory (NWI) Maps, Federal Emergency Management

Agency (FEMA) Flood Insurance Rate Maps (FIRMS), U.S. Geological Survey (USGS) 7.5-minute topographic maps, and USGS National Hydrography Dataset.

Chambers Creek FRS No. 4

Waters of the U.S.

The Chambers Creek Dam No. 4 watershed includes 560 acres in Ellis County, Texas (Attachment C-3 in Appendix C). The head of the watershed is located west of the intersection of U.S. Highway 67 and Dove Lane and extends approximately 1.3 miles south to the outlet of the dam located on an unnamed tributary of Waxahachie Creek. The waterbody created by the dam is identified as Soil Conservation Service Site 4 Reservoir (Attachment C-21 in Appendix C). USFWS NWI data identified freshwater emergent and freshwater forested/shrub wetlands within the watershed.

Wetlands

A wetland investigation for Chambers Creek No. 4 was completed during the growing season of 2020. Prior to conducting fieldwork, an off-site evaluation was completed. NRCS consulted the USGS 7.5-minute Topographic Quadrangle Map, the National Wetland Inventory Interactive Mapper (NWI) website administered by the USFWS, and soil survey information provided by NRCS. Fieldwork was conducted using methods as outlined in the *1987 Corps of Engineers Wetland Delineation Manual and the Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Great Plains (Version 2.0).* The shorelines of the Chambers Creek FRS No. 4 reservoir were visually surveyed and wetlands were identified in the upper reaches of the normal pool, near the transition from ephemeral channel to open water (Attachment C-21 in Appendix C).

Threatened and Endangered Species

The USFWS Information for Planning and Consultation (IPaC) website (20220) provides a list of federally listed species which have been identified as potentially occurring in Ellis County. Likewise, Texas Parks and Wildlife Department (TPWD) provides information on state listed species. Multiple state and federally listed species potentially occur in Ellis County, however, none of the animal species have designated habitats within the Dam No. 4 watershed. IPaC coordination resulted in the creation of an official species list and Consistency Letter (dated March 14, 2022) to assess the potential effects of the project on federally listed species (Appendix D). It was determined that the project would have no effect on federally listed species, and no critical habitat is designated near the project area.

Project information was submitted to the TPWD Wildlife Assessment Program (WHAB) and the official response, including project recommendations can be found in Appendix D. Of all listed species in Ellis County, the state-listed Alligator Snapping Turtle (*Macrochelys temminckii*) and Texas Horned Lizard (*Phrynosoma cornutum*) have the highest probability of occurrence in the watershed. Additionally, the Texas Natural Diversity Database (NDD) search identified no previous T&E species occurrences within the project area.

Cultural Resources

Consultation with the SHPO was performed and concurrence was received for no effect to historic properties. Although the Williams Creek FRS No. 2 structure was constructed in 1958 and meets the 50+ years old age requirement, the dam is not considered a historic resource for NRHP inclusion.

A desktop assessment identified no previously recorded cultural resource sites within the Dam No. 4 APE , however, one park and one school were found (see Attachment C-23 in Appendix C.). The school is T.E. Baxter Elementary School, part of the Midlothian Independent School District, and located at 1050 Park Place, Midlothian, Texas 76065. The park is the Mockingbird Nature Park (city-owned) located at 104 W Avenue E, Midlothian, Texas 76065. The records review revealed no historic properties or previously recorded archeological sites within the APE, however the records review revealed one historical marker for the Site of the Old Hawkins Springs (5139007114) within one kilometer of the project.

Hazardous Materials

The desktop assessment identified one EPA facility interest within the extents of the project area - the Midlothian Agricultural Science Facility (Table D-12). Other EPA facility interests and NPDES points were identified downstream of the dam see Attachment C-25 in Appendix C.

Table D-12: Hazardous Material Sites within Project Area Watershed (EPA Facility Detail Reports)

Site Description	EPA Registry ID	Environmental Interest Type	Site Location
Midlothian ISD Agricultural Science Facility[1]	110038203422	State Master	1851 Mockingbird Lane, Midlothian, TX 76065

[1]https://ofmpub.epa.gov/frs_public2/fii_query_detail.disp_program_facility?p_registry_id=110038203422

Chambers Creek FRS No. 6

Waters of the U.S.

The Chambers Creek Dam No. 6 watershed includes 1,048 acres in Ellis County, Texas (Attachment C-4 in Appendix C). The head of the watershed is located south of the intersection of FM 663 and Ashford Lane and extends approximately 3 miles northeast to the outlet of the dam located on an unnamed tributary of Waxahachie Creek. The waterbody created by the dam is identified as Soil Conservation Service Site 6 Reservoir (Attachment C-22 in Appendix C). USFWS NWI data identified freshwater emergent and freshwater forested/shrub wetlands within the watershed.

Wetlands

A wetland investigation for Chambers Creek No. 6 was completed during the growing season of 2020. Prior to conducting fieldwork, an off-site evaluation was completed. NRCS consulted the USGS 7.5-minute Topographic Quadrangle Map, the National Wetland Inventory Interactive Mapper (NWI) website administered by the USFWS, and soil survey information provided by NRCS. Fieldwork was conducted using methods as outlined in the *1987 Corps of Engineers Wetland Delineation Manual and the Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Great Plains (Version 2.0)*. The shorelines of the Chambers Creek FRS No. 6 were visually surveyed and wetlands were identified in the upper reaches of the normal pool, near the transition from ephemeral channel to open water (Attachment C-22 in Appendix C).

Threatened and Endangered Species

The USFWS Information for Planning and Consultation (IPaC) website (2022) provides a list of federally listed species which have been identified as potentially occurring in Ellis County. Likewise, TPWD provides information on state listed species. Multiple state and federally listed species potentially occur in

Ellis County, however, none of the animal species have designated habitats within the Dam No. 6 watershed. IPaC coordination resulted in the creation of an official species list and Consistency Letter to assess the potential effects of the project on federally listed species (Appendix D). It was determined that the project would have no effect on federally listed species, and no critical habitat is designated near the project area.

Project information was submitted to the TPWD Wildlife Assessment Program (WHAB) and the official response, including project recommendations can be found in Appendix D. Of all listed species in Ellis County, the state-listed Alligator Snapping Turtle (*Macrochelys temminckii*) and Texas horned lizard (*Phrynosoma cornutum*) have the highest probability of occurrence in the watershed. Additionally, the Texas Natural Diversity Database (NDD) search identified no previous T&E species occurrences within the project area.

Cultural Resources

Consultation with the SHPO was performed and concurrence was received for no effect to historic properties. Although the Chambers Creek FRS No. 6 structure was constructed in 1959 and meets the 50+ years old age requirement, the dam is not considered a historic resource for NRHP inclusion.

A desktop assessment identified no previously recorded cultural resource sites within the Dam No. 6 watershed, however one park and two schools were found (see Attachment C-24 in Appendix C.). The schools are Larue Miller and Mt. Peak elementary schools in the Midlothian Independent School District and are located at 2800 Sudith Lane and 5201 FM 663, Midlothian, Texas 76065. The park is the Midlothian Community Park (city owned) located at 3601 South 14th Street, Midlothian, Texas 76065.

Hazardous Materials

The desktop assessment identified six EPA facility interests within the extent of the Dam No. 6 watershed. These are described further in Table D-13. Other EPA facility interests and NPDES points were identified nearby, but outside of the project area watershed.

Table D-13: Hazardous Material Sites within Project Area Watershed (EPA Facility Detail Reports)

Site Description	EPA Registry ID	Environmental Interest Type	Site Location
Satterfield and Pontikes Construction MISD Elementary School 6[1]	110034824590	State Master	2800 Sudith Lane, Midlothian, Ellis County, TX 76065
Plainview Manor[2]	110070355989	Non-Major	Midlothian, TX 76065
Plainview Manor[2]	110070355989	Stormwater Construction	Midlothian, TX 76065
Midlothian ISD – Middle School 3[3]	110070389845	Non-Major	NW of Intersection of Sudith Lane and Sunbeam Court, Midlothian, TX 76065
Midlothian ISD – Middle School 3[3]	110070389845	Stormwater Construction	NW of Intersection of Sudith Lane and Sunbeam Court, Midlothian, TX 76065
Brandi Ridge Addition[4]	110033284078	State Master	Midlothian, TX 76065

Hillstone Estates[5]	110070517584	Non-Major	Northeast of Blue Bonnet Lane and FM 663, Midlothian, TX 76065
Hillstone Estates[5]	110070517584	Stormwater Construction	Northeast of Blue Bonnet Lane and FM 663, Midlothian, TX 76065
South 14th Street[6]	110070370518	Stormwater Construction	Midlothian, TX 76065
South 14th Street[6]	110070370518	Non-Major	Midlothian, TX 76065

[1]https://ofmpub.epa.gov/frs_public2/fii_query_detail.disp_program_facility?p_registry_id=110034824590
[2]https://ofmpub.epa.gov/frs_public2/fii_query_detail.disp_program_facility?p_registry_id=110070355989
[3]https://ofmpub.epa.gov/frs_public2/fii_query_detail.disp_program_facility?p_registry_id=110070389845
[4]https://ofmpub.epa.gov/frs_public2/fii_query_detail.disp_program_facility?p_registry_id=110033284078
[5]https://ofmpub.epa.gov/frs_public2/fii_query_detail.disp_program_facility?p_registry_id=110070517584
[6]https://ofmpub.epa.gov/frs_public2/fii_query_detail.disp_program_facility?p_registry_id=110070370518

Economics

Chambers Creek FRS No. 4

The analysis was conducted according to Principles, Requirements, and Guidelines for Water and Land Related Resources Implementation Studies and Federal Water Resource Investment, 2017 (PR&G). The project area limits selected for the analysis include the watershed which drains to the site and the inundation area downstream of the dam to the I-35E bridge that crosses over Waxahachie Creek. The breach inundation area downstream limit is the approximate location that the breach water surface elevation has receded below the 100-year flood water surface. FNI evaluated a number of plans which are listed in Table D-14. Analyzed benefits under the proposed plans were limited to flood damage reduction, including damages to structures, crops, pasture, bridges and culverts in addition to erosion and sedimentation damages.

Table D-14 Description of Proposed Plans for FRS No. 4

Plan Name	Description
Future Without Federal Investment (Alternative 1)	No federal funds expended on project. The local sponsor, public, and project stakeholders opposed to a dam decommissioning and do not have funds to rehabilitate the dam without federal investment. Hence, this a true no-action alternative in which no rehabilitation measures take place. The dam would remain in its current configuration with regular maintenance continuing. The dam would not be in compliance with the NRCS or TCEQ criteria for a high hazard dam, and the embankment would remain in place with elevated breach risk. This alternative is utilized as the baseline to perform the economic analysis and determine the benefit/cost ratio of all the alternatives analyzed in this plan. The baseline conditions assume the dam is not in place, since the dam would be expected to fail at some time in the future.
Decommission (Alternative 2)	Remove the storage function of the dam and reconnect, restore, and stabilize the stream and floodplain functions.
Alternative 3	Install new 30-inch principal spillway, raise the existing auxiliary spillway crest 0.4 feet and maintain a width of 50 feet, raise dam crest approximately 2.4 feet
Alternative 4	Install new 30-inch principal spillway, remove the existing earthen auxiliary spillway, install a new 170-foot wide RCC auxiliary spillway, maintain dam crest elevation
Alternative 5	Install new 36-inch principal spillway, maintain existing auxiliary spillway crest elevation and maintain a width of 50 feet, raise dam crest approximately 2.1 feet

Structure Damages

The maximum water depths and flow velocities were imported into ArcMap directly from the HEC-RAS 2D hydraulic model for each alternative and frequency event. The water depths and flow velocities are then identified at the locations of interest (e.g., bridges, culverts, houses, structures, etc.) using Google Earth web imagery. This process is possible due to HEC-RAS 2D capabilities to generate georeferenced shapefiles. The values obtained at the desired locations are then used in conjunction with the stage/velocity damage curves associated to each kind of structure.

Structure Occupancy Types

Sixty-three structures were identified within the project area and categorized using aerial photography, street level imagery, and data from the Ellis County appraisal district. The project area was determined as the combination of the 500-year and breach inundation areas, clipped where the breach water surface elevation falls below the 500-year water surface elevation. Forty of these structures are residential houses and twenty-three are barns. The floor elevations of the structures were assigned based on the 2009 LiDAR data that was obtained through the TNRIS StratMap website (TNRIS, 2009).

For multiple structure types, stage-damage and associated uncertainty was based on guidance from the U.S. Army Corps of Engineers (USACE) Economic Guidance Memorandum (EGM) 04-01 (USACE 2003, 2006). This document includes damage to structures and contents. Figure D-5 shows the relationship between water depth and flood damage as percentage of the structure's total damageable value. The finished floor elevation (FFE) from which damage was computed was assumed to be equal to the mean terrain elevation at the structure footprint plus 6 inches to represent the concrete slab. The content values for each structure were computed as 100% of the structure value for residential and commercial structures, based on NRCS guidance. The content values for barns/outbuildings was computed as 30% of the structure value. The damages to contents was computed based on unique depth-damage curves for contents, shown in Figure D-6.

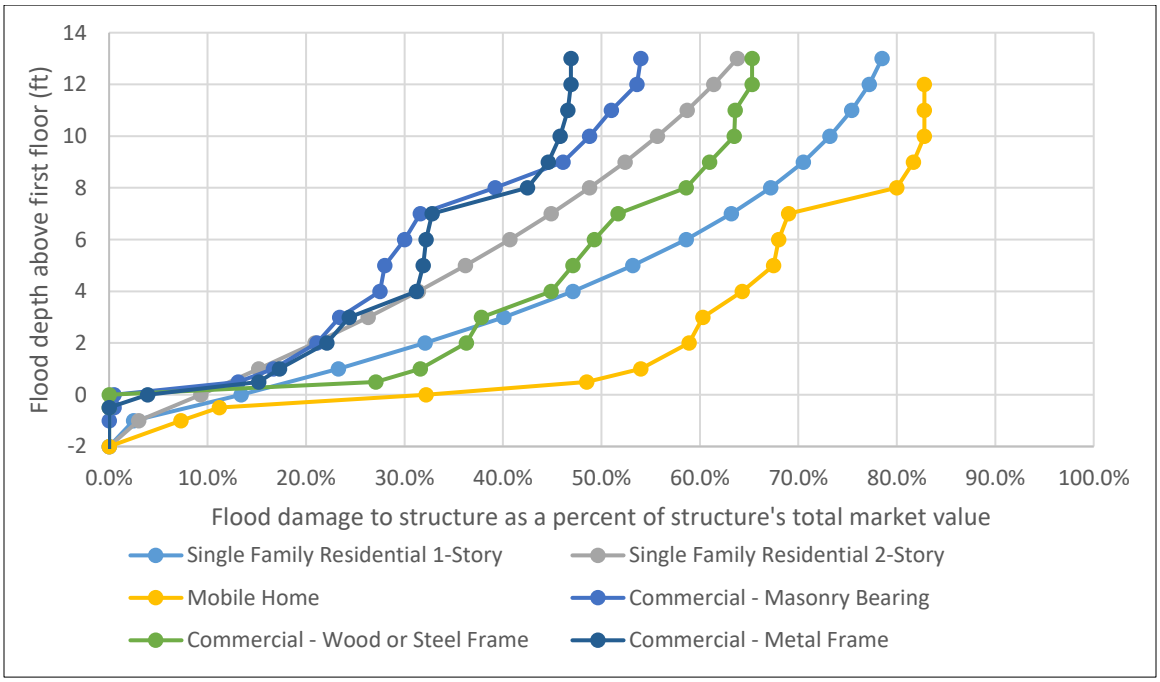

Figure D-5 Structure Depth-Damage Curves

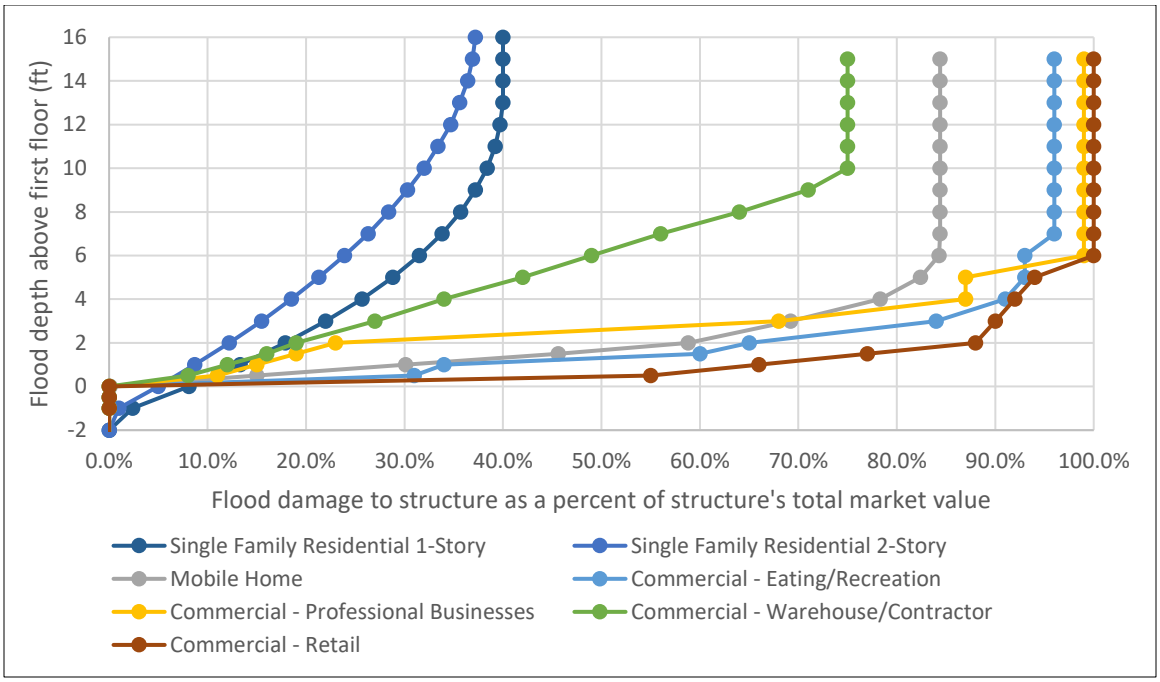

Figure D-6 Contents Depth-Damage Curves

Structure Inventory

Data from the Ellis County appraisal district was used to determine the 2021 market value of affected structures. Many barns/outbuildings did not have appraisal data available, and some had unrealistically low costs. The value of barns/outbuildings was assumed to be $30/SF based on online information about prefabricated structures on tuffshed.com. Appraisal district information did not provide sufficient detail to obtain the value of barns/outbuildings, with most omitted or having no value provided.

Some residential structures did not have appraisal data available. The value of these structures was estimated based on adjacent structures of the same type by computing their value per square foot. The structures inventory is shown in Table D-15 and the damages for each structure in existing conditions are shown in Table D-16.

Table D-15 Impacted Properties Within Project Area FRS No. 4

Structure Number	Appraised Value of Structure	Estimated Finished Floor Elevation	Occupancy Type
4	$212,170	699.87	Single Family Residential
6	$145,630	707.57	Single Family Residential
7	$162,460	708.31	Single Family Residential
8	$8,620	705.03	Barn
9	$155,500	708.08	Single Family Residential
10	$181,060	708.10	Single Family Residential
11	$140,350	709.24	Single Family Residential
12	$161,120	697.95	Single Family Residential
13	$170,510	700.65	Single Family Residential
14	$36,769	697.69	Barn
15	$159,820	701.81	Single Family Residential
16	$15,188	698.55	Barn

Structure Number	Appraised Value of Structure	Estimated Finished Floor Elevation	Occupancy Type
17	$14,337	699.01	Barn
18	$171,320	701.60	Single Family Residential
19	$147,610	705.57	Single Family Residential
20	$185,240	703.56	Single Family Residential
21	$158,850	700.71	Single Family Residential
22	$145,250	698.14	Single Family Residential
23	$208,140	695.93	Single Family Residential
24	$5,350	694.36	Barn
25	$156,170	695.76	Single Family Residential
26	$140,720	706.70	Single Family Residential
27	$188,950	706.51	Single Family Residential
28	$15,031	703.95	Barn
29	$164,270	704.92	Single Family Residential
30	$125,373	705.44	Single Family Residential
31	$146,770	704.52	Single Family Residential
32	$980	700.09	Single Family Residential
35	$191,460	700.29	Single Family Residential
39	$18,945	675.00	Barn
40	$334,780	678.51	Single Family Residential
71	$24,098	665.07	Barn
74	$255,700	656.62	Single Family Residential
81	$161,540	709.88	Single Family Residential
82	$20,531	707.65	Barn
83	$155,240	708.94	Single Family Residential
84	$210,020	711.20	Single Family Residential
85	$39,250	712.98	Barn
104	$140,710	694.90	Single Family Residential
105	$14,008	695.11	Barn
106	$4,513	688.78	Barn
107	$37,851	687.23	Barn
108	$223,460	689.54	Single Family Residential
109	$122,259	697.95	Single Family Residential
110	$142,446	696.11	Single Family Residential
111	$7,324	691.54	Barn
112	$155,010	694.98	Single Family Residential
113	$189,130	695.61	Single Family Residential
114	$158,680	694.46	Single Family Residential
115	$4,818	691.83	Barn
116	$109,690	697.29	Single Family Residential
117	$206,040	690.93	Single Family Residential
118	$3,638	688.80	Barn
119	$2,173	688.65	Barn
120	$191,660	693.71	Single Family Residential
121	$157,950	693.73	Single Family Residential
122	$5,622	692.00	Barn
123	$5,588	691.82	Barn
124	$160,510	694.53	Single Family Residential
125	$9,799	692.02	Barn
129	$32,163	679.63	Barn
130	$184,300	678.61	Single Family Residential
131	$46,708	689.59	Barn

Table D-16 Impacted Properties Within Project Area FRS No. 4: Flood Damages in Existing Conditions by Frequency Event

Structure Number	Appraised Value of Structure	2-year	5-year	10-year	25-year	50-year	100-year	200-year	500-year
4	$212,170	$0	$0	$0	$0	$0	$0	$0	$0
6	$145,630	$0	$0	$0	$0	$0	$0	$0	$0
7	$162,460	$0	$0	$0	$0	$0	$0	$0	$0
8	$8,620	$0	$0	$0	$0	$0	$0	$0	$0
9	$155,500	$0	$0	$0	$0	$0	$0	$0	$0
10	$181,060	$0	$0	$0	$0	$0	$0	$0	$0
11	$140,350	$0	$0	$0	$0	$0	$0	$0	$0
12	$161,120	$0	$0	$0	$0	$0	$0	$0	$0
13	$170,510	$0	$0	$0	$0	$0	$0	$0	$0
14	$36,769	$807	$807	$830	$833	$1,893	$3,034	$3,390	$3,915
15	$159,820	$0	$0	$0	$0	$0	$0	$0	$0
16	$15,188	$1,250	$1,250	$1,262	$1,262	$1,482	$1,774	$2,078	$2,399
17	$14,337	$852	$852	$877	$878	$1,375	$1,852	$2,259	$2,619
18	$171,320	$0	$0	$0	$0	$0	$0	$0	$399
19	$147,610	$0	$0	$0	$0	$0	$0	$0	$0
20	$185,240	$0	$0	$0	$0	$0	$0	$0	$0
21	$158,850	$0	$0	$0	$0	$0	$0	$0	$0
22	$145,250	$0	$0	$0	$0	$0	$0	$0	$0
23	$208,140	$0	$0	$0	$0	$0	$0	$0	$5,198
24	$5,350	$0	$0	$0	$0	$0	$0	$0	$0
25	$156,170	$0	$0	$0	$0	$0	$0	$14,942	$20,972
26	$140,720	$0	$0	$0	$0	$0	$0	$0	$0
27	$188,950	$0	$0	$0	$0	$0	$0	$0	$0
28	$15,031	$0	$0	$0	$0	$0	$0	$0	$0
29	$164,270	$0	$0	$0	$0	$0	$0	$0	$0
30	$125,373	$0	$0	$0	$0	$0	$0	$0	$0
31	$146,770	$0	$0	$0	$0	$0	$0	$0	$0
32	$980	$0	$0	$0	$0	$0	$0	$0	$0
35	$191,460	$0	$0	$0	$0	$0	$0	$0	$0
39	$18,945	$2,694	$2,826	$2,961	$3,113	$3,179	$3,297	$3,446	$3,644
40	$334,780	$0	$0	$0	$0	$0	$44,776	$45,342	$45,939
71	$24,098	$0	$2,523	$3,518	$4,397	$4,820	$5,041	$5,584	$5,761
74	$255,700	$0	$0	$27,317	$45,123	$56,135	$53,785	$79,494	$78,788
81	$161,540	$0	$0	$0	$0	$0	$0	$0	$7,346
82	$20,531	$0	$0	$0	$0	$0	$0	$0	$0
83	$155,240	$0	$0	$0	$0	$0	$0	$0	$0
84	$210,020	$0	$0	$0	$0	$0	$0	$0	$0
85	$39,250	$0	$0	$0	$0	$0	$0	$0	$0
104	$140,710	$0	$0	$0	$0	$0	$0	$0	$0
105	$14,008	$0	$0	$0	$0	$0	$0	$0	$0
106	$4,513	$0	$0	$0	$0	$0	$520	$657	$777
107	$37,851	$0	$0	$0	$0	$0	$0	$0	$1,034
108	$223,460	$0	$0	$0	$0	$0	$0	$0	$0
109	$122,259	$0	$0	$0	$0	$0	$0	$0	$0
110	$142,446	$0	$0	$0	$0	$0	$0	$0	$0
111	$7,324	$0	$0	$0	$0	$0	$0	$696	$1,208

Structure Number	Appraised Value of Structure	2-year	5-year	10-year	25-year	50-year	100-year	200-year	500-year
112	$155,010	$0	$0	$0	$0	$0	$0	$0	$0
113	$189,130	$0	$0	$0	$0	$0	$0	$0	$0
114	$158,680	$0	$0	$0	$0	$0	$0	$0	$0
115	$4,818	$0	$0	$0	$0	$7	$77	$279	$640
116	$109,690	$0	$0	$0	$0	$0	$0	$0	$0
117	$206,040	$0	$0	$0	$0	$0	$0	$0	$0
118	$3,638	$0	$0	$0	$0	$0	$0	$319	$421
119	$2,173	$0	$0	$0	$0	$0	$0	$145	$246
120	$191,660	$0	$0	$0	$0	$0	$0	$0	$0
121	$157,950	$0	$0	$0	$0	$0	$0	$0	$0
122	$5,622	$0	$0	$0	$0	$0	$0	$0	$384
123	$5,588	$0	$0	$0	$0	$0	$0	$0	$435
124	$160,510	$0	$0	$0	$0	$0	$0	$0	$0
125	$9,799	$0	$0	$0	$0	$0	$0	$0	$725
129	$32,163	$0	$0	$0	$0	$0	$0	$0	$0
130	$184,300	$0	$0	$0	$0	$0	$0	$0	$0
131	$46,708	$0	$0	$0	$0	$0	$0	$0	$0

Stage-Damage Function

The flood damage for each structure is determined using the water depths obtained from HEC-RAS, the stage-damage relationship, and the structure market value. The flood damage to the structure as a percent of the total market value is determined from Figure D-5, using the water depths obtained in HEC-RAS, then this percentage is multiplied by the structure's total damageable value and the result corresponds to the damage for a specific structure. This process is repeated for each of the frequency storm event in order to plot a damage-probability curve for each alternative. The damages for each frequency storm by alternative are shown in Table D-17. The integral of this curve is the annual damage to the structures for each alternative, shown in Table D-18.

Table D-17 Expected Frequency Storm Damages to Structures

Frequency Event	Existing	No Dam	Alt. 3	Alt. 4	Alt. 5
2-year	$164,638	$281,536	$169,611	$169,610	$170,376
5-year	$377,479	$544,738	$384,921	$384,920	$387,063
10-year	$584,802	$864,910	$594,164	$594,162	$597,466
25-year	$827,232	$1,198,220	$837,496	$837,497	$841,217
50-year	$1,068,249	$1,545,282	$1,081,201	$1,081,195	$1,087,484
100-year	$1,291,573	$1,797,046	$1,300,579	$1,300,577	$1,308,715
200-year	$1,978,581	$2,553,075	$1,966,499	$2,005,060	$1,991,415
500-year	$2,370,610	$4,995,772	$2,470,808	$2,554,354	$2,553,910

Table D-18 Expected Annual Damages to Structures by FRS No. 4

Existing	No Dam	Alt. 3	Alt. 4	Alt. 5
$216,706	$321,063	$220,418	$220,655	$221,716

Agricultural Damages

For the purpose of this study, agricultural damages include damages to crops and pastureland productivity due to inundation by floodwaters. Damages associated with agricultural production are included in the Erosion and Sedimentation category for damages to the value of the land itself.

Crop Damages

Seasonal Damage Factor

Since crops do not exist for 100 percent of a year, the damageable value must be adjusted down based on seasonal factors. The U.S. Department of Agriculture's National Agricultural Statistics Service (NASS) publishes typical planting and harvesting dates for various crops (USDA 1997). Crops were assumed to vary linearly from 0 percent damageable to 100 percent damageable between the planting start date and harvesting start date; from 100percent damageable to 0 percent damageable between harvest start date and harvest end date; and remain at 0 percent damageable between harvest end and planting start date. The seasonal damage factor is computed as the average annual damage factor (as a percent of total damageable crop value) of each crop type.

Inundation Damage Factor

Floodwater is not especially harmful to crops except when either flood depth, velocity, and/or duration are high. For this study, duration and velocity effects were neglected and only water depth was considered. Depth of flooding was separated into three categories: < 1 foot, between 1 and 3 feet, and > 3 feet. For each crop and depth category, a factor was assigned based on how much damage a crop would be expected to sustain. Data for these factors was used from examples in the Water Resources Economic Handbook (USDA 1988). A detailed study of agricultural inundation damage factors was deemed unwarranted due to the low expected magnitude of the damages.

Crop Yield and Market Value

The NASS publishes yields and prices for various crops by state and year. Since these values have significant variability, the average yield and prices for the last three years (2017 to 2019) were used in the analysis. The crop prices were adjusted to real 2021 dollars prior to averaging. Prices were adjusted using the GDP implicit price deflator, which is a broad measure of the change of the value of money over long periods of time Damageable unit value for each crop is determined by multiplying yield by unit price and the two damage factors described above. Table D-19 shows the development of the damageable values for the crops in the project area.

Table D-19 Development of Damageable Values for Crops affected by FRS No. 4

Crop	Corn	Cotton	Sorghum	Spring Wheat	Winter Wheat	Oats	Other Hay/Non-Alfalfa
Planting Starts	1-Mar	22-Mar	1-Mar	28-Mar	4-Sep	7-Sep	23-Feb
Harvesting Starts	18-Jul	10-Aug	25-Jun	23-Jul	25-May	13-May	1-May
Harvesting Ends	8-Nov	11-Jan	6-Dec	29-Sep	12-Jul	20-Jul	30-Sep
Seasonal Damage Factor	0.35	0.40	0.38	0.25	0.43	0.43	0.30
Inundation Damage Factor (≤ 1ft)	0.26	0.17	0.23	0.33	0.33	0.32	0.20
Inundation Damage Factor (1-3 ft)	0.35	0.41	0.36	0.50	0.50	0.50	0.23
Inundation Damage Factor (≥ 3 ft)	0.47	0.54	0.47	0.63	0.63	0.63	0.36
2019 Unit Price	3.56	0.614	3.34	4.66	4.53	2.82	135
2020 Unit Price	4.53	0.663	5.04	5.09	4.98	2.77	132
2021 Unit Price	5.45	0.814	5.46	8	6.8	4	147
Unit	bushels	pounds	bushels	pounds	bushels	bushels	tons
2019 GDP Deflator	112.29	112.29	112.29	112.29	112.29	112.29	112.29
2020 GDP Deflator	113.65	113.65	113.65	113.65	113.65	113.65	113.65

2021 GDP Deflator	118.37	118.37	118.37	118.37	118.37	118.37	118.37
2019 Yield (unit/acre)	81	589	43.1	34	46	50	1.80
2020 Yield (unit/acre)	97	685	45.6	30	54	45	1.85
2021 Yield (unit/acre)	71	695	48.0	37	53	45	1.85
2019 Areal Unit Value (2021 dollars)	$303.97	$381.22	$151.61	$167.01	$217.27	$148.63	$256.15
2020 Areal Unit Value (2021 dollars)	$456.26	$473.03	$239.07	$159.05	$279.06	$129.83	$254.35
2021 Areal Unit Value (2021 dollars)	$385.86	$565.73	$262.04	$296.00	$357.68	$180.00	$271.95
Average Value per Acre (2021)	$382.03	$473.33	$217.57	$207.35	$284.67	$152.82	$260.82
Damageable Value per Acre (≤ 1ft)	$34.29	$32.52	$19.19	$17.34	$40.02	$21.24	$15.72
Damageable Value per Acre (1-3 ft)	$46.16	$78.42	$30.18	$26.27	$60.64	$33.18	$18.08
Damageable Value per Acre (≥ 3 ft)	$61.98	$103.29	$39.36	$33.11	$76.40	$41.81	$28.30

Determination of Damages

The NASS publishes the *Cropscape* GIS data layer of land use (USDA n.d.-b). HEC-RAS provides GIS shapefiles of areal inundation extents for each frequency flood event. These shapefiles were intersected with the *Cropscape* layer to aggregate the area inundated for each land use type, depth category, and plan for each frequency storm event. The total damage is determined by multiplying the inundated area in each depth category for each crop by its corresponding damageable unit value. The total damages for each frequency storm event are summed and plotted with probability. The integral of this curve is the expected annual damages to crops for each plan, which are shown in Table D-20.

Table D-20 Expected Annual Damages to Crops

	Existing	**No Dam**	**Alt. 3**	**Alt. 4**	**Alt. 5**
Annual Damages	$584	$610	$585	$585	$586
Affected Cropland area (ac)	82	85	83	83	83

Pasture Damages

NASS publishes county-wide average pasture cash rental rates each year (USDA 2021). This is assumed to be the flood-free productive value of the land. NRCS developed generalized damage factors for pastureland grasses in a 1978 Technical Note (USDA 1978). Pastureland was assumed to be made up of Grassland and Shrubland cover types in the NASS Cropscape dataset.

The damage factors are expressed as a percentage of the flood-free yield and include seasonal changes and changes in actual damage to productive value based on depth. Using the same methodology and land use data as the crop damage analysis, inundated pastureland areas were aggregated for each depth category, frequency storm event, and plan. The total damages for each frequency storm event are summed and plotted with probability. The integral of this curve is the expected annual damages to pastureland productive value for each plan. Table D-21 and Table D-22 present the development of pastureland damageable values in the project area and the expected annual damages for each alternative, respectively.

Table D-21 Development of Pastureland Damageable Values

Damage factor (≤ 2 feet depth)	0.14
Damage factor (> 2 feet depth)	0.23
2021 Cash Rental Rate for Pasture	$11.00
Damageable Value per Acre (≤ 2ft)	$1.49
Damageable Value per Acre (> 2 ft)	$2.50

Table D-22 Expected Annual Damages to Pastureland Affected by FRS No.4

	Existing	No Dam	Alt. 3	Alt. 4	Alt. 5
Annual Damages	$83	$92	$85	$85	$86
Affected Pastureland area (ac)	235	249	235	236	235

Bridge and Culvert Damages

There are fourteen bridges and twenty-four culverts in the project area. The Texas Department of Transportation (TxDOT) publishes average unit costs for bridge and culvert projects (TxDOT 2018). This data was last published in 2020, so these costs were adjusted to 2021 dollars using the ENR construction cost index. The area of each crossing was determined using aerial photography and LIDAR data. The replacement cost of each bridge/culvert is assumed to be the deck area times the average unit price from TxDOT in 2021 dollars.

Bridges

Bridges were assumed to receive no damages at water elevations below the low chord of the bridge. Total loss of the bridge (full replacement required) was assumed to occur based on flow depth and velocity in accordance with guidance in an NRCS Technical Note for estimating floodwater damages to roads and bridges (TxDOT 2018). Velocity and peak stage data from HEC-RAS was used to determine the total loss stage. Percent damage was linearly interpolated between the low chord of the bridge and the total loss stage.

Many railroad bridges were present within the project area. A number of these bridges appeared to be primarily wooden based on aerial imagery; however, TxDOT does not provide an estimate for the cost of a wooden railroad bridge. It was assumed that, if damaged, these bridges would be replaced with steel girder railroad bridges, for which TxDOT provides an estimate of cost.

Culverts

According to a 1987 Federal Highway Administration report (USDA 1969), performance of culvert embankments during flooding is influenced by a number of factors that have not been determined as a part of this study, including fill material types, grain size distributions of embankment material, armoring and vegetative cover, and duration of overtopping. For this reason, and the fact that culvert damages are not anticipated to constitute a significant portion of the flood damage reduction benefits generated by improvements to the dam (based on engineering judgment and the damage estimates in the original watershed plan) a simplified model was developed to account for damages to the culvert embankments.

One culvert (#14 – Driveway) was identified to likely be a low water crossing, thus it would not be damaged in frequent events. The damage start station was adjusted to the 25-year water surface elevation, as the estimated annual damages (EAD) did not appear to be reasonable.

Damage was assumed to begin when the water surface elevation in the stream reached the top of the culvert embankment and progress linearly to complete failure of the embankment at six feet of overtopping depth. Table D-23 shows the expected damages to bridges and culverts in frequency events. Table D-24 summarizes the results obtained for the bridges and culverts analyzed in the project area.

Table D-23 Expected Frequency Storm Damages to Bridges and Culverts

Frequency Event	Existing	No Dam	Alt. 3	Alt. 4	Alt. 5
2-year	$0	$19,070	$1,473	$1,473	$1,882
5-year	$135,711	$155,336	$138,158	$138,158	$138,860
10-year	$370,038	$385,282	$371,593	$371,593	$372,165
25-year	$433,636	$504,642	$436,450	$436,450	$438,219
50-year	$593,108	$859,536	$609,986	$609,986	$620,049

100-year	$697,924	$968,503	$713,685	$713,544	$724,158
200-year	$1,685,086	$1,872,421	$1,700,292	$1,703,789	$1,708,143
500-year	$3,183,339	$3,343,080	$3,190,983	$3,198,423	$3,198,584

Table D-24 Expected Annual Damages to Bridges and Culverts

Category	Existing	No Dam	Alt. 3	Alt. 4	Alt. 5
Bridges	$96,838	$112,013	$97,492	$97,497	$97,787
Culvert	$2,899	$15,119	$4,372	$4,391	$4,873
Total	**$99,737**	**$127,132**	**$101,865**	**$101,889**	**$102,659**

Erosion and Sedimentation Damages

Erosion and sedimentation damages were not independently estimated for this study to maintain consistency with the original watershed plan. Estimates for erosion and sedimentation were included in the original work plan for the Chambers Creek Watershed (USDA 1955). These estimates were not separated by the individual flood control structures and have a price base of 1955. The following assumptions were used in order to include these damages in the economic analysis:

- Erosion and sedimentation damage estimates in the original work plan for the Chambers Creek watershed were assumed to be representative of the present conditions. Significant development has occurred in the study area but does not appear to have caused a significant change to the stream channels, except for the addition of some culverts and bridges. The stream channels downstream of Chambers Creek 4 do not appear to be noticeably modified based on aerial imagery and historical USGS topographic maps. The upstream watershed contributing to Chambers Creek 4 has met some development; however, the sedimentation rate originally estimated in the watershed plan has proven to be a significant overestimate. Thus, the damage values were adjusted to reflect the decreased sedimentation rate. Land treatment measures included in the work plan were not included in the original flood damage reduction benefits.
- Erosion and sedimentation damages are generally proportional to watershed area.
- Erosion and sedimentation damages generally change in cost over time according to the US GDP implicit price deflator.
- The proposed plans would have generally no effect on erosion and sedimentation damages compared to the existing conditions between the 2-year and 500-year flood events. Damages for the proposed plans are assumed to be equal to those estimated for the existing structure under the original work plan.
- Erosion and sedimentation damages were included by taking the proportion of the damages from the original work plan for Chambers Creek Site 4 based on contribution to the total Chambers Creek Watershed and adjusting the prices to 2021 dollars using the GDP implicit price deflator.

Benefit-Cost Analysis

The flood damage reduction benefits are computed by subtracting the flood damages associated with each plan from the damages associated with the “future without federal investment” plan. Project costs were developed for each proposed plan and include construction costs, engineering, real property rights/acquisition, project administration, and annual operation and maintenance costs. All of these costs, except O&M, are capital costs and must be amortized in order to compare them to the annualized flood damage reduction benefits.

Federal agencies are required by the Water Resources Development Act of 1974 to use a specified discount rate in the formulation and evaluation of water and related land resource plans for the purpose of discounting future benefits and computing costs. The discount rate formula is established by Section 80 of the Act and is tied to yields on government securities with more than 15 years to maturity. This rate is computed

annually and published by the Bureau of Reclamation (USDA n.d.-c). The FY 2021 discount rate is 2.5 percent. It was assumed that the project lifespan will be 100 years.

The final portion of the economic analysis is a comparison between the costs and benefits for the proposed plan. The benefit-cost ratio (BCR) is the total annualized benefits divided by the total annualized costs.

The following tables show the results of the economic analysis. Table D-25 summarizes the flood damage reduction benefits of each alternative, Table D-26 summarizes the costs of each alternative, and Table D-27 presents the benefit-cost analysis for each alternative. Of the three structural rehabilitation options, Alternative 3 had the greatest cost-benefit ratio.

Table D-25 Flood damages and Damage Reduction Benefits for FRS No. 4[1]

	Expected Annual Damages					Damage Reduction Benefits			
Damage Category	**FWOFI[2] Alt 1**	**Decom. Alt2**	**Alt. 3**	**Alt. 4**	**Alt. 5**	**Decom. Alt2**	**Alt. 3**	**Alt. 4**	**Alt. 5**
Structures	$321,060	$321,060	$220,420	$220,660	$221,720	$0	$100,650	$100,410	$99,350
Crops	$610	$610	$590	$590	$590	$0	$30	$30	$20
Pastureland	$90	$90	$90	$90	$90	$0	$10	$10	$10
Roads and Bridges	$127,130	$127,130	$101,870	$101,890	$102,660	$0	$25,270	$25,240	$24,470
Erosion and Sedimentation	$720	$720	$110	$110	$110	$0	$610	$610	$610
Total	**$449,620**	**$449,620**	**$323,060**	**$323,320**	**$325,150**	**$0**	**$126,560**	**$126,300**	**$124,460**

[1]All numbers were rounded to the nearest ten.
[2]FWOFI represents no-dam conditions used as economic baseline.

Table D-26 Project Costs for FRS No. 4[1]

Cost Category	**FWOFI Alt 1**	**Decom. Alt 2**	**Alternative 3**	**Alternative 4**	**Alternative 5**
Capital Costs	-	$2,105,200	$3,221,900	$6,802,200	$3,234,700
O&M	-	$2,500	$8,850	$8,100	$8,100
Discount Rate	2.50%	2.50%	2.50%	2.50%	2.50%
Project Lifespan (years)	-	100	100	100	100
Total Annual Costs	**-**	**$60,000**	**$96,850**	**$193,880**	**$96,450**

[1]All numbers were rounded to the nearest ten.
[2]As described in Table D-14 FWOFI does not have a capital investment cost associated to it

Table D-27 Benefit-Cost Calculations for FRS No. 4[3]

	Decom. Alt 2	**Alternative 3**	**Alternative 4**	**Alternative 5**
Flood Damage Reduction Benefits[1]	$0	$126,600	$126,300	$124,500
Total Benefits	$0	$126,600	$126,300	$124,500
Annual Costs[2]	$60,000	$96,800	$193,900	$96,400
Benefit-Cost Ratio	**0.00**	**1.31**	**0.65**	**1.29**
Net NEE Benefits	**($60,000)**	**$29,700**	**($67,600)**	**$28,000**

[1]From Table D-25
[2]From Table D-26
[3]All number were rounded to the nearest hundred.
[4]FWOFI is not included in this table since it is the baseline to compute the benefit-cost analysis

Chambers Creek FRS No. 6

The analysis was conducted according to the guidelines in the Principles Requirements, and Guidelines for Water and Land Related Resources Implementation Studies and Federal Resources Investment (PR&G). The project area limits selected for the analysis include the watershed which drains to the site and the inundation area downstream of the dam to the I-35E bridge that crosses over Waxahachie Creek. The breach inundation area downstream limit is the approximate location that the breach water surface elevation has receded below the 100-year flood water surface. FNI evaluated a number of plans which are listed in Table D-28. Analyzed benefits under the proposed plans were limited to flood damage reduction, including damages to structures, crops, pasture, bridges and culverts in addition to erosion and sedimentation damages.

Table D-28 Description of Proposed Plans for FRS No. 6

Plan Name	Description
Future Without Federal Investment (Alternative 1)	No federal funds expended on project. The local sponsor, public, and project stakeholders opposed to a dam decommissioning and do not have funds to rehabilitate the dam without federal investment. Hence, this a true no-action alternative in which no rehabilitation measures take place. The dam would remain in its current configuration with regular maintenance continuing. The dam would not be in compliance with the NRCS or TCEQ criteria for a high hazard dam, and the embankment would remain in place with elevated breach risk. This alternative is utilized as the baseline to perform the economic analysis and determine the benefit/cost ratio of all the alternatives analyzed in this plan. The baseline conditions assume the dam is not in place, since the dam would be expected to fail at some time in the future.
Decommission (Alternative 2)	Remove the storage function of the dam and reconnect, restore, and stabilize the stream and floodplain functions.
Alternative 3	Install new 30-inch principal spillway, raise the existing auxiliary spillway crest 0.24 feet and widen to 200 feet, raise dam crest approximately 2.1 feet
Alternative 4	Install new 36-inch principal spillway, lower the existing auxiliary spillway crest 0.44 feet and maintain width at 75 feet, raise dam crest approximately 4.4 feet
Alternative 5	Install new 36-inch principal spillway, lower the existing auxiliary spillway crest 0.44 feet and widen to 200 feet, raise dam crest approximately 1.5 feet

Structure Damages

The maximum water depths and flow velocities were imported into ArcMap directly from the HEC-RAS 2D hydraulic model for each alternative and frequency event. The water depths and flow velocities are then identified at the locations of interest (e.g., bridges, culverts, houses, structures, etc.) using Google Earth web imagery. This process is possible due to HEC-RAS 2D capabilities to generate georeferenced shapefiles.

The values obtained at the desired locations are then used in conjunction with the stage/velocity damage curves associated to each kind of structure.

Structure Occupancy Types

Sixty-one structures were identified within the project area and categorized using aerial photography, street level imagery, and data from the Ellis County appraisal district. The project area was determined as the combination of the 500-year and breach inundation areas, clipped where the breach water surface elevation falls below the 500-year water surface elevation. Twenty-six of these structures are residential houses, four are mobile homes, seven are commercial buildings, and forty are barns. The floor elevations of the structures were assigned based on the 2009 LiDAR data that was obtained through the TNRIS StratMap website (TNRIS, 2009).

For multiple structure types, stage-damage and associated uncertainty was based on guidance from the U.S. Army Corps of Engineers (USACE) Economic Guidance Memorandum (EGM) 04-01 (USACE 2003, 2006). This document includes damage to structures and contents. Figure D-7 shows the relationship between water depth and flood damage as percentage of the structure's total damageable value. The finished floor elevation (FFE) from which damage was computed was assumed to be equal to the mean terrain elevation at the structure footprint plus 6 inches. The content values for each structure were computed as 100% of the structure value for residential and commercial structures, based on NRCS guidance. The content values for barns/outbuildings was computed as 30% of the structure value. The damages to contents was computed based on unique depth-damage curves for contents, shown in Figure D-8.

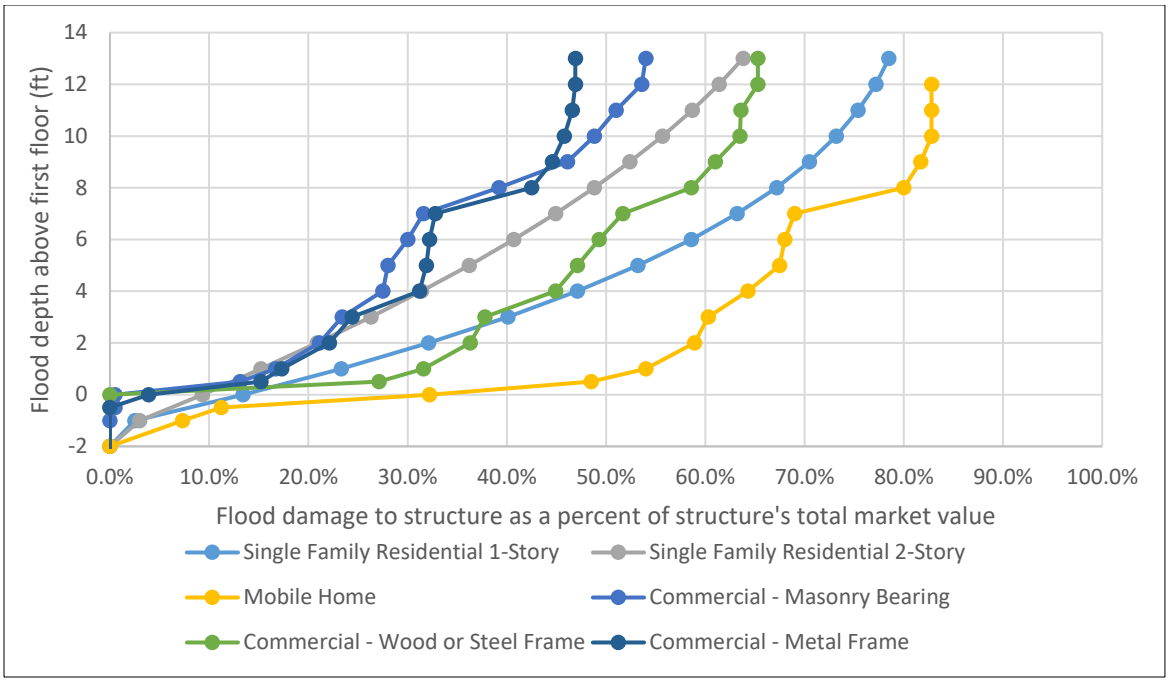

Figure D-7 Structure Depth-Damage Curves

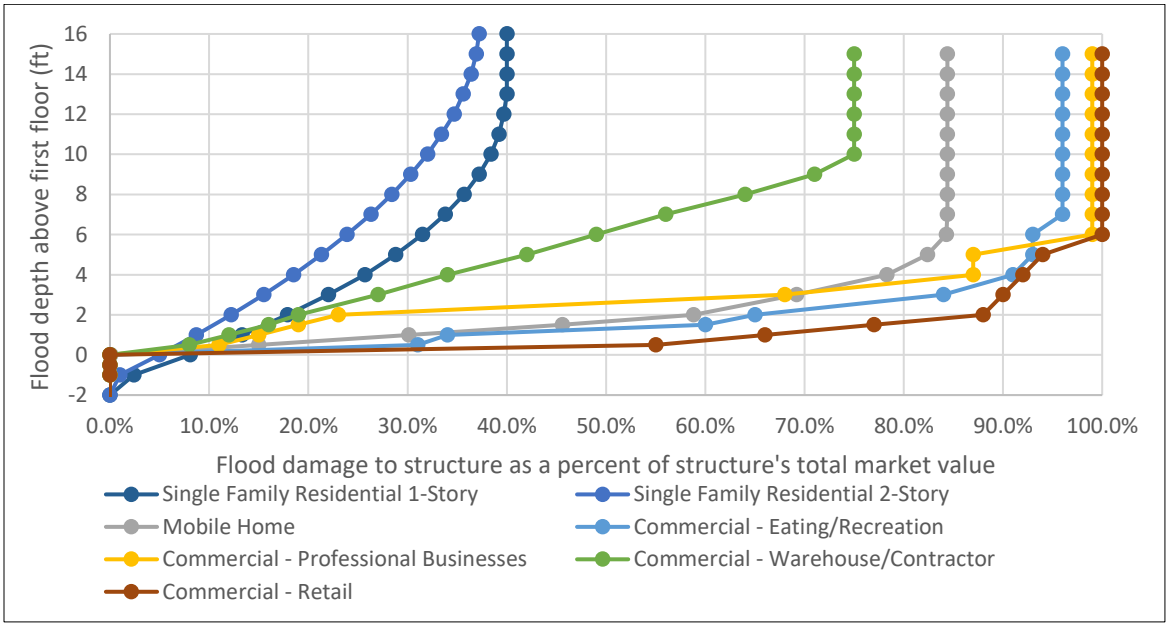

Figure D-8 Contents Depth-Damage Curves

<u>Structure Inventory</u>

Data from the Ellis County appraisal district was used to determine the 2021 market value of affected structures. Many barns/outbuildings did not have appraisal data available, and some had unrealistically low costs. The value of barns/outbuildings was assumed to be $30/SF based on online information about prefabricated structures. Some residential structures did not have appraisal data available. The value of these structures was estimated based on adjacent structures of the same type by computing their value per

square foot. The structures inventory is shown in Table D-29 and the damages for each structure in existing conditions are shown in Table D-30.

Table D-29 Impacted Properties within Project Area FRS No. 6

Structure Number	Appraised Value of Structure	Estimated Finished Floor Elevation	Occupancy Type
1	$16,487	630.98	Barn
2	$73,830	632.39	Commercial
3	$3,134	630.81	Barn
37	$65,537	650.01	Barn
48	$44,910	637.43	Single Family Residential
49	$62,305	645.04	Barn
50	$73,885	653.50	Barn
51	$38,116	650.14	Barn
52	$149,398	655.47	Single Family Residential
53	$54,844	639.53	Barn
54	$21,465	639.80	Barn
76	$45,691	639.06	Barn
77	$74,150	645.74	Mobile Home
86	$93,820	640.70	Single Family Residential
87	$53,485	641.61	Barn
88	$12,999	640.65	Barn
99	$17,100	643.78	Single Family Residential
100	$78,561	638.47	Barn
101	$317,590	639.14	Single Family Residential
132	$9,900	647.49	Barn
137	$180,670	637.56	Single Family Residential
138	$13,489	634.11	Barn
140	$4,500	612.19	Commercial

Table D-30 Impacted Properties Within Project Area FRS No. 6: Flood Damages in Existing Conditions by Frequency Event

Structure Number	Appraised Value of Structure	2-year	5-year	10-year	25-year	50-year	100-year	200-year	500-year
1	$16,487	$0	$0	$0	$0	$2,054	$2,164	$4,881	$5,199
2	$73,830	$0	$0	$0	$0	$0	$0	$24,916	$25,838
3	$3,134	$0	$0	$0	$0	$484	$503	$1,011	$1,067
37	$65,537	$0	$0	$0	$0	$0	$0	$0	$0
48	$44,910	$0	$0	$0	$0	$0	$0	$5,831	$6,829
49	$62,305	$0	$0	$0	$0	$0	$0	$0	$0
50	$73,885	$0	$0	$0	$0	$0	$0	$0	$0
51	$38,116	$0	$0	$0	$0	$0	$0	$0	$0
52	$149,398	$0	$0	$0	$0	$0	$0	$0	$0
53	$54,844	$0	$0	$0	$0	$6,671	$6,516	$14,286	$14,580
54	$21,465	$0	$0	$0	$0	$2,445	$2,372	$5,454	$5,569
76	$45,691	$5,893	$13,124	$17,355	$21,180	$23,214	$23,096	$26,743	$26,828
77	$74,150	$0	$0	$0	$0	$0	$0	$35,166	$36,414
86	$93,820	$8,747	$10,277	$10,992	$11,452	$11,554	$11,545	$11,462	$11,231
87	$53,485	$5,227	$6,317	$7,026	$7,353	$7,414	$7,440	$7,441	$7,406

Structure Number	Appraised Value of Structure	2-year	5-year	10-year	25-year	50-year	100-year	200-year	500-year
88	$12,999	$0	$0	$1,104	$1,428	$1,501	$1,558	$1,610	$1,651
99	$17,100	$0	$0	$0	$0	$0	$0	$0	$0
100	$78,561	$0	$0	$0	$0	$0	$0	$7,563	$8,698
101	$317,590	$0	$0	$0	$0	$19,815	$19,175	$59,693	$61,459
132	$9,900	$0	$0	$0	$0	$0	$0	$0	$0
137	$180,670	$0	$0	$0	$7,724	$10,539	$12,685	$15,132	$18,366
138	$13,489	$0	$0	$0	$1,891	$3,025	$3,090	$5,074	$5,291
140	$4,500	$0	$0	$0	$734	$880	$942	$1,072	$1,126

Stage-Damage Function

The flood damage for each structure is determined using the water depths obtained from HEC-RAS, the stage-damage relationship, and the structure market value. The flood damage to the structure as a percent of the total market value is determined from Figure 1, using the water depths obtained in HEC-RAS, then this percentage is multiplied by the structure's total damageable value and the result corresponds to the damage for a specific structure. This process is repeated for each of the frequency storm event in order to plot a damage-probability curve for each alternative. The damages for each frequency storm by alternative are shown in Table D-31. The integral of this curve is the annual damage to the structures for each alternative, shown in Table D-32.

Table D-31 Expected Frequency Storm Damages to Structures

Frequency Event	Existing	Decom.	Alt. 3	Alt. 4	Alt. 5
2-year	$164,638	$196,543	$165,233	$165,502	$165,501
5-year	$377,479	$417,986	$382,181	$384,378	$384,378
10-year	$584,802	$625,065	$587,891	$589,650	$589,647
25-year	$827,232	$948,424	$831,159	$833,535	$833,535
50-year	$1,068,249	$1,266,269	$1,078,343	$1,084,894	$1,084,894
100-year	$1,291,407	$1,478,555	$1,299,495	$1,306,925	$1,306,926
200-year	$1,978,429	$2,169,298	$1,987,528	$1,992,924	$1,992,924
500-year	$2,370,459	$5,312,356	$2,508,341	$2,601,302	$2,601,302

Table D-32 Expected Annual Damages to Structures by FRS No. 6

Existing	Decom.	Alt. 3	Alt. 4	Alt. 5
$216,704	$245,833	$218,528	$219,516	$219,516

Agricultural Damages

For the purpose of this study, agricultural damages include damages to crops and pastureland productivity due to inundation by floodwaters. Damages associated with agricultural production are included in the Erosion and Sedimentation category for damages to the value of the land itself.

Crop Damages

Seasonal Damage Factor

Since crops do not exist for 100 percent of a year, the damageable value must be adjusted down based on seasonal factors. The U.S. Department of Agriculture's National Agricultural Statistics Service (NASS) publishes typical planting and harvesting dates for various crops (USDA 1997). Crops were assumed to vary linearly from 0 percent damageable to 100 percent damageable between the planting start date and

harvesting start date; from 100 percent damageable to 0 percent damageable between harvest start date and harvest end date; and remain at 0 percent damageable between harvest end and planting start date. The seasonal damage factor is computed as the average annual damage factor (as a percent of total damageable crop value) of each crop type.

Inundation Damage Factor

Floodwater is not especially harmful to crops except when either flood depth, velocity, and/or duration are high. For this study, duration and velocity effects were neglected and only water depth was considered. Depth of flooding was separated into three categories: < 1 foot, between 1 and 3 feet, and > 3 feet. For each crop and depth category, a factor was assigned based on how much damage a crop would be expected to sustain. Data for these factors was used from examples in the Water Resources Economic Handbook (USDA 1988). A detailed study of agricultural inundation damage factors was deemed unwarranted due to the low expected magnitude of the damages.

Crop Yield and Market Value

The NASS publishes yields and prices for various crops by state and year [6]. Since these values have significant variability, the average yield and prices for the last three years (2017 to 2019) were used in the analysis. The crop prices were adjusted to real 2018 dollars prior to averaging. Prices were adjusted using the GDP implicit price deflator, which is a broad measure of the change of the value of money over long periods of time Damageable unit value for each crop is determined by multiplying yield by unit price and the two damage factors described above. Table D-33 shows the development of the damageable values for the crops in the project area.

Table D-33 Development of Damageable Values for Crops Affected by FRS No. 6

Crop	Corn	Cotton	Sorghum	Spring Wheat	Winter Wheat	Oats	Other Hay/Non-Alfalfa
Planting Starts	1-Mar	22-Mar	1-Mar	28-Mar	4-Sep	7-Sep	23-Feb
Harvesting Starts	18-Jul	10-Aug	25-Jun	23-Jul	25-May	13-May	1-May
Harvesting Ends	8-Nov	11-Jan	6-Dec	29-Sep	12-Jul	20-Jul	30-Sep
Seasonal Damage Factor	0.35	0.40	0.38	0.25	0.43	0.43	0.30
Inundation Damage Factor (≤ 1ft)	0.26	0.17	0.23	0.33	0.33	0.32	0.20
Inundation Damage Factor (1-3 ft)	0.35	0.41	0.36	0.50	0.50	0.50	0.23
Inundation Damage Factor (≥ 3 ft)	0.47	0.54	0.47	0.63	0.63	0.63	0.36
2019 Unit Price	3.56	0.614	3.34	4.66	4.53	2.82	135
2020 Unit Price	4.53	0.663	5.04	5.09	4.98	2.77	132
2021 Unit Price	5.45	0.814	5.46	8	6.8	4	147
2019 GDP Deflator	112.29	112.29	112.29	112.29	112.29	112.29	112.29
2020 GDP Deflator	113.65	113.65	113.65	113.65	113.65	113.65	113.65
2021 GDP Deflator	118.37	118.37	118.37	118.37	118.37	118.37	118.37
2019 Yield (unit/acre)	81	589	43.1	34	46	50	1.80
2020 Yield (unit/acre)	97	685	45.6	30	54	45	1.85
2021 Yield (unit/acre)	71	695	48.0	37	53	45	1.85
2019 Areal Unit Value (2021 dollars)	$303.97	$381.22	$151.61	$167.01	$217.27	$148.63	$256.15
2020 Areal Unit Value (2021 dollars)	$456.26	$473.03	$239.07	$159.05	$279.06	$129.83	$254.35
2021 Areal Unit Value (2021 dollars)	$385.86	$565.73	$262.04	$296.00	$357.68	$180.00	$271.95
Average Value per Acre (2021)	$382.03	$473.33	$217.57	$207.35	$284.67	$152.82	$260.82
Damageable Value per Acre (≤ 1ft)	$34.29	$32.52	$19.19	$17.34	$40.02	$21.24	$15.72
Damageable Value per Acre (1-3 ft)	$46.16	$78.42	$30.18	$26.27	$60.64	$33.18	$18.08

Damageable Value per Acre (≥ 3 ft)	$61.98	$103.29	$39.36	$33.11	$76.40	$41.81	$28.30

Determination of Damages

The NASS publishes the *Cropscape* GIS data layer of land use (USDA n.d.-b). HEC-RAS provides GIS shapefiles of areal inundation extents for each frequency flood event. These shapefiles were intersected with the *Cropscape* layer to aggregate the area inundated for each land use type, depth category, and plan for each frequency storm event. The total damage is determined by multiplying the inundated area in each depth category for each crop by its corresponding damageable unit value. The total damages for each frequency storm event are summed and plotted with probability. The integral of this curve is the expected annual damages to crops for each plan, which are shown in Table D-34.

Table D-34 Expected Annual Damages to Crops Affected by FRS No. 6

	Existing	No Dam	Alt. 3	Alt. 4	Alt. 5
Annual Damages	$584	$657	$591	$595	$595
Affected Cropland area (ac)	82	87	83	83	83

Pasture Damages

NASS publishes county-wide average pasture cash rental rates each year (USDA 2021). This is assumed to be the flood-free productive value of the land. NRCS developed generalized damage factors for pastureland grasses in a 1978 Technical Note (USDA 1978). Pastureland was assumed to be made up of Grassland and Shrubland cover types in the NASS Cropscape dataset.

The damage factors are expressed as a percentage of the flood-free yield and include seasonal changes and changes in actual damage to productive value based on depth. Using the same methodology and land use data as the crop damage analysis, inundated pastureland areas were aggregated for each depth category, frequency storm event, and plan. The total damages for each frequency storm event are summed and plotted with probability. The integral of this curve is the expected annual damages to pastureland productive value for each plan. Table D-35 and Table D-36 present the development of pastureland damageable values in the project area and the expected annual damages for each alternative, respectively.

Table D-35 Development of Pastureland Damageable Values

Damage factor (≤ 2 feet depth)	0.14
Damage factor (> 2 feet depth)	0.23
2021 Cash Rental Rate for Pasture	$11.00
Damageable Value per Acre (≤ 2ft)	$1.49
Damageable Value per Acre (> 2 ft)	$2.50

Table D-36 Expected Annual Damages to Pastureland Affected by FRS No. 6

	Existing	No Dam	Alt. 3	Alt. 4	Alt. 5
Annual Damages	$83	$93	$84	$85	$85
Affected Pastureland area (ac)	235	252	236	236	236

Bridge and Culvert Damages

There are fourteen bridges and twenty-four culverts in the project area. The Texas Department of Transportation (TxDOT) publishes average unit costs for bridge and culvert projects (TxDOT 2018). This data was last published in 2020, so these costs were adjusted to 2021 dollars using the ENR construction cost index. The area of each crossing was determined using aerial photography and LIDAR data. The

replacement cost of each bridge/culvert is assumed to be the deck area times the average unit price from TxDOT in 2021 dollars.

Bridges

Bridges were assumed to receive no damages at water elevations below the low chord of the bridge. Total loss of the bridge (full replacement required) was assumed to occur based on flow depth and velocity in accordance with guidance in an NRCS Technical Note for estimating floodwater damages to roads and bridges (TxDOT 2018). Velocity and peak stage data from HEC-RAS was used to determine the total loss stage. Percent damage was linearly interpolated between the low chord of the bridge and the total loss stage.

Many railroad bridges were present within the project area. A number of these bridges appeared to be primarily wooden based on aerial imagery; however, TxDOT does not provide an estimate for the cost of a wooden railroad bridge. It was assumed that, if damaged, these bridges would be replaced with steel girder railroad bridges, for which TxDOT provides an estimate of cost.

Culverts

According to a 1987 Federal Highway Administration report (USDA 1969), performance of culvert embankments during flooding is influenced by a number of factors that have not been determined as a part of this study, including fill material types, grain size distributions of embankment material, armoring and vegetative cover, and duration of overtopping. For this reason, and the fact that culvert damages are not anticipated to constitute a significant portion of the flood damage reduction benefits generated by improvements to the dam (based on engineering judgment and the damage estimates in the original watershed plan) a simplified model was developed to account for damages to the culvert embankments.

One culvert (#14 – Driveway) was identified to likely be a low water crossing, thus it would not be damaged in frequent events. The damage start station was adjusted to the 25-year water surface elevation, as the estimated annual damages (EAD) did not appear to be reasonable.

Damage was assumed to begin when the water surface elevation in the stream reached the top of the culvert embankment and progress linearly to complete failure of the embankment at six feet of overtopping depth. Table D-37 shows the expected damages to bridges and culverts in frequency events. Table D-38 summarizes the results obtained for the bridges and culverts analyzed in the project area.

Table D-37 Expected Frequency Storm Damages to Bridges and Culverts

Frequency Event	Existing	No Dam	Alt. 3	Alt. 4	Alt. 5
2-year	$0	$33,314	$0	$0	$0
5-year	$114,047	$150,966	$117,312	$119,023	$119,023
10-year	$310,967	$315,741	$310,967	$310,967	$310,967
25-year	$376,250	$461,712	$378,728	$380,258	$380,258
50-year	$524,019	$753,637	$538,122	$547,422	$547,422
100-year	$623,310	$874,876	$637,074	$646,257	$646,257
200-year	$1,511,027	$1,706,826	$1,524,766	$1,530,684	$1,531,507
500-year	$2,997,472	$3,181,986	$3,006,792	$3,011,472	$3,014,831

Table D-38 Expected Annual Damages to Bridges and Culverts

Category	Existing	No Dam	Alt. 3	Alt. 4	Alt. 5
Bridges	$2,531	$8,049	$2,568	$2,590	$2,593
Culvert	$83,281	$116,992	$84,380	$85,000	$85,006
Total	**$85,812**	**$125,041**	**$86,948**	**$87,590**	**$87,599**

Erosion and Sedimentation Damages

Erosion and sedimentation damages were not independently estimated for this study to maintain consistency with the original watershed plan. Estimates for erosion and sedimentation were included in the original work plan for the Chambers Creek Watershed [12]. These estimates were not separated by the individual flood control structures and have a price base of 1955. The following assumptions were used in order to include these damages in the economic analysis:

- Erosion and sedimentation damage estimates in the original work plan for the Chambers Creek watershed were assumed to be representative of the present conditions. Significant development has occurred in the study area but does not appear to have caused a significant change to the stream channels, except for the addition of some culverts and bridges. The stream channels downstream of Chambers Creek do not appear to be noticeably modified based on aerial imagery and historical USGS topographic maps. The upstream watershed contributing to Chambers Creek 6 has met some development; however, the sedimentation rate originally estimated in the watershed plan has proven to be a significant overestimate. Thus, the damage values were adjusted to reflect the decreased sedimentation rate. Land treatment measures included in the work plan were not included in the original flood damage reduction benefits.
- Erosion and sedimentation damages are generally proportional to watershed area.
- Erosion and sedimentation damages generally change in cost over time according to the US GDP implicit price deflator.
- The proposed plans would have generally no effect on erosion and sedimentation damages compared to the existing conditions between the 2-year and 500-year flood events. Damages for the proposed plans are assumed to be equal to those estimated for the existing structure under the original work plan.
- Erosion and sedimentation damages were included by taking the proportion of the damages from the original work plan for Chambers Creek Site 6 based on contribution to the total Chambers Creek Watershed and adjusting the prices to 2021 dollars using the GDP implicit price deflator.

Benefit-Cost Analysis

The flood damage reduction benefits are computed by subtracting the flood damages associated with each plan from the damages associated with the "future without federal investment" plan. Project costs were developed for each proposed plan and include construction costs, engineering, real property rights/acquisition, project administration, and annual operation and maintenance costs. All of these costs, except O&M, are capital costs and must be amortized in order to compare them to the annualized flood damage reduction benefits.

Federal agencies are required by the Water Resources Development Act of 1974 to use a specified discount rate in the formulation and evaluation of water and related land resource plans for the purpose of discounting future benefits and computing costs. The discount rate formula is established by Section 80 of the Act and is tied to yields on government securities with more than 15 years to maturity. This rate is computed annually and published by the Bureau of Reclamation (USDA n.d.-c). The FY 2021 discount rate is 2.5 percent. It was assumed that the project lifespan will be 100 years.

The final portion of the economic analysis is a comparison between the costs and benefits for the proposed plan. The benefit-cost ratio (BCR) is the total annualized benefits divided by the total annualized costs.

The following tables show the results of the economic analysis. Table D-39 summarizes the flood damage reduction benefits of each alternative, Table D-40 summarizes the costs of each alternative, and Table D-41 presents the benefit-cost analysis for each alternative. Of the three structural rehabilitation options, Alternative 3 had the greatest cost-benefit ratio.

Table D-39 Flood damages and Damage Reduction Benefits for FRS No. 6[1]

	Expected Annual Damages					Damage Reduction Benefits			
Damage Category	**FWOFI[2] Alt 1**	**Decom. Alt2**	**Alt. 3**	**Alt. 4**	**Alt. 5**	**Decom. Alt2**	**Alt. 3**	**Alt. 4**	**Alt. 5**
Structures	$245,830	$245,830	$218,530	$219,520	$219,520	$0	$27,310	$26,320	$26,320
Crops	$660	$660	$590	$600	$600	$0	$70	$60	$60
Pastureland	$90	$90	$80	$90	$90	$0	$10	$10	$10
Roads and Bridges	$125,040	$125,040	$86,950	$87,590	$87,600	$0	$38,090	$37,450	$37,440
Erosion and Sedimentation	$1,190	$1,190	$170	$170	$170	$0	$1,020	$1,020	$1,020
Total	**$372,810**	**$372,810**	**$306,320**	**$307,960**	**$307,970**	**$0**	**$66,490**	**$64,850**	**$64,840**

[1]All number were rounded to the nearest ten.
[2]FWOFI represents no-dam conditions used as economic baseline.

Table D-40 Project Costs for FRS No. 6[1]

Cost Category	**FWOFI Alt 1**	**Decom. Alt 2**	**Alternative 3**	**Alternative 4**	**Alternative 5**
Capital Costs	-	$2,939,800	$3,608,800	$6,958,900	$3,667,900
O&M	-	$2,500	$8,850	$9,600	$8,850
Discount Rate	2.50%	2.50%	2.50%	2.50%	2.50%
Project Lifespan (years)	-	100	100	100	100
Total Annual Costs	**-**	**$82,790**	**$107,410**	**$199,660**	**$109,030**

[1]All number were rounded to the nearest ten.
[2]As described in Table D-28, FWOFI does not have a capital investment cost associated to it.

Table D-41 Benefit-Cost Calculations for FRS No. 6[3]

	Decom. Alt 2	**Alternative 3**	**Alternative 4**	**Alternative 5**
Flood Damage Reduction Benefits[1]	$0	$66,500	$64,900	$64,800
Total Benefits	$0	$66,500	$64,900	$64,800
Annual Costs[2]	$82,800	$107,400	$199,700	$109,000
Benefit-Cost Ratio	**0.00**	**0.62**	**0.32**	**0.59**
Net NEE Benefits	**($82,800)**	**($40,900)**	**($134,800)**	**($44,200)**

[1]From Table D-39
[2]From Table D-40
[3]All number were rounded to the nearest hundred. [4]FWOFI is not included in this table since it is the baseline to compute the benefit-cost analysis

United States Department of the Interior

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In Reply Refer To: March 14, 2022
Project Code: 2022-0019296
Project Name: Chambers Creek Dams #4 & #6

Subject: List of threatened and endangered species that may occur in your proposed project location or may be affected by your proposed project

To Whom It May Concern:

The enclosed species list identifies threatened, endangered, proposed, and candidate species, as well as proposed and final designated critical habitat, which may occur within the boundary of your proposed project. The species list fulfills the requirements of the U.S. Fish and Wildlife Service (Service) under section 7(c) of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 et seq.).

The purpose of the Act is to provide a means whereby threatened and endangered species and the ecosystems upon which they depend may be conserved. Under section 7(a)(1) of the Act, Federal agencies are directed to utilize their authorities to carry out programs for the conservation of threatened and endangered species. Under and 7(a)(2) and its implementing regulations (50 CFR 402 et seq.), Federal agencies are required to determine whether their actions may affect threatened and endangered species and/or designated critical habitat. A Federal action is an activity or program authorized, funded, or carried out, in whole or in part, by a Federal agency (50 CFR 402.02).

A Biological Assessment is required for construction projects (or other undertakings having similar physical impacts) that are major Federal actions significantly affecting the quality of the human environment as defined in the National Environmental Policy Act (42 U.S.C. 4332(2) (c)). For Federal actions other than major construction activities, the Service suggests that a biological evaluation (similar to a Biological Assessment) be prepared to determine whether the project may affect listed or proposed species and/or designated or proposed critical habitat. Recommended contents of a Biological Assessment are described at 50 CFR 402.12.

After evaluating the potential effects of a proposed action on federally listed species, one of the following determinations should be made by the Federal agency:

1. *No effect* - the appropriate determination when a project, as proposed, is anticipated to have no effects to listed species or critical habitat. A "no effect" determination does not require section 7 consultation and no coordination or contact with the Service is necessary. However, the action agency should maintain a complete record of their evaluation, including the steps leading to the determination of affect, the qualified personnel conducting the evaluation, habitat conditions, site photographs, and any other related information.
2. *May affect, but is not likely to adversely affect* - the appropriate determination when a proposed action's anticipated effects to listed species or critical habitat are insignificant, discountable, or completely beneficial. Insignificant effects relate to the size of the impact and should never reach the scale where "take" of a listed species occurs. Discountable effects are those extremely unlikely to occur. Based on best judgment, a person would not be able to meaningfully measure, detect, or evaluate insignificant effects, or expect discountable effects to occur. This determination requires written concurrence from the Service. A biological evaluation or other supporting information justifying this determination should be submitted with a request for written concurrence.
3. *May affect, is likely to adversely affect* - the appropriate determination if any adverse effect to listed species or critical habitat may occur as a consequence of the proposed action, and the effect is not discountable or insignificant. This determination requires formal section 7 consultation.

The Service has performed up-front analysis for certain project types and species in your project area. These analyses have been compiled into *determination keys*, which allows an action agency, or its designated non-federal representative, to initiate a streamlined process for determining a proposed project's potential effects on federally listed species. The determination keys can be accessed through

IPaC.

The Service recommends that candidate species, proposed species, and proposed critical habitat be addressed should consultation be necessary. More information on the regulations and procedures for section 7 consultation, including the role of permit or license applicants, can be found in the "Endangered Species Consultation Handbook" at: http://www.fws.gov/endangered/esa-library/pdf/TOC-GLOS.PDF

New information based on updated surveys, changes in the abundance and distribution of species, changed habitat conditions, or other factors could change this list. Please feel free to contact us if you need more current information or assistance regarding the potential impacts to federally proposed, listed, and candidate species and federally designated and proposed critical habitat. Please note that under 50 CFR 402.12(e) of the regulations implementing section 7 of the Act, the accuracy of this species list should be verified after 90 days. This verification can be completed formally or informally as desired. The Service recommends that verification be completed by visiting the IPaC website at regular intervals during project planning and implementation for updates to species lists and information. An updated list may be requested through the IPaC system by completing the same process used to receive the enclosed list.

Please be aware that bald and golden eagles are protected under the Bald and Golden Eagle Protection Act (16 U.S.C. 668 et seq.), and projects affecting these species may require development of an eagle conservation plan (https://www.fws.gov/birds/management/managed-species/eagle-management.php). Additionally, wind energy projects should follow the wind energy guidelines (http://www.fws.gov/windenergy/) for minimizing impacts to migratory birds and bats.

Guidance for minimizing impacts to migratory birds for projects including communications towers (e.g., cellular, digital television, radio, and emergency broadcast) can be found at: https://www.fws.gov/birds/bird-enthusiasts/threats-to-birds/collisions/communication-towers.php.
For additional information concerning migratory birds and eagle conservation plans, please contact the Service's Migratory Bird Office at 505-248-7882.

We appreciate your concern for threatened and endangered species. The Service encourages Federal agencies to include conservation of threatened and endangered species into their project planning to further the purposes of the Act. Please include the Consultation Tracking Number in the header of this letter with any request for consultation or correspondence about your project that you submit to our office.

Attachment(s):

- Official Species List
- USFWS National Wildlife Refuges and Fish Hatcheries
- Migratory Birds
- Wetlands

Official Species List

This list is provided pursuant to Section 7 of the Endangered Species Act, and fulfills the requirement for Federal agencies to "request of the Secretary of the Interior information whether any species which is listed or proposed to be listed may be present in the area of a proposed action".

This species list is provided by:

Arlington Ecological Services Field Office
2005 Ne Green Oaks Blvd
Suite 140
Arlington, TX 76006-6247
(817) 277-1100

Project Summary

Project Code: 2022-0019296
Event Code: None
Project Name: Chambers Creek Dams #4 & #6
Project Type: Dam - Maintenance/Modification
Project Description: NRCS dam rehabilitation
Project Location:

Approximate location of the project can be viewed in Google Maps: https://www.google.com/maps/@32.473538649999995,-96.99002099907082,14z

Counties: Ellis County, Texas

Endangered Species Act Species

There is a total of 5 threatened, endangered, or candidate species on this species list.

Species on this list should be considered in an effects analysis for your project and could include species that exist in another geographic area. For example, certain fish may appear on the species list because a project could affect downstream species. Note that 2 of these species should be considered only under certain conditions.

IPaC does not display listed species or critical habitats under the sole jurisdiction of NOAA Fisheries[1], as USFWS does not have the authority to speak on behalf of NOAA and the Department of Commerce.

See the "Critical habitats" section below for those critical habitats that lie wholly or partially within your project area under this office's jurisdiction. Please contact the designated FWS office if you have questions.

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1. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

Birds

NAME	STATUS
Piping Plover *Charadrius melodus* Population: [Atlantic Coast and Northern Great Plains populations] - Wherever found, except those areas where listed as endangered. There is **final** critical habitat for this species. The location of the critical habitat is not available. This species only needs to be considered under the following conditions: ▪ Wind Energy Projects Species profile: https://ecos.fws.gov/ecp/species/6039	Threatened
Red Knot *Calidris canutus rufa* There is **proposed** critical habitat for this species. The location of the critical habitat is not available. This species only needs to be considered under the following conditions: ▪ Wind Energy Projects Species profile: https://ecos.fws.gov/ecp/species/1864	Threatened
Whooping Crane *Grus americana* Population: Wherever found, except where listed as an experimental population There is **final** critical habitat for this species. The location of the critical habitat is not available. Species profile: https://ecos.fws.gov/ecp/species/758	Endangered

Clams

NAME	STATUS
Texas Fawnsfoot *Truncilla macrodon* There is **proposed** critical habitat for this species. The location of the critical habitat is not available. Species profile: https://ecos.fws.gov/ecp/species/8965	Proposed Threatened

Insects

NAME	STATUS
Monarch Butterfly *Danaus plexippus* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/9743	Candidate

Critical habitats

THERE ARE NO CRITICAL HABITATS WITHIN YOUR PROJECT AREA UNDER THIS OFFICE'S JURISDICTION.

USFWS National Wildlife Refuge Lands And Fish Hatcheries

Any activity proposed on lands managed by the National Wildlife Refuge system must undergo a 'Compatibility Determination' conducted by the Refuge. Please contact the individual Refuges to discuss any questions or concerns.

THERE ARE NO REFUGE LANDS OR FISH HATCHERIES WITHIN YOUR PROJECT AREA.

Migratory Birds

Certain birds are protected under the Migratory Bird Treaty Act[1] and the Bald and Golden Eagle Protection Act[2].

Any person or organization who plans or conducts activities that may result in impacts to migratory birds, eagles, and their habitats should follow appropriate regulations and consider implementing appropriate conservation measures, as described below.

---

1. The Migratory Birds Treaty Act of 1918.
2. The Bald and Golden Eagle Protection Act of 1940.
3. 50 C.F.R. Sec. 10.12 and 16 U.S.C. Sec. 668(a)

The birds listed below are birds of particular concern either because they occur on the USFWS Birds of Conservation Concern (BCC) list or warrant special attention in your project location. To learn more about the levels of concern for birds on your list and how this list is generated, see the FAQ below. This is not a list of every bird you may find in this location, nor a guarantee that every bird on this list will be found in your project area. To see exact locations of where birders and the general public have sighted birds in and around your project area, visit the E-bird data mapping tool (Tip: enter your location, desired date range and a species on your list). For projects that occur off the Atlantic Coast, additional maps and models detailing the relative occurrence and abundance of bird species on your list are available. Links to additional information about Atlantic Coast birds, and other important information about your migratory bird list, including how to properly interpret and use your migratory bird report, can be found below.

For guidance on when to schedule activities or implement avoidance and minimization measures to reduce impacts to migratory birds on your list, click on the PROBABILITY OF PRESENCE SUMMARY at the top of your list to see when these birds are most likely to be present and breeding in your project area.

NAME	BREEDING SEASON
Bald Eagle *Haliaeetus leucocephalus* This is not a Bird of Conservation Concern (BCC) in this area, but warrants attention because of the Eagle Act or for potential susceptibilities in offshore areas from certain types of development or activities. https://ecos.fws.gov/ecp/species/1626	Breeds Sep 1 to Jul 31
Lesser Yellowlegs *Tringa flavipes* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska. https://ecos.fws.gov/ecp/species/9679	Breeds elsewhere

NAME	BREEDING SEASON
Red-headed Woodpecker *Melanerpes erythrocephalus* This is a Bird of Conservation Concern (BCC) throughout its range in the continental USA and Alaska.	Breeds May 10 to Sep 10

Probability Of Presence Summary

The graphs below provide our best understanding of when birds of concern are most likely to be present in your project area. This information can be used to tailor and schedule your project activities to avoid or minimize impacts to birds. Please make sure you read and understand the FAQ "Proper Interpretation and Use of Your Migratory Bird Report" before using or attempting to interpret this report.

Probability of Presence (■)

Each green bar represents the bird's relative probability of presence in the 10km grid cell(s) your project overlaps during a particular week of the year. (A year is represented as 12 4-week months.) A taller bar indicates a higher probability of species presence. The survey effort (see below) can be used to establish a level of confidence in the presence score. One can have higher confidence in the presence score if the corresponding survey effort is also high.

How is the probability of presence score calculated? The calculation is done in three steps:

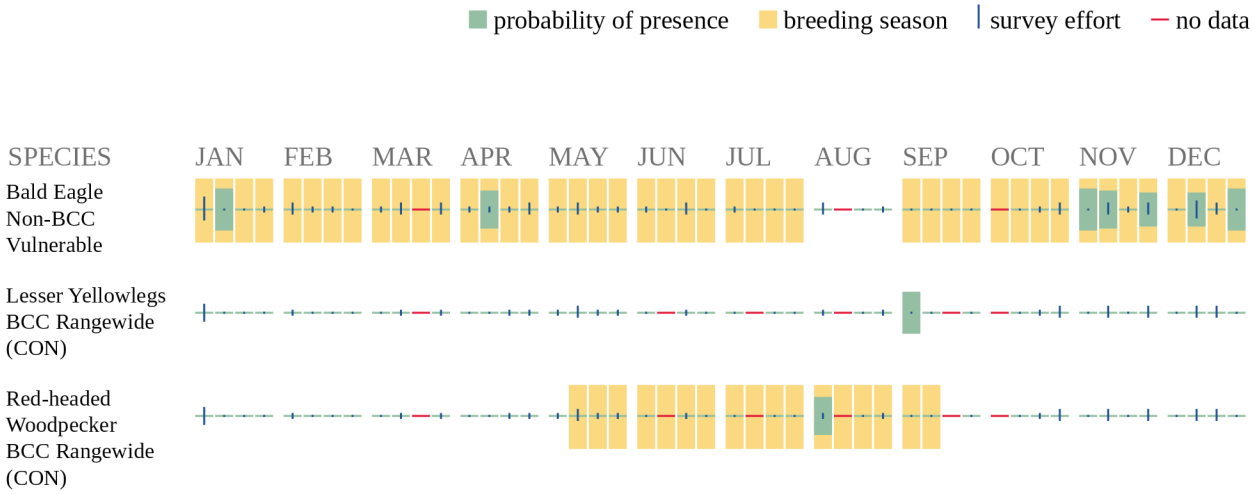
1. The probability of presence for each week is calculated as the number of survey events in the week where the species was detected divided by the total number of survey events for that week. For example, if in week 12 there were 20 survey events and the Spotted Towhee was found in 5 of them, the probability of presence of the Spotted Towhee in week 12 is 0.25.
2. To properly present the pattern of presence across the year, the relative probability of presence is calculated. This is the probability of presence divided by the maximum probability of presence across all weeks. For example, imagine the probability of presence in week 20 for the Spotted Towhee is 0.05, and that the probability of presence at week 12 (0.25) is the maximum of any week of the year. The relative probability of presence on week 12 is 0.25/0.25 = 1; at week 20 it is 0.05/0.25 = 0.2.
3. The relative probability of presence calculated in the previous step undergoes a statistical conversion so that all possible values fall between 0 and 10, inclusive. This is the probability of presence score.

Breeding Season (■)
Yellow bars denote a very liberal estimate of the time-frame inside which the bird breeds across its entire range. If there are no yellow bars shown for a bird, it does not breed in your project area.

Survey Effort (|)
Vertical black lines superimposed on probability of presence bars indicate the number of surveys performed for that species in the 10km grid cell(s) your project area overlaps. The number of surveys is expressed as a range, for example, 33 to 64 surveys.

No Data (–)
A week is marked as having no data if there were no survey events for that week.

Survey Timeframe
Surveys from only the last 10 years are used in order to ensure delivery of currently relevant information. The exception to this is areas off the Atlantic coast, where bird returns are based on all years of available data, since data in these areas is currently much more sparse.



Additional information can be found using the following links:

- Birds of Conservation Concern http://www.fws.gov/birds/management/managed-species/birds-of-conservation-concern.php
- Measures for avoiding and minimizing impacts to birds http://www.fws.gov/birds/management/project-assessment-tools-and-guidance/conservation-measures.php
- Nationwide conservation measures for birds http://www.fws.gov/migratorybirds/pdf/management/nationwidestandardconservationmeasures.pdf

Migratory Birds FAQ

Tell me more about conservation measures I can implement to avoid or minimize impacts to migratory birds.
Nationwide Conservation Measures describes measures that can help avoid and minimize impacts to all birds at any location year round. Implementation of these measures is particularly important when birds are most likely to occur in the project area. When birds may be breeding in the area, identifying the locations of any active nests and avoiding their destruction is a very helpful impact minimization measure. To see when birds are most likely to occur and be breeding in your project area, view the Probability of Presence Summary. Additional measures or permits may be advisable depending on the type of activity you are conducting and the type of infrastructure or bird species present on your project site.

What does IPaC use to generate the migratory birds potentially occurring in my specified location?
The Migratory Bird Resource List is comprised of USFWS Birds of Conservation Concern (BCC) and other species that may warrant special attention in your project location.

The migratory bird list generated for your project is derived from data provided by the Avian Knowledge Network (AKN). The AKN data is based on a growing collection of survey, banding, and citizen science datasets and is queried and filtered to return a list of those birds reported as occurring in the 10km grid cell(s) which your project intersects, and that have been identified as warranting special attention because they are a BCC species in that area, an eagle (Eagle Act requirements may apply), or a species that has a particular vulnerability to offshore activities or development.

Again, the Migratory Bird Resource list includes only a subset of birds that may occur in your project area. It is not representative of all birds that may occur in your project area. To get a list of all birds potentially present in your project area, please visit the AKN Phenology Tool.

What does IPaC use to generate the probability of presence graphs for the migratory birds potentially occurring in my specified location?
The probability of presence graphs associated with your migratory bird list are based on data provided by the Avian Knowledge Network (AKN). This data is derived from a growing collection of survey, banding, and citizen science datasets .

Probability of presence data is continuously being updated as new and better information becomes available. To learn more about how the probability of presence graphs are produced and how to interpret them, go the Probability of Presence Summary and then click on the "Tell me about these graphs" link.

How do I know if a bird is breeding, wintering, migrating or present year-round in my project area?
To see what part of a particular bird's range your project area falls within (i.e. breeding, wintering, migrating or year-round), you may refer to the following resources: The Cornell Lab of Ornithology All About Birds Bird Guide, or (if you are unsuccessful in locating the bird of interest there), the Cornell Lab of Ornithology Neotropical Birds guide. If a bird on your migratory bird species list has a breeding season associated with it, if that bird does occur in your project area, there may be nests present at some point within the timeframe specified. If "Breeds elsewhere" is indicated, then the bird likely does not breed in your project area.

What are the levels of concern for migratory birds?
Migratory birds delivered through IPaC fall into the following distinct categories of concern:

1. "BCC Rangewide" birds are Birds of Conservation Concern (BCC) that are of concern throughout their range anywhere within the USA (including Hawaii, the Pacific Islands, Puerto Rico, and the Virgin Islands);
2. "BCC - BCR" birds are BCCs that are of concern only in particular Bird Conservation Regions (BCRs) in the continental USA; and

3. "Non-BCC - Vulnerable" birds are not BCC species in your project area, but appear on your list either because of the Eagle Act requirements (for eagles) or (for non-eagles) potential susceptibilities in offshore areas from certain types of development or activities (e.g. offshore energy development or longline fishing).

Although it is important to try to avoid and minimize impacts to all birds, efforts should be made, in particular, to avoid and minimize impacts to the birds on this list, especially eagles and BCC species of rangewide concern. For more information on conservation measures you can implement to help avoid and minimize migratory bird impacts and requirements for eagles, please see the FAQs for these topics.

Details about birds that are potentially affected by offshore projects
For additional details about the relative occurrence and abundance of both individual bird species and groups of bird species within your project area off the Atlantic Coast, please visit the Northeast Ocean Data Portal. The Portal also offers data and information about other taxa besides birds that may be helpful to you in your project review. Alternately, you may download the bird model results files underlying the portal maps through the NOAA NCCOS Integrative Statistical Modeling and Predictive Mapping of Marine Bird Distributions and Abundance on the Atlantic Outer Continental Shelf project webpage.

Bird tracking data can also provide additional details about occurrence and habitat use throughout the year, including migration. Models relying on survey data may not include this information. For additional information on marine bird tracking data, see the Diving Bird Study and the nanotag studies or contact Caleb Spiegel or Pam Loring.

What if I have eagles on my list?
If your project has the potential to disturb or kill eagles, you may need to obtain a permit to avoid violating the Eagle Act should such impacts occur.

Proper Interpretation and Use of Your Migratory Bird Report
The migratory bird list generated is not a list of all birds in your project area, only a subset of birds of priority concern. To learn more about how your list is generated, and see options for identifying what other birds may be in your project area, please see the FAQ "What does IPaC use to generate the migratory birds potentially occurring in my specified location". Please be aware this report provides the "probability of presence" of birds within the 10 km grid cell(s) that overlap your project; not your exact project footprint. On the graphs provided, please also look carefully at the survey effort (indicated by the black vertical bar) and for the existence of the "no data" indicator (a red horizontal bar). A high survey effort is the key component. If the survey effort is high, then the probability of presence score can be viewed as more dependable. In contrast, a low survey effort bar or no data bar means a lack of data and, therefore, a lack of certainty about presence of the species. This list is not perfect; it is simply a starting point for identifying what birds of concern have the potential to be in your project area, when they might be there, and if they might be breeding (which means nests might be present). The list helps you know what to look for to confirm presence, and helps guide you in knowing when to implement conservation measures to avoid or minimize potential impacts from your project activities, should presence be confirmed. To learn more about conservation measures, visit the FAQ "Tell

me about conservation measures I can implement to avoid or minimize impacts to migratory birds" at the bottom of your migratory bird trust resources page.

Wetlands

Impacts to NWI wetlands and other aquatic habitats may be subject to regulation under Section 404 of the Clean Water Act, or other State/Federal statutes.

For more information please contact the Regulatory Program of the local U.S. Army Corps of Engineers District.

Please note that the NWI data being shown may be out of date. We are currently working to update our NWI data set. We recommend you verify these results with a site visit to determine the actual extent of wetlands on site.

Due to your project's size, the list below may be incomplete, or the acreages reported may be inaccurate. For a full list, please contact the local U.S. Fish and Wildlife office or visit https://www.fws.gov/wetlands/data/mapper.HTML

FRESHWATER EMERGENT WETLAND

- PEM1A
- PEM1Fh
- PEM1F
- PEM1Ax
- PEM1Ch
- PEM1C
- PEM1Ah

RIVERINE

- R4SBC
- R4SBA
- R2UBH
- R5UBH

FRESHWATER POND

- PUBH
- PUBHh
- PUSCx
- PUBFh
- PUSCh
- PUBFx
- PUSAh
- PAB4Hh
- PUSC
- PUBHx

FRESHWATER FORESTED/SHRUB WETLAND

- PSS1/EM1A
- PFO1A
- PSS1C
- PFO1Ah
- PFO1Ch
- PFO1C
- PFO1/EM1Ch
- PSS1Ch

LAKE

- L1UBHx
- L1UBHh
- L2USAh

IPaC User Contact Information

Agency:	Natural Resources Conservation Svc
Name:	Tam Tran
Address:	10431 Morado Circle
Address Line 2:	Suite 300
City:	Austin
State:	TX
Zip:	78759
Email	tamhtran88@gmail.com
Phone:	5123811830

Lead Agency Contact Information

Lead Agency: Natural Resources Conservation Svc

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Arlington Ecological Services Field Office
2005 Ne Green Oaks Blvd
Suite 140
Arlington, TX 76006-6247
Phone: (817) 277-1100 Fax: (817) 277-1129
http://www.fws.gov/southwest/es/arlingtontexas/
http://www.fws.gov/southwest/es/EndangeredSpecies/lists/

In Reply Refer To: March 14, 2022
Project code: 2022-0019296
Project Name: Chambers Creek Dams #4 & #6

Subject: Consistency letter for 'Chambers Creek Dams #4 & #6' for specified federally threatened and endangered species and designated critical habitat that may occur in your proposed project area consistent with the Arlington Ecological Services Field Office (ESFO) Determination Key (DKey) for project review and guidance for federally listed species.

Tam Tran:

The U.S. Fish and Wildlife Service (Service) received on **March 14, 2022** your effects determination for the 'Chambers Creek Dams #4 & #6' (the Action) using the Arlington ESFO DKey for project review and guidance for federally-listed species within the Information for Planning and Consultation (IPaC) system. The Service developed this system in accordance with the Endangered Species Act of 1973 (ESA) (87 Stat. 884, as amended; 16 U.S.C. 1531 et seq.).

Based on your answers and the assistance of the Service's Arlington ESFO DKey, you determined the proposed Action will have "No Effect" on the following species:

Species	**Listing Status**	**Determination**
Piping Plover (*Charadrius melodus*)	Threatened	No effect
Red Knot (*Calidris canutus rufa*)	Threatened	No effect
Whooping Crane (*Grus americana*)	Endangered	No effect

Consultation Status

Thank you for informing the Service of your "No Effect" determinations for this project. No further consultation/coordination for this project is required for these species.

This letter only covers the listed species in the above table. The following candidate species that may also occur in the Action area:

- Monarch Butterfly *Danaus plexippus* Candidate
- Texas Fawnsfoot *Truncilla macrodon* Proposed Threatened

Candidate species are not afforded protection under the ESA; however, we recommend they be considered in project planning and that conservation measures be implemented to avoid or minimize impacts to individuals or their habitat as much as possible.

The Service recommends that your agency contact the Arlington ESFO or re-evaluate the Action in IPaC if: 1) the scope, timing, duration, or location of the Action changes, 2) new information reveals the Action may affect listed species or designated critical habitat, or 3) a new species is listed or critical habitat designated. If any of the above conditions occurs, additional consultation with the Arlington ESFO should take place before project changes are final or resources committed.

At Risk Species: The Service's responsibilities under the ESA include evaluating species that have been petitioned to be listed or are candidates for listing under the ESA. These "at risk" species are not afforded protection under the ESA; however, we continue to collect information on their status and potential threats in order to assess their biological status and address requirements under the ESA. For these reasons, we request any information on the status of these species (e.g., surveys) be provided to the Arlington ESFO for consideration. This may also include any conservation measures implemented to avoid or reduce impacts to these species as a result of proposed actions. The proposed project falls within the range of the following at risk species:

Texas heelsplitter (https://ecos.fws.gov/ecp0/profile/speciesProfile?spcode=F02K)
Texas fawnsfoot (https://ecos.fws.gov/ecp0/profile/speciesProfile?spcode=F04E)
Western chicken turtle (https://ecos.fws.gov/ecp0/profile/speciesProfile?sId=9903)

Bald and Golden Eagle Protection Act(BGEPA): The following resources are provided to project proponents and consulting agencies as additional information. Bald and golden eagles are not included in this section 7(a)(2) consultation and this information does not constitute a determination of effects by the Service.

The Service developed the National Bald Eagle Management Guidelines to advise landowners, land managers, and others who share public and private lands with bald eagles when and under what circumstances the protective provisions of the BGEPA may apply to their activities. The guidelines should be consulted prior to conducting new or intermittent activity near an eagle nest. This document may be downloaded from the following site: https://www.fws.gov/migratorybirds/pdf/management/nationalbaldeaglenanagementguidelines.pdf

If the recommendations detailed in the National Bald Eagle Management Guidelines cannot be followed, you may apply for a permit to authorize removal or relocation of an eagle nest in certain instances. The application form is located at http://www.fws.gov/forms/3-200-72.pdf.

Please note this guidance does not authorize bird mortality for species that are protected under the Migratory Bird Treaty Act of 1918, as amended (16 U.S.C. sec. 703-712). If you believe migratory birds will be affected by this activity, we recommend you contact our Migratory Bird Permit Office at P.O. Box 709, Albuquerque, NM 87103, (505) 248-7882.

Action Description
You provided to IPaC the following name and description for the subject Action.

1. Name

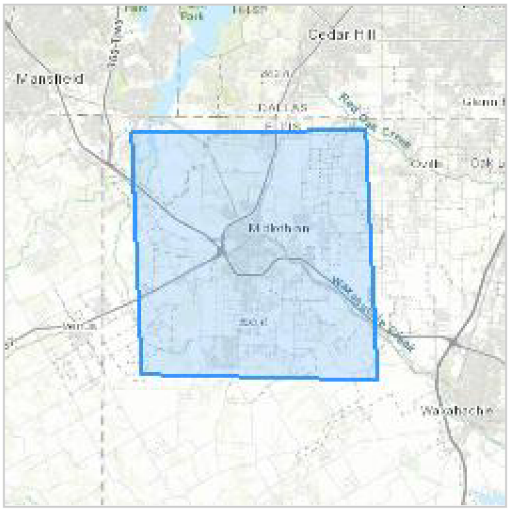
Chambers Creek Dams #4 & #6

2. Description

The following description was provided for the project 'Chambers Creek Dams #4 & #6':

NRCS dam rehabilitation

Approximate location of the project can be viewed in Google Maps: https://www.google.com/maps/@32.473538649999995,-96.99002099907082,14z



Qualification Interview

1. Does the proposed project involve research or other actions that include the collection, capture, handling, or harassment of any individual federally listed threatened, endangered or proposed species?

   No

2. Is the action authorized, funded, or being carried out by a Federal agency?

   Yes

3. Are you the Federal agency or designated non-federal representative?

   Yes

4. Is this a wind energy project ?

   No

5. Is this a solar energy project ?

   No

6. [Semantic] Does the project intersect the piping plover AOI?

   Automatically answered
   Yes

7. [Semantic] Does the project intersect the red knot AOI?

   Automatically answered
   Yes

8. [Semantic] Does the project intersect the whooping crane AOI?

   Automatically answered
   Yes

9. Does the action area have habitat that may be used by whooping cranes during spring and fall migrations (Mar 19- Apr 30, Oct 20 – Nov 24)?

   Note: Note: Whooping crane habitat includes croplands and grasslands interspersed with wetlands such as lakes, ponds and rivers. The portion of water bodies used by whooping cranes tend to be shallow (up to 20 inches in depth). More information on stopover habitat can be found here: https://pubs.er.usgs.gov/publication/70202378.

   No

10. [Semantic] Does the project intersect the black-capped vireo range?

    Automatically answered
    No

11. [Semantic] Does the project intersect the Texas kangaroo rat range?

    Automatically answered
    No

12. [Semantic] Does the project intersect the lesser prairie-chicken range?

    Automatically answered
    No

13. [Semantic] Does the project intersect the alligator snapping turtle range?

    Automatically answered
    No
14. [Semantic] Does the project intersect the Texas screwstem range?

    Automatically answered
    No
15. [Semantic] Does the project intersect the peppered chub range?

    Automatically answered
    No
16. [Semantic] Does the project intersect the Texas heelsplitter range?

    Automatically answered
    Yes
17. [Semantic] Does the project intersect the Louisiana pigtoe range?

    Automatically answered
    No
18. [Semantic] Does the project intersect the Texas fawnsfoot range?

    Automatically answered
    Yes
19. [Semantic] Does the project intersect the western chicken turtle range?

    Automatically answered
    Yes

IPaC User Contact Information

Agency:	Natural Resources Conservation Svc
Name:	Tam Tran
Address:	10431 Morado Circle
Address Line 2:	Suite 300
City:	Austin
State:	TX
Zip:	78759
Email	tamhtran88@gmail.com
Phone:	5123811830

Lead Agency Contact Information

Lead Agency: Natural Resources Conservation Svc

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Carter P. Smith
Executive Director

March 2, 2022

Ms. Kelsey Calvez
Freese and Nichols, Inc.
10431 Morado Circle
Bldg 5, Suite 300
Austin, TX 78759

RE: Draft Environmental Assessment for Rehabilitation of Floodwater Retarding Structures No. 4 & 6 of the Chambers Creek Watershed in Ellis County

Dear Ms. Calvez:

Freese and Nichols, Inc, on behalf of the U.S. Department of Agriculture, Natural Resources Conservation Service (NRCS), has provided the draft environmental assessment (EA) for rehabilitation of floodwater retarding structures (FRS) Nos. 4 & 6 of the Chambers Creek watershed in Ellis County for Texas Parks and Wildlife Department (TPWD) review regarding potential impacts to threatened and endangered species.

As the state agency with primary responsibility for protecting the state's fish and wildlife resources, in accordance with the authority granted by Texas Parks and Wildlife Code (PWC) section 12.0011, TPWD provides the following informational comments and recommendations to minimize potential adverse impacts to the state's fish and wildlife resources, including rare, threatened, and endangered species, in association with the proposed project.

Project Description

To provide continued flood protection and meet dam safety standards, NRCS proposes rehabilitation of the Chambers Creek FRS No. 4 and 6.

The preferred alternative for FRS No. 4 is to rehabilitate the dam, providing sediment storage for 100 years after construction and maintaining the level of flood protection that minimizes changes to present conditions downstream. This includes raising the top of the dam an average 2.4 feet and lengthening the dam by 160 feet in the right end abutment area, installing a 30-inch principal spillway pipe with an intake riser and impact basin, raising the crest of the auxiliary spillway 0.4 feet, and maintaining the auxiliary spillway width at 50 feet.

The preferred alternative for FRS No. 6 is to rehabilitate the dam, providing sediment storage for 100 years after construction and maintaining the level of flood protection that minimizes changes to present conditions downstream. This includes raising the top of the dam an average 2.1 feet and lengthening the dam by 55 feet in the right end abutment area, installing a 30-inch principal spillway pipe with an intake riser and impact basin, raising the crest of the auxiliary spillway 0.24 feet, and widening the auxiliary spillway from 75 feet to 200 feet.

4200 SMITH SCHOOL ROAD
AUSTIN, TEXAS 78744-3291
512.389.4800
www.tpwd.texas.gov

To manage and conserve the natural and cultural resources of Texas and to provide hunting, fishing and outdoor recreation opportunities for the use and enjoyment of present and future generations.

Federal Regulations - Endangered Species Act

Please note that since the writing of the draft EA, the USFWS IPaC for Ellis County now includes the monarch butterfly (*Danaus plexippus*), a candidate species. TPWD recommends the EA include the monarch butterfly in its analysis.

State Regulations - Aquatic Resources

PWC section 1.011 grants TPWD authority to regulate and conserve aquatic animal life of public waters. Texas Administrative Code (TAC) section 57.157 regulates take of all native freshwater mussels, including mussels that are not state listed. TPWD regulates the introduction and stocking of fish, shellfish, and aquatic plants into public waters of the state under PWC sections 12.015, 12.019, and 66.015 and TAC 52.101-52.105, 52.202, and 57.251-57.259.

Dewatering activities can impact aquatic resources through stranding fish and mussels. Other harmful construction activities can trample, dredge, or fill areas exhibiting stationary aquatic resources such as plants and mussels. Relocating aquatic life to an area of suitable habitat outside the project footprint avoids or reduces impacts to aquatic life. Relocation activities are done under the authority of a TPWD *Permit to Introduce Fish, Shellfish or Aquatic Plants into Public Waters* with an approved Aquatic Resource Relocation Plans (ARRP). The permit allows for movement (i.e., introduction, stocking, transplant, relocation) of aquatic species in waters of the state. ARRPs are used to plan resource handling activities and assist in the permitting process. If dewatering activities and other project-related activities cause mortality to fish and wildlife species, then the responsible party would be subject to investigation by the TPWD KAST and will be liable for the value of lost resources under the authority of PWC sections 12.0011 (b) (1) and 12.301.

The EA only addresses potential impacts to terrestrial wildlife and does not consider potential impacts to aquatic wildlife. Although the Affected Environment sections of the EA indicate that there is no essential fish habitat protected under the Magnusson-Stevens Fishery Conservation and Management Act, the lakes associated with FRS No. 4 and 6 contain aquatic wildlife that may be impacted by actions to lower lake levels or dewater the lake during construction. Impacts to both terrestrial and aquatic wildlife should be included in the Environmental Consequences section of the EA.

> **Recommendation:** TPWD recommends impact avoidance measures for aquatic organisms, including all native fish and freshwater mussel species, regardless of federal or state listing status, be considered during project planning and construction activities. TPWD recommends the EA include an assessment of potential impacts to aquatic wildlife and identify beneficial management practices (BMP) to be used to avoid or minimize potential impacts to aquatic wildlife.

Because the project activities would occur within public waters, some activities may be subject to coordination with TPWD KAST. For additional information please see the TPWD KAST website and *TPWD Guidelines for Aquatic Resource Relocation Plans for Fish and Shellfish, Including Freshwater Mussels*.

> **Recommendation:** If construction occurs during times when water is present and dewatering, excavation, fill, or trampling activities are involved, then TPWD recommends relocating native aquatic resources, including fish and mussels, in conjunction with a *Permit to Introduce Fish, Shellfish or Aquatic Plants into Public Waters* and an ARRP. The ARRP should approved by the department 30 days prior to activity within project waters or resource relocation and submitted with an application for a no-cost permit. ARRPs can be submitted to Bregan Brown TPWD Region 2 KAST available at Kirian.Brown@tpwd.texas.gov and 903-566-2518.

State Regulations – Aquatic Invasive Species

Per TAC chapter 57, it is an offense for any person to possess, transport, or release into the water of this state any species, hybrid of a species, subspecies, eggs, seeds, or any part of any species defined as a harmful or potentially harmful exotic fish, shellfish, or aquatic plant. This rule applies not only to zebra mussels (*Dreissena polymorpha*) (live or dead) and their larvae but also to any species or fragments thereof designated as harmful or potentially harmful under this subchapter (e.g., giant salvinia, hydrilla, Eurasian watermilfoil). The full list of prohibited species can be found on the TPWD website regarding prohibited aquatic species.

The EA indicted the presence of King Ranch bluestem, an invasive species observed at the project area and indicated that care will be taken to avoid the spread or distribution of invasive species by cleaning construction vehicles and equipment of vegetative matter before entering the project area.

The EA indicates that construction activities will require equipment to come in contact with inland water bodies. Unwashed equipment entering the site could contain contaminated mud, debris, or standing water in crevices and are a risk of transporting aquatic invasive species (AIS) to the site, especially if the equipment is coming from a previous job that involved work in contaminated water bodies. Additionally, equipment leaving the project area at the end of the job could transport invasive species to the next job site if not properly drained and cleaned. Please keep in mind that many aquatic invasive plant species can propagate from very small fragments and that certain life stages of the invasive zebra mussels are very small; thus, both plant and animal AIS are a potential concern for introduction to the project site or spread from the project site, even if not clearly visible upon inspection.

> **Recommendation:** When equipment will come in contact with inland waterbodies, TPWD recommends preparing and following an AIS transfer prevention plan which outlines BMPs for preventing inadvertent transfer of aquatic

invasive plants and animals on project equipment and materials. To minimize the risk of transporting AIS, TPWD recommends the NRCS and its contractors review and adhere to the AIS BMPs identified in the ARRP guidelines packet and the *TPWD Clean/Drain/Dry Procedures and Zebra Mussel Decontamination Procedures for Contractors Working in Inland Public Waters*. The BMP should be repeated after use to prevent transfer to another water body.

Species of Greatest Conservation Need

In addition to listed species, TPWD monitors other species of greatest conservation need (SGCN) and actively promotes their conservation. TPWD considers it important to evaluate and, if feasible, minimize impacts to SGCN and their habitat to reduce the likelihood of endangerment and preclude the need to list as threatened or endangered in the future. TPWD provides online access to state listed species information through the TPWD Rare, Threatened, and Endangered Species of Texas by County (RTEST) application. This application provides county-level information regarding protected and rare species and may be utilized to inform construction project planning.

The RTEST list for Ellis County identifies the following SGCN flora and fauna with potential to occur with the county. These species could be impacted in association with construction activities if suitable habitat or the species occur at the project site. General habitat descriptions for these species are included on the RTEST list:

Taxon	Scientific Name	Common Name	GRank[1]	SRank[2]
Amphibians	Anaxyrus woodhousii	Woodhouse's toad	G5	SU
Amphibians	Pseudacris streckeri	Strecker's chorus frog	G5	S3
Amphibians	Lithobates areolatus areolatus	southern crawfish frog	G4T4	S3
Birds	Plegadis chihi	white-faced ibis*	G5	S4B
Birds	Mycteria americana	wood stork*	G4	SHB,S2N
Birds	Haliaeetus leucocephalus	bald eagle	G5	S3B,S3N
Birds	Leucophaeus pipixcan	Franklin's gull	G5	S2N
Birds	Sternula antillarum athalassos	interior least tern**	G4T3Q	S1B
Birds	Athene cunicularia hypugaea	western burrowing owl	G4T4	S2
Birds	Calcarius ornatus	Chestnut-collared Longspur	G5	S3
Mammals	Myotis austroriparius	southeastern myotis bat	G4	S3?
Mammals	Myotis velifer	cave myotis bat	G4G5	S2S3
Mammals	Perimyotis subflavus	tricolored bat	G2G3	S2
Mammals	Eptesicus fuscus	big brown bat	G5	S5

Mammals	Lasiurus borealis	eastern red bat	G3G4	S4
Mammals	Lasiurus cinereus	hoary bat	G3G4	S4
Mammals	Sylvilagus aquaticus	swamp rabbit	G5	S5
Mammals	Ondatra zibethicus	Muskrat	G5	S5
Mammals	Mustela frenata	long-tailed weasel	G5	S5
Mammals	Spilogale putorius	eastern spotted skunk	G4	S1S3
Mammals	Conepatus leuconotus	western hog-nosed skunk	G4	S4
Mammals	Puma concolor	mountain lion	G5	S2S3
Reptiles	Macrochelys temminckii	alligator snapping turtle*	G3	S2
Reptiles	Deirochelys reticularia miaria	western chicken turtle	G5T5	S2S3
Reptiles	Terrapene carolina	eastern box turtle	G5	S3
Reptiles	Terrapene ornata	western box turtle	G5	S3
Reptiles	Ophisaurus attenuatus	slender glass lizard	G5	S3
Reptiles	Phrynosoma cornutum	Texas horned lizard*	G4G5	S3
Reptiles	Plestiodon septentrionalis	Prairie Skink	G5	S5
Reptiles	Thamnophis sirtalis	common garter snake	G5	S2
Reptiles	Thamnophis sirtalis annectens	Texas garter snake	G5T4	S1
Reptiles	Crotalus horridus	timber (canebrake) rattlesnake	G4	S4
Insects	Bombus pensylvanicus	American bumblebee	G3G4	SNR
Insects	Amblycorypha uhleri	a katydid	G2G3	SNA
Insects	Arethaea ambulator	No common name	GNR	SNR
Mollusks	Lampsilis satura	Sandbank Pocketbook*	G2?	S1
Mollusks	Pleurobema riddellii	Louisiana Pigtoe*	G1G2	S1
Mollusks	Potamilus amphichaenus	Texas Heelsplitter*	G1G3	S1
Mollusks	Fusconaia chunii	Trinity Pigtoe*	GNR	S1
Plants	Physaria engelmannii	Engelmann's bladderpod	G4	S3
Plants	Dalea hallii	Hall's prairie clover	G3	S2
Plants	Crataegus viridis var. glabriuscula	Sutherland hawthorn	G5T3T4	S3

*State listed threatened ** Federal and state listed threatened or endangered
[1]GRank is the NatureServe global conservation status rank.
[2]SRank is the NatureServe subnational or state level conservation status rank.
See NatureServe's website for specific global and state ranking definitions.

TPWD recommends that precautions be taken to avoid impacts to threatened, endangered, and other SGCN flora and fauna if encountered in the project area during construction, maintenance, or operation activities. TPWD recommends implementation of the following BMP to avoid or minimize potential impacts to wildlife resources potentially occurring at the construction site:

1. TPWD recommends informing employees and contractors of the potential for SGCN to occur in the project area and to avoid impacts to all wildlife that are encountered. Wildlife observed during construction should be allowed to safely leave the site on their own or be translocated to a nearby area with similar habitat that would not be disturbed during construction. NRCS and its contractors should abide by any applicable federal or state law when translocating state listed species. TPWD recommends that any translocations of reptiles be the minimum distance possible no greater than one mile, preferably within 100-200 yards from the initial encounter location.

2. Small vertebrates including snakes, lizards, toads, and mice can fall into trenches or excavated areas and become trapped. Wildlife unable to escape from trenches or excavated areas are susceptible to loss from backfilling activities, exposure to elements, starvation, dehydration, and predation by other wildlife. Where trenching or other excavation is involved in construction, TPWD recommends providing escape ramps, covering excavated areas overnight, or covering excavated areas while unattended for long periods of time. Trenches or excavation areas should be inspected for the presence of trapped wildlife prior to backfilling.

3. For soil stabilization and revegetation of disturbed areas within the proposed project area, TPWD recommends erosion and seed and mulch stabilization materials that avoid entanglement hazards to snakes and other wildlife species. Because the mesh found in many erosion control blankets or mats pose an entanglement hazard to wildlife, TPWD recommends the use of no-till drilling, hydromulching, or hydroseeding rather than erosion control blankets or mats due to a reduced risk to wildlife. If erosion control blankets or mats will be used, the product should contain no netting or contain loosely woven, natural fiber netting in which the mesh design allows the threads to move, therefore allowing expansion of the mesh openings. Plastic mesh matting and hydromulch containing plastic ingredients should be avoided.

4. To aid in the scientific knowledge of a species' status and current range, TPWD encourages reporting encounters of protected and rare species to the Texas Natural Diversity Database (TXNDD) according to the data submittal instructions found at the TPWD TXNDD webpage. An additional method for reporting observations of species is the iNaturalist community app where plant and animal observations are uploaded from a smartphone. The observer then selects to add the observation to specific TPWD Texas Nature Tracker Projects appropriate for the taxa observed,

including Herps of Texas, Birds of Texas, Texas Eagle Nests, Texas Whooper Watch, Mammals of Texas, Rare Plants of Texas, Bees & Wasps of Texas, Terrestrial Mollusks of Texas, Texas Freshwater Mussels, Fishes of Texas, and All Texas Nature.

Thank you for considering the fish and wildlife resources of Texas. If you have any questions, please contact me at Karen.Hardin@tpwd.texas.gov or (903) 322-5001.

Sincerely,

Karen B. Hardin
Wildlife Habitat Assessment Program
Wildlife Division

kbh/48162

Erin Kelly

From: noreply@thc.state.tx.us
Sent: Monday, September 20, 2021 2:52 PM
To: Erin Kelly; reviews@thc.state.tx.us; james.e.barrera@usace.army.mil
Subject: Section 106 Submission

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TEXAS HISTORICAL COMMISSION
real places telling real stories

Re: Project Review under Section 106 of the National Historic Preservation Act and/or the Antiquities Code of Texas
THC Tracking #202200009
Date: 09/20/2021
Chambers Creek Flood Retarding Structures No. 4 and 6 Rehabilitation
3480 Mt Zion Road
Midlothian,TX 76065

Description: Chambers Creek FRS Nos. 4 & 6 are classified as high-hazard dams. Rehabilitation is proposed to resolve safety issues and maintain flood control benefits.

Dear Erin Kelly:
Thank you for your submittal regarding the above-referenced project. This response represents the comments of the State Historic Preservation Officer, the Executive Director of the Texas Historical Commission (THC), pursuant to review under Section 106 of the National Historic Preservation Act and the Antiquities Code of Texas.

The review staff, led by Amy Borgens, Rebecca Shelton, Caitlin Brashear, has completed its review and has made the following determinations based on the information submitted for review:

Above-Ground Resources

- No historic properties are present or affected by the project as proposed. However, if historic properties are discovered or unanticipated effects on historic properties are found, work should cease in the immediate area; work can continue where no historic properties are present. Please contact the THC's History Programs Division at 512-463-5853 to consult on further actions that may be necessary to protect historic properties.

Archeology Comments

- No historic properties affected. However, if cultural materials are encountered during construction or disturbance activities, work should cease in the immediate area; work can continue where no cultural materials are present. Please contact the THC's Archeology Division at 512-463-6096 to consult on further actions that may be necessary to protect the cultural remains.

We look forward to further consultation with your office and hope to maintain a partnership that will foster effective historic preservation. Thank you for your cooperation in this review process, and for your efforts to preserve the irreplaceable heritage of Texas. If the project changes, or if new historic properties are found, please contact the review staff. If you have any questions concerning our review or if we can be of further assistance, please email the following reviewers: amy.borgens@thc.texas.gov, rebecca.shelton@thc.texas.gov, caitlin.brashear@thc.texas.gov.

This response has been sent through the electronic THC review and compliance system (eTRAC). Submitting your project via eTRAC eliminates mailing delays and allows you to check the status of the review, receive an electronic response, and generate reports on your submissions. For more information, visit http://thc.texas.gov/etrac-system.

Sincerely,

for Mark Wolfe, State Historic Preservation Officer
Executive Director, Texas Historical Commission

Please do not respond to this email.

cc: james.e.barrera@usace.army.mil

Appendix E – Other Supporting Information

Attachment E-1: Geotechnical Information

Chambers Creek 4 Vicinity Map

FREESE AND NICHOLS
4055 International Plaza, Suite 200
Fort Worth, TX 76109 - 4895
Phone - (817) 735 - 7300

N W E S

TX STATE SOIL AND WATER CONSERVATION
WRPP CHAMBERS CREEK SITE 4

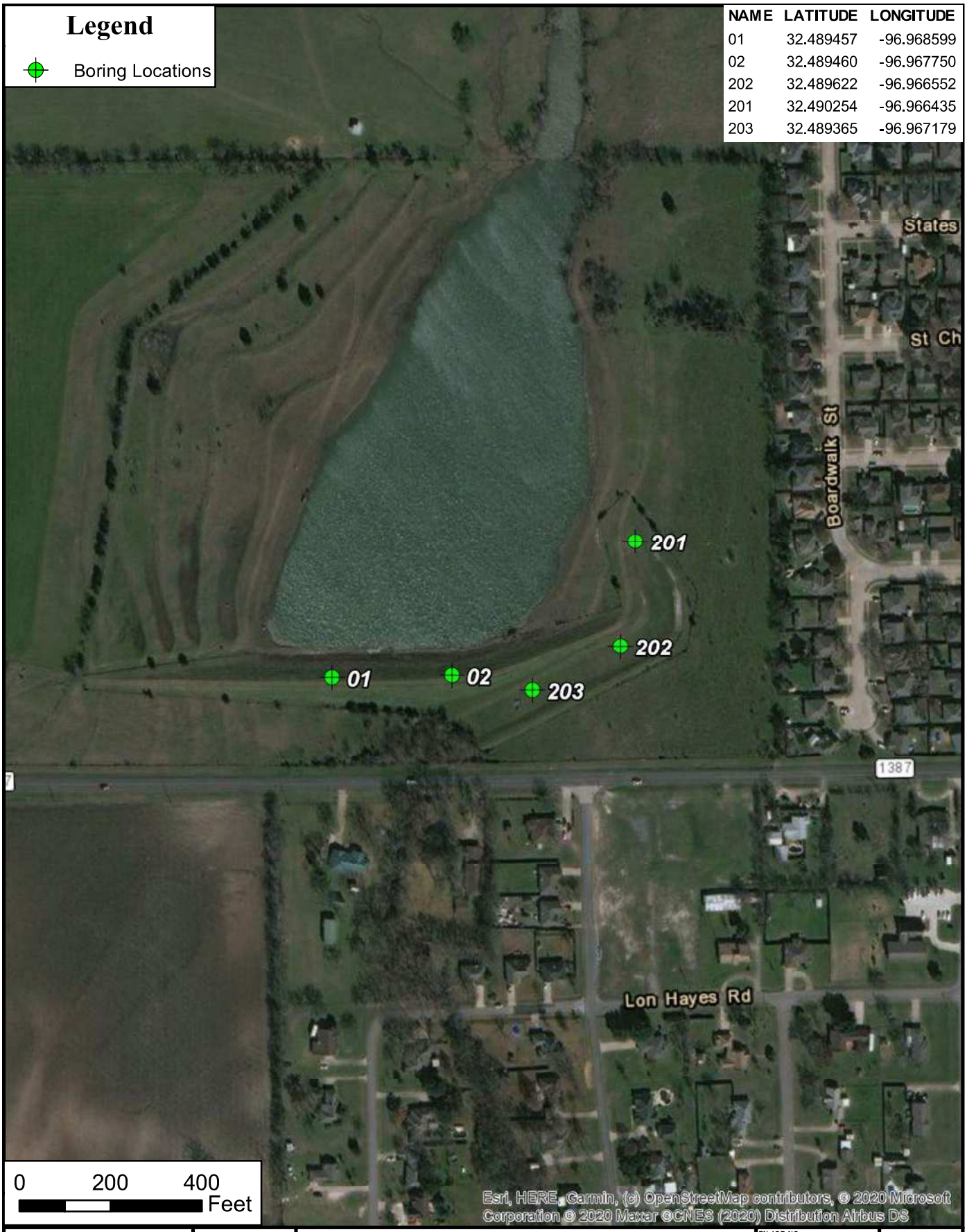
Vicinity Map

FN JOB NO	TSW20319
FILE	VIC_CC_SITE4
DATE	7/13/2020
SCALE	1:50,000
DESIGNED	Masha Hedayati
DRAFTED	ZDC

1
FIGURE

Attachment E-2: Geotechnical Information

Chambers Creek 4 Boring Location Map



NAME	LATITUDE	LONGITUDE
01	32.489457	-96.968599
02	32.489460	-96.967750
202	32.489622	-96.966552
201	32.490254	-96.966435
203	32.489365	-96.967179

FREESE AND NICHOLS
4055 International Plaza, Suite 200
Fort Worth, TX 76109 - 4895
Phone - (817) 735 - 7300

N W E S

TX STATE SOIL AND WATER CONSERVATION
WRPP CHAMBERS CREEK SITE 4

Boring Location Map

FN JOB NO	TSW20319
FILE	BLM_CC_SITE4.mxd
DATE	7/13/2020
SCALE	1:3,500
DESIGNED	Masha Hedayati
DRAFTED	ZDC

2
FIGURE

Attachment E-3: Geotechnical Information

Chambers Creek 4 Boring Log

LOG OF BORING NO. 01

Project Description: Watershed Rehabilitation Chambers Creek 4
Project Location: Midlothian, Texas
Date Drilling Started: 6/1/2020
Logged By: A. Brewer
Rig Type: CME 75
Latitude: 32.489457

Drilling Co.: Texplor of Dallas, Inc.
Hammer Type: N/A
Longitude: -96.968599

Project No.: TSW20319
Phase No.: CC4
Date Drilling Completed: 6/1/2020
Drill Method: HSA & Rotary Wash
Elevation:

DEPTH, ft	SAMPLE TYPE	BLOW COUNTS	HAND PENETROMETER (P) / TORVANE (T), tsf	RECOVERY, %	RQD, %	SYMBOL	MATERIAL DESCRIPTION	WATER CONTENT, %	UNIT DRY WEIGHT, pcf	% PASSING NO. 200 SIEVE	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	UNC. COMPRESSIVE STRENGTH, tsf	STRAIN AT FAILURE, %	ELEVATION, ft
	U-1		4.5+ (P)	25			GRAVELLY FAT CLAY (CH), dark brown to brown, very stiff, moist, with limestone fragments and fine to coarse limestone gravel - sub-rounded to sub-angular, some iron oxide nodules and orange staining (FILL)	17								
	U-2		4.0 (P)	38				19			59	24	35			
5	U-3		3.5 (P)	35				19	108	74				2.7	6.5	
	U-4		4.25 (P)	38			FAT CLAY (CH), brown, very stiff, moist, with variable limestone fragments and gravel content throughout, some iron oxide nodules and orange staining (FILL) 6/	20		88						
	U-5		4.0 (P)	50				21			57	20	37			
10																
	U-6		3.5 (P)	43			-dark gray to brown, stiff, moist, with fine limestone gravel, iron oxide nodules and limestone fragments	25	102					2.9	4.7	
15																
	U-7		3.5 (P)	43			LEAN CLAY (CL), light yellow-brown and gray-brown, stiff, moist, with fine calcareous nodules and iron oxide nodules, trace iron oxidation (FILL) 17/	26								
20																
	U-8		1.5 (P)	31			FAT CLAY (CH), dark gray, soft, moist to wet (FILL) 21/	27		96	77	26	51			
25																
30							LIMESTONE, light yellow-brown, moderately to slightly weathered, soft to moderately soft rock (Austin Chalk Formation) 27/ -6-in thick hard, calcareous clay seams at 28 feet -discontinuities at 30 - 30.5 feet	16		79						

GROUND WATER OBSERVATIONS

MEASUREMENT	∇ At Time Of Drilling	▼ At End of Drilling	▼ After Drilling
DATE			
DEPTH (ft.bgs.)			
NOTES	Dry		

Remarks:
0-30 feet - hollow stem augers; 30-60 feet - NX rock core with water. Borehole backfilled with tremie-placed cement bentonite grout. Water was not encountered prior to coring.

The stratification lines represent approximate strata boundaries. In situ, the transition may be gradual.These logs are subject to the limitations, conclusions, and recommendations in the associated report.

LOG OF BORING NO. 01

Project Description: Watershed Rehabilitation Chambers Creek 4
Project Location: Midlothian, Texas
Date Drilling Started: 6/1/2020
Logged By: A. Brewer
Rig Type: CME 75
Latitude: 32.489457

Drilling Co.: Texplor of Dallas, Inc.
Hammer Type: N/A
Longitude: -96.968599

Project No.: TSW20319
Phase No.: CC4
Date Drilling Completed: 6/1/2020
Drill Method: HSA & Rotary Wash
Elevation:

DEPTH, ft	SAMPLE TYPE	BLOW COUNTS	HAND PENETROMETER (P) / TORVANE (T), tsf	RECOVERY, %	RQD, %	SYMBOL	MATERIAL DESCRIPTION	WATER CONTENT, %	UNIT DRY WEIGHT, pcf	% PASSING NO. 200 SIEVE	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	UNC. COMPRESSIVE STRENGTH, tsf	STRAIN AT FAILURE, %	ELEVATION, ft
							(no recovery), 30.9 feet (clayey), 31.28 feet (mechanical horizontal) *(Continued)*									
35	C-1			95	95		LIMESTONE, light gray to dark gray, fresh, moderately soft rock, argillaceous, thickly bedded, with zones of bioturbation and intraclasts, occasional very thin beds and laminations that are fissile/shaly, some fossil fragments, trace pyrite (Austin Chalk Formation) 33.1/	14	118					81.2	1.5	
							-dark gray, very soft, shaly from 34.9 to 35.7 feet									
							-discontinuities at 35.7, 36.65, 39.4 feet (mechanical-horizontal)									
							-very soft, shaly at 38 feet									
40							-dark gray, very soft, fissile, shaly from 38.7 to 38.9 feet									
							-high angle fault, stained, smooth from 40 to 50 feet 41/	14	123					93.8	1.7	
45	C-2			89	56		SHALY LIMESTONE, light gray to dark gray, fresh, moderately soft rock, argillaceous, thinly bedded to laminated, slickensided, fissile, brittle, some fossil fragments, trace pyrite (Austin Chalk Formation)									
50							LIMESTONE, light gray to dark gray, fresh, moderately soft rock, argillaceous, thickly bedded, with zones of bioturbation and intraclasts, occasional very thin beds and laminations that are fissile/shaly, some fossil fragments, trace pyrite (Austin Chalk Formation) 50/									
							-dark gray, fissile, shaly from 51.7 to 51.9 feet	17	116					55.2	1.1	
55	C-3			98	98		-discontinuities at 51.8 and 56.4 feet (mechanical-horizontal)									
							-dark gray, fissile, shaly from 54.7 to 55 feet									
60							Total boring depth 60.0 ft.									

GROUND WATER OBSERVATIONS

MEASUREMENT	▽ At Time Of Drilling	▼ At End of Drilling	▼ After Drilling
DATE			
DEPTH (ft.bgs.)			
NOTES	Dry		

Remarks:
0-30 feet - hollow stem augers; 30-60 feet - NX rock core with water. Borehole backfilled with tremie-placed cement bentonite grout. Water was not encountered prior to coring.

The stratification lines represent approximate strata boundaries. In situ, the transition may be gradual.These logs are subject to the limitations, conclusions, and recommendations in the associated report.

LOG OF BORING NO. 02

Project Description: Watershed Rehabilitation Chambers Creek 4
Project Location: Midlothian, Texas
Date Drilling Started: 6/1/2020
Logged By: A. Brewer
Rig Type: CME 55
Latitude: 32.489460

Drilling Co.: Texplor of Dallas, Inc.
Hammer Type: Automatic
Longitude: -96.967750

Project No.: TSW20319
Phase No.: CC4
Date Drilling Completed: 6/1/2020
Drill Method: HSA & Rotary Wash
Elevation:

DEPTH, ft	SAMPLE TYPE	BLOW COUNTS	HAND PENETROMETER (P) / TORVANE (T), tsf	RECOVERY, %	RQD, %	SYMBOL	MATERIAL DESCRIPTION	WATER CONTENT, %	UNIT DRY WEIGHT, pcf	% PASSING NO. 200 SIEVE	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	UNC. COMPRESSIVE STRENGTH, tsf	STRAIN AT FAILURE, %	ELEVATION, ft
	U-1		4.5+ (P)	38			GRAVELLY LEAN CLAY (CL), dark brown to brown, stiff to very stiff, moist, with limestone fragments and fine to coarse limestone gravel - sub-rounded to sub-angular, some iron oxide nodules and orange staining, variable limestone fragment and gravel content throughout (FILL)	17								
	U-2		4.5+ (P)	33				18	109	58				2.3	4.2	
5	U-3		4.5+ (P)	48				18			42	22	20			
	U-4		3.75 (P)	30				18								
	U-5		3.0 (P)	50			-pale brown to yellow-brown, stiff, moist, with some limestone fragments and limestone gravel, trace calcareous nodules and iron oxide nodules	19			48	21	27			
10																
	U-6		3.5 (P)	43			LEAN CLAY (CL), gray-brown, stiff, moist, with some limestone fragments, fine limestone gravel, trace calcareous nodules and iron oxide nodules (FILL) 13/	23	106	88				2.5	5.5	
15																
	U-7		3.5 (P)	48			FAT CLAY (CH), dark brown, very stiff, moist to wet, some fine limestone gravel, trace calcareous nodules and iron oxide nodules (FILL) 18/	26			68	24	44			
20																
	U-8		4.0 (P)	38			-very stiff, moist, trace calcareous nodules, iron oxide nodules, and shell fragments	25								
25																
							LIMESTONE, light yellow-brown, moderately weathered, soft to moderately soft rock , occasional very 28/									

GROUND WATER OBSERVATIONS

MEASUREMENT	▽ At Time Of Drilling	▼ At End of Drilling	▼ After Drilling
DATE			
DEPTH (ft.bgs.)			
NOTES	Dry		

Remarks:
0-30 feet - hollow stem augers; 30-50 feet - NX rock core with water. Borehole backfilled with tremie-placed cement bentonite grout. Water was not encountered prior to coring.

The stratification lines represent approximate strata boundaries. In situ, the transition may be gradual.These logs are subject to the limitations, conclusions, and recommendations in the associated report.

LOG OF BORING NO. 02

Project Description: Watershed Rehabilitation Chambers Creek 4
Project Location: Midlothian, Texas
Date Drilling Started: 6/1/2020
Logged By: A. Brewer
Rig Type: CME 55
Latitude: 32.489460

Drilling Co.: Texplor of Dallas, Inc.
Hammer Type: Automatic
Longitude: -96.967750

Project No.: TSW20319
Phase No.: CC4
Date Drilling Completed: 6/1/2020
Drill Method: HSA & Rotary Wash
Elevation:

DEPTH, ft	SAMPLE TYPE	BLOW COUNTS	HAND PENE-TROMETER (P) / TORVANE (T), tsf	RECOVERY, %	RQD, %	SYMBOL	MATERIAL DESCRIPTION	WATER CONTENT, %	UNIT DRY WEIGHT, pcf	% PASSING NO. 200 SIEVE	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	UNC. COMPRESSIVE STRENGTH, tsf	STRAIN AT FAILURE, %	ELEVATION, ft
							thin beds of calcareous clay (Austin Chalk Formation) *(Continued)* 30/									
35	C-1			70	49		-with discontinuities at 35.8, 36.25, 36.4, 36.7, 37.05 feet (mechanical - horizontal)	14	120					69.3	1.1	
							LIMESTONE, light gray to dark gray, fresh, moderately soft to moderately hard rock, argillaceous, thickly bedded, with zones of bioturbation and intraclasts, occasional very thin beds and laminations that are fissile/shaly, some fossil fragments, trace pyrite (Austin Chalk Formation) 37.4/									
40							-dark gray, very soft, shaly at 37.4 feet -high angle joint at 39.7 feet -dark gray, soft, shaly from 40.6 to 40.9 feet -high angle fault at 42.6 feet, smooth, thin, stained, slickensided	12	122					137	1.6	
45	C-2			99	88		-with discontinuities at 42.6, 43.1, 43.5, 44.7, 45.5 and 47.4 feet (horizontal-mechanical) -calcite infilled joints, high angle, thin to narrow from 43.4 to 45 feet -dark gray, soft, shaly from 45.7 to 47 feet -high angle fault at 45.8 feet, smooth, thin, stained, slickensided									
50							-high angle fault at 46.8 feet, smooth, thin, stained, slickensided -dark gray, soft, shaly from 48 to 48.3 feet Total boring depth 50.0 ft.									
55																

GROUND WATER OBSERVATIONS

MEASUREMENT	At Time Of Drilling	At End of Drilling	After Drilling
DATE			
DEPTH (ft.bgs.)			
NOTES	Dry		

Remarks:
0-30 feet - hollow stem augers; 30-50 feet - NX rock core with water. Borehole backfilled with tremie-placed cement bentonite grout. Water was not encountered prior to coring.

The stratification lines represent approximate strata boundaries. In situ, the transition may be gradual.These logs are subject to the limitations, conclusions, and recommendations in the associated report.

LOG OF BORING NO. 201

Project Description: Watershed Rehabilitation Chambers Creek 4
Project Location: Midlothian, Texas
Date Drilling Started: 6/1/2020
Logged By: A. Brewer
Rig Type: CME 75
Latitude: 32.490254

Drilling Co.: Texplor of Dallas, Inc.
Hammer Type: Automatic
Longitude: -96.966435

Project No.: TSW20319
Phase No.: CC4
Date Drilling Completed: 6/1/2020
Drill Method: HSA & Rotary Wash
Elevation:

DEPTH, ft	SAMPLE TYPE	BLOW COUNTS	HAND PENE-TROMETER (P) / TORVANE (T), tsf	RECOVERY, %	RQD, %	SYMBOL	MATERIAL DESCRIPTION	WATER CONTENT, %	UNIT DRY WEIGHT, pcf	% PASSING NO. 200 SIEVE	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	UNC. COMPRESSIVE STRENGTH, tsf	STRAIN AT FAILURE, %	ELEVATION, ft
	U-1		4.5+ (P)	65			FAT CLAY, dark brown, stiff, moist (Residual Austin Chalk Formation) 0.5/	36								
							LIMESTONE, yellow-brown, severely weathered, very soft, with orange staining 2/									
							LIMESTONE, light yellow-brown, moderately weathered, soft to moderately soft rock (Austin Chalk Formation)									
5							-horizontal stained joints from 5 to 5.5 feet, 5.95, 6.2 and 6.6 feet									
							LIMESTONE, light gray to dark gray, fresh, moderately soft to moderately hard rock, argillaceous, thickly bedded, with zones of bioturbation and intraclasts, occasional very thin beds and laminations that are fissile/shaly, some fossil fragments, trace pyrite (Austin Chalk Formation) 7.25/									
10	C-1			100	92		-dark gray, soft, shaly from 8.9 to 9.2 feet -discontinuities at 10.6 and 11.8 feet (horizontal-mechanical) -dark gray, soft, shaly from 11.6 to 12.6 feet -dark gray, soft, shaly from 13.3 to 13.7 feet	12	125					141.3	1.6	
15							-dark gray, soft, shaly from 15.3 to 15.5 feet -discontinuities at 15.4, 15.5 and 18.6 feet (horizontal-mechanical)									
							-dark gray, soft, shaly from 18.6 to 18.7 feet	14	119					98.3	1.9	
20	C-2			97	96		-dark gray, soft, shaly from 21 to 21.1 feet									
25							-dark gray, soft, shaly from 24.7 to 24.8 feet									
							Total boring depth 25.0 ft.									

GROUND WATER OBSERVATIONS

MEASUREMENT	∇ At Time Of Drilling	▼ At End of Drilling	▼ After Drilling
DATE			
DEPTH (ft.bgs.)			
NOTES	Dry		

Remarks:
0-5 feet - hollow stem augers; 5-25 feet - NX rock core with water. Borehole backfilled with tremie-placed cement bentonite grout. Water was not encountered prior to coring.

The stratification lines represent approximate strata boundaries. In situ, the transition may be gradual.These logs are subject to the limitations, conclusions, and recommendations in the associated report.

LOG OF BORING NO. 202

Project Description: Watershed Rehabilitation Chambers Creek 4
Project Location: Midlothian, Texas
Date Drilling Started: 6/2/2020
Logged By: A. Brewer
Rig Type: CME 75
Latitude: 32.489622

Drilling Co.: Texplor of Dallas, Inc.
Hammer Type: Automatic
Longitude: -96.966552

Project No.: TSW20319
Phase No.: CC4
Date Drilling Completed: 6/2/2020
Drill Method: HSA & Rotary Wash
Elevation:

DEPTH, ft	SAMPLE TYPE	BLOW COUNTS	HAND PENETROMETER (P) / TORVANE (T), tsf	RECOVERY, %	RQD, %	SYMBOL	MATERIAL DESCRIPTION	WATER CONTENT, %	UNIT DRY WEIGHT, pcf	% PASSING NO. 200 SIEVE	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	UNC. COMPRESSIVE STRENGTH, tsf	STRAIN AT FAILURE, %	ELEVATION, ft
	U-1		4.5+ (P)	55			FAT CLAY, dark brown, moist, stiff (Residual Austin Chalk Formation) 0.5/	24			71	30	41			
							LIMESTONE, light yellow-brown, moderately weathered, soft to moderately soft rock, some orange staining, trace pyrite and fossil fragments (Austin Chalk Formation)									
5							-discontinuities at 5.7, 5.9, and 7.2 feet (horizontal - mechanical) -horizontal stained joints at 6.5, 6.9, 7.45, 7.8, and 8.8 feet -vertical stained joints at 7.4 to 7.7 feet									
10	C-01			96	83		-gray limestone bed from 9.3 to 9.6 feet -horizontal stained joints at 9, 9.4, 11, 12.2, 12.3 and 12.6 feet	15	118					55.5	1.5	
							-high angle fault at 11.9 feet, slickensides, smooth, stained -horizontal stained joints at 13.3 and 13.5 feet									
15							-horizontal stained joints at 16.9, 17.1 and 17.3 feet									
							LIMESTONE, light gray to dark gray, fresh, moderately soft rock, argillaceous, thickly bedded, with zones of bioturbation and intraclasts, occasional very thin beds and laminations that are fissile/shaly, trace pyrite and fossil fragments (Austin Chalk Formation) 17.25/	12	127					118.1	2.3	
20	C-02			99	92		-dark gray, very soft, shaly from 18.8 to 20 feet -dark gray, very soft, shaly from 22.4 to 22.6 feet -discontinuities at 22.46 and 24.57 feet (mechanical - horizontal)									
25							Total boring depth 25.0 ft.									

GROUND WATER OBSERVATIONS

MEASUREMENT	At Time Of Drilling	At End of Drilling	After Drilling
DATE			
DEPTH (ft.bgs.)			
NOTES	Dry		

Remarks:
0-5 feet - hollow stem augers; 5-25 feet - NX rock core with water. Borehole backfilled with tremie-placed cement bentonite grout. Water was not encountered prior to coring.

The stratification lines represent approximate strata boundaries. In situ, the transition may be gradual.These logs are subject to the limitations, conclusions, and recommendations in the associated report.

LOG OF BORING NO. 203

Project Description: Watershed Rehabilitation Chambers Creek 4
Project Location: Midlothian, Texas
Date Drilling Started: 6/2/2020
Logged By: A. Brewer
Rig Type: CME 75
Latitude: 32.489365

Drilling Co.: Texplor of Dallas, Inc.
Hammer Type: Automatic
Longitude: -96.967179

Project No.: TSW20319
Phase No.: CC4
Date Drilling Completed: 6/2/2020
Drill Method: HSA & Rotary Wash
Elevation:

DEPTH, ft	SAMPLE TYPE	BLOW COUNTS	HAND PENETROMETER (P) / TORVANE (T), tsf	RECOVERY, %	RQD, %	SYMBOL	MATERIAL DESCRIPTION	WATER CONTENT, %	UNIT DRY WEIGHT, pcf	% PASSING NO. 200 SIEVE	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	UNC. COMPRESSIVE STRENGTH, tsf	STRAIN AT FAILURE, %	ELEVATION, ft
	U-1		4.5+ (P)	38			FAT CLAY (CH), dark brown, stiff, moist, with limestone fragments (Residual Austin Chalk Formation)	22								
							LIMESTONE, very light yellow-brown, completely weathered, very soft rock, with orange staining (Austin Chalk Formation) 1.75/	20		81	43	26	17			
							-1-ft thick hard, calcareous clay seams at 2 feet 3/									
5							LIMESTONE, light yellow-brown, moderately weathered, moderately soft rock, some orange staining, trace pyrite and fossil fragments (Austin Chalk Formation) -horizontal stained joints at 6.15, 6.25, 6.7 and 7.15 feet -high angle stained joint at 8.7 feet									
10	C-01			99	94		-gray limestone bed from 8.6 to 9.4 feet	16	118					112.3	1.4	
							-horizontal stained joints at 11.43, 12.03 and 12.45 feet									
15							-high angle fault at 15 feet, thin, stained, planar, smooth, slickensided 15.35/									
20	C-02			94	95		LIMESTONE, light gray to dark gray, fresh, moderately hard rock, argillaceous, thickly bedded, with zones of bioturbation and intraclasts, occasional very thin beds and laminations that are fissile/shaly, trace pyrite and fossil fragments (Austin Chalk Formation) -dark gray, soft, shaly from 18.95 to 19.1 feet -discontinuities at 19.07, 20.07 and 21.70 feet (horizontal - mechanical) -dark gray, soft, shaly from 20.05 to 20.13 feet	12	123					162.8	1.8	
25							-dark gray, soft, shaly from 24.2 to 24.35 feet									
							Total boring depth 25.0 ft.									

GROUND WATER OBSERVATIONS

MEASUREMENT	∇ At Time Of Drilling	▼ At End of Drilling	▼ After Drilling
DATE			
DEPTH (ft.bgs.)			
NOTES	Dry		

Remarks:
0-5 feet - hollow stem augers; 5-25 feet - NX rock core with water. Borehole backfilled with tremie-placed cement bentonite grout. Water was not encountered prior to coring.

The stratification lines represent approximate strata boundaries. In situ, the transition may be gradual.These logs are subject to the limitations, conclusions, and recommendations in the associated report.

BORING LOG LEGEND AND NOMENCLATURE

Abbreviations		
U – Undisturbed Sample (tube)	SPT – Standard Penetration Test	TV – Torvane
A – Auger Sample	TCP – Texas Cone Penetration	NP – Non Plastic
CS – Continuous Sample	CFA – Continuous Flight Auger	ATD – At Time of Drilling
C – Rock Core	HSA – Hollow Stem Auger	AD – After Drilling

General Terms	
Term	Description
Blow Counts	Results from either the Standard Penetration Test (SPT) or the Texas Cone Penetration (TCP) test.
Recovery	Length of sample or core recovered divided by the total length pushed, driven, or cored (expressed as a %)
Rock Quality Designation (RQD)	Cumulative length of unfractured pieces of core material more than 4 inches in length divided by the total length of material cored (expressed as a percentage)

Consistency of Cohesive Soil				
Description	Comp. Strength, tsf	SPT Blows	TCP Blows	Criteria
Very Soft	< 0.25	0 – 2	0 – 8	Sample sags under its own weight and is easily deformed
Soft	≥ 0.25 – < 0.5	> 2 – 4	> 8 – 20	Easily pinched between fingers and remolded with light finger pressure
Medium Stiff	≥ 0.5 – < 1.0	> 4 – 8	N/A for TxDOT	Imprinted easily with fingers and remolded with firm finger pressure
Stiff	≥ 1.0 – < 2.0	> 8 – 15	>20 – 40	Imprinted with strong finger pressure or indented easily with fingernail
Very Stiff	≥ 2.0 – < 4.0	> 15 – 30	> 40 to 80	Light imprint from finger or light indent with fingernail
Hard	≥ 4.0	> 30	>80	Difficult to indent with fingernail

Apparent Density of Cohesionless Soil		
Description	SPT Blow Count	Texas Cone Blow Count
Very Loose	0 – 4	0 – 8
Loose	> 4 – 10	> 8 – 20
Medium Dense	> 10 – 30	> 20 to 80
Dense	> 30 – 50	80 to ≥ 5”
Very Dense	> 50	0” to < 5”

Soil Structure	
Description	Criteria
Stratified	Alternating layers of varying material/color with layers ≥ 1/4-inch thick
Laminated	Alternating layers of varying material/color with layers < 1/4-inch thick
Fissured	Breaks along definite planes with little resistance
Slickensided	Fracture planes appear polished or glossy; shows movement direction
Blocky	Cohesive soil that can be broken into small, angular lumps
Lensed	Inclusion of small pockets of soil that is different from dominate type
Homogenous	Same color and appearance throughout

Moisture Condition	
Description	Criteria
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water

Textural Adjectives	
Textural Item	Description
Pit	Pinhole sized openings
Vug	Small openings up to 4 inches in size
Cavity	Opening larger than 4 inches
Honeycomb	Numerous and grouped pits and vugs
Vesicle	Small openings in volcanic rocks

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BORING LOG LEGEND AND NOMENCLATURE

Rock Hardness Descriptors			
Grade	Approx. Comp. Strength, tsf	Approx. TCP Range	Field Test
Very Soft	< 10 - 100	>6”	Can be peeled with pocket knife, crumbles under firm blows of geological hammer
Soft	100 - 500	4” - 6”	Can be peeled with pocket knife with difficulty, indented by firm blows of geological hammer
Hard	500 - 1000	1” - 5”	Cannot be peeled with pocket knife, can be fractured by single firm blow of hammer
Very Hard	1000 - 2000	0” - 2”	Specimen requires more than one blow of geological hammer to fracture it
Extremely Hard	> 2000	0”	Specimen requires many blows of geological hammer to fracture it

Degree of Rock Weathering	
Description	Criteria
Unweathered	No evidence of chemical or mechanical alteration
Slightly Weathered	Slight discoloration of surface or discontinuities; < 10% volume altered
Weathered	Discoloring evident; 10 to 50% of volume altered
Highly Weathered	Entire mass discolored; alteration through majority of rock
Decomposed	Rock reduced to soil consistency with some rock-like texture

Rock Bedding Structure	
Description	Criteria
Laminated	< 3/8 inch
Very Thinly Bedded	3/8—1 inch
Thinly Bedded	1 inch—4 inches
Moderately Bedded	4 inches—1 foot
Thickly Bedded	1 foot—3 feet
Very Thickly Bedded	3– 10 feet
Massive	> 10 feet

Soil Column Graphic Symbols*			
Graphic	Represented Soil Types	Graphic	Represented Soil Types
	Fat Clay, Fat Clay with sand, Sandy Fat Clay		Well-Graded Sand or Poorly-Graded Sand; little to no fines
	Lean Clay, Lean Clay with sand, Sandy Lean Clay, Silty Clay		Clayey Gravel, Gravel-Sand-Clay Mixtures
	Inorganic Silt and Organic Silt		Silty Gravel, Gravel-Sand-Silt Mixtures
	Clayey Sand, Clay-Sand Mixtures		Well-Graded Gravel or Poorly-Graded Gravel; little to no fines
	Silty Sands, Sand-Silt Mixtures		Fill with Significant Debris or Deleterious Material

Rock Column Graphic Symbols*			
Graphic	Represented Rock Types	Graphic	Represented Rock Types
	Limestone, Shaly/Marly Limestone, Limestone with Shale		Marl, Marl with Limestone, Marl with Shale
	Shale, Shale with Limestone		Sandstone, Shaly Sandstone, Sandstone with Shale
	Mudstone		Generic Bedrock Symbol

* Combined graphics may be used for dual classifications. Not all graphics represented. Refer to lithology description for soil classification or rock type.

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Attachment E-4: Geotechnical Information

Chambers Creek 4 Sample Photos Log

30.5’ 35’

35’ 40’

40’ 45’

FNI PROJECT: TSW20319	FREESE AND NICHOLS	Texas State Soil and Water Conservation Board Chambers Creek Site 4 Dam	Plate 01-1
FILE: T:\3.0 DESIGN\# WORKING FOLDERS\GEO\Big Sandy 43\3_Field Exploration\05_Boring			
DATE: July 2020	10497 TOWN AND COUNTRY WAY, STE 500 HOUSTON, TX 77024	SAMPLE PHOTOGRAPHS 01 (Centerline of Dam)	
PREPARED: SK			

45’ 50’

50’ 55’

55’ 60’

FNI PROJECT: TSW20319	FREESE AND NICHOLS	Texas State Soil and Water Conservation Board Chambers Creek Site 4 Dam	Plate 01-2
FILE: T:\3.0 DESIGN\# WORKING FOLDERS\GEO\Big Sandy 43\3_Field Exploration\05_Boring			
DATE: July 2020	10497 TOWN AND COUNTRY WAY, STE 500 HOUSTON, TX 77024	SAMPLE PHOTOGRAPHS 01 (Centerline of Dam)	
PREPARED: SK			

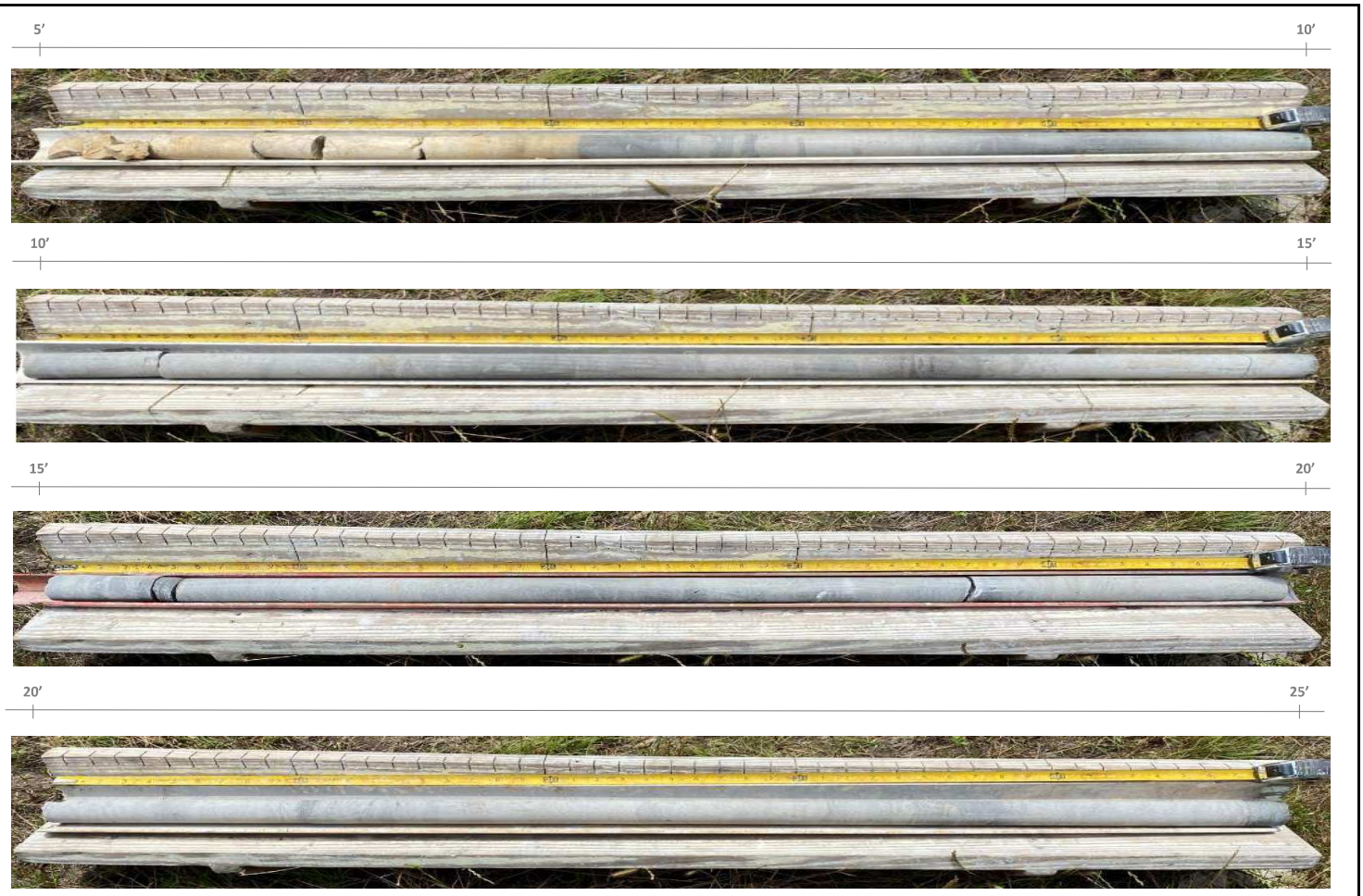
30’ 35’

35’ 40’

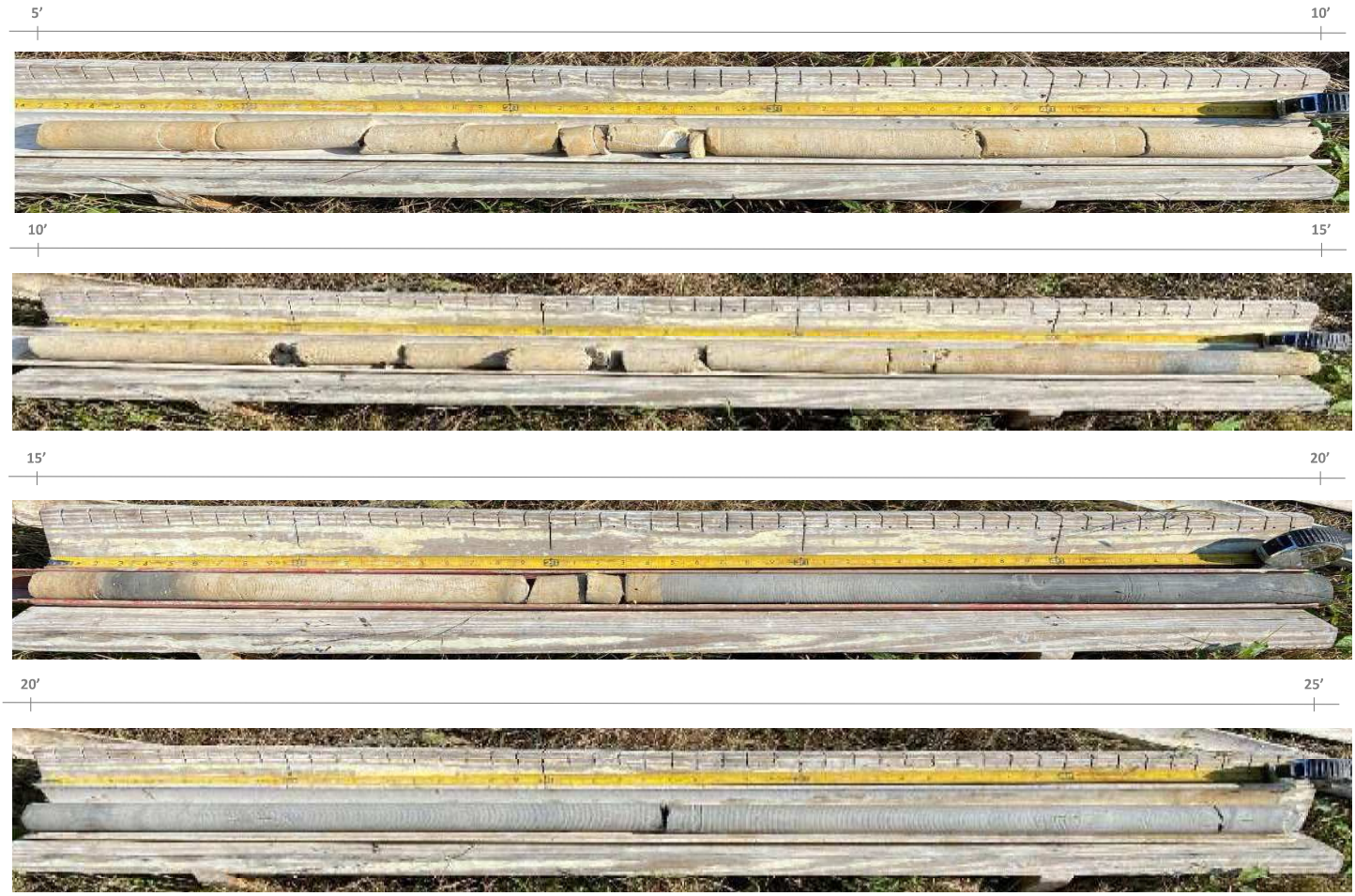
40’ 45’

45’ 50’

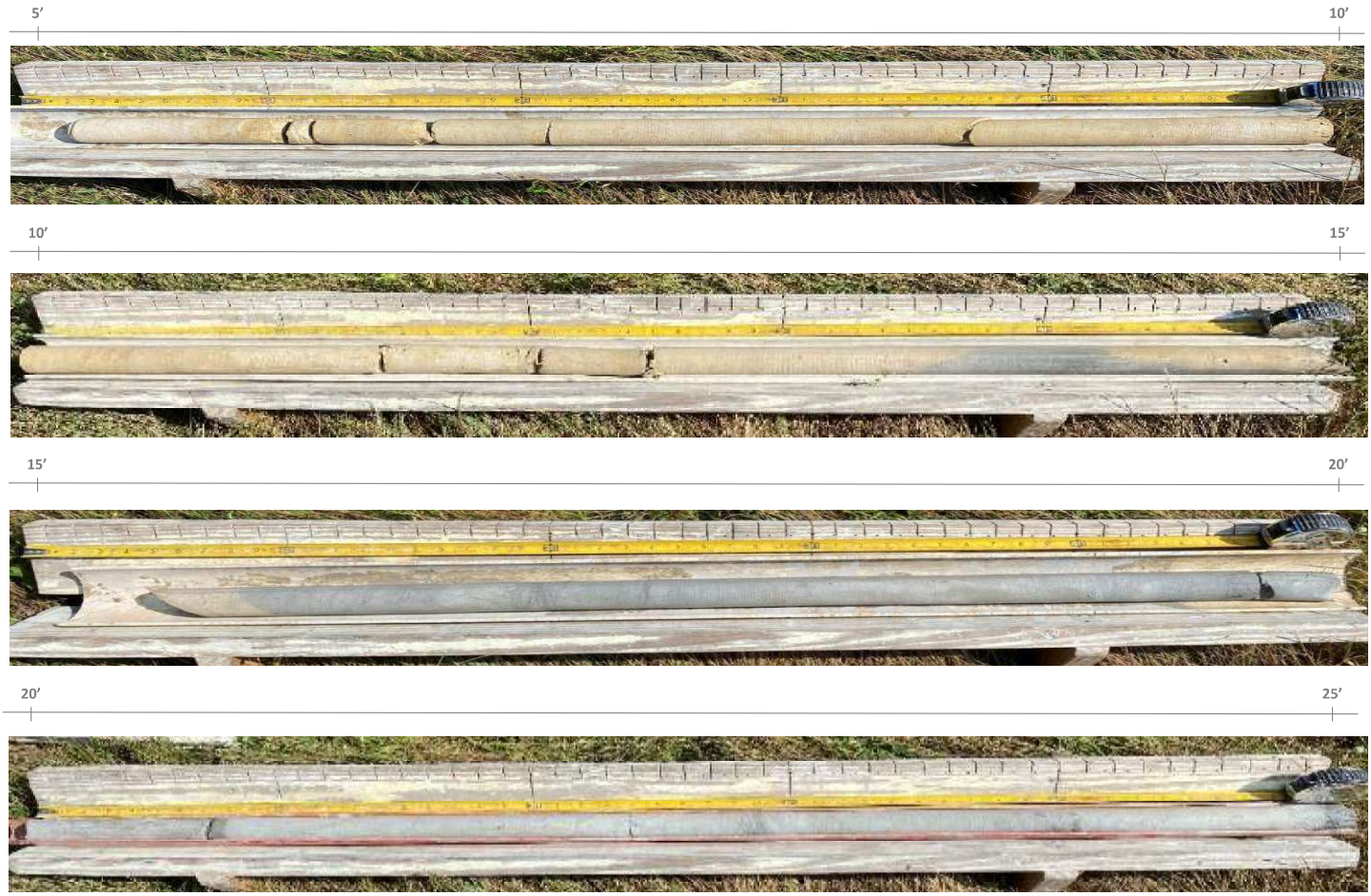
FNI PROJECT: TSW20319	FREESE AND NICHOLS	Texas State Soil and Water Conservation Board Chambers Creek Site 4 Dam	Plate 02-1
FILE: T:\3.0 DESIGN\# WORKING FOLDERS\GEO\Big Sandy 43\3_Field Exploration\05_Boring			
DATE: July 2020	10497 TOWN AND COUNTRY WAY, STE 500 HOUSTON, TX 77024	SAMPLE PHOTOGRAPHS 02 (Centerline of Dam)	
PREPARED: SK			



FNI PROJECT: TSW20319	FREESE AND NICHOLS	Texas State Soil and Water Conservation Board Chambers Creek Site 4 Dam	Plate 201-1
FILE: T:\3.0 DESIGN\# WORKING FOLDERS\GEO\Big Sandy 43\3_Field Exploration\05_Boring			
DATE: July 2020	10497 TOWN AND COUNTRY WAY, STE 500 HOUSTON, TX 77024	SAMPLE PHOTOGRAPHS 201 (Existing Eastern Spillway)	
PREPARED: SK			



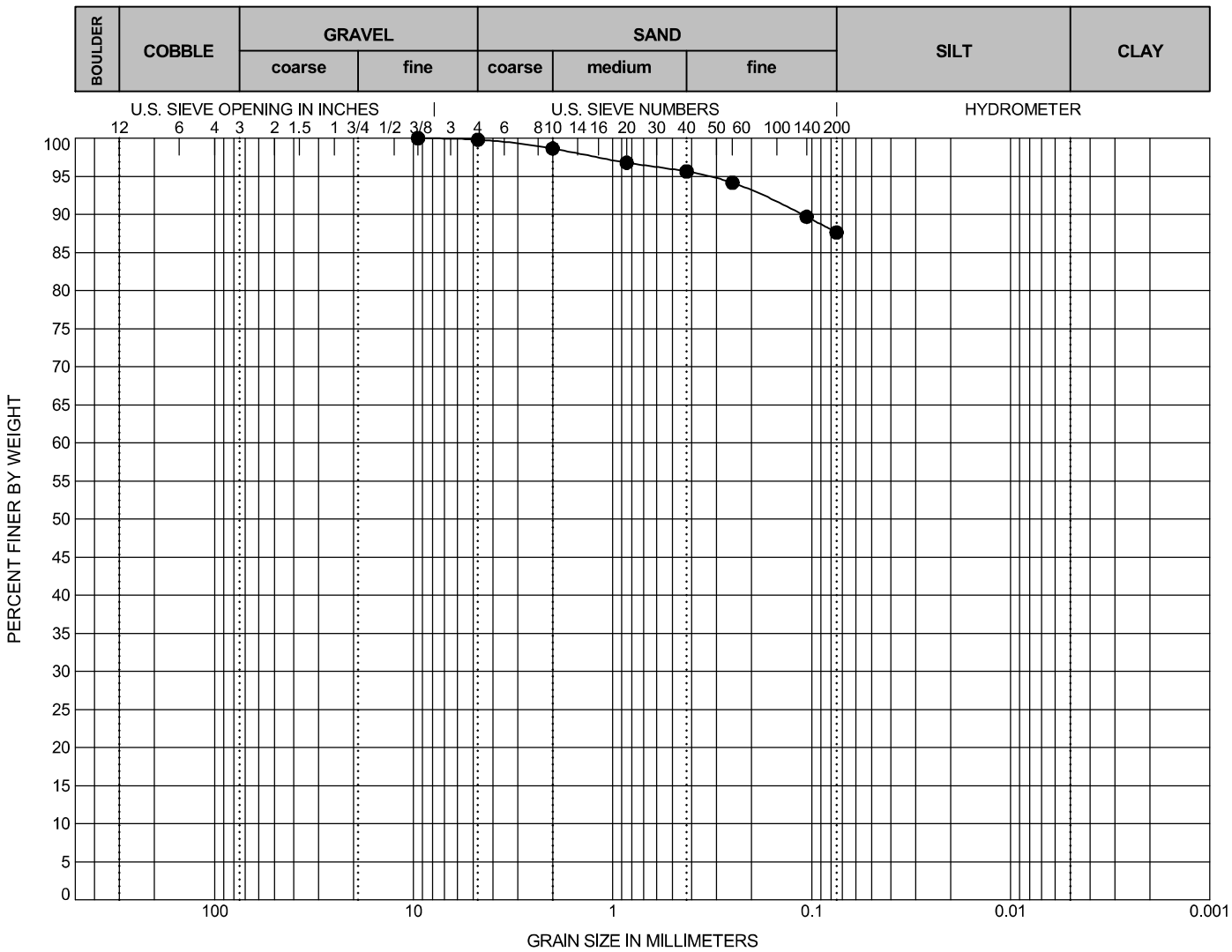
FNI PROJECT: TSW20319	FREESE AND NICHOLS	Texas State Soil and Water Conservation Board Chambers Creek Site 4 Dam	Plate 202-1
FILE: T:\3.0 DESIGN\# WORKING FOLDERS\GEO\Big Sandy 43\3_Field Exploration\05_Boring			
DATE: July 2020	10497 TOWN AND COUNTRY WAY, STE 500 HOUSTON, TX 77024	SAMPLE PHOTOGRAPHS 202 (Existing Eastern Spillway)	
PREPARED: SK			



FNI PROJECT: TSW20319	FREESE AND NICHOLS	Texas State Soil and Water Conservation Board Chambers Creek Site 4 Dam	Plate 203-1
FILE: T:\3.0 DESIGN\# WORKING FOLDERS\GEO\Big Sandy 43\3_Field Exploration\05_Boring			
DATE: July 2020	10497 TOWN AND COUNTRY WAY, STE 500 HOUSTON, TX 77024	SAMPLE PHOTOGRAPHS 203 (Existing Eastern Spillway)	
PREPARED: SK			

Attachment E-5: Geotechnical Information

Chambers Creek 4 Laboratory Test Results



Exploration ID	Depth (ft.)	Sample Description	LL	PL	PI
● 01	6		NM	NM	NM

Exploration ID	Depth (ft.)	D_{100}	D_{60}	D_{30}	D_{10}	Cc	Cu	Passing 3/4"	Passing #4	Passing #200	%Silt	%Clay
● 01	6	9.5	NM	NM	NM	NM	NM		100	88	NM	NM

Coefficients of Uniformity - $C_u = D_{60} / D_{10}$

Coefficients of Curvature - $C_C = (D_{30})^2 / D_{60} D_{10}$

D_{60} = Grain diameter at 60% passing

D_{30} = Grain diameter at 30% passing

D_{10} = Grain diameter at 10% passing

Sieve Analysis and Hydrometer Analysis testing performed in general accordance with ASTM D422.
NP = Nonplastic
NM = Not Measured

KLEINFELDER
Bright People. Right Solutions.

PROJECT NO.: 20183284
DRAWN BY:
CHECKED BY:
DATE:
REVISED: -

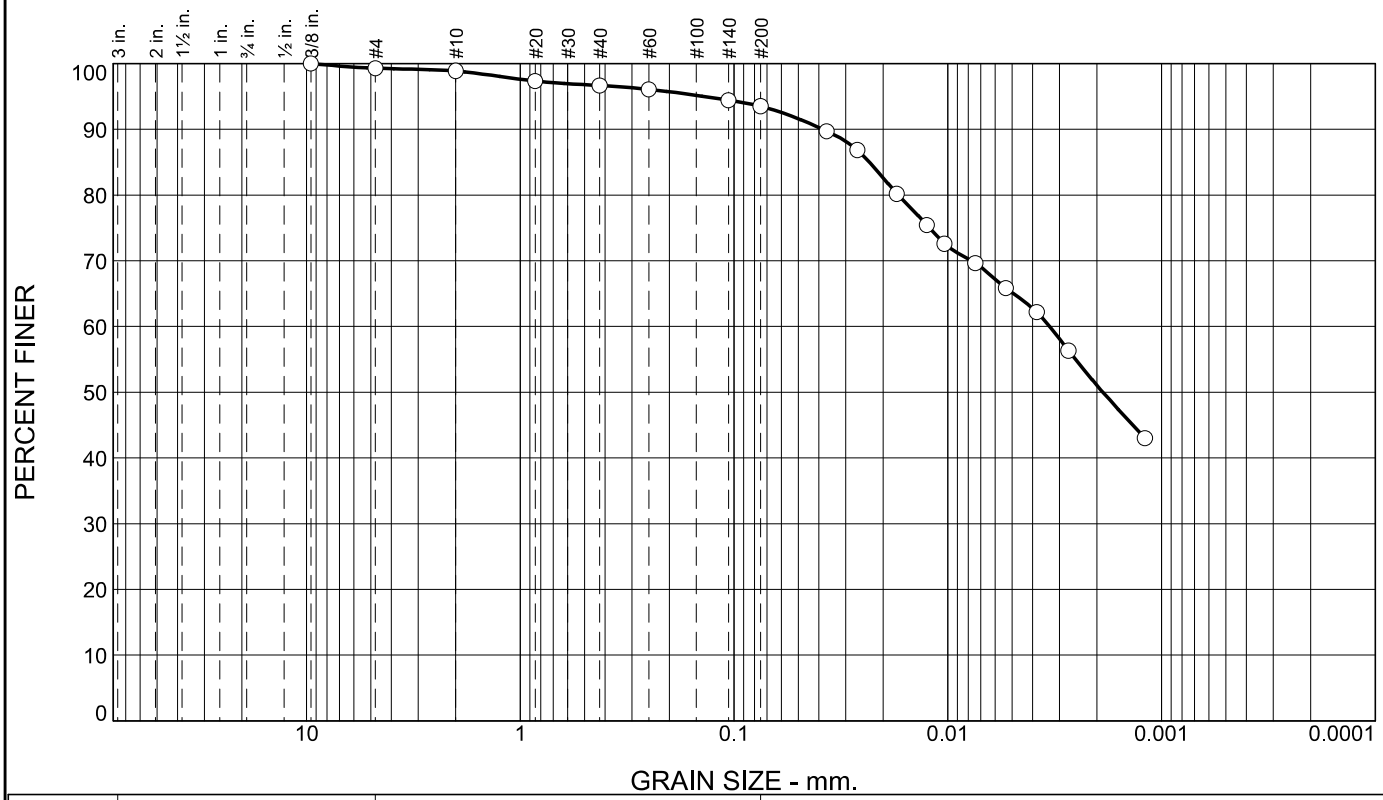
SIEVE ANALYSIS

Chambers Creek 6
Water Resources Design CC4: TSW20319

TABLE
1

PLOTTED: 06/22/2020 05:01 PM BY: EArapi
OFFICE FILTER: DALLAS
PROJECT NUMBER: 20183284.001A_13-0000
gINT FILE: Klf_gint_master_2018
gINT TEMPLATE: E:KLF_STANDARD_GINT_LIBRARY_2018.GLB [KLF_SIEVE_ANALYSIS(SINGLE)]

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.7	0.4	2.2	3.2	42.5	51.0

TEST RESULTS

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
3/8	100.0		
#4	99.3		
#10	98.9		
#20	97.4		
#40	96.7		
#60	96.1		
#140	94.4		
#200	93.5		
0.0368 mm.	89.7		
0.0264 mm.	86.8		
0.0173 mm.	80.2		
0.0125 mm.	75.4		
0.0104 mm.	72.6		
0.0074 mm.	69.6		
0.0053 mm.	65.8		
0.0038 mm.	62.2		
0.0027 mm.	56.3		
0.0012 mm.	43.0		

* (no specification provided)

Material Description

Fat Clay, brown, with calcareous nodules

Atterberg Limits (ASTM D 4318)

PL= **LL=** **PI=**

Classification

USCS (D 2487)= CH **AASHTO (M 145)=**

Coefficients

D_{90}= 0.0385 D_{85}= 0.0232 D_{60}= 0.0033
D_{50}= 0.0019 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Remarks

Date Received: **Date Tested:** 06/18/20

Tested By: E.Arapi

Checked By: S.Dinakaran

Title:

Source of Sample: 01 **Depth:** 13.0' - 15.0' **Date Sampled:** 06/01/20
Sample Number: U6

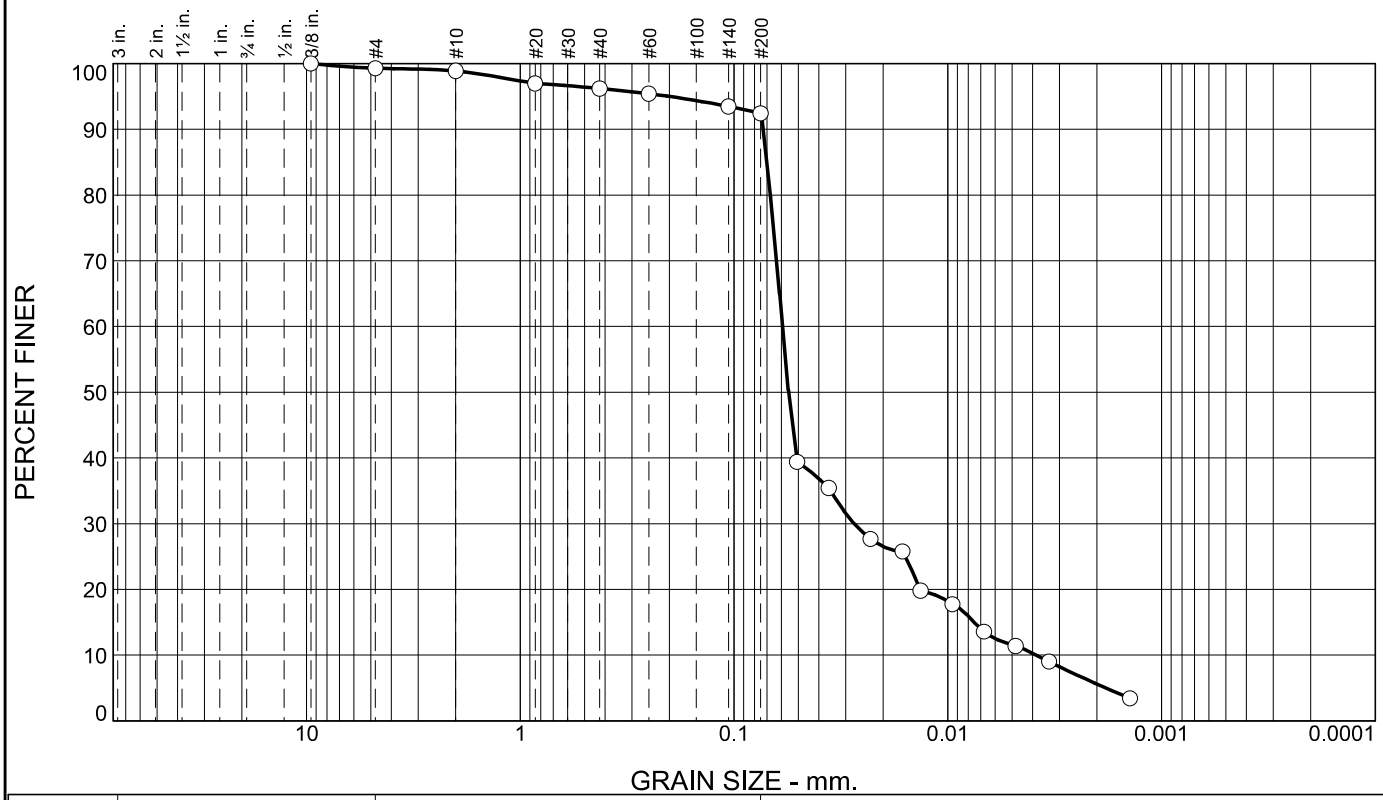
Kleinfelder, Inc.

Irving, TX

Client: Freese and Nichols
Project: FNI: 2018 Misc Lab Testing
Water Resources Design CC4: TSW20319
Project No: 20183284.001A **Figure**

Material Classification, unless data is available, is based on the ASTM D 2488 (Visual-Manual Procedures)
Vertical Loads were applied for Project Request

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.7	0.4	2.7	3.8	86.8	5.6

TEST RESULTS

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
3/8	100.0		
#4	99.3		
#10	98.9		
#20	97.0		
#40	96.2		
#60	95.4		
#140	93.5		
#200	92.4		
0.0506 mm.	39.4		
0.0360 mm.	35.4		
0.0230 mm.	27.7		
0.0163 mm.	25.8		
0.0134 mm.	19.8		
0.0095 mm.	17.7		
0.0068 mm.	13.6		
0.0048 mm.	11.4		
0.0034 mm.	9.0		
0.0014 mm.	3.4		

* (no specification provided)

Material Description

Fat Clay, brown, with calcareous nodules

Atterberg Limits (ASTM D 4318)

PL= **LL=** **PI=**

Classification

USCS (D 2487)= CH **AASHTO (M 145)=**

Coefficients

D_{90}= 0.0731 D_{85}= 0.0700 D_{60}= 0.0594
D_{50}= 0.0555 D_{30}= 0.0274 D_{15}= 0.0075
D_{10}= 0.0039 C_u= 15.40 C_c= 3.28

Remarks

Date Received: **Date Tested:** 06/18/20

Tested By: E.Arapi

Checked By: S.Dinakaran

Title:

Source of Sample: 01 **Depth:** 13.0' - 15.0' **Date Sampled:** 06/01/20
Sample Number: U6

Kleinfelder, Inc.

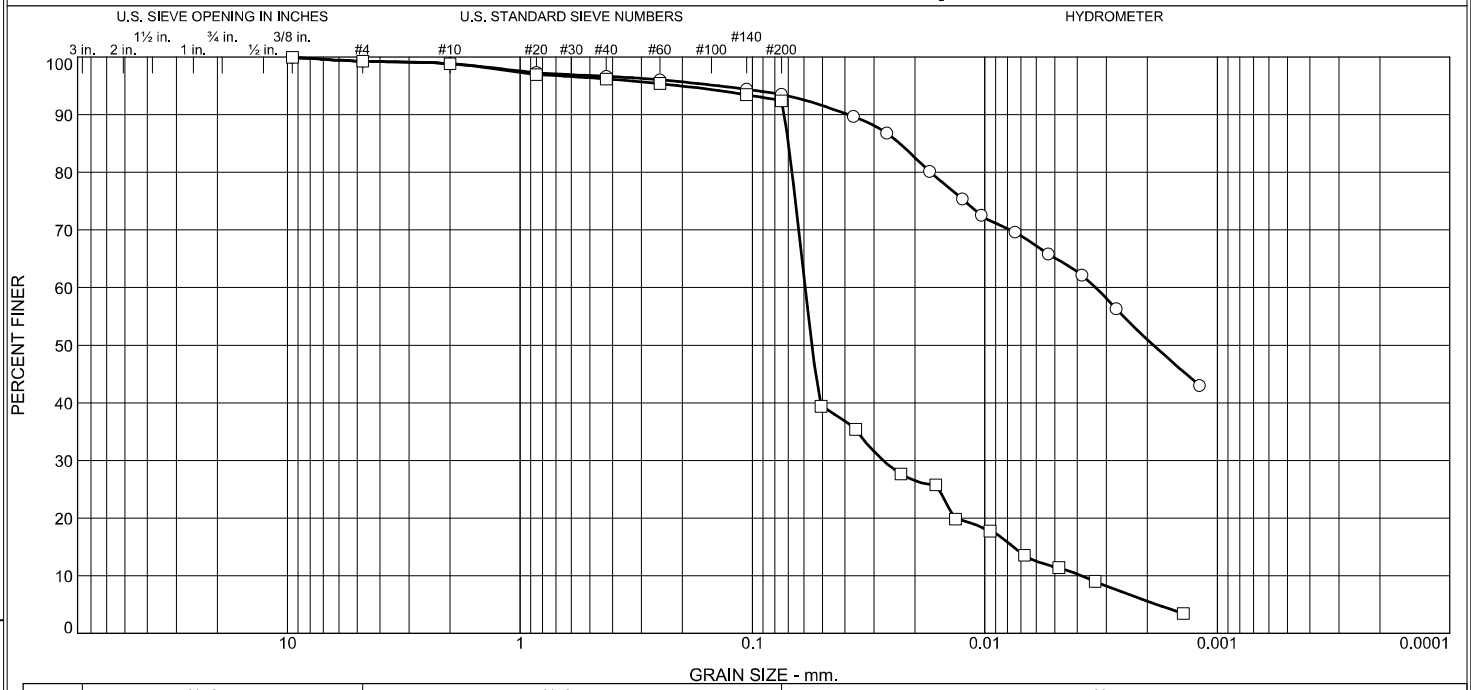
Irving, TX

Client: Freese and Nichols
Project: FNI: 2018 Misc Lab Testing
Water Resources Design CC4: TSW20319
Project No: 20183284.001A **Figure**

Material Classification, unless data is available, is based on the ASTM D 2488 (Visual-Manual Procedures)
Vertical Loads were applied for Project Request

Material Classification, unless data is available, is based on the ASTM D 2488 (Visual-Manual Procedures)
Vertical Loads were applied for Project Request

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.7	0.4	2.2	3.2	42.5	51.0
□	0.0	0.0	0.7	0.4	2.7	3.8	86.8	5.6

	Source	Sample #	Depth/Elev.	Date Sampled	USCS	Material Description	NM %	LL	PL
○	01	U6	13.0' - 15.0'	06/01/20	CH	Fat Clay, brown, with calcareous nodules			
□	01	U6	13.0' - 15.0'	06/01/20	CH	Fat Clay, brown, with calcareous nodules			

Client Freese and Nichols
Project FNI: 2018 Misc Lab Testing
Water Resources Design CC4: TSW20319
Project No. 20183284.001A Figure

Kleinfelder, Inc.

Irving, TX

Tested By: E.Arapi **Checked By:** S.Dinakaran

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p| 972.868.5900
f| 972.409.0008
kleinfelder.com

SOIL DISPERSION (ASTM D-6572)

PROJECT: FNI: 2018 Misc Lab Testing
ChambersCreek #6_TSW20319/CC6/0AH0/1110
ENGINEER: Freese and Nichols, Inc.
TESTING AGENCY: KLEINFELDER

PROJECT NO.: 20183284.001A

REPORT DATE: 06/17/20

Assignment date : 06/08/20
Sample Location : Boring # 01 Sample # U2 Depth: 2.0 - 4.0 ft.
Sample Description : Fat Clay, brown and light brown, with calcareous nodules
Trial #: 1

Moisture Content [%]		
Tare Number	A-117	
Tare + Wet Mass	69.19	[gr]
Tare + Dry Mass	62.87	[gr]
Tare Mass	30.44	[gr]
Moisture Content	**19.5**	[%]

Figure No.1 [2 min]

Figure No.2 [1 hour]

Target Reading	Grade	Temp (°C)	Method
2 min	1	20.9	A
1 hour	1	19.7	
6 hours	1	16.8	
Dispersive Classification	Gr.1 Non-Dispersive		

Figure No.3 [6 hours]

KLEINFELDER INC.

Reviewed By:
Sri Dinakaran, PE, DGE

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ENGINEER: Freese and Nichols, Inc.
TESTING AGENCY: KLEINFELDER

PROJECT NO.: 20183284.001A

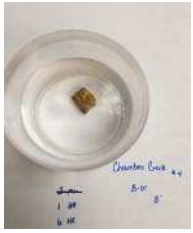
REPORT DATE: 06/17/20

Assignment date : 06/08/20
Sample Location : Boring # 01 Sample # U5 Depth: 8.0-10.0 ft.
Sample Description : Fat Clay, brown and light brown, with calcareous nodules
Trial #: 1

Moisture Content [%]		
Tare Number	C-22	
Tare + Wet Mass	73.83	[gr]
Tare + Dry Mass	66.40	[gr]
Tare Mass	30.65	[gr]
Moisture Content	**20.8**	[%]

Figure No.1 [2 min]

Figure No.2 [1 hour]



Target Reading	Grade	Temp (°C)	Method
2 min	1	20.9	A
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ENGINEER: Freese and Nichols, Inc.
TESTING AGENCY: KLEINFELDER

PROJECT NO.: 20183284.001A

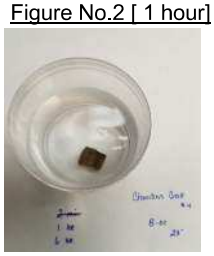
REPORT DATE: 06/17/20

Assignment date : 06/08/20
Sample Location : Boring # 01 Sample # U8 Depth: 23.0-25.0 ft.
Sample Description : Fat Clay, brown and olive brown, calcareous
Trial #: 1

Moisture Content [%]		
Tare Number	A-85	
Tare + Wet Mass	57.76	[gr]
Tare + Dry Mass	51.91	[gr]
Tare Mass	30.27	[gr]
Moisture Content	**27.0**	[%]

Figure No.1 [2 min]

Figure No.2 [1 hour]



Target Reading	Grade	Temp (°C)	Method
2 min	1	20.9	A
1 hour	1	19.7	
6 hours	1	16.8	
Dispersive Classification	Gr.1 Non-Dispersive		

Figure No.3 [6 hours]

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ChambersCreek #6_TSW20319/CC6/0AH0/1110
ENGINEER: Freese and Nichols, Inc.
TESTING AGENCY: KLEINFELDER

PROJECT NO.: 20183284.001A

REPORT DATE: 06/17/20

Assignment date : 06/08/20
Sample Location : Boring # 02 Sample # U1 Depth: 0.0-2.0 ft.
Sample Description : Lean Clay, light brown and yellow brown
Trial #: 1

Moisture Content [%]		
Tare Number	C-45	
Tare + Wet Mass	85.80	[gr]
Tare + Dry Mass	77.75	[gr]
Tare Mass	30.65	[gr]
Moisture Content	**17.1**	[%]

Figure No.1 [2 min]

Figure No.2 [1 hour]

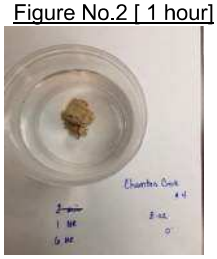

Figure No.3 [6 hours]

Target Reading	Grade	Temp (°C)	Method
2 min	1	20.9	A
1 hour	1	19.7	
6 hours	1	16.8	
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ChambersCreek #6_TSW20319/CC6/0AH0/1110
ENGINEER: Freese and Nichols, Inc.
TESTING AGENCY: KLEINFELDER

PROJECT NO.: 20183284.001A

REPORT DATE: 06/17/20

Assignment date : 06/08/20
Sample Location : Boring # 02 Sample # U5 Depth: 8.0-10.0 ft.
Sample Description : Lean Clay, olive brown and light brown, with calcareous nodules
Trial #: 1

Moisture Content [%]		
Tare Number	C-22	
Tare + Wet Mass	66.68	[gr]
Tare + Dry Mass	61.01	[gr]
Tare Mass	30.65	[gr]
Moisture Content	**18.7**	[%]

Target Reading	Grade	Temp (°C)	Method
2 min	1	20.9	A
1 hour	1	19.7	
6 hours	1	16.8	
Dispersive Classification	Gr.1 Non-Dispersive		

Figure No.1 [2 min]

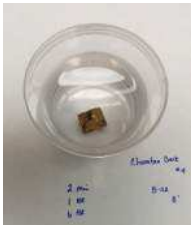
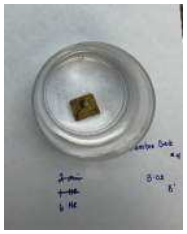


Figure No.2 [1 hour]

Figure No.3 [6 hours]



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ENGINEER: Freese and Nichols, Inc.
TESTING AGENCY: KLEINFELDER

PROJECT NO.: 20183284.001A

REPORT DATE: 06/17/20

Assignment date : 06/08/20
Sample Location : Boring # 02 Sample # U8 Depth: 23.0-25.0 ft.
Sample Description : Fat Clay, dark brown, with calcareous nodules
Trial #: 1

Moisture Content [%]		
Tare Number	C-43	
Tare + Wet Mass	101.48	[gr]
Tare + Dry Mass	87.42	[gr]
Tare Mass	30.32	[gr]
Moisture Content	**24.6**	[%]

Figure No.1 [2 min]

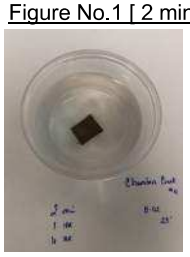
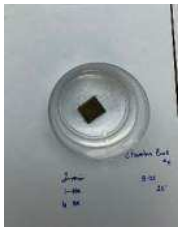


Figure No.2 [1 hour]

Target Reading	Grade	Temp (°C)	Method
2 min	1	20.9	A
1 hour	1	19.7	
6 hours	1	16.8	
Dispersive Classification	Gr.1 Non-Dispersive		

Figure No.3 [6 hours]



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ENGINEER: Freese and Nichols, Inc.
TESTING AGENCY: KLEINFELDER

PROJECT NO.: 20183284.001A

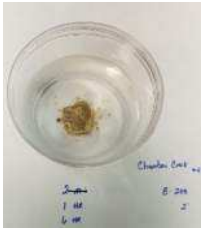
REPORT DATE: 06/17/20

Assignment date : 06/08/20
Sample Location : Boring # 01 Sample # U2 Depth: 2.0 - 4.0 ft.
Sample Description : Lean Clay with Sand, light brown and brown
Trial #: 1

Moisture Content [%]		
Tare Number	L-412	
Tare + Wet Mass	240.01	[gr]
Tare + Dry Mass	216.62	[gr]
Tare Mass	101.22	[gr]
Moisture Content	**20.3**	[%]

Figure No.1 [2 min]

Figure No.2 [1 hour]



Target Reading	Grade	Temp (°C)	Method
2 min	1	20.9	A
1 hour	1	19.7	
6 hours	1	16.8	
Dispersive Classification	Gr.1 Non-Dispersive		

Figure No.3 [6 hours]

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Attachment E-6: Headcut Erodibility Index Calculation Information

Chambers Creek 4

1.0 PURPOSE

Chambers Creek Watershed Site 4 (Site 4) is a flood control structure and water supply reservoir located in Ellis County, Texas. As part of the geotechnical investigation phase, Freese and Nichols, Inc. (FNI) developed Headcut Erodibility Index (K_h) values for the existing auxiliary spillway based on NRCS, Part 628, Chapter 52 (NRCS guidance). This calculation is intended to describe the development of the K_h values for the auxiliary spillway at Site 4.

2.0 REFERENCES

1) Field Procedures Guide for the Headcut Erodibility Index (NRCS, Part 628, Chapter 52, 1997)
2) Boring Logs (FNI, 2020) – Borings 201 through 203

3.0 GEOTECHNICAL INVESTIGATION

3.1 Field Investigation

The developed K_h values were based on the information from the boreholes (201 through 203) that were drilled in June 2020 by FNI within the existing auxiliary spillway. The FNI borings were drilled to a depth of 25 feet. All sets of borings encountered a thin layer of clay overlying limestone.

3.2 Laboratory Results

Laboratory testing for the FNI field investigations included unconfined compressive strength testing on the limestone to be used to develop K_h values. Field and laboratory data required for the headcut erodibility calculation was based on the FNI investigations.

3.3 Stratigraphy

Soils within the borings at the auxiliary spillway were classified as fat (CH) clays by the FNI in-situ testing and laboratory tests. The clay ranges in thickness from 0.5 to 1.8 feet. All sets of encountered 7 to 17 feet of weathered limestone. Representative laboratory testing was not available for the clay materials in the auxiliary spillway. Therefore, a liquid limit, plasticity index, clay fraction, and unconfined compression strength were assumed based on the descriptions on the boring logs and laboratory data from the similar materials obtained from the field investigation at Site 4. The limestone was divided into layers based on the RQD values. Strength values for the limestone were selected based on average unconfined compression test results from the investigation for the weathered and unweathered limestone. Table 1 summarizes the values selected in order to calculate K_h for the materials.

Table 1: Summary of Input Data to Calculate K_h

Layer	Description	LL (%)	PI (%)	Clay Fraction (%)	UCS (MPa)	RQD (%)
1	Overlying Clays	57	29	50	0.1	--
2	Weathered Limestone	--	--	--	5.3	83
3	Fresh Limestone	--	--	--	9.4	91

4.0 HEADCUT ERODIBILITY INDEX

There are four components that must be evaluated in order to calculate K_h for each stratum identified along the spillway cross-section. These components are material strength number, block/particle size number, discontinuity/interparticle bond shear strength number, and the relative ground structure number. The procedures for determining the value of each component is described in the NRCS guidelines. The headcut erodibility index, K_h, represents a measure of the resistance of the earth material to erosion. The index takes the general form:

$$K_h = M_s * K_b * K_d * J_c$$

Where: M_s = material strength number of the earth material
K_b = block or particle size number
K_d = discontinuity or interparticle bond shear strength number
J_s = relative ground structure number

4.1 Material Strength Number (M_s)

The material strength number (M_s) expresses the unconfined compressive strength of an intact representative sample of the material itself without consideration of innate geologic variability within the mass. For the clays, M_s is approximated using the formula found in Table 52-3 of the NRCS guidelines, which uses the unconfined compressive strength (UCS) of the material as the variable. For the limestone, M_s is approximated using the formula found in Table 52-4 for the NRCS guidelines, which uses the unconfined compressive strength (UCS) of the rock as a variable.

4.2 Block/Particle Size Number (K_b)

The block/particle size number (K_b) refers to the mean block size of intact rock material as determined by the spacing of discontinuities within the rock mass or mean grain size for granular material. For intact, cohesive soils and coarse detritus, gravels and boulder formations for which D>0.1 meter, K_b = 1. Therefore, K_b = 1 was used for the clays.

For rock and rock-like materials, the primary method to calculate K_b is:

$$K_b = \frac{RQD}{J_n}$$

Where: RQD = rock quality designation
J_n = joint set number

After review of the core runs within the limestone at the auxiliary spillway site, RQD values varied with depth. Therefore, the limestone was separated into five layers with varying ranges of RQD and the lowest RQD encountered within each layer was selected for the development of K_b as a conservative approach.

The joint set number (J_n) is a scale factor representing the effect of different individual discontinuity spacings relative to the average discontinuity spacing as summarized in Table 52-5 of the NRCS guidelines. For development of K_b, a joint set number, J_n of 5 (more than four joint set) was estimated after review of the logs and core photos.

4.3 Discontinuity/Interparticle Bond Shear Strength Number (K_d)

K_d represents the shear strength of a discontinuity in a rock mass, or strength of interparticle bonds of the gouge (soil material) within the aperture of a discontinuity. If the material under consideration occurs as a soil mass or as gouge in the apertures of rock discontinuities, K_d is determined by:

$$K_d \approx \tan \emptyset'_r$$

Where: Φ'_r = joint roughness number

For ≤ 20% clay, $\Phi'_r = 169.58\ (LL)^{-0.4925}$

For 25 - 45% clay, $\Phi'_r = 329.56\ (LL)^{-0.7100}$

For ≥ 50% clay, $\Phi'_r = 234.73\ (LL)^{-0.6655}$

If the material under consideration is a rock or rock-like material, K_d is determined by:

$$K_d = \frac{J_r}{J_a}$$

Where: J_r = joint roughness number

J_a = joint alteration number

The joint roughness number (J_r) represents the degree of roughness of opposing faces of a rock discontinuity as summarized in Table 52-8 of the NRCS guidelines. An overall joint roughness number of 1.5 was selected based on descriptions of the limestone on the boring logs. The joint alteration number (J_a) represents the degree of alteration of the materials that form the faces as summarized in Table 52-9 of the NRCS guidelines. The limestone was assigned J_a = 6.0.

4.0 Relative Ground Structure Number (J_s)

J_s accounts for the structure of the ground with respect to streamflow. The NRCS guidelines state that soil material is considered intact (without structure), in which case J_s = 1. Therefore, J_s = 1 was used for the clay soils.

For rock, the relative ground structure number (J_s) represents the orientation of the effective dip of the least favorable discontinuity with respect to spillway flow. To calculate the effective dip (q), the apparent dip of the bedrock is first determined by using the following relationship, expressing horizontal angles in degrees azimuth and vertical angles in degrees:

$$\tan a = (\tan b)\ (\sin c)$$

Where: a = apparent dip of discontinuity

b = true dip of discontinuity

c = (strike of discontinuity) – (spillway flow direction)

Since no field mapping of the joint sets was performed, ground structure number, Js was conservatively calculated using NRCS spreadsheet with an exit channel slope of 4.55°, spillway flow azimuth direction of 63°, bedrock strike of 11°, bedrock dip of 0.65°, and bedrock dip azimuth direction of 101°. Therefore, an apparent dip (degree) of -0.5° and effective dip (degree) of 4° were calculated. Assuming the effective dip angle is with the flow and a 1:1 ratio of joint spacing results in a J_s of 1.3. for the limestone strata.

5.0 Summary

A summary of the SITES parameters developed by FNI are provided in Table 2. The values provided in the Table 2 are based on the laboratory data obtained in June 2020 by FNI. The unconfined compression test results indicated that the limestone is generally "moderately soft rock" with an average compressive strength of 9.4 MPa for unweathered sections.

Table 2: Summary of SITES Input Parameters for Site 10

Layer	Description	PI* (%)	Dry Density* (pcf)	Clay Fraction* (%)	Representative Diameter – D_{75}* (in)	Percent Passing No. 200 Sieve	Head Cut Index (K_h)
1	Overlying Clays	29	100	50	0.001	81	0.02
2	Weathered Limestone	--	123	--	--	--	8.6
3	Fresh Limestone	--	124	--	--	--	106.2

*Representative Laboratory data is not available for the clays in the Auxiliary Spillway. Values are assumed based on averages from the investigation across Site 4.

Attachment E-7: TR-60 Breach Calculations

Chambers Creek 4

TR-60 Breach Calculations
Hydrologic Breach

Watershed Name	Chambers Creek	Date	27-Apr-20
Site No.	4	Prepared By:	JFA

Elevations					
Top of Dam	734.6	Ft msl	Top Width	12	Ft
Breach Hydrograph	734.6	Ft msl	Upstream Slope Above Berm	3	:1
Wave Berm	718.2	Ft msl	Upstream Slope Below Berm	3	:1
Average Valley Floor	706.0	Ft msl	Downstream Slope Above Berm	2	:1
Stability Berm	707.6	Ft msl	Downstream Slope Below Berm	2	:1
Length of Dam at Breach Elev	1159.5	Ft	Wave Berm Width	10	Ft
Volume of Breach	510.75	Ac Ft	Stability Berm Width	0	Ft

Breach Discharge Computations

Volume of Breach (Vs)	511	Ac Ft
Height Of Breach (Hw)	29	Ft
Cross-Section Area at Breach (A)	2,510	FT^2
$T = 65(H^{0.35})/0.416$	505	

If L > T,		
$Br = (Vs * Hw)/A$	6	
$Qmax = 1{,}100\ (Br)^{1.35}$	11,857	CFS
If L < T,		
$Qmax = 0.416\ (L)(Hw^{1.5})$	73,776	CFS
Qmax NOT GREATER THAN		
$Qmax = 65(HW^{1.85})$	32,151	CFS
Qmax NOT LESS THAN		
$Qmax = 3.2(Hw^{5/2})$	13,998	CFS

Breach Qmax for Hazard Classification = 14,000 CFS

TR-60 Breach Calculations
Seismic Breach

Watershed Name	Chambers Creek	Date	27-Apr-20
Site No.	4	Prepared By:	JFA

Elevations					
Top of Dam	734.6	Ft msl	Top Width	12	Ft
Breach Hydrograph	719.2	Ft msl	Upstream Slope Above Berm	3	:1
Wave Berm	718.2	Ft msl	Upstream Slope Below Berm	3	:1
Average Valley Floor	706.0	Ft msl	Downstream Slope Above Berm	2	:1
Stability Berm	707.6	Ft msl	Downstream Slope Below Berm	2	:1
Length of Dam at Breach Elev	576	Ft	Wave Berm Width	10	Ft
Volume of Breach	62	Ac Ft	Stability Berm Width	0	Ft

Breach Discharge Computations

Volume of Breach (Vs)	62	Ac Ft
Height Of Breach (Hw)	13	Ft
Cross-Section Area at Breach (A)	2,510	FT^2
$T = 65(H^{0.35})/0.416$	385	

If L > T,		
$Br = (Vs * Hw)/A$	0	
$Qmax = 1{,}100\ (Br)^{1.35}$	242	CFS
If L < T,		
$Qmax = 0.416\ (L)(Hw^{1.5})$	11,491	CFS
Qmax NOT GREATER THAN		
$Qmax = 65(HW^{1.85})$	7,691	CFS
Qmax NOT LESS THAN		
$Qmax = 3.2(Hw^{5/2})$	2,026	CFS

Breach Qmax for Hazard Classification = 2,000 CFS

TR-60 Breach Calculations
Static Breach

Watershed Name	Chambers Creek	Date	27-Apr-20
Site No.	4	Prepared By:	JFA

Elevations					
Top of Dam	734.6	Ft msl	Top Width	12	Ft
Breach Hydrograph	729.6	Ft msl	Upstream Slope Above Berm	3	:1
Wave Berm	718.2	Ft msl	Upstream Slope Below Berm	3	:1
Average Valley Floor	706.0	Ft msl	Downstream Slope Above Berm	2	:1
Stability Berm	707.6	Ft msl	Downstream Slope Below Berm	2	:1
Length of Dam at Breach Elev	1050.3	Ft	Wave Berm Width	10	Ft
Volume of Breach	273.93	Ac Ft	Stability Berm Width	0	Ft

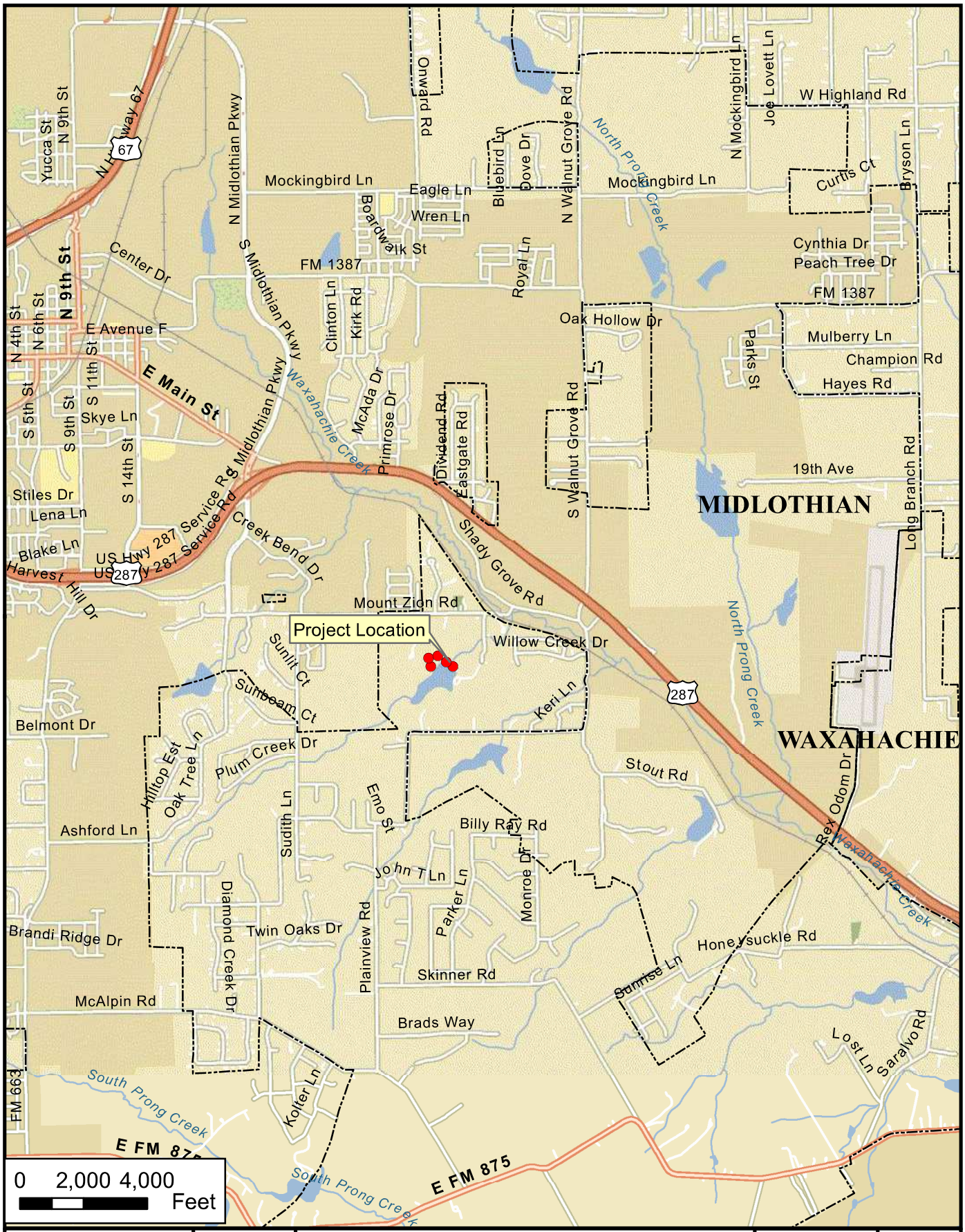
Breach Discharge Computations

Volume of Breach (Vs)	274	Ac Ft
Height Of Breach (Hw)	24	Ft
Cross-Section Area at Breach (A)	2,510	FT^2
$T = 65(H^{0.35})/0.416$	472	

If L > T,		
$Br = (Vs * Hw)/A$	3	
$Qmax = 1{,}100\ (Br)^{1.35}$	3,945	CFS
If L < T,		
$Qmax = 0.416\ (L)(Hw^{1.5})$	50,093	CFS
Qmax NOT GREATER THAN		
$Qmax = 65(HW^{1.85})$	22,532	CFS
Qmax NOT LESS THAN		
$Qmax = 3.2(Hw^{5/2})$	8,658	CFS
Breach Qmax for Hazard Classification =	**8,700**	**CFS**

Attachment E-8: Geotechnical Information

Chambers Creek 6 Vicinity Map



FREESE AND NICHOLS

4055 International Plaza, Suite 200
Fort Worth, TX 76109 - 4895
Phone - (817) 735 - 7300

N W E S

TX STATE SOIL AND WATER CONSERVATION
WRPP CHAMBERS CREEK SITE 6

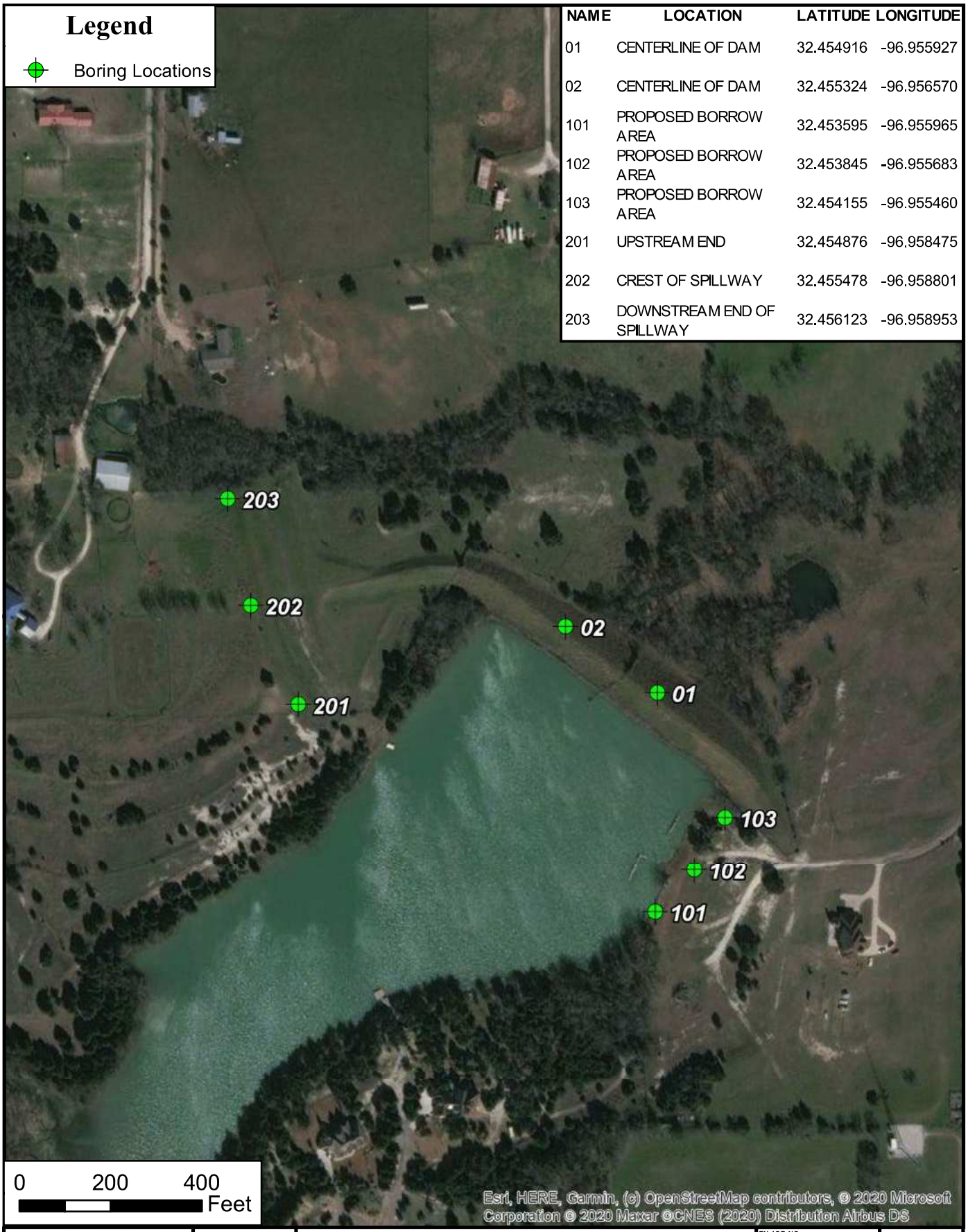
Vicinity Map

FN JOB NO	TSW20319
FILE	VIC_CC_SITE6
DATE	7/23/2020
SCALE	1:50,000
DESIGNED	Mahsa Hedayati
DRAFTED	ZDC

1
FIGURE

Attachment E-9: Geotechnical Information

Chambers Creek 6 Boring Location Map



NAME	LOCATION	LATITUDE	LONGITUDE
01	CENTERLINE OF DAM	32.454916	-96.955927
02	CENTERLINE OF DAM	32.455324	-96.956570
101	PROPOSED BORROW AREA	32.453595	-96.955965
102	PROPOSED BORROW AREA	32.453845	-96.955683
103	PROPOSED BORROW AREA	32.454155	-96.955460
201	UPSTREAM END	32.454876	-96.958475
202	CREST OF SPILLWAY	32.455478	-96.958801
203	DOWNSTREAM END OF SPILLWAY	32.456123	-96.958953

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N W E S

TX STATE SOIL AND WATER CONSERVATION
WRPP CHAMBERS CREEK SITE 6

Boring Location Map

FN JOB NO	TSW20319
FILE	BLM_CC_SITE6.mxd
DATE	7/23/2020
SCALE	1:3,500
DESIGNED	Mahsa Hedayati
DRAFTED	ZDC

2
FIGURE

Attachment E-10: Geotechnical Information

Chambers Creek 6 Boring Logs

LOG OF BORING NO. 01

Project Description: Watershed Rehabilitation Chambers Creek 6
Project Location: Midlothian, Texas
Date Drilling Started: 5/28/2020
Logged By: A. Brewer
Rig Type: CME 75
Latitude: 32.454916

Drilling Co.: Texplor of Dallas, Inc.
Hammer Type: N/A
Longitude: -96.955927

Project No.: TSW20319
Phase No.: CC6
Date Drilling Completed: 5/28/2020
Drill Method: HSA & Rock Core
Elevation:

DEPTH, ft	SAMPLE TYPE	BLOW COUNTS	HAND PENETROMETER (P) / TORVANE (T), tsf	RECOVERY, %	RQD, %	SYMBOL	MATERIAL DESCRIPTION	WATER CONTENT, %	UNIT DRY WEIGHT, pcf	% PASSING NO. 200 SIEVE	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	UNC. COMPRESSIVE STRENGTH, tsf	STRAIN AT FAILURE, %	ELEVATION, ft
	U-1		3.5 (P)	25			FAT CLAY (CH), brown, very stiff, moist, with variable limestone fragment and gravel content throughout, some iron oxide nodules and orange staining (FILL)	19								
	U-2		3.75 (P)	30				19		87	52	19	33			
5	U-3		4.5+ (P)	50				22	102					1.8	4.9	
	U-4		4.5+ (P)	48				21								
	U-5		2.75 (P)	50				23	104					3	11	
10																
							LEAN CLAY (CL), pale brown to yellow-brown, very stiff, moist, with fine limestone gravel and light yellow-brown limestone fragments (FILL) 12/								
	U-6		4.5+ (P)	50				20			44	18	26			
15																
	U-7		4.5+ (P)	55			-gray-brown, very stiff, moist, with fine limestone gravel and light yellow-brown to gray limestone fragments	22			48	22	26			
20																
	U-8		3.0 (P)	28			-pale gray-brown, stiff, wet, with fine limestone gravel, iron oxide nodules, some orange staining	22								
25																
	U-9		2.0 (P)	45			FAT CLAY (CH), dark gray, stiff, moist, with fine limestone gravel, brown mottling (FILL) 28/	31		93	66	23	43			

GROUND WATER OBSERVATIONS

MEASUREMENT	∇ At Time Of Drilling	▼ At End of Drilling	▼ After Drilling
DATE			
DEPTH (ft.bgs.)			
NOTES	Dry		

Remarks:
0-50 feet - hollow stem augers; 50-70 feet - NX rock core with water. Borehole backfilled with tremie-placed cement bentonite grout. Water was not encountered prior to coring.

The stratification lines represent approximate strata boundaries. In situ, the transition may be gradual.These logs are subject to the limitations, conclusions, and recommendations in the associated report.

LOG OF BORING NO. 01

Project Description: Watershed Rehabilitation Chambers Creek 6
Project Location: Midlothian, Texas
Date Drilling Started: 5/28/2020
Logged By: A. Brewer
Rig Type: CME 75
Latitude: 32.454916

Drilling Co.: Texplor of Dallas, Inc.
Hammer Type: N/A
Longitude: -96.955927

Project No.: TSW20319
Phase No.: CC6
Date Drilling Completed: 5/28/2020
Drill Method: HSA & Rock Core
Elevation:

DEPTH, ft	SAMPLE TYPE	BLOW COUNTS	HAND PENETROMETER (P) / TORVANE (T), tsf	RECOVERY, %	RQD, %	SYMBOL	MATERIAL DESCRIPTION	WATER CONTENT, %	UNIT DRY WEIGHT, pcf	% PASSING NO. 200 SIEVE	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	UNC. COMPRESSIVE STRENGTH, tsf	STRAIN AT FAILURE, %	ELEVATION, ft
							FAT CLAY (CH), dark gray, stiff, moist, with fine limestone gravel, brown mottling (FILL) *(continued)*									
	U-10		3.5 (P)	35			-brown, very stiff, moist, with fine limestone gravel, iron oxide nodules, some orange staining and gray mottling	23								
35																
	U-11		3.0 (P)	35			-dark gray, very stiff, moist, trace fine limestone gravel and shell fragments	28								
40																
	U-12		4.5+ (P)	55			-dark gray, very stiff, moist, with fine limestone gravel, some iron oxide nodules and orange staining	28		92	72	24	48			
45																
							LIMESTONE, yellow-brown, slightly weathered, soft to moderately soft rock with 4.2-inch thick calcareous clay layer (Austin Chalk Formation) 48/	21								
50							50/ LIMESTONE, light gray to dark gray, fresh, moderately hard rock, agrillaceous, thickly bedded, with zones of bioturbation and intraclasts, occasional very thin beds and laminations that are fissile/shaly, some fossil fragments, trace pyrite (Austin Chalk Formation)									
55	C-1			100	93		-discontinuities at 52.8, 53.6, 54.9, 55.3, 55.5 feet (mechanical - horizontal) -soft from 55.1 to 55.7 feet	12	122					178.9	2.5	
							-discontinuities at 56.6, 58.6, 59.1, 59.4, 59.9 feet (mechanical - horizontal)									

GROUND WATER OBSERVATIONS

MEASUREMENT	∇ At Time Of Drilling	▼ At End of Drilling	▽ After Drilling
DATE			
DEPTH (ft.bgs.)			
NOTES	Dry		

Remarks:
0-50 feet - hollow stem augers; 50-70 feet - NX rock core with water. Borehole backfilled with tremie-placed cement bentonite grout. Water was not encountered prior to coring.

The stratification lines represent approximate strata boundaries. In situ, the transition may be gradual.These logs are subject to the limitations, conclusions, and recommendations in the associated report.

LOG OF BORING NO. 01

Project Description: Watershed Rehabilitation Chambers Creek 6
Project Location: Midlothian, Texas
Date Drilling Started: 5/28/2020
Logged By: A. Brewer
Rig Type: CME 75
Latitude: 32.454916

Drilling Co.: Texplor of Dallas, Inc.
Hammer Type: N/A
Longitude: -96.955927

Project No.: TSW20319
Phase No.: CC6
Date Drilling Completed: 5/28/2020
Drill Method: HSA & Rock Core
Elevation:

DEPTH, ft	SAMPLE TYPE	BLOW COUNTS	HAND PENETROMETER (P) / TORVANE (T), tsf	RECOVERY, %	RQD, %	SYMBOL	MATERIAL DESCRIPTION	WATER CONTENT, %	UNIT DRY WEIGHT, pcf	% PASSING NO. 200 SIEVE	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	UNC. COMPRESSIVE STRENGTH, tsf	STRAIN AT FAILURE, %	ELEVATION, ft
65	C-2			97	88		LIMESTONE, light gray to dark gray, fresh, moderately hard rock, agrillaceous, thickly bedded, with zones of bioturbation and intraclasts, occasional very thin beds and laminations that are fissile/shaly, some fossil fragments, trace pyrite (Austin Chalk Formation) *(continued)* -dark gray to light gray bentonite bed from 61.8 to 62.7 feet - very soft -discontinuities at 61.9, 62.6, 62.7, 65.4 feet (mechanical - horizontal) -discontinuity from 61.9 to 62.2 feet (mechanical - vertical) -dark gray, very soft, shaly at 67.2 feet -dark gray, very soft, shaly at 69.2 feet	12	126					204.4	2	
70							Total boring depth 70.0 ft.									
75																
80																
85																

GROUND WATER OBSERVATIONS

MEASUREMENT	▽ At Time Of Drilling	▼ At End of Drilling	▼ After Drilling
DATE			
DEPTH (ft.bgs.)			
NOTES	Dry		

Remarks:
0-50 feet - hollow stem augers; 50-70 feet - NX rock core with water. Borehole backfilled with tremie-placed cement bentonite grout. Water was not encountered prior to coring.

The stratification lines represent approximate strata boundaries. In situ, the transition may be gradual.These logs are subject to the limitations, conclusions, and recommendations in the associated report.

LOG OF BORING NO. 02

Project Description: Watershed Rehabilitation Chambers Creek 6
Project Location: Midlothian, Texas
Date Drilling Started: 5/28/2020
Logged By: A. Brewer
Rig Type: CME 75
Latitude: 32.455324

Drilling Co.: Texplor of Dallas, Inc.
Hammer Type: N/A
Longitude: -96.956570

Project No.: TSW20319
Phase No.: CC6
Date Drilling Completed: 5/28/2020
Drill Method: HSA & Rock Core
Elevation:

DEPTH, ft	SAMPLE TYPE	BLOW COUNTS	HAND PENETROMETER (P) / TORVANE (T), tsf	RECOVERY, %	RQD, %	SYMBOL	MATERIAL DESCRIPTION	WATER CONTENT, %	UNIT DRY WEIGHT, pcf	% PASSING NO. 200 SIEVE	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	UNC. COMPRESSIVE STRENGTH, tsf	STRAIN AT FAILURE, %	ELEVATION, ft
	U-1		4.5+ (P)	25			FAT CLAY (CH), brown, very stiff, moist, with variable limestone fragment and gravel content throughout, some iron oxide nodules and orange staining (FILL)	20								
	U-2		4.5+ (P)	50				24								
5	U-3		4.5+ (P)	45				19								
	U-4		3.5 (P)	60				20	106					2.6	7.8	
	U-5		4.5+ (P)	58				22		94	60	20	40			
10																
							LEAN CLAY (CL), pale brown to yellow-brown, very stiff, moist, with limestone and fine limestone gravel, some limestone cobbles (FILL) 12/								
	U-6		4.5+ (P)	38				21								
15																
							FAT CLAY (CH), dark gray-brown, very stiff, moist, mottled, with fine limestone gravel, some iron oxide nodules and orange staining (FILL) 17/								
	U-7		4.5+ (P)	65				19		94	53	19	34			
20																
	U-8		3.5 (P)	38				23								
25																
	U-9		2.5 (P)	43				29		92	62	22	40			
30																

GROUND WATER OBSERVATIONS

MEASUREMENT	▽ At Time Of Drilling	▼ At End of Drilling	▼ After Drilling
DATE			
DEPTH (ft.bgs.)			
NOTES	Dry		

Remarks:
0-35 feet - hollow stem augers; 35-60 feet - NX rock core with water. Borehole backfilled with tremie-placed cement bentonite grout. Water was not encountered prior to coring.

The stratification lines represent approximate strata boundaries. In situ, the transition may be gradual.These logs are subject to the limitations, conclusions, and recommendations in the associated report.

LOG OF BORING NO. 02

Project Description: Watershed Rehabilitation Chambers Creek 6
Project Location: Midlothian, Texas
Date Drilling Started: 5/28/2020
Logged By: A. Brewer
Rig Type: CME 75
Latitude: 32.455324

Drilling Co.: Texplor of Dallas, Inc.
Hammer Type: N/A
Longitude: -96.956570

Project No.: TSW20319
Phase No.: CC6
Date Drilling Completed: 5/28/2020
Drill Method: HSA & Rock Core
Elevation:

DEPTH, ft	SAMPLE TYPE	BLOW COUNTS	HAND PENE-TROMETER (P) / TORVANE (T), tsf	RECOVERY, %	RQD, %	SYMBOL	MATERIAL DESCRIPTION	WATER CONTENT, %	UNIT DRY WEIGHT, pcf	% PASSING NO. 200 SIEVE	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	UNC. COMPRESSIVE STRENGTH, tsf	STRAIN AT FAILURE, %	ELEVATION, ft
							FAT CLAY (CH), dark gray-brown, very stiff, moist, mottled, with fine limestone gravel, some iron oxide nodules and orange staining (FILL) *(Continued)*									
							33/ LIMESTONE, yellow-brown, slightly weathered, soft to moderately soft rock, thickly bedded, with alternating beds of gray limestone (Austin Chalk Formation)									
35																
	C-1			82	77		-high angle fault at 36.1 feet, thin, stained, slickensides, smooth, planar -horizontal joint at 36.23 feet, thin, stained, rough, wavy -bentonite bed washed out from 36.3 to 37.2 feet	11	126					171.6	2.3	
							37.3/ LIMESTONE, light gray to dark gray, fresh, moderately hard rock, argillaceous, thickly bedded, with zones of bioturbation intraclasts, occasional very thin beds and laminations that are fissile/shaly, some fossil fragments, trace (Austin Chalk Formation) -discontinuities at 40.7, 41.5, 43.5 feet (mechanical - horizontal)									
40																
45	C-2			92	87											
							-discontinuities at 46.6, 47.7, 48.4, 48.7 48.9, and 49.3 feet (mechanical - horizontal)	11	127					196.8	2.3	
50																
55	C-3			95	86		-very soft, shaly at 54.7 feet -discontinuities at 54.5, 54.7, 55 to 55.4, 55.6, 55.9,56.45 feet (mechanical - horizontal)									
								14	120					177.6	2	
60							Total boring depth 60.0 ft.									

GROUND WATER OBSERVATIONS

MEASUREMENT	▽ At Time Of Drilling	▼ At End of Drilling	▼ After Drilling
DATE			
DEPTH (ft.bgs.)			
NOTES	Dry		

Remarks:
0-35 feet - hollow stem augers; 35-60 feet - NX rock core with water. Borehole backfilled with tremie-placed cement bentonite grout. Water was not encountered prior to coring.

The stratification lines represent approximate strata boundaries. In situ, the transition may be gradual.These logs are subject to the limitations, conclusions, and recommendations in the associated report.

LOG OF BORING NO. 101

Project Description: Watershed Rehabilitation Chambers Creek 6
Project Location: Midlothian, Texas
Date Drilling Started: 5/28/2020
Logged By: A. Brewer
Rig Type: CME 75
Latitude: 32.453595

Drilling Co.: Texplor of Dallas, Inc.
Hammer Type: N/A
Longitude: -96.955965

Project No.: TSW20319
Phase No.: CC6
Date Drilling Completed: 5/28/2020
Drill Method: CFA
Elevation:

DEPTH, ft	SAMPLE TYPE	BLOW COUNTS	HAND PENETROMETER (P) / TORVANE (T), tsf	RECOVERY, %	RQD, %	SYMBOL	MATERIAL DESCRIPTION	WATER CONTENT, %	UNIT DRY WEIGHT, pcf	% PASSING NO. 200 SIEVE	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	UNC. COMPRESSIVE STRENGTH, tsf	STRAIN AT FAILURE, %	ELEVATION, ft
	A-1						LEAN CLAY (CL), dark brown, stiff, moist (Residual Austin Chalk Formation)	26			46	21	25			
							LEAN CLAY (CL), yellow-brown, stiff, moist (Residual Austin Chalk Formation) 3.5/									
5	A-2															
							LIMESTONE, yellow-brown, slightly weathered, soft to moderately soft rock (Austin Chalk Formation) 9/									
10							Total boring depth 10.0 ft.									
15																
20																
25																

GROUND WATER OBSERVATIONS

MEASUREMENT	At Time Of Drilling	At End of Drilling	After Drilling
DATE			
DEPTH (ft.bgs.)	6	3.5	
NOTES			

Remarks:
0-10 feet - continuous flight augers. Borehole backfilled with tremie-placed cement bentonite grout.

The stratification lines represent approximate strata boundaries. In situ, the transition may be gradual.These logs are subject to the limitations, conclusions, and recommendations in the associated report.

LOG OF BORING NO. 102

Project Description: Watershed Rehabilitation Chambers Creek 6
Project Location: Midlothian, Texas
Date Drilling Started: 5/28/2020
Logged By: A. Brewer
Rig Type: CME 75
Latitude: 32.453845

Drilling Co.: Texplor of Dallas, Inc.
Hammer Type: N/A
Longitude: -96.955683

Project No.: TSW20319
Phase No.: CC6
Date Drilling Completed: 5/28/2020
Drill Method: CFA
Elevation:

DEPTH, ft	SAMPLE TYPE	BLOW COUNTS	HAND PENE-TROMETER (P) / TORVANE (T), tsf	RECOVERY, %	RQD, %	SYMBOL	MATERIAL DESCRIPTION	WATER CONTENT, %	UNIT DRY WEIGHT, pcf	% PASSING NO. 200 SIEVE	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	UNC. COMPRESSIVE STRENGTH, tsf	STRAIN AT FAILURE, %	ELEVATION, ft
							LEAN CLAY (CL), brown, soft, moist (Residual Austin Chalk Formation)	15			39	18	21			
	A-1						LIMESTONE, yellow-brown, slightly weathered, soft to moderately soft rock (Austin Chalk Formation) 1/ 2/	15			39	18	21			
5							LIMESTONE, gray, fresh, moderately soft rock (Austin Chalk Formation)									
	A-2															
10							Total boring depth 10.0 ft.									
15																
20																
25																

GROUND WATER OBSERVATIONS

MEASUREMENT	▽ At Time Of Drilling	▼ At End of Drilling	▼ After Drilling
DATE			
DEPTH (ft.bgs.)			
NOTES	Dry	Dry	

Remarks:
0-10 feet - continuous flight augers. Borehole backfilled with tremie-placed cement bentonite grout.

The stratification lines represent approximate strata boundaries. In situ, the transition may be gradual.These logs are subject to the limitations, conclusions, and recommendations in the associated report.

LOG OF BORING NO. 103

Project Description: Watershed Rehabilitation Chambers Creek 6
Project Location: Midlothian, Texas
Date Drilling Started: 5/28/2020
Logged By: A. Brewer
Rig Type: CME 75
Latitude: 32.454155

Drilling Co.: Texplor of Dallas, Inc.
Hammer Type: N/A
Longitude: -96.955460

Project No.: TSW20319
Phase No.: CC6
Date Drilling Completed: 5/28/2020
Drill Method: CFA
Elevation:

DEPTH, ft	SAMPLE TYPE	BLOW COUNTS	HAND PENE-TROMETER (P) / TORVANE (T), tsf	RECOVERY, %	RQD, %	SYMBOL	MATERIAL DESCRIPTION	WATER CONTENT, %	UNIT DRY WEIGHT, pcf	% PASSING NO. 200 SIEVE	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	UNC. COMPRESSIVE STRENGTH, tsf	STRAIN AT FAILURE, %	ELEVATION, ft
	A-1						LIMESTONE, yellow-brown, moderately to slightly weathered, soft rock, with calcareous clay interbedded (Austin Chalk Formation)									
5	A-2															
10							Total boring depth 10.0 ft.									
15																
20																
25																

GROUND WATER OBSERVATIONS

MEASUREMENT	At Time Of Drilling	At End of Drilling	After Drilling
DATE			
DEPTH (ft.bgs.)			
NOTES	Dry	Dry	

Remarks:
0-10 feet - continuous flight augers. Borehole backfilled with tremie-placed cement bentonite grout.

The stratification lines represent approximate strata boundaries. In situ, the transition may be gradual.These logs are subject to the limitations, conclusions, and recommendations in the associated report.

LOG OF BORING NO. 201

Project Description: Watershed Rehabilitation Chambers Creek 6
Project Location: Midlothian, Texas
Date Drilling Started: 5/28/2020
Logged By: A. Brewer
Rig Type: CME 75
Latitude: 32.454876

Drilling Co.: Texplor of Dallas, Inc.
Hammer Type: N/A
Longitude: -96.958475

Project No.: TSW20319
Phase No.: CC6
Date Drilling Completed: 5/28/2020
Drill Method: HSA & Rock Core
Elevation:

DEPTH, ft	SAMPLE TYPE	BLOW COUNTS	HAND PENE-TROMETER (P) / TORVANE (T), tsf	RECOVERY, %	RQD, %	SYMBOL	MATERIAL DESCRIPTION	WATER CONTENT, %	UNIT DRY WEIGHT, pcf	% PASSING NO. 200 SIEVE	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	UNC. COMPRESSIVE STRENGTH, tsf	STRAIN AT FAILURE, %	ELEVATION, ft
	U-1		4.0 (P)	28			FAT CLAY, brown, very stiff, moist, with fine limestone gravel (FILL)	29								
	U-2		4.5+ (P)	55			LEAN CLAY, yellow-brown, very stiff, moist, silty (Residual Austin Chalk Formation) 3/ 4/	21	107	83	41	24	17	3.6	3.9	
5							LIMESTONE, yellow-brown, slightly weathered, soft to moderately soft rock, jointed, trace pyrite (Austin Chalk Formation) -with stained horizontal joints at 5.2, 5.4, 5.6, 6.15, 6.6, 6.7, and 6.8 feet 7.5/									
10	C-1			100	91		LIMESTONE, light gray to dark gray, fresh, moderately hard rock, argillaceous, thickly bedded, with zones of bioturbation and intraclasts, occasional very thin beds and laminations that are fissile/shaly, some pyrite, trace fossil fragments and lignite (Austin Chalk Formation)	16	116					136.5	1.7	
15																
							-very soft, shaly at 18.2 feet	17	114					114.3	1.7	
20	C-2			100	100		-discontinuities at 18.2, 19.6, 20.75, 23.6 feet (mechanical - horizontal) -lignite seam with pyrite from 20.75 to 20.8 feet									
25							Total boring depth 25.0 ft.									

GROUND WATER OBSERVATIONS

MEASUREMENT	▽ At Time Of Drilling	▼ At End of Drilling	▼ After Drilling
DATE			
DEPTH (ft.bgs.)			
NOTES	Dry		

Remarks:
0-5 feet - hollow stem augers; 5-25 feet - NX rock core with water. Borehole backfilled with tremie-placed cement bentonite grout. Water was not encountered prior to coring.

The stratification lines represent approximate strata boundaries. In situ, the transition may be gradual.These logs are subject to the limitations, conclusions, and recommendations in the associated report.

LOG OF BORING NO. 202

Project Description: Watershed Rehabilitation Chambers Creek 6
Project Location: Midlothian, Texas
Date Drilling Started: 5/29/2020
Logged By: A. Brewer
Rig Type: CME 75
Latitude: 32.455478

Drilling Co.: Texplor of Dallas, Inc.
Hammer Type: N/A
Longitude: -96.958801

Project No.: TSW20319
Phase No.: CC6
Date Drilling Completed: 5/29/2020
Drill Method: HSA & Rock Core
Elevation:

DEPTH, ft	SAMPLE TYPE	BLOW COUNTS	HAND PENE-TROMETER (P) / TORVANE (T), tsf	RECOVERY, %	RQD, %	SYMBOL	MATERIAL DESCRIPTION	WATER CONTENT, %	UNIT DRY WEIGHT, pcf	% PASSING NO. 200 SIEVE	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	UNC. COMPRESSIVE STRENGTH, tsf	STRAIN AT FAILURE, %	ELEVATION, ft
	U-1		3.0 (P)	35			FAT CLAY (CH), dark brown, stiff, moist, some calcareous nodules and iron oxide nodules, trace fine limestone gravel, completely weathered (FILL)	37								
	U-2		2.5 (P)	35				37	83	98				1.9	4.7	
5	U-3		3.0 (P)	40			-abundant fine-to coarse-grained limestone at 6 feet	29			82	27	55			
	U-4		4.5+ (P)	80			6/ GRAVELLY FAT CLAY, brown, very stiff, moist, with fine limestone gravel throughout, subrounded (Residual Austin Chalk Formation)	20								
							7.5/ 8.5/ LIMESTONE, yellow-brown, highly weathered, soft rock, jointed, with calcareous clay layer and orange staining (Austin Chalk Formation)									
10	C-1			77	36		LIMESTONE, yellow-brown, moderate to slightly weathered, soft to moderately soft rock, jointed, trace pyrite (Austin Chalk Formation) -stained vertical joints at 11 to 11.5 feet with pyrite, 11.8 to 12.5, 13.85 to 14.1 and 14.7 to 14.9 feet -stained horizontal joints at 11.5, 11.6, 12.05, 12.2, 13.1, 13.4, 13.5, 13.8, 14.1, 14.7 feet	14	120					94.7	1.8	
15							-very soft from 15 to 20 feet, with horizontal joints									
20	C-2			75	64											
							-stained horizontal joints at 21.6, 21.8, 22 and 23.4 feet -dark gray, very soft, shaly from 22.7 to 22.9 feet -very soft clayey bed from 24.5 to 25 feet -mechanical discontinuity at 24.7 feet	16	118					86.5	2.2	
25							Total boring depth 25.0 ft.									

GROUND WATER OBSERVATIONS

MEASUREMENT	At Time Of Drilling	At End of Drilling	After Drilling
DATE			
DEPTH (ft.bgs.)			
NOTES	Dry		

Remarks:
0-10 feet - hollow stem augers; 10-25 feet - NX rock core with water. Borehole backfilled with tremie-placed cement bentonite grout. Water was not encountered prior to coring.

The stratification lines represent approximate strata boundaries. In situ, the transition may be gradual.These logs are subject to the limitations, conclusions, and recommendations in the associated report.

LOG OF BORING NO. 203

Project Description: Watershed Rehabilitation Chambers Creek 6
Project Location: Midlothian, Texas
Date Drilling Started: 5/29/2020
Logged By: A. Brewer
Rig Type: CME 75
Latitude: 32.456123

Drilling Co.: Texplor of Dallas, Inc.
Hammer Type: N/A
Longitude: -96.958953

Project No.: TSW20319
Phase No.: CC6
Date Drilling Completed: 5/29/2020
Drill Method: HSA & Rock Core
Elevation:

DEPTH, ft	SAMPLE TYPE	BLOW COUNTS	HAND PENE-TROMETER (P) / TORVANE (T), tsf	RECOVERY, %	RQD, %	SYMBOL	MATERIAL DESCRIPTION	WATER CONTENT, %	UNIT DRY WEIGHT, pcf	% PASSING NO. 200 SIEVE	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX	UNC. COMPRESSIVE STRENGTH, tsf	STRAIN AT FAILURE, %	ELEVATION, ft
	U-1			100			GRAVELLY FAT CLAY (CH), dark brown, stiff, moist, fine limestone gravel (Residual Austin Chalk Formation) 1/	21		72						
							LIMESTONE, yellow-brown, slightly weathered, moderately soft rock (Austin Formation) 3/									
5							LIMESTONE, light gray to dark gray, fresh, moderately hard rock, argillaceous, thickly bedded, with zones of bioturbation and intraclasts, occasional very thin beds and laminations that are fissile/shaly, some pyrite, trace fossil fragments and lignite (Austin Chalk Formation)									
							-very soft from 8.8 to 9.1 feet									
10	C-1			96	96		-discontinuities at 9.0, 12.1 and 14.3 feet (mechanical - horizontal)	13	123					158.6	1.8	
15																
							-very soft, shaly at 17.3 feet -very soft, shaly from 19.3 to19.5 feet, shaly									
20	C-2			87	81		-discontinuities at 17.3 and 19.35 feet (mechanical - horizontal) -very soft, shaly from 21.3 to 21.7 feet -very soft, shaly from 22.1 to 22.2 feet	10	132					104.1	2	
							-discontinuities at 23.2, 23.4, 23.5, 23.7 feet (mechanical - horizontal) -no recovery from 23.8 to 25 feet									
25							Total boring depth 25.0 ft.									

GROUND WATER OBSERVATIONS

MEASUREMENT	At Time Of Drilling	At End of Drilling	After Drilling
DATE			
DEPTH (ft.bgs.)			
NOTES	Dry		

Remarks:
0-5 feet - hollow stem augers; 5-25 feet - NX rock core with water. Borehole backfilled with tremie-placed cement bentonite grout. Water was not encountered prior to coring.

The stratification lines represent approximate strata boundaries. In situ, the transition may be gradual.These logs are subject to the limitations, conclusions, and recommendations in the associated report.

BORING LOG LEGEND AND NOMENCLATURE

Abbreviations		
U – Undisturbed Sample (tube)	SPT – Standard Penetration Test	TV – Torvane
A – Auger Sample	TCP – Texas Cone Penetration	NP – Non Plastic
CS – Continuous Sample	CFA – Continuous Flight Auger	ATD – At Time of Drilling
C – Rock Core	HSA – Hollow Stem Auger	AD – After Drilling

General Terms	
Term	Description
Blow Counts	Results from either the Standard Penetration Test (SPT) or the Texas Cone Penetration (TCP) test.
Recovery	Length of sample or core recovered divided by the total length pushed, driven, or cored (expressed as a %)
Rock Quality Designation (RQD)	Cumulative length of unfractured pieces of core material more than 4 inches in length divided by the total length of material cored (expressed as a percentage)

Consistency of Cohesive Soil				
Description	Comp. Strength, tsf	SPT Blows	TCP Blows	Criteria
Very Soft	< 0.25	0 – 2	0 – 8	Sample sags under its own weight and is easily deformed
Soft	≥ 0.25 – < 0.5	> 2 – 4	> 8 – 20	Easily pinched between fingers and remolded with light finger pressure
Medium Stiff	≥ 0.5 – < 1.0	> 4 – 8	N/A for TxDOT	Imprinted easily with fingers and remolded with firm finger pressure
Stiff	≥ 1.0 – < 2.0	> 8 – 15	>20 – 40	Imprinted with strong finger pressure or indented easily with fingernail
Very Stiff	≥ 2.0 – < 4.0	> 15 – 30	> 40 to 80	Light imprint from finger or light indent with fingernail
Hard	≥ 4.0	> 30	>80	Difficult to indent with fingernail

Apparent Density of Cohesionless Soil		
Description	SPT Blow Count	Texas Cone Blow Count
Very Loose	0 – 4	0 – 8
Loose	> 4 – 10	> 8 – 20
Medium Dense	> 10 – 30	> 20 to 80
Dense	> 30 – 50	80 to ≥ 5”
Very Dense	> 50	0” to < 5”

Soil Structure	
Description	Criteria
Stratified	Alternating layers of varying material/color with layers ≥ 1/4-inch thick
Laminated	Alternating layers of varying material/color with layers < 1/4-inch thick
Fissured	Breaks along definite planes with little resistance
Slickensided	Fracture planes appear polished or glossy; shows movement direction
Blocky	Cohesive soil that can be broken into small, angular lumps
Lensed	Inclusion of small pockets of soil that is different from dominate type
Homogenous	Same color and appearance throughout

Moisture Condition	
Description	Criteria
Dry	Absence of moisture, dusty, dry to the touch
Moist	Damp but no visible water
Wet	Visible free water

Textural Adjectives	
Textural Item	Description
Pit	Pinhole sized openings
Vug	Small openings up to 4 inches in size
Cavity	Opening larger than 4 inches
Honeycomb	Numerous and grouped pits and vugs
Vesicle	Small openings in volcanic rocks

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BORING LOG LEGEND AND NOMENCLATURE

Rock Hardness Descriptors			
Grade	Approx. Comp. Strength, tsf	Approx. TCP Range	Field Test
Very Soft	< 10 - 100	>6”	Can be peeled with pocket knife, crumbles under firm blows of geological hammer
Soft	100 - 500	4” - 6”	Can be peeled with pocket knife with difficulty, indented by firm blows of geological hammer
Hard	500 - 1000	1” - 5”	Cannot be peeled with pocket knife, can be fractured by single firm blow of hammer
Very Hard	1000 - 2000	0” - 2”	Specimen requires more than one blow of geological hammer to fracture it
Extremely Hard	> 2000	0”	Specimen requires many blows of geological hammer to fracture it

Degree of Rock Weathering	
Description	Criteria
Unweathered	No evidence of chemical or mechanical alteration
Slightly Weathered	Slight discoloration of surface or discontinuities; < 10% volume altered
Weathered	Discoloring evident; 10 to 50% of volume altered
Highly Weathered	Entire mass discolored; alteration through majority of rock
Decomposed	Rock reduced to soil consistency with some rock-like texture

Rock Bedding Structure	
Description	Criteria
Laminated	< 3/8 inch
Very Thinly Bedded	3/8—1 inch
Thinly Bedded	1 inch—4 inches
Moderately Bedded	4 inches—1 foot
Thickly Bedded	1 foot—3 feet
Very Thickly Bedded	3– 10 feet
Massive	> 10 feet

Soil Column Graphic Symbols*			
Graphic	Represented Soil Types	Graphic	Represented Soil Types
	Fat Clay, Fat Clay with sand, Sandy Fat Clay		Well-Graded Sand or Poorly-Graded Sand; little to no fines
	Lean Clay, Lean Clay with sand, Sandy Lean Clay, Silty Clay		Clayey Gravel, Gravel-Sand-Clay Mixtures
	Inorganic Silt and Organic Silt		Silty Gravel, Gravel-Sand-Silt Mixtures
	Clayey Sand, Clay-Sand Mixtures		Well-Graded Gravel or Poorly-Graded Gravel; little to no fines
	Silty Sands, Sand-Silt Mixtures		Fill with Significant Debris or Deleterious Material

Rock Column Graphic Symbols*			
Graphic	Represented Rock Types	Graphic	Represented Rock Types
	Limestone, Shaly/Marly Limestone, Limestone with Shale		Marl, Marl with Limestone, Marl with Shale
	Shale, Shale with Limestone		Sandstone, Shaly Sandstone, Sandstone with Shale
	Mudstone		Generic Bedrock Symbol

* Combined graphics may be used for dual classifications. Not all graphics represented. Refer to lithology description for soil classification or rock type.

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Attachment E-11: Geotechnical Information

Chambers Creek 6 Sample Photos Log

50’ 55’

55’ 60’

60’ 65’

65’ 70’

FNI PROJECT: TSW20319	FREESE AND NICHOLS	Texas State Soil and Water Conservation Board Chambers Creek Site 6 Dam	Plate 01-1
FILE: T:\3.0 DESIGN\# WORKING FOLDERS\GEO\Big Sandy 43\3_Field Exploration\05_Boring			
DATE: July 2020	10497 TOWN AND COUNTRY WAY, STE 500 HOUSTON, TX 77024	SAMPLE PHOTOGRAPHS 01 (Centerline of Dam)	
PREPARED: SK			

45’ 50’

50’ 55’

55’ 60’

FNI PROJECT: TSW20319	FREESE AND NICHOLS	Texas State Soil and Water Conservation Board Chambers Creek Site 6 Dam	Plate 01-2
FILE: T:\3.0 DESIGN\4 WORKING FOLDERS\GEO\Big Sandy 43\3_Field Exploration\05_Boring			
DATE: July 2020	10497 TOWN AND COUNTRY WAY, STE 500 HOUSTON, TX 77024	SAMPLE PHOTOGRAPHS 01 (Centerline of Dam)	
PREPARED: SK			

35’ 40’

40’ 45’

45’ 50’

FNI PROJECT: TSW20319	FREESE AND NICHOLS	Texas State Soil and Water Conservation Board Chambers Creek Site 6 Dam	Plate 02-1
FILE: T:\3.0 DESIGN\# WORKING FOLDERS\GEO\Big Sandy 43\3_Field Exploration\05_Boring			
DATE: July 2020	10497 TOWN AND COUNTRY WAY, STE 500 HOUSTON, TX 77024	SAMPLE PHOTOGRAPHS 02 (Centerline of Dam)	
PREPARED: SK			

50’ 55’

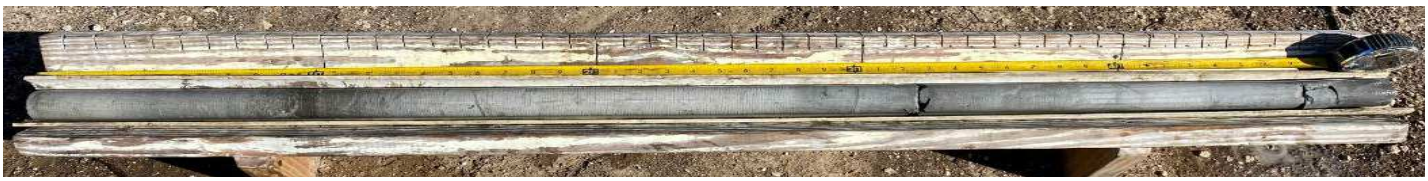
55’ 60’

FNI PROJECT: TSW20319	FREESE AND NICHOLS	Texas State Soil and Water Conservation Board Chambers Creek Site 6 Dam	Plate 02-2
FILE: T:\3.0 DESIGN\# WORKING FOLDERS\GEO\Big Sandy 43\3_Field Exploration\05_Boring			
DATE: July 2020	10497 TOWN AND COUNTRY WAY, STE 500 HOUSTON, TX 77024	SAMPLE PHOTOGRAPHS 02 (Centerline of Dam)	
PREPARED: SK			

5’ 10’

10’ 15’

15’ 20’



20’ 25’

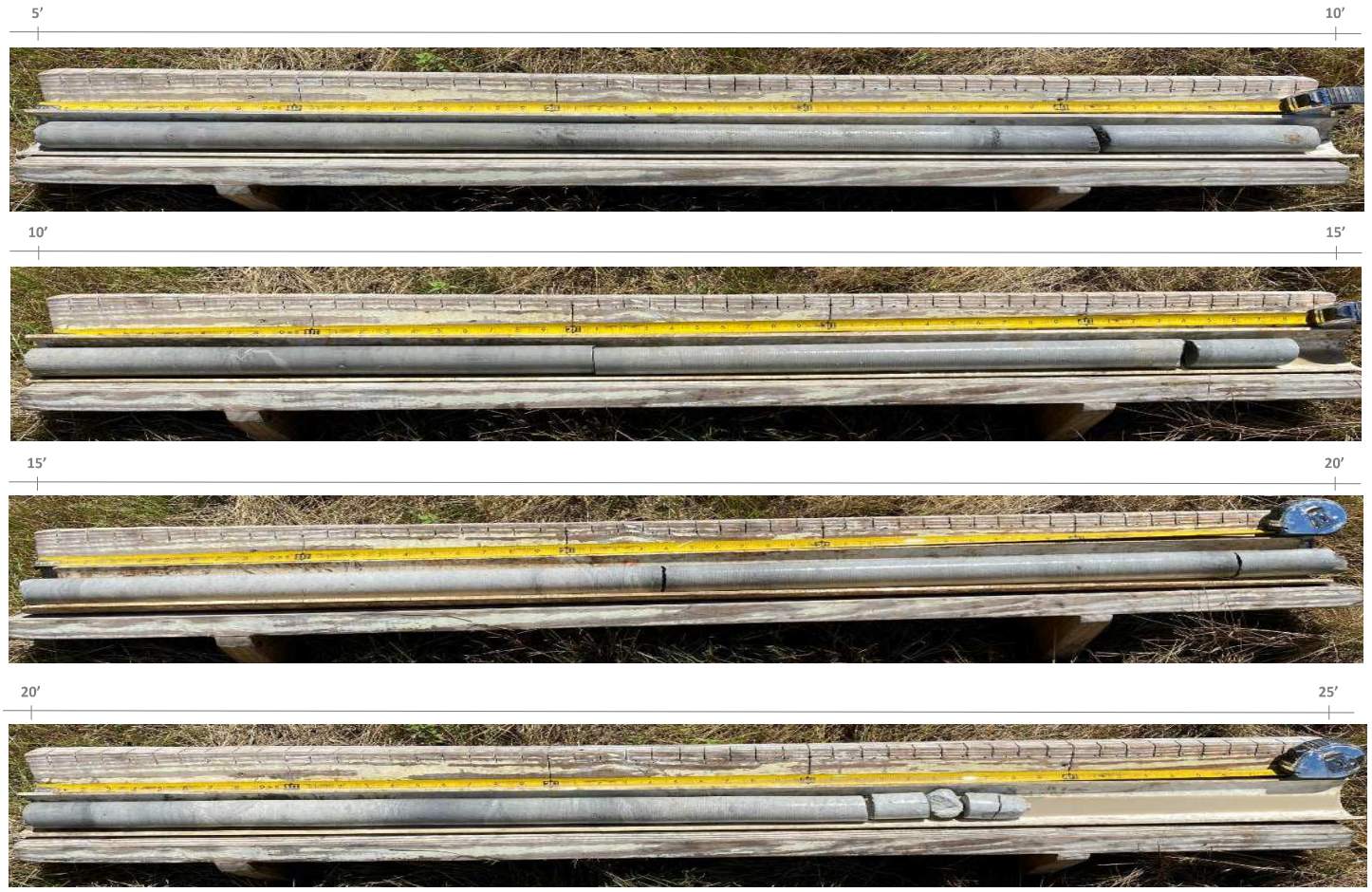
FNI PROJECT: TSW20319	FREESE AND NICHOLS	Texas State Soil and Water Conservation Board Chambers Creek Site 6 Dam	Plate 201-1
FILE: T:\3.0 DESIGN\# WORKING FOLDERS\GEO\Big Sandy 43\3_Field Exploration\05_Boring			
DATE: July 2020	10497 TOWN AND COUNTRY WAY, STE 500 HOUSTON, TX 77024	SAMPLE PHOTOGRAPHS 201 (Existing Eastern Spillway)	
PREPARED: SK			

10’ 15’

15’ 20’

20’ 25’

FNI PROJECT: TSW20319	FREESE AND NICHOLS	Texas State Soil and Water Conservation Board Chambers Creek Site 6 Dam	Plate 202-1
FILE: T:\3.0 DESIGN\# WORKING FOLDERS\GEO\Big Sandy 43\3_Field Exploration\05_Boring			
DATE: July 2020	10497 TOWN AND COUNTRY WAY, STE 500 HOUSTON, TX 77024	SAMPLE PHOTOGRAPHS 202 (Existing Eastern Spillway)	
PREPARED: SK			

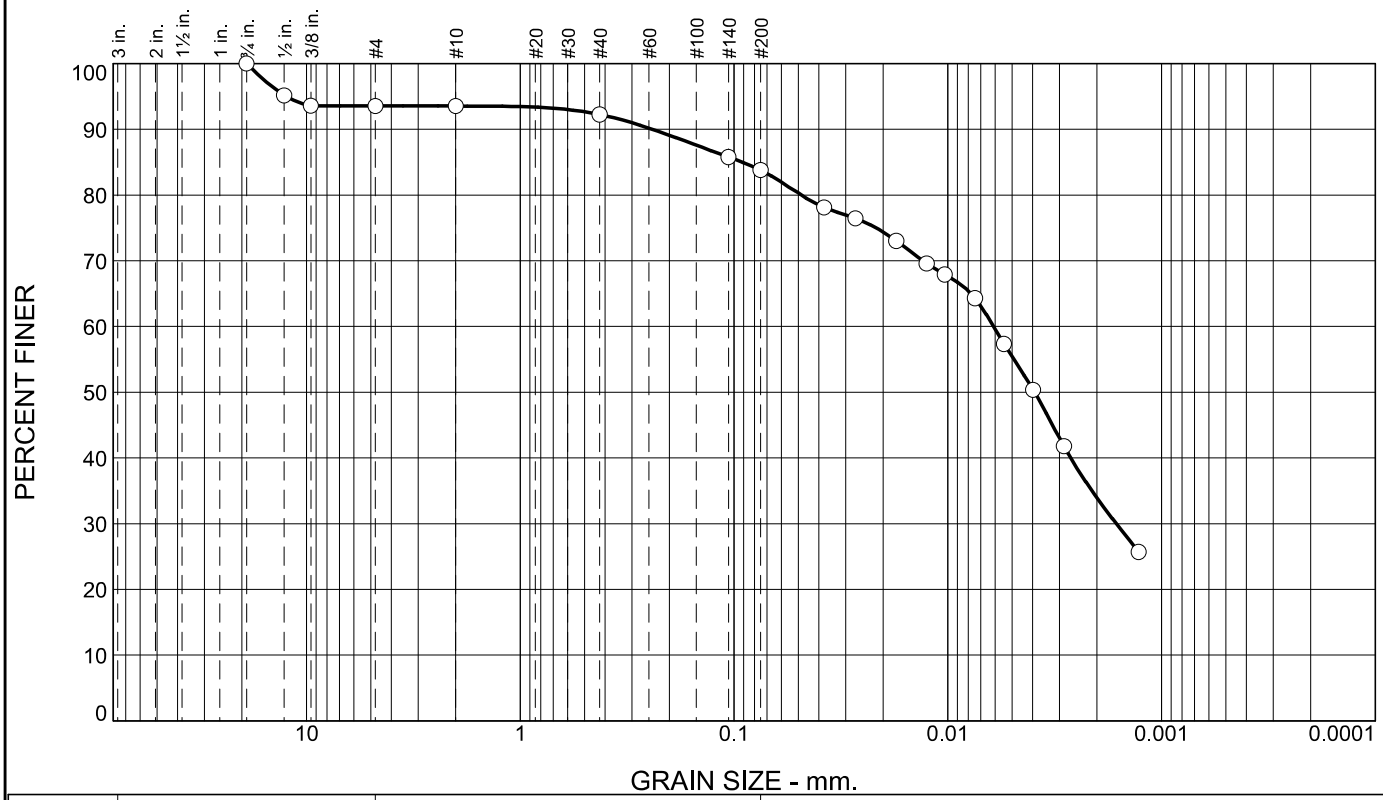


FNI PROJECT: TSW20319	FREESE AND NICHOLS	Texas State Soil and Water Conservation Board Chambers Creek Site 6 Dam	Plate 203-1
FILE: T:\3.0 DESIGN\# WORKING FOLDERS\GEO\Big Sandy 43\3_Field Exploration\05_Boring			
DATE: July 2020	10497 TOWN AND COUNTRY WAY, STE 500 HOUSTON, TX 77024	SAMPLE PHOTOGRAPHS **203 (Existing Eastern Spillway)**	
PREPARED: SK			

Attachment E-12: Geotechnical Information

Chambers Creek 6 Laboratory Test Results

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	6.4	0.0	1.3	8.5	50.0	33.8

TEST RESULTS

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
3/4	100.0		
1/2	95.2		
3/8	93.6		
#4	93.6		
#10	93.6		
#40	92.3		
#140	85.8		
#200	83.8		
0.0378 mm.	78.1		
0.0270 mm.	76.5		
0.0174 mm.	73.0		
0.0125 mm.	69.6		
0.0103 mm.	67.9		
0.0074 mm.	64.3		
0.0055 mm.	57.3		
0.0040 mm.	50.4		
0.0029 mm.	41.8		
0.0013 mm.	25.7		

* (no specification provided)

Material Description

Fat Clay with Sand, light brown

Atterberg Limits (ASTM D 4318)

PL= N/A **LL=** N/A **PI=** N/A

Classification

USCS (D 2487)= CH **AASHTO (M 145)=**

Coefficients

D_{90}= 0.2398 D_{85}= 0.0911 D_{60}= 0.0061
D_{50}= 0.0039 D_{30}= 0.0016 D_{15}=
D_{10}= C_u= C_c=

Remarks

Date Received: 06/02/20 **Date Tested:** 06/09/20

Tested By: T.Reid

Checked By: S.Dinakaran

Title:

Source of Sample: 202 **Depth:** 6.0' - 8.0' **Date Sampled:** 05/29/20
Sample Number: U4

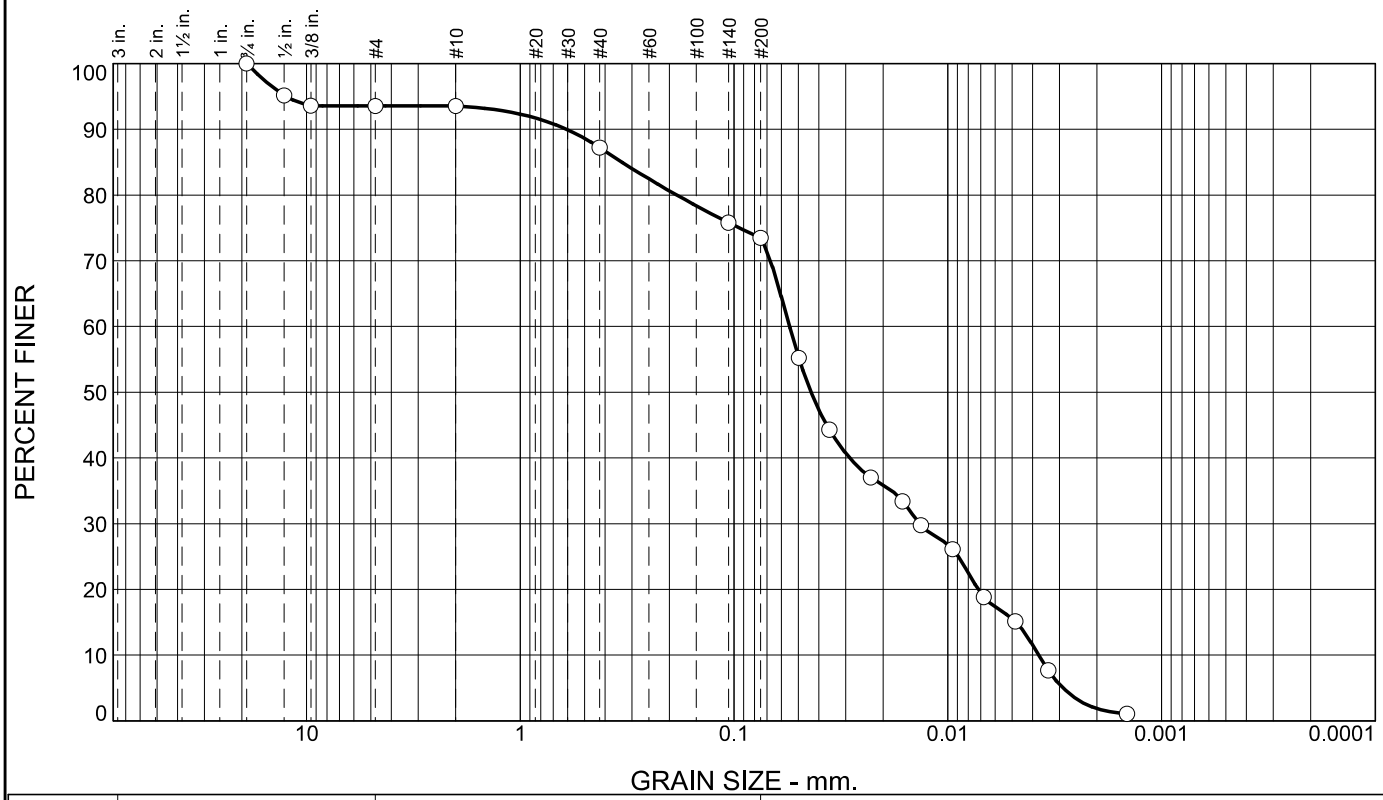
Kleinfelder, Inc.

Irving, TX

Client: Freese and Nichols
Project: FNI: 2018 Misc Lab Testing
Water Resources Design CC6: TSW20319
Project No: 20183284.001A **Figure**

Material Classification, unless data is available, is based on the ASTM D 2488 (Visual-Manual Procedures)
Vertical Loads were applied for Project Request

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	6.4	0.0	6.4	13.7	71.7	1.8

TEST RESULTS

Opening Size	Percent Finer	Spec.* (Percent)	Pass? (X=Fail)
3/4	100.0		
1/2	95.2		
3/8	93.6		
#4	93.6		
#10	93.6		
#40	87.2		
#140	75.8		
#200	73.5		
0.0497 mm.	55.2		
0.0357 mm.	44.3		
0.0229 mm.	37.0		
0.0163 mm.	33.4		
0.0133 mm.	29.7		
0.0095 mm.	26.1		
0.0068 mm.	18.8		
0.0048 mm.	15.1		
0.0034 mm.	7.7		
0.0014 mm.	1.1		

* (no specification provided)

Material Description

Fat Clay with Sand, light brown

Atterberg Limits (ASTM D 4318)

PL= N/A **LL=** N/A **PI=** N/A

Classification

USCS (D 2487)= CH **AASHTO (M 145)=**

Coefficients

D_{90}= 0.6060 D_{85}= 0.3339 D_{60}= 0.0549
D_{50}= 0.0435 D_{30}= 0.0136 D_{15}= 0.0048
D_{10}= 0.0038 C_u= 14.59 C_c= 0.89

Remarks

Date Received: 06/02/20 **Date Tested:** 06/09/20

Tested By: T.Reid

Checked By: S.Dinakaran

Title:

Source of Sample: 202 **Depth:** 6.0' - 8.0' **Date Sampled:** 05/29/20
Sample Number: U4

Kleinfelder, Inc.

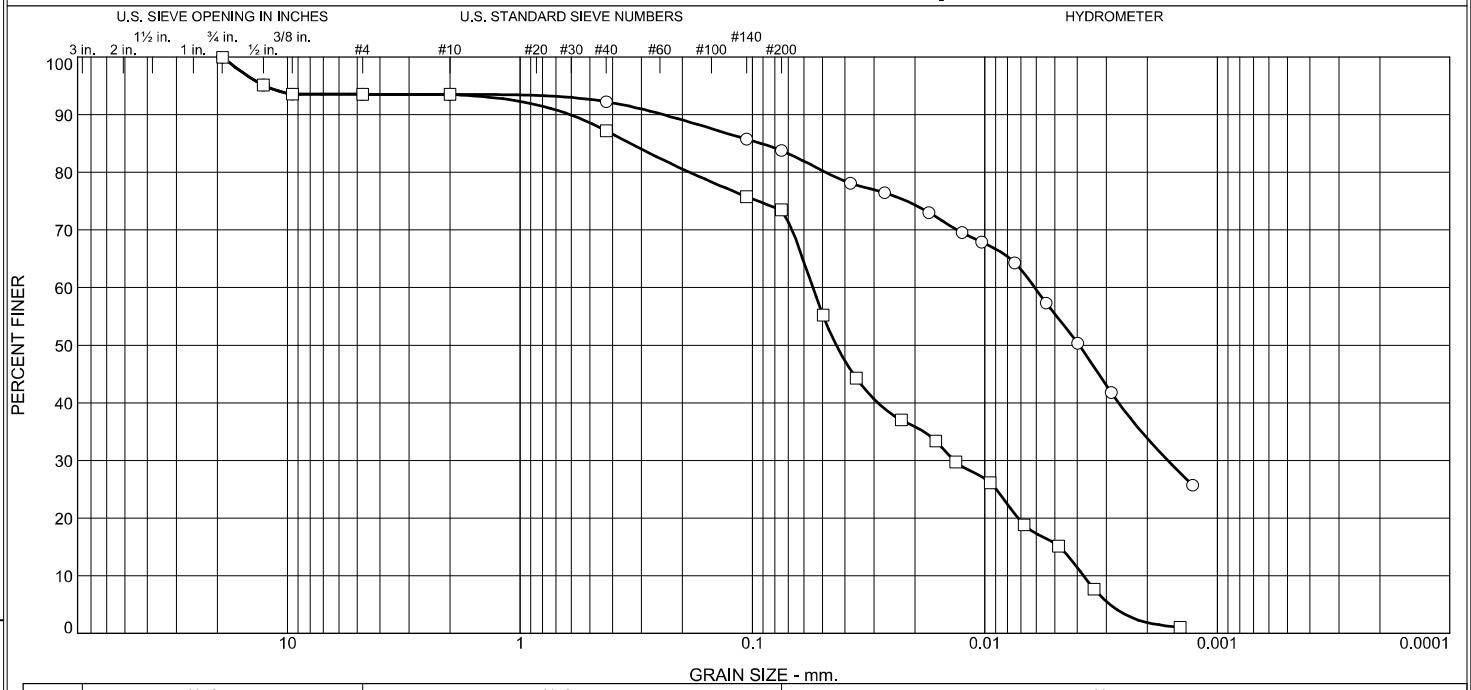
Irving, TX

Client: Freese and Nichols
Project: FNI: 2018 Misc Lab Testing
Water Resources Design CC6: TSW20319
Project No: 20183284.001A **Figure**

Material Classification, unless data is available, is based on the ASTM D 2488 (Visual-Manual Procedures)
Vertical Loads were applied for Project Request

Material Classification, unless data is available, is based on the ASTM D 2488 (Visual-Manual Procedures)
Vertical Loads were applied for Project Request

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	6.4	0.0	1.3	8.5	50.0	33.8
□	0.0	0.0	6.4	0.0	6.4	13.7	71.7	1.8

	Source	Sample #	Depth/Elev.	Date Sampled	USCS	Material Description	NM %	LL	PL
○	202	U4	6.0' - 8.0'	05/29/20	CH	Fat Clay with Sand, light brown		N/A	N/A
□	202	U4	6.0' - 8.0'	05/29/20	CH	Fat Clay with Sand, light brown		N/A	N/A

Client Freese and Nichols
Project FNI: 2018 Misc Lab Testing
Water Resources Design CC6: TSW20319
Project No. 20183284.001A Figure

Kleinfelder, Inc.

Irving, TX

Tested By: T.Reid **Checked By:** S.Dinakaran

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f| 972.409.0008
kleinfelder.com

SOIL DISPERSION (ASTM D-6572)

PROJECT: FNI: 2018 Misc Lab Testing
ChambersCreek #6_TSW20319/CC6/0AH0/1110
ENGINEER: Freese and Nichols, Inc.
TESTING AGENCY: KLEINFELDER

PROJECT NO.: 20183284.001A

REPORT DATE: 06/08/20

Assignment date : 06/01/20
Sample Location : Boring # 01 Sample # U3 Depth: 4.0 - 6.0' ft.
Sample Description : Fat Clay, dark brown
Trial #: 1

Moisture Content [%]		
Tare Number	C-26	
Tare + Wet Mass	132.71	[gr]
Tare + Dry Mass	114.18	[gr]
Tare Mass	30.71	[gr]
Moisture Content	**22.2**	[%]

Figure No.1 [2 min]

Figure No.2 [1 hour]

Target Reading	Grade	Temp (°C)	Method
2 min	1	21.3	A
1 hour	1	21.0	
6 hours	1	19.3	
Dispersive Classification	Gr.1 Non-Dispersive		

Figure No.3 [6 hours]

KLEINFELDER INC.

Reviewed By:
Sri Dinakaran, PE, DGE

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SOIL DISPERSION (ASTM D-6572)

PROJECT: FNI: 2018 Misc Lab Testing
ChambersCreek #6_TSW20319/CC6/0AH0/1110
ENGINEER: Freese and Nichols, Inc.
TESTING AGENCY: KLEINFELDER

PROJECT NO.: 20183284.001A

REPORT DATE: 06/08/20

Assignment date : 06/01/20
Sample Location : Boring # 02 Sample # U2 Depth: 2.0 - 4.0 ft.
Sample Description : Fat Clay, dark brown
Trial #: 1

Moisture Content [%]		
Tare Number	A-46	
Tare + Wet Mass	127.63	[gr]
Tare + Dry Mass	108.82	[gr]
Tare Mass	30.40	[gr]
Moisture Content	**24.0**	[%]

Target Reading	Grade	Temp (°C)	Method
2 min	1	21.4	A
1 hour	1	21.0	
6 hours	1	19.3	
Dispersive Classification	Gr.1 Non-Dispersive		

Figure No.1 [2 min]

Figure No.2 [1 hour]

Figure No.3 [6 hours]

KLEINFELDER INC.

Reviewed By:
Sri Dinakaran, PE, DGE

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SOIL DISPERSION (ASTM D-6572)

PROJECT: FNI: 2018 Misc Lab Testing
ChambersCreek #6_TSW20319/CC6/0AH0/1110
ENGINEER: Freese and Nichols, Inc.
TESTING AGENCY: KLEINFELDER

PROJECT NO.: 20183284.001A

REPORT DATE: 06/08/20

Assignment date : 06/01/20
Sample Location : Boring # 101 Sample # A1 Depth: 0.0 - 5.0 ft.
Sample Description : Lean Clay with Sand, light brown
Trial #: 1

Moisture Content [%]		
Tare Number	A-9	
Tare + Wet Mass	128.94	[gr]
Tare + Dry Mass	108.84	[gr]
Tare Mass	31.30	[gr]
Moisture Content	**25.9**	[%]

Figure No.1 [2 min]

Figure No.2 [1 hour]

Target Reading	Grade	Temp (°C)	Method
2 min	1	21.5	A
1 hour	1	21.0	
6 hours	1	19.3	
Dispersive Classification	Gr.1 Non-Dispersive		

Figure No.3 [6 hours]

KLEINFELDER INC.

Reviewed By:
Sri Dinakaran, PE, DGE

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kleinfelder.com

SOIL DISPERSION (ASTM D-6572)

PROJECT: FNI: 2018 Misc Lab Testing
ChambersCreek #6_TSW20319/CC6/0AH0/1110
ENGINEER: Freese and Nichols, Inc.
TESTING AGENCY: KLEINFELDER

PROJECT NO.: 20183284.001A

REPORT DATE: 06/08/20

Assignment date : 06/01/20
Sample Location : Boring # 201 Sample # U2 Depth: 2.0 - 4.0 ft.
Sample Description : Lean Clay with Sand, yellow brown
Trial #: 1

Moisture Content [%]		
Tare Number	L-400	
Tare + Wet Mass	235.90	[gr]
Tare + Dry Mass	212.10	[gr]
Tare Mass	101.35	[gr]
Moisture Content	**21.5**	[%]

Figure No.1 [2 min]

Figure No.2 [1 hour]

Target Reading	Grade	Temp (°C)	Method
2 min	1	21.4	A
1 hour	1	21.0	
6 hours	1	19.3	
Dispersive Classification	Gr.1 Non-Dispersive		

Figure No.3 [6 hours]

KLEINFELDER INC.

Reviewed By:
Sri Dinakaran, PE, DGE

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SOIL DISPERSION (ASTM D-6572)

PROJECT: FNI: 2018 Misc Lab Testing
ChambersCreek #6_TSW20319/CC6/0AH0/1110
ENGINEER: Freese and Nichols, Inc.
TESTING AGENCY: KLEINFELDER

PROJECT NO.: 20183284.001A

REPORT DATE: 06/08/20

Assignment date : 06/01/20
Sample Location : Boring # 202 Sample # U4 Depth: 6.0 - 8.0 ft.
Sample Description : Fat Clay, yellow brown and gray
Trial #: 1

Moisture Content [%]		
Tare Number	75	
Tare + Wet Mass	116.56	[gr]
Tare + Dry Mass	102.37	[gr]
Tare Mass	30.79	[gr]
Moisture Content	**19.8**	[%]

Figure No.1 [2 min]

Figure No.2 [1 hour]

Target Reading	Grade	Temp (°C)	Method
2 min	1	21.4	A
1 hour	1	21.0	
6 hours	1	19.3	
Dispersive Classification	Gr.1 Non-Dispersive		

Figure No.3 [6 hours]

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PROJECT: FNI: 2018 Misc Lab Testing
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ENGINEER: Freese and Nichols, Inc.
TESTING AGENCY: KLEINFELDER

PROJECT NO.: 20183284.001A

REPORT DATE: 06/08/20

Assignment date : 06/01/20
Sample Location : Boring # 202 Sample # U4 Depth: 6.0 - 8.0 ft.
Sample Description : Fat Clay with Sand, brown
Trial #: 1

Moisture Content [%]		
Tare Number	L125	
Tare + Wet Mass	271.41	[gr]
Tare + Dry Mass	241.78	[gr]
Tare Mass	102.10	[gr]
Moisture Content	**21.2**	[%]

Target Reading	Grade	Temp (°C)	Method
2 min	1	21.5	A
1 hour	1	21.0	
6 hours	1	19.3	
Dispersive Classification	Gr.1 Non-Dispersive		

Figure No.1 [2 min]

Figure No.2 [1 hour]

Figure No.3 [6 hours]

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Attachment E-13: TR-60 Head Cut Erodibility Index Calculation Information

Chambers Creek 6

1.0 PURPOSE

Chambers Creek Watershed Site 6 (Site 6) is a flood control structure and water supply reservoir located in Ellis County, Texas. As part of the geotechnical investigation phase, Freese and Nichols, Inc. (FNI) developed Headcut Erodibility Index (K_h) values for the existing auxiliary spillway based on NRCS, Part 628, Chapter 52 (NRCS guidance). This calculation is intended to describe the development of the K_h values for the auxiliary spillway at Site 6.

2.0 REFERENCES

1) Field Procedures Guide for the Headcut Erodibility Index (NRCS, Part 628, Chapter 52, 1997)
2) Boring Logs (FNI, 2020) – Borings 201 through 203

3.0 GEOTECHNICAL INVESTIGATION

3.1 Field Investigation

The developed K_h values were based on the information from the boreholes (201 through 203) that were drilled in May 2020 by FNI within the existing auxiliary spillway. The FNI borings were drilled to a depth of 25 feet. All sets of borings encountered a layer of clay overlying limestone.

3.2 Laboratory Results

Laboratory testing for the FNI field investigations included unconfined compressive strength testing on the limestone to be used to develop K_h values. Field and laboratory data required for the headcut erodibility calculation was based on the FNI investigations.

3.3 Stratigraphy

Soils within the borings at the auxiliary spillway were classified as fat (CH) and lean (CL) clays by the FNI in-situ testing and laboratory tests. The clay ranges in thickness from 1 to 7.5 feet. All sets of encountered 1 to 24 feet of weathered limestone. Representative liquid limit, plasticity index, clay fraction, and unconfined compression strength were selected based on the descriptions on the boring logs and laboratory data from the borings at the auxiliary spillway and the similar materials obtained from the field investigation at Site 6. The limestone was divided into layers based on the RQD values. Strength values for the limestone were selected based on average unconfined compression test results from the investigation for the weathered and unweathered limestone. Table 1 summarizes the values selected in order to calculate K_h for the materials.

Table 1: Summary of Input Data to Calculate K_h

Layer	Description	LL (%)	PI (%)	Clay Fraction (%)	UCS (MPa)	RQD (%)
1	Lean Clay	41	17	74	0.26	--
2	Weathered Limestone	--	--	--	8.7	50
3	Fresh Limestone	--	--	--	12.3	92

4.0 HEADCUT ERODIBILITY INDEX

There are four components that must be evaluated in order to calculate K_h for each stratum identified along the spillway cross-section. These components are material strength number, block/particle size number, discontinuity/interparticle bond shear strength number, and the relative ground structure number. The procedures for determining the value of each component is described in the NRCS guidelines. The headcut erodibility index, K_h, represents a measure of the resistance of the earth material to erosion. The index takes the general form:

$$K_h = M_s * K_b * K_d * J_c$$

Where: M_s = material strength number of the earth material
K_b = block or particle size number
K_d = discontinuity or interparticle bond shear strength number
J_s = relative ground structure number

4.1 Material Strength Number (M_s)

The material strength number (M_s) expresses the unconfined compressive strength of an intact representative sample of the material itself without consideration of innate geologic variability within the mass. For the clays, M_s is approximated using the formula found in Table 52-3 of the NRCS guidelines, which uses the unconfined compressive strength (UCS) of the material as the variable. For the limestone, M_s is approximated using the formula found in Table 52-4 for the NRCS guidelines, which uses the unconfined compressive strength (UCS) of the rock as a variable.

4.2 Block/Particle Size Number (K_b)

The block/particle size number (K_b) refers to the mean block size of intact rock material as determined by the spacing of discontinuities within the rock mass or mean grain size for granular material. For intact, cohesive soils and coarse detritus, gravels and boulder formations for which D>0.1 meter, K_b = 1. Therefore, K_b = 1 was used for the clays.

For rock and rock-like materials, the primary method to calculate K_b is:

$$K_b = \frac{RQD}{J_n}$$

Where: RQD = rock quality designation
J_n = joint set number

After review of the core runs within the limestone at the auxiliary spillway site, RQD values varied with depth. Therefore, the limestone was separated into five layers with varying ranges of RQD and the lowest RQD encountered within each layer was selected for the development of K_b as a conservative approach.

The joint set number (J_n) is a scale factor representing the effect of different individual discontinuity spacings relative to the average discontinuity spacing as summarized in Table 52-5 of the NRCS guidelines. For development of K_b, a joint set number, J_n of 5 (more than four joint set) was estimated after review of the logs and core photos.

4.3 Discontinuity/Interparticle Bond Shear Strength Number (K_d)

K_d represents the shear strength of a discontinuity in a rock mass, or strength of interparticle bonds of the gouge (soil material) within the aperture of a discontinuity. If the material under consideration occurs as a soil mass or as gouge in the apertures of rock discontinuities, K_d is determined by:

$$K_d \approx \tan \emptyset'_r$$

Where: Φ'_r = joint roughness number

For ≤ 20% clay, $\Phi'_r = 169.58\ (LL)^{-0.4925}$

For 25 - 45% clay, $\Phi'_r = 329.56\ (LL)^{-0.7100}$

For ≥ 50% clay, $\Phi'_r = 234.73\ (LL)^{-0.6655}$

If the material under consideration is a rock or rock-like material, K_d is determined by:

$$K_d = \frac{J_r}{J_a}$$

Where: J_r = joint roughness number

J_a = joint alteration number

The joint roughness number (J_r) represents the degree of roughness of opposing faces of a rock discontinuity as summarized in Table 52-8 of the NRCS guidelines. An overall joint roughness number of 1.0 was selected based on descriptions of the limestone on the boring logs. The joint alteration number (J_a) represents the degree of alteration of the materials that form the faces as summarized in Table 52-9 of the NRCS guidelines. The limestone was assigned J_a = 6.0.

4.0 Relative Ground Structure Number (J_s)

J_s accounts for the structure of the ground with respect to streamflow. The NRCS guidelines state that soil material is considered intact (without structure), in which case J_s = 1. Therefore, J_s = 1 was used for the clay soils.

For rock, the relative ground structure number (J_s) represents the orientation of the effective dip of the least favorable discontinuity with respect to spillway flow. To calculate the effective dip (q), the apparent dip of the bedrock is first determined by using the following relationship, expressing horizontal angles in degrees azimuth and vertical angles in degrees:

$$\tan a = (\tan b)\ (\sin c)$$

Where: a = apparent dip of discontinuity

b = true dip of discontinuity

c = (strike of discontinuity) – (spillway flow direction)

Since no field mapping of the joint sets was performed, ground structure number, Js was conservatively calculated using NRCS spreadsheet with an exit channel slope of 4°, spillway flow azimuth direction of 301°, bedrock strike of 11°, bedrock dip of 0.7°, and bedrock dip azimuth direction of 101°. Therefore, an apparent dip (degree) of 0.6° and effective dip (degree) of 4.6° were calculated. Assuming the effective dip angle is against the flow and a 1:1 ratio of joint spacing results in a J_s of 0.74. for the limestone strata.

5.0 Summary

A summary of the SITES parameters developed by FNI are provided in Table 2. The values provided in the Table 2 are based on the laboratory data obtained in May 2020 by FNI. The unconfined compression test results indicated that the limestone is generally "moderately soft rock" with an average compressive strength of 12.3 MPa for unweathered sections.

Table 2: Summary of SITES Input Parameters for Site 10

Layer	Description	PI (%)	Dry Density* (pcf)	Clay Fraction (%)	Representative Diameter – D_{75} (in)	Percent Passing No. 200 Sieve	Head Cut Index (K_h)
1	Lean Clay	17	107	74	0.001	80	0.06
2	Weathered Limestone	--	119	--	--	--	22.8
3	Fresh Limestone	--	121	--	--	--	366.6

*Representative Laboratory data is not available for the clays in the Auxiliary Spillway. Values are assumed based on averages from the investigation across Site 6.

Attachment E-14: TR-60 Breach Calculations

Chambers Creek 6

TR-60 Breach Calculations
Hydrologic Breach

Watershed Name	Chambers Creek	Date	27-Apr-20
Site No.	6	Prepared By:	JFA

Elevations				
Top of Dam	697.0	Ft msl	Top Width	14 Ft
Breach Hydrograph	697.0	Ft msl	Upstream Slope Above Berm	3 :1
Wave Berm	679.0	Ft msl	Upstream Slope Below Berm	3 :1
Average Valley Floor	656.0	Ft msl	Downstream Slope Above Berm	2 :1
Stability Berm	662.0	Ft msl	Downstream Slope Below Berm	2 :1
Length of Dam at Breach Elev	1287.5	Ft	Wave Berm Width	12 Ft
Volume of Breach	825.6	Ac Ft	Stability Berm Width	0 Ft

Breach Discharge Computations

Volume of Breach (Vs)	826	Ac Ft
Height Of Breach (Hw)	41	Ft
Cross-Section Area at Breach (A)	5,053	FT^2
$T = 65(H^{0.35})/0.416$	573	

If L > T,		
$Br = (Vs * Hw)/A$	7	
$Qmax = 1{,}100\ (Br)^{1.35}$	14,340	CFS
If L < T,		
$Qmax = 0.416\ (L)(Hw^{1.5})$	140,610	CFS
Qmax NOT GREATER THAN		
$Qmax = 65(HW^{1.85})$	62,598	CFS
Qmax NOT LESS THAN		
$Qmax = 3.2(Hw^{5/2})$	34,444	CFS

Breach Qmax for Hazard Classification = 34,400 CFS ←

TR-60 Breach Calculations
Static Breach

Watershed Name	Chambers Creek	Date	27-Apr-20
Site No.	6	Prepared By:	JFA

Elevations				
Top of Dam	697.0	Ft msl	Top Width	14 Ft
Breach Hydrograph	693.5	Ft msl	Upstream Slope Above Berm	3 :1
Wave Berm	679.0	Ft msl	Upstream Slope Below Berm	3 :1
Average Valley Floor	656.0	Ft msl	Downstream Slope Above Berm	2 :1
Stability Berm	662.0	Ft msl	Downstream Slope Below Berm	2 :1
Length of Dam at Breach Elev	1253	Ft	Wave Berm Width	12 Ft
Volume of Breach	623.82	Ac Ft	Stability Berm Width	0 Ft

Breach Discharge Computations

Volume of Breach (Vs)	624	Ac Ft
Height Of Breach (Hw)	38	Ft
Cross-Section Area at Breach (A)	5,053	FT^2
$T = 65(H^{0.35})/0.416$	556	

If L > T,		
$Br = (Vs * Hw)/A$	5	
$Qmax = 1{,}100\ (Br)^{1.35}$	8,708	CFS
If L < T,		
$Qmax = 0.416\ (L)(Hw^{1.5})$	119,699	CFS
Qmax NOT GREATER THAN		
$Qmax = 65(HW^{1.85})$	53,073	CFS
Qmax NOT LESS THAN		
$Qmax = 3.2(Hw^{5/2})$	27,557	CFS

Breach Qmax for Hazard Classification = 27,600 CFS

TR-60 Breach Calculations
Seismic Breach

Watershed Name	Chambers Creek	Date	27-Apr-20
Site No.	6	Prepared By:	JFA

Elevations				
Top of Dam	697.0	Ft msl	Top Width	14 Ft
Breach Hydrograph	680.0	Ft msl	Upstream Slope Above Berm	3 :1
Wave Berm	679.0	Ft msl	Upstream Slope Below Berm	3 :1
Average Valley Floor	656.0	Ft msl	Downstream Slope Above Berm	2 :1
Stability Berm	662.0	Ft msl	Downstream Slope Below Berm	2 :1
Length of Dam at Breach Elev	697	Ft	Wave Berm Width	12 Ft
Volume of Breach	148.71	Ac Ft	Stability Berm Width	0 Ft

Breach Discharge Computations

Volume of Breach (Vs)	149	Ac Ft
Height Of Breach (Hw)	24	Ft
Cross-Section Area at Breach (A)	5,053	FT^2
$T = 65(H^{0.35})/0.416$	475	

If L > T,		
$Br = (Vs * Hw)/A$	1	
$Qmax = 1{,}100\ (Br)^{1.35}$	688	CFS
If L < T,		
$Qmax = 0.416\ (L)(Hw^{1.5})$	34,091	CFS
Qmax NOT GREATER THAN		
$Qmax = 65(HW^{1.85})$	23,244	CFS
Qmax NOT LESS THAN		
$Qmax = 3.2(Hw^{5/2})$	9,030	CFS

Breach Qmax for Hazard Classification = 9,000 CFS